APPENDIX J

PRELIMINARY ECOLOGICAL RISK ASSESSMENT

Technical Memorandum

Preliminary Ecological Risk Assessment
For The
Impact Area South Of the POW Training Facility

Fort McClellan
Calhoun County, Alabama

This Technical Memorandum presents the Preliminary Ecological Risk Assessment (PERA) for the Impact Area South of the POW Training Facility at Fort McClellan (FTMC) located in Calhoun County, Alabama. The PERA approach is a shortened version of the Screening-Level Ecological Risk Assessment (SLERA) protocol that has been developed for FTMC as a means to evaluate numerous sites in a uniform and economical way. It is assumed that the reader is familiar with FTMC and the fundamentals of the SLERA protocol presented in the Installation-Wide Work Plan (IT Corporation [IT], 1998). Each step of the PERA is described in the following sections.

Ecological Habitat Description. The Impact Area South of the POW Training Facility (Impact Area) is approximately 3 acres in size and is located near the northern boundary of the FTMC Main Post. The site is topographically flat with a dirt road traversing the site in a southwest-to-northeast direction.

Northwest of the dirt road was formerly cleared and maintained; however, maintenance activities have ceased and pioneer species are colonizing much of the site. Typically, the species most likely to colonize these areas are the "weed" species that tend to be vigorous pioneer plants that grow and spread rapidly. The first of the pioneer species to invade these abandoned areas are the grasses and herbaceous species. These formerly maintained grassy areas are classified as being in an early old field successional state. Over time, shrubs and small trees will follow these grass and herbaceous species. The early old field, successional habitat at the Impact Area is dominated by various grasses and herbs including *Rumex spp.* (dock), *Trifolium spp.* (clover), *Astragalus spp.* (vetch), *Ascelepias spp.* (milkweed), *Galium spp.* (bed straw), *Chrysanthemum leucanthemum* (ox-eye daisy), and *Sorghum halepense* (Johnson grass). Other old field herbaceous species occurring at the Impact Area are *Rubus occidentalis* (black raspberry), *Toxicodendron radicans* (poison ivy), *Rubus glabra* (smooth sumac), *Smilax rotundiflora* (green brier), *Lonicera japonica* (Japanese honeysuckle), *Vitus labrusca* (fox grape), and *Rosa multiflora* (multiflora rose). Loblolly pine (*Pinus taeda)* saplings have also begun to encroach into this oldfield, early successional habitat. Longleaf pine (*Pinus palustris*) may also be found in this habitat as relicts of the original woodlands that occurred here.

Typical terrestrial species inhabiting the oldfield early successional habitat include Eastern cottontail (*Sylvilagus floridanus*), whitetail deer (*Odocoileus virginianus*), wild turkey (*Meleagris gallopavo*), shorttail shrew (*Blarina brevicauda* or *Blarina carolinensis*), red fox (*Vulpes vulpes*), white-footed mouse (*Peromyscus leucopus*), American robin (*Turdus migratorius*), and red-tailed hawk (*Buteo jamaicensis*).

There are no water bodies or wetlands associated with the Impact Area; therefore, aquatic habitats are not present at this site.

Media of Interest and Data Selection. The medium of interest at the Impact Area is surface soil. Since there are no wetlands or surface water bodies associated with this site, surface water and sediment exposures are not applicable. Exposures to sub-surface soil and groundwater are unlikely for ecological receptors at this study area. Twenty-two surface soil and depositional soil samples were collected and analyzed for metals, volatile organic compounds (VOC), semivolatile organic compounds (SVOC), pesticides, herbicides, and explosives.

Identification of Constituents of Potential Ecological Concern. In order to determine whether constituents detected in environmental samples collected at the Impact Area have the potential to pose adverse ecological risks, screening-level hazard quotients were developed. The screening-level hazard quotients were developed via a three-step process as follows:

- Comparison to Ecological Screening Values (ESV);
- Identification of essential macro-nutrients; and
- Comparison to naturally-occurring background concentrations.

The ecological screening values (ESV) used in this assessment represent the most conservative values available from various literature sources and have been selected to be protective of the most sensitive ecological assessment endpoints. These ESVs have been developed specifically for FTMC in conjunction with USEPA Region IV and are presented in the *Final Human Health and Ecological Screening Values and PAH Background Summary Report* (IT, 2000). The ESVs used in this assessment are based on no-observed-adverse-effect-levels (NOAEL) when available. If a NOAEL-based ESV was not available for a certain constituent, then the most health-protective value available from the scientific literature was used in this assessment.

Constituents that were detected in surface soil at the Impact Area were evaluated against the ESVs by calculating a screening-level hazard quotient (HQ_{screen}) for each constituent. An HQ_{screen} was calculated by dividing the maximum detected constituent concentration in surface soil by its corresponding ESV as follows:

$$HQ_{screen} = \frac{MDCC}{ESV}$$

Where:

HQ_{screen}	=	screening-level hazard quotient;
$MDCC$	=	maximum detected constituent concentration; and
ESV	=	ecological screening value.

A calculated HQ_{screen} value of one indicated that the MDCC was equal to the chemical's conservative ESV and was interpreted in this assessment as a constituent that does not pose the potential for adverse ecological risk. An HQ_{screen} value less than one indicated that the MDCC was less than the conservative ESV and that the chemical is not likely to pose adverse ecological hazards to most receptors. Conversely, an HQ_{screen} value greater than one indicated that the MDCC was greater than the ESV and that the chemical might pose adverse ecological hazards to one or more receptors.

In order to better understand the potential risks posed by chemical constituents at the Impact Area, a mean hazard quotient was also calculated by comparing the arithmetic mean constituent concentration in surface soil to the corresponding ESV. The calculated screening-level hazard quotients for constituents in surface soil at the Impact Area are presented in Table 1.

The USEPA recognizes several constituents in abiotic media that are necessary to maintain normal function in many organisms. These essential macro-nutrients are iron, magnesium, calcium, potassium, and sodium (USEPA, 1989). Most organisms have mechanisms designed to regulate nutrient fluxes within their systems; therefore, these nutrients are generally only toxic at very high concentrations. Although iron is an essential nutrient and is regulated within many organisms, it may become increasingly bioavailable at lower pH values, thus increasing its potential to elicit adverse affects. Therefore, iron was not evaluated as an essential nutrient in this PERA. Essential macro-nutrients were only considered COPECs if they were present in site samples at concentrations ten times the naturally-occurring background concentration.

The comparison of detected constituent concentrations with naturally occurring constituent concentrations was conducted via a three-tier process outlined in a technical memorandum dated June 24, 2003 (Shaw, 2003). The first tier of the background comparison process was a comparison of the maximum detected constituent concentration to the background threshold value (BTV). A study of the natural geochemical composition associated with FTMC (SAIC, 1998) determined the mean concentrations of 24 metals in surface soil, surface water, sediment, and groundwater samples collected from presumably un-impacted areas. Per agreement with USEPA Region IV, the background threshold value (BTV) for each metal was calculated as two times the mean background concentration for that metal. The BTV for each metal was used to represent the upper boundary of the range of natural background concentrations expected at FTMC, and was used as the basis for evaluating metal concentrations measured in site samples. Site sample metal concentrations less than or equal to the corresponding BTV represent the natural geochemical composition of media at FTMC, and not contamination associated with site activity. Site sample metal concentrations greater than the corresponding BTV require further background assessment.

If maximum constituent concentrations were greater than the BTV, then the second tier of the background comparison was employed. Tier two of the background comparison consists of statistical comparisons of the site data to background data using the Slippage Test and the Wilcoxon Rank Sum (WRS) Test. If the site data failed either the Slippage Test or the WRS Test, then the site data were subjected to a geochemical evaluation (Tier 3) to determine whether concentrations of inorganic compounds are naturally occurring or are elevated due to contamination. The three-tier background comparison process is described in detail in Appendix H of this report.

Thus, the first step in determining screening-level hazard quotients was a comparison of maximum detected constituent concentrations to appropriate ESVs. Constituents with HQ_{screen} values less than one were considered to pose insignificant ecological risk and were eliminated from further consideration. Constituents with HQ_{screen} values greater than one were eliminated from further consideration if they were macro-nutrients. Those constituents that had HQ_{screen} values greater one and were not considered macro-nutrients were then compared to background using the three-tier background screening process. If constituent concentrations were determined to be less than their naturally-occurring background concentrations, then a risk management decision could result in eliminating these constituents from further assessment.

The constituents that exceeded their respective ESVs, are not essential macro-nutrients, and were detected at concentrations that exceeded naturally occurring levels include the following:

- trichloroethene;
- copper; and
- lead.

Additional lines of evidence are sometimes useful in determining whether a certain constituent is in fact site-related and a COPEC. Some of the additional lines of evidence used in the process of identifying COPECs include: 1) frequency of detection, 2) magnitude of the HQ_{screen} value, 3) spatial distribution, 4) alternative ESVs; and 5) association of a chemical with known Army activities. These additional lines-of-evidence were used to further define the COPECs at the Impact Area South of the POW Training Facility.

The Impact Area South of the POW Training Facility (Impact Area) is known to have received rifle and machine gun fire and is contaminated with bullet fragments and the metals contained in bullets. Lead is the contaminant released in greatest quantities, as reflected in the concentrations observed in surface soil. Lead exceeds both the ESV and BTV in surface soil and as such, has been identified as a COPEC. Surface soil samples have also displayed anomalously high concentrations of lead compared to naturally occurring background levels. Also, the pattern of lead contamination has been sufficiently characterized to identify three separate and distinct areas of contamination. It is reasonable to expect that all site-related metals (i.e., bullet-related constituents) would exhibit the same distribution pattern., which may serve as a useful line of evidence to resolve the status of the other metals detected in surface soil.

Copper is also a site-related chemical that is a recognized component of bullets, particularly those with copper jackets. The distribution of copper in relation to lead validates the assertion that the distribution pattern of a chemical may be used to help identify site-related chemicals. There appears to be a clear and direct correlation between copper and lead concentrations. The pattern of copper contamination has been sufficiently characterized to identify three separate and distinct areas of contamination that correspond directly with the areas identified as those with the highest lead concentrations. Copper was detected in 19 samples at concentrations exceeding its BTV. Surface soil samples have also displayed anomalously high concentrations of copper compared to naturally occurring background levels. Therefore, copper was identified as a COPEC in surface soil at the Impact Area.

Trichloroethene was detected in one out of three surface soil samples (IMP-IASPOW-MW02) at the Impact Area at a concentration that slightly exceeded the ESV. The calculated HQ_{screen} value for trichloroethene was 1.9. Trichloroethene was detected in the southwestern portion of the site in an area that did not exhibit elevated concentrations of any other constituent. Because of the isolated nature of the detected trichloroethene in soil and the relatively low detected concentration of trichloroethene in surface soil, it was not considered a COPEC in surface soil at the Impact Area.

Ecological Risk Characterization. Lead and copper were frequently detected in surface soil from the Impact Area at concentrations that exceeded their respective ESVs and naturally

occurring levels. As such, these two constituents have the potential to pose ecological risk. It is important to note that the pattern of lead and copper contamination in surface soil has been sufficiently characterized to identify three separate and distinct areas of contamination at the Impact Area that are consistent with past site usage. The remaining inorganic constituents were determined to be either not site-related or posed insignificant potential for ecological risk.

The VOC trichloroethene was detected in one out of three surface soil samples (IMP-IASPOW-MW02) at a concentration that slightly exceeded its ESV. The calculated HQ_{screen} value for trichloroethene was 1.9. Trichloroethene was detected in the southwestern portion of the site in an area that did not exhibit elevated concentrations of any other constituent. Because of the isolated nature of the detected trichloroethene in soil and the relatively low detected concentration it is unlikely that trichloroethene would pose significant ecological risk in surface soil at the Impact Area.

References

IT Corporation, 2000, ***Final Human Health and Ecological Screening Values and PAH Background Summary Report, Fort McClellan, Calhoun County, Alabama***, July.

IT Corporation, 1998, ***Installation-Wide Work Plan, Fort McClellan, Calhoun County, Alabama***, August.

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TABLE 1
CONSTITUENTS OF POTENTIAL ECOLOGICAL CONCERN IN SURFACE SOIL
Impact Area South of the POW Training Facility
Fort McClellan, Calhoun County, Alabama

Detected Constituents	Background Threshold Value[a] (mg/kg)	Ecological Screening Value[b] (mg/kg)	Frequency of Detection	Maximum Detected Concentration (mg/kg)	Minimum Detected Concentration (mg/kg)	Mean Detected Concentration (mg/kg)	Maximum Hazard Quotient	Mean Hazard Quotient	Constituent of Potential Ecological Concern
Volatiles :									
2-Butanone	NA	89.6	1 of 3	0.018	0.018	0.012	0.00020	0.00014	1
Acetone	NA	2.5	3 of 3	0.33	0.14	0.22	0.13200	0.08667	1
Methylene chloride	NA	2	2 of 3	0.0055	0.003	0.0050	0.00275	0.00249	1
Tetrachloroethene	NA	0.01	1 of 3	0.0027	0.0012	0.0020	0.27000	0.20333	1
Trichloroethene	NA	0.001	1 of 3	0.0019	0.0019	0.0023	1.90000	2.26667	YES[7]
Trichlorofluoromethane	NA	0.1	2 of 3	0.0027	0.002	0.0023	0.02700	0.02300	1
Metals :									
Aluminum	16,300	50	22 of 22	32,000	8,440	22,756	640	455.12727	5
Antimony	1.99	3.5	1 of 22	6.20	5.41	5.86	1.771	1.67545	4
Arsenic	13.7	10	22 of 22	16.6	4.78	8.89	1.66	0.88855	5
Barium	124	165	22 of 22	124	30.2	78.98	0.752	0.47868	1,3,5
Beryllium	0.8	1.1	22 of 22	1.57	0.455	0.80	1.427	0.73050	5
Calcium	1,720	NA	22 of 22	1,390	72.7	354.35	ND	ND	2,3
Chromium	37	0.4	22 of 22	37.7	6.6	18.23	94.25	45.57955	5
Cobalt	15.2	20	22 of 22	23.4	4	9.90	1.17	0.49482	5
Copper	12.7	40	22 of 22	200	9.87	43.74	5	1.09338	YES
Iron	34,200	200	22 of 22	45,400	14,400	27,964	227	139.81818	5
Lead	40.1	50	22 of 22	809	14.6	180.42	16.18	3.60836	YES
Magnesium	1,030	440,000	22 of 22	1,420	326	782	0.0032	0.00178	1,2,5
Manganese	1,580	100	22 of 22	3,190	299	1,582	31.9	15.81545	5
Mercury	0.08	0.1	20 of 22	0.112	0.0333	0.06	1.12	0.58986	4,5
Nickel	10.3	30	22 of 22	18.2	6.42	12.21	0.607	0.40712	1,5
Potassium	800	NA	22 of 22	1,110	433	742.05	ND	ND	2,5
Selenium	0.48	0.81	13 of 22	2.08	0.627	0.71	2.568	0.88053	5
Silver	0.36	2	4 of 22	2.13	1.74	1.31	1.065	0.65420	5
Sodium	634	NA	20 of 22	68.2	23.6	56.34	ND	ND	2,3
Vanadium	58.8	2	22 of 22	52.9	16	38.60	26.45	19.30227	3
Zinc	40.6	50	22 of 22	55.4	17.4	35.83	1.108	0.71664	5
Herbicides :									
4,4'-DDT	NA	0.0025	1 of 3	0.00235	0.00089	0.0018	0.94	0.73867	1

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[a] Background threshold value is two times (2x) the arithmetic mean of background metals (SAIC, 1998). For SVOCs, the BTV is the background screening value for soils adjacent to asphalt as given in IT Corporation (IT), 2000, *Final Human Health and Ecological Screening Values and PAH Background Summary Report, Fort McClellan, Calhoun County, Alabama*, July.

[b] Ecological Screening Values (ESV) are presented in *Human Health and Ecological Screening Values and PAH Background Summary Report* (IT, 2000).

NA - Not available. ND - Not determined.

Rationale for inclusion / exclusion as a COPEC:

1 - Maximum detected concentration is less than ESV
2 - Essential macro-nutrient, only toxic at extremely high concentrations (i.e. 10-times naturally-occurring background concentrations).
3 - Maximum detected concentration is less than the background threshold value (BTV).
4 - Slippage Test and Wilcoxon Rank Sum Test indicate the concentration of this constituent is statistically similar to background concentrations.
5 - Geochemical evaluation of the data indicate that this constituent is naturally occurring.
6 - No ESV available; however, maximum detected concentration of this constituent is less than ESV for similar compounds.
7 - Additional lines of evidence indicate that this constituent may not be a COPEC (see text).