



RELATIVE RISK SITE EVALUATION

Muniz Air National Guard Base, Puerto Rico

Introduction

The Department of Defense (DoD) identified certain per- and polyfluoroalkyl substances (PFAS) as emerging contaminants of concern which affected installations across the Air Force. When the term "Air Force" is used in this fact sheet, it includes Air National Guard. Specifically, perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), and perfluorobutanesulfonic acid (PFBS) are components of legacy Aqueous Film Forming Foam (AFFF) that the Air Force began using in the 1970s as a firefighting agent to extinguish petroleum fires. The U.S. Environmental Protection Agency (EPA) issued lifetime drinking water Health Advisories (HA) for PFOS and PFOA, and health-based regional screening levels for PFBS.

The Air Force has systematically evaluated potential AFFF releases on all Installations and former Installations. It began with the Preliminary Assessments, or PAs, that identified potential release areas. First responders, fire chiefs, and hangar staff were interviewed to determine where a release or a spill may have occurred on an Installation (for example, aircraft crash site or an accidental hangar AFFF release). Once the information in the PA was collected, we began Site Inspections, or SIs, to take soil and water samples and analyzed the media for PFAS compounds at the potential release areas. The intention of the SI was to determine if a release had occurred and to determine the impacts to soil and/or groundwater. The next step in the process is called the Relative Risk Site Evaluation, or RRSE, which is a tool used to sequence Sites/Installations to begin a Remedial Investigation, or RI. Air Force Installations are at the beginning of the more detailed investigative stage, the RI, to determine, where action is needed and to identify remedial technologies.

The Muniz ANGB PFAS PA and SI can be found at the Air Force CERCLA Administrative Record (AR): <https://ar.afcec-cloud.af.mil/> Scroll to the bottom of the page and click on "Continue to site", then select Air National Guard, scroll down the Installation List and click on Muniz Int'l Airport (San Juan), PR, then enter the AR Number 474972 in the "AR #" field for the PA. For the SI, enter the AR Number 592274. Then click "Search" at the bottom of the page. Click on the spy glass to view the document.

More information on the Air Force response to PFOS and PFOA can be found at: <https://www.afcec.af.mil/WhatWeDo/Environment/Perfluorinated-Compounds/>

Acronyms

AFFF - Aqueous Film Forming Foam

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act

CHF – Contaminant Hazard Factor

DoD - Department of Defense

EDR - Environmental Data Resources

EPA – US Environmental Protection Agency

FSS - Fire Suppression System

HA – Health Advisory

IRP - Installation Restoration Program

MPF – Migration Pathway Factor

OWS - Oil/water separator

PA – Preliminary Assessment

PFAS - Per-and polyfluoroalkyl substances

PFBS – Perfluorobutanesulfonic acid

PFOA - Perfluorooctanoic acid

PFOS - Perfluorooctane sulfonate

PRL - Potential Release Location

RF – Receptor Factor

RI – Remedial Investigation

RRSE – Relative Risk Site Evaluation

SI – Site Inspection

WWTP - Wastewater treatment plant



RELATIVE RISK SITE EVALUATION, cont.

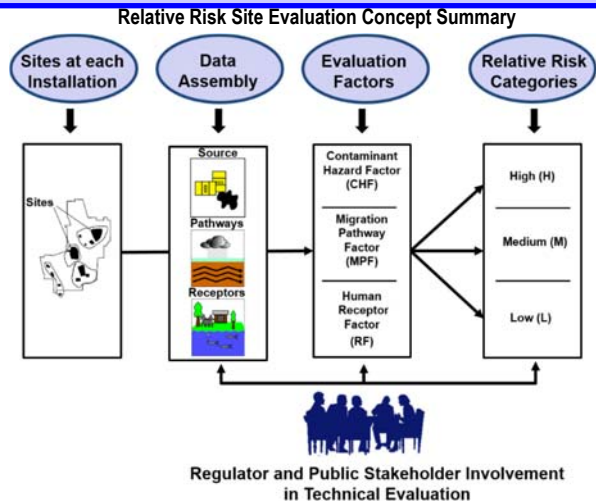


Q. What is the Relative Risk Site Evaluation (RRSE)?

A. RRSE is a methodology to sequence environmental restoration work used by the Department of Defense (DoD). The RRSE process is used to evaluate the relative risk posed by an environmental restoration site in relation to other sites. The DoD fundamental premise in site prioritization is "worst first," meaning the DoD Component shall address sites that pose a relatively greater potential risk to public safety, human health, or the environment before sites posing a lesser risk. Relative risk is not the sole factor in determining the sequence of environmental restoration work, but it is an important consideration in the priority setting process. The methodology is described in the DoD, Relative Risk Site Evaluation Primer, Summer 1997 Revised Edition: <https://denix.osd.mil/references/dod/policy-guidance/relative-risk-site-evaluation-primer/>

Q. What is the RRSE framework?

A. The RRSE framework provides a DoD-wide approach for evaluating the relative risk to human health and the environment posed by contamination present at sites. The **Relative Risk Site Evaluation Concept Summary** (shown in the figure) illustrates the selection of sites, evaluation of the site data using three evaluation factors, and placement into high, medium, and low categories. The relative risk site evaluation framework is based on information fundamental to risk assessment: sources, pathways, and receptors to sequence restoration work. The RRSE is not a baseline risk assessment or health assessment in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process. Regulators and public stakeholders in the environmental restoration process are provided the opportunity to participate in the process in accordance with the DoD Defense Environmental Restoration Program.



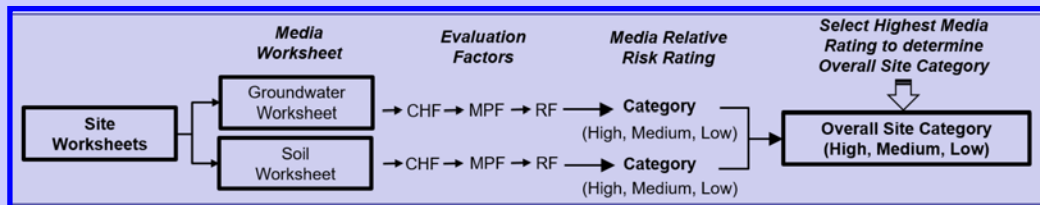
Sites at Each Installation

Q. What restoration sites are required to be evaluated in the RRSE process?

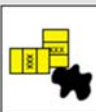


A. Restoration sites in CERCLA phases prior to remedy-in-place are evaluated in the process. Worksheets are developed for environmental media at each site. For consistency across all the Installations, only surface soil (0-1 foot deep) and groundwater media were evaluated in the RRSE.

The figure shows the process for a media to be evaluated using the contaminant hazard factor (CHF), the migration pathway factor (MPF), and the receptor factor (RF). Each media is scored to obtain a relative risk rating of High, Medium, or Low. The highest media rating determines the Overall Site Category.



Q. How is the Contaminant Hazard Factor (CHF) determined?



A. The Contaminant Hazard Factor (CHF) is determined by dividing the maximum level for a contaminant at each site by the approved screening values (i.e., risk-based comparison values). Contaminant concentration ratios are totaled to arrive at a **Contaminant Hazard Factor (CHF)**. A CHF sum of greater than 100 earns a **Significant (High)** ranking. **Moderate (Medium)** is when the total is 2 to 100. **Minimal (Low)** is when a CHF is less than two.

FOR MORE INFORMATION

Air Force Civil Engineer Center
Environmental Restoration Program
www.afcec.af.mil

AFCEC CERCLA
Administrative Record (AR)
<https://ar.afcec-cloud.af.mil/>

POINT OF CONTACT
Mark Dickerson NGB/A4VR
(240) 612-8445
mark.dickerson@us.af.mil

Q. How is the Migration Pathway Factor (MPF) determined?

A. The movement of contamination at a site is evaluated and assigned a **Migration Pathway Factor (MPF)** rating.



Ratings for MPFs are designated as: **evident**, **potential**, or **confined** (for High, Medium, and Low). **Evident** exposure means the contamination is at a point where exposure to humans or the environment can occur, such as at a drinking water well. **Potential** ratings are given to sites where exposure may happen. A **confined** rating is given to sites where a low possibility for exposure may occur.

Q. How is the Receptor Factor (RF) determined?



A. The **Receptor Factor (RF)** is determined by a receptor's, such as humans, potential to come into contact with contaminated media. RFs are designated as: identified, potential, or limited (**High, Medium, and Low**). **Identified** rating is given when receptors are in contact or threat of contact with contaminated media. **Potential** is given when receptor may contact contaminated media. **Limited** is given when there is little or no contact with contaminated media.

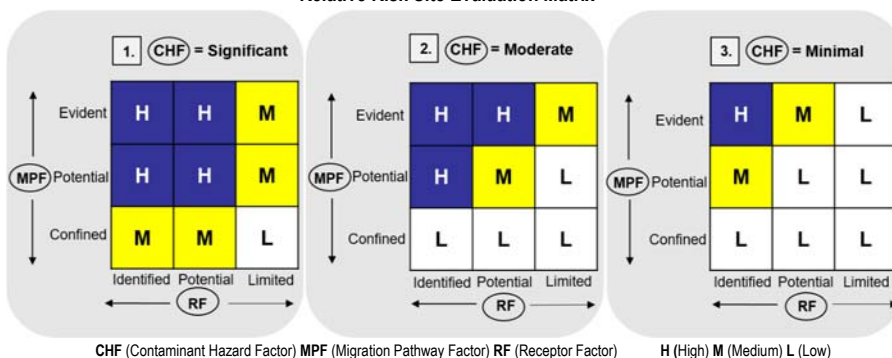
RELATIVE RISK SITE EVALUTION, cont.

Media Relative Risk Rating

Q. How is the media relative risk rating determined?

A. Use the chart to determine the relative risk rating for each media evaluated. Start by choosing the **CHF** result of the evaluation. If the **CHF** is **Significant**, use **box 1.**; if **Moderate**, use **box 2.**; if **Minimal**, use **box 3.** Then find the **MPF** and **RF** results and move to the square where the results meet. That square indicates the media relative risk rating. For example, if the **CHF** is **Significant** (go to **box 1.**), the **MPF** is **Potential** and the **RF** is **Identified**, then the rating is **High (H)**.

Relative Risk Site Evaluation Matrix



Overall Site Category

Q. How do I determine the Overall Site Category?

A. The highest relative risk media rating becomes the **Overall Site Category** for the site. For example, if a site has a groundwater relative risk rating of **High**, and soil relative risk rating of **Low**, then the Overall Site Category rating for the site is **High**.

Regulatory and Stakeholder Involvement

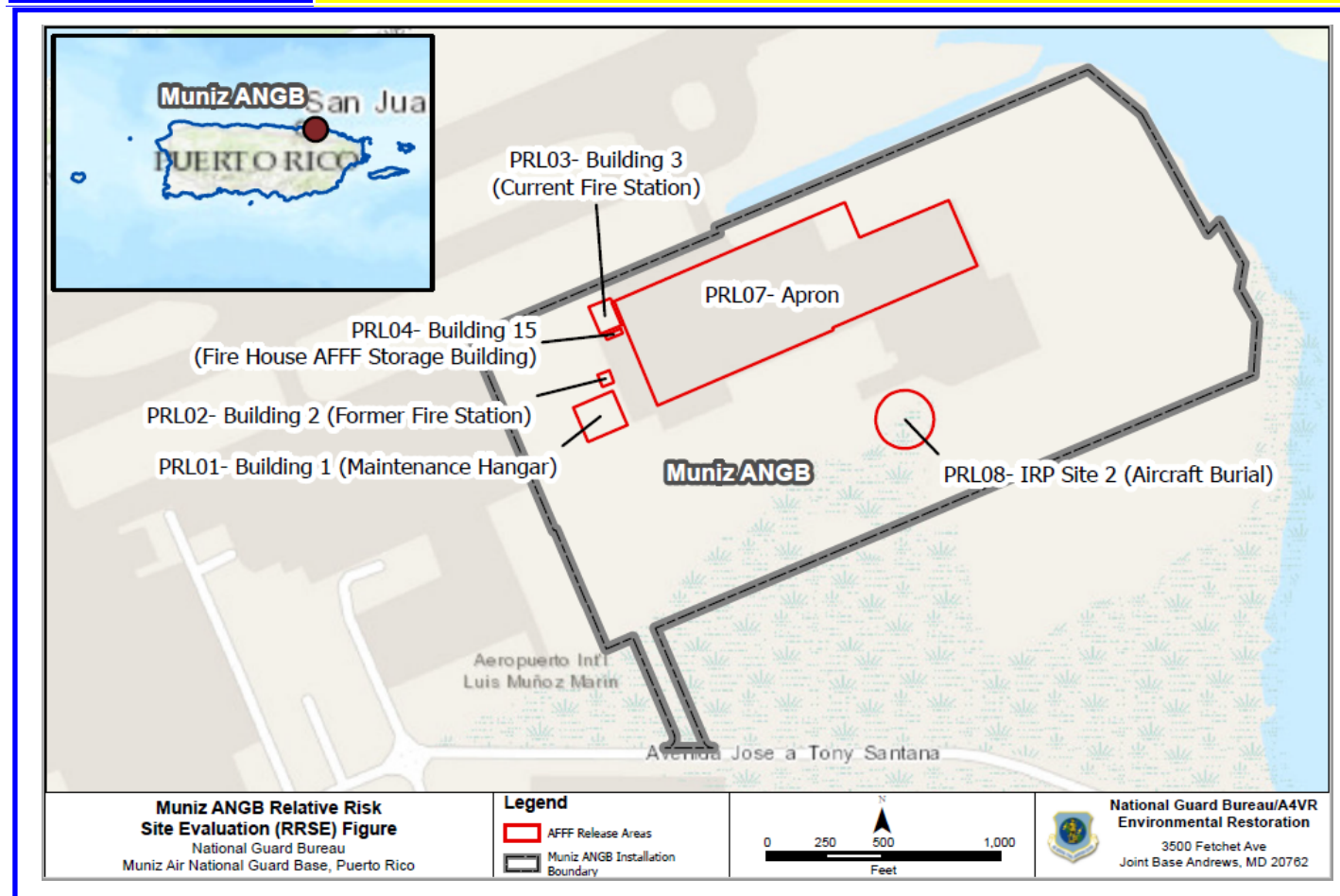
Q. How do I participate as Stakeholder?



A. To offer opportunity to participate in RRSE, the Air Force announces a public comment period in your local newspaper. There is also opportunity to participate during installation Restoration Advisory Committees where active. Installation Restoration Advisory Committee meetings are also announced in your local newspaper.

Relative Risk Site Evaluation Summary Muniz ANGB, PR

Overall Site Category	Site Name (Sites are shown on the map below and RRSE Worksheets are attached)
HIGH	N/A
MEDIUM	PRL 2, PRL 3, PRL 4
LOW	PRL 1, PRL 7, PRL 8



Site Background Information			
Installation:	Muniz ANG Base	Date:	10/14/2021
Location (State):	Puerto Rico	Media Evaluated:	Groundwater, Soil
Site Name and ID:	Building 1 Maintenance Hangar - PRL 1	Phase of Execution (e.g., RI, Record of Decision (ROD)):	N/A
RPM's Name:	Mark Dickerson	Agreement Status (e.g., Federal Facility Agreement date signed):	N/A
OVERALL SITE CATEGORY: LOW			

Site Summary	
Brief Site Description:	<p>Building 1 was built in 1956 and currently serves as the Base Maintenance Hangar, used for the repair and maintenance of various Base maintenance and support vehicles. The aqueous film forming foam (AFFF) fire suppression system (FSS) (installation date unknown) was in place until 2004 when the system was retrofitted for high expansion foam. According to Base personnel, there were no documented releases of AFFF from the FSS. The water tank associated with the FSS is captioned in the 2007 Environmental Baseline Survey photograph log as "AFFF Tank West of Building 1". However, confirmation was obtained during the 2016 preliminary assessment (PA) site visit that this tank stored water and never served as AFFF storage. The AFFF storage tank was located in the mixing room and has not contained AFFF since 2004. Any incidental releases of AFFF within the building would have been captured by the floor trench drains, which lead to an oil/water separator (OWS), ultimately discharging to the Carolina Regional Wastewater Treatment Plant (WWTP) via the sanitary sewer. There is a stormwater drainage system outside the building that drains to Outfall 018.</p>
Brief Description of Pathways:	<p>The Installation is located on land consisting of artificial fill overlying swamp and marsh sediments of Quaternary age (fill for construction began in 1955). The thickness of the sediments varies, but averages about 100 feet. The Aguada Limestone Formation of Miocene age underlies the quaternary swamp sediments and is approximately 200 feet thick. The principal aquifer system is the North Coast Limestone which is present in the Aguada Limestones and the upper part of the Cibao Formation (clays and muds). The North Coast Limestone aquifer system consists of an upper "water table" (mostly unconfined) aquifer and a lower (mostly confined) aquifer. The upper aquifer is present at the Base in the shallow sand at depths ranging from 3 to 8 feet below ground surface (bgs). The upper aquifer is of poor quality due to the salinity and its hydraulic connection with La Torrecilla lagoon and the Atlantic Ocean. The upper aquifer flow direction was found to be highly influenced by tidal fluctuations but is generally to the NNE. The lower aquifer occurs in minor limestone lenses and is confined within the Cibao Formation beneath the Base. The quality of water in the lower aquifer ranges from fresh to brackish, and therefore is not used for potable supply. The hangar is surrounded on all four sides by concrete surfaces where any runoff would have drained to catch basins that drain to Stormwater Outfall 018.</p>
Brief Description of Receptors:	<p>A review of the Environmental Data Resources (EDR) Radius Map™ Report with Geotcheck® dated March 7, 2016, lists no water wells on the Base or within a 1-mile radius surrounding the Base. There are no potable water wells on-Base. Rainwater is collected and stored in surface reservoirs and the majority of the water is used as the principal water supply. Potable water is supplied to the Base by the Puerto Rico Aqueduct and Sewer Authority. PRL 1 is located behind a secondary fence within the perimeter fence. PFAS including PFOA, PFOS, and PFBS have been detected at multiple on-site wells at varying concentrations.</p>

Groundwater Worksheet

Installation Muniz ANG Base

Site ID: PRL 1

AFFF Release Area #: AFFF 1

Contaminant	Maximum Concentration (ug/L)	Comparison Value (ug/L)	Ratios	
PFOS	0.27	0.04	6.8	
PFOA	0.18	0.04	4.5	
PFBS	0.23	0.602	0.4	
CHF Scale	CHF Value	Contamination Hazard Factor (CHF)	11.6	
CHF > 100	H (High)	$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$		
100 > CHF > 2	M (Medium)			
2 > CHF	L (Low)			
CHF Value	CHF VALUE		M	
<u>Migratory Pathway Factor</u>				
Evident	Analytical data or direct observation indicates that contamination in the groundwater has moved to a point of exposure (e.g., well)			
Potential	Contamination in the groundwater has moved beyond the source or insufficient information available to make a determination of Evident or Confined		M	
Confined	Analytical data or direct observation indicates that the potential for contaminant migration from the source via groundwater is limited (possibly due to geological structures or physical controls)			
Migratory Pathway Factor	DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H).		M	
<u>Receptor Factor</u>				
Identified	Impacted drinking water well with detected contaminants or existing downgradient water supply well within 4 miles and groundwater is current source of drinking water (EPA Class I or IIA groundwater)			
Potential	Existing downgradient drinking water well beyond 4 miles with no contaminant detection(s) or no known drinking water wells downgradient and groundwater is currently or potentially usable for drinking water (i.e., EPA Class I or II groundwater) or other beneficial use (e.g., agricultural)			
Limited	No known water supply wells downgradient and groundwater is not considered potential drinking water source and is of limited beneficial use (Class III)		L	
Receptor Factor	DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H).		L	
Groundwater Category			LOW	

Soil Worksheet

Installation Muniz ANG Base

Site ID: PRL 1

AFFF Release Area #: AFFF 1

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios	
PFOS	0.44	0.126	3.5	
PFOA	0.011	0.126	0.1	
PFBS	0.0043	1.9	0.0	
CHF Scale	CHF Value	Contamination Hazard Factor (CHF)	3.6	
CHF > 100	H (High)	$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$		
100 > CHF > 2	M (Medium)			
2 > CHF	L (Low)			
CHF Value	CHF VALUE		M	
<u>Migratory Pathway Factor</u>				
Evident	Analytical data or observable evidence that contamination is present at a point of exposure			
Potential	Contamination has moved beyond the source, could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined			
Confined	Low possibility for contamination to be present at or migrate to a point of exposure		L	
Migratory Pathway Factor	DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H).		L	
<u>Receptor Factor</u>				
Identified	Receptors identified that have access to contaminated soil			
Potential	Potential for receptors to have access to contaminated soil			
Limited	No potential for receptors to have access to contaminated soil		L	
Receptor Factor	DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H).		L	
Soil Category			LOW	

Site Background Information			
Installation:	Muniz ANG Base	Date:	10/14/2021
Location (State):	Puerto Rico	Media Evaluated:	Groundwater, Soil
Site Name and ID:	Building 2 Former Fire Station - PRL 2	Phase of Execution (e.g., RI, Record of Decision (ROD)):	N/A
RPM's Name:	Mark Dickerson	Agreement Status (e.g., Federal Facility Agreement date signed):	N/A
OVERALL SITE CATEGORY: MEDIUM			

Site Summary	
Brief Site Description:	<p>Prior to relocation to Building 3, the Fire Department was stationed in Building 2 from 1956 until 2007. The building is currently used as storage and does not contain AFFF. AFFF was likely used in the Former Fire Station from the late 1970s until 2007. The Former Fire Station housed two fire crash and rescue vehicles containing AFFF, as well as an FSS. The two vehicles, P19 and P4, had an unknown capacity for AFFF. There are no records to indicate that unused AFFF has ever been disposed of. Any incidental releases of AFFF within the building would have been captured by the floor trench drains, which lead to an OWS with subsequent discharge to the sanitary sewer and the Carolina Regional WWTP. There are no documented releases of AFFF within the Former Fire Station.</p>
Brief Description of Pathways:	<p>The Installation is located on land consisting of artificial fill overlying swamp and marsh sediments of Quaternary age (fill for construction began in 1955). The thickness of the sediments varies, but averages about 100 feet. The Aguada Limestone Formation of Miocene age underlies the quaternary swamp sediments and is approximately 200 feet thick. The principal aquifer system is the North Coast Limestone which is present in the Aguada Limestones and the upper part of the Cibao Formation (clays and muds). The North Coast Limestone aquifer system consists of an upper "water table" (mostly unconfined) aquifer and a lower (mostly confined) aquifer. The upper aquifer is present at the Base in the shallow sand at depths ranging from 3 to 8 feet bgs. The upper aquifer is of poor quality due to the salinity and its hydraulic connection with La Torrecilla lagoon and the Atlantic Ocean. The upper aquifer flow direction was found to be highly influenced by tidal fluctuations but is generally to the NNE. The lower aquifer occurs in minor limestone lenses and is confined within the Cibao Formation beneath the Base. The quality of water in the lower aquifer ranges from fresh to brackish, and therefore is not used for potable supply. The Former Fire Station is surrounded on all four sides by concrete surfaces where any runoff would have drained to catch basins that drain to Stormwater Outfall 018.</p>
Brief Description of Receptors:	<p>A review of the EDR Radius Map™ Report with Geoscheck® dated March 7, 2016, lists no water wells on the Base or within a 1-mile radius surrounding the Base. There are no potable water wells on-Base. Rainwater is collected and stored in surface reservoirs and the majority of the water is used as the principal water supply. Potable water is supplied to the Base by the Puerto Rico Aqueduct and Sewer Authority. PRL 2 is located behind a secondary fence as well as the Base perimeter fence which limits receptors to Base personnel and authorized visitors. PFAS including PFOA, PFOS, and PFBS have been detected at multiple on-site wells at varying concentrations.</p>

Groundwater Worksheet

Installation Muniz ANG Base

Site ID: PRL 2

AFFF Release Area #: AFFF 2

Contaminant	Maximum Concentration (ug/L)	Comparison Value (ug/L)	Ratios	
PFOS	2.9	0.04	72.5	
PFOA	2.3	0.04	57.5	
PFBS	0.068	0.602	0.1	
CHF Scale	CHF Value	Contamination Hazard Factor (CHF)	130.1	
CHF > 100	H (High)	$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$		
100 > CHF > 2	M (Medium)			
2 > CHF	L (Low)			
CHF Value	CHF VALUE		H	
<u>Migratory Pathway Factor</u>				
Evident	Analytical data or direct observation indicates that contamination in the groundwater has moved to a point of exposure (e.g., well)			
Potential	Contamination in the groundwater has moved beyond the source or insufficient information available to make a determination of Evident or Confined		M	
Confined	Analytical data or direct observation indicates that the potential for contaminant migration from the source via groundwater is limited (possibly due to geological structures or physical controls)			
Migratory Pathway Factor	DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H).		M	
<u>Receptor Factor</u>				
Identified	Impacted drinking water well with detected contaminants or existing downgradient water supply well within 4 miles and groundwater is current source of drinking water (EPA Class I or IIA groundwater)			
Potential	Existing downgradient drinking water well beyond 4 miles with no contaminant detection(s) or no known drinking water wells downgradient and groundwater is currently or potentially usable for drinking water (i.e., EPA Class I or II groundwater) or other beneficial use (e.g., agricultural)			
Limited	No known water supply wells downgradient and groundwater is not considered potential drinking water source and is of limited beneficial use (Class III)		L	
Receptor Factor	DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H).		L	
Groundwater Category			MEDIUM	

Soil Worksheet

Installation Muniz ANG Base

Site ID: PRL 2

AFFF Release Area #: AFFF 2

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios	
PFOS	0.077	0.126	0.6	
PFOA	0.0024	0.126	0.0	
PFBS	0.00021	1.9	0.0	
CHF Scale	CHF Value	Contamination Hazard Factor (CHF)	0.6	
CHF > 100	H (High)	$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$		
100 > CHF > 2	M (Medium)			
2 > CHF	L (Low)			
CHF Value	CHF VALUE		L	
<u>Migratory Pathway Factor</u>				
Evident	Analytical data or observable evidence that contamination is present at a point of exposure			
Potential	Contamination has moved beyond the source, could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined			
Confined	Low possibility for contamination to be present at or migrate to a point of exposure		L	
Migratory Pathway Factor	DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H).		L	
<u>Receptor Factor</u>				
Identified	Receptors identified that have access to contaminated soil			
Potential	Potential for receptors to have access to contaminated soil			
Limited	No potential for receptors to have access to contaminated soil		L	
Receptor Factor	DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H).		L	
Soil Category			LOW	

Site Background Information			
Installation:	Muniz ANG Base	Date:	10/14/2021
Location (State):	Puerto Rico	Media Evaluated:	Groundwater, Soil
Site Name and ID:	Building 3 Current Fire Station - PRL 3	Phase of Execution (e.g., RI, Record of Decision (ROD)):	N/A
RPM's Name:	Mark Dickerson	Agreement Status (e.g., Federal Facility Agreement date signed):	N/A
OVERALL SITE CATEGORY: MEDIUM			

Site Summary	
Brief Site Description:	Building 3, constructed in 1996, was remodeled from a hangar to the new Fire Station in 2007. Fire Department vehicles are currently washed in this building. The building houses four vehicles that are filled with AFFF on an as-needed basis by directly pouring the AFFF into the vehicle from a pail. The total capacity of AFFF within the fire crash and rescue vehicles is 1,275 to 1,310 gallons (gal). AFFF is stored in six 55-gal drums within the building, which has a total AFFF capacity of 1,605 to 1,620 gal. Any incidental releases of AFFF within the building would drain to floor trench drains, which lead to a 300-gal OWS installed in 1980 with subsequent discharge to the sanitary sewer. There are no documented releases of AFFF within the Fire Station. There is a stormwater trench drain outside the building that would transport any outside discharges to Outfall 017.
Brief Description of Pathways:	The Installation is located on land consisting of artificial fill overlying swamp and marsh sediments of Quaternary age (fill for construction began in 1955). The thickness of the sediments varies, but averages about 100 feet. The Aguada Limestone Formation of Miocene age underlies the quaternary swamp sediments and is approximately 200 feet thick. The principal aquifer system is the North Coast Limestone which is present in the Aguada Limestones and the upper part of the Cibao Formation (clays and muds). The North Coast Limestone aquifer system consists of an upper "water table" (mostly unconfined) aquifer and a lower (mostly confined) aquifer. The upper aquifer is present at the Base in the shallow sand at depths ranging from 3 to 8 feet bgs. The upper aquifer is of poor quality due to the salinity and its hydraulic connection with La Torrecilla lagoon and the Atlantic Ocean. The upper aquifer flow direction was found to be highly influenced by tidal fluctuations but is generally to the NNE. The lower aquifer occurs in minor limestone lenses and is confined within the Cibao Formation beneath the Base. The quality of water in the lower aquifer ranges from fresh to brackish, and therefore is not used for potable supply. Samples were collected from the two grassy areas along the west and northeast sides of the building. The rest of the building is surrounded by concrete paved areas.
Brief Description of Receptors:	A review of the EDR Radius Map™ Report with Geoscheck® dated March 7, 2016, lists no water wells on the Base or within a 1-mile radius surrounding the Base. There are no potable water wells on-Base. Rainwater is collected and stored in surface reservoirs and the majority of the water is used as the principal water supply. Potable water is supplied to the Base by the Puerto Rico Aqueduct and Sewer Authority. PRL 3 is located behind a secondary fence within the Base perimeter fence which limits receptors to Base personnel and authorized visitors. PFAS including PFOA, PFOS, and PFBS have been detected at multiple on-site wells at varying concentrations.

Groundwater Worksheet

Installation Muniz ANG Base

Site ID: PRL 3

AFFF Release Area #: AFFF 3

Contaminant	Maximum Concentration (ug/L)	Comparison Value (ug/L)	Ratios	
PFOS	7	0.04	175.0	
PFOA	2	0.04	50.0	
PFBS	0.15	0.602	0.2	
CHF Scale	CHF Value	Contamination Hazard Factor (CHF)	225.2	
CHF > 100	H (High)	$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$		
100 > CHF > 2	M (Medium)			
2 > CHF	L (Low)			
CHF Value	CHF VALUE		H	
<u>Migratory Pathway Factor</u>				
Evident	Analytical data or direct observation indicates that contamination in the groundwater has moved to a point of exposure (e.g., well)			
Potential	Contamination in the groundwater has moved beyond the source or insufficient information available to make a determination of Evident or Confined		M	
Confined	Analytical data or direct observation indicates that the potential for contaminant migration from the source via groundwater is limited (possibly due to geological structures or physical controls)			
Migratory Pathway Factor	DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H).		M	
<u>Receptor Factor</u>				
Identified	Impacted drinking water well with detected contaminants or existing downgradient water supply well within 4 miles and groundwater is current source of drinking water (EPA Class I or IIA groundwater)			
Potential	Existing downgradient drinking water well beyond 4 miles with no contaminant detection(s) or no known drinking water wells downgradient and groundwater is currently or potentially usable for drinking water (i.e., EPA Class I or II groundwater) or other beneficial use (e.g., agricultural)			
Limited	No known water supply wells downgradient and groundwater is not considered potential drinking water source and is of limited beneficial use (Class III)		L	
Receptor Factor	DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H).		L	
Groundwater Category			MEDIUM	

Soil Worksheet

Installation: Muniz ANG Base, PR

Site ID: PRL 3

AFFF Release Area #: AFFF 3

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios	
PFOS	0.057	0.126	0.5	
PFOA	0.0037	0.126	0.0	
PFBS	0.00018	1.9	0.0	
CHF Scale	CHF Value	Contamination Hazard Factor (CHF)	0.5	
CHF > 100	H (High)	$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$		
100 > CHF > 2	M (Medium)			
2 > CHF	L (Low)			
CHF Value	CHF VALUE		L	
<u>Migratory Pathway Factor</u>				
Evident	Analytical data or observable evidence that contamination is present at a point of exposure			
Potential	Contamination has moved beyond the source, could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined			
Confined	Low possibility for contamination to be present at or migrate to a point of exposure		L	
Migratory Pathway Factor	DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H).		L	
<u>Receptor Factor</u>				
Identified	Receptors identified that have access to contaminated soil			
Potential	Potential for receptors to have access to contaminated soil			
Limited	No potential for receptors to have access to contaminated soil		L	
Receptor Factor	DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H).		L	
Soil Category			LOW	

Site Background Information			
Installation:	Muniz ANG Base	Date:	10/14/2021
Location (State):	Puerto Rico	Media Evaluated:	Groundwater, Soil
Site Name and ID:	Building 15 Fire House AFFF Storage - PRL 4	Phase of Execution (e.g., RI, Record of Decision (ROD)):	N/A
RPM's Name:	Mark Dickerson	Agreement Status (e.g., Federal Facility Agreement date signed):	N/A
OVERALL SITE CATEGORY: MEDIUM			

Site Summary	
Brief Site Description:	Building 15 was built in 1963 and serves as storage for AFFF. There is no secondary containment for the AFFF storage area; however, there are no documented releases of AFFF. Any incidental releases of AFFF within the building would have discharged to floor trench drains, which lead to a 300-gal OWS with subsequent discharge to the sanitary sewer. There is a stormwater trench drain outside the building that could transport outside discharges to Outfall 017.
Brief Description of Pathways:	The Installation is located on land consisting of artificial fill overlying swamp and marsh sediments of Quaternary age (fill for construction began in 1955). The thickness of the sediments varies, but averages about 100 feet. The Aguada Limestone Formation of Miocene age underlies the quaternary swamp sediments and is approximately 200 feet thick. The principal aquifer system is the North Coast Limestone which is present in the Aguada Limestones and the upper part of the Cibao Formation (clays and muds). The North Coast Limestone aquifer system consists of an upper "water table" (mostly unconfined) aquifer and a lower (mostly confined) aquifer. The upper aquifer is present at the Base in the shallow sand at depths ranging from 3 to 8 feet bgs. The upper aquifer is of poor quality due to the salinity and its hydraulic connection with La Torrecilla lagoon and the Atlantic Ocean. The upper aquifer flow direction was found to be highly influenced by tidal fluctuations but is generally to the NNE. The lower aquifer occurs in minor limestone lenses and is confined within the Cibao Formation beneath the Base. The quality of water in the lower aquifer ranges from fresh to brackish, and therefore is not used for potable supply. This PRL is surrounded by concrete paved areas and Building 3.
Brief Description of Receptors:	A review of the EDR Radius Map™ Report with Geotcheck® dated March 7, 2016, lists no water wells on the Base or within a 1-mile radius surrounding the Base. There are no potable water wells on-Base. Rainwater is collected and stored in surface reservoirs and the majority of the water is used as the principal water supply. Potable water is supplied to the Base by the Puerto Rico Aqueduct and Sewer Authority. PRL 4 is located behind a secondary fence within the Base perimeter fence which limits receptors to Base personnel and authorized visitors. PFAS including PFOA, PFOS, and PFBS have been detected at multiple on-site wells at varying concentrations.

Groundwater Worksheet

Installation Muniz ANG Base

Site ID: PRL 4

AFFF Release Area #: AFFF 4

Contaminant	Maximum Concentration (ug/L)	Comparison Value (ug/L)	Ratios	
PFOS	11	0.04	275.0	
PFOA	0.52	0.04	13.0	
PFBS	0.13	0.602	0.2	
CHF Scale	CHF Value	Contamination Hazard Factor (CHF)	288.2	
CHF > 100	H (High)	$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$		
100 > CHF > 2	M (Medium)			
2 > CHF	L (Low)			
CHF Value	CHF VALUE		H	
<u>Migratory Pathway Factor</u>				
Evident	Analytical data or direct observation indicates that contamination in the groundwater has moved to a point of exposure (e.g., well)			
Potential	Contamination in the groundwater has moved beyond the source or insufficient information available to make a determination of Evident or Confined		M	
Confined	Analytical data or direct observation indicates that the potential for contaminant migration from the source via groundwater is limited (possibly due to geological structures or physical controls)			
Migratory Pathway Factor	DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H).		M	
<u>Receptor Factor</u>				
Identified	Impacted drinking water well with detected contaminants or existing downgradient water supply well within 4 miles and groundwater is current source of drinking water (EPA Class I or IIA groundwater)			
Potential	Existing downgradient drinking water well beyond 4 miles with no contaminant detection(s) or no known drinking water wells downgradient and groundwater is currently or potentially usable for drinking water (i.e., EPA Class I or II groundwater) or other beneficial use (e.g., agricultural)			
Limited	No known water supply wells downgradient and groundwater is not considered potential drinking water source and is of limited beneficial use (Class III)		L	
Receptor Factor	DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H).		L	
Groundwater Category			MEDIUM	

Soil Worksheet

Installation Muniz ANG Base

Site ID: PRL 4

AFFF Release Area #: AFFF 4

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios	
PFOS	0.002	0.126	0.0	
PFOA	0.00011	0.126	0.0	
CHF Scale	CHF Value	Contamination Hazard Factor (CHF)	0.0	
CHF > 100	H (High)	$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$		
100 > CHF > 2	M (Medium)			
2 > CHF	L (Low)			
CHF Value	CHF VALUE		L	
Migratory Pathway Factor				
Evident	Analytical data or observable evidence that contamination is present at a point of exposure			
Potential	Contamination has moved beyond the source, could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined			
Confined	Low possibility for contamination to be present at or migrate to a point of exposure		L	
Migratory Pathway Factor	DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H).		L	
Receptor Factor				
Identified	Receptors identified that have access to contaminated soil			
Potential	Potential for receptors to have access to contaminated soil			
Limited	No potential for receptors to have access to contaminated soil		L	
Receptor Factor	DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H).		L	
Soil Category			LOW	

Site Background Information			
Installation:	Muniz ANG Base	Date:	10/14/2021
Location (State):	Puerto Rico	Media Evaluated:	Groundwater, Soil
Site Name and ID:	Aircraft Apron - PRL 7	Phase of Execution (e.g., RI, Record of Decision (ROD)):	N/A
RPM's Name:	Mark Dickerson	Agreement Status (e.g., Federal Facility Agreement date signed):	N/A
OVERALL SITE CATEGORY: LOW			

Site Summary	
Brief Site Description:	<p>The primary Aircraft Apron is located to the east of Building 1 (Maintenance Hangar), Building 2 (Former Fire Station), Building 3 (Current Fire Station), and Building 15 (Fire House AFFF Storage Building). Historic operations in this area may have resulted in periodic releases of AFFF to the concrete surface, which would have ultimately drained to an OWS on the west side of Building 3 and then discharged into the sanitary sewer system. Any releases of AFFF to the apron would have drained to an OWS on the west side of Building 3 and then discharged into the sanitary sewer system or have runoff to the grassy area along the north side of the apron and infiltrated the underlying soils. In 1981, nine A-7D aircrafts and one F-104 aircraft caught fire on the Apron. Wreckage was later buried at Installation Restoration Program (IRP) Site 2. AFFF (unknown quantity) may have been used to suppress the fire.</p>
Brief Description of Pathways:	<p>The Installation is located on land consisting of artificial fill overlying swamp and marsh sediments of Quaternary age (fill for construction began in 1955). The thickness of the sediments varies, but averages about 100 feet. The Aguada Limestone Formation of Miocene age underlies the quaternary swamp sediments and is approximately 200 feet thick. The principal aquifer system is the North Coast Limestone which is present in the Aguada Limestones and the upper part of the Cibao Formation (clays and muds). The North Coast Limestone aquifer system consists of an upper "water table" (mostly unconfined) aquifer and a lower (mostly confined) aquifer. The upper aquifer is present at the Base in the shallow sand at depths ranging from 3 to 8 feet bgs. The upper aquifer is of poor quality due to the salinity and its hydraulic connection with La Torrecilla lagoon and the Atlantic Ocean. The upper aquifer flow direction was found to be highly influenced by tidal fluctuations but is generally to the NNE. The lower aquifer occurs in minor limestone lenses and is confined within the Cibao Formation beneath the Base. The quality of water in the lower aquifer ranges from fresh to brackish, and therefore is not used for potable supply.</p>
Brief Description of Receptors:	<p>A review of the EDR Radius Map™ Report with Geospatial® dated March 7, 2016, lists no water wells on the Base or within a 1-mile radius surrounding the Base. There are no potable water wells on-Base. Rainwater is collected and stored in surface reservoirs and the majority of the water is used as the principal water supply. Potable water is supplied to the Base by the Puerto Rico Aqueduct and Sewer Authority. The Apron is located behind a secondary fence within the Base perimeter fence which limits receptors to Base personnel and authorized visitors. PFAS including PFOA, PFOS, and PFBS have been detected at multiple on-site wells at varying concentrations.</p>

Groundwater Worksheet

Installation Muniz ANG Base

Site ID: PRL 7

AFFF Release Area #: AFFF 7

Contaminant	Maximum Concentration (ug/L)	Comparison Value (ug/L)	Ratios	
PFOS	0.16	0.04	4.0	
PFOA	0.049	0.04	1.2	
PFBS	0.0089	0.602	0.0	
CHF Scale	CHF Value	Contamination Hazard Factor (CHF)	5.2	
CHF > 100	H (High)	$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$		
100 > CHF > 2	M (Medium)			
2 > CHF	L (Low)			
CHF Value	CHF VALUE		M	
Migratory Pathway Factor				
Evident	Analytical data or direct observation indicates that contamination in the groundwater has moved to a point of exposure (e.g., well)			
Potential	Contamination in the groundwater has moved beyond the source or insufficient information available to make a determination of Evident or Confined		M	
Confined	Analytical data or direct observation indicates that the potential for contaminant migration from the source via groundwater is limited (possibly due to geological structures or physical controls)			
Migratory Pathway Factor	DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H).		M	
Receptor Factor				
Identified	Impacted drinking water well with detected contaminants or existing downgradient water supply well within 4 miles and groundwater is current source of drinking water (EPA Class I or IIA groundwater)			
Potential	Existing downgradient drinking water well beyond 4 miles with no contaminant detection(s) or no known drinking water wells downgradient and groundwater is currently or potentially usable for drinking water (i.e., EPA Class I or II groundwater) or other beneficial use (e.g., agricultural)			
Limited	No known water supply wells downgradient and groundwater is not considered potential drinking water source and is of limited beneficial use (Class III)		L	
Receptor Factor	DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H).		L	
Groundwater Category			LOW	

Soil Worksheet

Installation: Muniz ANG Base, PR

Site ID: PRL 7

AFFF Release Area #: AFFF 7

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
PFOS	0.022	0.126	0.2
PFOA	0.00056	0.126	0.0
PFBS	0.000067	1.9	0.0
CHF Scale	CHF Value	Contamination Hazard Factor (CHF)	0.2
CHF > 100	H (High)	$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		
CHF Value	CHF VALUE		L
<u>Migratory Pathway Factor</u>			
Evident	Analytical data or observable evidence that contamination is present at a point of exposure		
Potential	Contamination has moved beyond the source, could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined		
Confined	Low possibility for contamination to be present at or migrate to a point of exposure		L
Migratory Pathway Factor	DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H).		L
<u>Receptor Factor</u>			
Identified	Receptors identified that have access to contaminated soil		
Potential	Potential for receptors to have access to contaminated soil		
Limited	No potential for receptors to have access to contaminated soil		L
Receptor Factor	DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H).		L
Soil Category			LOW

Site Background Information			
Installation:	Muniz ANG Base	Date:	10/14/2021
Location (State):	Puerto Rico	Media Evaluated:	Groundwater, Soil
Site Name and ID:	IRP Site 2 Aircraft Burial - PRL 8	Phase of Execution (e.g., RI, Record of Decision (ROD)):	N/A
RPM's Name:	Mark Dickerson	Agreement Status (e.g., Federal Facility Agreement date signed):	N/A
OVERALL SITE CATEGORY: LOW			

Site Summary	
Brief Site Description:	IRP Site 2 is located south of Buildings 7 and 80 and contains debris from the aircraft that were destroyed in 1981. Nine A-7D aircraft and one F-104 aircraft caught fire on the Apron, which likely led to the subsequent use of AFFF to suppress the fire. The remaining debris, potentially containing the released AFFF, was buried at IRP Site 2.
Brief Description of Pathways:	The Installation is located on land consisting of artificial fill overlying swamp and marsh sediments of Quaternary age (fill for construction began in 1955). The thickness of the sediments varies, but averages about 100 feet. The Aguada Limestone Formation of Miocene age underlies the quaternary swamp sediments and is approximately 200 feet thick. The principal aquifer system is the North Coast Limestone which is present in the Aguada Limestones and the upper part of the Cibao Formation (clays and muds). The North Coast Limestone aquifer system consists of an upper "water table" (mostly unconfined) aquifer and a lower (mostly confined) aquifer. The upper aquifer is present at the Base in the shallow sand at depths ranging from 3 to 8 feet bgs. The upper aquifer is of poor quality due to the salinity and its hydraulic connection with La Torrecilla lagoon and the Atlantic Ocean. The upper aquifer flow direction was found to be highly influenced by tidal fluctuations but is generally to the NNE. The lower aquifer occurs in minor limestone lenses and is confined within the Cibao Formation beneath the Base. The quality of water in the lower aquifer ranges from fresh to brackish, and therefore is not used for potable supply.
Brief Description of Receptors:	A review of the EDR Radius Map™ Report with Geotcheck® dated March 7, 2016, lists no water wells on the Base or within a 1-mile radius surrounding the Base. There are no potable water wells on-Base. Rainwater is collected and stored in surface reservoirs and the majority of the water is used as the principal water supply. Potable water is supplied to the Base by the Puerto Rico Aqueduct and Sewer Authority. This PRL is within the perimeter fencing and access is through a controlled gate which limits receptors to Base personnel and authorized visitors. PFAS including PFOA, PFOS, and PFBS have been detected at multiple on-site wells at varying concentrations.

Groundwater Worksheet

Installation Muniz ANG Base

Site ID: PRL 8

AFFF Release Area #: AFFF 8

Contaminant	Maximum Concentration (ug/L)	Comparison Value (ug/L)	Ratios	
PFOS	1.1	0.04	27.5	
PFOA	0.07	0.04	1.8	
PFBS	0.015	0.602	0.0	
CHF Scale	CHF Value	Contamination Hazard Factor (CHF)	29.3	
CHF > 100	H (High)	$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$		
100 > CHF > 2	M (Medium)			
2 > CHF	L (Low)			
CHF Value	CHF VALUE		M	
<u>Migratory Pathway Factor</u>				
Evident	Analytical data or direct observation indicates that contamination in the groundwater has moved to a point of exposure (e.g., well)			
Potential	Contamination in the groundwater has moved beyond the source or insufficient information available to make a determination of Evident or Confined		M	
Confined	Analytical data or direct observation indicates that the potential for contaminant migration from the source via groundwater is limited (possibly due to geological structures or physical controls)			
Migratory Pathway Factor	DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H).		M	
<u>Receptor Factor</u>				
Identified	Impacted drinking water well with detected contaminants or existing downgradient water supply well within 4 miles and groundwater is current source of drinking water (EPA Class I or IIA groundwater)			
Potential	Existing downgradient drinking water well beyond 4 miles with no contaminant detection(s) or no known drinking water wells downgradient and groundwater is currently or potentially usable for drinking water (i.e., EPA Class I or II groundwater) or other beneficial use (e.g., agricultural)			
Limited	No known water supply wells downgradient and groundwater is not considered potential drinking water source and is of limited beneficial use (Class III)		L	
Receptor Factor	DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H).		L	
Groundwater Category			LOW	

Soil Worksheet

Installation: Muniz ANG Base, PR

Site ID: PRL 8

AFFF Release Area #: AFFF 8

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios	
PFOS	0.029	0.126	0.2	
PFOA	0.00046	0.126	0.0	
CHF Scale	CHF Value	Contamination Hazard Factor (CHF)	0.2	
CHF > 100	H (High)	$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$		
100 > CHF > 2	M (Medium)			
2 > CHF	L (Low)			
CHF Value	CHF VALUE		L	
<u>Migratory Pathway Factor</u>				
Evident	Analytical data or observable evidence that contamination is present at a point of exposure			
Potential	Contamination has moved beyond the source, could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined			
Confined	Low possibility for contamination to be present at or migrate to a point of exposure		L	
Migratory Pathway Factor	DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H).		L	
<u>Receptor Factor</u>				
Identified	Receptors identified that have access to contaminated soil			
Potential	Potential for receptors to have access to contaminated soil			
Limited	No potential for receptors to have access to contaminated soil		L	
Receptor Factor	DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H).		L	
Soil Category			LOW	