

APPENDIX I
PRELIMINARY ECOLOGICAL RISK ASSESSMENT

Technical Memorandum

Preliminary Ecological Risk Assessment Range 23A Multipurpose Range, Parcel 109(7)/152Q-X

Fort McClellan, Calhoun County, Alabama

1.0 Introduction

This Technical Memorandum presents the Preliminary Ecological Risk Assessment (PERA) for Range 23A Multipurpose Range, Parcel 109(7)/152Q-X 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 which 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.

2.0 Ecological Habitat Description

Range 23A, Multipurpose Range, is approximately 41 acres in size and is located in the north-central portion of Pelham Range. There is a north-south trending depression in the center of the site. The topography of the site gradually rises approximately 75 feet to the east and 50 feet to the west of this depression. The vast majority of the site is characteristic of an oldfield ecosystem. The eastern portion of the site is forested with a relatively immature mixed deciduous/coniferous forest.

The majority of the site was formerly cleared and maintained, but since maintenance activities have ceased in this area, pioneer species are colonizing 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 oldfield successional state. Over time, these grass and herbaceous species will be followed by shrubs and small trees. The early oldfield, successional habitat at Range 23A is dominated by various grasses and herbs including *Rumex spp.* (dock), *Trifolium spp.* (clover), *Astragalus spp.* (vetch), *Asclepias spp.* (milkweed), *Galium spp.* (bed straw), *Chrysanthemum leucanthemum* (ox-eye daisy), and *Sorghum halepense* (Johnson grass). Other oldfield herbaceous species occurring at Range 23A are *Toxicodendron radicans* (poison ivy), *Rubus glabra* (smooth sumac), *Smilax rotundiflora* (green brier), *Lonicera japonica* (Japanese honeysuckle), *Vitis labrusca* (fox grape), and *Rosa multiflora* (multiflora rose). Loblolly pine (*Pinus taeda*) and shortleaf pine (*Pinus echinata*) saplings have also begun to encroach into this oldfield, early successional habitat. There are also significant areas of bare soil within the oldfield ecosystem at Range 23A where vegetation is absent.

The eastern boundary of the site is characterized by relatively immature mixed deciduous/coniferous forest. The cover species typically found in these forested areas include scrub pine (*Pinus virginiana*), loblolly pine (*Pinus taeda*), white oak (*Quercus alba*), post oak (*Quercus stellata*), chestnut oak (*Quercus prinus*), southern red oak (*Quercus falcata*), wild black cherry (*Prunus serotina*), hackberry (*Celtis occidentalis*), black walnut (*Juglans nigra*), and flowering dogwood (*Cornus florida*). These mixed deciduous/coniferous forests exhibit sparse, shade-tolerant undergrowth species such as *Parthenocissus quinquefolia* (Virginia creeper), *Polystrichum acrotichoides* (Christmas fern), and *Toxicodendron radicans* (poison ivy). Understory and shrub species are typically sparse in this type of habitat. A mat of pine needles and leaves generally inhibits the growth of shrub and herbaceous layers within this forest type.

Typical terrestrial species inhabiting this type of habitat include eastern gray squirrel (*Sciurus carolinensis*), 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*).

A small ephemeral drainage feature runs in a north-to-south direction within the topographic depression near the center of the study area. This drainage feature is dry during significant periods of time during a normal year. It is narrow (2 to 3 feet wide) and shallow (0 to 6 inches deep) with substrates of mainly cobbles and gravel interspersed with small depositional areas of mud and sand. The small size and ephemeral nature of this drainage feature preclude the presence of large fish species and other animals that might prey on fish (piscivores); however, semi-aquatic species (amphibians) would be expected to occur in this drainage feature.

3.0 Media of Interest and Data Selection

The media of interest at Range 23A are surface soil, surface water, sediment, and groundwater. Exposures to subsurface soil are unlikely for ecological receptors at this study area. Terrestrial species could be exposed to surface soil via a number of pathways during routine feeding, grooming, and nesting habits. Terrestrial and semi-aquatic species could be exposed to surface water and/or sediment via surface water consumption and other routine feeding activities. Semi-aquatic species could be exposed to groundwater via groundwater intrusion to surface water bodies (e.g. ephemeral stream) and subsequent surface water exposure pathways. Eleven surface soil samples were collected and analyzed for metals, volatile organic compounds (VOC), semivolatile organic compounds (SVOC), pesticides, herbicides, and explosives. Six surface water, and six sediment samples were collected and analyzed for metals, VOCs, SVOCs, pesticides, herbicides, and explosives. Four groundwater samples were collected and analyzed for metals, VOCs, SVOCs, pesticides, herbicides, and explosives.

4.0 Identification of Constituents of Potential Ecological Concern

In order to determine whether constituents detected in samples collected at Range 23A 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 macronutrients; and
- Comparison to naturally occurring background concentrations.

The ESVs 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, surface water, sediment, or groundwater at the Range 23A were evaluated against the corresponding ESVs by calculating a screening-level hazard quotient (HQ_{screen}) for each constituent in each environmental medium. An HQ_{screen} was calculated by dividing the maximum detected constituent concentration in each medium 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 Range 23A, a mean hazard quotient was also calculated by comparing the arithmetic mean constituent concentration in surface soil, surface water, sediment, and groundwater to the corresponding ESV. The calculated screening-level hazard quotients for constituents in surface soil, surface water, sediment, and groundwater at Range 23A are presented in Tables 1 through 4, respectively.

The USEPA recognizes several constituents in abiotic media that are necessary to maintain normal function in many organisms. These essential macronutrients 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 macronutrients 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 Shaw technical memorandum (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 4, 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 consisted 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 provided separately in the SI 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 macronutrients and were present at concentrations less than 10-times the naturally occurring levels. Those constituents that had HQ_{screen} values greater one and were not considered macronutrients 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.

None of the constituents in surface soil at Range 23A were identified as COPECs (Table 1).

None of the constituents in surface water at Range 23A were identified as COPECs (Table 2).

None of the constituents in sediment at Range 23A were identified as COPECs (Table 3).

Groundwater at the Range 23A was assessed using surface water ESVs in order to determine the potential for impacts to aquatic organisms from groundwater intrusion to the ephemeral drainage feature at the site. It is important to note that surface water ESVs are not intended to be applied to groundwater data because ecological receptors are not directly exposed to groundwater under most circumstances. However, in order to address the potential for future groundwater intrusion into this ephemeral drainage feature, the groundwater-to-surface water ESV comparison was incorporated into this PERA. Current conditions in the ephemeral drainage feature at the Range

23A are most appropriately assessed via a comparison of surface water data from the drainage feature to surface water ESVs (Table 2). A comparison of the groundwater data to surface water ESVs indicated that none of the constituents in groundwater at Range 23A were identified as COPECs (Table 4).

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. Because no constituents were identified as COPECs in surface soil, surface water, sediment, or groundwater, it was not necessary to consider additional lines of evidence at Range 23A.

5.0 Ecological Risk Characterization

Range 23A is characterized as mostly oldfield ecosystem with a relatively immature mixed deciduous/coniferous forest along the eastern boundary of the study area. An ephemeral drainage feature runs in a north-to-south direction through the center of the study area along a topographical depression. This drainage feature is dry during significant periods of time during a normal year.

In general, a number of inorganic constituents and low levels of several VOCs were detected in the environmental media at Range 23A. None of the constituents detected in surface soil, surface water, sediment, or groundwater were identified as COPECs; therefore, ecological risks from exposure to surface soil, surface water, sediment and groundwater at Range 23A are expected to be negligible.

6.0 Uncertainty Evaluation

A number of uncertainties are inherent in the PERA process, the vast majority of which err on the side of ecological protectiveness. One significant source of uncertainty that may impart a non-conservative bias on the PERA results is the exclusion of metals determined to be present at concentrations comparable to naturally occurring background concentrations from consideration as COPECs. The chemicals excluded from selection as COPECs based solely on their comparison to background concentrations are discussed below.

As noted above, the exclusion of chemicals from the list of COPECs based on comparison to naturally occurring levels is performed via a three-tiered protocol (Shaw, 2003). Tier 1 – comparison of the maximum detected constituent concentration to the BTV – is generally considered to be sufficiently conservative so that the uncertainty associated with chemicals eliminated in this tier of the protocol is minimal. Therefore, only chemicals excluded as COPECs via tiers 2 or 3 of the background screening protocol are discussed herein.

6.1 Surface Soil

Arsenic and zinc were eliminated from consideration as COPECs solely on geochemical comparisons to naturally occurring levels of these metals. The HQ_{screen} values for arsenic and

zinc were calculated to be 2.3 and 1.3, respectively. Additionally, only one surface soil sample exhibited a zinc concentration greater than the ESV. Because the maximum detected concentrations of arsenic and zinc only slightly exceeded their highly conservative ESVs, and zinc was detected at an elevated concentration in only one sample, the level of uncertainty in eliminating these metals from the list of COPECs is minimal.

6.2 Surface Water

Cobalt was the only constituent eliminated from consideration as a COPEC in surface water solely on statistical and geochemical comparisons to naturally occurring levels in surface water. The calculated HQ_{screen} value for cobalt in surface water was 5.7. The USEPA Region 5 (2004) Ecological Screening Level (ESL) for cobalt is 0.024 mg/L. If this value is considered as an alternative ESV for cobalt in surface water, then none of the detected concentrations of cobalt in surface water exceed this alternative ESV. Based on the comparison to alternative ESVs, the exclusion of cobalt from the list of COPECs introduced minimal uncertainty into the results of the PERA.

6.3 Sediment

Aluminum, manganese, and selenium were eliminated from consideration as COPECs in sediment solely on statistical and geochemical comparisons to naturally occurring levels in sediment. Both statistical tests (Wilcoxon Rank Sum and Slippage Test) (USEPA Region 4, 1998) indicated manganese and selenium concentrations in sediment were comparable to background concentrations. Sediment ESVs are not available for these three constituents; therefore, the exclusion of these metals from consideration as COPECs introduces an unknown level of uncertainty into this PERA.

6.4 Groundwater

Aluminum, barium, beryllium, cobalt, copper, iron, lead, manganese, mercury, and vanadium were eliminated from consideration as COPECs in groundwater solely on statistical and geochemical comparisons to naturally occurring levels in groundwater. The National Recommended Water Quality Criteria (USEPA, 2002) for mercury is 0.077 $\mu\text{g/L}$. If this value is considered as an alternative ESV for mercury, then all of the detected concentrations of mercury in groundwater were less than this alternative ESV. Therefore, exclusion of mercury from the list of groundwater COPECs imparts minimal uncertainty in the PERA results.

The USEPA Region 5 (2004) ESLs for barium and beryllium are 0.22 mg/L and 0.0036 mg/L, respectively. If these values are used as alternative ESVs, then all of the detected concentrations of barium and beryllium in groundwater were less than these alternative ESVs and the exclusion of barium and beryllium from the list of COPECs in groundwater imparts minimal uncertainty in the PERA results.

Copper, lead, and vanadium were detected in one out of four groundwater samples at concentrations that exceeded their respective surface water ESVs. None of these three metals were detected in surface water samples from Range 23A. Therefore, based on the infrequency of detection in groundwater and the absence of detectable levels of these constituents in surface water, elimination of these constituents from consideration as groundwater COPECs imparts minimal uncertainty on the results of this PERA.

The maximum detected concentration of iron in groundwater was less than the BTV for iron in surface water; therefore, the elimination of iron from consideration as a groundwater COPEC imparts minimal uncertainty in the PERA results.

The exclusion of aluminum, cobalt, and manganese from the list of groundwater COPECs remains a source of uncertainty in this PERA

7.0 Summary and Conclusions

In summary, 11 surface soil samples, 6 surface water and sediment samples, and 4 groundwater samples from Range 23A were analyzed for metals, nitroaromatic/nitramine explosives, VOCs, SVOCs, organochlorine pesticides, and chlorinated phenoxyacid herbicides. In general, a number of inorganic compounds and low levels of VOCs were detected in the environmental media samples from Range 23A.

None of the constituents detected in surface soil, surface water, sediment, or groundwater were identified as COPECs. Therefore, the potential risks to ecological receptors from exposure to surface soil, surface water, sediment, or groundwater at Range 23A are insignificant.

8.0 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, *Final Installation-Wide Work Plan, Fort McClellan, Calhoun County, Alabama*, August.

Shaw Environmental, Inc., 2003, "Selecting Site-Related Chemicals for Human Health and Ecological Risk Assessments for FTMC: Revision 2," technical memorandum dated June 24.

Science Applications International Corporation (SAIC), 1998, *Final Background Metals Survey Report, Fort McClellan, Alabama*, July.

USEPA Region 5, 2004, *RCRA Ecological Screening Levels*, online.

USEPA, 2002, *National Recommended Water Quality Criteria for Priority Toxic Pollutants*, Office of Water, Washington, DC, EPA/822-R-02-047.

USEPA, 2000, *Ecological Soil Screening Level Guidance*, Draft, Office of Emergency and Remedial Response, Washington, DC.

USEPA Region 4, 1998, *Statistical Tests for Background Comparison at Hazardous Waste Sites*, Waste Management Division, Atlanta, GA.

USEPA, 1989, *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A)*, Office of Emergency and Remedial Response, Washington, DC. EPA/540/1-89/002.

TABLE 1
CONSTITUENTS OF POTENTIAL ECOLOGICAL CONCERN IN SURFACE SOIL
Range 23A Multipurpose Range, Parcel 109(7)/152Q-X
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 :									
1,2,4-Trimethylbenzene	NA	0.1	2 of 11	0.0021	0.0014	0.0018	0.021	0.0175	1
1,2-Dimethylbenzene	NA	0.1	1 of 11	0.0021	0.0021	0.0021	0.021	0.021	1
2-Butanone	NA	89.6	4 of 11	0.012	0.0062	0.0098	0.00013	0.00011	1
Acetone	NA	2.5	4 of 4	0.18	0.0072	0.1168	0.072	0.04672	1
m,p-Xylenes	NA	0.05	2 of 11	0.004	0.0013	0.0027	0.080	0.053	1
Toluene	NA	0.05	2 of 11	0.0023	0.0017	0.0020	0.046	0.04	1
Metals :									
Aluminum	16,300	50	11 of 11	16,200	5,960	11,458	324	229	3
Arsenic	13.7	10	11 of 11	23.2	5.07	12.47	2,320	1.247	5
Barium	124	165	11 of 11	43.3	18.3	29.9	0.262	0.181	1,3
Beryllium	0.8	1.1	3 of 11	0.572	0.398	0.478	0.520	0.435	1,3
Calcium	1,720	NA	9 of 9	246	117	165	ND	ND	2,3
Chromium	37	0.4	11 of 11	22.2	7.49	13.49	55.5	33.7	3
Cobalt	15.2	20	7 of 8	9.64	3.47	6.07	0.482	0.304	1,3
Copper	12.7	40	11 of 11	19.2	7.58	10.21	0.480	0.255	1,5
Iron	34,200	200	11 of 11	24,700	8,100	14,214	123.5	71.1	3
Lead	40.1	50	11 of 11	15.5	7.2	9.3	0.310	0.186	1,3
Magnesium	1,030	440,000	11 of 11	1,040	311	605	0.00236	0.00137	1,2,5
Manganese	1,580	100	11 of 11	620	42.8	246.7	6.20	2.47	3
Mercury	0.08	0.1	1 of 10	0.039	0.039	0.039	0.39	0.39	1,3,5
Nickel	10.3	30	4 of 4	11.6	4.91	7.65	0.387	0.255	1,4
Potassium	800	NA	11 of 11	1,180	280	499.18	ND	ND	2,5
Selenium	0.48	0.81	4 of 8	0.704	0.669	0.68	0.869	0.840	1,5
Silver	0.36	2	6 of 10	1.93	1.29	1.55	0.965	0.773	1,5
Sodium	634	NA	11 of 11	45.7	33.8	38.1	ND	ND	2,3
Vanadium	58.8	2	11 of 11	38.4	13.7	25.9	19.20	12.97	3
Zinc	40.6	50	11 of 11	66.8	11.5	30.0	1.336	0.601	5

TABLE 1
CONSTITUENTS OF POTENTIAL ECOLOGICAL CONCERN IN SURFACE SOIL
Range 23A Multipurpose Range, Parcel 109(7)/152Q-X
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
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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 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).

TABLE 2
CONSTITUENTS OF POTENTIAL ECOLOGICAL CONCERN IN SURFACE WATER
Range 23A Multipurpose Range, Parcel 109(7)/152Q-X
Fort McClellan, Calhoun County, Alabama

Detected Constituents	Background Threshold Value ^a (mg/L)	Ecological Screening Value ^b (mg/L)	Frequency of Detection	Maximum Detected Concentration (mg/L)	Minimum Detected Concentration (mg/L)	Mean Detected Concentration (mg/L)	Maximum Hazard Quotient	Mean Hazard Quotient	Constituent of Potential Ecological Concern
Volatiles :									
Acetone	NA	78	3 of 3	0.025	0.018	0.022	0.00032	0.00028	1
Metals :									
Aluminum	5.26	0.087	6 of 6	3.37	0.196	1.736	38.736	19.9540	3
Arsenic	0.00217	0.19	2 of 6	0.00363	0.00193	0.00278	0.019	0.0146	1,5
Barium	0.0754	0.0039	6 of 6	0.0306	0.0196	0.0242	7.846	6.2009	3
Calcium	25.2	116	6 of 6	4.27	1.76	2.43	0.037	0.0210	1,2,3
Cobalt	NA	0.003	3 of 6	0.017	0.0116	0.0144	5.667	4.8000	4
Iron	19.6	1	6 of 6	2.2	0.545	1.094	2.200	1.0940	3
Magnesium	11	82	6 of 6	2.3	0.677	1.101	0.028	0.0134	1,2,3
Manganese	0.565	0.08	6 of 6	0.195	0.0128	0.1227	2.438	1.5338	3
Potassium	2.56	53	1 of 6	0.807	0.807	0.807	0.015	0.0152	1,2,3
Sodium	3.44	680	3 of 3	1.07	0.954	1.03	0.002	0.0015	1,2,3

^a Background threshold value is two times (2x) the arithmetic mean of background metals (SAIC, 1998).

^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 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).

TABLE 3

CONSTITUENTS OF POTENTIAL ECOLOGICAL CONCERN IN SEDIMENT
Range 23A Multipurpose Range, Parcel 109(7)/152Q-X
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 :									
1,2,4-Trimethylbenzene	NA	NA	1 of 6	0.0018	0.0018	0.0018	ND	ND	6
2-Butanone	NA	0.137	4 of 6	0.033	0.015	0.0210	0.24088	0.15328	1
Acetone	NA	0.453	2 of 3	0.17	0.17	0.17	0.37528	0.37528	1
Carbon disulfide	NA	0.134	1 of 6	0.0028	0.0028	0.0028	0.0209	0.0209	1
m,p-Xylenes	NA	0.025	2 of 6	0.0024	0.0017	0.0021	0.096	0.082	1
Toluene	NA	0.67	5 of 6	0.0046	0.0013	0.0027	0.00687	0.00400	1
Metals :									
Aluminum	8,590	NA	6 of 6	13,500	3,900	8,945	ND	ND	5
Arsenic	11.3	7.24	6 of 6	10.4	5.56	7.95	1.436	1.098	3
Barium	98.9	NA	6 of 6	78.4	9.2	40.4	ND	ND	3
Beryllium	0.97	NA	1 of 6	0.674	0.674	0.674	ND	ND	3
Calcium	1,110	NA	6 of 6	1,360	70.6	384.77	ND	ND	2,4
Chromium	31.2	52.3	6 of 6	15.8	6.61	9.99	0.302	0.191	1,3
Cobalt	11	50	6 of 6	8.07	1.61	5.35	0.161	0.107	1,3
Copper	17.1	18.7	6 of 6	16.9	7.99	11.30	0.904	0.604	1,3
Iron	35,300	NA	6 of 6	14,700	8,060	10,680	ND	ND	3
Lead	37.8	30.2	6 of 6	18.1	4.2	11.7	0.599	0.386	1,3
Magnesium	906	NA	6 of 6	738	194	467	ND	ND	2,3
Manganese	712	NA	6 of 6	1,130	72	427	ND	ND	4
Mercury	0.11	0.13	1 of 6	0.0427	0.0427	0.0427	0.328	0.328	1,3
Nickel	13	15.9	6 of 6	8.49	2.09	6.16	0.534	0.387	1,3
Potassium	1,010	NA	6 of 6	479	202	314	ND	ND	2,3
Selenium	0.72	NA	3 of 6	0.897	0.667	0.774	ND	ND	4
Sodium	692	NA	6 of 6	53.5	37.2	46.7	ND	ND	2,3
Vanadium	40.9	NA	6 of 6	25	12.8	19.5	ND	ND	3
Zinc	52.7	124	6 of 6	39	11	28	0.315	0.222	1,3

TABLE 3
CONSTITUENTS OF POTENTIAL ECOLOGICAL CONCERN IN SEDIMENT
Range 23A Multipurpose Range, Parcel 109(7)/152Q-X
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
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^a Background threshold value is two times (2x) the arithmetic mean of background metals (SAIC, 1998).

^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 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).

TABLE 4
CONSTITUENTS OF POTENTIAL ECOLOGICAL CONCERN IN GROUNDWATER
Range 23A Multipurpose Range, Parcel 109(7)/152Q-X
Fort McClellan, Calhoun County, Alabama

Detected Constituents	Background Threshold Value ^a (mg/L)	Ecological Screening Value ^b (mg/L)	Frequency of Detection	Maximum Detected Concentration (mg/L)	Minimum Detected Concentration (mg/L)	Mean Detected Concentration (mg/L)	Maximum Hazard Quotient	Mean Hazard Quotient	Constituent of Potential Ecological Concern
Volatiles :									
Acetone	NA	78	1 of 1	0.72	0.72	0.72	0.00923	0.00923	1
Metals :									
Aluminum	2.34	0.087	4 of 4	19.7	0.080	5.08	226.437	58.390	5
Arsenic	0.0178	0.19	2 of 4	0.0132	0.00219	0.0077	0.0695	0.0405	1,3
Barium	0.127	0.0039	4 of 4	0.136	0.013	0.048	34.872	12.205	4
Beryllium	0.00125	0.00053	1 of 4	0.00366	0.00366	0.004	6.906	6.906	4
Calcium	56.5	116	3 of 4	8.41	0.652	3.241	0.0725	0.0279	1,2,3
Chromium	0.0111	0.011	1 of 4	0.00656	0.00656	0.01	0.5964	0.5964	1,3,4
Cobalt	0.0234	0.003	2 of 4	0.0611	0.0302	0.046	20.367	15.217	5
Copper	0.0255	0.00654	1 of 4	0.0343	0.0343	0.03	5.245	5.245	4
Iron	7.04	1	4 of 4	16.9	0.0408	5.27	16.90	5.27	4
Lead	0.008	0.00132	1 of 4	0.043	0.043	0.04	32.58	32.58	4
Magnesium	21.3	82	3 of 3	4.91	0.345	2.00	0.0599	0.0243	1,2,3
Manganese	0.581	0.08	4 of 4	1.43	0.0273	0.62	17.875	7.723	4
Mercury	NA	0.000012	1 of 4	0.000274	0.000274	0.000274	22.833	22.833	5
Nickel	0.0225	0.0877	2 of 4	0.043	0.0164	0.03	0.490	0.339	1,5
Sodium	14.8	680	3 of 3	45.7	1.04	16.94	0.0672	0.0249	1,2,4
Vanadium	0.017	0.019	1 of 3	0.0201	0.0201	0.02	1.058	1.058	4
Zinc	0.22	0.0589	1 of 4	0.135	0.135	0.14	2.292	2.292	3

^a Background threshold value is two times (2x) the arithmetic mean of background metals (SAIC, 1998).

^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 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).