APPENDIX J

PRELIMINARY HUMAN HEALTH RISK ASSESSMENT

Technical Memorandum

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To: Range 4A Fog Oil Storage Area, Parcel 123(6), Pelham Range, Fort McClellan Preliminary Risk Assessment File

Date: 3 April 2002

Subject: **PRELIMINARY RISK ASSESSMENT FOR SUBJECT SITE**

This memorandum provides a preliminary risk assessment (PRA) for exposure to surface or subsurface soil and groundwater at the Range 4AFog Oil Storage Area. The PRA approach is a shortened version of the streamlined risk assessment (SRA) protocol developed as a uniform and economical approach to evaluating hundreds of similar sites at Fort McClellan (FTMC). It is assumed that the reader is familiar with FTMC and the fundamentals of the SRA protocol. The reader is referred to the *Installation-Wide Work Plan* (IWWP) (IT, 1998) for more detail. All the comparison and computational operations of the PRA are performed within EXCEL® spread sheet tables. The results of each step are described below.

Media of Interest and Data Selection. Data consist of 5 surface soil and 3 depositional soil samples (collectively evaluated as surface soil), 4 subsurface soil samples, and 5 groundwater samples. All samples were analyzed for metals, volatile organic compounds and semivolatile organic compounds. The validated data are summarized by sample location in Tables 5-1 (surface soil), 5-2 (subsurface soil), and 5-3 (groundwater) from the site investigation (SI).

Site-Related Chemical Selection. Site-related chemicals are those presumed to be released because of activities performed by the army during operation of FTMC. They are identified in Table 1 (surface soil), Table 2 (subsurface soil), and Table 3 (groundwater) by comparing the maximum detected concentration (MDC) of each chemical with its background screening criterion (BSC), computed as two times the mean of the background data set, in accordance with EPA (2001a) Region 4 guidance. BSCs were taken from Tables 5-1, 5-2, and 5-3. Upper tolerance limits (UTL), the highest metal concentrations reasonably considered to be within background, are also included in Tables 1, 2, and 3 for information, but were not used to select site-related chemicals. The UTL provides a more refined statistical approach than the BSC for comparing site and background data. UTLs were developed for the entire FTMC facility, combining data from the Main Post and Pelham Range. The UTLs for total soil were adopted for subsurface soil.

Chemical of Potential Concern Selection. Chemicals of potential concern (COPC) are site-related chemicals whose MDCs exceed their site-specific screening levels (SSSL), and which may contribute significantly to risk. The SSSLs are receptor-, medium-, and chemical-specific risk-based concentrations that capture all the exposure assumptions and toxicity assessment of a full-blown baseline risk assessment. COPCs are selected for both cancer risk and noncancer effects when the data permit (Tables 1, 2, and 3).

Receptor Scenario Selection. The Range 4A Fog Oil Storage Area is currently used by the Alabama Army National Guard. This use is expected to continue in the future. The most plausible receptor is a National Guardsperson (Goetchius, 2001). An on-site resident is also included as the upper-bound evaluation of exposure and risk, and to provide additional perspective. SSSLs for both receptor scenarios were used in COPC selection and to characterize risk.

Risk Characterization. Risk characterization combines the exposure assumptions and toxicity assessment (incorporated in the SSSLs) with the exposure-point concentration (EPC) to quantify the incremental lifetime cancer risk (ILCR) and noncancer hazard index (HI). ILCR and HI estimates are computed for each chemical in each medium, and are summed to yield a total ILCR and total HI for each receptor scenario. The PRA differs from an SRA in that no attempt is made to estimate an EPC for soil that reflects a conservative estimate of average concentration. A 95 percent upper confidence limit (UCL) on the mean is usually used for this purpose. Instead, the MDC is adopted as the EPC, which imparts a conservative bias to the PRA.

The only plausible receptor scenario for the Range 4A Fog Oil Storage Area is the National Guardsperson. No COPCs were selected for National Guardsperson exposure to surface soil (Table 1); therefore, neither ILCR nor HI were estimated for this receptor for exposure to surface soil. COPCs for the National Guardsperson for exposure to subsurface soil are limited to arsenic and manganese (Table 2). The total ILCR of 1.79E-5 is within the EPA (1990) risk management range. The total HI of 9.93E-1, due entirely to manganese, is just below the threshold value of 1.

COPCs for the National Guardsperson for exposure to groundwater include beryllium, cadmium, chromium and manganese. No COPCs were selected for cancer risk; therefore, no ILCR was estimated for National Guardsperson exposure to groundwater. The total HI of 1.11E+0 slightly exceeds the threshold level of 1. It should be noted that beryllium, cadmium, and chromium were detected only in sample HH3001 from monitoring well PR-123-MW01 (Table 5-3 from the SI). Field parameters presented in Table 3-6 of the SI indicate that this sample had a turbidity reading of greater than 1,000 nephelometric turbidity units (NTU), suggesting that the water sample was grossly contaminated with sediment. The presence of beryllium, cadmium and chromium identified in PR-123-MW01 appears to result from sediment rather than from chemical contamination of the groundwater, and the HI estimated for these chemicals should not be included in the total. The total HI for National Guardsperson exposure to groundwater without the contribution from beryllium, cadmium, and chromium is 1.98E-1, which is below the threshold value of 1. It is concluded that National Guardsperson exposure to soil and groundwater at the Range 4A Fog Oil Storage Area is unlikely to result in unacceptable cancer risk or adverse noncancer health effects.

The on-site resident was also evaluated as the upper-bound on exposure and risk and to provide additional perspective. No COPCs were selected for residential exposure to surface soil (Table 1); therefore, neither ILCR nor HI were estimated for this receptor for exposure to surface soil. COPCs for residential exposure to subsurface soil include arsenic, manganese, and thallium (Table 2). The total ILCR of 1.56E-4, due entirely to arsenic, exceeds the EPA risk management range. The total HI of 3.60E+0 exceeds the threshold value of 1, due largely to arsenic, but with

significant contributions from manganese and thallium. However, the MDCs of manganese and thallium fall below their respective UTLs and within the range of background for subsurface soil at Pelham Range (data not shown) (SAIC, 1998). Therefore, it is deemed that manganese and thallium in subsurface soil represent background rather than site-related chemicals. Arsenic is clearly the only risk driver in subsurface soil at the Range 4A Fog Oil Storage Area.

There is no apparent explanation for the occurrence of arsenic as a site-related chemical in subsurface soil at the Range 4A Fog Oil Storage Area because arsenic is not a component of fog oil or other materials known to be used or handled at the site. Only one sample location, PR-123-MW01, yielded a concentration exceeding the BSC (Table 5-2 from the SI). The concentration also exceeded the UTL and fell above the range for subsurface soil at Pelham Range (data not shown) (SAIC, 1998). Therefore, arsenic in subsurface soil was evaluated as a site-related chemical. However, it is not plausible that a resident would be exposed to subsurface soil alone; excavation would result in mixing of surface and subsurface soil. A more reasonable evaluation, therefore, is performed by combining the data for surface and subsurface soil. The combined data set for arsenic was determined to be distributed nonparametrically (data not shown). The mean arsenic concentration was 1.33E+1 milligram per kilogram (mg/kg). A UCL on the mean of 1.21E+1 mg/kg was estimated for arsenic using the protocol described by IT (1998) for nonparametric distributions. An ILCR for residential exposure to combined surface and subsurface soil of 2.84E-5, within the EPA risk management range, is estimated when the UCL is used as the EPC for arsenic in the combined soil data set. An HI of 5.16E-1, below the threshold value of 1, is estimated using the UCL for arsenic.

COPCs for the residential for exposure to groundwater include aluminum, beryllium, cadmium, chromium cobalt, manganese and nickel. No COPCs were selected for cancer risk; therefore, no ILCR was estimated for residential exposure to groundwater. The total HI of 1.41E+1 exceeds the threshold level of 1. The presence of beryllium, cadmium, and chromium is associated with sediment as described above. Also, cobalt was detected at levels above background only in well PR-123-MW01 (Table 5-3 from the SI), which had a turbidity reading greater than 1,000 NTU (Table 3-6 from the SI). Therefore, cobalt is attributed to sediment rather than chemical contamination of groundwater. Although the MDC of aluminum exceeded its BSC, it fell below the UTL and within the range of background for Pelham Range (SAIC, 1998), and is deemed to be present as a background chemical. The concentration of manganese exceeded its BSC in two wells: PR-123-MW01 and PR-123-MW02 (Table 5-3 from the SI). Both wells had NTU readings greater than 100 (Table 3-6 from the SI), suggesting contamination with sediment. Manganese concentrations in the other wells ranged from 2.21E-1 to 9.18E-1 mg/Liter, well within the range of background. It is deemed that manganese in groundwater is present as background concentrations. In other words, all chemicals selected as COPCs in groundwater except nickel appear to be present at background concentrations or at higher levels as a result of sample contamination with sediment. Therefore, only the HI for nickel should be included in the total HI for groundwater.

The total ILCR for the resident exposed to soil and groundwater is 2.84E-5, due entirely to arsenic in surface and subsurface soil. The HI for arsenic in soil (5.16E-1) and the HI for nickel in groundwater (3.08E-1) should not be summed because arsenic and nickel do not share a common target organ (please see toxicity profiles appended to IT [2000]). Thus, this evaluation

suggests that both the ILCR and HI for residential exposure to soil and groundwater fall within acceptable limits, and that the site can be released for unrestricted use requiring no further action.

It should be noted that the UCL on the mean of 1.21E+1 mg/kg for arsenic in the combined soil data set is slightly less than the mean of 1.33E+1 mg/kg (data not shown), which is counter-intuitive. When this situation is encountered, a more reasonable UCL may be estimated by the "Chebychev" approach, as suggested by EPA (1997). The UCL on the mean of 3.52E+1 mg/kg estimated by the Chebychev approach falls between the mean (1.33E+1 mg/kg) and the MDC (6.63E+1 mg/kg), suggesting that the Chebychev approach returned the more reasonable result. An ILCR of 8.28E-5, within the EPA risk management range, is calculated from the Chebychev UCL of 3.52E+1 mg/kg for arsenic. An HI of 1.50E+0 is also calculated from the Chebychev UCL.

The HI of 1.50E+0 for arsenic slightly exceeds the threshold level of 1, raising concern about releasing the site for unrestricted use with no further action. However, the HI of 1.50E+0 is near the low end of the HI range of 1 to 3 often used by EPA (2001a) for establishing remedial goal options. Also, there is no reason to believe that arsenic is a site-related chemical at the Range 4A Fog Oil Storage Area. Finally, the HI is based on an EPA (2001b) oral reference dose (RfD) of 3E-4 mg/kg-day. EPA (2001b) notes that the RfD is enveloped with considerable uncertainty, and that values from 1E-4 to 8E-4 mg/kg-day would be reasonable. An HI of 5.63E-1 is estimated from an RfD of 8E-4 mg/kg-day. Given these factors, IT recommends that the site can be released for unrestricted use requiring no further action.

References

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*Note: the Installation-Wide Work Plan was revised in September 2001 but has not yet been released for distribution. The description of the protocol and application of the SRA, however, was not substantively changed.

Table 1

Preliminary Risk Evaluation for Exposure to Surface Soil
Range 4A Fog Oil Storage Area, Parcel 123(6)
Fort McClellan, Calhoun County, Alabama

Chemical	MDC	BSC	UTL	Site-Related Chemical?[a]	Res Soil SSSL-c[b]	Res Soil SSSL-n[c]	Res Cancer COPC?[d]	Res Noncancer COPC?[e]	Res ILCR[f]	Res HI[g]	NG Soil SSSL-c[h]	NG Soil SSSL-n[i]	NG Cancer COPC?[d]	NG Noncancer COPC?[e]	NG ILCR[j]	NG HI[k]
METALS																
Aluminum	8.39E+03	1.63E+04	2.14E+04			7.80E+03						1.47E+04				
Arsenic	1.30E+01	1.37E+01	2.54E+01		4.26E-01	2.34E+00					3.70E+00	7.96E+01				
Barium	4.16E+01	1.24E+02	1.94E+02			5.47E+02						1.43E+03				
Beryllium	4.40E-01	8.00E-01	8.68E-01			9.60E+00					3.42E+01	4.42E+01				
Calcium	5.75E+03	1.72E+03	3.54E+03	5.75E+03												
Chromium	1.99E+01	3.70E+01	6.44E+01			2.32E+01					6.85E+00	2.26E+02				
Cobalt	1.97E+01	1.52E+01	3.25E+01	1.97E+01		4.68E+02						6.30E+01				
Copper	4.61E+01	1.27E+01	2.25E+01	4.61E+01		3.13E+02						1.06E+04				
Iron	3.19E+04	3.42E+04	5.54E+04			2.34E+03						7.96E+04				
Lead	3.05E+01	4.01E+01	6.38E+01			4.00E+02						8.80E+02				
Magnesium	3.44E+03	1.03E+03	9.60E+03	3.44E+03												
Manganese	5.07E+02	1.58E+03	4.66E+03			3.63E+02						1.53E+02				
Mercury	5.20E-02	8.00E-02	3.22E-01			2.33E+00						7.12E+01				
Nickel	3.18E+01	1.03E+01	2.00E+01	3.18E+01		1.54E+02					3.42E+02	5.00E+03				
Potassium	7.21E+02	8.00E+02	6.01E+03													
Silver	5.71E-01	3.60E-01	1.13E+00	5.71E-01		3.91E+01						1.33E+03				
Sodium	3.97E+01	6.34E+02	5.63E+02													
Thallium	7.80E-01	3.43E+00	4.53E-01			5.08E-01						1.73E+01				
Vanadium	3.93E+01	5.88E+01	9.94E+01			5.31E+01						1.65E+03				
Zinc	8.39E+01	4.06E+01	7.37E+01	8.39E+01		2.34E+03						7.90E+04				
VOCs																
1,2-Dibromoethane	5.10E-03			5.10E-03	7.38E-03						7.83E-02	6.32E+02				
2-Butanone	3.80E-02			3.80E-02		4.66E+03						1.48E+05				
Acetone	6.10E-01			6.10E-01		7.76E+02						2.58E+04				
Methylene chloride	2.40E-03			2.40E-03	8.41E+01	4.66E+02					8.92E+02	1.55E+04				
Toluene	2.70E-03			2.70E-03		1.55E+03						4.98E+04				
Total ILCR, HI																

All concentrations expressed as mg/kg.
MDC = maximum detected concentration; BSC = background screening criterion; UTL = 95% upper tolerance limit (incorporates data from Main Post and Pelham Range).
VOCs = volatile organic compounds.

[a] MDC presented only if it exceeds BSC.

[b] Site-specific screening level based on cancer risk for residential exposure to soil.

[c] Site-specific screening level based on noncancer hazard for residential exposure to soil.

[d] MDC presented only if it exceeds SSSL-c.

[e] MDC presented only if it exceeds SSSL-n.

[f] Incremental lifetime cancer risk for resident exposed to chemical in soil.

[g] Hazard index for noncancer effects for resident exposed to chemical in soil.

[h] Site-specific screening level based on cancer risk for National Guardsperson exposure to soil.

[i] Site-specific screening level based on noncancer hazard for National Guardsperson exposure to soil.

[j] Incremental lifetime cancer risk for National Guardsperson exposed to chemical in soil.

[k] Hazard index for noncancer effects for National Guardsperson exposed to chemical in soil.

Table 2

Preliminary Risk Evaluation for Exposure to Subsurface Soil
Range 4A Fog Oil Storage Area, Parcel 123(6)
Fort McClellan, Calhoun County, Alabama

Chemical	MDC	BSC	UTL	Site-Related Chemical?[a]	Res Soil SSSL-c[b]	Res Soil SSSL-n[c]	Res Cancer COPC?[d]	Res Noncancer COPC?[e]	Res ILCR[f]	Res HI[g]	NG Soil SSSL-c[h]	NG Soil SSSL-n[i]	NG Cancer COPC?[d]	NG Noncancer COPC?[e]	NG ILCR[j]	NG HI[k]
METALS																
Aluminum	9.72E+03	1.36E+04	1.80E+04			7.80E+03						1.47E+04				
Arsenic	6.63E+01	1.83E+01	3.24E+01	6.63E+01	4.26E-01	2.34E+00	6.63E+01	6.63E+01	1.56E-04	2.83E+00	3.70E+00	7.96E+01	6.63E+01		1.79E-05	
Barium	5.76E+01	2.34E+02	2.42E+02			5.47E+02						1.43E+03				
Beryllium	8.04E-01	8.60E-01	1.50E+00			9.60E+00					3.42E+01	4.42E+01				
Calcium	1.56E+03	6.37E+02	2.41E+03	1.56E+03												
Chromium	3.47E+01	3.83E+01	5.63E+01			2.32E+01					6.85E+00	2.26E+02				
Cobalt	4.87E+01	1.75E+01	3.63E+01	4.87E+01		4.68E+02						6.30E+01				
Copper	6.42E+01	1.94E+01	2.59E+01	6.42E+01		3.13E+02						1.06E+04				
Iron	3.89E+04	4.48E+04	5.63E+04			2.34E+03						7.96E+04				
Lead	1.08E+02	3.85E+01	6.05E+01	1.08E+02		4.00E+02						8.80E+02				
Magnesium	8.84E+02	7.66E+02	5.54E+03	8.84E+02												
Manganese	1.52E+03	1.36E+03	4.12E+03	1.52E+03		3.63E+02		1.52E+03		4.19E-01		1.53E+02		1.52E+03		9.93E-01
Mercury	4.71E-01	7.00E-02	1.71E-01	4.71E-01		2.33E+00						7.12E+01				
Nickel	6.71E+01	1.29E+01	2.07E+01	6.71E+01		1.54E+02					3.42E+02	5.00E+03				
Potassium	4.06E+02	7.11E+02	5.78E+03													
Sodium	3.62E+01	7.02E+02	6.23E+02													
Thallium	1.79E+00	1.40E+00	6.62E+00	1.79E+00		5.08E-01		1.79E+00		3.52E-01		1.73E+01				
Vanadium	5.77E+01	6.49E+01	9.05E+01			5.31E+01						1.65E+03				
Zinc	2.04E+02	3.49E+01	7.13E+01	2.04E+02		2.34E+03						7.90E+04				
VOCs	0.00E+00															
Acetone	3.20E-02			3.20E-02		7.76E+02						2.58E+04				
Methylene chloride	3.50E-03			3.50E-03	8.41E+01	4.66E+02					8.92E+02	1.55E+04				
Total ILCR, HI									1.56E-04	3.60E+00					1.79E-05	9.93E-01

All concentrations expressed as mg/kg.
MDC = maximum detected concentration; BSC = background screening criterion; UTL = 95% upper tolerance limit (values for total soil; incorporates data from Main Post and Pelham Range).
VOCs = volatile organic compounds.
[a] MDC presented only if it exceeds BSC.
[b] Site-specific screening level based on cancer risk for residential exposure to soil.
[c] Site-specific screening level based on noncancer hazard for residential exposure to soil.
[d] MDC presented only if it exceeds SSSL-c.
[e] MDC presented only if it exceeds SSSL-n.
[f] Incremental lifetime cancer risk for resident exposed to chemical in soil.
[g] Hazard index for noncancer effects for resident exposed to chemical in soil.
[h] Site-specific screening level based on cancer risk for National Guardsperson exposure to soil.
[i] Site-specific screening level based on noncancer hazard for National Guardsperson exposure to soil.
[j] Incremental lifetime cancer risk for National Guardsperson exposed to chemical in soil.
[k] Hazard index for noncancer effects for National Guardsperson exposed to chemical in soil.

Table 3

Preliminary Risk Evaluation for Exposure to Groundwater
Range 4A Fog Oil Storage Area
Fort McClellan, Calhoun County, Alabama

Chemical	MDC	BSC	UTL	Site-Related Chemical?[a]	Res GW SSSL-c[b]	Res GW SSSL-n[c]	Res Cancer COPC?[d]	Res Noncancer COPC?[e]	Res ILCR[f]	Res HI[g]	NG GW SSSL-c[h]	NG GW SSSL-n[i]	NG Cancer COPC?[d]	NG Noncancer COPC?[e]	NG ILCR[j]	NG HI[k]
METALS																
Aluminum	3.68E+00	2.34E+00	9.60E+00	3.68E+00		1.56E+00		3.68E+00		2.36E-01		1.90E+01				
Arsenic	3.30E-03	1.78E-02	2.22E-01		4.46E-05	4.69E-04					3.29E-04	5.70E-03				
Barium	7.50E-02	1.27E-01	4.72E-01			1.10E-01						1.30E+00				
Beryllium	6.02E-02	1.24E-03	2.37E-03	6.02E-02		3.13E-03		6.02E-02		1.92E+00		3.80E-02		6.02E-02		1.58E-01
Cadmium	6.08E-02	2.51E-03	5.30E-03	6.08E-02		7.82E-04		6.08E-02		7.77E+00		9.51E-03		6.08E-02		6.39E-01
Calcium	1.22E+00	5.65E+01	4.52E+02													
Chromium	6.22E-02			6.22E-02		4.69E-03		6.22E-02		1.33E+00		5.70E-02		6.22E-02		1.09E-01
Cobalt	9.70E-02	2.34E-02	2.52E-02	9.70E-02		9.39E-02		9.70E-02		1.03E-01		1.14E+00				
Copper	6.03E-02	2.55E-02	2.35E-01	6.03E-02		6.26E-02						7.60E-01				
Iron	1.09E+00	7.04E+00	2.58E+01			4.69E-01						5.70E+00				
Lead	5.93E-03	7.99E-03	2.58E-02			1.50E-02										
Magnesium	7.78E-01	2.13E+01	1.49E+02													
Manganese	1.77E+00	5.81E-01	4.13E+00	1.77E+00		7.35E-02		1.77E+00		2.41E+00		8.93E-01		1.77E+00		1.98E-01
Nickel	9.64E-02			9.64E-02		3.13E-02		9.64E-02		3.08E-01	3.42E+02	3.80E-01				
Selenium	3.72E-03			3.72E-03		7.82E-03						9.51E-02				
Silver	5.55E-03	4.00E-03	4.00E-04	5.55E-03		7.82E-03						9.51E-02				
Sodium	1.56E+00	1.48E+01	4.90E+01			5.08E-01										
Vanadium	5.36E-02	1.70E-02	1.14E-02	5.36E-02		1.10E-02						1.33E-01				
Zinc	7.61E-02	2.20E-01	1.52E+00			4.69E-01						5.70E+00				
Total ILCR, HI										1.41E+01						1.11E+00

All concentrations expressed as mg/L.
MDC = maximum detected concentration; BSC = background screening criterion; UTL = 95% upper tolerance limit (incorporates data from Main Post and Pelham Range).
[a] MDC presented only if it exceeds BSC.
[b] Site-specific screening level based on cancer risk for residential exposure to groundwater.
[c] Site-specific screening level based on noncancer hazard for residential exposure to groundwater.
[d] MDC presented only if it exceeds SSSL-c.
[e] MDC presented only if it exceeds SSSL-n.
[f] Incremental lifetime cancer risk for resident exposed to chemical in groundwater.
[g] Hazard index for noncancer effects for resident exposed to chemical in groundwater.
[h] Site-specific screening level based on cancer risk for National Guardsperson exposure to groundwater.
[i] Site-specific screening level based on noncancer hazard for National Guardsperson exposure to groundwater.
[j] Incremental lifetime cancer risk for National Guardsperson exposed to chemical in groundwater.
[k] Hazard index for noncancer effects for National Guardsperson exposed to chemical in groundwater.