10.0 Data Analysis, Validation, and Interpretation

Data usefulness is paramount relative to the BERA and related testing and analysis. The principal objective in the study design is to ensure that the hypotheses are effectively tested and rejected or accepted with a high degree of confidence. A summary of the statistical methods is provided below, and a discussion of hypothetical results follows. These hypothetical results should assist the reader in better understanding the usefulness of the collected data as they relate to characterizing risk to terrestrial receptors within and around the IMR and BGR ranges, as well as the aquatic data associated with Cane Creek.

10.1 Data Analysis and Validation

As described in the problem formulation, the surface soils at the IMR and BGR ranges have been characterized by their capacity to bind inorganic compounds. Three metal-binding soil classifications (high, medium, and low) have been established. Figures 9-1, 9-2, and 9-3 present the sample locations for a five-point concentration gradient within each of the three metal-binding soil types. It is important to note that, in order to obtain sample soils with various lead concentrations from the three different soil types, soil samples will be collected from both the IMR and BGR ranges.

The hypothetical results provided in Table 10-1 would indicate that the NOAEL for low binding capacity soils may be as low as 266 ppm for lead, while the NOAEL for medium and high binding capacity soils could be as high as 1,890 ppm and 7,100 ppm, respectively. Results such as these could be useful to risk managers in setting possible soil cleanup goals based on soil type.

Similarly, Table 10-2 provides hypothetical results whereby acute and chronic toxicity is observed in Ceriodaphnids in test chambers with 1.57 ppm of lead, when compared to reference waters, but no toxicity is evident in any of the fathead minnow tests nor in any lower concentrations for Ceriodaphnids. The assessors could report that the site-specific NOAEL for fathead minnows exposed to Cane Creek water is 0.0981 ppm, and the LOAEL is 1.57 ppm. Risk managers may therefore conclude that the ecological cleanup goal should be between the NOAEL of 0.0981 ppm and the LOAEL of 1.57 ppm for lead.

The sediment chironomid toxicity tests in conjunction with the RBP will provide lines of evidence regarding potential sediment toxicity (e.g., NOAEL and LOAEL values for sediment) and also quantitative comparisons of Cane Creek benthic invertebrate assemblages with benthic

Table 10-1

Hypothetical Test Results
Terrestrial Old Field Habitats
Small Arms Ranges at Iron Mountain Road and Bains Gap Road Ranges
Fort McClellan, Calhoun County, Alabama

Soil Binding Capacity Type	Lead Concentration (ppm)	Test/Measure	Significant Difference When Compared to Reference Location at p = 0.05		LOAEL/ NOAEL
			Yes	No	
High Binding Capacity (IMR Ranges)	114,000	Earthworm Toxicity	X		
		Earthworm Tissue Conc.	X		
	25,300	Earthworm Toxicity	X		LOAEL
		Earthworm Tissue Conc.	X		
	7,100	Earthworm Toxicity		X	NOAEL
		Earthworm Tissue Conc.		X	
	1,300	Earthworm Toxicity		X	
		Earthworm Tissue Conc.		X	
	147	Earthworm Toxicity		X	
		Earthworm Tissue Conc.		X	
Medium Binding Capacity (BGR Ranges)	30,700	Earthworm Toxicity	X		
		Earthworm Tissue Conc.	X		
	11,800	Earthworm Toxicity	X		
		Earthworm Tissue Conc.	X		
	8,810	Earthworm Toxicity	X		LOAEL
		Earthworm Tissue Conc.	X		
	1,890	Earthworm Toxicity		X	NOAEL
		Earthworm Tissue Conc.		X	
	221	Earthworm Toxicity		X	
		Earthworm Tissue Conc.		X	
Low Binding Capacity (IMR Ranges)	116,000	Earthworm Toxicity	X		
		Earthworm Tissue Conc.	X		
	28,0000	Earthworm Toxicity	X		
		Earthworm Tissue Conc.	X		
	8,110	Earthworm Toxicity	X		
		Earthworm Tissue Conc.	X		
	1,150	Earthworm Toxicity	X		LOAEL
		Earthworm Tissue Conc.	X		
	266	Earthworm Toxicity		X	NOAEL
		Earthworm Tissue Conc.		X	

BGR - Bains Gap Road.
IMR - Iron Mountain Road.
LOAEL - Lowest observed adverse effects level.
NOAEL - No observed adverse effects level.
ppm - Parts per million.

Table 10-2

Hypothetical Test Results
Cane Creek - Surface Water Habitat
Small Arms Ranges at IMR and BGR
Fort McClellan, Calhoun County, Alabama

Surface Water Lead Concentration (ppm)	Test	Significant difference when compared to reference water (p = 0.05)		LOAEL/ NOAEL
		No	Yes	
1.57	*P. promelas*			
	Acute	X		
	Chronic	X		
	C. dubia			
	Acute		X	LOAEL
	Chronic		X	
0.0981	*P. promelas*			NOAEL
	Acute	X		
	Chronic	X		
	C. dubia			
	Acute	X		
	Chronic	X		
0.0256	*P. promelas*			
	Acute	X		
	Chronic	X		
	C. dubia			
	Acute	X		
	Chronic	X		
0.0129	*P. promelas*			
	Acute	X		
	Chronic	X		
	C. dubia			
	Acute	X		
	Chronic	X		
0.003	*P. promelas*			
	Acute	X		
	Chronic	X		
	C. dubia			
	Acute	X		
	Chronic	X		

BGR - Bains Gap Road.
IMR - Iron Mountain Road.
LOAEL - Lowest observed adverse effects level.
NOAEL - No observed adverse effects level.
ppm - Parts per million.

invertebrate assemblages from an un-impacted reference stream and literature-based benthic assemblages. The no effect level of the most sensitive test or indicator could be used as the sediment cleanup goal.

The overall objective in conducting the field- and laboratory-based studies is to test the null hypotheses stated in Section 7.0. Each hypothesis will be accepted or rejected based on findings from the relevant toxicity test or field measurement. Acceptance or rejection of each hypothesis will be instrumental in characterizing ecological risks associated with the surface soils, surface water, and sediment at the BGR ranges.

LC_{50} values for soil, surface water, and sediment will be computed using the EPA-recommended Probit Analysis (EPA, 1989); NOAEL and LOAEL values will be derived using Dunnett's procedure or Steel's Many-One Rank Test. Dunnett's procedure is a parametric test that assumes that observations within treatments are independent and normally distributed and that the variance of the observations is homogenous across all toxicant concentrations. The Shapiro-Wilk's test will be used to test for normality in order to decide whether to use parametric (Dunnett's) or nonparametric (Steel's Many-One Rank) analyses. In order to test the variances of the data obtained from each toxicant concentration and the control, Bartlett's test for variance will be employed.

It is important to note that the field-collected soil samples will not be cut or diluted into a dilution series but will be tested as 100 percent "un-cut" samples. Derivation of toxicity response curves in the form of LC_{50} values, NOAELs, and LOAELs will be done via the lead concentration gradient. By collecting soil samples with five concentrations of lead from each of the three soil types, a gradient series will be present and appropriate toxicity response curves can be computed. Therefore, Dunnet's Procedure (for parametric distributions) or Steel's Many-One Rank Test (for nonparametric distributions) can be applied.

In addition to deriving toxicant dose-response curves (i.e., LC_{50}, LD_{50}, NOAEL, LOAEL), it is critical to apply Analysis of Variance (ANOVA) tests to determine if soil, sediment, and water samples differ from off-site reference samples, thus dictating whether null hypotheses are accepted or rejected. A significance level of = 0.05 will be adopted as a probability of committing a Type I or Type II error.

In comparing toxicity or biomeasurement results, single and nested ANOVAs will be conducted coincident with appropriate normality and variance testing.

10.2 Data Interpretation

Interpretation of bioassay results is dependent upon bracketing a response or effect level and a no effect level. Effects will be measured via toxicity responses within a specified exposure period, depending on the exposure medium and test species. At a confidence level of 95 percent ($p \leq 0.05$), test responses consisting of acute toxicity will be compared to reference soil, surface water, or sediment responses. Test chambers that are statistically different from reference chambers will be characterized as "effect concentrations," while those exhibiting no significant difference will be listed as "no-effect concentrations." The highest no-effect concentration and the lowest effect concentration will be reported as the NOAEL and LOAEL, respectively.

A second use of the data relates to COPEC concentrations measured within tissues following completion of exposure periods. Organisms from each replicate chamber will be tested as separate and distinct composite samples. The mean concentration and 95 percent UCL for each exposure concentration will be used to derive body burden concentrations which will then be used as input values for the food chain models as described in Section 5.0. These models, representing the various terrestrial and riparian trophic levels, will then be employed for HQ derivations.

In order to estimate soil-to-invertebrate bioaccumulation factors and sediment-to-chironomid bioaccumulation factors, COPEC concentrations in earthworms will be plotted versus the COPEC concentrations in the soils, and COPEC concentrations in chironomids will be plotted versus the COPEC concentrations in sediment. This analysis will be conducted for each of the three different binding-capacity soil types. The resultant slopes of the lines that best fit the worm-to-soil and chironomid-to-sediment concentration relationships will be used to represent the soil-to-invertebrate and sediment-to-chironomid bioaccumulation factors for each soil type and sediment.

11.0 Data Management Plan

The primary data management activities for the FTMC Environmental Restoration Program will include:

- Data transfer from field and laboratory activities to a project filing system
- Data management to ensure that data are stored and output in a manner that continues the chain of custody
- Review of requirements to ensure that plans for data collection were fulfilled
- Validation of analytical data that will report data to be used for treatment interpretation activities
- Evaluation of analytical and field data resulting in a report of guidance to be followed for using project data in treatment interpretation
- Reporting functions, which may include outputting data for report tables, statistical analysis, interpretation of data, and electronic transfer.

The FTMC IT Environmental Management System database will be used for data management. A series of programs allows electronic reporting of data. The laboratory is responsible for reporting data in both hard copy and electronic data deliverable.

11.1 Records Control

All project documentation and original reports will be maintained in a central file for the project.

11.2 Document Filing and Access

At least two copies of all data forms and deliverables will be generated during the project and sorted at different locations. Wherever practical, original forms will be archived at IT in Knoxville, Tennessee, and the laboratory and field personnel will retain copies. Analytical data, hard copy, and electronic files will be archived at least seven years by the laboratory.

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ATTACHMENT 1

LIST OF ABBREVIATIONS AND ACRONYMS

List of Abbreviations and Acronyms

2,4-D	2,4-dichlorophenoxyacetic acid
2,4,5-T	2,4,5-trichlorophenoxyacetic acid
2,4,5-TP	silvex
3D	3D International Environmental Group
AB	ambient blank
AbB3	Anniston gravelly clay loam, 2 to 6 percent slopes, severely eroded
AbC3	Anniston gravelly clay loam, 6 to 10 percent slopes, severely eroded
AbD3	Anniston and Allen gravelly clay loams, 10 to 15 percent slopes, eroded
Abs	skin absorption
ABS	dermal absorption factor
AC	hydrogen cyanide
ACAD	AutoCadd
AcB2	Anniston and Allen gravelly loams, 2 to 6 percent slopes, eroded
AcC2	Anniston and Allen gravelly loams, 6 to 10 percent slopes, eroded
AcD2	Anniston and Allen gravelly loams, 10 to 15 percent slopes, eroded
AcE2	Anniston and Allen gravelly loams, 15 to 25 percent slopes, eroded
ACGIH	American Conference of Governmental Industrial Hygienists
AdE	Anniston and Allen stony loam, 10 to 25 percent slope
ADEM	Alabama Department of Environmental Management
ADPH	Alabama Department of Public Health
AEC	U.S. Army Environmental Center
AEL	airborne exposure limit
AET	adverse effect threshold
AF	soil-to-skin adherence factor
AHA	ammunition holding area
AL	Alabama
ALARNG	Alabama Army National Guard
ALAD	ä-aminolevulinic acid dehydratase
ALDOT	Alabama Department of Transportation
amb.	amber
amsl	above mean sea level
ANAD	Anniston Army Depot
AOC	area of concern
AP	armor piercing
APEC	areas of potential ecological concern
APT	armor-piercing tracer
AR	analysis request
ARAR	applicable or relevant and appropriate requirement
AREE	area requiring environmental evaluation
AS/SVE	air sparging/soil vapor extraction
ASP	Ammunition Supply Point
ASR	Archives Search Report
AST	aboveground storage tank
ASTM	American Society for Testing and Materials
AT	averaging time
ATSDR	Agency for Toxic Substances and Disease Registry
ATV	all-terrain vehicle
AUF	area use factor
AWARE	Associated Water and Air Resources Engineers, Inc.
AWQC	ambient water quality criteria
AWWSB	Anniston Water Works and Sewer Board
'B'	Analyte detected in laboratory or field blank at concentration greater than the reporting limit (and greater than zero)
BCF	blank correction factor; bioconcentration factor
BCT	BRAC Cleanup Team
BERA	baseline ecological risk assessment
BEHP	bis(2-ethylhexyl)phthalate
BFB	bromofluorobenzene
BFE	base flood elevation
BG	Bacillus globigii
BGR	Bains Gap Road
bgs	below ground surface
BHC	hexachlorocyclohexane
BHHRA	baseline human health risk assessment
BIRTC	Branch Immaterial Replacement Training Center
bkg	background
bls	below land surface
BOD	biological oxygen demand
Bp	soil-to-plant biotransfer factors
BRAC	Base Realignment and Closure
Braun	Braun Intertec Corporation
BSAF	biota-to-sediment accumulation factors
BSC	background screening criterion
BTAG	Biological Technical Assistance Group
BTEX	benzene, toluene, ethyl benzene, and xylenes
BTOC	below top of casing
BTV	background threshold value
BW	biological warfare; body weight
BZ	breathing zone; 3-quinuclidinyl benzilate
C	ceiling limit value
Ca	carcinogen
$CaCO_3$	calcium carbonate
CAA	Clean Air Act
CAB	chemical warfare agent breakdown products
CAMU	corrective action management unit
CBR	chemical, biological, and radiological
CCAL	continuing calibration
CCB	continuing calibration blank
CCV	continuing calibration verification
CD	compact disc
CDTF	Chemical Defense Training Facility
CEHNC	U.S. Army Engineering and Support Center, Huntsville
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERFA	Community Environmental Response Facilitation Act
CESAS	Corps of Engineers South Atlantic Savannah
CF	conversion factor
CFC	chlorofluorocarbon
CFDP	Center for Domestic Preparedness
CFR	Code of Federal Regulations
CG	carbonyl chloride (phosgene)
CGI	combustible gas indicator
ch	inorganic clays of high plasticity
CHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
CK	cyanogen chloride
cl	inorganic clays of low to medium plasticity
Cl	chlorinated
CLP	Contract Laboratory Program
cm	centimeter
CN	chloroacetophenone
CNB	chloroacetophenone, benzene, and carbon tetrachloride
CNS	chloroacetophenone, chloropicrin, and chloroform
CO	carbon monoxide
CO_2	carbon dioxide
Co-60	cobalt-60
CoA	Code of Alabama
COC	chain of custody; chemical of concern
COE	Corps of Engineers
Con	skin or eye contact
COPC	chemical(s) of potential concern
COPEC	chemical(s)/constituent(s) of potential ecological concern
CPSS	chemicals present in site samples
CQCSM	Contract Quality Control System Manager
CRDL	contract-required detection limit
CRL	certified reporting limit
CRQL	contract-required quantitation limit
CRZ	contamination reduction zone
Cs-137	cesium-137
CS	ortho-chlorobenzylidene-malononitrile
CSEM	conceptual site exposure model
CSM	conceptual site model
CT	central tendency
ctr.	container
CWA	chemical warfare agent; Clean Water Act
CWM	chemical warfare material; clear, wide mouth
CX	dichloroformoxime
'D'	duplicate; dilution
D&I	detection and identification
DAAMS	depot area air monitoring system
DAF	dilution-attenuation factor
DANC	decontamination agent, non-corrosive
°C	degrees Celsius
°F	degrees Fahrenheit
DCA	dichloroethane
DCE	dichloroethene

List of Abbreviations and Acronyms (Continued)

DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethene
DDT	dichlorodiphenyltrichloroethane
DEH	Directorate of Engineering and Housing
DEP	depositional soil
DFTPP	decafluorotriphenylphosphine
DI	deionized
DID	data item description
DIMP	di-isopropylmethylphosphonate
DM	dry matter; adamsite
DMBA	dimethylbenz(a)anthracene
DMMP	dimethylmethylphosphonate
DO	dissolved oxygen
DOD	U.S. Department of Defense
DOJ	U.S. Department of Justice
DOT	U.S. Department of Transportation
DP	direct-push
DPDO	Defense Property Disposal Office
DPT	direct-push technology
DQO	data quality objective
DRMO	Defense Reutilization and Marketing Office
DRO	diesel range organics
DS	deep (subsurface) soil
DS2	Decontamination Solution Number 2
DSERTS	Defense Site Environmental Restoration Tracking System
DWEL	drinking water equivalent level
E&E	Ecology and Environment, Inc.
EB	equipment blank
EBS	environmental baseline survey
EC_{50}	effects concentration for 50 percent of a population
ECBC	Edgewood Chemical/Biological Command
ED	exposure duration
EDD	electronic data deliverable
EF	exposure frequency
EDQL	ecological data quality level
EE/CA	engineering evaluation and cost analysis
Elev.	elevation
EM	electromagnetic
EMI	Environmental Management Inc.
EM31	Geonics Limited EM31 Terrain Conductivity Meter
EM61	Geonics Limited EM61 High-Resolution Metal Detector
EOD	explosive ordnance disposal
EODT	explosive ordnance disposal team
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
EPIC	Environmental Photographic Interpretation Center
EPRI	Electrical Power Research Institute
ER	equipment rinsate
ERA	ecological risk assessment
ER-L	effects range-low
ER-M	effects range-medium
ESE	Environmental Science and Engineering, Inc.
ESMP	Endangered Species Management Plan
ESN	Environmental Services Network, Inc.
ESV	ecological screening value
ET	exposure time
EU	exposure unit
Exp.	explosives
E-W	east to west
EZ	exclusion zone
FAR	Federal Acquisition Regulations
FB	field blank
FD	field duplicate
FDA	U.S. Food and Drug Administration
Fe^{+3}	ferric iron
Fe^{+2}	ferrous iron
FedEx	Federal Express, Inc.
FEMA	Federal Emergency Management Agency
FFCA	Federal Facilities Compliance Act
FFE	field flame expedient
FFS	focused feasibility study
FI	fraction of exposure
Fil	filtered
Flt	filtered
FMDC	Fort McClellan Development Commission
FML	flexible membrane liner
FMP 1300	Former Motor Pool 1300
f_{oc}	fraction organic carbon
FOMRA	Former Ordnance Motor Repair Area
FOST	Finding of Suitability to Transfer
Foster Wheeler	Foster Wheeler Environmental Corporation
FR	Federal Register
Frtn	fraction
FS	field split; feasibility study
FSP	field sampling plan
ft	feet
ft/day	feet per day
ft/ft	feet per foot
ft/yr	feet per year
FTA	Fire Training Area
FTMC	Fort McClellan
FTRRA	FTMC Reuse & Redevelopment Authority
g	gram
g/m^3	gram per cubic meter
G-856	Geometrics, Inc. G-856 magnetometer
G-858G	Geometrics, Inc. G-858G magnetic gradiometer
GAF	gastrointestinal absorption factor
gal	gallon
gal/min	gallons per minute
GB	sarin
gc	clay gravels; gravel-sand-clay mixtures
GC	gas chromatograph
GCL	geosynthetic clay liner
GC/MS	gas chromatograph/mass spectrometer
GCR	geosynthetic clay liner
GFAA	graphite furnace atomic absorption
GIS	Geographic Information System
gm	silty gravels; gravel-sand-silt mixtures
gp	poorly graded gravels; gravel-sand mixtures
gpm	gallons per minute
GPR	ground-penetrating radar
GPS	global positioning system
GRA	general response action
GS	ground scar
GSA	General Services Administration; Geologic Survey of Alabama
GSBP	Ground Scar Boiler Plant
GSSI	Geophysical Survey Systems, Inc.
GST	ground stain
GW	groundwater
gw	well-graded gravels; gravel-sand mixtures
H&S	health and safety
HA	hand auger
HCl	hydrochloric acid
HD	distilled mustard
HDPE	high-density polyethylene
HE	high explosive
HEAST	Health Effects Assessment Summary Tables
Herb.	herbicides
HHRA	human health risk assessment
HI	hazard index
H_2O_2	hydrogen peroxide
HPLC	high performance liquid chromatography
HNO_3	nitric acid
HQ	hazard quotient
HQ_{screen}	screening-level hazard quotient
hr	hour
HRC	hydrogen releasing compound
HSA	hollow-stem auger
HTRW	hazardous, toxic, and radioactive waste
'I'	out of control, data rejected due to low recovery
IATA	International Air Transport Authority
ICAL	initial calibration
ICB	initial calibration blank
ICP	inductively-coupled plasma

List of Abbreviations and Acronyms (Continued)

ICRP	International Commission on Radiological Protection
ICS	interference check sample
ID	inside diameter
IDL	instrument detection limit
IDLH	immediately dangerous to life or health
IDM	investigative-derived media
IDW	investigation-derived waste
IEUBK	Integrated Exposure Uptake Biokinetic
IF	ingestion factor; inhalation factor
ILCR	incremental lifetime cancer risk
IMPA	isopropylmethyl phosphonic acid
IMR	Iron Mountain Road
in.	inch
Ing	ingestion
Inh	inhalation
IP	ionization potential
IPS	International Pipe Standard
IR	ingestion rate
IRDMIS	Installation Restoration Data Management Information System
IRIS	Integrated Risk Information Service
IRP	Installation Restoration Program
IS	internal standard
ISCP	Installation Spill Contingency Plan
IT	IT Corporation
ITEMS	IT Environmental Management System™
'J'	estimated concentration
JeB2	Jefferson gravelly fine sandy loam, 2 to 6 percent slopes, eroded
JeC2	Jefferson gravelly fine sandy loam, 6 to 10 percent slopes, eroded
JfB	Jefferson stony fine sandy loam, 0 to 10 percent slopes have strong slopes
JPA	Joint Powers Authority
K	conductivity
K_d	soil-water distribution coefficient
kg	kilogram
KeV	kilo electron volt
K_{oc}	organic carbon partioning coefficient
K_{ow}	octonal-water partition coefficient
$KMnO_4$	potassium permanganate
L	lewisite; liter
L/kg/day	liters per kilogram per day
l	liter
LAW	light anti-tank weapon
lb	pound
LBP	lead-based paint
LC	liquid chromatography
LCS	laboratory control sample
LC_{50}	lethal concentration for 50 percent population tested
LD_{50}	lethal dose for 50 percent population tested
LEL	lower explosive limit
LOAEL	lowest-observed-advserse-effects-level
LRA	land redevelopment authority
LT	less than the certified reporting limit
LUC	land-use control
LUCAP	land-use control assurance plan
LUCIP	land-use control implementation plan
max	maximum
MB	method blank
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MCPA	4-chloro-2-methylphenoxyacetic acid
MCPP	2-(2-methyl-4-chlorophenoxy)propionic acid
MCS	media cleanup standard
MD	matrix duplicate
MDC	maximum detected concentration
MDCC	maximum detected constituent concentration
MDL	method detection limit
mg	milligrams
mg/kg	milligrams per kilogram
mg/kg/day	milligram per kilogram per day
mg/kgbw/day	milligrams per kilogram of body weight per day
mg/L	milligrams per liter
mg/m^3	milligrams per cubic meter
mh	inorganic silts, micaceous or diatomaceous fine, sandy or silt soils
MHz	megahertz
µg/g	micrograms per gram
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
µmhos/cm	micromhos per centimeter
MeV	mega electron volt
min	minimum
MINICAMS	miniature continuous air monitoring system
ml	inorganic silts and very fine sands
mL	milliliter
mm	millimeter
MM	mounded material
MMBtu/hr	million Btu per hour
MNA	monitored natural attenuation
MnO_4-	permanganate ion
MOA	Memorandum of Agreement
MOGAS	motor vehicle gasoline
MOUT	Military Operations in Urban Terrain
MP	Military Police
MPA	methyl phosphonic acid
MPM	most probable munition
MQL	method quantitation limit
MR	molasses residue
MRL	method reporting limit
MS	matrix spike
mS/cm	millisiemens per centimeter
mS/m	millisiemens per meter
MSD	matrix spike duplicate
MTBE	methyl tertiary butyl ether
msl	mean sea level
MtD3	Montevallo shaly, silty clay loam, 10 to 40 percent slopes , severely eroded
mV	millivolts
MW	monitoring well
MWI&P	Monitoring Well Installation and Management Plan
Na	sodium
NA	not applicable; not available
NAD	North American Datum
NAD83	North American Datum of 1983
$NaMnO_4$	sodium permanganate
NAVD88	North American Vertical Datum of 1988
NAS	National Academy of Sciences
NCEA	National Center for Environmental Assessment
NCP	National Contingency Plan
NCRP	National Council on Radiation Protection and Measurements
ND	not detected
NE	no evidence; northeast
ne	not evaluated
NEW	net explosive weight
NFA	No Further Action
NG	National Guard
NGP	National Guardsperson
ng/L	nanograms per liter
NGVD	National Geodetic Vertical Datum
Ni	nickel
NIC	notice of intended change
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NLM	National Library of Medicine
NO_3^-	nitrate
NPDES	National Pollutant Discharge Elimination System
NPW	net present worth
No.	number
NOAA	National Oceanic and Atmospheric Administration
NOAEL	no-observed-adverse-effects-level
NR	not requested; not recorded; no risk
NRC	National Research Council
NRCC	National Research Council of Canada
NRHP	National Register of Historic Places
ns	nanosecond
N-S	north to south
NS	not surveyed
NSA	New South Associates, Inc.

List of Abbreviations and Acronyms (Continued)

nT	nanotesla
nT/m	nanoteslas per meter
NTU	nephelometric turbidity unit
nv	not validated
O_2	oxygen
O_3	ozone
O&G	oil and grease
O&M	operation and maintenance
OB/OD	open burning/open detonation
OD	outside diameter
OE	ordnance and explosives
oh	organic clays of medium to high plasticity
OH•	hydroxyl radical
ol	organic silts and organic silty clays of low plasticity
OP	organophosphorus
ORC	Oxygen Releasing Compound
ORP	oxidation-reduction potential
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
OVM-PID/FID	organic vapor meter-photoionization detector/flame ionization detector
OWS	oil/water separator
oz	ounce
PA	preliminary assessment
PAH	polynuclear aromatic hydrocarbon
PARCCS	precision, accuracy, representativeness, comparability, completeness, and sensitivity
Parsons	Parsons Engineering Science, Inc.
Pb	lead
PBMS	performance-based measurement system
PC	permeability coefficient
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo-p-dioxins
PCDF	polychlorinated dibenzofurans
PCE	perchloroethene
PCP	pentachlorophenol
PDS	Personnel Decontamination Station
PEF	particulate emission factor
PEL	permissible exposure limit
PERA	preliminary ecological risk assessment
PES	potential explosive site
Pest.	pesticides
PETN	pentarey thritol tetranitrate
PFT	portable flamethrower
PG	professional geologist
PID	photoionization detector
PkA	Philo and Stendal soils local alluvium, 0 to 2 percent slopes
PM	project manager
POC	point of contact
POL	petroleum, oils, and lubricants
POTW	publicly owned treatment works
POW	prisoner of war
PP	peristaltic pump; Proposed Plan
ppb	parts per billion
PPE	personal protective equipment
ppm	parts per million
PPMP	Print Plant Motor Pool
ppt	parts per thousand
PR	potential risk
PRA	preliminary risk assessment
PRG	preliminary remediation goal
PS	chloropicrin
PSSC	potential site-specific chemical
pt	peat or other highly organic silts
PVC	polyvinyl chloride
QA	quality assurance
QA/QC	quality assurance/quality control
QAM	quality assurance manual
QAO	quality assurance officer
QAP	installation-wide quality assurance plan
QC	quality control
QST	QST Environmental, Inc.
qty	quantity
Qual	qualifier
R	rejected data; resample; retardation factor
R&A	relevant and appropriate
RA	remedial action
RAO	remedial action objective
RBC	risk-based concentration; red blood cell
RCRA	Resource Conservation and Recovery Act
RD	remedial design
RDX	cyclotrimethylenetrinitramine
ReB3	Rarden silty clay loams
REG	regular field sample
REL	recommended exposure limit
RFA	request for analysis
RfC	reference concentration
RfD	reference dose
RGO	remedial goal option
RI	remedial investigation
RL	reporting limit
RME	reasonable maximum exposure
ROD	Record of Decision
RPD	relative percent difference
RRF	relative response factor
RSD	relative standard deviation
RTC	Recruiting Training Center
RTECS	Registry of Toxic Effects of Chemical Substances
RTK	real-time kinematic
SA	exposed skin surface area
SAD	South Atlantic Division
SAE	Society of Automotive Engineers
SAIC	Science Applications International Corporation
SAP	installation-wide sampling and analysis plan
SARA	Superfund Amendments and Reauthorization Act
sc	clayey sands; sand-clay mixtures
Sch.	Schedule
SCM	site conceptual model
SD	sediment
SDG	sample delivery group
SDWA	Safe Drinking Water Act
SDZ	safe distance zone; surface danger zone
SEMS	Southern Environmental Management & Specialties, Inc.
SF	cancer slope factor
SFSP	site-specific field sampling plan
SGF	standard grade fuels
SHP	installation-wide safety and health plan
SI	site investigation
SINA	Special Interest Natural Area
SL	standing liquid
SLERA	screening-level ecological risk assessment
sm	silty sands; sand-silt mixtures
SM	Serratia marcescens
SMDP	Scientific Management Decision Point
s/n	signal-to-noise ratio
SO_4^{-2}	sulfate
SOD	soil oxidant demand
SOP	standard operating procedure
SOPQAM	U.S. EPA's *Standard Operating Procedure/Quality Assurance Manual*
sp	poorly graded sands; gravelly sands
SP	submersible pump
SPCC	system performance calibration compound
SPCS	State Plane Coordinate System
SPM	sample planning module
SQRT	screening quick reference tables
Sr-90	strontium-90
SRA	streamlined human health risk assessment
SRM	standard reference material
Ss	stony rough land, sandstone series
SS	surface soil
SSC	site-specific chemical
SSHO	site safety and health officer
SSHP	site-specific safety and health plan
SSL	soil screening level
SSSL	site-specific screening level

SSSSL	site-specific soil screening level
STB	supertropical bleach
STC	source-term concentration
STD	standard deviation
STEL	short-term exposure limit
STL	Severn-Trent Laboratories
STOLS	Surface Towed Ordnance Locator System®
Std. units	standard units
SU	standard unit
SUXOS	senior UXO supervisor
SVOC	semivolatile organic compound
SW	surface water
SW-846	U.S. EPA's *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*
SWMU	solid waste management unit
SWPP	storm water pollution prevention plan
SZ	support zone
TAL	target analyte list
TAT	turn around time
TB	trip blank
TBC	to be considered
TCA	trichloroethane
TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
TCDF	tetrachlorodibenzofurans
TCE	trichloroethene
TCL	target compound list
TCLP	toxicity characteristic leaching procedure
TDEC	Tennessee Department of Environment and Conservation
TDGCL	thiodiglycol
TDGCLA	thiodiglycol chloroacetic acid
TEA	triethylaluminum
Tetryl	trinitrophenylmethylnitramine
TERC	Total Environmental Restoration Contract
THI	target hazard index
TIC	tentatively identified compound
TLV	threshold limit value
TN	Tennessee
TNT	trinitrotoluene
TOC	top of casing; total organic carbon
TPH	total petroleum hydrocarbons
TR	target cancer risk
TRADOC	U.S. Army Training and Doctrine Command
TRPH	total recoverable petroleum hydrocarbons
TSCA	Toxic Substances Control Act
TSDF	treatment, storage, and disposal facility
TWA	time-weighted average
UBR	upper background range
UCL	upper confidence limit
UCR	upper certified range
'U'	not detected above reporting limit
UIC	underground injection control
UF	uncertainty factor
USACE	U.S. Army Corps of Engineers
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
USAEC	U.S. Army Environmental Center
USAEHA	U.S. Army Environmental Hygiene Agency
USACMLS	U.S. Army Chemical School
USAMPS	U.S. Army Military Police School
USATCES	U.S. Army Technical Center for Explosive Safety
USATEU	U.S. Army Technical Escort Unit
USATHAMA	U.S. Army Toxic and Hazardous Material Agency
USC	United States Code
USCS	Unified Soil Classification System
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	underground storage tank
UTL	upper tolerance level; upper tolerance limit
UXO	unexploded ordnance
UXOQCS	UXO Quality Control Supervisor
UXOSO	UXO safety officer
V	vanadium
VC	vinyl chloride
VOA	volatile organic analyte
VOC	volatile organic compound
VOH	volatile organic hydrocarbon
VQlfr	validation qualifier
VQual	validation qualifier
VX	nerve agent (O-ethyl-S-[diisopropylaminoethyl]-methylphosphonothiolate)
WAC	Women's Army Corps
Weston	Roy F. Weston, Inc.
WP	installation-wide work plan
WRS	Wilcoxon rank sum
WS	watershed
WSA	Watershed Screening Assessment
WWI	World War I
WWII	World War II
XRF	x-ray fluorescence
yd^3	cubic yards

APPENDIX A

FIELD SAMPLING AND ANALYSIS PLAN
SURFACE SOIL AT THE IRON MOUNTAIN ROAD AND BAINS GAP ROAD RANGES
FORT MCCLELLAN, CALHOUN COUNTY, ALABAMA

Appendix A
Field Sampling and Analysis Plan
Surface Soil at the Iron Mountain Road and Bains Gap Road Ranges
Fort McClellan, Calhoun County, Alabama

1.0 Introduction

As presented in the baseline ecological risk assessment (BERA) problem formulation for the Bains Gap Road (BGR) ranges (IT Corporation [IT], 2002a), four inorganic constituents (antimony, copper, lead, and zinc) were identified as chemicals of potential ecological concern (COPEC) for terrestrial receptors located at the small arms ranges at BGR ranges. As part of the BERA, surface soil (0 to 0.5 feet below ground surface) will be collected from within the investigation area and analyzed for toxicity to earthworms. Additionally, soil-to-worm accumulation factors will be developed for use in food chain modeling to higher trophic level receptors that reside within the BGR ranges.

2.0 Selection of Sample Locations

Sample locations for the BERA are based on the three different soil types identified at the Bains Gap Road (BGR) ranges (low, medium, and high metal-binding capacity soils) and the gradient of lead detected in these soils. A more detailed discussion of the designation of soils based on their relative metal-binding capacity is presented in Section 7.0 of this report. Because lead has been identified as a COPEC at all of the BGR ranges and has been used as one of the indicators of potential contamination from Army activities at small arms ranges at Fort McClellan, ecological sample locations will be based upon lead concentrations.

Neuhauser, et al. (1985) studied acute effects of lead to the earthworm *(Eisenia fetida)* using an artificial soil (pH 6), and estimated a 14-day lethal concentration killing 50 percent of the test population (LC_{50}) of 5,940 parts per million (ppm) lead as $Pb(NO_3)$. Further, *E. fetida* studies by Spurgeon, et al. (1994) estimated a 56-day lead LC_{50} as $Pb(NO_3)_2$, of 3,760 ppm using artificial soil at pH 6.3. Based on these tested concentrations of lead in soil that cause earthworm toxicity and the range of lead concentrations detected in BGR range soils, a lead concentration gradient was established within which samples will be collected and tested. A concentration gradient approach will be used in which sample locations will be selected for five different lead concentrations. The five lead concentrations that will be sampled from each of the three soil types are the following:

- 100 milligrams per kilogram (mg/kg) - 799 mg/kg (low concentration range)
- 800 mg/kg - 9,999 mg/kg (medium-low concentration range)
- 10,000 mg/kg - 19,999 mg/kg (medium concentration range)
- 20,000 mg/kg - 99,999 mg/kg (medium-high concentration range)
- 100,000 mg/kg - 116,000 mg/kg (high concentration range).

In addition, one surface soil sample will be collected from each of the five different soil mapping units in non-impacted areas within or adjacent to Fort McClellan. These five soil samples will serve as reference soils for the toxicity and bioaccumulation tests described herein.

Figures 9-1, 9-2, and 9-3 present the approximate locations of the surface soil samples representative of the lead concentration gradients within the three different soil types. It is important to note that in order to sample the entire lead concentration gradient within each of the three soil types, it will be necessary to collect surface soil samples from both the IMR ranges and the BGR ranges.

3.0 Sampling and Analysis Requirements

The following presents sampling and analysis requirements for the collection of soil for the use in the earthworm toxicity and bioaccumulation studies in conjunction with the BERA for the BGR ranges.

3.1 Sample Confirmation

Prior to the collection of soil for analytical and toxicological testing, lead concentrations at the selected sample locations will be screened *in situ* using x-ray fluorescence technology to verify that the selected locations are appropriate (i.e., lead concentration) for the intended lead gradient. X-ray fluorescence methodology will follow the procedures outlined in the installation-wide sampling and analysis plan (IT, 2002b).

3.2 Sample Collection Procedures

Once the lead concentrations have been confirmed using x-ray fluorescence, soil will be collected to a depth of 0.5 feet, using a stainless-steel hand auger or spoon, and homogenized in a stainless-steel bowl following the sampling procedures outlined in the installation-wide sampling and analysis plan (IT, 2002b). Soil samples will then be transferred to the appropriate sample containers. Visible bullets and lead fragments will be manually removed from the sample prior to being transferred to the sample containers. Samples for chemical analysis and toxicity testing will not be sieved.

3.3 Decontamination Procedures

All equipment used for collection, homogenization, and transfer will be properly decontaminated prior to collecting samples and between sampling locations, as described in the installation-wide sampling and analysis plan (IT, 2002b).

3.4 Quality Assurance/Quality Control Samples

As established by the data quality objectives process, field and laboratory quality assurance/quality control indicator soil samples and analyses will be collected to provide information concerning the measured quality and usability of the field data. As presented in the installation-wide sampling and analysis plan (IT, 2002b), the frequency of field duplicates, matrix spike/matrix spike duplicates, and equipment rinse blanks will be 1 in 10 (10 percent), 1 in 20 (5 percent), and once per sampling event, respectively.

As presented in the earthworm toxicity/bioaccumulation protocol (Section 3.6), both a reference and laboratory control sample will be used to ensure the quality of biological testing.

3.5 Sample Labeling, Packaging, and Shipment

All prepared samples will be labeled, packaged, and shipped to the appropriate analytical or biological testing laboratory as presented in the installation-wide sampling and analysis plan (IT, 2002b).

3.6 Analysis

3.6.1 Chemical Analyses

As presented in Table A-1, chemical analyses of soils collected for earthworm toxicity and bioaccumulation studies will include target analyte list (TAL) metals, VOCs, SVOC, chlorinated pesticides, organophosphorus pesticides, chlorinated herbicides, PCBs, total organic carbon, pH, and grain size. Chemical analyses of earthworm tissue after termination of the toxicity tests will include TAL metals (Table A-2).

3.6.2 Biological Testing

Surface soil used for earthworm toxicity and bioaccumulation testing will be "split" from the soil samples used for chemical analysis. The 28-day earthworm survival and growth tests and the earthworm bioaccumulation tests will be conducted using the earthworm *E. fetida*.

Table A-1

Surface Soil Sample Designations and QA/QC Sample Quantities
Baseline Ecological Risk Assessment Study Design for the Iron Mountain Road and Bains Gap Road Ranges
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples			Analytical Suite
			Field Duplicates[a]	Field Splits	MS/MSD[a]	
HR-75Q-SS03	HR-75Q-SS03-SS-RW0001-REG	0-0.5				VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, TAL Metals by SW6010B/ SW7471A, and PCBs by 8082. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and 28-day Earthworm Survival and Growth Test. Particulate bullet fragment determination by Peddicord/La Kind.
SAR-85-SS37	SAR-85-SS37-SS-RW0002-REG	0-0.5	SAR-85-SS37-SS-RW0003-FD			VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, TAL Metals by SW6010B/ SW7471A, and PCBs by 8082. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and 28-day Earthworm Survival and Growth Test. Particulate bullet fragment determination by Peddicord/La Kind.
SAR-85-SS34	SAR-85-SS34-SS-RW0004-REG	0-0.5				VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, TAL Metals by SW6010B/ SW7471A, and PCBs by 8082. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and 28-day Earthworm Survival and Growth Test. Particulate bullet fragment determination by Peddicord/La Kind.
SAR-71-SS05	SAR-71-SS05-SS-RW0005-REG	0-0.5				VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, TAL Metals by SW6010B/ SW7471A, and PCBs by 8082. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and 28-day Earthworm Survival and Growth Test. Particulate bullet fragment determination by Peddicord/La Kind.
SAR-71-SS09	SAR-71-SS09-SS-RW0006-REG	0-0.5			SAR-71-SS09-SS-RW0006-MS/MSD	VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, TAL Metals by SW6010B/ SW7471A, and PCBs by 8082. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and 28-day Earthworm Survival and Growth Test. Particulate bullet fragment determination by Peddicord/La Kind.

Table A-1

Surface Soil Sample Designations and QA/QC Sample Quantities
Baseline Ecological Risk Assessment Study Design for the Iron Mountain Road and Bains Gap Road Ranges
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples			Analytical Suite
			Field Duplicates[a]	Field Splits	MS/MSD[a]	
LMBC-REF1	LMBC-REF1-SS-RW0007-REG	0-0.5				VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, TAL Metals by SW6010B/ SW7471A, and PCBs by 8082. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and 28-day Earthworm Survival and Growth Test. Particulate bullet fragment determination by Peddicord/La Kind.
LMBC-REF2	LMBC-REF2-SS-RW0008-REG	0-0.5				VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, TAL Metals by SW6010B/ SW7471A, and PCBs by 8082. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and 28-day Earthworm Survival and Growth Test. Particulate bullet fragment determination by Peddicord/La Kind.
LMBC-REF3	LMBC-REF3-SS-RW0009-REG	0-0.5				VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, TAL Metals by SW6010B/ SW7471A, and PCBs by 8082. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and 28-day Earthworm Survival and Growth Test. Particulate bullet fragment determination by Peddicord/La Kind.
HR-77Q-SS01	HR-77Q-SS01-SS-RW0010-REG	0-0.5	HR-77Q-SS01-SS-RW0011-FD			VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, TAL Metals by SW6010B/ SW7471A, and PCBs by 8082. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and 28-day Earthworm Survival and Growth Test. Particulate bullet fragment determination by Peddicord/La Kind.
SAR-78-SS34	SAR-78-SS34-SS-RW0012-REG	0-0.5				VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, TAL Metals by SW6010B/ SW7471A, and PCBs by 8082. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and 28-day Earthworm Survival and Growth Test. Particulate bullet fragment determination by Peddicord/La Kind.

Table A-1

Surface Soil Sample Designations and QA/QC Sample Quantities
Baseline Ecological Risk Assessment Study Design for the Iron Mountain Road and Bains Gap Road Ranges
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples			Analytical Suite
			Field Duplicates[a]	Field Splits	MS/MSD[a]	
SAR-77-SS33	SAR-77-SS33-SS-RW0013-REG	0-0.5				VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, TAL Metals by SW6010B/ SW7471A, and PCBs by 8082. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and 28-day Earthworm Survival and Growth Test. Particulate bullet fragment determination by Peddicord/La Kind.
HR-80Q-MW02	SAR-80Q-MW02-SS-RW0014-REG	0-0.5			SAR-80Q-MW02-SS-RW0014-MS/MSD	VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, TAL Metals by SW6010B/ SW7471A, and PCBs by 8082. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and 28-day Earthworm Survival and Growth Test. Particulate bullet fragment determination by Peddicord/La Kind.
SAR-77-SS50	SAR-77-SS50-SS-RW0015-REG	0-0.5				VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, TAL Metals by SW6010B/ SW7471A, and PCBs by 8082. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and 28-day Earthworm Survival and Growth Test. Particulate bullet fragment determination by Peddicord/La Kind.
MMBC-REF	MMBC-REF-SS-RW0016-REG	0-0.5				VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, TAL Metals by SW6010B/ SW7471A, and PCBs by 8082. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and 28-day Earthworm Survival and Growth Test. Particulate bullet fragment determination by Peddicord/La Kind.
SAR-78-SS35	SAR-78-SS35-SS-RW0017-REG	0-0.5				VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, TAL Metals by SW6010B/ SW7471A, and PCBs by 8082. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and 28-day Earthworm Survival and Growth Test. Particulate bullet fragment determination by Peddicord/La Kind.

Table A-1

Surface Soil Sample Designations and QA/QC Sample Quantities
Baseline Ecological Risk Assessment Study Design for the Iron Mountain Road and Bains Gap Road Ranges
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples			Analytical Suite
			Field Duplicates[a]	Field Splits	MS/MSD[a]	
SAR-78-SS25	SAR-78-SS25-SS-RW0018-REG	0-0.5				VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, TAL Metals by SW6010B/ SW7471A, and PCBs by 8082. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and 28-day Earthworm Survival and Growth Test. Particulate bullet fragment determination by Peddicord/La Kind.
SAR-78-SS17	SAR-78-SS17-SS-RW0019-REG	0-0.5	SAR-78-SS17-SS-RW0020-FD			VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, TAL Metals by SW6010B/ SW7471A, and PCBs by 8082. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and 28-day Earthworm Survival and Growth Test. Particulate bullet fragment determination by Peddicord/La Kind.
SAR-69-SS11	SAR-69-SS11-SS-RW0021-REG	0-0.5				VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, TAL Metals by SW6010B/ SW7471A, and PCBs by 8082. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and 28-day Earthworm Survival and Growth Test. Particulate bullet fragment determination by Peddicord/La Kind.
SAR-85-SS02	SAR-85-SS02-SS-RW0022-REG	0-0.5			SAR-85-SS02-SS-RW0022-MS/MSD	VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, TAL Metals by SW6010B/ SW7471A, and PCBs by 8082. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and 28-day Earthworm Survival and Growth Test. Particulate bullet fragment determination by Peddicord/La Kind.
HMBC-REF	HMBC-REF-SS-RW0023-REG	0-0.5				VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, TAL Metals by SW6010B/ SW7471A, and PCBs by 8082. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422 and 28-day Earthworm Survival and Growth Test. Particulate bullet fragment determination by Peddicord/La Kind.

[a] Field duplicates and MS/MSDs are collected for chemical analysis only and not for biological testing.

FD - Field duplicate.
FS - Field split.
MS/MSD - Matrix spike/matrix spike duplicate.
QA/QC - Quality assurance/quality control.
REG - Field sample.
LMBC-REF- Low Metal-Binding Capacity Reference Soil.
MMBC-REF- Medium Metal-Binding Capacity Reference Soil.
HMBC-REF- High Metal-Binding Capacity Reference Soil.
TAL - Target Analyte List.
TOC - Total Organic Carbon.
VOCs - Volatile Organic Compounds.
SVOCs - Semivolatile Organic Compounds.
PCBs - polychlorinated biphenyls.
ASTM - American Society of Testing and Materials.

Table A-2

Earthworm Tissue Sample Designations and QA/QC Sample Quantities
Baseline Ecological Risk Assessment Study Design for the Iron Mountain Road and Bains Gap Road Ranges
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples			Analytical Suite
			Field Duplicates	Field Splits	MS/MSD	
HR-75Q-SS03	HR-75Q-SS03-BIOA-RW7001W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-75Q-SS03-BIOA-RW7002W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-75Q-SS03-BIOA-RW7003W-REG	N/A				TAL Metals by SW6010B/SW7471A
SAR-85-SS37	SAR-85-SS37-BIOA-RW7004W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS37-BIOA-RW7005W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS37-BIOA-RW7006W-REG	N/A				TAL Metals by SW6010B/SW7471A
SAR-85-SS34	SAR-85-SS34-BIOA-RW7007W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS34-BIOA-RW7008W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS34-BIOA-RW7009W-REG	N/A				TAL Metals by SW6010B/SW7471A
SAR-71-SS05	SAR-71-SS05-BIOA-RW7010W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-71-SS05-BIOA-RW7011W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-71-SS05-BIOA-RW7012W-REG	N/A				TAL Metals by SW6010B/SW7471A
SAR-71-SS09	SAR-71-SS09-BIOA-RW7013W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-71-SS09-BIOA-RW7014W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-71-SS09-BIOA-RW7015W-REG	N/A				TAL Metals by SW6010B/SW7471A
LMBC-REF1	LMBC-REF1-SS-BIOA-RW7016W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF1-SS-BIOA-RW7017W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF1-SS-BIOA-RW7018W-REG	N/A				TAL Metals by SW6010B/SW7471A
LMBC-REF2	LMBC-REF2-SS-BIOA-RW7019W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF2-SS-BIOA-RW7020W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF2-SS-BIOA-RW7021W-REG	N/A				TAL Metals by SW6010B/SW7471A
LMBC-REF3	LMBC-REF3-SS-BIOA-RW7022W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF3-SS-BIOA-RW7023W-REG	N/A				TAL Metals by SW6010B/SW7471A
	LMBC-REF3-SS-BIOA-RW7024W-REG	N/A				TAL Metals by SW6010B/SW7471A
HR-77Q-SS01	HR-77Q-SS01-BIOA-RW7025W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-77Q-SS01-BIOA-RW7026W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-77Q-SS01-BIOA-RW7027W-REG	N/A				TAL Metals by SW6010B/SW7471A
SAR-78-SS34	SAR-78-SS34-BIOA-RW7028W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS34-BIOA-RW7029W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS34-BIOA-RW7030W-REG	N/A				TAL Metals by SW6010B/SW7471A

Table A-2

Earthworm Tissue Sample Designations and QA/QC Sample Quantities
Baseline Ecological Risk Assessment Study Design for the Iron Mountain Road and Bains Gap Road Ranges
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples			Analytical Suite
			Field Duplicates	Field Splits	MS/MSD	
SAR-77-SS33	SAR-77-SS33-BIOA-RW7031W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-77-SS33-BIOA-RW7032W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-77-SS33-BIOA-RW7033W-REG	N/A				TAL Metals by SW6010B/SW7471A
HR-80Q-MW02	HR-80Q-MW02-BIOA-RW7034W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-80Q-MW02-BIOA-RW7035W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HR-80Q-MW02-BIOA-RW7036W-REG	N/A				TAL Metals by SW6010B/SW7471A
SAR-77-SS50	SAR-77-SS50-BIOA-RW7037W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-77-SS50-BIOA-RW7038W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-77-SS50-BIOA-RW7039W-REG	N/A				TAL Metals by SW6010B/SW7471A
MMBC-REF	MMBC-REF-BIOA-RW7040W-REG	N/A				TAL Metals by SW6010B/SW7471A
	MMBC-REF-BIOA-RW7041W-REG	N/A				TAL Metals by SW6010B/SW7471A
	MMBC-REF-BIOA-RW7042W-REG	N/A				TAL Metals by SW6010B/SW7471A
SAR-78-SS35	SAR-78-SS35-BIOA-RW7043W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS35-BIOA-RW7044W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS35-BIOA-RW7045W-REG	N/A				TAL Metals by SW6010B/SW7471A
SAR-78-SS25	SAR-78-SS25-BIOA-RW7046W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS25-BIOA-RW7047W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS25-BIOA-RW7048W-REG	N/A				TAL Metals by SW6010B/SW7471A
SAR-78-SS17	SAR-78-SS17-BIOA-RW7049W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS17-BIOA-RW7050W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-78-SS17-BIOA-RW7051W-REG	N/A				TAL Metals by SW6010B/SW7471A
SAR-69-SS11	SAR-69-SS11-BIOA-RW7052W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-69-SS11-BIOA-RW7053W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-69-SS11-BIOA-RW7054W-REG	N/A				TAL Metals by SW6010B/SW7471A
SAR-85-SS02	SAR-85-SS02-BIOA-RW7055W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS02-BIOA-RW7056W-REG	N/A				TAL Metals by SW6010B/SW7471A
	SAR-85-SS02-BIOA-RW7057W-REG	N/A				TAL Metals by SW6010B/SW7471A

Table A-2

Earthworm Tissue Sample Designations and QA/QC Sample Quantities
Baseline Ecological Risk Assessment Study Design for the Iron Mountain Road and Bains Gap Road Ranges
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples			Analytical Suite
			Field Duplicates	Field Splits	MS/MSD	
HMBC-REF	HMBC-REF-BIOA-RW7058W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HMBC-REF-BIOA-RW7059W-REG	N/A				TAL Metals by SW6010B/SW7471A
	HMBC-REF-BIOA-RW7060W-REG	N/A				TAL Metals by SW6010B/SW7471A

FD - Field duplicate.
FS - Field split.
MS/MSD - Matrix spike/matrix spike duplicate.
QA/QC - Quality assurance/quality control.
REG - Field sample.
TAL - Target Analyte List.
TOC - Total Organic Carbon

LMBC-REF- Low Metal-Binding Capacity Reference Soil.
MMBC-REF- Medium Metal-Binding Capacity Reference Soil.
HMBC-REF- High Metal-Binding Capacity Reference Soil.

3.6.2.1 Test Initiation

Earthworm toxicity/bioaccumulation tests will begin within 10 days of test soil collection. Immediately prior to testing, the temperature of the test soils will be adjusted to 20 ±2 degrees Celsius (°C). Test conditions are presented in Table A-3.

Test soils will be hydrated with deionized water to create a moist testing environment. The earthworm test soils will be hydrated to 75 percent of water holding capacity.

Ten earthworms will be placed into each of five replicate containers each containing 200 grams (dry weight) of test soil.

The earthworms will be placed on the surface of the test soil in a pint jar, capped, and secured. The tests will be incubated within an environmental chamber to give soil temperature of 20 ±2°C under continuous light.

Lighting will be at continuous ambient laboratory levels, which is approximately 540 to 1,080 lux, with no shading.

3.6.2.2 Termination of the Test

Mortality will be assessed after 7, 14, 21, and 28 days (termination of the test) by emptying the test soil onto a tray and sorting the worms from the soil. Dead worms will be separated and preserved at 4°C for subsequent tissue analysis (TAL metals). Live worms will be placed back into their test jars and placed on the surface of the soil. The numbers of live and dead worms in each test chamber will be recorded at 7, 14, 21 days and the termination of the test (28 days). The total weight of earthworms in each test chamber will also be recorded at the termination of the test.

3.6.2.3 Acceptability of Test Results

For test results to be acceptable, mean survival in the laboratory control tests must be at least 90 percent.

4.0 Data Interpretation

The effects measured in the earthworm toxicity tests are death and growth, while the effect measured in the earthworm bioaccumulation tests is COPEC concentration within whole earthworm tissue. Results of the toxicity and bioaccumulation testing will be interpreted as described in Section 10.0 of the BERA study design report.

Table A-3

Summary of Test Conditions for *E. fetida* Survival and Bioaccumulation Test
IMR and BGR Ranges BERA Study Design
Fort McClellan, Calhoun County, Alabama

1. Test Type	Static
2. Soil temperature (°C)	20 ±2°C
3. Light quality	Ambient laboratory light
4. Light intensity	540-1,080 lux
5. Photoperiod	Continuous illumination
6. Test vessel type and size	1-pint glass canning jars with rings and lids; 1/8-inch air hole
7. Test soil mass	200g
8. Test soil pH*	≥4 but ≤10
9. Artificial soil (% weight) (Control)	10% 2.36-mm screened sphagnum peat, 20% colloidal kaolinite clay, and 70% grade 70 silica sand
10. Test soil moisture content	75% water holding capacity
11. Renewal of test materials	None
12. Age of test organisms	≥60 days
13. Number of test organisms per chamber	10
14. Number of replicate chambers	5
15. Feeding regime	No feeding, unless reference site mortality is 20% or greater, or if the total mean weight of worms in reference soil decreases 30 percent or more
16. Dilution factor	None (100% undiluted site soil)
17. Test duration	28 days
18. Effects measured	Death, growth and tissue analysis for COPEC burdens

BGR - Bains Gap Road.
COPEC - Constituent of potential concern.
°C - Degrees Celsius.
g - Gram.
IMR - Iron Mountain Road.
mm - Millimeter.

5.0 Safety and Health and Unexploded Ordnance Support

All work conducted during the BERA study design for the BGR ranges will be conducted in accordance with the August 2001, Site Specific Safety and Health Plan and Site-Unexploded Ordnance Safety Plan Attachments to the Site-Specific Field Sampling Plan for the Ranges at Iron Mountain Road and Ranges At Bains Gap Road. These attachments will be updated to be consistent with the February 2002, *Draft Revision 3, Installation-Wide Sampling and Analysis Plan, Fort McClellan, Calhoun County, Alabama*, for the final BERA study design for the BGR ranges.

6.0 References

IT Corporation (IT), 2002a, ***Baseline Ecological Risk Assessment Problem Formulation for Small Arms Ranges at Iron Mountain Road, Fort McClellan, Calhoun County, Alabama***, August.

IT Corporation (IT), 2002b, ***Draft Revision 3, Installation-Wide Sampling and Analysis Plan, Fort McClellan, Calhoun County, Alabama***, February.

Neuhauser, E. F., R. C. Loehr, D. L. Milligan, and M. R. Malecki, 1985, "Toxicity of Metals to the Earthworm *Eisenia fetida*", ***Biol. Fertil. Soils***, 1: 149 - 152.

Spurgeon, D. J., S. P. Hopkin, and D. T. Jones, 1994, "Effects of Cadmium, Copper, Lead, and Zinc on Growth, Reproduction, and Survival of the Earthworm *Eisenia fetida* (Savigney): Assessing the Environmental Impact of Point Source Metal Contamination in Terrestrial Ecosystems," ***Environ. Pollut.***, 84: 123 – 130.

APPENDIX B

FIELD SAMPLING AND ANALYSIS PLAN SURFACE WATER AND SEDIMENT AT THE BAINS GAP ROAD RANGES

Appendix B
Field Sampling and Analysis Plan
Surface Water and Sediment at the Bains Gap Road Ranges

1.0 Introduction

As stated in the *Baseline Ecological Risk Assessment Problem Formulation for the Bains Gap Road Ranges* (IT, 2002a), copper and lead were identified as COPECs in surface water, and barium, copper, lead, manganese, and thallium were identified as COPECs in sediment for receptors in Cane Creek in the vicinity of the BGR ranges. To provide information for the BERA, surface water and sediment samples will be collected and analyzed for a full suite metals, volatiles, semivolatiles, chlorinated pesticides, organophosphorus pesticides, chlorinated herbicides, and PCBs. In addition, sediment samples will be analyzed for toxicity to chironomid larva, and surface water samples will be analyzed for toxicity to daphnids and fathead minnows. COPEC concentrations in sediments will also be used in food web models to predict the total daily doses of COPECs in invertivorous mammals and birds. Summaries of test conditions and procedures are provided in Attachments B-1 through B-3. In addition, Figures B-1 and B-2 provide flow diagrams of the sampling regimes for surface waters and sediments, respectively.

2.0 Site Selection

Ten surface water samples will be collected from locations representative of five lead concentration ranges in surface water within Cane Creek (i.e., two surface water samples will be collected from each of the five lead concentration ranges). Surface water sample locations will be based on historical lead concentrations in surface water because lead has been identified as a COPEC in surface water at each of the BGR ranges, and has been used as one of the indicators of potential contamination from Army activities at small arms ranges at FTMC. Surface water will also be collected from a stream with similar physical characteristics as Cane Creek but outside the influence of the BGR ranges to serve as reference water for the toxicity tests.

Ten sediment samples will be collected from locations representative of five lead concentration ranges in sediment within Cane Creek (i.e., two sediment samples will be collected from each of the five lead concentration ranges). Sediment will also be collected from a stream with similar substrate characteristics as Cane Creek but outside the influence of the BGR ranges to serve as reference sediment for the toxicity tests. Additionally, the benthic invertebrate community will

be analyzed using the rapid bioassessment protocol II (RBP II) at each of the 10-sediment sample locations and the reference site. Sediment sample locations will be identified by analyzing sediments using x-ray fluorescence technology to verify that the selected locations exhibit the intended lead concentration range. X-ray fluorescence methodology will follow the procedures outlined in the installation-wide sampling and analysis plan (IT, 2002b).

3.0 Sample Collection Procedures

Unless otherwise specified, sample collection procedures will follow the *Installation-Wide Sampling and Analysis Plan* (IT, 2002b). At each location, surface water samples will be collected first, followed by sediment samples. Surface water and sediment samples will be collected from the farthest downstream location first and then proceed upstream. The benthic macroinvertebrate community at each surface water/sediment sampling location will then be evaluated using the RBP II procedure.

3.1 Surface Water Sampling

Surface water samples will be collected as shown in Table B-1 through Teflon or Teflon lined plastic tubing with a peristaltic pump, according to the procedures identified in the *Installation-Wide Sampling and Analysis Plan* (IT, 2002b). As surface water samples are collected, in-stream measurements of the following parameters will be recorded:

- pH
- conductivity
- dissolved oxygen
- temperature
- turbidity
- oxidation reduction potential

At each location, the water depth, stream width, and approximate flow velocity will also be recorded. Other observations that may be recorded include weather conditions, surrounding vegetative cover and evidence of erosion.

As indicated in the *Installation-Wide Sampling and Analysis Plan* (IT, 2002b), care will be taken so that bottom sediment is not disturbed and introduced into the surface water sample containers. The plan also provides a list of the sample containers and preservatives required for each analysis for surface water samples.

Table B-1

Surface Water Sample Designations and QA/QC Sample Quantities
Baseline Ecological Risk Assessment Study Design
for Ranges at Bains Gap Road
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples			Analytical Suite
			Field Duplicates[a]	Field Splits	MS/MSD[a]	
SAR-85-SW05	SAR-85-SW05-SW-RW2001-REG					TAL Metals by SW6010B/SW7470A, VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, and PBCs by 8082A. TOC by SW9060, Hardness by EPA 130, Total Suspended Solids by EPA 160.2, Alkalinity by EPA 310.1, *Ceriodaphnia dubia* Invertebrate Survival and Reproduction Test by EPA 1002.0 (screening test) and *Pimephales promelas* Larval Survival and Growth Test by EPA 1000.0 (screening test).
SAR-85-SW07	SAR-85-SW07-SW-RW2002-REG		SAR-85-SW07-SW-RW2003-FD			TAL Metals by SW6010B/SW7470A, VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, and PBCs by 8082A. TOC by SW9060, Hardness by EPA 130, Total Suspended Solids by EPA 160.2, Alkalinity by EPA 310.1, *Ceriodaphnia dubia* Invertebrate Survival and Reproduction Test by EPA 1002.0 (screening test) and *Pimephales promelas* Larval Survival and Growth Test by EPA 1000.0 (screening test).
SAR-78-SW12	SAR-78-SW12-SW-RW2004-REG					TAL Metals by SW6010B/SW7470A, VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, and PBCs by 8082A. TOC by SW9060, Hardness by EPA 130, Total Suspended Solids by EPA 160.2, Alkalinity by EPA 310.1, *Ceriodaphnia dubia* Invertebrate Survival and Reproduction Test by EPA 1002.0 (screening test) and *Pimephales promelas* Larval Survival and Growth Test by EPA 1000.0 (screening test).
SAR-85-SW08	SAR-85-SW08-SW-RW2005-REG					TAL Metals by SW6010B/SW7470A, VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, and PBCs by 8082A. TOC by SW9060, Hardness by EPA 130, Total Suspended Solids by EPA 160.2, Alkalinity by EPA 310.1, *Ceriodaphnia dubia* Invertebrate Survival and Reproduction Test by EPA 1002.0 (screening test) and *Pimephales promelas* Larval Survival and Growth Test by EPA 1000.0 (screening test).
SAR-78-SW13	SAR-78-SW13-SW-RW2006-REG				SAR-78-SW13-SW-RW2006-MS/MSD	TAL Metals by SW6010B/SW7470A, VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, and PBCs by 8082A. TOC by SW9060, Hardness by EPA 130, Total Suspended Solids by EPA 160.2, Alkalinity by EPA 310.1, *Ceriodaphnia dubia* Invertebrate Survival and Reproduction Test by EPA 1002.0 (screening test) and *Pimephales promelas* Larval Survival and Growth Test by EPA 1000.0 (screening test).

Table B-1

Surface Water Sample Designations and QA/QC Sample Quantities
Baseline Ecological Risk Assessment Study Design
for Ranges at Bains Gap Road
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples			Analytical Suite
			Field Duplicates[a]	Field Splits	MS/MSD[a]	
HR-85Q-SW02	HR-85Q-SW02-SW-RW2007-REG					TAL Metals by SW6010B/SW7470A, VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, and PBCs by 8082A. TOC by SW9060, Hardness by EPA 130, Total Suspended Solids by EPA 160.2, Alkalinity by EPA 310.1, *Ceriodaphnia dubia* Invertebrate Survival and Reproduction Test by EPA 1002.0 (screening test) and *Pimephales promelas* Larval Survival and Growth Test by EPA 1000.0 (screening test).
SAR-77-SW15	SAR-77-SW15-SW-RW2008-REG					TAL Metals by SW6010B/SW7470A, VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, and PBCs by 8082A. TOC by SW9060, Hardness by EPA 130, Total Suspended Solids by EPA 160.2, Alkalinity by EPA 310.1, *Ceriodaphnia dubia* Invertebrate Survival and Reproduction Test by EPA 1002.0 (screening test) and *Pimephales promelas* Larval Survival and Growth Test by EPA 1000.0 (screening test).
SAR-78-SW14	SAR-78-SW14-SW-RW2009-REG					TAL Metals by SW6010B/SW7470A, VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, and PBCs by 8082A. TOC by SW9060, Hardness by EPA 130, Total Suspended Solids by EPA 160.2, Alkalinity by EPA 310.1, *Ceriodaphnia dubia* Invertebrate Survival and Reproduction Test by EPA 1002.0 (screening test) and *Pimephales promelas* Larval Survival and Growth Test by EPA 1000.0 (screening test).
SAR-77-SW19	SAR-77-SW19-SW-RW2010-REG					TAL Metals by SW6010B/SW7470A, VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, and PBCs by 8082A. TOC by SW9060, Hardness by EPA 130, Total Suspended Solids by EPA 160.2, Alkalinity by EPA 310.1, *Ceriodaphnia dubia* Invertebrate Survival and Reproduction Test by EPA 1002.0 (screening test) and *Pimephales promelas* Larval Survival and Growth Test by EPA 1000.0 (screening test).
SAR-77-SW20	SAR-77-SW20-SW-RW2011-REG					TAL Metals by SW6010B/SW7470A, VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, and PBCs by 8082A. TOC by SW9060, Hardness by EPA 130, Total Suspended Solids by EPA 160.2, Alkalinity by EPA 310.1, *Ceriodaphnia dubia* Invertebrate Survival and Reproduction Test by EPA 1002.0 (screening test) and *Pimephales promelas* Larval Survival and Growth Test by EPA 1000.0 (screening test).

Table B-1

Surface Water Sample Designations and QA/QC Sample Quantities
Baseline Ecological Risk Assessment Study Design
for Ranges at Bains Gap Road
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples			Analytical Suite
			Field Duplicates[a]	Field Splits	MS/MSD[a]	
Reference [b]	____-SW-RW2012-REG					TAL Metals by SW6010B/SW7470A, VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, and PBCs by 8082A. TOC by SW9060, Hardness by EPA 130, Total Suspended Solids by EPA 160.2, Alkalinity by EPA 310.1, *Ceriodaphnia dubia* Invertebrate Survival and Reproduction Test by EPA 1002.0 (screening test) and *Pimephales promelas* Larval Survival and Growth Test by EPA 1000.0 (screening test).

[a] Field duplicates and MS/MSDs are collected for chemical analysis only and not for biological testing.

[b] Reference location will be selected onsite from a comparable adjoining watershed.

FD - Field duplicate.
FS - Field split.
MS/MSD - Matrix spike/matrix spike duplicate.
QA/QC - Quality assurance/quality control.
REG - Field sample.
TAL - Target analyte list.
VOCs - volatile organic compounds.
SVOCs - semivolatile organic compounds.
PCBs - polychlorinated biphenyls.
TOC - Total Organic Carbon.

3.2 Sediment Sampling

Prior to the collection of sediment samples, in-stream water quality measurements will be recorded. Sediment samples will be collected as shown in Table B-2, to a depth of 0.5 feet with stainless steel spoons or trowels and homogenized in a stainless steel bowl following the procedures outlined in the *Installation-Wide Sampling and Analysis Plan* (IT, 2002b). A list of the sample containers and preservatives required for each analysis for sediment samples is also provided in the Installation-Wide Sampling and Analysis Plan (IT, 2002b).

3.3 Rapid Bioassessment

A biological assessment of the benthic invertebrate community using the EPA Rapid Bioassessment Protocol II (RBP II) (Plafkin, et. al., 1989) will be performed at each surface water and sediment sampling location. RBP II will used to determine whether on-site benthic invertebrate community structure is being adversely affected by COPECs at the BGR ranges

The locations for benthic invertebrate community analysis will be co-located with the sediment sample locations. The sampling locations will be located in areas similar in habitat so that the benthic community can be evaluated under similar environmental conditions.

Rapid Bioassessment Protocol (RBP) II as developed by EPA (Plafkin et. al., 1989) will be used to quantitatively assess the biotic health of surface waters within Cane Creek near the BGR ranges. RBPs were initially designed as a relatively inexpensive screening tool for use in determining if freshwater streams were capable of supporting designated aquatic life uses. However according to EPA, the bioassessment protocols have also been found useful in characterizing the existence and severity of use impairment within freshwater systems including full watersheds, as well as identifying sources and causes to the impairment. RBP II is well-suited for screening the streams within FTMC for biotic integrity.

At each sampling location, water quality measurements will be obtained. Habitat quality observations including substrate type, surrounding land use, evidence of erosion and pollutant sources, vegetative stream canopy, and other relevant data will be noted.

3.3.1 Macroinvertebrate Sampling

Two macroinvertebrate samples will be collected at each sampling station, the riffle/run sample will be collected with a kick net and the CPOM sample will be collected by hand.

Table B-2

Sediment Sample Designations and QA/QC Sample Quantities
Baseline Ecological Risk Assessment Study Design
for Ranges at Bains Gap Road
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples			Analytical Suite
			Field Duplicates[a]	Field Splits	MS/MSD[a]	
HR-78Q-SD01/ HR-78Q-RPB01	HR-78Q-SD01-SD-RW1001-REG					TAL Metals by SW6010B/SW7470A, VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, and PBCs by 8082A. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422, *Chironomus riparius* 10-day Survival and Growth Test by EPA 100.2.
SAR-78-SD10/ SAR-78-RPB10	SAR-78-SD10-SD-RW1002-REG		SAR-78-SD10-SD-RW1003-FD			TAL Metals by SW6010B/SW7470A, VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, and PBCs by 8082A. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422, *Chironomus riparius* 10-day Survival and Growth Test by EPA 100.2.
SAR-85-SD07/ SAR-85-RPB07	SAR-85-SD07-SD-RW1004-REG					TAL Metals by SW6010B/SW7470A, VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, and PBCs by 8082A. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422, *Chironomus riparius* 10-day Survival and Growth Test by EPA 100.2.
SAR-85-SD08/ SAR-85-RPB08	SAR-85-SD08-SD-RW1005-REG					TAL Metals by SW6010B/SW7470A, VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, and PBCs by 8082A. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422, *Chironomus riparius* 10-day Survival and Growth Test by EPA 100.2.
SAR-77-SD25/ SAR-77-RPB25	SAR-77-SD25-SD-RW1006-REG				SAR-77-SD25-SD-RW1006-MS/MSD	TAL Metals by SW6010B/SW7470A, VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, and PBCs by 8082A. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422, *Chironomus riparius* 10-day Survival and Growth Test by EPA 100.2.
SAR-85-SD02/ SAR-85-RPB02	SAR-85-SD02-SD-RW1007-REG					TAL Metals by SW6010B/SW7470A, VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, and PBCs by 8082A. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422, *Chironomus riparius* 10-day Survival and Growth Test by EPA 100.2.
SAR-77-SD23/ SAR-77-RPB23	SAR-77-SD23-SD-RW1008-REG					TAL Metals by SW6010B/SW7470A, VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, and PBCs by 8082A. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422, *Chironomus riparius* 10-day Survival and Growth Test by EPA 100.2.

Table B-2

Sediment Sample Designations and QA/QC Sample Quantities
Baseline Ecological Risk Assessment Study Design
for Ranges at Bains Gap Road
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples			Analytical Suite
			Field Duplicates[a]	Field Splits	MS/MSD[a]	
HR-85Q-SD02/ HR-85Q-RPB02	HR-85Q-SD02-SD-RW1009-REG					TAL Metals by SW6010B/SW7470A, VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, and PBCs by 8082A. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422, *Chironomus riparius* 10-day Survival and Growth Test by EPA 100.2.
HR-80Q-SD03/ HR-80Q-RPB03	HR-80Q-SD03-SD-RW1010-REG					TAL Metals by SW6010B/SW7470A, VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, and PBCs by 8082A. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422, *Chironomus riparius* 10-day Survival and Growth Test by EPA 100.2.
HR-80Q-SD06/ HR-80Q-RPB06	HR-80Q-SD06-SD-RW1011-REG					TAL Metals by SW6010B/SW7470A, VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, and PBCs by 8082A. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422, *Chironomus riparius* 10-day Survival and Growth Test by EPA 100.2.
Reference[b]	____-SD-RW2012-REG					TAL Metals by SW6010B/SW7470A, VOCs by 8260B, SVOCs by 8270C, Chlorinated Pesticides by 8081A, Organophosphorus Pesticides by 8141A, Chlorinated Herbicides by 8151A, and PBCs by 8082A. TOC by Walkley Black, pH by SW9045C, Grain Size by ASTM 421/422, *Chironomus riparius* 10-day Survival and Growth Test by EPA 100.2.

[a] Field duplicates and MS/MSDs are collected for chemical analysis only and not for biological testing.

[b] Reference location will be selected onsite from a comparable adjoining watershed.

FD - Field duplicate.
FS - Field split.
MS/MSD - Matrix spike/matrix spike duplicate.
QA/QC - Quality assurance/quality control.
REG - Field sample.
TAL - Target analyte list.
VOCs - volatile organic compounds.
SVOCs - semivolatile organic compounds.
PCBs - polychlorinated biphenyls.
TOC - Total Organic Carbon.

ATTACHMENT B-1

CERIODAPHNIA DUBIA IINVERTEBRATE SURVIVAL AND REPRODUCTION TEST (US EPA METHOD 100.20)

Attachment B-1
Ceriodaphnia dubia Invertebrate Survival and Reproduction Test
(US EPA Method 100.20)

Test Objectives

The standard 7-day Ceriodaphnid test will be used to evaluate possible effects and subsequent risks of site-specific COPECs present in surface waters to herbivorous aquatic invertebrates. Survival and reproduction over a 7-day exposure period will be used as the observable test endpoints. COPECs present in surface waters could be acutely lethal to these sensitive water fleas or simply affect their ability to release neonates into test waters. Such a sub-lethal response could have a detrimental affect on population dynamics. The daphnids used for this testing (*C. dubia*) have also been shown to be sensitive to toxic metals. Test conditions are presented in Table B-1-1.

Test Water Dilution Series

Ceriodaphnids will be exposed in a static renewal system to the following test concentrations:

100% - undiluted stream water
50% - stream water/control water
25% - stream water/control water
12.5% - stream water/control water
6.25% - stream water/control water

In addition, reference waters will be collected and tested with the same dilution factors, and control chambers will be set up consisting of 100% undiluted laboratory control water.

Surface water toxicity will be determined with samples used directly as collected. Approximately 400 mL of sample will be used for each test, assuming 10 replicates of 15 mL, and sufficient additional sample for each chemical analysis.

A volume of 15 mL of test solution should be adequate for the organisms and will provide a depth in which it is possible to count the animals under a stereomicroscope with a minimum of refocusing. Ten test chambers will be used for each stream water dilution and for the control. The volume of water required for daily renewal of 10 replicates per concentration, each

Table B-1-1

Summary of Recommended Toxicity Test Conditions for the Ceriodaphnia Survival and Reproduction Test

1.	Test type:	Static renewal
2.	Temperature:	25±1°C
3.	Light quality:	Ambient laboratory illumination
4.	Light intensity:	10-20 uE/m^2/s, or 50-100 ft-c (ambient laboratory levels)
5.	Photoperiod:	16 h light, 8 h dark
6.	Test chamber size:	30 mL
7.	Test solution volume:	15 mL
8.	Renewal of test solutions:	Daily
9.	Age of test organisms:	Less than 24 h; and all released within an 8-h period
10.	No. replicate test chambers per concentration:	1
11.	No. neonates per test concentration:	10
13.	Feeding regime:	Feed 0.1 mL each of YCT and algal suspension per test chamber daily.
14.	Aeration:	None
15.	Dilution water:	Moderately hard synthetic water is prepared using MILLIPORE MILLI-Q^R or equivalent deionized water and reagent grade chemicals or 20% DMW
16.	Stream water concentrations:	100%, 50%, 25%, 12.5%, 6.25% and a control
17.	Test duration:	Until 60% of control females have three broods (may require more or less than 7 days).
18.	Endpoints:	Survival and reproduction
19.	Test acceptability:	80% or greater survival and an average of 15 or more young/surviving female in the control solutions. At least 60% of surviving females in controls should have produced their third brood.
20.	Sample volume required:	1 L

containing 15 mL of test solution, with a dilution series of 50 percent will be approximately 2 L. Approximately 600 mL at each test concentration will be prepared in order to provide 400 mL additional volume for chemical analyses.

Test Initiation

Tests will be initiated within 10 days of sample collection. Just prior to testing, the temperature of the sample will be adjusted to 25±1°C and maintained at that temperature until portions are added to the dilution water.

The test solutions, consisting of 10 replicates of each of five treatments and a control, will be randomly assigned to a board using a template or a table of random numbers.

Ceriodaphnid neonates less than 24 h old, and all within 8 h of the same age, will be used to begin the test. The neonates will be obtained from individual cultures using brood boards. Neonates will be taken only from adults that have eight or more young in their third or subsequent broods. These adults will also be used as brood stock until they are 14 days old.

Ten brood cups, each with 8 or more young, will be selected from the brood board for use in setting up a test. To start the test, one neonate from the first brood cup will be transferred to each of the six test chambers in the first row on the test board. A second brood cup will be selected, and one neonate from this cup will be transferred to each of the six test chambers in the second row on the test board. This process will be continued until each of the 60 test chambers contains one neonate.

The blocking procedure will allow the performance of each female to be tracked. If a female produces one weak offspring or male, the likelihood of producing all weak offspring or all males is greater. By using this known parentage technique, poor performance of young from a given female will be omitted from all concentrations.

Light, Photoperiod, and Temperature

The light quality and intensity will be at ambient laboratory levels, approximately 10-20 uE/m^2/s, or 50 to 100 foot candles (ft-c), with a photoperiod of 16 h of light and 8 h of darkness. The test water temperature will be maintained at 25±1°C to obtain three broods in seven days.

Feeding

The organisms will be fed when the test is initiated, and daily thereafter. Food will be added to the fresh medium immediately before or immediately after the adults are transferred. Each

feeding will consist of 0.1 mL YCT/15 mL test solution and 0.1 mL Selenastrum concentrate /15 mL test solution (0.1 mL of algal concentrate containing 3.0-3.5 X 10^7 cells/mL will provide 2-2.3 x10^5 cells/mL in the test chamber).

Test Solution Renewal

Test solutions will be renewed daily. A single sample will be collected prior to test initiation and all test solution renewals will be obtained from this sample. The sample will be maintained in a refrigerator at 4°C for the duration of the test.

New test solutions will be prepared daily, and the test organisms will be transferred to the freshly prepared solutions using a small-bore (2 mm) glass or polyethylene dropper or pipet. The animals will be released under the surface of the water so that air is not trapped under the carapace. Organisms that are dropped or injured will be discarded.

Routine Chemical and Physical Determinations

Dissolved oxygen and pH will be measured at the beginning and end of each 24-h exposure period in the high, medium, and low test concentrations, and in the control.

Temperature will be monitored continuously or observed and recorded daily for at least two locations in the environmental control system or the samples.

Conductivity, alkalinity, and hardness will be measured in each new sample and in the control.

Observations During the Test

Three broods should be obtained in the controls in the 7-day exposure period conducted at 25±1°C. In the controls, the first brood of two-to-five young will usually be released on the third or fourth day of the test, soon after the adults will be transferred to fresh test solutions. Successive broods should be released every 36 to 48 h thereafter. The second and third broods usually consist of eight to 20 young each.

The release of a brood may be inadvertently interrupted during the daily transfer of organisms to fresh test solutions, resulting in a split in the brood count between two successive days. For example, four neonates of a brood of five might be released on Day 4, just prior to test solution renewal, and the fifth released just after renewal, and counted on Day 5. Partial broods, released over a two-day period, should be counted as one brood.

Each day, the live adults will be transferred to fresh test solutions, and the numbers of live young will be recorded. If difficulty is encountered in counting the live young because of their erratic motion, two drops of 1 normal hydrochloric acid will be added to the chamber (except in chambers used for DO and pH measurements) after the adult has been transferred. Upon addition of acid, the young die quickly and settle to the bottom of the test chamber where they will be counted with a minimum of effort and error. The young will be discarded after counting.

Termination of the Test

Tests will be terminated when 60% or more of the surviving females in the controls have produced their third brood. Because of the rapid rate of development of *Ceriodaphnia,* at test termination all observations on organism survival and numbers of offspring will be completed within two hours.

Acceptability of Test Results

For the test results to be acceptable, survival in the controls must be at least 80%, and reproduction in the controls must average 15 or more young per surviving female.

Data Analysis

The endpoints of toxicity tests using *Ceriodaphia* will be based on the adverse effects on survival and reproduction. Point estimates, such as lethal concentrations and inhibition concentrations, will be calculated using point estimation techniques. LOAEL and NOAEL values, for survival and growth, will be obtained using a hypothesis test approach such as Fisher's Exact Test (Finney, 1948; Pearson and Hartley, 1962), Dunnett's Procedure (Dunnett, 1955) or Steel's Many-one Rank Test (Steel, 1959; Miller, 1981).

ATTACHMENT B-2

PIMEPHALES PROMELAS LARVAL SURVIVAL AND GROWTH TEST (US EPA METHOD 1000.0)

Attachment B-2
Pimephales promelas Larval Survival and Growth Test
(US EPA Method 1000.0)

Test Objectives

The fathead minnow (*Pimephales promelas*) is a freshwater finfish commonly used in aquatic bioassay testing. The newly hatched larvae are not only sensitive to metal toxicity, but a wealth of information exists on their physiological formation as well as their response to natural physio-chemical gradients such as dissolved oxygen, pH, temperature, alkalinity, hardness, and conductivity. Moreover, the fathead minnow is commonly cultured and tested in most bioassay laboratories throughout the country and its response to reference toxicants is well documented.

The COPECs present in nearby surface waters could be acutely toxic (lethal) to the sensitive newly hatched minnows, or the constituents may inhibit their growth. The sub-lethal growth inhibition response could signify risks associated with a general decline in the minnow's ability to grow into adults and ultimately affect population dynamics.

The minnow larvae will be exposed over a 7-day period to 5 separate concentrations. Test conditions are presented in Table B-2-1.

Test Water Dilution Series

Pimephales promelas will be exposed in a static renewal system to the following test concentrations:

100% - undiluted stream water
50% - stream water/control water
25% - stream water/control water
12.5% - stream water/control water
6.25% - stream water/control water

In addition, reference waters will be collected and tested with the same dilution factors, and control chambers will be set up consisting of 100% undiluted laboratory control water.

Surface water toxicity will be determined with samples used directly as collected. Approximately 2,500 mL of sample will be used for each test, assuming 4 replicates of 250 mL, and sufficient additional sample for each chemical analysis.

Table B-2-1

Summary of Recommended Stream Water Toxicity Test Conditions for the Fathead Minnow (*Pimephales promelas*) Larval Survival and Growth Test

1.	Test type:	Static renewal
2.	Temperature (°C):	25±1°C
3.	Light quality:	Ambient laboratory illumination
4.	Light intensity:	10-20 uE/m^2/s (50-100 ft-c) (ambient laboratory levels)
5.	Photoperiod:	16 h light, 8 h darkness
6.	Test chamber size:	500 mL
7.	Test solution volume:	250 mL/replicate
8.	Renewal of test concentrations:	Daily
9.	Age of test organisms:	Newly hatched larvae less than 24 h old.
10.	No. larvae per test chamber:	15
11.	No. replicate chambers per concentration:	4
12.	No. larvae per concentration:	60
13.	Feeding regime:	Feed 0.1 mL newly hatched (less than 24-h old) brine shrimp nauplii three times daily at 4-h intervals or, as a minimum, 0.15 mL twice daily, 6 h between feedings (at the beginning of the work day prior to renewal, and at the end of the work day following renewal). Sufficient larvae are added to provide an excess. Larvae are not fed during the final 12 h of the test.
14.	Cleaning:	Siphon daily, immediately before test solution renewal
15.	Aeration:	None, unless DO concentration falls below 40% saturation. Rate should not exceed 100 bubbles/min
16.	Dilution water:	Moderately hard synthetic water is prepared using MILLIPORE MILI-Q^R or equivalent deionized water and reagent grade chemicals or 20% DMW
17.	Stream water concentrations:	100%, 50%, 25%, 12.5%, 6.25% and a control

Table B-2-1

Summary of Recommended Stream Water Toxicity Test Conditions for the Fathead Minnow (*Pimephales promelas*) Larval Survival and Growth Test

18.	Test duration:	7 days
19.	Endpoints:	Survival and growth (weight)
20.	Test acceptability:	80% or greater survival in controls; average dry weight of surviving controls equals or exceeds 0.25 mg
21.	Sample volume required:	2.5 L/day

A volume of 250 mL of test solution should be adequate for the organisms, and will provide a depth in which it is possible to count the animals under a stereomicroscope with a minimum of re-focusing. Four test chambers will be used for each stream water dilution and for the control. The volume of water required for daily renewal of 4 replicates per concentration, each containing 250 mL of test solution, with a dilution series of 50 percent will be approximately 2 L. Approximately 2,500 mL at each test concentration will be prepared in order to provide 400 mL additional volume for chemical analyses.

Test Initiation

Tests will be initiated within 10 days of sample collection. The temperature of the sample should be adjusted to ($25\pm1^{\circ}C$) and maintained at that temperature until portions are added to the dilution water.

The testing laboratory will have in-house fathead minnow breeding cultures and will use larvae less than 24-h old.

The larvae will be pooled and placed one to four at a time into each test chamber in sequential order, until each chamber contains 15 larvae, for a total of 60 larvae for each concentration. The test organisms will come from a pool of larvae consisting of at least three separate spawnings. The amount of water added to the chambers when transferring the larvae to the compartments will be kept to a minimum to avoid unnecessary dilution of the test concentrations.

Light, Photoperiod and Temperature

The light quality and intensity will be at ambient laboratory levels, which is approximately 10-20 $uE/m^2/s$, or 50 to 100 foot candles (ft-c), with a photoperiod of 16 h of light and 8 h or darkness. The water temperature in the test chambers will be maintained at $25 \pm 1^{\circ}C$.

Dissolved Oxygen (DO)

Aeration may affect the toxicity of effluents and will be used only as a last resort to maintain satisfactory dissolved oxygen concentrations. The dissolved oxygen concentrations will not fall below 40% saturation. If it is necessary to aerate, all concentrations and the control will be aerated. The aeration rate will not exceed 100 bubbles/min, using a pipet with an orifice of approximately 1.5 mm, such as a 1-mL, Kimax serological pipet, No. 37033, or equivalent. Care will be taken to ensure that turbulence resulting from aeration does not cause undue physical stress to the fish.

Feeding

The fish in each test chamber will be fed 0.1 mL (approximately 700 to 1000) of a concentrated suspension of newly hatched (less than 24-h old) brine shrimp nauplii three times daily at 4-h intervals.

The feeding schedule will depend on when the test solutions are renewed. If the test is initiated after 1200 PM, the larvae may be fed only once the first day. On following days, the larvae normally would be fed at the beginning of the work day, at least 2 h before test solution renewal, and at the end of the work day, after test solution renewal. However, if the test solutions are changed at the beginning of the work day, the first feeding would be after test solution renewal in the morning, and the remaining feeding(s) would be at the appropriate intervals. The larvae will not be fed during the final 12 h of the test.

The nauplii will be rinsed with freshwater before use. The amount of food provided in each feeding will be sufficient to ensure the presence of a small amount of uneaten food at the next feeding.

Daily Cleaning of Test Chambers

At the time of the daily renewal of test solutions, uneaten and dead brine shrimp and other debris will be removed from the bottom of the test chambers with a siphon hose.

Test Solution Renewal

Test solutions will be renewed daily. A single sample will be collected prior to test initiation and all test solution renewals will be obtained from this sample. The sample will be maintained in a refrigerator at 4°C for the duration of the test.

The test solutions will be renewed immediately after cleaning the test chambers. The water level in each chamber will be lowered to a depth of 7 to 10 mm, which leaves 15 to 20% of the test solution. New test solution will be added slowly by pouring down the side of the test chamber to avoid subjecting the larvae to excessive turbulence.

Routine Chemical and Physical Analysis

Dissolved oxygen and pH will be measured at the beginning and end of each 24-h exposure period in one test chamber at the high, medium, and low test concentrations, and in the control.

Temperature will be monitored continuously or observed and recorded daily for at least two locations in the environmental control system or the samples.

Conductivity, alkalinity, and hardness will be measured in each new sample (100% stream water or receiving water) and in the control.

Observations During the Test

The number of live and dead larvae in each test chamber will be recorded daily and the dead larvae will be discarded.

Termination of the Test

The test will be terminated after seven days of exposure. At test termination, the surviving larvae in each test chamber (replicate) will be counted and prepared as a group for dry weight determination. Immediately prior to the dry weight analysis, each group of larvae will be rinsed with distilled water to remove food particles, transferred to a tared weighing boat, and dried at 100°C for a minimum of 2 h. Immediately upon removal from the drying oven, the weighing boats will be placed in a dessicator until weighed, to prevent the absorption of moisture from the air. All weights will be measured to the nearest 0.01 mg.

Acceptability of Test Results

For the test results to be acceptable, survival in the controls must be at least 80%. In tests initiated with larvae less than 24-h old, the average dry weight of control larvae surviving at the end of the test should equal or exceed 0.25 mg.

Data Analysis

The endpoints of toxicity tests using the fathead minnow larvae will be based on the adverse effects on survival and growth. Point estimates, such as lethal concentrations and inhibition concentrations will be calculated using point estimation techniques. LOAEL and NOAEL values, for survival and growth, will be obtained using a hypothesis test approach such as Dunnett's Procedure (Dunnett, 1955) or Steel's Many-one Rank Test (Steel, 1959; Miller, 1981).

ATTACHMENT B-3

CHIRONOMUS RIPARIUS SURVIVAL AND GROWTH TEST (U.S. EPA METHOD 100.2)

Attachment B-3
Chironomus riparius Survival and Growth Test
(U.S. EPA Method 100.2)

Test Objective

The direct toxicity of sediment-bound COPECs will be measured by exposing the benthic invertebrates (*Chironomus riparius*) to streambed sediment. Use of chironomids to measure toxicity of sediment associated contaminants is quite common and has been standardized by EPA (EPA, 2000).

Measuring growth as well as survival over the 10-day exposure period permits an evaluation of chronic (sub-lethal) potentials along with acute toxicity. Adverse sub-lethal responses could affect the long-term viability of benthic invertebrate communities within impact zones and, therefore, affect the stability of the stream ecosystem.

The assessors are proposing use of *Chironomus riparius* rather than *C. tentans,* because historical data indicate that *Chironomus riparius* is more sensitive to metal toxicity than *C. tentons*. Since the sediment-bound COPECs are all metals, use of the more sensitive *C. riparius* should be a better indication of risk from a weight of evidence standpoint. A summary of the test conditions is provided in Table B-3-1.

Test Sediment Dilution Series

Given the uncertainties and difficulties associated with laboratory dilution and subsequent mixing of sediments, test organisms will be exposed to 100 percent undiluted field collected sediment. Tests will be set up with exposure to laboratory based control sediment, reference sediment, and sediment representing five separate and distinct concentrations of lead.

Test Initiation

Tests will be initiated within 10 days of sample collection, and the laboratory grade overlying test water will be maintained at $23 \pm 1^{\circ}C$. Test chambers will consist of 300 ml high form lipless beakers containing 100 mg of sediment and 175 ml of overlying water. Ten second to third instar *C. riparius* midges (approximately 10 days old) will be used at test initiation. A total of 10 replicates will be employed for each parallel test.

Midges within each test chamber will be fed 1-5 ml of a 4-g/l tetrafin suspension on a daily basis throughout the 10-day test period. Each replicate test chamber will receive two-volume

Table B-3-1

Summary of *Chironomus riparius* Survival, Growth , and Emergence Test

	Parameter	Conditions
1.	Test Type	Whole-sediment toxicity with renewal of overlying water
2.	Temperature	23 $\pm$1°C
3.	Light Quality	Wide-spectrum fluorescent lights
4.	Illuminance	~100-1000 lux
5.	Photoperiod	16 hours light:8 hours dark
6.	Test chamber	300-ml high form lipless beaker
7.	Sediment volume	100 ml
8.	Overlying water volume	175 ml
9.	Renewal of overlying water	2 volume additions per day, either continuous or Intermittent
10.	Age of organisms	<24 hour old larvae at start of test
11.	Number of organisms per chamber	10
12.	Number of replicate chambers per treatment	10
13.	Feeding	Tetrafin goldfish food, fed 1.5 ml daily to each test Chamber starting Day-1. If fungal or bacterial growth develops on sediment surface, feeding should be suspended for one or more days. If DO drops below 2.5 mg/L during the test, feeding should be suspended for the amount of time necessary to increase the DO. If feeding is suspended in one treatment, it is suspended in all treatments.
14.	Areation	None, unless DO in overlying water drops below 2.5 mg/L
15.	Overlying water	Culture water, laboratory-grade freshwater, or Reconstituted water
16.	Test chamber cleaning	Gently brush outside of overflow screens if they become clogged

Table B-3-1

Summary of *Chironomus riparius* Survival, Growth , and Emergence Test

17.	Overlying water quality	Hardness, alkalinity, conductivity, and ammonia at the beginning, on Day 10, and at the end of the test. Temperature daily. DO and pH three times/week. Conductivity weekly. Concentrations of DO should be measured more often if DO has declined by more than 1 mg/L since previous measurement. Overlying water quality should be measured just prior to water renewals. Overlying water should be measured from about 1 to 2 cm above the sediment surface.
18.	Test duration	Ten replicates are ended at 10 days for survival and weight.
19.	Endpoints	10-day survival and weight; COPEC concentration in chironomid tissues.
20.	Test acceptabilty	Average size of C. riparius in control sediment at 10 days $\geq$0.6 mg/surviving organism as dry weight or 0.48 mg/surviving organisms as AFDW. Emergence $\geq$50%

additions/day of overlying water. Water renewals will be conducted in a manner that minimizes suspension of sediment. All testing will, therefore, be static daily renewals with careful monitoring of physico-chemical parameters within the overlying water. These parameters will include pH, temperature, ammonia, alkalinity, hardness, conductivity, and dissolved oxygen.

Test Monitoring

All chambers will be checked daily and observations made to assess test organism behavior such as sediment avoidance.

Measurement of Overlying Water-Quality Characteristics

Conductivity, hardness, pH, alkalinity, and ammonia will be measured in all treatments at the beginning and end of a test. Overlying water will be sampled just before water renewal from about 1 to 2 cm above the sediment surface using a pipet.

Test Termination

Immobile organisms isolated from the sediment surface or from sieved material will be considered dead. A #40 sieve (425-µm mesh) will be used to remove midges from sediment. Surviving midges will be isolated from pans.

Test Data

Ash-free dry weight (AFDW) and survival will be the endpoints measured at the end of the 10-day sediment toxicity test.

For determination of AFDW, all living larvae in each replicate will be pooled and the sample will be dried to a constant weight (e.g., 60°C for 24 hours).

At the termination of the test and after the determination of AFDW, each pooled sample will be analyzed for the COPECs as shown in Table B-3-2.

Table B-3-2

Chironomid Tissue Sample Designations and QA/QC Sample Quantities
Baseline Ecological Risk Assessment Study Design for the Iron Mountain Road and Bains Gap Road Ranges
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples			Analytical Suite
			Field Duplicates	Field Splits	MS/MSD	
HR-78Q-SD01	HR-78Q-SD01-BIOA-RW8000C-REG	N/A				TAL Metals by SW6010B/SW7471A
SAR-78-SD10	SAR-78-SD10-BIOA-RW8001C-REG	N/A				TAL Metals by SW6010B/SW7471A
SAR-85-SD07	SAR-85-SD07-BIOA-RW8002C-REG	N/A				TAL Metals by SW6010B/SW7471A
SAR-85-SD08	SAR-85-SD08-BIOA-RW8003C-REG	N/A				TAL Metals by SW6010B/SW7471A
SAR-77-SD25	SAR-77-SD25-BIOA-RW8004C-REG	N/A				TAL Metals by SW6010B/SW7471A
SAR-85-SD02	SAR-85-SD02-BIOA-RW8005C-REG	N/A				TAL Metals by SW6010B/SW7471A
SAR-77-SD23	SAR-77-SD23-BIOA-RW8006C-REG	N/A				TAL Metals by SW6010B/SW7471A
HR-85Q-SD02	HR-85Q-SD02-BIOA-RW8007C-REG	N/A				TAL Metals by SW6010B/SW7471A
HR-80Q-SD03	HR-77Q-SS01-BIOA-RW8008C-REG	N/A				TAL Metals by SW6010B/SW7471A
HR-80Q-SD06	HR-80Q-SD06-BIOA-RW8009C-REG	N/A				TAL Metals by SW6010B/SW7471A
SED-REF	SED-REF-BIOA-RW8010C-REG	N/A				TAL Metals by SW6010B/SW7471A

FD - Field duplicate.
FS - Field split.
MS/MSD - Matrix spike/matrix spike duplicate.
QA/QC - Quality assurance/quality control.
REG - Field sample.
TAL - Target Analyte List.
TOC - Total Organic Carbon
SED-REF- Sediment reference location collected from a comparable adjoining watershed.