In cooperation with the U.S. Army Joint Readiness Training Center and Fort Polk

Physicochemical Properties and Chemical Characteristics of Water, Bed Sediment, and Mussel Tissue from Selected Streams near the Redleg and Peason Ridge Impact Areas, Fort Polk Military Reservation, Louisiana, June 2001–November 2003

Scientific Investigations Report 2007–5151

U.S. Department of the Interior
U.S. Geological Survey

Cover photographs (Fort Polk Military Reservation, Louisiana)

Background: Hilltop in an impact area, Peason Ridge Training Area.

Left: Little Sandy Creek near northern boundary of Peason Ridge Training Area.

Right: Collection pan containing depositional bed sediment.

(Photographs by Roland W. Tollett, U.S. Geological Survey.)

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Conversion Factors, Datum, and Abbreviations

Inch/Pound to SI

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
acre	4,047	square meter (m^2)
	Volume	
gallon (gal)	3.785	liter (L)
	Flow rate	
foot per second (ft/s)	0.3048	meter per second (m/s)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

°F=(1.8×°C)+32

Datum:

Vertical coordinate information is referenced to National Geodetic Vertical Datum of 1929 (NGVD 29).

Altitude, as used in this report, refers to distance above the vertical datum.

Abbreviated water-quality units:

milligrams per liter (mg/L)
micrograms per liter (µg/L)
micrometers (µm)
microsiemens per centimeter at 25 degrees Celsius (µS/cm)

Abbreviated bed-sediment units:

centimeters (cm)
grams (g)
milligrams per kilogram (mg/kg)
millimeters (mm)

Acronyms:

CCC, Criterion Continuous Concentration
CMC, Criterion Maximum Concentration
CCME, Canadian Council of Ministers of the Environment
DNB, dinitrobenzene
DNT, dinitrotoluene

DWEL, Drinking Water Equivalent Level
FW, freshwater
HA, Health Advisory
HMX, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
ISQG, Interim Sediment Quality Guideline
MCL, Maximum Contaminant Level
MCLG, Maximum Contaminant Level Goal
NTU, nephelometric turbidity unit
NWQL, National Water Quality Laboratory
PEL, Probable Effect Level
PETN, pentaerythritol tetranitrate
PRIA, Peason Ridge impact areas
RDX, hexahydro-1,3,5-trinitro-1,3,5-triazine
RIA, Redleg impact area
ROE, residue on evaporation at 180 degrees Celsius
RPD, relative percent difference
SDWR, Secondary Drinking-Water Regulation
STL, Severn Trent Laboratory
TDS, total dissolved solids
TKN, total Kjeldahl nitrogen
TNB, trinitrobenzene
TNT, trinitrotoluene
TSS, total suspended solids
TOC, total organic carbon
USACHPPM, U.S. Army Center for Health Promotion and Preventive Medicine
USEPA, U.S. Environmental Protection Agency
USGS, U.S. Geological Survey

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Abstract

At the request of the U.S. Army Joint Readiness Training Center and Fort Polk, the U.S. Geological Survey collected and analyzed water, bed-sediment, and mussel-tissue samples from selected streams near the Redleg impact area (RIA) and Peason Ridge impact areas (PRIA) at the Fort Polk Military Reservation (Reservation), Louisiana, from June 2001 through November 2003. Samples were collected from 13 sites, including 2 reference sites. Water was analyzed for physicochemical properties; water and bed sediment were analyzed for major inorganic ions, cyanide, perchlorate, trace elements, total organic carbon, nutrients, and explosive compounds; and mussel tissue from three sites was analyzed for explosive compounds only. The two reference sites, one near the RIA and one near the PRIA, were selected to provide baseline data for these areas.

Streams near the RIA were acidic and low in buffering capacity, with pH measurements ranging from 5.0 to 6.6. Cation concentrations were less than or equal to E3.3J mg/L (E, estimated; J, method blank contamination; milligrams per liter), and anion concentrations were less than or equal to E7.3 mg/L. Field measurements and major inorganic ions concentrations were similar to the RIA reference site and to previously sampled nearby streams, indicating streams near the RIA were typical of streams near the eastern part of the Main Post.

Streams near the PRIA were slightly acidic to neutral and low in buffering capacity, with pH measurements ranging from 5.7 to 6.9. Cation concentrations were less than or equal to 6.2 mg/L, and anion concentrations were less than or equal to 16 mg/L. Streams near the PRIA were higher than the RIA for most physicochemical properties and constituents, but typical of streams near the headwaters of the Calcasieu River. All concentrations of sulfate, chloride, and fluoride were less than the U.S. Environmental Protection Agency (USEPA) Secondary Drinking-Water Regulations (SDWR) of 250, 250, and 2.0 mg/L, respectively.

Concentrations of cations calcium, magnesium, and potassium for sites near both the RIA and PRIA were higher in depositional bed-sediment samples than in bulk samples. Higher cation concentrations were likely due to higher clay and organic content in the depositional samples.

The trace elements detected in the highest concentrations in water and bed sediment were aluminum, iron, and manganese. All aluminum concentrations in water were within the range or greater than the USEPA SDWR range from 50 to 200 µg/L (micrograms per liter). All but four iron concentrations in water exceeded the SDWR. Manganese concentrations in seven water samples at the RIA sites and four samples at the PRIA sites were greater than the SDWR. These concentrations of cations were consistent with soil characteristics and low pH measurements of stream water and rainfall in the area. All other trace-element concentrations in water were less than regulatory guidelines and regulations except the USEPA Maximum Contaminant Level Goal of 0 µg/L for arsenic and lead and 0.5 µg/L for thallium. Arsenic, lead, and thallium concentrations were similar to those detected in blank samples or those reported for the reference sites.

The Canadian Council of Ministers of the Environment (CCME) has established bed-sediment guidelines for seven trace elements: arsenic, cadmium, chromium, copper, lead, mercury, and zinc. No concentrations exceeded the CCME Probable Effect Level, and only one arsenic concentration of 8.87 mg/kg (milligrams per kilogram), in a depositional sample from one of the RIA sites, exceeded the CCME Interim Sediment Quality Guideline of 5.9 mg/kg.

The median concentrations of total organic carbon in water were 5.3 mg/L at the RIA and 4.0 mg/L at the PRIA, and both concentrations were less than the average dissolved organic carbon concentration of 5.75 mg/L for all world rivers. All detected nutrient concentrations in water were less than USEPA guidelines and regulations. The largest nutrient concentrations in water and bed-sediment samples were total organic nitrogen, measured as total Kjeldahl nitrogen; they included a maximum concentration of 0.53 mg/L in water

at the RIA sites, E0.38 mg/L in water at the PRIA sites, 294 mg/kg in bulk bed sediment, and 1,740 mg/kg in depositional bed sediment.

Four explosive compounds, 1,3,5-trinitrobenzene, 2,4,6-trinitrotoluene, RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine), and tetryl, were detected in water near the RIA; one compound, HMX (octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine), was detected in bed sediment near the PRIA; and one compound, nitroglycerin, was detected in mussel tissue near the RIA. The most frequently detected explosive compound, RDX, was detected in 10 water samples from 5 sites near the RIA. Concentrations of explosive compounds in water were less than USEPA Health Advisories available for reference.

Introduction

Combat training at the Fort Polk Military Reservation, Louisiana (hereinafter referred to as the Reservation) (fig. 1) often involves using materials such as ammunition, propellants, projectiles, explosives, and pyrotechnics. Residues from these materials could affect the quality of surface water and ground water near training areas of the Reservation. These typically hydrophobic compounds (U.S. Environmental Protection Agency, 2003a) can be transported when contaminants are dispersed in surface-water runoff or when they are adsorbed to suspended solids in the runoff or the stream. The U.S. Army is required to assess the effects of training activities on possible drinking-water sources (Dr. Charles H. Stagg, U.S. Army Joint Readiness Training Center and Fort Polk, oral commun., 2005). The U.S. Army Joint Readiness Training Center and Fort Polk has worked with the U.S. Army Forces Command, the U.S. Army Environmental Center, and the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) to develop an integrated water-quality sampling approach which includes monitoring drinking-water wells at the Reservation as well as monitoring surface water and ground water near impact areas[1]. Preserving the natural conditions of the streams is of great importance to the U.S. Army and Fort Polk.

The U.S. Geological Survey (USGS), in cooperation with the U.S. Army Joint Readiness Training Center and Fort Polk, performed a surface-water assessment by sampling water quality, bed sediment, and tissue of freshwater mussels from streams that originate on or near designated impact areas: the Redleg impact area (RIA) on the Main Post and the Peason Ridge impact areas (PRIA) at the Peason Ridge Training Area (fig. 1). Selected streams draining the designated impact areas were the focus of this study. The primary objective of this study was to determine whether runoff from areas of intensive military training affects the physicochemical properties and chemical characteristics of streams draining the areas.

Purpose and Scope

This report describes the physicochemical properties and chemical characteristics of water and presents laboratory methods. Data from eight sites and one reference site near the RIA and three sites and one reference site near the PRIA include physicochemical properties and chemical constituents in water, namely specific conductance, pH, water temperature, turbidity, alkalinity, total dissolved solids (TDS) and total suspended solids (TSS), major inorganic ions, cyanide, perchlorate, 21 trace elements, total organic carbon (TOC), 7 nutrients, and explosive compounds; and chemical constituents in bed sediment, namely major inorganic ions, cyanide, perchlorate, 21 trace elements, TOC, 7 nutrients, and explosive compounds. Explosive compounds were analyzed in tissue of freshwater mussels collected at Alligator Lake and in tissue of transplanted mussels from Alligator Lake placed at three sites near the RIA. Statistical summaries (minimum, median, and maximum) of the data are presented in tables, and all analyzed data are presented in appendixes.

Data were compared to previously collected data from other sites near the impact areas. The information in this report may help improve understanding of water-quality conditions in similar hydrogeologic settings.

Acknowledgments

The authors express appreciation to Dr. Charles H. Stagg, Chief of the Environmental and Natural Resources Management Division of the Directorate of Public Works for the U.S. Army Joint Readiness Training Center and Fort Polk. His assistance contributed greatly to the design of the study and preparation of this report.

Description of Study Areas

The Reservation is located in west-central Louisiana and encompasses about 199,000 acres: 165,500 acres of the Main Post and 33,500 acres of the Peason Ridge Training Area (fig. 1). The western part of the Main Post includes a southern and northern cantonment area (South Fort Polk and North Fort Polk); the east-central part includes the RIA; and the remainder is used for military training activities. The Peason Ridge Training Area is located north and slightly west of the Main Post and includes parts of three parishes at their intersection: Sabine, Natchitoches, and Vernon Parishes. The north-central part of the Peason Ridge Training Area includes two impact areas (referred to as the PRIA), and the remaining part is used for military training activities.

[1]An impact area is defined by Army Regulation 385-63 (U.S. Army, 1983) as the primary danger area for indirect fire weapons that is established for the impact of all rounds, whether exploded or unexploded (duds). When applied to direct fire weapons, it is the area located between established range limits. The impact area is within the approved surface danger zone which is that segment of the range area which is endangered by a particular type of weapon firing.

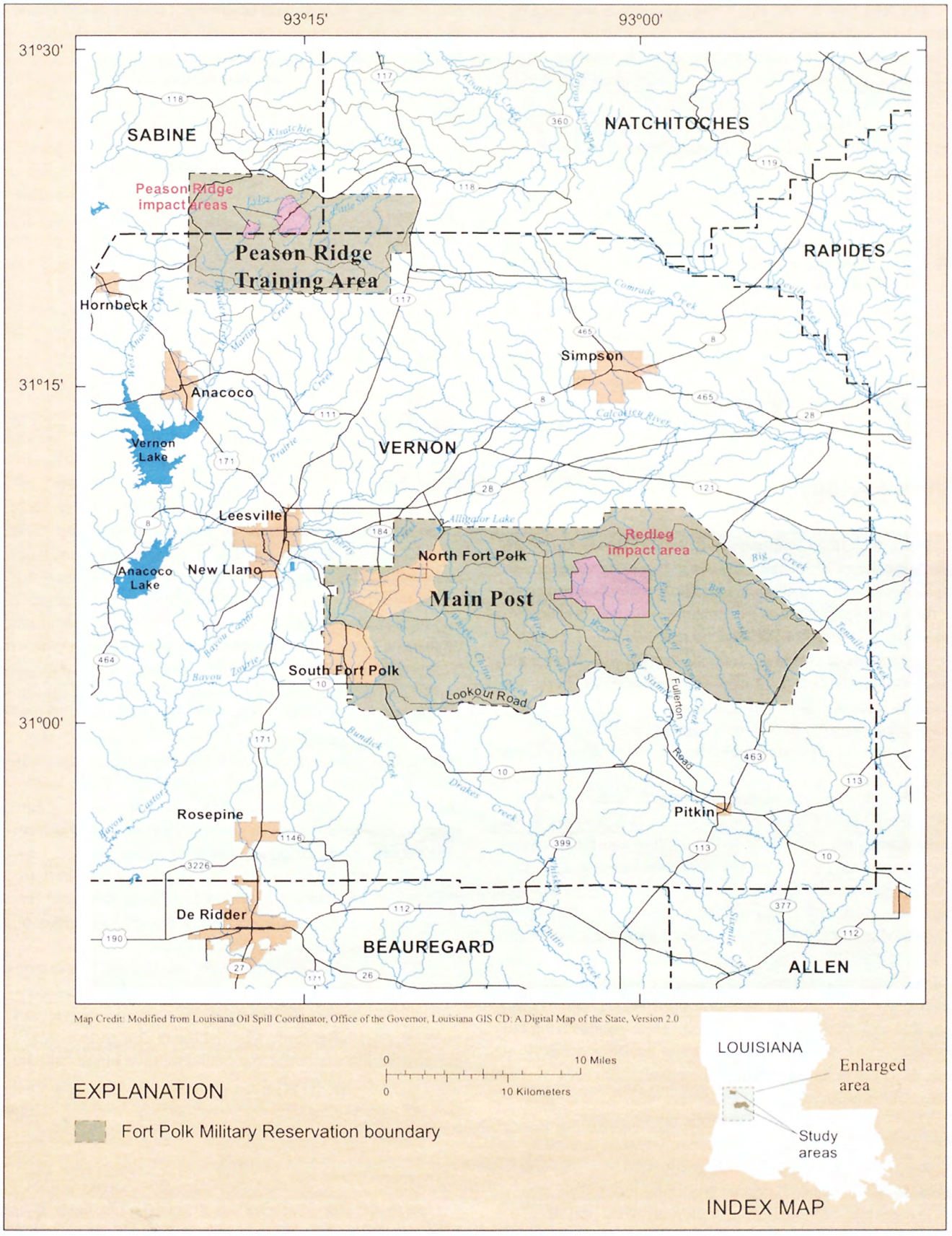


Figure 1. Location of the impact areas at the Fort Polk Military Reservation in west-central Louisiana.

The RIA (fig. 2) and PRIA (fig. 3) are characterized by rolling hills and second growth timber. The impact areas are located on topographic highs and are near the headwaters of the Calcasieu River (fig. 1). Drainage basins are characterized by loamy soils, high runoff and infiltration, and rapid changes in stream stage during heavy rainfall. Drainage basins range in altitude from about 200 to 450 ft above NGVD 29 and exhibit highly erodible soils. The streams in the study areas are classified as first- and second-order streams that drain hilly, densely forested, piney uplands. Streams in the RIA are West Fork of Sixmile Creek and selected tributaries and East Fork of Sixmile Creek and selected tributaries (fig. 2). A reference site, site 10, was located nearby on Big Creek. The streams in the PRIA are Dowden Creek, Little Sandy Creek, and Lyles Creek (fig. 3). The climate in west-central Louisiana is humid subtropical, with an average annual rainfall of 58 in. and temperature of 18.9 °C (Elizabeth Mons, Louisiana Office of State Climatology, written commun., 2000).

Hydrogeology

Unconsolidated sedimentary deposits ranging in age from Miocene to Holocene crop out in the study area. Stratigraphic units in the study area include, from oldest to youngest, the Fleming Formation of Miocene-Pliocene age, unnamed sedimentary deposits of Pleistocene age, and alluvial and terrace deposits of Holocene (recent) age (fig. 4). The Fleming Formation consists of, from oldest to youngest, the Lena, Carnahan Bayou, Dough Hills, and Williamson Creek Members of Miocene age, the Castor Creek Member of early Miocene age, and the Blounts Creek Member of Miocene-Pliocene age.

The stratigraphic unit that crops out or underlies the RIA is the Blounts Creek Member, which is equivalent to the Evangeline aquifer (fig. 4). The Evangeline aquifer crops out between the underlying Castor Creek Member and deposits of Pleistocene age. Much of the unit is masked by overlying Pleistocene deposits. In Vernon Parish, the Evangeline aquifer is thicker than 500 ft. Sand beds in the Evangeline aquifer may be thicker than 80 ft (Rogers and Calandro, 1965). The aquifer is of fluvial origin and consists of sandstone and siltstone and interbedded sand, silt, and clay (Welch, 1942). South of the RIA, thin clay beds separate the Evangeline aquifer from the overlying aquifers, including the Chicot aquifer system. Where these thin clay beds are missing, the uppermost sands of the Evangeline aquifer are in direct contact with these aquifers.

The stratigraphic unit that crops out or underlies the PRIA is the Carnahan Bayou Member, which is equivalent to the Carnahan Bayou aquifer (fig. 4). The Carnahan Bayou aquifer overlies the Lena confining unit in this area (McWreath and Smoot, 1989). In the northwest part of Vernon Parish the Carnahan Bayou aquifer is about 540 ft thick (Rogers and Calandro, 1965). Sand beds in the aquifer may be 70 ft or more, but most are thinner. The Carnahan Bayou aquifer is of fluvial origin and consists of sandstone and siltstone and interbedded sand, silt, and clay (Welch, 1942).

The Evangeline, Carnahan Bayou, and Williamson Creek aquifers are valuable water-supply sources in west-central Louisiana. In southwestern Louisiana, the Evangeline and Chicot aquifer system are valuable water-supply sources. U.S. Environmental Protection Agency (USEPA) has designated the Chicot aquifer system as a Sole Source Aquifer[2] (U.S. Environmental Protection Agency, 2003b). Streams draining the RIA and PRIA flow through recharge areas of these aquifers, thus potentially affecting the water quality of these aquifers.

Data Collection and Methods

Methods used to collect and analyze water-quality, bed-sediment, and mussel-tissue samples are discussed in the following section. Water-quality and bed-sediment data were collected at 13 sites (table 1, figs. 2 and 3). Mussel-tissue samples were collected at 3 of the 13 sites. Sites were located on perennial streams draining the impact areas and as close to the impact area boundaries as possible. Two of the 13 sites, sites 10 and 14, were selected as reference sites to provide baseline data because the sites were considered to be influenced minimally or unaffected by military training practices and represented natural physical and chemical characteristics of streams in the area. The data for the study were collected between June 2001 and November 2003 and are listed in appendixes 1–13. No historical data were available for the 13 sites.

Sampling equipment for water quality, bed sediment, and mussel tissue was cleaned following USGS ultra-clean protocols (Shelton, 1994; Shelton and Capel, 1994; Wilde, 2004 and 2005). Prior to sampling each site, sampling equipment was cleaned thoroughly with a progression of 0.2-percent nonphosphate detergent wash, tap-water rinse, deionized-water rinse, a 5-percent hydrochloric acid solution bath to remove residual metal compounds, and final methanol rinse to remove residual organic compounds. Sampling equipment was stored in clean plastic bags or containers.

Where applicable, codes were used by the laboratories to qualify analytical results. Estimated values (E), are concentrations less than the reporting limit for the analyte, but above the detection limit. Method blank contamination (J), are concentrations where the associated method blank contains the target analyte at a reportable level. Elevated reporting limits (Q), are concentrations where the reporting limit is elevated due to high analyte concentrations.

[2] A Sole Source Aquifer is an aquifer designated by USEPA as the "sole or principal source" of drinking water for a given service area; that is, an aquifer which is needed to supply 50 percent or more of the drinking water for that area and for which there are no reasonably available alternative sources should the aquifer become contaminated (U.S. Environmental Protection Agency, 2003b).

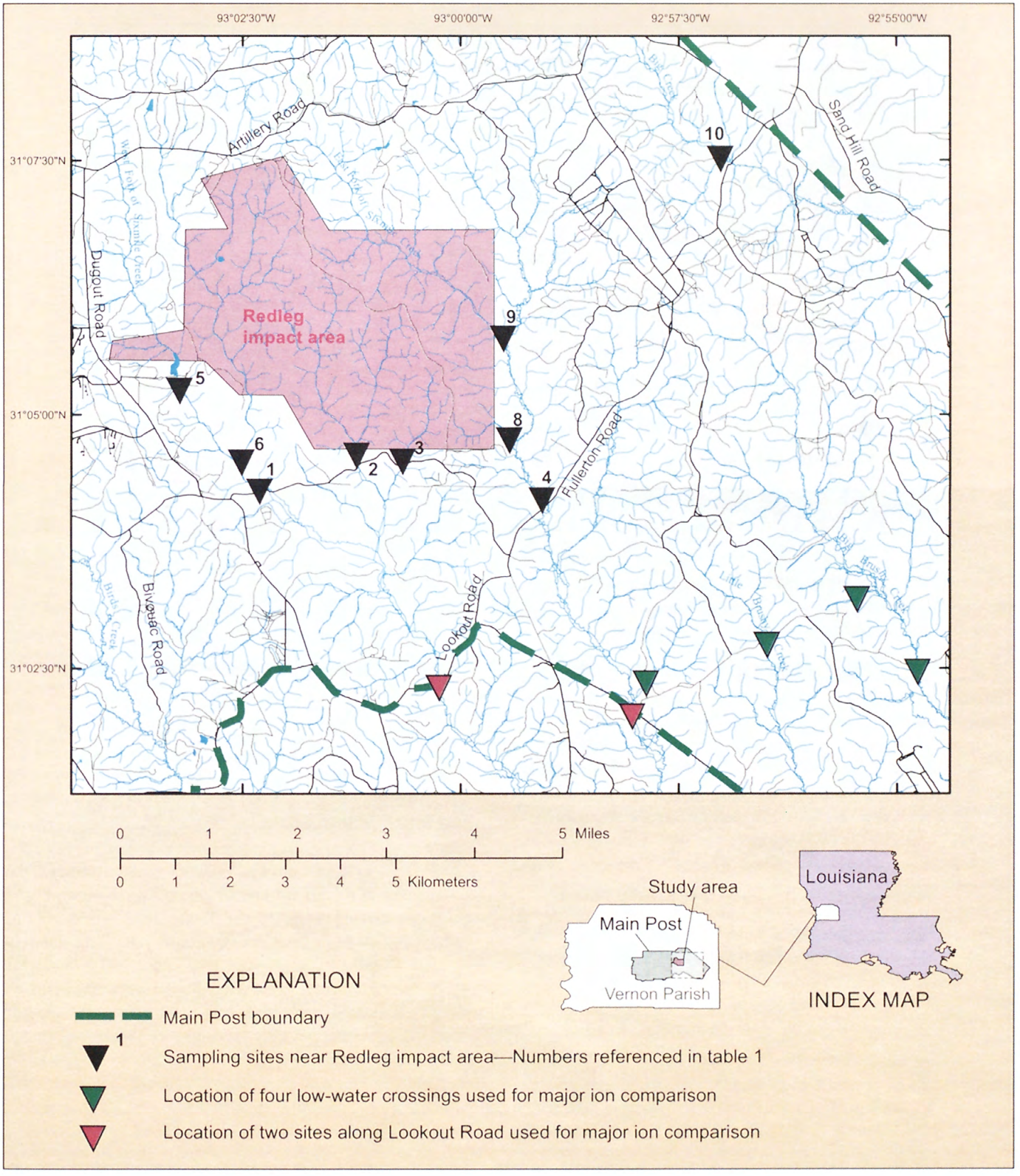


Figure 2. Location of the data-collection sites and streams near the Redleg impact area at the Main Post, Fort Polk Military Reservation, Louisiana, 2001–03.

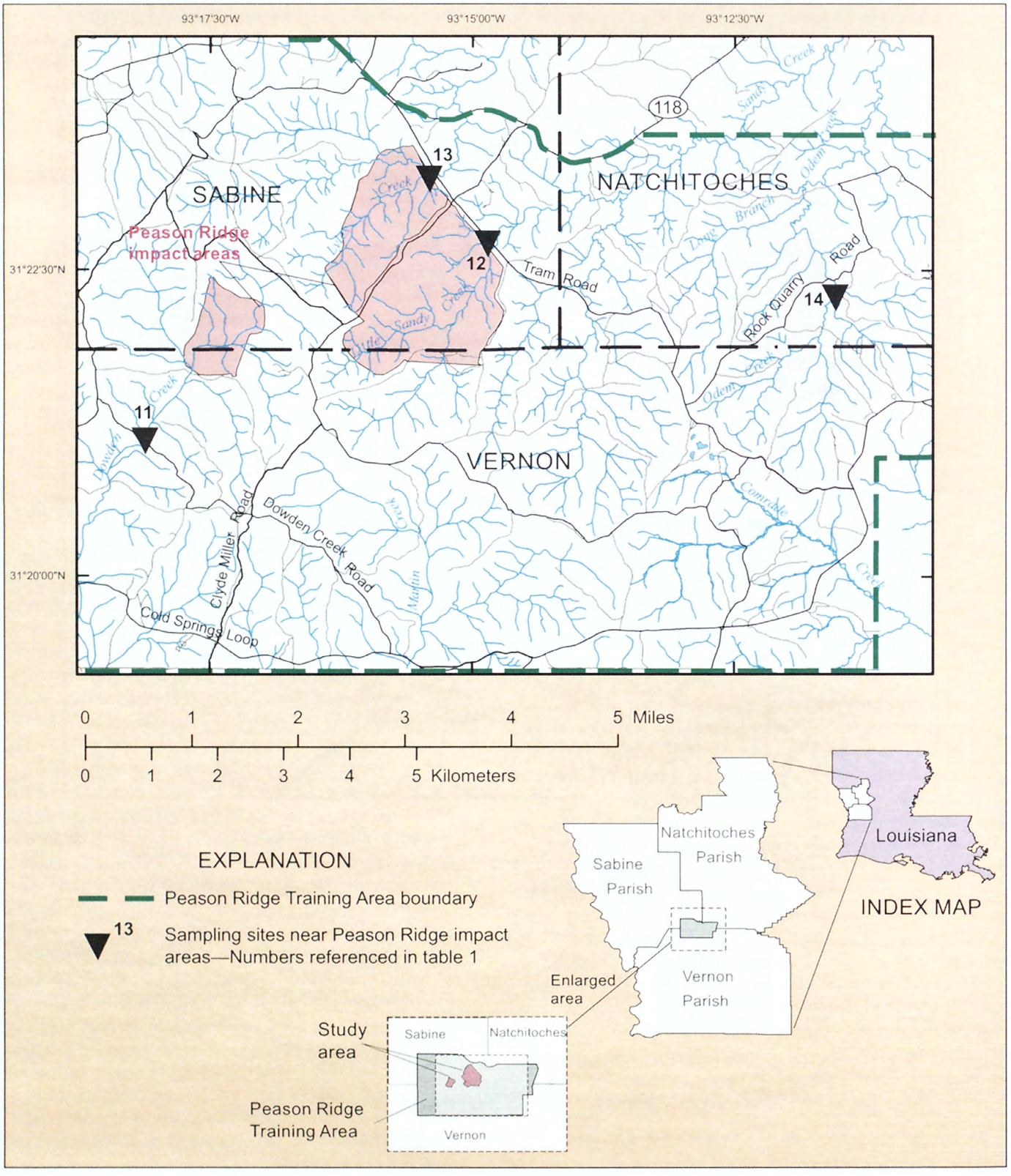


Figure 3. Location of the data-collection sites and streams near impact areas at the Peason Ridge Training Area, Fort Polk Military Reservation, Louisiana, 2001–02.

System	Series (age)	Stratigraphic unit		Hydrogeologic unit	
Quarternary	Holocene	Alluvial and upland terrace deposits		Alluvial and upland terrace aquifers	
	Pleistocene	Unnamed Pleistocene deposits		Chicot aquifer system	
Tertiary	Pliocene ?	Fleming Formation	Blounts Creek Member	Evangeline aquifer	
	Miocene		Castor Creek Member	Castor Creek confining unit	
			Williamson Creek Member	Jasper aquifer system	Williamson Creek aquifer
			Dough Hills Member		Dough Hills confining unit
			Carnahan Bayou Member		Carnahan Bayou aquifer
			Lena Member	Lena confining unit	
		Catahoula Formation		Catahoula aquifer	

Figure 4. Partial column of stratigraphic and hydrogeologic units in west-central Louisiana (adapted from McWreath and Smoot, 1989).

Water Quality

Water samples were collected and analyzed for physicochemical properties and selected chemical constituents at the 13 sites (table 1, figs. 2 and 3) during three periods: June 25 to July 10, 2001, January 9 to 15, 2002, and June 24 to July 2, 2002. Water was collected and analyzed for explosive compounds at only three sites, sites 1, 5, and 6, during rising stream stages on 2 days: February 11 and November 18, 2003. Water-quality samples were collected using USGS field methods (Shelton, 1994; U.S. Geological Survey, variously dated) and analyzed for selected constituents by one of four laboratories: Severn Trent Laboratory (STL), Denver, Colorado, or Sacramento, California; Frontier Laboratory, Seattle, Washington; or U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM), Aberdeen Proving Ground, Maryland. Methods used to analyze water samples are listed in table 2.

Specific conductance, pH, water temperature, turbidity, and alkalinity were measured at the time of sample collection. A multiparameter water-quality data recorder was suspended about 1 ft below the water surface at the center of the stream to measure specific conductance, pH, water temperature, and turbidity. Alkalinity was determined in the field by incremental titration, and bicarbonate was calculated by multiplying alkalinity values by a factor of 1.22 (Rounds and Wilde, 2001).

Water samples for analysis of selected chemical constituents were collected from the shallow, slow-moving streams (wadable and velocity generally less than 1.5 ft/s) by midstream "point" sampling. Whole water samples were collected by dipping the appropriate bottle just below the surface of the water. The mouth of the bottle was pointed upstream, as near to the center of flow as possible without disturbing the bottom sediments. Whole water samples were analyzed for concentrations of TSS, cyanide, perchlorate, trace elements, TOC, selected nutrients (nitrate, nitrite, nitrate plus nitrite, total organic nitrogen measured as TKN [total Kjeldahl nitrogen], and phosphorus), and explosive compounds. Water for filtered samples (dissolved constituents) was collected in a clean 1-gal plastic jug. Using a peristaltic pump with dedicated tubing, the water was passed through a 0.45-µm cellulose nitrate filter cartridge into the appropriate bottle (Wilde and others, 2004). Filtered samples were analyzed for concentrations of TDS, major inorganic ions, and selected nutrients (ammonia and orthophosphate). Samples requiring preservation (acidification) were either collected in pretreated laboratory-supplied containers or were treated at the time of collection. All bottles were chilled and shipped to the appropriate laboratory.

Bed Sediment

Bulk and depositional bed-sediment samples were collected using two different techniques from the 13 sites during three time periods: June 25 to July 10, 2001, January 9 to 15, 2002, and June 24 to July 2, 2002. Bulk samples were used to interpret the overall distribution or presence of explosive compounds in the sediments, and samples from depositional areas, consisting primarily of silt, clay, and organic material, were used to assess whether these compounds were more likely to adhere to the fine fraction of the bed sediment.

Table 1. Description of sampling sites and types of data collected near the Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana.

[Site numbers in **bold** are **reference sites** that represent natural physicochemical properties and chemical characteristics of streams in an area considered to be influenced minimally (unimpacted) by runoff from impact areas. --, not sampled]

Site number[1] (figs. 2, 3)	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Site description	Type of data collected		
				Water quality	Bed sediment	Mussel tissue
Sites near the Redleg impact area						
1	310419	930219	Main stem of downstream reach from West Fork of Sixmile Creek north of bridge on Sixmile Creek Road near the southern boundary of the Redleg impact area	X	X	X
2	310433	930113	West Fork of lower east tributary to West Fork of Sixmile Creek north of bridge on Sixmile Creek Road near the southern boundary of the Redleg impact area	X	X	--
3	310435	930039	East Fork of lower east tributary to West Fork of Sixmile Creek north of bridge on Sixmile Creek Road near the southern boundary of the Redleg impact area	X	X	--
4	310411	925903	Main stem of downstream reach from East Fork of Sixmile Creek northwest of bridge on Fullerton Road near the southeast corner of the Redleg impact area	X	X	--
5	310517	930314	Main stem of upstream reach from West Fork of Sixmile Creek off unimproved dirt road east of Dugout Road near the southwest corner of the Redleg impact area	X	X	X
6	310433	930231	Site on upper east tributary to West Fork of Sixmile Creek near the southern boundary of the Redleg impact area	X	X	X
8	310445	925924	West tributary of East Fork of Sixmile Creek near the southeast corner of the Redleg impact area	X	X	--
9	310548	925930	Main stem of upstream reach from East Fork of Sixmile Creek near the eastern boundary of the Redleg impact area	X	X	--
10	310729	925657	Big Creek north of the low-water crossing on Fullerton Road, northeast of the Redleg impact area	X	X	--
Sites near Peason Ridge impact areas						
11	312112	931808	Dowden Creek north of the bridge on Dowden Creek Road near the southwest corner of Peason Ridge impact areas	X	X	--
12	312241	931451	Little Sandy Creek southwest of the bridge on Tram Road near the northern boundary of Peason Ridge impact areas	X	X	--
13	312317	931521	Lyles Creek southwest of the bridge on Tram Road near the northern boundary of Peason Ridge impact areas	X	X	--
14	312222	931135	Odom Creek south of the bridge on Rock Quarry Road east of Peason Ridge impact areas	X	X	--

[1] Site 7 was dry; therefore, no samples were collected.

Table 2. Methods used to determine physicochemical properties and selected chemical constituents in water from selected streams near impact areas, Fort Polk Military Reservation, Louisiana, June 2001–November 2003.

[Analytical methods for 2001 samples are listed first and, if methods changed, other methods for 2002 and 2003 samples are listed second. All constituents are total unless otherwise noted. USEPA, U.S. Environmental Protection Agency; TNB, trinitrobenzene; USACHPPM, U.S. Army Center for Health Promotion and Preventive Medicine; DNB, dinitrobenzene; TNT, trinitrotoluene; DNT, dinitrotoluene; HMX, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine; PETN, pentaerythritol tetranitrate; RDX, hexahydro-1,3,5-trinitro-1,3,5-triazine]

Property or constituent	Analytical method[1]	Property or constituent	Analytical method[1]
Physicochemical properties			
Specific conductance	Radtke and others (2005)	Turbidity	Anderson (2004)
pH	Radtke and others (2003)	Alkalinity	Rounds and Wilde (2001)
Temperature	Radtke and others (2004)		
Total dissolved solids, total suspended solids, and major inorganic ions			
Total dissolved solids	USEPA 160.1	Bicarbonate (alkalinity)	Rounds and Wilde (2001)
Total suspended solids	USEPA 160.2	Sulfate, dissolved	USEPA 300.0A
Calcium, dissolved	USEPA 200.7	Chloride	USEPA 300.0A
Magnesium, dissolved	USEPA 200.7	Fluoride	USEPA 300.0A
Sodium, dissolved	USEPA 200.7	Silica, dissolved	USEPA 200.7
Potassium, dissolved	USEPA 200.7		
Cyanide, perchlorate, and trace elements			
Cyanide	USEPA 335.2	Lead	USEPA 1638, 200.8
Perchlorate	USEPA 314	Manganese	USEPA 1638, 200.8
Aluminum	USEPA 1638, 200.7	Mercury	USEPA 1631
Antimony	USEPA 1638, 200.8	Molybdenum	USEPA 1638, 200.8
Arsenic	USEPA 1638, 200.8	Nickel	USEPA 1638, 200.8
Barium	USEPA 1638, 200.8	Selenium	USEPA 1638, 200.8
Beryllium	USEPA 1638, 200.8	Silver	USEPA 1638, 200.8
Cadmium	USEPA 1638, 200.8	Thallium	USEPA 1638, 200.8
Chromium	USEPA 1638, 200.8	Tin	USEPA 1638, 200.8
Cobalt	USEPA 1638, 200.8	Vanadium	USEPA 1638, 200.8
Copper	USEPA 1638, 200.8	Zinc	USEPA 1638, 200.8
Iron	USEPA 1638, 200.7		
Total organic carbon and nutrients			
Total organic carbon	USEPA 415.1	Nitrogen, nitrate plus nitrite, dissolved	USEPA 353.2
Nitrogen, ammonia, dissolved	USEPA 350.1	Nitrogen, total Kjeldahl or ammonia plus organic nitrogen, dissolved	USEPA 351.2
Nitrogen, nitrate	USEPA 300.0A	Phosphorus as P, dissolved	USEPA 365.3
Nitrogen, nitrite	USEPA 300.0A	Orthophosphate	USEPA 300.0A
Explosive compounds			
1,3,5-TNB	USEPA 8321A; USACHPPM 13.2	4-Amino-2, 6-DNT	USEPA 8321A; USACHPPM 13.2
1,3-DNB	USEPA 8321A; USACHPPM 13.2	4-Nitrotoluene	USEPA 8321A; USACHPPM 13.2
2,4,6-TNT	USEPA 8321A; USACHPPM 13.2	HMX	USEPA 8321A; USACHPPM 13.2
2,4-DNT	USEPA 8321A; USACHPPM 13.2	Nitrobenzene	USEPA 8321A; USACHPPM 13.2
2,6-DNT	USEPA 8321A; USACHPPM 13.2	Nitroglycerin	USEPA 8321A; USACHPPM 13.2
2-Amino-4, 6-DNT	USEPA 8321A; USACHPPM 13.2	PETN	USEPA 8321A
2-Nitrotoluene	USEPA 8321A; USACHPPM 13.2	RDX	USEPA 8321A; USACHPPM 13.2
3-Nitrotoluene	USEPA 8321A; USACHPPM 13.2	Tetryl	USEPA 8321A; USACHPPM 13.2

[1] USEPA methods: U.S. Environmental Protection Agency (2005a); USACHPPM method: U.S. Army Center for Health Promotion and Preventive Medicine (2005).

Bed-sediment samples were collected using modified USGS methods (Radtke, 2005; Shelton and Capel, 1994), and STL or USACHPPM analyzed the samples for selected chemical constituents. Chemical constituents analyzed in the bulk and depositional bed-sediment samples included major inorganic ions, cyanide, perchlorate, 21 trace elements, percent moisture, TOC, nutrients, and selected explosive compounds (table 3). Methods used to analyze bed-sediment samples are listed in table 3. Nitrobenzene was not analyzed by USEPA Method 8330, and PETN was not analyzed by USACHPPM Method 55.1.

Bulk bed-sediment samples were collected with a Teflon-coated petite ponar (fig. 5) from the middle, left bank, and right bank of a center transect, and the middle of an upstream

Table 3. Methods used to determine selected chemical constituents in bed sediment from selected streams near impact areas, Fort Polk Military Reservation, Louisiana, June 2001–July 2002.

[Analytical methods for 2001 samples are listed first and, if methods changed, other methods for 2002 and 2003 samples are listed second. USEPA, U.S. Environmental Protection Agency; TNB, trinitrobenzene; USACHPPM, U.S. Army Center for Health Promotion and Preventive Medicine; DNB, dinitrobenzene; TNT, trinitrotoluene; DNT, dinitrotoluene; HMX, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine; PETN, pentaerythritol tetranitrate; RDX, hexahydro-1,3,5-trinitro-1,3,5-triazine]

Constituent	Analytical method[1]	Constituent	Analytical method[1]
Major inorganic ions			
Calcium	USEPA 6010B	Chloride	USEPA 9056
Magnesium	USEPA 6010B	Fluoride	USEPA 9056
Potassium	USEPA 6010B	Sulfate	USEPA 9056
Sodium	USEPA 6010B		
Cyanide, perchlorate, and trace elements			
Cyanide	USEPA 9012A	Lead	USEPA 1638, 6020
Perchlorate	USEPA 314	Manganese	USEPA 1638, 6020
Aluminum	USEPA 1638, 6010B	Mercury	USEPA 1631, 7471A
Antimony	USEPA 1638, 6020	Molybdenum	USEPA 1638, 6020
Arsenic	USEPA 1638, 6020	Nickel	USEPA 1638, 6020
Barium	USEPA 1638, 6020	Selenium	USEPA 1638, 6020
Beryllium	USEPA 1638, 6020	Silver	USEPA 1638, 6020
Cadmium	USEPA 1638, 6020	Thallium	USEPA 1638, 6020
Chromium	USEPA 1638, 6020	Tin	USEPA 1638, 6020
Cobalt	USEPA 1638, 6020	Vanadium	USEPA 1638, 6020
Copper	USEPA 1638, 6020	Zinc	USEPA 1638, 6020
Iron	USEPA 1638, 6010B		
Percent moisture, total organic carbon, and nutrients			
Percent moisture	USEPA 160.3	Nitrogen, nitrate plus nitrite	USEPA 353.2
Total organic carbon	USEPA 9060	Nitrogen, total Kjeldahl or ammonia plus organic nitrogen	USEPA 351.2
Nitrogen, ammonia	USEPA 350.1	Phosphorus as P, total	USEPA 365.3
Nitrogen, nitrate	USEPA 9056	Orthophosphate	USEPA 9056
Nitrogen, nitrite	USEPA 9056		
Explosive compounds			
1,3,5-TNB	USEPA 8321A, 8330; USACHPPM 55.1	4-Amino-2, 6-DNT	USEPA 8321A, 8330; USACHPPM 55.1
1,3-DNB	USEPA 8321A, 8330; USACHPPM 55.1	4-Nitrotoluene	USEPA 8321A, 8330; USACHPPM 55.1
2,4,6-TNT	USEPA 8321A, 8330; USACHPPM 55.1	HMX	USEPA 8321A, 8330; USACHPPM 55.1
2,4-DNT	USEPA 8321A, 8330; USACHPPM 55.1	Nitrobenzene	USEPA 8321A; USACHPPM 55.1
2,6-DNT	USEPA 8321A, 8330; USACHPPM 55.1	Nitroglycerin	USEPA 8321A, 8330; USACHPPM 55.1
2-Amino-4, 6-DNT	USEPA 8321A, 8330; USACHPPM 55.1	PETN	USEPA 8321A, 8330
2-Nitrotoluene	USEPA 8321A, 8330; USACHPPM 55.1	RDX	USEPA 8321A, 8330; USACHPPM 55.1
3-Nitrotoluene	USEPA 8321A, 8330; USACHPPM 55.1	Tetryl	USEPA 8321A, 8330; USACHPPM 55.1

[1] USEPA methods: U.S. Environmental Protection Agency (2005a); USACHPPM method: U.S. Army Center for Health Promotion and Preventive Medicine (2005).

Figure 5. Petite ponar used to collect bulk bed-sediment samples from selected streams near impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.

and downstream transect (Radtke, 2005; Shelton and Capel, 1994) and composited in a Teflon-coated stainless-steel pan. Bulk samples were mixed with clean disposable plastic spatulas and passed through a 2-mm disposable plastic mesh sieve to remove larger particles and organic debris. About 500 g was scooped into the sample container and sent to the appropriate laboratory.

Depositional bed-sediment samples were collected with a 3-cm-diameter, 5-in.-length Teflon tube. A clean disposable plastic spatula was used to trap 1 to 2 in. of sediment in the tube at about 50 depositional areas within 10 channel widths upstream and downstream from the center transect (Shelton and Capel, 1994). This sediment was composited in a Teflon-coated stainless-steel pan, mixed with clean disposable plastic spatulas, and passed through a 2-mm disposable plastic mesh sieve to remove larger particles and organic debris. Methods were modified as fine fraction was not sieved through 63-µm mesh due to time constraints and limited access to the sites. About 200 g was scooped into the sample container and sent to the appropriate laboratory.

Mussel Tissue

Alligator Lake (fig. 1) was used as a source of freshwater mussels to transplant into selected streams near the impact areas. Alligator Lake was selected because it is positioned on a topographic high (hilltop) and receives little rainwater runoff from the Reservation. Approximately 1,000 freshwater mussels, species *Corbicula fluminea,* were collected from Alligator Lake on October 17, 2002. The mussels were identified, sorted, and placed in groups of about 100 mussels each by Malcolm Vidrine (Environmental Consultant, Eunice, Louisiana). Tissue from one group of mussels was collected, processed, and sent to STL. The tissue was analyzed using USEPA Methods 8321A (STL, Denver) and 8330 (STL, Sacramento) to provide baseline data (table 4) to compare with mussels moved to the RIA. The remaining groups were placed in methanol-rinsed, vinyl-coated steel, 1/4-in. mesh cages, and placed back into Alligator Lake.

After determining mussels contained no detectable concentrations of explosive compounds, two cages, with about 100 live mussels in each, were deployed at three sites, sites 1, 5, and 6, near the RIA on November 18, 2002 (fig. 2). Two cages were used at each site to ensure enough tissue from

Table 4. Methods used to determine selected chemical constituents in tissue of mussels from Alligator Lake and selected streams near the Redleg impact area, Fort Polk Military Reservation, Louisiana, 2002–03.

[Analytical methods for 2001 samples are listed first and, if methods changed, other methods for 2002 and 2003 samples are listed second. USEPA, U.S. Environmental Protection Agency; TNB, trinitrobenzene; DNB, dinitrobenzene; TNT, trinitrotoluene; DNT, dinitrotoluene; HMX, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine; PETN, pentaerythritol tetranitrate; RDX, hexahydro-1,3,5-trinitro-1,3,5-triazine]

Property or constituent	Analytical method[1]	Property or constituent	Analytical method[1]
Percent lipids			
Percent lipids	USEPA SW-846 Total residue		
Explosive compounds			
1,3,5-TNB	USEPA 8321A, 8330	4-Amino-2, 6-DNT	USEPA 8321A, 8330
1,3-DNB	USEPA 8321A, 8330	4-Nitrotoluene	USEPA 8321A, 8330
2,4,6-TNT	USEPA 8321A, 8330	HMX	USEPA 8321A, 8330
2,4-DNT	USEPA 8321A, 8330	Nitrobenzene	USEPA 8321A, 8330
2,6-DNT	USEPA 8321A, 8330	Nitroglycerin	USEPA 8321A, 8330
2-Amino-4, 6-DNT	USEPA 8321A, 8330	PETN	USEPA 8321A, 8330
2-Nitrotoluene	USEPA 8321A, 8330	RDX	USEPA 8321A, 8330
3-Nitrotoluene	USEPA 8321A, 8330	Tetryl	USEPA 8321A, 8330

[1] U.S. Environmental Protection Agency (2005a).

living mussels would be available for analysis. Two additional cages were deployed at site 5 to serve as a replicate sample. Using small floats attached to the corners of each cage, the cages were suspended just below the water surface and tethered to steel rods driven into the streambed near the center of each channel. After being suspended in the streams for about 110 days, the mussels were collected and processed on March 12 and 13, 2003, and shipped to STL for analysis.

The mussels were not gut purged prior to sampling to minimize the possibility of sample contamination during the purging process and because explosive compounds in stream water and bed sediments typically are low: less than (<) E0.14 µg/L[3] in stream water (appendix 11); <0.20 mg/kg (appendixes 12 and 13) or not detected in bed sediments (Tollett and Fendick, 1998); and <1.3 mg/kg in mussel tissue (Tollett and Kolb, 2005) in streams on or near the Main Post.

Ultra-clean sample collection and handling protocols were employed to reduce the potential for sample contamination and to ensure to the greatest extent possible that, if present, explosives were retained in the mussel tissues for laboratory analysis. Mussels were opened with stainless-steel oyster knives inside a clear, plastic bag sample chamber. The soft tissue was removed with a stainless-steel oyster knife and placed in a clean glass jar provided by the analytical laboratory. Approximately 500 g of mussel tissue (wet weight) were collected for each sample to meet the laboratory requirement of 50 g of dry weight per sample. The mussel-tissue samples were chilled and shipped to the laboratory for analysis.

Quality-Control Data and Analysis

Quality-control data were collected to quality assure sample-collection procedures, sample processing, and field and laboratory analyses. Quality-control procedures included calibration of instruments for field measurements (specific conductance, pH, water temperature, turbidity, and alkalinity), and the collection of field-blank and replicate environmental samples (Mueller and others, 1997) for determination of selected constituents. The pH and specific conductance probes on the multiparameter water-quality data recorder, a separate pH meter (used for alkalinity titrations), and turbidity meter were checked with laboratory-grade standard solutions each day before use, following manufacturer's procedures and USGS methods in Wilde (chapter sections variously dated). The temperature probe was checked against a National Institute of Standards and Technology Traceable thermometer prior to each sampling period. Field-blank samples were collected to assure that cleaning procedures were sufficient and that collection, preparation, processing, and analytical procedures did not contaminate the environmental samples. Field-blank samples for water were collected and analyzed at three sites: site 1, June 28, 2001; site 5, January 10, 2002; and site 11, July 1, 2002 (appendixes 2, 5, 8, and 11). The source solution for field-blank samples was inorganic-free or organic-free water obtained from the USGS Field Supply Services, National Water Quality Laboratory (NWQL). Field-blank samples analyzed for unfiltered constituents were poured streamside, and field-blank samples analyzed for filtered constituents were passed through processing equipment into the appropriate bottles. Inorganic-free blank water samples were analyzed for major inorganic ions, cyanide, perchlorate, trace elements, selected nutrients; organic-free blank water samples were analyzed for concentrations of TOC and explosive compounds. Concentrations of major inorganic ions were less than analytical reporting limits or were reported as estimated concentrations except for calcium, magnesium, and silica in one blank sample (site 5, January 10, 2002). Cyanide, perchlorate, and all trace elements, except one thallium concentration, were less than the analytical reporting limits or estimated concentrations. All nutrient concentrations were less than analytical reporting limits or estimated concentrations, except one concentration of total phosphorus. Field blanks were not collected for sediment samples. Results of field-blank analyses generally indicated cleaning procedures were sufficient to prevent on-site and cross-contamination between sites.

Replicate environmental samples were collected to quality assure sample-collection methods and laboratory-analytical procedures, including accuracy and precision. Replicate environmental samples for water were collected for the constituents listed in the previous paragraph at six sites: site 13, June 27, 2001; site 1, June 28, 2001; site 2, January 9, 2002; site 12, January 14, 2002; site 5, June 24, 2002; and site 11, July 1, 2002 (appendixes 2, 5, 8, and 11). Replicate environmental samples for bulk and depositional bed sediments were collected at the same six sites on the same dates (appendixes 3, 4, 6, 7, 9, 10, 12, and 13). A replicate environmental sample was collected at site 5 on March 13, 2003 (appendix 14), for mussel tissue analyzed by USEPA Methods 8321A and 8330 (U.S. Environmental Protection Agency, 2005a).

The relative percent difference (RPD) between the concentrations of environmental sample and corresponding replicate environmental sample was calculated by multiplying 100 by the absolute value of the difference between the environmental and replicate concentrations divided by the average of the environmental and replicate concentrations. The RPD's were not calculated when concentrations were estimated or not detected for either the environmental or replicate environmental sample. The RPD's between the environmental samples and replicate samples for major inorganic ions in water typically were <5 percent. The two highest RPD's, 72 and 44 percent, were for sulfate and potassium, respectively. The RPD's for nutrients ranged from 0 to 88 percent. The nutrient with the highest RPD was ammonia, as nitrogen, at site 11. The RPD's for cyanide, perchlorate, and trace elements ranged from 0 to 136 percent (antimony), with 57 of 100 samples, <10 percent. Only one explosive compound, RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine), was detected in water in both the environmental sample and replicate sample. The concentration for

[3] The estimated value of a concentration is reported when an analyte is detected at a concentration less than the reporting limit.

both samples was E0.04 µg/L at site 2 on January 9, 2002 (appendix 11).

The RPD's varied between the environmental samples and replicate environmental samples for bulk bed-sediment samples. Selected major inorganic ions ranged from 0 to 77 percent and generally were <10 percent; nutrients ranged from 0 to 130 percent and generally were <30 percent. All concentrations for both nitrate and orthophosphate were less than reporting limits. The RPD's for trace elements ranged from 0.25 to 182 percent. This high range in RPD would be typical due to the heterogeneity of the sediments. The only explosive compound detected in a replicate environmental sample was HMX (octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine) at a concentration of E0.036 mg/kg at site 11 on July 1, 2002 (appendix 12). The HMX concentration in the environmental sample at site 11 was less than the reporting limit.

The RPD's varied between the environmental samples and replicate environmental samples for depositional bed-sediment samples. Selected major inorganic ions ranged from 2.4 to 177 percent and generally were <40 percent; nutrients ranged from 4.4 to 116 percent and generally were <30 percent. All concentrations for both nitrate and orthophosphate were less than the reporting limits. The RPD's for trace elements ranged from 0 to 166 percent, likely due to the heterogeneity of the sediments. The only explosive compound detected in a replicate environmental sample was HMX at a concentration of E0.064 mg/kg at site 11 on July 11, 2002 (appendix 13). The HMX concentration in the environmental sample at site 11 was 0.200 mg/kg.

Two replicate environmental samples were collected from site 5 on March 13, 2003, for analysis of explosive compounds in mussel tissue (appendix 14). One sample was analyzed using both USEPA Methods, 8321A and 8330. Nitroglycerin, analyzed using USEPA Method 8330, was detected in both the environmental sample, at a concentration of E0.46 mg/kg (appendix 14), and the replicate sample at a concentration of 0.19 mg/kg. Nitroglycerin was not detected in mussel tissue at site 5 using USEPA Method 8321A.

Physicochemical Properties and Chemical Characteristics of Water, Bed Sediment, and Mussel Tissue from Selected Streams

The streams draining the RIA and PRIA are not used as sources of drinking water, but these streams originate in impact areas located in the recharge areas of two aquifers—the Evangeline and Carnahan Bayou aquifers, respectively—that are used for public supply. For reference purposes, water-quality data were compared to applicable USEPA drinking-water standards and Health Advisories (HA's, U.S. Environmental Protection Agency, 2004a) and USEPA National Recommended Water Quality Criteria (U.S. Environmental Protection Agency, 2004b) and to data collected previously by the USGS from streams on or near the Main Post. Currently (2006), there are no USEPA standards for bed-sediment quality. Therefore, concentrations of selected constituents detected in bed sediment were compared to two Canadian freshwater sediment-quality criteria, Interim Sediment Quality Guidelines (ISQG) and Probable Effect Level (PEL), established by the CCME (Canadian Council of Ministers of the Environment, 1999) (table 5). There are no USEPA standards for explosive compounds detected in bed sediment and mussel tissue, and thus, no comparisons were made.

The USEPA established drinking-water standards Maximum Contaminant Levels (MCL's), Secondary Drinking Water Regulations (SDWR's), and selected HA's for physicochemical and selected chemical constituents are listed in table 5. The MCL is the maximum permissible level of a contaminant that is allowed in treated drinking water and is an enforceable standard for public drinking-water supplies. The SDWR is a nonenforceable guideline regarding aesthetic effects (such as taste, odor, or color) or cosmetic effects (such as tooth or skin discoloration) caused by drinking water. The HA's are non-enforceable guidelines that serve as estimates of acceptable concentrations of a chemical based on health effects information and serve as technical guidance to assist Federal, State, and local officials. The HA's included Drinking Water Equivalent Level (DWEL)[4], lifetime health advisory[5], and 10^{-4} cancer risk[6]; and the Aquatic Life Criteria for freshwater included Criterion Maximum Concentration (CMC)[7] and Criterion Continuous Concentration (CCC)[8], which are part of the USEPA National Recommended Water Quality Criteria (table 5) (see U.S. Environmental Protection Agency, 2004a).

Physicochemical Properties

A statistical summary of the physicochemical properties of the 13 sites is listed in table 6, and all the data are listed in appendix 1. The median specific conductance (field) at the RIA sites (1–6, 8, and 9) was 19 µS/cm, and values ranged from 12 to 24 µS/cm (table 6). The maximum specific conductance at RIA reference site 10 was 28 µS/cm, which was slightly higher than at the RIA sites but an indication that specific conductance is very low in the RIA. Values for specific

[4] A lifetime exposure concentration protective of adverse, non-cancer health effects, that assumes all of the exposure to a contaminant is from drinking water.

[5] The concentration of a chemical in drinking water that is not expected to cause any adverse noncarcinogenic effects for a lifetime of exposure.

[6] The concentration of a chemical in drinking water corresponding to an excess estimated lifetime cancer risk of 1 in 10,000.

[7] An estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect.

[8] An estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect.

Table 5. Guidelines, criteria, or standards used as a reference for water-quality and bed-sediment data collected from selected streams near impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.

[USEPA, U.S. Environmental Protection Agency; MCLG, Maximum Contaminant Level Goal; MCL, Maximum Contaminant Level; SDWR, Secondary Drinking-Water Regulation; DWEL, Drinking Water Equivalent Level; FW, freshwater; CMC, Criterion Maximum Concentration; CCC, Criterion Continuous Concentration; CCME, Canadian Council of Ministers of the Environment; ISQG, Interim Sediment Quality Guideline; PEL, Probable Effect Level; $CaCO_3$, calcium carbonate; NTU, nephelometric turbidity unit; mg/L, milligrams per liter; ROE, residue on evaporation; °C, degrees Celsius; µg/L, micrograms per liter; mg/kg, milligrams per kilogram; DNB, dinitrobenzene; TNT, trinitrotoluene; DNT, dinitrotoluene; HMX, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine; RDX, hexahydro-1,3,5-trinitro-1,3,5-triazine]

Property or constituent	Guideline, criteria, or standard									
	Drinking water[1]						Surface water		Bed sediment	
				USEPA Health Advisories			USEPA aquatic life criteria (FW)[2]		CCME guidelines[3]	
	USEPA MCLG	USEPA MCL	USEPA SDWR	DWEL	Lifetime	10^{-4} Cancer risk	CMC	CCC	ISQG	PEL
Physicochemical properties										
pH, field, in standard units	--	--	6.5–8.5	--	--	--	--	6.5–9.0		
Turbidity, in NTU	--	5.0	--	--	--	--	--	--	--	--
Alkalinity, as $CaCO_3$, field, in mg/L	--	--	--	--	--	--	--	20	--	--
Dissolved solids and major inorganic ions, in mg/L										
Dissolved solids, ROE at 180 °C	--	--	500	--	--	--	--	--	--	--
Sodium, as Na	--	--	[4]20	--	--	--	--	--	--	--
Sulfate, as SO_4	--	--	250	--	--	--	--	--	--	--
Chloride, as Cl	--	--	250	--	--	--	860	230	--	--
Fluoride, as F	4.0	4.0	2.0	--	--	--	--	--	--	--
Cyanide, perchlorate, and trace elements, in µg/L (unless noted)										
Cyanide	200	200	--	800	200	--	22	5.2	--	--
Perchlorate	--	--	--	24.5		--	--	--	--	--
Aluminum, as Al	--	--	50–200	--	--	--	750	87	--	--
Antimony, as Sb	6	6	--	10	6	--	--	--	--	--
Arsenic, as As	0	10	--	10	--	--	340	150	5.9 mg/kg	17 mg/kg
Barium, as Ba	2,000	2,000	--	2,000	2,000	--	--	--	--	--
Beryllium, as Be	4	4	--	70	--	--	--	--	--	--
Boron, as B	--	--	--	3,000	600	--	--	--	--	--
Cadmium, as Cd	5	5	--	20	5	--	2	.25	.6 mg/kg	3.5 mg/kg
Chromium, as Cr	[5]100	[5]100	--	100	--	--	--	--	37.3 mg/kg	90 mg/kg
Cobalt, as Co	--	--	--	--	--	--	--	--	--	--
Copper, as Cu	[6]1,300	[6]1,300	1,000	--	--	--	13	9	35.7 mg/kg	197 mg/kg
Iron, as Fe	--	--	300	--	--	--	--	1,000	--	--
Lead, as Pb	0	15	--	--	--	--	65	2.5	35 mg/kg	91.3 mg/kg
Manganese, as Mn	--	--	50	1,600	300	--	--	--	--	--
Mercury, total, as Hg (inorganic)	2	2	--	10	2	--	1.4	.77	.170 mg/kg	.486 mg/kg
Molybdenum, as Mo	--	--	--	200	40	--	--	--	--	--
Nickel, as Ni	--	--	--	700	100	--	470	52	--	--
Selenium, as Se	50	50	--	200	50	--	--	5	--	--
Silver, as Ag	--	--	100	200	100	--	3.2	--	--	--
Strontium, as Sr	--	--	--	20,000	4,000	--	--	--	--	--
Thallium, as Tl	.5	2	--	2	.5	--	--	--	--	--
Zinc, as Zn	--	--	5,000	10,000	2,000	--	120	120	123 mg/kg	315 mg/kg
Nutrients, in mg/L										
Nitrogen, ammonia, dissolved	--	--	30	--	30	--	--	--	--	--
Nitrogen, nitrate	10	10	--	--	--	--	--	--	--	--
Nitrogen, nitrite	1.0	1.0	--	--	--	--	--	--	--	--
Nitrogen, nitrate plus nitrite	10	10	--	--	--	--	--	--	--	--
Explosive compounds, in µg/L										
1,3-DNB	--	--	--	5	1	--	--	--	--	--
2,4,6-TNT	--	--	--	20	2	100	--	--	--	--
2,4-DNT	--	--	--	100	--	5	--	--	--	--
2,6-DNT	--	--	--	40	--	5	--	--	--	--
HMX	--	--	--	2,000	400	--	--	--	--	--
RDX	--	--	--	100	2	30	--	--	--	--

[1] U.S. Environmental Protection Agency (2004a).

[2] U.S. Environmental Protection Agency (2004b).

[3] Canadian Council of Ministers of the Environment (1999).

[4] Health based value for individuals on 500-milligrams-per-day restricted sodium diet.

[5] Total.

[6] Action level.

Table 6. Statistical summary of physicochemical properties of selected streams near impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.

[RIA, Redleg impact area; PRIA, Peason Ridge impact areas; µS/cm, microsiemens per centimeter at 25 degrees Celsius; °C, degrees Celsius; NTU, nephelometric turbidity units; mg/L, milligrams per liter; IT, incremental titration; $CaCO_3$, calcium carbonate]

Property or constituent	Statistical summary									
	RIA sites (1–6, 8, and 9) (fig. 2)				RIA reference site 10 (fig. 2)	PRIA sites (11–13) (fig. 3)				PRIA reference site 14 (fig. 3)
	Number of detections/ number of samples	Minimum detection	Median of all samples	Maximum detection	Maximum detection	Number of detections/ number of samples	Minimum detection	Median of all samples	Maximum detection	Maximum detection
Specific conductance, in µS/cm	24/24	12	19	24	28	9/9	20	32	66	46
pH, field, in standard units	24/24	5.0	5.6	6.6	6.4	9/9	5.7	6.3	6.9	7.2
Water temperature, in °C	24/24	9.0	21.8	29.4	22.1	9/9	6.4	23.9	27.6	26.6
Turbidity, in NTU	24/24	1.3	8.4	21.5	31.1	9/9	13.6	29.6	126	25.5
Alkalinity, IT, field, in mg/L as $CaCO_3$	24/24	.3	1.8	5.5	6.0	9/9	2.8	5.8	13.5	8.1

conductance ranged from 16 to 36 µS/cm at nearby low-water crossing sites (fig. 2) (Tollett and others, 2002, p. 19), 17 to 26 µS/cm at West Fork of Sixmile Creek (Tollett, 1998, p. 140–141), and 14 to 24 µS/cm at East Fork of Sixmile Creek (Tollett, 1998, p. 146–147). These values were similar to those near the RIA sites and the RIA reference site, indicating specific conductance is typically low in streams near the eastern part of Main Post (fig. 2). The median specific conductance at the PRIA sites (11–13) was 32 µS/cm, and values ranged from 20 to 66 µS/cm. The maximum specific conductance at PRIA reference site 14 was 46 µS/cm, within the range of values at the PRIA sites. These values also are considered low compared to specific conductance at most streams in the State (Baumann and others, 2004). Specific conductance reported for streams in the RIA and PRIA is similar to that reported for the Calcasieu River (Garrison, 1997).

The median pH (field) at the RIA sites was 5.6, and values ranged from 5.0 to 6.6 (table 6), indicating the streams are acidic. The maximum pH at RIA reference site 10 was 6.4, within the range at the RIA sites (table 6). The SDWR for pH is 6.5 to 8.5 (U.S. Environmental Protection Agency, 2004a) and the USEPA Aquatic Life Criteria CCC is 6.5 to 9.0 (table 5) (U.S. Environmental Protection Agency, 2004b). Of the 24 pH measurements at the RIA sites, only one (6.6 at site 4, appendix 1) was within the range of the SDWR and CCC, and the other values were <6.5. Values for pH ranged from 4.4 to 6.5 at nearby low-water crossing sites (Tollett and others, 2002, p. 19), 5.1 to 6.4 at West Fork of Sixmile Creek (Tollett, 1998, p. 142–143), and 5.1 to 6.7 at East Fork of Sixmile Creek (Tollett, 1998, p. 148–149). These values were similar to those near the RIA and RIA reference site, indicating pH is typically low in streams near the eastern part of Main Post (fig. 2). The median pH was 6.3 at the PRIA sites, and values ranged from 5.7 to 6.9, indicating streams that are slightly acidic to neutral. Of the nine pH measurements at the PRIA sites, only two (6.7 and 6.9, appendix 1) were within the range of the SDWR and CCC. The maximum pH was 7.2 at PRIA reference site 14 (table 6), which was slightly higher than the PRIA sites. All three samples collected at PRIA reference site 14 were within the range of the SDWR and CCC (table 5 and appendix 1).

The median turbidity was 8.4 nephelometric turbidity units (NTU) at the RIA sites, and values ranged from 1.3 to 21.5 NTU (table 6). Turbidity exceeded the MCL of 5.0 NTU (table 5) in 19 of the 24 samples collected. The maximum turbidity was 31.1 NTU at RIA reference site 10, which is greater than the range of values at the RIA sites. The median turbidity was 29.6 NTU at the PRIA sites, and values ranged from 13.6 to 126 NTU. The maximum was 25.5 NTU at PRIA reference site 14, within the range of values at the PRIA sites. All turbidity values at the PRIA sites and PRIA reference site were greater than the MCL of 5.0 NTU for treated drinking water. Values for turbidity were considered low (5–30 NTU) for stream water, with only 6 of 39 values greater than 30 NTU and only 2 of these values greater than 35 NTU. The 2 values greater than 35 NTU were recorded after brief storms.

The median alkalinity, as calcium carbonate ($CaCO_3$), was 1.8 mg/L at the RIA sites, and concentrations ranged from 0.3 to 5.5 mg/L (table 6). The maximum alkalinity concentration was 6.0 mg/L at RIA reference site 10, which was higher than the range of concentrations at the RIA sites. The USEPA Aquatic Life Criteria CCC of 20 mg/L for alkalinity, as $CaCO_3$ (table 5), was not exceeded at any of the RIA sites. Concentrations for acid neutralizing capacity (unfiltered sample) ranged from 1.6 to 6.7 mg/L at nearby low-water crossing sites (Tollett and others, 2002, p. 19), and alkalinity ranged from 4.8 to 10.7 mg/L at West Fork of Sixmile Creek (Tollett, 1998, p. 163) and 4.2 to 11.9 mg/L at East Fork of Sixmile Creek (Tollett, 1998, p. 168). Acid neutralizing capacity and alkalinity concentrations were similar to those near the RIA sites and RIA reference site, indicating the buffering capacity of water in streams is typically low near the eastern part of Main Post (fig. 2). The median alkalinity at the PRIA sites was 5.8 mg/L, and concentrations ranged from 2.8 to 13.5 mg/L. The maximum alkalinity concentration was 8.1 mg/L at the PRIA reference site, which was within the range of concentrations at the PRIA sites. The USEPA Aquatic Life Criteria CCC was not exceeded at any of the PRIA sites.

Total Dissolved Solids, Total Suspended Solids, and Major Inorganic Ions

A statistical summary of TDS, TSS, and major inorganic ions in water and bed sediment from the 13 sites is listed in table 7. All the data are listed in appendix 2 for water, appendix 3 for bulk bed sediment, and appendix 4 for depositional bed sediment.

Water

The TDS concentrations at the RIA sites ranged from 15 to 78 mg/L, with a median concentration of 36 mg/L (table 7). The maximum concentration at RIA reference site 10 was 56 mg/L, within the range of concentrations at the RIA sites. The TDS concentrations at the PRIA sites ranged from 59 to 115 mg/L, with a median concentration of 81 mg/L. The maximum concentration at PRIA reference site 14 was 100 mg/L, within the range of concentrations at the PRIA sites. All concentrations for TDS were less than the SDWR of 500 mg/L (table 5, appendix 2).

The TSS concentration at the RIA sites ranged from E2.0 to 9.0 mg/L, with a median concentration of E2.0 mg/L (table 7). The maximum concentration at RIA reference site 10 was 6.8 mg/L, within the range of concentrations at the RIA sites. The TSS concentration at the PRIA sites ranged from E1.6 mg/L to 134Q mg/L, with a median concentration of E3.2 mg/L. The maximum concentration at PRIA reference site 14 was 8.8 mg/L, within the range of concentrations at the PRIA sites.

Major inorganic ions (cations and anions) and silica were the primary constituents of TDS in the water samples (table 7). Of the cations (calcium, magnesium, sodium, and potassium) analyzed, the SDWR for sodium is 20 mg/L (table 5). At the RIA sites, calcium concentrations ranged from 0.4 to 1.7 mg/L, magnesium concentrations ranged from 0.3 to 0.7 mg/L, sodium concentrations ranged from E1.9J to E3.3J mg/L, and potassium concentrations ranged from E0.2 to E1.7 mg/L. At the PRIA sites, calcium concentrations ranged from 0.7 to 3.5 mg/L, magnesium concentrations ranged from 0.3 to 1.3 mg/L, sodium concentrations ranged from E1.8 to 6.2 mg/L, and potassium concentrations ranged from E0.7 to E2.3 mg/L.

All concentrations for sulfate, chloride, and fluoride from the 13 sites (table 7, appendix 2) were less than the SDWR's, which were 250, 250, and 2.0 mg/L, respectively (table 5). The alkalinity concentrations, as $CaCO_3$, were converted to bicarbonate to facilitate discussion of the major anions. The CCC for alkalinity is 20 mg/L (table 5). Calculated concentrations of bicarbonate, as HCO_3, ranged from 0.4 to 6.7 mg/L at the RIA sites. Concentrations of sulfate ranged from E0.7 to E1.8 mg/L, chloride concentrations ranged from E0.80 to 7.3 mg/L, and fluoride concentrations ranged from E0.10 to E0.2 mg/L. At the PRIA sites, calculated concentrations of bicarbonate ranged from 3.4 to 16 mg/L. Sulfate concentrations ranged from E1.2 to 5.4 mg/L, chloride concentrations ranged from E2.6 to 6.1 mg/L, and fluoride concentrations ranged from E0.1 to E0.2 mg/L. Bicarbonate and silica were the only major inorganic ions with concentrations greater than 10 mg/L, and the highest silica concentration of the RIA and PRIA sites was 42.1J mg/L (table 7). Concentrations for silica typically are high for nearby streams in the area, ranging from 7.7 to 13 mg/L (Tollett and others, 2002, p. 19; Tollett, 1998, p. 164 and 169). Concentrations for most properties and constituents in water from streams near the PRIA were higher than those near the RIA, but typical of streams near the headwaters of the Calcasieu River (Garrison, 1997).

A Piper (trilinear) diagram summarizing concentrations of major inorganic ions in percentage of milliequivalents per liter in surface-water samples revealed slight differences between RIA and PRIA sites (fig. 6). Surface-water compositions for the 13 sites were mixed sodium, calcium, bicarbonate, and chloride waters. At the RIA sites and RIA reference site, ratios of cations ranged approximately from 45 to 70 percent sodium plus potassium, 10 to 35 percent calcium, and 15 to 30 percent magnesium. Ratios of anions ranged approximately from 35 to 75 percent chloride plus fluoride, 10 to 50 percent carbonate plus bicarbonate, and 10 to 25 percent sulfate.

At the PRIA sites and PRIA reference site, ratios of cations ranged approximately from 30 to 70 percent sodium plus potassium, 15 to 50 percent calcium, and 10 to 30 percent magnesium. Ratios of anions ranged approximately from 25 to 50 percent chloride plus fluoride, 25 to 65 percent carbonate plus bicarbonate, and 10 to 35 percent sulfate. Carbonate was not considered as a contributor to alkalinity because pH measurements were <8.1 standard units (Rounds and Wilde, 2001). All fluoride concentrations were estimated; therefore, fluoride was a minor contributor to the ionic balance.

Table 7. Statistical summary of total dissolved solids, total suspended solids, and major inorganic ions in water and major inorganic ions in bed sediment from selected streams near impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.

[Constituents are dissolved unless otherwise noted. RIA, Redleg impact area; PRIA, Peason Ridge impact areas; mg/L, milligrams per liter; ROE, residue on evaporation; °C, degrees Celsius; E, estimated; Q, elevated reporting limit; J, method blank contamination; mg/kg, milligrams per kilogram; <, less than; ND, not detected]

Property or constituent	Statistical summary									
	RIA sites (1–6, 8, and 9) (fig. 2)				RIA reference site 10 (fig. 2)	PRIA sites (11–13) (fig. 3)				PRIA reference site 14 (fig. 3)
	Number of detections/ number of samples	Minimum detection	Median of all samples	Maximum detection	Maximum detection	Number of detections/ number of samples	Minimum detection	Median of all samples	Maximum detection	Maximum detection
Water, in mg/L										
Total dissolved solids, ROE at 180 °C	24/24	15	36	78	56	9/9	59	81	115	100
Total suspended solids, ROE at 180 °C	13/24	E2.0	E2.0	9.0	6.8	7/9	E1.6	E3.2	134Q	8.8
Calcium, as Ca	23/24	.40	.8	1.7	1.5	9/9	.7	1.6	3.5	1.7
Magnesium, as Mg	23/24	.30	.4	.7	.7	9/9	.3	.6	1.3	E4.0
Sodium, as Na	14/24	E1.9J	E2.1	E3.3J	E2.6J	8/9	E1.8	E3.3	6.2	E4.6
Potassium, as K	19/24	E.20	E.2J	E1.7	E.9	9/9	E.7	E1.0	E2.3	5.0
Bicarbonate, as HCO_3 (calculated)	24/24	.40	2.4	6.7	7.3	9/9	3.4	7.1	16	9.9
Sulfate, as SO_4	23/24	E.70	E1.0	E1.8	E1.9	9/9	E1.2	E3.9	5.4	5.3
Chloride, as Cl	24/24	E.80	3.2	7.3	3.7	9/9	E2.6	3.6	6.1	4.0
Fluoride, as F	13/24	E.10	E.1	E.2	E.2	8/9	E.1	E.1	E.2	E1.2
Silica, as Si	24/24	E.10J	9.9	14	9.3	9/9	18	23	42	42.1J
Bulk bed sediment, in mg/kg										
Calcium, as Ca	24/24	E10.1	42.8	185J	79.2J	9/9	46.0J	113J	258J	155J
Magnesium, as Mg	24/24	E10.4	26.6	88.9	187	9/9	41.4	78.7	297J	112
Sodium, as Na	6/24	E135	<656	E355	ND	0/9	ND	<638	ND	ND
Potassium, as K	11/24	E46.0	<402	E185	E155	7/9	E56.9	E122	E197	E131
Sulfate, as SO_4	5/24	E6.50	<65.3	E24.9J	E5.30	1/9	E7.80	<63.8	E7.80	ND
Chloride, as Cl	24/24	E13.7J	E19.4	93.1	E32.1J	9/9	E13.4J	E16.9J	50.1J	E22.6J
Fluoride, as F	0/24	ND	<13.1	ND	ND	1/9	E2.70	<12.8	E2.70	E2.30
Depositional bed sediment, in mg/kg										
Calcium, as Ca	24/24	41.7	154.5	403J	334	9/9	632J	997J	1,790	1,050
Magnesium, as Mg	24/24	81.8	218	684J	637	9/9	653	1,120J	1,660	814
Sodium, as Na	5/24	E84.9	<716	E370	ND	1/9	E211	<777	E211	ND
Potassium, as K	24/24	E105	E190	E472	E356	9/9	E369	624	1,100	642
Sulfate, as SO_4	9/24	E5.9	<73.0	E12.0	E4.90	6/9	E5.90	E6.90	E13.1	E19.7
Chloride, as Cl	24/24	E15.6J	E37.3	163	49.2J	9/9	E20.3	E27.3	68.2J	E39.3J
Fluoride, as F	5/24	E1.9	<13.8	E3.00	E2.90	6/9	E2.30	E2.30	E5.60	E3.00

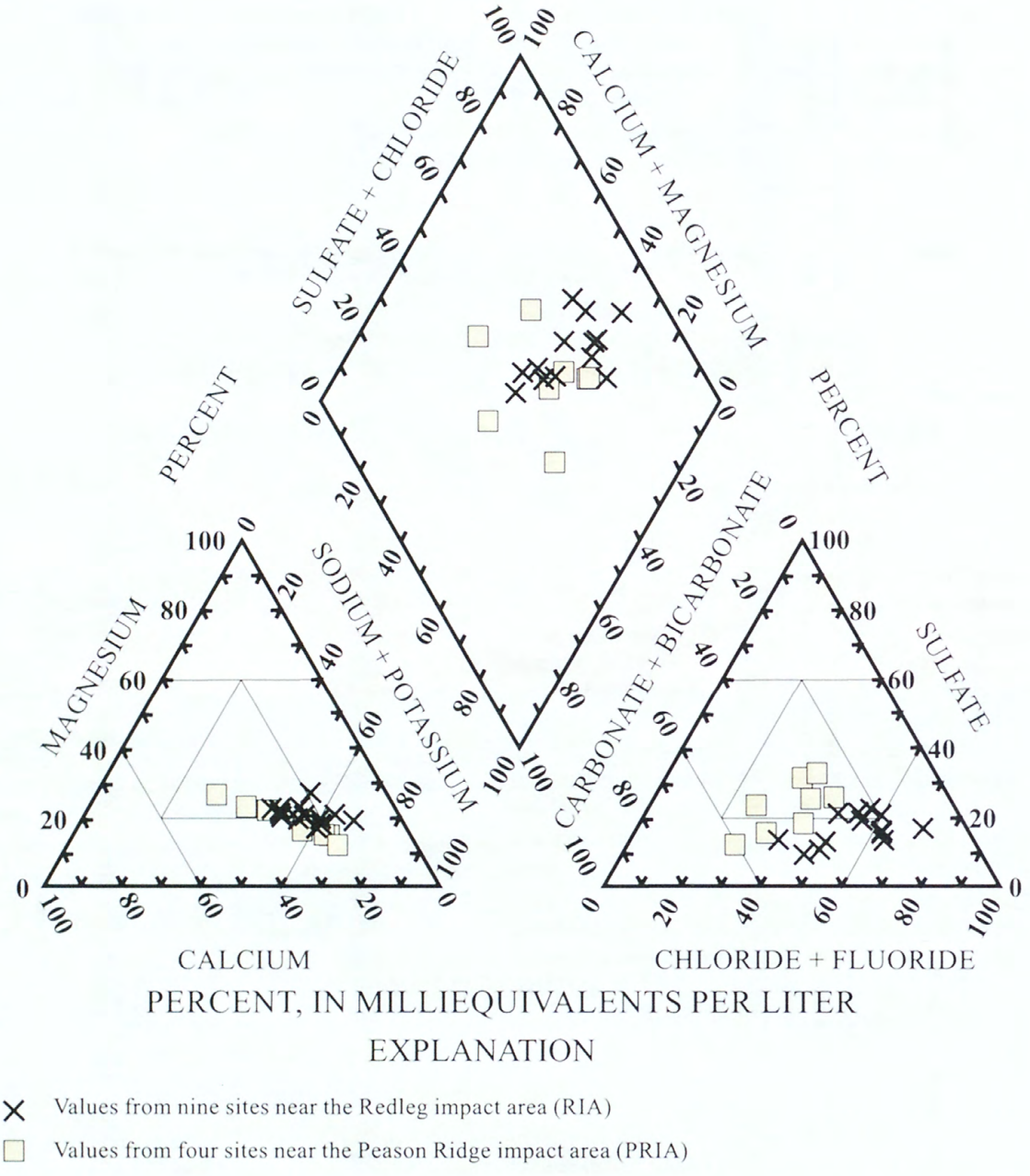


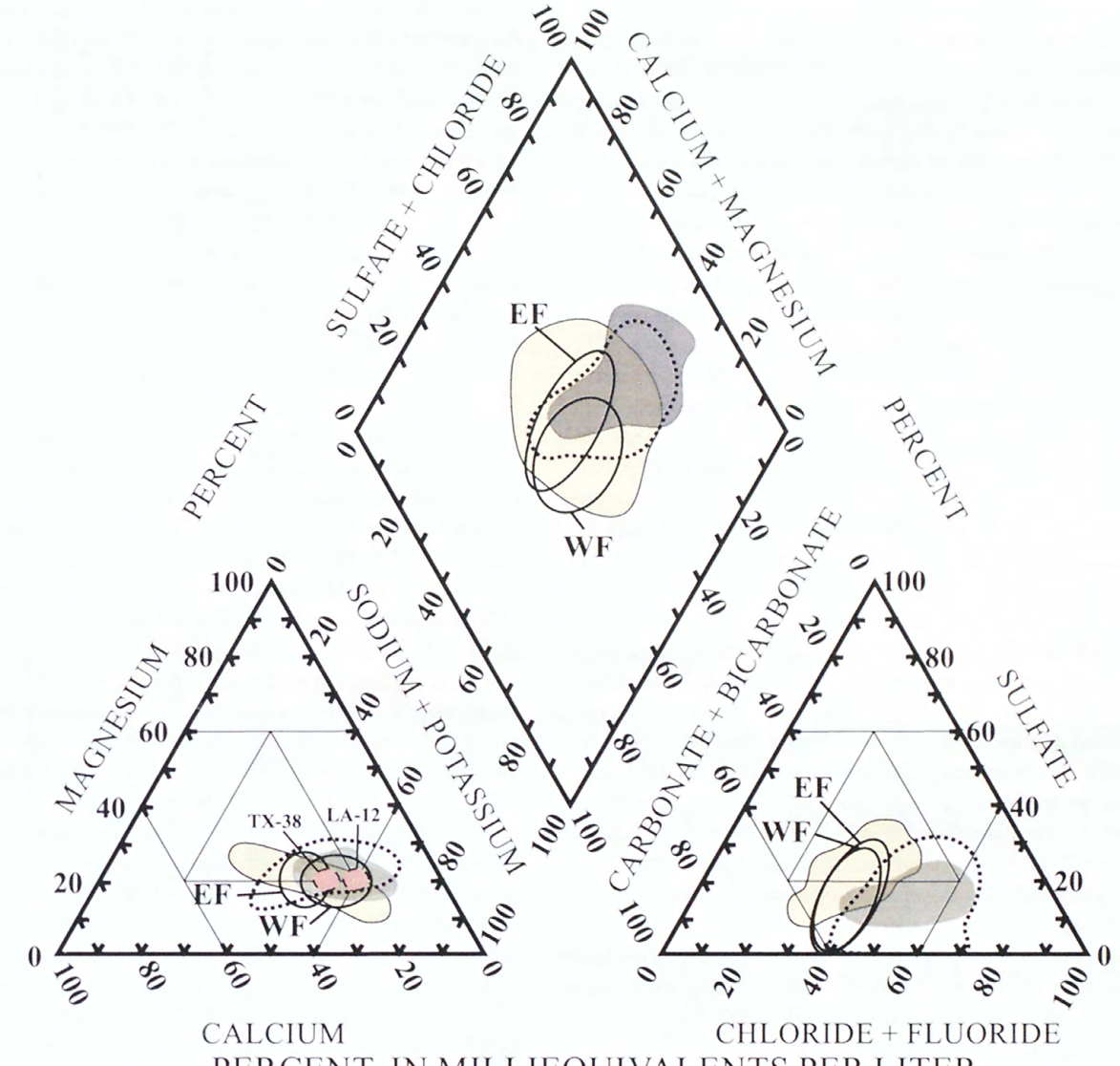
Figure 6. Piper diagram showing percentages of major inorganic ion composition of water from selected streams near impact areas, Fort Polk Military Reservation, Louisiana, 2001–02

A Piper diagram (fig. 7) also was used to show that percentages of major inorganic ion concentrations near the RIA were similar to previous data collected from six other sites (fig. 2) located on the eastern part of the Main Post. Shallow ground water in this area is recharged locally by rainwater (Tollett and others, 2002; Tollett, 1998). Generally, ratios of major cations (calcium, magnesium, sodium, and potassium) in the stream samples reflected those of concentrated rainwater (fig. 7) comprising the shallow ground water and subsequent shallow-ground-water discharge to the streams during low-flow stream conditions.

Physicochemical properties and selected chemical constituents indicated that the streams are mineral-poor and low in alkaline earth metals and buffering capacity (Tollett and Fendick, 1998), as was expected for these small headwater streams located on highly weathered soils.

Bed Sediment

Major inorganic ions, including four cations (calcium, magnesium, sodium, and potassium) and three anions (sulfate, chloride, and fluoride), were analyzed in both bulk and



EXPLANATION

Values from nine sites near the Redleg impact area (RIA)

Values from four sites near the Peason Ridge impact area (PRIA)

Dashed area indicates the range of values obtained from major inorganic ion data from the eight sites upstream and downstream of the four low-water crossings (LWC) (Tollett and others, 2002)

WF

Solid outline area indicates the range of values obtained from major inorganic ion data from East Fork (EF) and West Fork (WF) of Sixmile Creek (Tollett and Fendick, 1998; Tollett, 1998)

TX-38

Shaded circle represents National Atmospheric Deposition Program/National Trend Network major inorganic cation rainfall data, 1986 to 1997 (Tollett and others, 2002)

TX-38 at Forest Seed Center, Nacogdoches County, Texas, about 100 miles west-northwest of study area

LA-12 at Iberia Research Station, Iberia Parish, Louisiana, about 125 miles southeast of study area

Figure 7. Piper diagram showing percentages of major inorganic ion composition of water from selected streams, Fort Polk Military Reservation, Louisiana, and rainfall data from two National Atmospheric Deposition Program sites, 2001–02.

depositional bed-sediment samples. Calcium, magnesium, and chloride were the only major inorganic ions with detected or estimated concentrations in all 24 bulk and 24 depositional samples from the RIA, and 9 bulk and 9 depositional samples from the PRIA (table 7). Because of elevated reporting limits (generally a magnitude of order), sodium and potassium were detected less frequently. Sodium was detected in only 6 of 24 RIA bulk samples, 5 of 24 RIA depositional samples, 0 of 9 PRIA bulk samples, and 1 of 9 PRIA depositional samples. Potassium concentrations in bulk samples ranged from E46.0 mg/kg (RIA) to E197 mg/kg (PRIA) and were higher in depositional samples, with concentrations ranging from E105 mg/kg (RIA) to 1,100 mg/kg (PRIA). Sulfate was detected in only 5 of 24 RIA bulk samples, 9 of 24 RIA depositional samples, 1 of 9 PRIA bulk samples, and 6 of 9 PRIA depositional samples. Fluoride was not detected in any of the 24 RIA bulk samples, and was detected in only 5 of 24 RIA depositional samples, 1 of 9 PRIA bulk samples, and 6 of 9 PRIA depositional samples. The maximum magnesium concentration (187 mg/kg) in bulk sediment at RIA reference site 10 was the only major inorganic ion outside the range of bulk and depositional concentrations at the RIA sites. The maximum sulfate concentration (E19.7 mg/kg) in depositional samples at PRIA reference site 14 was the only major inorganic ion outside the range of bulk and depositional concentrations at the PRIA sites. In addition to characterizing bed-sediment quality in 2003, the data will be useful as baseline data for future studies near the RIA and PRIA on the Reservation.

Overall, potassium concentrations were low compared to other streams in southwestern Louisiana (Skrobialowski, 2002). Concentrations of calcium, magnesium, and potassium were much higher in the depositional samples than in the bulk samples. Higher cation concentrations likely were due to higher clay and organic content in the depositional samples. Clay and organic particles typically have negative surface charges, which allow the colloidal surfaces to adsorb and exchange cations (Moore and Reynolds, 1989, p. 115; Drever, 1997, p. 82). Therefore, higher cation concentrations were expected in the depositional samples.

Cyanide, Perchlorate, and Trace Elements

A statistical summary of cyanide, perchlorate, and trace elements in water and bed sediment from the 13 sites is listed in table 8. All the data are listed in appendix 5 for water, appendix 6 for bulk bed sediment, and appendix 7 for depositional bed sediment.

Water

Cyanide concentrations at the RIA sites ranged from E2.7 to E9.5 µg/L (table 8), and detected concentrations at the PRIA sites ranged from E3.6 to 41 µg/L. Two concentrations of cyanide, E2.4 µg/L at site 1 on June 28, 2001, and E7.9 µg/L at site 5 on January 10, 2002, were detected in field-blank water samples (appendix 5). All concentrations for the summer 2001 sampling period were slightly larger than the 2001 blank concentration. All except two concentrations, E11 µg/L at site 12 and E9.6 µg/L at site 13 on January 14, 2002, were less than the January 2002 blank concentration, which indicated concentrations less than about 10 µg/L may be biased high. The highest detected cyanide concentration (110 µg/L) was at PRIA reference site 14. Concentrations in 14 of the 24 samples at the RIA sites, 1 (11 µg/L) at RIA reference site 10, 4 of the 9 samples at the PRIA sites, and 2 at PRIA reference site 14 were above the USEPA Aquatic Life Criteria CCC of 5.2 µg/L (U.S. Environmental Protection Agency, 2004b). However, all concentrations for cyanide were less than the MCLG and MCL of 200 µg/L for drinking water (U.S. Environmental Protection Agency, 2004a).

Perchlorate, a primary ingredient in solid rocket propellant and pyrotechnics, was detected in one RIA water sample, at E14.3 µg/L at site 5 (table 8). This concentration was below the USEPA DWEL of 24.5 µg/L (U.S. Environmental Protection Agency, 2005b). There were no detections of perchlorate at RIA reference site 10, the PRIA sites, PRIA reference site 14, or in blank water samples.

The highest concentrations of trace elements in stream water were for aluminum, iron, and manganese. Aluminum concentrations ranged from 130 to 478 µg/L at the RIA sites and ranged from 353 to 5,810 µg/L at the PRIA sites. All the aluminum concentrations were above the SDWR range of 50 to 200 µg/L (U.S. Environmental Protection Agency, 2004a). Iron concentrations ranged from 127 to 2,610 µg/L at the RIA sites and ranged from 440 to 3,920 µg/L at the PRIA sites. All but four iron concentrations at the RIA sites were above the SDWR (300 µg/L). Manganese concentrations ranged from 2.60 to 126 µg/L at the RIA sites and ranged from 2.80 to 97.6 µg/L at the PRIA sites. Concentrations in 7 of 24 samples at the RIA sites and 4 of 9 samples at the PRIA sites were above the SDWR (50 µg/L) for manganese (U.S. Environmental Protection Agency, 2004a). Only two concentrations of aluminum, iron, or manganese were detected in blank water samples: one concentration for iron, E5.2 µg/L, and one for manganese, E0.33 µg/L (appendix 5), both of which were much lower than stream-water concentrations. The concentrations of these three constituents were typical for the soil characteristics (Tollett, 1998; Greenwood, 2000) and low pH measurements for stream water and rainfall in the area (National Atmospheric Deposition Program, 2005a). The highly weathered soils adjacent to streams near the southern boundary of the Main Post are high in silica and aluminosilicate clay minerals (Tollett, 1998). Previous studies in the eastern part of the Main Post indicated the clay composition was primarily kaolinite and smectite (Tollett, 1998; Greenwood, 2000). Pleistocene material typically present on hill tops in the area also is high in silica and kaolinite, and has reddish brown (ferrous iron) coatings on particles (Tollett, 1998; Greenwood, 2000). The low pH rainfall can react with these soils, stripping or leaching aluminum, iron (by converting ferrous iron to ferric iron), and manganese from the surfaces of the soil particles

Table 8. Statistical summary of concentrations of cyanide, perchlorate, and trace elements in water and bed sediment from selected streams near impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.

[RIA, Redleg impact area; PRIA, Peason Ridge impact areas; µg/L, micrograms per liter; E, estimated; J, method blank contamination; <, less than; ND, not detected; mg/kg, milligram per kilogram]

Property or constituent	Statistical summary									
	RIA sites (1–6, 8, and 9) (fig. 2)				RIA reference site 10 (fig. 2)	PRIA sites (11–13) (fig. 3)				PRIA reference site 14 (fig. 3)
	Number of detections/ number of samples	Minimum detection	Median of all samples	Maximum detection	Maximum detection	Number of detections/ number of samples	Minimum detection	Median of all samples	Maximum detection	Maximum detection
Water, in µg/L										
Cyanide	21/24	E2.7	E5.5	E9.5	11	6/9	E3.6	E4.5	41	110J
Perchlorate	1/24	E14.3	<20	E14.3	ND	0/9	ND	<20	ND	ND
Aluminum, as Al	24/24	130	223	478	869	9/9	353	1,100	5,810	957
Antimony, as Sb	21/24	.019	E.125	E.580J	E.310J	7/9	.019	.058	E.650J	E.240J
Arsenic, as As	15/24	.222	.256	E1.20	E1.10	9/9	.318	.72	6.1	E2.00
Barium, as Ba	24/24	2.9	24.2	34	33	9/9	27.5	51.7	128	49.1J
Beryllium, as Be	8/24	.042	<1.00	.097	.087	5/9	.053	.053	E.290	E.140
Cadmium, as Cd	10/24	.012	<1.00	.037	.01	6/9	.008	.021	E.089	E.039
Chromium, as Cr	24/24	.221	E1.05J	2.9	2	9/9	.206	E1.40J	2.1	E1.60
Cobalt, as Co	23/23	E.220	E.550	1.4	1.1	9/9	.248	.469	1.9	E.430
Copper, as Cu	23/23	.175	.767	3.13	E.960	9/9	.464	E.980	2.6	E.970
Iron, as Fe	24/24	127	716	2,610	2,100	9/9	440	796	3,920	743
Lead, as Pb	23/24	E.300	.546	1.5	E.840J	9/9	.447	E.780	3.40J	1.10J
Manganese, as Mn	24/24	2.60J	37	126	99.2	9/9	2.80J	34.4	97.6J	11.7
Mercury, total, as Hg	24/24	.001	.002	.005	.004	9/9	.002J	.004	.008J	.004
Molybdenum, as Mo	13/24	.02	.021	E.130J	E.370J	6/9	.022	.046	E.410J	E.440J
Nickel, as Ni	24/24	.297	E.585J	5.8	.955	9/9	.256	E.680	E1.70J	E1.20J
Selenium, as Se	9/24	E.140	<5.00	.49	.318	6/9	.128	.177	E1.00	E.980
Silver, as Ag	7/24	.004	<1.00	.006	.004	6/9	.002	.004	E.068J	E.077J
Thallium, as Tl	12/23	.021	.021	E.310	E.600	9/9	.014	E.036J	1.2	1.2
Tin, as Sn	1/24	E.880	<1.00	E.880	ND	0/9	ND	<1.00	ND	ND
Vanadium, as V	20/24	.612	1.265	E2.40	E2.40	9/9	.744	1.8	E4.50	E2.60J
Zinc, as Zn	17/24	.996	2.945	E8.70	E8.50	6/9	.437	1.06	12.8J	E6.30J
Bulk bed sediment, in mg/kg										
Cyanide	16/24	E.14	E.225	E.590	E.460	6/9	E.260	E.28	E.54	.71
Perchlorate	0/24	ND	<.26	ND	ND	0/9	ND	<.26	ND	ND
Aluminum, as Al	24/24	223J	824	4,290	4,980	9/9	512	1,920	8,030	5,840
Antimony, as Sb	13/24	E.004	E.005	.267	.087	2/9	E.048	<.257	.114	ND
Arsenic, as As	23/24	E.049	E.240	4.33	2.07	9/9	E.105	E.226	1.75	1.56
Barium, as Ba	24/24	2.27J	6.84	79	60.7	9/9	4.43	14.6	282	187
Beryllium, as Be	19/24	E.014	E.048	.174	.166	8/9	E.029	.06	.29	.186
Cadmium, as Cd	18/24	E.004	E.011	.119	.011	7/9	E.002	E.008	.028	E.003
Chromium, as Cr	23/24	.206	.88	4.79	4.98	9/9	.506	.976	2.94	2.69
Cobalt, as Co	23/24	E.06	.406	1.39	1.3	8/9	.08	.201	.49	2.86
Copper, as Cu	24/24	E.122J	.53	2.49J	1.71	9/9	.273J	.624J	1.4	.859

Table 8. Statistical summary of concentrations of cyanide, perchlorate, and trace elements in water and bed sediment from selected streams near impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.—Continued

[RIA, Redleg impact area; PRIA, Peason Ridge impact areas; µg/L, micrograms per liter; E, estimated; J, method blank contamination; <, less than; ND, not detected; mg/kg, milligram per kilogram]

Property or constituent	Statistical summary									
	RIA sites (1–6, 8, and 9) (fig. 2)				RIA reference site 10 (fig. 2)	PRIA sites (11–13) (fig. 3)				PRIA reference site 14 (fig. 3)
	Number of detections/ number of samples	Minimum detection	Median of all samples	Maximum detection	Maximum detection	Number of detections/ number of samples	Minimum detection	Median of all samples	Maximum detection	Maximum detection
Bulk bed sediment, in mg/kg—Continued										
Iron, as Fe	24/24	88.8J	307	2,810	3,270	9/9	318	713	2,410	1,550
Lead, as Pb	24/24	.899	2.6	5.6	4.41	9/9	.978	2.11	6.6	4.86
Manganese, as Mn	24/24	1.41J	18.4J	65.8	44.4	9/9	3.56J	10.0J	24.9	18
Mercury, as Hg	11/24	.002	<.044	.044	.004	2/9	E.006	<.042	.007	ND
Molybdenum, as Mo	12/24	E.020	<.268	.28	E.047J	3/9	E.013	<.257	E.062	E.016
Nickel, as Ni	24/24	.165J	.356J	1.70J	1.42	9/9	.143J	.429J	.969	.807
Selenium, as Se	5/24	E.139	<.669	3.25	ND	3/9	E.072	<.694	3.17	ND
Silver, as Ag	15/24	E.006	E.009	.112	E.009	6/9	E.02	E.013J	E.026J	E.020J
Thallium, as Tl	24/24	E.005	E.016	.313	.15	9/9	E.007	E.023	.131	.092
Tin, as Sn	17/24	E.191J	E.468J	E1.12J	E.495J	5/9	E.223J	E.223J	E1.03J	E.536J
Vanadium, as V	23/24	E.485	1.61	14.7J	8.694	9/9	.972	1.68	6.2	4.45
Zinc, as Zn	24/24	E.732	2.39	8.52	5.84	9/9	E1.15	2.39	4.93	3.52
Depositional bed sediment, in mg/kg										
Cyanide	18/24	E.20	E.335	E.610	.88	7/9	E.16	E.380	E.770	E.470
Perchlorate	0/24	ND	<.28	ND	ND	0/9	ND	<.290	ND	ND
Aluminum, as Al	24/24	1,540	5,995J	25,900	23,400	9/9	6,230	13,700	37,800	29,600
Antimony, as Sb	15/24	E.005J	E.013J	.627	.464	3/9	.245	<.335	.466	.396
Arsenic, as As	23/24	E.221	1.42	8.87	5.05	9/9	E.677	1.13	2.74	2.36
Barium, as Ba	24/24	12.0J	25.8J	327	219	9/9	49	73.3	519	530
Beryllium, as Be	24/24	E.084	.176	.747	.574	9/9	.294	.442	1.69	1.1
Cadmium, as Cd	23/24	E.008	.024	.063	E.023	9/9	.018	E.034	E.075	E.021
Chromium, as Cr	24/24	2.06	5.98	24.3	22	9/9	3.41J	5.1	21.8	14.5
Cobalt, as Co	24/24	.35	1.76	7.38	6.19	9/9	1.26	2.33	5.41	2.85
Copper, as Cu	23/24	.543J	2.16	6.9	6.55	9/9	2.37J	3.02J	8.46	5.53
Iron, as Fe	24/24	1,580	3,230J	16,700	16,600	9/9	3,730	5,870	19,700	9,920
Lead, as Pb	24/24	3.79J	8.44	25	16.3	9/9	6.13	8.58	17.1	17
Manganese, as Mn	24/24	6.96J	83.9	522J	295J	9/9	40.3	91	286	81.2
Mercury, as Hg	22/24	E.008	E.012	E.028	.013	9/9	E.004	E.010	E.026	E.008
Molybdenum, as Mo	21/24	E.058	E.108	.346	.299	6/9	E.016	E.0268	.352	.12
Nickel, as Ni	24/24	.471J	1.54J	6.4	5.35	9/9	1.531	2.11J	7.64	3.47
Selenium, as Se	20/24	E.147	E.254	3.86	4.01	9/9	E.188	E.355	3.34	E.324
Silver, as Ag	16/24	E.013	E.029	E.060	E.05	6/9	E.046J	E.049J	E.091J	.063
Thallium, as Tl	24/24	E.048	E.137	.456	.456	9/9	E.094	E.138	.588	.444
Tin, as Sn	14/24	E.098J	E.160J	E.465J	E.144J	2/9	E.235J	<1.55	1.35	E.107J
Vanadium, as V	24/24	3.84	1	37.7	38.8	9/9	6.16J	10.2	41.7	25.9
Zinc, as Zn	24/24	2.69	6.16	18.9	20.4	9/9	8.58	13.4	37.5	22.1

and transporting these constituents to the streams (Drever, 1997).

Most of the other trace-element concentrations in water from the 13 sites were below 10 µg/L (table 8), and all detected concentrations were below guidelines and regulations except MCLG's for arsenic, lead, and thallium (appendix 5). Concentrations in 15 of 24 samples at the RIA sites and all 9 samples at the PRIA sites were above the MCLG of 0 µg/L for arsenic; however, no concentration exceeded the MCL of 10 µg/L (U.S. Environmental Protection Agency, 2004a). An arsenic concentration of E0.76 µg/L was detected in the blank water sample at site 11 on July 1, 2002. One concentration (E0.580) detected at site 4 on June 25, 2002, was less than this blank concentration during the summer 2002 sampling period. Arsenic concentrations at the impact areas were similar to their respective reference sites.

Lead concentrations were similar to those of arsenic. Concentrations in 23 of 24 samples at the RIA sites and all 9 samples at the PRIA sites were above the MCLG of 0 µg/L for lead; however, no concentrations exceeded the MCL of 15 µg/L (U.S. Environmental Protection Agency, 2004a). A lead concentration of E0.30 µg/L was detected in the blank water sample at site 11 on July 1, 2002. All concentrations of lead for the summer 2002 sampling period were slightly larger than this blank concentration. Concentrations of lead at the impact areas were similar to their respective reference sites.

Thallium concentrations were similar to those of arsenic and lead. One concentration at RIA reference site 10, four concentrations at the PRIA sites, and one concentration at PRIA reference site 14 were above the MCLG of 0.5 µg/L for thallium; however, no concentration exceeded the MCL of 2 µg/L (U.S. Environmental Protection Agency, 2004a). A thallium concentration of 1.10 µg/L was detected in the blank water sample at site 11 on July 1, 2002. All thallium concentrations for the summer 2002 sampling period except two, a concentration of 1.20 µg/L at both site 13 and site 14, were less than this blank concentration. Thallium concentrations at the impact areas were similar to their respective reference sites.

Mercury concentrations in the water samples were low and similar to concentrations in rainfall. The maximum mercury concentration was 0.005 µg/L at two RIA sites and 0.008J µg/L at the PRIA sites (table 8, appendix 5). The maximum mercury concentration at both reference sites was 0.004 µg/L, which was similar to the concentrations observed at sites near the impact areas.

Bed Sediment

All concentrations of cyanide in bulk and depositional bed-sediment samples were below the reporting limit or were estimated values except for concentrations in three samples: 0.71 mg/kg, in a bulk sample at PRIA reference site 14; 0.88 mg/kg, in a depositional sample at RIA reference site 10; and 0.74 mg/kg, in a depositional sample at PRIA site 12. All concentrations at the impact area sites were similar to those observed at their respective reference site.

Perchlorate was not detected in bed-sediment samples. Reporting limits ranged from <0.24 to <0.32 mg/kg in RIA bulk samples, <0.25 to <0.28 mg/kg in PRIA bulk samples, <0.24 to <0.41 mg/kg in RIA depositional samples, and <0.24 to <0.39 mg/kg in PRIA depositional samples.

Aluminum concentrations were greater than most other trace elements in bed-sediment samples. The median concentrations of aluminum were about seven times larger in depositional samples than in bulk samples. Median concentrations of aluminum were 824 mg/kg for RIA bulk samples, 1,920 mg/kg for PRIA bulk samples, 5,995J mg/kg in RIA depositional samples, and 13,700 mg/kg in PRIA depositional samples. The higher aluminum concentrations in the depositional samples were consistent with the higher aluminosilicate minerals (clay) present in the depositional areas within each stream targeted by the sampling design. Thus the sampling design appears to have achieved the goal of sampling two environments (bulk and depositional) within the streams.

The next highest concentrations of trace elements in bed sediment were for iron, manganese, and barium (table 8). The median concentration of iron was 307 mg/kg in RIA bulk samples, 713 mg/kg in PRIA bulk samples, 3,230J mg/kg in RIA depositional samples, and 5,870 mg/kg in PRIA depositional samples. The median concentration of manganese was 18.4J mg/kg in RIA bulk samples, 10.0J mg/kg in PRIA bulk samples, 83.9 mg/kg in RIA depositional samples, and 91.0 mg/kg in PRIA depositional samples. The median concentration of barium was 6.84 mg/kg in RIA bulk samples, 14.6 mg/kg in PRIA bulk samples, 25.8 mg/kg in RIA depositional samples, and 73.3 mg/kg in PRIA depositional samples. Iron, manganese, and barium concentrations at the impact area sites were similar to concentrations observed at their respective reference sites.

Most other trace-element concentrations in bulk and depositional bed-sediment samples were <15 mg/kg. Similar to calcium, magnesium, and potassium, concentrations of trace elements were generally larger in the depositional samples than in the bulk samples. The depositional samples had a much higher clay and organic content than the bulk samples. Clay and organic particles typically have negative surface charges, which under normal environmental conditions (pH measurements above 2.0), may attract the positively charged trace elements (Moore and Reynolds, 1989, p. 115; Drever, 1997, p. 97–99). Therefore, larger trace-element concentrations were expected to be associated with the depositional samples than with bulk samples.

The CCME has established bed-sediment guidelines for seven trace elements: arsenic, cadmium, chromium, copper, lead, mercury, and zinc (table 5). The ISQG's are less than the PEL's. There were no PEL exceedances, and only one arsenic concentration (8.87 mg/kg) in a depositional sample from site 5 at the RIA exceeded the ISQG value of 5.9 mg/kg (table 5). The maximum concentration of arsenic was 4.33 mg/kg in RIA bulk samples, 1.75 mg/kg in PRIA bulk samples, 8.87 mg/kg in RIA depositional samples, and 2.74 mg/kg in PRIA depositional samples. Concentrations at

RIA reference site 10 (maximum bulk concentration of 2.07 mg/kg, maximum depositional concentration of 5.05 mg/kg) and PRIA reference site 14 (maximum bulk concentration of 1.56 mg/kg, maximum depositional concentration of 2.36 mg/kg) were similar to the concentrations for the other sites.

Total Organic Carbon and Nutrients

A statistical summary for TOC and nutrients in water and bed sediment from the 13 sites is listed in table 9. The data are listed in appendix 8 for water, appendix 9 for bulk bed sediment, and appendix 10 for depositional bed sediment.

Water

The TOC concentrations at the RIA sites ranged from 2.8 to 10.6 mg/L, with a median concentration of 5.3 mg/L. The maximum concentration at RIA reference site 10 was 7.1 mg/L. The TOC concentrations at the PRIA sites ranged from 2.4 to 6.8 mg/L, with a median concentration of 4.0 mg/L. The maximum concentration at PRIA reference site 14 was 3.9 mg/L. The TOC concentrations were expected to be similar to dissolved organic carbon concentrations because the streams near the impact areas were clear with low turbidity during low-flow sampling. In addition, the median TOC concentrations at the RIA and PRIA sites were less than the average dissolved organic carbon concentration of 5.75 mg/L for all world rivers (Meybeck, 1982).

All detected concentrations of nutrients, including nitrogen as ammonia, nitrate, nitrite, nitrate plus nitrite, total organic nitrogen measured as TKN, phosphorus, and orthophosphorus at the RIA and PRIA sites were less than USEPA guidelines and regulations. Nutrient concentrations were low, with a maximum concentration of 0.53 mg/L for total organic nitrogen measured as TKN at the RIA sites, and a concentration of E0.38 mg/L for total organic nitrogen measured as TKN at the PRIA sites. Concentrations of nutrients at sites in the impact areas were similar to the concentrations observed at their respective reference sites.

Bed Sediment

The TOC concentrations for bulk samples at the RIA sites ranged from E1,000 to 19,800 mg/kg, with a median concentration of 2,850 mg/kg. The maximum concentration at RIA reference site 10 was 4,300 mg/kg (table 9). The TOC concentrations for bulk samples at the PRIA sites ranged from E980 to 5,800 mg/kg, with a median concentration of E980 mg/kg. The maximum concentration at PRIA reference site 14 was E1,400 mg/kg.

The TOC concentrations in depositional samples at the RIA sites ranged from E1,800 to 33,300 mg/kg, with a median concentration of 6,750 mg/kg. The maximum concentration at RIA reference site 10 was 7,500 mg/kg. The TOC concentrations in depositional samples at the PRIA sites ranged from E1,700 to 27,100 mg/kg, with a median concentration of 4,400 mg/kg. The maximum concentration at PRIA reference site 14 was 7,700 mg/kg. Concentrations of TOC were larger in depositional samples than in bulk samples.

The largest nutrient concentrations were total organic nitrogen measured as TKN, with a maximum concentration of 294 mg/kg in bulk samples and 1,740 mg/kg in depositional samples. The next largest nutrient concentration was for total phosphorus, with a maximum concentration of 16.7 mg/kg (site 8) in bulk samples and 124 mg/kg (site 13) in depositional samples, and then nitrogen as ammonia, with a maximum concentration of 10.5 mg/kg in bulk samples and 10.3 mg/kg in depositional samples. All other nutrient concentrations were <4 mg/kg. Nutrient concentrations were similar between bulk and depositional bed-sediment samples, except for total organic nitrogen measured as TKN and total phosphorus, and concentrations in depositional samples were greater than in bulk samples. Median concentrations in most nutrient bed-sediment samples at sites in the impact area were similar to the maximum concentrations observed at their respective reference sites.

Explosive Compounds

Concentrations of explosive compounds detected in water, bed sediment, and mussel tissue samples from the sites are listed in table 10. All the data are listed in appendix 11 for water, appendix 12 for bulk bed sediment, appendix 13 for depositional bed sediment, and appendix 14 for mussel tissue.

Water

Only 17 concentrations of explosive compounds were detected in water (including one replicate sample), all at estimated concentrations, among the more than 800 analyses reported. Four explosive compounds, 1,3,5-trinitrobenzene, 2,4,6-trinitrotoluene, RDX, and tetryl, were detected at 7 of the 9 sites near the RIA. One compound was detected at sites 1 and 3, and two compounds were detected at sites 2, 4, 5, 8, and 9. Concentrations of explosive compounds detected ranged from E0.02 to E0.14 µg/L (table 10). Three compounds, 1,3,5-trinitrobenzene, 2,4,6-trinitrotoluene, and tetryl, were detected by USEPA Method 8321A (U.S. Environmental Protection Agency, 2005a). The most frequently detected explosive compound, RDX, was detected by both USEPA Method 8321A (U.S. Environmental Protection Agency, 2005a) and USACHPPM Method 13.2 (U.S. Army Center for Health Promotion and Preventive Medicine, 2005). The RDX was detected in 10 samples from 5 RIA sites (sites 1, 2, 4, 5, and 9). Concentrations of explosive compounds were less than the HA's available for reference (table 5). No explosive compounds were detected at the RIA reference site 10. No explosive compounds were detected in water samples at PRIA sites or PRIA reference site 14.

Table 9. Statistical summary of concentrations of total organic carbon and nutrients in water and bed sediment from selected streams near impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.

[Constituents are total unless otherwise noted. RIA, Redleg impact area; PRIA, Peason Ridge impact areas; mg/L, milligrams per liter; J, method blank contamination; E, estimated; <, less than; ND, not detected; TKN, measured as total Kjeldahl nitrogen; mg/kg, milligrams per kilogram; Q, elevated reporting limit]

Property or constituent	Statistical summary									
	RIA sites (1–6, 8, and 9) (fig. 2)				RIA reference site 10 (fig. 2)	PRIA sites (11–13) (fig. 3)				PRIA reference site 14 (fig. 3)
	Number of detections/ number of samples	Minimum detection	Median of all samples	Maximum detection	Maximum detection	Number of detections/ number of samples	Minimum detection	Median of all samples	Maximum detection	Maximum detection
Water, in mg/L										
Total organic carbon (TOC)	24/24	2.8J	5.3	10.6	7.1	9/9	2.4	4	6.8	3.9
Nitrogen, ammonia	22/24	E.03	E.053	.27	E.06	6/9	E.04	E.06	E.09	E.06
Nitrogen, nitrate	10/24	E.13	<.50	E.19	E.20	1/9	E.15	<.50	E.15	ND
Nitrogen, nitrite	15/24	E.10	E.10	E.16	E.16	7/9	E.11	E.15	E.16	E.15
Nitrogen, nitrate plus nitrite[1]	12/24	E.01	<.10	E.09	E.06	5/9	E.02	E.02	E.03	ND
Total organic nitrogen (TKN)	12/24	E.15	<.50	.53	E.25	4/9	E.16	<.50	E.38	E.18
Phosphorus	15/24	E.02J	E.03J	.05J	E.04	7/9	E.03J	E.04J	.081J	E.03J
Orthophosphate	0/24	ND	<.50	ND	ND	0/9	ND	<.50	ND	ND
Bulk bed sediment, in mg/kg										
Total organic carbon (TOC)	24/24	E1,000	2,850	19,800	4,300	5/9	E980	E980	5,800	E1,400
Nitrogen, ammonia	22/24	E.23	E.89	10.5	1.7	9/9	E.21	E.47	1.5	E1.60
Nitrogen, nitrate	1/24	E2.1	<6.6	E2.1	ND	1/9	E2.5	<6.4	E2.5	ND
Nitrogen, nitrite	9/24	E2.0	<6.7	E2.4	E2.6	5/9	E1.9	E1.9	E2.8	E2.4
Nitrogen, nitrate plus nitrite[1]	9/24	E.28	<1.3	E.76	E.44	4/9	E.31	<1.3	E.91	E.28
Total organic nitrogen (TKN)	23/24	E40	120	294Q	125	6/9	E19.6	E37.9	242	E30.4
Phosphorus	22/24	E1.6	E3.8	16.7	E6.1	9/9	E2.1	E4.8J	10.4J	E3.4J
Orthophosphate	0/24	ND	<6.6	ND	ND	0/9	ND	<6.4	ND	ND
Depositional bed sediment, in mg/kg										
Total organic carbon (TOC)	23/24	E1,800	6,750	33,300	7,500	9/9	E1,700	4,400	27,100	7,700
Nitrogen, ammonia	24/24	E.25	1.2	10.3	E1.2	9/9	E.30	1.4	9	1.5
Nitrogen, nitrate	2/24	E2.1	<7.0	E2.4	ND	1/9	E2.8	<7.4	E2.8	E2.5
Nitrogen, nitrite	13/24	E2.0	E2.0	E3.8	E2.8	8/9	E2.1	E2.5	E3.3	E3.4
Nitrogen, nitrate plus nitrite[1]	13/24	E.32	E.34	E1.20	E.50	5/9	E.56	E.56	1.9	E.47
Total organic nitrogen (TKN)	24/24	96	316	1,740Q	400	9/9	102	219	690	176
Phosphorus	24/24	E2.2	14	72.4	79.1	9/9	19.3	41.0J	124	30.6J
Orthophosphate	0/24	ND	<6.9	ND	ND	0/9	ND	<7.4	ND	ND

[1] Different analytical methods were used to determine nitrate plus nitrite concentrations and nitrate and nitrite concentrations. Therefore, the sum of nitrate and nitrite concentrations may not equal the concentration for nitrate plus nitrite.

Table 10. Concentrations of explosive compounds detected in water, bed-sediment, and mussel-tissue samples from selected streams near impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.

[Concentrations in water are in micrograms per liter. Concentrations in bed-sediment and mussel-tissue samples are in milligrams per kilogram. TNB, trinitrobenzene; TNT, trinitrotoluene; RDX, hexahydro-1,3,5-trinitro-1,3,5-triazine; HMX, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine; USACHPPM, U.S. Army Center for Health Promotion and Preventive Medicine; --, no data; E, estimated; USEPA, U.S. Environmental Protection Agency; Rep, replicate environmental sample; Bulk, bulk bed sediment; Depo, depositional bed sediment]

Site number (figs. 2, 3)	Sample type	Sample date	Method[1]	Explosive compound					
				1,3,5-TNB	2,4,6-TNT	RDX	Tetryl	HMX	Nitro-glycerin
Sites near the Redleg impact area									
1	Water	1-10-2002	USACHPPM 13.2	--	--	E0.03	--	--	--
1	Tissue[2]	3-12-2003	USEPA 8330	--	--	--	--	--	E0.38
2	Water	7-13-2001	USEPA 8321A	E0.02	--	--	--	--	--
2	Water	1-19-2002		--	--	E.04	--	--	--
2 Rep	Water	1-19-2002	USACHPPM 13.2	--	--	E.04	--	--	--
3	Water	7-13-2001	USEPA 8321A	E.02	--	--	--	--	--
4	Water	7-13-2001	USEPA 8321A	E.02	--	E.04	--	--	--
4	Water	1-11-2002	USACHPPM 13.2	--	--	E.02	--	--	--
5	Water	7-9-2001	USEPA 8321A	--	E0.05	--	--	--	--
5	Water	1-10-2002	USACHPPM 13.2	--	--	E.14	--	--	--
5	Water	6-24-2002	USACHPPM 13.2	--	--	E.02	--	--	--
5	Tissue[2]	3-13-2003	USEPA 8330	--	--	--	--	--	E.46
5 Rep	Tissue[2]	3-13-2003	USEPA 8330	--	--	--	--	--	E.19
6	Tissue[2]	3-13-2003	USEPA 8330	--	--	--	--	--	E.20
8	Water	7-13-2001	USEPA 8321A	E.03	--	--	E0.03	--	--
9	Water	7-13-2001	USEPA 8321A	E.02	--	E.08	--	--	--
9	Water	1-11-2002	USACHPPM 13.2	--	--	E.04	--	--	--
9	Water	6-26-2002	USACHPPM 13.2	--	--	E.05	--	--	--
Sites near Peason Ridge impact areas									
11 Rep	Bulk	7-1-2002	USACHPPM 55.1	--	--	--	--	[3]E0.036	--
11	Depo	7-1-2002	USACHPPM 55.1	--	--	--	--	.200	--
11 Rep	Depo	7-1-2002	USACHPPM 55.1	--	--	--	--	E.064	--
12	Depo	7-1-2002	USACHPPM 55.1	--	--	--	--	E.074	--
13	Bulk	7-1-2002	USACHPPM 55.1	--	--	--	--	.200	--
[4]14	Depo	7-2-2002	USACHPPM 55.1	--	--	--	--	.120	--

[1] USACHPPM methods: U.S. Army Center for Health Promotion and Preventive Medicine (2005); USEPA methods: U.S. Environmental Protection Agency (2005a).

[2] Mussel tissue was collected at only three sites: sites 1, 5, and 6.

[3] HMX not detected in environmental bulk bed-sediment sample at site 11, July 2002.

[4] Reference site for Peason Ridge impact areas.

Bed Sediment

Only one explosive compound, HMX, was detected in bulk and depositional bed-sediment samples among the more than 1,800 analyses reported (including replicate environmental samples). The HMX was detected six times, three of which were at estimated concentrations and two of which were replicate samples. The compound was detected only at PRIA sites sampled in July 2002 using USACHPPM Method 55.1 (U.S. Army Center for Health Promotion and Preventive Medicine, 2005). The HMX was detected in two bulk samples, a concentration of E0.036 mg/kg in a replicate sample from site 11 and a concentration of 0.200 mg/kg at site 13 (table 10). The HMX was detected in four depositional samples: a concentration of 0.200 mg/kg in a sample from site 11, E0.064 mg/kg in a replicate sample from site 11, E0.074 mg/kg at site 12, and 0.120 mg/kg at PRIA reference site 14. The HMX concentrations in the depositional samples from site 11 were larger than the concentration in the bulk sample collected on the same date, July 1, 2002. The HMX detection at PRIA reference site 14 could be an indication that this site, which is located away from the impact area but on the Reservation, is susceptible to contamination from past military training activities, or it could be a false positive identification of HMX by laboratory procedures. Field contamination is less likely to have caused the detection of HMX at PRIA reference site 14 due to ultra-clean sampling and handling procedures.

Mussel Tissue

Explosive compounds were not detected in the tissue of mussels, *Corbicula fluminea*, collected from Alligator Lake. One explosive compound, nitroglycerin, was detected by using USEPA Method 8330 (U.S. Environmental Protection Agency, 1994) for samples from the three sites: E0.38 mg/kg at site 1, E0.46 mg/kg at site 5, and E0.20 mg/kg at site 6 (table 10), where the transplanted mussels from Alligator Lake were placed for about 110 days near the RIA. Nitroglycerin, at a concentration of E0.19 mg/kg in the replicate environmental sample at site 5, also was detected by using Method 8330 (U.S. Environmental Protection Agency, 1994). These findings were similar to a previous study of mussel tissue, which indicated that mussels near the Reservation were capable of uptaking explosive compounds but at very low concentrations and with few compounds detected (Tollett and Kolb, 2005).

Summary and Conclusions

At the request of the U.S. Army Joint Readiness Training Center and Fort Polk, the U.S. Geological Survey collected and analyzed water, bed-sediment, and mussel-tissue samples from selected streams near the Redleg impact area (RIA) and Peason Ridge impact areas (PRIA) at the Fort Polk Military Reservation (Reservation), Louisiana from June 2001 through November 2003. Samples were collected from 13 sites, including 2 reference sites. The sites were located on streams that originate on or near the RIA on the Main Post and PRIA in the Peason Ridge Training Area at the Reservation. The stratigraphic unit that crops out or underlies the RIA is the Blounts Creek Member, which is equivalent to the Evangeline aquifer. South of the RIA, thin clay beds separate the Evangeline aquifer from the overlying aquifers, including the Chicot aquifer system, which has been designated by the U.S. Environmental Protection Agency (USEPA) as a Sole Source Aquifer. The stratigraphic unit that crops out or underlies the PRIA is the Carnahan Bayou Member, which is equivalent to the Carnahan Bayou aquifer. Streams draining the RIA and PRIA flow through recharge areas of these aquifers, thus potentially affecting the water quality of these aquifers.

The data from this study were collected and analyzed to (1) describe the quality of water, bed-sediment, and mussel-tissue data near the RIA and PRIA at the Reservation and (2) relate that water quality to drinking-water, human-health, bed-sediment, and aquatic-life standards. Water was analyzed for physicochemical properties; water and bed sediment were analyzed for major inorganic ions, cyanide, perchlorate, trace elements, total organic carbon, nutrients, and explosive compounds; and mussel tissue from three sites was analyzed for explosive compounds only. The two reference sites, one near the RIA and one near the PRIA, were selected to provide baseline data for these areas.

Field measurements of specific conductance ranged from 12 to 24 microsiemens per centimeter at 25 degrees Celsius in streams near the RIA. The streams were acidic and low in buffering capacity, with pH measurements ranging from 5.0 to 6.6. Alkalinity ranged from 0.3 to 5.5 mg/L (milligrams per liter). Total dissolved solids concentrations ranged from 15 to 78 mg/L. Major inorganic ions were the primary constituents of dissolved solids in the water samples. The highest cation concentration was E3.3J mg/L (E, estimated; J, method blank contamination) for sodium, and the highest anion concentration was 7.3 mg/L for chloride. Field measurements and major inorganic ion concentrations were similar to those for the RIA reference site and previously sampled nearby streams, indicating streams near the RIA were typical of streams near the eastern part of the Main Post.

Field measurements of specific conductance ranged from 20 to 66 microsiemens per centimeter at 25 degrees Celsius in streams near the PRIA. The streams were slightly acidic to neutral and low in buffering capacity, with pH measurements ranging from 5.7 to 6.9. Alkalinity ranged from 2.8 to 13.5 mg/L as calcium carbonate. Total dissolved solids concentrations ranged from 59 to 115 mg/L. The highest cation concentration was low, 6.2 mg/L for sodium, and the highest anion concentration also was low, 16 mg/L for bicarbonate (calculated). Water-quality data indicated most physicochemical properties and constituents in streams near the PRIA were higher than in streams near the RIA, but typical of streams near the headwaters of the Calcasieu River. All concentrations of sulfate, chloride, and fluoride were less than USEPA

Secondary Drinking-Water Regulations (SDWR) of 250, 250, and 2.0 mg/L, respectively.

Concentrations of cations calcium, magnesium, and potassium were much higher in depositional bed-sediment samples than in bulk samples. Clay and organic content were higher in depositional samples than in the bulk samples. Higher cation concentrations likely were due to higher clay and organic content in the depositional samples. Clay and organic particles typically have negative surface charges, which allow the colloidal surfaces to adsorb and exchange cations. Therefore, higher cation concentrations were expected in the depositional samples.

The maximum concentration of cyanide in water was E9.5 µg/L (micrograms per liter) at the RIA sites, 11 µg/L at the RIA reference site, 41 µg/L at the PRIA sites, and 110 µg/L at the PRIA reference site. Fourteen concentrations at the RIA sites, one at the RIA reference site, four at the PRIA sites, and two at the PRIA reference site exceeded the USEPA Aquatic Life Criteria Criterion Continuous Concentration of 5.2 µg/L, but were less than the USEPA Maximum Contaminant Level Goal (MCLG) and Maximum Contaminant Level (MCL) of 200 µg/L for drinking water. Cyanide was detected in two blank samples; therefore, concentrations of cyanide may be biased high.

All cyanide concentrations in bulk and depositional bed-sediment samples were less than the detection limit or were estimated values except three: 0.71 mg/kg (milligram per kilogram) in a bulk sample at the PRIA reference site, 0.88 mg/kg in a depositional sample at the RIA reference site, and 0.74 mg/kg in a depositional sample at a PRIA site. Concentrations at the RIA and PRIA reference sites were similar to those for the sites near the impact areas, indicating cyanide concentrations at the impact area sites were similar to those at the reference sites.

Perchlorate, a primary ingredient in solid rocket propellant, was detected in one water sample, E14.3 µg/L at an RIA site, and was less than the USEPA Health Advisory Drinking Water Equivalent Level of 24.5 µg/L. All perchlorate concentrations in bed-sediment samples were less than the reporting limits.

The trace elements detected in the highest concentrations in water and bed sediment were aluminum, iron, and manganese. Aluminum concentrations were within the range or greater than the SDWR range from 50 to 200 µg/L, with a maximum concentration of 478 µg/L at the RIA sites and 5,810 µg/L at the PRIA sites. The median concentrations of aluminum in bed sediment were about seven times higher in depositional samples than in bulk samples. Median concentrations of aluminum were 824 mg/kg in RIA bulk samples, 5,995 mg/kg in RIA depositional samples, 1,920 mg/kg in PRIA bulk samples, and 13,700 mg/kg in PRIA depositional samples. All but four iron concentrations in water were greater than the SDWR of 300 µg/L, with a maximum of 2,610 µg/L at the RIA sites and 3,920 µg/L at the PRIA sites. Seven of 24 concentrations at the RIA sites and 4 of 9 concentrations at the PRIA sites were greater than the SDWR of 50 µg/L for manganese, with a maximum concentration of 126 µg/L at the RIA sites and 97.6 µg/L at the PRIA sites. These concentrations of cations were consistent with soil characteristics and low pH measurements of stream water and rainfall in the area.

All other trace-element concentrations in water were less than regulatory guidelines and regulations except MCLG's for arsenic, lead, and thallium. Concentrations in 15 samples at the RIA sites and 9 samples at the PRIA sites were greater than the MCLG of 0 µg/L for arsenic; however, no concentrations exceeded the MCL of 10 µg/L. Concentrations in 23 samples at the RIA sites and 9 samples at the PRIA sites were greater than the MCLG of 0 µg/L for lead; however, no concentrations exceeded the MCL of 15 µg/L. One concentration at RIA reference site 10, four concentrations at the PRIA sites, and one concentration at the PRIA reference site exceeded the MCLG of 0.5 µg/L for thallium; however, no concentrations exceeded the MCL of 2 µg/L. Arsenic, lead, and thallium concentrations were similar to those detected in blank samples or those reported for reference sites.

The Canadian Council of Ministers of the Environment (CCME) has established bed-sediment guidelines for seven trace elements: arsenic, cadmium, chromium, copper, lead, mercury, and zinc. No concentrations exceeded the CCME Probable Effect Level, and only one arsenic concentration of 8.87 mg/kg, in a depositional sample from one of the RIA sites, exceeded the CCME Interim Sediment Quality Guideline of 5.9 mg/kg.

Total organic carbon and nutrient concentrations were low in water and high in bed sediment. The median concentrations of total organic carbon were 5.3 mg/L at the RIA sites and 4.0 mg/L at the PRIA sites, and both concentrations were less than the average dissolved organic carbon concentration of 5.75 mg/L for all world rivers. The median total organic carbon concentrations in bed sediments were 2,850 mg/kg in RIA bulk samples, E980 mg/kg in PRIA bulk samples, 6,750 mg/kg in RIA depositional samples, and 4,400 mg/kg in PRIA depositional samples. All detected nutrient concentrations in water were less than USEPA guidelines and regulations. The largest nutrient concentrations in water and bed-sediment samples were total organic nitrogen measured as total Kjeldahl nitrogen; they included a maximum concentration of 0.53 mg/L in water at the RIA sites, E0.38 mg/L in water at the PRIA sites, 294 mg/kg in bulk bed sediment, and 1,740 mg/kg in depositional bed sediment.

Only 17 concentrations of explosive compounds were detected in water (including one replicate sample), all at estimated concentrations, among the over 800 analyses reported. Four explosive compounds, 1,3,5-trinitrobenzene, 2,4,6-trinitrotoluene, RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine), and tetryl, were detected at seven of the nine sites near the RIA. Concentrations of explosive compounds detected ranged from E0.02 to E0.14 µg/L. The most frequently detected compound, RDX, was detected in 10 water samples from 5 RIA sites. Concentrations of explosive compounds were less than the USEPA Health Advisories available for reference. No

explosive compounds were detected at the RIA reference site, the PRIA sites, or PRIA reference site.

Only one explosive compound, HMX (octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine), was detected in bulk and depositional bed-sediment samples among the more than 1,800 analyses reported (including replicate environmental samples). The HMX was detected six times, three of which were at estimated concentrations and two of which were replicate samples. The compound was detected only at PRIA sites. The maximum HMX concentration, 0.200 mg/kg, was detected twice, once each in a bulk and depositional sample. One concentration, 0.120 mg/kg, was detected at the PRIA reference site, which could be an indication that this site is susceptible to contamination from past military training activities, or which could be a false positive identification of HMX by laboratory procedures. Field contamination is less likely to have caused the detection of HMX at the PRIA reference site due to ultra-clean sampling and handling procedures.

Explosive compounds were not detected in tissue of freshwater mussels, *Corbicula fluminea*, collected from Alligator Lake. One explosive compound, nitroglycerin, was detected in the tissue of transplanted mussels at each of the three sites near the RIA: E0.38 mg/kg at site 1, E0.46 mg/kg at site 5, and E0.20 mg/kg at site 6. This compound also was detected in the replicate environmental sample at site 5, E0.19 mg/kg. These findings were similar to a previous study of mussel tissue, which indicated that mussels near the Reservation were capable of uptaking explosive compounds but at very low concentrations and with few compounds detected.

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Appendixes 1–14

Appendix 1. Physicochemical properties of selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana 2001–02.

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; °C, degrees Celsius; mg/L, milligrams per liter; $CaCO_3$, calcium carbonate]

Site number (figs. 2, 3)	Sample date	Sample time	Specific conductance (µS/cm)	pH (standard units)	Water temperature (°C)	Turbidity (nephelometric turbidity units)	Alkalinity, incremental titration, field (mg/L as $CaCO_3$)
Sites near the Redleg impact area							
1	6–28–2001	1000	21	5.7	21.8	21.5	1.1
1	1–10–2002	1500	15	6.0	11.7	8.7	1.8
1	6–24–2002	1400	20	6.2	22.5	5.9	3.5
2	6–26–2001	1400	18	5.5	23.1	4.4	1.3
2	1–9–2002	1300	12	5.8	9.0	4.3	1.0
2	6–25–2002	1200	21	5.6	22.2	8.4	2.7
3	6–26–2001	1200	20	5.1	21.7	1.6	1.5
3	1–9–2002	0900	15	5.0	9.0	1.3	1.7
3	6–25–2002	1300	24	5.1	21.9	4.3	1.7
4	6–25–2001	1030	19	5.6	21.1	20.7	2.0
4	1–11–2002	0800	15	6.6	12.4	10.1	2.0
4	6–25–2002	0900	21	6.1	21.7	14.8	5.5
5	7–9–2001	0900	20	5.8	25.5	11.4	3.8
5	1–10–2002	0900	16	5.7	9.6	14.3	3.5
5	6–24–2002	1200	23	5.6	25.4	5.9	4.5
6	7–10–2001	0800	21	5.9	23.7	14.1	1.5
6	1–10–2002	1100	14	5.6	11.5	8.4	1.5
6	6–26–2002	1300	19	6.3	21.9	5.3	1.4
8	6–25–2001	1700	22	5.4	22.5	8.2	.3
8	1–11–2002	1200	17	5.4	12.5	5.5	1.4
8	6–26–2002	1100	23	5.5	22.6	6.0	.4

Appendix 1. Physicochemical properties of selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana 2001–02.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; °C, degrees Celsius; mg/L, milligrams per liter; $CaCO_3$, calcium carbonate]

Site number (figs. 2, 3)	Sample date	Sample time	Specific conductance (µS/cm)	pH (standard units)	Water temperature (°C)	Turbidity (nephelometric turbidity units)	Alkalinity, incremental titration, field (mg/L as $CaCO_3$)
Sites near the Redleg impact area—Continued							
9	6–25–2001	1430	19	5.6	22.4	11.5	2.3
9	1–11–2002	1100	13	6.1	29.4	8.4	2.2
9	6–26–2002	1000	19	6.3	21.7	8.8	2.8
10	6–26–2001	0900	28	6.1	21.8	31.1	4.5
10	1–9–2002	1500	19	5.9	10.4	17.3	2.5
10	6–25–2002	0800	26	6.4	22.1	30.6	6.0
Sites near Peason Ridge impact areas							
11	6–27–2001	1000	22	6.2	21.6	13.6	2.8
11	1–14–2002	1600	20	6.4	8.3	18.4	3.1
11	7–1–2002	1000	26	5.8	24.6	49.0	3.7
12	6–28–2001	1500	43	6.4	26.7	26.9	6.3
12	1–14–2002	1330	32	6.9	6.4	34.5	5.8
12	7–1–2002	1500	56	6.3	27.6	15.6	11.6
13	6–27–2001	1300	66	6.2	23.9	30.4	13.5
13	1–14–2002	1400	26	6.7	6.9	29.6	3.9
13	7–1–2002	1400	47	5.7	24.3	126	11.7
14	6–27–2001	1630	34	6.8	26.6	25.5	6.5
14	1–15–2002	0800	20	7.2	5.4	22.6	6.8
14	7–2–2002	0900	46	7.1	24.5	18.8	8.1

Appendix 2. Concentrations of total dissolved solids, total suspended solids, and major inorganic ions in water from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.

[All analyses were done by Severn Trent Laboratory. U.S. Environmental Protection Agency (2005a) methods are in parentheses. Concentrations are in milligrams per liter. ROE, residue on evaporation; °C, degrees Celsius; E, estimated; <, less than; Rep, replicate environmental sample; ---, no data; Blk, field blank, organic-free blank-water sample; J, method blank contamination; Q, elevated reporting limit]

Site number (figs. 2, 3)	Sample date	Sample time	Total dissolved solids, ROE at 180 °C (160.1)	Total suspended solids, ROE at 180 °C (160.2)	Calcium, as Ca (200.7)	Magnesium, as Mg (200.7)	Sodium, as Na (200.7)	Potassium, as K (200.7)	Bicarbonate, as HCO_3 (calculated)	Sulfate, as SO_4 (300.0A)	Chloride, as Cl (300.0A)	Fluoride, as F (300.0A)	Silica, as Si (200.7)
Sites near the Redleg impact area													
1	6–28–2001	1000	78	8.8	0.9	0.4	<5.0	<3.0	1.3	E1.0	3.3	E0.13	9.4
1 Rep	6–28–2001	1001	66	8	1	.4	<5.0	E.4	---	E1.6	3.2	E.12	8.5
1 Blk	6–28–2001	1005	<10.0	<4.0	<.2	<.2	<5.0	E.8	---	<5.0	<3.0	<1.0	<3.0
1	1–10–2002	1500	35	<4.0	.7	.4	E2.5	E.9J	2.2	E1.4	3.0J	<1.0	10.2J
1	6–24–2002	1400	15	E2.0	1	.5	E2.2J	E1.0J	4.3	E.8	3.1	E.1	11.2J
2	6–26–2001	1400	47	E2.8	.7	.4	<5.0	E.4	1.6	E.7	E2.9	E.1	8.6
2	1–9–2002	1300	26	<4.0	.4	.3	<5.0	<3.0	1.4	E1.4	E2.7J	<1.0	8.4J
2 Rep	1–9–2002	1301	20	4.2	.4	.3	<5.0	<3.0	---	E1.5	E2.7J	<1.0	8.2J
2	6–25–2002	1200	36	<4.0	1	.5	E2.4J	<3.0	3.3	E1.8	3.2J	<1.0	10.7J
3	6–26–2001	1200	42	<4.0	.4	.3	<5.0	<3.0	1.8	E.8	3.5	E.1	8.1
3	1–9–2002	0900	20	<4.0	.4	.4	E2.6	E.9J	2.1	E1.7	3.2J	<1.0	9.0J
3	6–25–2002	1300	34	<4.0	.7	.6	E2.2J	E.7J	2.1	E1.8	3.8J	<1.0	10.8J
4	6–25–2001	1030	62	6.4	1	.4	<5.0	E1.1	2.4	E.7	7.3	<1.0	10
4	1–11–2002	0800	33	<4.0	.8	.4	<5.0	E.7J	2.4	E1.4	E2.9	E.2	10.1J
4	6–25–2002	0900	22	E3.0	1.2	.5	E2.1J	E1.0J	6.7	E1.4	3.0J	E.1	11.4J
5	7–9–2001	0900	59	E3.2	1.7	.7	E3.2	E1.7	4.7	E.9	3.4	E.1	8.5
5	1–10–2002	0900	38	4.2	<.2	<.2	<5.0	<3.0	4.4	E1.6	3.3J	<1.0	E.1J
5 Blk	1–10–2002	0905	<10	<4.0	.9	.5	E3.6	E1.2J	---	<5.0	E.8J	<1.0	9.2J
5	6–24–2002	1200	33	E3.2	1.2	.5	E2.1J	E.7J	5.5	E1.7	3.2	E.13	8.1J
5 Rep	6–24–2002	1201	30	<4.0	1.2	.5	E2.6J	E1.0J	---	E.8	3.3	<1.0	8.2J
6	7–10–2001	0800	52	2.6	1	.5	E3.1	E1.6	1.8	E.8	3	E.1	13.8
6	1–10–2002	1100	29	9	.7	.4	E2.2	E1.1J	1.8	E1.5	E2.8J	<1.0	10.6J
6	6–26–2002	1300	41	<4.0	1	.4	E1.9J	E1.0J	1.7	E1.0	E2.9	<1.0	13.7J
8	6–25–2001	1700	59	E2.0	.7	.5	<5.0	E.3	.4	E.9	3.7	E.1	9.6
8	1–11–2002	1200	36	<4.0	.6	.5	<5.0	E.5J	1.7	E1.6	3.6	E.2	9.6J
8	6–26–2002	1100	16	E3.2	.8	.6	E3.3J	E.8J	.5	E1.2	3.9	E.2	11.7J

Appendix 2. Concentrations of total dissolved solids, total suspended solids, and major inorganic ions in water from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.—Continued

[All analyses were done by Severn Trent Laboratory. U.S. Environmental Protection Agency (2005a) methods are in parentheses. Concentrations are in milligrams per liter. ROE, residue on evaporation; °C, degrees Celsius; E, estimated; <, less than; Rep, replicate environmental sample; ---, no data; Blk, field blank, organic-free blank-water sample; J, method blank contamination; Q, elevated reporting limit]

Site number (figs. 2, 3)	Sample date	Sample time	Total dissolved solids, ROE at 180 °C (160.1)	Total suspended solids, ROE at 180 °C (160.2)	Calcium, as Ca (200.7)	Magnesium, as Mg (200.7)	Sodium, as Na (200.7)	Potassium, as K (200.7)	Bicarbonate, as HCO_3 (calculated)	Sulfate, as SO_4 (300.0A)	Chloride, as Cl (300.0A)	Fluoride, as F (300.0A)	Silica, as Si (200.7)
Sites near the Redleg impact area—Continued													
9	6–25–2001	1430	56	4	0.8	0.4	<5.0	E0.2	2.8	E0.7	E2.9	E0.1	9.8
9	1–11–2002	1100	32	<4.0	.7	.3	E2.1	E1.1J	2.7	<5.0	E.8	<1.0	1.0J
9	6–26–2002	1000	31	<4.0	1	.5	E2.4J	E1.1J	3.4	E1.0	E2.9	E.1	12.7J
10	6–26–2001	0900	56	6.4	1.5	.7	<5.0	E.9	5.6	E1.2	3.7	E.1	9.3
10	1–9–2002	1500	40	<4.0	1.1	.6	<5.0	E.6J	3	E1.9	3.6J	E.2	1.1J
10	6–25–2002	0800	26	6.8	1.5	.7	E2.6J	E.8J	7.3	E.8	3.3J	E.2	1.1J
Sites near Peason Ridge impact areas													
11	6–27–2001	1000	59	E3.2	.7	.3	<5.0	1	3.4	E1.2	3	E.1	21.1
11	1–14–2002	1600	67	<4.0	.9	.4	E3.3	E.7	3.8	E2.6	3.3	E.2	21
11	7–1–2002	1000	75	E6.0	.7	.3	E1.8	E.7	4.5	E1.6	E2.6	E.1	17.8J
11 Rep	7–1–2002	1001	70	E9.0	.7	.3	E2.0	E1.1	---	E1.6	E2.6	E.1	17.7J
11 Blk	7–1–2002	1005	E5.0	<4.0	<.2	<.2	<5	<3	---	<5.0	E.8	<1.0	E.1J
12	6–28–2001	1500	103	E1.6	1.6	.6	E1.9	E1.0	7.6	5.4	4.4	E.1	34.8
12	1–14–2002	1330	84	4	1.8	.7	E4.5	E1.4	7.1	E4.1	4.6	E.2	22.6
12 Rep	1–14–2002	1331	97	E2.8	1.8	.7	E3.7	E1.2	---	E4.2	4.6	E.2	22.3
12	7–1–2002	1500	91	<10.0	1.6	.6	6.2	E.9	14	5.2	4.3	<1.0	42.2J
13	6–27–2001	1300	78	29.6	3.5	1.3	E2.8	E2.3	16	E3.9	6.1	E.2	27.8
13 Rep	6–27–2001	1301	107	26	3.5	1.3	E4.0	E2.5	---	E3.9	6.1	E.2	27.9
13	1–14–2002	1400	81	E2.2	1.1	.4	E3.6	E.7	4.8	E4.1	3.4	E.2	26.2
13	7–1–2002	1400	115	134Q	2.3	.9	E3.6	E1.8	14	E2.3	3.6	E.1	19.3J
14	6–27–2001	1630	100	E1.6	1.7	.6	E3.4	E1.6	7.9	5.3	4	E.1	39.4
14	1–15–2002	0800	84	E2.6	1.7	.6	E4.6	E.7	8.3	E4.9	3.4	E.2	32.1
14	7–2–2002	0900	4.1J	8.8	E.2	E4.0	---	5	9.9	---	.6	E1.2	42.1J

Appendix 3. Concentrations of major inorganic ions in bulk bed sediment from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.

[All analyses were done by Severn Trent Laboratory. U.S. Environmental Protection Agency (2005a) methods are in parentheses. Concentrations are in milligrams per kilogram. <, less than; E, estimated value; Rep, replicate environmental sample; J, method blank contamination]

Site number (figs. 2, 3)	Sample date	Calcium, as Ca (6010B)	Magnesium, as Mg (6010B)	Sodium, as Na (6010B)	Potassium, as K (6010B)	Sulfate, as SO_4 (9056)	Chloride, as Cl (9056)	Fluoride, as F (9056)
Sites near the Redleg impact area								
1	6–28–01	52	28.5	<615	<369	<61.5	E17.4	<12.3
1 Rep	6–28–01	53.8	27.2	<616	E87	<61.6	E17.4	<12.3
1	1–10–02	63.0J	E17.9	<669	<401	<66.9	E18.1J	<13.4
1	6–24–02	29.3	E24.5	<663	<398	E24.9J	E27.4J	<13.3
2	6–26–01	146	52.8	E215	<392	<65.3	E18.2	<13.1
2	1–09–02	185J	60.5	<810	<486	<81.0	E34.5J	<16.2
2 Rep	1–09–02	195J	61.3	<716	<429	<71.6	E31.1J	<14.3
2	6–25–02	124	67.5	E135	E113	E13.0	E21.9	<14.3
3	6–26–01	E23.9	E17.8	E355	E121	<65.8	E18.0	<13.2
3	1–09–02	32.9J	E10.4	<656	<394	E6.6	82.8J	<13.1
3	6–25–02	E18.9	E18.9	<651	E46.0	<65.1	E32.2	<13.0
4	6–25–01	30	35.2	E160	E82.6	<59.1	E17.0	<11.8
4	1–11–02	61.8J	E16.3	<626	<376	<62.6	E16.0J	<12.5
4	6–25–02	E20.6	E14.6	<646	E59.5	<64.6	E24.1	<12.9
5	7–09–01	56.8	88.9	E169	E185	<64.4	E16.8	<12.9
5	1–10–02	85.7J	80.4	<666	E136	<66.6	E20.8J	<13.3
5	6–24–02	E10.1	26.7	<636	E60.1	<63.6	E13.7J	<12.7
5 Rep	6–24–02	E12.2	26.9	<633	E46.5	<63.3	E13.7J	<12.7
6	7–10–01	42.9	E18.8	<669	E113	<66.9	E18.5	<13.4
6	1–10–02	36.7J	E11.3	<650	<390	<65.0	E19.3J	<13.0
6	6–26–02	E25.5	26.6J	<656	<394	<65.6	E26.6	<13.1
8	6–25–01	57.1	44.4	<624	E81.2	<62.4	E19.4	<12.5
8	1–11–02	75.2J	40.2	<655	<393	E8.7	E21.5J	<13.1

Appendix 3. Concentrations of major inorganic ions in bulk bed sediment from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.—Continued

[All analyses were done by Severn Trent Laboratory. U.S. Environmental Protection Agency (2005a) methods are in parentheses. Concentrations are in milligrams per kilogram. <, less than; E, estimated value; Rep, replicate environmental sample; J, method blank contamination]

Site number (figs. 2, 3)	Sample date	Calcium, as Ca (6010B)	Magnesium, as Mg (6010B)	Sodium, as Na (6010B)	Potassium, as K (6010B)	Sulfate, as SO_4 (9056)	Chloride, as Cl (9056)	Fluoride, as F (9056)
Sites near the Redleg impact area—Continued								
9	6–25–01	E25.8	E17.3	E354	E91.7	<66.3	E19.3	<13.3
9	1–11–02	68.4J	E19.6	<671	<402	E6.5	E17.2J	<13.4
9	6–26–02	42.6	60.6J	<639	<383	<63.9	E26.3	<12.8
10	6–26–01	76.8	187	<688	E155	E5.3	E19.6	<13.8
10	1–09–02	79.2J	37.5	<650	<390	<65.0	E32.1J	<13.0
10	6–25–02	31.6	44.3	<645	E46.6	<64.5	E14.8	<12.9
Sites near Peason Ridge impact areas								
11	6–27–01	63.7	50.4	<620	<372	<62.0	E16.6	<12.4
11	1–14–02	118J	125	<694	E190	<69.4	E23.4J	<13.9
11	7–01–02	122J	117J	<665	E56.9	<66.5	E13.4J	<13.3
11 Rep	7–01–02	104J	106J	<662	<397	<66.2	E13.4J	<13.2
12	6–28–01	67.5	48.3	<621	E84.8	<62.1	E15.7	<12.4
12	1–14–02	113J	78.7	<642	E132	<64.2	E16.9J	<12.8
12 Rep	1–14–02	53.9J	34.9	<636	<381	E6.7	E12.7J	<12.7
12	7–01–02	46.0J	42.0J	<638	<383	<63.8	E15.4J	<12.8
13	6–27–01	173	172	<626	E197	<62.6	E17.5	E2.7
13 Rep	6–27–01	144	133	<625	E170	<62.5	E17.7	E2.5
13	1–14–02	81.9J	41.4	<636	E122	<63.6	50.1J	<12.7
13	7–01–02	258J	297J	<649	E153	E7.8	E19.4J	<13.0
14	6–27–01	146	112	<597	E108	<59.7	E16.1	E2.3
14	1–15–02	155J	83.1	<641	E131	<64.1	E16.3J	<12.8
14	7–02–02	125	111	<634	E56.1	<63.4	E22.6J	<12.7

Appendix 4. Concentrations of major inorganic ions in depositional bed sediment from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.

[All analyses were done by Severn Trent Laboratory. U.S. Environmental Protection Agency (2005a) methods are in parentheses. Concentrations are in milligrams per kilogram. <, less than; E, estimated value; Rep, replicate environmental sample; J, method blank contamination]

Site number (figs. 2, 3)	Sample date	Calcium, as Ca (6010B)	Magnesium, as Mg (6010B)	Sodium, as Na (6010B)	Potassium, as K (6010B)	Sulfate, as SO_4 (9056)	Chloride, as Cl (9056)	Fluoride, as F (9056)
Sites near the Redleg impact area								
1	6–28–01	290	388	<1,020	E472	E10.4	E37.0	<20.4
1 Rep	6–28–01	146	218	E231	E272	E7.4	E26.9	<15.5
1	1–10–02	153J	198	<692	E171	<69.2	E33.0J	<13.8
1	6–24–02	143	309	<719	E240	E9.6J	E15.6J	<14.4
2	6–26–01	70.9	126	E322	E124	<61.3	E16.7	<12.3
2	1–09–02	113J	81.8	<666	E115	<66.6	E32.8J	<13.3
2 Rep	1–09–02	87.6J	66.4	<644	<386	<64.4	E34.3J	<12.9
2	6–25–02	166	208	<841	E223	E10.2	55.1	<16.8
3	6–26–01	81.7	256	E370	E174	<73.0	E21.5	E2.8
3	1–09–02	67.7J	97.2	<759	E116	<75.9	E43.1J	<15.2
3	6–25–02	62.8	184	<881	E242	E12.0	163	E2.3
4	6–25–01	116	226	<618	E270	E5.9	E18.1	<12.4
4	1–11–02	136J	204	<658	E156	<65.8	41.9J	<13.2
4	6–25–02	41.7	211	E84.9	E192	E9.1	38.4	<12.6
5	7–09–01	130	245	E202	E312	<67.3	E17.4	<13.5
5	1–10–02	132J	177	<637	E184	<63.7	E32.9J	<12.7
5	6–24–02	190	297	<700	E309	E0.10J	E16.6J	E1.9
5 Rep	6–24–02	E11.8	E27.8	<738	<443	<73.8	E15.6J	<14.8
6	7–10–01	74.7	86.3	<792	E161	<79.2	E21.2	E3.0
6	1–10–02	120J	151	<672	E144	<67.2	48.4J	<13.4
6	6–26–02	113	189J	<716	E162	<71.6	57	<14.3
8	6–25–01	227	564	E194	E394	E6.0	E20.3	E2.7
8	1–11–02	214J	438	<706	E366	<70.6	E37.6J	<14.1
8	6–26–02	92.8	128J	<688	E105	<68.8	77.2	<13.8

Appendix 4. Concentrations of major inorganic ions in depositional bed sediment from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.—Continued

[All analyses were done by Severn Trent Laboratory. U.S. Environmental Protection Agency (2005a) methods are in parentheses. Concentrations are in milligrams per kilogram. <, less than; E, estimated value; Rep, replicate environmental sample; J, method blank contamination]

Site number (figs. 2, 3)	Sample date	Calcium, as Ca (6010B)	Magnesium, as Mg (6010B)	Sodium, as Na (6010B)	Potassium, as K (6010B)	Sulfate, as SO_4 (9056)	Chloride, as Cl (9056)	Fluoride, as F (9056)
Sites near the Redleg impact area—Continued								
9	6–25–01	109	158	<605	E189	<60.5	41	<12.1
9	1–11–02	403J	369	<740	E243	<74.0	64.5J	<14.8
9	6–26–02	180	684J	<680	426	E8.4	88	<13.6
10	6–26–01	334	637	<737	E356	E4.9	E20.8	E2.9
10	1–09–02	199J	280	<663	E179	<66.3	49.2J	<13.3
10	6–25–02	231	461	<669	E292	<66.9	E22.3	E1.7
Sites near Peason Ridge impact areas								
11	6–27–01	935	653	E211	E369	E5.9	E20.3	E2.6
11	1–14–02	632J	767	<838	E497	E8.3	52.7J	<16.8
11	7–01–02	907J	1,120J	<985	624	E13.1	E21.5J	E2.6
11 Rep	7–01–02	829J	1,060J	<927	586	E13.6	E21.0J	<18.5
12	6–28–01	1,670	1,390	<736	1,030	<73.6	E27.3	E3.8
12	1–14–02	997J	942	<715	592	<71.5	E39.9J	<14.3
12 Rep	1–14–02	1,200J	1,100	<763	632	<76.3	E27.7J	<15.3
12	7–01–02	1,350J	1,290J	<801	808	10.4	E28.6J	E2.3
13	6–27–01	1,790	1,660	<686	1,100	<68.6	E23.2	E5.6
13 Rep	6–27–01	937	849	E194	693	<60.4	E18.7	E3.9
13	1–14–02	952J	857	<715	614	E6.9	68.2J	<14.3
13	7–01–02	1,690J	1,640J	<777	846	E10.1	E25.4J	E2.3
14	6–27–01	1,050	814	<684	642	<68.4	E24.7	E3.0
14	1–15–02	499J	403	<721	E349	E10.1	E39.3J	<14.4
14	7–02–02	657	582	<664	E389	E19.7	E14.6J	E2.0

Appendix 5. Concentrations of cyanide, perchlorate, and trace elements in water from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.

[U.S. Environmental Protection Agency (2005a) methods are in parentheses; if two methods are listed, the first method was used for 2001 samples, and the second method was used for 2002 samples. Concentrations are in micrograms per liter. E, estimated; <, less than; Rep, replicate environmental sample; Blk, field blank, organic-free blank-water sample; STL, Severn Trent Laboratory; J, method blank contamination; --, no data]

Site number (figs. 2, 3)	Sample date	Labora-tory	Cyanide (335.2)	Perchlorate (314)	Aluminum, as Al (1638/200.7)	Antimony, as Sb (1638/200.8)	Arsenic, as As (1638/200.8)	Barium, as Ba (1638/200.8)	Beryllium, as Be (1638/200.8)	Cadmium, as Cd (1638/200.8)	Chromium, as Cr (1638/200.8)	Cobalt, as Co (1638/200.8)	Copper, as Cu (1638/200.8)	Iron, as Fe (1638/200.7)
Sites near the Redleg impact area														
1	6–28–01	Frontier	E5.3	<20	335	0.029	0.646	33.8	0.092	0.028	0.464	0.750	0.767	1,420
1 Rep	6–28–01	Frontier	E3.2	<20	368	.036	.527	37.8	.102	.037	.409	.744	.865	1,180
1 Blk	6–28–01	Frontier	E2.4	<20	<.4	<. 002	<.050	<.013	<.002	<.002	<.040	<.040	<.010	<2.60
1	1–10–02	STL	E5.7	<20	213	E.260	E.380J	21.0	<1.00	<1.00	E1.00J	E.360	E.540	478
1	6–24–02	STL	E4.1	<20	172	E.270J	E.840	26.5	<1.00	<1.00	E1.70	E.540	E.570	1,190
2	6–26–01	Frontier	E8.0	<20	273	.024	.572	3.20	.074	.027	.337	.745	.814	1,240
2	1–09–02	STL	E6.6	<20	131	<2.00	<5.00	16.3	<1.00	<1.00	E1.10J	E.320	E.460	242
2 Rep	1–09–02	STL	E4.9	<20	158	E.210	E.230J	16.6	<1.00	<1.00	E1.20J	E.360	E.640	255
2	6–25–02	STL	E4.6	<20	257	E.150J	<5.00	34.0	<1.00	E.033	E1.90	E.730	E1.30	761
3	6–26–01	Frontier	E8.0	<20	188	.019	.240	19.7	.042	.012	.221	.611	.175	338
3	1–09–02	STL	E5.7	<20	130	<2.00	<5.00	17.8	<1.00	<1.00	E1.10J	E.430	E1.10	127
3	6–25–02	STL	<10	<20	216	E.130J	<5.00	29.8	<1.00	E.027	E1.80	E.660	E.30	273
4	6–25–01	Frontier	E7.9	<20	400	.049	.504	32.2	.088	.020	.457	.593	1.73	978
4	1–11–02	STL	E3.2	<20	254	E.290	E.240J	19.5	<1.00	<1.00	E.830J	E.250	E.890	524
4	6–25–02	STL	E2.7	<20	478	E.120J	E.580	3.5	<1.00	<1.00	E1.80	E.590	E.780	891
5	7–09–01	Frontier	E5.2	E14.3	296	.034	1.17	31.9	.052	.037	.660	--	--	2,610
5	1–10–02	STL	E4.9	<20	372	E.210	E.340J	2.90	<1.00	<1.00	E1.20J	E.270	E.470	671
5 Blk	1–10–02	STL	E7.9	<20	<50	<2.00	<5.00	<1.00	<1.00	<1.00	E.720J	<1.00	<2.00	E5.20
5	6–24–02	STL	E9.5	<20	207	E.580J	E1.20	30.3	<1.00	<1.00	2.90	1.40	E.690	2,270
5 Rep	6–24–02	STL	<10	<20	220	E.110J	E1.10	29.8	<1.00	E.035	E1.40	1.30	E.650	2,240
6	7–10–01	Frontier	E7.7	<20	213	.021	.630	27.7	.073	.028	.480	.540	.62	1,350
6	1–10–02	STL	E7.0	<20	210	E.340	E.310J	21.2	<1.00	<1.00	E.960J	E.550	E1.00	478
6	6–26–02	STL	<10	<20	171	E.180J	<5.00	27.6	<1.00	<1.00	E1.80	E.430	E.620	781
8	6–25–01	Frontier	E8.3	<20	305	.028	.222	27.0	.097	.018	.385	1.40	.395	612
8	1–11–02	STL	E3.2	<20	161	<2.00	<5.00	21.7	<1.00	<1.00	E1.20J	E.710	E.290	237
8	6–26–02	STL	E9.5	<20	271	E.150J	<5.00	28.7	<1.00	<1.00	E1.70	E.950	E.920	554

Appendix 5. Concentrations of cyanide, perchlorate, and trace elements in water from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.—Continued

[U.S. Environmental Protection Agency (2005a) methods are in parentheses; if two methods are listed, the first method was used for 2001 samples, and the second method was used for 2002 samples. Concentrations are in micrograms per liter. E, estimated; <, less than; Rep, replicate environmental sample; Blk, field blank, organic-free blank-water sample; STL, Severn Trent Laboratory; J, method blank contamination; --, no data]

Site number (figs. 2, 3)	Sample date	Labora-tory	Cyanide (335.2)	Perchlorate (314)	Aluminum, as Al (1638/200.7)	Antimony, as Sb (1638/200.8)	Arsenic, as As (1638/200.8)	Barium, as Ba (1638/200.8)	Beryllium, as Be (1638/200.8)	Cadmium, as Cd (1638/200.8)	Chromium, as Cr (1638/200.8)	Cobalt, as Co (1638/200.8)	Copper, as Cu (1638/200.8)	Iron, as Fe (1638/200.7)
Sites near the Redleg impact area—Continued														
9	6–25–01	Frontier	E7.1	<20	304	0.048	0.272	27.9	0.085	0.020	0.295	0.541	3.13	970
9	1–11–02	STL	E3.4	<20	230	E.220	<5.00	17.6	<1.00	<1.00	E.860J	E.220	E1.50	474
9	6–26–02	STL	<10	<20	202	E.320J	<5.00	21.9	<1.00	<1.00	E1.60	E.330	E1.70	765
10	6–26–01	Frontier	11	<20	457	.035	.467	33.0	.087	.010	.346	1.07	.586	1,870
10	1–09–02	STL	E4.4	<20	552	E.270	E.260J	27.2	<1.00	<1.00	E1.30J	1.10	E.960	902
10	6–25–02	STL	<10	<20	869	E.310J	E1.10	25.9	<1.00	<1.00	2.00	E.980	E.530	2,100
Sites near Peason Ridge impact areas														
11	6–27–01	Frontier	41	<20	353	.019	.318	27.5	.053	.008	.206	.248	.464	440
11	1–14–02	STL	E7.7	<20	751	<2.00	E.340	38.2J	E.240	<1.00	E1.40J	E.330	E.740	536
11	7–01–02	STL	<10	<20	1,450	E.230J	E1.60	38.7	<1.00	E.038	2.00	E.930	E1.10	1,340
11 Rep	7–01–02	STL	<10	<20	1,420	E.240J	E1.70	39.4	<1.00	E.047	E1.90	E.900	E1.10	1,270
11 Blk	7–01–02	STL	<10	<20	<50	E.190J	E.760	E.98 0	<1.00	<1.00	E1.40	E.220	<2.00	<100
12	6–28–01	Frontier	E3.6	<20	1,210	.0381	.720	51.7	.121	.021	.483	.469	.807	532
12	1–14–02	STL	E7.8	<20	1,310	<2.00	E.650	66.2J	<1.00	<1.00	E1.80J	E.330	E.980	796
12 Rep	1–14–02	STL	11	<20	1,320	<2.00	E.560	67.1J	<1.00	<1.00	E1.40J	E.280	E.830	806
12	7–01–02	STL	<10	<20	813	E.270J	E2.60	55.9	<1.00	E.062	E1.80	E.880	E1.20	799
13	6–27–01	Frontier	E4.5	<20	729	.058	3.53	101	.136	.027	.321	.976	.673	1,020
13 Rep	6–27–01	Frontier	E4.6	<20	1,230	.061	3.54	99.0	.131	.025	.589	1.04	.743	1,140
13	1–14–02	STL	E9.6	<20	1,100	E.650J	E.420	45.5	<1.00	<1.00	E1.30J	E.310	E.980	581
13	7–01–02	STL	<10	<20	5,810	E.260J	6.10	128	E.290	E.089	2.10	1.90	2.60	3,920
14	6–27–01	Frontier	11	<20	957	.043	.697	44.4	.132	.007	.413	.264	.562	743
14	1–15–02	STL	<10	<20	806	<2.00	E.450	49.1J	<1.00	<1.00	E1.20J	E.210	E.590	485
14	7–02–02	STL	110J	<20	780	E.240J	E2.00	44.3	E.140	E.039	E1.60	E.430	E.970	603

Appendix 5. Concentrations of cyanide, perchlorate, and trace elements in water from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.—Continued

[U.S. Environmental Protection Agency (2005a) methods are in parentheses; if two methods are listed, the first method was used for 2001 samples, and the second method was used for 2002 samples. Concentrations are in micrograms per liter. E, estimated; <, less than; Rep, replicate environmental sample; Blk, field blank, organic-free blank-water sample; STL, Severn Trent Laboratory; J, method blank contamination; --, no data]

Site number (figs. 2, 3)	Sample date	Laboratory	Lead, as Pb (1638/200.8)	Manganese, as Mn (1638/200.8)	Mercury, as Hg (1631)	Molybdenum, as Mo (1638/200.8)	Nickel, as Ni (1638/200.8)	Selenium, as Se (1638/200.8)	Silver, as Ag (1638/200.8)	Thallium, as Tl (1638/200.8)	Tin, as Sn (1638/200.8)	Vanadium, as V (1638/200.8)	Zinc, as Zn (1638/200.8)
Sites near the Redleg impact area													
1	6–28–01	Frontier	1.01	75.1	0.005	0.026	0.692	0.152	0.004	0.048	<0.090	1.19	2.93
1 Rep	6–28–01	Frontier	.93	79.6	.006	.026	.716	.221	.004	.03	<.090	1.12	3.48
1 Blk	6–28–01	Frontier	<.013	<.020	0	<.010	<.010	<.090	<.002	<.003	<.090	<.010	<.050
1	1–10–02	STL	E.390	34.5J	.002J	<2.00	E.480	<5.00	<1.00	<1.00	<1.00	E1.50	<10.0
1	6–24–02	STL	E.690J	59.9J	.003J	E.100J	E.500J	E.200	<1.00	E.069	<1.00	<5.00	E5.10J
2	6–26–01	Frontier	.562	6.84	E.004	.022	.732	.331	.005	<.025	<.080	.88	3.28
2	1–09–02	STL	<1.00	29.1J	.002	<2.00	E.380	<5.00	<1.00	<1.00	<1.00	E2.10	<10.0
2 Rep	1–09–02	STL	E.280	31.5J	.002J	<2.00	E.720	<5.00	<1.00	<1.00	<10.0	E2.10	E8.10
2	6–25–02	STL	E.560J	69.7J	.004J	E.056J	E.830J	E.250	<1.00	E.051	<1.00	E1.80	E8.50J
3	6–26–01	Frontier	.356	27.1	.002	<.010	.297	.284	.004	<.025	<.080	.612	.996
3	1–09–02	STL	E.320	23.2J	.001	<2.00	E.370	<5.00	<1.00	<1.00	<1.00	E1.70	E8.70
3	6–25–02	STL	E.440J	32.4J	.003J	<2.00	E.450J	<5.00	<1.00	E.046	<1.00	E1.70	E6.90J
4	6–25–01	Frontier	.868	5.67	.004	.023	.755	.234	.004	.046	<.080	1.18	2.96
4	1–11–02	STL	E.390	19.9J	.002	<2.00	E.400	<5.00	<1.00	<1.00	<1.00	E.780	<1.00
4	6–25–02	STL	E.790J	45.3J	.004J	<2.00	E.530J	<5.00	<1.00	E.038	<1.00	E2.00	E4.60J
5	7–09–01	Frontier	.601	126	.005	.03	.82	<.200	.005		<.030	1.34	2.76
5	1–10–02	STL	E.340	2.60J	.002J	<2.00	E.500	<5.00	<1.00	<1.00	<1.00	E2.40	<1.0
5 Blk	1–10–02	STL	<1.00	<1.00	<.001	<2.00	<2.00	<5.00	<1.00	<1.00	<10.0	E1.40	<10.0
5	6–24–02	STL	E.480J	110J	.003J	E.086J	E.640J	<5.00	<1.00	E.059	<1.00	E1.90	E5.00J
5 Rep	6–24–02	STL	E.460J	106J	.003J	E.076J	E.680J	<5.00	<1.00	E.057	<10.0	<5.00	E6.00J
6	7–10–01	Frontier	.565	43.3	.004	.02	.71	<.200	<.003	.021	<.030	.92	2.51
6	1–10–02	STL	1.5	46.4J	.002J	<2.00	5.8	<5.00	<1.00	E.310	<1.00	E2.10	<10.0
6	6–26–02	STL	E.620J	39.5J	.002J	E.130J	E.570J	<5.00	<1.00	E.170	<1.00	<5.00	E6.20J
8	6–25–01	Frontier	.533	65.7	.003	.023	.668	.49	.006	<.025	<.080	.919	2.03
8	1–11–02	STL	E.300	33.6J	.002	<2.00	E.540	<5.00	<1.00	<1.00	<1.00	E1.50	<1.00
8	6–26–02	STL	E.490J	43. 3J	.002J	E.051J	E.650J	E.140	<1.00	E.036	<1.00	<5.00	E4.60J

Appendix 5. Concentrations of cyanide, perchlorate, and trace elements in water from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.—Continued

[U.S. Environmental Protection Agency (2005a) methods are in parentheses; if two methods are listed, the first method was used for 2001 samples, and the second method was used for 2002 samples. Concentrations are in micrograms per liter. E, estimated; <, less than; Rep, replicate environmental sample; Blk, field blank, organic-free blank-water sample; STL, Severn Trent Laboratory; J, method blank contamination; --, no data]

Site number (figs. 2, 3)	Sample date	Laboratory	Lead, as Pb (1638/200.8)	Manganese, as Mn (1638/200.8)	Mercury, as Hg (1631)	Molybdenum, as Mo (1638/200.8)	Nickel, as Ni (1638/200.8)	Selenium, as Se (1638/200.8)	Silver, as Ag (1638/200.8)	Thallium, as Tl (1638/200.8)	Tin, as Sn (1638/200.8)	Vanadium, as V (1638/200.8)	Zinc, as Zn (1638/200.8)
Sites near the Redleg impact area—Continued													
9	6–25–01	Frontier	0.976	51.1	0.004	0.025	0.756	0.341	0.005	<0.025	<0.080	0.911	3.98
9	1–11–02	STL	E.420	21.3J	.002	<2.00	E.490	<5.00	<1.00	<1.00	<1.00	E1.50	<1.00
9	6–26–02	STL	E.900J	3.30J	.002J	E.120J	E.600J	<5.00	<1.00	E.130	E.880	<5.00	E7.50J
10	6–26–01	Frontier	.707	99.2	.004	.023	.955	.318	.004	<.025	<.080	1.57	1.48
10	1–09–02	STL	E.380	77.8J	.003	<2.00	E.870	<5.00	<1.00	<1.00	<1.00	E2.30	E8.50
10	6–25–02	STL	E.840J	85.7J	.004J	E.370J	E.780J	E.160	<1.00	E.600	<1.00	E2.40	E5.90J
Sites near Peason Ridge impact areas													
11	6–27–01	Frontier	.447	24.6	.004	.022	.256	.128	.002	.014	<.090	.744	1.06
11	1–14–02	STL	E.480	32.1J	.004	<2.00	E.480	<5.00	<1.00	E.036J	<1.00	E1.20J	<1.00
11	7–01–02	STL	1.10J	75.9J	.006J	E.340J	E.770J	E.800	E.033	1	<1.00	E2.90	E6.00J
11 Rep	7–01–02	STL	1.10J	74.3J	.007J	E.360J	E.870J	E.810	E.055	1.1	<1.0	E2.20	E7.40J
11 Blk	7–01–02	STL	E.300J	E.330	0	E.370J	E.370J	E.750	<1.00	1.1	<10.0	<5.00	E1.80J
12	6–28–01	Frontier	.743	34.4	.004	.046	.479	.177	.006	.03	<.090	1.51	1.73
12	1–14–02	STL	E.780	17.5J	.004	<2.00	E.680	<5.00	.068E,J	E.032J	<1.00	E2.50J	<1.00
12 Rep	1–14–02	STL	E.710	16.3J	--	<2.00	E.700	<5.00	<1.00	E.027J	<10.0	E2.10J	<10.0
12	7–01–02	STL	1.00J	54.7J	.008J	E.410J	E.910J	E.780	E.026	1.1	<10.0	E2.60	E9.70J
13	6–27–01	Frontier	.972	78.8	.006	.067	.852	.291	.004	.035	<.090	1.8	.437
13 Rep	6–27–01	Frontier	1.06	79.6	.005	.074	.934	.277	.005	.04	<.090	2.29	.862
13	1–14–02	STL	E.700	2.80J	.004	<2.00	E.590	<5.00	<1.00	E.140	<10.0	E1.30	<10.0
13	7–01–02	STL	3.40J	97.6J	.002J	E.400J	E1.70J	E1.00	<1.00	1.2	<10.0	E4.50	12.8J
14	6–27–01	Frontier	.774	11.7	.004	.06	.473	.192	.004	.033	<.090	1.72	.624
14	1–15–02	STL	E.510	11.7J	.003	<2.00	E1.00	<5.00	E.077J	E.200J	<10.0	E2.60J	<10.0
14	7–02–02	STL	1.10J	8.60J	.004J	E.440J	E1.20J	E.980	E.067	1.2	<10.0	E2.50	E6.30J

Appendix 6. Concentrations of cyanide, perchlorate, and trace elements in bulk bed sediment from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana 2001–02.

[U.S. Environmental Protection Agency (2005a) methods are in parentheses; if two methods are listed, the first method was used for 2001 samples, and the second method was used for 2002 samples. Concentrations are in milligrams per kilogram. E, estimated; <, less than; Rep, replicate environmental sample; STL, Severn Trent Laboratory; J, method blank contamination]

Site number (figs. 2, 3)	Sample date	Laboratory	Cyanide[1] (9012A)	Perchlorate[1] (314)	Aluminum, as Al (1638/6010B)	Antimony, as Sb (1638/6020)	Arsenic, as As (1638/6020)	Barium, as Ba (1638/6020)	Beryllium, as Be (1638/6020)	Cadmium, as Cd (1638/6020)	Chromium, as Cr (1638/6020)	Cobalt, as Co (1638/6020)	Copper, as Cu (1638/6020)
Sites near the Redleg impact area													
1	6–28–01	Frontier	E0.26	<0.25	1,870	0.267	1.79	77.2	0.072	0.027	0.889	0.487	1.11
1 Rep	6–28–01	Frontier	<.62	<.25	2,880	.1	1.46	77.6	.092	<.018	1.74	.623	1.34
1	1–10–02	STL	E.22	<.27	3,89J	<.268	E.098	6.87J	E.049	E.015	.840	.384	.493J
1	6–24–02	STL	<.66	<.27	494	E.061J	E.132	6.80J	E.038	E.020	.878J	.628	.456J
2	6–26–01	Frontier	<.65	<.26	1,790	.114	1.63	67.0	.113	.038	1.40	.248	1.42
2	1–09–02	STL	E.32	<.32	10,30J	<.324	E.174	17.4 J	E.089	E.041	1.56	.568	.745J
2 Rep	1–09–02	STL	E.30	<.29	9,66J	<.286	E.159	21.1J	E.121	E.045	1.36	.587	1.03J
2	6–25–02	STL	E.25J	<.29	1,170	E.010J	E.197	19.7J	E.106	E.044	1.77J	.720	.940J
3	6–26–01	Frontier	<.66	<.26	611	<.080	1.30	48.5	.058	<.008	.206	<.180	.724
3	1–09–02	STL	E.42	<.26	2,23J	<.262	<.656	2.72J	<.131	<.131	.538	E.060	E.122J
3	6–25–02	STL	E.16J	<.26	336	E.010J	E.049	4.04J	E.017	E.005	.570J	E.094	E.206J
4	6–25–01	Frontier	<.59	<.24	3,600	.110	1.60	78.2	.100	.013	2.60	.313	1.30
4	1–11–02	STL	E.37	<.25	2,95J	<.251	E.065	3.23J	<.125	<.125	.465	.225	E.184J
4	6–25–02	STL	<.65	<.26	342	E.004J	E.052	2.77J	E.014	E.004	.547J	.218	E.223J
5	7–09–01	Frontier	<.64	<.26	4,290	.225	4.33	41.1	.161	.119	4.02	.840	1.91
5	1–10–02	STL	E.34	<.27	2,510J	<.267	1.44	18.7J	.174	E.023	4.79	.695	2.49J
5	6–24–02	STL	<.64	<.25	799	E.012J	E.283	2.27J	E.017	E.006	2.02J	.169	.356J
5 Rep	6–24–02	STL	E.12	<.25	869	E.016J	2.35	23.5J	.169	E.033	9.54J	2.19	3.87J
6	7–10–01	Frontier	E.42	<.27	1,960	.068	2.93	72.7	<.038	.005	<.300	.420	.470
6	1–10–02	STL	E.26	<.26	230J	<.260	E.113	3.60J	<.130	<.130	.466	.337	.375J
6	6–26–02	STL	E.18	<.26	338J	E.006J	E.094	5.02J	E.028	E.011	.693J	.408	.369J
8	6–25–01	Frontier	<.62	<.25	1,950	<.080	1.72	33.2	.092	.017	4.55	1.39	.993
8	1–11–02	STL	E.58	<.26	850J	<.262	E.510	4.77J	E.048	<.131	2.55	.556	.307J
8	6–26–02	STL	E.23	<.26	376J	E.007J	E.084	5.26J	E.028	E.011	.779J	.422	.565J

Appendix 6. Concentrations of cyanide, perchlorate, and trace elements in bulk bed sediment from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana 2001–02.—Continued

[U.S. Environmental Protection Agency (2005a) methods are in parentheses; if two methods are listed, the first method was used for 2001 samples, and the second method was used for 2002 samples. Concentrations are in milligrams per kilogram. E, estimated; <, less than; Rep, replicate environmental sample; STL, Severn Trent Laboratory; J, method blank contamination]

Site number (figs. 2, 3)	Sample date	Laboratory	Cyanide[1] (9012A)	Perchlorate[1] (314)	Aluminum, as Al (1638/6010B)	Antimony, as Sb (1638/6020)	Arsenic, as As (1638/6020)	Barium, as Ba (1638/6020)	Beryllium, as Be (1638/6020)	Cadmium, as Cd (1638/6020)	Chromium, as Cr (1638/6020)	Cobalt, as Co (1638/6020)	Copper, as Cu (1638/6020)
Sites near the Redleg impact area—Continued													
9	6–25–01	Frontier	E0.59	<0.27	1,480	<0.080	1.71	79.0	0.062	<0.008	0.965	0.202	1.16
9	1–11–02	STL	E.44	<.27	338J	<.268	E.091	5.54J	<.134	E.012	.795	.403	.611J
9	6–26–02	STL	E.14	<.26	1,120J	E.012J	E.536	5.35J	E.069	E.006	1.92J	.922	.494J
10	6–26–01	Frontier	E.46	<.28	4,980	.0866	2.07	60.7	.166	.011	4.98	1.30	1.71
10	1–09–02	STL	E.31	<.26	816J	<.26	E.178	3.81J	<.130	<.130	1.25	.644	.308J
10	6–25–02	STL	E.17J	<.26	1,030	E.006J	E.283	6.11J	E.056	E.010	1.68J	1.05	.551J
Sites near Peason Ridge impact areas													
11	6–27–01	Frontier	<.62	<.25	2,574	.114	1.18	89.0	.060	.013	1.04	<.180	.758
11	1–14–02	STL	E.32	<.28	1,920	<.278	E.226	15.0	E.076	E.021	.976	.488	.689J
11	7–01–02	STL	E.54	<.27	1,710	E.048	E.105	9.14	E.046	E.013	.914J	.252	.428J
11 Rep	7–01–02	STL	E.57	<.26	1,300	<.265	E.086	11.3	E.045	E.009	.771J	.228	.402J
12	6–28–01	Frontier	<.62	<.25	4,950	<.080	1.75	228	.290	.003	2.94	.080	1.08
12	1–14–02	STL	E.28	<.26	765	<.257	E.201	6.38	E.043	<.128	.641	.201	.273J
12 Rep	1–14–02	STL	E.30	<.25	425	<.254	E.185	6.40	E.039	<.127	.581	.188	.258J
12	7–01–02	STL	E.28	<.26	528	<.255	E.148	4.85	E.029	E.002	.573J	E.107	.328J
13	6–27–01	Frontier	<.62	<.25	8,030	<.080	1.54	282	.185	.028	2.60	.491	1.40
13 Rep	6–27–01	Frontier	<.62	<.25	9,270	.113	1.40	208	.208	<.018	1.87	.447	1.25
13	1–14–02	STL	E.26	<.25	512	<.254	E.180	4.43	<.127	<.127	.506	E.113	.540J
13	7–01–02	STL	E.38	<.26	2,700	<.260	E.328	14.6	E.081	E.008	1.19J	.340	.624J
14	6–27–01	Frontier	.71	<.24	5,840	<.080	1.56	187	.186	<.008	2.69	.253	.859
14	1–15–02	STL	E.57	<.26	858	<.256	E.132	4.64	E.038	<.128	.428	.163	E.178J
14	7–02–02	STL	E.26J	<.25	919	<.254	E.303	7.00	E.067	E.003	.900J	.286	.360J

Appendix 6. Concentrations of cyanide, perchlorate, and trace elements in bulk bed sediment from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana 2001–02.—Continued

[U.S. Environmental Protection Agency (2005a) methods are in parentheses; if two methods are listed, the first method was used for 2001 samples, and the second method was used for 2002 samples. Concentrations are in milligrams per kilogram. E, estimated; <, less than; Rep, replicate environmental sample; STL, Severn Trent Laboratory; J, method blank contamination]

Site number (figs. 2, 3)	Sample date	Laboratory	Iron, as Fe (1638/6010B)	Lead, as Pb (1638/6020)	Manganese, as Mn (1638/6020)	Mercury, as Hg (1631/7471A)	Molybdenum, as Mo (1638/6020)	Nickel, as Ni (1638/6020)	Selenium, as Se (1638/6020)	Silver, as Ag (1638/6020)	Thallium, as Tl (1638/6020)	Tin, as Sn (1638/6020)	Vanadium, as V (1638/6020)	Zinc, as Zn (1638/6020)
Sites near the Redleg impact area														
1	6–28–01	Frontier	477	5.6	30.5	0.002	<0.16	0.634	<1.70	0.085	0.079	<0.870	2.33	3.83
1 Rep	6–28–01	Frontier	743	4.94	30.6	.004	<.09	.719	1.75	<.051	.424	.097	2.6	3.35
1	1–10–02	STL	166J	2.41	15.3J	<.044	<.27	.345J	<.669	E.011	E.016	E.558J	1.04	2.32
1	6–24–02	STL	259	2.83J	30.9J	<.044	E.08J	.364J	<.663	E.014	E.026	E1.12J	1.06J	2.34
2	6–26–01	Frontier	597	5.04	19.9	.005	<.16	.669	3.24	<.051	.039	<.870	3.27	4.64
2	1–09–02	STL	354J	3.94	17.6J	E.008	E.04	.589J	<.810	E.015	E.033	E.350J	2.25	4.97
2 Rep	1–09–02	STL	401J	3.93	20.7J	E.008	E.04	.618J	E.102	E.015	E.030	E.329J	2.15	5.29
2	6–25–02	STL	415	4.71J	24.7J	E.009	E.05J	.714J	E.139	E.021	E.039	E.564J	2.68J	4.18
3	6–26–01	Frontier	220	2.59	5.67	.005	<.16	.404	<1.70	<.051	.008	<.870	1.38	1.42
3	1–09–02	STL	88.8J	.948	1.41J	<.043	<.26	.165J	<.656	<.131	E.005	E.592J	E.582	E.903
3	6–25–02	STL	134	1.39J	2.38J	<.043	E.02J	.184J	<.651	E.006	E.007	E1.01J	.717J	E.732
4	6–25–01	Frontier	781	4.61	17.6	.006	<.16	.931	2.16	<.051	.07	<.870	4.28	3.08
4	1–11–02	STL	180J	.899	10.7J	<.041	<.25	.184J	<.626	<.125	E.007	E.582J	E.576	1.65
4	6–25–02	STL	156	1.04 J	7.85J	<.043	E.02J	.203J	<.646	E.008	E.009	E 1.00J	E.543J	2.04
5	7–09–01	Frontier	1,940	4.55	28.5	.002	.28	1.57	<1.39	<.088	.313	.2	4.66	5.36
5	1–10–02	STL	2,330J	4.96	19.0J	.044	E.20	1.70J	E.301	E.025	E.036	E.191J	8.3	5.74
5	6–24–02	STL	672	1.73 J	4.87J	<.042	E.06J	.342J	<.636	E.022	E.006	E.926J	14.7J	8.52
5 Rep	6–24–02	STL	748	7.80J	101J	<.042	.29J	3.23J	E.260	E.050	E.072	E.842J	14.7J	8.52
6	7–10–01	Frontier	260	2.37	17	.002	<.17	.31	<1.39	.112	.041	<.110	<.460	2.04
6	1–10–02	STL	137J	1.7	18.1J	<.043	<.26	.220J	<.650	E.011	E.008	E.651J	E.485	E.974
6	6–26–02	STL	164	2.66J	18.9J	<.043	E.03J	.259J	<.656	E.006	E.012	E.928J	.659J	1.91
8	6–25–01	Frontier	2,810	2.84	65.8	.006	<.16	.745	2.75	<.051	.032	<.870	5.75	2.93
8	1–11–02	STL	1,900J	1.19	13.1J	<.043	E.05	.348J	<.655	<.131	E.011	E.313J	3.66	1.63
8	6–26–02	STL	186	2.24J	2.4J	<.042	E.03J	.274J	<.643	E.014	E.012	E.741J	.837J	3.34

Appendix 6. Concentrations of cyanide, perchlorate, and trace elements in bulk bed sediment from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana 2001–02.—Continued

[U.S. Environmental Protection Agency (2005a) methods are in parentheses; if two methods are listed, the first method was used for 2001 samples, and the second method was used for 2002 samples. Concentrations are in milligrams per kilogram. E, estimated; <, less than; Rep, replicate environmental sample; STL, Severn Trent Laboratory; J, method blank contamination]

Site number (figs. 2, 3)	Sample date	Laboratory	Iron, as Fe (1638/6010B)	Lead, as Pb (1638/6020)	Manganese, as Mn (1638/6020)	Mercury, as Hg (1631/7471A)	Molybdenum, as Mo (1638/6020)	Nickel, as Ni (1638/6020)	Selenium, as Se (1638/6020)	Silver, as Ag (1638/6020)	Thallium, as Tl (1638/6020)	Tin, as Sn (1638/6020)	Vanadium, as V (1638/6020)	Zinc, as Zn (1638/6020)
Sites near the Redleg impact area—Continued														
9	6–25–01	Frontier	445	4.55	19.6	0.003	<0.160	0.405	<1.70	<0.051	0.042	<0.870	1.84	2.44
9	1–11–02	STL	208J	2.6	18.8 J	<.044	<.268	.257J	<.671	E.009	E.015	E.510J	1.02	2.22
9	6–26–02	STL	2,590	1.56J	19.0J	<.042	E.067J	.449J	<.639	E.009	E.016	E.425J	3.24J	2.79
10	6–26–01	Frontier	3,270	4.41	44.4	.004	<.160	1.42	<1.70	<.051	.15	<.870	8.69	5.84
10	1–09–02	STL	1,050J	1.12	25.1J	<.043	<.260	.428J	<.650	<.130	E.011	E.341J	1.66	1.69
10	6–25–02	STL	958	1.41J	34.7J	<.043	E.047J	.704J	<.645	E.009	E.018	E.495J	2.30J	2.2
Sites near Peason Ridge impact areas														
11	6–27–01	Frontier	690	3.4	15.8	<.002	<.160	.509	3.17	<.051	.075	<.870	2.56	2.39
11	1–14–02	STL	859J	2.79	17.8	E.006	<.278	.429J	<.694	E.020J	E.026	<1.39	1.68	3.28
11	7–01–02	STL	713	2.01	10.0J	<.044	E.062	.338J	<.665	E.025J	E.019	E.734J	1.38J	2.08
11 Rep	7–01–02	STL	479	1.76	9.21J	<.044	E.013	.282J	<.662	E.018J	E.015	E.579J	1.12J	1.86
12	6–28–01	Frontier	1,500	6.6	24.9	<.002	<.160	.536	2.28	<.051	.087	<.870	5.08	2.93
12	1–14–02	STL	482J	1.18	6.22	<.042	<.257	.270J	<.642	E.026J	E.011	E.330J	1.32	1.32
12 Rep	1–14–02	STL	287J	1.24	5.71	<.042	<.254	.255J	<.636	E.019J	E.011	E.260J	1.34	1.35
12	7–01–02	STL	318	1.18	3.56J	<.042	E.015	.159J	<.638	E.012J	E.008	E1.03J	1.23J	1.8
13	6–27–01	Frontier	2,410	6.22	19.2	.007	<.160	.969	<1.70	<.051	.131	<.870	6.2	4.93
13 Rep	6–27–01	Frontier	1,740	6.04	13.3	.001	<.090	.798	2.42	<.051	.193	.105	4.67	3.73
13	1–14–02	STL	360J	.978	5.12	<.042	<.254	.143J	<.636	E.013J	E.007	E.311J	.972	E1.15
13	7–01–02	STL	1,610	2.11	8.22J	<.043	E.013	.439J	E.072	E.020J	E.023	E.223J	2.40J	2.6
14	6–27–01	Frontier	1,550	4.86	18	<.002	<.160	.807	<1.70	<.051	.092	<.870	4.45	3.52
14	1–15–02	STL	501J	1.03	5.25	<.042	<.256	.176J	<.641	E.008J	E.010	E.247J	.961	1.34
14	7–02–02	STL	746	1.75	8.75J	<.042	E.016	.285J	<.634	E.020J	E.016	E.536J	2.26J	1.85

[1] Cyanide and perchlorate were analyzed by Severn Trent Laboratory for all sample data listed.

Appendix 7. Concentrations of cyanide, perchlorate, and trace elements in depositional bed sediment from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.

[U.S. Environmental Protection Agency (2005a) methods are in parentheses; if two methods are listed, the first method was used for 2001 samples, and the second method was used for 2002 samples. Concentrations are in milligrams per kilogram. E, estimated; <, less than; Rep, replicate environmental sample; Severn Trent Laboratory; J, method blank contamination]

Site number (figs. 2, 3)	Sample date	Laboratory	Cyanide[1] (9012A)	Perchlorate[1] (314)	Aluminum, as Al (1638/6010B)	Antimony, as Sb (1638/6020)	Arsenic, as As (1638/6020)	Barium, as Ba (1638/6020)	Beryllium, as Be (1638/6020)	Cadmium, as Cd (1638/6020)	Chromium, as Cr (1638/6020)	Cobalt, as Co (1638/6020)	Copper, as Cu (1638/6020)
Sites near the Redleg impact area													
1	6–28–01	Frontier	E0.61	<0.41	15,800	0.489	3.75	216	0.47	0.063	9.78	5.99	5.92
1 Rep	6–28–01	Frontier	<.78	<.31	23,600	.605	4.40	119	.503	.064	15.7	9.29	7.50
1	1–10–02	STL	E.42	<.28	3,770J	<.277	.734	21.8J	E.134	E.025	3.45	3.17	1.11J
1	6–24–02	STL	E.59	<.29	6,040	E.021J	E.709	27.0J	.170	E.033	5.9 9J	3.27	2.02J
2	6–26–01	Frontier	<.61	<.25	5,450	.238	2.52	120	.21	<.008	6	.608	2.53
2	1–09–02	STL	E.30	<.27	1,540	<.266	E.263	12.0J	E.084	E.009	2.06	.553	.770J
2 Rep	1–09–02	STL	E.35	<.26	1,230J	<.258	E.320	11.2J	E.051	E.008	1.98	.535	.859J
2	6–25–02	STL	E.21J	<.34	4,050	E.016J	E.297	19.7J	E.131	E.033	2.74J	1.41	1.02J
3	6–26–01	Frontier	<.73	<.29	6,740	.271	2.49	128	.169	.024	8.15	.35	2.99
3	1–09–02	STL	E.35	<.30	2,310J	<.304	E.447	13.1J	E.093	E.014	2.59	.82	.543J
3	6–25–02	STL	E.33J	<.35	4,290	E.015J	E.587	2.2J	.178	E.032	4.17J	1.72	1.25J
4	6–25–01	Frontier	<.62	<.25	18,200	.627	3.80	327	.412	.014	20.9	1.33	6.69
4	1–11–02	STL	E.50	<.26	4,740J	<.263	E.371	19.3J	.140	E.013	4.84	1.30	1.10J
4	6–25–02	STL	E.22J	<.25	4,690	<.253	E.221	16.0J	.163	E.008	3.80J	.746	.700J
5	7–09–01	Frontier	E.26	<.27	24,100	.301	8.87	123	.167	.032	18.3	1.79	4.31
5	1–10–02	STL	E.43	<.25	5,950J	<.255	1.71	21.6J	E.125	E.029	7.26	1.19	3.15J
5	6–24–02	STL	<.70	<.28	9,700	E.016J	2.37	23.8J	.177	E.035	9.97J	2.48	4J
5 Rep	6–24–02	STL	E.55	<.30	908	E.013J	E.491	3.89J	E.029	E.006	2.95J	.237	.534J
6	7–10–01	Frontier	E.38	<.32	11,500	.222	3.82	232	.213	.028	5.96	1.34	2.31
6	1–10–02	STL	E.34	<.27	3,250J	<.269	1.12	24.6J	.175	E.024	4.29	6.03	1.73J
6	6–26–02	STL	E.36	<.29	3,740J	E.005J	E.490	21.7J	.201	E.031	3.59J	3.06	1.51J
8	6–25–01	Frontier	<.70	<.28	25,900	.467	5.14	205	.747	.010	24.3	4.72	6.90
8	1–11–02	STL	E.61	<.28	8,600J	<.283	1.95	61.5J	.506	E.015	10.7	5.45	3.75J
8	6–26–02	STL	E.20	<.28	2,200J	E.011J	E.526	17.4J	E.111	E.022	2.91J	1.71	1.49J

Appendix 7. Concentrations of cyanide, perchlorate, and trace elements in depositional bed sediment from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.—Continued.

[U.S. Environmental Protection Agency (2005a) methods are in parentheses; if two methods are listed, the first method was used for 2001 samples, and the second method was used for 2002 samples. Concentrations are in milligrams per kilogram. E, estimated; <, less than; Rep, replicate environmental sample; Severn Trent Laboratory; J, method blank contamination]

Site number (figs. 2, 3)	Sample date	Laboratory	Cyanide[1] (9012A)	Perchlorate[1] (314)	Aluminum, as Al (1638/6010B)	Antimony, as Sb (1638/6020)	Arsenic, as As (1638/6020)	Barium, as Ba (1638/6020)	Beryllium, as Be (1638/6020)	Cadmium, as Cd (1638/6020)	Chromium, as Cr (1638/6020)	Cobalt, as Co (1638/6020)	Copper, as Cu (1638/6020)
Sites near the Redleg impact area—Continued													
9	6–25–01	Frontier	<0.60	<0.24	20,400	0.582	3.83	276	0.383	0.02	22.4	2.03	6.34
9	1–11–02	STL	E.57	<.30	7,190J	<.296	1.05	38.7J	.22	E.040	5.28	7.38	3.79J
9	6–26–02	STL	E.41	<.27	12,200J	E.008J	2.32	60.2J	.492	E.016	13.9J	7.17	<2.72
10	6–26–01	Frontier	.88	<.29	23,400	.464	5.05	219	.574	.01	22	4.28	6.55
10	1–09–02	STL	E.27	<.27	5,270J	<.265	1.28	27.1J	.262	E.022	6.34	6.19	2.11J
10	6–25–02	STL	E.14J	<.27	7,690	E.006J	1.16	25.9J	.255	E.023	7.46J	4.47	2.40J
Sites near Peason Ridge impact areas													
11	6–27–01	Frontier	<.66	<.26	13,700	.245	1.44	334	.294	.028	6.04	1.26	2.79
11	1–14–02	STL	E.42	<.34	10,600	<.335	1.28	73.3	.463	E.075	5.8	5.41	3.55J
11	7–01–02	STL	E.77	<.39	16,100	<.394	E.839	60.6	.363	E.063	4.96J	3.15	2.97J
11 Rep	7–01–02	STL	E.53	<.37	15,300	<.371	E.804	57.8	.341	E.062	4.76J	3.01	2.98J
12	6–28–01	Frontier	<.74	<.29	19,800	.466	2.74	375	1.3	.018	21.8	5.39	8.27
12	1–14–02	STL	.74	<.29	9,820	<.286	1.13	96.4	.52	E.035	5.1	2.33	3.02J
12 Rep	1–14–02	STL	.5	<.31	11,700	<.305	1.32	115	.655	E.045	5.22	2.6	3.48J
12	7–01–02	STL	E.16	<.32	9,110	<.320	.83	68.4	.442	E.056	4.36J	2.12	3.03J
13	6–27–01	Frontier	E.38	<.24	37,800	.426	2.24	519	1.69	.033	17.8	4.68	8.46
13 Rep	6–27–01	Frontier	E.36	<.24	38,200	.484	2.94	535	1.31	.037	10.9	3.62	5.67
13	1–14–02	STL	E.40	<.29	6,230	<.286	E.677	49	.345	E.026	3.75	1.7	2.53J
13	7–01–02	STL	E.35	<.31	14,200	<.311	.799	59.2	.393	E.034	3.41J	1.67	2.37J
14	6–27–01	Frontier	E.36	<.27	29,600	.396	2.36	530	1.1	.013	14.5	2.85	5.53
14	1–15–02	STL	E.47	<.29	4,590	<.288	E.550	41.8	.313	E.021	2.54	1.23	1.25J
14	7–02–02	STL	E.38J	<.27	6,720	<.266	.681	79.2	.291	E.016	3.36J	1.43	1.48J

Appendix 7. Concentrations of cyanide, perchlorate, and trace elements in depositional bed sediment from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02—Continued.

[U.S. Environmental Protection Agency (2005a) methods are in parentheses; if two methods are listed, the first method was used for 2001 samples, and the second method was used for 2002 samples. Concentrations are in milligrams per kilogram. E, estimated; <, less than; Rep, replicate environmental sample; Severn Trent Laboratory; J, method blank contamination]

Site number (figs. 2, 3)	Sample date	Laboratory	Iron, as Fe (1638/6010B)	Lead, as Pb (1638/6020)	Manganese, as Mn (1638/6020)	Mercury, as Hg (1631/7471A)	Molybdenum, as Mo (1638/6020)	Nickel, as Ni (1638/6020)	Selenium, as Se (1638/6020)	Silver, as Ag (1638/6020)	Thallium, as Tl (1638/6020)	Tin, as Sn (1638/6020)	Vanadium, as V (1638/6020)	Zinc, as Zn (1638/6020)
Sites near the Redleg impact area														
1	6–28–01	Frontier	5,490	25.0	387	0.027	0.209	3.76	1.99	<0.051	0.310	<0.870	18.1	16.4
1 Rep	6–28–01	Frontier	8,540	28.6	438	.041	.559	5.03	<1.70	<.051	.508	.811	24.2	16.9
1	1–10–02	STL	2,820J	8.21	205J	E.016	E.081	1.16J	E.202	E.032	E.111	E.167J	6.61	5.85
1	6–24–02	STL	3,480	10.8J	167J	E.015	E.136J	1.91J	E.380	E.048	.192	E.267J	11.3J	7.27
2	6–26–01	Frontier	2,260	8.4	32.1	.008	<.160	1.21	<1.70	<.051	.162	<.870	11.2	5.27
2	1–09–02	STL	1,900J	4.14	19.2J	<.044	E.058	.471J	E.147	E.018	E.0573	E.266J	3.84	2.69
2 Rep	1–09–02	STL	1,630J	3.48	19.2J	<.043	E.056	.430J	E.121	E.016	E.0545	E.216J	3.67	2.37
2	6–25–02	STL	2,050	6.66J	45.2J	E.021	E.084J	1.00J	E.197	E.028	E.0728	E.465J	4.55J	4.04
3	6–26–01	Frontier	2,770	8.48	27.0	.026	<.160	1.36	<1.70	<.051	.135	<.870	13.1	5.66
3	1–09–02	STL	1,650J	5.64	20.0J	E.015	E.064	.797J	E.224	E.020	E.058	E.179J	5.34	3.55
3	6–25–02	STL	3,010	9.33J	28.0J	E.028	E.118J	1.52J	E.411	E.036	E.0942	E.406J	7.50J	4.90
4	6–25–01	Frontier	5,890	17.6	83.9	.024	<.160	3.3	2.59	<.051	.4	<.870	24.6	13.6
4	1–11–02	STL	3,370J	6.54	49.1J	E.008	E.082	1.23J	E.231	E.035	E.131	E.098J	10.7	5.62
4	6–25–02	STL	1,580	6.45J	13.5J	E.008	E.063J	1.13J	E.233	E.032	E.106	E.196J	5.84J	3.92
5	7–09–01	Frontier	10,400	6.03	116	.008	.33	3.74	<1.39	<.088	.138	.29	14.7	11.1
5	1–10–02	STL	6,230J	5.87	41.6J	E.010	E.193	2.16J	E.176	E.034	E.048	<1.27	11.4	7.83
5	6–24–02	STL	7,880	3.79J	6.96J	E.012	E.118J	3.38J	E.272	E.013	E.073	E.297J	14.8J	8.83
5 Rep	6–24–02	STL	743	3.79J	6.96J	E.012	E.118J	.554J	<.738	E.013	E.009	E.339J	2.03J	2.95
6	7–10–01	Frontier	1,940	6.52	69.6	.013	.2	1.5	<1.39	<.088	.167	.18	6.82	5.43
6	1–10–02	STL	3,090J	9.8	395J	E.010	E.113	1.57J	E.262	.042	.14	E.154J	8.73	6.46
6	6–26–02	STL	2,430	10.1J	157J	E.015	E.077J	1.33J	E.315	E.030	E.110	E.264J	5.54J	4.93
8	6–25–01	Frontier	16,700	15.5	120	.011	.346	6.4	3.86	<.051	.408	<.870	37.7	18.9
8	1–11–02	STL	9,130J	10.6	196J	E.008	E.161	3.45J	E.376	E.054	.213	<1.41	24.9	12.5
8	6–26–02	STL	1,620	6.35J	86.4J	E.008	E.077J	.957J	E.247	E.031	E.091	E.312J	4.90J	4.51

Appendix 7. Concentrations of cyanide, perchlorate, and trace elements in depositional bed sediment from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.—Continued

[U.S. Environmental Protection Agency (2005a) methods are in parentheses; if two methods are listed, the first method was used for 2001 samples, and the second method was used for 2002 samples. Concentrations are in milligrams per kilogram. E, estimated; <, less than; Rep, replicate environmental sample; Severn Trent Laboratory; J, method blank contamination]

Site number (figs. 2, 3)	Sample date	Laboratory	Iron, as Fe (1638/6010B)	Lead, as Pb (1638/6020)	Manganese, as Mn (1638/6020)	Mercury, as Hg (1631/7471A)	Molybdenum, as Mo (1638/6020)	Nickel, as Ni (1638/6020)	Selenium, as Se (1638/6020)	Silver, as Ag (1638/6020)	Thallium, as Tl (1638/6020)	Tin, as Sn (1638/6020)	Vanadium, as V (1638/6020)	Zinc, as Zn (1638/6020)
Sites near the Redleg impact area—Continued														
9	6–25–01	Frontier	8,680	16.3	106	0.018	0.19	3.22	1.93	<0.051	0.456	<0.870	27.5	15.0
9	1–11–02	STL	5,720J	11.5	522J	E.012	E.10	1.77J	E.307	E.045	.178	<1.48	10.8	9.84
9	6–26–02	STL	9,950	12.6J	216J	<.045	E.20J	4.92J	E.657	E.060	.255	<1.36	30.5J	14.8
10	6–26–01	Frontier	16,600	16.3	124	.013	.3	5.35	4.01	<.051	.456	<.870	38.8	20.4
10	1–09–02	STL	5,730J	6.23	295J	E.013	E.15	2.41J	E.275	E.043	E.118	E.101J	13.5	8.77
10	6–25–02	STL	7,050	7.03J	173J	E.008	E.13J	2.75J	E.567	E.050	.148	E.144J	15.5J	10.3
Sites near Peason Ridge impact areas														
11	6–27–01	Frontier	3,730	11.7	91.0	.007	<.16	1.53	2.18	<.051	.254	<.870	11.0	8.58
11	1–14–02	STL	5,870J	10.9	286	E.026	E.10	2.57J	E.234	E.081J	E.167	<1.68	11.5	14.4
11	7–01–02	STL	7,960	8.58	173J	E.013	E.08	2.05J	E.355	E.070J	E.138	E.235J	9.32J	12.1
11 Rep	7–01–02	STL	7,440	8.31	164J	E.017	E.06	1.99J	E.342	E.061J	E.129	E.245J	8.74J	12.7
12	6–28–01	Frontier	19,700	17.1	104	.011	.35	7.64	3.34	<.051	.588	1.35	41.7	37.5
12	1–14–02	STL	5,490J	7.72	54.4	E.011	E.06	2.59J	E.202	E.091J	E.130	<1.43	10.2	13.4
12 Rep	1–14–02	STL	6,410J	8.45	61.2	E.014	E.05	2.80J	E.269	E.082J	E.136	<1.53	10.3	15.0
12	7–01–02	STL	5,870	7.23	60.1J	E.004	E.03	2.11J	E.409	E.046J	E.114	<1.60	7.62J	13.5
13	6–27–01	Frontier	16,800	16.6	137	.007	<.16	6.29	2.05	<.051	.528	<.870	33.0	36.8
13 Rep	6–27–01	Frontier	7,600	21.0	117	.010	.18	3.82	6.03	<.051	.578	.79	21.4	18.2
13	1–14–02	STL	4,070J	6.7	40.3	E.010	<.29	1.66J	E.188	E.057J	E.111	<1.43	6.4	10.4
13	7–01–02	STL	7,650	6.13	45.2J	E.004	E.02	1.69J	E.272	E.049J	E.094	<1.55	6.16J	10.3
14	6–27–01	Frontier	9,920	17.0	81.2	.007	.12	3.47	<1.70	.063	.444	<.870	25.9	22.1
14	1–15–02	STL	2,830J	7.94	41.7	E.008	<.29	1.06J	E.238	E.044J	E.073	<1.44	5.02	5.89
14	7–02–02	STL	4,020	6.95	29.8J	E.005	E.03	1.43J	E.324	E.049J	E.083	E.107J	6.20J	8.96

[1] Cyanide and perchlorate were analyzed by Severn Trent Laboratory for all sample data listed.

Appendix 8. Concentrations of total organic carbon and nutrients in water from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.

[All analyses were done by Severn Trent Laboratory. U.S. Environmental Protection Agency (2005a) methods are in parentheses. Concentrations are in milligrams per liter. TKN, measured as total Kjeldahl nitrogen; E, estimated; <, less than; Rep, replicate environmental sample; Blk, field blank; organic-free blank-water sample; J, method blank contamination]

Site number (figs. 2, 3)	Sample date	Total organic carbon (415.1)	Nitrogen, ammonia, dissolved (353.2)	Nitrogen, nitrate, total (300.0A)	Nitrogen, nitrite, total (300.0A)	Nitrogen, nitrate plus nitrite (353.2)	Total organic nitrogen (TKN) (351.2)	Phosphorus, total (365.3)	Orthophosphate, dissolved (300.0A)
Sites near the Redleg impact area									
1	6–28–2001	8.2	E0.057	<0.50	E0.12	E0.041	E0.36	E0.031	<0.50
1 Rep	6–28–2001	9.8	E.051	<.50	E.12	E.037	E.39	<.050	<.50
1 Blk	6–28–2001	<1.0	E.058	<.50	<.50	<.100	<.50	<.050	<.50
1	1–10–2002	2.9J	E.043	<.50	E.15	E.010	<.50	E.036J	<.50
1	6–24–2002	4.3	E.076	E.16	E.15	E.015	E.15	<.050	<.50
2	6–26–2001	10.6	E.062	<.50	E.10	E<.100	.5	<.050	<.50
2	1–9–2002	2.9J	E.032	E.17	E.15	<.100	<.50	E.045J	<.50
2 Rep	1–9–2002	2.7J	E.044	<.50	E.16	<.100	<.50	E.029J	<.50
2	6–25–2002	8.8	.15	E.18	E.15	E.022	E.28	E.038J	<.50
3	6–26–2001	7	E.045	<.50	E.10	<.100	E.33	<.050	<.50
3	1–9–2002	3.3J	E.050	<.50	E.15	<.100	<.50	E.043J	<.50
3	6–25–2002	8.5	E.060	E.15	E.16	<.100	E.26	E.020J	<.50
4	6–25–2001	8.2	E.046	<.50	<.50	<.100	E.36	<.050	<.50
4	1–11–2002	2.8	E.054	E.18	<.50	E.028	<.50	.051J	<.50
4	6–25–2002	5.8	E.034	E.19	E.15	E.087	<.50	E.024J	<.50
5	7–9–2001	8.8	.27	<.50	<.50	E.040	.53	<.050	<.50
5	1–10–2002	3.1J	E.039	<.50	E.15	<.100	<.50	E.035J	<.50
5 Blk	1–10–2002	<1.0	E.048	<.50	E.16	<.100	E.15	.088J	<.50
5	6–24–2002	7.1	E.096	<.50	E.15	<.100	E.26	<.050	<.50
5 Rep	6–24–2002	7.1	E.067	<.50	E.16	<.100	<.50	<.050	<.50
6	7–10–2001	4.7	.21	E.13	<.50	<.100	E.37	E.035	<.50
6	1–10–2002	2.8J	E.044	<.50	E.15	E.010	<.50	E.035J	<.50
6	6–26–2002	4.8	E.058	E.15	<.50	E.045	E.23	E.027J	<.50

Appendix 8. Concentrations of total organic carbon and nutrients in water from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.—Continued

[All analyses were done by Severn Trent Laboratory. U.S. Environmental Protection Agency (2005a) methods are in parentheses. Concentrations are in milligrams per liter. TKN, measured as total Kjeldahl nitrogen; E, estimated; <, less than; Rep, replicate environmental sample; Blk, field blank; organic-free blank-water sample; J, method blank contamination]

Site number (figs. 2, 3)	Sample date	Total organic carbon (415.1)	Nitrogen, ammonia, dissolved (353.2)	Nitrogen, nitrate, total (300.0A)	Nitrogen, nitrite, total (300.0A)	Nitrogen, nitrate plus nitrite (353.2)	Total organic nitrogen (TKN) (351.2)	Phosphorus, total (365.3)	Orthophosphate, dissolved (300.0A)
Sites near the Redleg impact area—Continued									
8	6–25–2001	7.5	E0.053	<0.50	E0.11	E<0.100	E<0.50	<0.050	<0.50
8	1–11–2002	2.9	<.100	<.50	<.50	E.016	<.50	.054J	<.50
8	6–26–2002	7.3	.14	E.15	<.50	<.100	<.50	E.027J	<.50
9	6–25–2001	8.2	E.047	<.50	E.10	<.100	E.27	<.050	<.50
9	1–11–2002	3	<.100	<.50	<.50	E.011	<.50	<.050	<.50
9	6–26–2002	4.3	.17	E.15	<.50	E.041	<.50	E.020J	<.50
10	6–26–2001	7.1	E.055	<.50	E.10	E.032	<.50	<.050	<.50
10	1–9–2002	2.9J	E.049	E.20	E.16	E.044	<.50	E.042J	<.50
10	6–25–2002	3.3	E.046	E.20	E.16	E.059	E.25	E.033J	<.50
Sites near Peason Ridge impact areas									
11	6–27–2001	4	E.087	<.50	<.50	E.032	<.50	<.050	<.50
11	1–14–2002	3.3	<.100	<.50	E.16	<.100	<.50	E.048J	<.50
11	7–1–2002	4.3	E.072	E.15	E.16	E.031	E.38	E.035J	<.50
11 Rep	7–1–2002	4.4	E.028	E.15	E.15	E.033	.53	E.041J	<.50
11 Blk	7–1–2002	<1.0	<.100	<.50	E.14	<.100	<.50	E.045J	<.50
12	6–28–2001	2.4	E.055	<.50	E.11	<.100	<.50	<.050	<.50
12	1–14–2002	4.1	<.100	<.50	<.50	E.016	<.50	E.027J	<.50
12 Rep	1–14–2002	4	<.100	E.18	E.16	E.013	<.50	.051J	<.50
12	7–1–2002	2.4	E.086	<.50	E.15	E.020	<.50	E.043J	<.50
13	6–27–2001	6.8	E.084	<.50	E.13	<.100	E.27	.064	<.50
13 Rep	6–27–2001	7.2	E.062	<.50	E.12	<.100	<.50	<.050	<.50
13	1–14–2002	2.7	<.100	<.50	E.16	<.100	E.16	E.034J	<.50
13	7–1–2002	6.5	E.043	<.50	E.15	E.034	E.35	.081J	<.50
14	6–27–2001	3.9	E.055	<.50	E.11	<.100	<.50	<.050	<.50
14	1–15–2002	3.3	<.100	<.50	E.15	<.100	<.50	E.033J	<.50
14	7–2–2002	3.3	E.046	<.50	<.50	<.100	E.18	E.033J	<.50

Appendix 9. Percent moisture, total organic carbon concentrations, and nutrient concentrations in bulk bed sediment from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.

[All analyses were done by Severn Trent Laboratory. U.S. Environmental Protection Agency (2005a) methods are in parentheses. Concentrations are in milligrams per kilogram. TKN, measured as total Kjeldahl nitrogen; <, less than; E, estimated; Rep, replicate environmental sample; J, method blank contamination; Q, elevated reporting limit]

Site number (figs. 2, 3)	Sample date	Percent moisture (160.3)	Total organic carbon (9060)	Nitrogen, ammonia (350.1)	Nitrogen, nitrate (9056)	Nitrogen, nitrite (9056)	Nitrogen, nitrate plus nitrite (353.2)	Total organic nitrogen (TKN) (351.2)	Phosphorus, total (365.3)	Orthophosphate (9056)
Sites near the Redleg impact area										
1	6–28–01	18.7	3,000	2.2	<6.2	E2.2	<1.2	129	7.4	<6.2
1 Rep	6–28–01	18.8	2,600	1.9	<6.2	E2.2	E.62	144	E4.1	<6.2
1	1–10–02	25.3	4,000	E.72J	<6.7	<6.7	E.47	92.9	E4.2J	<6.7
1	6–24–02	24.6	3,900	<1.3	E2.1	<6.6	E.67	122	<6.6	<6.6
2	6–26–01	23.4	5,200	2.7	<6.5	E2.4	<1.3	263Q	11	<6.5
2	1–09–02	38.3	15,800	1.6J	<8.1	<8.1	E.76	285	12J	<8.1
2 Rep	1–09–02	30.1	19,100	E1.2J	<7.2	<7.2	E.70	201	E4.6J	<7.2
2	6–25–02	3.3	19,800	E.64	<7.2	E2.0	<1.4	294Q	7.8	<7.2
3	6–26–01	24	3,200	10.5	<6.6	E2.3	<1.3	248	7.3	<6.6
3	1–09–02	23.8	2,000	E.63J	<6.6	<6.6	E.28	117	E3.2J	<6.6
3	6–25–02	23.1	3,500	E1.2	<6.5	<6.5	<1.3	153	E3.8	<6.5
4	6–25–01	15.4	E1,700	<1.2	<5.9	E2.2	<1.2	183	E3.7	<5.9
4	1–11–02	20.2	E1,400	3.1J	<6.3	<6.3	E.44	107	E3.4	<6.3
4	6–25–02	22.6	E1,000	E.36	<6.5	<6.5	<1.3	E39.9	E1.6	<6.5
5	7–09–01	22.4	2,300	E.41	<6.4	E2.2	<1.3	E45.5	8	<6.4
5	1–10–02	25	E1,800	E.83J	<6.7	<6.7	E.59	E55.5	E3.5J	<6.7
5	6–24–02	21.4	4,600	E.23	<6.4	<6.4	<1.3	<63.6	<6.4	<6.4
5 Rep	6–24–02	21.1	<2,000	E.31	<6.3	<6.3	<1.3	<63.3	32	<6.3
6	7–10–01	25.3	E1,500	E.95	<6.7	E2.2	<1.3	78.1	E4.9	<6.7
6	1–10–02	23.1	2,100	E.66J	<6.5	<6.5	E.39	98.5	E2.9J	<6.5
6	6–26–02	23.8	3,200	E1.1	<6.6	<6.6	<1.3	89	E2.1	<6.6
8	6–25–01	19.9	2,600	1.8	<6.2	E2.3	<1.2	200	17	<6.2
8	1–11–02	23.7	2,700	E.58J	<6.6	<6.6	E.49	94.3	E4.8	<6.6
8	6–26–02	22.2	3,700	E1.2	<6.4	<6.4	<1.3	137	E2.9	<6.4

Appendix 9. Percent moisture, total organic carbon concentrations, and nutrient concentrations in bulk bed sediment from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.—Continued

[All analyses were done by Severn Trent Laboratory. U.S. Environmental Protection Agency (2005a) methods are in parentheses. Concentrations are in milligrams per kilogram. TKN, measured as total Kjeldahl nitrogen; <, less than; E, estimated; Rep, replicate environmental sample; J, method blank contamination; Q, elevated reporting limit]

Site number (figs. 2, 3)	Sample date	Percent moisture (160.3)	Total organic carbon (9060)	Nitrogen, ammonia (350.1)	Nitrogen, nitrate (9056)	Nitrogen, nitrite (9056)	Nitrogen, nitrate plus nitrite (353.2)	Total organic nitrogen (TKN) (351.2)	Phosphorus, total (365.3)	Orthophosphate (9056)
Sites near the Redleg impact area—Continued										
9	6–25–01	24.6	2,400	2	<6.6	E2.4	<1.3	124	E3.6	<6.6
9	1–11–02	25.4	3,100	E.66J	<6.7	<6.7	E.46	141	E4.4	<6.7
9	6–26–02	21.7	E1,700	1.3	<6.4	<6.4	<1.3	84.2	E3.4	<6.4
10	6–26–01	27.4	4,000	1.7	<6.9	E2.6	<1.4	125	E6.1	<6.9
10	1–09–02	23	E1,400	E.64J	<6.5	<6.5	E.44	90.4	E5.0J	<6.5
10	6–25–02	22.5	4,300	E.52	<6.4	<6.4	<1.3	121	E1.8	<6.4
Sites near Peason Ridge impact areas										
11	6–27–01	19.3	E1,000	1.5	<6.2	E2.2	<1.2	67.8	E3.7	<6.2
11	1–14–02	27.9	5,800	E.40	E2.5	E2.8	E.78	242	10.4J	<6.9
11	7–01–02	24.8	3,400	E.47	<6.7	<6.7	<1.3	113	7.8J	<6.7
11 Rep	7–01–02	24.4	2,600	1.7	<6.6	<6.6	E.28	109	E5.7J	<6.6
12	6–28–01	19.5	<2,000	E.21	<6.2	<6.2	E.91	E19.6	E2.1	<6.2
12	1–14–02	22.1	E980	E.32	<6.4	E1.9	E.31	<64.2	E4.8J	<6.4
12 Rep	1–14–02	21.3	E1,200	1.5	<6.4	E1.9	E.47	E43.8	8.6J	<6.4
12	7–01–02	21.7	<2,000	E.40	<6.4	<6.4	<1.3	<63.8	E3.3J	<6.4
13	6–27–01	20.1	<2,000	E1.2	<6.3	E2.3	<1.3	E37.9	E5.3	<6.3
13 Rep	6–27–01	20	E750	E.61	<6.2	E2.2	<1.2	E36.4	6.6	<6.2
13	1–14–02	21.4	<2,000	1.3	<6.4	E2.0	E.70	<63.6	E4.8J	<6.4
13	7–01–02	23	E1,800	E.54	<6.5	<6.5	<1.3	E41.8	E4.4J	<6.5
14	6–27–01	16.2	E880	1.6	<6.0	E2.1	<1.2	E30.4	E2.5	<6.0
14	1–15–02	22	E1,000	E.26	<6.4	E2.4	E.28	<64.1	E3.4J	<6.4
14	7–02–02	21.2	E1,400	E.60	<6.3	<6.3	<1.3	<63.4	E3.3J	<6.3

Appendix 10. Percent moisture, total organic carbon concentrations, and nutrient concentrations in depositional bed sediment from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.

[All analyses were done by Severn Trent Laboratory. U.S. Environmental Protection Agency (2005a) methods are in parentheses. Concentrations are in milligrams per kilogram. TKN, measured as total Kjeldahl nitrogen; <, less than; E, estimated; Q, elevated reporting limit; Rep, replicate environmental sample; J, method blank contamination]

Site number (figs. 2, 3)	Sample date	Percent moisture (160.3)	Total organic carbon (9060)	Nitrogen, ammonia (350.1)	Nitrogen, nitrate (9056)	Nitrogen, nitrite (9056)	Nitrogen, nitrate plus nitrite (353.2)	Total organic nitrogen (TKN) (351.2)	Phosphorus, total (365.3)	Orthophosphate (9056)
Sites near the Redleg impact area										
1	6–28–01	51	33,300	3.5	<10	E3.8	E0.57	1,740Q	72	<10
1 Rep	6–28–01	35.7	32,500	2.6	E2.8	E2.8	E.89	1,320Q	77	<7.8
1	1–10–02	27.8	17,300	E.91J	E2.4	E2.1	E.65	326	37J	<6.9
1	6–24–02	30.4	10,200	E.25	E2.1	<7.2	E1.2	484	21	<7.2
2	6–26–01	18.4	6,900	1.4	<6.1	E2.2	<1.2	95.8	6.9	<6.1
2	1–09–02	24.9	4,200	E.73J	<6.7	<6.7	E.48	261	E3.2J	<6.7
2 Rep	1–09–02	22.4	3,100	E.91J	<6.4	<6.4	E.52	208	E5.1J	<6.4
2	6–25–02	40.5	17,900	3.5	<8.4	<8.4	<1.7	1,310Q	29	<8.4
3	6–26–01	31.5	E1,800	E1.4	<7.3	E2.7	<1.5	255	10	<7.3
3	1–09–02	34.1	16,500	E1.4J	<7.6	<7.6	E.90	606	30J	<7.6
3	6–25–02	43.3	26,300	10	<8.8	<8.8	<1.8	1,200Q	72	<8.8
4	6–25–01	19.1	28,100	E.30	<6.2	E2.2	<1.2	196Q	9	<6.2
4	1–11–02	24	3,700	E.59J	<6.6	E2.1	E.37	238	8.7	<6.6
4	6–25–02	20.8	3,600	E.86	<6.3	<6.3	<1.3	159	E2.2	<6.3
5	7–09–01	25.7	6,400	E.71	<6.7	E2.3	<1.3	247	36	<6.7
5	1–10–02	21.4	5,000	E1.1J	<6.4	E2.0	E1.1	136	20J	<6.4
5	6–24–02	28.6	<2,000	E.32	<7.0	<7.0	E.39	322	37	<7.0
5 Rep	6–24–02	32.2	6,100	E.38	<7.4	<7.4	<1.5	359	<7.4	<7.4
6	7–10–01	36.9	6,600	E.35	<7.9	E2.6	<1.6	1,480Q	13	<7.9
6	1–10–02	25.6	10,200	1.3J	<6.7	<6.7	E.58	298	9.9J	<6.7
6	6–26–02	30.2	11,600	2.2	<7.2	<7.2	E.40	615Q	32	<7.2
8	6–25–01	28.2	4,500	1.4	<7.0	E2.6	<1.4	321	14	<7.0
8	1–11–02	29.2	4,600	1.4J	<7.1	E2.2	E.62	310	E5.7	<7.1
8	6–26–02	27.4	11,000	4.9	<6.9	<6.9	E.32	402Q	14	<6.9

Appendix 10. Percent moisture, total organic carbon concentrations, and nutrient concentrations in depositional bed sediment from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.—Continued

[All analyses were done by Severn Trent Laboratory. U.S. Environmental Protection Agency (2005a) methods are in parentheses. Concentrations are in milligrams per kilogram. TKN, measured as total Kjeldahl nitrogen; <, less than; E, estimated; Q, elevated reporting limit; Rep, replicate environmental sample; J, method blank contamination]

Site number (figs. 2, 3)	Sample date	Percent moisture (160.3)	Total organic carbon (9060)	Nitrogen, ammonia (350.1)	Nitrogen, nitrate (9056)	Nitrogen, nitrite (9056)	Nitrogen, nitrate plus nitrite (353.2)	Total organic nitrogen (TKN) (351.2)	Phosphorus, total (365.3)	Orthophosphate (9056)
Sites near the Redleg impact area—Continued										
9	6–25–01	17.4	6,600	E0.41	<6.0	E2.1	<1.2	259Q	13	<6.0
9	1–11–02	32.5	10,500	1.5J	<7.4	E2.3	E.56	926	21	<7.4
9	6–26–02	26.4	3,400	E.63	<6.8	<6.8	<1.4	201Q	E5.7	<6.8
10	6–26–01	32.2	3,900	E1.2	<7.4	E2.8	<1.5	E282Q	79	<7.4
10	1–09–02	24.6	7,500	E1.1J	<6.6	<6.6	E.50	400	26J	<6.6
10	6–25–02	25.2	4,200	E.23	<6.7	<6.7	<1.3	255	9.1	<6.7
Sites near Peason Ridge impact areas										
11	6–27–01	24.4	3,500	1.4	<6.6	E2.5	<1.3	270Q	19	<6.6
11	1–14–02	40.3	14,800	E.30	E2.8	E3.3	E.64	312	86J	<8.4
11	7–01–02	49.3	8,100	2.1	<9.9	<9.9	<2.0	690	63J	<9.9
11 Rep	7–01–02	46.1	10,500	2.3	<9.3	<9.3	<1.9	789Q	39J	<9.3
12	6–28–01	32	2,900	1.5	<7.4	E2.7	E.91	102	19	<7.4
12	1–14–02	30.1	9,900	E.43	<7.2	E2.2	E.56	470	41J	<7.2
12 Rep	1–14–02	34.5	10,900	E.27	<7.6	E2.3	E.53	375	39J	<7.6
12	7–01–02	37.6	4,200	E.50	<8.0	E2.4	<1.6	219	35J	<8.0
13	6–27–01	17.2	E1,700	9	<6.9	E3.2	1.9	104	124	<6.9
13 Rep	6–27–01	16.2	E740	2.4	<6.0	E2.2	E.94	E42.7	51	<6.0
13	1–14–02	30.1	4,400	E.59	<7.2	E2.8	E.69	219	52J	<7.2
13	7–01–02	35.6	27,100	2.9	<7.8	E2.1	<1.6	209	21J	<7.8
14	6–27–01	26.8	<2,000	1.5	E2.5	E3.4	<1.4	158	11	<6.8
14	1–15–02	30.7	7,700	E.26	<7.2	E3.0	<1.4	155	31J	<7.2
14	7–02–02	24.7	3,900	E.69	<6.6	<6.6	E.47	176	9.9J	<6.6

Appendix 11. Concentrations of explosive compounds detected in water from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–03.

[Concentrations are in micrograms per liter. STL, Severn Trent Laboratory; <, less than; Rep, replicate environmental sample; Blk, field blank, organic-free-blank-water sample; USACHPPM, U.S. Army Center for Health Promotion and Preventive Medicine; E, estimated; HMX, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine; PETN, pentaerythritol tetranitrate; RDX, hexahydro-1,3,5-trinitro-1,3,5-triazine; --, no data]

Site number (figs. 2, 3)	Sample date	Laboratory	Method[1]	1,3,5-Trinitrobenzene	1,3-Dinitrobenzene	2,4,6-Trinitrotoluene	2,4-Dinitrotoluene	2,6-Dinitrotoluene	2-Amino-4,6-dinitrotoluene	2-Nitrotoluene	3-Nitrotoluene
Sites near the Redleg impact area											
1	6–28–01	STL	8321A	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12
1 Rep	6–28–01	STL	8321A	<.12	<.12	<.12	<.12	<.12	<.12	<.12	<.12
1 Blk	6–28–01	STL	8321A	<.12	<.12	<.12	<.12	<.12	<.12	<.12	<.12
1	1–10–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
1	6–24–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
1	2–11–03	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
1	11–18–03	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
2	7–13–01	STL	8321A	E.02	<.12	<.12	<.12	<.12	<.12	<.12	<.12
2	1–09–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
2 Rep	1–09–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
2	6–25–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
3	7–13–01	STL	8321A	E.02	<.12	<.12	<.12	<.12	<.12	<.12	<.12
3	1–09–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
3	6–25–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
4	7–13–01	STL	8321A	E.02	<.12	<.12	<.12	<.12	<.12	<.12	<.12
4	1–11–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
4	6–25–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
5	7–09–01	STL	8321A	<.12	<.12	E.05	<.12	<.12	<.12	<.12	<.12
5	1–10–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
5 Blk	1–10–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
5	6–24–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
5 Rep	6–24–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
5	2–11–03	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
5	11–18–03	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
6	7–10–01	STL	8321A	<.12	<.12	<.12	<.12	<.12	<.12	<.12	<.12
6	1–10–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
6	6–26–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
6	2–11–03	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
6	11–18–03	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09

Appendix 11. Concentrations of explosive compounds detected in water from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–03.—Continued

[Concentrations are in micrograms per liter. STL, Severn Trent Laboratory; <, less than; Rep, replicate environmental sample; Blk, field blank, organic-free-blank-water sample; USACHPPM, U.S. Army Center for Health Promotion and Preventive Medicine; E, estimated; HMX, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine; PETN, pentaerythritol tetranitrate; RDX, hexahydro-1,3,5-trinitro-1,3,5-triazine; --, no data]

Site number (figs. 2, 3)	Sample date	Laboratory	Method[1]	1,3,5-Trinitrobenzene	1,3-Dinitrobenzene	2,4,6-Trinitrotoluene	2,4-Dinitrotoluene	2,6-Dinitrotoluene	2-Amino-4,6-dinitrotoluene	2-Nitrotoluene	3-Nitrotoluene
Sites near the Redleg impact area—Continued											
8	7–13–01	STL	8321A	E0.03	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12
8	1–11–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
8	6–26–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
9	7–13–01	STL	8321A	E.02	<.12	<.12	<.12	<.12	<.12	<.12	<.12
9	1–11–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
9	6–26–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
10	7–13–01	STL	8321A	<.12	<.12	<.12	<.12	<.12	<.12	<.12	<.12
10	1–09–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
10	6–25–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
Sites near Peason Ridge impact areas											
11	6–27–01	STL	8321A	<.12	<.12	<.12	<.12	<.12	<.12	<.12	<.12
11	1–14–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
11	7–01–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
11 Rep	7–01–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
11 Blk	7–01–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
12	6–28–01	STL	8321A	<.12	<.12	<.12	<.12	<.12	<.12	<.12	<.12
12	1–14–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
12 Rep	1–14–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
12	7–01–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
13	6–27–01	STL	8321A	<.12	<.12	<.12	<.12	<.12	<.12	<.12	<.12
13 Rep	6–27–01	STL	8321A	<.12	<.12	<.12	<.12	<.12	<.12	<.12	<.12
13	1–14–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
13	7–01–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
14	6–27–01	STL	8321A	<.12	<.12	<.12	<.12	<.12	<.12	<.12	<.12
14	1–15–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09
14	7–02–02	USACHPPM	13.2	<.03	<.09	<.03	<.02	<.01	<.10	<.09	<.09

Appendix 11. Concentrations of explosive compounds detected in water from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–03.—Continued

[Concentrations are in micrograms per liter. STL, Severn Trent Laboratory; <, less than; Rep, replicate environmental sample; Blk, field blank, organic-free-blank-water sample; USACHPPM, U.S. Army Center for Health Promotion and Preventive Medicine; E, estimated; HMX, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine; PETN, pentaerythritol tetranitrate; RDX, hexahydro-1,3,5-trinitro-1,3,5-triazine; --, no data]

Site number (figs. 2, 3)	Sample date	Laboratory	Method[1]	4-Amino-2,6-dinitrotoluene	4-Nitrotoluene	HMX	Nitrobenzene	Nitroglycerin	PETN	RDX	Tetryl
Sites near the Redleg impact area											
1	6–28–01	STL	8321A	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12
1 Rep	6–28–01	STL	8321A	<.12	<.12	<.12	<.12	<.12	<.12	<.12	<.12
1 Blk	6–28–01	STL	8321A	<.12	<.12	<.12	<.12	<.12	<.12	<.12	<.12
1	1–10–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	E.03	<.50
1	6–24–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
1	2–11–03	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
1	11–18–03	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
2	7–13–01	STL	8321A	<.12	<.12	<.12	<.12	<.12	<.12	<.12	<.12
2	1–09–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	E.04	<.50
2 Rep	1–09–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	E.04	<.50
2	6–25–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
3	7–13–01	STL	8321A	<.12	<.12	<.12	<.12	<.12	<.12	<.12	<.12
3	1–09–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
3	6–25–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
4	7–13–01	STL	8321A	<.12	<.12	<.12	<.12	<.12	<.12	E.04	<.12
4	1–11–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	E.02	<.50
4	6–25–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
5	7–09–01	STL	8321A	<.12	<.12	<.12	<.12	<.12	<.12	<.12	<.12
5	1–10–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	E.14	<.50
5 Blk	1–10–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
5	6–24–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	E.02	<.50
5 Rep	6–24–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
5	2–11–03	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
5	11–18–03	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
6	7–10–01	STL	8321A	<.12	<.12	<.12	<.12	<.12	<.12	<.12	<.12
6	1–10–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
6	6–26–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
6	2–11–03	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
6	11–18–03	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50

Appendix 11. Concentrations of explosive compounds detected in water from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–03.—Continued

[Concentrations are in micrograms per liter. STL, Severn Trent Laboratory; <, less than; Rep, replicate environmental sample; Blk, field blank, organic-free-blank-water sample; USACHPPM, U.S. Army Center for Health Promotion and Preventive Medicine; E, estimated; HMX, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine; PETN, pentaerythritol tetranitrate; RDX, hexahydro-1,3,5-trinitro-1,3,5-triazine; --, no data]

Site number (figs. 2, 3)	Sample date	Laboratory	Method[1]	4-Amino-2,6-dinitrotoluene	4-Nitrotoluene	HMX	Nitrobenzene	Nitroglycerin	PETN	RDX	Tetryl
Sites near the Redleg impact area—Continued											
8	7–13–01	STL	8321A	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	E0.03
8	1–11–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
8	6–26–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
9	7–13–01	STL	8321A	<.12	<.12	<.12	<.12	<.12	<.12	E.08	<.12
9	1–11–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	E.04	<.50
9	6–26–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	E.05	<.50
10	7–13–01	STL	8321A	<.12	<.12	<.12	<.12	<.12	<.12	<.12	<.12
10	1–09–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
10	6–25–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
Sites near Peason Ridge impact areas											
11	6–27–01	STL	8321A	<.12	<.12	<.12	<.12	<.12	<.12	<.12	<.12
11	1–14–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
11	7–01–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
11 Rep	7–01–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
11 Blk	7–01–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
12	6–28–01	STL	8321A	<.12	<.12	<.12	<.12	<.12	<.12	<.12	<.12
12	1–14–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
12 Rep	1–14–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
12	7–01–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
13	6–27–01	STL	8321A	<.12	<.12	<.12	<.12	<.12	<.12	<.12	<.12
13 Rep	6–27–01	STL	8321A	<.12	<.12	<.12	<.12	<.12	<.12	<.12	<.12
13	1–14–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
13	7–01–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
14	6–27–01	STL	8321A	<.12	<.12	<.12	<.12	<.12	<.12	<.12	<.12
14	1–15–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50
14	7–02–02	USACHPPM	13.2	<.10	<.09	<3.0	<.03	<.09	--	<.10	<.50

[1] Methods: 8321A, U.S. Environmental Protection Agency (2005a); 13.2, U.S. Army Center for Health Promotion and Preventive Medicine (2005).

Appendix 12. Concentrations of explosive compounds detected in bulk bed sediment from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.

[Concentrations are in milligrams per kilogram. STL, Severn Trent Laboratory; <, less than laboratory reporting limit; Rep, replicate environmental sample; USACHPPM, U.S. Army Center for Health Promotion and Preventive Medicine; HMX, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine; PETN, pentaerythritol tetranitrate; RDX, hexahydro-1,3,5-trinitro-1,3,5-triazine; --, no data]

Site number (figs. 2-3)	Sample date	Laboratory	Method[1]	1,3,5-Trinitro-benzene	1,3-Dinitro-benzene	2,4,6-Trinitro-toluene	2,4-Dinitrotoluene	2,6-Dinitrotoluene	2-Amino-4,6-dinitrotoluene	2-Nitrotoluene
Sites near the Redleg impact area										
1	6–28–01	STL	8321A	<0.250	<0.250	<0.250	<0.250	<0.500	<0.250	<0.500
1 Rep	6–28–01	STL	8321A	<.250	<.250	<.250	<.250	<.500	<.250	<.500
1	6–28–01	STL	8330	<.310	<.310	<.310	<.310	<.310	<.310	<.310
1 Rep	6–28–01	STL	8330	<.310	<.310	<.310	<.310	<.310	<.310	<.310
1	1–10–02	USACHPPM	55.1	<.035	<.035	<.035	<.035	<.035	<.035	<.035
1	6–24–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050
2	6–26–01	STL	8321A	<.250	<.250	<.250	<.250	<.500	<.250	<.500
2	6–26–01	STL	8330	<.330	<.330	<.330	<.330	<.330	<.330	<.330
2	1–09–02	USACHPPM	55.1	<.038	<.038	<.038	<.038	<.038	<.038	<.038
2 Rep	1–09–02	USACHPPM	55.1	<.038	<.038	<.038	<.038	<.038	<.038	<.038
2	6–25–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050
3	6–26–01	STL	8321A	<.250	<.250	<.250	<.250	<.500	<.250	<.500
3	6–26–01	STL	8330	<.330	<.330	<.330	<.330	<.330	<.330	<.330
3	1–09–02	USACHPPM	55.1	<.036	<.036	<.036	<.036	<.036	<.036	<.036
3	6–25–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050
4	6–25–01	STL	8321A	<.250	<.250	<.250	<.250	<.500	<.250	<.500
4	6–25–01	STL	8330	<.300	<.300	<.300	<.300	<.300	<.300	<.300
4	1–11–02	USACHPPM	55.1	<.036	<.036	<.036	<.036	<.036	<.036	<.036
4	6–25–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050
5	7–09–01	STL	8321A	<.320	<.320	<.320	<.320	<.640	<.320	<.640
5	1–10–02	USACHPPM	55.1	<.033	<.033	<.033	<.033	<.033	<.033	<.033
5	6–24–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050
5 Rep	6–24–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050
6	7–10–01	STL	8321A	<.250	<.250	<.250	<.250	<.500	<.250	<.500
6	1–10–02	USACHPPM	55.1	<.035	<.035	<.035	<.035	<.035	<.035	<.035
6	6–26–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050
8	6–25–01	STL	8321A	<.250	<.250	<.250	<.250	<.500	<.250	<.500
8	6–25–01	STL	8330	<.310	<.310	<.310	<.310	<.310	<.310	<.310
8	1–11–02	USACHPPM	55.1	<.033	<.033	<.033	<.033	<.033	<.033	<.033
8	6–26–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050

Appendix 12. Concentrations of explosive compounds detected in bulk bed sediment from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.—Continued

[Concentrations are in milligrams per kilogram. STL, Severn Trent Laboratory; <, less than laboratory reporting limit; Rep, replicate environmental sample; USACHPPM, U.S. Army Center for Health Promotion and Preventive Medicine; HMX, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine; PETN, pentaerythritol tetranitrate; RDX, hexahydro-1,3,5-trinitro-1,3,5-triazine; --, no data]

Site number (figs. 2-3)	Sample date	Laboratory	Method[1]	1,3,5-Trinitro-benzene	1,3-Dinitro-benzene	2,4,6-Trinitro-toluene	2,4-Dinitrotoluene	2,6-Dinitrotoluene	2-Amino-4,6-dinitrotoluene	2-Nitrotoluene
Sites near the Redleg impact area—Continued										
9	6–25–01	STL	8321A	<0.250	<0.250	<0.250	<0.250	<0.500	<0.250	<0.500
9	6–25–01	STL	8330	<.330	<.330	<.330	<.330	<.330	<.330	<.330
9	1–11–02	USACHPPM	55.1	<.035	<.035	<.035	<.035	<.035	<.035	<.035
9	6–26–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050
10	6–26–01	STL	8321A	<.250	<.250	<.250	<.250	<.500	<.250	<.500
10	6–26–01	STL	8330	<.340	<.340	<.340	<.340	<.340	<.340	<.340
10	1–09–02	USACHPPM	55.1	<.037	<.037	<.037	<.037	<.037	<.037	<.037
10	6–25–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050
Sites near Peason Ridge impact areas										
11	6–27–01	STL	8321A	<.250	<.250	<.250	<.250	<.500	<.250	<.500
11	6–27–01	STL	8330	<.310	<.310	<.310	<.310	<.310	<.310	<.310
11	1–14–02	USACHPPM	55.1	<.036	<.036	<.036	<.036	<.036	<.036	<.036
11	7–01–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050
11 Rep	7–01–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050
12	6–28–01	STL	8321A	<.250	<.250	<.250	<.250	<.500	<.250	<.500
12	6–28–01	STL	8330	<.310	<.310	<.310	<.310	<.310	<.310	<.310
12	1–14–02	USACHPPM	55.1	<.036	<.036	<.036	<.036	<.036	<.036	<.036
12 Rep	1–14–02	USACHPPM	55.1	<.033	<.033	<.033	<.033	<.033	<.033	<.033
12	7–01–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050
13	6–27–01	STL	8321A	<.250	<.250	<.250	<.250	<.500	<.250	<.500
13 Rep	6–27–01	STL	8321A	<.250	<.250	<.250	<.250	<.500	<.250	<.500
13	6–27–01	STL	8330	<.310	<.310	<.310	<.310	<.310	<.310	<.310
13 Rep	6–27–01	STL	8330	<.310	<.310	<.310	<.310	<.310	<.310	<.310
13	1–14–02	USACHPPM	55.1	<.037	<.037	<.037	<.037	<.037	<.037	<.037
13	7–01–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050
14	6–27–01	STL	8321A	<.250	<.250	<.250	<.250	<.500	<.250	<.500
14	6–27–01	STL	8330	<.300	<.300	<.300	<.300	<.300	<.300	<.300
14	1–15–02	USACHPPM	55.1	<.033	<.033	<.033	<.033	<.033	<.033	<.033
14	7–02–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050

Appendix 12. Concentrations of explosive compounds detected in bulk bed sediment from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.—Continued

[Concentrations are in milligrams per kilogram. STL, Severn Trent Laboratory; <, less than laboratory reporting limit; Rep, replicate environmental sample; USACHPPM, U.S. Army Center for Health Promotion and Preventive Medicine; HMX, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine; PETN, pentaerythritol tetranitrate; RDX, hexahydro-1,3,5-trinitro-1,3,5-triazine; --, no data]

Site number (figs. 2, 3)	Sample date	Laboratory	Method[1]	3-Nitrotoluene	4-Amino-2,6-dinitrotoluene	4-Nitrotoluene	HMX	Nitrobenzene	Nitroglycerin	PETN	RDX	Tetryl
Sites near the Redleg impact area												
1	6–28–01	STL	8321A	<1.00	<0.250	<0.120	<0.500	<0.250	<0.120	<0.120	<0.250	<0.250
1 Rep	6–28–01	STL	8321A	<1.00	<.250	<.120	<.500	<.250	<.120	<.120	<.250	<.250
1	6–28–01	STL	8330	<.310	<.310	<.310	<.310	--	<6.20	<3.10	<.310	<.620
1Rep	6–28–01	STL	8330	<.310	<.310	<.310	<.310	--	<6.20	<3.10	<.310	<.620
1	1–10–02	USACHPPM	55.1	<.035	<.035	<.035	<.071	<.035	<.035	--	<.035	<.035
1	6–24–02	USACHPPM	55.1	<.050	<.050	<.050	<.100	<.050	<.050	--	<.050	<.050
2	6–26–01	STL	8321A	<1.00	<.250	<.120	<.500	<.250	<.120	<.120	<.250	<.250
2	6–26–01	STL	8330	<.330	<.330	<.330	<.330	--	<6.50	<3.30	<.330	<.650
2	1–09–02	USACHPPM	55.1	<.038	<.038	<.038	<.077	<.038	<.038	--	<.038	<.038
2 Rep	1–09–02	USACHPPM	55.1	<.038	<.038	<.038	<.075	<.038	<.038	--	<.038	<.038
2	6–25–02	USACHPPM	55.1	<.050	<.050	<.050	<.100	<.050	<.050	--	<.050	<.050
3	6–26–01	STL	8321A	<1.00	<.250	<.120	<.500	<.250	<.120	<.120	<.250	<.250
3	6–26–01	STL	8330	<.330	<.330	<.330	<.330	--	<6.60	<3.30	<.330	<.660
3	1–09–02	USACHPPM	55.1	<.036	<.036	<.036	<.072	<.036	<.036	--	<.036	<.036
3	6–25–02	USACHPPM	55.1	<.050	<.050	<.050	<.100	<.050	<.050	--	<.050	<.050
4	6–25–01	STL	8321A	<1.00	<.250	<.120	<.500	<.250	<.120	<.120	<.250	<.250
4	6–25–01	STL	8330	<.300	<.300	<.300	<.300	--	<5.90	<3.00	<.300	<.590
4	1–11–02	USACHPPM	55.1	<.036	<.036	<.036	<.071	<.036	<.036	--	<.036	<.036
4	6–25–02	USACHPPM	55.1	<.050	<.050	<.050	<.100	<.050	<.050	--	<.050	<.050
5	7–09–01	STL	8321A	<1.30	<.320	<.160	<.640	<.320	<.160	<.160	<.320	<.320
5	1–10–02	USACHPPM	55.1	<.033	<.033	<.033	<.067	<.033	<.033	--	<.033	<.033
5	6–24–02	USACHPPM	55.1	<.050	<.050	<.050	<.100	<.050	<.050	--	<.050	<.050
5 Rep	6–24–02	USACHPPM	55.1	<.050	<.050	<.050	<.100	<.050	<.050	--	<.050	<.050
6	7–10–01	STL	8321A	<1.00	<.250	<.120	<.500	<.250	<.120	<.120	<.250	<.250
6	1–10–02	USACHPPM	55.1	<.035	<.035	<.035	<.070	<.035	<.035	--	<.035	<.035
6	6–26–02	USACHPPM	55.1	<.050	<.050	<.050	<.10	<.050	<.050	--	<.050	<.050
8	6–25–01	STL	8321A	<1.00	<.250	<.120	<.500	<.250	<.120	<.120	<.250	<.250
8	6–25–01	STL	8330	<.310	<.310	<.310	<.310	--	<6.20	<3.10	<.310	<.620
8	1–11–02	USACHPPM	55.1	<.033	<.033	<.033	<.066	<.033	<.033	--	<.033	<.033
8	6–26–02	USACHPPM	55.1	<.050	<.050	<.050	<.100	<.050	<.050	--	<.050	<.050

Appendix 12. Concentrations of explosive compounds detected in bulk bed sediment from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.—Continued

[Concentrations are in milligrams per kilogram. STL, Severn Trent Laboratory; <, less than laboratory reporting limit; Rep, replicate environmental sample; USACHPPM, U.S. Army Center for Health Promotion and Preventive Medicine; HMX, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine; PETN, pentaerythritol tetranitrate; RDX, hexahydro-1,3,5-trinitro-1,3,5-triazine; --, no data]

Site number (figs. 2, 3)	Sample date	Laboratory	Method[1]	3-Nitrotoluene	4-Amino-2,6-dinitrotoluene	4-Nitrotoluene	HMX	Nitrobenzene	Nitroglycerin	PETN	RDX	Tetryl
Sites near the Redleg impact area—Continued												
9	6–25–01	STL	8321A	<1.00	<0.250	<0.120	<0.500	<0.250	<0.120	<0.120	<0.250	<0.250
9	6–25–01	STL	8330	<.330	<.330	<.330	<.330	--	<6.60	<3.30	<.330	<.660
9	1–11–02	USACHPPM	55.1	<.035	<.035	<.035	<.069	<.035	<.035	--	<.035	<.035
9	6–26–02	USACHPPM	55.1	<.050	<.050	<.050	<.100	<.050	<.050	--	<.050	<.050
10	6–26–01	STL	8321A	<1.00	<.250	<.120	<.500	<.250	<.120	<.120	<.250	<.250
10	6–26–01	STL	8330	<.340	<.340	<.340	<.340	--	<6.90	<3.40	<.340	<.690
10	1–09–02	USACHPPM	55.1	<.037	<.037	<.037	<.073	<.037	<.037	--	<.037	<.037
10	6–25–02	USACHPPM	55.1	<.050	<.050	<.050	<.100	<.050	<.050	--	<.050	<.050
Sites near Peason Ridge impact areas												
11	6–27–01	STL	8321A	<1.00	<.250	<.120	<.500	<.250	<.120	<.120	<.250	<.250
11	6–27–01	STL	8330	<.310	<.310	<.310	<.310	--	<6.20	<3.10	<.310	<.620
11	1–14–02	USACHPPM	55.1	<.036	<.036	<.036	<.072	<.036	<.036	--	<.036	<.036
11	7–01–02	USACHPPM	55.1	<.050	<.050	<.050	<.100	<.050	<.050	--	<.050	<.050
11 Rep	7–01–02	USACHPPM	55.1	<.050	<.050	<.050	E.036	<.050	<.050	--	<.050	<.050
12	6–28–01	STL	8321A	<1.00	<.250	<.120	<.500	<.250	<.120	<.120	<.250	<.250
12	6–28–01	STL	8330	<.310	<.310	<.310	<.310	--	<6.20	<3.10	<.310	<.620
12	1–14–02	USACHPPM	55.1	<.036	<.036	<.036	<.071	<.036	<.036	--	<.036	<.036
12 Rep	1–14–02	USACHPPM	55.1	<.033	<.033	<.033	<.067	<.033	<.033	--	<.033	<.033
12	7–01–02	USACHPPM	55.1	<.050	<.050	<.050	<.100	<.050	<.050	--	<.050	<.050
13	6–27–01	STL	8321A	<1.00	<.250	<.120	<.500	<.250	<.120	<.120	<.250	<.250
13 Rep	6–27–01	STL	8321A	<1.00	<.250	<.120	<.500	<.250	<.120	<.120	<.250	<.250
13	6–27–01	STL	8330	<.310	<.310	<.310	<.310	--	<6.30	<3.10	<.310	<.630
13 Rep	6–27–01	STL	8330	<.310	<.310	<.310	<.310	--	<6.20	<3.10	<.310	<.620
13	1–14–02	USACHPPM	55.1	<.037	<.037	<.037	<.074	<.037	<.037	--	<.037	<.037
13	7–01–02	USACHPPM	55.1	<.050	<.050	<.050	.2	<.050	<.050	--	<.050	<.050
14	6–27–01	STL	8321A	<1.00	<.250	<.120	<.500	<.250	<.120	<.120	<.250	<.250
14	6–27–01	STL	8330	<.300	<.300	<.300	<.300	--	<6.00	<3.00	<.300	<.600
14	1–15–02	USACHPPM	55.1	<.033	<.033	<.033	<.065	<.033	<.033	--	<.033	<.033
14	7–02–02	USACHPPM	55.1	<.050	<.050	<.050	<.100	<.050	<.050	--	<.050	<.050

[1] Methods: 8321A and 8330, U.S. Environmental Protection Agency (2005a); 55.1, U.S. Army Center for Health Promotion and Preventive Medicine (2005).

Appendix 13. Concentrations of explosive compounds detected in depositional bed sediment from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.

[Concentrations are in milligrams per kilogram. STL, Severn Trent Laboratory; <, less than; Rep, replicate environmental sample; USACHPPM, U.S. Army Center for Health Promotion and Preventive Medicine; HMX, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine; PETN, pentaerythritol tetranitrate; RDX, hexahydro-1,3,5-trinitro-1,3,5-triazine; --, no data]

Site number (figs. 2, 3)	Sample date	Laboratory	Method[1]	1,3,5-Trinitro-benzene	1,3-Dinitro-benzene	2,4,6-Trinitro-toluene	2,4-Dinitro-toluene	2,6-Dinitro-toluene	2-Amino-4,6-dinitrotoluene	2-Nitro-toluene
Sites near the Redleg impact area										
1	6–28–01	STL	8321A	<0.250	<0.250	<0.250	<0.250	<0.500	<0.250	<0.500
1 Rep	6–28–01	STL	8321A	<.250	<.250	<.250	<.250	<.500	<.250	<.500
1	6–28–01	STL	8330	<.510	<.510	<.510	<.510	<.510	<.510	<.510
1 Rep	6–28–01	STL	8330	<.390	<.390	<.390	<.390	<.390	<.390	<.390
1	1–10–02	USACHPPM	55.1	<.044	<.044	<.044	<.044	<.044	<.044	<.044
1	6–24–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050
2	6–26–01	STL	8321A	<.250	<.250	<.250	<.250	<.500	<.250	<.500
2	6–26–01	STL	8330	<.310	<.310	<.310	<.310	<.310	<.310	<.310
2	1–09–02	USACHPPM	55.1	<.034	<.034	<.034	<.034	<.034	<.034	<.034
2 Rep	1–09–02	USACHPPM	55.1	<.034	<.034	<.034	<.034	<.034	<.034	<.034
2	6–25–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050
3	6–26–01	STL	8321A	<.250	<.250	<.250	<.250	<.500	<.250	<.500
3	6–26–01	STL	8330	<.360	<.360	<.360	<.360	<.360	<.360	<.360
3	1–09–02	USACHPPM	55.1	<.037	<.037	<.037	<.037	<.037	<.037	<.037
3	6–25–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050
4	6–25–01	STL	8321A	<.250	<.250	<.250	<.250	<.500	<.250	<.500
4	6–25–01	STL	8330	<.310	<.310	<.310	<.310	<.310	<.310	<.310
4	1–11–02	USACHPPM	55.1	<.033	<.033	<.033	<.033	<.033	<.033	<.033
4	6–25–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050
5	7–09–01	STL	8321A	<.340	<.340	<.340	<.340	<.670	<.340	<.670
5	1–10–02	USACHPPM	55.1	<.036	<.036	<.036	<.036	<.036	<.036	<.036
5	6–24–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050
5 Rep	6–24–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050
6	7–10–01	STL	8321A	<.250	<.250	<.250	<.250	<.500	<.250	<.500
6	1–10–02	USACHPPM	55.1	<.044	<.044	<.044	<.044	<.044	<.044	<.044
6	6–26–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050
8	6–25–01	STL	8321A	<.250	<.250	<.250	<.250	<.500	<.250	<.500
8	6–25–01	STL	8330	<.350	<.350	<.350	<.350	<.350	<.350	<.350
8	1–11–02	USACHPPM	55.1	<.029	<.029	<.029	<.029	<.029	<.029	<.029
8	6–26–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050

Appendix 13. Concentrations of explosive compounds detected in depositional bed sediment from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.—Continued

[Concentrations are in milligrams per kilogram. STL, Severn Trent Laboratory; <, less than; Rep, replicate environmental sample; USACHPPM, U.S. Army Center for Health Promotion and Preventive Medicine; HMX, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine; PETN, pentaerythritol tetranitrate; RDX, hexahydro-1,3,5-trinitro-1,3,5-triazine; --, no data]

Site number (figs. 2, 3)	Sample date	Laboratory	Method[1]	1,3,5-Trinitro-benzene	1,3-Dinitro-benzene	2,4,6-Trinitro-toluene	2,4-Dinitro-toluene	2,6-Dinitro-toluene	2-Amino-4,6-dinitrotoluene	2-Nitro-toluene
Sites near the Redleg impact area—Continued										
9	6–25–01	STL	8321A	<0.250	<0.250	<0.250	<0.250	<0.500	<0.250	<0.500
9	6–25–01	STL	8330	<.300	<.300	<.300	<.300	<.300	<.300	<.300
9	1–11–02	USACHPPM	55.1	<.044	<.044	<.044	<.044	<.044	<.044	<.044
9	6–26–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050
10	6–26–01	STL	8321A	<.250	<.250	<.250	<.250	<.500	<.250	<.500
10	6–26–01	STL	8330	<.370	<.370	<.370	<.370	<.370	<.370	<.370
10	1–09–02	USACHPPM	55.1	<.038	<.038	<.038	<.038	<.038	<.038	<.038
10	6–25–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050
Sites near Peason Ridge impact areas										
11	6–27–01	STL	8321A	<.250	<.250	<.250	<.250	<.500	<.250	<.500
11	6–27–01	STL	8330	<.330	<.330	<.330	<.330	<.330	<.330	<.330
11	1–14–02	USACHPPM	55.1	<.044	<.044	<.044	<.044	<.044	<.044	<.044
11	7–01–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050
11 Rep	7–01–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050
12	6–28–01	STL	8321A	<.250	<.250	<.250	<.250	<.500	<.250	<.500
12	6–28–01	STL	8330	<.370	<.370	<.370	<.370	<.370	<.370	<.37
12	1–14–02	USACHPPM	55.1	<.037	<.037	<.037	<.037	<.037	<.037	<.037
12 Rep	1–14–02	USACHPPM	55.1	<.036	<.036	<.036	<.036	<.036	<.036	<.036
12	7–01–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050
13	6–27–01	STL	8321A	<.250	<.250	<.250	<.250	<.500	<.250	<.500
13 Rep	6–27–01	STL	8321A	<.250	<.250	<.250	<.250	<.500	<.250	<.500
13	6–27–01	STL	8330	<.340	<.340	<.340	<.340	<.340	<.340	<.340
13 Rep	6–27–01	STL	8330	<.300	<.300	<.300	<.300	<.300	<.300	<.300
13	1–14–02	USACHPPM	55.1	<.040	<.040	<.040	<.040	<.040	<.040	<.040
13	7–01–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050
14	6–27–01	STL	8321A	<.250	<.250	<.250	<.250	<.500	<.250	<.500
14	6–27–01	STL	8330	<.340	<.340	<.340	<.340	<.340	<.340	<.340
14	1–15–02	USACHPPM	55.1	<.034	<.034	<.034	<.034	<.034	<.034	<.034
14	7–02–02	USACHPPM	55.1	<.050	<.050	<.050	<.050	<.050	<.050	<.050

Appendix 13. Concentrations of explosive compounds detected in depositional bed sediment from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.—Continued

[Concentrations are in milligrams per kilogram. STL, Severn Trent Laboratory; <, less than; Rep, replicate environmental sample; USACHPPM, U.S. Army Center for Health Promotion and Preventive Medicine; HMX, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine; PETN, pentaerythritol tetranitrate; RDX, hexahydro-1,3,5-trinitro-1,3,5-triazine; --, no data]

Site number (figs. 2, 3)	Sample date	Laboratory	Method[1]	3-Nitrotoluene	4-Amino-2,6-dinitrotoluene	4-Nitrotoluene	HMX	Nitrobenzene	Nitroglycerin	PETN	RDX	Tetryl
Sites near the Redleg impact area												
1	6–28–01	STL	8321A	<1.00	<0.250	<0.120	<0.500	<0.250	<0.120	<0.120	<0.250	<0.250
1 Rep	6–28–01	STL	8321A	<1.00	<.250	<.120	<.500	<.250	<.120	<.120	<.250	<.250
1	6–28–01	STL	8330	<.510	<.510	<.510	<.510	--	<1.0	<5.10	<.510	<1.00
1 Rep	6–28–01	STL	8330	<.390	<.390	<.390	<.390	--	<7.80	<3.90	<.390	<.780
1	1–10–02	USACHPPM	55.1	<.044	<.044	<.044	<.089	<.044	<.044	--	<.044	<.044
1	6–24–02	USACHPPM	55.1	<.050	<.050	<.050	<.100	<.050	<.050	--	<.050	<.050
2	6–26–01	STL	8321A	<1.00	<.250	<.120	<.500	<.250	<.120	<.120	<.250	<.250
2	6–26–01	STL	8330	<.310	<.310	<.310	<.310	--	<6.10	<3.10	<.310	<.610
2	1–09–02	USACHPPM	55.1	<.034	<.034	<.034	<.068	<.034	<.034	--	<.034	<.034
2 Rep	1–09–02	USACHPPM	55.1	<.034	<.034	<.034	<.069	<.034	<.034	--	<.034	<.034
2	6–25–02	USACHPPM	55.1	<.050	<.050	<.050	<.100	<.050	<.050	--	<.050	<.050
3	6–26–01	STL	8321A	<1.00	<.250	<.120	<.500	<.250	<.120	<.120	<.250	<.250
3	6–26–01	STL	8330	<.360	<.360	<.360	<.360	--	<7.30	<3.60	<.360	<.730
3	1–09–02	USACHPPM	55.1	<.037	<.037	<.037	<.075	<.037	<.037	--	<.037	<.037
3	6–25–02	USACHPPM	55.1	<.050	<.050	<.050	<.100	<.050	<.050	--	<.050	<.050
4	6–25–01	STL	8321A	<1.00	<.250	<.120	<.500	<.250	<.120	<.120	<.250	<.250
4	6–25–01	STL	8330	<.310	<.310	<.310	<.310	--	<6.20	<3.10	<.310	<.620
4	1–11–02	USACHPPM	55.1	<.033	<.033	<.033	<.065	<.033	<.033	--	<.033	<.033
4	6–25–02	USACHPPM	55.1	<.050	<.050	<.050	<.100	<.050	<.050	--	<.050	<.050
5	7–09–01	STL	8321A	<1.30	<.340	<.170	<.670	<.340	<.170	<.170	<.340	<.340
5	1–10–02	USACHPPM	55.1	<.036	<.036	<.036	<.072	<.036	<.036	--	<.036	<.036
5	6–24–02	USACHPPM	55.1	<.050	<.050	<.050	<.100	<.050	<.050	--	<.050	<.050
5 Rep	6–24–02	USACHPPM	55.1	<.050	<.050	<.050	<.100	<.050	<.050	--	<.050	<.050
6	7–10–01	STL	8321A	<1.00	<.250	<.120	<.500	<.250	<.120	<.120	<.250	<.250
6	1–10–02	USACHPPM	55.1	<.044	<.044	<.044	<.089	<.044	<.044	--	<.044	<.044
6	6–26–02	USACHPPM	55.1	<.050	<.050	<.050	<.100	<.050	<.050	--	<.050	<.050
8	6–25–01	STL	8321A	<1.00	<.250	<.120	<.500	<.250	<.120	<.120	<.250	<.250
8	6–25–01	STL	8330	<.350	<.350	<.350	<.350	--	<7.00	<3.50	<.350	<.700
8	1–11–02	USACHPPM	55.1	<.029	<.029	<.029	<.058	<.029	<.029	--	<.029	<.029
8	6–26–02	USACHPPM	55.1	<.050	<.050	<.050	<.100	<.050	<.050	--	<.050	<.050

Appendix 13. Concentrations of explosive compounds detected in depositional bed sediment from selected streams near Redleg and Peason Ridge impact areas, Fort Polk Military Reservation, Louisiana, 2001–02.—Continued

[Concentrations are in milligrams per kilogram. STL, Severn Trent Laboratory; <, less than; Rep, replicate environmental sample; USACHPPM, U.S. Army Center for Health Promotion and Preventive Medicine; HMX, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine; PETN, pentaerythritol tetranitrate; RDX, hexahydro-1,3,5-trinitro-1,3,5-triazine; --, no data]

Site number (figs. 2, 3)	Sample date	Laboratory	Method[1]	3-Nitrotoluene	4-Amino-2,6-dinitrotoluene	4-Nitrotoluene	HMX	Nitrobenzene	Nitroglycerin	PETN	RDX	Tetryl
Sites near the Redleg impact area—Continued												
9	6–25–01	STL	8321A	<1.00	<0.250	<0.120	<0.500	<0.250	<0.120	<0.120	<0.250	<0.250
9	6–25–01	STL	8330	<.300	<.300	<.300	<.300	--	<6.00	<3.00	<.300	<.600
9	1–11–02	USACHPPM	55.1	<.044	<.044	<.044	<.089	<.044	<.044	--	<.044	<.044
9	6–26–02	USACHPPM	55.1	<.050	<.050	<.050	<.100	<.050	<.050	--	<.050	<.050
10	6–26–01	STL	8321A	<1.00	<.250	<.120	<.500	<.250	<.120	<.120	<.250	<.250
10	6–26–01	STL	8330	<.370	<.370	<.370	<.370	--	<7.40	<3.70	<.370	<.740
10	1–09–02	USACHPPM	55.1	<.038	<.038	<.038	<.075	<.038	<.038	--	<.038	<.038
10	6–25–02	USACHPPM	55.1	<.050	<.050	<.050	<.100	<.050	<.050	--	<.050	<.050
Sites near Peason Ridge impact areas												
11	6–27–01	STL	8321A	<1.00	<.250	<.120	<.500	<.250	<.120	<.120	<.250	<.250
11	6–27–01	STL	8330	<.330	<.330	<.330	<.330	--	<6.60	<3.30	<.330	<.660
11	1–14–02	USACHPPM	55.1	<.044	<.044	<.044	<.088	<.044	<.044	--	<.044	<.044
11	7–01–02	USACHPPM	55.1	<.050	<.050	<.050	.2	<.050	<.050	--	<.050	<.050
11 Rep	7–01–02	USACHPPM	55.1	<.050	<.050	<.050	E.064	<.050	<.050	--	<.050	<.050
12	6–28–01	STL	8321A	<1.00	<.250	<.120	<.500	<.250	<.120	<.120	<.250	<.250
12	6–28–01	STL	8330	<.370	<.370	<.370	<.370	<.370	<7.40	<3.70	<.370	<.740
12	1–14–02	USACHPPM	55.1	<.037	<.037	<.037	<.074	<.037	<.037	--	<.037	<.037
12 Rep	1–14–02	USACHPPM	55.1	<.036	<.036	<.036	<.072	<.036	<.036	--	<.036	<.036
12	7–01–02	USACHPPM	55.1	<.050	<.050	<.050	E.074	<.050	<.050	--	<.050	<.050
13	6–27–01	STL	8321A	<1.00	<.250	<.120	<.500	<.250	<.120	<.120	<.250	<.250
13 Rep	6–27–01	STL	8321A	<1.00	<.250	<.120	<.500	<.250	<.120	<.120	<.250	<.250
13	6–27–01	STL	8330	<.340	<.340	<.340	<.340	--	<6.90	<3.40	<.340	<.690
13 Rep	6–27–01	STL	8330	<.300	<.300	<.300	<.300	--	<6.00	<3.00	<.300	<.600
13	1–14–02	USACHPPM	55.1	<.300	<.040	<.040	<.079	<.040	<.040	--	<.040	<.040
13	7–01–02	USACHPPM	55.1	<.040	<.050	<.050	<.100	<.050	<.050	--	<.050	<.050
14	6–27–01	STL	8321A	<1.00	<.250	<.120	<.500	<.250	<.120	<.120	<.250	<.250
14	6–27–01	STL	8330	<.340	<.340	<.340	<.340	--	<6.80	<3.40	<.340	<.680
14	1–15–02	USACHPPM	55.1	<.340	<.034	<.034	<.068	<.034	<.034	--	<.034	<.034
14	7–02–02	USACHPPM	55.1	<.034	<.050	<.050	.12	<.050	<.050	--	<.050	<.050

[1] Methods: 8321A and 8330, U.S. Environmental Protection Agency (2005a); 55.1, U.S. Army Center for Health Promotion and Preventive Medicine (2005).

Appendix 14. Concentrations of explosive compounds and percent lipids detected in tissue of mussels from Alligator Lake and selected streams near the Redleg impact area, Fort Polk Military Reservation, Louisiana, 2002–03.

[All analyses were done by Severn Trent Laboratory. Concentrations are in milligrams per kilogram. <, less than; Rep, replicate environmental sample; HMX, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine; PETN, pentaerythritol tetranitrate; RDX, hexahydro-1,3,5-trinitro-1,3,5-triazine; E, estimated]

Site number (fig. 2)	Sample date	Method[1]	1,3,5-Trinitro-benzene	1,3-Dinitrobenzene	2,4,6-Trinitro-toluene	2,4-Dinitro-toluene	2,6-Dinitro-toluene	2-Amino-4,6-dinitrotoluene	2-Nitrotoluene	3-Nitrotoluene
Alligator Lake	10–17–02	8321A	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12
Alligator Lake	10–17–02	8330	<.25	<.25	<.25	<.25	<.25	<.25	<.25	<.25
Sites near the Redleg impact area										
1	3–12–03	8321A	<.12	<.12	<.12	.12	<.12	<.12	<.12	<.12
1	3–12–03	8330	<2.5	<.25	<.25	<.25	<.25	<.25	<.25	<.25
5	3–13–03	8321A	<.12	<.12	<.12	<.12	<.12	<.12	<.12	<.12
5 Rep	3–13–03	8321A	<.12	<.12	<.12	<.12	<.12	<.12	<.12	<.12
5	3–13–03	8330	<2.5	<.25	<.25	<.25	<.25	<.25	<.25	<.25
5 Rep	3–13–03	8330	<2.5	<.25	<.25	<.25	<.25	<.25	<.25	<.25
6	3–12–03	8321A	<.12	<.12	<.12	<.12	<.12	<.12	<.12	<.12
6	3–12–03	8330	<2.5	<.25	<.25	<.25	<.25	<.25	<.25	<.25

Site number (fig. 2)	Sample date	Method[1]	4-Amino-2,6-dinitrotoluene	4-Nitrotoluene	HMX	Nitrobenzene	Nitroglycerin	PETN	RDX	Tetryl	Percent lipids
Alligator Lake	10–17–02	8321A	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	0.28
Alligator Lake	10–17–02	8330	<.25	<.25	<.25	<.25	<.50	<.50	<.25	<.25	.28
Sites near the Redleg impact area											
1	3–12–03	8321A	<.12	<.12	<.60	<.12	<.50	<.50	<.60	<.12	.33
1	3–12–03	8330	<.25	<.25	<2.5	<.25	E.38	<.50	<2.5	<.25	.33
5	3–13–03	8321A	<.12	<.12	<.60	<.12	<.50	<.50	<.60	<.12	E.06
5 Rep	3–13–03	8321A	<.12	<.12	<.60	<.12	<.50	<.50	<.60	<.12	E.06
5	3–13–03	8330	<.25	<.25	<2.5	<.25	E.46	<.50	<2.5	<.25	E.06
5 Rep	3–13–03	8330	<.25	<.25	<2.5	<.25	E.19	<.50	<2.5	<.25	E.06
6	3–12–03	8321A	<.12	<.12	<.60	<.12	<.50	<.50	<.60	<.12	E.06
6	3–12–03	8330	<.25	<.25	<2.6	<.25	E.20	<.50	<2.5	<.25	E.06

[1] Methods: 8321A and 8330, U.S. Environmental Protection Agency (2005a).

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