RELATIVE RISK SITE EVALUATION

Duluth Air National Guard Base, Minnesota

Introduction

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

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

The Duluth Air National Guard Base (ANGB) PFAS PA and SI can be found at the Air Force Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Administrative Record (AR): https://ar.afcec-cloud.af.mil/ Scroll to the bottom of the page and click on “Continue to site”, then select Air National Guard (e.g., Active, ANG, BRAC), scroll down the Installation List and click on Duluth Int Airport, MN, then enter the AR Number 469004 in the “AR #” field for the PA. For the SI, enter the AR Number 587482. Then click “Search” at the bottom of the page. Click on the spy glass to view the document.

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

Acronyms

AFFF - Aqueous Film Forming Foam

AST – Aboveground Storage Tank

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act

CHF – Contaminant Hazard Factor

DoD - Department of Defense

EPA – US Environmental Protection Agency

FTA – Fire Training Area

HA – Health Advisory

MPF – Migration Pathway Factor

PA – Preliminary Assessment

PFAS - Per-and polyfluoroalkyl substances

PFBS – Perfluorobutanesulfonic acid

PFOS - Perfluorooctane sulfonate

PFOA - Perfluorooctanoic acid

RCRA – Resource Conservation and Recovery Act

RF – Receptor Factor

RI – Remedial Investigation

RRSE – Relative Risk Site Evaluation

PRL - Potential Release Location

SI – Site Inspection

SWMU – Solid Waste Management Unit

RELATIVE RISK SITE EVALUATION, cont.

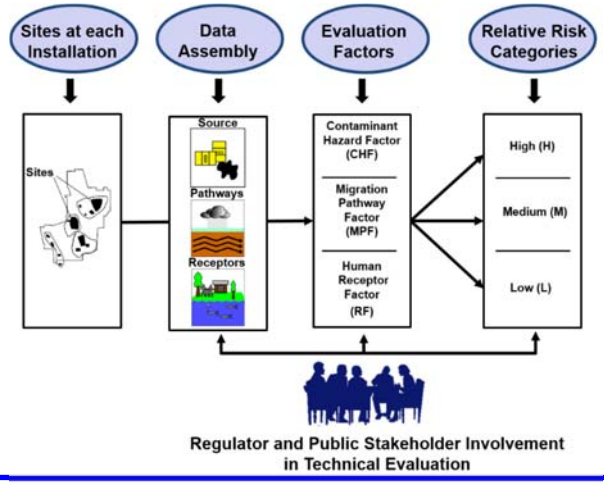
Q. What is the Relative Risk Site Evaluation (RRSE)?

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 fig-ure) 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.

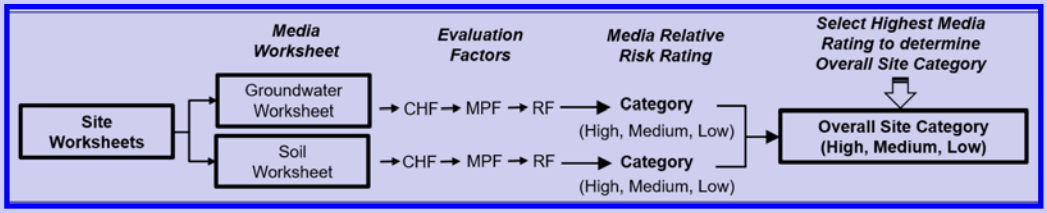
Relative Risk Site Evaluation Concept Summary



Sites at Each Installation

. 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.

. 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
Jim King NGB/A4VR
240-612-8763
james.king.45@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**.

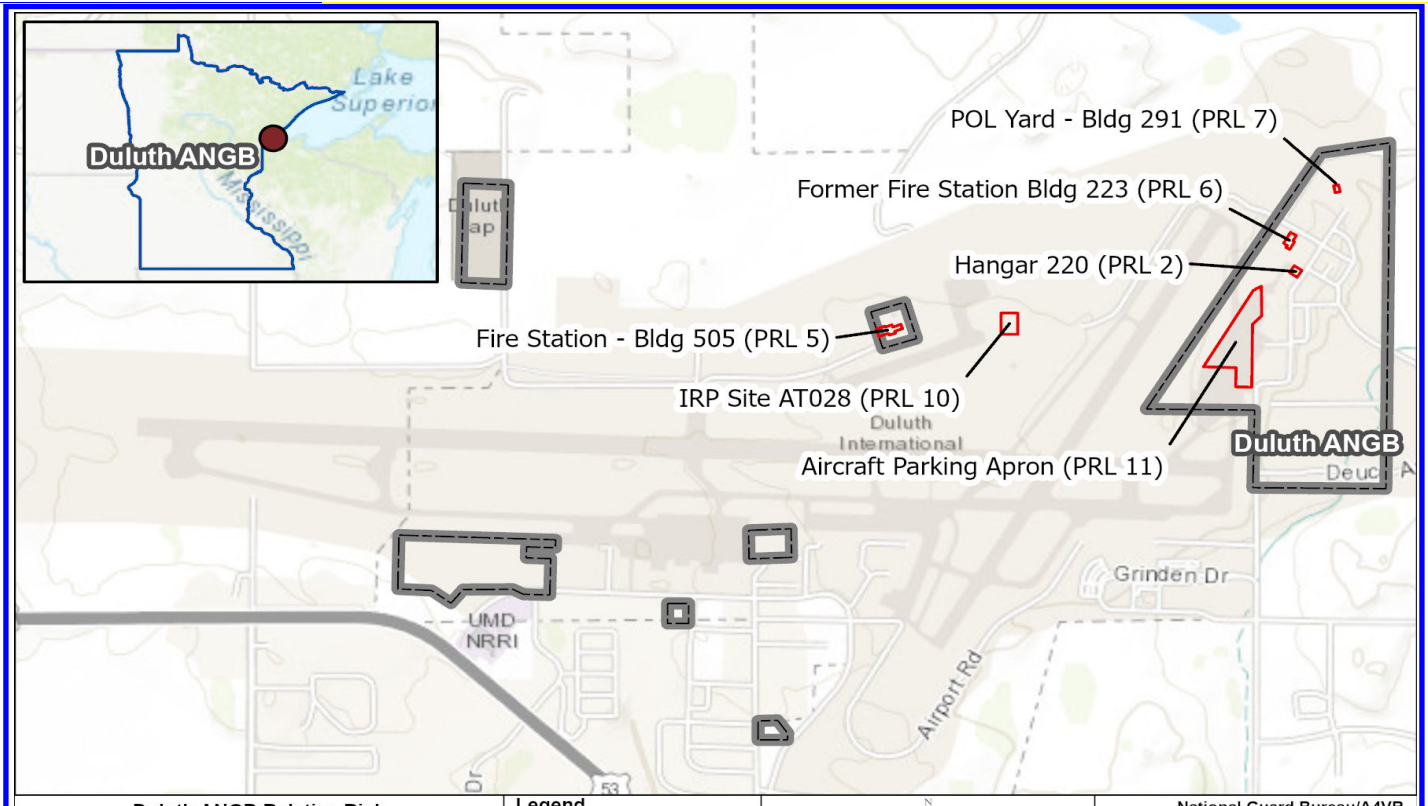
Regulatory and Stakeholder Involvement

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 Duluth ANGB, MN

Overall Site Category	Site Name (Sites are shown on the map below and RRSE Worksheets are attached)
HIGH	PRL 5, PRL 6, PRL 7, PRL 10, PRL 11
MEDIUM	PRL 2
LOW	



AFFF Area is another term for Potential Release Location (PRL)

Site Background Information			
Installation:	Duluth ANGB	**Date:**	9/22/2021
Location (State):	Minnesota	**Media Evaluated:**	Groundwater, Soil
Site Name and ID:	Hangar 220 - PRL 2	**Phase of Execution (e.g., RI, Record of Decision (ROD)):**	N/A
RPM's Name:	Jim King	**Agreement Status (e.g., Federal Facility Agreement date signed):**	N A
OVERALL SITE CATEGORY: MEDIUM			

Site Summary	
Brief Site Description:	Hangar 220 was comprised of three maintenance hangars. One of the hangars contained an aqueous film forming foam (AFFF) fire suppression system (FSS) with a secondary containment system. Two other hangars contained high expansion foam (HEF) systems. At that time, the mechanical room was located on the northeast side of the hangar, where a 200-gallon Aboveground Storage Tank (AST) containing 3% AFFF resided. A pipe system supplied AFFF from the mechanical room to the corrosion maintenance bay wherein overhead and underwing cannon AFFF delivery points were located. The floor drains within the corrosion maintenance bay connected to an Oil Water Separator (OWS) that was designed to capture any release of AFFF. The outflow from the OWS discharged to a municipal sanitary sewer system. According to 2015 Preliminary Assessment (PA) Report, in 2005 the AFFF FSS was tripped in the corrosion maintenance bay due to an equipment malfunction and an unknown amount of AFFF was discharged. Any foam was likely captured within the containment system and would not have flowed out of the hangar due to the drain system within the corrosion maintenance bay. According to 2015 PA Report, there was no evidence that a release to the environment occurred. The aircraft component maintenance hangar was equipped with high-expansion foam. Surface soil, subsurface soil and groundwater samples were collected during the Site Inspection (SI).
Brief Description of Pathways:	Two distinct hydrogeologic units were identified beneath the site. These include glacial drift and consolidated rock aquifers. groundwater within the glacial drift aquifer ranges from 3 to 25 feet (ft) below ground surface (bgs) and groundwater within the consolidated rock aquifer ranges from 10 to 30 ft bgs. Groundwater beneath the Duluth ANGB flows in a similar direction as the surface water, towards the southeast. A divide is located off-base in the vicinity of Runway 9-27 at the airport where the groundwater flow direction changes towards the northeast. Groundwater at PRL 2 was encountered at 16 ft bgs. The majority of the base is paved with storm drains and sloped pavement to control surface runoff. Adjoining areas have grass covered landscaping with drainage ditches to control surface runoff. in general flows to the southeast towards Lake Superior via Miller Creek. Surface runoff, to the west of Duluth ANGB, enters a manmade stormwater drainage system, which discharges into a large detention basin pond, which discharges to Beaver Creek, a tributary of Wild Rice Lake.
Brief Description of Receptors:	Nearby communities use water supplied by the City of Duluth, which is drawn from Lake Superior. Individual domestic or agricultural consumers located in isolated areas tend to rely on small capacity glacial drift wells, or deep low producing bedrock wells with sufficient open hole storage to provide adequate water supply. These deep bedrock wells often recharge with a significant amount of water derived from the shallow overlying glacial drift aquifer, which is recharged from infiltration and surface water. There are 60 groundwater wells within a 4-mile radius of the site. Sampling in 2010 indicated that three of 13 domestic wells had detections of per- and polyfluoroalkyl substances (PFAS). Exposure to surface and sub-surface soils may occur during routine activities or excavation activities. Surface water runoff from the base discharging to nearby surface water bodies is a potentially complete exposure pathway (e.g., Miller Creek, the large detention basin pond, Beaver Creek, Wild Rice Lake, or Lake Superior). Miller Creek is classified by the state for beneficial use for domestic consumption, and as such is protected for drinking water use. The surface water within Miller Creek is subject to water quality standards equivalent to those of drinking water standards, and therefore, drinking water regulations apply.

Groundwater Worksheet

Installation: Duluth ANGB

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

Contaminant	Maximum Concentration (ug/L)	Comparison Value (ug/L)	Ratios
PFOS	0.0085	0.04	0.2
PFOA	0.028	0.04	0.7
PFBS	0.034	0.602	0.1

CHF Scale	CHF Value	Contamination Hazard Factor (CHF)	1.0
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	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: Duluth ANGB

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

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
PFOS	0.0079	0.126	0.1
PFOA	0.00027	0.126	0.0
CHF Scale	**CHF Value**	**Contamination Hazard Factor (CHF)**	**0.1**
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	
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:	Duluth ANGB	**Date:**	9/22/2021
Location (State):	Minnesota	**Media Evaluated:**	Groundwater, Soil
Site Name and ID:	Building 505 (Fire Station) - PRL 5	**Phase of Execution (e.g., RI, Record of Decision (ROD)):**	N/A
RPM's Name:	Jim King	**Agreement Status (e.g., Federal Facility Agreement date signed):**	N A
OVERALL SITE CATEGORY: HIGH			

Site Summary	
Brief Site Description:	The Fire Station - Building 505 services the entire Duluth International Airport (DIA) and Duluth ANGB, and is located within the Duluth ANGB, although located on a separate parcel on the northwest side of the runway. As stated in the 2015 PA Report, Building 505 was comprised of two large vehicle and maintenance bays on either side of administrative and residential areas. The truck tanks were filled with AFFF within the bays of Building 505, using 5-gallon buckets. All of the concentrated AFFF for Duluth ANGB was stored in 5-gallon containers in one central location in the eastern vehicle and maintenance bay of Building 505. The 2015 PA Report stated that no spillage during filling or storage operations occurred however, the floor drains within the bays would capture any potential undocumented spills. The floor drains connect to the building s OWS, which is located adjacent to the fire station and flows to the municipal sanitary sewer system. According to the 2015 PA Report, there were no recent spray tests with AFFF.
Brief Description of Pathways:	Two distinct hydrogeologic units were identified beneath the site. These include glacial drift and consolidated rock aquifers. groundwater within the glacial drift aquifer ranges from 3 to 25 ft bgs and groundwater within the consolidated rock aquifer ranges from 10 to 30 ft bgs. Groundwater beneath the Duluth ANGB flows in a similar direction as the surface water, towards the southeast. A divide is located off-base in the vicinity of Runway 9-27 at the airport where the groundwater flow direction changes towards the northeast. Groundwater at PRL 5 was encountered at 15 ft bgs. The majority of the base is paved with storm drains and sloped pavement to control surface runoff. Adjoining areas have grass covered landscaping with drainage ditches to control surface runoff. in general flows to the southeast towards Lake Superior via Miller Creek. Surface runoff, to the west of Duluth ANGB, enters a manmade stormwater drainage system, which discharges into a large detention basin pond, which discharges to Beaver Creek, a tributary of Wild Rice Lake.
Brief Description of Receptors:	Nearby communities use water supplied by the City of Duluth, which is drawn from Lake Superior. Individual domestic or agricultural consumers located in isolated areas tend to rely on small capacity glacial drift wells, or deep low producing bedrock wells with sufficient open hole storage to provide adequate water supply. These deep bedrock wells often recharge with a significant amount of water derived from the shallow overlying glacial drift aquifer, which is recharged from infiltration and surface water. There are 60 groundwater wells within a 4-mile radius of the site. Sampling in 2010 indicated that three of 13 domestic wells had detections of PFAS. Exposure to surface and sub-surface soils may occur during routine activities or excavation activities. Surface water runoff from the base discharging to nearby surface water bodies is a potentially complete exposure pathway (e.g., Miller Creek, the large detention basin pond, Beaver Creek, Wild Rice Lake, or Lake Superior). Miller Creek is classified by the state for beneficial use for domestic consumption, and as such is protected for drinking water use. The surface water within Miller Creek is subject to water quality standards equivalent to those of drinking water standards, and therefore, drinking water regulations apply.

Groundwater Worksheet

Installation: Duluth ANGB

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

Contaminant	Maximum Concentration (ug/L)	Comparison Value (ug/L)	Ratios
PFOS	0.16	0.04	4.0
PFOA	0.018	0.04	0.4
PFBS	0.084	0.602	0.1

CHF Scale	CHF Value	Contamination Hazard Factor (CHF)	4.6
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	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)	H
Potential	Contamination in the groundwater has moved beyond the source or insufficient information available to make a determination of Evident or Confined	
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).	H

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: Duluth ANGB

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

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
PFOS	0.03	0.126	0.2
PFOA	0.00085	0.126	0.0
CHF Scale	**CHF Value**	**Contamination Hazard Factor (CHF)**	**0.2**
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CHF Value		**CHF VALUE**	**L**

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:	Duluth ANGB	**Date:**	9/22/2021
Location (State):	Minnesota	**Media Evaluated:**	Groundwater, Soil
Site Name and ID:	Former Fire STA BLD 223 - PRL 6	**Phase of Execution (e.g., RI, Record of Decision (ROD)):**	N/A
RPM's Name:	Jim King	**Agreement Status (e.g., Federal Facility Agreement date signed):**	N A
OVERALL SITE CATEGORY: HIGH			

Site Summary	
Brief Site Description:	The Former Fire Station - Building 223 was the fire station for Duluth ANGB until 2005 when it was replaced by Fire Station - Building 505 (PRL 5). Former Fire Station- Building 223 is currently a Jet Engine Maintenance Facility. According to the 2015 PA Report, fire trucks operated out of Building 223 and were filled with AFFF within the building bays from 400-gallon steel ASTs. No spillage was reported from past filling or storage operations, but floor drains within the bays would have captured any potential spillage. The floor drains connect to the building s OWS, which flows from the OWS to the municipal sanitary sewer system. The 2016 PA Letter Report recommended further investigation because of the historic use of AFFF at this PRL.
Brief Description of Pathways:	Two distinct hydrogeologic units were identified beneath the site. These include glacial drift and consolidated rock aquifers. groundwater within the glacial drift aquifer ranges from 3 to 25 ft bgs and groundwater within the consolidated rock aquifer ranges from 10 to 30 ft bgs. Groundwater beneath the Duluth ANGB flows in a similar direction as the surface water, towards the southeast. A divide is located off-base in the vicinity of Runway 9-27 at the airport where the groundwater flow direction changes towards the northeast. Groundwater at PRL 6 was encountered at 16 ft bgs. Depth to groundwater was encountered at 2.9 feet bgs at PRL 6 during the SI. Groundwater flow is to the east-southeast at PRL 6. The majority of the base is paved with storm drains and sloped pavement to control drainage. Adjoining areas have grass covered landscaping with drainage ditches to control runoff. Surface water runoff from the vast majority of Duluth ANGB flows southeast towards Lake Superior via Miller Creek. Surface water does recharge the shallow and rock aquifers in the vicinity of the site.
Brief Description of Receptors:	Nearby communities use water supplied by the City of Duluth, which is drawn from Lake Superior. Individual domestic or agricultural consumers located in isolated areas tend to rely on small capacity glacial drift wells, or deep low producing bedrock wells with sufficient open hole storage to provide adequate water supply. These deep bedrock wells often recharge with a significant amount of water derived from the shallow overlying glacial drift aquifer, which is recharged from infiltration and surface water. There are 60 groundwater wells within a 4-mile radius of the site. Sampling in 2010 indicated that three of 13 domestic wells had detections of PFAS. Exposure to surface and sub-surface soils may occur during routine activities or excavation activities. Surface water runoff from the base discharging to nearby surface water bodies is a potentially complete exposure pathway (e.g., Miller Creek, the large detention basin pond, Beaver Creek, Wild Rice Lake, or Lake Superior). Miller Creek is classified by the state for beneficial use for domestic consumption, and as such is protected for drinking water use. The surface water within Miller Creek is subject to water quality standards equivalent to those of drinking water standards, and therefore, drinking water regulations apply.

Groundwater Worksheet

Installation: Duluth ANGB

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

Contaminant	Maximum Concentration (ug/L)	Comparison Value (ug/L)	Ratios
PFOS	0.78	0.04	19.5
PFOA	0.067	0.04	1.7
PFBS	0.1	0.602	0.2

CHF Scale	CHF Value	Contamination Hazard Factor (CHF)	21.3
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)	H
Potential	Contamination in the groundwater has moved beyond the source or insufficient information available to make a determination of Evident or Confined	
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).	H

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: Duluth ANGB

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

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
PFOS	0.046	0.126	0.4
PFOA	0.00041	0.126	0.0
PFBS	0.0004	1.9	0.0

CHF Scale	CHF Value	Contamination Hazard Factor (CHF)	0.4
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:	Duluth ANGB	**Date:**	9/22/2021
Location (State):	Minnesota	**Media Evaluated:**	Groundwater, Soil
Site Name and ID:	POL Yard - Building 291 - PRL 7	**Phase of Execution (e.g., RI, Record of Decision (ROD)):**	N/A
RPM's Name:	Jim King	**Agreement Status (e.g., Federal Facility Agreement date signed):**	N A
OVERALL SITE CATEGORY: HIGH			

Site Summary	
Brief Site Description:	The Petroleum, Oils, and Lubricants (POL) Yard, including Building 291, was constructed in 2011. A Fire suppression system was installed in the mechanical room in Building 291 and also functioned in a bay utili ed for storage of fuel trucks and another storage room for non-fuel materials. AFFF is supplied from a 200-gallon AST, installed in the building, through overhead delivery pipes. According to the 2015 PA Report, the fire suppression system was activated for testing purposes following installation however, the AFFF was captured in tanks and no AFFF reached the floor of the building. The 2015 PA Report also stated that the AFFF system is occasionally tested however, the testing is controlled and no releases of AFFF to the environment were reported. Floor drains within building are connected to an OWS that is designed to capture any release of AFFF. The outflow from the OWS discharges to a municipal sanitary sewer system.
Brief Description of Pathways:	Two distinct hydrogeologic units were identified beneath the site. These include glacial drift and consolidated rock aquifers. groundwater within the glacial drift aquifer ranges from 3 to 25 ft bgs and groundwater within the consolidated rock aquifer ranges from 10 to 30 ft bgs. Groundwater beneath the Duluth ANGB flows in a similar direction as the surface water, towards the southeast. A divide is located off-base in the vicinity of Runway 9-27 at the airport where the groundwater flow direction changes towards the northeast. Groundwater at PRL 7 was encountered at 5.3 feet bgs. The majority of the base is paved with storm drains and sloped pavement to control surface runoff. Adjoining areas have grass covered landscaping with drainage ditches to control surface runoff. in general flows to the southeast towards Lake Superior via Miller Creek. Surface runoff to the west of Duluth ANGB enters a man-made stormwater drainage system, which discharges into a large detention basin pond, which discharges to Beaver Creek, a tributary of Wild Rice Lake.
Brief Description of Receptors:	Nearby communities use water supplied by the City of Duluth, which is drawn from Lake Superior. Individual domestic or agricultural consumers located in isolated areas tend to rely on small capacity glacial drift wells, or deep low producing bedrock wells with sufficient open hole storage to provide adequate water supply. These deep bedrock wells often recharge with a significant amount of water derived from the shallow overlying glacial drift aquifer, which is recharged from infiltration and surface water. There are 60 groundwater wells within a 4-mile radius of the site. Sampling in 2010 indicated that three of 13 domestic wells had detections of PFAS. Exposure to surface and sub-surface soils may occur during routine activities or excavation activities. Surface water runoff from the base discharging to nearby surface water bodies is a potentially complete exposure pathway (e.g., Miller Creek, the large detention basin pond, Beaver Creek, Wild Rice Lake, or Lake Superior). Miller Creek is classified by the state for beneficial use for domestic consumption, and as such is protected for drinking water use. The surface water within Miller Creek is subject to water quality standards equivalent to those of drinking water standards, and therefore, drinking water regulations apply.

Groundwater Worksheet

Installation: Duluth ANGB

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

Contaminant	Maximum Concentration (ug/L)	Comparison Value (ug/L)	Ratios
PFOS	0.058	0.04	1.4
PFOA	0.011	0.04	0.3
PFBS	0.012	0.602	0.0

CHF Scale	CHF Value	Contamination Hazard Factor (CHF)	1.7
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	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)	H
Potential	Contamination in the groundwater has moved beyond the source or insufficient information available to make a determination of Evident or Confined	
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).	H

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: Duluth ANGB

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

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
PFOS	0.0025	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	
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:	Duluth ANGB	**Date:**	9/22/2021
Location (State):	Minnesota	**Media Evaluated:**	Groundwater, Soil
Site Name and ID:	AT028 - IRP Site 2, FTAs1&2 - PRL 10	**Phase of Execution (e.g., RI, Record of Decision (ROD)):**	N/A
RPM's Name:	Jim King	**Agreement Status (e.g., Federal Facility Agreement date signed):**	N A
OVERALL SITE CATEGORY: HIGH			

Site Summary	
Brief Site Description:	Former Fire Training Areas (FTA), AT028, is located on Duluth International Airport property northwest of the Duluth Air National Guard property. The site is 50 acres of grassy and lightly wooded areas. The site was further delineated as two separate areas, FTA 1 and FTA 2, formerly used for fire training activities. FTA 1 was reportedly only used prior to 1960, therefore no AFFF-containing compounds were used. As such, only FTA 2 was investigated for the presence of PFAS. From 1960 until 1987, fire training activities were reportedly held twice a month at FTA 2. During that time, jet propulsion fuel #4 (JP-4), along with smaller volumes of fuels and oils, paint thinners, and solvents, were burned during fire training exercises. The fires were extinguished with AFFF.
Brief Description of Pathways:	Two distinct hydrogeologic units were identified beneath the site. These include glacial drift and consolidated rock aquifers. groundwater within the glacial drift aquifer ranges from 3 to 25 ft bgs and groundwater within the consolidated rock aquifer ranges from 10 to 30 ft bgs. Groundwater beneath the Duluth ANGB flows in a similar direction as the surface water, towards the southeast. A divide is located off-base in the vicinity of Runway 9-27 at the airport where the groundwater flow direction changes towards the northeast. Groundwater was encountered ranging from 2 ft to 7 ft bgs. Surface water runoff from the vast majority of Duluth ANGB flows southeast towards Lake Superior via Miller Creek. Surface runoff to the west of Duluth ANGB enters a manmade stormwater drainage system, which discharges into a large detention basin pond on the north side of Runway 9-27, the main east-west runway. The detention pond discharges to Beaver Creek, a tributary of Wild Rice Lake.
Brief Description of Receptors:	Nearby communities use water supplied by the City of Duluth, which is drawn from Lake Superior. Individual domestic or agricultural consumers located in isolated areas tend to rely on small capacity glacial drift wells, or deep low producing bedrock wells with sufficient open hole storage to provide adequate water supply. These deep bedrock wells often recharge with a significant amount of water derived from the shallow overlying glacial drift aquifer, which is recharged from infiltration and surface water. There are 60 groundwater wells within a 4-mile radius of the site. Sampling in 2010 indicated that three of 13 domestic wells had detections of PFAS. Exposure to surface and sub-surface soils may occur during routine activities or excavation activities. Surface water runoff from the base discharging to nearby surface water bodies is a potentially complete exposure pathway (e.g., Miller Creek, the large detention basin pond, Beaver Creek, Wild Rice Lake, or Lake Superior). Miller Creek is classified by the state for beneficial use for domestic consumption, and as such is protected for drinking water use. The surface water within Miller Creek is subject to water quality standards equivalent to those of drinking water standards, and therefore, drinking water regulations apply.

Groundwater Worksheet

Installation: Duluth ANGB

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

Contaminant	Maximum Concentration (ug/L)	Comparison Value (ug/L)	Ratios
PFOS	2.4	0.04	60.0
PFOA	33	0.04	825.0
PFBS	7.1	0.602	11.8

CHF Scale	CHF Value	Contamination Hazard Factor (CHF)	896.8
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)	H
Potential	Contamination in the groundwater has moved beyond the source or insufficient information available to make a determination of Evident or Confined	
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).	H

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: Duluth ANGB

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

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
PFOS	0.0178	0.126	0.1
PFOA	0.0144	0.126	0.1
PFBS	0.0058	1.9	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:	Duluth ANGB	**Date:**	9/22/2021
Location (State):	Minnesota	**Media Evaluated:**	Groundwater, Soil
Site Name and ID:	Aircraft Parking Apron - PRL 11	**Phase of Execution (e.g., RI, Record of Decision (ROD)):**	N/A
RPM's Name:	Jim King	**Agreement Status (e.g., Federal Facility Agreement date signed):**	N A
OVERALL SITE CATEGORY: HIGH			

Site Summary	
Brief Site Description:	The Aircraft Parking Apron has considerable aircraft operations. Drainage within this area is characteri ed by sheet flow into grassy, vegetated areas to the west and south of the Aircraft Parking Apron. According to the 2016 PA Letter Report, this area was included as a PRL due to the potential use and discharge of AFFF even though no documented spills of AFFF to the aircraft parking apron were reported.
Brief Description of Pathways:	Two distinct hydrogeologic units were identified beneath the site. These include glacial drift and consolidated rock aquifers. groundwater within the glacial drift aquifer ranges from 3 to 25 ft bgs and groundwater within the consolidated rock aquifer ranges from 10 to 30 ft bgs. Groundwater beneath the Duluth ANGB flows in a similar direction as the surface water, towards the southeast. A divide is located off-base in the vicinity of Runway 9-27 at the airport where the groundwater flow direction changes towards the northeast. Groundwater was encountered at PRL 11 at approximately 5 feet bgs. The majority of the base is paved with storm drains and sloped pavement to control surface runoff. Adjoining areas have grass covered landscaping with drainage ditches to control runoff. In general, surface water flows to the southeast towards Lake Superior via Miller Creek. Surface runoff to the west of Duluth ANGB enters a man-made stormwater drainage system, which discharges into a large detention basin pond, which discharges to Beaver Creek, a tributary of Wild Rice Lake. Surface runoff recharges the shallow and rock aquifers.
Brief Description of Receptors:	Nearby communities use water supplied by the City of Duluth, which is drawn from Lake Superior. Individual domestic or agricultural consumers located in isolated areas tend to rely on small capacity glacial drift wells, or deep low producing bedrock wells with sufficient open hole storage to provide adequate water supply. These deep bedrock wells often recharge with a significant amount of water derived from the shallow overlying glacial drift aquifer, which is recharged from infiltration and surface water. There are 60 groundwater wells within a 4-mile radius of the site. Sampling in 2010 indicated that three of 13 domestic wells had detections of PFAS. Exposure to surface and sub-surface soils may occur during routine activities or excavation activities. Surface water runoff from the base discharging to nearby surface water bodies is a potentially complete exposure pathway (e.g., Miller Creek, the large detention basin pond, Beaver Creek, Wild Rice Lake, or Lake Superior). Miller Creek is classified by the state for beneficial use for domestic consumption, and as such is protected for drinking water use. The surface water within Miller Creek is subject to water quality standards equivalent to those of drinking water standards, and therefore, drinking water regulations apply.

Groundwater Worksheet

Installation: Duluth ANGB

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

Contaminant	Maximum Concentration (ug/L)	Comparison Value (ug/L)	Ratios
PFOS	0.12	0.04	3.0
PFOA	0.0075	0.04	0.2
PFBS	0.0057	0.602	0.0

CHF Scale	CHF Value	Contamination Hazard Factor (CHF)	3.2
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		
CHF Value		CHF VALUE	M

Migratory Pathway Factor		
Evident	Analytical data or direct observation indicates that contamination in the groundwater has moved to a point of exposure (e.g., well)	H
Potential	Contamination in the groundwater has moved beyond the source or insufficient information available to make a determination of Evident or Confined	
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).	H

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: Duluth ANGB

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

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
PFOS	0.011	0.126	0.1
PFOA	0.00025	0.126	0.0
CHF Scale	**CHF Value**	**Contamination Hazard Factor (CHF)**	**0.1**
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	
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**