



**Final Proposed Plan for
Installation Restoration Program – Site 21
148th Fighter Wing
Minnesota Air National Guard
Duluth International Airport – Duluth, Minnesota**



**Air National Guard Announces
Proposed Plan**

This is a proposed plan for remediating a groundwater plume of trichloroethylene (TCE) at Installation Restoration Program Site 21 (IRP Site 21) located at the Minnesota Air National Guard (MNANG), 148th Fighter Wing (FW) at the Duluth International Airport (DIA) in Duluth, Minnesota. This Proposed Plan presents the Preferred Alternative of Phytoremediation and Enhanced Bioremediation for groundwater contamination at the site. This Proposed Plan provides the rationale for selection of Phytoremediation and Enhanced Bioremediation as the Preferred Combined Alternative. In addition, this Proposed Plan includes summaries of other alternatives evaluated for use at IRP Site 21.

This document is issued by the Air National Guard (ANG), the lead agency for site activities, and the Minnesota Pollution Control Agency (MPCA), the regulatory agency. MNANG, in consultation with MPCA, has concluded enhanced bioremediation and phytoremediation actions are required at IRP Site 21. Although this Proposed Plan recommends Phytoremediation and Enhanced Bioremediation for IRP Site 21, a final determination will not be made until the public comment period ends and all comments are reviewed and addressed. The Phytoremediation and Enhanced Bioremediation decision may be reviewed

MARK YOUR CALENDARS

PUBLIC COMMENT PERIOD:

May 9 – June 9, 2011

The Air National Guard (ANG) will accept written comments on the Proposed Plan during the public comment period. Comment letters must be postmarked by June 9, 2011 and should be submitted to:

Mr. Fred Kimble, ANG Program Manager
NGB/A7OR – Shepperd Hall
3501 Fetchet Avenue
Joint Base Andrews, Maryland 20762-5157

Email: fred.kimble@ang.af.mil
Fax: (301) 836-7420

To request an extension send a request in writing to Mr. Fred Kimble by 5:00 PM, June 2, 2011.

PUBLIC MEETING:

May 24, 2011, 6:30PM

The ANG will hold a public meeting to explain the Proposed Plan and the Preferred Combined Alternative of Phytoremediation and Enhanced Bioremediation. Oral and written comments will also be accepted at the meeting. The meeting will be held at the Inn on Lake Superior.

**The Inn on Lake Superior
Eagle Harbor Meeting Room
350 Canal Park Drive
Duluth, Minnesota 55802**

**For more information, see the Administrative
Record at the following locations:**

**Duluth Public Library
520 W. Superior St.
Duluth, Minnesota 55802**

and modified in the future if new information becomes available which indicates the presence of contamination or exposure routes that cause an unacceptable risk to human health or the environment. Therefore, the public is encouraged to review and comment on information presented in this Proposed Plan.

The ANG is issuing this Proposed Plan as part of its public participation responsibilities under Section 117 (a) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 USC § 9617(a) and Section 300.430 (f)(3) of the National Oil and Hazardous Substances Pollution Contingency Plan. This Proposed Plan summarizes information that can be found in greater detail in the IRP Site 21 Focused Feasibility Study (FFS) Report [*Installation Restoration Program Final Focused Feasibility Study Report, Site 21, 148th Fighter Wing, Minnesota Air National Guard, Duluth International Airport, Duluth, Minnesota*, dated September 2010. Copies of site documents are available for review at the Duluth Public Library, 520 West Superior Street (see Page 1 of this Proposed Plan for the location and address).

The ANG and the State of Minnesota encourage the public to review these documents to gain an understanding of IRP Site 21, and the investigation and cleanup activities that have been conducted. A Record of Decision will be prepared based on the findings of the Remedial Investigation (RI) Data Gap Investigation, Focused Feasibility Study (FFS), and public comments on the Proposed Plan. Public input to the Proposed Plan will be documented in a Responsiveness Summary Report, which will be included as an appendix to the Final Record of Decision.

Site History and Background

The MNANG 148th FW is located at the DIA (Figure 1). The 148th FW facilities are located on leased property from the State of Minnesota. Ownership of the remaining property at the airport is divided among the federal government, the State of Minnesota, and the City of Duluth.

The mission of the 148th FW is to maintain air sovereignty, provide atmospheric attack warning and assessment, and support the air defense of its assigned airspace according to applicable plans and directives.

IRP Site 21 (Figure 2), Imhoff Tank Treatment System, is a former treatment system that provided primary and secondary sewage treatment for the industrial and administrative areas of the 148th FW, MNANG (Base). Constructed in 1949, the system was comprised of an Imhoff tank, sludge drying beds, and a biological filter bed. A 750-foot outfall pipe discharged the system's liquid effluent into the wetland that is associated with Miller Creek. The City of Duluth connected the area to the municipal sewage system in 1969.

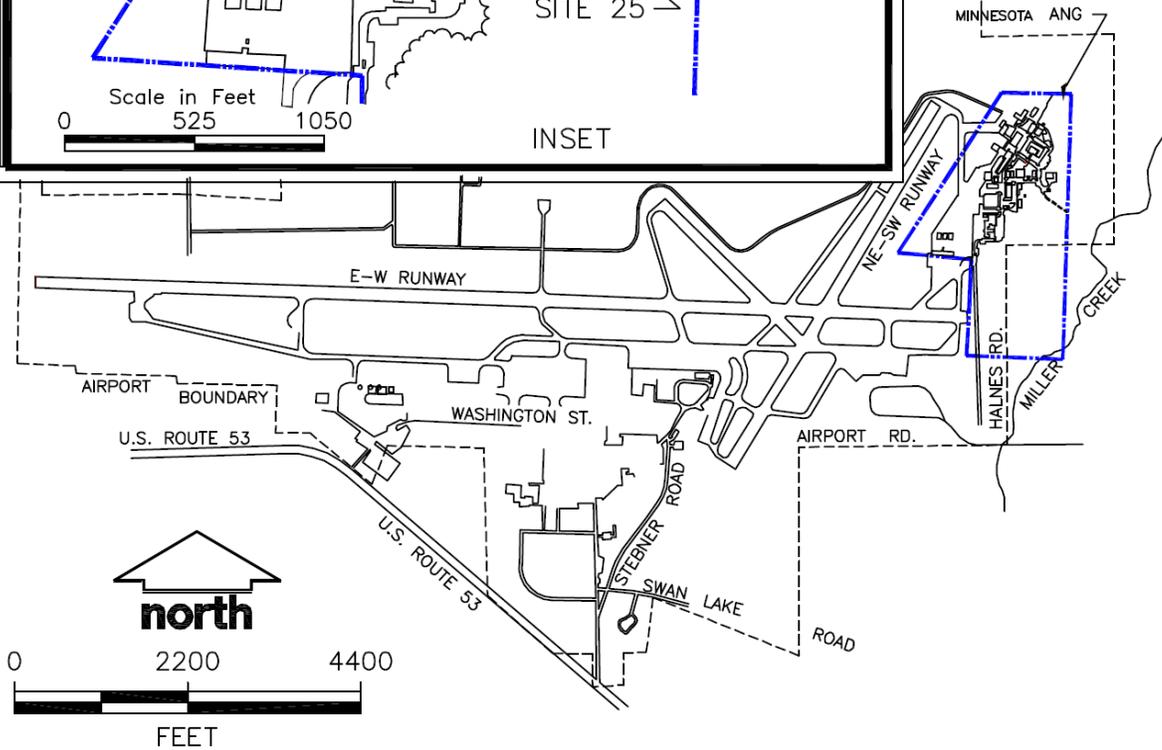
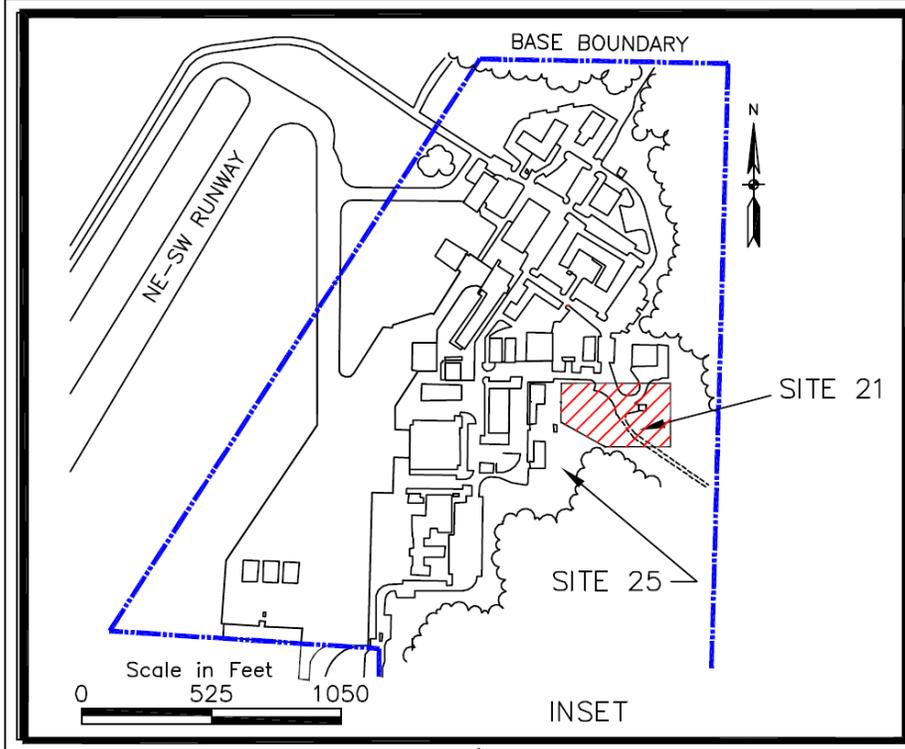
IRP Site 21 was identified in a Resource Conservation and Recovery Act (RCRA) Facility Assessment Sampling Visit Report, completed in July 1988 by Operational Technologies, Inc. (OpTech). A RCRA Facility Investigation was conducted in 1992 and detected toluene, xylenes, phenanthrene, pyrene, lead, and total petroleum hydrocarbons diesel range organics (TPH-DRO) in soil samples.

During the same investigation TCE and lead were detected in groundwater. During 2005 and 2006, additional investigation activities were conducted at IRP Site 21 by Environmental Resources Management (ERM), which consisted of installing seven additional groundwater monitoring wells at IRP Site 21 and collecting soil and groundwater samples. Results of soil sampling indicated no compounds were detected in soil greater than MPCA Tier 2 Industrial Soil Reference Values (SRVs). Results of the groundwater sampling indicated benzene, TCE, tetrachloroethylene

Revised By & Date: str 04/22/11 Approved By & Date:

Approved By & Date:

Drawn By & Date:



- LEGEND**
- INSTALLATION RESTORATION PROGRAM SITE 21
 - MINNESOTA ANG BOUNDARY
 - AIRPORT BOUNDARY
 - TREE LINE
- SITES**
- SITE 21 IMHOFF TANK TREATMENT SYSTEM

148th FIGHTER WNG, MINNESOTA AIR NATIONAL GUARD
 DULUTH INTERNATIONAL AIRPORT
 DULUTH, MINNESOTA
 IRP SITE 21
 SITE LOCATION MAP

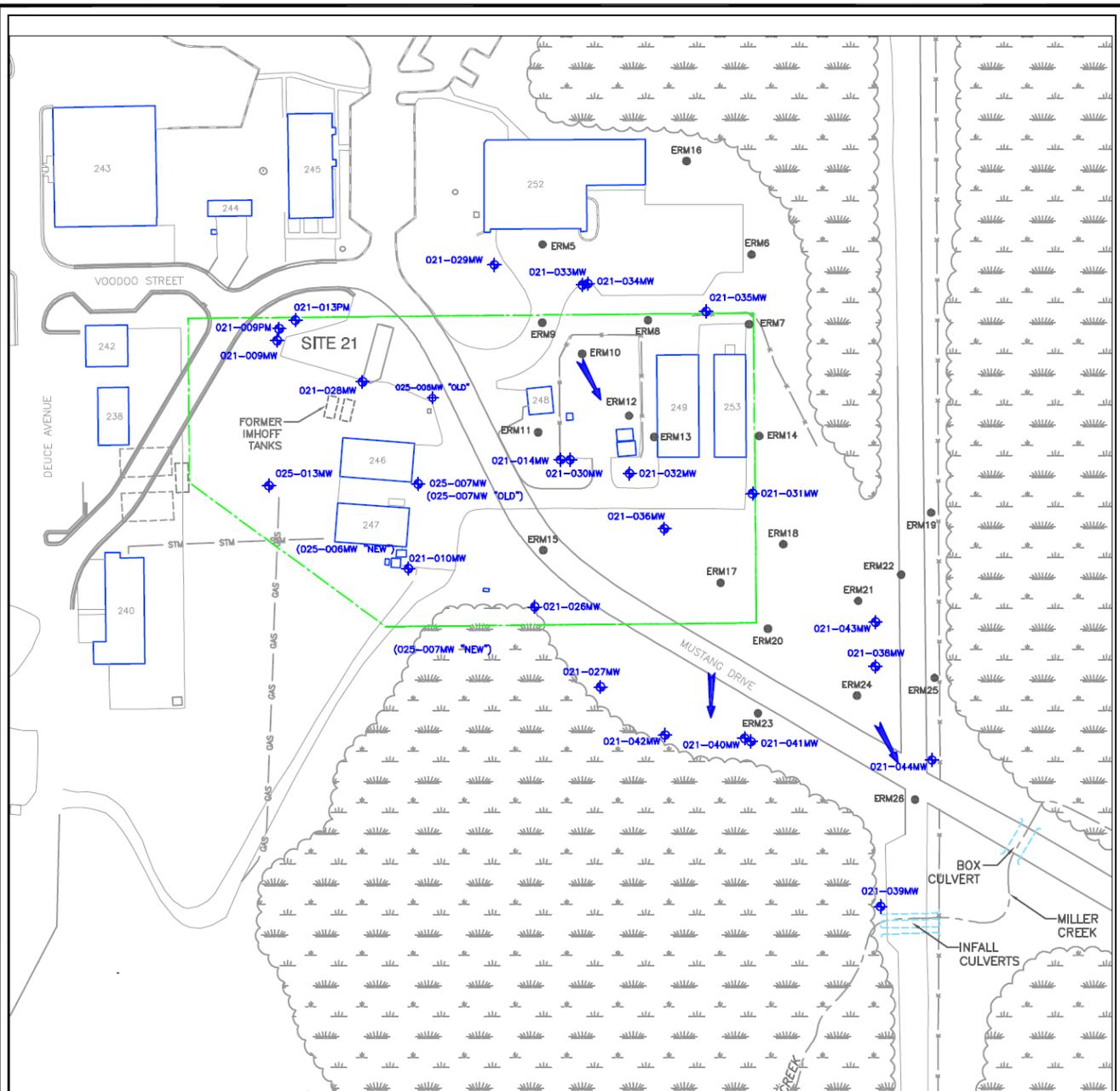
FIGURE 1



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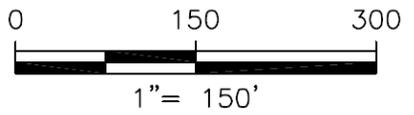
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LEGEND

- EXISTING MONITORING WELL
- ERM GEOPROBE LOCATION
- MARSH
- BUILDINGS
- IRP SITE 21 BOUNDARY
- GROUNDWATER FLOW DIRECTION



148TH FIGHTER WING, MINNESOTA AIR NATIONAL GUARD
DULUTH INTERNATIONAL AIRPORT

IRP SITE 21

FIGURE 2

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(PCE), and vinyl chloride (VC) were the primary groundwater contaminants of concern at IRP Site 21.

In July 2006 approximately 1,495 tons of contaminated soil were excavated and removed from IRP Site 21 during the installation of a sanitary sewer line along a new road alignment related to the Base Entrance Relocation Project. Laboratory analysis of the excavated soils indicated concentrations of TPH-DRO and TPH-gasoline range organic (GRO). No other contaminants were detected greater than their respective MPCA Tier 2 Industrial SRVs.

In June 2007 a Remedial Process Optimization (RPO) Study was conducted at IRP Site 21. This study was conducted to: evaluate the effectiveness of the current remedial approaches being conducted at IRP Site 21; provide recommendations for improving the cost effectiveness and efficiency of the current actions, if applicable; and evaluate options for future remedial actions at IRP Site 21 to proceed toward site closure.

Remedial Investigation Data Gap Investigation

Following the recommendations of the RPO Study, a RI Data Gap Investigation was conducted from 2008 to 2009 to fully characterize and delineate groundwater contamination. The results of these, as well as the previous investigations were incorporated into the *Final Site 21 Remedial Investigation Data Gap Investigation Technical Memorandum* in March 2010.

The primary objective of the RI Data Gap Investigation was to gather additional site data to sufficiently characterize groundwater contamination at IRP Site 21. The data were

evaluated by comparing the chemicals detected in groundwater to MPCA criteria.

The groundwater data were compared to Applicable or Relevant and Appropriate Requirements (ARARs) which included, the Minnesota Health Risk Limit (HRL), Groundwater Screening Value for Vapor Intrusion Pathway (GW_{ISV}), and MPCA Surface Water Quality Standards.

During the RI Data Gap Investigation vertical aquifer sampling (VAS), soil borings with temporary well sampling, permanent monitoring well installation and sampling, and PushPoint sampling were conducted. The RI Data Gap Investigation identified the following constituents of concern in groundwater at IRP Site 21:

Chlorinated solvent compounds:

- TCE
- VC

Petroleum related compounds:

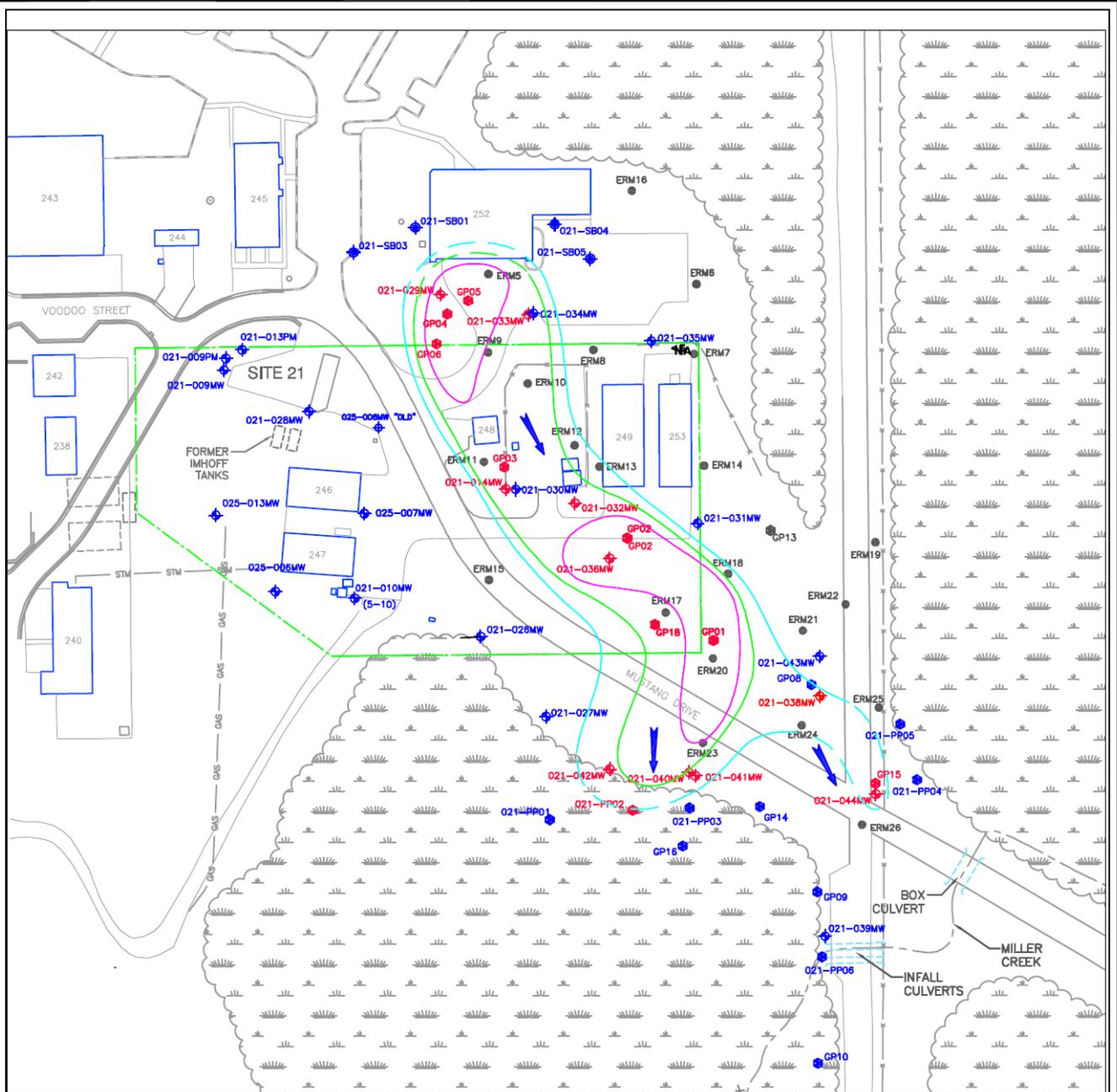
- Benzene
- 1,2,4-trimethylbenzene (1,2,4-TMB)
- TPH-DRO

The current distribution of TCE extends from just south of Building 252 to the marsh boundary located to the south of Mustang Drive (Figure 3). Miller Creek intersects the marsh to the south of the IRP Site 21. Although the groundwater plume does intersect a small portion the surrounding marsh wetlands to the south, there have been no confirmed impacts to off-site receptors above water quality criteria at Miller Creek. Please refer to the Summary of Site Risks Section for a discussion on the potential risks to Miller Creek. The MPCA suspects there are multiple small releases near Building 252, or a release of diluted dissolved-phase contamination from a stormwater outfall of the former Imhoff sewage treatment system; however, at this

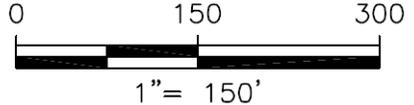
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- MARSH
- BUILDINGS
- ERM GEOPROBE POINT
- SOIL BORING LOCATION - AUGUST 2008/MAY 2009
- VAS - VERTICAL AQUIFER SAMPLING LOCATION
- MONITORING WELL SAMPLED
- MONITORING WELL SAMPLED - EXCEEDANCE OF HRL
- PUSHPOINT LOCATION SAMPLED
- PUSHPOINT LOCATION - EXCEEDANCE OF HRL
- 5 PPB TCE ISOCONTOUR
- 30 PPB TCE ISOCONTOUR
- 50 PPB TCE ISOCONTOUR
- DASHED LINE INDICATES INFERRED CONTOUR
- IRP SITE 21 BOUNDARY
- GROUNDWATER FLOW DIRECTION



148TH FIGHTER WING, MINNESOTA AIR NATIONAL GUARD
DULUTH INTERNATIONAL AIRPORT

TCE IN GROUNDWATER AT SITE 21

FIGURE 3

J:\N.C.B\Projects\Federal\DO #1 - Duluth Site 21\CADD\Proposed Plan\Figure 3.dwg Nov/01/10

time there is no evidence to verify the source of TCE or petroleum hydrocarbon contamination at IRP Site 21. The TCE plume appears to be bifurcated at the marsh boundary near the intersection of Mustang Drive and Perimeter Road. TCE was not detected within the marsh at concentrations greater than ARARs. The highest concentration of chlorinated solvent compounds is located at GP05 immediately south of Building 252. Petroleum hydrocarbon contamination present in groundwater is limited to monitoring well 021-029MW and the surrounding area immediately south of Building 252, but is not found downgradient near the marsh boundary.

Focused Feasibility Study

The FFS developed, screened, and evaluated possible alternatives potentially capable of cleaning up the groundwater contamination at IRP Site 21 based on the MPCA HRL. Proposed remedial action objectives (RAOs) for IRP Site 21 are to ensure the concentrations of groundwater contaminants at the marsh boundary and groundwater associated with IRP Site 21 are at levels that are protective of human health and the environment. For TCE, this protective concentration is 5 micrograms per liter ($\mu\text{g/L}$), based on both the federal MCL and the Minnesota HRL for TCE. A remedial action that meets the MCL and HRL for TCE in groundwater would be protective of other receptors and risks besides drinking water, including human contact, vapor intrusion and inhalation, and aquatic life, which all have higher screening values. The comparable protective concentrations for benzene and VC in groundwater are 2 $\mu\text{g/L}$ and 0.2 $\mu\text{g/L}$, respectively, both based on their HRL.

The selected remedies must be protective of human health and the environment. Selected remedies must also satisfy the requirements of any federal or state environmental law that is determined to be sufficiently similar to make them relevant and appropriate for the site.

Summary of Site Risks

A Focused Risk Assessment was conducted as part of the FFS for IRP Site 21 to evaluate the potential human and ecological risks associated with groundwater contamination. The focused risk assessment evaluated which exposure pathways were potentially complete for both human and ecological receptors, using the site-specific data that were collected and considering site-specific conditions.

Based on results of the focused screening level risk assessment, groundwater is not a medium of potential concern to either human or ecological receptors. The groundwater contamination is present at a depth below ecologically sensitive areas (wetlands), but has not apparently affected the surface water quality in Miller Creek. During the Tier 2 ecological evaluation, groundwater quality near Miller Creek was compared to surface water quality standards. Groundwater concentrations were less than surface water quality standards. While there was a single chemical (i.e., VC) at the leading edge (northern marsh boundary) of the wetland at a concentration greater than its Tier 2 surface water quality criteria, this would not be expected to pose an ecological concern because it is located at depth in an isolated location. Therefore, no additional ecological evaluation was recommended based on results of the Tier 2 evaluation. However, in accordance with MPCA Risk Based Site Evaluation (RBSE) Guidance Documents, Surface Water Pathway Evaluation guidance,

it is assumed that discharge may possibly occur if the plume of contaminated groundwater is within a two-year travel time of the surface water body. Although there may have been no confirmed impacts to off-site receptors above water quality criteria at Miller Creek, based on the MPCA RBSE Guidance, potential migration to Miller Creek should be considered. Therefore, the remediation being proposed at IRP Site 21 reflects that consideration.

Concentrations of volatile organic compounds (VOCs) in groundwater (i.e., primarily TCE and benzene) are greater than screening concentrations developed by MPCA to determine if vapor intrusion could represent a potential exposure concern to people inside of buildings as a result of groundwater contamination. However, a vapor intrusion investigation performed at the site showed indoor air quality inside the building is not being affected by the groundwater contamination. By implementing a remedial action at IRP Site 21, the following objectives will be addressed minimizing site risks.

- Preventing migration and discharge of TCE and other CVOC contaminants into the adjoining wetlands by reducing TCE concentrations in groundwater beneath the site to levels that are below surface water quality discharge standards.
- Preventing potential migration and discharge of TCE and other CVOC contaminants into Miller Creek by reducing TCE concentrations in groundwater beneath the site to levels that are below surface water quality discharge standards.
- Preventing current or future exposure to TCE, other CVOCs, benzene, and trimethylbenzene from vapor intrusion by reducing contamination concentration in groundwater beneath site to levels that

are below vapor intrusion groundwater screening values.

- Improving and protecting the quality of groundwater by accelerating the natural attenuation of TCE and other VOCs contaminants beneath the site.
- Limiting future exposure to residual TCE and VOC contamination in groundwater by construction workers and other future users of the site.

Summary of Remedial Alternatives

CERCLA statutory requirements §121(b) require each selected remedy meet the following: (1) be protective of human health and the environment (2) comply with ARARs; (3) be cost-effective; (4) utilize permanent solutions and alternative treatment technologies, or resource recovery technologies, to the maximum extent practicable; and (5) satisfy the preference for treatment as a principal element. The FFS report provided detailed analysis for remedial options for groundwater contamination.

The following presents the remedial alternatives for addressing contaminated groundwater at IRP Site 21. The description of alternatives listed below is as described in the FFS report, and are numbered to correspond with the alternative numbers in the FFS.

The technologies listed below only address TCE, and VC as a byproduct. Because the petroleum hydrocarbon detections at 021-029MW do not appear to be migrating, the use of Oxygen Releasing Compound[®] (ORC[®]) socks at monitoring well 021-029MW will address elevated benzene detections greater than the HRL. The use of ORC[®] socks can be used as an interim step to observe the success of remediating the localized detections of petroleum hydrocarbons at monitoring well

021-029MW. Following implementation of ORC[®] socks at 021-029MW, continued monitoring will indicate if there is a rebound in concentrations. Groundwater monitoring data will be used to determine if future remedial actions may be necessary in the area of 021-029MW.

The FFS contains greater detail of the remedial alternatives. The following are extracted from Chapter 4 of the FFS:

Summary of Remedial Alternatives for Groundwater at IRP Site 21	
Alternative	Description
1	Intrinsic Remediation (Monitored Natural Attenuation)
2	Phytoremediation
3	Enhanced Bioremediation
4	Permeable Reactive Barrier – Zero Valent Iron Wall

Alternative 1: Intrinsic Remediation (Monitored Natural Attenuation)

Estimated Present Cost (2010): Not Developed

Alternative 1 would implement groundwater institutional controls, including posting warning signs to deter unauthorized use of IRP Site 21, placing land use controls on the Installation Master Use Plan, and a prohibition on use of groundwater until regulatory criteria are achieved.

Alternative 1 would involve the continued sampling and analysis of groundwater from monitoring wells at IRP Site 21. Monitoring of IRP Site 21 would be conducted on an annual or semiannual basis in order to track plume migration and the progress of natural attenuation. United States Environmental Protection Agency’s (USEPA) Biochlor software was used to assess the viability of monitored natural attenuation (MNA) at this site. Completion of the USEPA’s screening

table yielded a score of 10, denoting that there is limited evidence for anaerobic biodegradation of chlorinated organics at IRP Site 21. Therefore, a cost was not developed for this option because the MNA screening results revealed natural attenuation is not a viable option as the primary groundwater remediation approach at IRP Site 21.

Alternative 2: Phytoremediation

Estimated Present Worth Cost (2010): \$577,072

Alternative 2 would combine groundwater institutional controls (as outlined in Alternative 1) and monitoring with active remediation of the chlorinated solvent plume. Phytoremediation would target the TCE plume above 5 micrograms per liter (µg/L).

Phytoremediation uses deep-rooted poplar trees to pump groundwater through leaves to the atmosphere via transpiration. The root-associated microflora in the subsurface mineralizes targeted chlorinated solvents (TCE and VC) or petroleum hydrocarbons (benzene) and will eventually reach regulated action levels in the near-surface aquifer. A 0.5-acre area is proposed for planting to treat groundwater to depths up to 15 feet below ground surface (bgs). Groundwater sampling will be conducted at seven monitoring wells annually for 15 years to monitor remediation of the TCE plume. Under this alternative, CERCLA five-year reviews would occur.

Alternative 3: Enhanced Bioremediation

Estimated Present Worth Cost (2010): \$850,710

Alternative 3 would combine groundwater institutional controls (as outlined in Alternative 1) and monitoring with active remediation of the chlorinated solvent plume. Anaerobic remediation would target the TCE plume above 5 µg/L.

Anaerobic bioremediation involves modification of the subsurface to stimulate bacteria and enhance biological degradation of organic contaminants. An organic substrate, such as emulsified oil substrate (EOS[®]), pH amendments and bioaugmentation cultures (if needed), and potable water would be injected at each of 59 injection locations. After injection of substrate, groundwater samples can be collected quarterly, and then semi-annually or annually, as biodegradation trends become established. Three new monitoring wells would be required to assess enhanced bioremediation. Prior to full implementation of Alternative 3, a pilot study will be conducted to assess the effectiveness of the substrate delivery method, to determine the radius of influence, and assess degradation of the contaminants of concern. The estimated duration of this alternative is seven years. Under this alternative, CERCLA five-year reviews would occur but were not included in the estimated cost as this alternative is designed to be used with other remedial alternatives.

Alternative 4: Permeable Reactive Barrier – Zero Valent Iron Wall

Estimated Present Worth Cost (2010): \$688,870

Alternative 4 would combine groundwater institutional controls (as outlined in Alternative 1) and monitoring with active remediation of the chlorinated solvent plume. Anaerobic remediation would target the TCE plume above 5 µg/L.

The installation of a permeable reactive barrier (PRB), specifically a zero valent iron (ZVI) wall, can be an effective remedial measure. The PRB-ZVI would be installed downgradient from, or in the flow path of, the TCE contaminant plume. The ZVI remediates TCE in groundwater as it

migrates through the reactive media from which the wall is composed (i.e., iron). As TCE migrates through the ZVI wall, dehalogenation occurs due to the oxidation of the iron. The electronegativity of the iron reduces the TCE to its breakdown compounds (dichloroethylene [DCE] and VC), and ultimately down to ethane and ethene (which is not toxic). The full-scale system has been estimated to be 160 feet long, 2 feet wide, and 25 feet deep. Additionally two new performance monitoring wells would be installed to monitor effectiveness of the PRB-ZVI. Groundwater sampling will be conducted annually for 15 years to monitor remediation of the TCE plume. Groundwater sampling will be conducted at ten monitoring wells annually for 15 years to monitor remediation of the TCE plume. Under this alternative, CERCLA five-year reviews would occur.

Evaluation of Alternatives

Nine criteria (summarized below) are used to evaluate the different remediation alternatives individually and against each other to select a remedy. This section of the Proposed Plan profiles the relative performance of each alternative against the nine criteria, noting how it compares to the other options under consideration. The “Detailed Analysis of Alternatives” can be found in the FFS.

EVALUATION CRITERIA FOR REMEDIAL ALTERNATIVES
1. Overall Protectiveness of Human Health and the Environment determines whether an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.
2. Compliance with ARARs evaluates whether the alternative meets federal and state environmental statutes, regulations, and other requirements that pertain to the site, or whether a waiver is justified.
3. Long-Term Effectiveness and Permanence considers the ability of an alternative to maintain protection of human health and the environment over time.
4. Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.
5. Short-Term Effectiveness considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation.
6. Implementability considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.
7. Cost includes estimated capital and annual operation and maintenance (O&M) costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.
8. State/Support Agency Acceptance considers whether the state agrees with ANG's analyses and recommendations, as described in the Feasibility Study (FS) and Proposed Plan.
9. Community Acceptance considers whether the local community agrees with ANG's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

1. Overall Protection of Human Health and the Environment

Each of the alternatives would provide some measure of protection to human health and the environment by eliminating, reducing, or controlling risk through treatment.

2. Compliance with ARARs

Alternative 1 would not be compliant with ARARs, as natural attenuation was determined not to be a viable option as a primary groundwater remediation approach at this site. Alternative 2 would achieve chemical specific ARARs in the area of application only to depths of 15 feet bgs and at locations downgradient of the installed area. Alternative 3 would achieve ARARs over the entire plume footprint in the shortest timeframe. Alternative 4 would achieve ARARs at the PRB-ZVI installation area. Groundwater upgradient of the PRB-ZVI installation area would not be treated.

3. Long-Term Effectiveness and Permanence

Alternative 1 would not have long-term reliability, effectiveness, or permanence. Alternatives 2, 3, and 4 would be effective over the long term; as each alternative removes contaminants from groundwater. In Alternative 3, the mass of TCE present between the locations of the enhanced bioremediation barriers would not be treated immediately, resulting in TCE concentrations existing between treatment areas that exceed the HRL migrating downgradient toward the next treatment zone. In Alternative 2 and Alternative 4, the mass of contaminant present between the remedy installation area and the marsh would not be treated; resulting in TCE at concentrations exceeding the HRL being discharged to the marsh for approximately 14 to 49 years after the installation.

4. Reduction of Toxicity, Mobility, or Volume of Contaminants Through Treatment

Alternative 1 does not reduce the toxicity, mobility, or volume of contaminants due to the limited natural attenuation occurring at the site. Alternatives 2 and 3 will reduce the toxicity and volume of contaminated groundwater. Alternative 3 will also likely address any potential source material, if present, in the area south of Building 252. Alternative 4 is a barrier that will prevent plume migration and mobility to the marsh boundary.

5. Short-Term Effectiveness

Institutional controls will be effective in reducing the possibility of human exposure to groundwater contamination at the site during implementation of each of the Alternatives. Groundwater sampling will effectively monitor remedial effectiveness for all Alternatives.

6. Implementability

All services and materials are readily available for each alternative. In Alternative 3 there is potential for operation and maintenance problems associated with injecting large volumes of water into the aquifer. All alternatives have few associated administrative difficulties.

7. Cost

A cost was not developed for intrinsic remediation (MNA), because there was limited evidence of natural attenuation occurring at IRP Site 21. The estimated total present value costs for each alternative are as follows:

8. State/Support Agency Acceptance

The state of Minnesota (MCPA) supports the combination of Alternatives 2 and 3 as the preferred alternative.

Alternative	Cost
1. Intrinsic Remediation (Monitored Natural Attenuation)	Not Developed
2. Phytoremediation	\$577,072
3. Enhanced Bioremediation	\$850,710
4. Permeable Reactive Barrier – Zero Valent Iron Wall	\$688,870

9. Community Acceptance

Community acceptance of the combination of Alternatives 2 and 3 as the preferred alternative will be evaluated after the public comment period ends and will be described in the Record of Decision for IRP Site 21.

Summary of the Preferred Alternative

Based upon the detailed and comparative analysis, the recommended remedial alternative for cleaning up the contaminated groundwater at IRP Site 21 is the combination of Alternative 2 (Phytoremediation) and Alternative 3 (Enhanced Bioremediation) plus institutional controls (Figure 4). Enhanced bioremediation will be implemented at 59 injection locations across the TCE plume footprint. Injection of an organic substrate will facilitate anaerobic reductive dechlorination of TCE and other chlorinated VOCs. It is anticipated the biostimulation solution will produce a 5-foot radius of influence at each injection location. Phytoremediation will address any residual groundwater contamination at a 0.5-acre treatment area at depths up to 15 feet bgs. Three new groundwater monitoring wells will be installed at IRP Site 21 to monitor Enhanced Bioremediation and Phytoremediation effectiveness. A total of eight monitoring wells will be monitored annually for 15 years. Under this combined alternative, CERCLA five-year reviews would occur. The combined cost for Alternatives 2 and 3 is **\$1,253,497**.

Additionally, the use of ORC[®] socks at monitoring well 021-029MW is recommended to address benzene and 1,2,4-TMB concentrations greater than the HRL and the GW_{ISV}. Costs for ORC[®] socks at 021-029MW were not developed, but are anticipated to be minimal when compared to the evaluated alternatives.

Groundwater institutional controls will include posting warning signs to deter unauthorized use of IRP Site 21, placing land use controls on the Installation Master Use Plan, and prohibiting the use of groundwater until regulatory criteria are achieved.

Community Participation

The ANG and MPCA provide information regarding the cleanup of IRP Site 21 to the public through public meetings, the Administrative Record file for IRP Site 21, and announcements published in the Duluth News Tribune. The ANG and the MPCA encourage the public to gain an understanding of IRP Site 21 and the investigation and cleanup activities that have been conducted at the site.

The dates for the public comment period; the date, location, and time of the public meeting; and the locations of the Administrative Record files, are provided on the Page 1 of this Proposed Plan.

For further information on IRP Site 21, please contact:

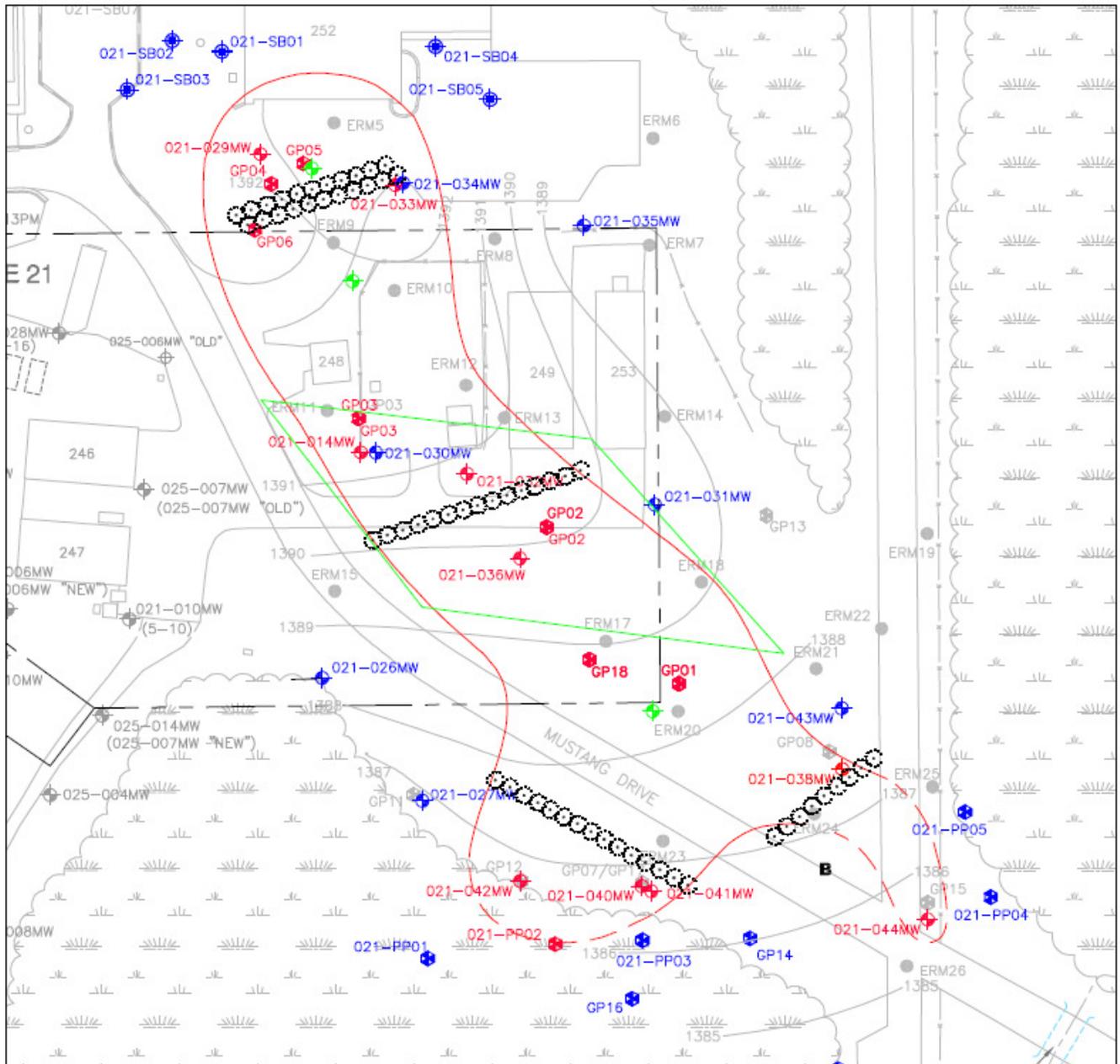
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Revised By & Date:

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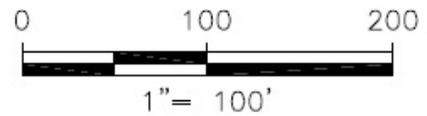
Drawn By & Date:



LEGEND

- MARSH
- BUILDINGS
- ERM GEOPROBE POINT
- SOIL BORING LOCATION - AUGUST 2008/MAY 2009
- VAS = VERTICAL AQUIFER SAMPLING LOCATION
- MONITORING WELL SAMPLED
- MONITORING WELL SAMPLED - EXCEEDANCE OF HRL
- PUSHPOINT LOCATION SAMPLED
- PUSHPOINT LOCATION - EXCEEDANCE OF HRL
- 5 PPB TCE ISOCONTOUR (APPROXIMATELY 92,942 SF)
- GROUNDWATER CONTOUR

- PHYTOREMEDIATION TREATMENT AREA (~0.5 ACRE)
- REDUCTIVE DECHLORINATION INJECTION LOCATION
- REDUCTIVE DECHLORINATION INJECTION RADIUS OF INFLUENCE
- NEW PERFORMANCE MONITORING WELL



148TH FIGHTER WING, MINNESOTA AIR NATIONAL GUARD
 DULUTH INTERNATIONAL AIRPORT

PREFERRED ALTERNATIVE
 ENHANCED BIOREMEDIATION AND PHYTOREMEDIATION

FIGURE 4



GLOSSARY OF TERMS

Specialized terms used in this handout are defined below:

Administrative Record – All documents that are considered, or relied on, in selecting the response action at a site, culminating in the Record of Decision for remedial action or an Action Memorandum for removal actions.

Applicable or Relevant and Appropriate Requirements (ARARs) – The federal and state environmental laws that a selected remedy will meet. These requirements may vary among sites and alternatives.

Bioremediation – The use of microorganisms to transform or alter, through metabolic or enzymatic action, hazardous organic contaminants into nonhazardous substances.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) – The Cleanup Program focuses on human health and environmental concerns related to human health. The Cleanup Program is primarily carried out by the U. S. Environmental Protection Agency, working with the states, on sites designated for cleanup on the National Priorities List (NPL). The Cleanup Program emphasizes local source contact and prevention of further spread from sources.

Contaminant – Harmful or hazardous matter introduced into the environment.

Contaminant Plume – A column of contamination with measurable horizontal and vertical dimensions that is suspended in, and moves with groundwater.

Focused Feasibility Study (FFS) – Analysis of the practicability of a proposal; e.g., a description and analysis of potential cleanup alternatives for a site.

Groundwater – Underground water that fills pores in soils or openings in rocks to the point of saturation. Groundwater is often used as a source of drinking water via municipal or domestic wells.

In Situ – In its original place; unmoved unexcavated; remaining at the site or in the subsurface.

Monitoring – Ongoing collection of information about the environment that helps gauge the effectiveness of a cleanup action. Monitoring wells drilled at different levels would be used to detect any leaks from containment structures.

Organic Compounds – Carbon compounds such as solvents, oils, and pesticides. Most are not readily dissolved in water. Some organic compounds can cause cancer.

Proposed Plan – A plan for a site cleanup that is available to the public for comment.

Remediation – Cleanup or other methods used to remove or contain a toxic spill or hazardous materials from a site.

Remedial Action – The actual construction or implementation phase of a site cleanup that follows remedial design.

Risk – A measure of the probability that damage to life, health, property, and/or the environment will occur as a result of a given hazard.

Risk Assessment – Qualitative and quantitative evaluation of the risk posed to human health and/or the environment by the actual or potential presence and/or use of specific pollutants.

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From:

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Stamp
Here

To:

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