# RELATIVE RISK SITE EVALUATION

## Shepherd Field Air National Guard Base, West Virginia

### 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. At Shepherd Field Air National Guard Base (ANGB), an Expanded SI was also completed. 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 Shepherd Field ANGB, PFAS PA, SI, and Expanded SI can be found at the AFCEC 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 Martinsburg (Shepherd Fd), WV, then enter the AR Number 469949 in the “AR #” field for the PA. For the SI, enter the AR Number 579242 (1 of 16). For the Expanded SI, enter the AR Number 603904 (1 of 30). 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

AFCEC - Air Force Civil Engineer Center
AFFF - Aqueous Film Forming Foam
ANG - Air National Guard
ANGB - Air National Guard Bureau
AOC - Area of Concern
CE - Civil Engineering
CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act
CHF – Contaminant Hazard Factor
DoD - Department of Defense
EPA – US Environmental Protection Agency
FSS - Fire Suppression System
FTA – Fire Training Area
HA – Health Advisory
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
RCRA – Resource Conservation and Recovery Act
RF – Receptor Factor
RI – Remedial Investigation
RRSE – Relative Risk Site Evaluation
SI – Site Inspection
WWTP - Waste Water Treatment Plant

# RELATIVE RISK SITE EVALUATION, cont.

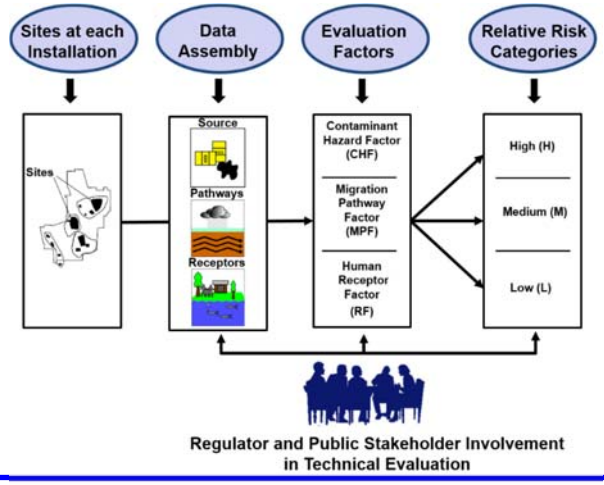
**Q. What is the Relative Risk Site Evaluation (RRSE)?**

**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.

**Relative Risk Site Evaluation Concept Summary**

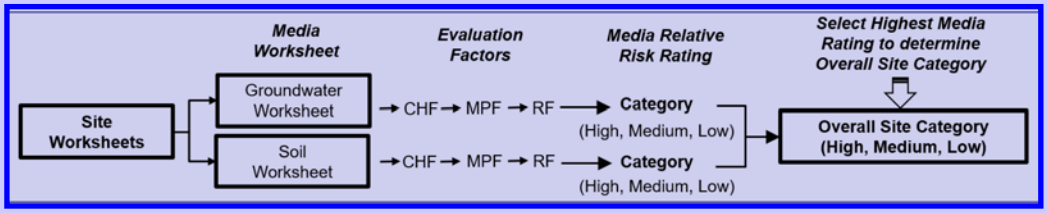



## Sites at Each Installation

**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., 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**
**Jenna Laube NGB/A4VR**
**240-612-9874**
**jenna.laube@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**

1. CHF = Significant

| MPF \ RF | Identified | Potential | Limited |
|---|---|---|---|
| Evident | H | H | M |
| Potential | H | H | M |
| Confined | M | M | L |

2. CHF = Moderate

| MPF \ RF | Identified | Potential | Limited |
|---|---|---|---|
| Evident | H | H | M |
| Potential | H | M | L |
| Confined | L | L | L |

3. CHF = Minimal

| MPF \ RF | Identified | Potential | Limited |
|---|---|---|---|
| Evident | H | M | L |
| Potential | M | L | L |
| Confined | L | L | L |

**CHF** (Contaminant Hazard Factor) **MPF** (Migration Pathway Factor) **RF** (Receptor Factor) **H** (High) **M** (Medium) **L** (Low)

## Overall Site Category

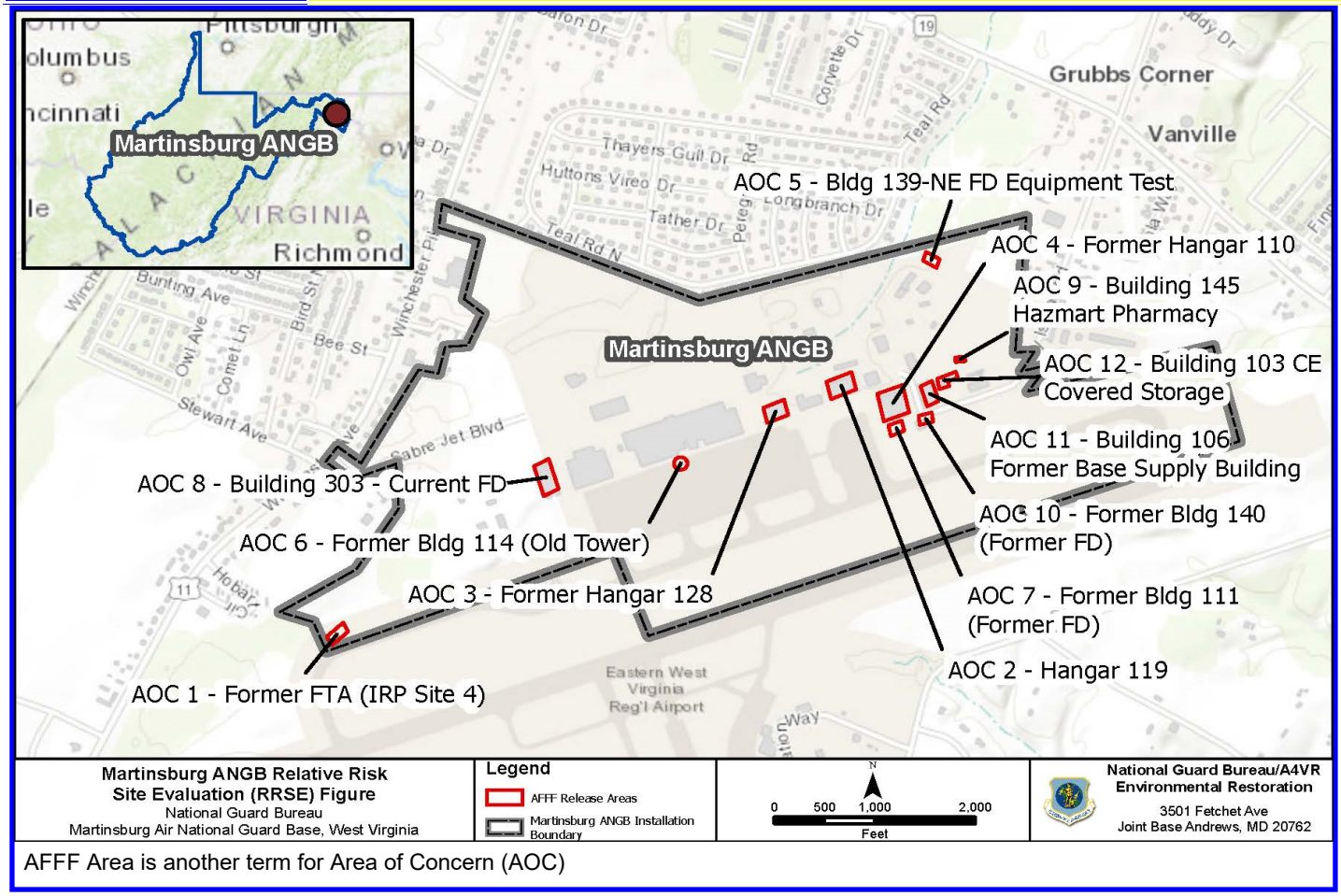
**Q. How do I determine the Overall Site Category?**
**A.** The highest relative risk media rating becomes the **Overall Site Category** for the site. For example, if a site has a groundwater relative risk rating of **High**, and soil relative risk rating of **Low**, then the Overall Site Category rating 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 Shepherd Field ANGB, WV

| Overall Site Category | Site Name (Sites are shown on the map below and RRSE Worksheets are attached) |
|---|---|
| HIGH | AOC 1, AOC 2, AOC 3, AOC 4, AOC 5, AOC 7, AOC 9, AOC 10, AOC 11, AOC 12 |
| MEDIUM | AOC 6, AOC 8 |
| LOW | |




AFFF Area is another term for Area of Concern (AOC)

| Site Background Information | | | |
|---|---|---|---|
| **Installation:** | Shepherd Field ANGB | **Date:** | 12/17/2021 |
| **Location (State):** | West Virginia | **Media Evaluated:** | Groundwater, Soil |
| **Site Name and ID:** | AOC 1 - Former FTA (IRP Site 4) | **Phase of Execution (e.g., RI, Record of Decision (ROD)):** | N/A |
| **RPM's Name:** | Jenna Laube | **Agreement Status (e.g., Federal Facility Agreement date signed):** | N/A |
| **OVERALL SITE CATEGORY: HIGH** | | | |

| Site Summary | |
|---|---|
| **Brief Site Description:** | AOC 1 consists of IRP Site 4, a former fire training area (FTA). The former FTA was in use from 1960 to 1975, and wood burning reportedly continued in this location through 1979. AOC 1 is located north of Taxiway A, southwest of the installation, and consists of a burn pit with an area of approximately 600 square feet (20 feet by 30 feet). The open, gravel-bottomed, elliptical bermed pit at the site was lined with layers of thick plastic sheeting that have degraded over time. Flammable liquids were poured into the pit and were ignited for fire training exercises. Approximately 75 ft. north of the pit, the ground slopes steeply toward a manmade drainage ditch. Water that accumulated in the pit was sometimes drained from the pit into the nearby drainage ditch. A remedial action, including excavation, on-site thermal treatment of contamination, and confirmation monitoring, was completed in 1996. |
| **Brief Description of Pathways:** | Groundwater in Berkeley County occurs in limestone and shale bedrock. The primary water-bearing stratum in the Shepherd Field area is the Beekmantown Limestone. Wells in this formation are generally in the 200-ft. range. Groundwater yield from shale is generally less than that of limestone; however, the depth and yield is generally more dependable -most wells in shale in this area are 100 to 150 ft. deep. Nearby underground tunnels associated with historic limestone mining may serve as preferential pathways for vertical groundwater migration to the bedrock aquifer. Groundwater flow on-top of bedrock is fracture-driven; therefore, PFOS/PFOA migration is dependent on natural bedrock fractures and the degree to which the fractures are interconnected, in addition to the tunnels. Groundwater flow is generally to the east; however, nearby water supply wells are inducing a strong groundwater gradient to the north, in the direction of one or more nearby wells. Surface soils are in exposed grassy areas |
| **Brief Description of Receptors:** | The nearest public water supply well (Big Springs Water Filtration Plant) is approximately one mile hydraulically downgradient (north) from the Base. Another public water supply system (Kilmer Springs Water Filtration Plant) is located approximately four miles north of the Base, also hydraulically downgradient. There have been detections of PFAS in the Big Springs and Kilmer Springs Water Filtration plant. In 2017, a granular activated carbon (GAC) system was installed at Big Springs Water Filtration plant, due to detections of PFOS/PFOA. Two on-base wells were no longer used due to bacterial and arsenic contamination; the well with bacterial contamination was abandoned in 2010; the other was taken off-line but no abandonment record was found. There are seven potable water wells that appeared on a review of the Environmental Data Resources (EDR) Radius Map™ Report with Geocheck® dated 21 July 2015 located within one mile of the Base. Mr. Steve Knipe of the city of Martinsburg's Water and Sewer Department, indicated there are multiple private potable water wells in the area but the exact number is currently unknown. AOC 1 is located adjacent to an aircraft taxiway. It is accessible by base personnel but likely restricted given its proximity to an active runway and therefore, exposure to surface soils would be limited. |

# Groundwater Worksheet

**Installation:** Shepherd Field ANGB

**Site ID:** AOC 1 **AFFF Release Area #:** AFFF 1

| Contaminant | Maximum Concentration (ug/L) | Comparison Value (ug/L) | Ratios |
|---|---|---|---|
| PFOS | 45.7 | 0.04 | 1142.5 |
| PFOA | 18.9 | 0.04 | 472.5 |
| PFBS | 2.55 | 0.602 | 4.2 |

| CHF Scale | CHF Value | Contamination Hazard Factor (CHF) | 1619.2 |
|---|---|---|---|
| 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 |

| 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) | H |
| **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) | |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | H |
| | **Groundwater Category** | **HIGH** |

# Soil Worksheet

**Installation:** Shepherd Field ANGB

**Site ID:** AOC 1 **AFFF Release Area #:** AFFF 1

| Contaminant | Maximum Concentration (mg/kg) | Comparison Value (mg/kg) | Ratios |
|---|---|---|---|
| PFOS | 0.265 | 0.126 | 2.1 |
| PFOA | 0.011 | 0.126 | 0.1 |
| PFBS | 0.0022 | 1.9 | 0.0 |
| **CHF Scale** | **CHF Value** | **Contamination Hazard Factor (CHF)** | **2.2** |
| **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 observable evidence that contamination is present at a point of exposure | H |
| **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 | |
| **Migratory Pathway Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | H |
| **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** | **MEDIUM** |

| Site Background Information | | | |
|---|---|---|---|
| **Installation:** | Shepherd Field ANGB | **Date:** | 12/17/2021 |
| **Location (State):** | West Virginia | **Media Evaluated:** | Groundwater, Soil |
| **Site Name and ID:** | AOC 2 - Hangar 119 | **Phase of Execution (e.g., RI, Record of Decision (ROD)):** | N/A |
| **RPM's Name:** | Jenna Laube | **Agreement Status (e.g., Federal Facility Agreement date signed):** | N/A |
| **OVERALL SITE CATEGORY: HIGH** | | | |

| Site Summary | |
|---|---|
| **Brief Site Description:** | AOC 2 consists of Hangar 119, which was constructed in the 1960s and was equipped with an aqueous film forming foam (AFFF) fire suppression system (FSS) from approximately 1989 until 2007. The suppression system was designed to contain, store, and in the case of system engagement, ultimately discharge the AFFF inside the hangar. In 2007, Hangar 119 was converted to house various functions such as Civil Engineering (CE) and Environmental Management and the AFFF FSS was removed. One spill was reported while the system was in place. The spill occurred in the 1990s and consisted of an approximate 500 - gallon release to the hangar floor. The AFFF was hosed down the sanitary sewer drains which were connected to an oil/water separator (OWS) as was the case with all the hangars at that time. Prior to 2007, the sanitary drains inside Hangar 119 were connected to the Base's wastewater treatment plant (WWTP) which discharged its effluent into the storm water drainage system which flows toward Cold Spring Run. Other Hangar 119 releases of AFFF occurred during FSS tests. It was estimated by Base personnel that an AFFF FSS test took place approximately every five years. Approximately 100 to 200 gallons of AFFF was released during each test. As indicated above, prior to 2007, AFFF from system tests was discharged to the Base WWTP. |
| **Brief Description of Pathways:** | Groundwater in Berkeley County occurs in limestone and shale bedrock. The primary water-bearing stratum in the Shepherd Field area is the Beekmantown Limestone. Wells in this formation are generally in the 200-ft. range. Groundwater yield from shale is generally less than that of limestone; however, the depth and yield is generally more dependable -most wells in shale in this area are 100 to 150 ft. deep. Nearby underground tunnels associated with historic limestone mining may serve as preferential pathways for vertical groundwater migration to the bedrock aquifer. Groundwater flow on-top of bedrock is fracture-driven; therefore, PFOS/PFOA migration is dependent on natural bedrock fractures and the degree to which the fractures are interconnected, in addition to the tunnels. Groundwater flow is generally to the east; however, nearby water supply wells are inducing a strong groundwater gradient to the north, in the direction of one or more nearby wells. Surface soils are in exposed grassy areas |
| **Brief Description of Receptors:** | The nearest public water supply well (Big Springs Water Filtration Plant) is approximately one mile hydraulically downgradient (north) from the Base. Another public water supply system (Kilmer Springs Water Filtration Plant) is located approximately four miles north of the Base, also hydraulically downgradient. There have been detections of PFAS in the Big Springs and Kilmer Springs Water Filtration plant. In 2017, a GAC system was installed at Big Springs Water Filtration plant, due to detections of PFOS/PFOA. Two on-base wells were no longer used due to bacterial and arsenic contamination; the well with bacterial contamination was abandoned in 2010; the other was taken off-line but no abandonment record was found. There are seven potable water wells that appeared on a review of the EDR Radius Map™ Report with Geocheck® dated 21 July 2015 located within one mile of the Base. Mr. Steve Knipe of the city of Martinsburg's Water and Sewer Department, indicated there are multiple private potable water wells in the area but the exact number is currently unknown. AOC 2 surface cover includes grassy landscaped areas adjacent to buildings accessible by CE personnel, environmental management personnel, and escorted visitors. |

# Groundwater Worksheet

**Installation:** Shepherd Field ANGB

**Site ID:** AOC 2 **AFFF Release Area #:** AFFF 2

| Contaminant | Maximum Concentration (ug/L) | Comparison Value (ug/L) | Ratios |
|---|---|---|---|
| PFOS | 0.59 | 0.04 | 14.7 |
| PFOA | 0.112 | 0.04 | 2.8 |
| PFBS | 0.0321 | 0.602 | 0.1 |

| CHF Scale | CHF Value | Contamination Hazard Factor (CHF) | 17.6 |
|---|---|---|---|
| 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 |

| | | |
|---|---|---|
| **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) | H |
| **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) | |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | H |
| | **Groundwater Category** | **HIGH** |

# Soil Worksheet

**Installation:** Shepherd Field ANGB

**Site ID:** AOC 2 **AFFF Release Area #:** AFFF 2

| Contaminant | Maximum Concentration (mg/kg) | Comparison Value (mg/kg) | Ratios |
|---|---|---|---|
| PFOS | 0.0404 | 0.126 | 0.3 |
| PFOA | 0.00289 | 0.126 | 0.0 |
| **CHF Scale** | **CHF Value** | **Contamination Hazard Factor (CHF)** | **0.3** |
| **CHF > 100** | **H (High)** | | |
| **100 > CHF > 2** | **M (Medium)** | | |
| **2 > CHF** | **L (Low)** | | |
| **CHF Value** | | **CHF VALUE** | **L** |

$$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$$

| 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 | M |
| **Confined** | Low possibility for contamination to be present at or migrate to a point of exposure | |
| **Migratory Pathway Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | M |

| Receptor Factor | | |
|---|---|---|
| **Identified** | Receptors identified that have access to contaminated soil | |
| **Potential** | Potential for receptors to have access to contaminated soil | M |
| **Limited** | No potential for receptors to have access to contaminated soil | |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | M |
| | **Soil Category** | **LOW** |

| Site Background Information | | | |
|---|---|---|---|
| **Installation:** | Shepherd Field ANGB | **Date:** | 12/17/2021 |
| **Location (State):** | West Virginia | **Media Evaluated:** | Groundwater, Soil |
| **Site Name and ID:** | AOC 3 - Former Hangar 128 | **Phase of Execution (e.g., RI, Record of Decision (ROD)):** | N/A |
| **RPM's Name:** | Jenna Laube | **Agreement Status (e.g., Federal Facility Agreement date** | N/A |
| **OVERALL SITE CATEGORY: HIGH** | | | |

| Site Summary | |
|---|---|
| **Brief Site Description:** | AOC 3 is the footprint of former Hangar 128. The hangar was constructed in the 1980s and was demolished in 2008. Hangar 128 was equipped with an AFFF FSS until decommissioning prior to demolition. The suppression system was designed to contain, store, and in the case of system engagement, ultimately discharge the AFFF inside the hangar. According to CE drawings, the hangar drained to the sanitary sewer which, prior to 2007, was connected to the Base WWTP which discharged to the storm water drainage system. In the 1990s, approximately 500 gallons of AFFF was released to the hangar floor. The AFFF was hosed down the sanitary sewer drains which were connected to an OWS as was the case with all the hangars at that time. However, prior to 2007 the sanitary sewer drains inside Hangar 128 were connected to the Base's WWTP which discharged its effluent into the storm water drainage system which flows toward Cold Spring Run. The WWTP was demolished in 2007 and the sanitary sewer connected to the city of Martinsburg. Other Hangar 128 releases of AFFF occurred during FSS tests. It was estimated by Base personnel that an AFFF FSS test took place approximately every five years. Approximately 100-200 gallons of AFFF was released during each test. |
| **Brief Description of Pathways:** | Groundwater in Berkeley County occurs in limestone and shale bedrock. The primary water-bearing stratum in the Shepherd Field area is the Beekmantown Limestone. Wells in this formation are generally in the 200-ft. range. Groundwater yield from shale is generally less than that of limestone; however, the depth and yield is generally more dependable -most wells in shale in this area are 100 to 150 ft. deep. Nearby underground tunnels associated with historic limestone mining may serve as preferential pathways for vertical groundwater migration to the bedrock aquifer. Groundwater flow on-top of bedrock is fracture-driven; therefore, PFOS/PFOA migration is dependent on natural bedrock fractures and the degree to which the fractures are interconnected, in addition to the tunnels. Groundwater flow is generally to the east; however, nearby water supply wells are inducing a strong groundwater gradient to the north, in the direction of one or more nearby wells. Surface soils are in exposed grassy areas. |
| **Brief Description of Receptors:** | The nearest public water supply well (Big Springs Water Filtration Plant) is approximately one mile hydraulically downgradient (north) from the Base. Another public water supply system (Kilmer Springs Water Filtration Plant) is located approximately four miles north of the Base, also hydraulically downgradient. There have been detections of PFAS in the Big Springs and Kilmer Springs Water Filtration plant. In 2017, a GAC system was installed at Big Springs Water Filtration plant, due to detections of PFOS/PFOA. Two on-base wells were no longer used due to bacterial and arsenic contamination; the well with bacterial contamination was abandoned in 2010; the other was taken off-line but no abandonment record was found. There are seven potable water wells that appeared on a review of the EDR Radius Map™ Report with Geocheck® dated 21 July 2015 located within one mile of the Base. Mr. Steve Knipe of the city of Martinsburg's Water and Sewer Department, indicated there are multiple private potable water wells in the area but the exact number is currently unknown. AOC 3 surface cover includes grassy landscaped areas adjacent to buildings accessible by base personnel and escorted visitors. |

# Groundwater Worksheet

**Installation** Shepherd Field ANGB

**Site ID:** AOC 3 **AFFF Release Area #:** AFFF 3

| Contaminant | Maximum Concentration (ug/L) | Comparison Value (ug/L) | Ratios |
|---|---|---|---|
| PFOS | 3.34 | 0.04 | 83.5 |
| PFOA | 0.112 | 0.04 | 2.8 |
| PFBS | 0.0607 | 0.602 | 0.1 |

| CHF Scale | CHF Value | Contamination Hazard Factor (CHF) | 86.4 |
|---|---|---|---|
| CHF > 100 | H (High) | | |
| 100 > CHF > 2 | M (Medium) | | |
| 2 > CHF | L (Low) | | |

$$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$$

| 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) | H |
| **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) | |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | H |
| | **Groundwater Category** | **HIGH** |

# Soil Worksheet

**Installation** Shepherd Field ANGB

**Site ID:** AOC 3 **AFFF Release Area #:** AFFF 3

| Contaminant | Maximum Concentration (mg/kg) | Comparison Value (mg/kg) | Ratios |
|---|---|---|---|
| PFOS | 0.000285 | 0.126 | 0.0 |
| **CHF Scale** | **CHF Value** | **Contamination Hazard Factor (CHF** | **0.0** |
| **CHF > 100** | **H (High)** | | |
| **100 > CHF > 2** | **M (Medium)** | $CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$ | |
| **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 | M |
| **Confined** | Low possibility for contamination to be present at or migrate to a point of exposure | |
| **Migratory Pathway Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | M |

| Receptor Factor | | |
|---|---|---|
| **Identified** | Receptors identified that have access to contaminated soil | |
| **Potential** | Potential for receptors to have access to contaminated soil | M |
| **Limited** | No potential for receptors to have access to contaminated soil | |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | M |
| | **Soil Category** | **LOW** |

| Site Background Information | | | |
|---|---|---|---|
| **Installation:** | Shepherd Field ANGB | **Date:** | 12/17/2021 |
| **Location (State):** | West Virginia | **Media Evaluated:** | Groundwater, Soil |
| **Site Name and ID:** | AOC 4 - Former Hangar 110 | **Phase of Execution (e.g., RI, Record of Decision (ROD)):** | N/A |
| **RPM's Name:** | Jenna Laube | **Agreement Status (e.g., Federal Facility Agreement date** | N/A |
| **OVERALL SITE CATEGORY: HIGH** | | | |

| Site Summary | |
|---|---|
| **Brief Site Description:** | AOC 4 is the footprint of former Hangar 110. Building 110 was constructed in the 1950s and demolished in 2011. The building was used as a hangar and was equipped with an AFFF FSS. The installation date for the AFFF FSS is not known; however, the system was decommissioned prior to demolition. As with other buildings at the Base, the floor drains in Hangar 110 discharged to the sanitary sewer system prior to 2007 when it was connected to the Base WWTP. Effluent from the Base WWTP was discharged to the storm water drainage system. The WWTP was demolished in 2007 and the sanitary sewer connected to the city of Martinsburg. According to the personnel interviewed during the PA, approximately 500 gallons of AFFF was released to the hangar floor in the 1990s. The AFFF was hosed down the sanitary sewer drains. However, prior to 2007 the sanitary sewer drains inside Hangar 110 were connected to the Base's WWTP which discharged its effluent into the storm water drainage system which flows toward Cold Spring Run. According to personnel interviewed during the preliminary assessment (PA), releases of AFFF may have occurred during FSS testing at Former Hangar 110. It was estimated by Base personnel that an AFFF FSS test took place approximately every five years. Approximately 100-200 gallons of AFFF was released during each test. |
| **Brief Description of Pathways:** | Groundwater in Berkeley County occurs in limestone and shale bedrock. The primary water-bearing stratum in the Shepherd Field area is the Beekmantown Limestone. Wells in this formation are generally in the 200-ft. range. Groundwater yield from shale is generally less than that of limestone; however, the depth and yield is generally more dependable -most wells in shale in this area are 100 to 150 ft. deep. Nearby underground tunnels associated with historic limestone mining may serve as preferential pathways for vertical groundwater migration to the bedrock aquifer. Groundwater flow on-top of bedrock is fracture-driven; therefore, PFOS/PFOA migration is dependent on natural bedrock fractures and the degree to which the fractures are interconnected, in addition to the tunnels. Groundwater flow is generally to the east; however, nearby water supply wells are inducing a strong groundwater gradient to the north, in the direction of one or more nearby wells. AOC 4 is a large grassy area with exposed surface soils. |
| **Brief Description of Receptors:** | The nearest public water supply well (Big Springs Water Filtration Plant) is approximately one mile hydraulically downgradient (north) from the Base. Another public water supply system (Kilmer Springs Water Filtration Plant) is located approximately four miles north of the Base, also hydraulically downgradient. There have been detections of PFAS in the Big Springs and Kilmer Springs Water Filtration plant. In 2017, a GAC system was installed at Big Springs Water Filtration plant, due to detections of PFOS/PFOA. Two on-base wells were no longer used due to bacterial and arsenic contamination; the well with bacterial contamination was abandoned in 2010; the other was taken off-line but no abandonment record was found. There are seven potable water wells that appeared on a review of the EDR Radius Map™ Report with Geocheck® dated 21 July 2015 located within one mile of the Base. Mr. Steve Knipe of the city of Martinsburg's Water and Sewer Department, indicated there are multiple private potable water wells in the area but the exact number is currently unknown. AOC 4 is a large grassy area among a group of buildings where surface soils would be accessible by base personnel and escorted visitors. |

# Groundwater Worksheet

**Installation** Shepherd Field ANGB

**Site ID:** AOC 4 **AFFF Release Area #:** AFFF 4

| Contaminant | Maximum Concentration (ug/L) | Comparison Value (ug/L) | Ratios |
|---|---|---|---|
| PFOS | 1.1 | 0.04 | 27.5 |
| PFOA | 0.54 | 0.04 | 13.5 |
| PFBS | 0.0896 | 0.602 | 0.1 |
| **CHF Scale** | **CHF Value** | **Contamination Hazard Factor (CHF)** | **41.1** |
| **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** | **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) | H |
| **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) | |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | H |
| | **Groundwater Category** | **HIGH** |

# Soil Worksheet

**Installation** Shepherd Field ANGB

**Site ID:** AOC 4 **AFFF Release Area #:** AFFF 4

| Contaminant | Maximum Concentration (mg/kg) | Comparison Value (mg/kg) | Ratios |
|---|---|---|---|
| PFOS | 0.000645 | 0.126 | 0.0 |
| PFOA | 0.000632 | 0.126 | 0.0 |
| **CHF Scale** | **CHF Value** | **Contamination Hazard Factor (CHF** | **0.0** |
| **CHF > 100** | **H (High)** | | |
| **100 > CHF > 2** | **M (Medium)** | | |
| **2 > CHF** | **L (Low)** | | |
| **CHF Value** | | **CHF VALUE** | **L** |

$$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$$

| | | |
|---|---|---|
| **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 | M |
| **Confined** | Low possibility for contamination to be present at or migrate to a point of exposure | |
| **Migratory Pathway Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | M |
| **Receptor Factor** | | |
| **Identified** | Receptors identified that have access to contaminated soil | |
| **Potential** | Potential for receptors to have access to contaminated soil | M |
| **Limited** | No potential for receptors to have access to contaminated soil | |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | M |
| | **Soil Category** | **LOW** |

| Site Background Information | | | |
|---|---|---|---|
| **Installation:** | Shepherd Field ANGB | **Date:** | 12/17/2021 |
| **Location (State):** | West Virginia | **Media Evaluated:** | Groundwater, Soil |
| **Site Name and ID:** | AOC 5 - Building 139 - Northeast Fire Department Equipment Testing Area | **Phase of Execution (e.g., RI, Record of Decision (ROD)):** | N/A |
| **RPM's Name:** | Jenna Laube | **Agreement Status (e.g., Federal Facility Agreement date** | N/A |
| **OVERALL SITE CATEGORY: HIGH** | | | |

| Site Summary | |
|---|---|
| **Brief Site Description:** | AOC 5 consists of a low-lying vegetated area just northeast of Building 139. According to base personnel interviewed during the PA, nozzles were tested at this Fire Department Testing Area from at least 1990 to 2008. Nozzles were tested over a fence and onto the low-lying vegetated area. A storm water conveyance ditch nearby appears to flow toward Cold Spring Run. The frequency of the nozzle tests was targeted to be completed quarterly; however, Base personnel indicated that the testing was sporadic. |
| **Brief Description of Pathways:** | Groundwater in Berkeley County occurs in limestone and shale bedrock. The primary water-bearing stratum in the Shepherd Field area is the Beekmantown Limestone. Wells in this formation are generally in the 200-ft. range. Groundwater yield from shale is generally less than that of limestone; however, the depth and yield is generally more dependable -most wells in shale in this area are 100 to 150 ft. deep. Nearby underground tunnels associated with historic limestone mining may serve as preferential pathways for vertical groundwater migration to the bedrock aquifer. Groundwater flow on-top of bedrock is fracture-driven; therefore, PFOS/PFOA migration is dependent on natural bedrock fractures and the degree to which the fractures are interconnected, in addition to the tunnels. Groundwater flow is generally to the east; however, nearby water supply wells are inducing a strong groundwater gradient to the north, in the direction of one or more nearby wells. Surface soils are exposed in grassy areas and bare earth. The area is used to move and stage gravel, sand, and landscaping materials. |
| **Brief Description of Receptors:** | The nearest public water supply well (Big Springs Water Filtration Plant) is approximately one mile hydraulically downgradient (north) from the Base. Another public water supply system (Kilmer Springs Water Filtration Plant) is located approximately four miles north of the Base, also hydraulically downgradient. There have been detections of PFAS in the Big Springs and Kilmer Springs Water Filtration plant. In 2017, a GAC system was installed at Big Springs Water Filtration plant, due to detections of PFOS/PFOA. Two on-base wells were no longer used due to bacterial and arsenic contamination; the well with bacterial contamination was abandoned in 2010; the other was taken off-line but no abandonment record was found. There are seven potable water wells that appeared on a review of the EDR Radius Map™ Report with Geocheck® dated 21 July 2015 located within one mile of the Base. Mr. Steve Knipe of the city of Martinsburg's Water and Sewer Department, indicated there are multiple private potable water wells in the area but the exact number is currently unknown. AOC 5 is located within the base boundary, but is immediately adjacent to an off-base open field. The area is used to move and store gravel, sand and landscaping materials and surface soils would be somewhat accessible to base personnel. |

# Groundwater Worksheet

**Installation** Shepherd Field ANGB

**Site ID:** AOC 5 **AFFF Release Area #:** AFFF 5

| Contaminant | Maximum Concentration (ug/L) | Comparison Value (ug/L) | Ratios |
|---|---|---|---|
| PFOS | 46 | 0.04 | 1150.0 |
| PFOA | 1.01 | 0.04 | 25.2 |
| PFBS | 3.84 | 0.602 | 6.4 |

| CHF Scale | CHF Value | Contamination Hazard Factor (CHF) | 1181.6 |
|---|---|---|---|
| CHF > 100 | H (High) | | |
| 100 > CHF > 2 | M (Medium) | | |
| 2 > CHF | L (Low) | | |

$$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$$

| CHF Value | CHF VALUE | H |
|---|---|---|

## 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) | H |
| **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) | |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | H |
| | **Groundwater Category** | **HIGH** |

# Soil Worksheet

**Installation** Shepherd Field ANGB

**Site ID:** AOC 5 **AFFF Release Area #:** AFFF 5

| Contaminant | Maximum Concentration (mg/kg) | Comparison Value (mg/kg) | Ratios |
|---|---|---|---|
| PFOS | 2.14 | 0.126 | 17.0 |
| PFOA | 0.0081 | 0.126 | 0.1 |
| PFBS | 0.0075 | 1.9 | 0.0 |
| **CHF Scale** | **CHF Value** | **Contamination Hazard Factor (CHF** | **17.1** |
| **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** | **M** |

| | | |
|---|---|---|
| **Migratory Pathway Factor** | | |
| **Evident** | Analytical data or observable evidence that contamination is present at a point of exposure | H |
| **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 | |
| **Migratory Pathway Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | H |
| **Receptor Factor** | | |
| **Identified** | Receptors identified that have access to contaminated soil | |
| **Potential** | Potential for receptors to have access to contaminated soil | M |
| **Limited** | No potential for receptors to have access to contaminated soil | |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | M |
| | **Soil Category** | **HIGH** |

| Site Background Information | | | |
|---|---|---|---|
| **Installation:** | Shepherd Field ANGB | **Date:** | 12/17/2021 |
| **Location (State):** | West Virginia | **Media Evaluated:** | Groundwater, Soil |
| **Site Name and ID:** | AOC 6 - Former Bldg 114 (Old Tower) | **Phase of Execution (e.g., RI, Record of Decision (ROD)):** | N/A |
| **RPM's Name:** | Jenna Laube | **Agreement Status (e.g., Federal Facility Agreement date** | N/A |
| **OVERALL SITE CATEGORY: MEDIUM** | | | |

| Site Summary | |
|---|---|
| **Brief Site Description:** | AOC 6 is the footprint of former Building 114. According to personnel interviewed during the PA, bulk storage of AFFF existed near Building 114 (current Red Ramp) in the 1990s. Also, in the 1990s, there was a release of AFFF to the soil in this area from a storage container. It was estimated that less than 100 gallons was released. There was no special effort made to clean up the spill, and it was allowed to naturally dissipate. When new hangars were constructed in the area from 2007 to 2010, this area was covered by approximately 2 ft. of concrete. |
| **Brief Description of Pathways:** | Groundwater in Berkeley County occurs in limestone and shale bedrock. The primary water-bearing stratum in the Shepherd Field area is the Beekmantown Limestone. Wells in this formation are generally in the 200-ft. range. Groundwater yield from shale is generally less than that of limestone; however, the depth and yield is generally more dependable -most wells in shale in this area are 100 to 150 ft. deep. Nearby underground tunnels associated with historic limestone mining may serve as preferential pathways for vertical groundwater migration to the bedrock aquifer. Groundwater flow on-top of bedrock is fracture-driven; therefore, PFOS/PFOA migration is dependent on natural bedrock fractures and the degree to which the fractures are interconnected, in addition to the tunnels. Groundwater flow is generally to the east; however, nearby water supply wells are inducing a strong groundwater gradient to the north, in the direction of one or more nearby wells. Soils in this AOC are covered by asphalt. |
| **Brief Description of Receptors:** | The nearest public water supply well (Big Springs Water Filtration Plant) is approximately one mile hydraulically downgradient (north) from the Base. Another public water supply system (Kilmer Springs Water Filtration Plant) is located approximately four miles north of the Base, also hydraulically downgradient. There have been detections of PFAS in the Big Springs and Kilmer Springs Water Filtration plant. In 2017, a GAC system was installed at Big Springs Water Filtration plant, due to detections of PFOS/PFOA. Two on-base wells were no longer used due to bacterial and arsenic contamination; the well with bacterial contamination was abandoned in 2010; the other was taken off-line but no abandonment record was found. There are seven potable water wells that appeared on a review of the EDR Radius Map™ Report with Geocheck® dated 21 July 2015 located within one mile of the Base. Mr. Steve Knipe of the city of Martinsburg's Water and Sewer Department, indicated there are multiple private potable water wells in the area but the exact number is currently unknown. AOC 6 is located in an aircraft parking/taxiway area where access to site soils would be restricted. |

# Groundwater Worksheet

**Installation** Shepherd Field ANGB

**Site ID:** AOC 6 **AFFF Release Area #:** AFFF 6

| Contaminant | Maximum Concentration (ug/L) | Comparison Value (ug/L) | Ratios |
|---|---|---|---|
| PFOS | 0.00519 | 0.04 | 0.1 |
| **CHF Scale** | **CHF Value** | **Contamination Hazard Factor (CHF)** | **0.1** |
| **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** | **L** |

| | | |
|---|---|---|
| **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) | H |
| **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) | |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | H |
| | **Groundwater Category** | **MEDIUM** |

# Soil Worksheet

**Installation** Shepherd Field ANGB

**Site ID:** AOC 6 **AFFF Release Area #:** AFFF 6

| Contaminant | Maximum Concentration (mg/kg) | Comparison Value (mg/kg) | Ratios |
|---|---|---|---|
| PFOS | 0.00206 | 0.126 | 0.0 |
| PFOA | 0.000676 | 0.126 | 0.0 |
| **CHF Scale** | **CHF Value** | **Contamination Hazard Factor (CHF** | **0.0** |
| **CHF > 100** | **H (High)** | | |
| **100 > CHF > 2** | **M (Medium)** | | |
| **2 > CHF** | **L (Low)** | | |
| **CHF Value** | | **CHF VALUE** | **L** |

$$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$$

| 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:** | Shepherd Field ANGB | **Date:** | 12/17/2021 |
| **Location (State):** | West Virginia | **Media Evaluated:** | Groundwater, Soil |
| **Site Name and ID:** | AOC 7 - Former Bldg 111 | **Phase of Execution (e.g., RI, Record of Decision (ROD)):** | N/A |
| **RPM's Name:** | Jenna Laube | **Agreement Status (e.g., Federal Facility Agreement date** | N/A |
| **OVERALL SITE CATEGORY: HIGH** | | | |

| Site Summary | |
|---|---|
| **Brief Site Description:** | AOC 7 is the footprint of former Building 111, a former fire department location. Building 111 was constructed in the 1950s and was demolished in 2011. After demolition, the area was regraded. From at least 2002 to 2008, the building was noted as a supply warehouse and sometime prior to 2002, it was the location of the former Base fire department. According to personnel interviewed during the PA, in the 1990s, a P-2 Fire Truck parked on the south side of Former Building 111 leaked approximately 50 gallons of AFFF to the soil in this area. The leak travelled into an open ditch and flowed toward Former Building 110. There was no special effort made to clean up the spill and it was allowed to naturally dissipate. Personnel interviewed were not aware of any other releases of AFFF at Former Building 111. However, fire trucks were historically power washed outside of Former Building 111, and it is possible that if any foam residue existed on the trucks, it could have been washed to the soil. |
| **Brief Description of Pathways:** | Groundwater in Berkeley County occurs in limestone and shale bedrock. The primary water-bearing stratum in the Shepherd Field area is the Beekmantown Limestone. Wells in this formation are generally in the 200-ft. range. Groundwater yield from shale is generally less than that of limestone; however, the depth and yield is generally more dependable -most wells in shale in this area are 100 to 150 ft. deep. Nearby underground tunnels associated with historic limestone mining may serve as preferential pathways for vertical groundwater migration to the bedrock aquifer. Groundwater flow on-top of bedrock is fracture-driven; therefore, PFOS/PFOA migration is dependent on natural bedrock fractures and the degree to which the fractures are interconnected, in addition to the tunnels. Groundwater flow is generally to the east; however, nearby water supply wells are inducing a strong groundwater gradient to the north, in the direction of one or more nearby wells. AOC 7 is a large grassy area with exposed soils. |
| **Brief Description of Receptors:** | The nearest public water supply well (Big Springs Water Filtration Plant) is approximately one mile hydraulically downgradient (north) from the Base. Another public water supply system (Kilmer Springs Water Filtration Plant) is located approximately four miles north of the Base, also hydraulically downgradient. There have been detections of PFAS in the Big Springs and Kilmer Springs Water Filtration plant. In 2017, a GAC system was installed at Big Springs Water Filtration plant, due to detections of PFOS/PFOA. Two on-base wells were no longer used due to bacterial and arsenic contamination; the well with bacterial contamination was abandoned in 2010; the other was taken off-line but no abandonment record was found. There are seven potable water wells that appeared on a review of the EDR Radius Map™ Report with Geocheck® dated 21 July 2015 located within one mile of the Base. Mr. Steve Knipe of the city of Martinsburg's Water and Sewer Department, indicated there are multiple private potable water wells in the area but the exact number is currently unknown. AOC 7 is adjacent to an active taxiway/aircraft parking area and the the main access road to the base where access to site soils would be limited to base personnel. |

# Groundwater Worksheet

**Installation** Shepherd Field ANGB

**Site ID:** AOC 7 **AFFF Release Area #:** AFFF 7

| Contaminant | Maximum Concentration (ug/L) | Comparison Value (ug/L) | Ratios |
|---|---|---|---|
| PFOS | 4.35 | 0.04 | 108.7 |
| PFOA | 1.23 | 0.04 | 30.8 |
| PFBS | 0.114 | 0.602 | 0.2 |

| CHF Scale | CHF Value | Contamination Hazard Factor (CHF) | 139.7 |
|---|---|---|---|
| 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 |

| 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) | H |
| **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) | |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | H |
| | **Groundwater Category** | **HIGH** |

# Soil Worksheet

**Installation** Shepherd Field ANGB

**Site ID:** AOC 7 **AFFF Release Area #:** AFFF 7

| Contaminant | Maximum Concentration (mg/kg) | Comparison Value (mg/kg) | Ratios |
|---|---|---|---|
| PFOS | 0.128 | 0.126 | 1.0 |
| PFOA | 0.0134 | 0.126 | 0.1 |
| PFBS | 0.000549 | 1.9 | 0.0 |
| **CHF Scale** | **CHF Value** | **Contamination Hazard Factor (CHF** | **1.1** |
| **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** | **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 | M |
| **Confined** | Low possibility for contamination to be present at or migrate to a point of exposure | |
| **Migratory Pathway Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | M |
| **Receptor Factor** | | |
| **Identified** | Receptors identified that have access to contaminated soil | |
| **Potential** | Potential for receptors to have access to contaminated soil | M |
| **Limited** | No potential for receptors to have access to contaminated soil | |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | M |
| | **Soil Category** | **LOW** |

| Site Background Information | | | |
|---|---|---|---|
| **Installation:** | Shepherd Field ANGB | **Date:** | 12/17/2021 |
| **Location (State):** | West Virginia | **Media Evaluated:** | Groundwater, Soil |
| **Site Name and ID:** | AOC 8 - Current Fire Department - Bldg 303 | **Phase of Execution (e.g., RI, Record of Decision (ROD)):** | N/A |
| **RPM's Name:** | Jenna Laube | **Agreement Status (e.g., Federal Facility Agreement date** | N/A |
| **OVERALL SITE CATEGORY: MEDIUM** | | | |

| Site Summary | |
|---|---|
| **Brief Site Description:** | AOC 8 consists of Building 303, which houses the current fire station and was constructed in 2009. This is the only building on Base that currently stores AFFF. In addition to the AFFF storage in the four fire department trucks, additional AFFF is stored in 5-gallon containers which are manually loaded into fire trucks equipped with a bayonet system that punctures the container within the fire truck's containment tank. There is no overhead fill system. A series of floor drains within the concrete floor lead to an OWS that appears to drain to an open ditch. While there have been no documented releases of AFFF from this new building, any potential release could flow toward the storm water drainage system. |
| **Brief Description of Pathways:** | Groundwater in Berkeley County occurs in limestone and shale bedrock. The primary water-bearing stratum in the Shepherd Field area is the Beekmantown Limestone. Wells in this formation are generally in the 200-ft. range. Groundwater yield from shale is generally less than that of limestone; however, the depth and yield is generally more dependable -most wells in shale in this area are 100 to 150 ft. deep. Nearby underground tunnels associated with historic limestone mining may serve as preferential pathways for vertical groundwater migration to the bedrock aquifer. Groundwater flow on-top of bedrock is fracture-driven; therefore, PFOS/PFOA migration is dependent on natural bedrock fractures and the degree to which the fractures are interconnected, in addition to the tunnels. Groundwater flow is generally to the east; however, nearby water supply wells are inducing a strong groundwater gradient to the north, in the direction of one or more nearby wells. Surface soils at AOC 8 are located in landscaped grassy areas adjacent to the fire station and an open dirt/grass field. |
| **Brief Description of Receptors:** | The nearest public water supply well (Big Springs Water Filtration Plant) is approximately one mile hydraulically downgradient (north) from the Base. Another public water supply system (Kilmer Springs Water Filtration Plant) is located approximately four miles north of the Base, also hydraulically downgradient. There have been detections of PFAS in the Big Springs and Kilmer Springs Water Filtration plant. In 2017, a GAC system was installed at Big Springs Water Filtration plant, due to detections of PFOS/PFOA. Two on-base wells were no longer used due to bacterial and arsenic contamination; the well with bacterial contamination was abandoned in 2010; the other was taken off-line but no abandonment record was found. There are seven potable water wells that appeared on a review of the EDR Radius Map™ Report with Geocheck® dated 21 July 2015 located within one mile of the Base. Mr. Steve Knipe of the city of Martinsburg's Water and Sewer Department, indicated there are multiple private potable water wells in the area but the exact number is currently unknown. The grassy areas at AOC 8 would have surface soils accessible only to base personnel, fire fighting personnel, and escorted visitors. |

# Groundwater Worksheet

**Installation** Shepherd Field ANGB

**Site ID:** AOC 8 **AFFF Release Area #:** AFFF 8

| Contaminant | Maximum Concentration (ug/L) | Comparison Value (ug/L) | Ratios |
|---|---|---|---|
| PFOS | 0.015 | 0.04 | 0.4 |
| PFBS | 0.00301 | 0.602 | 0.0 |
| **CHF Scale** | **CHF Value** | **Contamination Hazard Factor (CHF)** | **0.4** |
| **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 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) | H |
| **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) | |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | H |
| | **Groundwater Category** | **MEDIUM** |

# Soil Worksheet

**Installation** Shepherd Field ANGB

**Site ID:** AOC 8 **AFFF Release Area #:** AFFF 8

| Contaminant | Maximum Concentration (mg/kg) | Comparison Value (mg/kg) | Ratios |
|---|---|---|---|
| PFOS | 0.082 | 0.126 | 0.7 |
| PFOA | 0.00335 | 0.126 | 0.0 |
| PFBS | 0.00139 | 1.9 | 0.0 |
| **CHF Scale** | **CHF Value** | **Contamination Hazard Factor (CHF** | **0.7** |
| **CHF > 100** | **H (High)** | | |
| **100 > CHF > 2** | **M (Medium)** | $CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$ | |
| **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 | M |
| **Confined** | Low possibility for contamination to be present at or migrate to a point of exposure | |
| **Migratory Pathway Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | M |
| **Receptor Factor** | | |
| **Identified** | Receptors identified that have access to contaminated soil | |
| **Potential** | Potential for receptors to have access to contaminated soil | M |
| **Limited** | No potential for receptors to have access to contaminated soil | |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | M |
| | **Soil Category** | **LOW** |

| Site Background Information | | | |
|---|---|---|---|
| **Installation:** | Shepherd Field ANGB | **Date:** | 12/17/2021 |
| **Location (State):** | West Virginia | **Media Evaluated:** | Groundwater, Soil |
| **Site Name and ID:** | AOC 9 - Former Fire Department - Building 140 | **Phase of Execution (e.g., RI, Record of Decision (ROD)):** | N/A |
| **RPM's Name:** | Jenna Laube | **Agreement Status (e.g., Federal Facility Agreement date** | N/A |
| **OVERALL SITE CATEGORY: HIGH** | | | |

| Site Summary | |
|---|---|
| **Brief Site Description:** | AOC 9 consists of Building 140, a former fire department location. Building 140 was constructed in the 1990s and served as the former fire department building for an unknown timeframe. There was no AFFF storage at Building 140, with the exception of what was stored on the fire department trucks. However, fire department vehicles were power-washed inside Building 140. Any foam on the vehicle would have flowed into a floor drain and then to an OWS which connected to the Base WWTP prior to 2007. The WWTP was demolished in 2007 and the sanitary sewer connected to the city of Shepherd Field. Building 140 is currently used as the new aerospace ground equipment building. |
| **Brief Description of Pathways:** | Groundwater in Berkeley County occurs in limestone and shale bedrock. The primary water-bearing stratum in the Shepherd Field area is the Beekmantown Limestone. Wells in this formation are generally in the 200-ft. range. Groundwater yield from shale is generally less than that of limestone; however, the depth and yield is generally more dependable -most wells in shale in this area are 100 to 150 ft. deep. Nearby underground tunnels associated with historic limestone mining may serve as preferential pathways for vertical groundwater migration to the bedrock aquifer. Groundwater flow on-top of bedrock is fracture-driven; therefore, PFOS/PFOA migration is dependent on natural bedrock fractures and the degree to which the fractures are interconnected, in addition to the tunnels. Groundwater flow is generally to the east; however, nearby water supply wells are inducing a strong groundwater gradient to the north, in the direction of one or more nearby wells. Surface soils at AOC 9 are exposed in grassy landscaped areas adjacent to Building 140. |
| **Brief Description of Receptors:** | The nearest public water supply well (Big Springs Water Filtration Plant) is approximately one mile hydraulically downgradient (north) from the Base. Another public water supply system (Kilmer Springs Water Filtration Plant) is located approximately four miles north of the Base, also hydraulically downgradient. There have been detections of PFAS in the Big Springs and Kilmer Springs Water Filtration plant. In 2017, a GAC system was installed at Big Springs Water Filtration plant, due to detections of PFOS/PFOA. Two on-base wells were no longer used due to bacterial and arsenic contamination; the well with bacterial contamination was abandoned in 2010; the other was taken off-line but no abandonment record was found. There are seven potable water wells that appeared on a review of the EDR Radius Map™ Report with Geocheck® dated 21 July 2015 located within one mile of the Base. Mr. Steve Knipe of the city of Martinsburg's Water and Sewer Department, indicated there are multiple private potable water wells in the area but the exact number is currently unknown. AOC 9 is located within a gated area, where surface soils would be accessible only to base personnel. |

# Groundwater Worksheet

**Installation** Shepherd Field ANGB

**Site ID:** AOC 9 **AFFF Release Area #:** AFFF 9

| Contaminant | Maximum Concentration (ug/L) | Comparison Value (ug/L) | Ratios |
|---|---|---|---|
| PFOS | 0.297 | 0.04 | 7.4 |
| PFOA | 0.1 | 0.04 | 2.5 |
| PFBS | 0.0186 | 0.602 | 0.0 |

| CHF Scale | CHF Value | Contamination Hazard Factor (CHF) | 10.0 |
|---|---|---|---|
| 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 | 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) | H |
| **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) | |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | H |
| | **Groundwater Category** | **HIGH** |

# Soil Worksheet

**Installation** Shepherd Field ANGB

**Site ID:** AOC 9 **AFFF Release Area #:** AFFF 9

| Contaminant | Maximum Concentration (mg/kg) | Comparison Value (mg/kg) | Ratios |
|---|---|---|---|
| PFOS | 0.114 | 0.126 | 0.9 |
| PFOA | 0.00489 | 0.126 | 0.0 |
| **CHF Scale** | **CHF Value** | **Contamination Hazard Factor (CHF** | **0.9** |
| **CHF > 100** | **H (High)** | | |
| **100 > CHF > 2** | **M (Medium)** | | |
| **2 > CHF** | **L (Low)** | | |
| **CHF Value** | | **CHF VALUE** | **L** |

$$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$$

| | | |
|---|---|---|
| **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 | M |
| **Confined** | Low possibility for contamination to be present at or migrate to a point of exposure | |
| **Migratory Pathway Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | M |
| **Receptor Factor** | | |
| **Identified** | Receptors identified that have access to contaminated soil | |
| **Potential** | Potential for receptors to have access to contaminated soil | M |
| **Limited** | No potential for receptors to have access to contaminated soil | |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | M |
| | **Soil Category** | **LOW** |

| Site Background Information | | | |
|---|---|---|---|
| **Installation:** | Shepherd Field ANGB | **Date:** | 12/17/2021 |
| **Location (State):** | West Virginia | **Media Evaluated:** | Groundwater, Soil |
| **Site Name and ID:** | AOC 10 - Former WWTP | **Phase of Execution (e.g., RI, Record of Decision (ROD)):** | N/A |
| **RPM's Name:** | Jenna Laube | **Agreement Status (e.g., Federal Facility Agreement date** | N/A |
| **OVERALL SITE CATEGORY: HIGH** | | | |

| Site Summary | |
|---|---|
| **Brief Site Description:** | AOC 10 consists of the former WWTP. The former WWTP was constructed in the 1950s and demolished in 2007. Base sanitary sewer lines (including from hangars and fire stations) drained to the WWTP. The WWTP consisted of a wet well (underground pit), flow splitter box, clarifier, sand filters, chlorine contact tank, and a dechlorination tank before discharge. The effluent discharged to an open grass-lined ditch that drains toward Cold Spring Run. Any discharges of AFFF into the sanitary sewer prior to 2007 from hangars or fire stations would have been treated through this system and discharged to this open ditch. There is no documentation that AFFF discharged to the sanitary sewer had leaked out along the old sewer lines. However, the integrity of the sewer conveyance pipes at the time of the WWTP operation is unknown. |
| **Brief Description of Pathways:** | Groundwater in Berkeley County occurs in limestone and shale bedrock. The primary water-bearing stratum in the Shepherd Field area is the Beekmantown Limestone. Wells in this formation are generally in the 200-ft. range. Groundwater yield from shale is generally less than that of limestone; however, the depth and yield is generally more dependable -most wells in shale in this area are 100 to 150 ft. deep. Nearby underground tunnels associated with historic limestone mining may serve as preferential pathways for vertical groundwater migration to the bedrock aquifer. Groundwater flow on-top of bedrock is fracture-driven; therefore, PFOS/PFOA migration is dependent on natural bedrock fractures and the degree to which the fractures are interconnected, in addition to the tunnels. Groundwater flow is generally to the east; however, nearby water supply wells are inducing a strong groundwater gradient to the north, in the direction of one or more nearby wells. Soils at AOC 10 are exposed and are found in large grassy areas. |
| **Brief Description of Receptors:** | The nearest public water supply well (Big Springs Water Filtration Plant) is approximately one mile hydraulically downgradient (north) from the Base. Another public water supply system (Kilmer Springs Water Filtration Plant) is located approximately four miles north of the Base, also hydraulically downgradient. There have been detections of PFAS in the Big Springs and Kilmer Springs Water Filtration plant. In 2017, a GAC system was installed at Big Springs Water Filtration plant, due to detections of PFOS/PFOA. Two on-base wells were no longer used due to bacterial and arsenic contamination; the well with bacterial contamination was abandoned in 2010; the other was taken off-line but no abandonment record was found. There are seven potable water wells that appeared on a review of the EDR Radius Map™ Report with Geocheck® dated 21 July 2015 located within one mile of the Base. Mr. Steve Knipe of the city of Martinsburg's Water and Sewer Department, indicated there are multiple private potable water wells in the area but the exact number is currently unknown. AOC 10 is accessible to base personnel only therefore, access to surface soils would be limited. |

# Groundwater Worksheet

**Installation:** Shepherd Field ANGB

**Site ID:** AOC 10 **AFFF Release Area #:** AFFF 10

| Contaminant | Maximum Concentration (ug/L) | Comparison Value (ug/L) | Ratios |
|---|---|---|---|
| PFOS | 0.91 | 0.04 | 22.8 |
| PFOA | 0.043 | 0.04 | 1.1 |
| PFBS | 0.049 | 0.602 | 0.1 |

| CHF Scale | CHF Value | Contamination Hazard Factor (CHF) | 23.9 |
|---|---|---|---|
| CHF > 100 | H (High) | | |
| 100 > CHF > 2 | M (Medium) | | |
| 2 > CHF | L (Low) | | |

$$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$$

| 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) | H |
| **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) | |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | H |
| | **Groundwater Category** | **HIGH** |

# Soil Worksheet

**Installation** Shepherd Field ANGB

**Site ID:** AOC 10 **AFFF Release Area #:** AFFF 10

| Contaminant | Maximum Concentration (mg/kg) | Comparison Value (mg/kg) | Ratios |
|---|---|---|---|
| PFOS | 0.0436 | 0.126 | 0.3 |
| PFOA | 0.00191 | 0.126 | 0.0 |
| PFBS | 0.000362 | 1.9 | 0.0 |

| CHF Scale | CHF Value | Contamination Hazard Factor (CHF | 0.4 |
|---|---|---|---|
| CHF > 100 | H (High) | | |
| 100 > CHF > 2 | M (Medium) | | |
| 2 > CHF | L (Low) | | |
| CHF Value | | CHF VALUE | L |

$$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$$

| 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 | M |
| **Confined** | Low possibility for contamination to be present at or migrate to a point of exposure | |
| **Migratory Pathway Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | M |

| Receptor Factor | | |
|---|---|---|
| **Identified** | Receptors identified that have access to contaminated soil | |
| **Potential** | Potential for receptors to have access to contaminated soil | M |
| **Limited** | No potential for receptors to have access to contaminated soil | |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | M |
| | **Soil Category** | **LOW** |

| Site Background Information | | | |
|---|---|---|---|
| **Installation:** | Shepherd Field ANGB | **Date:** | 12/17/2021 |
| **Location (State):** | West Virginia | **Media Evaluated:** | Groundwater |
| **Site Name and ID:** | AOC 11 - West Stormwater Pond (North) | **Phase of Execution (e.g., RI, Record of Decision (ROD)):** | N/A |
| **RPM's Name:** | Jenna Laube | **Agreement Status (e.g., Federal Facility Agreement date** | N/A |
| **OVERALL SITE CATEGORY: HIGH** | | | |

| Site Summary | |
|---|---|
| **Brief Site Description:** | AOC 11 is the northern storm water retention pond on the western portion of the Base, where there are two ponds present. The PA indicated they were constructed in late 2006 – early 2007 AOCAOCAOCAOC 11 receives storm water from the second pond and discharges off-Base via an unnamed grass and rip rap rock-lined drainage ditch to the west. Residential development is directly to the west of AOC 11. |
| **Brief Description of Pathways:** | Groundwater in Berkeley County occurs in limestone and shale bedrock. The primary water-bearing stratum in the Shepherd Field area is the Beekmantown Limestone. Wells in this formation are generally in the 200-ft. range. Groundwater yield from shale is generally less than that of limestone; however, the depth and yield is generally more dependable -most wells in shale in this area are 100 to 150 ft. deep. Nearby underground tunnels associated with historic limestone mining may serve as preferential pathways for vertical groundwater migration to the bedrock aquifer. Groundwater flow on-top of bedrock is fracture-driven; therefore, PFOS/PFOA migration is dependent on natural bedrock fractures and the degree to which the fractures are interconnected, in addition to the tunnels. Groundwater flow is generally to the east; however, nearby water supply wells are inducing a strong groundwater gradient to the north, in the direction of one or more nearby wells. Soils at AOC 11 are exposed and are found in large grassy areas. |
| **Brief Description of Receptors:** | The nearest public water supply well (Big Springs Water Filtration Plant) is approximately one mile hydraulically downgradient (north) from the Base. Another public water supply system (Kilmer Springs Water Filtration Plant) is located approximately four miles north of the Base, also hydraulically downgradient. There have been detections of PFAS in the Big Springs and Kilmer Springs Water Filtration plant. In 2017, a GAC system was installed at Big Springs Water Filtration plant, due to detections of PFOS/PFOA. Two on-base wells were no longer used due to bacterial and arsenic contamination; the well with bacterial contamination was abandoned in 2010; the other was taken off-line but no abandonment record was found. There are seven potable water wells that appeared on a review of the EDR Radius Map™ Report with Geocheck® dated 21 July 2015 located within one mile of the Base. Mr. Steve Knipe of the city of Martinsburg's Water and Sewer Department, indicated there are multiple private potable water wells in the area but the exact number is currently unknown. AOC 11 is within the fenced boundary and surface soils would be accessible to base personnel or visitors only. |

# Groundwater Worksheet

**Installation** Shepherd Field ANGB

**Site ID:** AOC 11 **AFFF Release Area #:** AFFF 11

| Contaminant | Maximum Concentration (ug/L) | Comparison Value (ug/L) | Ratios |
|---|---|---|---|
| PFBS | 0.0044 | 0.602 | 0.0 |
| PFOS | 0.12 | 0.04 | 3.0 |
| PFOA | 0.11 | 0.04 | 2.7 |

| CHF Scale | CHF Value | Contamination Hazard Factor (CHF) | 5.8 |
|---|---|---|---|
| CHF > 100 | H (High) | | |
| 100 > CHF > 2 | M (Medium) | | |
| 2 > CHF | L (Low) | | |

$$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$$

| 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) | H |
| **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) | |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | H |
| | **Groundwater Category** | **HIGH** |

| Site Background Information | | | |
|---|---|---|---|
| **Installation:** | Shepherd Field ANGB | **Date:** | 12/17/2021 |
| **Location (State):** | West Virginia | **Media Evaluated:** | Groundwater |
| **Site Name and ID:** | AOC 12 - West Stormwater Pond (South) | **Phase of Execution (e.g., RI, Record of Decision (ROD)):** | N/A |
| **RPM's Name:** | Jenna Laube | **Agreement Status (e.g., Federal Facility Agreement date** | N/A |
| **OVERALL SITE CATEGORY: HIGH** | | | |

| Site Summary | |
|---|---|
| **Brief Site Description:** | AOC 12 is the southern storm water retention pond on the western portion of the Base, where there are two ponds present. The PA indicated they were constructed in late 2006 – early 2007AOC. AOC 12 drains to AOC 11 before discharging off-Base via an unnamed grass and rip rap rock-lined drainage ditch to the west. |
| **Brief Description of Pathways:** | Groundwater in Berkeley County occurs in limestone and shale bedrock. The primary water-bearing stratum in the Shepherd Field area is the Beekmantown Limestone. Wells in this formation are generally in the 200-ft. range. Groundwater yield from shale is generally less than that of limestone; however, the depth and yield is generally more dependable -most wells in shale in this area are 100 to 150 ft. deep. Nearby underground tunnels associated with historic limestone mining may serve as preferential pathways for vertical groundwater migration to the bedrock aquifer. Groundwater flow on-top of bedrock is fracture-driven; therefore, PFOS/PFOA migration is dependent on natural bedrock fractures and the degree to which the fractures are interconnected, in addition to the tunnels. Groundwater flow is generally to the east; however, nearby water supply wells are inducing a strong groundwater gradient to the north, in the direction of one or more nearby wells. Soils at AOC 12 are exposed and are found in large grassy areas. |
| **Brief Description of Receptors:** | The nearest public water supply well (Big Springs Water Filtration Plant) is approximately one mile hydraulically downgradient (north) from the Base. Another public water supply system (Kilmer Springs Water Filtration Plant) is located approximately four miles north of the Base, also hydraulically downgradient. There have been detections of PFAS in the Big Springs and Kilmer Springs Water Filtration plant. In 2017, a GAC system was installed at Big Springs Water Filtration plant, due to detections of PFOS/PFOA. Two on-base wells were no longer used due to bacterial and arsenic contamination; the well with bacterial contamination was abandoned in 2010; the other was taken off-line but no abandonment record was found. There are seven potable water wells that appeared on a review of the EDR Radius Map™ Report with Geocheck® dated 21 July 2015 located within one mile of the Base. Mr. Steve Knipe of the city of Martinsburg's Water and Sewer Department, indicated there are multiple private potable water wells in the area but the exact number is currently unknown. AOC 12 is within the base boundary and surface soils would be accessible to base personnel or visitors only. |

# Groundwater Worksheet

**Installation** Shepherd Field ANGB

**Site ID:** AOC 12 **AFFF Release Area #:** AFFF 12

| Contaminant | Maximum Concentration (ug/L) | Comparison Value (ug/L) | Ratios |
|---|---|---|---|
| PFBS | 0.0044 | 0.602 | 0.0 |
| PFOS | 0.12 | 0.04 | 3.0 |
| PFOA | 0.11 | 0.04 | 2.7 |

| CHF Scale | CHF Value | Contamination Hazard Factor (CHF) | 5.8 |
|---|---|---|---|
| CHF > 100 | H (High) | | |
| 100 > CHF > 2 | M (Medium) | | |
| 2 > CHF | L (Low) | | |

$$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$$

| 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) | H |
| **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) | |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | H |
| | **Groundwater Category** | **HIGH** |