Installation Restoration Program

Draft Final Decision Document

FLW-028, Directorate of Public Works Old Fire Training Area

Fort Leonard Wood, Missouri

Prepared for:

US Army Corps of Engineers
Kansas City District

Prepared by:

Conti and CH2MHILL

July 2010

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Acronyms and Abbreviations

AEDB-R	Army Environmental Database-Restoration
BERA	baseline ecological risk assessment
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	chemical of concern
DERP	Defense Environmental Restoration Program
DoD	Department of Defense
DPW	Directorate of Public Works
DTL	default target level
ELCR	excess lifetime cancer risk
EPC	exposure point concentration
ERA	ecological risk assessment
HHRA	human health risk assessment
HI	hazard index
IRP	Installation Restoration Program
MDNR	Missouri Department of Natural Resources
µg/kg	micrograms per kilogram
MRBCA	Missouri Risk-based Corrective Action
PAH	polycyclic aromatic hydrocarbon
PCOC	potential chemical of concern
RC	response complete
RCRA	Resource, Conservation, and Recovery Act
RFA	RCRA Facility Assessment
RI	remedial investigation
SARA	Superfund Amendments and Reauthorization Act
SLERA	screening level risk assessment
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TCLP	Toxicity Characteristic Leaching Procedure
USAEHA	U.S. Army Environmental Hygiene Agency
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
VOC	volatile organic compounds

Decision Document Declaration

Site Name and Location

This decision document addresses FLW-028, Directorate of Public Works (DPW) Old Fire Training Area, located at Fort Leonard Wood, Missouri.

Statement of Basis and Purpose

This decision document presents the selected remedy for FLW-028 at Fort Leonard Wood in Pulaski County, Missouri. The lead agency—the United States Army—and the Missouri Department of Natural Resources (MDNR) have worked together to select the remedy presented in this decision document.

The Defense Environmental Restoration Program (DERP), authorized under the Superfund Amendments and Reauthorization Act (SARA), was considered in determining whether the subject site was eligible for further action or management under the Fort Leonard Wood Installation Restoration Program (IRP).

FLW-028 will be categorized as response complete (RC) in the Army Environmental Database–Restoration (AEDB-R) since no response actions are required.

Description of Selected Remedy

No action is warranted at FLW-028 to protect public health, public welfare, or the environment based on the following:

- Nature and extent of contamination has been delineated, and no potential site-related impacts were identified
- Human health risk assessment (HHRA) found risks to be within acceptable levels
- Ecological risk assessment (ERA) found risks to be negligible

FLW-028 will be categorized as response complete (RC) in the AEDB-R. Because no response actions are required, an RC determination for this site is appropriate and consistent with Section 6.13 of the *Army Defense Environmental Restoration Program Management Guidance for Active Installations* (Department of the Army 2004).

Authorizing Signature

United States Army

Date

1. Introduction

This decision document summarizes the site management decision for FLW-028, the DPW Old Fire Training Area, at Fort Leonard Wood, Missouri. This section provides a brief description of Fort Leonard Wood and presents the regulatory framework and risk-based screening levels for the subject site.

1.1 Installation Location and Description

Fort Leonard Wood is located in south-central Missouri and encompasses approximately 62,910 acres (Figure 1-1). The majority of the installation is located in Pulaski County, with smaller portions in Texas and Laclede Counties. Fort Leonard Wood is approximately 120 miles southwest of St. Louis, about 85 miles northeast of Springfield, and 30 miles southwest of Rolla along Interstate 44.

Fort Leonard Wood lies near the center of the Houston-Rolla Ranger District of the Mark Twain National Forest. With the exception of the northern boundary, Fort Leonard Wood is surrounded by the national forest. Land use in this area primarily consists of forestry and agriculture with intermittent, low-density commercial, industrial, and residential uses. Most of the commercial and residential areas are clustered near the interchanges along Interstate 44.

1.2 Regulatory Framework

1.2.1 Defense Environmental Restoration Program

In 1984, the United States Congress formally established the DERP and codified it in Title 10 United States Code §2701 through §2707 and §2810. The DERP provides for the cleanup of Department of Defense (DoD) sites at active installations, Formerly Used Defense Sites, and Base Realignment and Closure sites (Department of the Army 2004). The statutory goals of the DERP are:

- Take appropriate response actions to investigate and, where necessary, address releases of hazardous substances or pollutants and contaminants, and correct other environmental damage that creates an imminent and substantial endangerment to the public health or welfare or to the environment.
- Protect public safety through the demolition and removal of unsafe DoD buildings and structures, including those at sites formerly used by or under the jurisdiction of the Secretary of Defense (Office of the Under Secretary of Defense 2001).

Cleanup activities under DERP are consistent with the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by SARA; the National Oil and Hazardous Substances Pollution Contingency Plan; and Executive Order 12580, Superfund Implementation.

SARA authorizes the Secretary of Defense to carry out the DERP. The Office of the Deputy Under Secretary of Defense for Installations and Environment establishes program goals and provides program management oversight. The Army, Navy, Air Force, and Defense Agencies manage individual transfer accounts that fund DERP activities. The Army transfer account is known as Environmental Restoration, Army.

The DERP established three program categories to describe the types of environmental restoration activities that occur under the DERP framework. The program categories are:

- IRP
- Military Munitions Response
- Building Demolition/Debris Removal

The site addressed in the decision document has been managed under the IRP program category, which refers to environmental responses (e.g., investigation and cleanup) associated with hazardous substances, pollutants, contaminants, and petroleum, oil, or lubricants (Department of the Army 2004). The Fort Leonard Wood IRP site locations are shown in Figure 1-1.

1.2.2 Eligibility of Activities

Consistent with Appendix E of the *Army Defense Environmental Restoration Program Management Guidance for Active Installations* (Department of the Army 2004), the following activities render a site eligible for Environmental Restoration, Army funding under the DERP:

- Sites where the release occurred prior to October 17, 1986
- Sites where the release occurred between October 17, 1986, and September 30, 2000, and where the site was identified and included in the Defense Site Environmental Restoration Tracking System prior to September 30, 2000

Historical records indicate that a release may have occurred when FLW-028 was operational between 1972 and 1988; therefore, the site is DERP eligible. The site location is shown on Figure 1-2.

1.2.3 Fort Leonard Wood Installation Restoration Program

Fort Leonard Wood originally managed its environmental sites under a framework consistent with the Resource Conservation and Recovery Act of 1976 (RCRA). The U.S. Environmental Protection Agency (USEPA) performed a RCRA Facility Assessment (RFA) in 1991 and issued an RFA report in 1992. Sites identified in the RFA form the basis of the current IRP at Fort Leonard Wood.

The Army serves as the lead agency for the Fort Leonard Wood IRP, while the MDNR acts as the lead agency for the state. Through a DoD State Memorandum of Agreement, the Army works with the MDNR to address sites covered under the IRP. The Federal Facilities Section of the MDNR coordinates all state agencies for sites covered under the IRP. Although Fort Leonard Wood is not a site on the National Priorities List, the installation follows the CERCLA process to move IRP sites through investigation, remedy selection, and remedy implementation.

Because Fort Leonard Wood originally followed a RCRA framework and shifted to CERCLA, IRP site names vary among historical documents. Many of the IRP site names were assigned solid waste management unit (SWMU) numbers in the 1992 RFA Report. Subsequently, the site names were changed to "FLW" designations. The DPW Old Fire Training Area was originally designated as SWMU-005 in the 1992 RFA Report (Black & Veatch 1992). The site designation was later changed to FLW-028 after shifting to the CERCLA framework.

1.3 Risk-Based Screening Levels

Conservative screening levels were developed for this project using the Missouri Risk-Based Corrective Action (MRBCA) framework. Specifically, default target levels (DTLs) and Missouri Water Quality Standards, provided a starting point for developing screening levels for soil, sediment, surface water, and groundwater.

1.3.1 Adjusted DTLs

In MRBCA, DTLs to protect the domestic use of groundwater are based on a 1×10^{-5} excess lifetime cancer risk (ELCR) level and on a noncancer hazard index (HI) of 1.0 for residential exposure to the chemicals. An ELCR of 1×10^{-5} is an upper-bounded estimate of the probability that one additional case of cancer will occur in 100,000 people over a 70-year lifetime as a result of individual exposure to the chemical. Aggregate exposures below a HI of 1.0 will likely not result in adverse noncancer health effects over less-than-lifetime exposure periods.

For screening level development on this project, DTLs in MRBCA were adjusted downward by a factor of 10 to reflect an ELCR of 1×10^{-6} and HI of 0.1. As a conservative and consistent approach, the DTLs that are based on protection of groundwater were also adjusted downward by a factor of 10.

1.3.2 Missouri Water Quality Standards

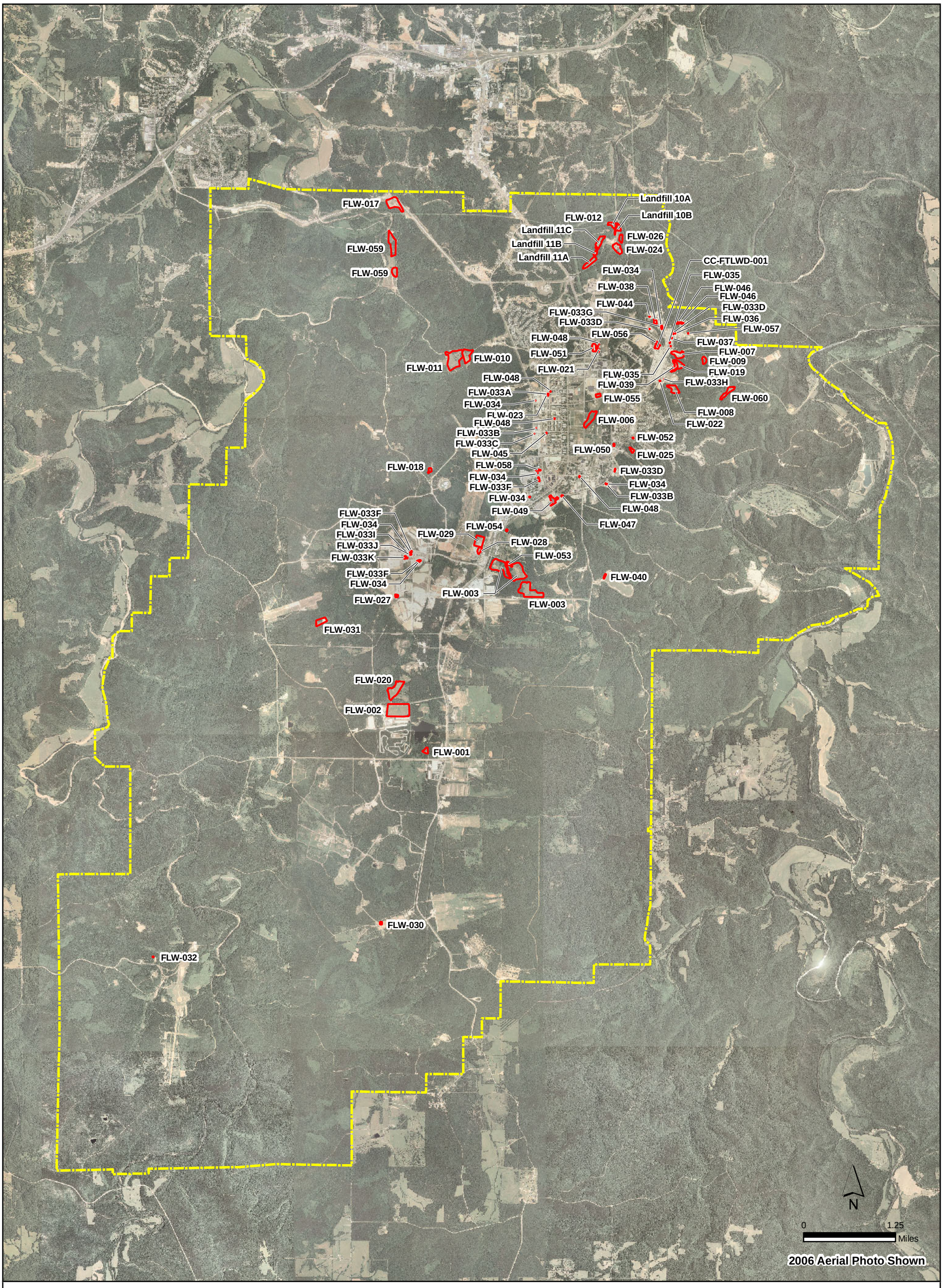
The Code of State Regulation (CSR) of 20 CSR 10-7, Missouri Water Quality Standards, provides chemical-specific regulatory limits for categories including human health protection–fish consumption, protection of aquatic life, drinking water supply, and groundwater. For each chemical, the lowest value from these sources was used as the screening level.

1.3.3 Screening Levels for Chemicals without Published DTLs

For chemicals without published DTLs, appropriate surrogate chemicals with DTLs were identified, where possible, and their DTLs were used. The values were adjusted downward by a factor of 10 to reflect an ELCR of 1×10^{-6} and an HI of 0.1. Surrogates for analyzed constituents without published DTLs were chosen using a three-step approach to identify the most appropriate surrogate with a published DTL value (CH2M HILL 2009).

1.3.4 Comparison between Screening Levels and Sample Quantitation Limits

When analyzing a broad suite of chemicals at a site, it is typical for a subset of analytical parameters to have laboratory sample quantitation limits exceeding risk-based screening levels. Non-detected chemicals with sample quantitation limits above screening levels were identified as possible potential chemicals of concern (PCOCs).



Legend

- Installation Boundary
- IRP Site Boundary

Figure 1-1
Fort Leonard Wood Installation Map
Decision Document
Fort Leonard Wood, Missouri

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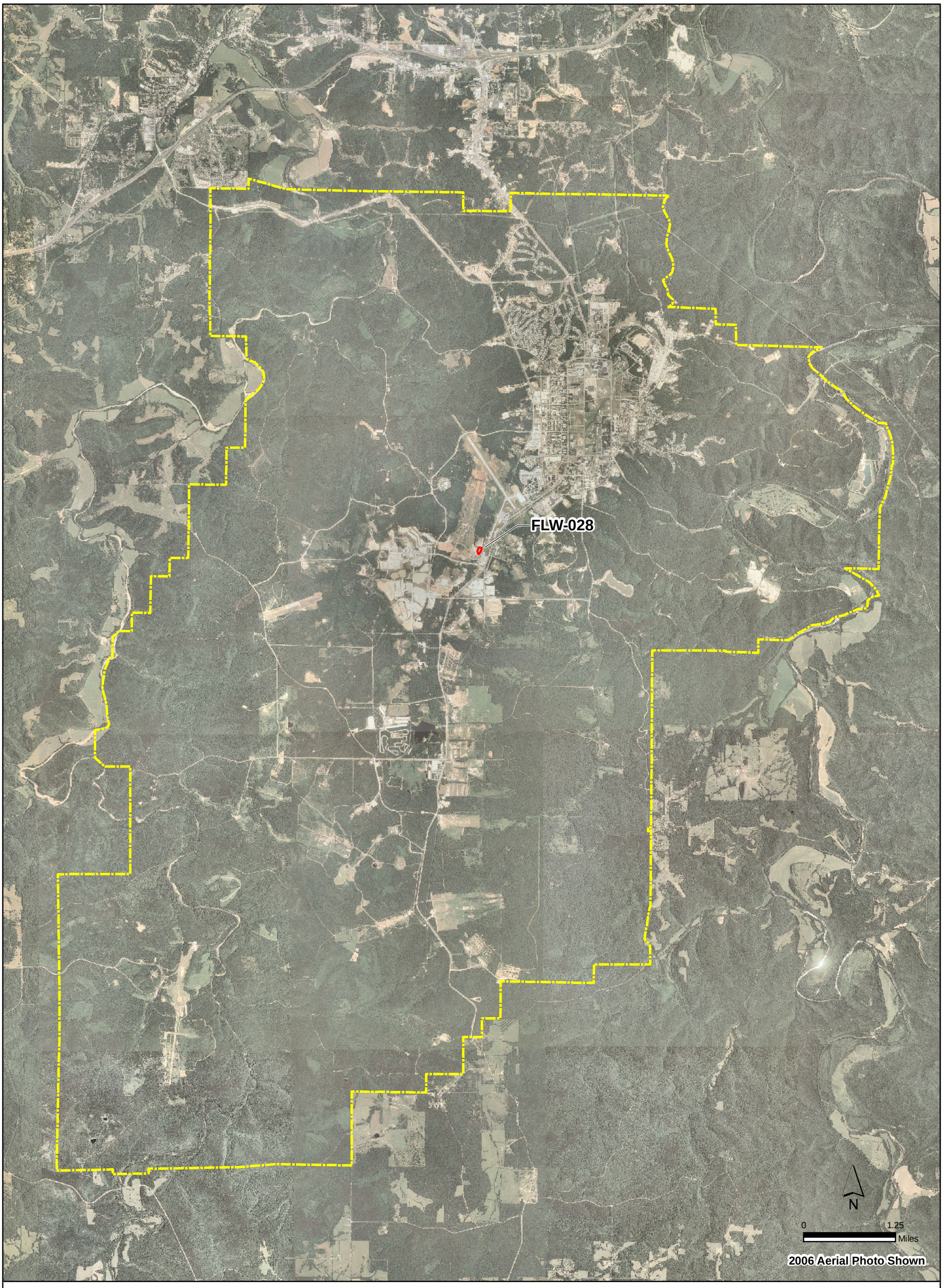

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- Installation Boundary
- IRP Site Boundary

Figure 1-2
Site Location Map
Decision Document
Fort Leonard Wood, Missouri

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2. Fort Leonard Wood Characteristics

2.1 Topography

Fort Leonard Wood is located within the Salem Plateau of the Ozark Plateaus Physiographic Province (U.S. Geological Survey [USGS] 2000). The area is characterized by rugged terrain of thin soils and narrow steep-walled valleys. Most of Fort Leonard Wood is located on a broad upland ridge between the northerly flowing Big Piney River to the east and the northerly flowing Roubidoux Creek to the west. Streams tributary to the Big Piney River and Roubidoux Creek drain the upland areas and are deeply incised into the sides of the ridges. Stream incision of nearly horizontal bedrock strata has produced a dendritic drainage pattern (USGS 2003).

Area relief generally is the result of gradual uplift of the Ozark Dome in southern Missouri and erosion of the uplifted rocks by precipitation runoff and stream flow. The regional ground surface elevation ranges from 1,150 feet above mean sea level along the central ridge to 750 feet at the Big Piney River near the northeastern corner of Fort Leonard Wood (USGS 1996).

2.2 Climate

Fort Leonard Wood has hot, humid summers and cold winters, receiving cold air moving south from Canada and warm, moist air moving north from the Gulf of Mexico, classifying its climate as continental. Annual temperatures range from below 0°F in winter to above 100°F in summer (MRCC 2006). The mean annual evapotranspiration for south-central Missouri is estimated to be on the order of 30 inches (Hu et al. 2005).

2.3 Geology

Fort Leonard Wood lies on the western flank of the Ozark Uplift of Southern Missouri. The Ozark Uplift is part of a large Precambrian rhyolite-granite basement complex. Through a series of depositional and erosional cycles extending from Cambrian through Pennsylvanian time, progressively younger geologic formations crop out in roughly concentric rings around the core of Precambrian rocks (USGS 2000).

Bedrock exposed at Fort Leonard Wood is part of the Ozark Aquifer. The Ozark Aquifer was formed between late Cambrian and Ordovician time and consists of, in order of increasing age, the Cotter Dolomite, Jefferson City Dolomite, Roubidoux Formation, Gasconade Dolomite, Eminence Dolomite, and Potosi Dolomite. The Ozark Aquifer is underlain by the St. Francois confining unit and St. Francois aquifer. The St. Francois confining unit impedes the vertical movement of groundwater between the Ozark and St. Francois aquifers. The basement confining unit, which is comprised of Precambrian-age igneous and metamorphic rocks, underlies the St. Francois aquifer (USGS 2003).

The permeability of bedrock units within the Fort Leonard Wood area has been greatly increased through the dissolution of dolomitic bedrock units (USGS 1996). Karst features at

Fort Leonard Wood commonly are well-developed and include sinkholes, springs, losing streams, and caves (USGS 2000). These features are more common in the central and northern parts of the site, where the Roubidoux Formation and Gasconade Dolomite crop out.

2.4 Hydrogeology

The regional groundwater table generally occurs within the lower Roubidoux Formation or upper Gasconade Dolomite within the Fort Leonard Wood area (USGS 2000). Both geologic units are productive, water-bearing units with well yields ranging from several tens to several hundreds of gallons per minute. The underlying Potosi Dolomite is the most productive water-bearing unit in the Ozark Aquifer, with well yields ranging from several hundred to as much as 1,000 gallons per minute. The Gasconade Dolomite and Potosi Dolomite are separated by the Eminence Dolomite, which forms a weak hydraulic barrier between the two geologic units (USGS 1996).

Recharge to groundwater at Fort Leonard Wood occurs through percolation of rainfall through permeable residuum and bedrock. Groundwater flow patterns at Fort Leonard Wood are the result of a complex combination of diffuse flow through porous residual material and bedrock and conduit flow through solution-enlarged openings along bedding planes and interconnected fractures. Depths to groundwater may range from 130 to 300 feet below ground surface in the upland areas to less than 25 feet in the Big Piney River or Roubidoux Creek valleys (USGS 2000). Groundwater levels and groundwater flow directions are similar under conditions of high base flow and low base flow (USGS 1996).

A north-trending groundwater divide occurs in Fort Leonard Wood with groundwater flowing away from the uplands along the axis of this divide east towards Big Piney River or west towards Roubidoux Creek (Figure 2-1). Karst features alter the movement of groundwater from flow patterns commonly associated with rock of more uniform permeability. Lateral separation between the groundwater and topographic divides in the central and northern parts of Fort Leonard Wood (between Bloodland Lake and the north part of the cantonment area) indicate larger bedrock permeability in the east-central rather than the west-central part of the installation. Groundwater that would normally flow west to Roubidoux Creek has been captured by a zone of large secondary permeability and redirected east toward the Big Piney River. Vertical groundwater flow generally moves downward from the Gasconade Dolomite to Potosi Dolomite, but it may move upward in areas of highly permeable karst terrain where groundwater levels in the Roubidoux Formation and Gasconade Dolomite are lowered because of rapid flow of groundwater through conduits to nearby springs (USGS 1996).

Previous studies have identified a connection between sinkholes and losing streams located at Fort Leonard Wood with four known perennial springs: Miller Spring, Sandstone Spring, Roubidoux Spring, and Shanghai Spring. A recharge area for Roubidoux Spring has not been defined (USGS 1996). The boundary between the recharge basins of the other three springs may overlap with each other or encompass a larger area within or outside the installation boundary (Figure 2-2).

Shanghai Spring is located along the Big Piney River about 2.5 miles northeast of the northern installation boundary (USGS 2000). The spring is located within the Gasconade

Dolomite. The Shanghai Spring recharge basin is 27 square miles in area and encompasses a substantial part of the north-central and northeastern parts of Fort Leonard Wood. The estimated average base-flow discharge of Shanghai Spring is 18 cubic feet per second. Previous dye-trace tests have indicated a subsurface connection between losing streams within the Fort Leonard Wood/St. Robert area and Shanghai Spring. As a result of this connection, the water quality of the spring has been affected by activities within the town and military installation.

2.5 Receptors

2.5.1 Population and Land Use

Fort Leonard Wood comprises 62,910 acres of land, of which 58,436 acres are unimproved. Additionally, 9,700 acres of U.S. Forest Service land are located within in the boundaries (Burns and McDonnell 1995). Fort Leonard Wood is bordered on the east, south, and west by the Houston-Rolla Ranger District of the Mark Twain National Forest, on the east by the Big Piney River, and on the west by Roubidoux Creek. Bordering the installation on the north are the towns of Waynesville and St. Robert, with an estimated combined population of 6,200 (U.S. Census 2006). As of May 2002, the Missouri Research Park indicates the average daily population as being more than 30,000 people.

Fort Leonard Wood has established a cantonment area in the north-central part of the installation. The area is highly developed and contains most of the buildings and structures within the facility. Areas outside the cantonment area are operational ranges for small arms training, vehicle maneuvers, heavy equipment training, aerial strafing, and bombardment training (CDM 2005).

2.5.2 Potable Water Supply

Although the Ozark aquifer is used extensively for domestic and public water supply, Fort Leonard Wood obtains 98 percent of its drinking water from a pumping station located on the Big Piney River near Sandstone Spring (Figure 2-3) (USGS 2003). Between 1993 and 1997, the average annual volume of water pumped from the Big Piney River was 1,260,000,000 gallons.

A smaller quantity of groundwater is supplied from eight public water-supply wells at Fort Leonard Wood (USGS 2003). A public water supply well, DW-015, also known as Indiana Avenue well, is located in the northern part of the installation and used only during peak demand. The remaining wells supply drinking water to training facilities scattered across the installation. These wells provide a much smaller quantity of water than the DW-015. Pumping records are not maintained for these wells (USGS 2000).

2.5.3 Ecology

Fort Leonard Wood is situated in the Osage/Gasconade Hills section of the Ozark Highlands ecoregion of the Eastern Temperate Forest (Chapman, et al. 2002). Major habitat types found on the site are forests, grasslands, and wetlands/riparian zones.

Twenty-five species of plants and animals known or suspected to inhabit Fort Leonard Wood are listed as species of concern. Table 2-1 summarizes the species and their federal

and state listing status. Three federal-listed species have been recorded at Fort Leonard Wood: Indiana bat (*Myotis sodalis*), gray bat (*M. grisescens*), and bald eagle (*Haliaeetus leucocephalus*). The Indiana bat primarily uses the caves of Fort Leonard Wood for winter hibernation. The current winter population on or adjacent to the installation is roughly 500 individuals (Fort Leonard Wood 2006). Gray bats are found throughout much of the southern half of Missouri. Fort Leonard Wood is near the center of the species range in Missouri. One maternity colony of gray bats inhabits Fort Leonard Wood.

Bald eagles are year-round residents. Fort Leonard Wood contains an active bald eagle's nest on the Big Piney River. A bald eagle pair first used the nest in 2001. Subsequent attempts to use the nest in 2002 and 2003 were unsuccessful. In 2004 and 2005 the bald eagle pair successfully fledged two eaglets during both nesting seasons. Wintering bald eagles occur on Fort Leonard Wood from November through March. The highest concentration of eagles occurs in the southwestern part of the installation.

Six rare plant species have been documented on Fort Leonard Wood. The only species currently federal- or state-listed is the narrowleaf rushfoil (*Crotonopsis linearis*), which has a state rank of S1 (critically imperiled in the state). Narrowleaf rushfoil has only been identified once—in 1932—on the western side of Roubidoux Creek, south of Cookville. Subsequent surveys have failed to detect any further occurrences (Fort Leonard Wood 2006).

TABLE 2-1
Threatened, Endangered, and Species of Conservation Concern at Fort Leonard Wood, Missouri
Decision Document, Fort Leonard Wood, Missouri

Common Name	Scientific Name	Federal Status [a]	State Status/ Rank [b] *	FLW Habitat
Mammals				
Gray bat	*Myotis grisescens*	E	E	Saltpeter No. 3, Davis No. 2, Freeman, and Wolf Den caves
Indiana bat	*Myotis sodalis*	E	E	Brooks, Davis No. 2, Wolf Den, and Joy caves
Long-tailed weasel	*Mustela frenata*		S2	Brushy riparian areas
Eastern small-footed myotis	*Myotis leibii*		SU	Northwest Roubidoux Creek and Ballard Hollow
Golden mouse	*Ochrotomys nuttalli*		S3?	Brushy riparian areas
Northern myotis	*Myotis septentrionalis*		S3	Caves—winter; Trees/rock crevices—summer
Birds				
Bald Eagle	*Haliaeetus leucocephalus*	T	E	Perch along Big Piney River and Roubidoux Creek
Brown Creeper	*Certhia americana*		SU	Riparian areas
Cerulean Warbler	*Dendroica cerulea*		S2S3	Riparian areas
Loggerhead shrike	*Lanius lodovicianus*		S2	Brushy old fields
Sharp-shinned Hawk	*Accipiter striatus*		S2	Upland areas
Great Egret	*Casmerodius albus*		S3	Big Piney River
Marsh Wren	*Cistothorus palustris*		S3	Marshes, wet fields, and brush piles
Chestnut-sided Warbler	*Dendroica pensylvanica*		S3	Woodland and forested areas
Osprey	*Pandion haliaetus*		SU	Big Piney River and Roubidoux Creek
Amphibians and Reptiles				
Grotto salamander	*Typhlotriton spelaeus*		S2S3	Martin and Henshaw Caves
Ringed salamander	*Ambystoma annulatum*		S3	Dry-mesic upland forests and foxholes on Range 12
Eastern hellbender	*Cryptobranchus alleganiensis*		E/S1	Big Piney River is marginal habitat
Bluestripe darter	*Percina cymatotaenia*		S2	Big Piney River/Roubidoux Creek, quiet pools and backwaters
Blacknose shiner	*Notropis heterolepis*		S2	The losing portion of Roubidoux Creek
Plains topminnow	*Fundulus sciadicus*		S3	Falls Hollow tributary and Big Piney River
Mooneye	*Hiodon tergisus*		S3	Big Piney River
Mussels				
Elktoe	*Alasmidonta marginata*		S2?	Roubidoux Creek
Spectaclecase	*Cumberlandia monodonta*		S3	Possibly in Big Piney River and Roubidoux Creek
Crustaceans				
Central Missouri cave amphipod	*Allocrangonyx hubrichti*		S1S2	Killman Cave
Plants				
Narrowleaf rushfoil	*Crotonopsis linearis*		S1	Roubidoux Creek

Notes:

[a] Federal Status:

E = Endangered. Endangered throughout range.

T = Threatened. Threatened throughout range.

[b] State Status/Rank:

E = Endangered. Survival of species in Missouri is in immediate jeopardy.

S1 = Critically imperiled in the state because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation from the state (typically five or fewer occurrences or very few remaining individuals).

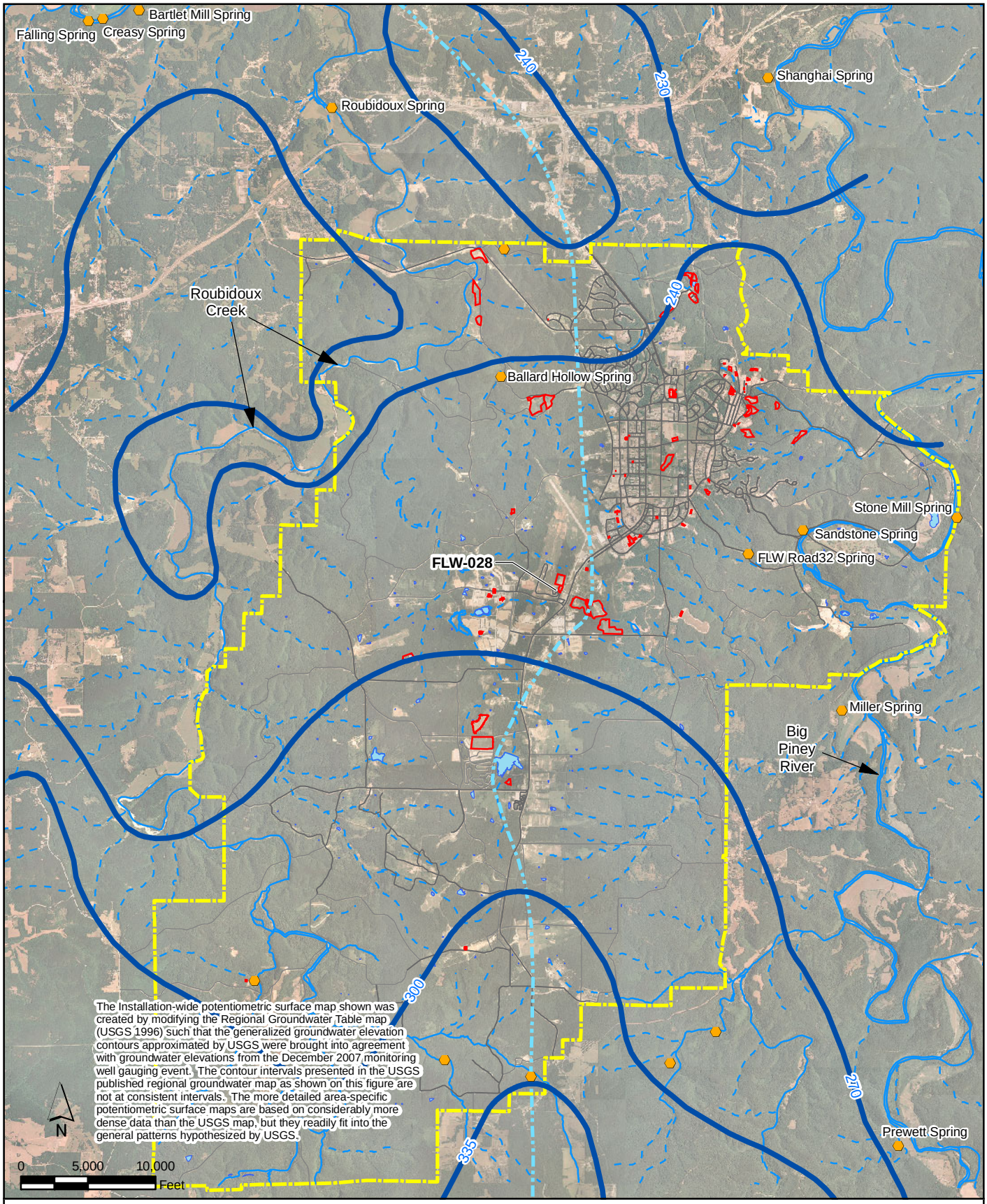
S2 = Imperiled in the state because of rarity or because of some factor(s) making it very vulnerable to extirpation from the state (6 to 20 occurrences or few remaining individuals or acres).

S3 = Rare and uncommon in the state (21 to 100 occurrences).

SU = Unrankable, species is not yet ranked in the state.

? = (Qualifier) Inexact or uncertain; For numeric ranks, denotes inexactness.

* www.mdc.missouri.gov/nathis/endangered/index.htm.



Legend

- Installation Boundary
- IRP Site Boundary
- Permanent Waterbody
- Primary Roads
- Secondary Roads
- Groundwater Divide
- Potentiometric Surface (meters)
- Ephemeral Stream
- Major River/Creek
- Spring

Figure 2-1
Regional Groundwater Table
Decision Document
Fort Leonard Wood, Missouri

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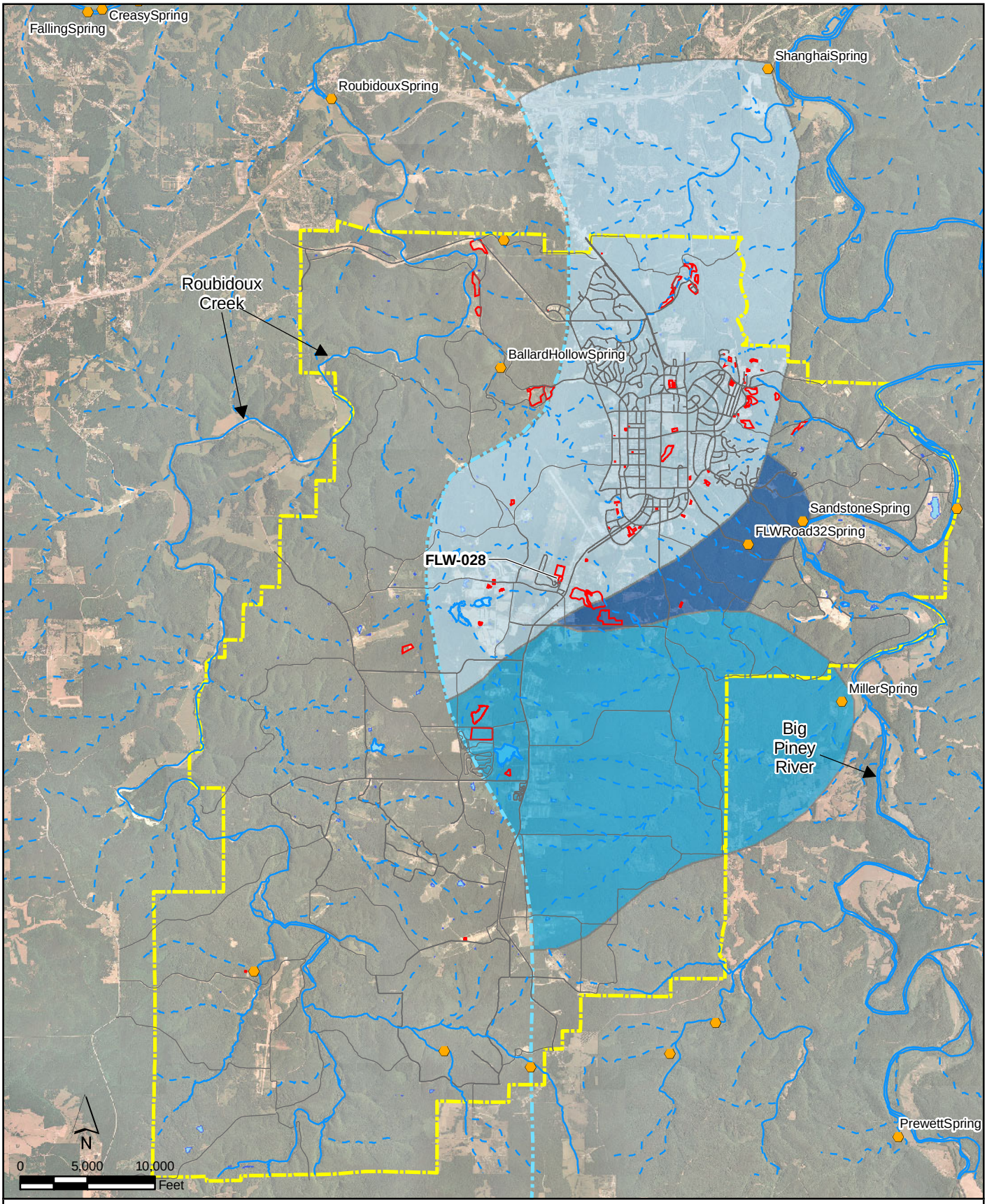

Legend

- Installation Boundary
- IRP Site Boundary
- Shanghai Spring Recharge Basin
- Miller Spring Recharge Basin
- Sandstone Spring Recharge Basin
- Permanent Waterbody
- Primary Roads
- Secondary Roads
- Ephemeral Stream
- Major River/Creek
- Groundwater Divide
- Spring

Figure 2-2
Spring Recharge Basins
Decision Document
Fort Leonard Wood, Missouri

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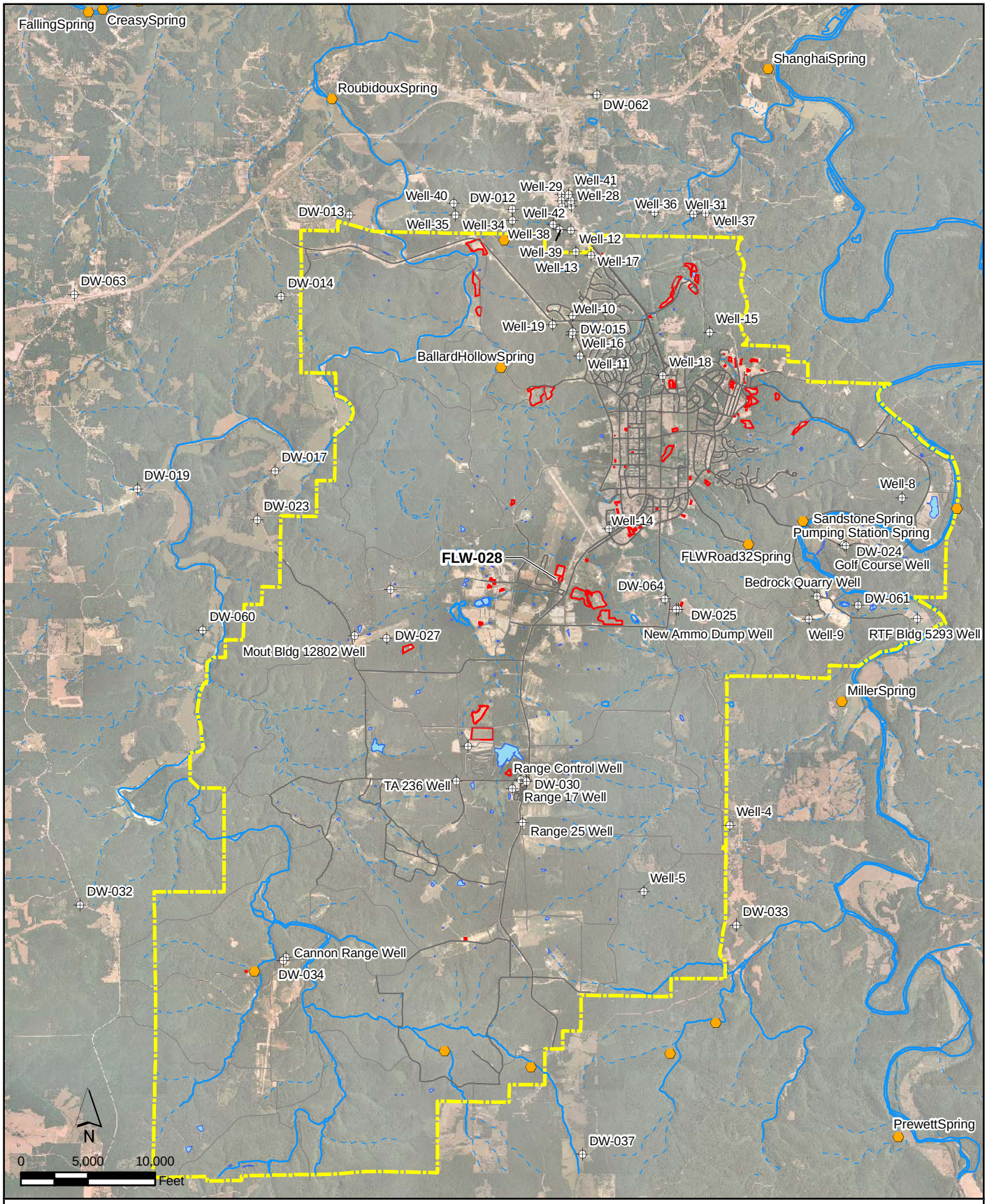

Legend

- Installation Boundary
- IRP Site Boundary
- Primary Roads
- Secondary Roads
- Permanent Waterbody
- Ephemeral Stream
- Perennial Stream
- Drinking Water Well
- Spring

Figure 2-3
Public and Domestic Water Supply Wells
Decision Document
Fort Leonard Wood, Missouri

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3. Decision Summary for FLW-028

This section summarizes the selected remedy for FLW-028, DPW Old Fire Training Area, and documents its removal from the Fort Leonard Wood IRP.

3.1 Site Name, Location, and Description

FLW-028 is a former fire training area located southwest of Forney Army Airfield, in the central part of the post, on a wide ridge that transects the central part of the post from south to north. The area within the site boundary is relatively flat (Figure 3-1). Surface water drainage flows radially away from the site. Engineered drainages that intermittently convey surface water from precipitation events and the spraying of skid tracks are present to the south, east, and west of FLW-028. Earthen berms formerly associated with fire training activities are still in place north of the site. The berms are about 6 feet high and 10 feet wide and constructed of soil excavated from the site (U.S. Army Environmental Hygiene Agency [USAEHA] 1988). Based on a review of Fort Leonard Wood historical records, FLW-028 first appeared as a site in a 1988 Interim Final Report (USAEHA 1988). The site was designated as SWMU-005 in a 1992 RFA Report (Black & Veatch 1992). FLW-028 is currently an IRP site. The U.S. Army is the property owner and lead agency for the action at this site.

3.2 Site History and Enforcement Activities

3.2.1 Site Operations

FLW-028 was used for emergency response fire training from 1972 until 1988 (USAEHA 1988). During fire training operations, which reportedly occurred twice each year, roughly 150 gallons of aviation fuel were placed and ignited on a concrete pad located in the center of the site. In the late 1990s, the area was partially paved with a circular asphalt track that is currently used as a vehicle skid track for military police training (U.S. Army Environmental Center 2006). To simulate wet road conditions during training exercises, large volumes of water are sprayed onto the asphalt skid track from an irrigation system located within the track infield.

3.2.2 Site Investigation Activities

Site investigation activities have been conducted at FLW-028 between 1990 and 2007. The following is a summary of investigation activities conducted in that timeframe.

In 1990, USAEHA advanced 10 soil borings (BH1 through BH10) (Figure 3-2). Seven of the borings were within the bermed area. Soil samples were collected from the soil borings for analysis of volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), explosives, total petroleum hydrocarbons, and toxicity characteristic leaching procedure (TCLP) metals. Explosives, total petroleum hydrocarbons, and TCLP metals were not detected. The only VOCs and SVOCs detected (methylene chloride, acetone, and isophorone) were attributed to laboratory contamination or misidentification (USGS 2000).

In September 1995, the USGS collected 25 surface soil samples (SO-001 through SO-025) and advanced 14 shallow soil borings (A through H and BH-001 through BH-006) (Figure 3-2). The surface soil samples were composited into five samples and analyzed for grain size distribution, inorganic constituents, and bulk mineralogy. Inorganic results for the samples were considered unusable because of discrepancies in the reported units for inorganic results in the source document (USGS 2000). Nine of the shallow soil borings (A through H and BH-003) encountered concrete refusal at 4 feet below ground surface (bgs). The other five boreholes drilled near the berm did not encounter the buried structure. Soil samples from BH-001, BH-002, BH-004, BH-005, and BH-006 were collected from depths of 3 and 6 feet bgs and analyzed for VOCs using a portable gas chromatograph. Although it is not clearly stated in the 2000 USGS report, it appears that samples collected from borings A through H and BH-003 were collected only from a depth of 3 feet bgs. Samples collected from 3 feet bgs in BH-001 through BH-006 were analyzed for SVOCs by an offsite laboratory (USGS 2000). Field gas chromatograph data were not presented individually in the 2000 USGS report; however, the report noted that results were negative with the exception of Borehole G, which contained benzene (estimated concentration of 0.2 microgram per kilogram [µg/kg]), toluene (estimated concentration of 1.5 µg/kg), para-xylene (estimated concentration of 2,000 µg/kg), m-xylene (50 µg/kg), ethylbenzene (not qualified), and various unresolved compounds. The concentration of para-xylene exceeded the screening level. No SVOCs were detected in the samples.

Remedial Investigation (RI) field activities at FLW-028 were performed in June and July 2007. The object of the field investigation was to characterize the extent of contamination in surface soil, subsurface soil, sediment, surface water, and groundwater. The field investigation consisted of drilling, and surface soil, subsurface soil, sediment, and surface water sampling. Soil, sediment, and surface water sample locations are presented in Figures 3-3, 3-4, and 3-5, respectively. No groundwater was encountered during drilling activities. Surface soil, subsurface soil, sediment, and surface water samples were submitted for analysis of VOCs, SVOCs, and inorganics. Total organic carbon was also analyzed in soil samples. SVOCs were retained as PCOCs in sediment and surface water, and inorganics were retained as PCOCs in soil, sediment, and surface water. PCOCs were further evaluated in human health and ecological risk assessments as part of the RI.

A summary of the nature and extent of contamination as observed during the 2007 RI is presented in Section 3.4 of this document.

3.2.3 Previous Remedial Actions

No previous remedial actions are known to have taken place at FLW-028.

3.2.4 Summary of Enforcement Actions

No enforcement actions have been taken at FLW-028. The Army has owned the property since 1941 and has been identified as the responsible party.

3.3 Site Geology and Hydrogeology

Unconsolidated materials underlying the site consist of fill material and native residuum. The residuum is likely derived from the in situ weathering of bedrock units within the

Jefferson City Dolomite. Historic site activities may have altered the shallow soil type. The thickness of fill material and depth to undisturbed native soil could not be determined during the RI. A concrete pad, assumed to be part of the former fire training area, encountered during the 1995 USGS investigation was not encountered during the RI. The dominant soil type observed at FLW-028 was a sandy to gravelly clay. According to regional geologic maps, FLW-028 is located near the contact of the Jefferson City Dolomite and Roubidoux Formation. No karst features have been mapped in the immediate vicinity of FLW-028.

Shallow groundwater was not encountered in soil borings advanced at FLW-028 during the RI. Wet soil conditions were observed in the upper 6 inches of soil in soil borings SS/SB-01 and SS/SB-02. Previous investigations also encountered shallow wet soil conditions. Shallow wet soil conditions are presumed to be the result of training facility personnel spraying water on the skid track to simulate wet road conditions. Based on a USGS regional groundwater map, the depth to regional groundwater beneath the site is roughly 250 feet (76.2 meters) bgs (USGS 2000). Regional groundwater flow is depicted to the northeast, but local flow may vary depending on structural and solution features within the underlying bedrock units. FLW-028 is located within the Shanghai Spring recharge basin.

3.4 Nature and Extent of Site Contaminants

Investigations at FLW-028 identified chemical concentrations in soil, sediment, and surface water samples. Historic samples collected before the 2007 RI and PCOCs identified are presented in Figure 3-2. The historic data were used to establish the scope of the 2007 sampling program. However, the historic data were not used to define PCOCs because of uncertainties and the screening-level quality of these data. These factors precluded the use of historic data in the risk assessment calculations. PCOCs identified from 2007 RI sampling are shown in Figures 3-3 through 3-5. The following subsections focus on the 2007 RI findings.

3.4.1 Soil

Table 3-1 summarizes the chemicals detected in soil. Chemical concentrations that exceed screening levels are highlighted in the table. Chemicals with one or more highlighted concentration correspond to PCOCs. Figure 3-3 displays the distribution of PCOCs in soil. No VOCs and SVOCs were detected in soil at concentrations exceeding their screening levels.

Eight inorganics were detected at concentrations exceeding their screening levels. These include aluminum, arsenic, beryllium, lead, manganese, selenium, thallium, and vanadium. Aluminum, arsenic, beryllium, and lead were detected at concentrations exceeding their screening levels at each of the surface and subsurface soil sampling locations. Aluminum, manganese, selenium, thallium, and vanadium were detected at concentrations below their respective MRBCA DTLs, which are 10 times greater than the screening levels used in this RI. The concentrations of inorganics are within the range of published inorganic concentrations in Missouri soil (Tidball 1984). The lateral and vertical distribution of inorganics is relatively uniform at FLW-028. These facts suggest that inorganics in soil are most likely naturally occurring and not attributed to fire training activities.

3.4.2 Sediment

Table 3-2 summarizes the chemicals detected in sediment. Chemical concentrations that exceed screening levels are highlighted in the table. Chemicals with one or more highlighted concentration correspond to PCOCs. Figure 3-4 presents the distribution of PCOCs in sediment at FLW-028. No VOCs were detected in sediment at concentrations exceeding their screening levels.

Benzo(a)pyrene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene were detected in sediment at concentrations above their screening levels. The SVOCs exceeding their screening levels were detected at concentrations below their respective MRBCA DTLs, which are 10 times greater than the screening levels used in this RI.

The presence of SVOCs in sediment may be attributable to chemicals released from the asphalt skid track. Asphalt products, particularly sealants, are prepared using petroleum products that contain a mixture of aliphatic and aromatic hydrocarbons, including polycyclic aromatic hydrocarbons (PAHs) such as those found in the FLW-028 sediment (Simon and Sobieraj 2006). The absence of semivolatile organic compounds concentrations above screening levels in soil within the infield of the skid track, where the concrete pad was previously located, suggests that SVOCs in sediment did not originate from this area.

The inorganics detected above screening levels in sediment were the same chemicals found above screening levels in soil. Aluminum, arsenic, beryllium, lead, selenium, and thallium were detected at concentrations above screening levels in both sediment samples. Vanadium was detected at a concentration above its screening level in sediment sample SD-01 and manganese was detected at a concentration above its screening level in sediment sample SD-02. The chemical concentrations in sediment are comparable to those in soil and are within the range of published inorganic concentrations in Missouri soil (Tidball 1984). This suggests that inorganics are naturally occurring and not attributed to site activities.

3.4.3 Surface Water

Table 3-3 summarizes the chemicals detected in surface water. Chemical concentrations that exceed screening levels are highlighted in the table. Chemicals with one or more highlighted concentration correspond to PCOCs. Figure 3-5 presents the distribution of PCOCs in surface water at FLW-028. No VOCs were detected in surface water at concentrations exceeding their screening levels.

Bis(2-ethylhexyl)phthalate exceeded its screening level in surface water sample SW-01. This chemical was detected at a concentration below its MRBCA DTL, which is 10 times greater than the screening levels used in this RI. It is a common laboratory contaminant according to the National Functional Guidelines. Although not specifically found in the blank sample associated with the surface water sample, it is possible that this estimated concentration is an artifact that originated with plasticizer leaching from the sampling or laboratory apparatus, and it is not actually present in surface water. This conclusion is based on the absence of bis(2-ethylhexyl)phthalate in sediment, soil, and surface water sample SW-02, and the low-level concentration detected in sample SW-01.

Three inorganics (arsenic, lead, and zinc) were detected in surface water at concentrations above their screening levels. The concentrations of inorganics in surface water are likely related to the concentrations of inorganics present in sediment and soil.

3.5 Current and Future Land and Resource Use

The site is used as a skid track for military police driver training and is expected to remain as such into the foreseeable future.

3.6 Summary of Site Risks

3.6.1 Human Health Risk Assessment

A MRBCA Tier 1 risk assessment was conducted for FLW-028. Chemicals of concern (COCs), potential exposure pathways, estimated chemical intakes, risk characterization, uncertainties (including an evaluation of chemicals that were 100 percent nondetected in an environmental matrix), and conclusions are presented in the RI Report (CH2M HILL 2009). This subsection summarizes the risk assessment.

3.6.1.1 Identification of Chemicals of Concern

Chemicals present at concentrations that exceed screening levels in one or more samples in each environmental medium (soil, surface water, sediment) were identified as PCOCs. Conservative screening levels were developed using the MRBCA framework (MDNR 2006). When developing the screening levels, the DTLs in MRBCA were adjusted downward by a factor of 10 to reflect an ELCR of 1×10^{-6} and a noncancer HI of 0.1.

For each environmental matrix evaluated during the risk assessment, the dataset was partitioned into two lists: one consisting of chemicals 100 percent not detected throughout the matrix (and specific soil zone), the other consisting of chemicals detected at least once (as described by MRBCA Section 7).

Following a screening process described in the RI Report, COCs were identified for each environmental medium at FLW-028. Detected chemicals that may be within background concentrations were retained as COCs for the risk estimates.

3.6.1.2 Exposure Assessment

The purpose of the exposure assessment was to estimate the type and magnitude of exposures to the COCs present or migrating from the site. The results of the exposure assessment are combined with chemical-specific toxicity information to characterize potential risk. Potential exposure pathways and receptors for FLW-028 are summarized in the conceptual site model (Figure 3-6).

Consistent with the current and foreseeable land uses specified in Section 3.5, the HHRA identified three types of onsite receptors: military personnel (military police who drive vehicles around the track for a few weeks as part of their advanced training); civilian instructors (who are present daily, mostly in Building 5153, which contains training classrooms and offices); and vehicle maintenance workers (civilian or military personnel who

are present daily, typically outdoors near Building 5153). The current and future onsite receptors were categorized as nonresidential worker receptors to perform the risk characterization. Construction workers will be potential future receptors during site redevelopment. A residential exposure scenario was evaluated in the HHRA because residential use may be a reasonably foreseeable land use for the site. Potential current and future exposures to surface soil (including inhalation of vapor emissions and particulates), construction zone soil (including inhalation of vapor emissions and particulates), surface water, and sediment (including inhalation of vapor emissions and particulates) were considered.

Shallow groundwater was not encountered within 13 feet of the ground surface. Migration of PCOCs in soil and sediment to groundwater is unlikely because of the low mobility of PCOCs, their low concentrations, and the absence of shallow groundwater. Visual observations of the soil during drilling indicate that the clay overburden is continuous. Based on a USGS regional groundwater map, the depth to regional groundwater beneath the site is roughly 250 feet bgs (USGS 2000). The tight nature of the soils at the site combined with the significant depth to the regional water bearing zone indicate that the site will have minimal or no impact on the regional groundwater resource. Therefore, the groundwater exposure pathway was not addressed directly in the Tier 1 risk assessment.

To evaluate possible migration of contaminants from FLW-028 into domestic groundwater, chemical concentrations of PCOCs in soil, sediment, and surface water were compared to MRBCA Appendix B, Table 11 concentrations, which are considered protective for domestic use of groundwater; results are provided below:

- Soil—Average concentrations do not exceed concentrations protective of groundwater.
- Sediment—Average concentrations are less than soil concentrations protective of groundwater except for arsenic and lead; however, sufficient time has elapsed for arsenic and lead to leach to groundwater, and site activities are not expected to result in significant leaching because of the neutral pH of the water used to wet the track. Therefore, a future increased rate of leaching of arsenic and lead into groundwater is highly unlikely.
- Surface Water—Average concentrations do not exceed concentrations protective of groundwater.

3.6.1.3 Toxicity Assessment

The purpose of the toxicity assessment is to provide an estimate of the relationship between the extent of exposure to a contaminant and the likelihood or severity of adverse effects. The toxicity data for the COCs are those presented in MRBCA documentation. For COCs without published toxicity values, toxicity values for surrogate chemicals are used. For exposure routes with missing toxicity values, toxicity data for other routes of exposure were used. The target organs and critical effects of COCs were obtained from USEPA Soil Screening Guidance (USEPA 1996).

3.6.1.4 Risk Characterization

Based on the appropriate exposure profiles for each potential receptor, the total site risk estimates were summed across the COCs for the following receptors and media (note that

surface soil, construction zone soil, and sediment exposure scenarios include inhalation of vapor emissions and particulates):

- Future onsite residents (adult and child)—surface soil, surface water, and sediment
- Future onsite construction workers—construction zone soil
- Current/future onsite nonresidential workers—surface soil, surface water, and sediment

After calculating the Tier 1 ELCRs and HIs, the total site risks were compared with the risk thresholds to determine whether a recommendation of no action is appropriate for the site.

Results of the Tier 1 HHRA indicate that individual ELCR estimates exceed acceptable levels for residents because of arsenic and beryllium concentrations in soil and sediment. However, maximum detected concentrations of arsenic and beryllium in soil and sediment are lower than the background threshold values for these chemicals (CH2M HILL 2008). The comparison of arsenic and beryllium concentrations in soil and sediment against Fort Leonard Wood site-wide background is presented in Table 3-4. Risk estimates were recalculated after eliminating arsenic and beryllium from the risk calculations for soil and sediment. Revised estimates indicate that potential site-related risks are within acceptable levels for residents, nonresidential workers, and construction workers. USEPA's and MDNR's acceptable range for total receptor risk (from all chemicals and exposure pathways) is 1×10^{-4} to 1×10^{-6}, and the target IELCR level used by MDNR for individual pathways and chemicals is 1×10^{-5}. Acceptable levels of noncancer risk are defined by USEPA and MDNR as a target organ-specific HI of 1 or less. Table 3-5 presents the three receptor groups and the cumulative risk estimates from exposure to all applicable media.

As noted in Section 1.3.4., non-detected chemicals with sample quantitation limits above screening levels were identified as possible PCOCs. The chemicals were evaluated in the HHRA, and the risk estimates associated with the chemicals were well below acceptable risk thresholds. The evaluation of the chemicals is provided in the RI Report (CH2M HILL 2009).

3.6.2 Ecological Risk Assessment

The ERA for FLW-028 was conducted in a manner consistent with the draft final MRBCA technical guidance (MDNR 2006) and USEPA guidance for ecological risk assessments (USEPA 1992, 1997, 1998) and is completed through Step 3 of the eight-step ERA process. A detailed description of the process can be found in Section 4.3 and the RI Work Plan (CH2M HILL 2007). Both MRBCA and USEPA guidance recommend an iterative approach that uses screening steps to focus the ERA on media, pathways, and receptors with the greatest potential to drive unacceptable risk. For Site FLW-028, the screening steps in the MRBCA approach were modified to be more consistent with those in USEPA guidance. The object was to ensure that PCOCs and receptors were not screened out of the ERA prematurely.

3.6.2.1 Screening Level Risk Assessment

The ERA began with a screening level risk assessment (SLERA) that incorporated MRBCA Levels 1 and 2 ecological risk evaluations. The MRBCA Level 1 evaluation indicated complete pathways to ecological receptors are present for the chemicals identified by comparison of site data to MRBCA Table 5-1 and DTLs. A Level 2 evaluation was therefore required to determine whether the chemicals pose unacceptable risk.

A preliminary problem formulation process was conducted to guide the SLERA process. Problem formulation establishes the goals, scope, and focus of an ERA. Based on the overall setting of Fort Leonard Wood and specific site characteristics for FLW-028, a generic conceptual site model was developed and presented in the RI Work Plan (CH2M HILL 2007). The potential source area is the exposed soil in the former fire training area. Assessment and measurement endpoints were selected to evaluate receptors for which complete and ecologically important exposure pathways exist. The fate, transport, and toxicological properties of the chemicals, particularly the potential for bioaccumulation, were also considered during this process. Ecological habitat at Fort Leonard Wood includes forests, grasslands, and wetlands/riparian zones that support a diversity of plant and animal species. FLW-028 consists of maintained grassy areas and roadways with drainage ditches west and southeast of the site that receive surface runoff.

The SLERA analysis consisted of an exposure assessment and an effects assessment. The principal activity associated with the exposure assessment was to estimate exposure point concentrations (EPCs) for chemicals to which ecological receptors may be exposed. For the SLERA, the EPCs were the maximum detected concentrations in surface soil, surface water, and sediment. For bioaccumulative constituents in the media, the maximum detected concentrations were used in bioaccumulation and food web models to estimate exposures to upper trophic level receptors. Chemical exposure levels (screening values) were developed in the effects assessment to represent conservative thresholds for adverse ecological effects.

The risk characterization part of the SLERA used the information generated during the problem formulation, exposure assessment, and effects assessment to estimate potential risks to ecological receptors. PCOCs were selected using the hazard quotient method as described in Section 4.0 of the RI Report. Two sets of risk calculations were performed, direct exposure (lower trophic level receptors) and food web exposure (upper trophic level receptors) for both terrestrial and aquatic habitats.

The SLERA identified PCOCs in surface soils (food web and direct exposure), surface water (direct exposure only), and sediment (direct exposure only). However, the risk estimates were based on conservative assumptions and had a high degree of uncertainty and, therefore, the results were not suited for decision making purposes. To put the identified potential risk in context, the ecological risk process proceeded to the first step of the baseline ecological risk assessment (BERA) (Step 3), which involved refining the assumptions and methods used in the SLERA to be more realistic of actual ecological receptor exposure and potential effects conditions.

3.6.2.2 Baseline Ecological Risk Assessment

In the initial step of the BERA, the PCOCs from the SLERA were reexamined using more realistic exposure assumptions to determine the range of potential risks and to determine whether the PCOCs should be eliminated from further consideration. Using less conservative and more realistic assumptions, such as average concentrations instead of maximum concentrations as EPCs, potential risks were identified for fewer compounds as compared to the potential risks identified using very conservative assumptions in the SLERA.

Aquatic and Terrestrial Food Web Exposure. Potential risks to upper trophic level receptors was not identified following the refinement of conservative assumptions.

Terrestrial Plants and Soil Invertebrates (Direct Exposure to Chemicals in Soil). Potential risk was indicated to terrestrial plants and soil invertebrates from direct exposure to four inorganic chemicals: aluminum, chromium, selenium, and vanadium. However, the levels of constituents were similar to regional background levels, and the screening values were either very conservative or based on other exposure routes. Since available habitat was limited to mowed grassy areas, although plant and invertebrate receptors are present at the site, the habitat does not represent a natural ecosystem as it is controlled by human activity. It was concluded that, although adverse effects to terrestrial plants and soil invertebrates could occur, the nature of the habitat in this regularly disturbed area is likely to limit the diversity/abundance of terrestrial plants and soil invertebrates and the overall potential for adverse effects to those receptor communities. The conditions suggest that risk is negligible, and no further investigation is warranted.

Aquatic Invertebrates, Plants, and Fish (Direct Exposure to Constituents in Sediment and Surface Water). Potential risk to invertebrates was indicated from zinc in surface water and PAHs in sediment. For zinc, the screening value was adjusted based on hardness levels and found to be higher than the levels measured at the site. For PAHs, risk to benthic organisms was not predicted after an equilibrium partitioning analysis. The results suggest that risk is negligible, and no further investigation is warranted.

3.7 Selected Remedy

Based on data collected and HHRA and ERA conclusions from the RI, no action will be performed at FLW-028, because action is not necessary at this site to protect public health or welfare or the environment. FLW-028 will be categorized as RC in the AEDB-R. Because no response actions are required, an RC determination for this site is appropriate and consistent with Section 6.13 of the *Army Defense Environmental Restoration Program Management Guidance for Active Installations* (Department of the Army 2004).

TABLE 3-1
2007 Remedial Investigation Results—Summary of Chemicals Detected in Soil
Decision Document, Fort Leonard Wood, Missouri

Chemical	Units	CASRN	Screening Level	FLW-028-SS-01/SB-01 028-SS-01-00 0–2 6/8/2007	FLW-028-SS-01/SB-01 028-SS-01-1.5 1.5–2 6/8/2007	FLW-028-SS-01/SB-01 028-SB-01-03 3–5 6/8/2007	FLW-028-SS-01/SB-01 028-SB-01-06 6–8 6/8/2007	FLW-028-SS-02/SB-02 028-SS-02-00 0–2 6/8/2007	FLW-028-SS-02/SB-02 028-SS-02-00 FD 0–2 6/8/2007	FLW-028-SS-02/SB-02 028-SB-02-05 5–7 6/8/2007	FLW-028-SS-02/SB-02 028-SB-02-07 7–9 6/8/2007	FLW-028-SS-03/SB-03 028-SS-03-00 0–2 6/8/2007	FLW-028-SS-03/SB-03 028-SS-03-1.5 1.5–2 6/8/2007	FLW-028-SS-03/SB-03 028-SB-03-05 5–7 6/8/2007
Volatile Organic Compounds														
1,1-Dichloroethene	µg/kg	75-35-4	10.8	—	< 0.52	< 0.65	< 0.74	< 0.7	< 0.73	< 0.74	< 0.75	—	< 0.73	< 0.72
Acetone	µg/kg	67-64-1	420	—	< 4.7	< 6	< 6.8	< 6.4	< 6.7	< 6.8	< 6.8	—	< 6.7	< 6.6
Benzene	µg/kg	71-43-2	5.61	—	< 0.41	< 0.52	< 0.59	< 0.56	< 0.58	< 0.59	< 0.6	—	< 0.58	< 0.58
Chloroform	µg/kg	67-66-3	7.66	—	< 0.26	< 0.32	< 0.37	< 0.34	**0.43 J**	**1.8 J**	**0.9 J**	—	< 0.36	< 0.36
Semivolatile Organic Compounds														
bis(2-Ethylhexyl)phthalate	µg/kg	117-81-7	34,700	**370 J**	—	**140 J**	**200 J**	**110 J**	**110 J**	**340 J**	**130 J**	**140 J**	—	**170 J**
Benzo(a)anthracene	µg/kg	56-55-3	612	< 24	—	< 28	< 28	< 24	**56 J**	< 28	< 26	< 24	—	< 28
Benzo(a)pyrene	µg/kg	50-32-8	62	< 24	—	< 28	< 28	< 24	**58 J**	< 28	< 26	< 24	—	< 28
Benzo(b)fluoranthene	µg/kg	205-99-2	619	**110 J**	—	< 37	< 37	**98 J**	**170 J**	< 36	< 34	**130 J**	—	< 36
Benzo(ghi)perylene	µg/kg	191-24-2	172,000	< 19	—	< 23	< 22	< 19	**73 J**	< 22	< 21	**56 J**	—	< 22
Chrysene	µg/kg	218-01-9	59,900	< 33	—	< 38	< 38	< 32	**68 J**	< 37	< 35	**42 J**	—	< 37
Fluoranthene	µg/kg	206-44-0	228,000	< 43	—	< 51	< 50	< 43	**120 J**	< 50	< 46	**48 J**	—	< 50
Indeno(1,2,3-cd)pyrene	µg/kg	193-39-5	377	< 27	—	< 31	< 31	< 26	**47 J**	< 30	< 28	< 26	—	< 30
Phenanthrene	µg/kg	85-01-8	15,800	< 20	—	< 24	< 24	< 20	**68 J**	< 24	< 22	< 20	—	< 23
Pyrene	µg/kg	129-00-0	150,000	< 15	—	< 17	< 17	< 14	**110 J**	< 17	< 16	**45 J**	—	< 17
Inorganics														
Aluminum	mg/kg	7429-90-5	7,550	**17,000**	—	**35,000**	**29,000**	**16,000**	**22,000**	**28,000**	**11,000**	**17,000**	—	**32,000**
Arsenic	mg/kg	7440-38-2	0.389	**5.9**	—	**9.1**	**5**	**6.4**	**7.2**	**6.1**	**2.2**	**5.9**	—	**6**
Barium	mg/kg	7440-39-3	204	**70**	—	**38**	**32**	**61**	**79**	**37**	**15**	**62**	—	**42**
Beryllium	mg/kg	7440-41-7	0.0737	**0.42**	—	**0.84**	**0.64**	**0.48**	**0.46**	**0.62**	**0.38**	**0.42**	—	**0.57**
Cadmium	mg/kg	7440-43-9	0.931	< 0.049	—	< 0.058	< 0.057	< 0.049	< 0.05	< 0.057	< 0.053	< 0.049	—	< 0.056
Calcium	mg/kg	7440-70-2	NA	**21,000**	—	**600**	**460**	**4,100**	**3,900**	**140**	**46 J**	**47,000**	—	**2,600**
Chromium	mg/kg	7440-47-3	7,460	**22**	—	**25**	**16**	**71 J**	**25 J**	**19**	**7.2**	**19**	—	**29**
Cobalt	mg/kg	7440-48-4	50.5	**3.7**	—	**4.4**	**2.8**	**3.2**	**4.1**	**2.9**	**1.9**	**3**	—	**3.1**
Copper	mg/kg	7440-50-8	61.7	**8.6**	—	**23**	**13**	**8.4**	**11**	**15**	**7.5**	**8.9**	—	**18**
Iron	mg/kg	7439-89-6	NA	**18,000**	—	**35,000**	**21,000**	**36,000**	**22,000**	**25,000**	**7,900**	**18,000**	—	**34,000**
Lead	mg/kg	7439-92-1	0.374	**13**	—	**32**	**18**	**18**	**15**	**17**	**8.4**	**13**	—	**22**
Magnesium	mg/kg	7439-95-4	NA	**13,000**	—	**1,300**	**980**	**2,900**	**3,100**	**890**	**490**	**30,000**	—	**2,100**
Manganese	mg/kg	7439-96-5	272	**190**	—	**140**	**94**	**160**	**170**	**68**	**19**	**160**	—	**110**
Mercury	mg/kg	7439-97-6	0.219	**0.026 J**	—	**0.0048 J**	< 0.0039	**0.016 J**	**0.016 J**	**0.0054 J**	< 0.0036	**0.022 J**	—	< 0.0039
Molybdenum	mg/kg	7439-98-7	3.87	**0.68 J**	—	**0.85 J**	**0.52 J**	**1.3 J**	**0.69 J**	**0.67 J**	< 0.33	**0.55 J**	—	**1.4 J**
Nickel	mg/kg	7440-02-0	50.5	**7.7**	—	**19**	**12**	**7.3**	**9.5**	**13**	**5.4**	**8.1**	—	**13**
Potassium	mg/kg	7440-09-7	NA	**850**	—	**2,100**	**1,600**	**690**	**1,100**	**1,300**	**840**	**910**	—	**1,500**
Selenium	mg/kg	7782-49-2	0.627	**0.53 J**	—	**0.49 J**	**0.41 J**	**0.5 J**	**0.64**	**0.4 J**	**0.34 J**	**0.76**	—	**0.39 J**
Sodium	mg/kg	7440-23-5	NA	**73 J**	—	**110 J**	**100 J**	< 70	**73 J**	**91 J**	< 76	**150 J**	—	**120 J**
Thallium	mg/kg	7440-28-0	0.22	**0.17**	—	**0.33**	**0.24**	**0.18**	**0.17**	**0.21**	**0.11 J**	**0.14**	—	**0.23**
Vanadium	mg/kg	7440-62-2	53	**38**	—	**62**	**42**	**84 J**	**46 J**	**48**	**13**	**40**	—	**63**
Zinc	mg/kg	7440-66-6	722	**19**	—	**32**	**27**	**17**	**24**	**24**	**12**	**19**	—	**26**
General Chemistry														
Total Organic Carbon by SW846-9060	g/kg	7440-44-0	NA	**6.1**	—	< 0.061	**0.35 J**	**4.8**	**4.5**	**2.7**	**2.9**	**2.1**	—	**0.34 J**

Notes:
Bold indicates a detected concentration.
Bold on gray indicates a detected concentration above the screening level.
CASRN = Chemical Abstract Services Registry Number
NA = Screening level not available for this chemical.
"—" = Not Sampled.
J = Reported value is estimated.
R = Data rejected during validation.
< = Chemical not detected above the sample quantitation limit.
The reported results have been corrected for moisture content.

TABLE 3-1
2007 Remedial Investigation Results—Summary of Chemicals Detected in Soil
Decision Document, Fort Leonard Wood, Missouri

Chemical	Units	CASRN	Screening Level	FLW-028-SS-03/SB-03 028-SB-03-07 7–9 6/8/2007	FLW-028-SS-03/SB-03 028-SB-03-07FD 7–9 6/8/2007	FLW-028-SS-04/SB-04 028-SS-04-00 0–2 6/8/2007	FLW-028-SS-04/SB-04 028-SS-04-1.5 1.5–2 6/8/2007	FLW-028-SS-04/SB-04 028-SB-04-03 3–5 6/8/2007	FLW-028-SS-04/SB-04 028-SB-04-05 5–7 6/8/2007	FLW-028-SS-05/SB-05 028-SS-05-00 0–2 6/8/2007	FLW-028-SS-05/SB-05 028-SS-05-1.5 1.5–2 6/8/2007	FLW-028-SS-05/SB-05 028-SB-05-03 3–5 6/8/2007	FLW-028-SS-05/SB-05 028-SB-05-08 8–10 6/8/2007
Volatile Organic Compounds													
1,1-Dichloroethene	µg/kg	75-35-4	10.8	< 0.37	< 0.79	—	< 0.57	< 0.7	**1 J**	—	< 0.49	< 0.65	< 0.74
Acetone	µg/kg	67-64-1	420	< 3.4	< 7.2	—	< 5.2	< 6.4	**9.9 J**	—	< 4.5	< 5.9	< 6.7
Benzene	µg/kg	71-43-2	5.61	< 0.29	< 0.63	—	< 0.46	< 0.56	< 0.61	—	< 0.39	**0.67 J**	< 0.59
Chloroform	µg/kg	67-66-3	7.66	< 0.18	< 0.39	—	< 0.28	< 0.35	< 0.38	—	< 0.24	< 0.32	< 0.36
Semivolatile Organic Compounds													
bis(2-Ethylhexyl)phthalate	µg/kg	117-81-7	34,700	< 64	**200 J**	**140 J**	—	**160 J**	**580**	**160 J**	—	**140 J**	**140 J**
Benzo(a)anthracene	µg/kg	56-55-3	612	< 28	< 30	< 23	—	< 26	< 26	< 23	—	< 26	< 27
Benzo(a)pyrene	µg/kg	50-32-8	62	< 28	< 30	< 23	—	< 26	< 26	< 23	—	< 26	< 27
Benzo(b)fluoranthene	µg/kg	205-99-2	619	< 37	< 39	< 30	—	< 35	< 34	< 30	—	< 34	< 35
Benzo(ghi)perylene	µg/kg	191-24-2	172,000	< 22	< 24	< 18	—	< 21	< 21	< 18	—	< 21	< 21
Chrysene	µg/kg	218-01-9	59,900	< 38	< 40	< 31	—	< 36	< 35	< 31	—	< 35	< 36
Fluoranthene	µg/kg	206-44-0	228,000	< 50	< 53	< 41	—	< 48	< 47	< 41	—	< 47	< 48
Indeno(1,2,3-cd)pyrene	µg/kg	193-39-5	377	< 31	< 33	< 25	—	< 29	< 29	< 25	—	< 28	< 29
Phenanthrene	µg/kg	85-01-8	15,800	< 24	< 25	< 19	—	< 23	< 22	< 20	—	< 22	< 23
Pyrene	µg/kg	129-00-0	150,000	< 17	< 18	< 14	—	< 16	< 16	< 14	—	< 16	< 16
Inorganics													
Aluminum	mg/kg	7429-90-5	7,550	**28,000**	**34,000**	**12,000**	—	**31,000**	**19,000**	**11,000**	—	**25,000**	**35,000**
Arsenic	mg/kg	7440-38-2	0.389	**5.6**	**6.1**	**5.5**	—	**5.1 J**	**3.3**	**3.6**	—	**7**	**6**
Barium	mg/kg	7440-39-3	204	**32**	**37**	**67**	—	**56**	**23**	**65**	—	**60**	**42**
Beryllium	mg/kg	7440-41-7	0.0737	**0.57**	**0.61**	**0.52**	—	**0.68**	**0.49**	**0.41**	—	**0.57**	**0.74**
Cadmium	mg/kg	7440-43-9	0.931	< 0.057	< 0.061	< 0.046	—	< 0.054	< 0.053	**0.12 J**	—	< 0.053	< 0.055
Calcium	mg/kg	7440-70-2	NA	**840**	**990**	**8,300**	—	**1,200**	**1,000**	**10,000**	—	**1,500**	**320**
Chromium	mg/kg	7440-47-3	7,460	**18**	**23**	**20**	—	**26 J**	**13**	**15**	—	**30**	**23**
Cobalt	mg/kg	7440-48-4	50.5	**2.8**	**3.3**	**4.3**	—	**3.2**	**1.9**	**4.8**	—	**3.7**	**4**
Copper	mg/kg	7440-50-8	61.7	**15**	**17**	**6.3**	—	**16**	**8.9**	**10**	—	**12**	**18**
Iron	mg/kg	7439-89-6	NA	**24,000**	**27,000**	**17,000**	—	**30,000**	**12,000**	**13,000**	—	**27,000**	**26,000**
Lead	mg/kg	7439-92-1	0.374	**20**	**21**	**15**	—	**19 J**	**10**	**15**	—	**15**	**22**
Magnesium	mg/kg	7439-95-4	NA	**1,200**	**1,300**	**4200**	—	**1600**	**980**	**6,500**	—	**1,300**	**1,200**
Manganese	mg/kg	7439-96-5	272	**120**	**100**	**280**	—	**R**	**57**	**400**	—	**200**	**110**
Mercury	mg/kg	7439-97-6	0.219	< 0.0039	< 0.0041	**0.04**	—	**0.011 J**	**0.0036 J**	**0.0073 J**	—	**0.02 J**	**0.02 J**
Molybdenum	mg/kg	7439-98-7	3.87	**0.44 J**	**0.54 J**	**0.71 J**	—	**0.69 J**	**0.63 J**	**0.45 J**	—	**0.88 J**	**0.53 J**
Nickel	mg/kg	7440-02-0	50.5	**12**	**15**	**6.4**	—	**17**	**7.5**	**7.1**	—	**11**	**16**
Potassium	mg/kg	7440-09-7	NA	**1500**	**1,700**	**640**	—	**1,600**	**1,200**	**860**	—	**1,200**	**1,900**
Selenium	mg/kg	7782-49-2	0.627	**0.37 J**	**0.45 J**	**0.62**	—	**0.44 J**	**0.27 J**	**0.35 J**	—	**0.62 J**	**0.39 J**
Sodium	mg/kg	7440-23-5	NA	< 82	**110 J**	< 67	—	< 78	< 77	< 68	—	**89 J**	**81 J**
Thallium	mg/kg	7440-28-0	0.22	**0.2**	**0.22**	**0.15**	—	**0.19**	**0.098 J**	**0.12**	—	**0.22**	**0.25**
Vanadium	mg/kg	7440-62-2	53	**47**	**53**	**35**	—	**55**	**23**	**26**	—	**54**	**51**
Zinc	mg/kg	7440-66-6	722	**26**	**29**	**17**	—	**26**	**15**	**32**	—	**22**	**33**
General Chemistry													
Total Organic Carbon by SW846-9060	g/kg	7440-44-0	NA	**4.8**	**0.97 J**	**6.1**	—	**1.4 J**	**2.7**	**9**	—	**3.1**	**0.29 J**

Notes:
Bold indicates a detected concentration.
Bold on gray indicates a detected concentration above the screening level.
CASRN = Chemical Abstract Services Registry Number
NA = Screening level not available for this chemical.
"—" = Not Sampled.
J = Reported value is estimated.
R = Data rejected during validation.
< = Chemical not detected above the sample quantitation limit.
The reported results have been corrected for moisture content.

TABLE 3-2
2007 Remedial Investigation Results—Summary of Chemicals Detected in Sediment
Decision Document, Fort Leonard Wood, Missouri

			Location>>	FLW-028-SW-01/SD-01	FLW-028-SW-02/SD-02
			Sample ID>>	028-SD-01-00	028-SD-02-00
			Sample Depth (ft)>>	0–0.5	0–0.5
			Sample Date>>	7/17/2007	7/17/2007
Chemical	Units	CASRN	Screening Level		
Semivolatile Organic Compounds					
bis(2-Ethylhexyl)phthalate	µg/kg	117-81-7	34,700	**150 J**	**120 J**
Carbazole	µg/kg	86-74-8	1,330	< 58	**70 J**
Benzo(a)anthracene	µg/kg	56-55-3	612	< 32	**97 J**
Benzo(a)pyrene	µg/kg	50-32-8	62	**120 J**	**260 J**
Benzo(b)fluoranthene	µg/kg	205-99-2	619	**260 J**	**780 J**
Benzo(ghi)perylene	µg/kg	191-24-2	172,000	**180 J**	**460**
Chrysene	µg/kg	218-01-9	59,900	**130 J**	**310 J**
Dibenzo(a,h)anthracene	µg/kg	53-70-3	62	< 31	**72 J**
Fluoranthene	µg/kg	206-44-0	228,000	**130 J**	**240 J**
Indeno(1,2,3-cd)pyrene	µg/kg	193-39-5	377	**140 J**	**370 J**
Phenanthrene	µg/kg	85-01-8	15,800	< 27	**77 J**
Pyrene	µg/kg	129-00-0	150,000	**130 J**	**240 J**
Inorganics					
Aluminum	mg/kg	7429-90-5	7,550	**30,000**	**18,000**
Arsenic	mg/kg	7440-38-2	0.389	**11**	**5.6**
Barium	mg/kg	7440-39-3	204	**69**	**110**
Beryllium	mg/kg	7440-41-7	0.0737	**0.73**	**0.66**
Calcium	mg/kg	7440-70-2	NA	**3,300**	**2,800**
Chromium	mg/kg	7440-47-3	7,460	**36**	**25**
Cobalt	mg/kg	7440-48-4	50.5	**3.7**	**7.6**
Copper	mg/kg	7440-50-8	61.7	**12**	**8**
Iron	mg/kg	7439-89-6	NA	**33,000**	**20,000**
Lead	mg/kg	7439-92-1	0.374	**28**	**20**
Magnesium	mg/kg	7439-95-4	NA	**2,400**	**2,600**
Manganese	mg/kg	7439-96-5	272	**200**	**360**
Molybdenum	mg/kg	7439-98-7	3.87	**0.98 J**	**0.73 J**
Nickel	mg/kg	7440-02-0	50.5	**12**	**9**
Potassium	mg/kg	7440-09-7	NA	**1,200**	**960**
Selenium	mg/kg	7782-49-2	0.627	**0.85**	**0.67**
Thallium	mg/kg	7440-28-0	0.22	**0.28 J**	**0.26 J**
Vanadium	mg/kg	7440-62-2	53	**68**	**44**
Zinc	mg/kg	7440-66-6	722	**200**	**31**

Notes:
Bold indicates a detected concentration.
Bold on gray indicates a detected concentration above the screening level.
CASRN = Chemical Abstract Services Registry Number
NA = Screening level not available for this chemical.
J = Reported value is estimated.
< = Chemical not detected above the sample quantitation limit.
The reported results have been corrected for moisture content.

TABLE 3-3
2007 Remedial Investigation Results—Summary of Chemicals Detected in Surface Water
Decision Document, Fort Leonard Wood, Missouri

			Location>>	FLW-028-SW-01/SD-01	FLW-028-SW-02/SD-02
			Sample ID>>	028-SW-01-00	028-SW-02-00
			Sample Depth (ft)>>	0	0
			Sample Date>>	7/17/2007	7/17/2007
Chemical	Units	CASRN	Screening Level		
Volatile Organic Compounds					
Chloroform	µg/L	67-66-3	5.7	**0.54 J**	**0.45 J**
Semivolatile Organic Compounds					
bis(2-Ethylhexyl)phthalate	µg/L	117-81-7	0.6	**2.6 J**	< 0.56
Inorganics					
Aluminum	mg/L	7429-90-5	0.75	**0.047 J**	**0.5 J**
Arsenic	mg/L	7440-38-2	0.001	**0.00065 J**	**0.0015 J**
Barium	mg/L	7440-39-3	0.2	**0.069**	**0.073**
Beryllium	mg/L	7440-41-7	0.0004	< 0.00008	**0.00013 J**
Cadmium	mg/L	7440-43-9	0.0002	< 0.00004	**0.00012 J**
Calcium	mg/L	7440-70-2	NA	**39**	**35**
Chromium	mg/L	7440-47-3	0.01	< 0.0005	**0.0047**
Copper	mg/L	7440-50-8	0.004	**0.00095 J**	**0.0036**
Iron	mg/L	7439-89-6	NA	**0.078 J**	**0.57 J**
Lead	mg/L	7439-92-1	0.001	< 0.00018	**0.0038**
Magnesium	mg/L	7439-95-4	NA	**24**	**21**
Manganese	mg/L	7439-96-5	0.05	**0.034**	**0.044**
Molybdenum	mg/L	7439-98-7	0.0078	**0.0012 J**	**0.0011 J**
Nickel	mg/L	7440-02-0	0.029	**0.0028**	**0.0038 J**
Potassium	mg/L	7440-09-7	NA	**2.2 J**	**1.8 J**
Sodium	mg/L	7440-23-5	NA	**5.4**	**4.4 J**
Vanadium	mg/L	7440-62-2	0.0109	**0.0011 J**	**0.0083 J**
Zinc	mg/L	7440-66-6	0.059	**0.12**	**0.023 J**

Notes:
Bold indicates a detected concentration.
Bold on gray indicates a detected concentration above the screening level.
CASRN = Chemical Abstract Services Registry Number
NA = Screening level not available for this chemical.
J = Reported value is estimated.
< = Chemical not detected above the sample quantitation limit.

TABLE 3-4

Comparison of Arsenic and Beryllium Concentrations to Fort Leonard Wood Site-wide Background

Decision Document, Fort Leonard Wood, Missouri

Media	Maximum Concentration	Representative Concentration	FLW Background	Background Exceeded?	
				Maximum Concentration	Representative Concentration
Arsenic					
Surface Soil (0-2 ft bgs)	7.2	5.62	11.2	No	No
Construction Zone Soil (0-10 ft bgs)	9.1	5.6	11.2	No	No
Subsurface Soil (2-10 ft bgs)	9.1	5.59	11.2	No	No
Sediment	11	8.3	11.2	No	No
All Soil and Sediment	11	NA	11.2	No	No
Beryllium					
Surface Soil (0-2 ft bgs)	0.52	0.45	1.4	No	No
Construction Zone Soil (0-10 ft bgs)	0.84	0.559	1.4	No	No
Subsurface Soil (2-10 ft bgs)	0.84	0.614	1.4	No	No
Sediment	0.73	0.695	1.4	No	No
All Soil and Sediment	0.84	NA	1.4	No	No

Notes:

Sediment and soil concentration are reported in mg/kg

IELCRs and HIs were calculated using Tier 1 Inputs presented in MRBCA Appendix E.

HI = hazard index

IELCR - individual excess lifetime cancer risk

NA = Value was listed as "NA" in MRBCA Appendix E

TABLE 3-5
Cumulative Risk Estimates
Decision Document, Fort Leonard Wood, Missouri

	Total Cumulative Risk	
Receptor	**IELCR**	**HI**
Resident	5.E-06	9.E-01
Child	5.E-06	1.E+00
Non-Resident Worker	1.E-06	7.E-02
Construction Worker	NA	1.E-02

Notes:
HI = hazard index
IELCR = individual excess lifetime cancer risk
IELCRs and HIs were calculated using Tier 1 Inputs presented in MRBCA Appendix E.
No chemicals exceed MRBCA target levels (individual chemical IELCR of 1x10-5 and HI of 1).
NA = Value was listed as "NA" in MRBCA Appendix E

Legend

- IRP Site Boundary
- Existing Building
- Former Buried Concrete Pad
- Primary Road
- Elevation Contour (1m interval)
- Drainage Ditch
- Skid Track

Figure 3-1
Site Features Map
FLW-028, DPW Old Fire Training Area
Decision Document
Fort Leonard Wood, Missouri

CH2MHILL

RDD \\BALDUR\PROJ\FT_LEONARD_WOOD_349765\MAPFILES\FLW028_DEC_DOC\FIG3-1_SITEFEAT_028DD.MXD 3/5/2009 21:29:44

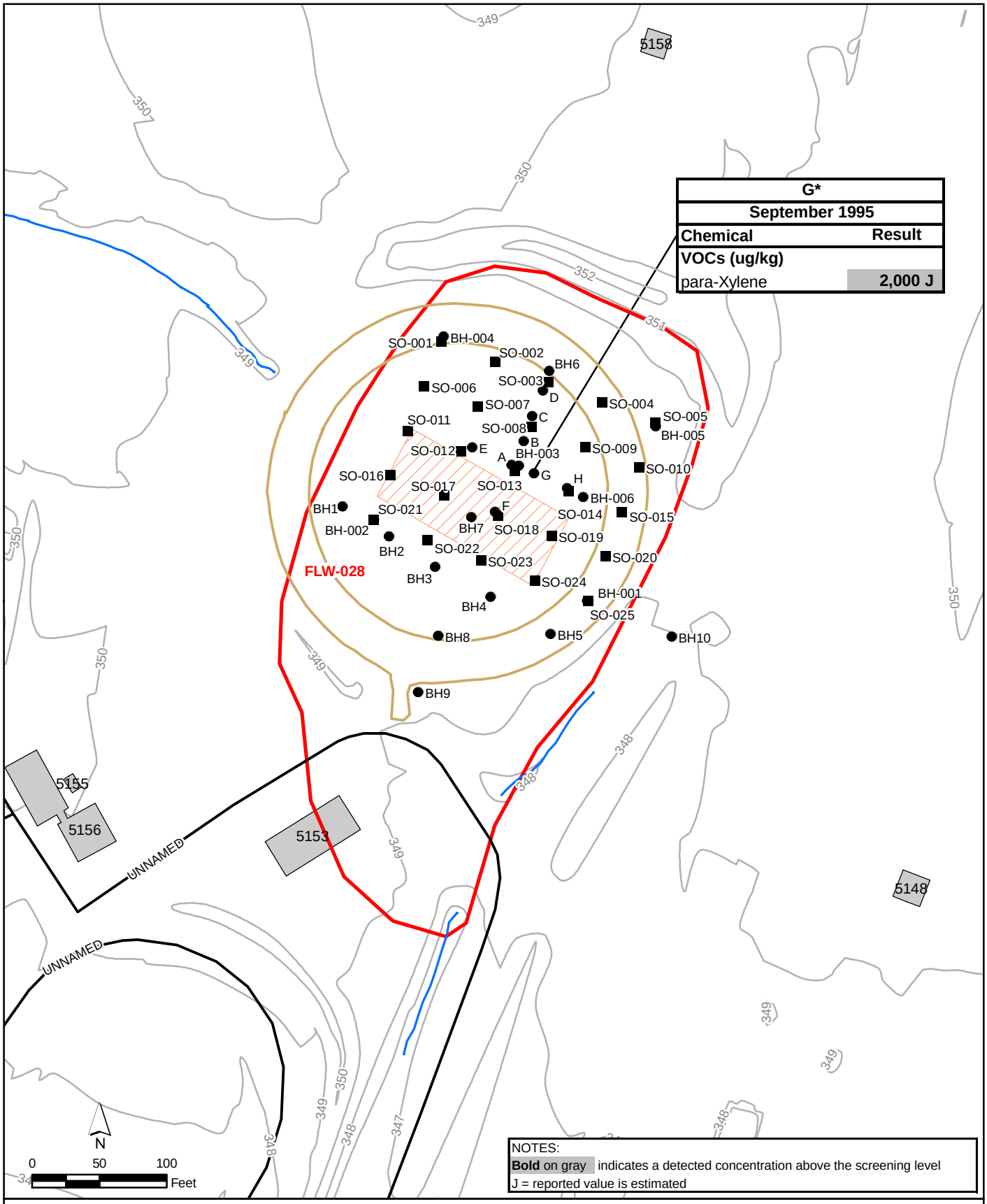
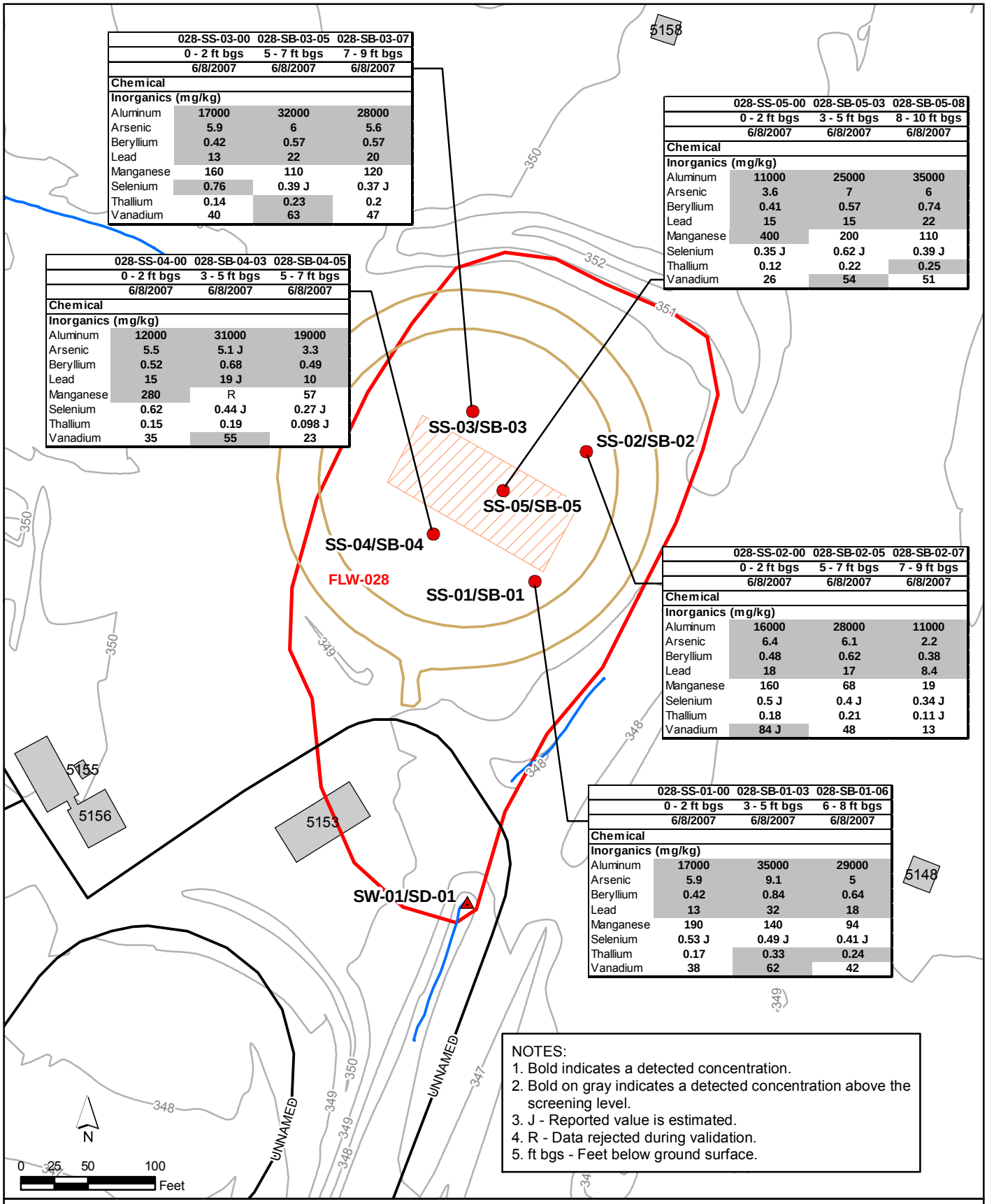


Figure 3-2
Historical Sample Locations and PCOCs
FLW-028, DPW Old Fire Training Area
Decision Document
Fort Leonard Wood, Missouri

CH2MHILL

RDD \\BALDUR\PROJ\FT_LEONARD_WOOD_349765\MAPFILES\FLW028_DEC_DOC\FIG3-2_HIST_PCOC_028DD.MXD 3/5/2009 21:34:25



	028-SS-03-00	028-SB-03-05	028-SB-03-07
	0 - 2 ft bgs	5 - 7 ft bgs	7 - 9 ft bgs
	6/8/2007	6/8/2007	6/8/2007
Chemical			
Inorganics (mg/kg)			
Aluminum	17000	32000	28000
Arsenic	5.9	6	5.6
Beryllium	0.42	0.57	0.57
Lead	13	22	20
Manganese	160	110	120
Selenium	0.76	0.39 J	0.37 J
Thallium	0.14	0.23	0.2
Vanadium	40	63	47

	028-SS-05-00	028-SB-05-03	028-SB-05-08
	0 - 2 ft bgs	3 - 5 ft bgs	8 - 10 ft bgs
	6/8/2007	6/8/2007	6/8/2007
Chemical			
Inorganics (mg/kg)			
Aluminum	11000	25000	35000
Arsenic	3.6	7	6
Beryllium	0.41	0.57	0.74
Lead	15	15	22
Manganese	400	200	110
Selenium	0.35 J	0.62 J	0.39 J
Thallium	0.12	0.22	0.25
Vanadium	26	54	51

	028-SS-04-00	028-SB-04-03	028-SB-04-05
	0 - 2 ft bgs	3 - 5 ft bgs	5 - 7 ft bgs
	6/8/2007	6/8/2007	6/8/2007
Chemical			
Inorganics (mg/kg)			
Aluminum	12000	31000	19000
Arsenic	5.5	5.1 J	3.3
Beryllium	0.52	0.68	0.49
Lead	15	19 J	10
Manganese	280	R	57
Selenium	0.62	0.44 J	0.27 J
Thallium	0.15	0.19	0.098 J
Vanadium	35	55	23

	028-SS-02-00	028-SB-02-05	028-SB-02-07
	0 - 2 ft bgs	5 - 7 ft bgs	7 - 9 ft bgs
	6/8/2007	6/8/2007	6/8/2007
Chemical			
Inorganics (mg/kg)			
Aluminum	16000	28000	11000
Arsenic	6.4	6.1	2.2
Beryllium	0.48	0.62	0.38
Lead	18	17	8.4
Manganese	160	68	19
Selenium	0.5 J	0.4 J	0.34 J
Thallium	0.18	0.21	0.11 J
Vanadium	84 J	48	13

	028-SS-01-00	028-SB-01-03	028-SB-01-06
	0 - 2 ft bgs	3 - 5 ft bgs	6 - 8 ft bgs
	6/8/2007	6/8/2007	6/8/2007
Chemical			
Inorganics (mg/kg)			
Aluminum	17000	35000	29000
Arsenic	5.9	9.1	5
Beryllium	0.42	0.84	0.64
Lead	13	32	18
Manganese	190	140	94
Selenium	0.53 J	0.49 J	0.41 J
Thallium	0.17	0.33	0.24
Vanadium	38	62	42

NOTES:
1. Bold indicates a detected concentration.
2. Bold on gray indicates a detected concentration above the screening level.
3. J - Reported value is estimated.
4. R - Data rejected during validation.
5. ft bgs - Feet below ground surface.

Legend
- IRP Site Boundary
- Existing Building
- Former Buried Concrete Pad
- Primary Road
- Elevation Contour (1m interval)
- Drainage Ditch
- Skid Track
- Soil Boring
- Surface Water/Sediment

Figure 3-3
PCOCs in Soil – 2007 Remedial Investigation
FLW-028, DPW Old Fire Training Area
Decision Document
Fort Leonard Wood, Missouri

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RDD \\BALDUR\PROJ\FT_LEONARD_WOOD_349765\MAPFILES\FLW028_DEC_DOC\FIG3-3_PCOC_SOIL_028DD.MXD 3/5/2009 21:38:14

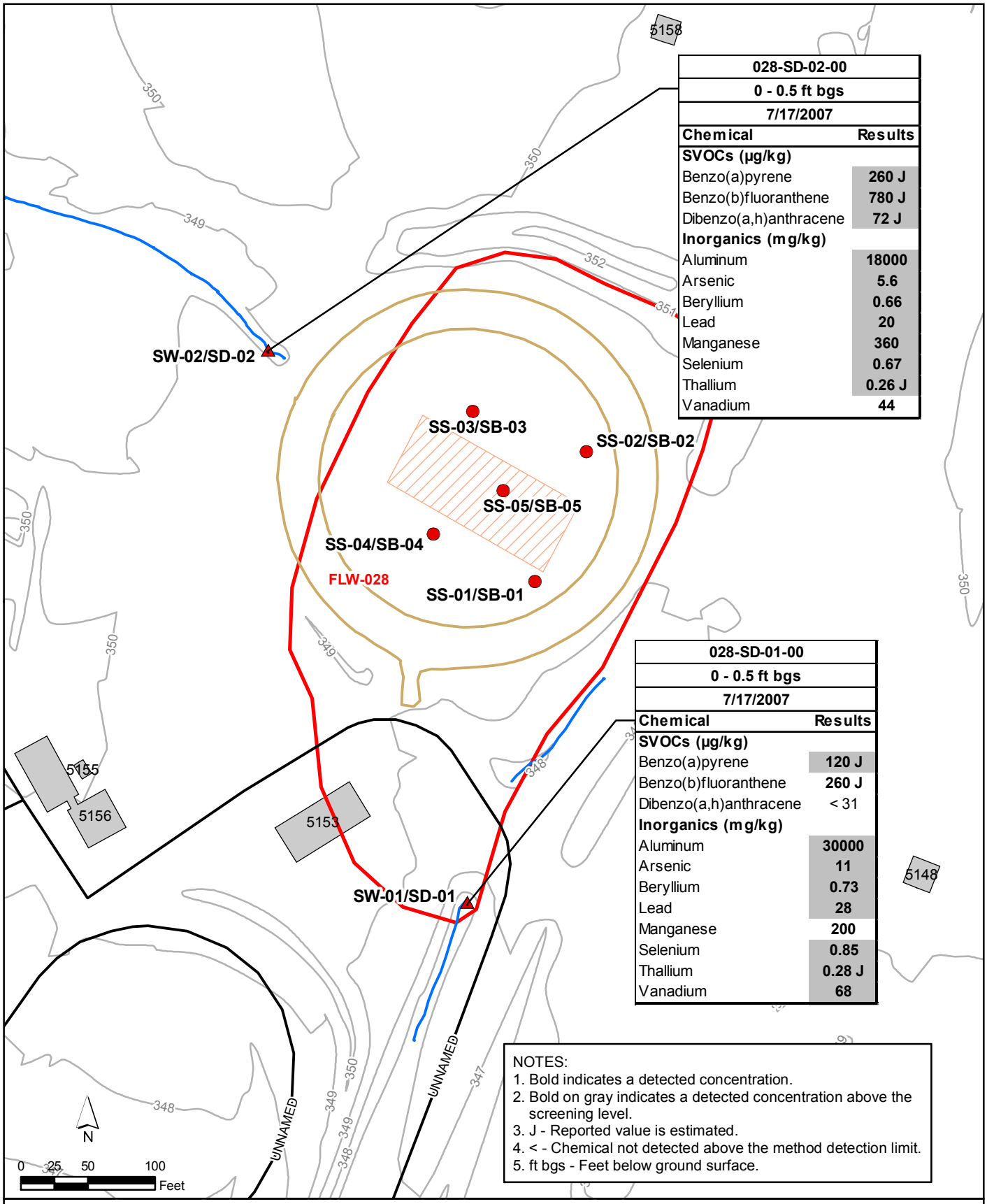

Figure 3-4
PCOCs in Sediment – 2007 Remedial Investigation
FLW-028, DPW Old Fire Training Area
Decision Document
Fort Leonard Wood, Missouri

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RDD \\BALDUR\PROJ\FT_LEONARD_WOOD_349765\MAPFILES\FLW028_DEC_DOC\FIG3-4_PCOC_SED_028DD.MXD 3/5/2009 21:40:59

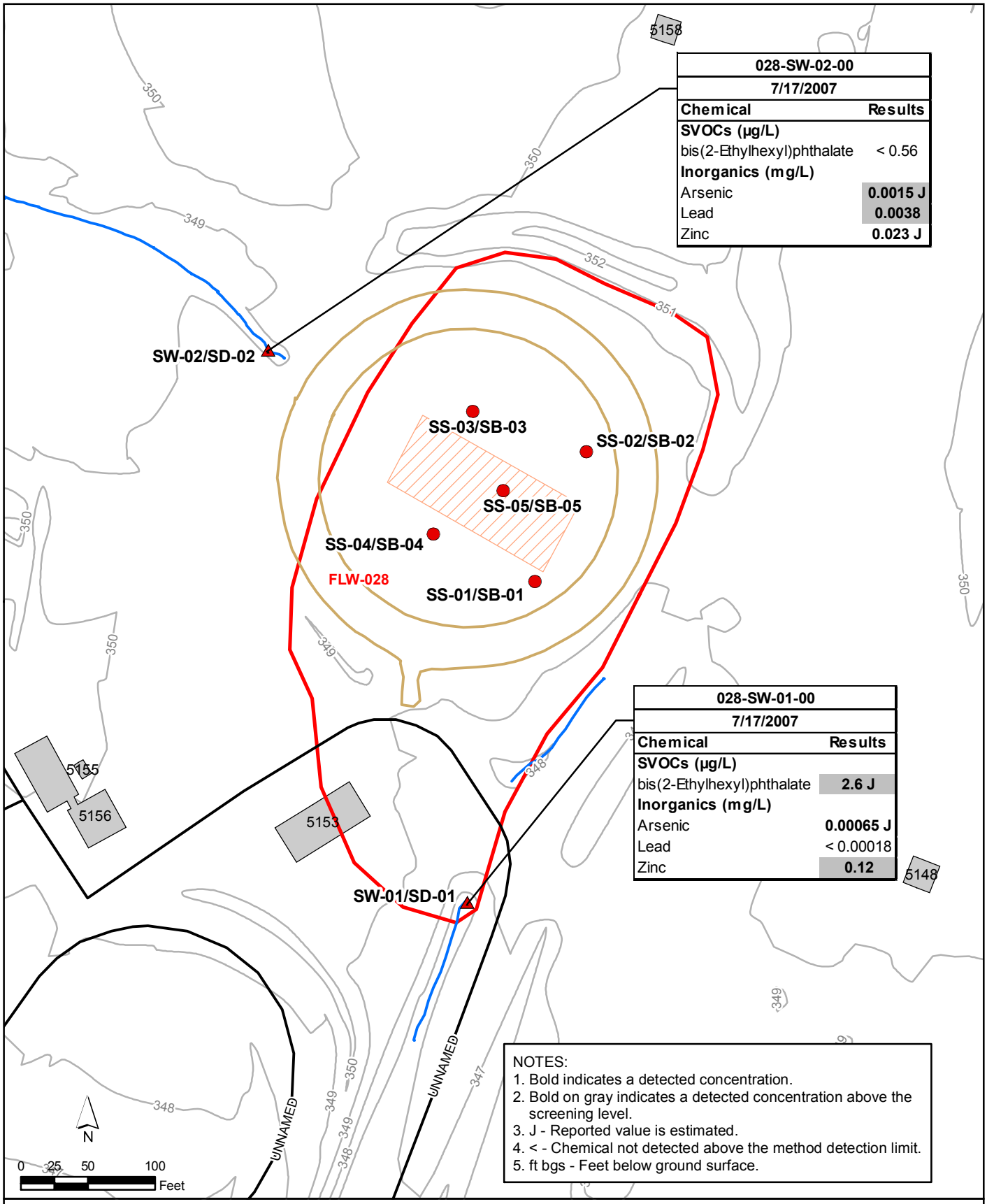

Figure 3-5
PCOCs in Surface Water – 2007 Remedial Investigation
FLW-028, DPW Old Fire Training Area
Decision Document
Fort Leonard Wood, Missouri

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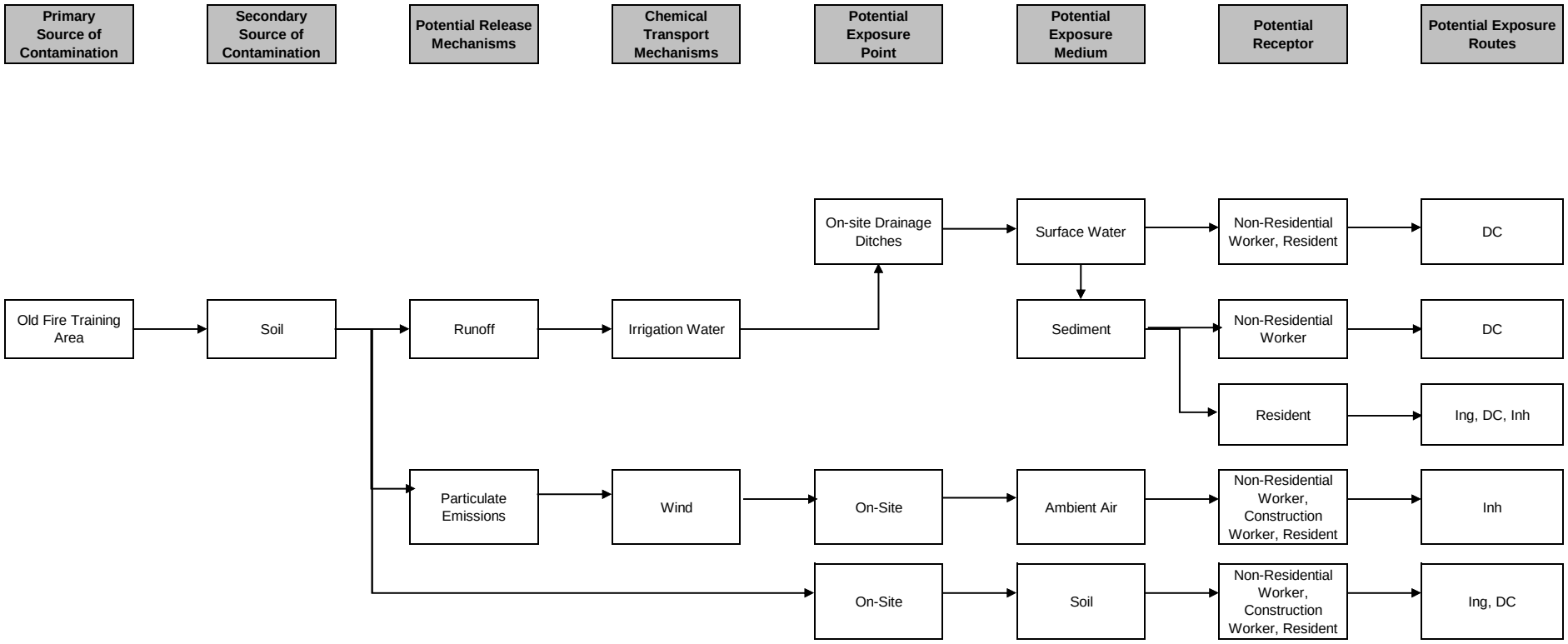
RDD \\BALDUR\PROJ\FT_LEONARD_WOOD_349765\MAPFILES\FLW028_DEC_DOC\FIG3-5_PCOC_SURF_WAT_028DD.MXD 3/5/2009 21:42:05



Notes:

Ing = Ingestion, DC = Dermal Contact, Inh = Inhalation

→ Potentially complete pathway

Figure 3-6
Human Health Conceptual Exposure Model
FLW-028, DPW Old Fire Training Area
Decision Document
Fort Leonard Wood, Missouri

4. References

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