Atlantic
Norfolk, Virginia

Final

Site Inspection Sampling and Analysis Plan for Per- and Polyfluoroalkyl Substances

Atlantic Fleet Weapons Training Area – Vieques
Former Naval Ammunition Support Detachment and
Former Vieques Naval Training Range
Vieques, Puerto Rico

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Executive Summary

This Sampling and Analysis Plan (SAP) presents the rationale and technical approach for the Per- and Polyfluoroalkyl Substances (PFAS) Site Inspection (SI) for the Former Naval Ammunition Support Detachment (NASD) and Former Vieques Naval Training Range (VNTR) in Vieques, Puerto Rico **(Figures ES-1 through ES-9)**. The objective of an SI is "release assessment." Specifically, the PFAS SI is intended to:

- Determine whether a release of PFAS occurred from past activities being investigated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) at 13 potential release areas identified during a Preliminary Assessment and, if so,
- Determine whether the release warrants further action

This SAP includes 37 worksheets that detail various aspects of the investigation rationale and process and serves as a guideline for the field activities and data assessment that will be employed during the SI. While the basis for SAP preparation remains the *Guidance for Quality Assurance Project Plans EPA QA/G-5* (EPA, 2002), the Intergovernmental Data Quality Task Force (IDQTF) has produced the following guidance that was used as a guide in preparing this PFAS SI SAP:

- *Uniform Federal Policy for Quality Assurance Project Plans, Optimized UFP-QAPP Worksheets* (IDQTF, 2012)

The Department of the Navy (Navy) purchased large portions of Vieques in the early 1940s to conduct activities related to military training. The former Naval facilities are located on the eastern half (i.e., former VNTR) and western one-third (i.e., former NASD) of the island, with the communities of Isabel Segunda and Esperanza located in between.

PFAS were identified as emerging contaminants with Navy policies issued beginning in 2014 requiring assessment of possible impacts from PFAS (DON; 2014, 2015). PFAS are a class of man-made chemicals of environmental concern because of their persistence in the environment and in organisms, their migration potential in aqueous systems (e.g., groundwater), their historically widespread use in commercial products, and their possible health effects at low levels of exposure. PFAS have been used in a variety of military applications, including as a component of aqueous film-forming foam (AFFF), which was routinely used at firefighting training areas and firefighting equipment test areas. AFFF containing PFAS was developed in the 1960s for use on Class B fires (i.e., fires in flammable liquids or vapors), and was put into routine use by the early 1970s. As such, most AFFF used at military installations after the 1970s likely included some combination of PFAS.

A Preliminary Assessment (PA) was completed that evaluated the potential for PFAS to be present based on historical practices conducted at the Vieques former NASD and/or former VNTR (CH2M, 2020). Listed below are 13 potential release areas (six within the former NASD and seven within the former VNTR[SWMU 10 and AOC G are counted as separate potential release areas but will be included as a single investigation due to their proximity to each other, additionally the Camp Garcia Runway and PI 5 are discussed together in this Executive Summary]) identified in the PA Report as potential source areas where AFFF or other PFAS-containing substances may have been released during historic activities associated with military training. **Table ES-1** summarizes the PFAS characterization rationale and approach for each potential release area.

- NASD Area of Concern (AOC) B: Former Wastewater Treatment Plant at the Public Works Area (**Figure ES-1**)
- NASD Former Fire Station Building 2046 at the Public Works Area (**Figure ES-1**)
- Potential Former NASD Motor Pool Area (**Figure ES-2**)

NOTE: THIS SUMMARY IS PRESENTED IN ENGLISH AND SPANISH FOR THE CONVENIENCE OF THE READER. EVERY EFFORT HAS BEEN MADE FOR THE TRANSLATIONS TO BE AS ACCURATE AS REASONABLY POSSIBLE. HOWEVER, READERS SHOULD BE AWARE THAT THE ENGLISH VERSION OF THE TEXT IS THE OFFICIAL VERSION.

- NASD AOC H: Abandoned Power Plant/Former Fire Training Area (**Figure ES-3**)
- NASD Solid Waste Management Unit (SWMU) 6: Former Mangrove Disposal Site (**Figure ES-4**)
- NASD SWMU 7: Former Quebrada Disposal Site (**Figure ES-5**)
- VNTR Former Camp Garcia Runway (**Figure ES-6**)
- VNTR Photo Identified (PI) 5: Surface Water Drainage Area from Former Camp Garcia Runway (**Figure ES-6**)
- VNTR SWMU 20: Former Helicopter Maintenance Area (**Figure ES-6**)
- Potential Former VNTR Motor Pool Area (Including Building 340) and Former Fire Department Building 330 (**Figure ES-7**)
- VNTR SWMU 10 and VNTR AOC G: Former Sewage Treatment Lagoons and Chlorination Building (**Figure ES-8**)
- VNTR SWMU 1: Former Camp Garcia Municipal Waste Management Unit (Landfill) (**Figure ES-9**)

Table ES-1. PFAS Site Inspection Summary

LOCATION	Figure	Conceptual PFAS Release Mechanism	Surface and Subsurface Soil Samples[1]	Rationale	Groundwater	Rationale	Sediment and Surface Water Samples[2]	Rationale
Former NASD								
AOC B: Former Wastewater Treatment Plant (WWTP)	Figure ES-1	If AFFF or other PFAS-containing substances were present in wastewater from the former NASD main support compound, they would have been discharged to the WWTP and ultimately directed to (and potentially accumulated in) the settlement lagoons	12	One surface and one subsurface soil sample collected within the historic sludge profile from each of the four settlement lagoons where PFAS would have been deposited if discharged to the WWTP. An additional 1-foot subsurface soil sample will be collected at the soil/water interface if this zone occurs in unconsolidated material.	1	One monitoring well installed and sampled along the downgradient border of the former lagoons to help determine if PFAS was discharged to the WWTP and leached from the lagoons to underlying groundwater	Not applicable (N/A)	N/A
Former Fire Station Building 2046 at the Public Works Area	Figure ES-1	AFFF may have been released to the ground surface during transfer onto trucks, fire truck cleaning, and pump testing	15	Three surface and three subsurface soil samples around the former fire station ramp where fire trucks were cleaned and filled; two surface and two subsurface soil samples at the location of the former conex box where AFFF was reportedly stored and transferred. An additional 1-foot subsurface soil sample will be collected at each location at the soil/water interface if this zone occurs in unconsolidated material.	2	One monitoring well installed and sampled at the ramp to help determine if AFFF was released at the ramp and leached to groundwater; one monitoring well installed and sampled downgradient of the former fire station and conex box to evaluate the fire station area as a whole for potential AFFF releases	N/A	N/A
Potential Former Motor Pool Area	Figure ES-2	If fire trucks containing AFFF were serviced/washed at the motor pool, AFFF could have been released to the ground surface	12	Four surface and four subsurface soil samples around the former motor pool wash rack where fire trucks could have been washed. An additional 1-foot subsurface soil sample will be collected at each location at the soil/water interface if this zone occurs in unconsolidated material.	3	One monitoring well installed and sampled along the downgradient edge of wash rack to help determine if AFFF was released at the wash rack and leached to groundwater; two monitoring wells along the downgradient border of the motor pool area to evaluate the area as a whole for potential AFFF releases because the exact fire truck maintenance location within the motor pool area is unknown	N/A	N/A
AOC H: Abandoned Power Plant/Former Fire Training Area	Figure ES-3	If AFFF was utilized during firefighting training in the abandoned power plant building, it could have reached the ground surface through openings in the building and/or cracks in the concrete floor	12	Four surface and four subsurface soil samples adjacent to each building opening through which AFFF may have been washed outside. An additional 1-foot subsurface soil sample will be collected at each location at the soil/water interface if this zone occurs in unconsolidated material.	2	One monitoring well installed and sampled in each of the downgradient directions from the building to help determine if AFFF was released and leached to groundwater	6	Three sediment samples within the adjacent ephemeral stream, one where runoff to the stream would most likely occur and two additional samples downstream to account for sediment transport during storm events. Three surface water samples will also be collected at the sediment sample locations.

Table ES-1. PFAS Site Inspection Summary

LOCATION	Figure	Conceptual PFAS Release Mechanism	Surface and Subsurface Soil Samples[1]	Rationale	Groundwater	Rationale	Sediment and Surface Water Samples[2]	Rationale
SWMU 6: Former Mangrove Disposal Site	Figure ES-4	If AFFF or other PFAS-containing substances were utilized at the former training facility, materials containing AFFF/PFAS (e.g., empty containers, firefighting training materials, etc.) could have been disposed of at SWMU 6 whereby they could have leached into the underlying soil	2	One surface and one subsurface soil sample within an area that is still terrestrial but was part of the former debris removal area. An additional 1-foot subsurface soil sample will be collected at the soil/water interface if this zone occurs in unconsolidated material.	N/A	N/A	4	Two sediment samples within the lagoon created by the historic debris removal action, one in the approximate lagoon center and one where the physical exchange between the SWMU 6 lagoon and the larger Laguna Kiani to the south and Laguna El Pobre to the north takes place. Two surface water samples will also be collected at sediment sample locations.
SWMU 7: Former Quebrada Disposal Site	Figure ES-5	If AFFF or other PFAS containing substances were utilized at the former training facility, materials containing AFFF/PFAS (e.g., empty containers, firefighting training materials, etc.) could have been disposed of at SWMU 7 whereby they could have leached into the underlying soil	9	Three surface and three subsurface soil samples within the ephemeral stream, two at the base of the ephemeral stream channel where debris was historically located and where runoff would have entered the stream and one downgradient to account for sediment transport during storm events. An additional 1-foot subsurface soil sample will be collected at the soil/water interface if this zone occurs in unconsolidated material. Note, some borings may be advanced with hand auger or similar tool due to the lack of drill rig accessibility. In these cases, the vertical depth of penetration may be limited.	1	One monitoring well installed and sampled within the former debris area to help determine if AFFF was released and leached to groundwater	N/A	N/A
Former VNTR								
Camp Garcia Runway/PI 5: Surface Water Drainage Area	Figure ES-6	If AFFF or other PFAS containing substances were utilized on the former runway as part of firefighting training, demonstration, or emergency response, they could have flowed off the runway into the drainage ditch system along the southern side of the runway, including PI 5	21	Three surface and three subsurface soil sample at the confluence of the drainage ditch system in the eastern most ephemeral stream that serves as conveyance for water in the drainage ditch. One surface and one subsurface soil sample will also be collected at each of two locations between the taxiway and runway where the ephemeral streams traverse. One surface and one subsurface soil samples will be collected adjacent to each of the locations of proposed wells VERW-PFAS-MW01 and VERW-PFAS-MW02. One surface and one subsurface soil sample will be collected at the head of the northwest-southeast trending drainage ditch on the east end of the runway and if the ditch contains water a surface water and sediment sample will be collected instead of a surface soil and subsurface soil sample. An additional 1-foot subsurface soil sample will be collected at each location at the soil/water interface if the saturated zone is encountered within unconsolidated material during monitoring well installation. Note, some borings may be advanced	4	Three new monitoring wells will be installed, and one existing monitoring well located along the southern (downgradient) drainage ditch. They will be sampled to evaluate the runway and drainage ditch as a whole to help determine if AFFF was released along the runway and either migrated through the runway or flowed into the drainage ditch and subsequently leached into groundwater.	N/A	N/A

Table ES-1. PFAS Site Inspection Summary

LOCATION	Figure	Conceptual PFAS Release Mechanism	Surface and Subsurface Soil Samples[1]	Rationale	Groundwater	Rationale	Sediment and Surface Water Samples[2]	Rationale
				with hand auger or similar tool due to the lack of drill rig accessibility. In these cases, the vertical depth of penetration may be limited.				
SWMU 20: Former Helicopter Maintenance Area	Figure ES-6	If AFFF or other PFAS-containing substances were used in the helicopter maintenance building/hangar fire suppression system, it could have been released to the ground surface during testing or emergency response	3	One surface and one subsurface soil sample at the location of the former building where AFFF could have been washed out of the building (downgradient side). An additional 1-foot subsurface soil sample will be collected at the soil/water interface if this zone occurs in unconsolidated material.	4	Groundwater samples from four existing monitoring wells, one at the soil sample location (i.e., where any AFFF release likely would have flowed or washed out of the building) and three further downgradient to evaluate potential releases from the maintenance area	N/A	N/A
Potential Former Motor Pool Area (including Building 340) and Former Fire Department Building 330	Figure ES-7	If fire trucks containing AFFF or other PFAS-containing substances were serviced/ washed at the motor pool or fire department building, they could have been released to the ground surface; however, there are no known records of specific fire truck maintenance or washing areas	4	No historical information has been found that identifies where specifically fire truck maintenance/washing occurred. Further, significant ground-disturbing activities occurred in the area during historic building demolition and construction of the new Vieques cleanup base of operations in the same area. One subsurface soil sample will be collected at two locations (one between the former locations of former Bldgs 330 and 340 and one south of the former Bldg 330. An additional 1-foot subsurface soil sample will be collected at each location at the soil/water interface if this zone occurs in unconsolidated material. However, collecting groundwater samples in the source area and downgradient is still believed to provide a higher level of confidence in detecting a release(s) that occurred anywhere within the target area.	2	Two monitoring wells will be installed and sampled; one in the source area and one near the downgradient border of the area of interest as previously substantiated.	N/A	N/A
SWMU 10 and AOC G: Former Sewage Treatment Lagoons and Chlorination Building	Figure ES-8	If AFFF or other PFAS-containing substances were washed into drains at the former Camp Garcia, they would have been discharged to the WWTP and ultimately directed to (and potentially accumulated in) the settlement lagoons and/or the ground surface south of the lagoons	18	One surface and one subsurface soil sample collected within the historic sludge profile from each of the four settlement lagoons where PFAS would have been deposited if discharged to the WWTP. One surface and one subsurface soil sample will also be collected adjacent to the location of each of the two proposed monitoring wells in the potential land discharge area to the south. An additional 1-foot subsurface soil sample will be collected at each location at the soil/water interface if this zone occurs in unconsolidated material.	4	Four monitoring wells installed and sampled along the downgradient border of the former lagoons, the chlorine contact chamber, and the potential land discharge area to the south to help determine if PFAS was discharged to the WWTP and leached from the lagoons, chamber, or land surface to underlying groundwater	N/A	N/A

Table ES-1. PFAS Site Inspection Summary

LOCATION	Figure	Conceptual PFAS Release Mechanism	Surface and Subsurface Soil Samples[1]	Rationale	Groundwater	Rationale	Sediment and Surface Water Samples[2]	Rationale
SWMU 1: Former Camp Garcia Municipal Solid Waste Management Unit (Landfill)	Figure ES-9	If AFFF or other PFAS-containing substances were utilized at Camp Garcia, materials containing AFFF/PFAS (e.g., empty containers, firefighting training materials, etc.) could have been disposed of at SWMU 1 whereby they could have leached into the underlying soil	0	No historical information has been found that identifies where specifically any waste potentially containing AFFF and/or other PFAS-containing materials would have been disposed of in the landfill; therefore, collecting soil samples would be unlikely to meet the project objective of determining the presence/absence of a release within the 51-acre landfill and groundwater would be a more prudent means of assessing whether a release has occurred anywhere in the landfill	6	Six existing monitoring wells within and along the downgradient landfill boundary sampled as previously substantiated; well selection consistent with logic for long-term groundwater monitoring conducted in accordance with Record of Decision	N/A	N/A

Notes:

All samples will be analyzed for the 18 PFAS listed in the EPA Method 537.1 (see **Worksheet #15** for individual parameters)

1 – Surface and subsurface soil samples will be collected at the same location unless otherwise noted.

2 – Surface water samples will only be collected at sediment sample locations where surface water is generally present.

Resumen Ejecutivo

Este Plan de Muestreo y Análisis (SAP) presenta la justificación y el enfoque técnico para la Inspección del Sitio (SI, por sus siglas en inglés) de Sustancias Perfluoroalquiladas y Polifluoroalquiladas (PFAS, por sus siglas en inglés) para el Antiguo Destacamento de Apoyo de Municiones Navales (NASD, por sus siglas en inglés) y el Antiguo Campo de Adiestramiento Naval de Vieques (VNTR, por sus siglas en inglés) en Vieques, Puerto Rico **(Figuras ES-1 a ES-9).** El objetivo de una SI es la "evaluación de la liberación". Específicamente, el PFAS SI está destinado a:

- Determinar si se produjo una liberación de PFAS a partir de actividades pasadas que se están investigando bajo la Ley de Respuesta Ambiental Integral, Compensación y Responsabilidad (CERCLA, por sus siglas en inglés) en 13 áreas de liberación potencial identificadas durante una Evaluación Preliminar y, de ser así,
- Determinar si la liberación justifica una acción adicional

Este SAP incluye 37 hojas de trabajo que detallan varios aspectos de la justificación y el proceso de la investigación y sirve como guía para las actividades de campo y la evaluación de datos que se emplearán durante la SI. Si bien la base para la preparación de SAP sigue siendo la *Guía para los Planes de Proyectos de Garantía de Calidad EPA QA/G-5* (EPA, 2002), el Grupo de Trabajo Intergubernamental de Calidad de Datos (IDQTF, por sus siglas en inglés) ha producido la siguiente guía que se utilizó como guía en la preparación de este PFAS SI SAP:

- Política Federal Uniforme para Planes de Proyectos de Aseguramiento de la Calidad, Hojas de Trabajo UFP-QAPP Optimizadas (IDQTF, 2012)

El Departamento de la Marina (*Navy*) compró grandes porciones de Vieques a principios de la década de 1940 para llevar a cabo actividades relacionadas con el entrenamiento militar. Las antiguas instalaciones navales se encuentran en la mitad oriental (es decir, antiguo VNTR) y el tercio occidental (es decir, antiguo NASD) de la isla, con las comunidades de Isabel Segunda y Esperanza ubicadas en el medio.

Los PFAS se identificaron como contaminantes emergentes con políticas de la Marina emitidas a partir de 2014 que requieren la evaluación de los posibles impactos de PFAS (DON; 2014, 2015). Los PFAS son una clase de productos químicos artificiales de preocupación ambiental debido a su persistencia en el medio ambiente y en los organismos, su potencial de migración en sistemas acuosos (por ejemplo, aguas subterráneas), su uso históricamente generalizado en productos comerciales y sus posibles efectos sobre la salud a bajos niveles de exposición. Los PFAS se han utilizado en una variedad de aplicaciones militares, incluso como componente de espuma formadora de película acuosa (AFFF, por sus siglas en inglés), que se utilizó rutinariamente en áreas de entrenamiento de extinción de incendios y áreas de prueba de equipos de extinción de incendios. AFFF que contiene PFAS se desarrolló en la década de 1960 para su uso en incendios de Clase B (es decir, incendios en líquidos o vapores inflamables), y se puso en uso rutinario a principios de la década de 1970. Como tal, la mayoría de los AFFF utilizados en instalaciones militares después de la década de 1970 probablemente incluían alguna combinación de PFAS.

Se completó una Evaluación Preliminar (PA, por sus siglas en inglés) que evaluó el potencial de que los PFAS estén presentes sobre la base de prácticas históricas realizadas en la antigua NASD y / o en el antiguo VNTR de Vieques (CH2M, 2020). A continuación se enumeran 13 áreas de liberación potencial (seis dentro de la antigua NASD y siete dentro de la antigua VNTR[SWMU 10 y AOC G se cuentan como áreas de liberación potencial separadas, pero se incluirán como una sola investigación debido a su proximidad entre sí, además, la pista de Campamento García y PI 5 se discuten juntas en este Resumen Ejecutivo])identificadas en el Informe de PA como áreas de origen potencial donde AFFF u otra Las sustancias que contienen PFAS pueden haber sido liberadas durante

actividades históricas asociadas con el entrenamiento militar. **La Tabla ES-1** resume la justificación y el enfoque de la caracterización de PFAS para cada área de liberación potencial.

- Área de preocupación de NASD (AOC, por sus siglas en inglés) B: Antigua planta de tratamiento de aguas residuales en el área de obras públicas (**Figura ES-1**)
- Antiguo Edificio de la Estación de Bomberos 2046 en el Área de Obras Públicas de NASD (**Figura ES-1**)
- Área potencial de la piscina de motores NASD (**Figura ES-2**)
- AOC H NASD: Planta de energía abandonada/antigua área de entrenamiento contra incendios (**Figura ES-3**)
- Unidad de Gestión de Residuos Sólidos (SWMU) 6 de NASD: Antiguo sitio de disposición de manglares (**Figura ES-4**)
- SWMU 7 NASD: Antiguo sitio de disposición de Quebrada (**Figura ES-5**)
- VNTR Antigua Pista de Campamento García (**Figura ES-6**)
- VNTR Foto Identificada (PI, por sus siglas en inglés) 5: Área de drenaje de aguas superficiales de la antigua pista de Campamento García (**Figura ES-6**)
- VNTR SWMU 20: Antigua área de mantenimiento de helicópteros (**Figura ES-6**)
- Posible área de la antigua piscina de motores VNTR (incluido el edificio 340) y el antiguo edificio 330 del Departamento de Bomberos **(Figura ES-7)**
- VNTR SWMU 10 y VNTR AOC G: Antiguas lagunas de tratamiento de aguas residuales y edificio de cloración (**Figura ES-8**)
- VNTR SWMU 1: Antigua Unidad de Gestión de Residuos Municipales (Vertedero) de Campamento García (**Figura ES-9**)

Table ES-1. Resumen de inspección del sitio PFAS

UBICACIÓN	Figura	Mecanismo conceptual de liberación de PFAS	Muestras de suelo superficial y subsuperficial[1]	Fundamento	Aguas subterránea	Fundamento	Muestras de sedimentos y aguas superficiales[2]	Fundamento
NASD Antiguo								
AOC B: Antigua Planta de Tratamiento de Aguas Residuales (PTAR)	Figura ES-1	Si AFFF u otras sustancias que contienen PFAS estuvieran presentes en las aguas residuales del antiguo compuesto de soporte principal de NASD, se habrían descargado a la PTAR y, en última instancia, se habrían dirigido a (y potencialmente se habrían acumulado en) las lagunas de asentamiento.	12	Una muestra de suelo superficial y una subsuperficial recogida dentro del perfil histórico de lodos de cada una de las cuatro lagunas de asentamiento donde se habrían depositado PFAS si se hubieran vertido a la PTAR. Se recolectará una muestra adicional de suelo subsuperficial de 1 pie en la interfaz suelo/agua si esta zona se encuentra en material no consolidado.	1	Un pozo de monitoreo instalado y muestreado a lo largo de la frontera descendente de las antiguas lagunas para ayudar a determinar si el PFAS se vertió en la PTAR y se lixivió de las lagunas a las aguas subterráneas subyacentes.	No aplica (N/A)	N/A
Antiguo Edificio de la Estación de Bomberos 2046 en el Área de Obras Públicas	Figura ES-1	AFFF puede haber sido liberado a la superficie del suelo durante la transferencia a camiones, la limpieza de camiones de bomberos y las pruebas de bombas.	15	Tres muestras de suelo superficial y tres subterráneas alrededor de la antigua rampa de la estación de bomberos donde se limpiaron y llenaron los camiones de bomberos; dos muestras de suelo superficial y dos subsuperficiales en la ubicación de la antigua caja de conex donde, según los informes, se almacenó y transfirió AFFF. Se recolectará una muestra adicional de suelo subsuperficial de 1 pie en cada ubicación en la interfaz suelo/agua si esta zona se encuentra en material no consolidado.	2	Un pozo de monitoreo instalado y muestreado en la rampa para ayudar a determinar si AFFF fue liberado en la rampa y lixiviado al agua subterránea; un pozo de monitoreo instalado y muestreado de la antigua estación de bomberos y una caja de conex para evaluar el área de la estación de bomberos en su conjunto para posibles liberaciones de AFFF.	N/A	N/A
Posible Área de la antigua piscina de motores	Figura ES-2	Si los camiones de bomberos que contienen AFFF fueron reparados/ lavados en la piscina de motores, AFFF podría haber sido liberado a la superficie del suelo	12	Cuatro muestras de suelo superficial y cuatro subterráneas alrededor del antiguo estante de lavado de la piscina de motores donde los camiones de bomberos podrían haber sido lavados. Se recolectará una muestra adicional de suelo subsuperficial de 1 pie en cada ubicación en la interfaz suelo/agua si esta zona se encuentra en material no consolidado.	3	Un pozo de monitoreo instalado y muestreado a lo largo del borde descendente del estante de lavado para ayudar a determinar si AFFF se liberó en el estante de lavado y se lixivió al agua subterránea; dos pozos de monitoreo a lo largo del borde descendente del área de la piscina de motores para evaluar el área en su conjunto para posibles liberaciones de AFFF porque se desconoce la ubicación exacta de mantenimiento de camiones de bomberos dentro del área de la piscina de motores	N/A	N/A

Table ES-1. Resumen de inspección del sitio PFAS

UBICACIÓN	Figura	Mecanismo conceptual de liberación de PFAS	Muestras de suelo superficial y subsuperficial[1]	Fundamento	Aguas subterránea	Fundamento	Muestras de sedimentos y aguas superficiales[2]	Fundamento
AOC H: Planta de energía abandonada/ Antigua área de entrenamiento contra incendios	Figura ES-3	Si AFFF se utilizó durante el entrenamiento de extinción de incendios en el edificio abandonado de la planta de energía, podría haber alcanzado la superficie del suelo a través de aberturas en el edificio y / o grietas en el piso de concreto.	12	Cuatro muestras de suelo superficial y cuatro subterráneas adyacentes a cada abertura del edificio a través de las cuales AFFF pudo haber sido lavado afuera. Se recolectará una muestra adicional de suelo subsuperficial de 1 pie en cada ubicación en la interfaz suelo/agua si esta zona se encuentra en material no consolidado.	2	Un pozo de monitoreo instalado y muestreado en cada una de las direcciones descendentes desde el edificio para ayudar a determinar si AFFF fue liberado y lixiviado al agua subterránea.	6	Tres muestras de sedimentos dentro de la corriente efímera adyacente, una donde probablemente ocurriría la escorrentía a la corriente y dos muestras adicionales aguas abajo para dar cuenta del transporte de sedimentos durante los eventos de tormenta. También se recogerán tres muestras de agua superficial en los lugares de muestreo de sedimentos.
SWMU 6: Antiguo sitio de disposición de manglares	Figura ES-4	Si se utilizaran AFFF u otras sustancias que contienen PFAS en la antigua instalación de capacitación, los materiales que contienen AFFF / PFAS (por ejemplo, contenedores vacíos, materiales de capacitación contra incendios, etc.) podrían haberse eliminado en SWMU 6, por lo que podrían haberse lixiviado en el suelo subyacente.	2	Una muestra de suelo superficial y una subsuperficial dentro de un área que todavía es terrestre pero que formaba parte de la antigua área de remoción de escombros. Se recolectará una muestra adicional de suelo subsuperficial de 1 pie en la interfaz suelo/agua si esta zona se encuentra en material no consolidado.	N/A	N/A	4	muestras de sedimentos dentro de la laguna creadas por la acción histórica de remoción de escombros, una en el centro aproximado de la laguna y otra donde se lleva a cabo el intercambio físico entre la laguna SWMU 6 y la Laguna Kiani más grande al sur y la Laguna El Pobre al norte. También se recogerán dos muestras de agua superficial en lugares de muestreo de sedimentos.
SWMU 7: Antiguo sitio de disposición de quebrada	Figura ES-5	Si se utilizaran AFFF u otras sustancias que contienen PFAS en la antigua instalación de capacitación, los materiales que contienen AFFF / PFAS (por ejemplo, contenedores vacíos, materiales de capacitación contra incendios, etc.) podrían haberse eliminado en SWMU 7, por lo que podrían haberse lixiviado en el suelo subyacente.	9	Tres muestras de suelo superficial y tres subsuperficiales dentro de la corriente efímera, dos en la base del canal de la corriente efímera donde históricamente se encontraban los escombros y donde la escorrentía habría entrado en la corriente y una pendiente descendente para dar cuenta del transporte de sedimentos durante los eventos de tormenta. Se recolectará una muestra adicional de suelo subsuperficial de 1 pie en la interfaz suelo/agua si esta zona se encuentra en material no consolidado. Tenga en cuenta que algunas perforaciones pueden avanzar con barrena de mano o herramienta similar debido a la falta de accesibilidad de la plataforma de perforación. En estos casos, la profundidad vertical de penetración puede ser limitada.	1	Un pozo de monitoreo instalado y muestreado dentro de la antigua área de escombros para ayudar a determinar si AFFF fue liberado y lixiviado a las aguas subterráneas.	N/A	N/A
Antiguo VNTR								
Pista Campamento García/PI 5: Área de drenaje de aguas superficiales	Figura ES-6	Si AFFF u otras sustancias que contienen PFAS se utilizaron en la pista anterior como parte de la capacitación, demostración o respuesta de emergencia contra incendios, podrían haber fluido	21	Tres muestras de suelo superficial y tres subterráneas en la confluencia del sistema de zanjas de drenaje en el arroyo más oriental y efímero que sirve de transporte de agua en la zanja de drenaje. También se	4	Se instalarán tres nuevos pozos de monitoreo y un pozo de monitoreo existente ubicado a lo largo de la zanja de drenaje sur (descendente). Se tomarán muestras para evaluar la pista y la zanja de	N/A	N/A

Table ES-1. Resumen de inspección del sitio PFAS

UBICACIÓN	Figura	Mecanismo conceptual de liberación de PFAS	Muestras de suelo superficial y subsuperficial[1]	Fundamento	Aguas subterránea	Fundamento	Muestras de sedimentos y aguas superficiales[2]	Fundamento
		fuera de la pista hacia el sistema de zanja de drenaje a lo largo del lado sur de la pista, incluido PI 5.		recolectará una muestra de suelo superficial y una subsuperficial en cada uno de los dos lugares entre la calle de rodaje y la pista donde atraviesan los arroyos efímeros. Se recogerán una muestra de suelo superficial y una subterránea adyacentes a cada una de las ubicaciones de los pozos propuestos VERW-PFAS-MW01 y VERW-PFAS-MW02. Se recolectará una muestra de suelo superficial y una subsuperficial en la cabecera de la zanja de drenaje de tendencia noroeste-sureste en el extremo este de la pista y, si la zanja contiene agua, se recolectará una muestra de agua superficial y sedimentos en lugar de una muestra de suelo superficial y suelo subsuperficial. Se recolectará una muestra adicional de suelo subsuperficial de 1 pie en cada ubicación en la interfaz suelo/agua si la zona saturada se encuentra dentro de material no consolidado durante la instalación del pozo de monitoreo. Tenga en cuenta que algunas perforaciones pueden avanzar con barrena de mano o herramienta similar debido a la falta de accesibilidad de la plataforma de perforación. En estos casos, la profundidad vertical de penetración puede ser limitada.		drenaje en su conjunto para ayudar a determinar si AFFF se liberó a lo largo de la pista y migró a través de la pista o fluyó hacia la zanja de drenaje y posteriormente se lixivió en el agua subterránea.		
SWMU 20: Antigua Área de Mantenimiento de Helicópteros	Figura ES-6	Si se utilizara AFFF u otras sustancias que contengan PFAS en el sistema de extinción de incendios del edificio de mantenimiento de helicópteros / hangar, podría haberse liberado a la superficie del suelo durante las pruebas o la respuesta de emergencia.	3	Una muestra de suelo superficial y una muestra de suelo subsuperficial en la ubicación del edificio anterior donde AFFF podría haber sido arrastrado fuera del edificio (lado descendente) Se recolectará una muestra adicional de suelo subterráneo de 1 pie en la interfaz suelo/agua si esta zona ocurre en material no resuelto.	4	Muestras de agua subterránea de cuatro pozos de monitoreo existentes, uno en el lugar de la muestra de suelo (es decir, donde cualquier liberación de AFFF probablemente habría fluido o lavado fuera del edificio) y tres más degradados para evaluar posibles liberaciones del área de mantenimiento.	N/A	N/A

Table ES-1. Resumen de inspección del sitio PFAS

UBICACIÓN	Figura	Mecanismo conceptual de liberación de PFAS	Muestras de suelo superficial y subsuperficial[1]	Fundamento	Aguas subterránea	Fundamento	Muestras de sedimentos y aguas superficiales[2]	Fundamento
Posible área de la antigua piscina de motores (incluido el edificio 340) y el antiguo edificio del Departamento de Bomberos 330	Figura ES-7	Si los camiones de bomberos que contienen AFFF u otras sustancias que contienen PFAS fueron reparados / lavados en la piscina de motores o en el edificio del departamento de bomberos, podrían haber sido liberados a la superficie del suelo; sin embargo, no hay registros conocidos de áreas específicas para mantenimiento o lavado de camiones de bomberos.	4	No se ha encontrado información histórica que identifique dónde ocurrió específicamente el mantenimiento / lavado de camiones de bomberos. Además, se produjeron importantes actividades perturbadoras del terreno en la zona durante la demolición de edificios históricos y la construcción de la nueva base de operaciones de limpieza de Vieques en la misma zona. Se recogerá una muestra de suelo subsuperficial en dos ubicaciones (una entre las antiguas ubicaciones de los antiguos bldgs 330 y 340 y otra al sur del antiguo Bldg 330. Se recolectará una muestra adicional de suelo subsuperficial de 1 pie en cada ubicación en la interfaz suelo/agua si esta zona se encuentra en material no consolidado. Sin embargo, todavía se cree que la recolección de muestras de agua subterránea en el área de origen y el gradiente descendente proporciona un mayor nivel de confianza en la detección de una(s) liberación(es) que ocurrió en cualquier lugar dentro del área objetivo.	2	Se instalarán y muestrearán dos pozos de monitoreo; uno en la zona de origen y otro cerca de la frontera descendente de la zona de interés, como se ha justificado anteriormente.	N/A	N/A
SWMU 10 and AOC G: Edificio de lagunas de tratamiento de aguas residuales y cloración	Figura ES-8	Si AFFF u otras sustancias que contienen PFAS se lavaran en los desagües en el antiguo Campamento García, se habrían descargado a la PTAR y, en última instancia, se habrían dirigido a (y potencialmente se habrían acumulado en) las lagunas de asentamiento y / o la superficie del suelo al sur de las lagunas.	18	Una muestra de suelo superficial y una subsuperficial recogida dentro del perfil histórico de lodos de cada una de las cuatro lagunas de asentamiento donde se habrían depositado PFAS si se hubieran vertido a la PTAR. También se recolectará una muestra de suelo superficial y una subsuperficial adyacente a la ubicación de cada uno de los dos pozos de monitoreo propuestos en el área potencial de descarga de tierra al sur. Se recolectará una muestra adicional de suelo subsuperficial de 1 pie en cada ubicación en la interfaz suelo/agua si esta zona se encuentra en material no consolidado.	4	Cuatro pozos de monitoreo instalados y muestreados a lo largo del borde descendente de las antiguas lagunas, la cámara de contacto con cloro y el área potencial de descarga de tierra hacia el sur para ayudar a determinar si PFAS se descargó a la PTAR y se lixivió desde las lagunas, la cámara o la superficie de la tierra a las aguas subterráneas subyacentes.	N/A	N/A

Table ES-1. Resumen de inspección del sitio PFAS

UBICACIÓN	Figura	Mecanismo conceptual de liberación de PFAS	Muestras de suelo superficial y subsuperficial[1]	Fundamento	Aguas subterránea	Fundamento	Muestras de sedimentos y aguas superficiales[2]	Fundamento
SWMU 1: Antigua Unidad de Gestión de Residuos Sólidos Urbanos (Vertedero) de Campamento García	Figura ES-9	Si se utilizaran AFFF u otras sustancias que contienen PFAS en Campamento García, los materiales que contienen AFFF / PFAS (por ejemplo, contenedores vacíos, materiales de capacitación contra incendios, etc.) podrían haberse eliminado en SWMU 1, por lo que podrían haberse lixiviado en el suelo subyacente.	0	No se ha encontrado información histórica que identifique dónde se habrían eliminado específicamente en el vertedero los desechos que potencialmente contienen AFFF y/u otros materiales que contienen PFAS; por lo tanto, es poco probable que la recolección de muestras de suelo cumpla con el objetivo del proyecto de determinar la presencia / ausencia de una liberación dentro del vertedero de 51 acres y las aguas subterráneas serían un medio más prudente de evaluar si se ha producido una liberación en cualquier lugar del vertedero.	6	Seis pozos de monitoreo existentes dentro y a lo largo del límite del vertedero de gradiente descendente muestreados como se corroboró anteriormente; selección de pozos consistente con la lógica para el monitoreo de aguas subterráneas a largo plazo realizado de acuerdo con el Registro de Decisión.	N/A	N/A

Notas:

Las muestras se analizarán para los 18 PFAS enumerados en el Método 537.1 de la EPA (consulte la **Hoja de trabajo # 15** para parámetros individuales)

1 – Las muestras de suelo superficial y subsuperficial se recogerán en el mismo lugar, a menos que se indique lo contrario.

2 – Las muestras de agua superficial solo se recolectarán en lugares de muestras de sedimentos donde el agua superficial generalmente está presente.

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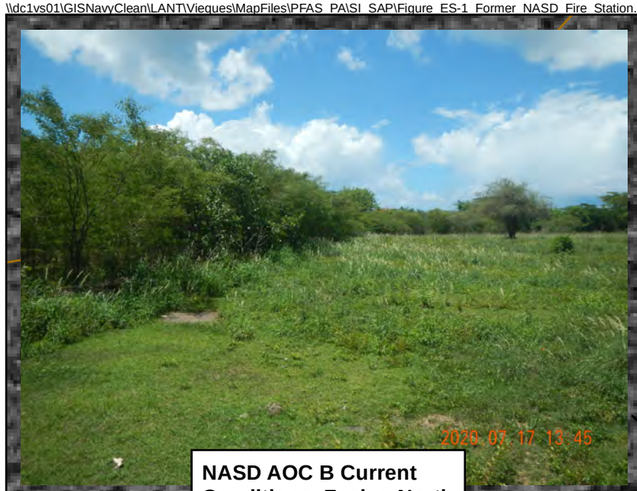


NASD AOC B Current Conditions, Facing North

AOC E

VWAB-PFAS-SS/SB03
VWAB-PFAS-SS/SB02
VWAB-PFAS-MW01
VWAB-PFAS-SS/SB04
VWAB-PFAS-SS/SB01

Building 2030

AOC B

Clarifier

VWFS-PFAS-MW02
VWFS-PFAS-SS/SB04
VWFS-PFAS-SS/SB05
VWFS-PFAS-MW01
VWFS-PFAS-SS/SB01
VWFS-PFAS-SS/SB02
VWFS-PFAS-SS/SB03

Possible location of conex container that stored AFFF solution

Approximate location of Fire Station Ramp

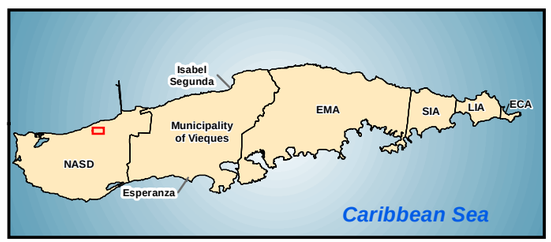
Former NASD Fire Station (Building 2046)

33
33
66
98
66
98

Building 2046 Current Conditions, Facing South

Legend

- Approximate Site Location
- Proposed Monitoring Well Location
- Proposed Soil Boring Location
- Groundwater Flow Direction (AOC E Annual Report (2019))
- Elevation Contour (feet)
- Ephemeral Stream
- Road



N
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0 75 150
Feet

Imagery Date: 1994

Figure ES-1
NASD Former Fire Station Building 2046 at the Public Works Area and NASD AOC B: Former Wastewater Treatment Plant
Site Inspection Sampling and Analysis Plan
for Per- and Polyfluoroalkyl Substances
Former NASD and Former VNTR
Vieques, Puerto Rico

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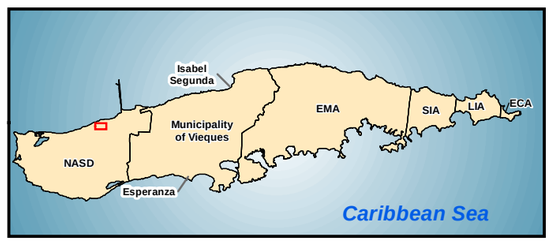
Motor Pool Area Current Conditions, Facing North

Legend

- Approximate Site Location
- Approximate Building Location
- AOC E Land Use Control Boundary
- Proposed Monitoring Well Location
- Proposed Soil Boring Location
- Groundwater Flow Direction (AOC E Annual Report (2019))
- Ephemeral Stream
- Elevation Contour (feet)
- Road



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Feet

Imagery Date: 1994

Figure ES-2
Potential Former NASD Motor Pool Area
Site Inspection Sampling and Analysis Plan
for Per- and Polyfluoroalkyl Substances
Former NASD and Former VNTR
Vieques, Puerto Rico

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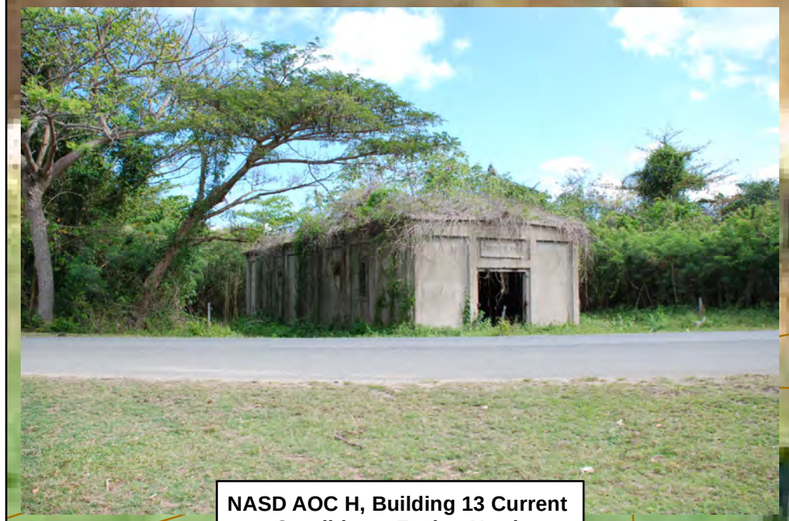


NASD AOC H, Building 13 Current Conditions, Facing North

Vieques Passage

Ephemeral Stream with Standing Water

VWAH-PFAS-SD03
VWAH-PFAS-SW03
VWAH-PFAS-SD02
VWAH-PFAS-SW02
AOC H
VWAH-PFAS-MW02
VWAH-PFAS-SS/SB01
Building 13
VWAH-PFAS-SD01
VWAH-PFAS-SW01
VWAH-PFAS-MW01
VWAH-PFAS-SS/SB03
VWAH-PFAS-SS/SB02
VWAH-PFAS-SS/SB04

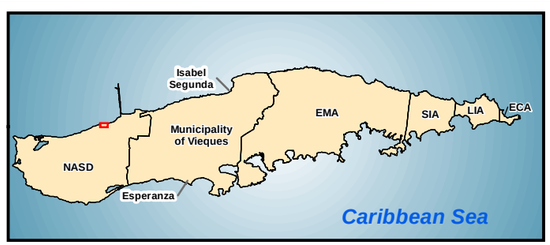
3
7
10
13
16
-2.0
-1.8
-1.6
-1.4
-1.2

Entrance to the public works area

PR-200

Legend

- Approximate Site Boundary
- Proposed Monitoring Well Location
- Proposed Soil Boring Location
- Surface Water and Sediment Sample Location
- Groundwater Potentiometric Contour (AOC H RI Report (2007))
- Groundwater Flow Direction (AOC H RI Report (2007))
- Ephemeral Stream
- Elevation Contour (feet)
- Road



N
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0 50 100
Feet

Imagery Date: 2004

Figure ES-3
NASD AOC H: Abandoned Power Plant
Site Inspection Sampling and Analysis Plan for Per- and Polyfluoroalkyl Substances Former NASD and Former VNTR Vieques, Puerto Rico

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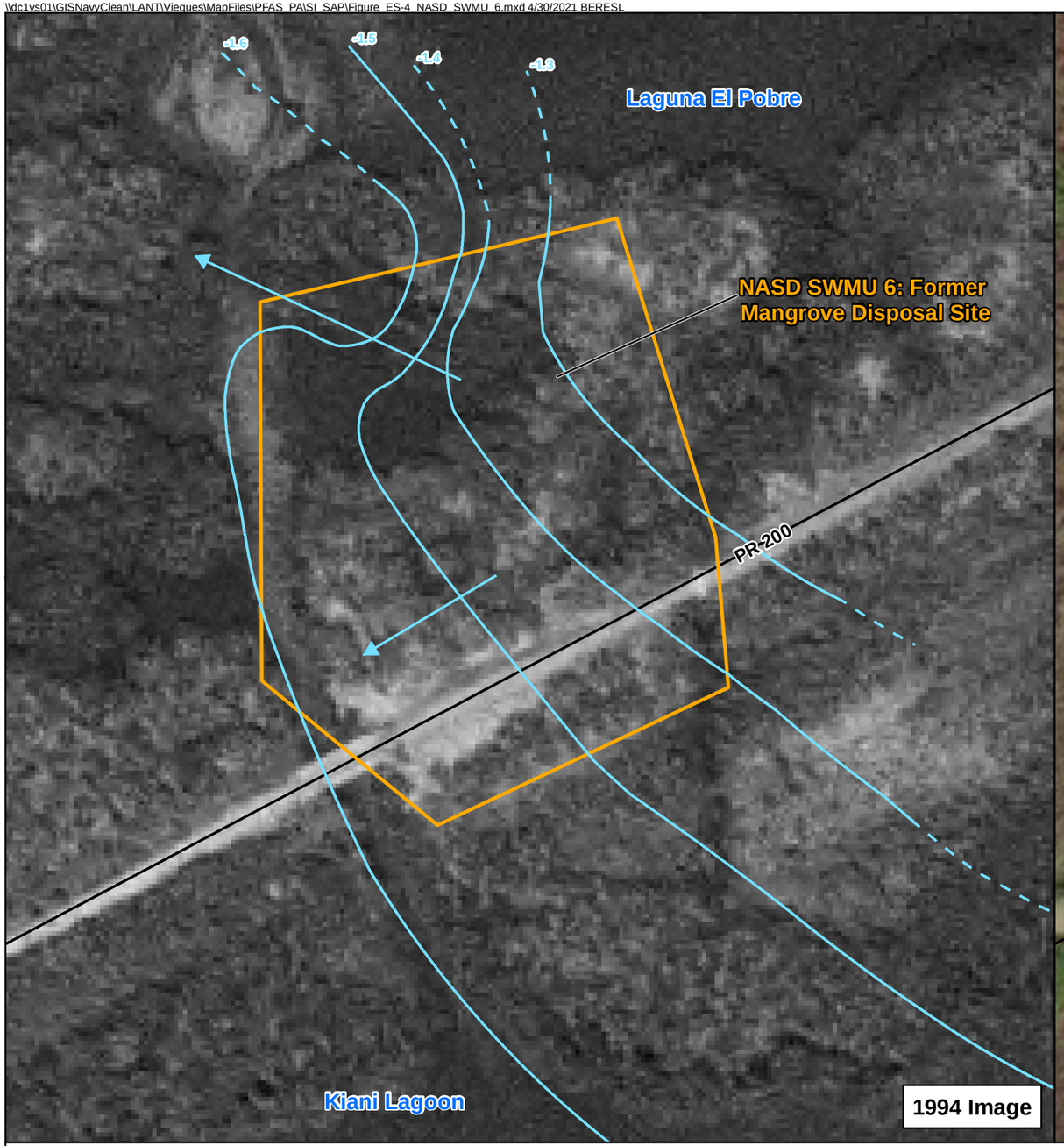
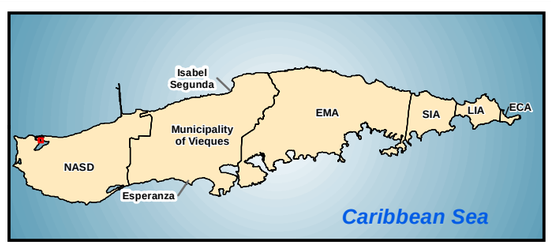


Legend

- Approximate Site Location
- Proposed Soil Boring Location
- Proposed Surface Water and Sediment Sample Location
- Potentiometric Contour (SWMU 6 RI Report (2007))
- Inferred Potentiometric Contour (SWMU 6 RI Report (2007))
- Groundwater Flow Direction (SWMU 6 RI Report (2007))
- Road



N
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S

0 50 100
Feet

Imagery Date: 1994 & 2009

Figure ES-4
NASD SWMU 6: Former Mangrove Disposal Site
Site Inspection Sampling and Analysis Plan
for Per- and Polyfluoroalkyl Substances
Former NASD and Former VNTR
Vieques, Puerto Rico

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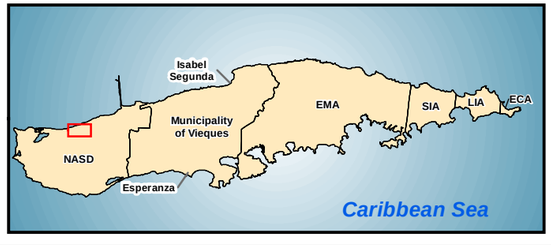
Legend

- Approximate Site Location
- Proposed Monitoring Well Location
- Proposed Soil Boring Location
- Fallback Monitoring Well Location if drill rig access along the quebrada is not possible
- Potentiometric Groundwater Contour (SWMU 7 RI Report (2008))
- Groundwater Flow Direction (SWMU 7 RI Report (2008))
- Interpreted Waste Boundary
- Road
- Elevation Contour (feet)
- Ephemeral Stream



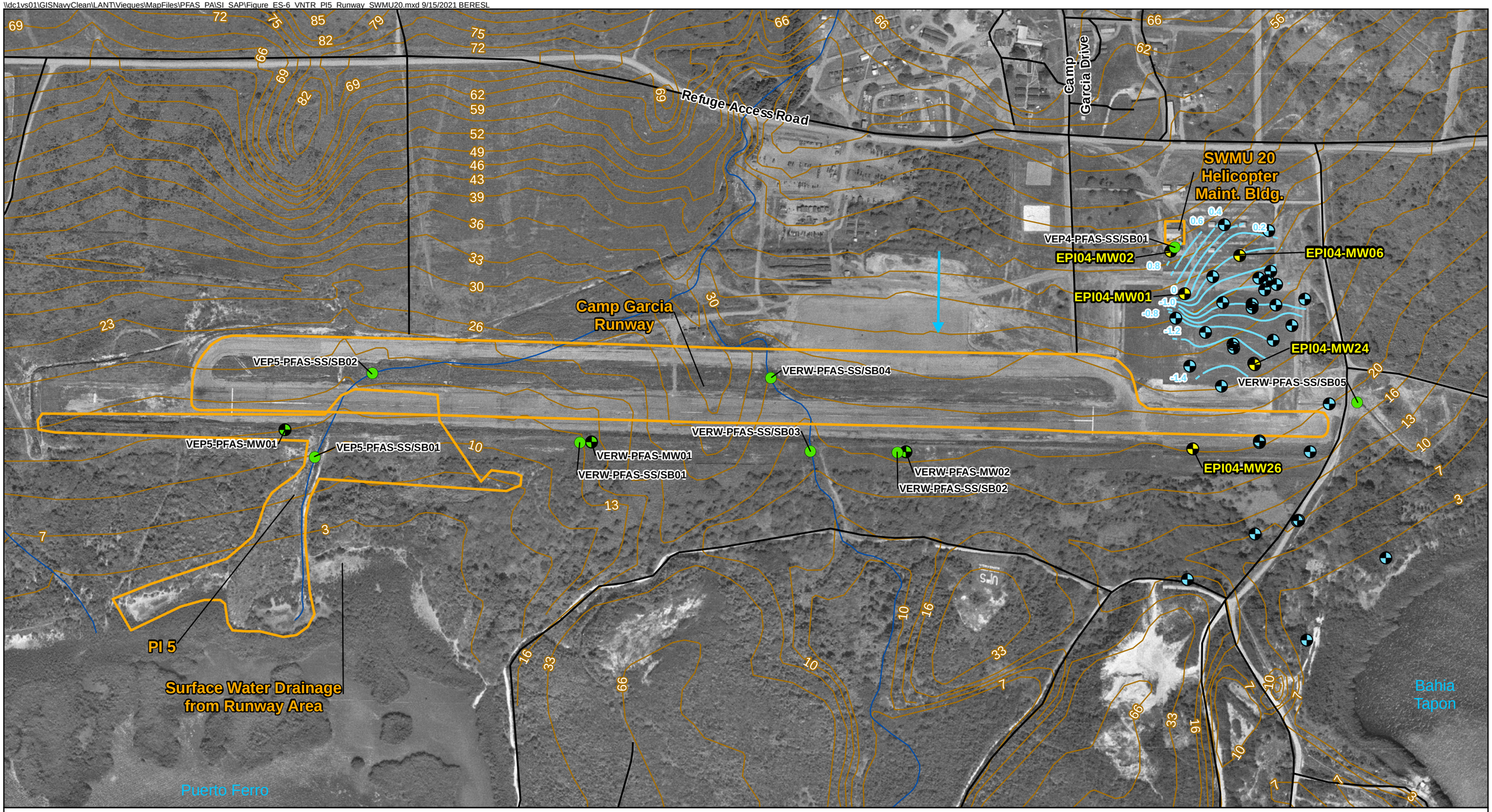
N W E S

0 40 80 Meters

Imagery Date: 1994

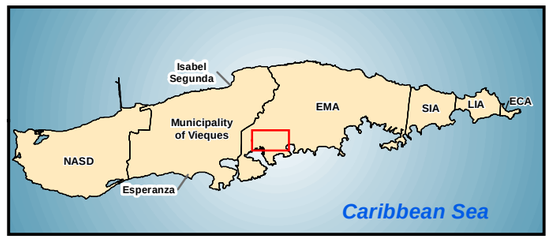
Figure ES-5
NASD SWMU 7: Former Quebrada Disposal Site
Site Inspection Sampling and Analysis Plan for Per- and Polyfluoroalkyl Substances Former NASD and Former VNTR Vieques, Puerto Rico

\\dc1vs01\GISNavyClean\LANT\Vieques\MapFiles\PFAS_PA\SI_SAP\Figure_ES-6_VNTR_PI5_Runway_SWMU20.mxd 9/15/2021 BERESL



Legend

- Approximate Site Location
- Proposed Monitoring Well Location
- Proposed Soil Boring Location
- Existing Wells to be Sampled
- Existing Wells not being Sampled
- Generalized Groundwater Flow Direction
- Groundwater Potentiometric Contour (SWMU 20 RI Report (2016))
- Road
- Elevation Contour (feet)
- Ephemeral Stream



N
W E
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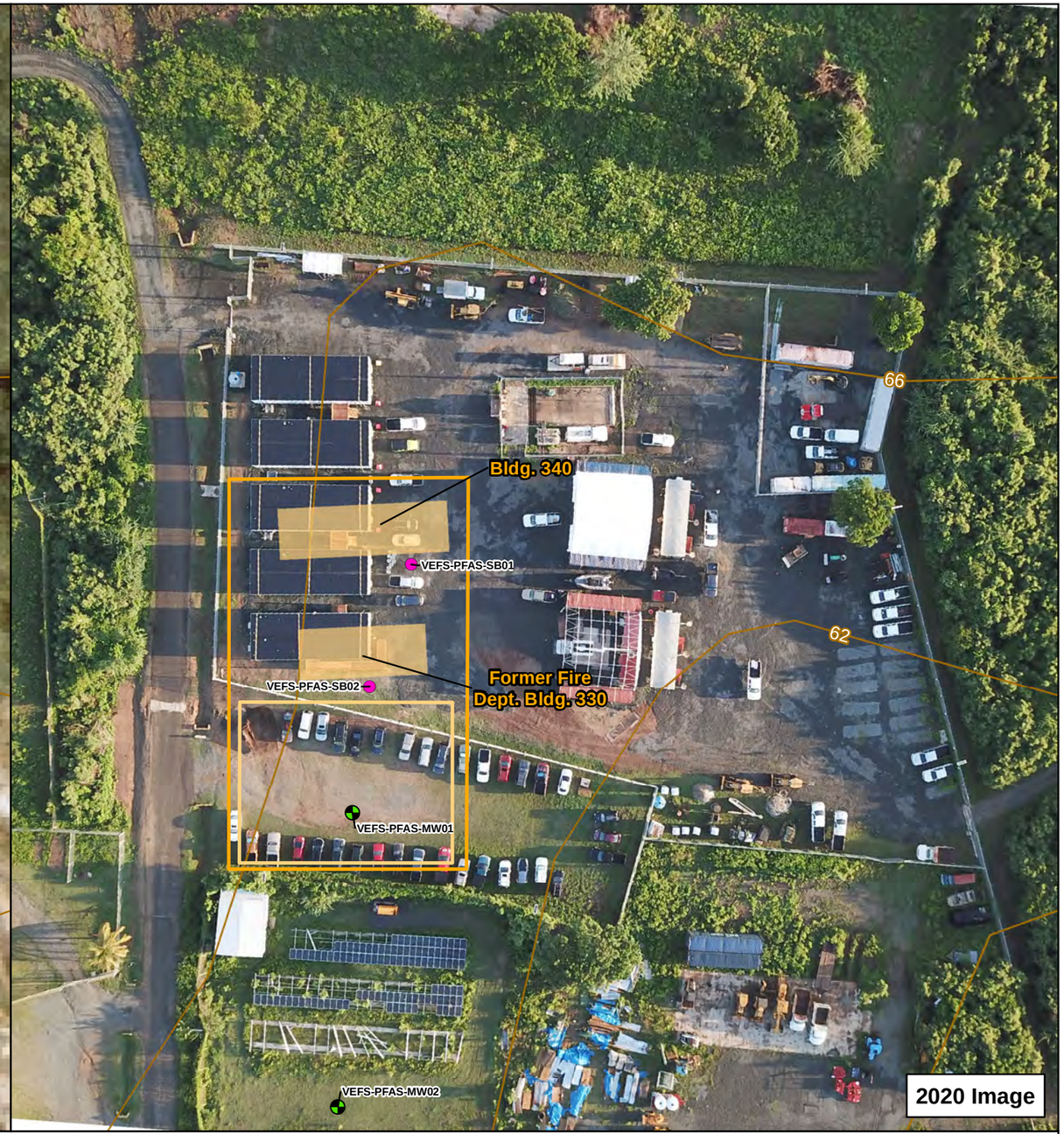
0 250 500 Feet

Imagery Date: 1964

Figure ES-6
VNTR Camp Garcia Runway, VNTR PI 5: Surface Water Drainage Area from Camp Garcia Runway (Down Gradient), and VNTR SWMU 20: Former Helicopter Maintenance Area
Site Inspection Sampling and Analysis Plan for Per- and Polyfluoroalkyl Substances Former NASD and Former VNTR Vieques, Puerto Rico

\\dc1vs01\GISNavyClean\LANT\Vieques\MapFiles\PFAS_PA\SI_SAP\Figure_ES-7_Former_VNTR_Motor_Pool_1983_2020.mxd 8/27/2021 BERESL



Legend

- Potential Former VNTR Motor Pool Area (including Building 340) and Former Fire Department Building 330
- Potential Former VNTR Motor Pool Area
- Former Building Area
- Elevation Contour (feet)
- Proposed Monitoring Well Location
- Subsurface Soil Sample

Note: Proposed subsurface sample locations are subject to change based on existing structures, drill rig access, utilities, and surface or subsurface soil disturbances related to recent site construction activities.

N
W E
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0 35 70
Feet

Imagery Date: 1983 & 2020

Figure ES-7
Potential Former VNTR Motor Pool Area (including Building 340) and Former Fire Department Building 330, 1983 and 2020 Aerial Photographs
Site Inspection Sampling and Analysis Plan
for Per- and Polyfluoroalkyl Substances
Former NASD and Former VNTR
Vieques, Puerto Rico

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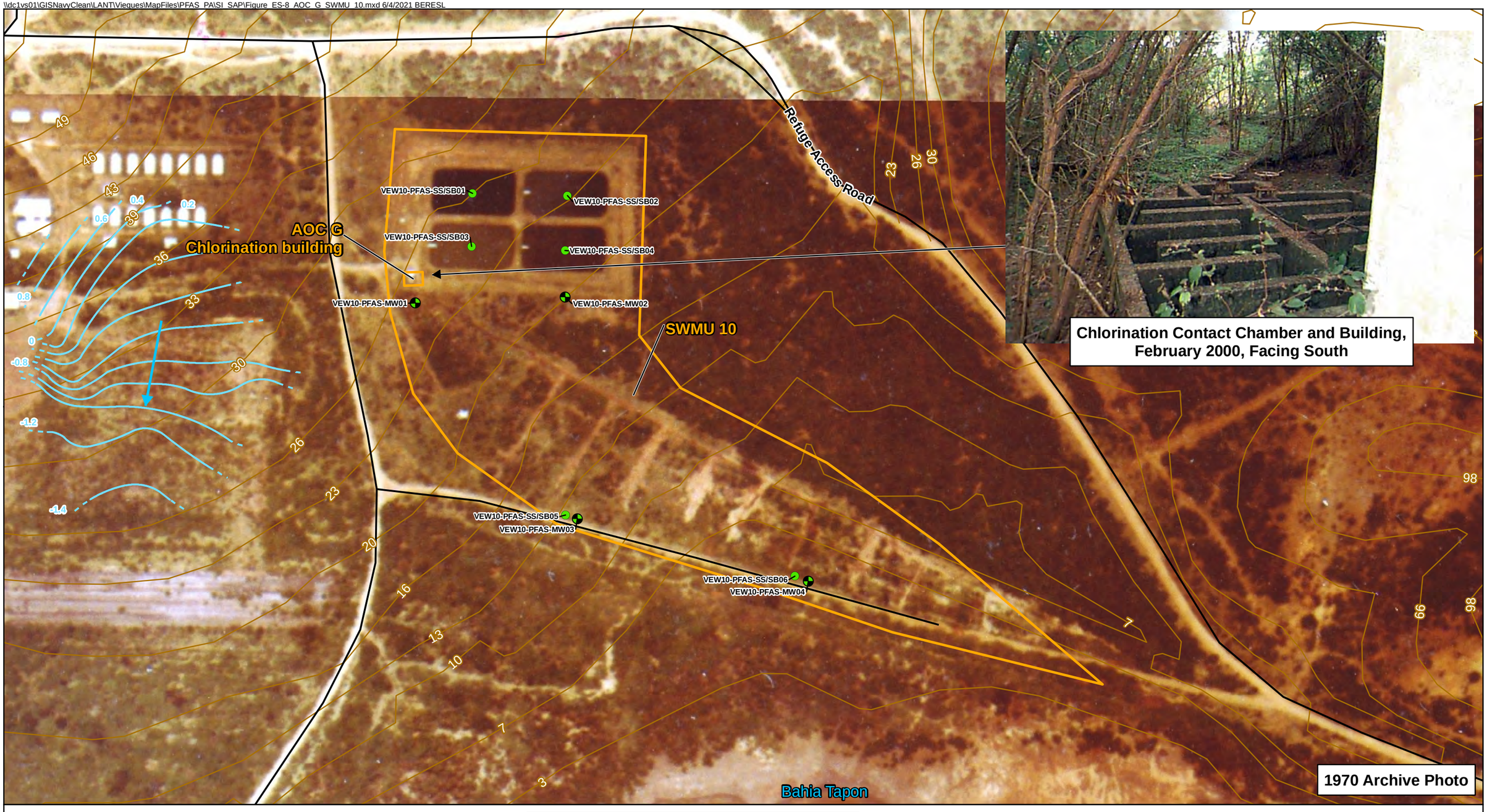
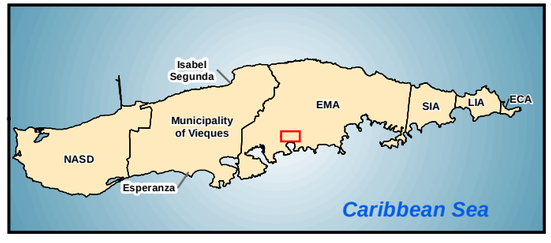


Chlorination Contact Chamber and Building, February 2000, Facing South

Legend

- Approximate Site Location
- Proposed Monitoring Well Location
- Proposed Soil Boring Location
- Groundwater Potentiometric Contour (SWMU 20 RI Report (2016))
- Inferred Groundwater Potentiometric Contour (SWMU 20 RI Report (2016))
- Elevation Contour (feet)
- Road



N
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0 125 250
Feet

Imagery Date: 1970

Figure ES-8
VNTR SWMU 10 and VNTR AOC G: Former Sewage Treatment Lagoons and Chlorination Building
Site Inspection Sampling and Analysis Plan for Per- and Polyfluoroalkyl Substances Former NASD and Former VNTR Vieques, Puerto Rico

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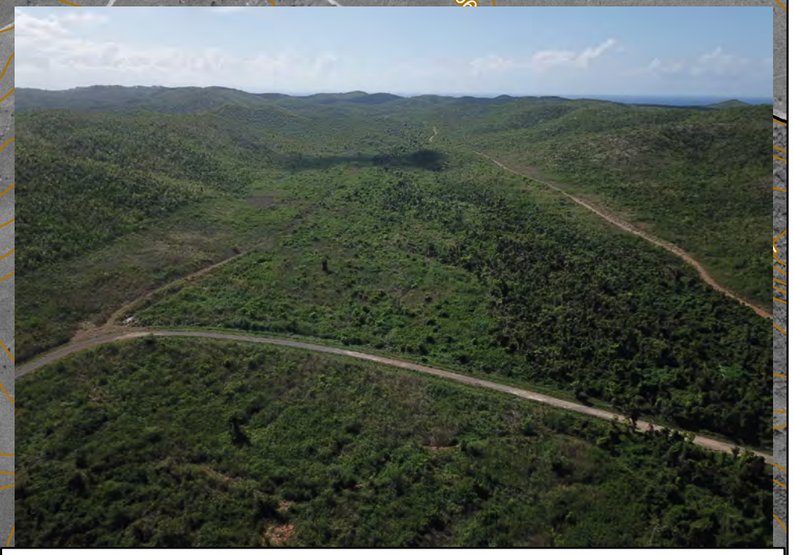


SWMU 1 Former Landfill Area Current Conditions, Facing North

SWMU 1

MW-08

MW-06

MW-02

MW-03

MW-11

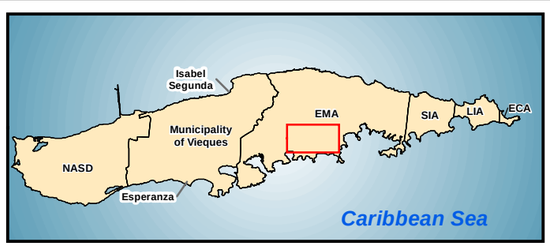
MW-10

Laguna la Chiva

40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0

Legend

- Approximate Site Location
- Existing Wells to be Sampled
- Monitoring Wells not being Sampled
- Road
- Elevation Contour (feet)
- Ephemeral Stream
- Potentiometric Groundwater Contour (SMWU 1 LTM Annual Report (2019))
- Inferred Potentiometric Groundwater Contour (SMWU 1 LTM Annual Report (2019))
- Groundwater Flow Direction (SMWU 1 LTM Annual Report (2019))



N
W E
S

0 350 700
Feet

Imagery Date: 1964

Figure ES-9
VNTR SWMU 1: Former Camp Garcia Municipal Solid Waste Management Unit (Landfill)
Site Inspection Sampling and Analysis Plan for Per- and Polyfluoroalkyl Substances
Former NASD and Former VNTR
Vieques, Puerto Rico

Contents

Attachments

Tables

Figures

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Acronyms and Abbreviations

°C	degrees Celsius
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
AFFF	aqueous film-forming foam
AHA	Activity Hazard Analysis
amsl	above mean sea level
amu	atomic mass unit
AOC	Area of Concern
bgs	below ground surface
bls	below land surface
CA	Corrective Action
CAP	Corrective Action Plan
CAR	Corrective Action Request
CAS	Chemical Abstract Services
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CH2M	CH2M HILL, Inc.
CPR	cardiopulmonary resuscitation
CQM-C	Construction Quality Management for Contractors
CSM	Conceptual Site Model
DL	Detection Limit
DO	dissolved oxygen
DoD	Department of Defense
DOI	Department of the Interior
DQE	Data Quality Evaluation
DQO	Data Quality Objective
DTW	depth to water
DUA	Data Usability Assessment
EB	equipment blank
EBS	Environmental Baseline Survey
ECA	Eastern Conservation Area
EDD	electronic data deliverables
ELAP	Environmental Laboratory Accreditation Program
EMA	Eastern Maneuver Area
EPA	Environmental Protection Agency Region 2
ERI	Environmental Research, Inc.
ESI	Expanded Site Inspection
ESV	Ecological Screening Value
FCR	Field Change Request
FD	field duplicate
FFA	Federal Facility Agreement
FRC	Federal Records Center
ft/ft	feet per foot

FTL	Field Team Leader
GIS	geographic information system
GPS	global positioning system
GW	groundwater
H&S	Health and Safety
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response (training)
HDPE	high-density polyethylene
HQ	hazard quotient
ICAL	initial calibration
ICV	initial calibration verification
ID	identification
IDQTF	Intergovernmental Data Quality Task Force
IDW	investigation-derived waste
IS	internal standards
ISC	instrument sensitivity check
LCL	Lower Control Limit
LC-MS	Liquid Chromatography-Mass Spectrometry
LCS	laboratory control sample
LIA	Live Impact Area
LIMS	Laboratory Information Management System
LOD	limit of detection
LOQ	limit of quantitation
MB	method blank
MCL	Maximum Contaminant Level
MD	matrix duplicate
ml	milliliter(s)
MOV	Municipality of Vieques
MPC	Measurement Performance Criteria
MS	matrix spike
MSD	matrix spike duplicate
mV	millivolt(s)
N/A	not applicable
NAF	Naval Ammunition Facility
NAPR	Naval Activity Puerto Rico
NASD	Naval Ammunition Support Detachment
NAVFAC	Naval Facilities Engineering Systems Command Atlantic
Navy	Department of the Navy
ng/L	nanograms per liter
NIRIS	Naval Installation Restoration Information Solution
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No Observed Adverse Effect Level
NPL	National Priorities List
NSRR	Naval Station Roosevelt Roads
NTU	Nephelometric Turbidity Units

ORP	oxidation-reduction potential
OSHA	Occupational Safety and Health Administration
PA	Preliminary Assessment
PAL	project action limit
PAOC	Potential Area of Concern
PC	Project Chemist
pdf	portable document format
PDM	Project Data Manager
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFOA	perfluorooctanesulfonic acid
PFOS	perfluorooctane sulfonate
pH	potential hydrogen
PI	Photo Identified (site)
PJLA	Perry Johnson Laboratory Accreditation, Inc.
PM	Project Manager
POC	point of contact
PPE	personal protective equipment
PQL	practical quantitation limit
PRDNER	Puerto Rico Department of Natural and Environmental Resources
PREQB	Puerto Rico Environmental Quality Board
PTFE	polytetrafluoroethylene
PVC	polyvinyl chloride
QA	quality assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
RCA	Root Cause Analysis
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RI	Remedial Investigation
ROD	Record of Decision
RPD	relative percent difference
RPM	Remedial Project Manager
RSD	relative standard deviation
S/N	signal-to-noise (ratio)
SAP	Sampling and Analysis Plan
SB	subsurface soil
SD	sediment
SI	Site Inspection
SIA	Surface Impact Area
SL	Screening Level
SOP	Standard Operating Procedure
SPE	solid phase extraction
SS	surface soil

SSC	Site Safety Coordinator
SW	surface water
SWMU	Solid Waste Management Unit
TAC	Terminal Area Chart
TAT	turnaround time
TBD	to be determined
TCE	trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
UCL	Upper Control Limit
UFP	Uniform Federal Policy
USACE	United States Army Corps of Engineers
USAE	USA Environmental, Inc.
USFWS	United States Fish and Wildlife Service
VDMS	Validation Data Management System
VNTR	Vieques Naval Training Range
VOC	volatile organic compound
WCHEM	wet chemistry
WWTP	wastewater treatment plant

Worksheet #1 & 2: Title and Approval Page

1. Project Identifying Information

a. Site Name/Project Name: Former Naval Ammunition Support Detachment (NASD) and Former Vieques Naval Training Range (VNTR) Site Inspection (SI) Sampling and Analysis Plan (SAP) for Per-and Polyfluoroalkyl Substances (PFAS) in Vieques, Puerto Rico

b. Site Location/Number: Atlantic Fleet Weapons Training Area – Vieques, Former NASD and Former VNTR, Vieques, Puerto Rico

c. Contract Number: CH2M: N62470-16-D-9000, Contract Task Order 0003

d. **Regulatory Program:** Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

2. Lead Organization (Naval Facilities Engineering Systems Command Atlantic [NAVFAC])

a. NAVFAC Remedial Project Manager (RPM)
Kevin Cloe

CLOE.KEVIN.R.1229533947 Digitally signed by CLOE.KEVIN.R.1229533947 Date: 2021.11.30 15:03:25 -05'00'

(Signature/Date)

b. NAVFAC Quality Assurance Officer (QAO)
Ken Bowers

BOWERS.KENNETH.A.1230092474 Digitally signed by BOWERS.KENNETH.A.1230092474 Date: 2020.10.22 14:09:09 -04'00'

3. Site Inspection Contractor (CH2M HILL, Inc. [CH2M])

a. CH2M Activity Manager (AM)
Bill Hannah

Bill Hannah Digitally signed by Bill Hannah Date: 2021.11.19 08:08:01 -05'00'

(Signature/Date)

b. CH2M Project Manager (PM)
John Swenfurth

John Swenfurth Digitally signed by John Swenfurth Date: 2021.11.19 08:01:06 -05'00'

(Signature/Date)

c. CH2M Project Delivery and Quality Manager
Brett Doerr

G. Brett Doerr Digitally signed by G. Brett Doerr Date: 2021.11.30 13:12:18 -05'00'

(Signature/Date)

d. CH2M Health and Safety (H&S) Manager
Stephen Brand

Stephen Brand Digitally signed by Stephen Brand Date: 2021.11.19 09:17:30 -05'00'

(Signature/Date)

4. Federal Regulatory Agency (United States Environmental Protection Agency Region 2 [EPA])

EPA RPM
Denise Zeno

Douglas M Pocze Digitally signed by Douglas M Pocze Date: 2021.11.30 16:46:21 -05'00'

(Signature/Date)

5. Commonwealth Regulatory Agency (Puerto Rico Department of Natural and Environmental Resources [PRDNER])

PRDNER RPM
Juan Baba Peebles

(Signature/Date)

6. Vieques National Wildlife Refuge System Supervisor (United States Fish and Wildlife Service [USFWS])

USFWS RPM
Susan Silander

SUSAN SILANDER Digitally signed by SUSAN SILANDER Date: 2021.12.02 17:06:14 -04'00'

(Signature/Date)

7. List of plans and reports from previous investigations relevant to this project:

- A. T. Kearney, Inc. and K. W. Brown and Associates, Inc. 1988. *Phase II RCRA Facility Assessment of the Atlantic Fleet Weapons Training Facility (LANT) Including the Eastern Maneuver Area, Camp Garcia and Inner Range, Vieques Island, Puerto Rico.* October.
  - Historical information on NASD Area of Concern (AOC) B
- Program Management Company. 2000. *Environmental Baseline Survey, Naval Ammunition Support Detachment Vieques, Vieques Island, Puerto Rico*. October 17.
  - Historical information on NASD AOC B, Fire Station, Motor Pool Area, AOC H, Solid Waste Management Unit (SWMU) 6, and SWMU 7
- CH2M. 2001. *Description of Current Conditions Report, Atlantic Fleet Weapons Training Facility, Vieques, Puerto Rico*. February.
  - Historical information on VNTR SWMU 1, SWMU 10, AOC G, and Photo Identified (PI) 5
- Naval Facilities Engineering Command Atlantic. 2003. *Environmental Baseline Survey, Vieques Naval Training Range Vieques island, Puerto Rico*. April 1.
  - Historical information on VNTR Fire Department, SWMU 1, SWMU 10/AOC G, SWMU 20 (formerly PI 4), Camp Garcia Runway, and PI 5
- CH2M. 2006. *No Further Action Report for Nine Sites, Former U.S. Naval Ammunition Support Detachment, Vieques, Puerto Rico*. October.
  - Historical information on NASD AOC B
- CH2M. 2007a. *Remedial Investigation Report Solid Waste Management Unit (SWMU) 6, Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico*. February.
  - Historical information on NASD SWMU 6
- CH2M. 2007b. *Remedial Investigation Report Area of Concern (AOC) H, Former Naval Ammunition Support Detachment, Vieques, Puerto Rico*. July.
  - Historical information on NASD AOC H
- CH2M. 2008a. *Remedial Investigation Report Solid Waste Management Unit (SWMU) 7, Former Naval Ammunition Support Detachment, Vieques, Puerto Rico*. March.
  - Historical information on NASD SWMU 7
- CH2M. 2008c. *Preliminary Assessment/Site Inspection Report 12 Consent Order Sites and 8 PI/PAOC Sites, Former Vieques Naval Training Range, Vieques, Puerto Rico*. June.
  - Historical information on VNTR SWMU 1, SWMU 10, AOC G, and SWMU 20 (formerly PI 4)

- CH2M. 2010a. *Site Inspection/Expanded Site Inspection Report, 7 Consent Order Sites and 16 PI/PAOC Sites, Former Vieques Naval Training Range, Vieques, Puerto Rico*. August.
  - Historical information on VNTR PI 5, SWMU 1, SWMU 10, AOC G, and SWMU 20 (formerly PI 4).
- CH2M. 2010b. *No Action/No Further Action Decision Document, 7 consent Order Sites and 14 PI/PAOC Sites, Former Vieques Naval Training Range, Vieques, Puerto Rico*. September.
  - Historical information on VNTR SWMU 10, AOC G, and PI 5
- CH2M. 2011a. *Streamlined Remedial Investigation/Feasibility Study Report, Solid Waste Management Unit 1 (SWMU 1), Former Vieques Naval Training Range, Vieques, Puerto Rico*. April.
  - Historical information on VNTR SWMU 1
- CH2M. 2016b. *Solid Waste Management Unit 20 Remedial Investigation Report, Atlantic Fleet Weapons Training Area – Vieques, Former Vieques Naval Training Range, Vieques, Puerto Rico*. August.
  - Historical information on VNTR SWMU 20
- CH2M. 2017. *Solid Waste Management Unit 1, Remedial Action Completion Report, Atlantic Fleet Weapons Training Area – Vieques, Former Vieques Naval Training Range, Vieques, Puerto Rico*. January.
  - Historical information on VNTR SWMU 1
- NAVFAC. 2017. *Interim Per- and Polyfluoroalkyl Substances (PFAS) Guidance for NAVFAC Remedial Project Managers (RPMs)*. September 28.
  - Guidance information on performing PFAS investigations
- CH2M. 2020. *Preliminary Assessment Report for Per- and Polyfluoroalkyl Substances, Atlantic Fleet Weapons Training Area – Vieques, Former Naval Ammunition Support Detachment and Former Vieques Naval Training Range, Vieques Puerto Rico*. April.
  - Historical information on NASD and VNTR potential release areas included in the PFAS SI

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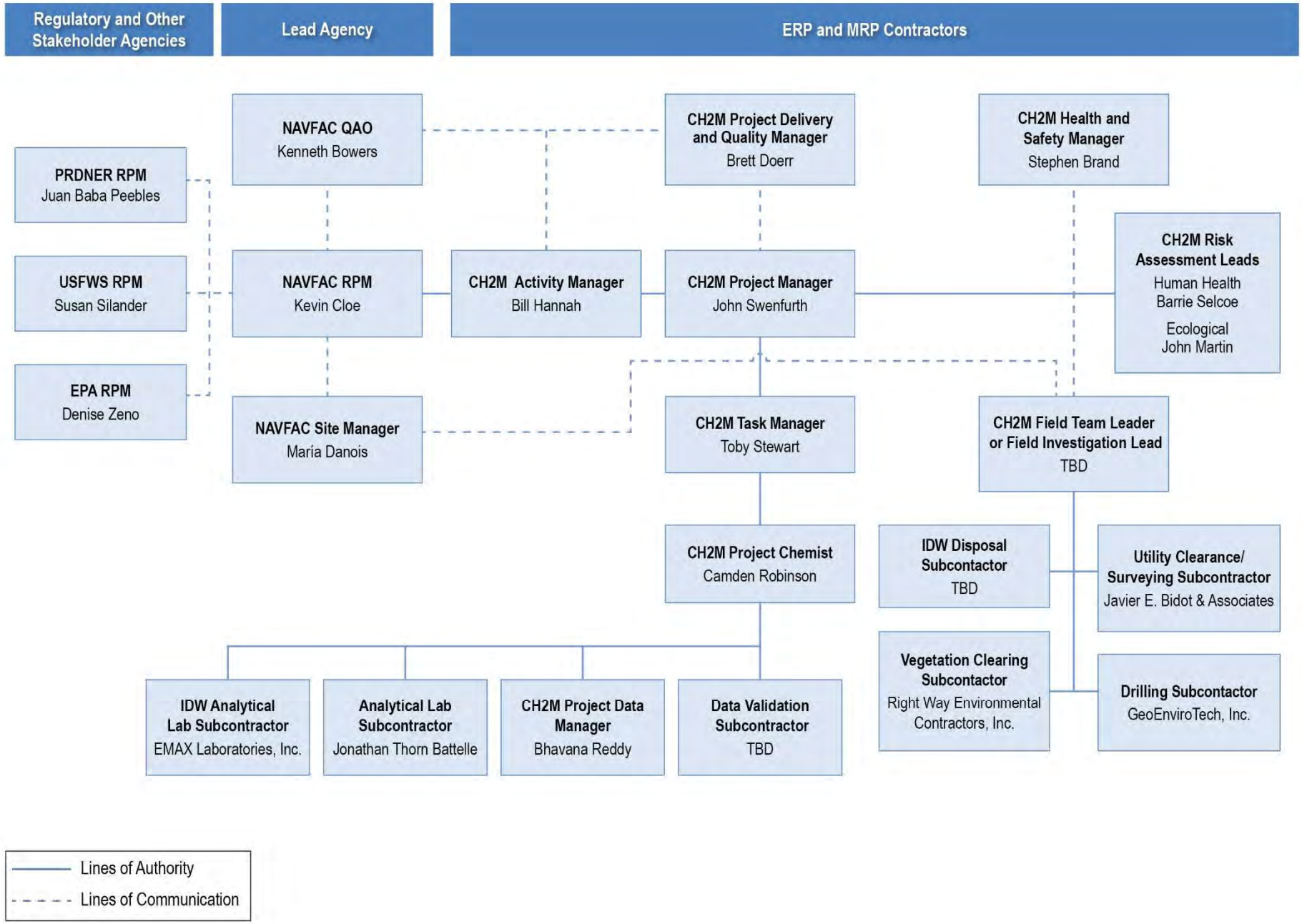
Worksheet #3 & 5: Project Organization and SI SAP Distribution

This worksheet contains personnel associated with implementing the SI SAP. The accompanying organizational chart includes key representatives of the project teams. Other members listed in **Worksheet #4, 7 & 8** but not included on the organizational chart represent subgroups of the roles/agencies included in the organizational chart.


Regulatory and Other Stakeholder Agencies
Lead Agency
ERP and MRP Contractors
NAVFAC QAO
Kenneth Bowers
CH2M Project Delivery and Quality Manager
Brett Doerr
CH2M Health and Safety Manager
Stephen Brand
PRDNER RPM
Juan Baba Peebles
USFWS RPM
Susan Silander
EPA RPM
Denise Zeno
NAVFAC RPM
Kevin Cloe
CH2M Activity Manager
Bill Hannah
CH2M Project Manager
John Swenfurth
CH2M Risk Assessment Leads
Human Health
Barrie Selcoe
Ecological
John Martin
NAVFAC Site Manager
María Danois
CH2M Task Manager
Toby Stewart
CH2M Field Team Leader or Field Investigation Lead
TBD
CH2M Project Chemist
Camden Robinson
IDW Disposal Subcontactor
TBD
Utility Clearance/ Surveying Subcontractor
Javier E. Bidot & Associates
Vegetation Clearing Subcontactor
Right Way Environmental Contractors, Inc.
Drilling Subcontactor
GeoEnviroTech, Inc.
IDW Analytical Lab Subcontractor
EMAX Laboratories, Inc.
Analytical Lab Subcontractor
Jonathan Thorn Battelle
CH2M Project Data Manager
Bhavana Reddy
Data Validation Subcontractor
TBD
Lines of Authority
Lines of Communication

Worksheet #4, 7 & 8: Personnel Qualifications and Sign-off Sheet

Name	Project Title	Education/Experience	Specialized Training	Required Licenses/ Certifications/ Authorizations	Signature/Date[1]
Bill Hannah	CH2M AM	• B.S., Geology, University of Alberta • Professional Geologist (California) • 22 years of environmental remediation experience		Not applicable (N/A)	
Brett Doerr	CH2M Project Delivery and Quality Manager	• M.S., Environmental Science, Purdue University • B.S., Chemistry, Virginia Commonwealth University • Professional Geologist (Virginia) • 28 years of environmental remediation experience		N/A	
Juliana Dean	CH2M PFAS Subject Matter Expert	• B.S. Chemistry, University of Mary Washington • M.S. Environmental Engineering, Pennsylvania State University • Engineer in Training (Virginia) • 9 years of environmental remediation experience including 6 years of overseeing investigation, treatability testing, and remediation of PFAS. •		N/A	
Stephen Brand	CH2M H&S Manager	• M.S., Geology, Texas A&M University • B.S., Geology, Washington & Lee University • Professional Geologist (Virginia) • 10 years of environmental remediation experience	• Certified Safety Professional • Occupational Health and Safety Technician	N/A	
John Swenfurth	CH2M PM	• M.S., Hydrogeology, Wright State University • B.S., Geology, Bowling Green State University • Professional Geologist (Florida) • 23 years of environmental remediation experience		N/A	
Toby Stewart (or other qualified staff)	CH2M Field Team Leader (FTL)	• M.S., Geology, Louisiana State University and Agricultural and Mechanical College • B.S., Geology, University of Oklahoma • 15 years of environmental field investigation experience	• 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training with current 8-hour refresher • 10-hour Occupational Safety and Health Administration (OSHA) Construction Certification • US Army Corps of Engineers (USACE) Construction Quality Management for Contractors (CQM-C) Certification • Cardiopulmonary resuscitation (CPR) and First Aid Training	N/A	
Jesse Clements	CH2M Geographic Information System (GIS) Manager	• B.S. Geographic Science, James Madison University • 15 years of geospatial and database management experience		N/A	
Anita Dodson	CH2M Program Chemist	• B.S. Chemistry, Tennessee Technological University • 26 years of experience		N/A	
Camden Robinson	CH2M Project Chemist (PC)	• B.A. in Chemistry, University of West Georgia	• Validation Data Management System (VDMS) Validation Tool	N/A	

Name	Project Title	Education/Experience	Specialized Training	Required Licenses/ Certifications/ Authorizations	Signature/Date[1]
		• 4 years of experience as a fuel analyst for Kinder Morgan • 21 years of experience in project chemistry and data validation	• USACE Automated Data Review Validation Tool		
Barrie Selcoe	CH2M Risk Assessment Lead - Human Health	• Master of Public Health, University of Pittsburgh Graduate School of Public Health • B.S., Microbiology, San Diego State University • 30 years of human health risk assessment experience	• Risk Assessment Issues in Toxics - The Probabilistic Approach (University of California Santa Barbara) • Risk Assessment and Risk Communication (EPA Air Risk Information Support Center)	N/A	
John Martin	CH2M Risk Assessment Lead - Ecological	• M.S., Biology, Memphis State University • B.S., Biology, Baldwin-Wallace College • 30 years of environmental remediation and munitions response experience		N/A	
To be determined (TBD)	CH2M Field Team Member/ Site Safety Coordinator (SSC)	TBD	• 40-hour HAZWOPER with current 8-hour refresher • CPR and First Aid Training	N/A	
Bhavana Reddy	CH2M Project Data Manager	• BA, Business Administration and Accounting, Bangalore University, Bangalore, India • Diploma in RDBMS Oracle, Software Solutions Integrated, Bangalore, India • Diploma in Oracle Financials, Comp-u-learn, Pittsburg, PA • 24 years of database programing and administration experience • 20 years of environmental database/data management experience	N/A	N/A	
Jonathan Thorn	Analytical Lab Subcontractor for PFAS (Battelle)	N/A	N/A	Laboratory Accreditation Letter	
TBD	IDW Analytical Lab Subcontractor for TCLP (EMAX Laboratories, Inc.)	N/A	N/A		
TBD	Data Validation Subcontractor	N/A	N/A		
Pedro Tejada	Vegetation clearing Subcontractor (Right Way Environmental Contractors, Inc.)	N/A	N/A	N/A	
Juan Negron	Drilling Subcontractor (GeoEnviroTech, Inc.)	N/A	N/A		
Carlos Lebron	Utility Clearance/Surveyor Subcontractor (Javier E. Bidot & Associates)	N/A	N/A	N/A	
TBD	Investigation-derived Waste (IDW) Subcontractor PM	TBD			

Note: Lines of Communications are shown in the **Worksheet #3 & 5** Project Organizational Structure.

[1] Signatures indicate personnel have read and concur with this SAP. Signed versions of **Worksheet #4** will be kept on file at CH2M along with other project documents.

Worksheet #6: Communication Pathways and Procedures

Communication Driver	Initiator (Name, Project Title)	Recipient (Name, Project Title)	Procedure (Timing, Pathway, Documentation)
Regulatory agency interface	Kevin Cloe NAVFAC RPM kevin.r.cloe.civ@us.navy.mil	Juan Baba Peebles PRDNER RPM Juanbaba@jca.pr.gov Susan Silander USFWS RPM Susan_silander@fws.gov Denise Zeno EPA RPM zeno.denise@epa.gov	NAVFAC RPM provides project updates to regulatory stakeholders via email, telephone, or meetings, as necessary; can delegate communication to other internal or external points of contact (POCs).
Communication to/from Navy from Vieques onsite contractors	Maria Danois NAVFAC Site Manager maria.m.danois.civ@us.navy.mil	Kevin Cloe NAVFAC RPM kevin.r.cloe.civ@us.navy.mil	On-island POC for Navy, provides updates to NAVFAC RPM via email, telephone, hardcopy, or in-person, as warranted; can delegate communication to other internal or external POCs.
Navy Chemistry Quality Input	Kenneth Bowers NAVFAC QAO kenneth.a.bowers.civ@us.navy.mil	Kevin Cloe NAVFAC RPM kevin.r.cloe.civ@us.navy.mil John Swenfurth CH2M PM john.swenfurth@jacobs.com	Provides review comments to Navy contractor on chemistry aspects of the pre-draft SAP via email through NAVFAC RPM. Provides overall Navy guidance via direct communication with Navy contractor, as warranted and as delegated.
Contractor communication to/from Navy (e.g., submission of SAP for review; responses to comments, updates on project progress, etc.)	Bill Hannah CH2M AM Bill.hannah@jacobs.com	Kevin Cloe NAVFAC RPM kevin.r.cloe.civ@us.navy.mil	CH2M AM provides documents and project updates to the Navy via hardcopy, email, telephone, or meetings, as necessary. Can delegate communication to other contractor staff, as appropriate.
Project administration and logistics	John Swenfurth CH2M PM john.swenfurth@jacobs.com	Various contractor and subcontractor staff (CH2M and subcontractors)	Direct communication (via email, telephone, hardcopy, or in person, as needed) to/from contractor/subcontractor project staff to ensure appropriate project implementation.

Communication Driver	Initiator (Name, Project Title)	Recipient (Name, Project Title)	Procedure (Timing, Pathway, Documentation)
Stop work due to safety issues	John Swenfurth CH2M PM john.swenfurth@jacobs.com	Maria Danois NAVFAC Site Manager maria.m.danois.civ@us.navy.mil Kevin Cloe NAVFAC RPM kevin.r.cloe.civ@us.navy.mil	As soon as possible following discovery, SSC informs the CH2M PM of critical safety issues and generates a follow-up Stop Work Memorandum. The CH2M PM will then inform the NAVFAC Site Manager and RPM. CH2M PM will also notify NAVFAC RPMs when safety issue has been addressed (including Root Cause Analysis [RCA], if necessary). Of note, other CH2M field staff will also observe for potentially unsafe conditions and stop work if conditions/activities deemed to be immediately dangerous to life or health are observed.
Access to sampling locations on National Wildlife Refuge	CH2M FTL (TBD)	Mike Barandiaran National Wildlife Refuge Manager Mike_Barandiaran@fws.gov	Access to all areas within the National Wildlife Refuge planned for sampling will be discussed with USFWS prior to access to ensure appropriate protective measures, as applicable, are employed while ensuring the SI objectives can be met.
Daily field progress reports; implementation of sampling activities	CH2M FTL (TBD)	John Swenfurth CH2M PM john.swenfurth@jacobs.com	At end of each day of fieldwork, FTL (or designee) will provide CH2M PM daily progress report. CH2M PM will then inform NAVFAC Site Manager and NAVFAC RPM via email, telephone, hardcopy, or in-person, as applicable.
Ensure staff H&S in the field	CH2M SSC (TBD)	Field staff (TBD)	Conducts daily safety tailgates; daily observations; real-time discussions of observations and changes to be implemented. Will report any deficiencies to the CH2M PM or H&S Manager.
Substantive SAP changes during project execution	John Swenfurth CH2M PM john.swenfurth@jacobs.com	Maria Danois NAVFAC Site Manager maria.m.danois.civ@us.navy.mil Kevin Cloe NAVFAC RPM kevin.r.cloe.civ@us.navy.mil	CH2M PM submits a Field Change Request (FCR) and, as applicable, a Corrective Action Request (CAR) and Corrective Action Plan (CAP) to NAVFAC Site Manager and RPM. The NAVFAC RPM provides review and approval. Following approval, the NAVFAC RPM will notify stakeholders via email and solicit feedback to the extent practicable.

Communication Driver	Initiator (Name, Project Title)	Recipient (Name, Project Title)	Procedure (Timing, Pathway, Documentation)
Communications regarding SAP changes associated with laboratory analysis	Anita Dodson CH2M Program Chemist Anita.dodson@jacobs.com Camden Robinson CH2M PC Camden.robinson@jacobs.com	Ken Bowers NAVFAC QAO kenneth.a.bowers.civ@us.navy.mil Kevin Cloe NAVFAC RPM kevin.r.cloe.civ@us.navy.mil Jonathan Thorn Analytical Lab Subcontractor - Battelle	Changes to the project that would prompt a potential SAP change that would require NAVFAC chemistry QAO approval include: the addition of an analytical suite not previously included in SAP, the addition of an environmental matrix not previously included in the SAP, laboratory accreditation to a new Department of Defense (DoD) Quality Systems Manual (QSM) version, inclusion of a new laboratory, or updates to the Conceptual Site Model (CSM) that prompt new Data Quality Objectives (DQO)s. Updated laboratory limits of quantitation (LOQ), limits of detection (LOD), and Detection Limit (DL) values will not prompt an SAP update for NAVFAC QAO chemist review and approval unless those updates negatively impact the ability to meet project action levels (PALs).
Quality control (QC) on laboratory data, release of analytical data for upload to database, data tracking from collection through upload to database	Camden Robinson CH2M PC Camden.robinson@jacobs.com	Jonathan Thorn Analytical Lab Subcontractor - Battelle John Swenfurth CH2M PM john.swenfurth@jacobs.com Ken Bowers NAVFAC QAO kenneth.a.bowers.civ@us.navy.mil	See **Worksheets #24, #25, and #28** for analytical Corrective Actions (CAs). Upon review of validated data to ensure adherence to project requirements, PC communicates via email to Project Data Manager (PDM) that data are ready for release (that is, upload to database). Will track data from sample collection through upload to database, ensuring SAP requirements are met by laboratory and field staff. Tracking involves receipt of electronic and hardcopy data from laboratory and data validator. Communicates with the laboratory PM, and data validator PM, as warranted, to ensure adherence to project analysis and validation requirements. Should there be laboratory quality assurance (QA)/QC issues that may impact project objectives, completeness goals, or project schedule, the PC will communicate this information to the PM and NAVFAC QAO - Chemistry. Also coordinates data upload with CH2M PDM.

Communication Driver	Initiator (Name, Project Title)	Recipient (Name, Project Title)	Procedure (Timing, Pathway, Documentation)
Uploading project data and maintaining the database to ensure data are stored properly and can be retrieved by the PDM	Camden Robinson CH2M PC Camden.robinson@jacobs.com	Bhavana Reddy CH2M PDM Bhavanna.reddy@jacobs.com	Once CH2M chemist ensures data are appropriate for upload to database, PDM submits data electronically to CH2M database manager, who uploads data to Naval Installation Restoration Information Solution (NIRIS).
Reporting lab data quality issues	Jonathan Thorn Analytical Lab Subcontractor - Battelle	John Swenfurth CH2M PM john.swenfurth@jacobs.com Camden Robinson CH2M PC camden.robinson@jacobs.com Kevin Cloe NAVFAC RPM kevin.r.cloe.civ@us.navy.mil	All QA/QC issues with project field samples will be reported by the Laboratory PM to the CH2M PM, PC, and/or PDM via email within 2 business days. For "serious" analytical laboratory issues (i.e., those that may affect data usability such that meeting project objectives may be in jeopardy), the PC will notify the PM who will in turn notify the RPM as soon as practical once the issue is discovered.
Technical and quality support and reporting	Brett Doerr CH2M Project Delivery and Quality Manager Brett.doerr@jacobs.com	Various contractor staff (CH2M)	Project delivery and quality support, including scope development, guidance, and technical/quality review.
Technical support for PFAS related issues	Juliana Dean CH2M PFAS Subject Matter Expert Juliana.dean@jacobs.com	John Swenfurth CH2M PM john.swenfurth@jacobs.com	Data evaluation, analysis, and interpretation associated with PFAS data.
Technical support and reporting associated with human health risk evaluation	Barrie Selcoe CH2M Risk Assessment Lead - Human Health barrie.selcoe@jacobs.com	John Swenfurth CH2M PM john.swenfurth@jacobs.com	Data evaluation, analysis, and interpretation associated with potential human health risk based on PFAS levels detected in various media.

Communication Driver	Initiator (Name, Project Title)	Recipient (Name, Project Title)	Procedure (Timing, Pathway, Documentation)
Technical support and reporting associated with ecological risk evaluation	John Martin CH2M Risk Assessment Lead - Ecological john.martin@jacobs.com	John Swenfurth CH2M PM john.swenfurth@jacobs.com	Data evaluation, analysis, and interpretation associated with potential ecological risk based on PFAS levels detected in various media.

Note: The names reflected in this table are current at the time of SAP development, but any individual qualified to perform the roles may be substituted prior to or during project implementation.

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Worksheet #9: Project Planning Session Summary

Project Name: Site Inspection Sampling and Analysis Plan for Per- and Polyfluoroalkyl Substances

Site Location: Vieques, Puerto Rico

Site Name: NASD and VNTR

Projected Date(s) of Field Activities: TBD

CH2M Activity Manager: Bill Hannah

Date of Session: October 18, 2018

Scoping Session Purpose: Overview of PFAS and the Preliminary Assessment (PA)/SI objectives and general approach

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Project Name: Site Inspection Sampling and Analysis Plan for Per- and Polyfluoroalkyl Substances

Site Location: Vieques, Puerto Rico

Site Name: NASD and VNTR

Projected Date(s) of Field Activities: TBD

CH2M Activity Manager: Bill Hannah

Date of Session: October 18, 2018

Scoping Session Purpose: Overview of PFAS and the Preliminary Assessment (PA)/SI objectives and general approach

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Key Discussion Points

- To provide historical perspective of PFAS, especially as it relates to potential use and release at the former NASD and VNTR, and discuss the objectives and general approach of the PA/SI
- Discussed a three-tiered hierarchical approach to the PFAS SI

Project Name: Site Inspection Sampling and Analysis Plan for Per- and Polyfluoroalkyl Substances

Projected Date(s) of Field Activities: TBD

Date of Session: December 5, 2019

Site Location: Vieques, Puerto Rico

Site Name: NASD and VNTR

CH2M Activity Manager: Bill Hannah

Scoping Session Purpose: PFAS evaluation and potential release area recommendations

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Project Name: Site Inspection Sampling and Analysis Plan for Per- and Polyfluoroalkyl Substances

Projected Date(s) of Field Activities: TBD

Date of Session: December 5, 2019

Site Location: Vieques, Puerto Rico

Site Name: NASD and VNTR

CH2M Activity Manager: Bill Hannah

Scoping Session Purpose: PFAS evaluation and potential release area recommendations

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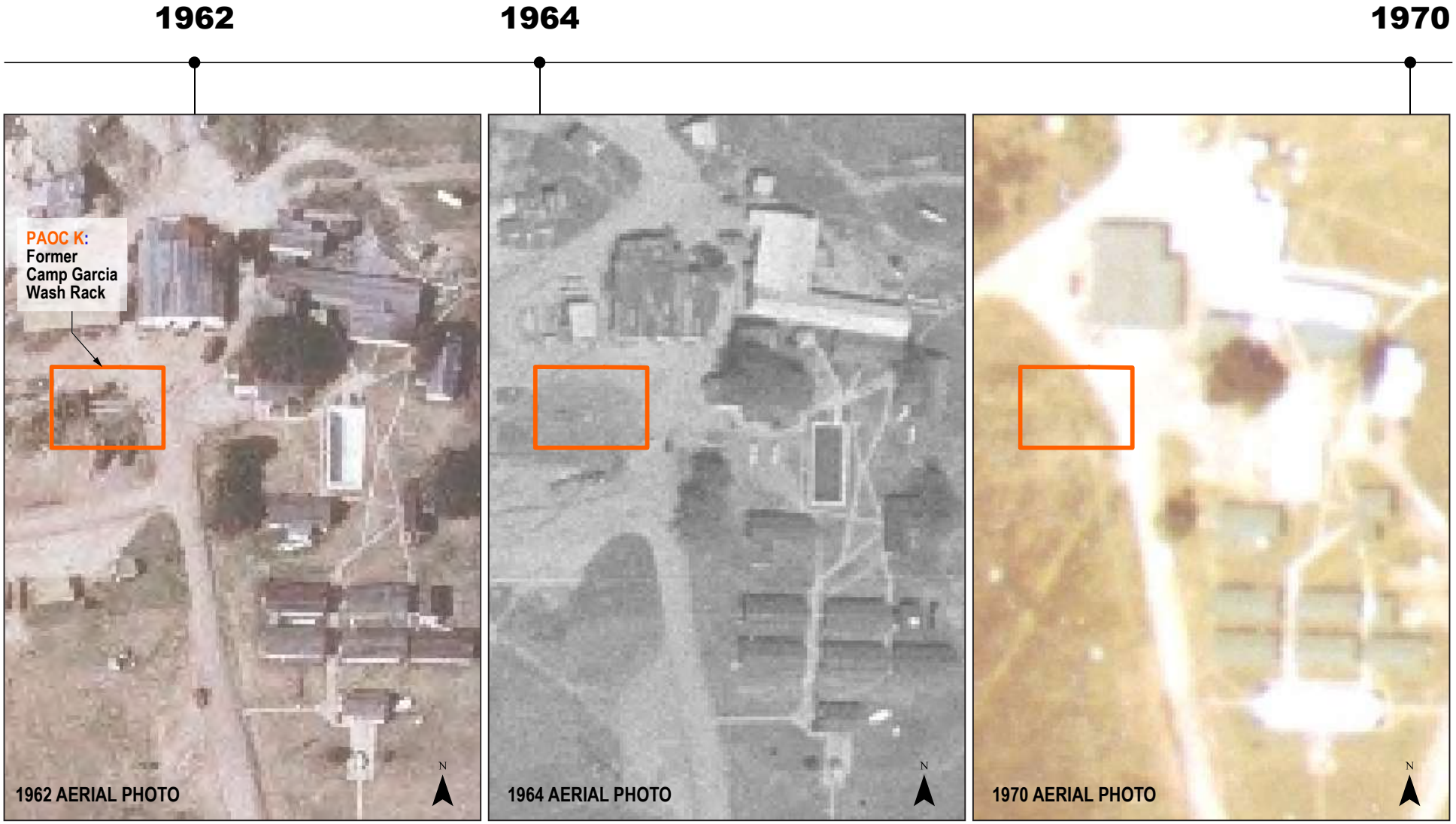
Key Discussion Points

- Regulatory comments on the Draft PA Report
- In addition to those proposed for an SI in the Draft PA Report, EPA and PRDNER recommended the following potential release areas to be included in the SI:
  - Potential Area of concern (PAOC) K
  - SWMU 20
  - PI 5
  - Camp Garcia Runway
- Consensus – The Technical Subcommittee concurred on the potential release areas that will be included in the PFAS SI, comprising the areas proposed by the Navy in the Draft PFAS PA Report (NASD AOC B, Former Fire Station, Potential Former Motor Pool Area, AOC H, SWMU 6, SWMU 7, VNTR Potential Former Motor Pool Area and Fire Department, SWMU 10, AOC G, and SWMU 1) and four additional areas recommended by EPA and/or PRDNER (VNTR PAOC K, SWMU 20, PI 5, and the Camp Garcia Runway). The Technical Subcommittee also concurred on the investigation logic because: (1) the potential release areas identified for the SI are those areas where if there has been a PFAS release(s), they are the ones most likely to demonstrate PFAS contamination, and (2) following completion of the sampling and evaluation of the SI results, the Navy and regulatory agencies will have the opportunity to reconvene and discuss whether any additional characterization is warranted, including whether any additional areas should be considered.

Updated Information since this Scoping Session related to PAOC K

During development of the PFAS SI SAP, additional historical information was found that indicates PAOC K is not a potential PFAS source area, specifically, the 1962, 1964, and 1970 aerial photographs (**Figure 9-1**). In 1962, PAOC K was an active wash rack; however, both the 1964 and 1970 aerial photographs show the wash rack is no longer present before AFFF-containing PFAS was first marketed by 3M Corporation (1964). Therefore, an SI for PAOC K is not warranted.



LEGEND

Approximate Site Location

FIGURE 9-1
PAOC K Historic Images (1962 to 1970)
Site Inspection Sampling and Analysis Plan
for Per- and Polyfluoroalkyl Substances
Former NASD and Former VNTR
Vieques, Puerto Rico

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Worksheet #10: Conceptual Site Model

Vieques is an island in the Caribbean Sea located approximately 7 miles southeast across the Vieques Passage from the eastern tip of the main island of Puerto Rico (**Figure 10-1**). The island is located on the Antillean Island Arc separating the Caribbean Sea from the Atlantic Ocean and is approximately 21 miles long, 4.5 miles wide and has an area of approximately 33,100 acres (51 square miles). Early in the 1940s, the Department of the Navy (Navy) purchased large portions of Vieques to conduct activities related to military training. The western side of the island is known as the former NASD (**Figure 10-2**), which was used mainly for ammunition loading and storage, vehicle and facility maintenance, and open burn/open detonation activities at the far western end of the island. The eastern side of Vieques is the former VNTR (**Figure 10-3**), which was used for various aspects of naval gunfire training, including air-to-ground ordnance delivery, amphibious landings, and housed the main base of operations at Camp Garcia for military training and support activities. On February 11, 2005, Vieques was placed on the National Priority List (NPL) as the former Atlantic Fleet Weapons Training Area - Vieques, which required all subsequent environmental restoration activities for Navy Installation Restoration sites on Vieques to be conducted under CERCLA until removed from CERCLA authority. The Navy, Department of the Interior (DOI), EPA, and Puerto Rico Environmental Quality Board (PREQB) executed a Federal Facility Agreement (FFA) on September 7, 2007 that established the procedural framework and schedule for implementing the CERCLA response actions for Vieques.

PFAS were identified as ”emerging chemicals”[1] with Navy policies issued beginning in 2014 requiring assessment of possible impacts from PFAS (DON, 2014, 2015). PFAS are a class of man-made chemicals that have been used since the mid-20th century to make products that resist heat, stains, grease, and water. PFAS have been widely used on products to enhance stain- and water-resistance properties (e.g., cookware, clothing, rugs, etc.). Additionally, PFAS are a component of some firefighting agents (e.g., aqueous film-forming foam [AFFF]) used to fight Class B fires (flammable liquid and gas fires).

Due to the chemical structure, PFAS are chemically and biologically stable and resist typical degradation processes. PFAS compounds therefore tend to persist in the environment. Additionally, although PFAS are water-soluble and tend to be relatively mobile in groundwater, complex partitioning mechanisms influence fate and transport. For example, a tendency for some PFAS to associate with organic carbon in soil and sediment can result in persistent concentrations in these media (NAVFAC, 2017).

A PA was completed that evaluated the potential for PFAS to be present based on certain historical practices conducted at the Vieques former NASD and/or former VNTR (CH2M, 2020). Based on information contained in the PA Report, 13 potential release areas are identified as possible AFFF or other PFAS-containing material source/release areas (see discussion in **Worksheet #9**); six areas within the former NASD and seven areas within the former VNTR (note SWMU 10 and AOC G are counted as separate potential release areas but included together for investigation purposes). **Figures 10-2 and 10-3** show the locations of all areas on the former NASD and the former VNTR to be investigated under this SI, respectively.

Facility Profile – Former Naval Ammunition Support Detachment

Location, Size, Facility History, and Ownership

The former NASD is located on the western end of Vieques, encompassing approximately 7,878 acres (**Figure 10-2**). The former NASD is bounded by the Vieques Sound to the north and east of Mosquito Pier, the

[1] The most current version of DoDI 4715.18 (4 SEPT 2019) defines emerging chemicals as "Chemicals relevant to the DoD that are characterized by a perceived or real threat to human health or the environment and that have new or changing toxicity values or new or changing human health or environmental regulatory standards. Changes may be due to new science discoveries, detection capabilities, or exposure pathways.

Vieques Passage to the northwest, the Caribbean Sea to the south, and the Municipality of Vieques (MOV) to the east. The western portion of the former NASD is the least developed, with the exception of the communications facility at the top of Mount Pirata; the central portion was used for munitions magazines; and the northeastern portion was the Navy's main support compound that included command offices, barracks, galley, and public works functions (e.g., vehicle and facility maintenance) (PMC, 2000).

The Navy began using the former NASD in 1941 as a base for Allied fleets during World War II. Construction of Mosquito Pier and the building of facilities and magazines for an ammunition storage depot were mostly completed by 1943. The Naval Ammunition Facility (NAF) on Vieques (the former name of the former NASD) operated until 1948, when ammunition was removed, and the facility closed. The former NASD was reactivated in 1962 and in 1971 the main compound was completed, and all support operations were relocated to that area (PMC, 2000).

The Navy ceased facility-wide operations on the former NASD in April 2001, in accordance with the January 30, 2000, Presidential Directive to the Secretary of Defense associated with the transfer of lands by quitclaim deed dated April 30, 2001 of the Navy-owned western portion of Vieques. The land transfer was completed on May 1, 2001, and the Navy has had no military presence at the main operational area since. Currently, the Navy's involvement at the former NASD comprises the environmental restoration program activities.

Receptors and Exposure Scenarios

Both human and ecological receptors are present at and around the former NASD. While receptor types are broadly similar across the former NASD, receptor types are discussed on a site-specific basis in the following subsections because they are influenced by current and potential future land uses and habitat conditions. The exposure media to be sampled at the NASD potential release areas include surface soil, subsurface soil, sediment, surface water, and/or groundwater.

NASD AOC B: Former Wastewater Treatment Plant at the Public Works Area

Location

AOC B, the Former Wastewater Treatment Plant (WWTP), is located 330 feet northwest of the former fire station within the former main support compound (**Figures 10-2 and 10-4**). The WWTP is no longer operational and the area is now overgrown with a mixture of dense vegetation and open grassy field with sparse trees. AOC B is approximately 0.68 acre in size.

Site History

AOC B was a prefabricated WWTP measuring approximately 230 feet by 230 feet with four shallow no-discharge basins located just northwest of Building 2030. It served the officers' quarters and other administrative buildings for municipal-type sewage discharges at the former NASD from 1983 until 2000. The former clarifier within Building 2030 consisted of one aeration tank and one separation tank with two blowers to supply the air for the biological treatment. Discharge from the WWTP drained into the four unlined, no-discharge lagoons. No wastewater leaks were observed from the lagoon dikes during the Environmental Baseline Survey (EBS; PMC, 2000). Sludge from the WWTP was pumped to a vacuum truck for offsite disposal (A.T. Kearney et al., 1988). The SI/Expanded Site Inspection (ESI) Report (CH2M, 2010a) indicates solids from a similar WWTP configuration at the former VNTR (i.e., SWMU 10) were pumped out and transported to drying beds at the former Naval Station Roosevelt Roads (NSRR) (currently Naval Activity Puerto Rico [NAPR]). It is reasonable to assume the same was done for the solids removed from AOC B. AOC B was investigated in an Expanded Preliminary Assessment/Site Investigation and results indicated the site warranted no further investigation/action (CH2M, 2002). Following the 2002 report a no further action report was produced that included the AOC B site (CH2M, 2006). However, no

historical evaluation/investigation included the potential for PFAS release at the site prior to the PFAS PA Report (CH2M, 2020).

Physical and Biological Characteristics

The area around AOC B is generally flat with a very gentle slope to the north-northwest. Soil in the area is primarily silty sand, based on the soil borings previously collected at AOC B to a maximum depth of 5.5 feet below ground surface (bgs). Groundwater flow is anticipated to follow the land topography, consistent with what has been observed at nearby AOC E (**Figure 10-4**). No surface water bodies exist within or near the area; the closest surface water body (i.e., Vieques Passage) is located approximately one-half mile to the north.

The plant community at AOC B has varied over time, ranging from being entirely dominated by herbaceous species because of ongoing grounds maintenance activities (mowing) within the Public Works Area, to being mostly overgrown by large invasive tree species once maintenance ceased. A few scattered shrubs and palm trees are present in the surrounding area. The herbaceous plant community has been dominated by several species including yellow bluestem grass (*Bothriochloa ishaemum*), southern crabgrass (*Digitaria ciliaris*), Bermuda grass (*Cynodon dactylon*), and dayflower (*Commelina erecta*). Invasive tree species include tantan (*Leucaena leucocephala*), mesquite (*Prosopis julifora*), and acacia (*Acacia* spp.). Wildlife observed in the area include mongoose (*Herpestes auropunctatus*), red-tailed hawk (*Buteo jamaicensis*), and killdeer (*Charadrius vociferous*). Other birds that potentially use this area include the common ground dove (*Columbina passerine*), northern mockingbird (*Mimus Polyglottus*), Greater Antillean grackle (*Quiscalus niger*), pearly-eyed thrasher (*Margarops fuscatus*), gray kingbird (*Tyrannus dominicensis*), white-winged dove (*Zenaida asiatica*), and zenaida dove (*Zenaida aurita*). No federally-protected species or preferred habitat occur at this area.

Summary of Key Conceptual Site Model Characteristics Supporting the Monitoring Rationale and Approach

Potential Sources of PFAS

Historical records and site visit(s) provide no evidence of a release of AFFF or other PFAS-containing substances into or at the former WWTP (CH2M, 2020). However, because AOC B was operational from 1983 through 2000 (CH2M, 2006), a timeframe when Navy use of AFFF and other PFAS-containing materials was occurring (though not necessarily on Vieques), if AFFF and/or other PFAS-containing substances were used, it is possible they may have ultimately been present in the AOC B WWTP influent.

Receptors and Exposure Scenarios

If AFFF or other PFAS-containing materials arrived at the WWTP, the most likely source area for a release(s) to the environment would have been the no-discharge lagoons into which all wastewater processed through the WWTP ultimately would have been deposited. If a release(s) occurred from these lagoons, it likely would have infiltrated through the lagoon sediment and underlying soil toward/to the underlying groundwater because data collected from soil borings collected during the Expanded PA/SI demonstrated the lagoons were unlined (CH2M, 2002).

AOC B is located within the fenced area of the much larger MOV compound where associated personnel are typically present during working hours. The compound gates are locked during non-working hours which would restrict public access. Currently the AOC B site contains mostly maintained grass but is also partially overgrown with dense invasive vegetation that would additionally limit access by visitors. However, because AOC B is near (about 400 feet) the former NASD fire station which has recently been converted to a public facility (i.e., rum distillery and outdoor concession stand), this area could possibly be visited by the public during business hours. Workers may also occasionally mow the grassed portion of AOC B. The grassed and forested habitats within and surrounding AOC B can support a variety of terrestrial birds and mammals.

NASD Former Fire Station Building 2046 at the Public Works Area

Location

The NASD Former Fire Station (Building 2046) is located within the southwestern portion of the MOV Public Works Compound (**Figures 10-2 and 10-4**). The building is now used as a rum distillery with an adjacent concession stand. The footprint of Building 2046 and associated ramp is approximately 0.07 acre in size. The surrounding area is uninhabited and is an open grassland with sparse tree presence.

Site History

Construction of Building 2046 was completed in 1972 and it was utilized as a fire station until the former NASD was decommissioned in 2000. The building included living quarters, bathrooms, laundry, and vehicle storage. The bathrooms were plumbed directly into the WWTP (AOC B) (PMC, 2000). The EBS Report (PMC, 2000) reported that no maintenance was performed within the building and no floor drains within the building were observed during the EBS. Storage sheds southwest of the building contained hoses and fire extinguishers, but no hazardous materials were observed. Storage sheds, although described in the EBS Report as being located southwest of the building and containing hoses and fire extinguishers, have not been located or observed on historical imagery or site visits conducted during the PA.

The document review and interview portions of the PA provided no definitive evidence of a release of AFFF or other PFAS-containing substances at the former fire station. However, information obtained during an interview suggest there is the potential AFFF was released to the environment in this area. Information obtained during an interview indicated that approximately 50 gallons of AFFF had been stored on each of two fire trucks. According to the interviewee, the AFFF concentrate was stored in 5-gallon containers in an onsite conex container located about 100 feet west of the fire station (**Figure 10-4**). AFFF was put into the fire trucks by pumping, pouring or by induction pump on the ramp of the fire station; fire trucks were also washed on this ramp. Once a month the fire trucks tanks containing AFFF were cleaned, and the pump tests were performed once a year; however, the interviewee indicated that no foam (AFFF) was used for pump testing. Additional interviews were conducted verifying AFFF was used in the firetrucks based at the NASD fire station (**Attachment A**). No disposal records for the AFFF were identified. Given likely truck cleaning procedures and that no disposal records for AFFF were identified, it is likely flushing occurred onto the ramp during cleaning. Additionally, spillage could have occurred during transfer of AFFF.

Physical and Biological Characteristics

Building 2046 contains a concrete slab and no significant cracks were observed (**Attachment B**); the vehicle driveways/ramp are also concrete slabs. The area around the building is grassy, with a flat terrain sloping gently to the north-northwest.

Soil and lithologic characteristics in this area are anticipated to be similar to those observed at AOC E, located to the northeast of the former fire station (**Figure 10-4**). AOC E sits atop unconsolidated clay and sandy clay, with a 5- to 15-foot thick bed of material ranging from silt to coarse sand. At AOC E the water table tends to stay below the basal sandy layer, occasionally rising into the sandy layer. Below the overburden the structure changes to a clay-rich saprolite (CH2M, 2008b). The primary direction of groundwater flow at AOC E is to the north-northwest toward the Vieques Passage. It is assumed that because of the close proximity of AOC E to the former fire station, the groundwater flow from the fire station would be comparable to that at AOC E. This is further supported by the dramatic increase in ground surface elevation to the south. No surface water bodies exist within this area; the closest surface water body (i.e., Vieques Passage) is located more than one-half mile to the north.

The plant community surrounding Building 2046 is dominated by herbaceous species because of ongoing grounds maintenance activities. A few scattered shrubs and palm trees are present in the surrounding area. The herbaceous plant community is dominated by several species including yellow bluestem grass, southern

crabgrass, Bermuda grass, and dayflower. Horses and mongoose occur in the area. Bird species known or likely to occur include red-tailed hawk, killdeer, common ground dove, northern mockingbird, Greater Antillean grackle, pearly-eyed thrasher, gray kingbird, white-winged dove, and zenaida dove. No federally-protected species or preferred habitat occur at this location.

Summary of Key Conceptual Site Model Characteristics Supporting the Monitoring Rationale and Approach

Potential Sources of PFAS

Historical records and site visit(s) provide no definitive evidence of a release of AFFF or other PFAS-containing substances at the former fire station area (CH2M, 2020). However, information obtained during a PA interview suggest there is the potential AFFF was released to the environment in this area. As noted previously, AFFF was stored on each of two fire trucks and within a nearby conex container. Releases of AFFF could then have occurred from leaks during storage, spills during transfer, washing of fire trucks on the fire station ramp, and testing of the fire truck pumps.

Receptors and Exposure Scenarios

If a release(s) of AFFF occurred as described previously, the most likely source areas for a release(s) to the environment would have been the fire station ramp and its immediate surroundings as well as the conex container area. If a release(s) occurred, it would likely have been to the ground surface and then could have infiltrated through the surface and subsurface soil toward/to groundwater.

The former fire station building (current rum distillery) is within the fenced portion of the MOV compound. Associated personnel are present during working hours and gates are locked during non-working hours which would restrict public access to the area. During business hours, the rum distillery and outdoor concession stand at this location would be accessed by the public. Maintenance workers are likely to conduct occasional landscaping and grounds maintenance around the building. The maintained grass habitat surrounding the building may support a limited diversity of terrestrial birds and mammals.

Potential Former NASD Motor Pool Area

Location

The potential former NASD Motor Pool Area is located within the former main support compound, now within the eastern-most area of the MOV Public Works compound (**Figures 10-2 and 10-5**). The area is currently used as a motor pool operated by the MOV for its government vehicles. The area is approximately 2.6 acres in size.

Site History

A former firefighter at NASD identified the former NASD motor pool area as being in the eastern-most area of the MOV Public Works compound, where a current motor pool is being operated by the MOV for its government vehicles (**Figures 10-2 and 10-5**). The EBS identifies the building at this location as Building 2022, an electrical plumbing and carpentry shop, not a motor pool (PMC, 2000). The building was constructed in 1966 and has been in continuous operation since Navy transfer of the property to the MOV. Vehicles are not present in 1985 aerial imagery but are present in the area beginning in 1994 aerial imagery (CH2M, 2020). Since the area may have been used as a motor pool that may have serviced fire trucks carrying AFFF, there is potential for AFFF or other PFAS-containing material to have been released at this location.

The surrounding area consists of six buildings (Buildings 4021, 2022, 2023, 4001, 4010, and 4011) which are actively utilized and a former wash rack pad (**Figure 10-5**). Historical records do not provide information regarding which, if any, of the buildings were used for vehicle maintenance. SWMU 10 (a historical site located within this area) was closed out in a no further action report in 2006 (CH2M, 2006). However, no historical

evaluation/investigation of SWMU 10 included the potential for a PFAS release(s) at this location prior to the PFAS PA Report (CH2M, 2020).

Physical and Biological Characteristics

The area is generally flat with a very gentle slope to the north-northwest. Because the former NASD motor pool area is located immediately adjacent to AOC E, the soil, lithologic, and hydrogeologic characteristics are likely to mimic those at AOC E, as described under the former NASD Fire Station subsection. Like AOC E, no surface water bodies exist at the former NASD motor pool area.

Grass and herbaceous species dominate the motor pool area due to ongoing grounds maintenance activities. A few scattered trees and shrubs are present in the general area, but the herbaceous ground cover is approximately 70 to 85 percent. The herbaceous plant community is dominated by southern crabgrass, dayflower, Bermuda grass, and yellow bluestem grass. Wildlife occurrences in this area are likely limited by routine human activity and the maintained open habitat; however, species known or likely to occur include horses, mongoose, killdeer, common ground dove, northern mockingbird, Greater Antillean grackle, pearly-eyed thrasher, gray kingbird, white-winged dove, and zenaida dove. No federally-protected species or preferred habitat occur at this location.

Summary of Key Conceptual Site Model Characteristics Supporting the Monitoring Rationale and Approach

Potential Sources of PFAS

Historical records and site visit(s) provide no definitive evidence of a release of AFFF or other PFAS-containing substances at the potential former NASD motor pool (CH2M, 2020). However, information obtained during a PA interview indicates activities that occurred there included vehicle maintenance, including maintenance on the NASD fire trucks. As stated under the former NASD Fire Station subsection, AFFF was stored on each of two fire trucks stationed at the fire station. Therefore, a release of AFFF could have occurred if AFFF was aboard the fire trucks while maintenance was being performed at the motor pool. Further, if the vehicle wash rack at the potential former motor pool was used to wash the fire trucks, residual AFFF may have been washed off the trucks to the surrounding ground surface. While the location of the wash rack is known (**Figure 10-5**), historical information does not indicate any of the buildings were used for vehicle maintenance. It is also noteworthy that the area continues to be used as a motor pool area for the MOV and as such, AFFF or other PFAS-containing substance releases were also possible after the Navy turned the property over to the MOV.

Receptors and Exposure Scenarios

If a release(s) of AFFF occurred as described, the most likely source area for a release(s) to the environment would have been the truck maintenance area (potentially a shop) or wash rack. If a release(s) occurred, it would have been to the ground surface and then could have infiltrated through the surface and subsurface soil toward/to groundwater.

The MOV currently is using the potential former NASD motor pool area as the municipality's vehicle maintenance and storage area. This area is within the fenced MOV compound where associated personnel are present during working hours, and gates that restrict public access are locked during non-working hours. MOV employees (such as mechanics) and lawn maintenance workers are the most likely receptors at this location. The predominant maintained grass habitat throughout the motor pool area may support a limited diversity of terrestrial birds and mammals.

NASD AOC H: Abandoned Power Plant

Location

AOC H, the Abandoned Power Plant, is located approximately 200 feet east of the entrance to the MOV Public Works Area, just north of Highway 200 and south of the Vieques Passage (**Figures 10-2 and 10-6**). The former power plant building has a footprint of approximately 2,000 square feet. The area is approximately 2 acres.

Site History

From 1941 to 1943 power generation equipment was stored in and around Building 13, including large diesel generators used to provide electricity to a nearby community. After 1943, the building was vacant until the 1960s when its use for fire training operations began. Fire training operations consisted of the use of diesel fuel, which was poured over rubber tires inside the building and ignited to simulate structural fires and extinguished during training operations. The fire training activities ceased in the 1980s. The power generation equipment is no longer present at the site. The site was investigated during the EBS (PMC, 2000), the Expanded PA/SI (CH2M, 2002), and a Remedial Investigation (RI; CH2M, 2007b). The results indicated the site warranted no further investigation/action and a No Action Record of Decision (ROD) was approved for the site in 2008 (NAVFAC, 2008). However, no historical evaluation/investigations included the potential for PFAS release at this location prior to the PFAS PA Report (CH2M, 2020).

Physical and Biological Characteristics

AOC H consists of an abandoned concrete building (Building 13) approximately 80 feet long and 25 feet wide. The floor of the building is concrete with several raised concrete pads (**Attachment B**). The surrounding area is uninhabited and is heavily vegetated with dense thorn shrubs and coastal forest. The area is generally flat and slopes gently toward an ephemeral stream to the west and the Vieques Passage just to the north of this location. Soils consist of approximately 15 feet of unconsolidated clay, silt, sand, and gravel.

Along the western boundary of AOC H, there is a 20 foot-wide by 400-foot-long ephemeral stream, with the water averaging approximately 3 feet deep. The ephemeral stream discharges to the north into the Vieques Passage; historically standing water was observed in the stream as it approached its confluence with the Vieques Passage. The groundwater flow direction at AOC H is predominantly to the north toward the Vieques Passage. However, at the western part of this location groundwater may flow locally to the west toward the ephemeral stream (**Figure 10-6**).

Vegetation immediately around the AOC H structure typically consists of a dense growth of predominantly invasive tree species which have occasionally been cleared to support access to the structure or surrounding area. The area to the east consists of dense thorn scrub. West of the building, a mixed thorn scrub and coastal forest exists that transitions to the ephemeral stream. To the north, a densely mixed thorn scrub and coastal forest is present. Dominant shrubs identified at the site include tantan, Christmas tree (*Randia aculeata*), and brisselet (*Erythroxylum brevipes*). The dominant herbs include bretonica prieta (*Melochia nodiflora*) and man-better-man (*Achyrantes aspera*). Hurricane grass (*Bothriochloa pertusa*) has been observed on the southern boundary of the site. The grassy road shoulder to the south is frequently maintained.

Several wildlife species have been observed using the abandoned power plant building and adjacent habitat. The exterior of the building provides shade, foraging areas, and cover for an abundant number of lizards such as the garden lizard (*Anolis pulchellus*), common lizard (*Anolis cristatellus*), and spotted lizard (*Anolis stratulus*). A ground lizard, *Ameiva exsul*, was seen immediately adjacent to the site among thorn scrub. In addition, the building has been observed to provide a roosting place for a population of West Indian fruit bats (*Artibeus jamaicensis*). Bird species observed near the power plant building include gray kingbird, Adelaide warbler (*Dendroica adelaidae*), and common ground doves. Wading and shorebirds may possibly forage in the inundated portion of the adjacent ephemeral stream including green heron (*Butorides virescens*), least bittern (*Ixobrychus exilis*), and spotted

sandpiper (*Actitis macularius*). Land crabs (*Cardisoma guanhumi*) also occur in the immediate vicinity of AOC H. Fish and invertebrates have been seen in the stream but have not been specifically surveyed. No endangered or threatened species have been observed within the AOC H area.

Summary of Key Conceptual Site Model Characteristics Supporting the Monitoring Rationale and Approach

Potential Sources of PFAS

Historical records and site visit(s) provide no definitive evidence of a release of AFFF or other PFAS-containing substances at AOC H (CH2M, 2020). However, because AFFF was reportedly stored on firetrucks stationed at the former NASD Fire Station and firefighting training was conducted in the abandoned power plant building during the period when AFFF could have been in use (i.e., 1970s and 1980s), releases of AFFF could have occurred at AOC H during these training activities.

Receptors and Exposure Scenarios

If a release(s) of AFFF occurred at AOC H, the most likely source areas for a release(s) to the environment would have been the areas within the building where tires set on fire for training were extinguished. If a release(s) occurred, it likely would have been washed outside through the abandoned building openings (or potentially infiltrated through the concrete floor), impacting surface soil initially, but migrating vertically through unconsolidated soil toward/into groundwater. It may also have traveled via overland runoff toward the Vieques Passage to the north and/or ephemeral stream along the western boundary.

Access to the AOC H building and surrounding grounds is not restricted, and locals, tourists, and municipality workers could gain access to the area via Highway 200, approximately 30 feet south of the structure. However, this abandoned structure is not routinely maintained and is typically heavily overgrown with vegetation, much of it thorny invasive species, and therefore is not readily viewable from the road or easily accessible. As a result, visits to this location are expected to be very infrequent. The typically inundated ephemeral stream along the western side of AOC H can support fish and invertebrates, and various terrestrial birds and mammals occupy the surrounding forested habitat. Much of the surrounding habitat also supports land crabs, burrows of which occur near the north, east, and western sides of the building.

NASD SWMU 6: Former Mangrove Disposal Site

Location

SWMU 6, the Former Mangrove Disposal Site, is located in a mangrove swamp in Laguna Arenas, part of the Laguna El Pobre and Kiani Lagoon system, along Highway 200 on the former NASD (**Figures 10-2 and 10-7**). The area is approximately 2.8 acres in size, bounded to the south by Highway 200, to the north and east by Laguna El Pobre mangroves and trees, and to the west by a channel from North Kiani Lagoon to South Kiani Lagoon. SWMU 6 is on DOI property managed by USFWS that has been designated part of the Vieques National Wildlife Refuge.

Site History

The site was used for the disposal of solid waste from Navy operations within the former NASD during the 1960s and 1970s. Waste discarded at the site included empty containers of lubricants, oil, solvents, and paints; glass, wood, tires, scrap metal, and rubble (PMC, 2000). The waste stream potentially may have also included PFAS or PFAS-containing materials. This material, as well as the general solid waste and contaminated soil, was removed during a removal action in 2009. Approximately 1,423 tons of soil and debris was removed with an average depth of 1 to 2 feet during the removal action (FSS, 2010). Due to the removal action, and the fact that no fill was brought into the site, the environmental setting was altered from a predominantly terrestrial habitat to a shallow

estuarine lagoon, marine habitat that is hydraulically (at least partially) connected to and tidally influenced by the adjacent Laguna Kiani complex. The site now supports a relatively diverse community of marine fish and invertebrates, along with foraging wildlife such as wading birds. Previous site investigation reports include an Initial Assessment Study (Greenleaf, 1984), Confirmation Study (ESE, 1986), EBS (PMC, 2000), Expanded PA/SI (CH2M, 2000), RI (CH2M, 2007a), Non-Time-Critical Removal Action (Shaw, 2010), Post-Removal Supplemental Confirmatory Sampling (CH2M, 2010a), Feasibility Study (CH2M, 2013), and Supplemental Remedial Investigation (CH2M, 2016a). Final results indicated the site warranted no further investigation/action and a No Action ROD was approved for the site in 2018 (NAVFAC, 2018). However, no historical evaluation/ investigations included the potential for PFAS release at this location prior to the PFAS PA Report (CH2M, 2020).

Physical and Biological Characteristics

SWMU 6 is characterized by a shallow, tidally influenced, mangrove lagoon created when waste historically dumped in a tidal flat area was removed. It is located in the vicinity of Kiani Lagoon to the south, and Laguna el Pobre to the north, both of which are hydrologically connected to Vieques Passage further to the north via a narrow tidal stream. The SWMU 6 area is located at elevations between sea level and 1 foot above mean sea level (amsl). Sediment and soil consist of silty sand with organic material and well-graded sand with crushed shells.

A dense stand of mangroves including black (*Avicennia germinans*), red (*Rhizophora mangle*), and white (*Laguncularia racemosa*) mangroves outlines the lagoon, except for the southern border along Highway 200 which is mostly unvegetated. Planted and naturally established red, black, white, and button (*Conocarpus erectus*) mangroves also grow within the shallower portions of the lagoon. Submerged aquatic plants and algae occur in the lagoon, including an area of naturally established turtle grass (*Thalassia testudinum*).

The shallow, open lagoon habitat contains a variety of fish and macroinvertebrates. Fish commonly observed include white mullet (*Mugil curema*), snook (*Centropomus undecimalis*), mangrove snapper (*Lutjanus griseus*), bigeye mojarra (*Eucinostomus havana*), and checkered puffer (*Sphoeroides testudineus*). Additional fish observed in nearby waters are also likely to occur and include flagfin mojarra (*Eucinostomus melanopterus*), spotfin mojarra (*Eucinostomus argenteus*), striped mojarra (*Diapterus plumieri*), bigeye anchovy (*Anchoa lamprotaenia*), crested goby (*Lophiogobius cyprinoides*), and redfin needlefish (*Strongylura notata*). Common macroinvertebrates observed include blue crab (*Callinectes sapidus*), Caribbean fiddler crab (*Uca rapax*), grass shrimp (*Palaeomonetes* sp.), hermit crab species, amphipod species, coffee bean snail (*Melampus coffeus*), virgin nerite (*Neritina virginea*), and upside-down jellyfish (*Cassiopeia xamachana*). Other benthic macroinvertebrates that may occur include various polychaetes, sponges, tunicates, amphipods, barnacles, and other species of crabs and mollusks.

The SWMU 6 lagoon supports a wide variety of foraging aquatic bird species. Species observed include greater yellowlegs (*Tringa melanoleuca*), lesser yellowlegs (*Tringa flavipes*), black-necked stilt (*Himantopus mexicanus*), spotted sandpiper, black bellied plover (*Pluvialis squatarola*), semi-palmated plover (*Charadrius semipalmatus*), Wilson's plover (*Charadrius wilsonia*), least sandpiper (*Calidris minutilla*), belted kingfisher (*Megaceryle alcyon*), northern waterthrush (*Parkesia noveboracensis*), green heron, little blue heron (*Egretta caerulea*), great egret (*Ardea alba*), great blue heron (*Ardea Herodias*), and clapper rail (*Rallus longirostris*).

There are no known occurrences of federally listed threatened or endangered species.

Summary of Key Conceptual Site Model Characteristics Supporting the Monitoring Rationale and Approach

Potential Sources of PFAS

Historical records and site visit(s) indicate no evidence of a release of AFFF or other PFAS-containing substances at SWMU 6 (CH2M, 2020). However, because information obtained during a PA interview suggests AFFF was present at the former training facility it is conservatively assumed that materials containing AFFF or other PFAS-containing substances (e.g., empty containers, firefighting training materials) could have been disposed of at SWMU 6.

Receptors and Exposure Scenarios

If a release(s) of AFFF or other PFAS-containing constituents occurred from the waste (when present), the most likely source area for a release(s) to the environment would have been the debris area (i.e., the area from which the waste was removed). If a release(s) occurred, it likely would have leached through the thin soil layer into the saturated zone below (now represented by the lagoon surface water and sediment) and/or may have been transported via overland flow into the adjacent lagoon system.

Access to SWMU 6 lagoon is not restricted and the former site is potentially accessible from Highway 200 which runs along the southern shoreline. Immediately south of SWMU 6, at the south side of Highway 200, is a small off-road parking area with a cleared shoreline access point to a tidal channel that connects Kiani Lagoon with the Vieques Passage. Typical users at this parking location include kayakers, shoreline fishermen, and visitors/fishers using the adjacent bridge over the channel. The relatively small and isolated SWMU 6 lagoon could support fishing, but the ecological evaluation performed during past investigations indicated the fish population could not sustain routine fishing. Further, fishermen would more likely focus on accessing the extensive Kiani Lagoon system and Vieques Passage for fishing. The SWMU 6 lagoon is also surrounded by dense mangroves that would block kayak access to the greater lagoon system; thus, kayaking or wading through the lagoon is not expected. The small area of currently exposed soil within the eastern end of the SWMU 6 lagoon could support occasional visitors wanting to investigate the lagoon, though over time this area is becoming overgrown by mangroves and will likely be inaccessible. The lagoon contains a variety of fish and invertebrates, supports many species of foraging aquatic birds, and contains a relatively young but rapidly growing stand of mangroves.

NASD SWMU 7: Former Quebrada Disposal Site

Location

SWMU 7, the Former Quebrada Disposal Site, is located along Highway 200 and 1,100 feet south of the Vieques Passage approximately 1 mile west of the MOV Public Works compound (**Figures 10-2 and 10-8**). The former site area is approximately 10 acres, but the former waste disposal area comprised less than about 2 acres. Currently, the area is uninhabited and is heavily vegetated, but is adjacent to several dwellings along Highway 200.

Site History

SWMU 7 was a Navy disposal site from the early 1960s until the late 1970s. Material discarded at the site included construction rubble, empty containers (drums, cans, and bottles), used batteries, old tires, and sheet metal (PMC, 2000). The waste stream potentially may have also included PFAS or PFAS-containing materials. Investigations completed at SWMU 7 included a Confirmation Study (ESE, 1986), an EBS (PMC, 2000), a Phase I PA/SI (CH2M, 2000), and an RI (CH2M, 2008a). Approximately 5,366 tons of soil and debris were removed from the site as documented in a Completion Report (FSS, 2010). Following the removal action, the site was closed with a No Further Action ROD in 2011 (NAVFAC, 2011a). However, no historical evaluation/investigation included the potential for PFAS release at this location prior to the PFAS PA Report (CH2M, 2020).

Physical and Biological Characteristics

SWMU 7 is part of a broad topographic feature that slopes gently north toward the Vieques Passage. The primary feature of the area itself is a steeply-banked ephemeral stream that flows in a north-northwest direction toward the Vieques Passage. Water flows in the ephemeral stream only during significant storm events. Otherwise, this stream is dry throughout the year and does not provide habitat supportive of aquatic organisms. The ephemeral stream varies from 20 to 40 feet in width and 10 to 20 feet in depth. The elevation is 15 to 115 feet amsl, as shown in **Figure 10-8**.

Soil samples collected during historical investigations indicate that the soils beneath SWMU 7 consist of a mixture of relatively thin (less than 10 feet) alluvial deposits of silty sand underlain by a saprolite or weathered

granodiorite (plutonic rock). During historical well installation, groundwater was encountered at the site at a depth of about 75 feet; however, water levels stabilized at depths of approximately 33 to 71 feet below land surface suggesting semi-confined conditions within the saprolite. The Resolución Valley aquifer does not occur under this site. General groundwater flow is to the north-northwest in the direction of the Vieques Passage.

Water flows in the ephemeral stream at SWMU 7 only during rainstorms. Distinct scouring marks along the embankment indicate rapid flows during storm events. The ephemeral stream drains to the north through a culvert under Highway 200 to Vieques Passage.

The plant community at this former site consists of shrub and tree canopy layers that provide nearly 100 percent cover. The dominant shrubs consist of tantan, swamp privet (*Foresteria eggersiana*), and acacia (*Acacia retusa*). Species such as cabbagebark tree (*Andira inermis*) and red manjack (*Cordia collococca*) are the dominant tree species observed. The dense canopy has precluded the development of an herbaceous stratum. Smallcane (*Lasiacis divaricata*) is present in scattered areas.

Wildlife species observed include red-tailed hawk, bananaquit (*Coereba flaveola*), adelaidae warbler, green-throated carib (*Eulampis holosericeus*), pearly-eyed thrasher, northern mockingbird, Louisiana waterthrush (*Parkesia motacilla*), loggerhead kingbird (*Tyrannus caudifasciatus*), gray kingbird, white-winged dove, and anolis lizards.

There are no federally protected species or preferred habitat known to occur at this location.

Summary of Key Conceptual Site Model Characteristics Supporting the Monitoring Rationale and Approach

Potential Sources of PFAS

Historical records and site visit(s) provide no evidence AFFF or other PFAS-containing substances were disposed of at SWMU 7 (CH2M, 2020). However, like SWMU 6, the site was used as an open dump. Therefore, it is conservatively assumed that materials containing AFFF or other PFAS-containing substances (e.g., empty containers, firefighting training materials) could have been disposed of at SWMU 7.

Receptors and Exposure Scenarios

If a release(s) of AFFF or other PFAS-containing material occurred from the waste (when present), the most likely source areas for a release(s) to the environment would have been the debris area (i.e., the area from which the waste was removed). Because the former waste located at SWMU 7 was along the ephemeral stream steep embankment and floor, if a release(s) of AFFF or other PFAS-containing constituents occurred from the waste (when it was still present), it likely would have flowed down-valley with periodic flow associated with rain events or infiltrated through the soil beneath the debris toward/to the underlying saprolite and fractured rock where it would have migrated with groundwater flow toward the Vieques Passage.

SWMU 7 is located approximately 1,000 feet south of Highway 200, and access is not restricted. The road that leads to SWMU 7 is located along the western side of a residential community; the nearest residential unit is approximately 200 feet east. The former waste disposal area is heavily vegetated and has very steep slopes that would make access difficult and potentially unsafe for visitors, and there are no obvious points of interest or other features that would attract visitors or nearby residents. The forested habitat within the ephemeral stream can support a variety of terrestrial birds and mammals, but the lack of permanent water prevents development of aquatic communities.

Facility Profile – Former Vieques Naval Training Range

Location, Size, Facility History, and Ownership

The former VNTR is located on the eastern half of Vieques, consists of approximately 14,600 acres, and is divided into four separate former operational areas that from west to east comprise: the 11,000-acre Eastern Maneuver Area (EMA), the 2,500-acre Surface Impact Area (SIA), the 900-acre Live Impact Area (LIA), and the 200-acre Eastern Conservation Area (ECA) (**Figure 10-3**). The former VNTR is bounded by the Vieques Sound to the north, and the Caribbean Sea to the east, and south, and the MOV to the west.

Military operations at the former VNTR included ground warfare and amphibious training for Marines, naval gunfire support training, and air to ground bombing. Following cessation of military operations on the former VNTR, the Navy subdivided the former operational areas into smaller parcels based on considerations such as historic use, geographic features, and land use. The parcels, referred to as UXO sites, were delineated in such a way to make them more manageable for the purposes of prioritization, munitions removal, site characterization, and decision making.

Camp Garcia, the largest single developed area within the former VNTR, occupied 240 acres, and provided support for training exercises, including food service, dormitories, security, facility maintenance, and fire protection. Camp Garcia and the airfield immediately south of the camp were constructed in 1947 to provide mission support services to the marine regiment stationed at NSRR who trained on the former VNTR. Tents were erected at Camp Garcia in 1954 and 1955 and were later replaced by Quonset huts and Butler buildings from 1960 through 1965. At the height of activity at Camp Garcia from the late 1950s to the early 1960s, Camp Garcia consisted of 171 buildings with 300 military personnel and 60 civilians stationed at the camp. In the 1970s, activity and employment at Camp Garcia declined steadily until it was officially decommissioned in 1978. However, Camp Garcia continued to maintain a cafeteria, motor pool, general store, facility maintenance buildings, a landing area, and office space. Temporary barracks were also located at Camp Garcia and were occasionally utilized by troops engaged in training exercises (NAVFAC, 2003).

On April 30, 2003, the former VNTR was transferred to the DOI to be operated and managed by the USFWS as a National Wildlife Refuge and, in some places, a Wilderness Area, pursuant to Section 1049 of the National Defense Authorization Act for Fiscal Year 2002 (Public Law 107-107). Although the DOI is directed to protect and conserve the transferred land as a wildlife refuge, the Navy retains the responsibility for conducting the environmental investigations and cleanup of the property, as warranted.

Potential Exposure Scenarios

Both human and ecological receptors are present at and around the former VNTR. While receptor types are broadly similar across the former VNTR, receptor types are discussed on a site-specific basis in the following subsections because they are influenced by current and potential future land uses and habitat conditions. The exposure media to be sampled at the VNTR sites include surface soil, subsurface soil, sediment, surface water, and/or groundwater.

VNTR Camp Garcia Runway

Location

The VNTR Camp Garcia Runway is an abandoned 5,016-foot east-west trending runway located one quarter mile south of Camp Garcia within the Vieques National Wildlife Refuge (**Figures 10-3 and 10-9**). The Camp Garcia Runway is approximately 48.8 acres in size with approximately 1.5 acres overlapping PI 5 on the western end of the runway. SWMU 20, the Former Helicopter Maintenance Area, is located north of the eastern end of the runway.

Site History

The 2003 EBS (NAVFAC, 2003) describes the Camp Garcia Runway as being active from 1959 to 1964. However, documented air operations occurred at the airfield annually with the last noted flights recorded in 1975. The 1977 Federal Aviation Administration Terminal Area Charts (TACs) show the runway as an east-west, 5,000-foot paved runway with no permanent structures. The TAC for Puerto Rico from October 10, 2019, shows the airfield as permanently closed. One interviewee interviewed during the PFAS PA indicated that "fire trucks were used to support operations at the two Vieques helicopter pads, but not at the airfield." No environmental investigations evaluating the potential for PFAS release have been conducted in the runway area.

Physical and Biological Characteristics

The former Camp Garcia Runway consists of an asphalt tarmac surrounded by dense vegetation and adjacent surface water ephemeral streams that are dry throughout the year except temporarily during significant storm events (including PI 5). These streams do not provide habitat supportive of aquatic organisms. The runway is relatively flat; however, southwest of the runway the area slopes to the south-southwest toward Puerto Ferro and southeast of the runway the area slopes to the south-southeast to Bahia Tapón (**Figure 10-9**).

Soil and lithologic characteristics in this area are anticipated to be similar to those encountered at PI 5, located on and adjacent to the western end of the runway, which is underlain by Quaternary alluvial deposits (sand, silt, silty sand, and sandy silt) that are underlain by a granodiorite and quartz diorite.

Groundwater beneath the runway is expected to be between 25 and 40 feet bgs with an overall southward flow direction, comparable to what has been observed at SWMU 20. While there are no perennial surface water bodies at or adjacent to the runway, two ephemeral streams convey water from the runway and from the drainage ditch system south of the runway (including PI 5) toward the sea.

The asphalt runway itself does not provide suitable habitat for wildlife or plants. However, surrounding the runway is a dense canopy of primarily invasive tree species such as tantan, mesquite, and acacia. Various shrubs, vines, and grasses also occur in some open areas within the canopy and along the edge of the flightline. Wildlife likely include mongoose, red-tailed hawk, bananaquit, adelaidae warbler, pearly-eyed thrasher, northern mockingbird, loggerhead kingbird, gray kingbird, ground dove, white-winged dove, zenaida dove, Greater Antillean grackle, and anolis lizards.

There are no federally protected species or preferred habitat known to occur at this location.

Summary of Key Conceptual Site Model Characteristics Supporting the Monitoring Rationale and Approach

Potential Sources of PFAS

Historical records and site visit(s) provide no definitive evidence of a release of AFFF or other PFAS-containing substances at the Camp Garcia Runway or PI 5 located adjacent to the western end of the runway (CH2M, 2020). However, because historical records indicate the runway was at least partially active between 1959 and 1975, a portion of which was when Navy use of AFFF was occurring (though not necessarily on Vieques), it is possible it was released at the airfield as part of fire-fighting demonstration or possibly in response to an aircraft crash (although no records of a crash have been identified).

Receptors and Exposure Scenarios

If a release(s) of AFFF occurred as described, the most likely source areas for a release(s) to the environment would have been any AFFF sprayed onto the runway that did not evaporate and flowed southward (downslope) across the runway into the drainage ditch system (including PI 5). It is also possible that some infiltration through the runway could have occurred, primarily through cracks, if present. If release to soil did occur, AFFF could have

been transported downgradient along the drainage features south of the runway with precipitation and/or could have migrated vertically toward groundwater.

The former runway is located within the Vieques Wildlife Refuge and may be accessed by the public during daylight hours. USFWS has used the runway as a staging area for Hurricane Maria vegetation debris and aggregate material utilized in road improvements. Though USFWS workers and visitors can access the paved runway, recurrent contact with soils surrounding the runway (including PI 5) is unlikely because of the dense vegetation and some steep slopes that would make access difficult and potentially unsafe. The forested habitat surrounding the runway and within associated PI 5 can support a variety of terrestrial birds and mammals.

VNTR PI 5: Surface Water Drainage Area from Camp Garcia Runway

Location

PI 5 is located adjacent to the western end of the former Camp Garcia Runway (**Figures 10-3 and 10-9**). It is bounded to the north by the former Camp Garcia Runway, to the south by Puerto Ferro, to the west by undeveloped land, and to the east by other areas of the runway drainage ditch system that only contain water during significant storm events. Approximately 1.5 acres of the PI 5 drainage area, located on the downgradient side of the former Camp Garcia Runway, overlaps the former runway.

Site History

The operational history of PI 5 is directly associated with the operations of the former Camp Garcia Runway, as described in that subsection. Past investigations of the site comprise the EBS (NAVFAC, 2003) and the SI/ESI (CH2M, 2010a). The results indicated the site warranted no further investigation/action and a No Action/No Further Action Decision Document was produced in September 2010 (CH2M, 2010b). However, no historic evaluation/investigations included the potential for PFAS release at this location prior to the PFAS PA Report (CH2M, 2020).

Physical and Biological Characteristics

See “Physical and Biological Characteristics” under VNTR Camp Garcia Runway.

Summary of Key Conceptual Site Model Characteristics Supporting the Monitoring Rationale and Approach

Potential Sources of PFAS

See Potential Sources of PFAS under VNTR Camp Garcia Runway.

Receptors and Exposure Scenarios

See Receptors and Exposure Scenarios under VNTR Camp Garcia Runway.

VNTR SWMU 20: Former Helicopter Maintenance Area

Location

SWMU 20 (formerly PI 4) is located south of Camp Garcia and just north of the eastern end of the Camp Garcia Runway (**Figures 10-3 and 10-9**). With respect to the PFAS SI, the most significant feature of SWMU 20 is the former 5,000-square-foot helicopter maintenance building. The site also includes over 30 wells that have been used to delineate an 18-acre groundwater contaminant plume (primarily trichloroethene [TCE]).

Site History

Historical information suggests the helicopter maintenance building was used from 1959 to 1975 for helicopter maintenance and as a helicopter hangar. Information obtained during a PA interview indicated that fire trucks

that historically stored and used AFFF supported operations at the two Vieques helicopter pads. In addition, since hangars commonly have fire suppression systems, AFFF may have been present at the site for at least a portion of the time the helicopter maintenance area/hangar was operational, although no historical records were found indicating a fire suppression system was present in the helicopter maintenance building or that AFFF was stored/used there.

Investigations performed for SWMU 20 comprised a PA/SI (CH2M, 2008c), an SI/ESI (CH2M, 2010a), a Supplemental ESI (CH2M, 2011b), and an RI (CH2M, 2016b). However, no historical evaluation/investigations included the potential for PFAS release at this location prior to the PFAS PA Report (CH2M, 2020).

Physical and Biological Characteristics

SWMU 20 is currently uninhabited, heavily vegetated, and the former helicopter maintenance building and other structures have been removed. The area around SWMU 20 slopes gently to the southeast with elevations dropping from about 50 feet amsl to approximately 20 feet amsl. Based upon historic lithologic characterization data from monitoring well boring logs, soil in the area is primarily poorly graded dry sands and dry silty sands with occasional trace clay and gravel and intermittent clay-silt lenses above weathered bedrock (saprolite) grading into fractured, competent granodiorite bedrock. Bedrock was encountered in the monitoring well borings at between 17 and 28 feet bgs.

There are no surface water bodies at the site. The closest surface water body topographically downgradient of the site is Bahia Tapón along the coast. Groundwater-level measurements and contaminant plume data indicate groundwater flows through the fractured bedrock in a south-southeast direction toward the Bahia Tapón. The measured hydraulic gradient at the site ranges from 0.002 to 0.005 feet per foot (ft/ft) (CH2M, 2016b).

The helicopter maintenance area is relatively small and entirely overgrown by invasive species including tantan, mesquite, and acacia. Wildlife likely include common forest species such as mongoose, bananaquit, adelaidae warbler, pearly-eyed thrasher, northern mockingbird, loggerhead kingbird, gray kingbird, ground dove, white-winged dove, zenaida dove, Greater Antillean grackle, and anolis lizards.

There are no federally protected species or preferred habitat known to occur at this site.

Summary of Key Conceptual Site Model Characteristics Supporting the Monitoring Rationale and Approach

Potential Sources of PFAS

Historical records and site visit(s) provide no definitive evidence of a release of AFFF or other PFAS-containing substances at SWMU 20, including no indication a fire suppression system was ever present in the hanger or that AFFF was stored or used there (CH2M, 2020). However, since hangars commonly have fire suppression systems and AFFF may have been present at the base for at least a portion of the time the helicopter maintenance area/hangar was operational, it is conservatively assumed that there is the potential PFAS could have been released there.

Receptors and Exposure Scenarios

If a release(s) of AFFF occurred, the most likely source area for a release(s) to the environment would have been at or immediately around the helicopter maintenance building/hanger. If a release(s) occurred, it likely would have been to the ground surface and then could have infiltrated through the surface and subsurface soil toward/to groundwater.

SWMU 20 is potentially accessible by USFWS workers and the public. However, because the area no longer contains any facilities and is unmaintained and densely vegetated, human contact with the site is likely infrequent. USFWS refuge management activities could occasionally occur, though there is no current or planned land use in

the area that includes SWMU 20. The onsite and surrounding forested habitat can support a variety of terrestrial birds and mammals.

Potential Former VNTR Motor Pool Area (Including Building 340) and Former Fire Department Building 330

Location

The potential former VNTR motor pool area and former fire department building are located at historic Camp Garcia, the base of operations supporting military training activities at the former VNTR. Buildings 330 and 340 are no longer present at Camp Garcia; however, the locations are identified in **Figure 10-10**. The area that includes these features encompasses approximately 0.5 acre and is located in the new base of operations for the Navy's cleanup program on Vieques (**Figure 10-10**).

Site History

Building 330 and 340 were identified on a hand-drawn map of unknown origin (CH2M, 2008c); on that map Building 330 was identified as the Camp Garcia Fire Department building. A PA interviewee indicated the area also included a possible motor pool where fire trucks, equipped with AFFF, were serviced. The EBS (NAVFAC, 2003) identifies no building or parking area (past or present) at the location indicated by the interviewee. Building 340 was located adjacent (to the north) to where the interviewee marked the location of the motor pool area, but no historical information has been found regarding the use of the building. Given its close proximity to the area referred to by the interviewee, it is possible the former Building 340 was associated with the motor pool. Both buildings are no longer present and no investigations have been performed at this location to date.

No historical information has been found that identifies where specifically fire truck maintenance/washing occurred. Further, significant ground-disturbing activities occurred in the area during historic building demolition and construction of the new Vieques cleanup base of operations in the same area.

Physical and Biological Characteristics

The Motor Pool and Fire Department area is located within the footprint of the current base of operations for the Navy's cleanup program (**Figure 10-10**). Specifically, the area currently includes offices and a parking area and is mostly gravel-covered with sparse grass cover in some areas. The area is relatively flat, with a very low-grade slope to the south.

Studies have shown the lithology beneath the area is underlain by a thin (up to about 4 feet), unconsolidated clayey gravel alluvium overlying late Cretaceous to Eocene age plutonic rock made up largely of granodiorite and quartz diorite. Groundwater flow in fractured bedrock in the vicinity of Camp Garcia is generally south toward the Caribbean Sea. There are no surface water bodies present at or near this location.

The habitat generally consists of regularly maintained grasses and invasive plants; however, the area is routinely disturbed by vehicle parking and human activity which may limit use by birds and mammals. The more frequently observed species in the vicinity of this area include horses, mongoose, northern mockingbird, gray kingbird, ground dove, white-winged dove, zenaida dove, house sparrow, and Greater Antillean grackle.

There are no federally protected species or preferred habitat known to occur at this location.

Summary of Key Conceptual Site Model Characteristics Supporting the Monitoring Rationale and Approach

Potential Sources of PFAS

Historical records and site visit(s) provide no definitive evidence of a release of AFFF or other PFAS-containing substances at the possible motor pool (area south of former Building 330 and/or area of former Building 340) (CH2M, 2006). However, information obtained during a PA interview indicated fire trucks in Vieques were equipped with AFFF. Therefore, a release of AFFF from the fire trucks could have occurred if AFFF was aboard the trucks or other vehicles while maintenance was being performed at the potential motor pool.

Receptors and Exposure Scenarios

If a release(s) of AFFF or AFFF-containing material occurred from fire trucks during maintenance activities at the Former Motor Pool, the release(s) would most likely have been to the surrounding ground surface. It could then infiltrate through the surface and subsurface soil toward/to groundwater.

Camp Garcia is currently a very active area for multiple contractors working five days a week, as well as USFWS and other governmental agencies. The area where Buildings 330 and 340 previously stood are now within the footprint of buildings and other structures associated with the Navy's cleanup program and an adjacent parking lot that is accessible to workers as well as grounds keepers and refuge management personnel. The area is secured by a fence and locked gates and monitored by security personnel; public access is not allowed except by permission of the Navy. Regular disturbance by worker activity and grounds maintenance minimizes use of the area by birds and mammals.

VNTR SWMU 10 and VNTR AOC G: Former Sewage Treatment Lagoons and Chlorination Building

Location

SWMU 10 and AOC G are located approximately 0.5 mile southeast of Camp Garcia (**Figures 10-3 and 10-12**) and 0.3 mile north of the Caribbean Sea. The former wastewater treatment system is no longer operational, and the area is now overgrown with dense vegetation. The former lagoons and chlorination building occupy an area of about 1.5 acres. The AOC G building is a dilapidated concrete structure measuring approximately 10 feet by 10 feet.

Site History

The original domestic sewage treatment lagoons for Camp Garcia went into service in the early 1950s. The facility consisted of four unlined lagoons, two of them serving as receiving/equalization lagoons, and the other two providing polishing treatment. Historically, the raw wastewater discharge to the lagoon system originated from the Camp Garcia area (NAVFAC, 2003). Effluent from the final two polishing lagoons was chlorinated in a chlorine contact chamber (AOC G). The 1988 and 1995 RCRA Facility Assessments (RFAs) indicated that the effluent from the final lagoons was discharged to the land (A.T. Kearney et al., 1988; PREQB, 1995). A historical report (ERI, 2000) noted probable piping leading from the chlorination building to a series of linear ground scars and ditches. Although it is possible that wastewater was discharged to the land following chlorination, the Current Conditions Report indicated the effluent from the final polishing lagoons was chlorinated in the chlorine contact chamber and then discharged to the sea (CH2M, 2001). This information was corroborated by an interview with the former Water Program Manager, NAPR Environmental Division (CH2M, 2010a).

In 1974, after the level of activity and associated domestic wastewater generation rate significantly decreased at Camp Garcia, the treatment lagoons were lined using a 2-foot compacted clay and plastic liner to create a no-discharge system. The lagoons were then utilized as evaporation lagoons until a new no-discharge lagoon was

constructed in September 2000 immediately northwest from the old lagoons. AOC G was the chlorination building at the sewage lagoons for Camp Garcia, located directly south of the old sewage treatment lagoons of SWMU 10. The area consists of a single structure that housed a pump station and chlorination equipment used in the past for the chlorination of the lagoon system effluent. These facilities were placed into operation in the 1950s and were decommissioned by 2000. Past investigation reports of the SWMU 10 and AOC G sites include the 1988 and 1995 RFAs (A.T. Kearney et al., 1988; PREQB, 1995), 2000 Environmental Research, Inc. (ERI) aerial photography in the Current Conditions Report (CH2M, 2001), EBS (NAVFAC, 2003), a field effort completed as part of the 2004 Phase I RCRA Facility Investigation (RFI) (CH2M, 2004), PA/SI (CH2M, 2008c), and SI/ESI (CH2M, 2010a). The results indicated the site warranted no further investigation/action and a No Action/No Further Action Decision Document was produced in September 2010 (CH2M, 2010b). However, no historic evaluation/investigations included the potential for PFAS release at this location prior to the PFAS PA Report (CH2M, 2020).

Physical and Biological Characteristics

The SWMU 10/AOC G area slopes relatively gently toward the southeast with an elevation change from about 32 feet amsl in the northwest corner to about 5 feet amsl in the southeast corner of this location. The area is uninhabited and heavily vegetated.

Based upon the soil borings previously performed, material above the lagoon liner consists of poorly graded sand and poorly graded sand with clay. Lean clays, poorly graded sands, and silty sands were encountered below the liner and refusal was encountered between approximately 1.2 and 3.6 feet bgs. (CH2M, 2008c). Lithology at this location includes plutonic rocks (largely granodiorite and quartz diorite) at a depth of approximately 20 and 25 feet bgs. Groundwater at this location occurs between 29 and 37 feet bgs in the bedrock and flows southward toward Bahia Tapón. There are no surface water bodies at this location; the closest surface water body (i.e., Bahia Tapón) is approximately 1,500 feet south.

The SWMU 10 area is entirely overgrown by invasive species including tantan, mesquite, and acacia. Wildlife likely include common forest species such as mongoose, red-tailed hawk, bananaquit, adelaidae warbler, pearly-eyed thrasher, northern mockingbird, loggerhead kingbird, gray kingbird, ground dove, white-winged dove, zenaida dove, Greater Antillean grackle, and anolis lizards.

There are no federally protected species or preferred habitat known to occur at this location.

Summary of Key Conceptual Site Model Characteristics Supporting the Monitoring Rationale and Approach

Potential Sources of PFAS

Historical records and site visit(s) provide no evidence of a release of AFFF or other PFAS-containing substances into or at SWMU 10 or AOC G (CH2M, 2006). However, because SWMU 10 and AOC G were operational during the time when Navy use of PFAS-containing materials was occurring, if AFFF and/or other PFAS-containing substances were used at the former VNTR, it is possible they may have ultimately been present in wastewater influent associated with the SWMU 10/AOC G wastewater treatment system.

Receptors and Exposure Scenarios

If AFFF or other PFAS-containing materials arrived at SWMU 10/AOC G, the most likely source area for a release(s) to the environment would be the lagoons into which wastewater was discharged or the land south of the lagoon where treated wastewater was reportedly discharged to the ground surface. If PFAS-containing substances were discharged to the lagoons prior to 1974 (when the lagoons were lined) or were discharged to the ground surface south of the lagoons, they could have infiltrated through the underlying soil to/toward groundwater. Once the lagoons were lined, subsequent discharges to the lagoon could have allowed PFAS-containing substances to accumulate on the liners.

SWMU 10 and AOC G are potentially accessible by USFWS workers and the public. However, because the area no longer contains any active facilities and is unmaintained and densely vegetated, human contact within this area is likely infrequent. USFWS refuge management activities could occasionally occur, though there is no current or planned land use in the area. The onsite and surrounding forested habitat can support a variety of terrestrial birds and mammals.

VNTR SWMU 1: Former Camp Garcia Municipal Waste Management Unit (Landfill)

Location

SWMU 1 is located approximately 4,000 feet northwest of Playa La Chiva (Blue Beach), roughly a mile east of the Camp Garcia Compound Area (**Figures 10-3 and 10-13**). The landfill covers an area of approximately 51 acres.

Site History

SWMU 1 was an active landfill from 1954 to 1978 for the disposal of municipal waste from Camp Garcia. Up to about 3,120 tons of waste was disposed in the landfill, but no hazardous materials reportedly were placed in the disposal area. Since AFFF was reportedly used at the former training facility, it is possible AFFF or other PFAS-containing materials were part of the waste stream disposed of in the landfill. During operation, materials were deposited in trenches, which were then covered with about 6 inches of soil to control blowing of litter. When operation of the SWMU 1 landfill ceased in 1978, a final 2-foot thick soil cover, consisting of compacted native soils, was placed over the trenches. Between 2013 and 2014, the SWMU 1 remedial action was implemented during which surficial debris was removed from across the landfill surface. Approximately 6 tons of debris were removed, and the landfill surface has been allowed to naturally revegetate since that time.

Past site investigation reports include the Environmental Impact Statement (Tippetts et al., 1979), Initial Assessment Study (Greenleaf et al., 1984), Phase II RFA (A.T. Kearney et al., 1988), Revised RFA (PREQB, 1995), Current Conditions Evaluation (CH2M, 2001) which included the ERI 2000 aerial photographic analysis, EBS (NAVFAC, 2003), Phase I RFI (CH2M, 2004), SI/ESI (CH2M, 2010a), and Streamlined RI/FS (CH2M, 2011a). A Record of Decision was signed which presented the remedial action consisting of enhanced native soil cover and institutional controls (NAVFAC, 2011b). However, no historic evaluation/investigations included the potential for PFAS release at this location prior to the PFAS PA Report (CH2M, 2020).

Physical and Biological Characteristics

SWMU 1 is situated in a valley that gently slopes from the northwest to the southeast, with an approximate 55-foot elevation change; it is bounded by steep hills to the west and an ephemeral stream as well as steep hills to the east (**Figure 10-12**). The area is densely vegetated, dominated by thick thorn scrub. Surface water occurs within the ephemeral stream only during periods of heavy and prolonged rainfall. The stretch of ephemeral stream bounding the eastern portion of the landfill is of higher energy adjacent to the upgradient third of the landfill than that adjacent to the remaining two thirds of the landfill. This is evident from a well-defined channel, coarse-grained sand, and sparse vegetation within the upgradient third of the ephemeral stream; south of this location, the ephemeral stream is nearly flat with no readily observable banks, more diverse grain sizes, more dense vegetation, and an undulating surface (CH2M, 2010a). A second, shorter ephemeral stream lies within the south-central portion of the landfill. Based on its geographic location toward the southern part of the island, surface runoff at SWMU 1 is anticipated to generally flow south toward the Caribbean Sea.

Based upon soil boring data from the PA/SI (CH2M, 2008c) and SI/ESI (CH2M, 2010a), soil encountered at SWMU 1 is similar in nature to other alluvial systems in Vieques: an ephemeral alluvial depositional environment with sand, clay, silt, and gravel overlying the substratum. SWMU 1 substratum includes Cretaceous aged andesite and late Cretaceous to Eocene quartz diorite/granodiorite saprolite (USGS, 1989). Bedrock was encountered from

the surface down to 35 feet bgs during monitoring well installation at the site. The saprolite is believed to be the weathered material of quartz diorite/granodiorite that is intruded into the andesite also present at the site.

The groundwater on eastern Vieques occurs in both the unconsolidated alluvial deposits and the saprolite and bedrock. Perched groundwater within the vadose zone was encountered during the drilling at the site but was discontinuous and localized to MW-01 and MW-09. Groundwater flow in the unconfined aquifer is generally to the south-southwest in the northern portion of the site at an average horizontal hydraulic gradient of 0.01 ft/ft and to the southeast in the southern portion of the site at an average horizontal hydraulic gradient of 0.006 ft/ft (CH2M, 2011a).

SWMU 1 is densely vegetated, dominated by thick thorn scrub habitat throughout most of the area, along with some mixed upland forest habitat in portions where landfill activities did not occur around the perimeter. Thorn scrub species within the area include acacia species, mesquite, tantan, Christmas tree, goatbush (*Pithecellobium unguis-cati*), sage (*Lantana involucrata*), and Croton species. The perimeter mixed upland forest community typically includes almacigo (*Bursera simaruba*), ironwood (*Krugiodendron ferreum*), caper trees (*Capparis spp*.), fiddlewood or "fish poison" (*Piscidia carthaginensis*), fustic (*Pictetia aculeata*), cat's claw (*Macfadyena unguis-cati*), Christmas tree, and myrtle trees (*Eugenia* spp.). Common terrestrial birds that likely occur include common ground dove, zenaida dove, Caribbean elaenia (*Elaenia martinica*), gray kingbird, mangrove cuckoo (*Coccyzus minor*), bananaquit, black-faced grassquit (*Tiaris bicolor*), Antillean grackle, pearly-eyed thrasher, Antillean crested hummingbird (*Orthorynchus cristatus*), and smooth-billed ani (*Crotophaga ani*). Bats, such as red fruit bats (*Stenoderma* spp.) and free-tailed bats (*Tadarida* spp.), may include SWMU 1 within their foraging range. Other mammals likely to occur include the rat (*Rattus* spp.), mongoose, and horses. Various anolis lizard species are also expected to occur. The ephemeral stream does not support fish or aquatic invertebrates due to temporary presence of water following storm events. The gray land crab has not been observed in the vicinity of the ephemeral stream.

There are no federally protected species known to occur at this location.

Summary of Key Conceptual Site Model Characteristics Supporting the Monitoring Rationale and Approach

Potential Sources of PFAS

Historical records and site visit(s) provide no evidence AFFF or other PFAS-containing substances were disposed of at SWMU 1 (CH2M, 2006). However, because information obtained during a PA interview suggests AFFF was present at the former training facility it is conservatively assumed that materials containing AFFF or other PFAS-containing substances (e.g., empty containers, firefighting training materials) could have been disposed of at SWMU 1.

Receptors and Exposure Scenarios

If a release(s) of AFFF occurred as described, the most likely source areas for a release(s) to the environment would have been the landfilled debris areas. If a release(s) occurred, it likely would have leached through the surface and/or subsurface soil toward/to groundwater because the landfill is unlined. Additionally, if there were releases to the ground surface from historical surficial debris, AFFF and/or other PFAS-containing substances could have been transported via overland flow the ephemeral streams.

Access to SWMU 1 is restricted by land use controls (i.e., fencing, signs). Additionally, there are no features within SWMU 1 that would attract visitors or trespassers and it is heavily vegetated. The habitat covering the former landfill consists of a dense forest of primarily invasive tree species that can support a variety of terrestrial birds and mammals. The ephemeral streams are typically dry, flowing only during storm events and therefore do not provide permanent aquatic habitats.

\\dc1vs01\GISNavyClean\LANT\Vieques\MapFiles\PFAS_PA\SI_SAP\Figure_10-1_RegionalLocationMap.mxd 9/8/2020 BERESL

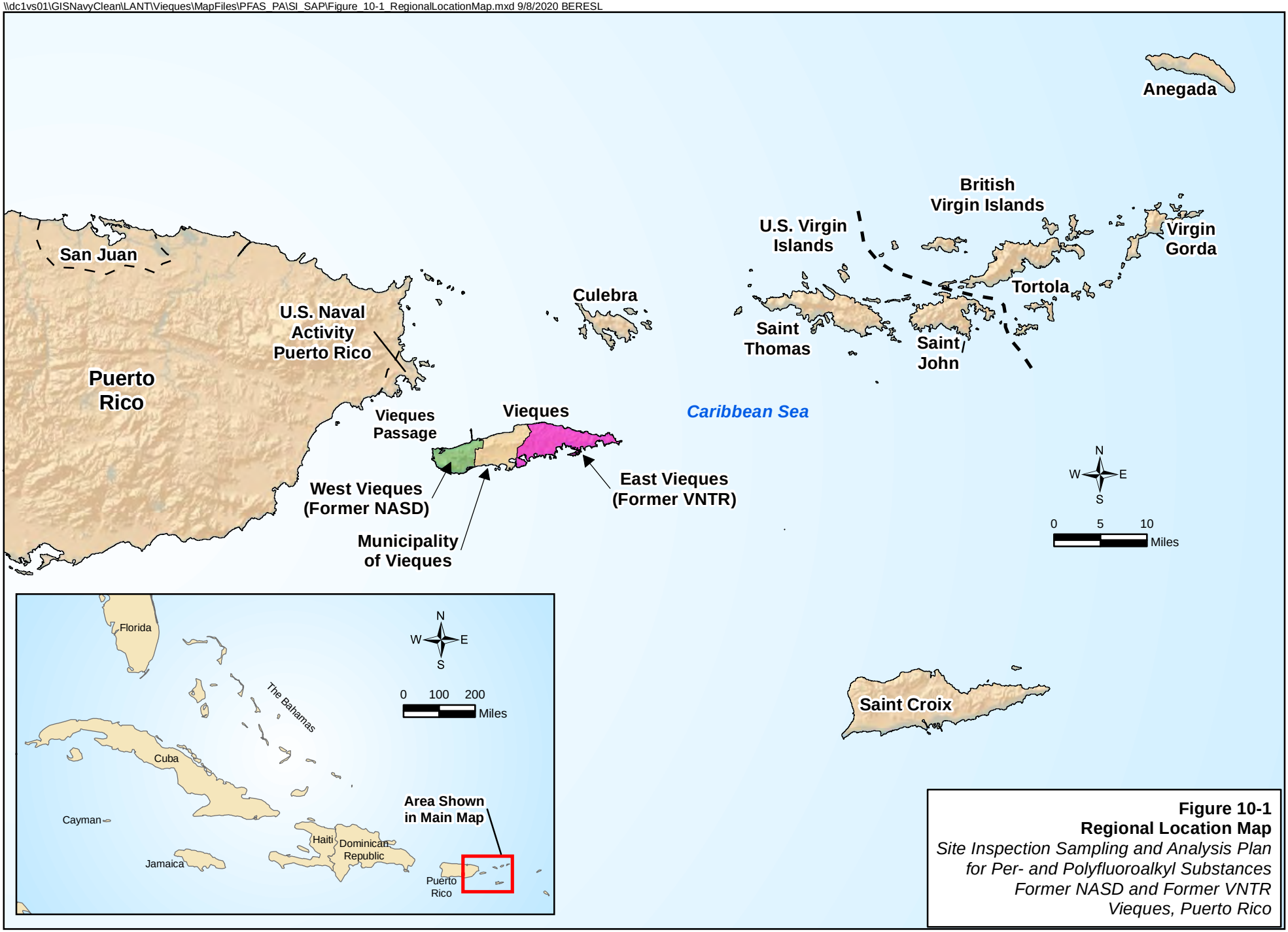

Figure 10-1
Regional Location Map
Site Inspection Sampling and Analysis Plan
for Per- and Polyfluoroalkyl Substances
Former NASD and Former VNTR
Vieques, Puerto Rico

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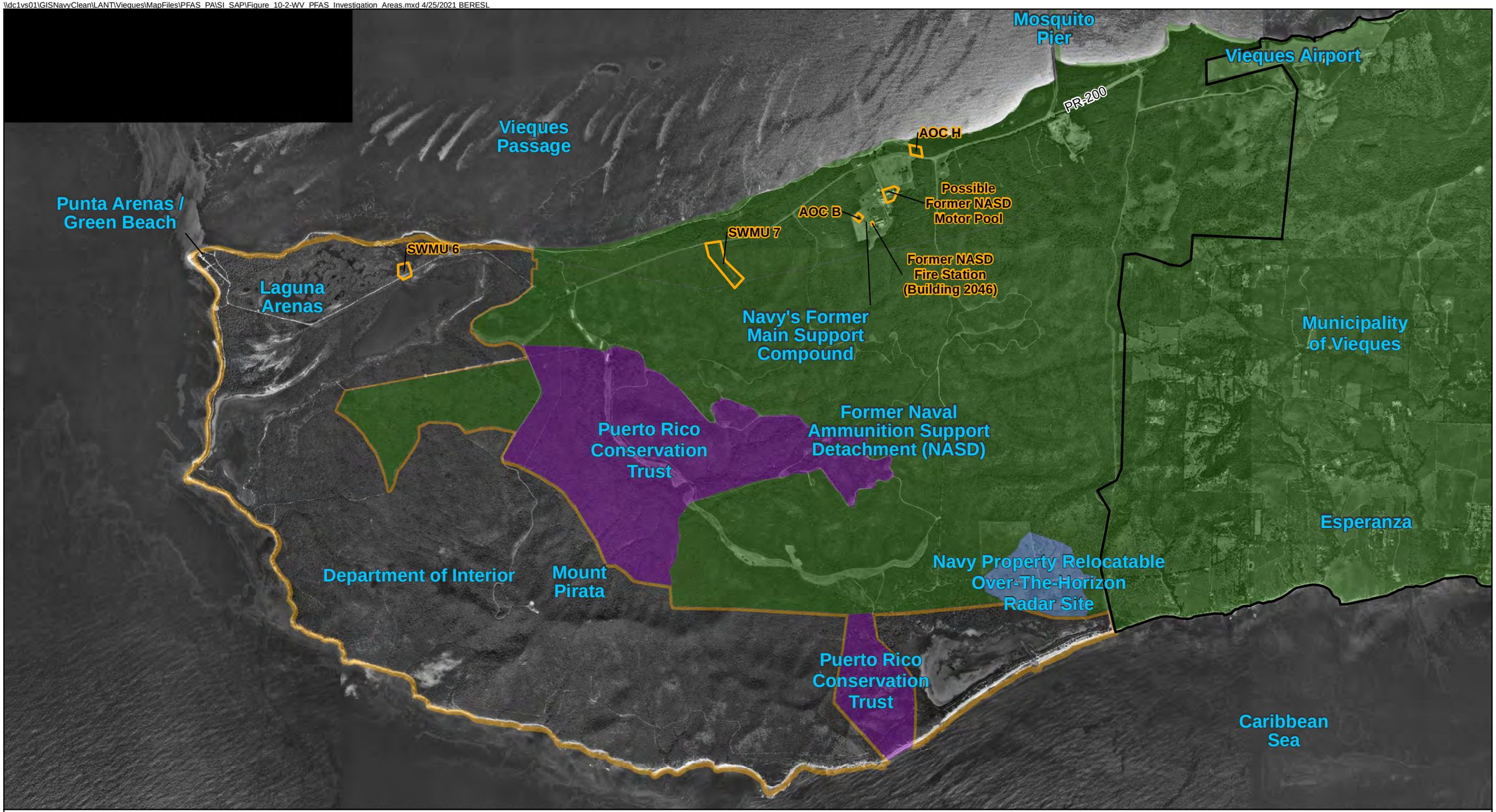
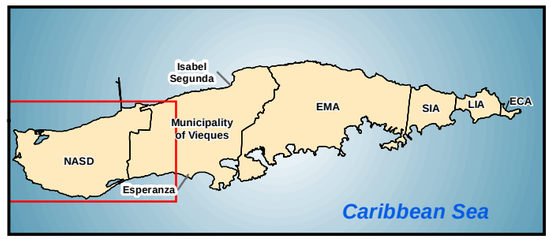
\\dc1vs01\GISNavyClean\LANT\Vieques\MapFiles\PFAS_PA\SI_SAP\Figure_10-2-WV_PFAS_Investigation_Areas.mxd 4/25/2021 BERESL



Legend

Potential PFAS Source Area



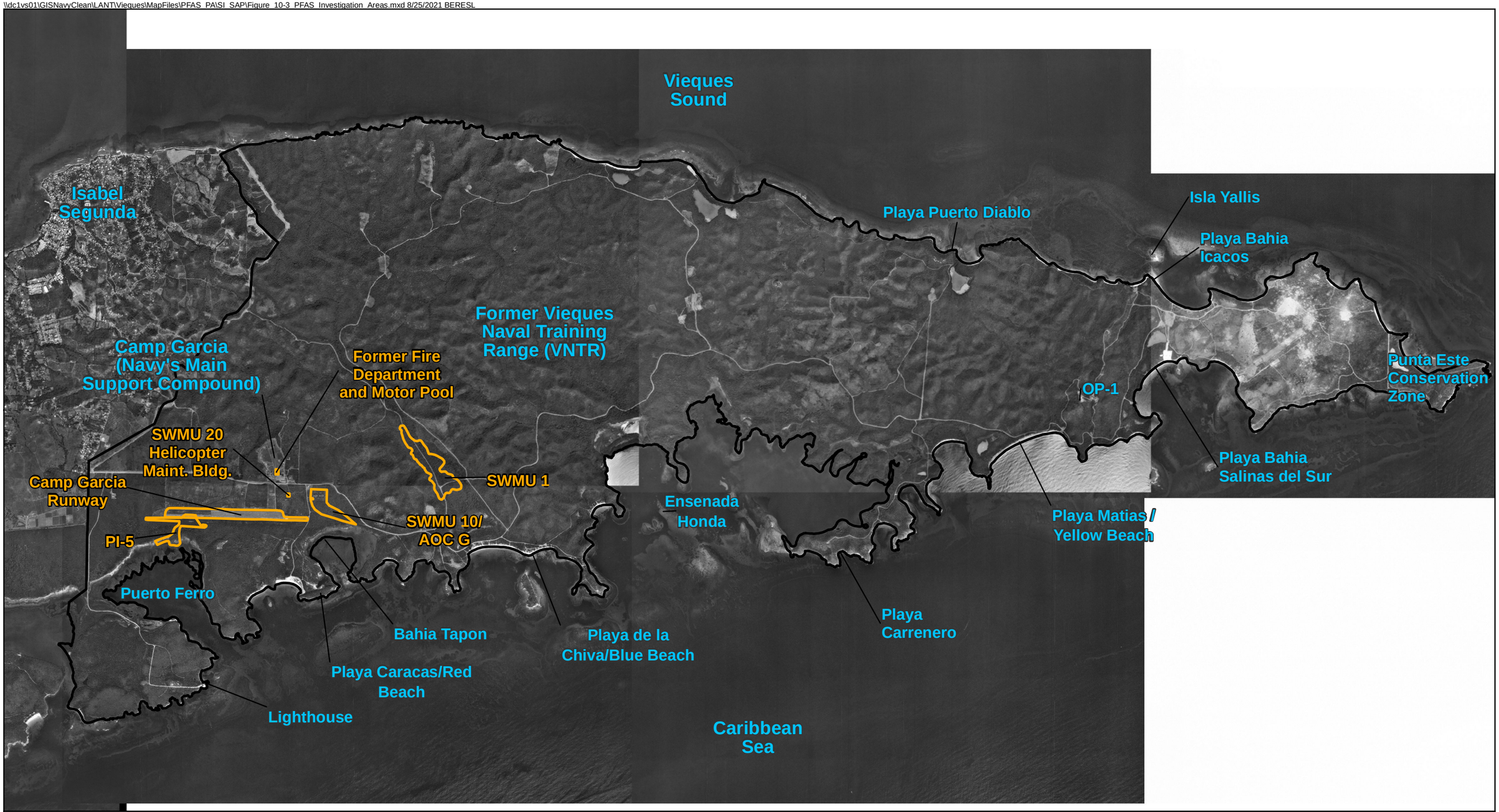
N
W E
S

0 1,250 2,500
Feet

1994 Aerial Photograph

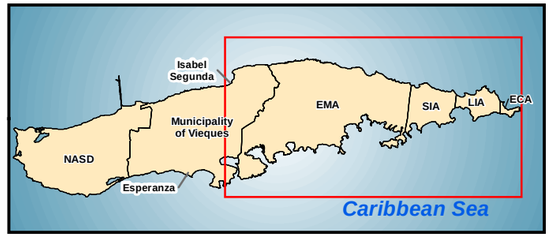
Figure 10-2
PFAS Investigation Areas at the Former NASD
Site Inspection Sampling and Analysis Plan
for Per- and Polyfluoroalkyl Substances
Former NASD and Former VNTR
Vieques, Puerto Rico

\\dc1vs01\GISNavyClean\LANT\Vieques\MapFiles\PFAS_PA\SI_SAP\Figure_10-3_PFAS_Investigation_Areas.mxd 8/25/2021 BERESL



Legend

Approximate Site Location



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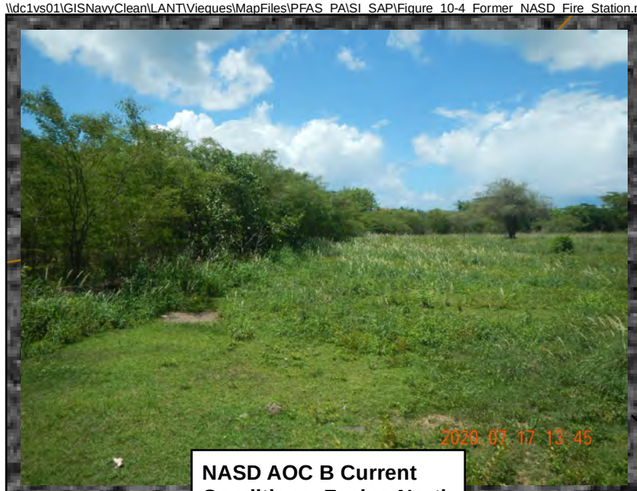
0 2,000 4,000 Feet

Imagery Date: 1994

Figure 10-3
PFAS Investigation Areas at the Former VNTR
Site Inspection Sampling and Analysis Plan
for Per- and Polyfluoroalkyl Substances
Former NASD and Former VNTR
Vieques, Puerto Rico

\\dc1vs01\GISNavyClean\LANT\Vieques\MapFiles\PFAS_PA\SI_SAP\Figure_10-4_Former_NASD_Fire_Station.mxd 4/28/2021 BERESL



NASD AOC B Current Conditions, Facing North

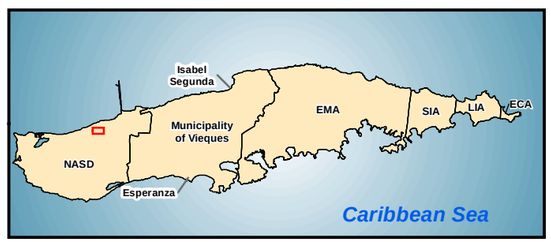
AOC E

VWAB-PFAS-SS/SB03
VWAB-PFAS-SS/SB02
VWAB-PFAS-MW01
VWAB-PFAS-SS/SB04
VWAB-PFAS-SS/SB01
AOC B
Clarifier
Building 2030
VWFS-PFAS-MW02
VWFS-PFAS-SS/SB04
VWFS-PFAS-SS/SB05
VWFS-PFAS-MW01
VWFS-PFAS-SS/SB01
VWFS-PFAS-SS/SB02
VWFS-PFAS-SS/SB03
Possible location of conex container that stored AFFF solution
Approximate location of Fire Station Ramp
Former NASD Fire Station (Building 2046)
33
66
98

Building 2046 Current Conditions, Facing South

Legend

- Approximate Site Location
- Proposed Monitoring Well Location
- Proposed Soil Boring Location
- Groundwater Flow Direction (AOC E Annual Report (2019))
- Elevation Contour (feet)
- Ephemeral Stream
- Road



N
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0 75 150
Feet

Imagery Date: 1994

Figure 10-4
NASD Former Fire Station Building 2046 at the Public Works Area and NASD AOC B: Former Wastewater Treatment Plant
Site Inspection Sampling and Analysis Plan for Per- and Polyfluoroalkyl Substances Former NASD and Former VNTR Vieques, Puerto Rico

\\dc1vs01\GISNavyClean\LANT\Vieques\MapFiles\PFAS_PA\SI_SAP\Figure_10-5_Former_NASD_Motor_Pool_Area.mxd 9/15/2021 BERESL

PR-200

16

33

33

33

VWMP-PFAS-MW03

VWMP-PFAS-MW02

VWMP-PFAS-MW01

VWMP-PFAS-SS/SB01

VWMP-PFAS-SS/SB02

VWMP-PFAS-SS/SB03

VWMP-PFAS-SS/SB04

2023

2022

4021

4001

4010

4011

AOC E

Potential
Former NASD
Motor Pool Area

Former
Wash Rack

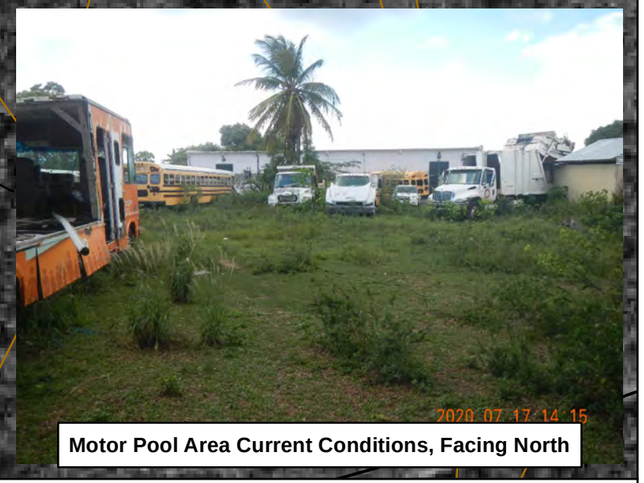
16

13

7

33

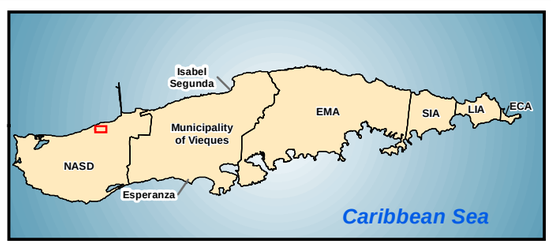
33



Motor Pool Area Current Conditions, Facing North

Legend

- Approximate Site Location
- Approximate Building Location
- AOC E Land Use Control Boundary
- Proposed Monitoring Well Location
- Proposed Soil Boring Location
- Groundwater Flow Direction (AOC E Annual Report (2019))
- Ephemeral Stream
- Elevation Contour (feet)
- Road



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0 75 150
Feet

Imagery Date: 1994

Figure 10-5
Potential Former NASD Motor Pool Area
Site Inspection Sampling and Analysis Plan
for Per- and Polyfluoroalkyl Substances
Former NASD and Former VNTR
Vieques, Puerto Rico

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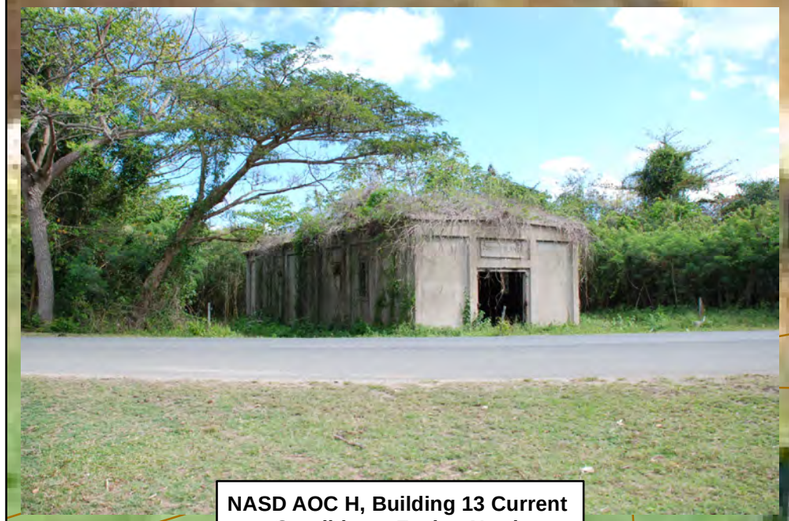


NASD AOC H, Building 13 Current Conditions, Facing North

Vieques Passage

Ephemeral Stream with Standing Water

VWAH-PFAS-SD03
VWAH-PFAS-SW03
VWAH-PFAS-SD02
VWAH-PFAS-SW02
AOC H
VWAH-PFAS-MW02
VWAH-PFAS-SS/SB01
Building 13
VWAH-PFAS-SD01
VWAH-PFAS-SW01
VWAH-PFAS-MW01
VWAH-PFAS-SS/SB03
VWAH-PFAS-SS/SB02
VWAH-PFAS-SS/SB04

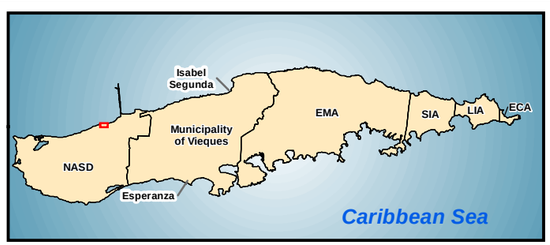
3
7
10
13
16
-2.0
-1.8
-1.6
-1.4
-1.2

Entrance to the public works area

PR-200

Legend

- Approximate Site Boundary
- Proposed Monitoring Well Location
- Proposed Soil Boring Location
- Surface Water and Sediment Sample Location
- Groundwater Potentiometric Contour (AOC H RI Report (2007))
- Groundwater Flow Direction (AOC H RI Report (2007))
- Ephemeral Stream
- Elevation Contour (feet)
- Road



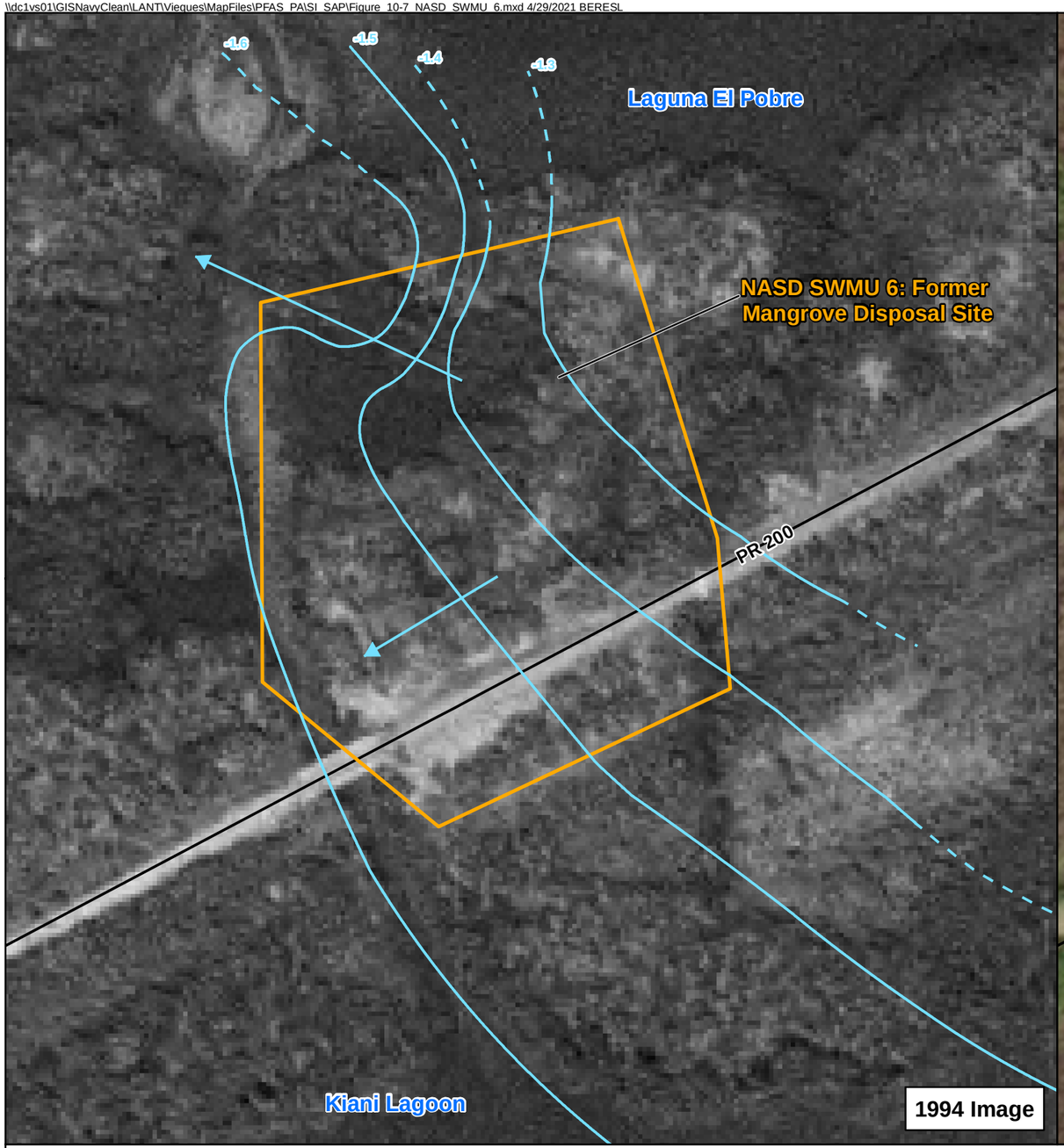
N
W E
S

0 50 100
Feet

Imagery Date: 2004

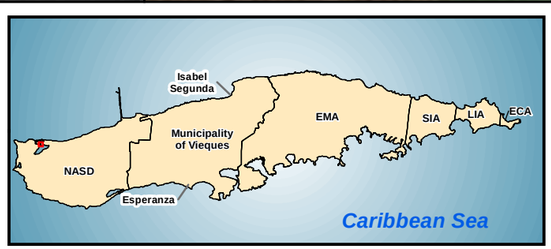
Figure 10-6
NASD AOC H: Abandoned Power Plant
Site Inspection Sampling and Analysis Plan for Per- and Polyfluoroalkyl Substances Former NASD and Former VNTR Vieques, Puerto Rico

\\dc1vs01\GISNavyClean\LANT\Vieques\MapFiles\PFAS_PA\SI_SAP\Figure_10-7_NASD_SWMU_6.mxd 4/29/2021 BERESL



Legend

- Approximate Site Location
- Proposed Soil Boring Location
- Proposed Surface Water and Sediment Sample Location
- Potentiometric Contour (SWMU 6 RI Report (2007))
- Inferred Potentiometric Contour (SWMU 6 RI Report (2007))
- Groundwater Flow Direction (SWMU 6 RI Report (2007))
- Road



N
W E
S

0 50 100
Feet

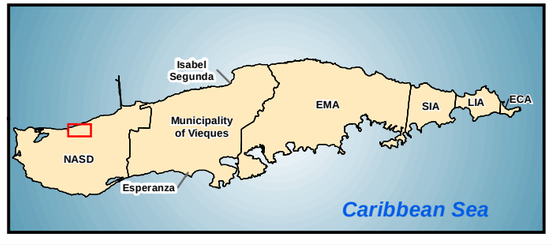
Imagery Date: 1994 & 2009

Figure 10-7
NASD SWMU 6: Former Mangrove Disposal Site
Site Inspection Sampling and Analysis Plan
for Per- and Polyfluoroalkyl Substances
Former NASD and Former VNTR
Vieques, Puerto Rico

\\dc1vs01\GISNavyClean\LANT\Vieques\MapFiles\PFAS_PA\SI_SAP\Figure_10-8_NASD_SWMU_7.mxd 9/22/2021 BERESL

Legend

- Approximate Site Location
- Proposed Monitoring Well Location
- Proposed Soil Boring Location
- Fallback Monitoring Well Location if drill rig access along the quebrada is not possible
- Potentiometric Groundwater Contour (SWMU 7 RI Report (2008))
- Groundwater Flow Direction (SWMU 7 RI Report (2008))
- Interpreted Waste Boundary
- Road
- Elevation Contour (feet)
- Ephemeral Stream



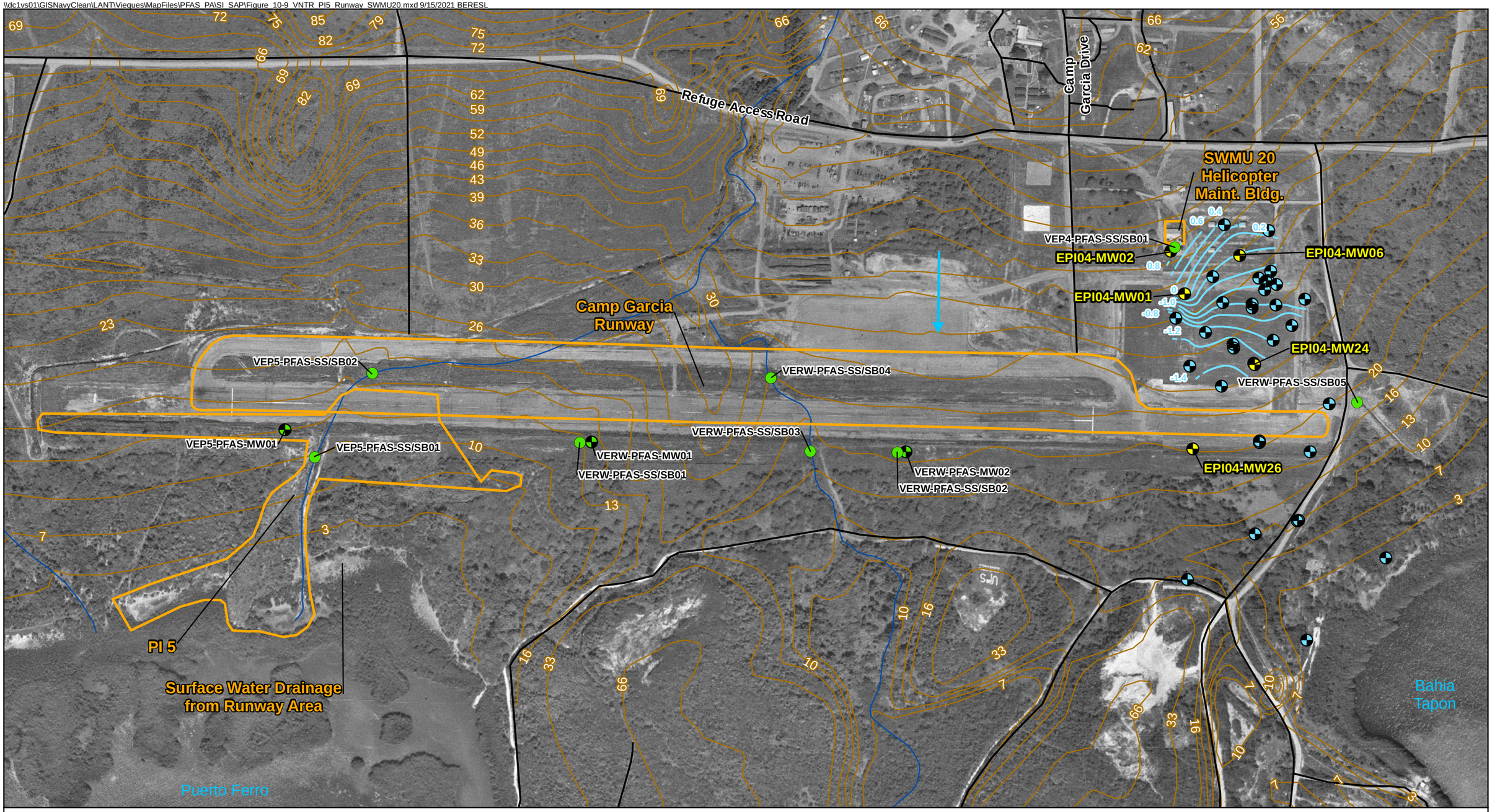
N
W E
S

0 40 80
Meters

Imagery Date: 1994

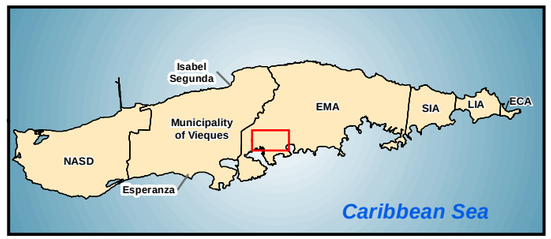
Figure 10-8
NASD SWMU 7: Former Quebrada Disposal Site
Site Inspection Sampling and Analysis Plan for Per- and Polyfluoroalkyl Substances Former NASD and Former VNTR Vieques, Puerto Rico

\\dc1vs01\GISNavyClean\LANT\Vieques\MapFiles\PFAS_PA\SI_SAP\Figure_10-9_VNTR_PI5_Runway_SWMU20.mxd 9/15/2021 BERESL



Legend

- Approximate Site Location
- Proposed Monitoring Well Location
- Proposed Soil Boring Location
- Existing Wells to be Sampled
- Existing Wells not being Sampled
- Generalized Groundwater Flow Direction
- Groundwater Potentiometric Contour (SWMU 20 RI Report (2016))
- Road
- Elevation Contour (feet)
- Ephemeral Stream



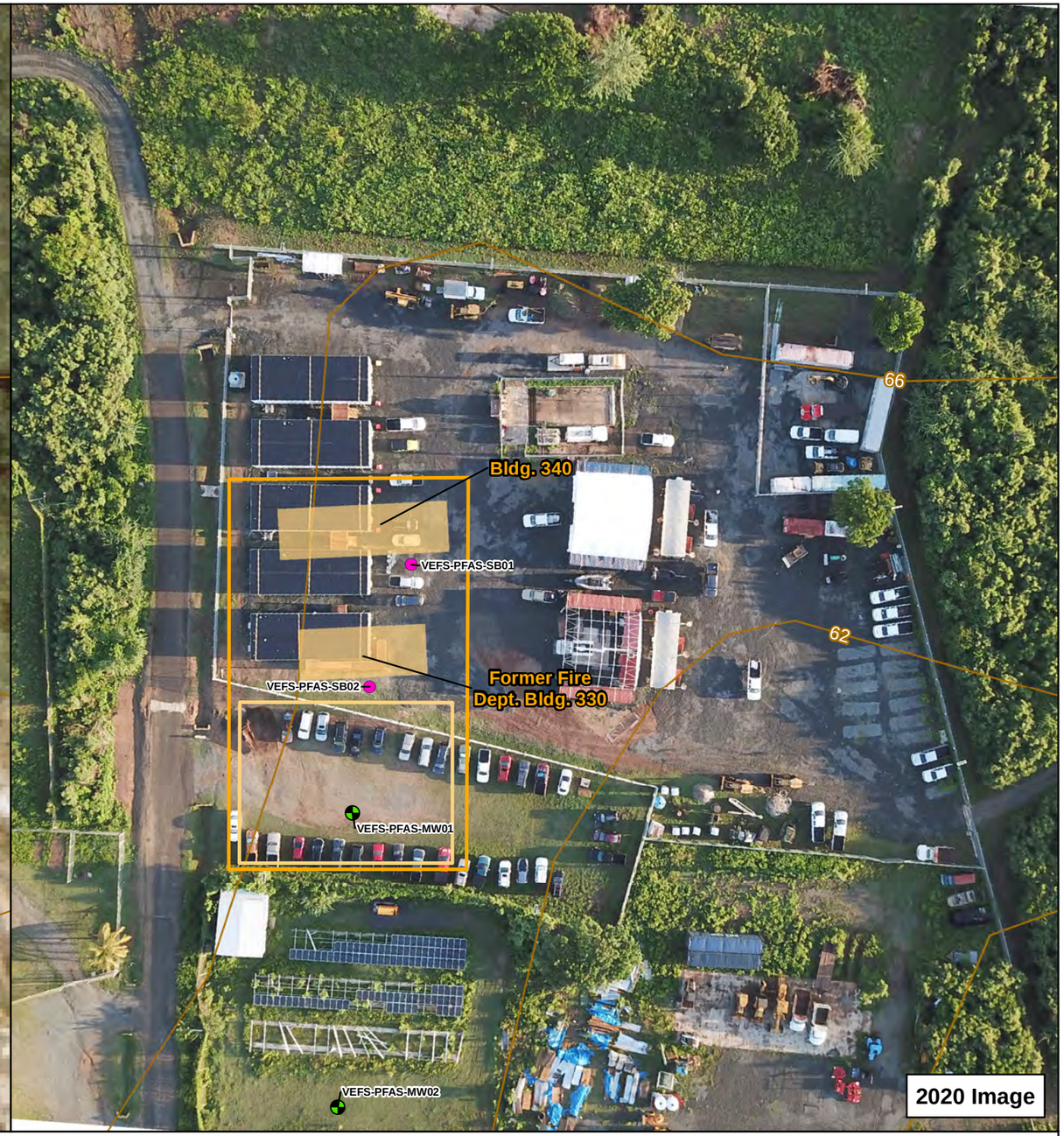
N
W E
S

0 250 500 Feet

Imagery Date: 1964

Figure 10-9
VNTR Camp Garcia Runway, VNTR PI 5: Surface Water Drainage Area from Camp Garcia Runway (Down Gradient), and VNTR SWMU 20: Former Helicopter Maintenance Area
Site Inspection Sampling and Analysis Plan for Per- and Polyfluoroalkyl Substances Former NASD and Former VNTR Vieques, Puerto Rico

\\dc1vs01\GISNavyClean\LANT\Vieques\MapFiles\PFAS_PA\SI_SAP\Figure_10-10_Former_VNTR_Motor_Pool_1983_2020.mxd 8/27/2021 BERESL



Legend

- Potential Former VNTR Motor Pool Area (including Building 340) and Former Fire Department Building 330
- Potential Former VNTR Motor Pool Area
- Former Building Area
- Elevation Contour (feet)
- Proposed Monitoring Well Location
- Subsurface Soil Sample

Note: Proposed subsurface sample locations are subject to change based on existing structures, drill rig access, utilities, and surface or subsurface soil disturbances related to recent site construction activities.

N
W E
S

0 35 70
Feet

Imagery Date: 1983 & 2020

Figure 10-10
Potential Former VNTR Motor Pool Area (including Building 340) and Former Fire Department Building 330, 1983 and 2020 Aerial Photographs
Site Inspection Sampling and Analysis Plan
for Per- and Polyfluoroalkyl Substances
Former NASD and Former VNTR
Vieques, Puerto Rico

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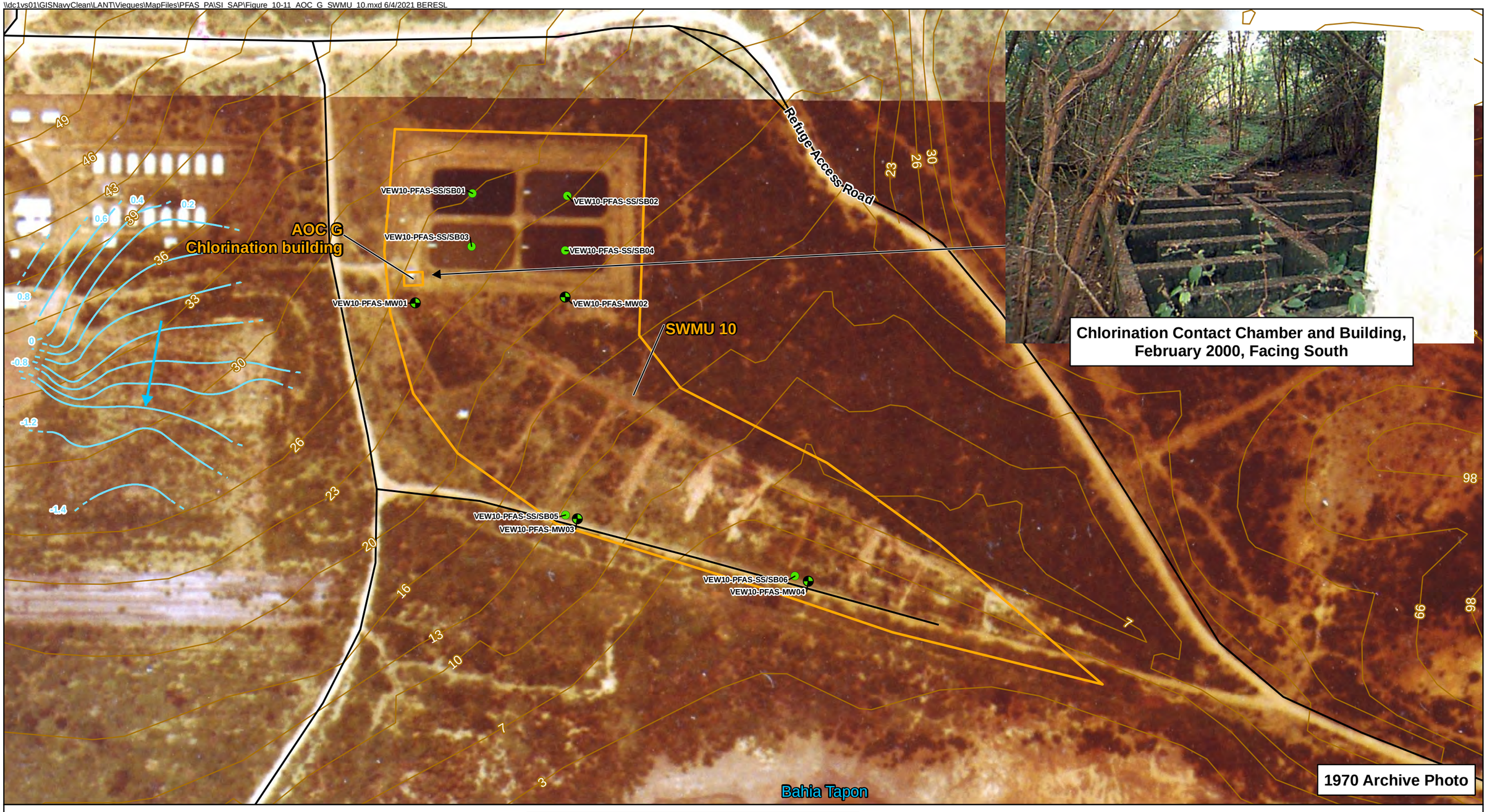
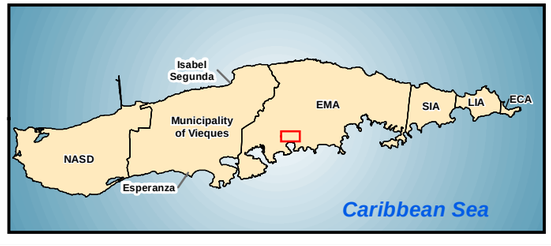


Chlorination Contact Chamber and Building, February 2000, Facing South

Legend

- Approximate Site Location
- Proposed Monitoring Well Location
- Proposed Soil Boring Location
- Groundwater Potentiometric Contour (SWMU 20 RI Report (2016))
- Inferred Groundwater Potentiometric Contour (SWMU 20 RI Report (2016))
- Elevation Contour (feet)
- Road



N
W E
S

0 125 250
Feet

Imagery Date: 1970

Figure 10-11
VNTR SWMU 10 and VNTR AOC G: Former Sewage Treatment Lagoons and Chlorination Building
Site Inspection Sampling and Analysis Plan for Per- and Polyfluoroalkyl Substances Former NASD and Former VNTR Vieques, Puerto Rico

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SWMU 1 Former Landfill Area Current Conditions, Facing North

SWMU 1

MW-08

MW-06

MW-02

MW-03

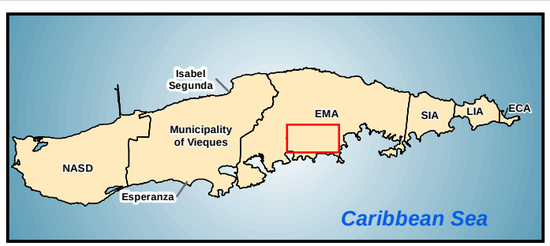
MW-11

MW-10

Laguna la Chiva

Legend

- Approximate Site Location
- Existing Wells to be Sampled
- Monitoring Wells not being Sampled
- Road
- Elevation Contour (feet)
- Ephemeral Stream
- Potentiometric Groundwater Contour (SMWU 1 LTM Annual Report (2019))
- Inferred Potentiometric Groundwater Contour (SMWU 1 LTM Annual Report (2019))
- Groundwater Flow Direction (SMWU 1 LTM Annual Report (2019))



N
W E
S

0 350 700
Feet

Imagery Date: 1964

Figure 10-12
VNTR SWMU 1: Former Camp Garcia Municipal Solid Waste Management Unit (Landfill)
Site Inspection Sampling and Analysis Plan for Per- and Polyfluoroalkyl Substances
Former NASD and Former VNTR
Vieques, Puerto Rico

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Worksheet #11: Project/Data Quality Objectives

This worksheet documents the DQOs for determining whether there has been a release(s) of PFAS at the various potential release areas at the former NASD and former VNTR based on the EPA seven-step DQO Process (EPA, 2006).

Step 1: State the Problem

Between 2019 and 2020, a PA was conducted to assess the potential for AFFF and other PFAS-containing substances to have been released at Navy facilities in Vieques as part of a Navy-wide facilities assessment of potential historical sources of PFAS (CH2M, 2020). The primary objective of the Vieques Navy facilities PFAS PA was to identify potential or actual PFAS sources/releases warranting further investigation (i.e., an SI). PFAS have been identified by the DoD and EPA as emerging chemicals of environmental concern because of their persistence in the environment and in organisms, their migration potential in aqueous systems (e.g., groundwater), their historically widespread use in commercial products, and their possible health effects at low levels of exposure. They are a class of anthropogenic (i.e., human-made) compounds that have a variety of applications, including use as a component of AFFF, which was developed in the 1960s and put into routine use by the military for firefighting, firefighting training, and firefighting equipment testing by the early 1970s. As such, features/areas such as firefighting training and staging areas, runways, firefighting equipment and AFFF storage areas, and waste disposal areas are potential source/release areas.

The Vieques Navy facilities PFAS PA evaluated 56 sites and areas for their potential to be PFAS source/release areas; 13 of the 56 sites/areas were identified as such. These sites/areas are listed in **Table 11-1** together with the primary rationale for determining they are potential PFAS source/release areas. Based on the rationale provided in **Table 11-1**, an SI was deemed warranted to confirm whether each is a PFAS source/release area.

Step 2: Identify the Goal

SI Goal: The objective of an SI is "release assessment." Specifically, the PFAS SI is intended to:

- Determine whether a release of PFAS has occurred from past activities being investigated under CERCLA and, if so,
- Determine whether the release warrants further action

Principal Study Questions:

1. For each of the 13 sites/areas in **Table 11-1**, has there been a release of PFAS? This question will be answered via the approach summarized in DQO Step 5 and further detailed in **Worksheet #17** utilizing information gathered during the SI and presented in the PFAS SI Report.
2. For each of the 13 sites/areas in **Table 11-1**, do the sample results indicate further investigation or action is warranted? This question will be answered utilizing information gathered during the SI, comparing detected concentrations to health-based screening criteria, and presenting the results in the PFAS SI Report.

Alternative Outcomes: Based on the Principal Study Questions and the activities performed (see DQO Step 5 and **Worksheet #17**) to answer the questions, the potential outcomes are:

- PFAS are detected in the medium/media sampled at a particular site/area. If PFAS are detected in any sample of any medium collected at a particular site/area and:
  - If the concentration of a PFAS compound that has a published Screening Level (SL) exceeds the SL (or adjusted SL [factor of 0.1] where multiple PFAS compounds are detected) further investigation via an RI will be recommended to delineate the associated nature and extent of PFAS contamination. SLs for PFOA, PFOS, and PFBS were identified in accordance with the September 15, 2021 update of *Investigating Per-*

and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program (DoD, 2021) and are based on a hazard quotient (HQ) of 0.1.

  - If the concentrations of all detected PFAS compounds with published SLs do not exceed the SL (or adjusted SLs where multiple PFAS compounds are detected) no further investigation/action at this time and until/unless new information and/or updated screening criteria are identified indicating further investigation/action is warranted will be recommended.

- PFAS are not detected in the medium/media sampled at a particular site/area. If PFAS are not detected in any sample of any medium collected at a particular site/area, no PFAS release(s) will have been confirmed at the site/area and no further investigation/action at this time and until/unless new information and/or updated screening criteria are identified indicating further investigation/action is warranted will be recommended.

As part of the alternative outcome determinations, a wholistic evaluation of each site, including observations made during sample collection, any additional pertinent information discovered during SI implementation, and SI sample data, will be performed to ensure the sample locations sufficiently represent the potential source/release area.

How data will be used to solve the problem: The PFAS data will be used to update the CSM, determine whether a PFAS release(s) occurred, and whether additional investigation or action is warranted. Where human health risk-based screening criteria are available, they will be used to qualitatively evaluate the magnitude of risk potentially posed by any detected PFAS constituent. If additional investigation or action is deemed warranted, the data will also be used to help design the investigation or action approach.

Step 3: Identify Information Inputs

The information inputs to the project decision include:

- CSMs (**Worksheet #10**) that describe the potential PFAS sources that are or may have been present at each site/area and the potential human and ecological receptors and exposure scenarios.
- Defensible PFAS data for each site/area such that determinations can be made of whether a PFAS release(s) has occurred and whether additional investigation or action is warranted. Defensible data will be achieved by employing appropriate sampling and analytical protocols and validating the resulting PFAS data, including data for QA/QC samples, to verify proper sampling and analytical protocols were followed, and performing a Data Quality Evaluation (DQE) to assess the availability and usability of the data for the intended purposes. Laboratory methods will meet the requirements provided in this SAP and the data will be validated per Region 2 protocol. **Worksheet #28** describes the Measurement Performance Criteria (MPC) for the data collected, and **Worksheet #17** describes the specific data collection design.

Step 4: Define Spatial and Temporal Boundaries

Because the objective of the SI is “release assessment” versus “nature and extent determination” (which is typically an objective of an RI), the investigation areas are focused on where a release(s) of PFAS to the environment most likely would have taken place. These areas are described by site/area in **Worksheet #17**.

The vertical boundaries of the SI at each site/area will be dependent on the medium or media sampled at the particular site/area. Unless otherwise defined for a particular location (see **Worksheet #17**), by medium these vertical boundaries will be:

- Soil – Sampling depths as defined in the Soil Sample Depth Selection Protocol (CH2M, 2018). In general, these depths will be:
  - Surface Soil:
    - Top 2 feet when sample location is near a surface water body and within verified land crab habitat

        - Top 1 foot when sample location is not near a surface water body and within verified land crab habitat
    - Subsurface Soil: Within a 2-foot interval within the zone from the base of the surface soil sample interval to 6 feet (or bedrock or groundwater if shallower) as follows:
        - 4-to-6-foot interval in the absence of obvious contamination
        - An additional 1-foot subsurface soil sample will also be collected at the soil/water interface at each site if this zone occurs in unconsolidated material
- Sediment – Top 6 inches of sediment, as described in the Sediment Standard Operating Procedure G-2 (CH2M, 2018)
- Surface Water – collected at AOC H and SWMU 6 sediment sample locations, as described in the Surface Water Standard Operating Procedure G-1 (CH2M, 2018)
- Groundwater – From well installed within first encountered saturated zone, as described in the Monitoring Well Installation Standard Operating Procedure D-1 and Groundwater Sampling Procedure Low Stress (Low Flow) Purging and Sampling Standard Operating Procedure B-1 (CH2M, 2018)

There are no specific temporal boundaries that could impact data collection. The planned sampling schedule will be coordinated with the property owner/manager associated with each potential release area to ensure minimal disruption of existing land use.

Step 5: Develop the Project Data Collection and Analysis Approach

As described in Step 2, the objective of the PFAS SI is to determine if there has been a release(s) of PFAS at each of 13 areas. The technical approach for achieving the SI objective involves collecting samples based on site-specific determination of the locations and medium or media where, if a PFAS release(s) occurred, it would most likely be detected. The sampling design and rationale for each of the 13 potential release areas are provided in **Worksheet #17**. The PFAS release assessment decision tree is shown in **Figure 11-1**.

With respect to sample analysis, all samples will be analyzed for the 18 PFAS analytes listed in **Worksheet #15**. With respect to PALs, they are medium-specific screening levels that end-users of data may need to provide a conservative assessment of site conditions (including presence or absence) and determine if further evaluation or action is warranted. The following list summarizes the PALs for each medium. **Worksheet #15** includes the reference limits based on the PALs for each constituent in each medium.

Surface Soil, Subsurface Soil, and Sediment:

- Human Health – SLs were identified in accordance with the September 15, 2021 update of *Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program* (DoD, 2021) and are based on a hazard quotient (HQ) of 0.1. The tables in **Worksheet #15** include May 2021 SLs (EPA, 2021). However, the most current screening levels available from EPA at the time of the data evaluation will be used.
- Ecological – While Ecological Screening Values (ESVs) are included in the SAP, they are not PALs but are instead included to ensure data quality will be sufficient for potential later use in ecological risk screening or risk assessment depending on the current state of promulgated standards and/or Navy policy. Currently available ESVs for these media are included in **Worksheet #15**.

Groundwater and Surface Water:

- Human Health – SLs identified in accordance with the September 15, 2021 update of *Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program* (DoD, 2021) and based on a hazard quotient (HQ) of 0.1. The tables in **Worksheet #15** include May 2021 SLs. However, the most current

screening levels available from EPA at the time of the data evaluation will be used. There are no Maximum Contaminant Levels [MCLs] or Puerto Rico Water Quality Standards for the 18 PFAS analytes.

- Ecological – While ESVs are included in the SAP, they are not PALs but are instead included to ensure data quality will be sufficient for potential later use in ecological risk screening or risk assessment depending on the current state of promulgated standards and/or Navy policy. Currently available ESVs for surface water are included in **Worksheet #15**.

As indicated in DQO Step 2, while all PFAS data will be used to assess whether a PFAS release(s) occurred at each location, only PFAS with published SLs will be used to determine whether further investigation or action is warranted. For PFAS compounds that do not have published SLs, their data will be provided in an appendix to the SI Report and archived for future use if appropriate PALs become available. However, if PFAS compounds with SLs are either not detected or detected at or below SLs (or adjusted SLs as applicable), the recommendation for no further investigation or action will include the following language: "at this time and until/unless new information and/or updated screening criteria are identified indicating further investigation/action is warranted."

Step 6: Specify Project Specific Measurement Performance Criteria

Worksheet #28 presents the project-specific MPC for the PFAS SI. Project-specific MPC are the criteria that collected data must meet to satisfy the DQOs. Failure to achieve the MPC may have an impact on end uses of the data, which will be discussed in the Data Usability Assessment (DUA), as discussed in **Worksheet #37**.

Step 7: Develop the Detailed Plan for Obtaining the Data

The study goal stated in DQO Step 2 and the MPC established in DQO Step 6 (documented in **Worksheet #28**) were used to develop the PFAS release assessment approach, which is briefly described in DQO Step 5 and detailed in **Worksheet #17**.

Table 11-1. Areas Identified as Potential PFAS Source Areas

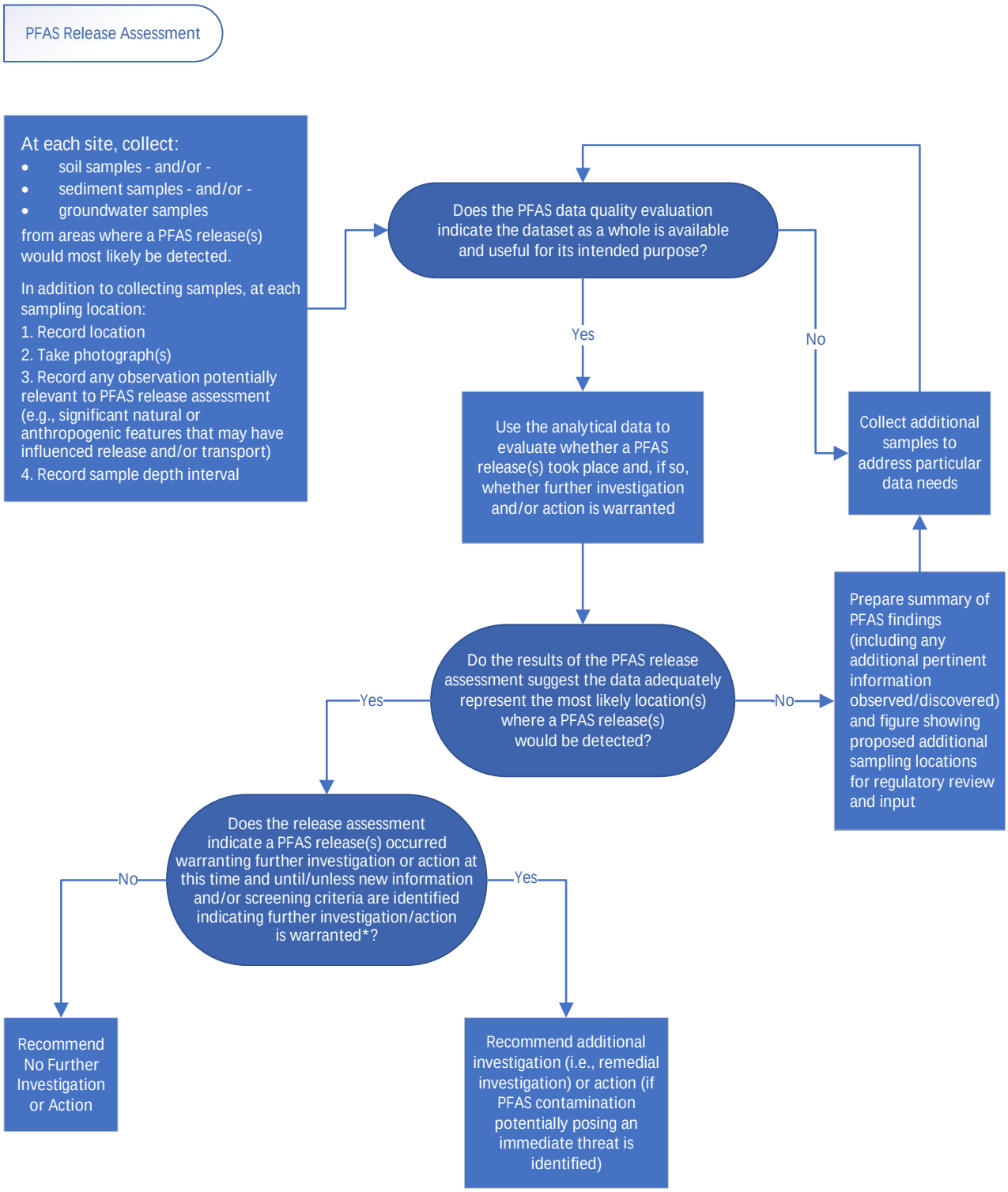
Area Assessed	Rationale
NASD AOC B: Former Wastewater Treatment Plant	• Former WWTP used as the primary treatment system for municipal (domestic) sewage discharge from the main operations area of the former NASD from 1983 until 2000. Four lagoons associated with the WWTP were no-discharge lagoons. • Although there is no evidence of AFFF or other PFAS-containing materials were disposed of through the treatment system, because no records were found regarding disposal of industrial wastewater at the main operations area, and because of the types of activities that took place in the main operations area, industrial-type wastewater could have been processed through this WWTP.
NASD Former Fire Station Building 2046 at the Public Works Area	• Interview indicates AFFF may have been stored adjacent to Building 2046 and that 50-gallons of AFFF were stored in each of two fire trucks located onsite. • Storage of the AFFF was reported to be in conex containers less than 100 feet to the southwest of the main building. • AFFF was added to the fire trucks on the ramp in front of the station; fire trucks containing AFFF were flushed once a month and were also washed on this ramp. • Annual pump tests and monthly cleaning were performed onsite. • No maintenance was reportedly performed in the building and no floor drains were observed, but the restrooms were tied directly to the WWTP (AOC B).
Potential Former NASD Motor Pool Area	• Interview indicates that maintenance was performed at the motor pool on the aforementioned fire trucks that may have contained AFFF.
NASD AOC H: Former Power Plant/Former Fire Training Area	• Based on information obtained from an interviewee, AFFF was utilized on fire trucks during at least part of the time the former power plant was used for fire training. The site was actively used as a fire training facility (1960s – 1980s) during the time AFFF could have been onsite (i.e., about 1970 forward). • Reportedly, diesel fuel was poured over rubber tires inside the building, ignited to simulate structural fires, and extinguished during training operations.
NASD SWMU 6: Former Mangrove Disposal Site	• Site was used for disposal of trash associated with operations at the former NASD from 1965 to 1980, including cans of lubricants, oils, solvents, and paints, some of which appeared to have been burned. • Based on site use, timeframe of site use, and activities that took place at the former NASD, as described previously, AFFF or other PFAS-containing materials could have been disposed of at this location.
NASD SWMU 7: Former Quebrada Disposal Site	• Site was used for disposal of debris associated with operations at the former NASD during the 1960s and 1970s, including empty containers (e.g., drums, cans, bottles). • Based on site use, timeframe of site use, and activities that took place at the former NASD, as described previously, AFFF or other PFAS-containing materials could have been disposed of at this location.

Table 11-1. Areas Identified as Potential PFAS Source Areas

Area Assessed	Rationale
Camp Garcia Runway	• This location was an active (at least periodically) runway from 1959 until 1975. No records of crashes, fires, or use of AFFF were identified. • AFFF containing PFAS was developed in the 1960s and was put into routine use in the early 1970s following a November 1969 MILSPEC issuance. Although there are no known records of AFFF use or demonstration at the Camp Garcia Runway, the runway was reportedly still in periodic use during a time when AFFF containing PFAS was reportedly in use by the Navy.
PI 5: Surface Water Drainage Area from Camp Garcia Runway	• This site was the drainage feature on the south (downgradient) side of the Camp Garcia Runway and includes drainage ditches leading from the airfield to Puerto Ferro. Its relevant operational history would mirror that of the former Camp Garcia Runway. • The potential for AFFF/PFAS release to PI 5 is based on the potential described for the former Camp Garcia Runway.
SWMU 20: Former Helicopter Maintenance Area	• Site was used as a helicopter maintenance area/hangar from 1959 to 1975 and included barracks, mess hall, trenched areas, disturbed areas, and bermed areas for fuel bladders. • No records were found that indicated a fire suppression system was present in the hanger or that AFFF was stored or used there. Nonetheless, hangars commonly have fire suppression systems and AFFF may have been present at the base for at least a portion of the time the helicopter maintenance area/hangar was operational.
Potential Former VNTR Motor Pool Area (including Building 340) and Former Fire Department Building 330	• Interview indicates that fire truck maintenance was performed at the motor pool, the location of which he marked on a map of Camp Garcia. • Building 330 is identified on a map as the Fire Department within Camp Garcia; motor pool was immediately adjacent. • No historical information has been found regarding the use of Building 340. However, given its close proximity to the former fire department building (Building 330) and that historical imagery shows no structure in the area referred to by the interviewee, it is possible Building 340 was associated with the motor pool. • No historical information has been found that identifies where specifically fire truck maintenance/washing occurred. Further, significant ground-disturbing activities occurred in the area during historic building demolition and construction of the new Vieques cleanup base of operations in the same area.
VNTR SWMU 10: Former Sewage Treatment Lagoons VNTR AOC G: Chlorination Building	• Former Camp Garcia sewage treatment lagoons in use from the 1950s until 2000 (with modification); replacement lagoon constructed immediately adjacent and used after 2000. Effluent from the two polishing lagoons was chlorinated in a chlorine contact chamber (AOC G). • Although there is no evidence of AFFF or other PFAS-containing materials were disposed of through the treatment system, because no records were found regarding disposal of industrial wastewater at Camp Garcia, and because of the types of activities that took place at Camp Garcia, industrial-type wastewater could have been processed through this WWTP.

Table 11-1. Areas Identified as Potential PFAS Source Areas

Area Assessed	Rationale
VNTR SWMU 1: Former Camp Garcia Municipal Solid Waste Management Unit (Landfill)	• Site was used as a municipal landfill for Camp Garcia from 1954 through 1978 (NAVFAC, 2003). Reported use of the landfill was restrained to municipal waste, and excavated test pits confirmed the debris were consistent with the reports with the exception of a few munitions-related items. • Because AFFF was reportedly present at the base and other PFAS-containing materials may have been used, and because of the timeframe during which the landfill was operational, the potential for disposal of empty drums of AFFF and containers of other PFAS-containing materials at the site exists.



* In accordance with DoD directive, if PFAS concentrations exceeds the published Screening Levels (SLs) (or adjusted SL [factor of 0.1] where multiple PFAS compounds are detected) further investigation via an RI will be recommended to delineate the associated nature and extent of PFAS contamination. SLs for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) are based on an HQ of 0.1 and were generated using the USEPA RSL calculator as described in the Assistant Secretary of Defense October 15, 2019 memorandum, "Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program" (DoD, 2019). SLs for perfluorobutanesulfonic acid (PFBS) were generated similarly, but values were updated to the May 2021 USEPA RSLs.

Figure 11-1
PFAS Release Assessment Decision Tree
Site Inspection Sampling and Analysis Plan for Per- and Polyfluoroalkyl Substances
Former NASD and Former VNTR
Vieques, Puerto Rico

Worksheet #12: Measurement Performance Criteria for Soil, Sediment, Surface Water, and Groundwater Sampling

As a matter of convention for Vieques SAP elements involving environmental media sampling, all MPC associated with soil, sediment, surface water, and groundwater sampling are provided in **Worksheet #28**.

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Worksheet #13: Secondary Data Uses and Limitations

This worksheet provides general information about secondary data and how they will be used in meeting the current project objectives, as well as any limitations on their use.

No historical investigations included PFAS characterization; therefore, there are no historical PFAS data associated with any of the sites/areas. The only historical information that is relevant to the PFAS SI is historical site use information, upon which the sampling approaches were developed. However, this historical information is the best information known to exist. It is recognized there is some level of uncertainty associated with any historical information, but that level likely varies by information type (e.g., there may be a higher level of uncertainty in personal recollection than in what is shown in an aerial photograph).

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Worksheet #14 & 16: Project Tasks & Schedule

The *Master Standard Operating Procedures, Protocols, and Plans - Revision 2018* (CH2M, 2018) in conjunction with the PFAS specific SOPs in **Attachment C** addresses the protocols and Standard Operating Procedures (SOPs) to be used for this sampling approach, in accordance with the Vieques Environmental Master Health and Safety Plan (CH2M, 2019). The proposed field activities are discussed herein. The technical approach and sample design for the proposed field activities are discussed in **Worksheet #17**.

Mobilization

Mobilization for the field effort includes scheduling support staff, procurement of necessary field equipment, initial transport to the site, and coordination with the subcontractor laboratory, data validator, and IDW disposal facility. Equipment and supplies will be brought to the site when the field team mobilizes for field activities.

Prior to mobilization, NAVFAC, EPA, PRDNER, USFWS, and the MOV will be notified to allow for appropriate oversight and/or coordination. Additionally, field team members will review this Uniform Federal Policy (UFP)-SAP and the project-specific Health and Safety Plan (HASP), and a field team kickoff meeting will be held to ensure that team personnel are familiar with the scope of field activities, field sampling procedures specific to PFAS, communication protocol, field equipment checklist, and safety issues, and will procure the following subcontractors to support investigation activities:

- Driller
- Surveyor (vertical)
- Analytical laboratory
- Data validation
- IDW disposal contractor

Protected and Important Species Occurrence and Avoidance

Thirty-eight federally listed threatened or endangered species may occur on Vieques or in the surrounding coastal waters. These include twelve plants, seven reptiles, three birds, five marine mammals, four fish, and seven corals. None of these species are known to occur on or in the immediate vicinity of any of the PFAS investigation areas.

Habitats at these locations are typically disturbed (historically or recently) upland areas overgrown with invasive species, or in some instances routinely maintained open areas to support active land uses. Four potential release areas contain or are located within the vicinity of inland or coastal mangrove habitat (i.e., NASD AOC H, NASD SWMU 6, VNTR PI 5, and VNTR SWMU 10). Although mangrove habitat is potentially supportive of Cóbana negra (*Stahlia monosperma*), a federally threatened tree species, previous biological surveys have not found them to be present at these locations. The USFWS considers mangrove tree species and commonly associated land crab colonies to be important resources warranting protection. Mangroves are also considered essential fish habitat and any alteration of this habitat requires coordination with the National Marine Fisheries Service Habitat Conservation Division. A biologist will ground truth the proposed access routes and PFAS sampling points including locations of soil borings, monitoring well installations, existing monitoring wells, and sediment sampling at these four areas. The biologist will assess whether mangroves and land crab burrows, if present, can be avoided during media sampling or well installation, and if not will work with the project team to develop acceptable alternate approaches such as different access routes or revised sampling locations to avoid or minimize impacts. Any vegetation clearance required to support sampling activities will be conducted in accordance with SOP I-1, as referenced in **Worksheet #21**.

Utility Locating

The contractor will investigate locations where functioning underground utilities may occur before beginning any intrusive activities. Utility clearance will be conducted in the vicinity of subsurface soil samples and monitoring well locations. Proposed locations within 10 feet of subsurface utilities will be relocated to avoid impacts while continuing to meet the intent of the sampling rationale.

Soil Sampling

Thirty-five surface, 37 subsurface soil, and potentially 36 deep subsurface samples will be collected with standard drilling methods (i.e., split spoon) and some soil samples collected with a hand auger or similar sampling device due to their location being inaccessible by drill rig (ex: SWMU 7 ephemeral stream samples). Samples will be collected in accordance with the Soil Sampling for PFAS SOPs in **Attachment C** as appropriate and as referenced in **Worksheet #21**. At those locations where a hand auger will be utilized, the hand auger may not be able to penetrate the entire unconsolidated depth and will instead be used to the maximum extent possible given the practical constraints associated with its use. Site-specific laboratory analytical parameters for soil samples are listed in **Worksheet #18**. Appropriate QA/QC samples will be collected as specified in **Worksheets #18 and #20**. At each location, the onsite geologist will log the material visually. Surface soil will be collected from 0 to 1 foot of the soil profile. If the sample location is near a surface water body and land crabs are potential receptors of concern, the surface soil sample will be collected from 0 to 2 feet. Subsurface soil samples will be collected from the 4-to-6 foot interval (or just above the water table or bedrock, if encountered before this depth), unless visual and/or instrument screening suggests a different potentially contaminated 2-foot interval between the surface soil interval and 6 feet. An additional 1-foot subsurface soil sample (deep subsurface) will also be collected at the soil/water interface if this zone occurs in unconsolidated material at each site.

Monitoring Well Installation, Development, and Sampling

Monitoring Well Installation

Eighteen new monitoring wells will be installed using hollow stem auger, air rotary, or rotosonic drilling methods and hand auger drilling techniques in accordance with SOPs D-1, D-2, B-1, and PFAS specific SOPs in **Attachment C** as appropriate and referenced in **Worksheet #21**. Well installation procedures and materials also will conform to the requirements of Puerto Rico standards and regulations, including submittal of well construction permits prior to well installation, as required by PRDNER. No materials used during well installation, such as drilling greases or bentonite formulations, will contain fluorine. Drillers and geologists overseeing drilling will avoid wearing of PFAS-containing fabrics such as Gore-Tex and other materials as defined in the project SOPs. Potable water supplied by mainland Puerto Rico will be used for monitoring well installation and will be analyzed prior to field work for the full list of 18 PFAS constituents. The selected water source (Purveyor Water Source Name: Rio Blanco, Vieques, Culebra and ID: PR0005386) was analyzed for six PFAS as part of the Third Unregulated Contaminant monitoring rule, and no PFAS were detected.

The new monitoring wells will be installed with PFAS-free well construction materials. Monitoring wells will be constructed using 2-inch inner-diameter Schedule 40 polyvinyl chloride (PVC) screen and riser and well screens will be 10 feet long and will be 0.010-inch machine slotted. The screens will extend from the top of the water table. A silica filter pack will be placed around the annular space of the well screen from the bottom of the boring extending to 2 feet above the top of the screen. A 2-foot-thick bentonite layer will be placed above the sand pack. After the bentonite has been hydrated, a cement-bentonite grout will be placed in the remaining annular space.

Monitoring wells will be completed with above-grade protective casings with watertight steel covers. A locking, watertight cap will be placed on the PVC pipe and the well will be clearly marked with its identification (ID)

number. Wells will be surrounded with bollards in uncontrolled areas, and flush mounted in driveways, right of ways, and high traffic areas. All monitoring wells will be locked.

Monitoring Well Development

Each new monitoring well will be developed in accordance with SOP D-2 as referenced in **Worksheet #21** using a PFAS-free submersible pump at least 24 hours after installation is complete. At least three well volumes of water will be removed, in addition to any amount of water that may have been added during the installation process. Any existing well will be redeveloped if information gathered during purging and sampling suggests redevelopment is warranted (e.g., significant sediment buildup, inability to sample by low-flow methodology when historical records indicate the well was successfully sampled in this manner, etc.).

Development will continue until water quality parameters of consecutive readings have stabilized to within 10 percent for 3 consecutive readings, and turbidity has been reduced to the extent practicable (preferably less than 10 nephelometric turbidity units [NTUs]). Development information, including turbidity, potential hydrogen (pH), specific conductivity, temperature, and volume of water purged, will be recorded in the field notes.

Groundwater Sampling

The groundwater monitoring events will include the sampling of 28 monitoring wells, 18 new and 10 previously existing. Prior to purging, the field team will measure and record the depth to water (DTW) in the logbook. Purging and sampling will be done either using a PFAS-free submersible pump or peristaltic pump. Purging will continue until water quality parameters are sufficiently stabilized for three consecutive readings. Water quality parameters will be obtained using a Yellow Springs Instruments, Inc. multi-meter or comparable water quality meter, the instrument calibrated per SOP C-1. Monitoring well water level measurements will be conducted per SOP H-2 with a water level indicator without a fluoropolymer (e.g., Teflon, Viton) coating. Groundwater sample collection procedures will be performed following SOP B-1 (CH2M, 2018) and Groundwater Sampling for PFAS SOP in **Attachment C** which describes the specific materials to use during sampling. Equipment and field blanks will be prepared per SOP H-6. These SOPs are referenced in **Worksheet #21**.

Groundwater samples will be collected by placing the sample tubing intake around the middle of the screened interval for monitoring wells where the ground water is above the screen anulus. Groundwater samples collected from wells installed during this SI will be collected by placing the sample tubing intake around the middle of the water column if the water level is below the top of the screen. To ensure sampling of the water-bearing unit, before sample collection, water quality parameters, including pH, oxidation-reduction potential (ORP), temperature, specific conductivity, turbidity, and dissolved oxygen (DO), will be measured with a water quality meter and recorded in the field notes approximately every 5 minutes. These water quality parameters will also provide information about the conditions of the water-bearing unit to help assess fate and transport of contaminants. The water quality meter will be calibrated daily (at a minimum) and the calibration documented in the field notes. Sampling will begin when water quality becomes stabilized for three consecutive measurements as follows:

- pH is within 0.1 pH units
- Specific conductivity is within 3 percent
- DO is within 10 percent
- ORP is within 10 percent
- Turbidity is within 10 percent

It should be noted that while SOPs will be followed for water quality measurements, professional judgment ultimately will be used to determine when sufficient volume has been purged (e.g., when formation water is being sampled). This is because at low parameter measurements, very small differences in measurements can result in

large percent differences, simply because of the innate heterogeneity of environmental media, not that equilibration is still occurring.

Sediment Sampling

Sediment samples will be collected at five locations and in accordance with Sediment Sampling for PFAS SOPs in **Attachment C** as referenced in **Worksheet #21**. Sediment samples will be collected from 0 to 6 inches bgs and analyzed for the site-specific laboratory analytical parameters listed in **Worksheet #17**. Appropriate QA/QC samples will be collected as specified in **Worksheet #20**.

Surface Water Sampling

Surface water samples will be collected at the five sediment sample locations where surface water is present under normal conditions and in accordance with Surface Water Sampling for PFAS SOPs in **Attachment C** as referenced in **Worksheet #21**. At the time of sampling, the depth of the water will be measured using a PFAS-free water level indicator, and water quality parameters including conductivity, salinity, temperature, pH, DO, turbidity, and ORP, will be collected. The water quality meter will be calibrated daily (at a minimum) and the calibration documented in the field notes. Surface water samples will be analyzed for the site-specific laboratory analytical parameters listed in **Worksheet #17**. Appropriate QA/QC samples will be collected as specified in **Worksheet #20**.

Sample Shipment

All samples for offsite analysis will be shipped in accordance with the SOP H-5 referenced in **Worksheet #21**, Packaging and Shipping Procedures for Samples Not Considered Dangerous Goods (CH2M, 2018). PFAS-containing shipping materials will be avoided to the greatest extent possible.

Surveying

The horizontal coordinates of the soil borings and sediment samples will be measured using a field global positioning system (GPS) unit in accordance with SOP H-7 referenced in **Worksheet #21**.

The coordinates for all newly-installed monitoring wells will be surveyed by a land surveyor registered in Puerto Rico. The vertical elevation accuracy will be ± 0.01 foot, and the horizontal location will have an accuracy of ± 0.1 foot. Specifically, the elevation for each monitoring well will be established at the top of the monitoring well's inner PVC casing (this elevation point will be designated by a permanent notch placed on the top of each well's inner casing) and at the ground surface.

Documentation

Pertinent field observations will be recorded in accordance with SOP H-1; however, notes will be taken on loose-leaf paper on a Masonite clipboard rather than in a standard waterproof field notebook or iPad due to potential for PFAS to be present in waterproof paper, screen coatings, and charging ports. Sharpie markers will not be used. Groundwater Sampling Procedure Low Stress (Low Flow) Purging and Sampling (B-1); H-1, Preparing Field Logbooks; and H-4, Chain-of-Custody (CH2M, 2018). All procedures are listed in **Worksheet #21**.

Equipment Decontamination

All non-disposable sampling equipment will be decontaminated before sampling commences and between each sampling location in accordance with SOP E-2, Decontamination of Drilling Rigs and Equipment (CH2M, 2018) in conjunction with the following: final rinses on non-disposable sampling equipment (but not augers) need to be done with laboratory-grade certified PFAS-free deionized water. Disposable equipment and personal protective

equipment (PPE) that is exposed to environmental media at the sites will be decontaminated in accordance with SOP E-1, Decontamination of Personnel and Equipment (CH2M, 2018), and disposed of with normal trash. PPE and miscellaneous consumables with gross contamination that cannot be removed in accordance with SOP E-1 procedures should be disposed of with IDW. All procedures are listed in **Worksheet #21**.

Investigation-derived Waste Management

IDW is expected to consist of drill cuttings from the soil borings generated during monitoring well installations, purge water from well development and groundwater sampling, and decontamination fluids. Aqueous IDW and solid IDW will be stored in separate roll-off containers, portable tanks, or drums. IDW will be managed in accordance with the Master Waste Management Plan of the Master Protocols (CH2M, 2018) and the SOP Management of Liquid Waste Containing Per- and Polyfluoroalkyl Substances (PFAS) included in **Attachment C**. IDW will be disposed of in accordance with all federal, state, and local laws and disposal facility requirements. Aqueous IDW will be treated, as needed, to levels less than 70 ng/L (combined PFOA and PFOS) or to the requirements of the disposal facility prior to disposal, whichever is more stringent. Incineration will only be conducted if other treatment options are determined to be infeasible. NAVFAC Headquarters approval must be obtained prior to incineration of any PFAS-containing waste. All efforts will be made to segregate release area IDW from that generated in downgradient areas where concentrations are likely to be lower to minimize the volume of aqueous IDW requiring treatment.

If practical, the liquid IDW will be allowed to evaporate. If this is not possible, it will be containerized and characterized for off-site disposal. Characterization will consist of sampling each site IDW drums for PFAS constituents. If no PFAS is detected the water may be taken back to the site from which it was generated and discharged to the ground surface. If a PFAS detection is present the water will be sampled for the standard disposal characteristics (full Toxicity Characteristic Leaching Procedure [TCLP], reactivity, corrosivity, ignitability) listed in the Master Waste Management Plan of the Master Protocols (CH2M, 2018).

Soil cuttings will be generated from soil borings and monitoring well installation. Any soil generated from soil borings will be put back into the boreholes after samples have been collected. Soil generated from monitoring well installation shall be containerized in 55-gallon drums and characterized for PFAS constituents. If there are no PFAS detections, the soil will be spread on the ground surface in the vicinity of the monitoring well boring where it was generated. If there are PFAS detections, the soil will then be characterized for standard disposal characteristics (full TCLP, reactivity, corrosivity, ignitability) listed in the Master Protocols (CH2M, 2018) for offsite disposal. PPE and other miscellaneous consumables will be decontaminated and disposed of as general trash.

Quality Control

In reference to the field tasks, all fieldwork will be overseen by the FTL, or his/her delegate, who is responsible for the QC of the new monitoring well installation/development and media sampling tasks. Summaries of daily field activities will be documented in field notes; these notes also will detail sampling activities and information regarding soil borings. Field sample QC is summarized in **Worksheets #20 and #28**.

Sample Analysis

The laboratory will analyze samples for the parameters shown on **Worksheet #18**. The laboratory will maintain, test, inspect, and calibrate analytical instruments (**Worksheets #24 and #25**).

Analytical and Validation Tasks

Sample analyses will be conducted by the laboratory (or backup laboratory) listed in **Worksheet #30**. The laboratories will maintain, test, inspect, and calibrate analytical instruments (**Worksheets #24 and #25**). The laboratories will process and prepare samples for analyses and will analyze samples in the manner shown on

Worksheets #15 and #18. Laboratory QC samples are described on Worksheet #28. SOPs for laboratory analytical tasks are tabulated on **Worksheet #23**.

Definitive analytical laboratory data will be validated before being used for risk assessment purposes and before Navy use. Screening levels will be checked by the PC before use (**Worksheets #35 and #36**).

If circumstances render the subcontracted laboratory unable to perform the analytical services, the backup laboratory will be contacted to confirm accreditations and quarterly LOD verification and the SAP will be updated with all associated laboratory worksheets and current Environmental Laboratory Accreditation Program (ELAP) accreditation letter.

Data Management

The Contractor PC and Contractor Database Manager, or other qualified personnel, are responsible for data tracking and storage. In addition, a third-party data validator will receive all analytical data from the laboratory and the data will be validated prior to their use for evaluation and decision-making purposes. All validated analytical data will be loaded into the NIRIS database.

Procedures for recording data, including guidelines for recording and correcting data, can be found as follows:

- Project Assessment and Audit (**Worksheets #31 and #32**)
- Data Review
  - Data Validation (**Worksheets #35 and #36**)
  - Data Usability Assessment (**Worksheet #37**)

Procedures for Recording and Correcting Data

- Field data will be recorded in field logbooks on loose-leaf paper
- Project Assessment/Audit: **Worksheet #31, 32 & 33**
- Data Validation: **Worksheets #35 and #36**
- Data Usability Assessment: **Worksheet #37**

Schedule

Sampling will be performed as soon as practical. Analytical data will be provided to the stakeholder agencies upon receipt from the analytical laboratory and, as applicable, the data validator, and entered into the NIRIS database. Evaluation of the PFAS data and associated recommendations will be included in an SI report. The official schedule of sampling activities, including data and evaluation submittals, will be submitted to the stakeholder agencies once an initial timetable has been established.

Worksheet #15-1: Project Action Limits and Laboratory-specific Detection/Quantitation Limits (PFAS in Soil/Sediment)

(Uniform Federal Policy [UFP]-Quality Assurance Project Plan [QAPP] Manual Section 2.6.2.3)

Matrix: SS, SB, SD
Analytical Method: LCMSMS Compliant with QSM 5.3 Table B-15
Analytical Group: PFAS (µg/kg unless otherwise specified)

Analyte	CAS No.	SLs[1]	ESV[2] [SS, SB]	ESV[2] [SD]	PQL Goal[3]	Laboratory-Specific Reporting Limits (µg/kg)			A/P Limits[4] (%) for LCS and MS/MSD		
						LOQ	LOD	DL	LCL	UCL	RPD
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	126	13[5]	1.4[8]	0.69	5.00	2.00	0.69	68	136	30
Perfluorooctanoic acid (PFOA)	335-67-1	126	570[6]	6.0[7]	0.61	5.00	2.00	0.61	69	133	30
Perfluorobutanesulfonic acid (PFBS)	375-73-5	1,900	9,100[7]	730[8]	365	5.00	1.00	0.35	72	128	30
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	-	-	-	-	5.00	2.00	0.75	61	139	30
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	-	-	-	-	5.00	2.50	1.02	63	144	30
Perfluorodecanoic acid (PFDA)	335-76-2	-	-	-	-	5.00	1.00	0.46	69	133	30
Perfluorododecanoic acid (PFDoA)	307-55-1	-	-	-	-	5.00	2.00	0.61	69	135	30
Perfluoroheptanoic acid (PFHpA)	375-85-9	-	-	-	-	5.00	1.50	0.51	71	131	30
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	-	-	-	-	5.00	2.00	0.81	67	130	30
Perfluorohexanoic acid (PFHxA)	307-24-4	-	-	-	-	5.00	2.00	0.71	70	132	30
Perfluorononanoic acid (PFNA)	375-95-1	-	-	-	-	5.00	1.00	0.49	72	129	30
Perfluorotetradecanoic acid (PFTA)	376-06-7	-	-	-	-	5.00	2.50	1.08	69	133	30

Matrix: SS, SB, SD
Analytical Method: LCMSMS Compliant with QSM 5.3 Table B-15
Analytical Group: PFAS (µg/kg unless otherwise specified)

Analyte	CAS No.	SLs[1]	ESV[2] [SS, SB]	ESV[2] [SD]	PQL Goal[3]	Laboratory-Specific Reporting Limits (µg/kg)			A/P Limits[4] (%) for LCS and MS/MSD		
						LOQ	LOD	DL	LCL	UCL	RPD
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	-	-	-	-	5.00	1.00	0.28	66	139	30
Perfluoroundecanoic acid (PFUnA)	2058-94-8	-	-	-	-	5.00	1.00	0.46	64	136	30
Hexafluoropropylene oxide dimer acid (HFPO-DA)	13252-13-6	-	-	-	-	5.00	2.00	0.64	**71**	**153**	**30**
4,8-dioxa-3H-perfluorononanoic acid (ADONA)	919005-14-4	-	-	-	-	5.00	2.00	0.83	**61**	**139**	**30**
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	763051-92-9	-	-	-	-	5.00	1.50	0.52	**40**	**160**	**30**
9-chlorohexadecafluoro-3-oxanone-1-sulfonic (9Cl-PF3ONS)	756426-58-1	-	-	-	-	5.00	1.00	0.48	**60**	**140**	**30**

Notes: Shading indicates screening levels that are less than the DL. Non-detects will not be treated as exceedances, although they will be reported at a value greater than the screening levels. Please refer to **Worksheet #11** for discussion on use of screening levels.

1. SLs for PFOA, PFOS, and PFBS were identified in accordance with the September 15, 2021 update of *Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program* (DoD, 2021) and are based on a hazard quotient (HQ) of 0.1.
2. While ESVs are included in the SAP, they are not PALs but are instead included to ensure data quality will be sufficient for potential later use in ecological risk screening or risk assessment depending on the current state of promulgated standards and/or Navy policy.
3. The project quantitation limit (PQL) is either one-half the minimum of applicable screening levels, or the detection limit if the value for one-half the screening level is less than the limit of quantitation.
4. Accuracy and precision limits are DOD QSM v5.3. Bolded values represent in-house limits when QSM v5.3 limits do not exist.
5. No observed adverse effect level (NOAEL) based on food web model for house wren. Source: Divine, C., J. Zodrow, M. Frenchmeyer, K. Dally, E. Osborn, and P. Anderson. 2020. Approach for Assessing PFAS Risk to Threatened and Endangered Species. Strategic Environmental Research and Development Program. Project ER18-1653.
6. NOAEL based on food web model for long-tailed weasel. Source: Divine et al. 2020.
7. NOAEL based on food web model for little brown bat. Source: Divine et al. 2020.
8. NOAEL based on food web model for tree swallow. Source: Divine et al. 2020.

Matrix: SS, SB, SD
Analytical Method: LCMSMS Compliant with QSM 5.3 Table B-15
Analytical Group: PFAS (µg/kg unless otherwise specified)

Analyte	CAS No.	SLs[1]	ESV[2] [SS, SB]	ESV[2] [SD]	PQL Goal[3]	Laboratory-Specific Reporting Limits (µg/kg)			A/P Limits[4] (%) for LCS and MS/MSD		
						LOQ	LOD	DL	LCL	UCL	RPD

µg/kg = micrograms per kilogram
A/P Limits = accuracy and precision limits
CAS = chemical abstract service
DL = detection limit
LCL = lower control limit
LCS = laboratory control sample
LOD = limit of detection
LOQ = limit of quantitation
MS = matrix spike
MSD = matrix spike duplicate
PQL = practical quantitation limit
RPD = relative percent difference
SB = subsurface soil
SD = sediment
SL = screening level
SS = surface soil
UCL = upper control limit

Worksheet #15-2: Project Action Limits and Laboratory-specific Detection/Quantitation Limits (PFAS in Groundwater/Surface Water)

(Uniform Federal Policy [UFP]-QAPP Manual Section 2.6.2.3)

Matrix: GW/SW
Analytical Method: LCMSMS Compliant with QSM 5.3 Table B-15
Analytical Group: PFAS (ng/L unless otherwise specified)

Analyte	CAS No.	SLs[1]	Freshwater ESVs[2]	Marine ESVs[2]	PQL Goal[3] (ng/L)	Laboratory-Specific Reporting Limits (ng/L)			A/P Limits[4] (%) for LCS and MS/MSD		
						LOQ	LOD	DL	LCL	UCL	RPD
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	40	75[5]	75[5]	20	5.00	1.00	0.44	65	140	30
Perfluorooctanoic acid (PFOA)	335-67-1	40	4,400[6]	20[8]	10	5.00	1.50	0.51	71	133	30
Perfluorobutanesulfonic acid (PFBS)	375-73-5	600	640,000[7]	37,000[9]	300	5.00	0.50	0.14	72	130	30
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	-	-	-	-	5.00	1.00	0.50	61	135	30
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	-	-	-	-	5.00	1.00	0.35	65	136	30
Perfluorodecanoic acid (PFDA)	335-76-2	-	-	-	-	5.00	0.50	0.14	71	129	30
Perfluorododecanoic acid (PFDoA)	307-55-1	-	-	-	-	5.00	0.50	0.19	72	134	30
Perfluoroheptanoic acid (PFHpA)	375-85-9	-	-	-	-	5.00	1.00	0.26	72	130	30
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	-	-	-	-	5.00	0.40	0.11	68	131	30
Perfluorohexanoic acid (PFHxA)	307-24-4	-	-	-	-	5.00	1.50	0.53	72	129	30
Perfluorononanoic acid (PFNA)	375-95-1	-	-	-	-	5.00	1.00	0.31	69	130	30

Matrix: GW/SW
Analytical Method: LCMSMS Compliant with QSM 5.3 Table B-15
Analytical Group: PFAS (ng/L unless otherwise specified)

Analyte	CAS No.	SLs[1]	Freshwater ESVs[2]	Marine ESVs[2]	PQL Goal[3] (ng/L)	Laboratory-Specific Reporting Limits (ng/L)			A/P Limits[4] (%) for LCS and MS/MSD		
						LOQ	LOD	DL	LCL	UCL	RPD
Perfluorotetradecanoic acid (PFTA)	376-06-7	-	-	-	-	5.00	2.00	0.73	71	132	30
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	-	-	-	-	5.00	0.50	0.15	65	144	30
Perfluoroundecanoic acid (PFUnA)	2058-94-8	-	-	-	-	5.00	0.50	0.22	69	133	30
Hexafluoropropylene oxide dimer acid (HFPO-DA)	13252-13-6	-	-	-	-	5.00	0.50	0.25	**74**	**148**	**30**
4,8-dioxa-3H-perfluorononanoic acid (ADONA)	919005-14-4	-	-	-	-	5.00	1.00	0.27	**61**	**143**	**30**
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	763051-92-9	-	-	-	-	5.00	0.50	0.23	**52**	**158**	**30**
9-chlorohexadecafluoro-3-oxanone-1-sulfonic (9Cl-PF3ONS)	756426-58-1	-	-	-	-	5.00	1.00	0.27	**59**	**147**	**30**

Notes:

1. SLs for PFOA, PFOS, and PFBS were identified in accordance with the September 15, 2021 update of *Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program* (DoD, 2021) and are based on a hazard quotient (HQ) of 0.1.
2. While ESVs are included in the SAP, they are not PALs but are instead included to ensure data quality will be sufficient for potential later use in ecological risk screening or risk assessment depending on the current state of promulgated standards and/or Navy policy. ESVs apply to surface water only.
3. The PQL Goal is one-half the minimum of applicable screening levels, or the detection limit if the value for one-half the screening level is less than the limit of quantitation.
4. Accuracy and precision limits are consistent with DoD QSM v5.3. Bolded values represent in-house limits when QSM v5.3 limits do not exist.
5. NOAEL based on food web model for brown pelican. Source: Divine, C., J. Zodrow, M. Frenchmeyer, K. Dally, E. Osborn, and P. Anderson. 2020. Approach for Assessing PFAS Risk to Threatened and Endangered Species. Strategic Environmental Research and Development Program. Project ER18-1653.
6. NOAEL based on food web model for little brown bat. Source: Divine et al. 2020.
7. NOAEL based on food web model for tree swallow. Source: Divine et al. 2020.

Matrix: GW/SW
Analytical Method: LCMSMS Compliant with QSM 5.3 Table B-15
Analytical Group: PFAS (ng/L unless otherwise specified)

Analyte	CAS No.	SLs[1]	Freshwater ESVs[2]	Marine ESVs[2]	PQL Goal[3] (ng/L)	Laboratory-Specific Reporting Limits (ng/L)			A/P Limits[4] (%) for LCS and MS/MSD		
						LOQ	LOD	DL	LCL	UCL	RPD

8. Quality Standard (saltwater; secondary poisoning in predators); Source: Valsecchi, S., D. Conti, R. Crebelli, S. Polesello, M. Rusconi, M. Mazzoni, E. Preziosi, M. Carere, L. Lucentini, E. Ferretti, S. Balzamo, MG. Simeone, and F. Aste. 2017. "Deriving Environmental Quality Standards for Perfluorooctanoic Acid (PFOA) and Related Short Chain Perfluorinated Alkyl Acids." J Hazard Mat. Vol. 323. pp. 84-98.
9. Quality Standard (saltwater pelagic community); Marine EC50 with an uncertainty factor of 10,000. Source: Valsecchi et al., 2017.

A/P Limits = accuracy and precision limits
CAS = chemical abstract service
DL = detection limit
EC50 = Effects concentration for 50 percent of test population
GW = groundwater
LCL = lower control limit
LCS = laboratory control sample
LOD = limit of detection
LOQ = limit of quantitation
MS = matrix spike
MSD = matrix spike duplicate
ng/L = nanograms per liter
PQL = practical quantitation limit
RPD = relative percent difference
SW = surface water
UCL = upper control limit

Worksheet #17: Sampling Design and Rationale

This worksheet documents the sampling design and rationale for the PFAS SI whose primary objective is to determine whether a release of PFAS has occurred from past activities being investigated under CERCLA. In addition, the information gathered during the SI, including observations made during sampling and any other pertinent information discovered during the SI implementation, will be used to determine whether the release warrants further investigation or action.

Based on the PA/SI primary goal (i.e., release assessment), the overarching rationale for selecting sample type/ locations at each of the 13 potential release areas is to ensure a PFAS release(s), if it occurred, would most likely be detected. The specific medium/media to be sampled, number of samples, and sample locations are discussed by potential release area, together with the details of the sampling rationale.

NASD AOC B: Former Wastewater Treatment Plant

As described in **Worksheet #10**, if AFFF or other PFAS-containing substances were discharged to the former WWTP, they would have been ultimately directed to the no-discharge lagoons into which all wastewater processed through the WWTP ultimately was deposited. Based on this, if there was a release(s) of AFFF or other PFAS-containing substances, the most likely location to detect them is in the former lagoon, especially because the contaminants would have had the potential to accumulate in the lagoons if there were multiple discharges over time. Because the location of the lagoon and associated cells are known, focused sampling in this area is appropriate for release assessment. As such, one surface and one subsurface soil sample will be collected from the approximate center of each of the four unlined evaporation/percolation cells at the former WWTP lagoon (VWAB-PFAS-SS/SB01, VWAB-PFAS-SS/SB02, VWAB-PFAS-SS/SB03, and VWAB-PFAS-SS/SB04) (**Figure 10-4**). The information will be pertinent in not only determining whether there were historic release(s) of PFAS but will provide an indication of the vertical distribution remaining in soil if there were release(s), which is applicable to any site/area where surface and subsurface soil samples will be collected at the same location.

Of note, the earthen berms that bordered the lagoon and interior cells appear to have been demolished sometime after plant closure (i.e., the current topography in the former lagoon area shows no mounding indicative of the historic berms). It is possible (even likely) the earthen berms were removed by leveling the soil across the lagoon basin (i.e., grading the soil from the berms into the lagoon cells). As a result, at each soil sample location, exploratory borings will be performed to help distinguish soil from the berms from historic lagoon sludge. Once that distinction is made, the surface soil sample in each cell will be collected from top foot of the historic lagoon sludge, thereby excluding any overlying soil layer that was not likely affected by wastewater discharges to the lagoons. The soil/sludge determination will be made by the sampling team FTL, taking into consideration the lagoon reportedly contained a clay layer at its bottom. Subsurface soil samples will be collected at the same locations as surface samples from the 4-to-6-foot interval below the top of the historic sludge (or just above the water table or bedrock, if encountered before this depth). An additional 1-foot subsurface soil sample will also be collected at the soil/water interface if this zone occurs in unconsolidated material.

Because the total lagoon size is relatively small (approximately 0.5 acre) and historical discharges would have likely been distributed in a relatively uniform manner in each cell, collecting soil from one location in each of the four interior cells is appropriate for characterizing potential WWTP lagoon “soil” contamination.

The small size of the lagoon also indicates a single well installed along the downgradient edge of the former lagoon is reasonable for the purposes of release assessment. Based on the groundwater flow direction identified at nearby AOC E (approximately 600 feet northeast), the northwest side of the former lagoon is the downgradient direction for AOC B (**Figure 10-4**). The well will be installed within the first encountered saturated zone, as will all wells installed as part of the SI due to the affinity of PFAS for the air-water interface. One groundwater sample will be collected at new monitoring well VWAB-PFAS-MW01 for PFAS.

NASD Former Fire Station Building 2046 at the Publics Works Area

As described in **Worksheet #10**, if AFFF or other PFAS-containing substances were released at the former fire station, the releasees likely would have occurred on the fire station ramp and surrounding area during washing of fire trucks and testing of fire truck pumps. Additionally, leaks/spills during AFFF storage or transfer into the firetrucks at the former conex container or ramp area could have occurred. Based on this, if there was a release(s) of AFFF or other PFAS-containing substances, the most likely location to detect them is immediately adjacent to the ramp and/or at the location of the former conex container.

One surface and one subsurface soil sample will be collected on each of the three sides of the former fire station ramp (VWFS-PFAS-SS/SB03, VWFS-PFAS-SS/SB04, VWFS-PFAS-SS/SB05) (**Figure 10-4**). To account for runoff onto soil in any direction, the soil samples will be positioned around the edge of the paved entrance ramp on which fire trucks were washed, fire truck AFFF tanks were filled, and tanks containing AFFF were cleaned. The soil boring along the north side of the ramp will be adjacent to the groundwater monitoring well (VWFS-PFAS-MW02) from which a groundwater sample will be collected. Due to the small area and localized nature of potential release(s) at the ramp, a single groundwater sample is reasonable for the purposes of release assessment.

In addition, two surface and two subsurface soil samples will be collected at the location of the former conex container located approximately 100 feet west of the former fire station building (VWFS-PFAS-SS/SB01, VWFS-PFAS-SS/SB02) (**Figure 10-4**). AFFF concentrate used at the fire station was reportedly stored in 5-gallon containers in the conex container. Based on a historic aerial photograph (1999) it is estimated that the conex container measured 10 feet wide and 40 feet long. The location of door on the conex container is not known. As a result, the soil samples will be collected at either end of the former conex container location to represent the most likely ingress/egress points where accidental releases could have occurred.

An additional monitoring well will be installed and sampled in a downgradient direction (as described for AOC B) from the conex container (VWFS-PFAS-MW01) (**Figure 10-4**) to account for any potential uncertainty in soil sample locations relative to where a release(s) associated with the aforementioned activities may have occurred.

All surface soil samples will be collected from 0 to 1 foot bgs. All subsurface soil samples will be collected at the same locations as surface samples from the 4-to-6-foot interval (or just above the water table or bedrock, if encountered before this depth). An additional 1-foot subsurface soil sample will also be collected at the soil/water interface if this zone occurs in unconsolidated material.

Potential Former NASD Motor Pool Area

As described in **Worksheet #10**, if AFFF or other PFAS-containing substances were released at the potential former motor pool area, the releases likely would have occurred where vehicles were serviced, specifically where the fire trucks were serviced. However, no historical information has been found that states where specifically within the motor pool area fire truck maintenance occurred. Therefore, a prudent approach for release determination is to sample groundwater on the downgradient edge of the motor pool area rather than to collect soil samples. In the absence of specific knowledge of where fire trucks were maintained, it is very likely that a potential release could be missed by soil sampling because their locations could not be definitively positioned to achieve the study goal. Conversely, a groundwater sampling location is generally representative of a broader area of potential release for soluble compounds like PFAS. Therefore, if a release is confirmed via downgradient groundwater sampling, the source area then can be located during future refinement efforts, as warranted. Based on this, three monitoring wells (VWMP-PFAS-MW01, VWMP-PFAS-MW02, and VWMP-PFAS-MW03) will be installed adjacent to the former wash rack, and approximately evenly spaced downgradient of the former motor pool area, as shown in **Figure 10-5**.

While historical records do not identify where vehicle maintenance occurred, the records do indicate a vehicle wash rack was located in the southwest corner of the former motor pool area. Although no records were found

indicating fire trucks were washed there (records indicate they were washed at the former fire station), as a conservative measure, the potential for fire trucks to have been washed on the vehicle was rack is assumed. Based on this, one surface and one subsurface soil sample will be collected along each side of the vehicle wash rack (VWMP-PFAS-SS/SB01, VWMP-PFAS-SS/SB02, VWMP-PFAS-SS/SB03, VWMP-PFAS-SS/SB04) to account for runoff onto soil in any direction (**Figure 10-5**). The soil boring along the north side of the wash rack will be adjacent to as the monitoring well (VWMP-PFAS-MW01) from which a groundwater sample will be collected.

All surface soil samples will be collected from 0 to 1-foot bgs. All subsurface soil samples will be collected at the same locations as surface samples from the 4-to-6-foot interval (or just above the water table or bedrock, if encountered before this depth). An additional 1-foot subsurface soil sample will also be collected at the soil/water interface if this zone occurs in unconsolidated material.

NASD AOC H: Abandoned Powerplant

As described in **Worksheet #10**, if AFFF or other PFAS-containing substances were released at the abandoned power plant, the releases likely would have occurred inside the abandoned building, but then would have been washed outside through the abandoned building openings or infiltrated through the concrete floor (e.g., through cracks). Once outside the building on the bare ground surface, they could have migrated via overland flow toward the adjacent ephemeral stream. They may have also migrated vertically through the concrete floor into the unsaturated zone, then into groundwater. Based on this, four surface and four subsurface soil samples will be positioned around the perimeter of the building where potentially contaminated water used for fire extinguishing would be expected to exit through the abandoned building openings to the surrounding soil (VWAH-PFAS-SS/SB01, VWAH-PFAS-SS/SB02, VWAH-PFAS-SS/SB03, and VWAH-PFAS-SS/SB04, as shown in **Figure 10-6**). Samples VWAH-PFAS-SS/SB01 and VWAH-PFAS-SS/SB04 will be collected as close as possible to the front and back entryways of the building and samples VWAH-PFAS-SS/SB02 will be collected as close as possible to the side door entrance on the east of the building. Considering land crab habitat occurs adjacent to the north, east, and west sides of the building, surface soil samples will be collected from 0 to 2-feet bgs at these locations (VWAH-PFAS-SS/SB01, VWAH-PFAS-SS/SB02, VWAH-PFAS-SS/SB03). The area at the south side of the building does not support land crabs; therefore, the surface soil sample will be collected from 0 to 1-foot bgs at this location (VWAH-PFAS-SS/SB04). All subsurface soil samples will be collected at the same locations as surface samples from the 4-to-6-foot interval (or just above the water table or bedrock, if encountered before this depth). An additional 1-foot subsurface soil sample will also be collected at the soil/water interface if this zone occurs in unconsolidated material.

Based on the direction of groundwater flow determined during historical investigations, two monitoring wells (VWAH-PFAS-MW01 and VWAH-PFAS-MW02 as shown in **Figure 10-6**) will be installed and sampled. One monitoring well will be installed near the west side of the building where groundwater flow is toward the adjacent ephemeral stream, though historical data indicate groundwater does not discharge to the stream. Another monitoring well will be installed approximately 100 feet north-northeast of the former power plant building to represent the predominant groundwater flow direction from this location, which is toward Vieques Passage approximately 400 feet to the north.

Because historic releases could have entered the adjacent ephemeral stream via overland flow, three surface water and three sediment samples (VWAH-PFAS-SW/SD01, VWAH-PFAS-SW/SD02, and VWAH-PFAS-SW/SD03) will be collected from the ephemeral stream from locations immediately adjacent to the building and proceeding downstream toward the Vieques Passage (**Figure 10-6**). One sediment sample is positioned at the nearest point to the AOC H building (approximately 40 feet) where runoff to the stream would most likely occur, and two additional samples are spaced at about 200 and 300 feet downstream toward Vieques Passage to account for sediment transport during periodic storm events. All sediment samples will be collected from 0 to 6 inches bgs. Because of the transient nature of surface water, sediment is likely to be more useful for release assessment to the ephemeral stream because of the tendency for some PFAS (particularly PFOS, which was the dominant

chemical in early AFFF formulations) to associate with organic carbon in solid material (e.g., sediment, soil). This tendency can result in persistent concentrations in these media. However, since surface water is always present at these locations surface water samples will also be collected. The presence of wetlands, mangroves, and tidal influence will be documented during field activities.

NASD SWMU 6: Former Mangrove Disposal Site

As described in **Worksheet #10**, if AFFF or other PFAS-containing substances were released at the former mangrove disposal site, they likely would have migrated via overland flow to the existing lagoon system or leached through the thin soil layer into the saturated zone (now represented by the lagoon created by the past removal action). Based on this, release assessment is appropriately made by sampling within the SWMU 6 lagoon structure as well as where physical transport takes place between the SWMU 6 lagoon and the larger Laguna Kiani complex. To that end, one surface and one subsurface soil sample (VWS6-PFAS-SS/SB01) will be collected at the Former Mangrove Disposal Site (**Figure 10-7**). This location is within an exposed soil area at the eastern end of the lagoon, where debris piles were historically located and removed during the 2009 non-time-critical removal action. Because the soil surface represents the horizon that was immediately below the debris and because the area supports land crabs, the surface soil sample will be collected from 0 to 2-feet bgs (or shallower if water is encountered before reaching 2 feet). If there is remaining unsaturated soil below the surface soil interval, it will be collected as a subsurface soil sample, but it is likely water will be encountered within the surface soil interval. An additional 1-foot subsurface soil sample will also be collected at the soil/water interface if this zone occurs in unconsolidated material.

Consistent with the logic for soil sample collection, two surface water and two sediment samples (VWS6-PFAS-SW/SD01 and VWS6-PFAS-SW/SD02) will be collected at SWMU 6 (**Figure 10-7**). One sample location (VWS6-PFAS-SD02) will be collected from the middle of the open water portion of the lagoon where debris piles were historically located. This sample will be used to determine if PFAS may have leached from the debris piles and remain following the removal action. The other sample location (VWS6-PFAS-SD01) will be collected where physical exchange can take place between the SWMU 6 lagoon and the larger Laguna Kiani lagoon complex. Under current conditions the SWMU 6 lagoon is tidally influenced, with water exchange occurring primarily through a narrow constriction at the north end through a dense stand of mangroves. The samples will be collected in the open water area immediately beyond these mangroves to evaluate if potential PFAS from SWMU 6 have been released beyond the debris removal area. Both sediment samples will be collected from 0 to 6 inches below the top of sediment

Because of the transient nature of surface water, sediment is likely to be more useful for release assessment to the ephemeral stream because of the tendency for some PFAS (particularly PFOS, which was the dominant chemical in early AFFF formulations) to associate with organic carbon in solid material (e.g., sediment, soil). This tendency can result in persistent concentrations in these media. However, since surface water is always present at these locations surface water samples will also be collected.

NASD SWMU 7: Former Quebrada Disposal Site

As described in **Worksheet #10**, if AFFF or other PFAS-containing substances were released at the former quebrada disposal site, they likely would have flowed down-valley with periodic flow associated with rain events or infiltrated through the soil beneath the debris toward/to the underlying saprolite and fractured rock where it would have migrated with groundwater flow toward the Vieques Passage. Based on this, release assessment is appropriately made by collecting soil samples along the ephemeral stream bed and groundwater downgradient of the former open dump area. In the absence of specific knowledge of where in the open dump there may have been debris (e.g., containers) containing AFFF or other PFAS-containing substances, it is very likely that a potential release could be missed by soil sampling in that area because their locations could not be definitively positioned to achieve the study goal. Conversely, a groundwater sampling location is generally representative of a broader

area of potential release that infiltrated vertically through soil. Ephemeral stream sampling locations provide information along the likely overland route of any surficial release.

Based on this, three surface and three subsurface soil samples (VWS7-PFAS-SS/SB01, VWS7-PFAS-SS/SB02, and VWS7-PFAS-SS/SB03) will be collected from the ephemeral stream bed in depositional areas if observed within and immediately downgradient of the open dump area (**Figure 10-8**). Two of the soil sample locations (VWS7-PFAS-SS/SB02 and VWS7-PFAS-SS/SB03) are positioned within the open dump area where debris accumulated in the ephemeral stream at the base of the eastern slope. The third soil sample location (VWS7-PFAS-SS/SB01) is positioned approximately 400 feet downgradient of the debris field in the ephemeral stream, intended to identify if potentially contaminated soil has migrated downstream during periodic rainfall events. All surface soil samples will be collected from 0 to 1 foot bgs. All subsurface soil samples will be collected at the same locations as surface samples from the 4-to-6-foot interval (or just above the water table or bedrock, if encountered before this depth). An additional 1-foot subsurface soil sample will also be collected at the soil/water interface if this zone occurs in unconsolidated material.

Based on the direction of groundwater flow determined during historical investigations one monitoring well (VWS7-PFAS-MW01) will be installed and sampled. The well will be installed in or as close to the downgradient edge of the former waste boundary as possible on the west side of the access road. If this location is too steep for drill rig access, a fallback location is shown on **Figure 10-8** which is located in the northwest corner of the SWMU 7 boundary, immediately adjacent to the ephemeral stream and near Highway 200 (**Figure 10-8**). The well location is well-positioned to evaluate whether a release(s) occurred that migrated to groundwater from beneath the debris or migrated with the ephemeral stream before migrating vertically to groundwater.

VNTR Camp Garcia Runway and VNTR PI 5 – Surface Water Drainage Area from Camp Garcia Runway

As described in **Worksheet #10**, if AFFF was released at the former Camp Garcia runway, it likely would have been from AFFF sprayed onto the runway that flowed southward (downgradient) across the runway to the PI 5 drainage ditch. It is also possible that some infiltration through the runway occurred via cracks, if present. If AFFF was washed into the drainage ditches on the south side of the runway (PI 5), it would then have likely drained toward the two ephemeral streams shown in **Figure 10-9**. AFFF present in soil within the drainage ditch or that which infiltrated through the runway could have migrated vertically to groundwater. Based on this, release assessment is appropriately made by collecting soil where the two ephemeral streams cross over between the runway and taxiway and where the two ephemeral streams would have collected water from the drainage ditches along the southern side of the runway as well as groundwater from locations along the southern side of the runway. Collecting groundwater samples is appropriate because if/where along the runway an AFFF release(s) occurred is unknown and sampling groundwater provides a greater likelihood of detecting a release under these circumstances.

Based on this, one surface and one subsurface soil sample will be collected from the confluence of the drainage ditch system and two ephemeral streams on the south side of the former runway (VEP5-PFAS-SS/SB01 and VERW-PFAS-SS/SB03) as shown in **Figure 10-9**. To the extent practicable, soil samples will be collected from depositional areas downstream of the runway. In addition, one surface and one subsurface soil sample will be collected along the drainage ditches where they cross between the taxiway and runway (VEP5-PFAS-SS/SB02 and VERW-PFAS-SS/SB04). Additionally, one surface (0 to 1 foot below land surface [bls]) and one subsurface soil sample (VERW-PFAS-SS/SB05) will be collected in a depositional area if observed at the head of the northwest southeast trending drainage ditch on the east side of the runway. If the ditch contains water a surface water and sediment sample will be collected instead of a surface soil and subsurface soil sample.

One surface and one subsurface soil sample will also be collected adjacent to two of the three proposed monitoring well locations (VERW-PFAS-SS/SB01 and VERW-PFAS-SS/SB02). All surface soil samples will be

collected from 0 to 1-foot bgs. All subsurface soil samples will be collected from the 4-to-6-foot interval (or just above the water table or bedrock, if encountered before this depth). An additional 1-foot subsurface soil sample will also be collected at the soil/water interface if this zone occurs in unconsolidated material.

Three monitoring wells (VEP5-PFAS-MW01, VERW-PFAS-MW01, and VERW-PFAS-MW02) will be installed along the southern side of the runway (**Figure 10-9**); these three wells plus an existing well near the eastern end of the runway (EPI04-MW26 as shown in **Figure 10-9**) will be sampled to help determine if there was an historic release(s) of AFFF anywhere along the runway.

VNTR SWMU 20: Former Helicopter Maintenance Area

As described in **Worksheet #10**, if AFFF or other PFAS-containing substances were released at the former helicopter maintenance area, the releases likely would have occurred inside the maintenance area since these types of areas commonly have fire suppression systems and AFFF may have been present at the base for at least a portion of the time the helicopter maintenance area/hangar was operational. If a release occurred, it likely would have been washed out of the building onto the ground surface. Based on this, release assessment is appropriately made by collecting soil where impact to the ground surface was likely (i.e., adjacent to former building footprint) as well as groundwater in the potential release area and downgradient.

Based on this, one surface (0 to 1 foot bls) and one subsurface soil sample (VEP4-PFAS-SS/SB01) will be collected at the same location in the former helicopter maintenance area (**Figure 10-9**). This location is adjacent to existing monitoring well EPI04-MW02 whose location was concurred upon during the SWMU 20 RI as being representative of a contaminant release at the former maintenance building. An additional 1-foot subsurface soil sample will also be collected at the soil/water interface of each soil boring if this zone occurs in unconsolidated material.

To help evaluate the potential for an AFFF release in the absence of specific release or release location knowledge, five groundwater samples in the immediate and downgradient direction from the former maintenance building will be collected from existing SWMU 20 monitoring wells (EPI04-MW01, EPI04-MW02, EPI04-MW06, EPI04-MW24, and EPI04-MW26, as shown in **Figure 10-9**).

Potential Former VNTR Motor Pool Area (including Building 340) and Former Fire Department Building 330

As described in **Worksheet #10**, if AFFF or other PFAS-containing substances were released at the former VNTR motor pool area and fire department building, the releases likely would have occurred where vehicles were serviced, specifically where the fire trucks were serviced. However, no historical information has been found that states where specifically within the motor pool area fire truck maintenance occurred, nor that it occurred in either building in that general area (i.e., Buildings 330 and 340). Therefore, a prudent approach for release determination is to sample groundwater on the downgradient edge of the motor pool area rather than to collect soil samples. This approach is comparable to the approach taken when multiple sites within Camp Garcia were historically investigated in an SI (CH2M, 2010a). In the absence of specific knowledge of where fire trucks were maintained, it is very likely that a potential release could be missed by soil sampling because their locations could not be definitively positioned to achieve the study goal. Further, soil in the area has been disturbed as part of construction of the new CERCLA cleanup base of operations. At the request of the regulatory agencies, one subsurface soil sample will be collected at two locations (one between the former locations of former Bldgs 330 and 340 and one south of the former Bldg 330). However, it should be noted that groundwater sampling is generally representative of a broader area of potential release and if a release is confirmed via downgradient groundwater sampling, the source area could be located during future refinement efforts, as warranted. An additional 1-foot subsurface soil sample will also be collected at the soil/water interface if this zone occurs in unconsolidated material.

Based on this, one monitoring well (VEFS-PFAS-MW01) will be installed downgradient of the source area and one monitoring well (VEFS-PFAS-MW02) will be installed on the downgradient edge of the former motor pool area and adjacent buildings, as shown in **Figure 10-10**. Groundwater samples will be collected from this well and the two wells (VECG-MW01 and VECG-MW02, as shown in **Figure 10-10**) installed historically to characterize potential contaminant releases at multiple Camp Garcia sites (CH2M, 2010a).

VNTR SWMU 10 and VNTR AOC G: Former Sewage Treatment Lagoons and Chlorination Building

As described in **Worksheet #10**, if AFFF or other PFAS-containing substances were discharged to the former sewage treatment facility, they would have been directed into the lagoons where they would have been released directly to soil if prior to 1974 before the lagoons were lined, or they would have accumulated in lagoon sediment if after 1974 when the lagoons were lined. If a release(s) occurred from the lagoons, it likely would have infiltrated through the lagoon sediment and underlying soil toward/to the underlying groundwater. It is also possible wastewater from the lagoons was discharged to an area just south of the lagoons, as shown in **Figure 10-11**.

Based on this, if there was a release(s) of AFFF or other PFAS-containing substances, the most likely location to detect them is at or in the immediate vicinity of the former lagoons, especially because the contaminants would have had the potential to accumulate in the lagoons if there were multiple discharges to them over time. Because the location of the lagoons and associated cells are known focused sampling in this area is appropriate for release assessment. As such, one surface and one subsurface soil sample will be collected from the approximate center of each of the four treatment lagoons (VEW10-PFAS-SS/SB01, VEW10-PFAS-SS/SB02, VEW10-PFAS-SS/SB03, and VEW10-PFAS-SS/SB04). One surface and one subsurface soil sample will be collected adjacent to monitoring well locations VEW10-PFAS-MW-03 and VEW10-PFAS-MW-04 (VEW10-PFAS-SS/SB05 and VEW10-PFAS-SS/SB06). All surface soil samples will be collected from 0 to 1 -foot bgs. All subsurface soil samples will be collected from the 4-to-6 foot interval (or just above the water table or bedrock, if encountered before this depth), unless visual and/or instrument screening suggests the potential presence of contamination at a shallower depth, in which case the shallower zone will be sampled. An additional 1-foot subsurface soil samples will also be collected at soil borings at the soil/water interface if this zone occurs in unconsolidated material.

Based on the direction of groundwater flow determined for adjacent SWMU 20, four monitoring wells (VEW10-PFAS-MW01, VEW10-PFAS-MW02, VEW10-PFAS-MW03, and VEW10-PFAS-MW04) will be installed at the locations shown in **Figure 10-11**). Groundwater flow in this area is generally to the southeast toward Bahia Tapón. One well will be positioned immediately downgradient (south) and central to the SWMU 10 lagoon system. A second groundwater sample location is positioned at the downgradient (south) side of the AOC G chlorination building and chlorine contact chamber. Because there is some evidence that after chlorination at AOC G, treated wastewater was piped to and surface-discharged at large drying field (evidenced as a series of linear ground scars and ditches in **Figure 10-11**) two additional monitoring wells will be installed just downgradient (south) of these features.

VNTR SWMU 1: Former Camp Garcia Municipal Solid Waste Management Unit (Landfill)

As described in **Worksheet #10**, if AFFF or other PFAS-containing substances were released at the former Camp Garcia landfill, they would have been released directly to subsurface soil from beneath the buried waste since the landfill is unlined and then would have infiltrated toward/to groundwater. Based on this, release assessment is appropriately made by collecting groundwater from within and downgradient of the former landfill. In the absence of specific knowledge of where in the landfill there may have been debris (e.g., containers) containing AFFF or other PFAS-containing substances, it is very likely that a potential release could be missed by soil sampling because their locations could not be definitively positioned to achieve the study goal. Conversely, a groundwater sampling approach is generally representative of a broader area of potential release that infiltrated vertically

through soil. Therefore, if a release is confirmed via groundwater sampling, the source area then can be located during future refinement efforts, as warranted.

Based on this, groundwater samples will be collected from the same six monitoring wells (VEW01-MW02, VEW01-MW03, VEW01-MW06, VEW01-MW08, VEW01-MW10, and VEW01-MW11, as shown in **Figure 10-12**) that are sampled as part of SWMU 1 long-term monitoring required by the SWMU 1 ROD. These wells were selected because they "provide appropriate coverage of the internal landfill conditions and, most importantly, the downgradient boundary conditions." (CH2M, 2012). This logic, developed to assess the potential for release of volatile organic compounds (VOCs) and metals from landfilled waste, is equally valid for PFAS release determination.

Worksheet #18: Sampling Locations and Methods

(UFP-QAPP Manual Section 3.1.1 and 3.1.2)

Sampling Location/ID Number	Matrix	Depth	Analytical Group	Sample Type /Number of Samples	Sampling SOP Reference
Quantities assume a single round of sampling (two days with decontaminated equipment)					
NASD AOC B: Former Wastewater Treatment Plant					
GW Samples					
VWAB-PFAS-MW01 / VWAB-PFAS-GW01-MMYY VWAB-PFAS-MW01 / VWAB-PFAS-GW01P-MMYY VWAB-PFAS-MW01 / VWAB-PFAS-GW01-MMYY-MS VWAB-PFAS-MW01 / VWAB-PFAS-GW01-MMYY-MSD	GW	--	PFAS	4 (N, FD, MS/MSD)	B-1 and Groundwater Sampling for PFAS in **Attachment C**
Surface Soil and Subsurface Soil Samples					
VWAB-PFAS-SO01 / VWAB-PFAS-SS01-0001	SS	0-1’	PFAS	SS: 2 (N, FD) SB: 2 (N, FD) SB: 2 (N, FD)	Soil Sampling for PFAS in **Attachment C**
VWAB-PFAS-SO01 / VWAB-PFAS-SS01P-0001	SS	0-1’			
VWAB-PFAS-SO01 / VWAB-PFAS-SB01-TDBD	SB	TBD			
VWAB-PFAS-SO01 / VWAB-PFAS-SB01P-TDBD	SB	TBD			
VWAB-PFAS-SO01 / VWAB-PFAS-SB01D-TDBD	SB	TBD			
VWAB-PFAS-SO01 / VWAB-PFAS-SB01DP-TDBD	SB	TBD			
VWAB-PFAS-SO02 / VWAB-PFAS-SS02-0001	SS	0-1’	PFAS	SS: 1 (N) SB: 1 (N) SB: 1 (N)	
VWAB-PFAS-SO02 / VWAB-PFAS-SB02-TDBD	SB	TBD			
VWAB-PFAS-SO02 / VWAB-PFAS-SB02D-TDBD	SB	TBD			
VWAB-PFAS-SO03 / VWAB-PFAS-SS03-0001	SS	0-1’	PFAS	SS: 3 (N, MS/MSD) SB: 3 (N, MS/MSD) SB: 3 (N, MS/MSD)	
VWAB-PFAS-SO03 / VWAB-PFAS-SS03-0001-MS	SS	0-1’			
VWAB-PFAS-SO03 / VWAB-PFAS-SS03-0001-MSD	SS	0-1’			
VWAB-PFAS-SO03 / VWAB-PFAS-SB03-TDBD	SB	TBD			
VWAB-PFAS-SO03 / VWAB-PFAS-SB03-TDBD-MS	SB	TBD			
VWAB-PFAS-SO03 / VWAB-PFAS-SB03-TDBD-MSD	SB	TBD			
VWAB-PFAS-SO03 / VWAB-PFAS-SB03D-TDBD	SB	TBD			
VWAB-PFAS-SO03 / VWAB-PFAS-SB03D-TDBD-MS	SB	TBD			
VWAB-PFAS-SO03 / VWAB-PFAS-SB03D-TDBD-MSD	SB	TBD			
VWAB-PFAS-SO04 / VWAB-PFAS-SS04-0001	SS	0-1’	PFAS	SS: 1 (N) SB: 1 (N) SB: 1 (N)	
VWAB-PFAS-SO04 / VWAB-PFAS-SB04-TDBD	SB	TBD			
VWAB-PFAS-SO04 / VWAB-PFAS-SB04D-TDBD	SB	TBD			

Sampling Location/ID Number	Matrix	Depth	Analytical Group	Sample Type /Number of Samples	Sampling SOP Reference
NASD Former Fire Station Building 2046 at the Public Works Area					
GW Samples					
VWFS-PFAS-MW01 / VWFS-PFAS-GW01-MMYY VWFS-PFAS-MW01 / VWFS-PFAS-GW01P-MMYY	GW	--	PFAS	2 (N, FD)	B-1 and Groundwater Sampling for PFAS in **Attachment C**
VWFS-PFAS-MW02 / VWFS-PFAS-GW02-MMYY VWFS-PFAS-MW02 / VWFS-PFAS-GW02-MMYY-MS VWFS-PFAS-MW02 / VWFS-PFAS-GW02-MMYY-MSD	GW	--	PFAS	3 (N, MS/MSD)	
Surface Soil and Subsurface Soil Samples					
VWFS-PFAS-SO01 / VWFS-PFAS-SS01-0001 VWFS-PFAS-SO01 / VWFS-PFAS-SB01-TDBD VWFS-PFAS-SO01 / VWFS-PFAS-SB01D-TDBD	SS SB SB	0-1' TBD TBD	PFAS	SS: 1 (N) SB: 1 (N) SB: 1 (N)	Soil Sampling for PFAS in **Attachment C**
VWFS-PFAS-SO02 / VWFS-PFAS-SS02-0001 VWFS-PFAS-SO02 / VWFS-PFAS-SS02P-0001 VWFS-PFAS-SO02 / VWFS-PFAS-SB02-TDBD VWFS-PFAS-SO02 / VWFS-PFAS-SB02P-TDBD VWFS-PFAS-SO02 / VWFS-PFAS-SB02D-TDBD VWFS-PFAS-SO02 / VWFS-PFAS-SB02DP-TDBD	SS SS SB SB SB SB	0-1' 0-1' TBD TBD TBD TBD	PFAS	SS: 2 (N, FD) SB: 2 (N, FD) SB: 2 (N, FD)	
VWFS-PFAS-SO03 / VWFS-PFAS-SS03-0001 VWFS-PFAS-SO03 / VWFS-PFAS-SS03-0001-MS VWFS-PFAS-SO03 / VWFS-PFAS-SS03-0001-MSD VWFS-PFAS-SO03 / VWFS-PFAS-SB03-TDBD VWFS-PFAS-SO03 / VWFS-PFAS-SB03-TDBD-MS VWFS-PFAS-SO03 / VWFS-PFAS-SB03-TDBD-MSD VWFS-PFAS-SO03 / VWFS-PFAS-SB03D-TDBD VWFS-PFAS-SO03 / VWFS-PFAS-SB03D-TDBD-MS VWFS-PFAS-SO03 / VWFS-PFAS-SB03D-TDBD-MSD	SS SS SS SB SB SB SB SB SB	0-1' 0-1' 0-1' TBD TBD TBD TBD TBD TBD	PFAS	SS: 3 (N, MS/MSD) SB: 3 (N, MS/MSD) SB: 3 (N, MS/MSD)	
VWFS-PFAS-SO04 / VWFS-PFAS-SS04-0001 VWFS-PFAS-SO04 / VWFS-PFAS-SB04-TDBD VWFS-PFAS-SO04 / VWFS-PFAS-SB04D-TDBD	SS SB SB	0-1' TBD TBD	PFAS	SS: 1 (N) SB: 1 (N) SB: 1 (N)	
VWFS-PFAS-SO05 / VWFS-PFAS-SS05-0001 VWFS-PFAS-SO05 / VWFS-PFAS-SB05-TDBD VWFS-PFAS-SO05 / VWFS-PFAS-SB05D-TDBD	SS SB SB	0-1' TBD TBD	PFAS	SS: 1 (N) SB: 1 (N) SB: 1 (N)	

Sampling Location/ID Number	Matrix	Depth	Analytical Group	Sample Type /Number of Samples	Sampling SOP Reference
Potential Former NASD Motor Pool Area					
GW Samples					
VWMP-PFAS-MW01 / VWMP-PFAS-GW01-MMYY	GW	--	PFAS	1 (N)	B-1 and Groundwater Sampling for PFAS in **Attachment C**
VWMP-PFAS-MW02 / VWMP-PFAS-GW02-MMYY	GW	--	PFAS	1 (N)	B-1 and Groundwater Sampling for PFAS in **Attachment C**
VWMP-PFAS-MW03 / VWMP-PFAS-GW03-MMYY	GW	--	PFAS	1 (N)	B-1 and Groundwater Sampling for PFAS in **Attachment C**
Surface Soil and Subsurface Soil Samples					
VWMP-PFAS-SO01 / VWFS-PFAS-SS01-0001	SS	0-1’	PFAS	SS: 1 (N)	Soil Sampling for PFAS in **Attachment C**
VWMP-PFAS-SO01 / VWFS-PFAS-SB01-TDBD	SB	TBD		SB: 1 (N)	
VWMP-PFAS-SO01 / VWFS-PFAS-SB01D-TDBD	SB	TBD		SB: 1 (N)	
VWMP-PFAS-SO02 / VWFS-PFAS-SS02-0001	SS	0-1’	PFAS	SS: 2 (N, FD) SB: 2 (N, FD) SB: 2 (N, FD)	
VWMP-PFAS-SO02 / VWFS-PFAS-SS02P-0001	SS	0-1’			
VWMP-PFAS-SO02 / VWFS-PFAS-SB02-TDBD	SB	TBD			
VWMP-PFAS-SO02 / VWFS-PFAS-SB02P-TDBD	SB	TBD			
VWMP-PFAS-SO02 / VWFS-PFAS-SB02D-TDBD	SB	TBD			
VWMP-PFAS-SO02 / VWFS-PFAS-SB02DP-TDBD	SB	TBD			
VWMP-PFAS-SO03 / VWFS-PFAS-SS03-0001	SS	0-1’	PFAS	SS: 1 (N)	
VWMP-PFAS-SO03 / VWFS-PFAS-SB03-TDBD	SB	TBD		SB: 1 (N)	
VWMP-PFAS-SO03 / VWFS-PFAS-SB03D-TDBD	SB	TBD		SB: 1 (N)	
VWMP-PFAS-SO04 / VWFS-PFAS-SS04-0001	SS	0-1’	PFAS	SS: 1 (N)	
VWMP-PFAS-SO04 / VWFS-PFAS-SB04-TDBD	SB	TBD		SB: 1 (N)	
VWMP-PFAS-SO04 / VWFS-PFAS-SB04D-TDBD	SB	TBD		SB: 1 (N)	

Sampling Location/ID Number	Matrix	Depth	Analytical Group	Sample Type /Number of Samples	Sampling SOP Reference
NASD AOC H: Abandoned Power Plant					
GW Samples					
VWAH-PFAS-MW01 / VWAH-PFAS-GW01-MMYY VWAH-PFAS-MW01 / VWAH-PFAS-GW01P-MMYY	GW	--	PFAS	2 (N, FD)	B-1 and Groundwater Sampling for PFAS in **Attachment C**
VWAH-PFAS-MW02 / VWAH-PFAS-GW02-MMYY	GW	--	PFAS	1 (N)	
Surface Soil and Subsurface Soil Samples					
VWAH-PFAS-SO01 / VWAH-PFAS-SS01-0002 VWAH-PFAS-SO01 / VWAH-PFAS-SB01-TDBD VWAH-PFAS-SO01 / VWAH-PFAS-SB01D-TDBD	SS SB SB	0-2’ TBD TBD	PFAS	SS: 1 (N) SB: 1 (N) SB: 1 (N)	Soil Sampling for PFAS in **Attachment C**
VWAH-PFAS-SO02 / VWAH-PFAS-SS02-0002 VWAH-PFAS-SO02 / VWAH-PFAS-SB02-TDBD VWAH-PFAS-SO02 / VWAH-PFAS-SB02D-TDBD	SS SB SB	0-2’ TBD TBD	PFAS	SS: 1 (N) SB: 1 (N) SB: 1 (N)	
VWAH-PFAS-SO03 / VWAH-PFAS-SS03-0002 VWAH-PFAS-SO03 / VWAH-PFAS-SB03-TDBD VWAH-PFAS-SO03 / VWAH-PFAS-SB03D-TDBD	SS SB SB	0-2’ TBD TBD	PFAS	SS: 1 (N) SB: 1 (N) SB: 1 (N)	
VWAH-PFAS-SO04 / VWAH-PFAS-SS04-0001 VWAH-PFAS-SO04 / VWAH-PFAS-SB04-TDBD VWAH-PFAS-SO04 / VWAH-PFAS-SB04D-TDBD	SS SB SB	0-1’ TBD TBD	PFAS	SS: 1 (N) SB: 1 (N) SB: 1 (N)	
Sediment and Surface Water Samples					
VWAH-PFAS-SDSW01 / VWAH-PFAS-SD01-0006VWAH-PFAS-SDSW01 / VWAH-PFAS-SD01P-0006 VWAH-PFAS-SDSW01 / VWAH-PFAS-SW01-MMYY VWAH-PFAS-SDSW01 / VWAH-PFAS-SW01P-MMYY	SD SD SW SW	0-6’’ 0-6” - -	PFAS	SD: 1(N) SD: 1 (FD) SW: 1(N) SW: 1(FD)	Sediment Sampling for PFAS and Surface Water Sampling for PFAS SOPs in **Attachment C**
VWAH-PFAS-SDSW02 / VWAH-PFAS-SD02-0006 VWAH-PFAS-SDSW02 / VWAH-PFAS-SD02-0006-MS VWAH-PFAS-SDSW02 / VWAH-PFAS-SD02-0006-MSD VWAH-PFAS-SDSW02 / VWAH-PFAS-SW02-MMYY VWAH-PFAS-SDSW02 / VWAH-PFAS-SW02-MMYY-MS VWAH-PFAS-SDSW02 / VWAH-PFAS-SW02-MMYY-MSD	SD SD SD SW SW SW	0-6’’ 0-6’’ 0-6’’ - - -	PFAS	SD: 1(N) SD: 1(MS) SD: 1(MSD) SW: 1(N) SW: 1(MS) SW: 1(MSD)	
VWAH-PFAS-SDSW03 / VWAH-PFAS-SD03-0006 VWAH-PFAS-SDSW03 / VWAH-PFAS-SW03-MMYY	SD SW	0-6’’ -	PFAS	SD: 1(N) SW: 1(N)	

Sampling Location/ID Number	Matrix	Depth	Analytical Group	Sample Type /Number of Samples	Sampling SOP Reference
NASD SWMU 6: Former Mangrove Disposal Site					
Surface Soil and Subsurface Soil Samples					
VWS6-PFAS-SO01 / VWS6-PFAS-SS01-0002 VWS6-PFAS-SO01 / VWS6-PFAS-SB01-TDBD	SS SB	0-2' TBD	PFAS	SS: 1 (N) SB: 1 (N)	Soil Sampling for PFAS in **Attachment C**
Sediment and Surface Water Samples					
VWS6-PFAS-SDSW01 / VWS6-PFAS-SD01-0006 VWS6-PFAS-SDSW01 / VWS6-PFAS-SW01-MMYY	SD SW	0-6'' -	PFAS	SD: 1 (N) SW: 1(N)	Sediment Sampling for PFAS and Surface Water Sampling for PFAS SOPs in **Attachment C**
VWS6-PFAS-SDSW02 / VWS6-PFAS-SD02-0006 VWS6-PFAS-SDSW02 / VWS6-PFAS-SW02-MMYY	SD SW	0-6'' -	PFAS	SD: 1 (N) SW: 1(N)	
NASD SWMU 7: Former Quebrada Disposal Site					
GW Samples					
VWS7-PFAS-MW01 / VWS7-PFAS-GW01-MMYY	GW	--	PFAS	1 (N)	B-1 and Groundwater Sampling for PFAS in **Attachment C**
Surface Soil and Subsurface Soil Samples					
VWS7-PFAS-SO01 / VWS7-PFAS-SS01-0001 VWS7-PFAS-SO01 / VWS7-PFAS-SS01P-0001 VWS7-PFAS-SO01 / VWS7-PFAS-SB01-TDBD VWS7-PFAS-SO01 / VWS7-PFAS-SB01P-TDBD VWS7-PFAS-SO01 / VWS7-PFAS-SB01D-TDBD VWS7-PFAS-SO01 / VWS7-PFAS-SB01DP-TDBD	SS SS SB SB SB SB	0-1' 0-1' TBD TBD TBD TBD	PFAS	SS: 1 (N) SS: 1 (FD) SB: 1 (N) SB: 1 (FD) SB: 1 (N) SB: 1 (FD)	Soil Sampling for PFAS in **Attachment C**
VWS7-PFAS-SO02 / VWS7-PFAS-SS02-0001 VWS7-PFAS-SO02 / VWS7-PFAS-SB02-TDBD VWS7-PFAS-SO02 / VWS7-PFAS-SB02D-TDBD	SS SB SB	0-1' TBD TBD	PFAS	SS: 1 (N) SB: 1 (N) SB: 1 (N)	
VWS7-PFAS-SO03 / VWS7-PFAS-SS03-0001 VWS7-PFAS-SO03 / VWS7-PFAS-SB03-TDBD VWS7-PFAS-SO03 / VWS7-PFAS-SB03D-TDBD	SS SB SB	0-1' TBD TBD	PFAS	SS: 1 (N) SB: 1 (N) SB: 1 (N)	

Sampling Location/ID Number	Matrix	Depth	Analytical Group	Sample Type /Number of Samples	Sampling SOP Reference
VNTR Camp Garcia Runway					
GW Samples					
VERW-PFAS-MW01 / VERW-PFAS-GW01-MMYY	GW	--	PFAS	1 (N)	B-1 and Groundwater Sampling for PFAS in **Attachment C**
VERW-PFAS-MW02 / VERW-PFAS-GW02-MMYY	GW	--	PFAS	1 (N)	
EPI04-MW26 / EPI04-PFAS-GW26-MMYY	GW	--	PFAS	1 (N)	
Surface Soil and Subsurface Soil Samples					
VERW-PFAS-SO01 / VERW-PFAS-SS01-0001 VERW-PFAS-SO01 / VERW-PFAS-SB01-TDBD VERW-PFAS-SO01 / VERW-PFAS-SB01D-TDBD	SS SB SB	0-1' TBD TBD	PFAS	SS: 1 (N) SB: 1 (N) SB: 1 (N)	Soil Sampling for PFAS in **Attachment C**
VERW-PFAS-SO02 / VERW-PFAS-SS02-0001 VERW-PFAS-SO02 / VERW-PFAS-SB02-TDBD VERW-PFAS-SO02 / VERW-PFAS-SB02D-TDBD	SS SB SB	0-1' TBD TBD	PFAS	SS: 1 (N) SB: 1 (N) SB: 1 (N)	
VERW-PFAS-SO03 / VERW-PFAS-SS03-0001 VERW-PFAS-SO03 / VERW-PFAS-SB03-TDBD VERW-PFAS-SO03 / VERW-PFAS-SB03D-TDBD	SS SB SB	0-1' TBD TBD	PFAS	SS: 1 (N) SB: 1 (N) SB: 1 (N)	
VERW-PFAS-SO04 / VERW-PFAS-SS04-0001 VERW-PFAS-SO04 / VERW-PFAS-SB04-TDBD VERW-PFAS-SO04 / VERW-PFAS-SB04D-TDBD	SS SB SB	0-1' TBD TBD	PFAS	SS: 1 (N) SB: 1 (N) SB: 1 (N)	
VERW-PFAS-SO05 / VERW-PFAS-SS05-0001 VERW-PFAS-SO05 / VERW-PFAS-SB05-TDBD VERW-PFAS-SO05 / VERW-PFAS-SB05D-TDBD	SS SB SB	0-1' TBD TBD	PFAS	SS: 1 (N) SB: 1 (N) SB: 1 (N)	
PI 5: Surface Water Drainage Area from Camp Garcia Runway					
GW Samples					
VEP5-PFAS-MW01 / VEP5-PFAS-GW01-MMYY	GW	--	PFAS	1 (N)	B-1 and Groundwater Sampling for PFAS in **Attachment C**

Sampling Location/ID Number	Matrix	Depth	Analytical Group	Sample Type /Number of Samples	Sampling SOP Reference
Surface Soil and Subsurface Soil Samples					
VEP5-PFAS-SO01 / VEP5-PFAS-SS01-0001 VEP5-PFAS-SO01 / VEP5-PFAS-SB01-TDBD VEP5-PFAS-SO01 / VEP5-PFAS-SB01D-TDBD	SS SB SB	0-1' TBD TBD	PFAS	SS: 1 (N) SB: 1 (N) SB: 1 (N)	Soil Sampling for PFAS in **Attachment C**
VEP5-PFAS-SO02 / VEP5-PFAS-SS02-0001VEP5-PFAS-SO02 / VEP5-PFAS-SB02-TDBD VEP5-PFAS-SO02 / VEP5-PFAS-SB02D-TDBD	SSSB SB	0-1'TBD TBD	PFAS	SS: 1 (N)SB: 1 (N) SB: 1 (N)	
VNTR SWMU 20: Former Helicopter Maintenance Area					
GW Samples					
EPI04-MW01 / VEP4-PFAS-GW01-MMYY	GW	--	PFAS	1 (N)	B-1 and Groundwater Sampling for PFAS in **Attachment C**
EPI04-MW02 / VEP4-PFAS-GW02-MMYY	GW	--	PFAS	1 (N)	
EPI04-MW06 / VEP4-PFAS-GW06-MMYY	GW	--	PFAS	1 (N)	
EPI04-MW24 / VEP4-PFAS-GW24-MMYY	GW	--	PFAS	1 (N)	
Surface Soil and Subsurface Soil Samples					
EPI04-SO01 / VEP4-PFAS-SS01-0001EPI04-SO01 / VEP4-PFAS-SB01-TDBD EPI04-SO01 / VEP4-PFAS-SB01D-TDBD	SSSB SB	0-1'TBD TBD	PFAS	SS: 1 (N)SB: 1 (N) SB: 1 (N)	Soil Sampling for PFAS in **Attachment C**
Potential Former VNTR Motor Pool Area (including Building 340) and Former Fire Department Building 330					
GW Samples					
VEFS-PFAS-MW01 / VEFS-PFAS-GW01-MMYY	GW	--	PFAS	1 (N)	B-1 and Groundwater Sampling for PFAS in **Attachment C**
VEFS-MW02 / VEFS-PFAS-GW02-MMYY	GW	--	PFAS	1 (N)	
Subsurface Soil Samples					
VEFS-SO01 / VEFS-PFAS-SB01-TDBD VEFS-SO01 / VEFS-PFAS-SB01D-TDBD	SB	TBD	PFAS	SB: 2 (N)	Soil Sampling for PFAS in **Attachment C**
VEFS-SO02 / VEFS-PFAS-SB02-TDBD VEFS-SO02 / VEFS-PFAS-SB02D-TDBD	SB	TBD	PFAS	SB: 2 (N)	

Sampling Location/ID Number	Matrix	Depth	Analytical Group	Sample Type /Number of Samples	Sampling SOP Reference
VNTR SWMU 10 and VNTR AOC G: Former Sewage Treatment Lagoons and Chlorination Building					
GW Samples					
VEW10-PFAS-MW01 / VEW10-PFAS-GW01-MMYY	GW	--	PFAS	1 (N)	B-1 and Groundwater Sampling for PFAS in **Attachment C**
VEW10-PFAS-MW02 / VEW10-PFAS-GW02-MMYY	GW	--	PFAS	1 (N)	
VEW10-PFAS-MW03 / VEW10-PFAS-GW03-MMYY	GW	--	PFAS	1 (N)	
VEW10-PFAS-MW04 / VEW10-PFAS-GW04-MMYY	GW	--	PFAS	1 (N)	
Surface Soil and Subsurface Soil Samples					
VEW10-PFAS-SO01 / VEW10-PFAS-SS01-0001	SS	0-1’	PFAS	SS: 1 (N)	Soil Sampling for PFAS in **Attachment C**
VEW10-PFAS-SO01 / VEW10-PFAS-SB01-TDBD	SB	TBD		SB: 1 (N)	
VEW10-PFAS-SO01 / VEW10-PFAS-SB01D-TDBD	SB	TBD		SB: 1 (N)	
VEW10-PFAS-SO02 / VEW10-PFAS-SS02-0001	SS	0-1’	PFAS	SS: 1 (N)	
VEW10-PFAS-SO02 / VEW10-PFAS-SB02-TDBD	SB	TBD		SB: 1 (N)	
VEW10-PFAS-SO02 / VEW10-PFAS-SB02D-TDBD	SB	TBD		SB: 1 (N)	
VEW10-PFAS-SO03 / VEW10-PFAS-SS03-0001	SS	0-1’	PFAS	SS: 1 (N)	
VEW10-PFAS-SO03 / VEW10-PFAS-SB03-TDBD	SB	TBD		SB: 1 (N)	
VEW10-PFAS-SO03 / VEW10-PFAS-SB03D-TDBD	SB	TBD		SB: 1 (N)	
VEW10-PFAS-SO04 / VEW10-PFAS-SS04-0001	SS	0-1’	PFAS	SS: 1 (N)	
VEW10-PFAS-SO04 / VEW10-PFAS-SB04-TDBD	SB	TBD		SB: 1 (N)	
VEW10-PFAS-SO04 / VEW10-PFAS-SB04D-TDBD	SB	TBD		SB: 1 (N)	
VEW10-PFAS-SO05 / VEW10-PFAS-SS05-0001	SS	0-1’	PFAS	SS: 1 (N)	
VEW10-PFAS-SO05 / VEW10-PFAS-SB05-TDBD	SB	TBD		SB: 1 (N)	
VEW10-PFAS-SO05 / VEW10-PFAS-SB05D-TDBD	SB	TBD		SB: 1 (N)	
VEW10-PFAS-SO06 / VEW10-PFAS-SS06-0001	SS	0-1’	PFAS	SS: 1 (N)	
VEW10-PFAS-SO06 / VEW10-PFAS-SB06-TDBD	SB	TBD		SB: 1 (N)	
VEW10-PFAS-SO06 / VEW10-PFAS-SB06D-TDBD	SB	TBD		SB: 1 (N)	

Sampling Location/ID Number	Matrix	Depth	Analytical Group	Sample Type /Number of Samples	Sampling SOP Reference
VNTR SWMU 1: Former Camp Garcia Municipal Solid Waste Management Unit (Landfill)					
GW Sampling					
CGW1MW02 / VEW01-PFAS-MW02-MMYY	GW	--	PFAS	1 (N)	B-1 and Groundwater Sampling for PFAS in **Attachment C**
CGW1MW03 / VEW01-PFAS-MW03-MMYY	GW	--	PFAS	1 (N)	
CGW1MW06 / VEW01-PFAS-MW06-MMYY	GW	--	PFAS	1 (N)	
CGW1MW08 / VEW01-PFAS-MW08-MMYY	GW	--	PFAS	1 (N)	
CGW1MW10 / VEW01-PFAS-MW10-MMYY	GW	--	PFAS	1 (N)	
CGW1MW11 / VEW01-PFAS-MW11-MMYY	GW	--	PFAS	1 (N)	
Camp Garcia Spigot Water Sample					
AQ-PFAS-01 / AQ-PFAS-01-MMYY	AQ	-	PFAS	1 (N)	B-1 and Groundwater Sampling for PFAS in **Attachment C**
Field QC					
VWFS-QC / VWFS-EB01-MMDDYY-GW	EB[1]	--	PFAS	1 (EB)	H-6
VERW-QC / VERW-EB01-MMDDYY-GW	EB[1]	--	PFAS	1 (EB)	H-6
VEW10-QC / VEW10-EB01-MMDDYY-GW	EB[1]	--	PFAS	1 (EB)	H-6
VWS7-QC / VWS7-EB01-MMDDYY-SS	EB[1]	--	PFAS	1 (EB)	H-6
VERW-QC / VERW-EB01-MMDDYY-SB	EB[1]	--	PFAS	1 (EB)	H-6
VWAB-QC / VWAB-EB01-MMDDYY-SS	EB[1]	--	PFAS	1 (EB)	H-6
VWAH-QC / VWAH-EB01-MMDDYY-SS	EB[1]	--	PFAS	1 (EB)	H-6
VWAH-QC / VWAH-EB01-MMDDYY-SW	EB[1]	--	PFAS	1 (EB)	H-6
EPI04-QC / EPI04-EB01-MMDDYY-SB	EB[1]	--	PFAS	1 (EB)	H-6
VWMP-QC / VWMP-EB01-MMDDYY-SB	EB[1]	--	PFAS	1 (EB)	H-6
VEW10-QC / VEW10-EB01-MMDDYY-SS	EB[1]	--	PFAS	1 (EB)	H-6
VWAB-QC / VWAB-EB01-MMDDYY-SB	EB[1]	--	PFAS	1 (EB)	H-6
VWAH-QC / VWAH-EB01-MMDDYY-SB	EB[1]	--	PFAS	1 (EB)	H-6
VEP5-QC / VEP5-MMDDYY-SB	EB[1]	--	PFAS	1 (EB)	H-6

Sampling Location/ID Number	Matrix	Depth	Analytical Group	Sample Type /Number of Samples	Sampling SOP Reference
VEFS-QC / VEFS-MMDDYY-SB	EB[1]	--	PFAS	1 (EB)	H-6
VEW10-QC / VEW10-MMDDYY-SB	EB[1]	--	PFAS	1 (EB)	H-6
VWAH-QC / VWAH-EB01-MMDDYY-SD	EB[1]	--	PFAS	1 (EB)	H-6

Notes:

1. The number of equipment blanks is based on a fundamental assumption. For surface and subsurface soil samples, it was assumed that 10 samples can be collected per day.
2. These depths will be taken from below the gravel at the first indication of natural soil. That depth will be considered the surface from which to start taking surface samples.
3. Subsurface soil sample depth will be referenced from the depth native soil was first encountered to maintain consistency.

D = depth
EB = equipment blank
FD = field duplicate
GW = groundwater
MMYY = Two-digit month and year of sampling date
MS = matrix spike
MSD = matrix spike duplicate
N = normal sample
QC = quality control
SB = subsurface soil
SD = sediment
SS = surface soil
TDBD = Top depth, bottom depth in feet (i.e., 0-6" is 000H)
TBD = To be determined; subsurface soil sample depth range to be determined based on field conditions

Worksheet #19 & 30: Sample Containers, Preservation, and Hold Times

Laboratory: Battelle
141 Longwater Drive, Suite 202
Norwell, MA 02061
781-681-5565
POC: Jonathan Thorn

Accreditations/certifications: DoD- ELAP for QSM v5.3

Back-up Laboratory: Vista Analytical Laboratory
1104 Windfield Way
El Dorado Hills, CA 95762
Phone: 916-673-1520
POC: Jade White

(UFP-QAPP Manual Section 3.1.2.2)

Analytical Group	Matrix	Analytical and Preparation Method / SOP Reference	Containers[1] (number, size &type per sample)	Accreditation Expiration Date	Sample Volume[2]	Preservation Requirements	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround Time
PFAS	GW, SW	LC-MS/MS Compliant with QSM 5.3 Table B-15/SOP 5-370-10; SOP 5-369-08	Two of 250ml HDPE	28 Feb 2021	250mL	< 10°C but not frozen	14 days	28 days	Standard 28 calendar-day TAT
PFAS	SS, SB, SD	LC-MS/MS Compliant with QSM 5.3 Table B-15/SOP 5-370-10; SOP 5-369-08	One of 8oz HDPE jar	28 Feb 2021	30g	< 10°C but not frozen	14 days	28 days	Standard 28 calendar-day TAT

Notes:

If circumstances render the subcontracted laboratory unable to perform the analytical services, the backup laboratory will be contacted to confirm accreditations and quarterly LOD verification and the SAP updated with all associated laboratory worksheets and current ELAP accreditation letter.

1. Triple volume is provided for samples designated MS/MSD.

2. Samples volumes shown are preparation amounts. Containers are filled to capacity.

Analytical Group	Matrix	Analytical and Preparation Method / SOP Reference	Containers[1] (number, size &type per sample)	Accreditation Expiration Date	Sample Volume[2]	Preservation Requirements	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround Time

°C = degree Celsius
HDPE = high-density polyethylene
LC-MS = Liquid Chromatography-Mass Spectrometry
ml = milliliter(s)
QSM = quality system manual
TAT = turnaround time

Worksheet #20: Field Quality Control

(UFP-QAPP Manual Section 3.1.1 and 3.1.2)

Matrix	Analytical Group	No. of Field Samples/Sampling Locations	No. of Field Duplicates	No. of MS/MSD Pairs	No. of Equipment Rinsate Blanks	Total No. of Samples to Lab
Groundwater (GW)	PFAS	29	3	2	3	39
Surface Soil (SS)	PFAS	35	4	2	4	47
Subsurface Soil (SB)	PFAS	37	4	2	4	49
Deep Subsurface Soil (SB)	PFAS	36	4	2	4	48
Sediment (SD)	PFAS	5	1	1	1	9
Surface Water (SW)	PFAS	5	1	1	1	9

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Worksheet #21: Field Standard Operating Procedures

Reference numbers refer to the SOP number in the Master Protocols (CH2M, 2018).

SOP # or Reference	Title, Revision, Date, and URL (if available)	Originating Organization	SOP Option or Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP B-1	Groundwater Sampling Procedure Low Stress (Low Flow) Purging and Sampling	CH2M	SOP to be used for groundwater sampling procedures and the Groundwater Sampling for PFAS for collecting PFAS groundwater samples in **Attachment C** to be used for sampling materials.	N	N/A
SOP C-1	Calibration and Measurement with Field Instruments, Oct 2018	CH2M	Water quality meter, calibration solution, distilled water	N	N/A
SOP D-1	Monitoring Well Installation, Oct 2018	CH2M	Drill rig, PFAS-free well construction materials (casing, screens, riser, plugs, sand, bentonite, grout, etc.)	N	N/A
SOP D-2	Monitoring Well Development, Oct 2018	CH2M	Drill rig, PFAS-free well development materials (Surge block, pipe, tubing, well development pump etc.)	N	N/A
SOP E-1	Decontamination of Personnel and Equipment, Oct 2018	CH2M	Certified PFAS-free water, distilled water, potable water, 2.5 percent Liquinox and water solution, methanol, plastic pails, 55-gallon drum for waste, gloves, decontamination pad, steam cleaner	N	N/A
SOP E-2	Decontamination of Drilling Rigs and Equipment, Oct 2018	CH2M	Steam cleaner, potable water, Liquinox, buckets, brushes, distilled water, methanol, deionized water, PFAS-free aluminum foil	N	N/A
SOP H-1	Preparing Field Notes, Oct 2018	CH2M	Loose leaf paper, Masonite or metal clipboard, ink pen (not Sharpie)	N	N/A
SOP H-2	Water-Level Measurements, Oct 2018	CH2M	Water level meter, interface probe	N	N/A
SOP H-4	Chain–of-Custody, Oct 2018	CH2M	Paper chain-of-custody form (provided by laboratory)	N	N/A

SOP # or Reference	Title, Revision, Date, and URL (if available)	Originating Organization	SOP Option or Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP H-6	Equipment Blank and Field Blank Preparation, Oct 2018	CH2M	Blank liquid (use American Society for Standards and Materials Type II grade certified PFAS-free water), sample bottles, gloves	N	N/A
SOP H-7	Surveying Specifications, Oct 2018	CH2M	Horizontal control work can be done using either standard surveying techniques or GPS techniques meeting the accuracy and specification requirements outlined in this scope	N	N/A
SOP I-1	Vegetation Clearance for Environmental Investigations, Oct 2018	CH2M	Follow the steps for developing site-specific vegetation clearance process, threatened or endangered species survey, develop study area map, initial site visit, document proposed route, conduct site visit with USFWS	N	N/A
Soil Sampling for PFAS	Soil Sampling for PFAS, Oct 2019	CH2M	Stainless steel tools, carbon steel tools, or steel tools with acetate sleeves; avoid Teflon, Viton, polytetrafluoroethylene (PTFE) or other fluorinated compounds	N	SOP in **Attachment C**
Groundwater Sampling for PFAS	Groundwater Sampling for PFAS, Oct 2019	CH2M	PFAS-free drilling equipment (lube and surge blocks), Teflon-free tubing, Teflon free bailer, PFAS-free pump, groundwater sample containers (high density polyethylene), laboratory prepared deionized, certified PFAS-free water, PFAS-free shipping supplies (labels, coolers, and ice), loose leaf paper without waterproof coating or a spiralbound notebook (not waterproof), metal clip board (if using loose-leaf paper), pen (not Sharpie), nitrile or latex gloves	N	SOP in **Attachment C**
Sediment Sampling for PFAS	Sediment Sampling for PFAS, Oct 2019	CH2M	PFAS-free sample collection device(s) (check with Subject Matter Expert), stainless steel or PFAS-free scoops, PPE (boots, gloves, hip waders etc. PFAS-free)	N	SOP in **Attachment C**

SOP # or Reference	Title, Revision, Date, and URL (if available)	Originating Organization	SOP Option or Equipment Type	Modified for Project Work? (Y/N)	Comments
Surface Water Sampling for PFAS	Surface Water Sampling for PFAS, Oct 2019	CH2M	PFAS-free sample collection device(s) (open tube sampler, dip sampler, weighted bottle sampler [no glass]), hand pump without Teflon components, Van Dorn sampler (Kemmerer cannot be used as it has Teflon caps), depth-integrating sampler, peristaltic pump). Sample containers (high density polyethylene with plastic screw cap [no Teflon caps]), PFAS-free shipping materials, loose leaf paper or a wire-bound notebook without waterproof coating, metal clipboard, pen (not Sharpie), nitrile or latex gloves (do not use Kleen Guard powder free nitrile gloves which were shown in research to contain fluorine), meters for specific conductance, temperature, pH, and DO, PPE (boots, gloves, hip waders, etc. PFAS-free)	N	SOP in **Attachment C**
Management of Liquid Waste Containing PFAS	Management of Liquid Waste Containing PFAS, Sep 2017	CH2M	Flow chart for IDW management	N	SOP in **Attachment C**

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Worksheet #22: Field Equipment Calibration, Maintenance, Testing, and Inspection

Field Equipment	Activity	SOP Reference	Title or position of responsible person	Frequency	Acceptance Criteria	Corrective Action
pH Probe	Calibrate probe using Calibration Standard Solution	SOP C-1	FTL	Daily, before use	pH reads 4.00 ±3%	Clean probe with deionized water and calibrate again. Do not use this instrument if unable to calibrate properly.
Specific Conductance Probe	Calibrate probe using Calibration Standard Solution	SOP C-1	FTL	Daily, before use	Conductivity reads 4.490 ±3%	Clean probe with deionized water and calibrate again. Do not use this instrument if unable to calibrate properly.
Turbidity Probe	Calibrate probe using Calibration Standard Solution	SOP C-1	FTL	Daily, before use	Turbidity reads 0.00 not to exceed 0.03 NTU	Clean probe with deionized water and calibrate again. Do not use this instrument if unable to calibrate properly.
DO and Temperature Probes	Calibrate probe using calibration Standard Solution	SOP C-1	FTL	Daily, before use	Consistent with the current atmospheric pressure and ambient temperature	Clean probe with deionized water and calibrate again. Do not use this instrument if unable to calibrate properly.
ORP	Calibrate using Zobell Solution	SOP C-1	FTL	Daily, before use	±10 millivolts (mV) of the theoretical redox standard value at that temperature	Clean probe with deionized water and calibrate again. Do not use this instrument if unable to calibrate properly.

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Worksheet #23: Analytical Standard Operating Procedures

(UFP-QAPP Manual Section 3.2.1)

Lab SOP Number	Title, Revision Date, and/or Number	Date last Revisited if not Revised[1]	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis[2]	Modified for Project Work?
5-369-08	PFAS Analytical; October 2019; Rev. 8	--	Definitive	SS, SB, SD, GW, SW / PFAS	LC-MS/MS	Battelle	N
5-370-10	PFAS Sample Preparation; March 2020; Rev. 10	--	Definitive	SS, SB, SD, GW, SW / PFAS	--	Battelle	N
6-010-19	Sample Receipt, Custody, and Handling; October 2018; Rev. 19	--	--	Sample Receipt	--	Battelle	N
5-114-09	The Storage and Disposal of Regulated and Non-Regulated Waste, 1/2015 (reviewed 7/18), Revision 9	--	--	Sample Disposal	--	Battelle	N

Notes:

1. Non-analytical SOPs do not require an annual review cycle. **Worksheet #23** is a snapshot as it pertains to laboratory SOPs.

2. Battelle's DoD ELAP accreditation through Perry Johnson Laboratory Accreditation, Inc. (PJLA) (QSM Version 5.3) is granted to 2/28/21. Refer to **Attachment D**.

LC-MS = Liquid Chromatography-Mass Spectrometry

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Worksheet #24: Analytical Instrument Calibration

(UFP-QAPP Manual Section 3.2.2)

Instrument	Calibration Procedure[1]	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference
Liquid Chromatography-Mass Spectrometry (LC-MS)/MS (for PFAS)	Initial Calibration (ICAL)	At instrument setup and after initial calibration verification (ICV) or continuing calibration verification (CCV) failure, prior to sample analysis. Calibration can be linear (minimum of 5 standards) or quadratic (minimum of 6 standards); weighting is allowed.	The isotopically labeled analog of an analyte (Extracted Internal Standard Analyte) must be used for quantitation if commercially available (Isotope Dilution Quantitation). If a labeled analog is not commercially available, the Extracted Internal Standard Analyte with the closest retention time to the analyte must be used for quantitation. (Internal Standard Quantitation) Signal-to-noise (S/N) Ratio: ≥ 10:1 for all ions used for quantification. For analytes having a promulgated standard, (e.g., HA levels for PFOA and PFOS) the qualitative (confirmation) transition ion must have an S/N Ratio of ≥ 3:1. The % relative standard deviation (RSD) of the response factors for all analytes must be <20%. Linear or nonlinear calibrations must have $r^2 \geq 0.99$ for each analyte. Analytes must be within 70-30% of their true value for each calibration standard. Isotope Dilution or Internal Standard Calibration is required for all analytes. External Calibration is not allowed.	Correct problem then repeat ICAL. Flagging criteria are not appropriate. No samples shall be analyzed until ICAL has passed.	Analyst	5-369-08
	ICV	Once after each ICAL, analysis of a second source standard prior to sample analysis.	Analyte concentrations must be within ±30% of their true value. No samples shall be analyzed until calibration has been verified.	Correct problem. Rerun ICV. If that fails, repeat ICAL. Flagging is not appropriate. No samples shall be analyzed until calibration has been verified with a second source.		
	Calibration, Calibration Verification, and Spiking Standards	All Analytes. Prior to sample analysis, after every 10 field samples, and at the end of the analytical sequence.	Standards containing both branched and linear isomers must be used when commercially available. PFAS method analytes may consist of both branched and linear isomers, but quantitative standards that contain the linear and branched isomers do not exist for all method analytes. For PFAS that do not have a quantitative branched and linear standard, identify the branched isomers by analyzing a qualitative standard that includes both linear and branched isomers and determine retention times, transitions, and transition ion ratios. Quantitate samples by integrating the total response (i.e., accounting for peaks that are identified as linear and branched isomers) and relying on the initial calibration that uses the linear isomer quantitative standard. Standards containing both branched and linear isomers are to be used during method validation to ensure the total response is quantitated for that analyte. Technical grade standards cannot be used for quantitative analysis. Analyte concentrations must be within ±30% of their true value.	Flagging is not appropriate.		
	Tune Check	When the masses fall outside of the ±0.5 atomic mass unit of the true value (as determined by the product ion formulas).	Mass assignments of tuning standard within 0.5 atomic mass unit (amu) of true value.	Retune instrument and verify. If the tuning will not meet acceptance criteria, an instrument mass calibration must be performed and the tuning redone. Flagging criteria are not appropriate. No samples shall be analyzed without a valid tune.		

Instrument	Calibration Procedure[1]	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference
	Mass Calibration	Initially prior to use and after performing major maintenance, as required to maintain documented instrument sensitivity and stability performance.	Calibrate the mass scale of the MS with calibration compounds and procedures described by the manufacturer. Entire range needs to be mass calibrated.	Flagging is not appropriate.		
	Mass Spectral Acquisition Rate	Each analyte, Extracted Internal Standard Analyte, and Injection Internal Standard Analyte.	A minimum of 10 spectra scans are acquired across each chromatographic peak.	Flagging is not appropriate.		
	Ion Transitions (Parent -> Product)	Ion Transitions (Parent -> Product)	Prior to method implementation.	The chemical derivation of the ion transitions, both those used for quantitation and those used for confirmation, must be documented. Two transitions and the ion transition ratio per analyte shall be monitored and documented with the exception of PFBA and PFPeA. In order to avoid biasing results high due to known inferences for some transitions, the following transitions must be used for the quantification of the following analytes: PFOA: 413 —› 369 PFOS: 499 —› 80 PFHxS: 399 —› 80 PFBS: 299 —› 80 4:2 FTS: 327 —› 307 6:2 FTS: 427 —› 407 8:2 FTS: 527 —› 507 NEtFOSAA: 584 —› 419 NMeFOSAA: 570 —› 419 If these transitions are not used, the reason must be technically justified and documented (e.g., alternate transition was due to observed interferences).		
	Instrument Sensitivity Check (ISC)	Prior to analysis and at least once every 12 hours.	Analyte concentrations must be at LOQ; concentrations must be within ±30% of their true values. No samples shall be analyzed until ISC has met acceptance criteria. ISC can serve as the initial daily CCV.	Correct problem, rerun ISC. If problem persists, repeat ICAL. Flagging is not appropriate.		

1. DoD QSM v. 5.3 is the basis for specifications shown on this table.

2. The analytical method and laboratory SOP is the basis for specifications shown on this table.

CCV = continuing calibration verification
ICAL = initial calibration
ICV = second source calibration verification
LC-MS = Liquid Chromatography-Mass Spectrometry
RSD = relative standard deviation

Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection

(UFP-QAPP Manual Section 3.2.3)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
LC-MS/MS	Clean Curtain Plate	LC/MS/MS	Visual inspection of curtain plate for residue.	As needed when curtain plate has visible residue present.	No visible residue on curtain plate.	Remove and clean the instrument curtain plate.	Analyst	5-369-08
	Preventative Maintenance	LC/MS/MS	Degradation of instrument performance.	Every six months or when instrument performance deteriorates.	ICAL within acceptance criteria on **Worksheet #24** and internal standards recovery within acceptance criteria on **Worksheet #28**.	Service provider performs preventative maintenance and mass calibration. Run tune check. Re-analyze samples with new ICAL, ICC, ISC, and instrument blank.		
	Replace Analytical Column	LC/MS/MS	Review peak shape, retention times, and peak separation on ICAL, ICC, and CCV samples.	Performed when chromatography deteriorates.	ICAL within acceptance criteria on **Worksheet #24** and internal standards recovery within acceptance criteria on **Worksheet #28**.	Replace analytical column. Reanalyze samples with new ICAL, ICC, ISC, and instrument blank.		
	Clean pump rollers, remove rust, and apply silicon spray. Replace O-rings, clean valve ports, replace stained tubing.	--	--	Monthly	--	--		

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Worksheet #26 & 27: Sample Handling, Custody, and Disposal

(UFP-QAPP Manual Section 3.3)

Sampling Organization: CH2M
Laboratory: Battelle
Method of sample delivery (shipper/carrier): FedEx
Number of days from reporting until sample disposal: 90 days

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT	
Sample Collection (Personnel/Organization):	FTL/CH2M
Sample Packaging (Personnel/Organization):	Sample processor or field team member/CH2M
Coordination of Shipment (Personnel/Organization):	Sample processor or field team member/CH2M
Type of Shipment/Carrier:	Overnight/FedEx
SAMPLE RECEIPT AND ANALYSIS	
Sample Receipt (Personnel/Organization):	Sample receipt personnel/Battelle
Sample Custody and Storage (Personnel/Organization):	Same personnel as for sample receipt
Sample Preparation (Personnel/Organization):	Preparations personnel/Battelle
Sample Determinative Analysis (Personnel/Organization):	Analyst/Battelle
SAMPLE ARCHIVING	
Field Sample Storage (Number of days from sample collection):	90 Days
Sample Extract/Digestate Storage (Number of days from extraction/digestion):	Extracts and digestates may be disposed of 90 days after extraction
Biological Sample Storage (Number of days from sample collection):	N/A
SAMPLE DISPOSAL	
Personnel/Organization:	Environmental H&S Officer/Battelle
Number of Days from Analysis:	Samples may be disposed of 90 days after report mail date

Sample Labeling

Sample labels will include, at a minimum, client name, site, sample ID, date/time collected, analysis group or method, preservative, and sampler's initials. Labels will be taped to the containers, so they do not separate. The following exceptions may apply:

- N/A

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory)

Samples will be collected by field team members under the supervision of the FTL. As samples are collected, they will be placed into containers and labeled, as outlined previously. Samples will be cushioned with packaging material and placed into coolers containing enough ice to keep the samples at less than or equal to 6 degrees Celsius (°C), but not freezing, until they are received by the laboratory. The chain-of-custody will also be placed into the cooler. Coolers will be shipped to the laboratory via FedEx, with the air bill number indicated on the chain-of-custody (to relinquish custody). Upon delivery, the laboratory will log in each cooler and report the status of the samples.

All fractions are sent directly to Battelle, the laboratory performing the analysis.

Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal)

Please refer to 6-010-19 for Sample Receipt, Custody, and Handling, and 5-114-09 for Sample Disposal at Battelle (**Attachment E**).

Sample Identification Procedures

Upon opening the cooler, the receiving clerk signs the chain-of-custody and then takes the temperature using the temperature blank (if absent, then a sample container or infrared thermometer is used). The sample containers in the cooler are unpacked and checked against the client's chain-of-custody, and any discrepancies or breakage is noted on the chain-of-custody. Next, if any water samples require preservative, the clerk will check the pH values to see if they are in the acceptable pH range. For purgeable fractions, pH is checked following analysis. The clerk will deliver the chain-of-custody (and any other paperwork, e.g., temperature or pH QA notice) to the project manager for Laboratory Information System (LIMS) entry and client contact (if needed).

The field logbook will identify the sample ID with the location, depth, date/time collected, and the parameters requested. The laboratory will assign each field sample a laboratory sample ID based on information in the chain-of-custody. The laboratory will send sample login forms to the project data manager to check sample IDs and parameters are correct.

Chain-of-Custody Procedures

Chains-of-custody will include, at a minimum, laboratory contact information, client contact information, sample information, and relinquished by/received by information. Sample information will include sample ID, date/time collected, number and type of containers, preservative information, analysis method, and comments. The chain-of-custody also will have the sampler's name and signature. The chain-of-custody will link location of the sample from the field logbook to the laboratory receipt of the sample. The laboratory will use the sample information to populate the LIMS database for each sample.

Worksheet #28-1: Analytical Quality Control and Corrective Action (PFAS in Soil/Sediment)

(UFP-QAPP Manual Section 3.4

Matrix: SB, SS, SD
Analytical Group: PFAS
Analytical Method / SOP Reference: LC-MS/MS Compliant with QSM 5.3 Table B-15 / SOP 5-369-08

QC Sample[1]	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator	Measurement Performance Criteria
Sample Cleanup Procedure using ENVI-Carb™ or equivalent	Each sample and associated batch QC samples. Not applicable to AFFF formulation samples.	Removal of inferences from matrix. Cleanup should reduce bias from matrix background.	Flagging is not appropriate.	Analyst	--	--
Instrument Blanks	Immediately following the highest standard analyzed and daily prior to sample analysis.	Concentration of each analyte must be ≤ 1/2 the LOQ.	If acceptance criteria are not met after the highest calibration standard, calibration must be performed using a lower concentration for the highest standard until acceptance criteria is met. If acceptance criteria are not met after the highest standard which is not included in the calibration, the standard cannot be used to determine the highest concentration samples at which carryover does not occur. If acceptance criteria are not met after a sample, additional instrument blanks must be analyzed until acceptance criteria are met. Additional samples shall not be analyzed until acceptance criteria are met. Flagging is only appropriate in cases when the sample cannot be reanalyzed and when there is no more sample left. Note: Successful analysis following the highest standard analyzed determines the highest concentration that carryover does not occur. The highest standard analyzed may not be analyzed as part of the calibration curve or following the calibration curve. If analyzed following the calibration curve, it is not used to extend out the calibration range. It is used only to document a higher concentration at which carryover still does not occur. if sample concentrations exceed this range and the sample(s) following exceed this acceptance criteria (>1/2 LOQ), they must be reanalyzed.	Analyst	Precision/ Accuracy/ Bias	Concentration of each analyte must be ≤ 1/2 the LOQ.
Extracted Internal Standard Analytes	Every field sample, standard, blank, and QC sample.	Added to sample prior to extraction. Extracted Internal Standard Analyte recoveries must be within 50% to 150% of the true value.	If recoveries are acceptable for QC samples, but not field samples, the field samples must be re-prepped and reanalyzed (greater dilution may be needed). If recoveries are unacceptable for QC samples, correct problem, and reanalyze all associated failed field samples. Apply Q-flag and discuss in the Case Narrative only if reanalysis confirms failures in exactly the same manner. Failing analytes shall be thoroughly documented in the Case Narrative.	Analyst	Precision/ Accuracy/ Bias	Added to sample prior to extraction. Extracted Internal Standard Analyte recoveries must be within 50% to 150% of the true value.

Matrix: SB, SS, SD
Analytical Group: PFAS
Analytical Method / SOP Reference: LC-MS/MS Compliant with QSM 5.3 Table B-15 / SOP 5-369-08

QC Sample[1]	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator	Measurement Performance Criteria
Injection Internal Standard Analytes	Every field sample, standard, blank, and QC sample.	Added to aliquot of sample dilutions, QC samples, and standards prior to analysis. Peak areas must be within -50% to +50% of the area measured in the ICAL midpoint standard. On days when ICAL is not preformed, the peak areas must be within -50% to +50% of the peak area measured in the daily initial CCV.	If peak areas are not acceptable, analyze a second aliquot of the extract or sample if enough remains. If there is not enough extract, reanalyze the first aliquot. If second analysis meets acceptance criteria, report the second analysis. If it fails, either analysis may be reported with the appropriate flags. Apply Q-flag and discuss in the Case Narrative. Alternate Injection Internal Standard Analytes are recommended when there is obvious chromatographic interference.	Analyst	Precision/ Accuracy/ Bias	Added to aliquot of sample dilutions, QC samples, and standards prior to analysis. Peak areas must be within -50% to +50% of the area measured in the ICAL midpoint standard. On days when ICAL is not preformed, the peak areas must be within -50% to +50% of the peak area measured in the daily initial CCV.
Method Blank (MB)	One per preparatory batch.	No analytes detected >1/2 LOQ or >1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater.	Correct problem. If required, re-prep and reanalyze MB and all QC samples and field samples processed with the contaminated blank. If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply B-Flag to all results for the specific analyte(s) in all samples in the associated preparatory batch. Results may not be reported without a valid MB. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst	Bias/ Contamination	No analytes detected >1/2 LOQ or >1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater.
Laboratory Control Sample (LCS)	One per preparatory batch.	Blank spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. Refer to **Worksheet #15-1**.	Correct problem, then re-prep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes if sufficient sample material is available. If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be re-prepped and reanalyzed.	Analyst	Accuracy/ Bias	Blank spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. Refer to **Worksheet #15-1**.
Matrix Spike (MS)	In the field, one per 20 normal field samples. At the lab, one per preparatory batch.	Sample spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. Refer to **Worksheet #15-1**.	Data Validator: Assess matrix effects or potential analytical error. Qualify as per **Worksheet #36**. Analyst: Examine the project-specific requirements. Contact the client as to additional measures to be taken. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met and explain in the Case Narrative. For matrix evaluation only. If MS results are outside the limits, the data shall be evaluated to determine the source(s) of difference (i.e., matrix effect or analytical error).	Analyst, Data Validator	Accuracy	Sample spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. Refer to **Worksheet #15-1**.

Matrix: SB, SS, SD
Analytical Group: PFAS
Analytical Method / SOP Reference: LC-MS/MS Compliant with QSM 5.3 Table B-15 / SOP 5-369-08

QC Sample[1]	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator	Measurement Performance Criteria
Matrix Spike Duplicate (MSD) or Matrix Duplicate (MD)	In the field, one per 20 normal field samples. At the lab, for MSD: One per preparatory batch.	For MSD: Sample spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. For MSD: Refer to **Worksheet #15-1**. Relative percent difference (RPD) ≤ 30% (between MS and MSD or sample and MD).	Data Validator: Assess matrix effects or potential analytical error. Qualify as per **Worksheet #36**. Analyst: Examine the project-specific requirements. Contact the client as to additional measures to be taken. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met and explain in the Case Narrative. The data shall be evaluated to determine the source of difference. For Sample/MD: RPD criteria only apply to analytes whose concentration in the sample is greater than or equal to the LOQ. The MD is a second aliquot of the field sample that has been prepared by serial dilution.	Analyst, Data Validator	Accuracy/ Precision	For MSD: Sample spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. For MSD: Refer to **Worksheet #15-1**. RPD ≤ 30% (between MS and MSD or sample and MD).
LOD Verification	Quarterly for every analyte.	Spike a quality system matrix at concentration 2-4x the DL. Must meet 3:1 S/N, or for data systems that do not measure noise, results must be at least 3 standard deviations greater than the mean method blank concentration.	If verification fails, the DL determination must be repeated and a LOD verification. Alternatively pass two consecutive LOD verification at a higher spike and set the LOD at the higher concentration.	Analyst	Accuracy	Spike a quality system matrix at concentration 2-4x the DL. Must meet 3:1 S/N, or for data systems that do not measure noise, results must be at least 3 standard deviations greater than the mean method blank concentration.
LOQ Verification	Quarterly for every analyte.	Spike a quality system matrix at a concentration equal to or greater than the low point of the calibration curve.	Must meet laboratory specified precision and bias limits. If LOQ fails, repeat at a higher level until limits are met.	Analyst	Precision/ Bias	Spike a quality system matrix at a concentration equal to or greater than the low point of the calibration curve.
Results reported between DL and LOQ	--	Apply J-flag to all results between DL and LOQ. Non-detect results are reported as U-Values at the LOD.	--	Analyst	Accuracy	--
Field QA/QC Samples						
Field Duplicate (FD)	One per 10 normal field samples.	%RPD < 35% for soils.	Assess field precision and collection techniques. Assess matrix heterogeneity and sample compositing techniques. Qualify as per **Worksheet #36**.	FTL, PM, Data Validator	Precision	%RPD < 35% for soils.
Equipment Rinseate Blank (EB)	One per day for decontaminated equipment. One per event for disposable equipment.	Same as for method blank.	Assess decontamination techniques. Qualify as per **Worksheet #36**.	FTL, PM, Data Validator	Contamination	Same as for method blank.
Field Reagent Blank	One per week.	No target analytes detected > 1/2 LOQ.	Assess whether method analytes or other interferences are present in the field environment. Qualify as per **Worksheet #36**.	FTL, PM, Data Validator	Bias/ Contamination	No target analytes detected > 1/2 LOQ.
Temperature Blank	One per cooler.	≤ 10°C but not frozen.	Assess cooler packing techniques. Consider recollection of samples if data will be rejected. Qualify as per **Worksheet #36**.	FTL, PM, DV	Representativeness	≤ 10°C but not frozen.

Matrix: SB, SS, SD
Analytical Group: PFAS
Analytical Method / SOP Reference: LC-MS/MS Compliant with QSM 5.3 Table B-15 / SOP 5-369-08

QC Sample[1]	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator	Measurement Performance Criteria

Notes:

1. DoD QSM version 5.3 is the basis for specifications on this table.

The preservative Trizma is only required for aqueous samples collected from chlorinated drinking water sources. Since the field samples are not from chlorinated drinking water sources, the laboratory supplied PFAS-free water for the PFAS Field Reagent Blank, as well as sample containers, do not contain Trizma.

Worksheet #28-2: Analytical Quality Control and Corrective Action (PFAS in Groundwater/Surface Water)

(UFP-QAPP Manual Section 3.4)

Matrix: GW, SW
Analytical Group: PFAS
Analytical Method / SOP Reference: LC-MS/MS Compliant with QSM 5.3 Table B-15 / SOP 5-369-08

QC Sample[1]	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator	Measurement Performance Criteria
Aqueous Sample Preparation	Each sample and associated batch QC samples.	Solid Phase Extraction (SPE) must be used unless samples are known to contain high PFAS concentrations (e.g., AFFF formulations). Inline SPE is acceptable. Samples of known high PFAS concentrations can be prepared by serial dilution instead of SPE, with documented project approval.	--	Analyst	--	--
Sample Cleanup Procedure using ENVI-Carb or equivalent	Each sample and associated batch QC samples. Not applicable to AFFF formulation samples.	Removal of inferences from matrix. Cleanup should reduce bias from matrix background.	Flagging is not appropriate.	Analyst	--	--
Instrument Blanks	Immediately following the highest standard analyzed and daily prior to sample analysis.	Concentration of each analyte must be ≤ 1/2 the LOQ.	If acceptance criteria are not met after the highest calibration standard, calibration must be performed using a lower concentration for the highest standard until acceptance criteria is met. If acceptance criteria are not met after the highest standard which is not included in the calibration, the standard cannot be used to determine the highest concentration samples at which carryover does not occur. If acceptance criteria are not met after a sample, additional instrument blanks must be analyzed until acceptance criteria are met. Additional samples shall not be analyzed until acceptance criteria are met. Flagging is only appropriate in cases when the sample cannot be reanalyzed and when there is no more sample left. Note: Successful analysis following the highest standard analyzed determines the highest concentration that carryover does not occur. The highest standard analyzed may not be analyzed as part of the calibration curve or following the calibration curve. If analyzed following the calibration curve, it is not used to extend out the calibration range. It is used only to document a higher concentration at which carryover still does not occur. If sample concentrations exceed this range and the sample(s) following exceed this acceptance criteria (>1/2 LOQ), they must be reanalyzed.	Analyst	Precision/ Accuracy/ Bias	Concentration of each analyte must be ≤ 1/2 the LOQ.
Extracted Internal Standard Analytes	Every field sample, standard, blank, and QC sample.	Added to sample prior to extraction. For aqueous samples prepared by serial dilution instead of SPE, added to samples prior to analysis. Extracted Internal Standard Analyte recoveries must be within 50% to 150% of the true value.	If recoveries are acceptable for QC samples, but not field samples, the field samples must be re-prepped and reanalyzed (greater dilution may be needed). If recoveries are unacceptable for QC samples, correct problem, and reanalyze all associated failed field samples. Apply Q-flag and discuss in the Case Narrative only if reanalysis confirms failures in exactly the same manner. Failing analytes shall be thoroughly documented in the Case Narrative.	Analyst	Precision/ Accuracy/ Bias	Added to sample prior to extraction. For aqueous samples prepared by serial dilution instead of SPE, added to samples prior to analysis. Extracted Internal Standard Analyte recoveries must be within 50% to 150% of the true value.

Matrix: GW, SW
Analytical Group: PFAS
Analytical Method / SOP Reference: LC-MS/MS Compliant with QSM 5.3 Table B-15 / SOP 5-369-08

QC Sample[1]	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator	Measurement Performance Criteria
Injection Internal Standard Analytes	Every field sample, standard, blank, and QC sample.	Added to aliquot of sample dilutions, QC samples, and standards prior to analysis. Peak areas must be within -50% to +50% of the area measured in the ICAL midpoint standard. On days when ICAL is not preformed, the peak areas must be within -50% to +50% of the peak area measured in the daily initial CCV.	If peak areas are not acceptable, analyze a second aliquot of the extract or sample if enough remains. If there is not enough extract, reanalyze the first aliquot. If second analysis meets acceptance criteria, report the second analysis. If it fails, either analysis may be reported with the appropriate flags. Apply Q-flag and discuss in the Case Narrative. Alternate Injection Internal Standard Analytes are recommended when there is obvious chromatographic interference.	Analyst	Precision/ Accuracy/ Bias	Added to aliquot of sample dilutions, QC samples, and standards prior to analysis. Peak areas must be within -50% to +50% of the area measured in the ICAL midpoint standard. On days when ICAL is not preformed, the peak areas must be within -50% to +50% of the peak area measured in the daily initial CCV.
MB	One per preparatory batch.	No analytes detected >1/2 LOQ or >1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater.	Correct problem. If required, re-prep and reanalyze MB and all QC samples and field samples processed with the contaminated blank. If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply B-Flag to all results for the specific analyte(s) in all samples in the associated preparatory batch. Results may not be reported without a valid MB. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst	Bias/ Contamination	No analytes detected >1/2 LOQ or >1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater.
LCS	One per preparatory batch.	Blank spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. Refer to **Worksheet #15-2**.	Correct problem, then re-prep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes if sufficient sample material is available. If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be re-prepped and reanalyzed.	Analyst	Accuracy/ Bias	Blank spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. Refer to **Worksheet #15-2**.
MS	In the field, one per 20 normal field samples. At the lab, one per preparatory batch.Not required for aqueous samples prepared by serial dilution instead of SPE.	Sample spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration.Refer to **Worksheet #15-2**.	Data Validator: Assess matrix effects or potential analytical error. Qualify as per **Worksheet #36**. Analyst: Examine the project-specific requirements. Contact the client as to additional measures to be taken. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met and explain in the Case Narrative. For matrix evaluation only. If MS results are outside the limits, the data shall be evaluated to determine the source(s) of difference (i.e., matrix effect or analytical error).	Analyst	Accuracy	Sample spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration.Refer to **Worksheet #15-2**.

Matrix: GW, SW
Analytical Group: PFAS
Analytical Method / SOP Reference: LC-MS/MS Compliant with QSM 5.3 Table B-15 / SOP 5-369-08

QC Sample[1]	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator	Measurement Performance Criteria
MSD or MD	In the field, one per 20 normal field samples. At the lab, for MSD: One per preparatory batch or for MD: Each aqueous sample prepared by serial dilution instead of SPE.	For MSD: Sample spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. For MSD: Refer to **Worksheet #15-2**. RPD ≤ 30% (between MS and MSD or sample and MD).	Data Validator: Assess matrix effects or potential analytical error. Qualify as per **Worksheet #36**. Analyst: Examine the project-specific requirements. Contact the client as to additional measures to be taken. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met and explain in the Case Narrative. The data shall be evaluated to determine the source of difference. For Sample/MD: RPD criteria only apply to analytes whose concentration in the sample is greater than or equal to the LOQ. The MD is a second aliquot of the field sample that has been prepared by serial dilution.	Analyst, Data Validator	Accuracy/ Precision	For MSD: Sample spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. For MSD: Refer to **Worksheet #15-2**. RPD ≤ 30% (between MS and MSD or sample and MD).
Post Spike Sample	Only applies to aqueous samples prepared by serial dilution instead of SPE that have reported value of "<LOQ" for analyte(s).	Spike aliquot(s) of sample at the final dilution(s) reported for sample with all analytes that have reported value of "<LOQ" in the final dilution. The spike must be at the LOQ concentration to be reported with the sample (the "<LOQ" value). When analyte concentrations are calculated as "<LOQ," the spike must recover within 70-130% of its true value.	When analyte concentrations are calculated as "<LOQ," and the spike recovery does not meet the 70-130% acceptance criteria, the sample, sample duplicate, and post spike sample must be reanalyzed at consecutively higher dilutions until the criteria is met. Flagging is not appropriate. When analyte concentrations are calculated as "<LOQ," results may not be reported without acceptable post spike recoveries.	Analyst	Accuracy/ Precision	Spike aliquot(s) of sample at the final dilution(s) reported for sample with all analytes that have reported value of "<LOQ" in the final dilution. The spike must be at the LOQ concentration to be reported with the sample (the "<LOQ" value). When analyte concentration is calculated as "<LOQ," the spike must recover within 70-130% of its true value.
LOD Verification	Quarterly for every analyte.	Spike a quality system matrix at concentration 2-4x the DL. Must meet 3:1 S/N, or for data systems that do not measure noise, results must be at least 3 standard deviations greater than the mean method blank concentration.	If verification fails, the DL determination must be repeated and a LOD verification. Alternatively pass two consecutive LOD verification at a higher spike and set the LOD at the higher concentration.	Analyst	Accuracy	Spike a quality system matrix at concentration 2-4x the DL. Must meet 3:1 S/N, or for data systems that do not measure noise, results must be at least 3 standard deviations greater than the mean method blank concentration.
LOQ Verification	Quarterly for every analyte.	Spike a quality system matrix at a concentration equal to or greater than the low point of the calibration curve.	Must meet laboratory specified precision and bias limits. If LOQ fails, repeat at a higher level until limits are met.	Analyst	Precision/ Bias	Spike a quality system matrix at a concentration equal to or greater than the low point of the calibration curve.
Results reported between DL and LOQ	--	Apply J-flag to all results between DL and LOQ. Non-detect results are reported as U-Values at the LOD.	--	Analyst	Accuracy	--

Matrix: GW, SW
Analytical Group: PFAS
Analytical Method / SOP Reference: LC-MS/MS Compliant with QSM 5.3 Table B-15 / SOP 5-369-08

QC Sample[1]	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator	Measurement Performance Criteria
Field QA/QC Samples						
FD	One per 10 normal field samples.	%RPD < 25% for waters.	Assess field precision and collection techniques. Assess matrix heterogeneity and sample compositing techniques. Qualify as per **Worksheet #36**.	FTL, PM, Data Validator	Precision	%RPD < 25% for waters.
EB	One per day for decontaminated equipment. One per event for disposable equipment.	Same as for method blank.	Assess decontamination techniques. Qualify as per **Worksheet #36**.	FTL, PM, Data Validator	Contamination	Same as for method blank.
Field Reagent Blank	One per week.	No target analytes detected > 1/2 LOQ.	Assess whether method analytes or other interferences are present in the field environment. Qualify as per **Worksheet #36**.	FTL, PM, Data Validator	Bias/ Contamination	No target analytes detected > 1/2 LOQ.
Temperature Blank	One per cooler.	≤ 10°C but not frozen.	Assess cooler packing techniques. Consider recollection of samples if data will be rejected. Qualify as per **Worksheet #36**.	FTL, PM, Data Validator	Representativeness	≤ 10°C but not frozen.

Notes:

1. DoD QSM version 5.3 is the basis for specifications on this table.

The preservative Trizma is only required for aqueous samples collected from chlorinated drinking water sources. Since the field samples are not from chlorinated drinking water sources, the laboratory supplied PFAS-free water for the PFAS Field Reagent Blank, as well as sample containers, do not contain Trizma.

Worksheet #29: Project Documents and Records

Document/Record	Generation	Verification	Format/Storage Location/Archive Requirements
Sample Collection and Field Records			
Photographic documentation, as warranted	Field sampler/TBD	FTL/TBD	Digital/CH2M network and secure SharePoint library/project file and computer server
Field Change Request forms	PM	AM and Project Delivery and Quality Manger	Digital/CH2M network and secure SharePoint library/project file and computer server
Field logbook/various field measurements/field equipment calibration information	Field sampler/TBD	FTL/TBD	Digital/CH2M network and secure SharePoint library/project file and computer server
Water quality field parameters collected during groundwater sampling	Field sampler/TBD	FTL/TBD PC/Camden Robinson	Recorded in Field Notebook; stored in NIRIS
Chain-of-Custody records	PC/Camden Robinson	FTL/TBD	Electronic portable document format (pdf) copies in the project file; hardcopy in the project file; archived at project closeout
Air bills	Field sampler/TBD	FTL/TBD	Hardcopy in the project file; archived at project closeout
Telephone logs			Hardcopy in the project file; archived at project closeout
Daily QC Reports	FTL/TBD	PM/John Swenfurth	Hardcopy in the project file; archived at project closeout
Corrective Action Reports	PC/Camden Robinson FTL/TBD	PM/John Swenfurth	Electronic pdf copies in the project file; hardcopy in the project file; archived at project closeout
Pre-Task Safety Plan forms or Safety Task Analysis Cards	Field Auditor/TBD	H&S Manager/Stephen Brand PM/John Swenfurth	Recorded in Field Notebook; hardcopy in the project file; archived at project closeout

Document/Record	Generation	Verification	Format/Storage Location/Archive Requirements
Beyond Zero Observations	Field Auditor/TBD	H&S Manager/Stephen Brand PM/John Swenfurth	Recorded in Field Notebook; hardcopy in the project file; archived at project closeout
Signed HASP and associated Activity Hazard Analysis (AHA) forms	H&S Officer/Stephen Brand	FTL/TBD PM/John Swenfurth	Recorded in Field Notebook; hardcopy in the project file; archived at project closeout
Project Assessment			
Field Audit Checklists			Hardcopy in the project file; archived at project closeout
Data Verification Checklists	Data Validator/TBD	PC/Camden Robinson	If completed, hardcopy in the project file; archived at project closeout
Data Validation Reports	Data Validator/TBD	PC/Camden Robinson	Electronic pdf copies in the project file; hardcopy stored with the data package; archived at project closeout
Data Usability Assessment Report	PC/Camden Robinson	PM/John Swenfurth	Digital/CH2M network and secure SharePoint library/project file and computer server
Laboratory Records			
Sample receipt, custody, and tracking records	Sample receipt personnel/Battelle	PC/Camden Robinson	Electronic pdf copies in the project file; hardcopy in the full data package
Equipment Calibration Logs	Analyst/Battelle	QA Officer/Battelle	Hardcopy in the full data package[1]; archived at project closeout
Sample Preparation Logs	Digestion personnel/Battelle	QA Officer/Battelle Data Validator/ TBD	Hardcopy in the full data package[1]; archived at project closeout
Run logs	Analyst/Battelle	QA Officer/Battelle Data Validator/ TBD	Hardcopy in the full data package[1]; archived at project closeout
Reported field sample results	Analyst/Battelle	QA Officer/Battelle Data Validator/ TBD	Electronic pdf copies in the project file; hardcopy in the full data package[1]; archived at project closeout

Document/Record	Generation	Verification	Format/Storage Location/Archive Requirements
Reported results for standards, qc checks, and qc samples	Analyst/Battelle	QA Officer/Battelle Data Validator/ TBD	Hardcopy in the full data package[1]; archived at project closeout
Instrument printouts (raw data) for field samples, standards, qc checks, and qc samples	Analyst/Battelle	QA Officer/Battelle Data Validator/ TBD	Hardcopy in the full data package[1]; archived at project closeout
Sample disposal records	Environmental H&S Officer/Battelle	QA Officer/Battelle Laboratory Manager/Battelle	Maintained by the laboratory
Extraction/cleanup records	Extraction personnel/Battelle	QA Officer/Battelle Data Validator/ TBD	Hardcopy in the full data package[1]
Raw data	Analyst/Battelle	QA Officer/Battelle Data Validator/ TBD	Hardcopy in the full data package[1]; archived at project closeout

After completion of the project, project documents required to be maintained will be stored at the Federal Records Center (FRC) in Suitland, MD:

Washington National Records Center
4205 Suitland Road
Suitland, Maryland 20746-8001

1. CH2M requires a “Level 4” package.

Laboratory Data Deliverables	
Document/Record	**PFAS**
Case Narrative	X
Sample ID cross reference sheet (Lab IDs and Client IDs)	X
Chain-of-custody	X
Sample preparation (extraction/digestion) logs	X
Copies of Nonconformance Memos and Corrective Actions	X
Sample results	X
Post Spike Recovery Summary	X
MS/MSD Accuracy and Precision Summary	X
LCS Accuracy Summary	X
Instrument and Method Blank Summary	X
Initial Calibration Summary (including concentration levels of standards)	X
Continuing Calibration Summary	X
Analytical sequence	X
Quantitation Reports	X
Compound Identification Summary	X
Chromatograms	X

Worksheet #31, 32 & 33: Assessments and Corrective Action

Table 31-1: Planned Project Assessments

Assessment Type	Organization Performing Assessment	Frequency	Assessment Deliverable	Person(s) Responsible for Performing Assessment (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing CAs (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (title and organizational affiliation)
Field Performance Audit	Monitoring and QA performed by CH2M	Periodically during sampling activities (not necessarily for each sampling event)	Field Performance Audit Checklist	Field Auditor Monitoring and QA performed by CH2M	Project field team Monitoring and QA performed by CH2M	PM Monitoring and QA performed by CH2M	Program Quality Manager Monitoring and QA performed by CH2M
AHA	Monitoring and QA performed by CH2M	One prior to each sampling event	AHA Form	Field Auditor Monitoring and QA performed by CH2M	Project field team Monitoring and QA performed by CH2M	H&S Officer Monitoring and QA performed by CH2M	H&S Officer Monitoring and QA performed by CH2M
Pre-Task Safety Analysis	Monitoring and QA performed by CH2M	One per day during field activities	Daily Tailgate Field form	Field Auditor Monitoring and QA performed by CH2M	Project field team Monitoring and QA performed by CH2M	H&S Officer Monitoring and QA performed by CH2M	H&S Officer Monitoring and QA performed by CH2M
Beyond Zero Observations	Monitoring and QA performed by CH2M	One per week during field activities	Safe Work Observation	Field Auditor Monitoring and QA performed by CH2M	Project field team Monitoring and QA performed by CH2M	H&S Officer Monitoring and QA performed by CH2M	H&S Officer Monitoring and QA performed by CH2M

Table 32-1: Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (name, title, organization)	Timeframe of Notification	Nature of CA Response Documentation	Individual(s) Receiving CA Response (name, title, organization)	Timeframe for Response
Field Performance Audit	Field Performance Audit Checklist	Field team PM	Within one week of audit	Verbal and CA Form	FTL PM	Within one week of receipt of CA Form
Beyond Zero Observations	Beyond Zero Observations computer based or phone app form	FTL Field team PM H&S Officer	Immediately (person involved or observed person) H&S Officer. Following day (field team).	On Beyond Zero Observation electronic form either on phone or computer	FTL and individual being observed, and the PM and H&S Officer	Corrected in the field immediately, and within 1 week if elevated

Table 33-1: QA Management Reports

Type of Report	Frequency (Daily, Weekly, Monthly, Quarterly, Annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliations)
Field Audit Report	One for each audit performed	Submitted with report in which data are analyzed and presented	PM: Monitoring and QA performed by CH2M	H&S Manager: Monitoring and QA performed by CH2M; included in project files
Data Validation Reports	Once, after analysis by laboratory, for all laboratory analytical data except wet chemistry (WCHEM) analyses	Submitted by the data validator within 14 calendar-days of notification to begin)	PM: Monitoring and QA performed by CH2M	PC: Monitoring and QA performed by CH2M PM: Monitoring and QA performed by CH2M
Data Usability Assessments (Data Quality Evaluation)	Once, as an appendix to the report in which data are analyzed and presented	Along with the project report	PC: Monitoring and QA performed by CH2M	Vieques EPA RPM and Vieques PRDNER RPM

Laboratory Corrective Action Form

Person initiating CA _____ Date: _____

Description of problem and when identified: _____

Cause of problem, if known or suspected: _____

Sequence of CA (including date implemented, action planned, and personnel/data affected): _____

CA implemented by: _____ Date: _____

CA initially approved by: _____ Date: _____

Follow-up date: _____

Final CA approved by: _____ Date: _____

Information copies to:

Anita Dodson, CH2M Program Chemist

Groundwater Field Performance Audit Checklist

Project Responsibilities

Project No.: _____ Date: _____

Project Location: Signature:

Team Members			
Yes	No	1)	Is the approved work plan being followed?
		Comments:	
Yes	No	2)	Was a briefing held for project participants?
		Comments:	
Yes	No	3)	Were additional instructions given to project participants?
		Comments:	
Sample Collection			
Yes	No	1)	Is there a written list of sampling locations and descriptions?
		Comments:	
Yes	No	2)	Are samples collected as stated in the Master SOPs?
		Comments:	
Yes	No	3)	Are samples collected in the type of containers specified in the work plan?
		Comments:	
Yes	No	4)	Are samples preserved as specified in the work plan?
		Comments:	
Yes	No	5)	Are the number, frequency, and type of samples collected as specified in the work plan?
		Comments:	
Yes	No	6)	Are QA checks performed as specified in the work plan?
		Comments:	
Yes	No	7)	Are photographs taken and documented?
		Comments:	
Document Control			
Yes	No	1)	Have any accountable documents been lost?
		Comments:	
Yes	No	2)	Have any accountable documents been voided?
		Comments:	

Yes	No	3) Have any accountable documents been disposed of? Comments:
Yes	No	4) Are the samples identified with sample tags? Comments:
Yes	No	5) Are blank and duplicate samples properly identified? Comments:
Yes	No	6) Are samples listed on a chain-of-custody record? Comments:
Yes	No	7) Is chain-of-custody documented and maintained? Comments:

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Worksheet #34, 35 & 36: Data Verification and Validation (Steps I & IIa/IIb)

Table 34-1. Data Verification, Validation, and Usability Inputs

Description	Verification (completeness)	Validation (conformance to specifications)	Usability (achievement of DQOs and MPCs)
Daily Field Reports	X	X	X
Instrument Functionality Checklists	X	X	X
Field logbooks	X	X	X
QC Reports (as needed)	X	X	X
Assessment Reports and responses	X	X	X
GIS data	X	X	X

Table 35-1. Data Verification and Validation Procedures

Activity and Records Reviewed	Requirements/ Specifications	Process Description/Frequency	Responsible Person	Documentation
Field logbook	SAP, SOPs	All information is complete for each day of field activities. Any changes/exceptions are documented and reported in accordance with requirements. Required signatures are present.	Munitions Response Dive Leader	Daily logbook/ digital forms/Daily Report

(UFP-QAPP Manual Section 5.2.1), (UFP-QAPP Manual Section 5.2.2), Figure 37 UFP-QAPP Manual), (Table 9 UFP-QAPP Manual)

Records Reviewed	Process Description	Responsible Person, Organization	Internal/ External	Step I / IIa / IIb1
Field Notes	Field notes will be reviewed internally and placed into the project file for archival at project closeout.	FTL (TBD)/CH2M	Internal	Step I
Chains-of-custody and shipping forms	Chain-of custody forms and shipping documentation will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the chain-of-custody will be initialed by the reviewer, a copy of the chain-of-custody retained in the site file, and the original and remaining copies taped inside the cooler for shipment.	FTL (TBD)/CH2M PC: Camden Robinson/CH2M	Internal/ External	Step I
Sample condition upon receipt	Any discrepancies, missing, or leaking containers will be communicated to the PC in the form of laboratory logins.	PC: Camden Robinson/CH2M	External	Step I
Documentation of laboratory method deviations	Laboratory method deviations will be discussed and approved by the PC. Documentation will be incorporated into the case narrative that becomes part of the final hardcopy data package.	PC: Camden Robinson/CH2M	Internal/ External	Step I
Electronic data deliverables (EDD)	Electronic data deliverables will be compared against hardcopy laboratory results (10% check).	PC: Camden Robinson/CH2M	External	Step I
Case Narrative	Case Narratives will be reviewed by the data validator during the data validation process. This is verification that they were generated and are applicable to the data packages.	Data Validator: TBD	External	Step I
Laboratory data	All laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal.	Laboratory QA Officer/Battelle	Internal	Step I
Laboratory data	The data will be verified for completeness by the PC.	PC: Camden Robinson/CH2M	External	Step I
Audit Reports	Upon report completion, a copy of all audit reports will be placed in the site file. If CAs are required, a copy of the documented corrective action taken will be attached to the appropriate audit report in the QA site file. Periodically, and at the completion of site work, site file audit reports and CA forms will be reviewed internally to ensure that all appropriate CAs have been taken and that CA reports are attached. If CAs have not been taken, the site manager will be notified to ensure action is taken.	PM: John Swenfurth/CH2M PC: Camden Robinson/CH2M	Internal/ External External	Step I Step I

Records Reviewed	Process Description	Responsible Person, Organization	Internal/ External	Step I / IIa / IIb1
CA reports	CA reports will be reviewed by the PC or PM and placed into the project file for archival at project closeout.	PM: John Swenfurth/CH2M	Internal/ External	Step I
		PC: Camden Robinson/CH2M	External	Step I
Laboratory Methods	Ensure the laboratory analyzed samples using the correct methods.	PC: Camden Robinson/CH2M	External	Step IIa
Target compound list and target analyte list	Ensure the laboratory reported all analytes from each analysis group as described in **Worksheet #15**.	PC: Camden Robinson/CH2M	External	Step IIa
Reporting limits	Ensure the laboratory met the project-designated reporting limits as described in **Worksheet #15**. If reporting limits were not met, the reason will be identified and documented.	PC: Camden Robinson/CH2M	External	Step IIb
Laboratory SOPs	Ensure that approved analytical laboratory SOPs were followed.	Data Validator: TBD	External	Step IIa
Sample chronology	Holding times from collection to extraction or analysis and from extraction to analysis will be considered by the data validator during the data validation process.	Data Validator: TBD	External	Step lla / llb
Raw data	10 percent Stage 4 review of raw data to confirm laboratory calculations; remainder Stage 2B plus EDD.	Data Validator: TBD	External	Step lla
Onsite screening	All non-analytical field data will be reviewed against SAP requirements for completeness and accuracy based on the field calibration records.	FTL (TBD)	External	Step lla / llb
Documentation of method QC results	Establish that all required QC samples were run and met limits.	Data Validator: TBD	External	Step lla
Documentation of field QC sample results	Establish that all required SAP QC samples were run and met limits.	PC: Camden Robinson/CH2M	External	Step llb
		Data Validator: TBD		

Records Reviewed	Process Description	Responsible Person, Organization	Internal/ External	Step I / IIa / IIb1
PFAS[2]	For definitive data, analytical methods, and laboratory SOPs, as presented in this UFP-SAP, will be used to evaluate compliance against QA/QC criteria. QA/QC criteria for field QC samples are presented in **Worksheet #28**, reporting limits and screening levels are presented in **Worksheet #15**, QA/QC criteria for calibrations are presented in **Worksheet #24**, and QA/QC criteria for laboratory QC samples are presented in **Worksheet #28**. Data may be qualified if QA/QC exceedances have occurred. *Guidance and qualifiers from DoD General Data Validation Guidelines* (DoD, 2019) and *United States Department of Defense General Data Validation Guidelines, Module 3 - Data Validation Procedure for Per- and Polyfluoroalkyl Substances Analysis by QSM Table B-15*, (DoD, 2020) will be applied as appropriate. The data validator can supplement notated guidance with the National Functional Guidelines for Organic Data Review and Validator's Professional Judgement, as necessary.	Data Validator: TBD	External	Step IIa and IIb

Notes:

1 I = verification
IIa = compliance with methods, procedures, and contracts [see Table 10, page 117, UFP-QAPP manual, V.1, March 2005. (IDQTF, 2005)]
IIb = comparison with measurement performance criteria in the UFP-SAP [see Table 11, page 118, UFP-QAPP manual, V.1, March 2005. (IDQTF, 2005)]

2 Data validation guidance documents are subject to update.

Data Validator: TBD

Analytical Group/Method	PFAS – LC-MS/MS Compliant with QSM 5.3 Table B-15
Data deliverable requirements:	Stage 4 plus EDDs
Analytical specifications:	Worksheets #15-1, #15-2, #24, #28-1, #28-2
Measurement performance criteria:	Worksheets #15-1, #15-2, #28-1, #28-2
Percent of data packages to be validated:	100%
Percent of raw data reviewed:	100%
Percent of results to be recalculated:	10%
Validation procedure[1]:	"United States Department of Defense General Data Validation Guidelines, Module 3 - Data Validation Procedure for Per- and Polyfluoroalkyl Substances Analysis by QSM Table B-15", (DoD, May 2020).
Electronic validation program/version:	--

Notes

1. Data Validator can supplement notated guidance with the National Functional Guidelines for Organic Data Review and Validator's Professional Judgement, as necessary.

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Worksheet #37: Data Usability Assessment

Data usability evaluation comprises critical assessment of the data with respect to the project objective. Given that the primary objective of the site investigation is to determine if a release of PFAS exists, the comprehensive datasets from the offsite analytical laboratory, validated as applicable, and from the field measurements will be reviewed to determine if they are adequate for making the project-specific determinations.

Some specific examples of data availability and usability protocol are:

- The third-party data validator is the only party that may apply qualifiers to the data. Minor QC exceedances will result in "estimated" data, represented by J, NJ, and UJ qualifiers. Major QC exceedances will be represented by a X qualifier due to the presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a PC), but exclusion of the data is recommended. An R qualifier "rejected" data will be applied once the project team has decided that the result is not reliable. The effect on availability and usability of rejected results will be evaluated.
- The use of "estimated" data will be discussed in the report. "Estimated" data are generally considered usable for all purposes. For results reported between the DL and LOQ the laboratory will apply J-flags.
- While all non-rejected data are available for use to the project team, non-detect (and attributable to blank contamination) results may not be useful if the LOD is greater than the associated PAL. In these cases, the project team will determine whether or not the laboratory would likely have detected the contaminant if present at or above the PAL (i.e., evaluation of the PAL versus the DL).
- Ten percent of hardcopy analytical data will be checked against the electronic data to identify discrepancies. This check will be performed manually. The check will verify results and qualifiers. This process is intended to identify discrepancies between the hardcopy and electronic data. If any discrepancies are identified during the ten percent verification, the laboratory will be contacted, the discrepancies will be communicated, and the laboratory will resolve the discrepancies.
- If significant deviation is evident between parent samples and their field or laboratory duplicate, the cause will be investigated. The possibility of a switched sample will be examined. Field duplicates are expected to exhibit greater deviation than laboratory duplicates. Field duplicate and laboratory duplicate reproducibility is outlined in **Worksheet #28**.
- Significant biases may be evident based on LCS, MS/MSD, and spiked surrogate exceedances. The third-party data validator will consider QC exceedances and biases when applying qualifiers to data. The project team will consider the direction of bias when determining the usability of qualified data compared to PALs. Low biases are expected to occur more frequently than high biases. In the case of rejected non-detect data, low biases represent the inability of the laboratory to detect contaminants that may or may not be present at the site. The project team will act conservatively and understand that it is not known whether or not the specific analyte is below, at, or above the PAL. High biases indicate that a result may be lower than it is reported. When high-biased data are greater than a PAL, the project team will examine the proximity of the result to the PAL to determine whether additional data are needed or if the result should simply be considered a PAL exceedance.
- After completion of the data validation, the distribution of applied data validation qualifiers will be examined to determine if there are patterns that negatively affect the usability of data. This information will be compiled into a DQE.

- Deviations from the SAP sampling and analytical protocols will be reviewed to ascertain whether or not they are significant enough to negatively affect the usability of data.
- Precision is accessed via percent difference or relative percent difference. Percent difference is typically used when one value is considered theoretically correct and relative percent difference is typically used when both values are experimental. Percent difference is calculated by taking the absolute value of the difference divided by the theoretical value. This is also expressed as

  $$((|X_1 - X_2|) / X_1) * 100$$

  where X1 is the theoretical value and X2 is the experimental value. If it is necessary to imply the direction of a bias, such as for percent drift, the absolute value need not be considered. Relative percent difference is calculated by taking the absolute value of the difference divided by the mean. This is also expressed as

  $$((|X_1 - X_2|) / ((X_1 + X_2)/2)) * 100$$

  where X1 and X2 are both measured values. Percent difference and relative percent difference often have upper control limits for precision.
- Accuracy is accessed via percent recovery. This is calculated by taking the measured value divided by the theoretical value. This is also expressed as

  $$(X_2 / X_1) * 100$$

  where X1 is the theoretical value and X2 is the experimental value, both positive numbers because they are 'amounts' or concentrations. Percent recovery can be negative, such as for MS and MSD recovery, if X2 is calculated by subtracting a parent concentration from an experimental recovery. Percent recovery often has upper and lower control limits for accuracy.
- Completeness is calculated by taking the number of available results divided by the total number of results. This is also expressed as

  $$(X_2 / X_1) * 100$$

  where X2 is the number of distinct results deemed "available for use" (not rejected) and X1 is the total number of distinct results (not excluded). Completeness is calculated for the entire data set, for each matrix, and for each combination of matrix and analysis group. If patterns of rejection are evident in the data set, completeness may also be calculated for select combinations of matrix, analysis group, and analyte or other combinations as applicable for the data quality evaluation. Completeness has a lower control limit (completeness goal) and cannot exceed 100%.

Notes:

1. Completeness is defined as the percentage of measurements that are judged to be available compared to the total number of measurements made. The objective of the overall completeness goal for this project is set at 95% available data. This goal is inclusive of both field and laboratory analytical data.
2. Discussions of precision, accuracy, representativeness (qualitative), completeness, and comparability (qualitative) will be included in the data quality review to describe the impact of data quality on project data quality objectives and data usability. Sensitivity is assessed by comparing non-detect results, LODs, and DLs to the screening levels.

Personnel (Organization and Position/Title) Responsible for Participating in the DUA

- QA Contractor, Bill Hannah, CH2M AM
- QA Contractor, Brett Doerr, CH2M Project Delivery and Quality Manager

- QA Contractor, John Swenfurth, CH2M PM
- QA Contractor, Camden Robinson, CH2M PC
- QA Contractor, TBD, CH2M FTL

Documents Used as Input to Each Phase of the DUA

- SAP
- Final Verification and Validation Plan
- Weekly QC Reports
- Assessment Reports
- Site-specific Library
- Data Validation Report

How will the DUA be Documented?

Data usability will be discussed in the DUA Technical Memorandum, which will contain sufficient documentation to support conclusions of the DUA. The following steps describe the documentation and processes that will be used during the DUA and notes how DUA results will be presented so they identify trends, relationships (correlations), and anomalies. Field personnel will submit field data daily for initial QC verification and processing. The QC PM will review the data and submit them as deliverables. Copies of original paper forms will be maintained on site for reference, and the originals will be forwarded to the data coordinator for review, inclusion in the project database, and final storage in the central project files. The documents used as inputs to the DUA include the SAP, daily field notes, and Data Validation Reports.

How the DUA will be Documented

Step 1 **Review the project's objectives and sampling design.**

Review the DQOs. Are underlying assumptions valid? Were the project boundaries appropriate? Were sources of uncertainty accounted for and appropriately managed? Summarize any deviations from the planned sampling design and describe their impacts on the DQOs.

Step 2 **Review the data verification/validation outputs and evaluate conformance to MPCs documented on Worksheet #28.**

Review the data verification/validation reports and supporting data, if necessary (e.g., daily/ weekly QC reports, assessment reports, and corrective action reports. Was the RCA/CA effective? Evaluate the implications of unacceptable QC results.

- Evaluate conformance to MPCs documented on **Worksheet #28**.
- Evaluate data completeness. Were all data inputs satisfied? Identify data gaps.

Step 3 **Document data usability, update the CSM, apply decision rules, and draw conclusions.**

Assess the performance of the sampling design and Identify any limitations on data use. Considering the implications of any deviations and data gaps, can the data be used as intended? Are the data sufficient to answer the study questions?

- Update the CSMs, apply decision rules, and document conclusions.

Step 4 **Document lessons learned and make recommendations.**

Summarize lessons learned and make recommendations for changes to DQOs or the sampling design for the next phase of investigation or future investigations.

Prepare the data usability summary report.

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Attachment A
Interview Records

1. NAPR crash crew member 1. Crash crew from 1982 – 2004.
   Previous phone interviews for NAPR by Pedro Ruiz and then Renee in March 2017.
2. Civilian Assistant Fire Chief at the Base and Crash Crew Fire Stations. NAPR fire personnel from 1971 – 1999.
   Previous phone interview by Bryan Burkingstock in April 2017 for NAPR.
3. NAPR crash crew member 2. Crash crew at facility from 1984 – 2004.
   Previous phone interview for NAPR by Bryan Burkingstock in March 2017.
4. Former Vieques Firefighter that now lives in Florida. Has not been previously interviewed.

August 26, 2020

1400 – called former firefighter – phone number has been disconnected.

1430 – called NAPR crash crew member 1 – left a message with my call back information.

1445 – called Civilian Assistant Fire Chief – conducted interview. Sent them map of Fire Department location at Camp Garcia. They were traveling and will return to their home on Thursday 8/27/20 and will look at the map sent to them.

1600 – NAPR crash crew member 2 – conducted interview. Member 2 is recently retired from USAE working in Vieques. He was a firefighter at Roosevelt Roads for 15 years but never worked on Vieques as a firefighter and has no knowledge of the operations there during his time at Roosevelt Roads.

August 28, 2020

1540 – called Civilian Assistant Fire Chief – conducted interview.

PFAS Preliminary Assessment Questionnaire
Vieques, Puerto Rico

Name:	Civilian Assistant Fire Chief and wife
Title:	Civilian Assistant Fire Chief at the Base and Crash Crew Fire Stations (There 70s to 1999. Went back and forth to Vieques and Roosevelt Roads. His wife worked at Roosevelt Roads Fire Dept (1984-1993) and ordered the AFFF for Vieques and Roosevelt Roads.
Date of Interview:	8/26/20 and 8/28/20

Notes:

Please answer the questions based on your direct knowledge of actual activities and not information about standard protocol or supposition of what may have happened. If it is unsure or unknown, please state unknown.

If you can recommend additional contacts that you feel may be able to provide additional information, please provide the name and as much contact information as you have. Thank you.

Firefighting Training Areas

1. On west Vieques there is a building referred to as the Former Power Plant (Building 13), approximately located across the street from the Public Works Area. It was reported that between the 1960s and the 1980s, it was used for fire training operations where diesel fuel was poured over rubber tires inside the building, ignited to simulate structural fires, and extinguished during training operations. Do you have any recollection of AFFF being used at this site?

   AFFF not used at any fire training areas. They had some brush fires but only water was used for them. AFFF was too expensive to use. Only two firefighters stationed on Vieques.

2. As part of historical operational training, were any other Firefighting Training Areas (FTAs) present on the facility?

   None on Vieques.

   If yes, please show the location/s of the FTAs on the map provided.

3. To the best of your knowledge, what were the years of operation for each FTA you identified in your answer to Question #2?

   N/A

4. To the best of your knowledge, were fuels/flammables other than "typical" (such as JP-5, #2 Fuel Oil) used at the FTAs? If yes, what was used?

   N/A

5. When AFFF was used during a fire training exercise, to the best of your knowledge, was the AFFF used contained and disposed, and if so, how was the AFFF cleaned up and disposed?

   N/A

6. To the best of your knowledge, were historical FTAs lined? If so, with anything other than concrete?

   N/A

AFFF Purchasing, Handling, and Storage

1. Where was AFFF and AFFF equipment stored on base, and in what approximate quantities?

   Very little on Vieques, kept at the NASD fire station. Small quantities approx. ten 5 gal containers kept onsite. Wife ordered about five 5-gallaon cans for Vieques per year. Referred to AFFF as "light water." They used mostly water on Vieques.

2. Was AFFF stored at the former Fire Station? (Please show locations on map provided.).

   Fire Truck and AFFF kept in fire station building on the NASD. There was a fire station at Camp Garcia but it was destroyed in 1989 by hurricane Hugo. That is when the fire station moved from Camp Garcia to the NASD. AFFF was never stored or used at the Camp Garcia Fire Station, it was only kept in the truck at the NASD fire station.

   a. Please describe procedures for how AFFF equipment was cleaned/decontaminated.

      Truck had a foam tank on it that was separate from water tank. The foam mixes with water (6% foam mixer). Foam tanks never were cleaned or dumped because it was too expensive. If truck was going out of commission it was sent to Roosevelt Roads.

   b. To the best of your knowledge, where was the equipment maintained?

      Roosevelt Roads public works.

3. Was AFFF stored and handled on the base? If so, provide any information regarding where, when, and what type.

   Regular foam (protein foam) was used for years then they switched at some point to AFFF. Very little used on Vieques.

   a. If yes, where was AFFF solution handled (such as mixed, contained, released for calibration, transferred)?

      5-gallon jugs poured into the 50-gallon foam tank. Kept 50-gallons of AFFF on the truck.

Hangars and Buildings

-No foam used in hangars/buildings, only water suppression systems used.

1. To the best of your knowledge, which areas (such as hangars, buildings, fuel or hazardous waste storage areas) historically had automated and/or manually-activated AFFF fire suppression systems?
2. There is an area on the eastern side of the runway, which had a Helicopter Maintenance Building. Do you recall any AFFF being used there?
3. The runway itself had a lot of aircraft training. Do you recall an AFFF being used on the runway?
4. There is a helicopter pad located adjacent to OP-1. Do you recall any AFFF being used at that pad?
5. To the best of your knowledge, please describe the procedure on how the suppression systems were supplied with AFFF (that is, is system contained within the building, or are there separate buildings that serve to mix AFFF to supply one or more hangers with suppression systems).
6. Please describe the fire suppression system layout/activation process and if available, provide system plans or drawings.
7. When the fire suppression system engages/or engaged, what is the historical response process for addressing AFFF used (that is, was AFFF cleaned up after being used and how)?
8. To the best of your knowledge, have there been inadvertent releases of AFFF from hangar fire suppression systems (such as equipment failure)? If so, please provide additional details (such as when, in which hangars/buildings, could the release be quantified, was the release removed or cleaned up)?

9. To the best of your, knowledge, who was responsible for historical routine maintenance of the AFFF system/s? To the best of your knowledge, were maintenance records kept, and if so where are they located?
10. To the best of your knowledge, for any historical activation (accidental, testing, or in response to an emergency) of AFFF systems within hangars and/or buildings, provide any information regarding the fate of the release (that is, did releases occur near drainage swales; were they washed to a pervious surface; did they occur on poorly maintained pervious surfaces [cracked concrete, porous asphalt]; were they directed to a storm drain, trench drain, oil/water separator [OWS], wastewater treatment plant).

Trucks and Trailers

1. Provide a list of historical parking/storage areas for AFFF equipment.
2. To the best of your knowledge, were the trucks tested for spray patterns to make sure equipment is working properly? If so, how often and where are/were these spray tests performed? Once a year tested foam and pump tested at Roosevelt roads on NAPR runway.
3. To the best of your knowledge, what is the procedure on how trucks and trailers were supplied with AFFF?
    a. Where did this resupply occur?

        Came in 5-gallon cans, didn't need foam very much on Vieques.

    b. Was there secondary containment in this area?

        Kept out of sun, kept covered, so plastic containers wouldn't crack.

    c. What happened to the empty AFFF containers?

        People took them home, washed them out and kept them for water jugs.
4. To the best of your knowledge, what was the procedure for how these vehicles are/were cleaned, and where was vehicle cleaning performed (historically)?

    Foam tank was never emptied, if any service needed to be done it was taken to Roosevelt Roads.

Records, Spill logs, Historical Information

1. To the best of your knowledge, are there any historical data/documents/records associated with AFFF that we may review/copy (such as reports/work plans, historical or operational records, incident reports, crash data, inspection reports, AFFF spill logs, documentation of AFFF releases, photo interpretation)?

    None. He had never heard of a crash on Vieques that he knew of. Fire trucks mainly used to put out brush fires using water.
2. Do you have recollection or records of AFFF being used in response to any of the following:
    a. Fuel releases to prevent fires.

        No.

    b. Emergency response sites (such as plane, helicopter, or vehicle crash sites and fires)

        No.

    c. Emergency runway landings where foam might have been used as a precaution

        No.

    d. Other (such as air show demonstrations, AFFF "salutes")

        No.
3. What are the historical storage location(s) of the wreckage from emergency response incidents (if wreckage is stored outside)?

4. If yes to #2, please provide any information you have regarding how and if the releases were addressed and how any released material (including foam and contaminated soil) was disposed?
5. In the potential absence of written records or incomplete written records, can you provide anecdotal/verbal information and locations of spills or other emergency response incidents where AFFF was used (such as hangars, buildings, fire stations, firefighting equipment testing and maintenance areas, emergency response sites, storm water/surface water, wastewater treatment plants, landfills/disposal areas, and AFFF ponds/lagoons)?

General Information

1. Is there anyone else or other base organization personnel that you would recommend we interview? Name, organization, position, phone number, e-mail.

2. Are there any other organizations that historically use AFFF?

Interview conducted by John Swenfurth, CH2M on 8/26/20.

Attachment B
Site Photographs

ATTACHMENT B

Site Photographs

NASD AOC B: Former Wastewater Treatment Plant

Photo 1: AOC B facing north; site located within heavy vegetation in vicinity of proposed SS/SB-01 sample location. (7/17/2020)

Photo 2: AOC B looking west approximately 70 feet into heavy brush in the vicinity of proposed SS/SB-004 sample location. (7/17/2020)

NASD Former Fire Station Building 2046 at the Public Works Area

Photo 3: NASD Former Fire Station facing east. (10/5/2018)

Photo 4: NASD Former Fire Station facing northeast. (10/5/2018)

Photo 5: NASD Former Fire Station facing north. (10/5/2018)

Photo 6: NASD Former Fire Station facing northwest. (10/5/2018)

Photo 7: NASD Former Fire Station facing southeast. (10/5/2018)

Photo 8: NASD Former Fire Station facing south. (10/5/2018)

Photo 9: NASD Former Fire Station facing south-southwest. (10/5/2018)

Photo 10: NASD Former Fire Station facing west-northwest. (10/5/2018)

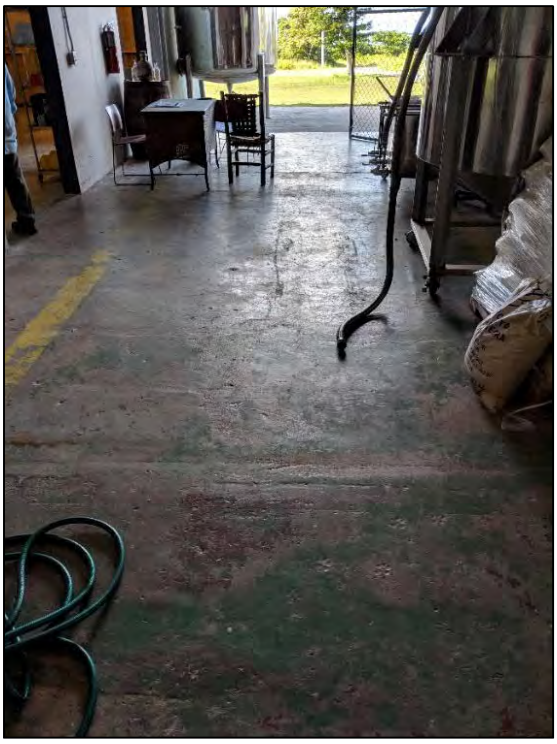


Photo 11: NASD Former Fire Station, inside building. (12/5/2018)

Photo 12: NASD Former Fire Station, inside building. (12/5/2018)

Photo 13: NASD Former Fire Station, inside building. (12/5/2018)

Photo 14: NASD Former Fire Station, inside building. (12/5/2018)

Photo 15: NASD Former Fire Station, concrete ramp adjacent to bay door. (12/5/2018)

Photo 16: NASD Former Fire Station, concrete ramp adjacent to bay door. (12/5/2018)

Photo 17: Former Fire Station 2046 facing east, above ground tank adjacent to building used for current rum distillery in the vicinity of proposed MW-02. (7/17/2020)

Photo 18: Former Fire Station 2046 facing south, alongside of former fire station in vicinity of proposed MW-03. (7/17/2020)

Potential Former NASD Motor Pool Area

Photo 19: Former Motor Pool Area facing west-southwest, in vicinity of proposed MW-02. (7/17/2020)

Photo 20: Former Motor Pool Area facing east, in vicinity of proposed MW-03. (7/17/2020)

Photo 21: Former Motor Pool Area facing north, in vicinity of proposed MW-03. (7/17/2020)

Photo 22: Former Motor Pool Area facing west, in vicinity of proposed MW-03. (7/17/2020)

NASD AOC H: Former Power Plant/Former Fire Training Area

Photo 23: Former Fire Training Area Building facing northeast, entrance to building. (7/17/2020)

Photo 24: Former Fire Training Area Building facing northeast, heavy vegetation in vicinity of proposed MW-03. (7/17/2020)

Photo 25: Former Fire Training Area Building facing north, standing water in streambed in vicinity of proposed sample SD-02. (7/17/2020)

Photo 26: Former Fire Training Area Building facing south, floor of building with several raised concrete pads. (8/14/2020)

Photo 27 Former Fire Training Area Building facing north, floor of building with several raised concrete pads. (8/14/2020)

Photo 28: Former Fire Training Area Building facing north, looking at west side of building in vicinity of proposed SS/SB-03. (7/17/2020)

NASD SWMU 6: Former Mangrove Disposal Site

Photo 29: SWMU 6 facing northeast, in vicinity of proposed SD-02 and SS/SB-01. (7/20/2019)

NASD SWMU 7: Former Quebrada Disposal Site

Photo 30: SWMU 7 facing west, in vicinity of proposed MW-01. (7/16/2020)

Photo 31: SWMU 7 facing north, heavy vegetation off path in vicinity of proposed SS/SB-03 sample location. (7/16/2020)

VNTR Camp Garcia Runway

Photo 32: Former Camp Garcia Runway facing east, in vicinity of proposed SS/SB-02 and SS/SB-03 sample locations. (7/15/2020)

Photo 33: Former Camp Garcia Runway facing east, in vicinity of proposed MW-01. (7/15/2020)

Photo 34: Former Camp Garcia Runway facing south, in vicinity of proposed MW-02. (7/15/2020)

Photo 35: Former Camp Garcia Runway facing west from eastern end of runway. (7/15/2020)

VNTR PI 5: Surface Water Drainage Area from Camp Garcia Runway

Area heavily vegetated, no current photos.

VNTR SWMU 20: Former Helicopter Maintenance Area

Photo 36: SWMU 20 facing west, area heavily vegetated. (7/16/2020)

Potential Former VNTR Motor Pool Area (Including Building 340) and Former Fire Department Building 330

Photo 37: Former Fire Department Building 330 facing east, in current Camp Garcia Compound in vicinity of proposed SS/SB-03 sample location. (7/16/2020)

Photo 38: Former Fire Department Building 330 facing east, in current Camp Garcia Compound in vicinity of proposed SS/SB-04 sample location. (7/16/2020)

Photo 39: Former Motor Pool Area facing east, in vicinity of proposed MW-01. (7/16/2020)

Photo 40: Former Building 340 facing east, in vicinity of proposed SS/SB-01 sample location. (7/16/2020)

Photo 41: Former Building 340 facing east, in vicinity of proposed SS/SB-02 sample location. (7/16/2020)

VNTR SWMU 10 and VNTR AOC G: Former Sewage Treatment Lagoons and Chlorination Building

Photo 42: AOC G facing south, mixing chamber in vicinity of proposed MW-01. (7/16/2020)

Photo 43: SWMU 10 facing east, entrance to the SWMU 10 site, heavy vegetation. (7/16/2020)

VNTR SWMU 1: Former Camp Garcia Municipal Waste Management Unit (Landfill)

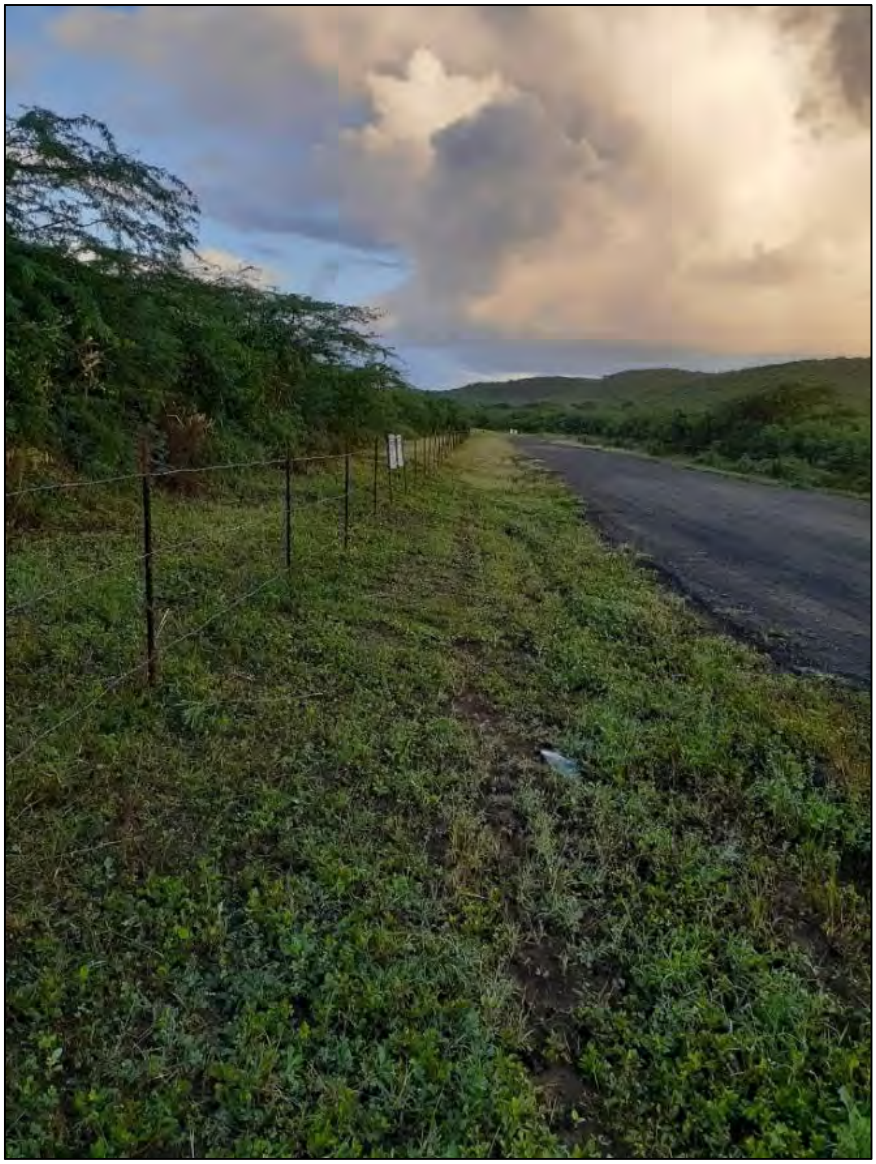


Photo 44: SWMU 1 facing north, fence for land use control. (12/30/2019)

Attachment C
PFAS Specific Standard Operating Procedures

Soil Sampling for Per- and Polyfluoroalkyl Substances

I. Purpose

This SOP provides guidelines for soil sample collection and handling for samples that will be analyzed for per- and polyfluoroalkyl substances (PFAS) via LC/MS/MS Compliant with the most recent version of the Quality Systems Manual (QSM) for which the lab is certified at the time of analysis. Standard techniques for collecting representative samples are summarized. These procedures are specific to the Navy Comprehensive Long-term Environmental Action Navy (CLEAN) Program. Materials, equipment, and procedures may vary; refer to the Sampling and Analysis Plan and operator's manuals for specific details.

II. Equipment and Materials

A. Equipment and Materials Required

A hand auger or other device that can be used to remove the soil from the ground. Stainless steel tools, carbon steel tools, or steel DPT tooling with acetate sleeves are preferred for PFAS sampling. Avoid any sampling materials containing PFAS (such as Teflon, Viton, PTFE, or other fluorinated compounds). Any plastic sampling materials should be evaluated thoroughly before selection to ensure they are fluorine-free.

A stainless steel spatula or fluorine-free disposable plastic scoop should be used to remove material from the sampling device.

Unpainted wooden stakes or pin flags

Fiberglass measuring tape (at least 200 feet in length)

GPS Unit

- PFAS-free labels (if available[1]) shipping materials
- Loose leaf paper or a wire-bound notebook without waterproof coating or tablet (see notes on tablet use below)
- Metal clipboard (if using loose-leaf paper)
- Pen (not Sharpie)

Personal protection equipment (rubber or latex gloves, boots, etc.). Check with your SME prior to selecting PPE to ensure there are no fluorine-containing components.

[1] Efforts will be made to obtain PFAS-free labels; however, information on labels is scarce and labels are frequently mounted on PFAS-coated paper to allow for easy removal.

Sample jars (sample jars should be made of high density polyethylene (HDPE) as glass jars may sorb PFAS, please notify the project manager [PM] if glass jars are provided by the lab). Sample containers should not contain Teflon lids.

Laboratory-prepared deionized, certified PFAS-free water for field blank collection

B. Equipment and Materials to Avoid During Sampling

Equipment and materials used to collect soil samples should not contain any fluorinated compounds including Teflon or synthetic rubber with fluoropolymer elastomers (e.g. Viton).

If a driller is supporting collection of soil samples in split spoons or acetate DPT sleeves, ensure the driller has not used and will not use drilling lube containing polytetrafluoroethylene (PTFE) or any other fluorine-containing substance. Biolube has been determined to be an acceptable substitute.

Specifically, the following material should be avoided during sampling:

- Gore-Tex brand or similar high-performance outdoor clothing, clothing treated with ScotchGuard brand or similar water repellent, fluoropolymer-coated Tyvek, wrinkle-resistant fabrics, and fire-resistant clothing with fluorochemical treatment or anything advertised as water repellant.
- Weather-proof log books with fluorochemical coatings.
- New clothing that has been washed fewer than six times.

The sample collection area should be clear of the following items:

- Pre-packaged food wrappers (e.g., fast food sandwich wrappers, pizza boxes, etc.)
- Microwave popcorn bags
- Blue ice containers
- Aluminum foil
- Kim-Wipes
- Sunscreen, insect repellant and other personal hygiene products that may contain PFAS

Contact your PFAS SME for an approved list of sunscreens and insect repellants.

The use of electronics (e.g., cell phones and tablets) should be avoided without the implementation of precautionary measures outlined below:

- All devices should be used with clean, ungloved hands and an approved stylus (if desired).

Following the use of a device, hands must be washed with soap and water and clean gloves should be used prior to contact with sampling equipment (bottleware, tubing, etc.).

III. Procedures and Guidelines

Once the area has been determined to be free of materials potentially containing PFAS, these steps can be followed to collect the soil samples:

Wear protective gear, as specified in the Health and Safety Plan.

To locate samples, identify the correct location using the pin flags or stakes. Proceed to collect a sample from the undisturbed soil adjacent to the marker following steps C and D. If markers are not present, the following procedures will be used.

A. Samples On A Grid

1. Use measuring tape to locate each sampling point on the first grid line as prescribed in the sampling plan. As each point is located, drive a numbered stake in the ground and record its location on the site map and in the field notebook/clipboard.
2. Proceed to sample the points on the grid line.
3. Measure to location where next grid line is to start and stake first sample. For subsequent samples on the line take two orthogonal measurements: one to the previous grid line, and one to the previous sample on the same grid line.
4. Proceed to sample the points on the grid line as described in Section C below.
5. Make sure to stake location after sample collection in case professional surveying is to be completed.
6. Repeat 1c and 1e above until all samples are collected from the area.
7. Or, a GPS unit can be used to identify each location based on map coordinates, if available.

B. Non-Grid Samples

1. Use measuring tape to position sampling point at location described in the sampling plan by taking two measurements from fixed landmarks (e.g., corner of house and fence post).
2. Note measurements, landmarks, and sampling point on a sketch in the field notebook, and on a site location map.
3. Proceed to sample as described in Section C below.
4. Make sure to stake location after sample collection in case professional surveying is to be completed.
5. Repeat 2a through 2d above until all samples are collected from the area.
6. Or, a GPS unit can be used to identify each location based on map coordinated, if available.

To the extent possible, differentiate between fill and natural soil. If both are encountered at a boring location, sample both as prescribed in the field sampling plan. Do not locate samples in debris, tree roots, or standing water. In residential areas, do not sample in areas where residents' activities may impact the sample (e.g., barbecue areas, beneath eaves of roofs, driveways, garbage areas). If an obstacle prevents sampling at a measured grid point, move as close as possible, but up to a distance of one half the grid spacing in any direction to locate an appropriate sample. If an appropriate location cannot be found, consult with the Field Team Leader (FTL). If the FTL concurs, the sampling point may be deleted from the program. The FTL will contact the CH2M HILL PM immediately. The PM and Navy Technical Representative (NTR) will discuss whether the point should be deleted from the program. If it is deleted, the PM will follow-up with the NTR in writing.

C. Collecting Samples Using Hand Tools

1. Use a decontaminated stainless steel scoop/trowel or disposable plastic scoop to scrape away surficial organic material (grass, leaves, etc.) adjacent to the stake. New disposable scoops or trowels may also be used to reduce the need for equipment blanks if the disposable scoops have been confirmed by your project PFAS subject matter expert (SME) to be PFAS free.

2. If sampling:
    - Surface soil: Obtain soil sample by scooping soil using the augering scoop/trowel, starting from the surface and digging down to a depth of about 6 inches, or the depth specified in the workplan.
    - Subsurface soil: Obtain the subsurface soil sample using an auger down to the depths prescribed in the field sampling plan.
3. Record lithologic description and any pertinent observations (such as discoloration) in the field notebook/clipboard.
4. Empty the contents of the scoop/trowel into a decontaminated stainless steel pan or dedicated sealable bag.
5. Repeat this procedure until sufficient soil is collected to meet volume requirements.
6. Homogenize cuttings in the pan using a decontaminated stainless steel utensil.
7. Transfer sample for analysis into appropriate containers with a decontaminated utensil. Affix labels after bottles have been closed; collect only one sample at a time to avoid mislabeling.
8. Immediately upon collection, all samples for chemical analysis are to be placed in a closed container on ice unless it is not possible to do so. Although unusual and uncommon, there may be instances where it is not possible to have containers with ice at the sample location. In these instances, the samples should be placed on ice as soon as practical and during the time between collection and placing the samples on ice, the samples should be kept as cool as possible.
9. Backfill the hole with soil removed from the borehole. To the extent possible, replace topsoil and grass and attempt to return appearance of sampling area to its pre-sampled condition. For samples in non-residential, unmowed areas, mark the sample number on the stake and leave stake in place. In mowed areas, remove stake.

To Collect Samples Using DPT Methods

1. Decontaminate sampling tubes and other non-dedicated downhole equipment in accordance with SOP *Decontamination of Personnel and Equipment*. Ensure that decontamination water used is PFAS free (do not use water from fire hydrants on-base for steam cleaning unless the water has been demonstrated to be free of PFAS).
2. Drive sampling tube to the desired sampling depth using the truck-mounted hydraulic percussion hammer. If soil above the desired depth is not to be sampled, first drive the lead rod, without a sampling tube, to the top of the desired depth.
3. Remove the rods and sampling tube from the borehole and remove the sampling tube from the lead rod.
4. Cut open the acetate liner using a specific knife designed to slice the acetate liners (see below).

5. Fill all sample containers, using a decontaminated or dedicated sampling implement. Label the containers and immediately place samples on ice for shipment to the laboratory.
6. Decontaminate all non-dedicated downhole equipment (rods, sampling tubes, etc.) in accordance with SOP Decontamination of Personnel and Equipment and ensure decontamination water is from a PFAS-free water source.
7. Backfill borehole at each sampling location with grout or bentonite and repair the surface with like material (bentonite, asphalt patch, concrete, etc.), as required.

D. Equipment Decontamination

Whenever possible, use disposable equipment when collecting soil samples. If reusable equipment must be used, the equipment must be cleaned/decontaminated between uses. Alconox and Liquinox soap are acceptable for cleaning/decontaminating reusable equipment at PFAS sites. Any water used for cleaning/decontamination must be certified PFAS-free by a laboratory. Consider triple-rinsing. Once decontaminated, wrap equipment in plastic bags (such as Ziploc), and store away from potential PFAS sources.

IV. References

United States Environmental Protection Agency (USEPA), 2009. *Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS).* September.

United States Navy, 2020. *Interim Per- and Polyfluoroalkyl Substances (PFAS) Site Guidance for NAVFAC Remedial Project Managers (RPMs)/November 2020 Update.* November.

United States Navy, 2015. *Navy Drinking Water Sampling Policy for Perfluorochemicals: Perfluorooctane Sulfonate and Perfluorooctanoic Acid.* September

Sediment Sampling for Per- and Polyfluoroalkyl Substances

I. Purpose and Scope

This SOP provides guidelines for sediment sample collection and handling for samples that will be analyzed for per- and polyfluoroalklyl substances (PFAS) via LC/MS/MS Compliant with the most recent version of the Quality Systems Manual (QSM) for which the lab is certified at the time of analysis. Standard techniques for collecting representative samples are summarized. These procedures are specific to the Navy Comprehensive Long-term Environmental Action Navy (CLEAN) Program. Materials, equipment, and procedures may vary; refer to the Sampling and Analysis Plan and operator's manuals for specific details.

II. Equipment and Materials

A. Equipment and Materials Required

- Sample collection device (hand corer, scoop, dredge, grab sampler, or other suitable device). Check with your PFAS subject matter expert (SME) during field preparation to ensure all equipment is free of fluorine-containing components.
- Stainless steel spoon or spatula or fluorine-free plastic disposable scoop for media transfer
- Measuring tape
- GPS Unit
- PFAS-free labels (if available[1]) shipping materials
- Loose leaf paper or a wire-bound notebook without waterproof coating
- Metal clipboard (if using loose-leaf paper)
- Pen (not Sharpie)
- Personal protection equipment (rubber or latex gloves, boots, hip waders, etc.). Check with your SME prior to selecting PPE to ensure there are no fluorine-containing components.
- Materials for classifying soils, particularly the percentage of fines
- Sample jars (high density polyethylene [HDPE] with HDPE screw cap [no Teflon caps])
- Laboratory prepared deionized, certified PFAS-free water for field blank collection

[1] Efforts will be made to obtain PFAS-free labels; however, information on labels is scarce and labels are frequently mounted on PFAS-coated paper to allow for easy removal.

B. Equipment and Materials to Avoid During Sampling

Equipment and materials used to collect soil samples should not contain any fluorinated compounds including Teflon or synthetic rubber with fluoropolymer elastomers (e.g. Viton).

Specifically, the following material should be avoided during sampling:

- Gore-Tex brand or similar high-performance outdoor clothing, clothing treated with ScotchGuard brand or similar water repellent, fluoropolymer-coated Tyvek, wrinkle-resistant fabrics, and fire-resistant clothing with fluorochemical treatment or anything advertised as water repellant.
- Weather-proof log books with fluorochemical coatings.
- New clothing that has been washed fewer than six times.

The sample collection area should be clear of the following items:

- Pre-packaged food wrappers (e.g., fast food sandwich wrappers, pizza boxes, etc.)
- Microwave popcorn bags
- Blue ice containers
- Aluminum foil
- Kim-Wipes
- Sunscreen, insect repellant and other personal hygiene products that may contain PFAS

Contact your PFAS SME for an approved list of sunscreens and insect repellants.

The use of electronics (e.g., cell phones and tablets) should be avoided without the implementation of precautionary measures outlined below:

- All devices should be used with clean, ungloved hands and an approved stylus (if desired).

Following the use of a device, hands must be washed with soap and water and clean gloves should be used prior to contact with sampling equipment (bottleware, tubing, etc.).

III. Procedures and Guidelines

Wash hands with dish detergent before sampling and don nitrile gloves. Do not use Kleen Guard powder free nitrile gloves which were shown in research to contain fluorine.

Once the area has been determined to be free of materials potentially containing PFAS, these steps can be followed to collect the sediment samples:

1. Field personnel will start downstream and work upstream to prevent contamination of unsampled areas. In surface water bodies that are tidally influenced, sampling will be performed at low tide and under low flow conditions to minimize the dilution of possible contaminants. Sediment sampling activities will not occur immediately after periods of heavy rainfall.
2. Make a sketch of the sample area that shows important nearby river features and permanent structures that can be used to locate the sample points on a map. Whenever possible, include measured distances from such identifying features. Also include depth and width of waterway, rate of flow, type and consistency of sediment, and point and depth of sample removal (along shore, mid-channel, etc.).
3. Note in the field book any possible outside sources of contamination; for example, the outlet to a drainage culvert in the water body near your sampling location.

4. Transfer sample into stainless steel bowl and homogenize sample, then place sample into appropriate sample jars with a stainless steel utensil or plastic disposable scoop confirmed to be fluorine-free. Be especially careful to avoid the loss of the very fine clay/silt particles when collecting the sample. The fine particles have a higher adsorption capacity than larger particles. Minimize the amount of water that is collected within the sample matrix. Decant the water off the sample slowly and carefully to maximize retention of the very fine particles. The sampler's fingers should never touch the sediment. Classify the soil type of the sample using the Unified Soil Classification System, noting particularly the percentage of silt and clay. Affix the sample label to the container after the container has been closed; collect only one sample at a time to avoid mislabeling.
5. Rocks and other debris should be removed before placement in jars.
6. For channel sampling, be on the alert for submerged hazards (rocks, tree roots, drop-offs, loess silt and muck) which can make wading difficult.
7. Immediately upon collection, all samples are to be placed in a closed container on ice. Although unusual and uncommon, there may be instances where it is not possible to have containers with ice at the sample location. In these instances, the samples should be placed on ice as soon as practical and during the time between collection and placing the samples on ice, the samples should be kept as cool as possible.
8. Equipment Decontamination
    - Whenever possible, use disposable equipment when collecting sediment samples. If reusable equipment must be used, the equipment must be cleaned/decontaminated between uses. Alconox and Liquinox soap are acceptable for cleaning/decontaminating reusable equipment at PFAS sites. Any water used for cleaning/decontamination must be certified PFAS-free by a laboratory. Consider triple-rinsing. Once decontaminated, wrap equipment in plastic bags (such as Ziploc), and store away from potential PFAS sources.

IV. References

United States Environmental Protection Agency (USEPA), 2009. *Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS).* September.

United States Navy, 2015. *Navy Drinking Water Sampling Policy for Perfluorochemicals: Perfluorooctane Sulfonate and Perfluorooctanoic Acid.* September.

STANDARD OPERATING PROCEDURE
NAVY CLEAN PROGRAM

Surface Water Sampling for Per- and Polyfluoroalkyl Substances

I. Purpose and Scope

This SOP provides guidelines for surface water sample collection for samples that will be analyzed for per- and polyfluoroalklyl substances (PFAS) via LC/MS/MS Compliant with the most recent version of the Quality Systems Manual (QSM) for which the lab is certified at the time of analysis. Standard techniques for collecting representative samples are summarized. These procedures are specific to the Navy Comprehensive Long-term Environmental Action Navy (CLEAN) Program. Materials, equipment, and procedures may vary; refer to the Sampling and Analysis Plan and operator's manuals for specific details.

II. Materials and Equipment

A. Equipment and Materials Required

- Open tube sampler
- Dip sampler
- Weighted bottle sampler (no glass)
- Hand pump without Teflon components
- Van Dorn sampler (Kemmerer cannot be used as it has Teflon caps)
- Depth-integrating sampler
- Peristaltic pump and PFAS-free tubing
- High density polyethylene tubing (unlined)
- Masterflex tubing such as Cole Parmer C-Flex (06424 series) and Tygon E-3603 (06509 series) are suitable options
- Sample containers (high density polyethylene [HDPE] with HDPE screw cap [no Teflon caps])
- PFAS-free labels (if available[1]) and shipping materials
- Loose leaf paper or a wire-bound notebook without waterproof coating or tablet (see notes about tablet use below)

[1] Efforts will be made to obtain PFAS-free labels; however, information on labels is scarce and labels are frequently mounted on PFAS-coated paper to allow for easy removal.

- Metal clipboard (if using loose leaf paper)
- Pen (not Sharpie)
- Nitrile or Latex gloves (Do not use Kleen Guard powder free nitrile gloves which were shown in research to contain fluorine)
- Meters for specific conductance, temperature, pH, and dissolved oxygen

Equipment and materials used to collect surface water samples should not contain any fluorinated compounds including Teflon or synthetic rubber with fluoropolymer elastomers (e.g. Viton). Neoprene and rubber waders should not be an issue, however, check with your PFAS subject matter expert (SME) during field preparation to ensure all equipment is free of fluorine-containing components.

B. Equipment and Materials to Avoid During Sampling

Equipment and materials used to collect groundwater samples should not contain any fluorinated compounds, Teflon, or synthetic rubber with fluoropolymer elastomers (e.g., Viton).

Specifically, the following material should be avoided during sampling:

- Gore-Tex brand or similar high-performance outdoor clothing, clothing treated with ScotchGuard brand or similar water repellent, fluoropolymer-coated Tyvek, wrinkle-resistant fabrics, and fire-resistant clothing with fluorochemical treatment or anything advertised as water repellant.
- Weather-proof log books with fluorochemical coatings.
- New clothing that has been washed fewer than six times.

The sample collection area should be clear of the following items:

- Pre-packaged food wrappers (e.g., fast food sandwich wrappers, pizza boxes, etc.)
- Microwave popcorn bags
- Blue ice containers
- Aluminum foil
- Kim-Wipes
- Sunscreen, insect repellant and other personal hygiene products that may contain PFAS

Contact your PFAS SME for an approved list of sunscreens and insect repellants.

The use of electronics (e.g., cell phones and tablets) should be avoided without the implementation of precautionary measures outlined below:

- All devices should be used with clean, ungloved hands and an approved stylus (if desired).

Following the use of a device, hands must be washed with soap and water and clean gloves should be used prior to contact with sampling equipment (bottleware, tubing, etc.).

III. Procedures and Guidelines

Wash hands with dish detergent before sampling and don nitrile gloves. Do not use Kleen Guard powder free nitrile gloves which were shown in research to contain fluorine.

Before surface water samples are taken, all sampler assemblies and sample containers are cleaned and decontaminated as described in SOP *Decontamination of Personnel and Equipment* as well as this SOP (see below). Surface water samples collected from water bodies tidally influenced should be collected at

low tide and under low flow conditions to minimize the dilution of potential contaminants. Once the area has been determined to be free of materials potentially containing PFAS, follow the methods for surface water sample collection described below.

Surface water samples are collected manually by submerging a clean stainless steel or polypropylene container into the water body. Samples may be collected at depth with a covered bottle that can be removed with a tripline provided the bottle or bottle cap does not contain Teflon. The most common sampler types are sealable bottles, pond samplers, peristaltic pumps, and weighted bottle samplers. Pond samplers have a fixed or telescoping pole attached to the sample container. Weighted bottle samplers are lowered below water surface, where the attached bottle is opened, allowed to fill, and pulled out of the water. When retrieved, the bottle is tightly capped and removed from the sampler assembly. A specific type of weighted bottle sampler is the Van Dorn and is acceptable in most instances. The Kemmerer weighted bottle sampler cannot be used for PFAS sampling due to the Teflon caps.

A sample is taken with the following specific steps:

1. The location and desired depth for water sampling are selected.
2. The sample site is approached from downstream in a manner that avoids disturbance of bottom sediments as much as possible. The sample bottle is gently submerged with the mouth pointed upstream and the bottle tilted slightly downstream. Bubbles and floating materials should be prevented from entering the bottle. If using a Peristaltic pump, lower the tubing into the water to the desired depth.
3. For weighted bottle samplers, the assembly is slowly lowered to the desired depth. The bottle stopper is unseated with a sharp tug and the bottle is allowed to fill until bubbles stop rising to the surface.
4. When the bottle is full, it is gently removed from the water. If sample transfer is required, it should be performed at this time. Fill all sample containers to the middle of the bottle shoulder. Do not fill bottles completely. Affix labels after sample containers are closed; collect only one sample at a time to avoid mislabeling.
5. Measure dissolved oxygen, specific conductance, temperature, and pH at the sampling location.

A. Equipment Decontamination

Whenever possible, use disposable equipment when collecting surface water samples. If reusable equipment must be used, the equipment must be cleaned/decontaminated between uses. Alconox and Liquinox soap are acceptable for cleaning/decontaminating reusable equipment at PFAS sites. Any water used for cleaning/decontamination must be certified PFAS-free by a laboratory. Consider triple-rinsing. Once decontaminated, wrap equipment in plastic bags (such as Ziploc), and store away from potential PFAS sources.

Use of Water Quality Equipment

Water quality meters typically do not contain PFAS. However, consistent with general sampling SOPs, disconnect the water quality meter prior to sampling.

IV. References

United States Environmental Protection Agency (USEPA), 2009. *Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS).* September.

United States Navy, 2015. *Navy Drinking Water Sampling Policy for Perfluorochemicals: Perfluorooctane Sulfonate and Perfluorooctanoic Acid.* September.

Groundwater Sampling for Per- and Polyfluoroalkyl Substances (PFAS)

I. Purpose and Scope

This SOP provides guidelines for groundwater sample collection for samples that will be analyzed for per- and polyfluoroalklyl substances (PFAS) via LC/MS/MS Compliant with the most recent version of the Quality Systems Manual (QSM) for which the lab is certified. This SOP should be used in conjunction with approved region-specific groundwater sampling SOPs which provide methods for general and low-flow groundwater sampling. In cases in which information in this SOP conflicts with region-specific groundwater sampling SOPs, this SOP will supersede the information in the general SOPs.

Standard techniques for collecting representative samples are summarized. These procedures are specific to the Navy Comprehensive Long-term Environmental Action Navy (CLEAN) Program. Materials, equipment, and procedures may vary; refer to the Sampling and Analysis Plan and operator's manuals for specific details.

II. Equipment and Materials

A. Equipment and Materials Required

- If installing wells, ensure driller does not use polytetrafluoroethylene (PFTE)-containing drill lube or other drilling lubes containing PFAS. Biolube has been determined to be an acceptable drilling lube for installing wells where PFAS may be of concern. Additionally, Waterra surge blocks have been confirmed to not contain PFAS and may be used for development.
- Groundwater sampling equipment
  - PFAS-free tubing (avoid Teflon, Viton, PTFE and other fluorinated compounds)
    - High density polyethylene tubing (unlined)
    - If Masterflex tubing is needed for peristaltic pumps, Cole Parmer C-Flex (06424 series) and Tygon E-3603 (06509 series) are suitable options
  - PFAS-free Bailer (if using a bailer[1])

[1] Geotech and Waterra offer PFAS free bailer options

  - PFAS-free Pump such as:
    - Geotech PFAS-free Portable Bladder Pump (note, most bladder pumps include a Teflon-lined bladder, but Geotech currently has one model which is Teflon-free).
    - Panacea P120 or P125. The P200 Stainless Steel Pump may also be used, but the standard model contains Teflon at the tube connection. If you are using this Panacea model, you must request one with the "PTFE-free thread sealant option."
    - Waterra stainless foot-valve
    - QED Sample Pro
    - Monsoon or Mega Monsoon submersible pump
    - Grundfos Rediflo2 (this pump contains small Teflon components, but has not been shown to leach, it is less preferable than the other options)
    - Peristaltic pump (may be suitable for shallow locations)
- Groundwater sample containers (high density polyethylene [HDPE] bottle with HDPE screwcap), sample bottles should not be glass as glass may sorb PFAS. Sample bottle caps should not contain Teflon. Notify your project manager (PM) if bottles provided by the lab are glass or contain Teflon parts.
- Laboratory prepared deionized, certified PFAS-free water for field blank collection
- PFAS-free shipping supplies (labels [if available][2], coolers, and ice)
- Loose leaf paper without waterproof coating or a spiralbound notebook (not waterproof) or tablet (see tablet use notes below)
- Metal clip board (if using loose-leaf paper)
- Pen (not Sharpie)
- Nitrile or latex gloves

B. Equipment and Materials to Avoid During Sampling

Equipment and materials used to collect groundwater samples should not contain any fluorinated compounds, Teflon, or synthetic rubber with fluoropolymer elastomers (e.g., Viton).

Specifically, the following material should be avoided during sampling:

- Gore-Tex brand or similar high-performance outdoor clothing, clothing treated with ScotchGuard brand or similar water repellent, fluoropolymer-coated Tyvek, wrinkle-resistant fabrics, and fire-resistant clothing with fluorochemical treatment or anything advertised as water repellant.
- Weather-proof log books with fluorochemical coatings.
- New clothing that has been washed fewer than six times.

[2] Efforts will be made to obtain PFAS-free labels; however, information on labels is scarce and labels are frequently mounted on PFAS-coated paper to allow for easy removal.

The sample collection area should be clear of the following items:

- Pre-packaged food wrappers (e.g., fast food sandwich wrappers, pizza boxes, etc.)
- Microwave popcorn bags
- Blue ice containers
- Aluminum foil
- Kim-Wipes
- Sunscreen, insect repellant and other personal hygiene products that may contain PFAS

Research which has not yet been published has allowed us to generate a list of sunscreens and insect repellents which do not contain fluorine. Check with Bill Diguiseppi or Laura Cook on recommendations (because the research is not ours, it cannot be released externally at this time).

The use of electronics (e.g., cell phones and tablets) should be avoided without the implementation of precautionary measures outlined below:

- All devices should be used with clean, ungloved hands and an approved stylus (if desired).

Following the use of a device, hands must be washed with soap and water and clean gloves should be used prior to contact with sampling equipment (bottleware, tubing, etc.).

III. Procedures and Guidelines

Wash hands with dish detergent before sampling and don nitrile gloves. Do not use Kleen Guard powder free nitrile gloves which were shown in research to contain fluorine

Follow Navy CLEAN SOPs for low-flow or conventional groundwater sample collection, depending on site requirements.

A. Sample Collection

Once water quality parameters have stabilized for low-flow purging, samples can be collected. For conventional purging, if water quality parameters do not stabilize, a minimum of 3 well volumes must be purged prior to sample collection.

The steps to be followed for sample collection are as follows:

1. Ensure that the end of the tubing does not touch the ground or equipment. Remove the cap from the sample bottle. Position the sample bottle under the end of the tubing.
2. Fill the bottle. Do not fill the bottle past the middle of the bottle shoulder. Samples do not need to be collected headspace free.
3. Affix labels after bottles have been closed; collect only one sample at a time to avoid mislabeling. Pack the sample on ice immediately for shipment to the offsite laboratory. Avoid packing materials that may contain fluorine. Unpublished research has allowed us to generate a list of packing materials which do not contain fluorine. Please contact Bill Diguiseppi or Laura Cook for recommendations (because the research is not ours, it cannot be released externally at this time).

B. Equipment Decontamination

Whenever possible, use disposable equipment when collecting groundwater samples. If reusable equipment must be used, the equipment must be cleaned/decontaminated between uses. Alconox and Liquinox soap are acceptable for cleaning/decontaminating reusable equipment at PFAS sites. Any water

used for cleaning/decontamination must be certified PFAS-free by a laboratory. Consider triple-rinsing. Once decontaminated, wrap equipment in plastic bags (such as Ziploc), and store away from potential PFAS sources.

Use of Water Quality Equipment and Water Level Indicators

Water quality meters typically do not contain PFAS. However, consistent with general sampling SOPs, disconnect the water quality meter prior to sampling. Some water level indicators do contain small polyvinylidene fluoride (a PFAS constituent for which we do not currently monitor) or less frequently, Teflon, components, but we have not noted cross contamination from water level indicators at any sites. The Durham Geoslope Water Level Indicators and the Solinst Model 101 with the P2 meter have been shown to be fluorine free.

IV. References

United States Environmental Protection Agency (USEPA), 2009. *Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/ Tandem Mass Spectrometry (LC/MS/MS).* September.

United States Navy, 2020. *Interim Per- and Polyfluoroalkyl Substances (PFAS) Site Guidance for NAVFAC Remedial Project Managers (RPMs)/November 2020 Update*. November.

United States Navy, 2015. *Navy Drinking Water Sampling Policy for Perfluorochemicals: Perfluorooctane Sulfonate and Perfluorooctanoic Acid.* September.

Management of Liquid Waste Containing Per- and Polyfluoroalkyl Substances (PFAS)

I. Purpose and Scope

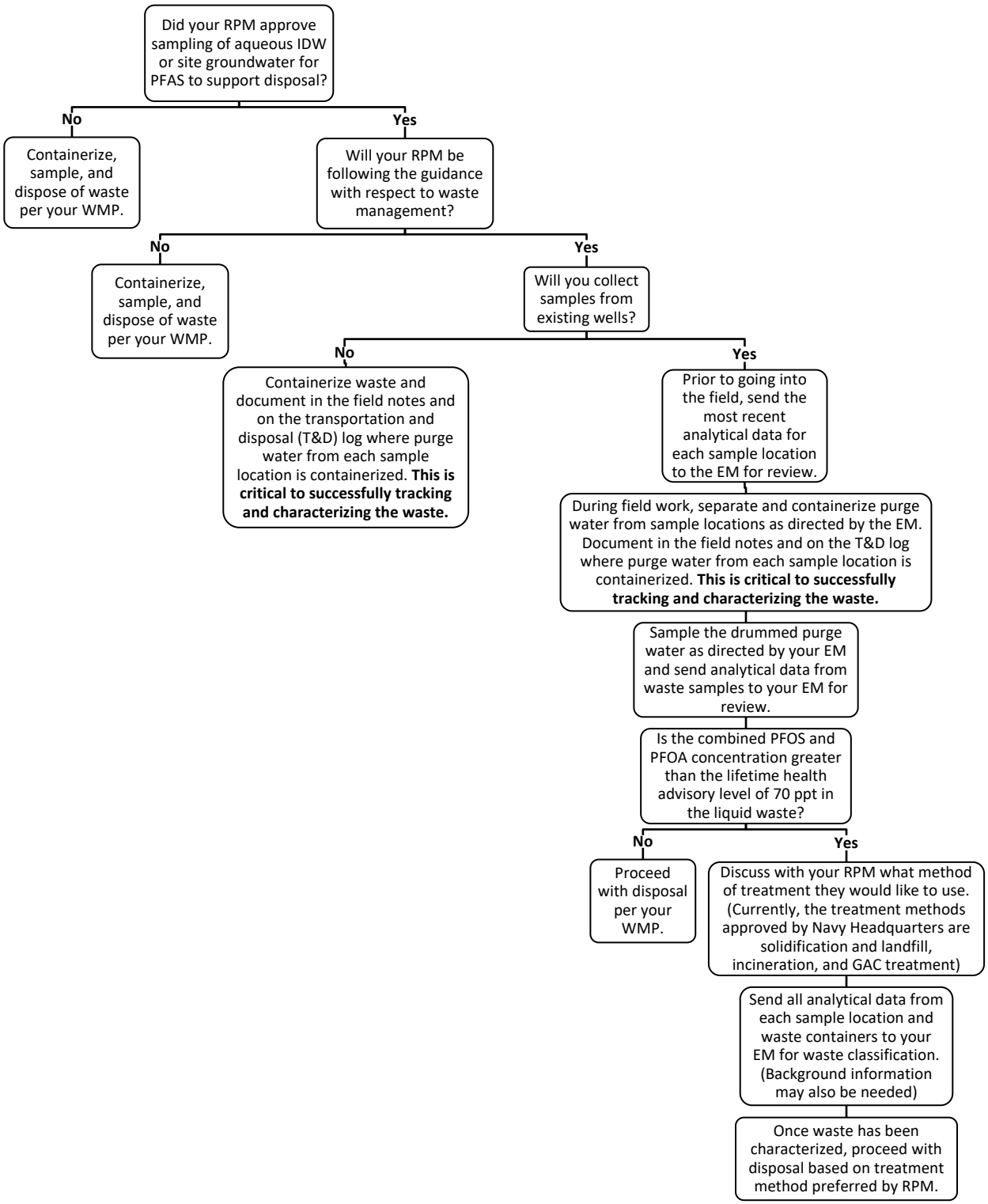
This SOP provides guidelines for managing waste containing per- and polyfluoroalkyl substances (PFAS) in accordance with the Interim Per- and Polyfluoroalkyl Substances (PFAS) Site Guidance for NAVFAC Remedial Project Managers (RPMs)/November 2020 Update (guidance). This SOP should be used in conjunction with an Environmental and/or Waste Management Plan (EMP and/or WMP) approved by your Environmental Manager (EM). If you do not have a site-specific EMP, please contact your EM.

Standard procedures for managing liquid waste during PFAS investigation are summarized. These procedures are specific to the Navy Comprehensive Long-term Environmental Action Navy (CLEAN) Program.

Currently, PFAS are not regulated as a hazardous waste in US EPA regulations (state and territory rules may vary). Treatment of liquid waste containing PFAS, as recommended by the guidance, is a client directed action. When and how it is implemented will be left to the discretion of the individual RPMs. These project specific actions will be communicated with the Project Manager (PM) and/or Activity Manager (AM).

II. Procedures and Guidelines

The following flowchart outlines the procedures required to manage liquid waste during PFAS investigations. Any deviations from this procedure must be approved by the EM.


Did your RPM approve sampling of aqueous IDW or site groundwater for PFAS to support disposal?
No
Yes
Containerize, sample, and dispose of waste per your WMP.
Will your RPM be following the guidance with respect to waste management?
No
Yes
Containerize, sample, and dispose of waste per your WMP.
Will you collect samples from existing wells?
No
Yes
Containerize waste and document in the field notes and on the transportation and disposal (T&D) log where purge water from each sample location is containerized. This is critical to successfully tracking and characterizing the waste.
Prior to going into the field, send the most recent analytical data for each sample location to the EM for review.
During field work, separate and containerize purge water from sample locations as directed by the EM. Document in the field notes and on the T&D log where purge water from each sample location is containerized. This is critical to successfully tracking and characterizing the waste.
Sample the drummed purge water as directed by your EM and send analytical data from waste samples to your EM for review.
Is the combined PFOS and PFOA concentration greater than the lifetime health advisory level of 70 ppt in the liquid waste?
No
Yes
Proceed with disposal per your WMP.
Discuss with your RPM what method of treatment they would like to use. (Currently, the treatment methods approved by Navy Headquarters are solidification and landfill, incineration, and GAC treatment)
Send all analytical data from each sample location and waste containers to your EM for waste classification. (Background information may also be needed)
Once waste has been characterized, proceed with disposal based on treatment method preferred by RPM.

Attachment D
Laboratory DoD ELAP Accreditation Letter

PERRY JOHNSON LABORATORY ACCREDITATION, INC.

Certificate of Accreditation

Perry Johnson Laboratory Accreditation, Inc. has assessed the Laboratory of:

Battelle

141 Longwater Drive, Suite 202, Norwell, MA 02061

(Hereinafter called the Organization) and hereby declares that Organization has met the requirements of ISO/IEC 17025:2017) General Requirements for the competence of Testing and Calibration Laboratories and the United States Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP) requirements identified within the DoD/DOE Quality Systems Manual (DoD/DOE QSM) Version 5.3 May 2019 and is accredited is accordance with the:

United States Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP)

This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system
(as outlined by the joint ISO-ILAC-IAF Communiqué dated April 2017):

Environmental Testing

(As detailed in the supplement)

Accreditation claims for such testing and/or calibration services shall only be made from addresses referenced within this certificate. This Accreditation is granted subject to the system rules governing the Accreditation referred to above, and the Organization hereby covenants with the Accreditation body's duty to observe and comply with the said rules.

For PJLA:

Tracy Szerszen
President

Perry Johnson Laboratory Accreditation, Inc. (PJLA)
755 W. Big Beaver, Suite 1325
Troy, Michigan 48084

Initial Accreditation Date:	*Issue Date:*	*Expiration Date:*
November 17, 2016	February 22, 2021	March 31, 2023

Accreditation No:	*Certificate No.:*
91667	L21-123

The validity of this certificate is maintained through ongoing assessments based on a continuous accreditation cycle. The validity of this certificate should be confirmed through the PJLA website: www.pjlabs.com

Certificate of Accreditation: Supplement

ISO/IEC 17025:2017 and DoD-ELAP

Battelle

141 Longwater Drive, Suite 202, Norwell, MA 02061

Contact Name: Jonathan Thorn Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Drinking Water	EPA 533	LC/MS/MS	11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)
Drinking Water	EPA 533	LC/MS/MS	9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)
Drinking Water	EPA 533	LC/MS/MS	4,8-dioxa-3H-perfluorononanoic acid (Adona)
Drinking Water	EPA 533	LC/MS/MS	Hexafluoropropylene oxide dimer acid (HFPO-DA)
Drinking Water	EPA 533	LC/MS/MS	Nonafluoro-3,6-Dioxaheptanoic Acid (NFDHA)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-n-butanoic Acid (PFBA)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-1-butanesulfonic Acid (PFBS)
Drinking Water	EPA 533	LC/MS/MS	1H,1H,2H,2H-Perfluorodecane sulfonate (8:2FTS)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-n-decanoic Acid (PFDA)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-n-dodecanoic acid (PFDoA)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro(2-ethoxyethane)sulfonic Acid (PFEESA)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-1-heptanesulfonate (PFHpS)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-n-heptanoic Acid (PFHpA)
Drinking Water	EPA 533	LC/MS/MS	1H,1H,2H,2H-Perfluorohexane sulfonate (4:2FTS)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-1-hexanesulfonic Acid (PFHxS)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-n-hexanoic acid (PFHxA)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-3-Methoxypropanoic Acid (PFMPA)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-4-Methoxybutanoic Acid (PFMBA)
Drinking Water	EPA 533	LC/MS/MS	Perfluorononanoic acid (PFNA)
Drinking Water	EPA 533	LC/MS/MS	1H,1H,2H,2H-Perfluorooctane sulfonate (6:2FTS)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-1-octanesulphonic Acid (PFOS)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-n-octanoic Acid (PFOA)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-n-pentanoic acid (PFPeA)
Drinking Water	EPA 533	LC/MS/MS	Sodium perfluoro-1-pentanesulfonate (PFPeS)
Drinking Water	EPA 533	LC/MS/MS	Perfluoro-n-undecanoic acid (PFUnA)
Drinking Water	EPA 537.1.1	LC/MS/MS	4,8-dioxa-3H-perfluorononanoic acid (ADONA)
Drinking Water	EPA 537.1.1	LC/MS/MS	9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)
Drinking Water	EPA 537.1.1	LC/MS/MS	11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)
Drinking Water	EPA 537.1.1	LC/MS/MS	Hexafluoropropylene oxide dimer acid (HFPO-DA)

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Matrix	Standard/Method	Technology	Analyte
Drinking Water	EPA 537.1.1	LC/MS/MS	Perfluoro-n-hexanoic acid (PFHxA)
Drinking Water	EPA 537.1.1	LC/MS/MS	Perfluoro-n-heptanoic Acid (PFHpA)
Drinking Water	EPA 537.1.1	LC/MS/MS	Perfluoro-n-octanoic Acid (PFOA)
Drinking Water	EPA 537.1.1	LC/MS/MS	Perfluorononanoic acid (PFNA)
Drinking Water	EPA 537.1.1	LC/MS/MS	Perfluoro-n-decanoic Acid (PFDA)
Drinking Water	EPA 537.1.1	LC/MS/MS	Perfluoro-n-undecanoic acid (PFUnA)
Drinking Water	EPA 537.1.1	LC/MS/MS	Perfluoro-n-dodecanoic acid (PFDoA)
Drinking Water	EPA 537.1.1	LC/MS/MS	Perfluoro-n-tridecanoic acid (PFTrDA)
Drinking Water	EPA 537.1.1	LC/MS/MS	Perfluoro-n-tetradecanoic acid (PFTeDA)
Drinking Water	EPA 537.1.1	LC/MS/MS	N-methylperfluoro-1-octanesulfonamidoacetic acid (NMeFOSAA)
Drinking Water	EPA 537.1.1	LC/MS/MS	N-ethylperfluoro-octanesulfonamidoacetic acid (NEtFOSAA)
Drinking Water	EPA 537.1.1	LC/MS/MS	Perfluoro-1-butanesulfonic Acid (PFBS)
Drinking Water	EPA 537.1.1	LC/MS/MS	Perfluoro-1-hexanesulfonic Acid (PFHxS)
Drinking Water	EPA 537.1.1	LC/MS/MS	Perfluoro-1-octanesulphonic Acid (PFOS)
Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	3-Perfluoropropyl propanoic Acid (3:3 FTCA)
Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	3-Perfluoropropyl propanoic acid (5:3 FTCA)
Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	3-Perfluoropropyl propanoic acid (7:3 FTCA)
Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-1-octanesulfonamide (PFOSA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	4,8-dioxa-3H-perfluorononanoic acid (Adona)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	9-chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9CI-PF3ONS)

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141 Longwater Drive, Suite 202, Norwell, MA 02061

Contact Name: Jonathan Thorn Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11CI-PF3OUdS)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Hexafluoropropylene oxide dimer acid (HFPO-DA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Sodium perfluoro-1-pentanesulfonate (PFPeS)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-1-nonanesulfonate (PFNS)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-1-heptanesulfonate (PFHpS)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	N-ethylperfluoro-octanesulfonamidoacetic acid (NEtFOSAA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	1H,1H,2H,2H-Perfluorohexane sulfonate (4:2FTS)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	1H,1H,2H,2H-Perfluorooctane sulfonate (6:2FTS)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	1H,1H,2H,2H-Perfluorodecane sulfonate (8:2FTS)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-n-butanoic Acid (PFBA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-n-pentanoic acid (PFPeA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-n-hexanoic acid (PFHxA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-n-heptanoic Acid (PFHpA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-n-octanoic Acid (PFOA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluorononanoic acid (PFNA)

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141 Longwater Drive, Suite 202, Norwell, MA 02061

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Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-n-decanoic Acid (PFDA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-n-undecanoic acid (PFUnA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-n-dodecanoic acid (PFDoA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-n-tridecanoic acid (PFTrDA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-n-tetradecanoic acid (PFTeDA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	N-methylperfluoro-1-octanesulfonamidoacetic acid (NMeFOSAA)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-1-butanesulfonic Acid (PFBS)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-1-hexanesulfonic Acid (PFHxS)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-1-octanesulphonic Acid (PFOS)
Aqueous/Solids/Tissues	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	LC/MS/MS	Perfluoro-1-decanesulfonate (PFDS)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',3,3',4,4'-Hexachlorobiphenyl (BZ 128)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',3,3',4,5-Hexachlorobiphenyl (BZ 129)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ 180)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ 183)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',3,4,4',5'-Hexachlorobiphenyl (BZ 138)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',3,4,4',6,6'-Heptachlorobiphen yl (BZ 184)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ 187)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',3,4,5'-Pentachlorobiphenyl (BZ 87)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',3,5'-Tetrachlorobiphenyl (BZ 44)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',4,4',5,5'-Hexachlorobiphenyl (BZ 153)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',4,5,5'-Pentachlorobiphenyl (BZ 101)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',4,5'-Tetrachlorobiphenyl (BZ 49)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',5,5'-Tetrachlorobiphenyl (BZ 52)

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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,2',5-Trichlorobiphenyl (BZ 18)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,3,3',4,4'-Pentachlorobiphenyl (BZ 105)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,3,3',4',6-Pentachlorobiphenyl (BZ 110)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,3',4,4',5-Pentachlorobiphenyl (BZ 118)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,3',4,4'-Tetrachlorobiphenyl (BZ 66)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,4,4'-Trichlorobiphenyl (BZ 28)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,4'-DDD
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,4'-DDE
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,4'-DDT
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	2,4'-Dichlorobiphenyl (BZ 8)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	3,3',4,4',5,5'-Hexachlorobiphenyl (BZ 169)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	3,3',4,4',5-Pentachlorobiphenyl (BZ 126)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	3,3',4,4'-Tetrachlorobiphenyl (BZ 77)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	4,4'-DDD
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	4,4'-DDE
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	4,4'-DDT
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Aldrin
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	alpha-BHC (alpha-Hexachlorocyclohexane)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	alpha-Chlordane
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	beta-BHC (beta-Hexachlorocyclohexane)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Chlorpyrifos
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	cis-Nonachlor
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Decachlorobiphenyl (BZ 209)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	delta-BHC
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Dieldrin
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Endosulfan II
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Endosulfan I
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Endosulfan sulfate
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Endrin
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Endrin aldehyde
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Endrin ketone
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	gamma-Chlordane
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Heptachlor
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Heptachlor epoxide
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Hexachlorobenzene

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Contact Name: Jonathan Thorn Phone: 781-681-5565

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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Methoxychlor
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Mirex
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	Oxychlordane
Aqueous/Solid/Tissue	EPA 8081 MOD	GC-ECD	trans-Nonachlor
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	1,4-Dichlorobenzene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	1-Methylnaphthalene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	1-Methylphenanthrene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ 206)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ 194)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl (BZ 207)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ 195)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ 170)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,4',6,6'-Octachlorobiphenyl (BZ 197)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,4',6-Heptachlorobiphenyl (BZ 171)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,4'-Hexachlorobiphenyl (BZ 128)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl (BZ 208)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,5,5',6-Octachlorobiphenyl (BZ 198)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,5,5',6'-Octachlorobiphenyl (BZ 199)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,5,5'-Heptachlorobiphenyl (BZ 172)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,5,6,6'-Octachlorobiphenyl (BZ 200)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ 201)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,5,6-Heptachlorobiphenyl (BZ 173)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ 174)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,5',6-Heptachlorobiphenyl (BZ 175)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ 177)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,5'-Hexachlorobiphenyl (BZ 130)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,6,6'-Heptachlorobiphenyl (BZ 176)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4,6-Hexachlorobiphenyl (BZ 131)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',4-Pentachlorobiphenyl (BZ 82)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',5,5',6,6'-Octachlorobiphenyl (BZ 202)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',5,5',6-Heptachlorobiphenyl (BZ 178)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',5,6,6'-Heptachlorobiphenyl (BZ 179)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',5,6-Hexachlorobiphenyl (BZ 134)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',5,6'-Hexachlorobiphenyl (BZ 135)

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Battelle

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Contact Name: Jonathan Thorn Phone: 781-681-5565

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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',5-Pentachlorobiphenyl (BZ 83)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',6,6'-Hexachlorobiphenyl (BZ 136)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3',6-Pentachlorobiphenyl (BZ 84)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,3'-Tetrachlorobiphenyl (BZ 40)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ 203)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ 180)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ 183)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4,4',5-Hexachlorobiphenyl (BZ 137)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4,4',5'-Hexachlorobiphenyl (BZ 138)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ 184)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4,4',6-Hexachlorobiphenyl (BZ 139)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4,4',6'-Hexachlorobiphenyl (BZ 140)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4,4'-Pentachlorobiphenyl (BZ 85)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4,5,5',6-Heptachlorobiphenyl (BZ 185)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ 187)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4,5,5'-Hexachlorobiphenyl (BZ 141)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4',5,5'-Hexachlorobiphenyl (BZ 146)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4',5,6,6'-Heptachlorobiphenyl (BZ 188)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4',5',6-Hexachlorobiphenyl (BZ 149)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4,5',6-Hexachlorobiphenyl (BZ 144)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4,5'-Pentachlorobiphenyl (BZ 87)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4',5'-Pentachlorobiphenyl (BZ 97)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4',6-Pentachlorobiphenyl (BZ 91)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4-Tetrachlorobiphenyl (BZ 41)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,4'-Tetrachlorobiphenyl (BZ 42)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,5,5',6-Hexachlorobiphenyl (BZ 151)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,5,5'-Pentachlorobiphenyl (BZ 92)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,5',6-Pentachlorobiphenyl (BZ 95)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,5-Tetrachlorobiphenyl (BZ 43)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,5'-Tetrachlorobiphenyl (BZ 44)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,6'-Tetrachlorobiphenyl (BZ 46)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3,6-Tetrachlorobiphenyl (BZ 45)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',3-Trichlorobiphenyl (BZ 16)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',4,4',5,5'-Hexachlorobiphenyl (BZ 153)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',4,4',5,6'-Hexachlorobiphenyl (BZ 154)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',4,4',5-Pentachlorobiphenyl (BZ 99)

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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',4,4',6,6'-Hexachlorobiphenyl (BZ 155)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',4,4',6-Pentachlorobiphenyl (BZ 100)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',4,4'-Tetrachlorobiphenyl (BZ 47)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',4,5,5'-Pentachlorobiphenyl (BZ 101)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',4,5-Tetrachlorobiphenyl (BZ 48)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',4,5'-Tetrachlorobiphenyl (BZ 49)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',4,6,6'-Pentachlorobiphenyl (BZ 104)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',4,6'-Tetrachlorobiphenyl (BZ 51)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',4,6-Tetrachlorobiphenyl (BZ 50)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',4-Trichlorobiphenyl (BZ 17)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',5,5'-Tetrachlorobiphenyl (BZ 52)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',5,6'-Tetrachlorobiphenyl (BZ 53)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',5-Trichlorobiphenyl (BZ 18)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',6,6'-Tetrachlorobiphenyl (BZ 54)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2',6-Trichlorobiphenyl (BZ 19)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,2'-Dichlorobiphenyl (BZ 4)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,3',4,4',5,5',6-Octachlorobiphenyl (BZ 205)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ 189)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,3',4,4',5,6-Heptachlorobiphenyl (BZ 190)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,3',4,4',5',6-Heptachlorobiphenyl (BZ 191)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,3',4,4',5-Hexachlorobiphenyl (BZ 156)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,3',4,4',5'-Hexachlorobiphenyl (BZ 157)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,3',4,4',6-Hexachlorobiphenyl (BZ 158)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,3',4,4'-Pentachlorobiphenyl (BZ 105)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,3',4',5,5',6-Heptachlorobiphenyl (BZ 193)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,3',4',5,6-Hexachlorobiphenyl (BZ 163)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,3',4',5',6-Hexachlorobiphenyl (BZ 164)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,3',4',6-Pentachlorobiphenyl (BZ 110)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,3',4'-Tetrachlorobiphenyl (BZ 56)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3',4,4',5,5'-Hexachlorobiphenyl (BZ 167)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,4,4',5,6-Hexachlorobiphenyl (BZ 166)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,4,4',5-Pentachlorobiphenyl (BZ 114)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3',4,4',5-Pentachlorobiphenyl (BZ 118)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3',4,4',5'-Pentachlorobiphenyl (BZ 123)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,4,4',6-Pentachlorobiphenyl (BZ 115)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,4,4'-Tetrachlorobiphenyl (BZ 60)

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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3',4,4'-Tetrachlorobiphenyl (BZ 66)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3',4',5,5'-Pentachlorobiphenyl (BZ 124)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3',4',5',6-Pentachlorobiphenyl (BZ 125)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,4',5-Tetrachlorobiphenyl (BZ 63)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3',4,5-Tetrachlorobiphenyl (BZ 67)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3',4',5-Tetrachlorobiphenyl (BZ 70)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,4',6-Tetrachlorobiphenyl (BZ 64)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3',4',6-Tetrachlorobiphenyl (BZ 71)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,4'-Trichlorobiphenyl (BZ 22)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3',4-Trichlorobiphenyl (BZ 25)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3',4'-Trichlorobiphenyl (BZ 33)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3',5-Trichlorobiphenyl (BZ 26)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,5-Trimethylnaphthalene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3,6-Trichlorobiphenyl (BZ 24)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3',6-Trichlorobiphenyl (BZ 27)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3-Dichlorobiphenyl (BZ 5)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,3'-Dichlorobiphenyl (BZ 6)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,4,4',5-Tetrachlorobiphenyl (BZ 74)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,4,4',6-Tetrachlorobiphenyl (BZ 75)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,4,4'-Trichlorobiphenyl (BZ 28)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,4,5-Trichlorobiphenyl (BZ 29)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,4',5-Trichlorobiphenyl (BZ 31)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,4,6-Trichlorobiphenyl (BZ 30)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,4',6-Trichlorobiphenyl (BZ 32)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,4'-DDD
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,4'-DDE
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,4'-DDT
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,4-Dichlorobiphenyl (BZ 7)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,4'-Dichlorobiphenyl (BZ 8)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,5-Dichlorobiphenyl (BZ 9)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2,6-Dimethylnaphthalene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2-Chlorobiphenyl (BZ 1)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2-Chloronaphthalene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2-Methylnaphthalene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	2-Methylphenanthrene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	3,3',4,4',5,5'-Hexachlorobiphenyl (BZ 169)

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Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	3,3',4,4',5-Pentachlorobiphenyl (BZ 126)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	3,3',4,4'-Tetrachlorobiphenyl (BZ 77)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	3,3',4,5,5'-Pentachlorobiphenyl (BZ 127)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	3,3',5,5'-Tetrachlorobiphenyl (BZ 80)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	3,3'-Dichlorobiphenyl (BZ 11)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	3,4,4',5-Tetrachlorobiphenyl (BZ 81)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	3,4,4'-Trichlorobiphenyl (BZ 37)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	3,4-Dichlorobiphenyl (BZ 12)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	3,4'-Dichlorobiphenyl (BZ 13)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	3,6-Dimethylphenanthrene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	4,4'-Dichlorobiphenyl (BZ 15)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	4-Chlorobiphenyl (BZ 3)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Acenaphthene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Acenaphthylene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Anthracene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Benzo(a)anthracene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Benzo(a)pyrene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Benzo(b)fluoranthene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Benzo(b)thiophene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Benzo(e)pyrene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Benzo(g,h,i)perylene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Benzo(k)fluoranthene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Biphenyl
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Chrysene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	cis-Decalin
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Decachlorobiphenyl (BZ 209)
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Dibenz(a,h)anthracene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Dibenzofuran
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Dibenzothiophene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Fluoranthene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Fluorene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	lndeno(l,2,3-cd)pyrene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Naphthalene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Perylene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Phenanthrene
Aqueous/Solid/Tissue	EPA 8270E MOD	GC-MS	Pyrene

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Aqueous/Solid/Tissue	EPA 8270DE MOD	GC-MS	trans-Decalin
Aqueous	EPA 3510 C	Separatory Funnel	Prep
Aqueous/Solid/Tissue	EPA 3640A MOD	Gel-permeation chromatography (GPC)	Cleanup
Aqueous/Solid/Tissue	EPA 3660B MOD	Sulfur Cleanup	Cleanup
Solids/Tissues	NOAA NOS ORCA 71	Orbital Shaker	Prep
Tissue	NOAA NOS ORCA 71	Tissuemizer	Prep

Attachment E
Laboratory Standard Operating Procedures

Site Inspection Sampling and Analysis Plan for
Per- and Polyfluoroalkyl Substances
Atlantic Fleet Weapons Training Area – Vieques
Former Naval Ammunition Support Detachment and
Former Vieques Naval Training Range
Vieques, Puerto Rico

NOTIFICATION: ATTACHMENT E CONTAINS SENSITIVE BUT UNCLASSIFIED INFORMATION WHICH IS PROTECTED BY THE FREEDOM OF INFORMATION ACT

FOIA Exemption 4 (5 USC 552(b)(4))
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Attachment F
Responses to Regulator Comments

Responses to Regulator Comments

Responses to EPA Comments on the
Draft Site Inspection Sampling and Analysis Plan for Per- andPolyfluoroalkyl Substances
Dated October 2020
Atlantic Fleet Weapons Training Area –Vieques

SPECIFIC COMMENTS

Comment 1 - Worksheet # 9 pages 38, 40:

EPA Comment: Diana Cutt name is misspelled in email address, pages 38 and 40.Add correct title/roll, page 40:
Angela Carpenter - "Superfund Special Projects Branch Chief"
Michael Sivak - "Human Health Risk Assessor"
Diana Cutt to - "Hydrogeologist"

Navy Response: The requested edits will be made.

Comment 2 - Figure 10-2, Page 64

EPA Comment: Add polygon identifying former NASD Fire Station.

Navy Response: The requested edit will be made.

Comment 3 - Figure 10-3, Page 65

EPA Comment: Please add: 'Helicopter Maint. Bldg.' after SWMU 20 as seen in Figure 10-9.

Navy Response: The requested edit will be made.

Comment 4 - Worksheet # 11, DQOs Pages 77-80, 84, The document indicates on:

Page 77 lines 23-25, states, "The objective of an SI is "release assessment. Specifically, the PFASSI is intended to: 1) Determine whether a release of PFAS has occurred from past CERCLA-related activities and, if so, 2) Determine whether the release warrants further action."

Page 77 lines 31-32, states: "comparing detected concentrations to health-based screening criteria,"'

Page 78 lines 28-29, states: "the objective of the SI is "release assessment" versus "nature and extent determination" (which is typically an objective of an RI), the investigation areas are focused on where a release(s) of PFAS to the environment most likely would have taken place."

Pages 77-79, 84, 95-100. There are multiple references to RSLs & EVS, under the following subjects: Principal Study Questions, Alternative Outcomes, DQO Step 5, Surface Soil, Subsurface Soil, and Sediment, Groundwater, Worksheet #15-1 & 15-2, and Footnotes on: Fig 11-1, PFAS Release Assessment Decision Tree, any other reference to RSLs and EVS.

EPA comment: The DQOs assumes that the SI sampling will thoroughly characterize any release,which may not the case. The SI's goals are well described in page 77, lines 23-25 and as describedin page 78, lines 28-29, the data collected for the SI are not collected with a goal or objective of defining nature and extent, but rather to identify if the PFAS are present at the site and are migrating to the surrounding environment.

In the document, the DQOs set forth a process that 'only sites/areas with concentrations that exceed RSLs would be carried into the RI, while sites/areas with detected concentrations that don't exceed the screening levels do not get carried forward.' Comparisons to health-based screening (RSLs) and/or ecological screening (ESV) criteria are done during the RI not the SI. Given that this is an SI, and there is uncertainty in the actual locations of potential PFAS releases and inthe fate and transport mechanisms of PFAS, any PFAS detection should trigger further investigation or action. At the SI stage, release samples are usually compared to background sample to determine if there is a release to the environment. However, we are not recommending background samples because PFAS, a manmade product, should not be present in any of the potential sources or proposed release samples. The presence of PFAS should be the trigger to further action (e.g., removal action, expanded SI, or an RI). The only criteria for no further action at this 'SI' stage would be if all the media results were ND (with appropriate detection limits). Please correct document to reflect goals of the SI. Remove references made to RSL/ESVs.

Navy Response: The Navy's stated objectives, DQOs, and proposed characterization approach are consistent with the purpose of an SI and are consistent with EPA SI guidance (EPA, 1992 and 2005). Further, the Navy does not find any reference within EPA guidance which states or indicates further action (e.g., removal action or remedial investigation) is triggered solely by the presence of compounds; rather the EPA guidance asserts that the SI not only demonstrate the presence of a release, but also whether the release poses a threat to human health or the environment (e.g., comparison to benchmarks such as those defined in Table 3-6 of EPA (1992). Therefore, the proposed evaluation in relation to risk-based screening values is consistent with guidance. Use of these values in the evaluation is not equivalent to evaluating risk, but is instead intended to determine whether a CERCLA-related release warrants further action/investigation. In responding to this comment, the Navy re-assessed the information provided in Worksheet #11 and believes the DQOs are consistent with the objectives of an SI as defined in guidance. That is, sampling at each site is proposed in locations where releases to impacted media would most likely be detected.

Notwithstanding the above information, it is recognized there are PFAS compounds for which there are currently no published screening levels, reference doses (RfDs), or sufficient study upon which to base "industry-wide" screening values, including ecological screening values (ESVs are included in the SAP to ensure data quality will be sufficient for potential later use in ecological risk screening or risk assessment). In addition, current DoD policy moves PFAS sites from SI to RI only if the concentrations of PFAS pose a potentially unacceptable human health risk based on a screening evaluation using PFAS for which there are either EPA RSLs (i.e., currently PFBS) or DoD-approved screening levels (i.e., PFOA and PFOS as documented in a memo from Assistant Secretary of Defense dated 15 Oct 2019). To account for this, the if/then statements under the Alternative Outcomes in Worksheet #11 and the footnote in Figure 11-1 have been revised to indicate no further investigation/action "at this time and until/unless new information and/or updated screening criteria are identified indicating further investigation/action is warranted" for sites where PFAS are either not detected or are detected but the concentrations do not represent a potentially unacceptable human health risk (assuming wholistic evaluation of site-related information in accordance with the evaluation process shown in Figure 11-1 indicates additional sampling as part of the SI is not necessary in order to draw this conclusion).

Comment 5 – Worksheet #11 Page 78 lines 37-39, Worksheet #18

It is stated that soil depths are as follows:

"Surface soils:

1) Top 2 feet when sample location is near a surface water body and within verified land crab habitat and

2) Top 1 foot when sample location is not near a surface water body and within verified land crab habitat."

EPA Comment: For SI purposes, surface soil sample depth should be collected within the top 2 feet. Please correct.

Navy Response: The surface soil sampling depth intervals included in the SAP are in accordance with the Soil Sample Depth Selection Protocol in the Final Master Standard Operating Procedures, Protocols, and Plans Revision 2018 (CH2M, 2018).

Comment 6 – Worksheet #11, page 79 lines 1-3; Worksheet #14 & 16, page 90; Worksheet #17,

pages 101-106

Page 79 - the document indicates: "Subsurface Soil: Within a 2-foot interval within the zone from the base of the surface soil sample interval 2 to 6 feet (or bedrock or groundwater if shallower) as follows: 4-to-6-foot interval in the absence of obvious contamination"

Page 90 – states: "Subsurface soil samples will be collected from the 4-to-6 foot interval (or just above the water table or bedrock, if encountered before this depth), unless visual and/or instrument screening suggests a different potentially contaminated 2-foot interval between thesurface soil interval and 6 feet."

Pages 101-106 have multiple references to 4-to-6-foot interval.

EPA Comment: Given that studies indicate that adsorption at the air/water interface is a significant source of retention for PFAS such as PFOA, subsurface soil sampling must be also conducted at the soil/water interface if this zone occurs in unconsolidated material. The subsurface sample depths should be no more than one-foot intervals and pre-planned at the sites where depth to water is known (i.e., sites with existing wells) and included in the SAP. In addition, there is no known visual,'obvious contamination,' and/or instrument screening for PFAS. Please correct.

Navy Response: For locations where subsurface soil sampling is planned, an additional sample at the soil/water interface (if within unconsolidated material) will be collected if feasible (as explained below). This information will be added to the QAPP. Subsurface soil samples will be collected in accordance with the Soil Sample Depth Selection Protocol in the Final Master Standard Operating Procedures, Protocols, and Plans Revision 2018 (CH2M, 2018). By site, the revisions to be made are:

<u>Former NASD Sites</u>

- AOC H – Will add an air/water interface subsurface soil sample at each of the four borings where subsurface soil sampling is planned. Air/water interface is anticipated to be in the unconsolidated material based on historical investigations.
- SWMU 6 – Given that the terrestrial area to be sampled at SWMU 6 is likely less than 2 feet above the lagoon surface, the surface soil sample or subsurface soil sample (if unsaturated soil thickness is greater than 2 feet) will be collected from the air/water interface.
- SWMU 7 – No air/water interface subsurface soil samples will be collected because first encountered groundwater at this site is in consolidated material based on historical investigations.
- AOC B, NASD Motor Pool, and NASD Fire Station – All three sites are immediately adjacent to AOC E where first encountered groundwater is in consolidated material (saprock). Therefore, no air/water interface soil samples will be collected because first encountered groundwater would be in the same formation as AOC E.

<u>Former VNTR Sites</u>

- SWMU 1 – Not applicable; all planned samples are groundwater from existing wells.
- SWMU 10/AOC G – No air/water interface subsurface soil samples will be collected because first encountered groundwater at these sites is in consolidated material based on historical investigations.

- SWMU 20 - No air/water interface subsurface soil samples will be collected because first encountered groundwater at this site is in consolidated material based on historical investigations.
- PI 5 and Camp Garcia Runway – Air/water interface subsurface soil samples will be collected from borings along the runway, only if drilling during the monitoring well installation encounters the saturated zone within unconsolidated material. Within the soil borings added at the downstream mouths of the two ephemeral streams south of the runway, air/water interface subsurface soil sample will be collected if the saturated zone is encountered in the unconsolidated material at or before the maximum penetration depth of the hand auger.
- Camp Garcia Fire Station and Motor Pool – No air/water interface subsurface soil samples will be collected at these sites because first encountered groundwater at Camp Garcia is in consolidated material based on historical investigations.

Comment 7 - Worksheet #11, page 79 line 17 states:

"The decision rules for the PFAS SI are shown in **Figure 11-2**."

EPA Comment: Typo. PFAS Release Assessment Decision Tree is Figure 11-1. Please correct.

Navy Response: The requested edit will be made.

Comment 8 - Worksheet #12, page 85

EPA Comment:

Worksheet #12 is intended to document the project Data Quality Indicators (DQIs: Accuracy, Precision, Completeness, etc.) that the analytical methods should achieve. Worksheet #28 documents that the selected methods can meet the DQIs. Please correct, follow UFP-QAPP Guidance.

Navy Response: Based on feedback received from EPA during development of a past SAP, it was concurred that as a matter of convention for Vieques SAPs, the DQIs for environmental media would be provided in Worksheet #28 and a note would be placed in Worksheet #12 stating that information. As indicated in the note provided in Worksheet #12, the DQIs for soil and groundwater are listed in Worksheets #28-1 and 28-2, respectively. The Navy would prefer to continue with the convention agreed to previously to help maintain consistency among SAPs.

Comment 9 - Worksheet #14 & 16, page 91 Lines 32-35

The document indicates: "It should be noted that while SOPs will be followed for water quality measurements, professional judgment ultimately will be used to determine when sufficient volume has been purged (e.g., when formation water is being sampled). This is because at low parameter measurements, very small differences in measurements can result in large percent differences, simply because of the innate heterogeneity of environmental media, not that equilibration is still occurring."

EPA Comment: Any deviations from accepted low-flow SOPs must be brought to the attention of the EPA. If adequate purge volumes are not removed from the well, the samples may not be considered representative of the surrounding groundwater.

Navy Response: As documented in Worksheets #14 and 16 of the SAP, the SOP for low flow groundwater sampling in the Final Master Standard Operating Procedures, Protocols, and Plans Revision 2018 (CH2M, 2018) will be followed. Any deviations from the accepted low-flow SOP will be brought to the attention of EPA.

Comment 10 - Worksheet #14 & 16, page 92, lines 28-41

1- The document indicates: "Investigation-derived Waste Management IDW generated during this project may consist of soil cuttings, development water, purge water, decontamination water, PPE, and other miscellaneous consumables other than PPE such as disposable sampling equipment. If practical, the liquid IDW will be allowed to evaporate. If this is not possible, it will be containerized and characterized for off-site disposal."

EPA comment: In general, all purge water needs to be containerized for proper disposal rather than left open to the elements.

Navy Response: The process defined in the SAP is in accordance with the Waste Management Plan included in the Final Master Standard Operating Procedures, Protocols, and Plans Revision 2018 (CH2M, 2018). Further, the liquid IDW will not be left open to the elements, but will be allowed to evaporate only if practical, as stated in the SAP. This is a process that has been approved by EPA and used successfully during past investigations.

2- The document indicates that "Characterization will consist of standard disposal characteristics (full Toxicity Characteristic Leaching Procedure [TCLP], reactivity, corrosivity, ignitability) listed in the Master Waste Management Plan of the Master Protocols (CH2M, 2018) as well as PFAS. If the combined PFOA and PFOS concentration in the IDW sample(s) exceeds 70 parts per thousand (ppt), the waste will be disposed through incineration or solidification and landfilling. Soil cuttings will be generated from soil borings and monitoring well installation. Any soil generated from soil borings will be put back into the boreholes after samples have been collected. Soil generated from monitoring well installation shall be containerized in 55-gallon drums and characterized for PFAS. If there are no PFAS detections, the soil will be spread on the ground surface in the vicinity of the monitoring well boring where it was generated. If there are PFAS detections, the soil will then be characterized for standard disposal characteristics (full TCLP, reactivity, corrosivity, ignitability) listed in the Master Protocols(CH2M, 2018) for offsite disposal."

EPA Comment: Any soil generated from soil borings need to be containerized and sampled for proper disposal. Please provide specific disposal locations for all PFAS IDW for the agencies to review.

Navy Response: The referenced approach to returning soil to borings is in accordance with the Waste Management Plan in the Final Master Standard Operating Procedures, Protocols, and Plans Revision 2018 (CH2M, 2018). This is the process that has been approved by EPA and used successfully during past investigations. If offsite disposal is necessary, once a disposal location is selected for PFAS IDW disposal, the information will be provided to the regulatory agencies.

Comment 11 - Worksheet #17, Table ES-1

The following language (or similar) has been used throughout the document: "As such, one co- located surface and subsurface soil sample will be collected from the approximate center of eachof the four unlined evaporation/percolation cells at the former WWTP lagoon (VWAB-PFAS- SS/SB01, VWAB-PFAS-SS/SB02, VWAB-PFAS-SS/SB03, and VWAB-PFAS-SS/SB04)".

EPA comment: The term 'co-located' sample should be removed from the document. EPA understands what co-located means on this document; however, Region 2 Quality Assurance Guidance and Standard Operating Procedures, define co-located samples as "a type of field duplicate… independent samples collected as close as possible to the same point in space and time", which does not fit the meaning of the proposed 'co-located' samples, except for field duplicates.

Navy Response: The text will be adjusted to remove the term "co-located."

EPA comment: Worksheet #18 identifies the proposed surface and subsurface samples accurately. However, the narrative does not reflect the # of samples proposed at each site/area. In addition, the concept of collecting "one"

sample per quadrant on the lagoon should be changed to reflect that samples will be collected at different depths. For example, the above description for the former WWTP lagoon does not reflect that a total of 8 samples will be collected and analyzed from the lagoon (4 SS and 4 SB). QAPP should be specific in terms of depth and number of proposed samples which is reflected in Worksheet #18 but not in the rest of the document. This comment applies to other areas under investigation. Revise QAPP/SAP to reflect these changes.

Navy Response: The requested clarifications will be made to the applicable narratives.

Comment 12 – Worksheet #17 and Figures 10-4 – 10-13 (and corresponding figures in Exec. Summary)

EPA Comments:

Figure 10-4, AOC B, Former NASD Fire Station, 'conex' container – Soil/GW samples

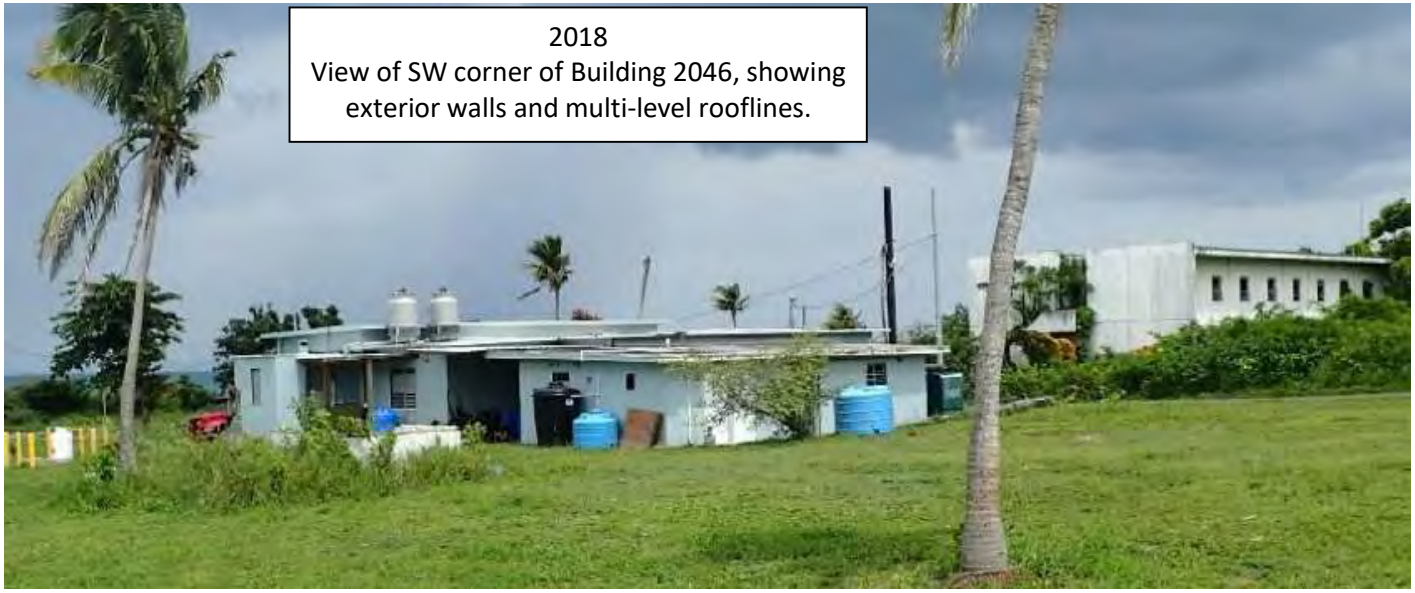
1- There are two aerial photographs in google earth showing a container similar to a 'conex' behind the building and a structure(s) adjacent to the west site of the building. Add 1 soil and 1 subsurface soil sample to be collected behind the building and add 1 SS and 1 SB soil sample as shown images below and next page.

Navy Response: The NASD Former Fire Station (Building 2046) was constructed in 1972 and was used as a fire station until it was decommissioned in 2000. It was only during this timeframe that potential releases of AFFF would have occurred. The first Google Earth image provided by the EPA reviewer is from 1994, and the white line identified by the reviewer as "a container similar to a 'conex' behind the building" is actually the south wall of Building 2046 viewed at an oblique angle; there is no container behind the building in the Google Earth image. Further, there is no conex behind the building in the 1999 aerial photograph; the apparent conex first appears in the 2006 aerial image, 6 years after the building was decommissioned as a fire station.

Similarly, the comment regarding "a structure(s) adjacent to the west side of the building" is part of Building 2046 and not a separate adjacent structure. As shown in the Google Earth snapshots below from 1994, 2006, and 2017, where identical portions of the building rooflines are outlined across the years, there was not a separate structure adjacent to the west side of the building; those features are all part of the building. The photo below from 2018 provides a southwest ground-level view of Building 2046 corner walls and variable rooflines, comparable to the aerial views since 1994 with the exception of a building addition at the northwest corner.

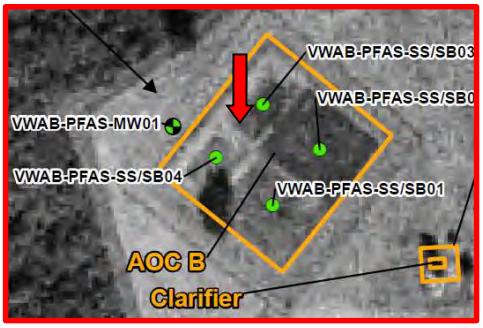
Based on the above, no additional samples are warranted.


1994
1999
2006
2017


2018
View of SW corner of Building 2046, showing exterior walls and multi-level rooflines.

2- Locate VWAB-PFAS-MW01 within the footprint of the former lagoon.

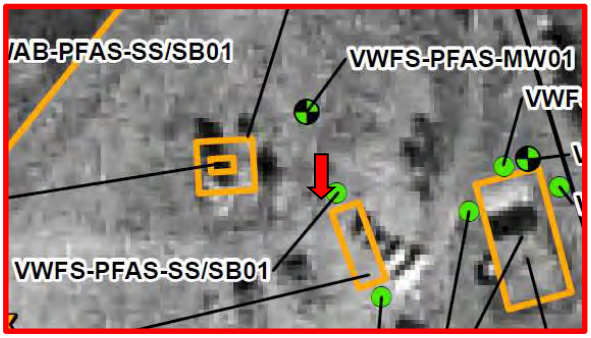
Navy Response: The groundwater monitoring well VWAB-PFAS-MW01 location will be moved approximately 75 feet eastward to be within the lagoon system and at the downgradient side of groundwater flow direction, as shown by the red arrow in the image below.



3- Co-locate VWFS-PFAS-MW01 with sampling location VWFS SS01/SB01 so that it is closer to the potential source of PFAS (i.e., the former conex container).

Navy Response: The monitoring well VWFS-PFAS-MW01 location will be moved as requested, as shown by the red arrow in the image below.

Suggested new MW01 location (red arrow)…



4- Move VWFS-PFAS-MW02 to the NW corner of the Building 2046 area to be more downgradient of the fire station ramp.

Navy Response: The monitoring well VWFS-PFAS-MW02 will be moved as requested, as shown by the red arrow in the image below.

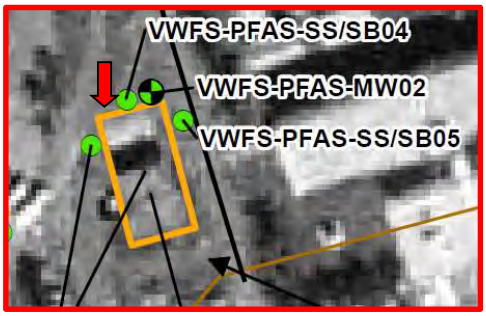
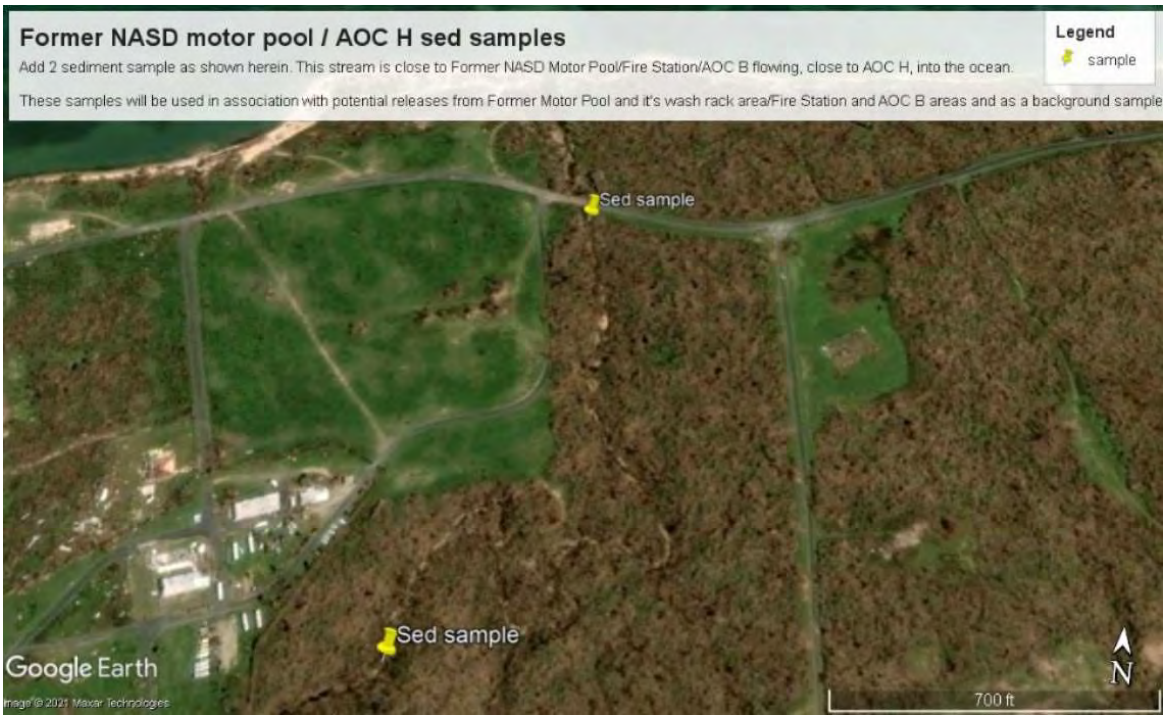


Figure 10-5 - Former NASD Motor Pool – Sed/GW samples

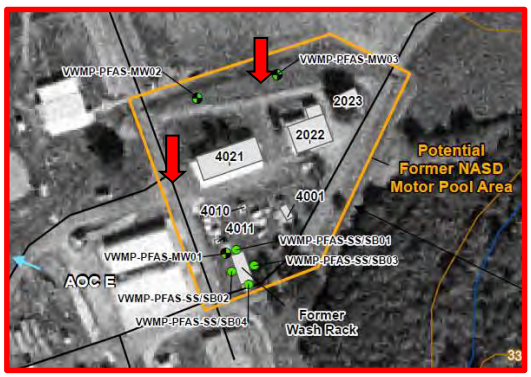
1- Add two sediment samples in the stream as shown in google earth image below.



Navy Response: Considering that the topography within and surrounding the former NASD Motor Pool is relatively flat at 33 feet msl (see Figure 10-5), contaminated surface runoff would have had to flow at least 200 feet southeastward across level, heavily vegetated terrain before entering the ephemeral stream, which is very unlikely. In that the purpose of this investigation is release assessment, the soil and groundwater samples proposed are most appropriate for making that determination. SI guidance indicates potential migration pathways should be evaluated, not necessarily sampled. Therefore, if a release is confirmed based on the samples proposed, evaluation of migration pathways will be performed and, if deemed significant, included in further characterization.

2- Relocate the proposed two monitoring wells (VWMP-PFAS-MW02 and -MW03) meant to be "along the downgradient border of the motor pool area to evaluate the area as a whole"about 75 ft. due west to be better located as downgradient wells.

Navy Response: The well locations will be revised as requested, as shown by the red arrow in the image below.



3- Add an additional monitoring well close to sample VWMP-PFAS-SS/SB04.

Navy Response: Because the investigation is release assessment and because groundwater flow is to the northwest, the currently proposed monitoring well VWMP-PFAS-MW01 location at the northwest (immediately downgradient) corner of this small wash rack location is optimal for detecting a site-related PFAS release to groundwater. An additional well close to sample VWMP-PFAS-SS/SB04 at the southern end of the wash rack would only be 30 feet away from currently proposed MW01. As a result, placing an additional well at the upgradient end of this small location is not warranted. However, if a release is confirmed, the need for additional characterization will be evaluated.

4- Add groundwater sample from existing MW #3 in AOC E.

Navy Response: Similar to the previous comment response, the proposed well is at the location best representative of a potential PFAS release to groundwater. As noted previously, if a release is confirmed, the need for additional characterization will be evaluated.

Figure 10-6 - AOC H – Soil/GW samples

1- Collect samples SS/SB 01 and SS/SB 04 as close as possible to the front and back entryways as seen in photos 23 and 27.

Navy Response: The text associated with Figure 10-6 will be revised to specify samples SS/SB 01 and SS/SB 04 are to be collected from as close as possible to the front and back entryways of the building as shown in photos 23 and 27 of Attachment B.

2- Collect SS/SB #02 or #03 (as applicable) as close as possible to the side door shown in Photo 26.

Navy Response: The location of soil sample VWAH-PFAS-SS/SB02 in Figure 10-6 will be adjusted to be adjacent to the estimated doorway location along the east side of the building, as shown by the red arrow in the image below. In addition, the text associated with Figure 10-6 will be revised to specify samples SS/SB 02 are to be collected from as close as possible to the side door entrance on the east of the building, as shown in photo 26 of Attachment B.

3- Locate VWAH-PFAS-MW02 next to the abandoned power plant building on the downgradient edge.

Navy Response: The location of VWAH-PFAS-MW02 will be moved as requested, as shown by the red arrow in the image below.

4- Collect sediment samples in areas close to the ones shown in google earth image below.(image in the report is so blurry that site features can be seen).

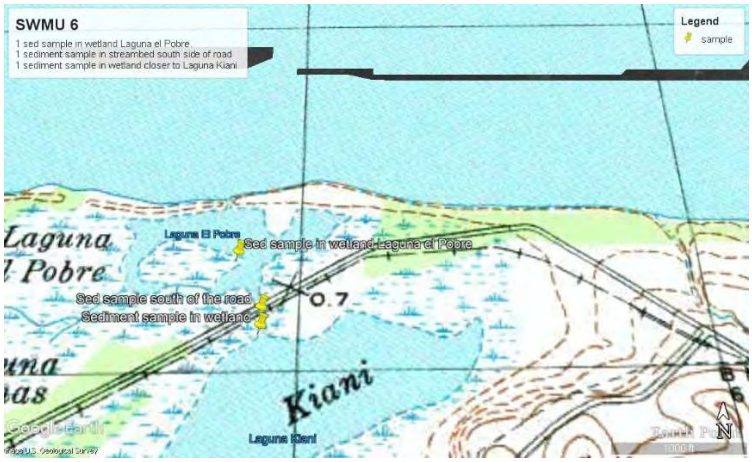
Navy Response: While the proposed sediment locations are already in close proximity to the locations provided in the Google Earth image provided with the comment, their locations will be modified to the locations provided in the comment image. Please note that the actual sediment sample locations may be modified based on field observations of any obvious sediment accumulation areas.

5- Document presence of wetlands/mangroves, tidal influence during field activities.

Navy Response: The SAP will be modified to include documenting the requested information during AOC H sampling.

Figure 10-7 - SWMU 6, Sediment samples

1- Water body is a tidally influenced. Add three sediment samples in the stream close towetlands/mangroves as shown in the images below.



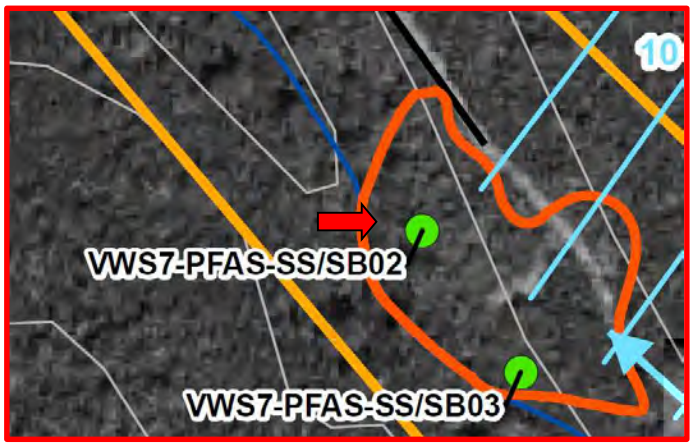
Navy Response: While the SWMU 6 lagoon is tidally influenced, with the primary point of tidal exchange with the Laguna Kiani/el Pobre complex is a narrow mangrove lined channel at the north end of the SWMU 6 lagoon. Because the objective of the SI is to determine whether a release of PFAS has occurred that warrants further investigation/action, the optimal sampling location to meet this objective would be close to this SWMU 6 tidal connection. During outgoing tides, the SWMU 6 lagoon discharges into a relatively calm and shallow open water lobe along the eastern shoreline of the much higher velocity and deeper tidal stream that connects Laguna Kiani and Laguna el Pobre with Vieques Passage. Sediment sample VWS6-PFAS-SD-01 is located within this open water lobe (Figure 10-7) near its boundary with SWMU 6. This is also a location where sediment was previously sampled (based on Navy and regulatory concurrence) to evaluate potential offsite migration from SWMU 6, as documented in the 2013 SWMU 6 Feasibility Study Report. Sediment here contains a high total organic carbon content (3.5 to 4.5 percent),

an indication that the calm hydrologic conditions support the accumulation of organic matter and likely other sediment particles. Given the objective of release assessment, the sediment sample locations proposed are those most appropriate for achieving the objective. However, if a release is confirmed, the need for additional characterization will be evaluated.

Figure 10-8 - SWMU 7, Soil/Sed, GW samples

1- Sample location VWS7-PFAS-SS/SB02 is shown in Figure 10-8 within the pile. Please move or add arrows showing that the sample will be collected from the intermittent stream bed as described in page 104.

Navy Response: Sample VWS7-PFAS-SS/SB02 will be moved west to better indicate it will be collected in the stream bed, as shown in by the red arrow in the image below.



2- Add 1 sediment or soil sample to be collected on the south side of PR 200 in the intermittent streambed as shown below. This sample will be a sediment or a soil sample depending on field conditions at the time of sampling. If soil samples are collected; then,add 1 SS and 1 SB soil samples.

Navy Response: The three proposed SS/SB samples shown in Figure 10-8 are optimally positioned to determine whether a release has occurred. As described in the SAP, samples VWS7-PFAS-SS/SB02 and VWS7-PFAS-SS/SB03 are within the stream bed in the former dump area, and sample VWS7-PFAS-SS/SB01 is about 400 feet downgradient to identify downstream migration. The addition of another SS/SB sample further downgradient (about 1,000 feet) at PR 200 is not warranted to determine if a release has occurred. However, if a release is confirmed, the need for additional characterization will be evaluated.

3- Add 1 SS and 1 SB soil samples within 200 feet from nearest dwelling to be collected at the closest point between the former waste pile and the dwelling as shown below.

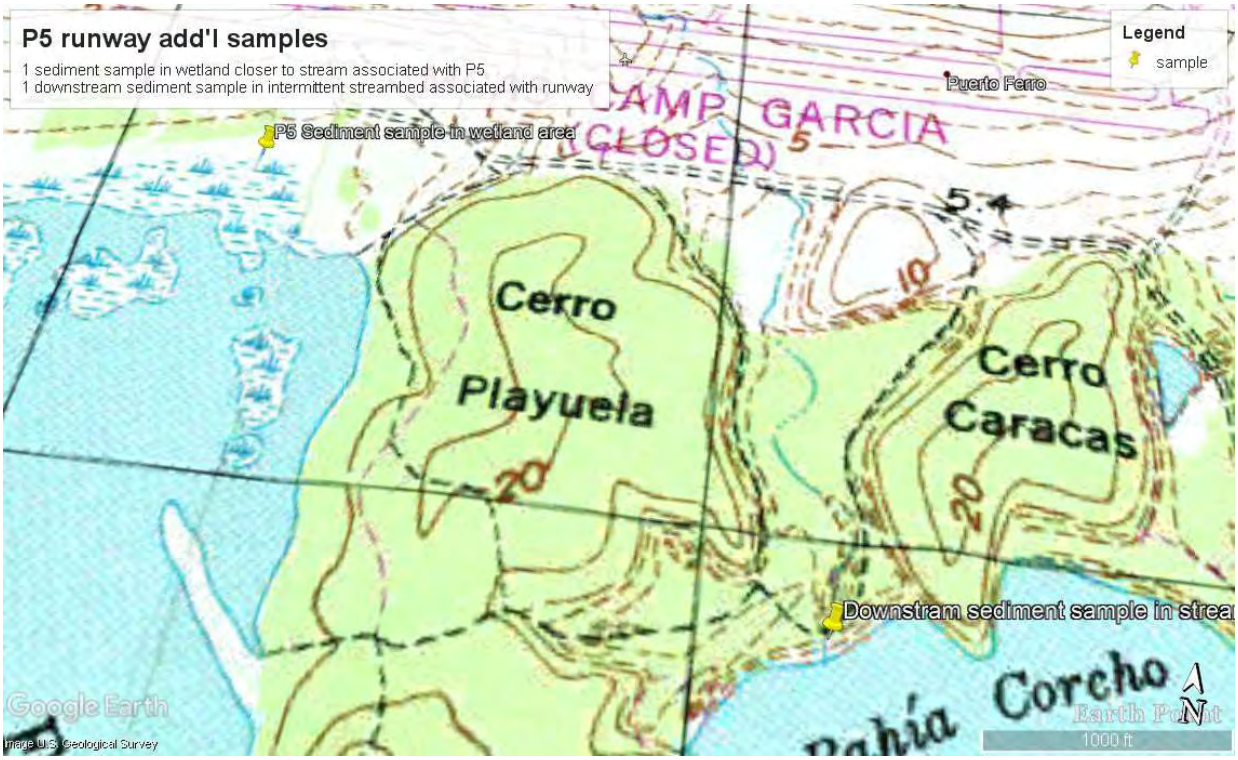
Navy Response: The former disposal site is located within a deep, steeply sloped quebrada. The nearest dwelling is located uphill and over 100 feet east of the disposal site boundary. It would not have been possible for site-related constituents in soil to migrate to these higher elevations; therefore, the addition of this soil sampling location is not warranted.

4- Locate VWS7-PFAS-MW01 adjacent to the downgradient edge of the waste boundary.

Navy Response: Drill rig access to the requested location is likely not possible due to the steeply sloped terrain associated with the quebrada. However, text will be added to the narrative associated with Figure 10-8 that states well MW01 will be placed as close to the downgradient edge of the former waste boundary as possible with the fallback location shown in Figure 10-8 to be selected if drill rig access along the quebrada is not possible.

Figure 10-9 - VNTR Camp Garcia Runway, PI5, SW Drainage Area Camp Garcia, Soil/sed, GWsamples

1- Add a sediment samples downgradient from VEP5-PFAS-SS/SB001. Sample should becollected in the wetlands area closer to the stream as shown below.



Navy Response: Sampling in the wetland is not warranted given the much broader and uncertain influence on the wetland conditions relative to potential discharge from the drainage feature from the runway area. To more appropriately assess potential release from the runway area through this drainage channel, a surface soil and subsurface soil (if unsaturated) will be collected from the mouth of the defined stream channel where its channel transitions from confined stream flow to broad, overland flow.

2- Add 1 SS and 1 SB soil samples associated with sampling location VERW-PFAS-MW01.

Navy Response: The soil samples will be added as requested.

3- Add 1 SS and 1 SB soil samples associated with sampling location VERW-PFAS-MW02.

Navy Response: The soil samples will be added as requested.

4- Add a sediment sample downgradient from VERW-PFAS-SS/SB01 sample should becollected as shown below.

Navy Response: Please see the response to EPA Comment #1 on Figure 10-9. The same logic and approach will be applied to siting and collecting the surface and subsurface soil samples within this drainage channel.

5- Add another monitoring well downgradient/south of the PI5 drainage ditch.

Navy Response: South of this north/south drainage ditch would place the monitoring well within the Puerto Ferro wetland where the water table would be near the ground surface, and groundwater would likely be

affected by seawater. In addition, this area would be inaccessible to a drill rig. Monitoring well VEP5-PFAS-MW01, located at the southern edge of the runway and near the head of the PI 5 drainage ditch, is more appropriate for determining whether a PFAS release from the runway has impacted groundwater (Figure 10-9).

Figures 10-10 and 10-11 - Soil samples

1- Add 1 SB soil sample adjacent to former building 330 footprint (south of building) as shown in photo # 37.

Navy Response: A subsurface soil sample will be added as requested, the location being subject to adjustment in the field based on existing structures, drill rig access, and underground utilities.

2- Add 1 SB soil sample adjacent to former building 340 footprint (south of building) as shown in photo #40.

Navy Response: A subsurface soil sample will be added as requested, the location being subject to adjustment in the field based on existing structures, drill rig access, and underground utilities.

The planned locations of the two additional samples are shown by the red arrows in the image below.

Figure 10-12 - GW/Sed samples

1- Adjust the locations of VEW10-PFAS-MW01 and MW02 approximately 125' east so that they are adjacent to, and downgradient of, the south side of the treatment lagoons.

Navy Response: The location of VEW10-PFAS-MW01 is designed to sample groundwater potentially associated with the AOC G chlorination building and chlorine contact chamber; therefore, it is proposed this well location be retained. The location of well MW02 will be adjusted as requested, as shown by the red arrow in the image below. This location is appropriate for evaluating potential release to groundwater from the lagoons considering that groundwater flow in this area is generally to the southeast.

2- Add 2 sediment samples to be collected in the wetland area as shown below.

Navy Response: Considering the large size of the Bahia Tapón mangrove wetland, significant uncertainty if/where runoff or groundwater discharge from SWMU 10/AOC G would enter the wetland, and the broad contributions and tidal influence associated with the wetland, collecting samples there as part of the SI is not warranted. As noted previously, the data collected during the SI will be evaluated to determine if additional characterization is warranted.

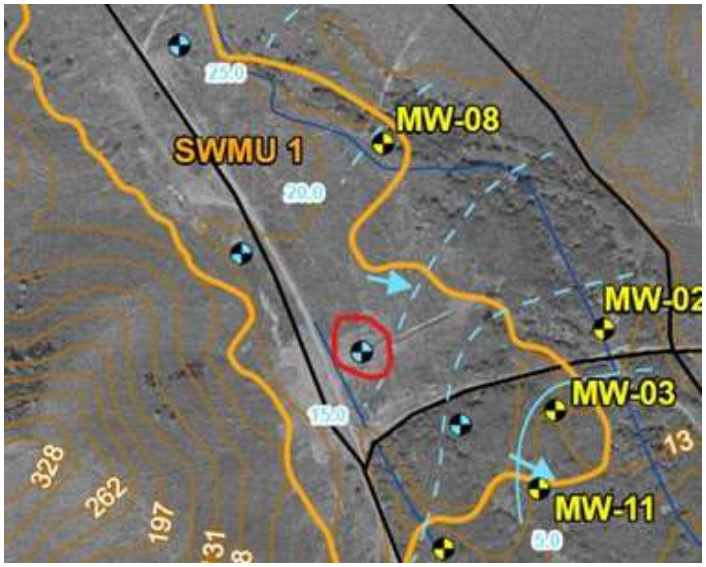
Figure 10-13 - SWMU 1 – GW/Sed samples

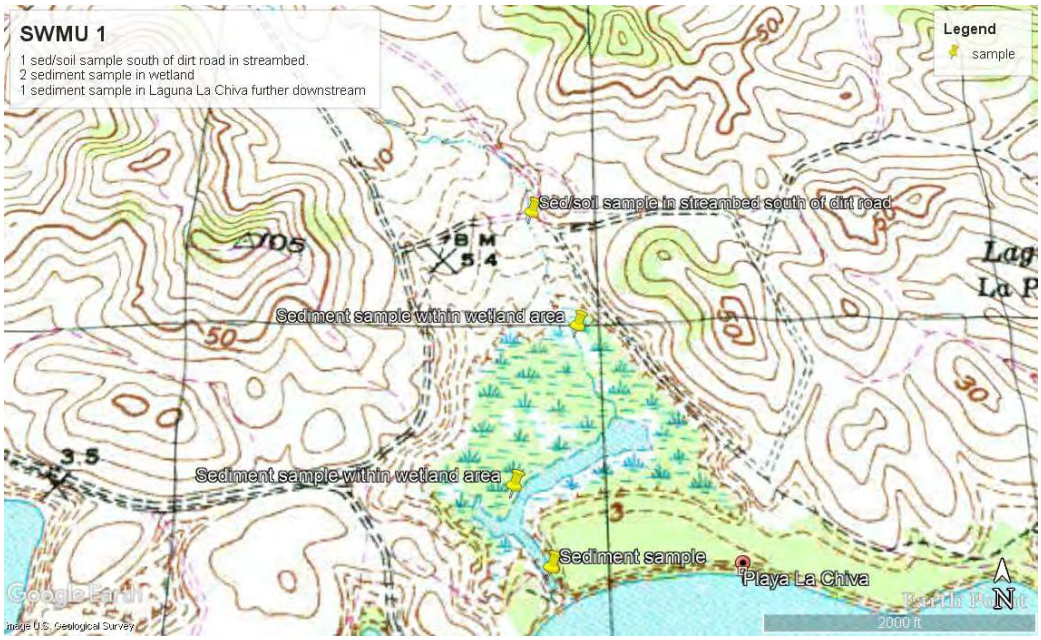
1- Collect 1 additional groundwater sampling from existing well, see red circle in the figurebelow, as a more direct measure of potential PFAS releases within the landfill.

Navy Response: An additional groundwater sample from existing well CGW1MW06 will be added as requested.

2- Add 4 sediment samples as shown in image below:

Navy Response: As demonstrated during the RI, the waste at SWMU 1 was deposited in trenches that were subsequently covered. The debris found on the surface appears to have represented an insignificant percentage of the total waste. Therefore, sampling groundwater is the most appropriate mechanism for determining whether PFAS releases from the landfilled waste occurred. If PFAS are detected, the need for additional characterization will be evaluated.





EPA Comment 13 - Worksheet #31, 32 & 33 –

Please identify the "Monitoring and QC Contractor" that will be performing these tasks.

Navy Response: All occurrences of "Monitoring and QA Contractor" will be corrected to "Site Inspection Contractor" to be consistent with Worksheet # 1 & 2.

EPA Comment 14 - Worksheet #36

A copy of the "United States Department of Defense General Data Validation Guidelines, Module3 - Data Validation Procedure for Per- and Polyfluoroalkyl Substances Analysis by QSM Table B- 15", (DoD, May 2020) should be attached to the QAPP.

Navy Response: As with all other guidance utilized in the preparation or performance of the planned SI, the document is referenced in Worksheets 34, 35, & 36 and is included as a reference in the Reference Section. Like the other guidance documents, it is publicly available and readily found on the internet.

Responses to EPA Follow-up Comments on the Navy's Response to Regulatory Comments (RTC) on the *Draft Site Inspection Sampling and Analysis Plan for Per- and Polyfluoroalkyl Substances, Atlantic Fleet Weapons Training Area – Vieques, Former Naval Ammunition Support Detachment and Former Vieques Naval Training Range, Vieques, Puerto Rico*

EPA Follow-up Comment to Navy's RTC #4:

Please use the following values:

For soils use 0.126 mg/kg or 126 ug/kg.

For GW use 0.40ug/L or 40 ng/L or ppt for each PFAS (e.g., 40 ppt for PFOA ... 40 ppt for PFOS).

Navy Follow-up Response: The values for PFOS and PFOA in soil will be changed to 126 ug/kg. The groundwater value of 40 ng/L was already included in the SAP.

EPA Follow-up Comment to Navy's RTC #6: Concur with proposed additional sampling in soil at the air/water the interface and the following exceptions; however, if water is encountered in these areas in the unconsolidated media during field activities, then a sample should be collected.

- Exceptions (will not have air/water interface sample) and rationale:
    - SWMU 7: water table located in consolidated material (saprock)
    - AOC B, NASD Motor Pool, NASD Fire Station: water table in consolidated material
    - SWMU 1: only collecting gw samples from existing wells
    - SWMU 10/AOC G: water table in consolidated material
    - SWMU 20: water table in consolidated material
    - Camp Garcia Fire Station/Motor Pool: water table in consolidated material

Navy Follow-up Response: Text will be added throughout the SAP to indicate if the air/groundwater interface is in unconsolidated material at any site where soil sampling is planned an additional 1-foot soil sample will be collected just above the interface. Note, some borings may be advanced with hand auger or similar tool due to the lack of drill rig accessibility. In these cases, the vertical depth of penetration may be limited.

EPA Comment to Navy's RTC #10: RTC states both liquid IDW "evaporation" and soil IDW "returned to soil borings" are in the approved Waste Management Plan in the Final Master SOP Revision 2018.

1) What are examples of conditions that liquid IDW will be allowed to evaporate "only if practical'?

   Navy Follow-up Response: The most likely condition is that the liquid IDW quantity at any particular site is small enough that it will evaporate in a reasonable amount of time (generally the timeframe of the investigation).

2) EPA retains that soil cuttings for the PFAS investigation should be containerized and characterized for disposal, not returned to boreholes.

Navy Follow-up Response: Managing soil IDW as stated in the SAP is consistent with the Waste Management Plan contained within the Master SOP Revision 2018 (CH2M, 2018) and EPA waste minimization policy. When this approach to waste minimization was discussed among the Technical Subcommittee and ultimately memorialized in the master Waste Management Plan, the Navy offered the following response to an EPA comment: **"**Please note that handling the IDW in this manner complies with the EPA's *Guide to Management of Investigation-Derived Waste* (EPA, 1992) with respect to IDW minimization, which states: "…The generation of IDW [should be minimized] to reduce the need for special storage or disposal requirements that may result in substantial additional costs yet provide little or no reduction in site risks relative to the final remedial action." This information was detailed in a Technical Memorandum entitled *Former VNTR Regional Well Investigation-Derived Waste Handling*" from the Navy to the Technical Subcommittee Members on August 3, 2012. The only exception is in circumstances where gross contamination is visible in the soil; in these circumstances, the soil will be containerized for offsite disposal."

This response was accepted by EPA at the January 31, 2018 Technical Subcommittee Meeting and remains applicable.

Responses to PRDNER Comments on the
Draft Site Inspection Sampling and Analysis Plan for
Per- and Polyfluoroalkyl Substances
Atlantic Fleet Weapons Training Area – Vieques
Former Vieques Naval Training Range
Vieques, Puerto Rico

Page-Specific Comments

1. Page 3, Line 4 - Executive Summary: Please clarify if the text should refer to Figures ES-1 through ES-9 and revise the text as appropriate.

   Navy Response: The Executive Summary Line 4 will be revised to read "…..(Figures ES-1 through ES-9)."

2. Page 3 of 164, Lines 6 and 7 - Executive Summary: Please revise the text to state "Determine whether a release of PFAS occurred from past activities being investigated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) at 13 potential…"

   Navy Response: The text will be revised as requested in the Executive Summary and in Worksheets 11 and 17.

3. Page 5, Table ES-1:

   a. AOC H: Sediment Rationale: Based on the description of the standing water present in the ephemeral stream on pages 49 and 50, please include the analysis of PFAS in surface water.

      Navy Response: The Sediment Rationale entry will be revised to state that if standing water is present at any of the sediment sampling locations, a surface water sample will be collected at that location. Worksheets throughout the SAP will be updated accordingly.

   b. SWMU 6: Conceptual PFAS Release Mechanism: Based on page 50, revise text to AFFF or other PFAS-containing substances.

      Navy Response: The Conceptual PFAS Release Mechanism entry will be revised to read: "If AFFF or PFAS-containing substances were used at the . . ."

   c. SWMU 6: Sediment Rationale: Based on the description of the lagoon surface water on pages 51 and 52, please include the analysis of PFAS in surface water.

      Navy Response: The Sediment Rationale entry will be revised to include a statement that a surface water sample will be collected at each sediment sampling location. Worksheets throughout the SAP will be updated accordingly.

   d. SWMU 7: Conceptual PFAS Release Mechanism: Revise text to state SWMU 7 instead of SWMU 6.

      Navy Response: The Conceptual PFAS Release Mechanism entry will be revised as requested.

   e. SWMU 7: Sediment Rationale: Based on the description of the ephemeral stream on page 52, please include the analysis of PFAS in surface water.

      Navy Response: As noted on Page 53, there is water in the ephemeral stream only during storm events, so the presence of water is unlikely during sampling especially because sampling will

unlikely take place during a significant storm event. The sentence on page 52, row 37 will be revised to read: "The primary feature of the area itself is a steeply-banked ephemeral stream oriented in a north-northwest direction toward the Vieques Passage. Water flows in the ephemeral stream only during significant storm events. Otherwise this stream is dry throughout the year and does not provide habitat supportive of aquatic organisms."

f. Camp Garcia Runway/PI-5 Surface Water Drainage Area: Sediment Rationale: Based on the description of the ephemeral streams on page 55, please include the analysis of PFAS in surface water. Nozzle testing spray areas are frequently located between parallel runways and taxiways. PRDNER recommends collecting at least two co-located surface and subsurface soils soil samples between the runway and taxiway.

   Navy Response: Similar to the ephemeral stream at SWMU 7, the ephemeral streams associated with the runway/PI 5 are dry throughout the year except for temporarily during significant storm events; therefore, the presence of water is unlikely during sampling especially because sampling will unlikely take place during a significant storm event. Clarifications have been added to the text as follows:

   On page 55, row 5, the sentence will be revised to read: "…. and adjacent surface water ephemeral streams that are dry throughout the year except temporarily during significant storm events (including PI 5). These streams do not provide habitat supportive of aquatic organisms."

   The VNTR PI 5 Section on page 56, row 5, will also be revised to read: "….areas of the runway drainage ditch system that only contain water during significant storm events."

g. Potential Former Motor Pool Area (VNTR): Sediment Rationale: Based on the description of the ephemeral streams on page 61, please include the analysis of PFAS in surface water. One monitoring wells is proposed for this area, yet at other AOCs/SWMUs where potential source areas are no longer identifiable, 2 or more downgradient wells are proposed to evaluate the entire area (e.g. NASD Potential Former Motor Pool Area). Please clarify why only one monitoring well is proposed for the VNTR?

   Navy Response: Page 61 is associated with SWMU 1 and not the Motor Pool Area; there are no ephemeral streams associated with the Motor Pool Area. The Potential Former Motor Pool Area (VNTR) description is located on pages 57 through 59 and states on page 58, row 24: "There are no surface water bodies present at or near this location." See response to Comment #18 for monitoring well sampling for the Motor Pool Area.

4. Page 34, Worksheet #6 – Communication Pathways and Procedures: Substantive Changes to the SAP during Project Execution: PRDNER wishes to be notified and have the opportunity to review and concur with substantive changes to the SAP that have the potential to adversely affect DQOs (e.g., any significant re-location of agreed upon sample locations).

   Navy Response: The words "as warranted" will be removed from the Communication Pathways and Procedures entry. All agencies will be given the opportunity to review and concur with the substantive changes. However, given the logistics of implementing the SI and because the timing of regulatory feedback would be unknown, it may not be practical to stand down fieldwork while awaiting feedback/concurrence. Therefore, fieldwork would continue, and any feedback received incorporated into the fieldwork to the extent possible. As with all investigations performed on Vieques, the regulatory agencies will have the opportunity to provide comment on the SI Report where any deviations from the original plan will be discussed, including any impact on achieving the SI objectives.

5. Page 38, Worksheet #9 – Project Planning Session Summary: Please correct the email address for Diana Cutt to Cutt.diana@epa.gov. Applies to page 40.

   Navy Response: The e-mail address will be corrected.

6. Page 40, Worksheet #9 – Project Planning Session Summary: Line 22 and Figure 9-1 refers to aerial photos from 1964, however the previous line refers to the aerial photos being from 1965. Please clarify and correct the text (and figure) as appropriate.

   Navy Response: The date in Worksheet 9, line 21 will be corrected to read "1964."

7. Page 52, Worksheet #10, NASD SWMU 7, Location: Please remove Figures 10-11 and 10-12 in first sentence and replace with Figure 10-8.

   Navy Response: The figure callout in the first sentence will be revised to read: "(Figures 10-2 and 10-8)."

8. Page 71, Figure 10-9: please include the groundwater flow direction arrow.

   Navy Response: A generalized groundwater flow direction arrow will be added to Figure 10-9.

9. Page 74, Figure 10-12: please include the groundwater flow direction arrow.

   Navy Response: A generalized groundwater flow direction arrow will be added to Figure 10-12.

10. Page 78, Worksheet #11 – Project Data Quality Objectives: Lines 1 and 2 – Please clarify if further action or investigation will be recommended if ESVs are exceeded.

    Navy Response: Current DoD policy moves PFAS sites from SI to RI only if the concentrations of PFAS pose a potentially unacceptable human health risk based on a screening evaluation using PFAS for which there are either EPA RSLs (i.e., currently PFBS) or DoD-approved screening levels (i.e., PFOA and PFOS as documented in a memo from Assistant Secretary of Defense dated 15 Oct 2019). However, it is recognized there are PFAS compounds for which there are currently no published screening levels, reference doses (RfDs), or sufficient study upon which to base "industry-wide" screening values, including ecological screening values (ESVs are included in the SAP to ensure data quality will be sufficient for potential later use in ecological risk screening or risk assessment). To account for this, the if/then statements under the Alternative Outcomes in Worksheet #11 and the footnote in Figure 11-1 have been revised to indicate no further investigation/action "at this time and until/unless new information and/or updated screening criteria are identified indicating further investigation/action is warranted" for sites where PFAS are either not detected or are detected but the concentrations do not represent a potentially unacceptable human health risk (assuming wholistic evaluation of site-related information in accordance with the evaluation process shown in Figure 11-1 indicates additional sampling as part of the SI is not necessary in order to draw this conclusion).

11. Page 78, Worksheet #11, Step 1: State the Problem, Alternative Outcomes: The top sub-bullet states that if the concentrations of all detected PFAS with published RSLs do not exceed the RSL (or adjusted RSL), no further investigation or action is needed. However, the bullet below this states that if no PFAS are detected, an additional evaluation will be performed to ensure the sample locations sufficiently represent the potential source/release area. This same evaluation should also be performed if the detected PFAS are below the RSLs.

Navy Response: Please see the response to Page-specific Comment #10. Also, the statements will be made clear to indicate a wholistic evaluation of each site, including the data collected during the SI, will be performed to ensure the characterization sufficiently represented the potential source/release area.

12. Page 79, Line 43, Worksheet 11: Please clarify as to whether "published RSLs" includes those from both the table and the RSL calculator.

    Navy Response: The referenced text will be revised to align with current DoD policy as stated in the response to Page-specific Comment #10.

13. Page 84, Figure 11-1: The box at the bottom of the figure states that only PFAS with RSLs are to be used for determining if further action or an RI is needed.

    Navy Response: Please see the responses to Page-specific Comments #11 and #12.

14. Page 90, Worksheet #14 and 16:

    a) Soil Sampling: Please revise the number of surface and subsurface soil samples from 34 to 28, per Table ES-1 and Worksheet #18

       Navy Response: The number of samples of each medium will be revised throughout the SAP, as applicable, based on resolution of regulatory comments.

    b) Please clarify if a hand auger is also being used for subsurface soil samples.

       Navy Response: The current plan is for a sonic rig using a core barrel and plastic sleeve to collect the majority of the soil samples. Some of the sampling locations are in ephemeral streams where a drill rig will not be able to access the sampling locations. At those locations a hand auger will be utilized, but it should be noted the hand auger may not be able to penetrate the entire unconsolidated depth and will instead be used to the maximum extent possible given the practical constraints associated with its use. Worksheet 14, Soil Sampling Section will be updated accordingly.

    c) Monitoring Well Installation, Development and Sampling:

       a. Please revise Line 18 to state that 17 (not 15) new monitoring wells will be installed per Table ES-1, Worksheet #18, and Figures 10-4 through 10-12.

          Navy Response: The number of wells will be revised throughout the SAP, as applicable, based on resolution of regulatory comments.

       b. The potable water source being used for monitoring well installation was previously analyzed for six of the 18 target PFAS. Please submit a sample of this potable water source to the laboratory for the full list of 18 PFAS.

          Navy Response: The SAP will be updated as requested.

    d) Monitoring Well Development: Please clarify why other existing wells besides VECG-MW01 and VECG-MW-02 are not being re-developed.

       Navy Response: The text regarding redevelopment will be revised to indicate any existing well will be redeveloped if information gathered during purging and sampling suggests redevelopment is warranted (e.g., significant sediment buildup, inability to sample by low-flow methodology when historical records indicate the well was successfully sampled in this manner, etc.).

e) Groundwater Sampling:

a. Please revise the number of new wells from 15 to 17, per Table ES-1 and Worksheet #18.

Navy Response: The number of wells will be revised throughout the SAP, as applicable, based on resolution of regulatory comments.

b. PRDNER recommends purging groundwater until clear samples can be collected (turbidity < 10 NTU). The laboratory's current SOP states they centrifuge and decan when aqueous samples appear to be >1% solids and the solids are discarded (not extracted). Sending turbid samples to the laboratory could lead to uncertainty in the reported results due to the arbitrary ("samples appear") SOP in removing solids. The EPA also recommends collecting clear groundwater samples with a measured turbidity of less than 10 NTU.

Navy Response: Sampling will be conducted in accordance with SOP B-1, *Groundwater Sampling Procedure Low Stress (Low Flow) Purging and Sampling* included in the Final Master Standard Operating Procedures, Protocols and Plans Revision 2018 (CH2M, 2018). Despite following the SOP, it is not always possible to achieve < 10 NTU due to innate characteristics of the water-bearing unit. If/where this condition is encountered, it will be documented.

15. Page 96, Worksheet 15-1 – Note 1, please replace "terrestrial" with soil in reference to the residential RSL values.

Navy Response: The footnote will be revised as requested.

16. Page 103, Worksheet #17: Three sediment samples are proposed for the ephemeral stream located along the western boundary of AOC H. The site description of this ephemeral stream on Worksheet #10 for AOC H identified standing water that was approximately 20 feet by 40 feet in extent and contained fish and aquatic invertebrates. Please indicate which sediment sample(s) will be collected from this area of standing water and clarify why a surface water sample is not proposed for the body. In addition, please indicate the presence of this area of standing water on Figure 10-6.

Navy Response: Worksheet #10 text will be corrected to clarify the dimensions of the area of likely standing water within the ephemeral stream are approximately 20 feet wide by 400 feet long. In this case, all three sediment samples are proposed to be collected within the likely standing water portion of the ephemeral stream. Please also see the response to Page-specific Comment 3a and the response to EPA Comment 3 on Figure 10-6.

17. Page 105, Worksheet #17, VNTR SWMU 20: Please include the depth of the surface soil samples in this area.

Navy Response: The surface soil samples will be collected from 0 to 1-foot bgs, which will be added to the text as requested.

18. Page 106, Worksheet #17: Lines 19-22 indicates that groundwater samples from two existing monitoring wells (VECG-MW01 and VECG-MW-02) will be collected to assess potential PFAS releases from the VNTR Motor Pool Area. However, based upon groundwater contours shown on Figure 10-10, these wells appear to be down and cross-gradient of the Former Fire Department Building, motor pool area and adjacent buildings and would be less likely to detect a PFAS release in this area if one had occurred. On this basis, PRDNER requests that in addition to monitoring well VEFS-PFAS-MW01, two new monitoring wells be

installed directly downgradient of the buildings in the area and sampled to characterize PFAS releases instead of sampling VECG-MW01 and VECG-MW02.

Navy Response: Given the small area of the former motor pool area, the well proposed is suitably positioned for determining whether a release at the former motor pool occurred. The reason sampling is proposed for the two historic wells at the downgradient boundary of Camp Garcia is that these wells were concurred upon by the Navy and regulatory agencies as locations appropriate for evaluating whether there were releases anywhere within Camp Garcia, including the motor pool area. While PFAS was not part of the historical investigation, the concept is equally applicable for evaluating potential releases of PFAS.

19. Page 123, Worksheet #22: Please include the daily calibration requirements for ORP.

    Navy Response: A row for ORP will be added to Worksheet 22.

20. Page 127, Worksheet #24: Initial Calibration: The acceptance criteria section states that isotope dilution or internal standard calibration is required for all analytes. PRDNER prefers that isotope dilution is performed to account for any potential matrix interferences.

    Navy Response: As shown in the worksheet, isotopic dilution is the preferred method. However, Page 218 of DoD QSM 5.3 states "If a labeled analog is not commercially available, the Extracted Internal Standard Analyte with the closest retention time or chemical similarity to the analyte must be used for quantitation. (Internal Standard Quantitation)." Therefore, the acceptance criteria are accurate as written.

21. Calibration Verification: Please revise the worksheet to include the frequency and acceptance criteria as noted in Table B-15 of the DoD QSM, Version 5.3.

    Navy Response: The worksheet will be revised as requested.

22. Pages 134 and 138, Worksheets #28-1 and 28-2: LCS:

    a. Please revise the corrective action to state "re-prep and reanalyze" instead of just "re-analyze."

       Navy Response: The correction action text will be revised as requested.

    b. Please remove the reference to "Precision" for the data quality indicator.

       Navy Response: The reference to Precision will be removed as requested.

23. Page 144, Worksheet #29, Laboratory Data Deliverables: Please add quantitation reports to the list of deliverables.

    Navy Response: The text will be revised as requested.

24. Pages 152-155, Worksheet #34, 35 & 36: These worksheets state that data validation will be performed by Environmental Data Services, Inc. However, Worksheets # 3&5 and 4, 7, & 8 state to be determined. Please clarify.

Navy Response: All references to Environmental Data Services, Inc. will be replaced with TBD. If the data validation services have been procured before the SAP is finalized, the subcontractor will be added to the SAP.

25. Page 159, Worksheet #37: How the DUA Will Be Documented: Please replace Worksheet #12 with Worksheet #28.

    Navy Response: The revision will be made as requested.

26. Attachment C, PFAS SOPs: Sediment Sampling for PFAS: Please revise the SOP to include a homogenization step.

    Navy Response: A homogenization step is included in Step D-6 under Procedures and Guidelines.

27. Attachment D, Laboratory DoD ELAP Accreditation Letter: Please clarify if the laboratory's certification is valid after February 2021.

    Navy Response: The updated accreditation letter will replace the previous letter. The new through date is March 31, 2023.

Figure-Specific Comments

28. Figure ES-2 and Figure 10-5: Based upon the inferred groundwater flow direction shown on these figures, PRDNER requests that VWMP-PFAS-MW02 be located approximately 60 feet southwest of the proposed location, north of the northwestern portion of building 4021.

    Navy Response: Please see the response to EPA Comment 2 on Figure 10-5. The revisions will be made to Figures ES-2 and 10-5.

29. Figure ES-5 and Figure 10-8, SWMU 7:

    a) It is unclear if PFAS could have traversed the distance from the interpreted waste boundary to the well location shown on Figure ES-5 given the long travel times associated with the generally lower permeability of soil frequently cited for Vieques. Therefore, PRDNER requests that the monitoring well be relocated approximately 400 to 500 feet closer to VWS -PFAS-SS/SB01 to increase the probability of detection of PFAS, if released, within the interpreted waste boundary. There appears to be a north-south trending road/trail to the east of VWS -PFAS-SS/SB01 that could potentially provide access to this area.

       Navy Response: Please see the response to EPA Comment 4 on Figure 10-8.

    b) PRDNER requests that at least one additional soil sample be collected from the ephemeral stream adjacent to the waste boundary and within a depositional area given the close proximity of the waste boundary to the stream indicated on the figures to assess the potential presence of PFAS transported by runoff from the area were waste was deposited. Comment will require updating the affected worksheets.

       Navy Response: The samples are intended to be collected along the base of the ephemeral stream channel; the figure will be revised to better reflect those locations.

30. Figure ES-6, Figure 10-9 and Table ES-1:

    a) PRDNER requests that soil samples collected from the drainage ditches associated with PI-5 be collected from depositional areas downstream of the runway. Please confirm in the text of the SAP.

    Navy Response: Language will be added for this site as well as all other sites where samples are proposed for collection in normally dry ephemeral streams (i.e., other than at AOC H) to clarify that field staff will look for obvious depositional areas in the vicinity of planned sample locations and areas and adjust those locations accordingly; this process will not constitute a SAP deviation.

    b) PRDNER requests that a groundwater sample also be collected from MW-24 at SWMU 20, which contained the highest concentration of TCE and analyzed for PFAS. While chlorinated compounds are not directly associated with AFFF, little is known of the source of the chlorinated compounds in groundwater and if related to a surface release, it is possible that AFFF potentially could have been used to suppress the vapors. Comment will require updating the affected worksheets.

    Navy Response: MW-24 will be added as requested.

    c) There appears to be a possible drainage outfall at the east end of the runway discharging to what appears to be a northwest-southeast trending drainage ditch southeast of SWMU 20 and former aprons along the northern part of the runway. Please clarify the nature of this feature. If this feature is in fact a drainage feature. Sampling within this feature for PFAS may be warranted.

    Navy Response: The topographic lines do not indicate the presence of a drainage ditch (like they do for the other drainage features associated with the runway). However, text will be added to the SAP that the location of the feature observed in the figure will be visually inspected and if confirmed to be a drainage ditch, one surface soil and one subsurface soil sample will be collected at in a manner consistent with sampling in the other drainage features associated with the runway.

31. Figure ES-8, Figure 10-12, and Figure ES-1: According to the text on page 60, treated wastewater was reported to be discharged to the ground surface in the area south of the lagoons at SWMU 10 and potentially would be accessible to potential receptors. PRDNER requests that surface and subsurface samples be collected during drilling of monitoring well locations VEW-PFAS-MW-03 and VEW-PFAS-MW-04 and analyzed for PFAS to assess the presence of PFAS associated with potential historical discharges to soil in this area.

    Navy Response: Collection of surface and subsurface soil samples at the two well locations will be added to the SAP.

32. Figure ES-1 and Figure 10-4: According to page 46 lines 26 and 27, it is likely that flushing occurred on the ramp. PRDNER requests that well VWFS-PFAS-MW02 be located in the area where water from the concrete ramp most likely drained.

    Navy Response: Please see the response to EPA Comment 4 on Figure 10-4.

Responses to PRDNER Follow-up Comments
Draft Site Inspection Sampling and Analysis Plan for
Per- and Polyfluoroalkyl Substances
Atlantic Fleet Weapons Training Area – Vieques
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Vieques, Puerto Rico

Page-Specific Comments

3. Page 5, Table ES-1:

   a. AOC H: Sediment Rationale: Based on the description of the standing water present in the ephemeral stream on pages 49 and 50, please include the analysis of PFAS in surface water.

      Navy Response: The Sediment Rationale entry will be revised to state that if standing water is present at any of the sediment sampling locations, a surface water sample will be collected at that location. Worksheets throughout the SAP will be updated accordingly.

      PRDNER Evaluation of Response: As written, significant standing water could potentially be present in areas between sediment sampling locations but not at sediment sampling locations themselves and used as justification for not collecting surface water samples. The conceptual model describes a 20- to 40-foot-wide area of standing water 3 feet in depth along the western boundary of AOC H which could potentially contain aquatic receptors. Water in an area of these dimensions should be sampled regardless of whether there is standing water at a sediment sample location. Please clarify the response to indicate that surface water samples will be collected if standing water is present in the ephemeral stream in the vicinity of the sediment locations.

      Navy Follow-up Response: Where sediment samples will be collected will have standing water and therefore surface water samples will be collected at all sediment sample locations. Table ES-1 will be edited to state: “Three sediment samples within the adjacent ephemeral stream, one where runoff to the stream would most likely occur and two additional samples downstream to account for sediment transport during storm events. Three surface water samples will also be collected at the sediment sample locations.” Additionally, the dimensions will be clarified in the text to be 20 feet wide by 400 feet long.

   f. Camp Garcia Runway/PI-5 Surface Water Drainage Area: Sediment Rationale: Based on the description of the ephemeral streams on page 55, please include the analysis of PFAS in surface water. Nozzle testing spray areas are frequently located between parallel runways and taxiways. PRDNER recommends collecting at least two co-located surface and subsurface soils soil samples between the runway and taxiway.

      Navy Response: Similar to the ephemeral stream at SWMU 7, the ephemeral streams associated with the runway/PI 5 are dry throughout the year except for temporarily during significant storm events; therefore, the presence of water is unlikely during sampling especially because sampling will unlikely take place during a significant storm event. Clarifications have been added to the text as follows:

      On page 55, row 5, the sentence will be revised to read: “…. and adjacent surface water ephemeral streams that are dry throughout the year except temporarily during significant storm events (including PI 5). These streams do not provide habitat supportive of aquatic organisms.”

The VNTR PI 5 Section on page 56, row 5, will also be revised to read: "….areas of the runway drainage ditch system that only contain water during significant storm events."

PRDNER Evaluation of Response: The response does not address the request for the collection of at least two co-located surface and subsurface soil samples between the runway and taxiway. Please address PRDNER's request.

Navy Follow-up Response: Table ES-1 will be edited to include two surface soil and subsurface soil samples between the runway and taxiways. The additional text will read: "One surface and one subsurface soil sample will also be collected at each of two locations between the taxiway and runway where the ephemeral streams traverse."

16. Page 103, Worksheet #17: Three sediment samples are proposed for the ephemeral stream located along the western boundary of AOC H. The site description of this ephemeral stream on Worksheet #10 for AOC H identified standing water that was approximately 20 feet by 40 feet in extent and contained fish and aquatic invertebrates. Please indicate which sediment sample(s) will be collected from this area of standing water and clarify why a surface water sample is not proposed for the body. In addition, please indicate the presence of this area of standing water on Figure 10-6.

    Navy Response: Worksheet #10 text will be corrected to clarify the dimensions of the area of likely standing water within the ephemeral stream are approximately 20 feet wide by 400 feet long. In this case, all three sediment samples are proposed to be collected within the likely standing water portion of the ephemeral stream. Please also see the response to Page-specific Comment 3a and the response to EPA Comment 3 on Figure 10-6.

    PRDNER Evaluation of Response: It is assumed the Navy means response to EPA Comment **4** for Figure 10-6 that indicates the locations of the three sediment samples for the ephemeral stream. Additionally, please confirm that the standing water area will be indicated on Figure 10-6 or note that the entire ephemeral stream shown on Figure 10-6 contains standing water.

    Navy Follow-up Response: Yes, the previous response should have referred to EPA Comment 4 on Figure 10-6. Figure 10-6 will be edited to identify the three sediment samples with three co-located surface water samples along with the approximate area of standing water within the stream.

Figure-Specific Comments

29. Figure ES-5 and Figure 10-8, SWMU 7:

    a) It is unclear if PFAS could have traversed the distance from the interpreted waste boundary to the well location shown on Figure ES-5 given the long travel times associated with the generally lower permeability of soil frequently cited for Vieques. Therefore, PRDNER requests that the monitoring well be relocated approximately 400 to 500 feet closer to VWS -PFAS-SS/SB01 to increase the probability of detection of PFAS, if released, within the interpreted waste boundary. There appears to be a north-south trending road/trail to the east of VWS -PFAS-SS/SB01 that could potentially provide access to this area.

    Navy Response: Please see the response to EPA Comment 4 on Figure 10-8.

    PRDNER Evaluation of Response: The Navy response to EPA's comment 4 referenced above states that Drill rig access to the requested location is likely not possible due to the steeply sloped terrain associated with the quebrada. However, text will be added to the narrative associated with Figure 10-8 that states well MW01 will be placed as close to the downgradient edge of the former waste boundary as possible with the fallback location shown in Figure 10-8 to be selected if drill rig access along the quebrada is not possible. In the event that MW01 is installed at the fallback location, PRDNER's concern regarding the low probability of detecting PFAS if released from the waste given the distance of the fall back well location

from the waste boundary and slow groundwater transport time remain. Please clarify why access for drilling equipment could not be constructed from the north-south trending road closer to the waste boundary for installation of the more optimal well location given that this is routine practices elsewhere.

Navy Follow-up Response: The north-south trending road is accessible to the drill rig but to the east of the road the terrain slopes steeply down to the base of the ephemeral stream. A monitoring well was installed within the edge of the former waste and east of the road previously during the PA/SI investigation (well ID: NDW07MW02R). This well has been since abandoned but a new well will be installed near this location, if still accessible (including vegetation cutting to access the location). Figure 10-8 will be edited to move VWS7-PFAS-MW01 to the new location. The remainder of the text will include the information provided in the response to EPA Comment 4 on Figure 10-8 as a fallback approach should the location not be accessible even with vegetation cutting.

30. Figure ES-6, Figure 10-9 and Table ES-1:

c) There appears to be a possible drainage outfall at the east end of the runway discharging to what appears to be a northwest-southeast trending drainage ditch southeast of SWMU 20 and former aprons along the northern part of the runway. Please clarify the nature of this feature. If this feature is in fact a drainage feature. Sampling within this feature for PFAS may be warranted.

Navy Response: The topographic lines do not indicate the presence of a drainage ditch (like they do for the other drainage features associated with the runway). However, text will be added to the SAP that the location of the feature observed in the figure will be visually inspected and if confirmed to be a drainage ditch, one surface soil and one subsurface soil sample will be collected at in a manner consistent with sampling in the other drainage features associated with the runway.

PRDNER Evaluation of Response: If the feature is confirmed to be a drainage ditch and the ditch contains water, the water should also be sampled. Please amend the response accordingly.

Navy Follow-up Response: In addition to the revision to be made based on the previous response the text will be revised to indicate if the ditch contains water a surface water and sediment sample will be collected instead of a surface soil and subsurface soil sample if it does not contain water.

Responses to PRDNER Evaluation of Draft Final Site Inspection Sampling and Analysis Plan for Per- and Polyfluoroalkyl Substances

Atlantic Fleet Weapons Training Area – Vieques
Former Vieques Naval Training Range
Vieques, Puerto Rico

We find the changes in the revised document are consistent with the Navy's responses to previous PRDNER comments with the exceptions or clarifications noted below. PRDNER requests clarification and/or corrections to the Draft Final document on the following comments:

19. Page 123, Worksheet #22: Please include the daily calibration requirements for ORP.

Navy Response: A row for ORP will be added to Worksheet 22.

PRDNER Evaluation of Response: Please specify that the Zobell solution will be used.

Navy Follow-up Response: SOP C-1 listed in Worksheet 22 of the SAP does specify the Zobell Solution will be used but for further clarity, in Worksheet 22 the text under "Activity" will be edited from "Calibrate using ORP Standard Solution" to "Calibrate using Zobell Solution."

21. Calibration Verification: Please revise the worksheet to include the frequency and acceptance criteria as noted in Table B-15 of the DoD QSM, Version 5.3.

Navy Response: The worksheet will be revised as requested.

PRDNER Evaluation of Response: The response is acceptable but the worksheet was not updated as indicated in the response. The frequency and acceptance criteria of the calibration verifications were not included. Please include text that indicates that the calibration verification will be analyzed prior to sample analysis, after every 10 samples, and at the end of the analytical sequence. Please add the acceptance criteria for the calibration verification: ±30% of the true value.

Navy Follow-up Response: On Worksheet 24 the Acceptance Criteria will be further clarified as follows:

Under "Frequency of Calibration:"

"Prior to sample analysis, after every 10 field samples, and at the end of the analytical sequence."

Under "Acceptance Criteria:"

"Analyte concentrations must be within ±30% of their true value."

26. Attachment C, PFAS SOPs: Sediment Sampling for PFAS: Please revise the SOP to include a homogenization step.

Navy Response: A homogenization step is included in Step D-6 under Procedures and Guidelines.

PRDNER Evaluation of Response: The response is acceptable but the SOP was not updated as indicated in the response. The SOP on pages 223-226 of the PDF still does not show a homogenization step and also does not show a Step D-6, as mentioned in the response.

Navy Follow-up Response: The Appendix C SOP, Sediment Sampling for Per- and Polyfluoroalkyl substances, Procedures and Guidelines, #4, first sentence will be revised to read: "Transfer sample into stainless steel bowl and homogenize sample, then place sample into appropriate sample jars……"

30. Figure ES-6, Figure 10-9, and Table ES-1:

c) There appears to be a possible drainage outfall at the east end of the runway discharging to what appears to be a northwest-southeast trending drainage ditch southeast of SWMU 20 and former aprons along the northern part of the runway. Please clarify the nature of this feature. If this feature is in fact a drainage feature. Sampling within this feature for PFAS may be warranted.

Navy Response: The topographic lines do not indicate the presence of a drainage ditch (like they do for the other drainage features associated with the runway). However, text will be added to the SAP that the location of the feature observed in the figure will be visually inspected and if confirmed to be a drainage ditch, one surface soil and one subsurface soil sample will be collected at in a manner consistent with sampling in the other drainage features associated with the runway.

PRDNER Evaluation of Response: If the feature is confirmed to be a drainage ditch and the ditch contains water, the water should also be sampled. Please amend the response accordingly.

Navy Follow-up Response: In addition to the revision to be made based on the previous response the text will be revised to indicate if the ditch contains water a surface water and sediment sample will be collected instead of a surface soil and subsurface soil sample if it does not contain water.

PRDNER Evaluation of Follow-up Response: The revised SAP did not include the revision as per the response (e.g., please add these details to page 118 of the RLSO PDF under VNTR Camp Garcia Runway and VNTR PI 5).

Navy Second Follow-up Response: The requested edit was included in Table ES-1 but inadvertently left out of Worksheet 17. The following edit will be made to Worksheet 17 on pdf page 119, first paragraph of the Redlined pdf: "Additionally, one surface (0 to 1 foot below land surface [bls]) and one subsurface soil sample (VERW-PFAS-SS/SB05) will be collected in a depositional area if observed at the head of the northwest southeast trending drainage ditch on the east side of the runway, and if the ditch contains water a surface water and sediment sample will be collected instead of a surface soil and subsurface soil sample."

Responses to USFWS Comments on the
Draft Site Inspection Sampling and Analysis Plan for Per- andPolyfluoroalkyl Substances
Dated October 2020
Atlantic Fleet Weapons Training Area –Vieques

Access to the sampling sites should be coordinated with the Vieques National Wildlife Refuge (NWR) manager in order to avoid any unnecessary impacts to natural resources, including land crab habitat, mangroves and dry forest, among others.

Navy Response: Access to all areas within the NWR planned for sampling will be discussed with USFWS prior to access to ensure appropriate protective measures, as applicable, are employed while ensuring the SI objectives can be met.