# 5.0 Site Investigation Tasks

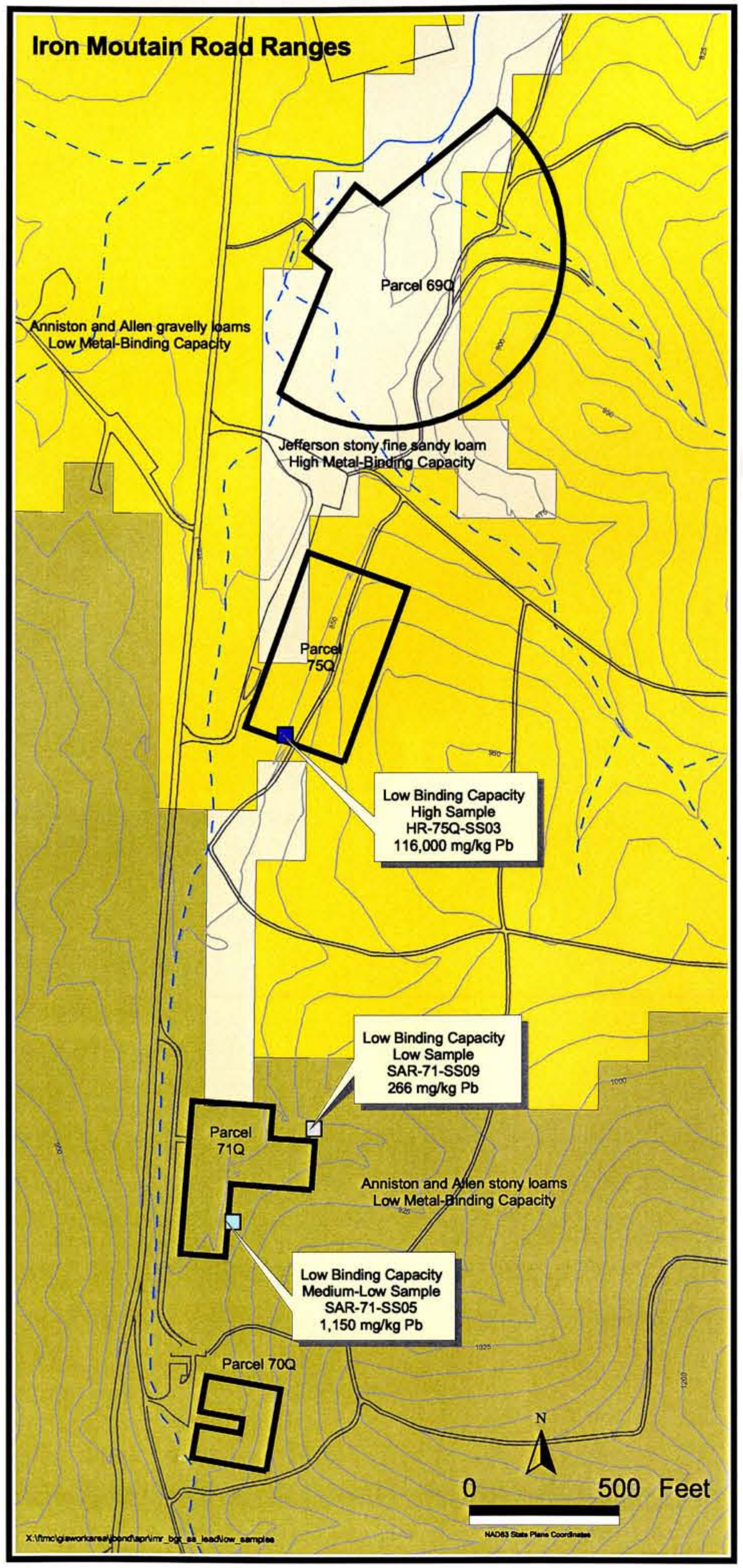
The BERA for the IMR ranges will focus on characterizing risk associated with the COPECs in surface soil within the old field terrestrial habitats and sediment in the ephemeral ditches and tributaries. The site investigation tasks are directly linked to the assessment and measurement endpoints described in the IMR problem formulation report (IT, 2002a) and presented in Section 3.4 of this report.

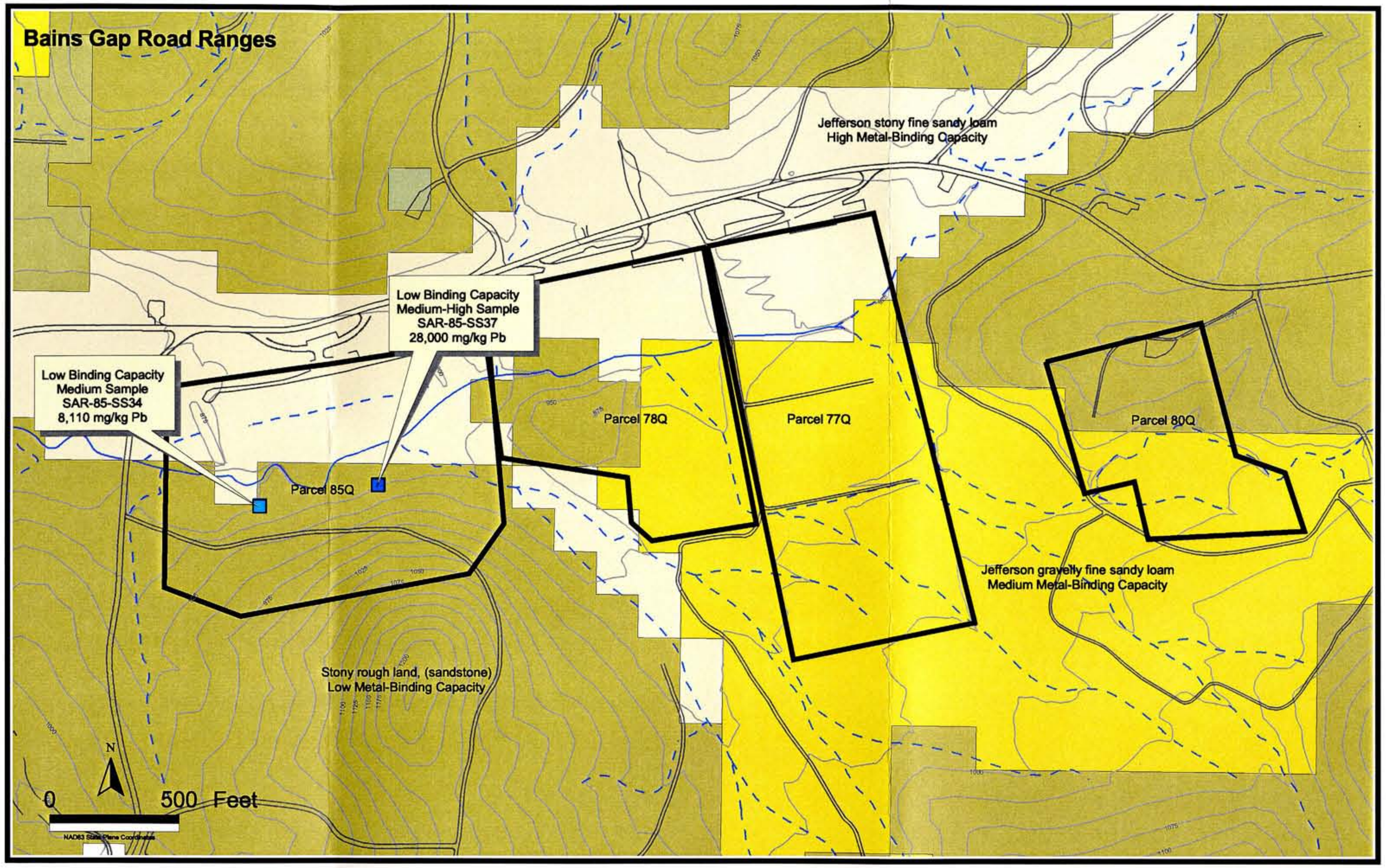
The principal objective of this site investigation is to outline a laboratory and field-based approach to reduce uncertainty associated with the SLERA process and to provide risk managers with information to incorporate into site remedial decisions. It is important to note that the study outlined in this section is designed to provide a number of lines of evidence relative to present and future risks to terrestrial and riparian receptors.

## 5.1 Soil Collection for Chemical Analysis

The site investigation tasks at the IMR ranges are all based on the fact that there are three soil types at the IMR and BGR ranges based on metal binding capacity; low, medium, and high. Surface soil (0 to 0.5 foot in depth) will be collected from five locations in each of these three soil types. Figures 5-1, 5-2, and 5-3 present the sample locations for a five point concentration gradient within each of the three metal-binding capacity soil types. These fifteen locations will represent the total lead gradient found within the three soil types at the IMR and BGR ranges. Locations for soil sampling will be identified using *in situ* x-ray fluorescence technology. These surface soil samples will be analyzed for a full suite of inorganic analytes. Additionally, one soil sample will be collected from each of the five different soil mapping units in an area that is unimpacted by FTMC activities. These five soil samples will represent the reference soils.

Analytical data from these surface soil samples will be used in conjunction with the earthworm toxicity test results to derive lowest-observed-adverse-effect-levels (LOAEL) and no-observed-adverse-effect-levels (NOAEL) for earthworms. These soil data will also be used in the food web models to calculate total COPEC doses for the invertivorous and omnivorous birds and mammals. Additionally, these soil data will be used in conjunction with the measured tissue concentrations of COPECs in the earthworms to estimate soil-to-earthworm bioaccumulation factors.




## Legend

| Symbol | Description |
|---|---|
| ☐ | Study Area |
| | Roads |
| | Streams (dashed where intermittent) |
| | Topographic Contours (25-foot interval) |

**Target Concentration Range**

- Low Sample
- Medium-Low Sample
- Medium Sample
- Medium-High Sample
- High Sample

**Soil Mapping Units**

- Anniston and Allen gravelly loams
- Anniston and Allen stony loams
- Jefferson gravelly fine sandy loam
- Jefferson stony fine sandy loam
- Stony rough land, (sandstone)
- mine or quarry (D)

Figure 5-1

**Low Metal-Binding Capacity Surface Soil Sample Locations**

Iron Mountain Road and Bains Gap Road Ranges, Fort McClellan, Alabama

U.S. Army Corps of Engineers
Mobile District

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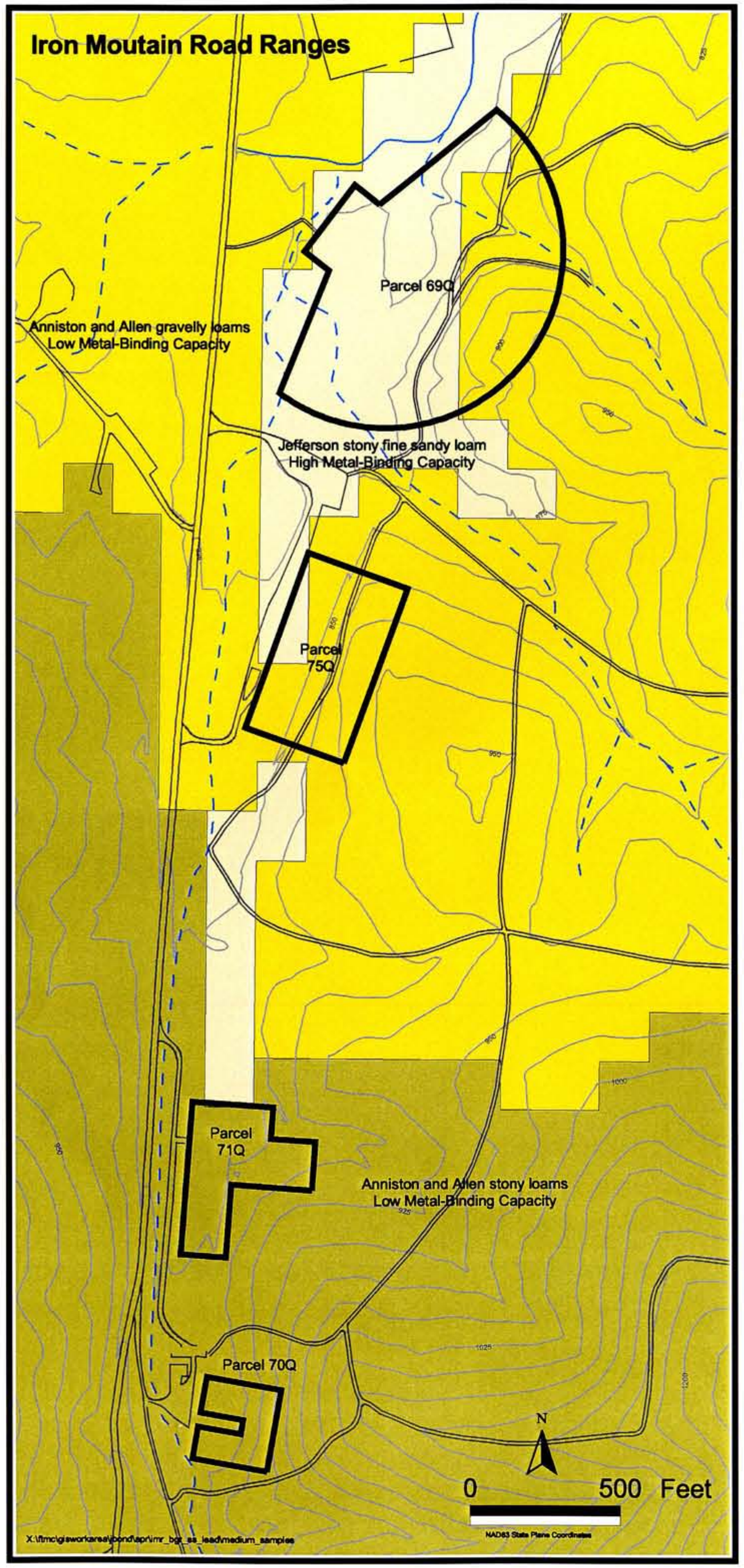


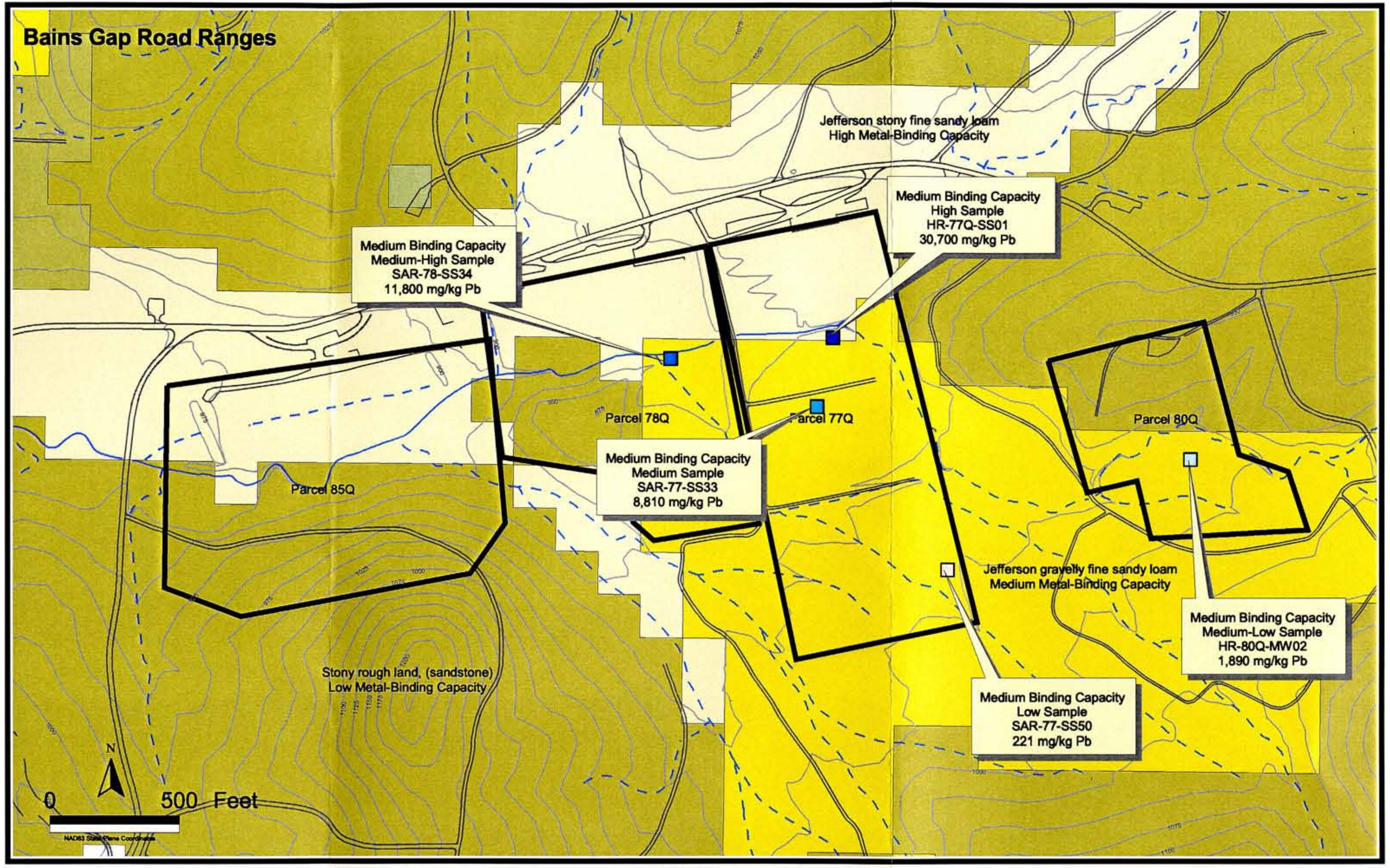


**Legend**

- Study Area
- Roads
- Streams (dashed where intermittent)
- Topographic Contours (25-foot interval)

**Target Concentration Range**

- Low Sample
- Medium-Low Sample
- Medium Sample
- Medium-High Sample
- High Sample

**Soil Mapping Units**

- Anniston and Allen gravelly loams
- Anniston and Allen stony loams
- Jefferson gravelly fine sandy loam
- Jefferson stony fine sandy loam
- Stony rough land, (sandstone)
- mine or quarry (D)

Figure 5-2

# Medium Metal-Binding Capacity Surface Soil Sample Locations

## Iron Mountain Road and Bains Gap Road Ranges, Fort McClellan, Alabama

U.S. Army Corps of Engineers
Mobile District

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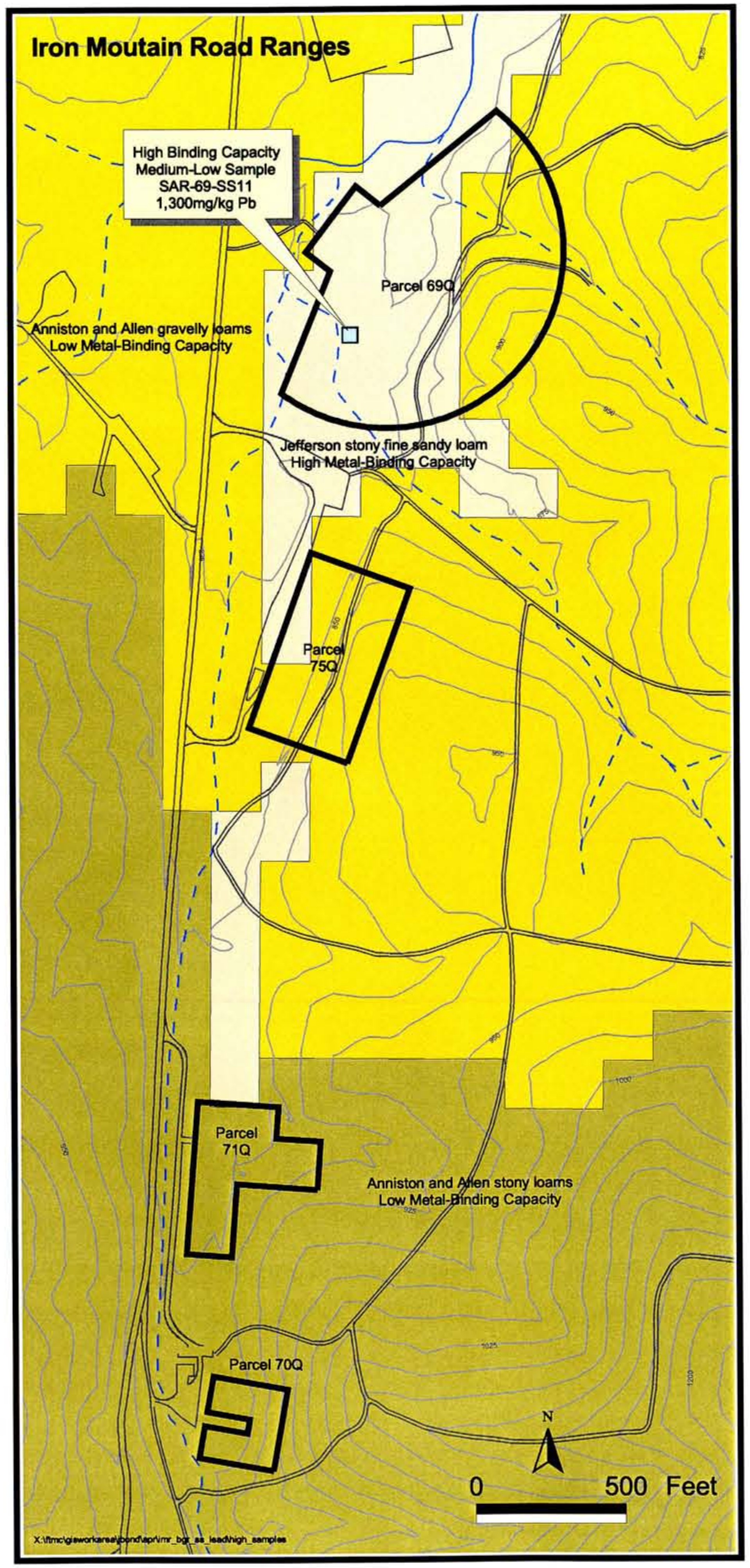


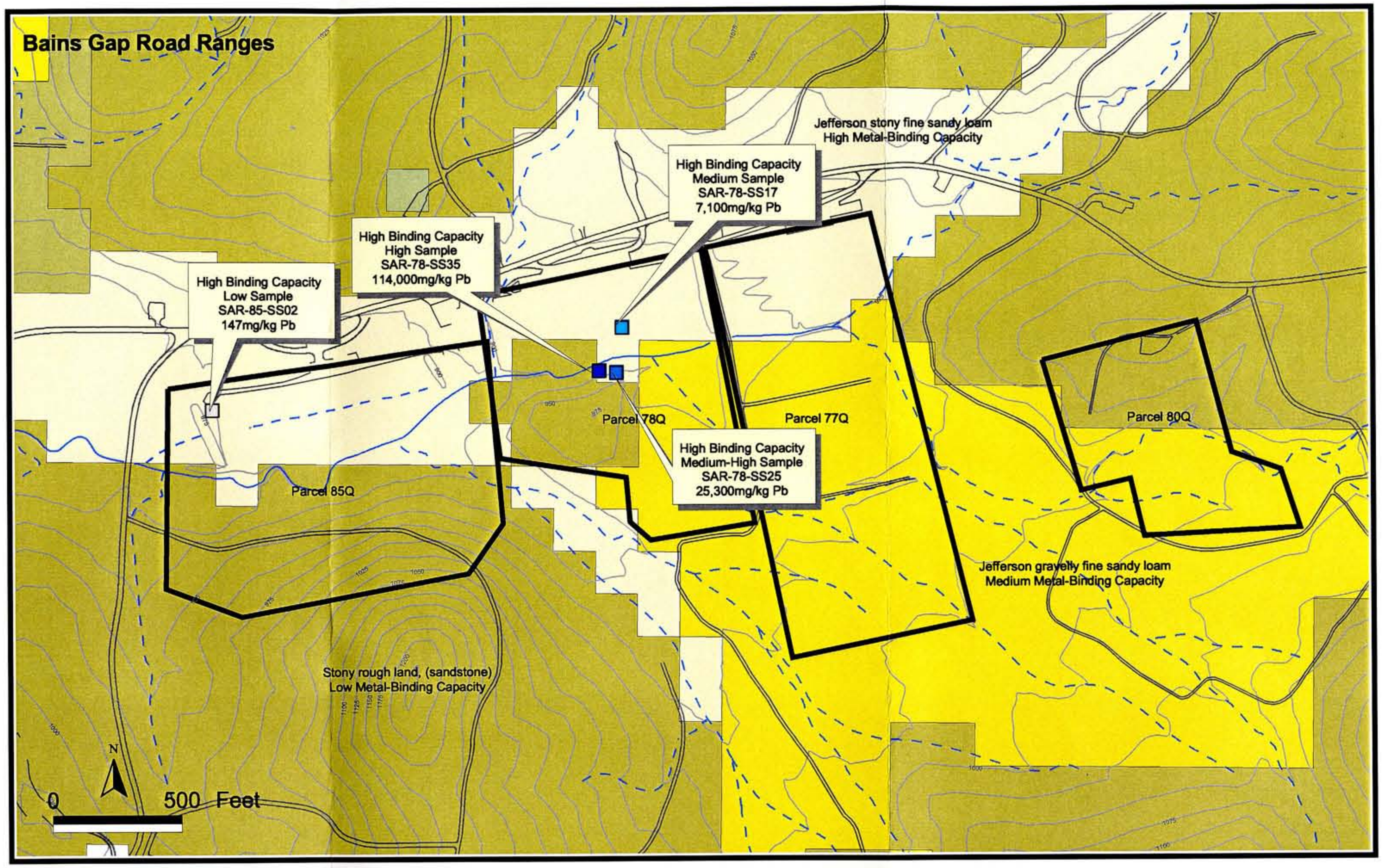


## Legend

- Study Area
- Roads
- Streams (dashed where intermittent)
- Topographic Contours (25-foot interval)

**Target Concentration Range**

- Low Sample
- Medium-Low Sample
- Medium Sample
- Medium-High Sample
- High Sample

**Soil Mapping Units**

- Anniston and Allen gravelly loams
- Anniston and Allen stony loams
- Jefferson gravelly fine sandy loam
- Jefferson stony fine sandy loam
- Stony rough land, (sandstone)
- mine or quarry (D)

Figure 5-3

# High Metal-Binding Capacity Surface Soil Sample Locations

Iron Mountain Road and Bains Gap Road Ranges, Fort McClellan, Alabama

U.S. Army Corps of Engineers Mobile District

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Details of the collection methods, decontamination procedures, quality assurance/quality control, and other sampling procedures are presented in the installation-wide sampling and analysis plan (IT, 2002c) and are summarized in Appendix A of this report.

## 5.2 Soil Collection for Earthworm Toxicity Tests

Assessment of the terrestrial invertebrate community associated with IMR range surface soils will be based on quantitative laboratory testing using the detritivorous earthworm. The earthworm's bioturbative feeding habits, its ability to bioaccumulate the identified COPECs, and its critical position in terrestrial food webs make it an ideal surrogate to represent the terrestrial invertebrate community.

Earthworm toxicity testing will use surface soil from the same locations identified in the previous section. As is the case with the soil samples for chemical analysis, soil samples for earthworm toxicity testing will be collected from fifteen locations representing five lead concentrations within the three different soil types.

Quantification of possible adverse effects to terrestrial invertebrates and the potential for constituent transfer up the food chain to higher trophic level feeding guilds will be accomplished with the use of earthworm toxicity tests and tissue burden analysis. As a soil-boring detritivore, the common earthworm (*Eisenia fetida*) is an excellent sentinel not only to assess surface soil toxicity, but also to approximate food chain bioaccumulation potential. The earthworm survival test recommended by the EPA (1989) will be employed to assess the potential for risk to members of this critical ecological trophic level. Earthworms have been shown to be acutely sensitive to soil-bound metal toxicity, and they represent a key prey item for mammalian and avian omnivores and invertivores.

Appendix A provides details relative to the EPA-recommended earthworm test. In brief, the 14-day static earthworm test will consist of exposing 10 worms per test chamber to 100 percent undiluted soil from the IMR and BGR ranges, soil from a reference location, and laboratory control soil. At the halfway point of the 14-day exposure period (7 days), mortality will be assessed within each test chamber/tray and dead worms will be removed. The 7-day mortality rate will be noted, along with soil pH and temperature. All live worms will be carefully re-introduced into the test soils. This same procedure will be followed upon completion of the test (14 days), with the exception that all living worms will be preserved in separate containers for COPEC whole-body burden analysis.

Since surface soil lead concentration gradients will be used as exposure gradients, as described in the sampling and analysis plan (Appendix A), data from earthworm tests will consist of 7-day NOAELs and LOAELs as well as 14-day NOAELs and LOAELs. In addition, whole-body tissue burdens for each of the COPECs will be determined. The maximum, mean, and minimum COPEC concentrations in exposed earthworms will be used in the food web models to calculate HQ values for terrestrial omnivorous and invertivorous birds and mammals. By providing three HQ values (maximum, mean, and minimum), a line of evidence will be established regarding biotransfer to higher trophic levels.

Details of the collection methods, decontamination procedures, quality assurance/quality control, and other sampling procedures are presented in the installation-wide sampling and analysis plan (IT, 2002c) and are summarized in Appendix A of this report.

### 5.3 Sediment Collection for Toxicity and Bioaccumulation Tests

The potential for toxicity to benthic invertebrates and bioaccumulation of COPECs from sediment to emergent aquatic invertebrates will be assessed by conducting quantitative toxicity and bioaccumulation tests in a laboratory. Emergent benthic invertebrates (*Chironomus sp.*) will be exposed to sediment collected from Cane Creek at the BGR ranges. Ten sediment samples will be collected from five locations (2 samples from each location) within Cane Creek and its tributaries representative of the range of lead detected within Cane Creek and Remount Creek during previous investigations. Lead will be used as the indicator of all COPEC concentrations in sediment because it has been detected in sediment at the BGR and IMR ranges and has been used as an indicator of contamination resulting from small arms range activity.

Sediment samples will be collected from Cane Creek for toxicity and bioaccumulation testing as described in the *Baseline Ecological Risk Assessment Problem Formulation and Study Design for the Bains Gap Road Ranges* (IT, 2002d). These sediment samples will be analyzed for a full suite of inorganic analytes. Analytical data from these sediment samples will be used in conjunction with measured tissue concentrations of COPECs in *Chironomus sp.* to estimate sediment-to-invertebrate bioaccumulation factors.

In order to evaluate potential toxicity to benthic invertebrates, the standard 20-day *Chironomus riparius* survival, growth, and emergence test will be conducted using sediment samples collected from Cane Creek representative of the five different COPEC concentration ranges. While most Chironomid sediment testing is abbreviated to a 10-day acute measure of lethality only, 20-day tests will be employed to assess the risk of acute and chronic sediment toxicity. Tests of 20 days in duration will permit observance of sub-lethal responses such as growth and emergence. Four replicates for each of the five sediment locations, a reference station, and laboratory controls, will be tested for measurements of lethality, growth, and emergence. All test organisms will be laboratory reared and less than 24 hours old at test initiation. Each test chamber will receive two volume additions of water per day (static daily renewal). Survival rate will be recorded at the end of the 20-day test period. The remaining live chironomids will be removed from the test chambers and analyzed for body burdens of the COPECs.

Although collected sediments will not be "cut" with reference or laboratory grade sediments to generate a concentration series, the five sediment collection sites will represent a gradient of sediment COPEC concentrations. This field-collected concentration gradient will allow investigators to generate a sediment concentration-based NOAEL and LOAEL in comparison to off-site reference sediments.

Details of the collection methods, decontamination procedures, quality assurance/quality control, and other sampling procedures are presented in the *Installation-Wide Sampling and Analysis Plan* (IT, 2002c) and are summarized in Appendix B of the *Baseline Ecological Risk Assessment Problem Formulation and Study Design for the Bains Gap Road Ranges* (IT, 2002d).