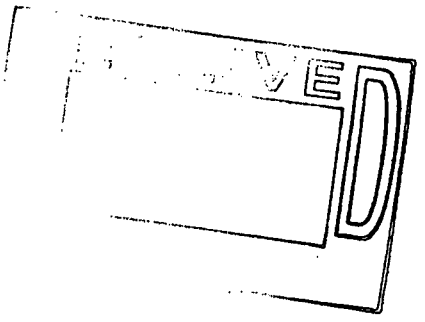
Agency DRAFT

Accelerated Action Ecological Risk Evaluation
North Firing Range



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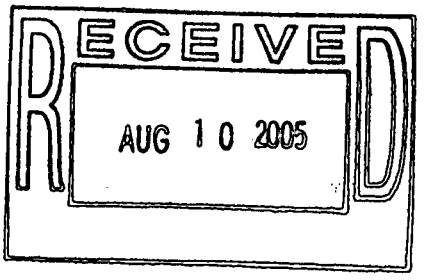

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ADMIN RECORD

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ACRONYMS

CD	Compact disc
CRA	Comprehensive Risk Assessment
DOE	U.S. Department of Energy
DQA	Data Quality Assessment
DQO	data quality objective
ECOI	ecological contaminant of interest
ECOPC	ecological contaminant of potential concern
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ERA	Ecological Risk Assessment
ESA	Endangered Species Act
ESL	ecological screening level
EU	Exposure Unit
HQ	hazard quotient
IA	Industrial Area
IHSS	Individual Hazardous Substance Site
MDC	maximum detected concentration
N/A	not applicable
NOAEL	no observed adverse effect level
ORNL	Oak Ridge National Laboratory
OU	Operable Unit
PAC	Potential Area of Concern
PMJM	Preble's meadow jumping mouse
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RI/FS	Remedial Investigation/Feasibility Study
SCM	Site Conceptual Model
tESL	threshold ecological screening level
TRV	toxicity reference value
UT	uncertain toxicity

ACRONYMS

WRS	Wilcoxon Rank Sum
WRW	Wildlife refuge worker
WRV	wildlife refuge visitor

UNIT DESCRIPTIONS

ft	foot or feet
L/day	liters per day
mg	milligram
mg/day	milligrams per day
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mL/day	milliliters per day
pCi/g	picocuries per gram
pCi/L	picocuries per liter
µg/kg	micrograms per kilogram (may be found as ug/kg)
µg/L	micrograms per liter

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EXECUTIVE SUMMARY

This report presents the results of the ecological risk evaluation for the North Firing Range located within the No Name Gulch Exposure Unit (NNEU) at the Rocky Flats Environmental Technology Site (RFETS). Data from within the North Firing Range were screened against wildlife refuge worker (WRW) action levels (ALs) and actions were subsequently taken to remove soils that exceeded the AL for lead. A series of confirmation samples were taken following removal of the soils.

This evaluation has been prepared in support of the Accelerated Action Closeout Report for IHSS Group NE-1 (North Firing Range (PAC NW-1505). The risk evaluation presents an assessment of risk to terrestrial ecological receptors within the NNEU to ecological chemicals of potential concern (ECOPCs) associated with the North Firing Range.

The sampling data for the following media are used in this evaluation:

- Surface soil;
- Subsurface soil; and
- Surface water.

Surface water data are used in predicting exposure to wildlife receptors through the drinking water exposure pathway only. Risks to aquatic receptors are not evaluated in this document since no aquatic habitat is present in the North Firing Range.

Ecological Risk Assessment

The ECOPC identification process examines ecological contaminants of interest (ECOIs) that have been detected in North Firing Range surface and subsurface soils. The ECOPC process can consist of two separate evaluations, one for the non-Preble's meadow jumping mouse (PMJM) receptors that include terrestrial plants and invertebrates, birds, and mammals; and one for the PMJM receptor. However, since there is no PMJM habitat within the North Firing Range, the PMJM receptor was not assessed in this document.

Surface Soil - Non-PMJM Receptors

The ECOPC identification process for non-PMJM receptors potentially exposed to surface soil identified aluminum, antimony, arsenic, barium, boron, chromium, copper, lead, lithium, manganese, mercury, nickel, thallium, tin, vanadium and zinc as having maximum detected concentrations (MDCs) from within the North Firing Range PAC that were above non-PMJM no observable adverse effects level (NOAEL) ecological screening levels (ESLs). Statistical comparisons of the North Firing Range data to background data indicate that the concentrations of arsenic, manganese, mercury, vanadium and zinc in surface soils are not significantly greater than background at the 0.1

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level of significance. North Firing Range surface soil concentrations of aluminum, chromium, copper, lead, lithium and nickel are statistically greater than background. Statistical background comparisons could not be conducted for antimony, thallium and tin due to a low percentage of detections in the background data set. Site-specific background data were not available for boron.

All ECOIs with concentrations statistically greater than background as well as those for which background comparisons could not be made were carried forward to the threshold ESL screen. Upper bound exposure point concentrations (EPCs) for the North Firing Range were calculated including the UCL and 95th upper tolerance limit (UTL). These EPCs were compared to the threshold ecological screening levels (tESLs) for the appropriate receptors. Lithium had an upper bound EPC lower than the most conservative tESL and was removed from further evaluation as an ECOPC. The remaining ECOIs, including aluminum, antimony, boron, chromium, copper, lead, nickel, thallium and tin had an upper bound EPC from soils within the North Firing Range that were greater than their limiting tESLs and were identified as ECOPCs for the North Firing Range.

This risk evaluation focuses on the overall results for the assessment endpoints as defined in the CRA Methodology (DOE 2004). This includes discussion of the potential for risk for each receptor group and level of biological organization (that is, individual or population level of protection), as appropriate for the assessment endpoints. The assessment endpoints used in the ERAs at RFETs are based on the population level of biological organization within defined EUs for all receptors except the federally protected PMJM (evaluated on an individual basis within appropriate habitat) for which no habitat is present in the North Firing Range. Given the small size of the North Firing Range only several individuals of small home range receptors would likely use the area as their primary home range and large home range receptors would only use the area as a small portion of their home ranges. To determine potential risks to the population of receptors, as indicated by the assessment endpoints, potential risks to the ECOPCs specific to the North Firing Range were evaluated over the entire NNEU.

Concentrations of aluminum, chromium and lead within the NNEU are not statistically different from background concentrations. Since risk to populations of receptors are not typically expected at concentrations not different from those found in background areas, no risk associated with the site is predicted from these North Firing Range ECOPCs to populations of receptors inhabiting the NNEU.

Copper and nickel had statistically greater concentrations within the NNEU when compared to background concentrations. Valid statistical comparisons could not be made for antimony, boron, thallium and tin.

Upper bound EPC concentrations were then calculated for antimony, boron, copper, nickel, thallium and tin using the entire NNEU surface soil dataset. These EPCs were compared to their limiting tESLs. The EPCs for antimony, boron, nickel, and tin were greater than their respective limiting tESLs and were carried into the quantitative risk characterization. The NNEU EPC for thallium was lower than its limiting tESL and was

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not carried forward into the risk characterization since population level effects are not expected within the NNEU.

Subsurface Soil – Burrowing Receptors

Subsurface soil within the North Firing Range was assessed for burrowing receptors, for which the prairie dog is the representative receptor. The ECOPC identification process for subsurface soil identified arsenic, copper, manganese and zinc as having MDCs that are greater than their respective NOAEL ESL. All of the ECOIs with MDCs greater than NOAEL ESLs were detected in greater than 5% of subsurface soil samples. Statistical comparisons to background indicated that only arsenic and copper had subsurface soil concentrations that were statistically greater than background concentrations. Upper bound EPCs for arsenic and copper were compared to tESLs for the prairie dog. Neither exceeded the tESL. Therefore, no ECOPCs were selected for subsurface soils in the North Firing Range.

Risk Characterization

Risk characterization was conducted for each ECPOC/receptor pair using a range of EPCs, exposure scenarios, and TRVs. This provided a range of risk estimates that could be used in the risk description to evaluate the overall potential for risk from North Firing Range ECOPCs to ecological receptors inhabiting the NNEU. The risk estimates for each ECOPC/receptor pair indicated that potential risks were low. Only the deer mouse (insectivore) receptor had HQs greater than 1 calculated when using the default LOAEL TRV for nickel. However, back calculated soil concentrations using the default LOAEL TRV result in concentrations well within the range of background concentrations. HQ results using an alternative, yet reasonable, LOAEL TRV resulted in no HQs greater than 1. In addition, using even the conservative LOAEL TRV but median bioaccumulation factors results in HQs less than 1.

Concentrations of several constituents within the North Firing Range are elevated when compared to the data set from the remainder of the NNEU. Particularly, aluminum, chromium and lead are present in surface soil at concentrations greater than site-specific background concentrations within the North Firing Range, but within the range of background concentrations when the entire NNEU dataset is considered. Since risk to populations of receptors are not typically expected at concentrations not different from those found in background areas, no risk associated with the site is predicted from these North Firing Range ECOPCs to populations of receptors inhabiting the NNEU.

Overall, the results of the ecological risk evaluation indicate risks to ecological receptors that may use the NNEU are low and no further action is necessary to reduce risks to populations of non-PMJM receptors.

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1.0 INTRODUCTION

The purpose of this document is to provide a summary of potential ecological risk for the Individual Hazardous Substance Site (IHSS) Group NE-1 North Firing Range (PAC NW-1505) within the No Name Gulch Drainage Exposure Unit (NNEU). The Draft Closeout Report for the North Firing Range was submitted for review in May, 2005 (DOE 2005). Accelerated Actions were conducted within the North Firing Range between October 2004 and April 2005 to remove approximately 32 cubic yards of soil for disposal.

In order to identify potential ecological risk issues within the North Firing Range, the Comprehensive Risk Assessment (CRA) Methodology (DOE 2004) was followed with several modifications.

Under the CRA Methodology, all Ecological Contaminants of Interest (ECOIs) are evaluated through a process designed to eliminate ECOIs that pose very little to no potential for risk to the receptors within large exposure units. Those ECOIs that remain following this process are termed Ecological Contaminants of Potential Concern (ECOPCs). In order to focus this assessment on the small area covered in the closeout report, rather than identifying ECOPCs for the entire exposure unit, ECOPCs specific to the North Firing Range were identified by first filtering the entire NNEU dataset to include only those samples from within the North Firing Range PAC. These data were then processed using the ECOPC Identification process outlined in Figure 7.3 of the CRA Methodology.

This modification to the CRA Methodology allows those chemicals of particular interest to the North Firing Range to be evaluated as part of the Accelerated Action process. Risks to ecological receptors are then assessed based on population level endpoints as prescribed in the CRA Methodology. Given the small size of the North Firing Range, it is not appropriate to assess risks to populations of receptors that could inhabit the NNEU in such a small area as the North Firing PAC. Therefore, once ECOPCs specific to the North Firing Range were identified, they were then reviewed and assessed in terms of their EU-wide distributions (both spatial and statistical). This step allows for the assessment endpoints for the NNEU to be evaluated as intended in the CRA Methodology but provides results specific to the North Firing Range PAC that can be used in Accelerated Action decision making.

Section 2 of the draft closeout report discusses the site-setting and physical layout of the North Firing Range.

2.0 IDENTIFICATION OF ECOLOGICAL CONTAMINANTS OF POTENTIAL CONCERN

The North Firing Range is located within the NNEU (Figures 2.1 through 2.3), north of the Industrial Area in an area of mesic mixed grassland habitat (Figure 2.4). The ECOPC identification process streamlines ecological risk characterization by focusing the

assessment of ECOIs that are present in the area of interest. For the purposes of this Accelerated Action assessment, ECOIs are defined as any chemical detected in the North Firing Range and are assessed for surface soil and subsurface soil. The ECOPC identification process typically consists of two separate evaluations: one for the PMJM receptor, and one for the non-PMJM receptors. The ECOPC identification process for the PMJM is more conservative than for other receptors because the PMJM is a federally listed threatened species under the Endangered Species Act (63 FR 26517) and contaminant effects on an individual basis must be assessed. However, because no viable habitat for PMJM is present within the North Firing Range, the assessment of risk to the PMJM is not addressed in this document.

The ECOPC identification process is based on the Site Conceptual Model (SCM) presented in the CRA Methodology and described in detail in Volume 2 of Appendix A of the RI/FS Report. The SCM presents the pathways of potential exposure from documented historical source areas to the receptors of concern. Data collected in the North Firing Range are discussed in detail in the Closeout Report.

The most significant exposure pathways identified in the CRA Methodology are the ingestion of plant, invertebrate, or animal tissue that could have accumulated ECOIs through direct uptake or dietary routes, and the direct ingestion of media potentially contaminated during normal activities at the North Firing Range.

The receptors of concern that were selected for assessment were discussed in the CRA Methodology and are introduced here on Table 2.3 and include representative bird and mammal receptors in addition to the general plant and terrestrial invertebrate communities. The receptors were selected based on several criteria, including their potential to be found in the various habitats present within the NNEU (and potentially their future presence within the North Firing Range), their potential to come into contact with ECOIs and the amount of life history and behavioral information available.

The ECOPC identification process for all receptors includes a screening step that compares maximum detected concentrations (MDCs) from within the North Firing Range to NOAEL ESLs. ESLs were calculated in the CRA Methodology based on the most significant exposure pathways and receptors presented in the SCM, and represent a soil concentration at which no effects to either individual receptors or populations of receptors are predicted. For avian and mammalian receptors, the ingestion pathways used to calculate the ESLs were the soil and food ingestion pathways. For the non-vertebrate receptors, only the direct contact with soil pathway was used to derive the ESLs.

If no ESL is available, the ECOI is identified as an ECOI of uncertain toxicity and will be discussed further in the uncertainty section (Section 4.3) and in the NNEU CRA (Volume 6). If an ECOI MDC exceeds the appropriate NOAEL ESL, additional screening steps are performed including a frequency of detection evaluation, comparison to background, comparison of calculated EPCs to threshold ESLs (tESLs), and a professional judgment evaluation.

A more detailed discussion of the ECOPC screening procedure and the assumptions inherent in this procedure are provided in Section 7.3 of the CRA Methodology and Volume 2 of Appendix A of the RI/FS Report.

2.1 Data Used in the Ecological Risk Assessment

The following data are used to identify ECOPCs specific to the North Firing Range:

- Surface soil samples (Figure 2.5) analyzed for inorganics (21 samples); and
- Subsurface soil samples (Figure 2.6) analyzed for inorganics (17 samples).

A data summary is provided in Table 2.1 for surface soil and in Table 2.2 for subsurface soil. The dataset used in the ECOPC identification process differs from the dataset presented in the closeout report for the North Firing Range in that only data from post-removal confirmation sampling and data from areas without excavation were used for this report. The differences between the two datasets are:

- The closeout report only reports those analytes greater than background. All analytes less than background are eliminated from further consideration.
- The closeout report includes X-Ray Fluorescence data that is not used in the CRA.
- The closeout report only discusses analytes with RFCA WRW soil action levels as listed in Attachment 5 of RFCA.
- Non-detected analytes are eliminated from the accelerated action data comparison, but for the ecological screen, one-half the result is used for non-detected results when calculating summary statistics.

Data collected in areas that were removed as part of the accelerated action were deemed no longer relevant and were excluded from the ECOPC identification process.

2.2 Identification of Surface Soil Ecological Contaminants of Potential Concern for Non-Preble's Meadow Jumping Mouse Receptors

ECOPCs for surface soil were identified for non-PMJM receptors in accordance with the sequence presented in the CRA Methodology.

2.2.1 Comparison to No Observed Adverse Effect Level Ecological Screening Levels

In the first step of the ECOPC identification process for non-PMJM receptors, the MDCs of ECOIs in North Firing Range surface soil were compared to receptor-specific NOAEL ESLs. NOAEL ESLs for surface soil were developed in the CRA Methodology for three receptor groups: terrestrial vertebrates, terrestrial invertebrates, and terrestrial plants.

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The NOAEL ESLs for non-PMJM receptors are compared to MDCs in surface soil in Table 2.3, while a summary of the results of the NOAEL ESL screening analyses for all receptor types are presented in Table 2.4. Analytes with a "Yes" in Table 2.4 are evaluated further.

NOAEL ESLs were not available for several ECOI/receptor pairs (Tables 2.3 and 2.4). These ECOI/receptor pairs will be discussed as ECOIs with uncertain toxicity along with the potential impacts to the risk assessment in Section 4.3.

2.2.2 Frequency of Detection Evaluation

The ECOPC identification process for non-PMJM receptors involves an evaluation of detection frequency for each ECOI retained after the NOAEL screening step. If the detection frequency is less than 5 percent, population-level risks are considered highly unlikely and the ECOI is further evaluated using professional judgment. The detection frequencies for analytes in surface soil are presented in Table 2.1. All of the analytes in surface soil at the North Firing Range that were retained after the NOAEL ESL screening step had a detection frequency of greater than 5 percent. No ECOIs were excluded from further analysis based on the frequency of detection evaluation.

2.2.3 Comparison to Background

The North Firing Range ECOIs retained after the NOAEL ESL screening and the detection frequency evaluations were compared to site-specific background concentrations where available.

The results of the background comparisons for the non-PMJM receptors are presented in Table 2.5.

2.2.4 Exposure Point Concentration (EPC) Comparison to Threshold ESLs

ECOIs retained after all previous evaluations for non-PMJM receptors are compared to tESLs using EPCs specific to small and large home-range receptors. The calculation of EPCs is discussed in the CRA Methodology (DOE 2004).

Statistical concentrations for each ECOI retained for the tESL screen are presented in Table 2.6. These EPCs represent only data from within the North Firing Range. The EPC for small home-range receptors is the 95th UCL of the 90th percentile (95th upper tolerance limit [UTL]) or the MDC in the event that the UTL is greater than the MDC. The EPC for large home-range receptors is the UCL or the MDC in the event that the UCL is greater than the MDC.

Small home-range receptors include terrestrial plants, terrestrial invertebrates, mourning dove, American kestrel, deer mouse, and black-tailed prairie dog. These receptors are evaluated by comparing the small home-range EPC (UTL) for each ECOI to the limiting (or lowest) small home-range receptor tESL (if available). In the event that tESLs are not

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available, the limiting NOAEL ESL is used in accordance with the CRA Methodology (DOE 2004).

Large home-range receptors include the coyote and mule deer, and are evaluated by comparing the large home-range EPC (UCL) for each ECOI to the limiting large home-range receptor tESL (if available). In the event that tESLs are not available, the limiting NOAEL ESL is used in accordance with the CRA Methodology (DOE 2004).

The EPC comparison to tESLs for small and large home-range receptors is presented in Table 2.7. Analytes that exceed the limiting tESLs are further evaluated by comparing to the receptor-specific tESLs (if available) to identify receptors of potential concern. Analytes exceeding the limiting tESL for small home-range receptors are compared to receptor-specific tESLs in Table 2.8. Analytes exceeding the limiting tESLs for large home-range receptors are compared to receptor-specific tESLs in Table 2.9.

Analytes that exceed any tESLs (if available) are typically assessed in the professional judgment evaluation in the CRA. However, for this Accelerated Action screening, no professional judgment evaluation was conducted since the analysis is focused on a historical source area for inorganic constituents. Therefore, any ECOI retained following the tESL screening is identified as an ECOPC for the North Firing Range and is discussed further in this document.

2.2.5 Summary of Surface Soil Ecological Contaminants of Potential Concern

Aluminum, antimony, boron, chromium, copper, lead, lithium, nickel, thallium and tin were identified as surface soil ECOPCs for the North Firing Range and will be assessed further in the following sections. The results of the surface soil ECOPC identification process for non-PMJM receptors are summarized in Table 2.10.

2.3 Identification of Subsurface Soil Ecological Contaminants of Potential Concern

A summary of subsurface soil data for soil collected at a starting depth of 0 to 8 ft in the North Firing Range is presented in Table 2.2 and sampling locations are shown on Figure 2.6.

2.3.1 Comparison to No Observed Adverse Effect Level Ecological Screening Levels

For subsurface soil, North Firing Range MDCs were compared to NOAEL ESLs for burrowing receptors (Table 2.11). Only arsenic, copper, and zinc had maximum subsurface soil concentrations greater than their respective NOAEL ESLs for the prairie dog. NOAEL ESLs are not available for the ECOIs labeled UT in Table 2.12. These chemicals are considered ECOIs with uncertain toxicity and are discussed in the uncertainty analysis (Section 4.3).

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2.3.2 Frequency of Detection Evaluation

No detection frequency evaluation was conducted because only 17 subsurface soil samples are available in the North Firing Range. Therefore, if an ECOI is detected the frequency of detection is greater than the 5 percent criteria for further evaluation.

2.3.3 Comparison to Background

The statistical comparison of the North Firing Range subsurface soil concentrations to background (Table 2.12) shows that the site data set is statistically different (p-value < 0.1) for arsenic and copper. No significant difference was noted between the North Firing Range concentrations of zinc with those found in the background dataset. Therefore, arsenic and copper are the only remaining ECOIs.

2.3.4 Exposure Point Concentration Comparison to Threshold ESLs

ECOIs retained after all previous evaluations for subsurface soil are compared to tESLs using the subsurface soil UTL.

The statistical concentrations for copper along with the tESL for the prairie dog are presented in Table 2.13. These EPCs represent only data from within the North Firing Range. The UTLs for arsenic and copper within the North Firing Range are less than their tESLs for the prairie dog receptor. Arsenic and copper are, therefore, eliminated from further consideration as an ECOI.

2.3.5 Summary of Subsurface Soil Ecological Contaminants of Potential Concern

All subsurface soil ECOIs for the burrowing receptor in the North Firing Range were eliminated from further consideration as ECOPCs. These decisions were based on either; (1) the MDC of the ECOI is less than the ESL for the burrowing receptor, (2) no ESLs are available (these ECOIs are discussed in Section 4.3), (3) concentrations of the ECOIs in subsurface soil were less than in background subsurface soil, or (4) the UTL was less than the tESL. The results of the subsurface soil ECOPC identification process for non-PMJM receptors are summarized in Table 2.14.

2.4 Summary of Ecological Contaminants of Potential Concern

ECOIs in surface and subsurface soil in the North Firing Range were evaluated in the ECOPC identification process. A summary of the screening process for each medium and receptor group is presented in Table 2.10 for surface soil (non-PMJM receptor) and Table 2.14 for subsurface soil (non-PMJM receptors). The ECOPCs identified for North Firing Range surface soils are evaluated further in Section 3.

3.0 NORTH FIRING RANGE RISK EVALUATION

This risk evaluation focuses on the overall results for the assessment endpoints. This includes discussion of the potential for risk for each receptor group and level of

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biological organization (that is, individual or population level of protection), as appropriate for the assessment endpoints. As noted by EPA (EPA 1997), a well-balanced risk characterization should "...present risk conclusions and information regarding the strengths and limitations of the assessment for other risk assessors, EPA decision-makers, and the public."

The assessment endpoints used in the ERAs at RFETs are based on the population level of biological organization within defined EUs for all receptors except the federally protected PMJM (evaluated on an individual basis within appropriate habitat). Given the small size of the North Firing Range only several individuals of small home range receptors could potentially use the area as their primary home range and large home range receptors would only use the area as a small portion of their home ranges. A more appropriate assessment technique to determine potential risks to the population of receptors, as indicated by the assessment endpoints, is to evaluate the potential risks to the ECOPCs specific to the North Firing Range over the entire NNEU. If elevated risks are predicted to the population of receptors within the NNEU, the data from the North Firing Range can then be reviewed in terms of the entire NNEU dataset to determine if risks are being driven by elevated concentrations within the North Firing Range.

The following sections discuss the potential risks to the ECOPCs identified for the North Firing Range in terms of their potential risks within the NNEU. Any potentially elevated risks within the NNEU are then discussed in terms of the potential contribution of remaining elevated concentrations of ECOPCs within the North Firing Range on the EU-wide assessment. Surface soil sample locations for the entire NNEU are shown on Figure 3.1.

Risk characterization typically has two main components: risk estimation and risk description. The risk estimation summarizes the results of the analysis, identifies the ECOPCs and associated receptors, presents a range of potential risks, and identifies the specific locations where risk may be present. The risk description provides the context for the analysis, including the proportions of habitats affected and interpretation of overall results.

The risk characterization, therefore, defines a range of potential risks to NNEU receptors from the ECOPCs of interest in the North Firing Range and defines the contribution of the North Firing Range area to risks within the much larger NNEU.

3.1 Exposure Unit Comparison to North Firing Range Data

Several ECOPCs were identified for the North Firing Range. These are further evaluated on an EU-wide basis in the following sections. Since the assessment endpoints that were applicable to the North Firing Range (i.e. non-PMJM terrestrial receptors) are discussed in the CRA Methodology as population level endpoints that are to be assessed on an EU-wide basis, further evaluation is necessary as part of the Accelerated Action screening.

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3.1.1 Background Evaluation for NNEU Data

Aluminum, antimony, boron, chromium, copper, lead, lithium, nickel, thallium and tin were all identified in Section 2.2.3 as either having concentrations within the North Firing Range that were statistically greater than site-specific surface soil background concentrations or the data were insufficient to make a valid statistical comparison.

An additional comparison of the NNEU concentrations of the ECOPCs to site-specific background concentrations is provided in Table 3.1. The NNEU surface soil data used in the background comparison is provided in Attachment 1 (on compact disc [CD]).

Of the ECOPCs identified for the North Firing Range, NNEU-wide concentrations of aluminum, chromium, lead and lithium are not statistically greater than site-specific background concentrations ($p > 0.1$). This indicates that while exposure to individual receptors that may utilize habitats within the North Firing Range for these ECOPCs has the potential to be greater than background exposures, the populations of receptors that inhabit the NNEU are not expected to be exposed at rates greater than those in site-specific background areas.

Based on the CRA Methodology, ECOIs that are not determined to be significantly different from background concentrations are removed from further consideration as EU-wide ECOPCs. The Accelerated Action risk evaluation is intended to identify areas that will require further accelerated actions by focusing in historical source areas. However, final risk decisions for the NNEU will be based on the results of the CRA. Therefore, although concentrations within the North Firing Range may be elevated above background concentrations for aluminum, chromium and lead, the concentrations from the entire NNEU dataset are not significantly greater than background and population-level risks are not expected to be greater than background risks to non-PMJM receptors in the NNEU from potential exposure to aluminum, chromium and lead.

Copper and nickel have statistically greater concentrations in NNEU than those from within the background dataset. Antimony, boron, thallium and tin could not be statistically compared to the background dataset due to either low numbers of detections or no data (boron only) within the background dataset. These ECOPCs for the North Firing Range are discussed further.

3.1.2 Comparison of NNEU EPCs to tESLs

Table 3.2 presents the range of statistical concentrations for the North Firing Range ECOPCs using the NNEU dataset. Table 3.3 presents a comparison of the applicable NNEU-wide EPCs to the limiting small and large home range receptor tESLs (nickel is the only ECOPC for large home range receptors in the North Firing Range).

All of the ECOPCs for the North Firing Range, except thallium, have NNEU-wide EPCs that are greater than their limiting tESLs and will be further evaluated in the Risk Characterization (Section 4). The NNEU-wide UTL for thallium is less than the tESL and is not further assessed in the risk characterization as the CRA Methodology indicates the analytes with EU-wide EPCs less than tESLs are of *de minimus* risk and do not

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require evaluation in a risk characterization. Since the CRA requires population-level risks in the entire EU to be evaluated and the North Firing Range makes up only a small proportion of the NNEU, concentrations that may be elevated within the North Firing Range, in this case, do not indicate that the risks to non-PMJM receptor populations within the NNEU are elevated. Thallium risks to non-PMJM receptors are not, therefore, further evaluated in this document.

3.2 Ecological Exposure Assessment

The steps presented above identified those chemicals that could not reliably be removed from further consideration in the ERA process. The list of ECOPC/receptor pairs of potential concern (Table 3.4) represents those media, chemicals, and receptors in the NNEU that require further assessment. The characterization of risk defines a range of potential exposures to receptors from the ECOPCs and a parallel evaluation of the potential toxicity of each of the ECOPCs. This section provides the EU-wide estimation of potential exposure to surface soil ECOPCs for North Firing Range.

Exposure results from contact between a receptor and ECOPCs in an environmental medium. For exposure to occur, a release must have occurred and a receptor must have a point of potential contact with that medium. The potential for receptor contact and identification of exposure routes are shown on the SCM originally presented in the CRA Methodology (DOE 2004).

The exposure model describes the relationships and equations used to estimate how much of a given chemical in a given medium is taken up by the receptor via a given exposure route. These relationships may be simple or complex depending on the receptor involved and the number of exposure routes evaluated. Two basic exposure models are used in ERAs: the concentration-based model and a dosage-based model.

3.2.1 Concentration-Based Exposure Model

The exposure model for some ecological receptors is expressed as the concentration of each chemical in the medium to which the receptor is most likely exposed. This exposure model is used for terrestrial plants and terrestrial invertebrates.

3.2.2 Dosage-Based Exposure Model

The exposure model used for avian and mammalian receptors is based on exposure to contaminants through multiple pathways including the ingestion of soils, food items (plant, invertebrate, and bird/mammal tissue), and surface water. Other potential exposure pathways (e.g., inhalation and dermal exposures) are not evaluated due to a lack of information necessary for their inclusion in the risk calculations. The total daily intake as a result of exposure via these pathways for terrestrial receptors is the sum of the intakes from the different pathways, with the total average daily intake ($Intake_{total}$) of a specific ECOPC calculated as:

$$Intake_{total} = Intake_{food} + Intake_{water} + Intake_{soil}$$

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where:

$Intake_{food}$ = average daily intake from ingestion of food items (vegetation, invertebrate, and animal tissues).

$Intake_{soil}$ = average daily intake from incidental ingestion of soil/residue or sediment.

$Intake_{water}$ = average daily intake from the ingestion of water.

The end product of the exposure estimate is a dosage (milligrams per kilogram [mg/kg] receptor body weight [BW] per day [mg/kg/BW/day]) rather than a medium concentration, as was the case for terrestrial and aquatic plants and invertebrates. This is a function of both the multiple pathway approach and the typical methods used in toxicity testing for birds and mammals.

Calculation of total intake assumes that receptors obtain 100 percent of exposure from the NNEU (i.e., area use factor [AUF] = 100 percent). This likely overestimates the exposure of wide-ranging receptors such as the coyote or mule deer that use the entire site in their feeding and resting activities.

The following equation was used to calculate the amount of individual ECOPCs that a wildlife receptor could obtain from the ingestion of food, soil, and surface water within the NNEU.

$$\text{Exposure(Intake)} = \left[(C_{soil} * P_{soil} * FIR * RBA_{soil}) + \left(\sum_{i=1}^{n} ([C_{food}] * P_{food} * FIR * RBA_{food}) + (C_{water} * WIR) \right] * AUF \right.$$

where:

Exposure (Intake) = rate at which an ECOPC is ingested from all sources (mg/kg/BW/day)

C_{soil} = contaminant concentration for contaminant (j) in soil (mg/kg dry weight)

n = number of different biota food types in diet

C_{food} = contaminant concentration in food type (i) calculated by bioaccumulation factor (BAF) C_{soil} (mg/kg dry weight)

C_{water} = contaminant concentration in water (milligrams per liter [mg/l])

P_{food} = proportion of biota type (i) in diet

FIR = food ingestion rate (kilogram [kg] food [dry weight]/kg BW [wet weight]/ day)

RBA_{food} = relative bioavailability of contaminant (j) from biota type (i) (RBA_{food} = 1)

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RBA_{soil} = relative bioavailability of contaminant (j) from soil (RBA_{soil} = 1)

P_{soil} = soil ingestion as proportion of diet

WIR = water ingestion rate (kg water/kg BW/day)

AUF = area use factor (AUF = 1)

3.2.3 Exposure Point Concentrations

Surface soil EPCs for non-PMJM receptors were calculated according to the CRA Methodology (DOE 2004) using two tiers of geospatial analysis. The Tier 1 geospatial analysis assumes that all samples are randomly located and are weighted equally. This method results in EPCs that are overly conservative when the data set is biased toward areas with elevated contamination and results in the calculation of the UCL and UTL discussed in Section 7.2.5. The Tier 2 geospatial analysis is described in Section 4.6 of the CRA Methodology and provides an alternative set of EPCs that provides a less conservative estimate of EU concentrations. The NNEU was overlain with a grid of squares 30 acres in area (Figure 3.2). The Tier 2 geospatial method groups samples collected within each 30-acre grid and estimates a mean concentration for each grid cell. The grid means are then used to calculate the Tier 2 UTL and UCL for the IAEU. The Tier 2 geospatial approach is then used to derive an alternative, less conservative, and a more realistic EPC. The Tier 1 and Tier 2 UTLs and UCLs are presented in Table 3.5.

Surface water EPCs consisted of values that corresponded to the soil EPCs being used. For example, if the soil EPC statistic was the UCL, then the UCL concentration in surface water was selected as the EPC. No Tier 2 statistics were calculated for surface water. Surface water EPCs for all ECOPCs are presented in Table 3.6.

3.2.4 Receptor-Specific Exposure Parameters

Receptor-specific exposure factors are needed to estimate exposure to ECOPCs for each representative species. These include BW; food, water, and media ingestion rates; and diet composition and respective proportion of each dietary component. Daily rates for intake of forage, prey, water, and incidental ingestion of soils were developed in the CRA Methodology (DOE 2004) and are presented in Table 3.7 for the receptors of potential concern carried forward in the ERA for the North Firing Range.

3.2.5 Bioaccumulation Factors

The measurement or estimation of concentrations of ECOPCs in wildlife food is necessary to evaluate how much of a receptor's exposure is via food versus direct uptake of contaminated media. Conservative BAFs were identified in the CRA Methodology (DOE 2004). These BAFs are either simple ratios between chemical concentrations in biota and soil or are based on quantitative relationships such as linear, logarithmic, or exponential equations. The values reported in the CRA Methodology are used as the "default" BAFs for purposes of risk estimation.

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Many of the simple ratio BAFs used in the default exposure model were based on conservative upper-bound estimates of the reported data. BAFs from the same references that represent the 50th percentile (or median) are also used in this ERA as more realistic estimates of bioaccumulation. These are identified as "alternative" BAFs for purposes of risk estimation. Where regression-based BAF models were used in the default exposure model, no alternative model was presented if the r-squared value of the model indicated that the model was adequate for predicting food tissue concentrations. In addition, where no BAF was available, a default value of 1 was used to estimate tissue concentrations.

3.2.6 Intake and Exposure Estimates

Intake and exposure estimates were completed for each ECOPC/receptor pair identified in Table 3.4. The "default" estimates use the default exposure parameters and BAFs presented in Appendix B of the CRA Methodology and described in the previous subsection. These intake calculations represent conservative estimates of food tissue concentrations calculated from the range of upper-bound EPCs including the Tier 1 and Tier 2 UTLs and UCLs.

The "alternative" exposure estimates differ from the "default" estimates only in that the BAFs used are the median values described in the previous subsection. Alternative exposure estimates are only calculated for those ECOPCs that had median BAFs.

The intake and exposure estimates for ECOPC/non-PMJM receptor pairs are presented in as follows:

- Antimony – Default exposure estimates for the deer mouse (herbivore and insectivore) are presented on Table 3.8.
- Copper – Default exposure estimates for the mourning dove (herbivore and insectivore) are presented on Table 3.9.
- Nickel – Default exposure estimates for the mourning dove (insectivore), deer mouse (herbivore and insectivore) and coyote (generalist and insectivore) are presented on Table 3.10. Exposures resulting from the use of an alternative (median) BAF for the soil-to-invertebrate exposure pathway are also presented for the insectivorous receptors on Table 3.11.
- Tin – Default exposure estimates for mourning dove (insectivore) and deer mouse (insectivore) are presented on Table 3.12.

3.3 Ecological Toxicity Assessment

Exposure to wildlife receptors was estimated for representative species of functional groups based on taxonomy and feeding behavior in Section 3.2 in the form of a daily rate of intake for each ECOPC/receptor pair. To estimate risk, soil concentrations (plants and invertebrate exposure) and calculated intakes (birds and mammals) must then be compared to the toxicological properties of each ECOPC. The laboratory-based toxicity benchmarks are termed toxicity reference values (TRVs) and are of several basic types.

The NOAEL and no observed effect concentration (NOEC) TRVs are intake rates or soil concentrations below which no ecologically significant effects are expected. The NOAEL and NOEC TRVs were used to calculate the NOAEL ESLs used in screening steps of the ECOPC identification process to eliminate chemicals that have no potential to cause risk to the representative receptors. The lowest observed adverse effects level (LOAEL) (TRV) is a concentration above which the potential for some ecologically significant adverse effect could be elevated. The threshold TRVs represent the hypothetical dose at which the response in a group of exposed organisms may first begin to be significantly greater than in unexposed receptors and is calculated as the geometric mean of the NOAEL and LOAEL. Threshold TRVs were calculated based on specific data quality rules for use in the ECOPC identification process for a small subset of ECOIs in the CRA Methodology (DOE 2004). Several other alternative TRVs are also presented in Table 3.13 for use in risk characterization. All of these alternative values were derived from sources approved for use in the CRA Methodology.

For plants, alternative TRVs for use in risk characterization are presented along with the ESLs in Table 3.14.

3.4 Ecological Risk Characterization

ECOPCs/Receptor pairs for the North Firing Range for which the potential for EU-wide risk could not be considered *de minimus* are characterized in the following sections. These ECOPC/receptor pairs were carried forward through the exposure assessment and toxicity assessment to identify input parameters necessary to characterize potential risk. The risk characterization, therefore, defines a range of potential risks to on-site receptors from the ECOPCs.

HQs are one tool used to estimate risk. The HQ is a ratio of the estimated exposure concentration to the TRV where:

$$HQ = \text{Intake/TRV}$$

In general, if the HQ is less than 1.0 for the NOAEL TRV, then no adverse effects are predicted. If the HQ for the threshold or LOAEL TRV is less than 1.0, adverse effects are considered highly unlikely and risks are classified as low. If the intake exceeds the LOAEL TRV, the risks to that receptor for the specific ECOPC require further evaluation. There is, however, no clear consensus from either EPA guidance or the scientific literature concerning the significance of the level of departure from HQs greater than 1.0.

One complicating issue is that an HQ greater than 1.0 by itself does not indicate the magnitude of effect or provide a measure of potential population-level effects (Menzie et al. 1992). For instance, a high HQ for a chemical may be the result of a small, isolated area of high concentration rather than widespread contamination.

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Predicted risks should be viewed in terms of the potential for the assumptions used in the risk characterization to occur in nature and in the potential for effects on the population of receptors that could inhabit the NNEU. HQs were calculated for each ECOPC/receptor pair based on the exposures estimated and TRVs presented in the preceding sections. Risks are discussed and presented to put the assumptions of the risk predictions into a context that can be used to make risk management decisions.

3.4.1 Antimony

Antimony was identified as an ECOPC for the terrestrial plant and deer mouse (insectivore and herbivore) receptors only. Evaluation of potential exposure to antimony was conducted using the default exposure scenarios only.

HQs greater than 1 were calculated using NOAEL TRVs for the deer mouse (insectivore) only (Table 3.15). No HQs greater than 1 were calculated using the LOAEL TRV or the calculated geometric mean of NOAEL or LOAEL TRVs (growth, reproduction and mortality) from USEPA EcoSSL guidance (USEPA 2003). Since no LOAEL TRVs resulted in HQs greater than 1, potential for risk to ecological receptors in the NNEU is considered low.

Additionally, antimony concentrations within the North Firing Range (UTL = 3.4 mg/kg) are comparable to the NNEU Tier 2 UTL (3.57 mg/kg) that resulted in no LOAEL HQs greater than 1.

For plants, very little toxicity information is available. The 5 mg/kg ESL was obtained from Efroymson et al. (1997) and is discussed by the authors as being obtained from secondary references noting unspecified qualitative information regarding toxic effects when antimony was added to surface soil at the ESL concentration. No note was made regarding the baseline concentration of antimony in the soil prior to addition of antimony. The authors put a low confidence in the ESL value. No additional soil benchmarks for antimony are available; however, given that the UTL for the North Firing Range is less than even the uncertain ESL, no risks are predicted.

No further action within the North Firing Range is necessary to reduce risks to populations of receptors inhabiting the NNEU from exposure to antimony in surface soils.

3.4.2 Boron

The Tier 1 UTL for boron in NNEU (6.47 mg/kg) exceeded the NOAEL ESL for only one receptor group, terrestrial plants (0.5 mg/kg). All other NOAEL ESLs were greater than the Tier 1 UTL and ranged from 30 to 6,070 mg/kg. Site-specific background data for boron were not available, but the MDC within NNEU (7.9 mg/kg) did not exceed the low end (20 mg/kg) of the background range presented in Shacklette and Boerngen (1984). This indicates the terrestrial plant NOAEL ESL (0.5 mg/kg) is consistent with expected background concentrations, and MDCs above the NOAEL ESL are not likely to be indicative of site-related risk to the terrestrial plant community in the NNEU. Kabata-Pendias and Pendias (1992) indicates soil with boron concentrations equal to 0.3 mg/kg is

critically deficient in boron and effects on plant reproduction would be expected. Additionally, the summary of boron toxicity in Efroymson et al. (1997) notes that the source of the 0.5 mg/kg NOAEL ESL indicates boron was toxic when added at 0.5 mg/kg to soil, but gives no indication of the boron concentration in the baseline soil before addition. The confidence placed by Efroymson et al. (1997) was low. Because no NOAEL ESLs other than the terrestrial plant NOAEL ESL are exceeded by the Tier 1 UTL, boron is highly unlikely to present a risk to terrestrial receptor populations in the NNEU and no further action within the North Firing Range is necessary to reduce risks to populations of receptors inhabiting the NNEU from exposure to boron in surface soils.

3.4.3 Copper

Copper was identified as an ECOPC for the mourning dove (insectivore and herbivore) receptors. HQs were calculated using the default exposure scenario only since no conservative ratio BAFs were used in the default scenario.

HQs greater than 1 were calculated for the insectivorous mourning dove receptor using the NOAEL TRV only (Table 3.16). No HQs greater than 1 were calculated for either receptor using the threshold or LOAEL TRVs. Risks to both receptors from copper are, therefore, considered low.

Copper concentrations within the North Firing Range are somewhat elevated when compared to the remainder of the data from the NNEU. However, the UTL within the North Firing Range is less than 10 times the NNEU UTL. The LOAEL TRV for copper (Table 3.13) is approximately 25 times the copper NOAEL. LOAEL HQs for both bird species will, therefore, be less than 1 even if it is assumed that the entire population of both species inhabits only the small area of the North Firing Range. Since exposures and risks to non-PMJM receptors are assessed on and EU-wide basis, this assumption is highly conservative. Given that the NNEU risks are low and no risks would be predicted if it was assumed that the North Firing Range was the entire exposure area, no further action within the North Firing Range is necessary to reduce risks to populations of receptors inhabiting the NNEU from exposure to copper in surface soils.

3.4.4 Nickel

Nickel was identified as an ECOPC for the mourning dove (insectivore), deer mouse (herbivore and insectivore) and coyote (generalist and insectivore) receptors only. HQs were calculated for all receptors using the default exposure factors and for the insectivorous receptors using an alternative exposure scenario that used an alternative (median) BAF to estimate invertebrate tissue concentrations in the food ingestion pathway. Since the herbivorous diet exposure estimation was not affected by the alternative exposure model, only the default model was used for the deer mouse (herbivore) receptor.

Nickel was evaluated using a range of EPCs. The default TRVs used for estimating potential risks to mammals is very low as compared to other peer-reviewed toxicity

information. The alternative TRVs, taken from Sample et al. (1996), provide additional and realistic estimates of potential toxicity (Table 3.17).

NOAEL HQs were >1 for mourning dove (insectivore), deer mouse (insectivore), coyote (generalist), and coyote (insectivore) under the default exposure/TRV scenarios. All receptors except coyote (generalist) had NOAEL HQs>1 for the alternative exposure/default TRV scenarios. Threshold HQs were >1 for the mourning dove under default exposure/TRV scenarios, but <1 for alternative exposure/default TRV scenarios. LOAEL HQs for all receptors (except deer mouse [insectivore]) were <1 for all exposure scenario combinations. All HQs were <1 for both default and alternative exposure scenarios when using alternative TRVs.

For the deer mouse (insectivore), LOAEL HQs greater than 1 were calculated using the default exposure scenario and default TRVs. The NOAEL-based ESL calculated for the deer mouse (insectivore) was equal to 0.431 mg/kg, a concentration less than all site-specific background samples (minimum background concentration = 3.8 mg/kg). The NOAEL TRV used to calculate the ESL was estimated from the LOAEL TRV in the CRA Methodology by dividing by a factor of 10. The LOAEL TRV for mammals (1.33 mg/kg BW/day) is based on pup mortality in rats. Given that the LOAEL TRV is ten times the NOAEL TRV, a back-calculated soil concentration using the LOAEL TRV would equal approximately 4.3 mg/kg. This concentration would exceed only the minimum detected concentration of nickel in background soils and would be exceeded by 19 of the 20 site-specific background soil concentrations. Since risks to ecological receptors are not generally expected in background areas, this indicates that the default TRVs used to calculate risks for mammals in general, and the deer mouse (insectivore) specifically, are too conservative. The CRA Methodology prescribed a hierarchy of TRV sources from which TRVs could be identified and used without modification. TRVs were selected first from USEPA EcoSSL guidance (USEPA 2003) from which no nickel TRVs were available. The second tier TRV source was PRC (1994), from which the LOAEL TRV was obtained and the NOAEL TRV was estimated. Since this value appears to be overly-conservative, the third tier TRV source (Sample et al. 1996) was reviewed for a usable TRV. Sample et al. (1996) presents TRVs for birds and mammals. HQs calculated using these TRVs as alternatives to the default TRV values are presented in Table 3.17. All HQs for all receptors are less than 1 using the alternative TRVs.

EPCs from within the North Firing Range are similar to those from the entire NNEU. Risks are low for all receptors in the NNEU, therefore, no further action is necessary in the North Firing Range to reduce risks to populations of receptors inhabiting the NNEU from exposures to nickel.

3.4.5 Tin

Tin was identified as an ECOPC for the mourning dove (insectivore) and deer mouse (insectivore) receptors only. HQs were calculated using the default exposure scenario only since no alternative BAFs were available.

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HQs greater than 1 were calculated for both receptors using only the NOAEL TRV (Table 3.18). No HQs greater than 1 were calculated for either receptor using the LOAEL TRV. Risks to the mourning dove (insectivore) and deer mouse (insectivore) receptors in the NNEU from tin are considered low.

Tin concentrations within the North Firing Range are somewhat elevated when compared to the remainder of the data from the NNEU. However, the UTL concentration within the North Firing Range is approximately only 2 times the NNEU UTL and the NNEU HQs using the LOAEL TRV are equal to 0.1 or less. LOAEL HQs for both receptors will, therefore, be less than 1 even if it is assumed that the entire population of both receptors inhabits only the small area of the North Firing Range. Since exposures and risks to non-PMJM receptors are assessed on and EU-wide basis, this assumption is highly conservative. Given that the NNEU risks are low and no risks would be predicted if it was assumed that the North Firing Range was the entire exposure area, no further action within the North Firing Range is necessary to reduce risks to populations of receptors inhabiting the NNEU from exposure to tin in surface soils.

4.0 UNCERTAINTIES ASSOCIATED WITH THE ECOLOGICAL RISK ASSESSMENT

Quantitative evaluation of ecological risks is limited by uncertainties regarding the assumptions used to predict risk and the data available for quantifying risk. These limitations are usually circumvented by making estimates based on the data available or by making assumptions based on professional judgment when data are limited. Because of these assumptions and estimates, the results of the risk calculations themselves are uncertain and it is important for risk managers and the public to view the results of the risk assessment with this in mind. The following sections summarize the various sources of uncertainty in the risk evaluation, along with a qualitative estimate of the direction and magnitude of the likely errors attributable to the uncertainty.

4.1 Uncertainties Associated With Data Adequacy and Quality

Volumes 2 and 8 of the CRA discuss the general data adequacy and data quality for the NNEU. Data of sufficient adequacy and quality for ERA purposes were collected for surface soil and subsurface soil.

4.2 Uncertainties Associated with the Ecological Contaminants of Potential Concern Identification Process

The ECOPC identification process was designed to eliminate chemicals that are not likely to be of ecological concern within the North Firing Range. This procedure included a comparison of MDCs to NOAEL-based ESLs. Use of this ECOPC identification process ensures that only those ECOIs related to historic activities within the North Firing Range are retained for additional quantitative evaluation.

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4.2.1 Uncertainties Associated With the Selection of Representative Receptors

ESLs were developed for several species that represent the various groups of species or feeding guilds potentially inhabiting RFETS. There are uncertainties associated with the selection of the representative receptors from the group of species identified at RFETS based on field observations. The receptors were selected based on several criteria, including their potential to be found in the various habitats present within the NNEU and in the North Firing Range, their potential to come into contact with ECOIs and the amount of life history and behavioral information available. The use of these criteria decreases the uncertainty associated with receptor selection, however, the direction and magnitude of the effects of this uncertainty are unknown.

4.2.2 Uncertainties Associated With Exposure Calculations

Exposure was also quantified using life history and behavioral parameters for each receptor. These parameters were used to estimate the amount of contact a receptor may have with contaminated media by various exposure routes. The following parameters were used in the exposure models in the CRA and in the ESL calculation procedures presented in the CRA Methodology:

- Ingestion rates of food, soil, and surface water;
- Body weight;
- Dietary proportions of each prey type; and
- Feeding habits.

Most of the exposure parameters used in this ERA are based on published values presented in the Wildlife Exposure Factors Handbook (EPA 1993) or other literature sources. However, some of the exposure factors used in the CRA were based on mathematical models, allometric equations, and professional judgment assumptions.

The use of exposure parameters derived from studies conducted in habitats and climates different from the landscape of the Site adds uncertainty to the CRA, because they may not reflect actual Site-related conditions. For example, ingestion rates cited in the Exposure Factors Handbook typically are based on eating habits of laboratory animals with access to an abundant food supply. It is likely that, in a wild setting such as that present at the Site, the same animals would not have access to such an abundant food supply, resulting in a lower actual ingestion rate than cited in the Exposure Factors Handbook. In this case, use of the published values would tend to bias the CRA toward an overestimation of risk; however, underestimation is also possible. The magnitude of over- or under-estimation of risk is unknown.

While the models used in the analysis of exposure and the derivation of ESLs are scientifically defensible and based on recognized ERA techniques, they are still essentially simplistic approximations of complex natural systems. As a result, there is uncertainty inherent in the use of models to describe the interactions that occur in a

natural system. Additional uncertainty is introduced into the modeling procedure because no species-specific studies were conducted to determine site-specific values for each exposure parameter for each receptor at this Site. Instead, literature values were used to estimate each parameter, and each receptor was assumed to spend 100 percent of its life cycle within the EU. Therefore, there is uncertainty involved with estimating exposure to ECOPCs by using modeling techniques that could over- or underestimate the actual risk to the receptors to an unknown degree.

Uncertainties associated with exposure modeling are introduced into the CRA in several other locations. First, the pathways selected for use in the exposure models included only the ingestion of ECOPCs in food items, incidentally ingested soil, and drinking water. These three exposure pathways make up the majority of the potential exposure to wildlife receptors; however, exposure also likely occurs to lesser degrees through inhalation of ECOPCs either in vapor form or adhered to particulate matter. Exposure can also occur through dermal absorption. These latter two pathways may be significant for some ECOPCs; however, the scientific data suitable for the quantification of these two pathways are lacking. The overall effect of not quantitatively evaluating exposure due to inhalation and dermal absorption likely underestimates risk to a low degree, but should be taken into consideration when reviewing the uncertainties related to exposure assessment.

Second, ESLs and exposure calculations rely heavily on literature-derived bioaccumulation factors and models as opposed to directly measured food item tissue concentrations. The factors and models used in the CRA are generally conservative and likely overestimate tissue concentrations to an unknown degree; there is considerable uncertainty inherent in the use of data not directly related to conditions at the Site.

Finally, the relative bioavailability of ECOPCs contacted through ingested soil or food items can create uncertainty in the risk characterization process. Such uncertainty can affect the EPCs used to estimate bioavailable forms (for example, dissolved metal in solution), as well as the toxicity endpoints used to derive toxicity reference values (TRVs). TRVs, for example, are generally based on observed dose-response relationships when the chemical is dissolved in water or some other readily soluble form. Thus, where ECOIs are not readily dissolved in the gastrointestinal tract of a receptor, potential risks to organisms associated with intake of the ECOPC will be overestimated.

Bioavailability and ecotoxicity of environmental contaminants are integrally linked to their environmental concentrations and chemical forms (EPA 1999). The toxicity of a contaminant is controlled by:

- Its environmental concentration;
- Its site-specific chemistry (especially its ionic solubility and speciation if a metal or metalloid);
- The physical matrix in which the contaminant is found; and
- The uptake pathway(s) into a target organism from its physical matrix.

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All of these factors help determine the exposure matrix for organisms in the field. Because the interplay of these factors determines the site-specific bioavailability and thus the potential expression of ecologically relevant effects, predictions of toxicity based solely on total concentrations in various environmental media have questionable scientific validity (EPA 1999). Therefore, assessment of ecological risks and the potential adverse effects of a contaminant require an understanding of the exposure matrix that may lead to actual uptake by a receptor species. For inorganic ECOPCs, the assumption of complete bioavailability in the soil ingestion pathways likely overestimates risk to a moderate degree. For inorganic ECOIs ingested through the food ingestion pathway and organic ECOIs ingested through the food or soil pathways, there is likely some overestimation of risk but to a lower degree than inorganics in the soil ingestion pathway.

4.2.3 Uncertainties Associated with Development of No Observed Adverse Effect Level Ecological Screening Levels

ESLs are typically based on information gained from laboratory and other carefully controlled experimental exposures described in the literature. This information is then used to extrapolate conditions likely to exist in the natural environment. The laboratory information often does not provide adequate background for these extrapolations. Consequently, assessment factors are often used to compensate for the many uncertainties inherent in the extrapolation from laboratory effects data to effects in natural ecosystems (Warren-Hicks and Moore 1998). Uncertainties can arise when extrapolations are made from the following (Calabrese and Baldwin 1993):

- Acute to chronic endpoints;
- One life stage to an entire life cycle;
- Individual effects to effects at the population level or higher;
- One species to many species;
- Laboratory to field conditions;
- One to all exposure routes;
- Direct to indirect effects;
- One ecosystem to all ecosystems; and/or
- One location or time to others.

The net effect of these uncertainties may result in either an overestimate or underestimate of risk to an unknown degree, depending on RFETS-specific conditions, the types of receptors included in the evaluation, and the particular ECOIs.

The CRA Methodology presents a strict set of rules for applying toxicity data to develop ESLs for the ECOIs and minimize uncertainty related to the extrapolations listed above.

No procedures for the identification of toxicity data and eventual development of ESLs can eliminate the uncertainty inherent in the overall development process for ESLs. However, a consistently conservative bias helps to ensure that risks are not underestimated.

4.3 Uncertainties Associated With the Lack of Toxicity Data for Ecological Contaminants of Interest

Several ECOIs detected in the North Firing Range do not have adequate toxicity data for the derivation of ESLs (CRA Methodology). These ECOIs are listed in Tables 2.4 and 2.11 with the UT designation. The Appendix B of the CRA Methodology outlined a detailed search process for toxicological information for the ECOIs that was intended to provide high quality data for a large proportion of the chemicals detected at RFETs. While the toxicity of those ECOIs that do not have ESLs calculated due to a lack of identified toxicity data is uncertain, the overall effect on the risk assessment is small since the primary chemicals historically used at RFETs have adequate toxicity data for use in the CRA. Therefore, while the potential for risk from these ECOPCs is uncertain and will tend to underestimate the overall risk calculated, the magnitude of underestimation is likely to be low.

ESLs and/or TRVs were not available for several of the ECOPC/receptor pairs identified in Section 2. These include antimony (birds), boron (birds and invertebrates), and tin (invertebrates). The risks to these ECOPC/receptor pairs is uncertain, however, since risk to all of the ECOPCs mentioned above is considered to be low for those receptors where toxicity information is available, this source of uncertainty is not expected to be significant.

4.4 Summary of Significant Sources of Uncertainty

The preceding discussion outlined the significant sources of uncertainty in the process for assessing ecological risk. While some of the sources of uncertainty discussed tend to underestimate risk, the majority of the uncertainties are somewhat biased toward the overestimation of risk to a generally unknown degree. The conservative nature of the risk estimations should, therefore, be taken into consideration when reviewing the conclusions of the risk assessment.

5.0 SUMMARY AND CONCLUSIONS

Risks to receptor populations inhabiting the NNEU is low from ECOPCs associated with the North Firing Range. A summary of the HQs calculated in Section 3 are presented in Table 5.1.

Concentrations of several constituents within the North Firing Range are elevated when compared to the data set from the remainder of the NNEU. Particularly, aluminum, chromium and lead are present in surface soil at concentrations statistically greater than site-specific background concentrations within the North Firing Range, but not statistically greater than background concentrations when the entire NNEU dataset is

considered. Since risk to populations of receptors are not typically expected at concentrations not different from those found in background areas, no risk associated with the site is predicted from these North Firing Range ECOPCs to populations of receptors inhabiting the NNEU. As a result, no further action is necessary to reduce risks to the populations of receptors within the NNEU from exposure to aluminum, chromium and lead in North Firing Range Surface Soils.

Similarly, concentrations of antimony, copper, nickel and tin are statistically greater than background concentrations both within the North Firing Range and the NNEU when compared to background concentrations. This document presented quantitative risk evaluations for each of the ECOPCs and found that risks are low.

No further action is necessary to reduce risks to the populations of receptors inhabiting the NNEU based on exposure to ECOPCs associated with the North Firing Range.

6.0 REFERENCES

Bekoff, M., 1977, Canis latrans, Mammalian Species, 79:1-9.

Beyer, N.M, E.E. Connor, and S. Gerould, 1994, "Estimates of Soil Ingestion by Wildlife", Journal of Wildlife Management, 58(2):375-382.

Calabrese, E.J. and L.A. Baldwin, 1993, Performing Ecological Risk Assessments, Chelsea, Michigan.

CalEPA, 2004, EcoTox Database, Online: http://www.oehha.ca.gov/ecotox/documents/caleco1.html.

Cronin, K.L. and E.L., Bradley, 1988, "The Relationship Between Food Intake, Body Fat and Reproductive Inhibition in Prairie Deer Mice (Peromyscus maniculatus bairdii)", Comparative Biochemistry and Physiology, 89:669-673.

DOE, 2004, Final Comprehensive Risk Assessment Work Plan and Methodology, Rocky Flats Environmental Technology Site, Golden, Colorado, September.

DOE, 2005. Draft Closeout Report for IHSS Group NE-1 (North Firing Range [PAC NW-1505]). May 2005.

Efroymson, R.A., M.E. Will, and G.W. Suter II, 1997, Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process, 1997 Revision, ES/ER/TM-126/R2, DOE, Lockheed Martin Energy Systems, Inc.

EPA, 1993, Wildlife Exposure Factors Handbook, Volumes I and II, Office of Research and Development, EPA/600/R-93/187a, Washington, D.C., December.

EPA, 1997, Ecological Risk Assessment for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final, Washington, D.C., July.

EPA, 1999, Integrated Approach to Assessing the Bioavailability and Toxicity of Metals in Surface waters and Sediments. EPA Office of Water, Office of Research and Development, EPA-822-E-99-001, Washington, D.C.

EPA, 2003, Guidance for Developing Ecological Soil Screening Levels, OSWER Directive #92857-55, Office of Solid Waste and Emergency Response, November.

Flake, L.D, 1973, "Food Habits of Four Species of Rodents on a Short-Grass Prairie in Colorado," Journal of Mammalogy, 54:636-647.

Gier, H.T, 1975, "Ecology and Behavior of the Coyote (Canis latrans)," In The Wild Canids, M.W, Fox, Ed, New York: Van Nostrand Reinhold.

Kabiata-Pendias, A., and H. Pendias, 1992, Trace elements in soils and plants, 2nd Edition, CRC Press, Boca Raton, Florida, 365 pp.

Menzie, C.A., D.E. Burmaster, J.S., Freshman, and C.A. Callahan, 1992. Assessment of Methods for Estimating Ecological Risk in the Terrestrial Component: A Case Study at the Baird and McGuire Superfund Site in Holbrook, Massachusetts. Environ. Toxicol. Chem. 11: 245-260.

PRC, 1994, Draft Technical Memorandum: Development of Toxicity Reference Values, as Part of a Regional Approach for Conducting Ecological Risk Assessment at Naval Facilities in California, PRC Environmental Management, Inc., Prepared for the U.S. Department of Navy.

Sample, B.E., D.M. Opresko, and G.W. Suter, II, 1996, Toxicological Benchmarks for Wildlife, 1996 Revision, Prepared for the DOE, Oak Ridge National Laboratory, ES/ER/TM-86/R3, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Shacklette, H.T., and Boerngen, J.G., 1984, Element Concentrations in Soils and Other Surface Materials of the Contiguous United States, U.S. Geological Survey, Professional Paper, 1270, Washington, D.C.

Warren-Hicks, W.J. and D.R.J. Moore, 1998, Uncertainty Analysis in Ecological Risk Assessment, SETAC Press, Pensacola, Florida.

Table 2.1
Summary of Detected Analytes in North Firing Range Surface Soils

Analyte	Range of Reported Detection Limits	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[a]	Standard Deviation[a]
Inorganics (mg/kg)							
Aluminum	4.2 - 5.2	21	100	9,100	22,000	15,000	3,470
Antimony	0.27 - 0.62	21	81	0.390	3.40	1.05	0.822
Arsenic	0.55 - 0.87	21	100	2.60	6.50	4.74	1.03
Barium	0.14 - 0.39	21	100	41.0	100	74.8	17.3
Beryllium	0.024 - 0.11	21	100	0.480	1.10	0.790	0.164
Boron	0.96 - 1.6	21	100	2.30	5.10	3.64	0.731
Cadmium	0.054 - 0.069	21	10	0.090	0.270	0.050	0.059
Calcium	6.7 - 11	21	100	1,600	6,900	3,050	1,310
Chromium	0.057 - 0.16	21	100	9.00	19.0	13.7	2.89
Cobalt	0.11 - 0.2	21	100	2.90	6.50	4.92	1.08
Copper	0.043 - 0.078	21	100	10.0	250	40.7	55.8
Iron	1.2 - 1.5	21	100	8,900	18,000	13,600	2,590
Lead	0.26 - 0.38	21	100	17.0	650	193	180
Lithium	0.27 - 0.52	21	100	5.40	14.0	8.92	2.26
Magnesium	5.5 - 8.1	21	100	1,400	3,800	2,180	562
Manganese	0.14 - 0.18	21	100	67.0	260	171	51.6
Mercury	0.0048 - 0.0057	21	100	0.014	0.340	0.046	0.068
Molybdenum	0.19 - 0.31	21	90	0.200	0.590	0.386	0.133
Nickel	0.19 - 0.21	21	100	6.80	16.0	11.4	2.60
Potassium	34 - 38	21	100	830	3,700	1,710	574
Silica	1.4 - 4.6	21	100	490	1,100	710	142
Sodium	89 - 140	21	14	160	270	76.7	65.9
Strontium	0.056 - 0.097	21	100	13.0	28.0	19.0	4.13
Thallium	0.3 - 0.97	21	29	0.340	5.80	0.589	1.23
Tin	0.54 - 0.9	21	19	1.70	22.0	2.15	4.56
Titanium	0.084 - 0.23	21	100	83.0	290	138	46.3
Vanadium	0.33 - 0.5	21	100	17.0	37.0	28.0	5.74
Zinc	0.43 - 0.52	21	100	14.0	43.0	26.0	7.46

[a] For inorganics, statistics are computed using one-half the reported value for nondetects.
N/A = Not applicable.

Table 2.2
Summary of Detected Analytes in North Firing Range Subsurface Soil/Subsurface Sediment

Analyte	Range of Reported Detection Limits	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[a]	Standard Deviation[a]
Inorganics (mg/kg)							
Aluminum	4 - 4.8	17	100	8000	35000	17400	7890
Antimony	0.28 - 0.65	17	76	0.67	5.3	1.26	1.29
Arsenic	0.53 - 0.81	17	100	2.8	13	5.96	2.87
Barium	0.14 - 0.37	17	100	30	120	68.8	26
Beryllium	0.023 - 0.1	17	100	0.52	1.5	0.889	0.294
Boron	1 - 1.7	17	100	1.7	5.8	3.18	1.34
Cadmium	0.052 - 0.065	17	6	0.35	0.35	0.0472	0.0781
Calcium	7 - 11	17	100	1500	4000	2640	683
Chromium	0.055 - 0.15	17	100	8.5	28	15.6	5.21
Cobalt	0.11 - 0.18	17	100	2.8	16	5.38	3.33
Copper	0.045 - 0.081	17	100	5.10	1,000	135	243
Iron	1.2 - 1.4	17	100	8,100	26,000	14,300	4,540
Lead	0.27 - 0.39	17	100	8.90	990	353	346
Lithium	0.27 - 0.48	17	100	4.50	18.0	9.45	4.15
Magnesium	5.3 - 7.5	17	100	1,300	3,400	2,140	587
Manganese	0.14 - 0.17	17	100	38.0	570	156	135
Mercury	0.005 - 0.006	17	100	0.007	0.082	0.036	0.018
Molybdenum	0.18 - 0.29	17	94.1	0.200	0.950	0.434	0.215
Nickel	0.18 - 0.22	17	100	6.90	23.0	12.6	4.25
Potassium	33 - 39	17	100.0	840	2,700	1,530	596
Selenium	0.66 - 0.8	17	6	0.820	0.820	0.380	0.115
Silica	1.4 - 4.3	17	100	560	980	732	145
Sodium	86 - 130	17	53	95.0	260	95.6	62.9
Strontium	0.058 - 0.1	17	100	12.0	30.0	19.4	5.52
Thallium	0.29 - 0.9	17	6	0.310	0.310	0.180	0.080
Titanium	0.087 - 0.24	17	100	76.0	240	126	51.9
Uranium	0.97 - 1.4	17	6	1.60	1.60	0.580	0.265
Vanadium	0.32 - 0.46	17	100	18.0	69.0	32.6	13.8
Zinc	0.45 - 0.55	17	100	20.0	1,400	196	376

[a] For inorganics, statistics are computed using one-half the reported value for nondetects.
N/A = Not applicable.

Table 2.3
Comparison of North Firing Range MDCs in Surface Soil to NOAEL ESLs for Terrestrial Plants, Invertebrates and Vertebrates

ECOI	MDC	Terrestrial Plants		Terrestrial Invertebrates		Mourning Dove Herbivore		Mourning Dove Insectivore		American Kestrel		Deer Mouse Herbivore		Deer Mouse Insectivore		Prairie Dog		Mule Deer		Coyote Carnivore		Coyote Generalist		Coyote Insectivore		Most Sensitive Receptor	Retain for Further Analysis?
		NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	Results	
Inorganics (mg/kg)																											
Aluminum	22000	50	**Yes**		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Terrestrial Plants	**Yes**
Antimony	3.4	5	No	78	No	N/A	N/A	N/A	N/A	N/A	N/A	9.89E+00	No	9.05E-01	**Yes**	1.87E+01	No	5.76E+01	No	1.38E+02	No	1.32E+01	No	3.85E+00	No	Deer Mouse Insectivore	**Yes**
Arsenic	6.5	10	No	60	No	2.00E+01	No	1.64E+02	No	1.03E+03	No	2.57E+00	**Yes**	5.14E+01	No	9.35E+00	No	1.30E+01	No	7.09E+02	No	3.41E+02	No	2.93E+02	No	Deer Mouse Herbivore	**Yes**
Barium	100	500	No	330	No	1.59E+02	No	3.57E+02	No	1.32E+03	No	9.30E+02	No	4.43E+03	No	3.22E+03	No	4.77E+03	No	2.49E+04	No	1.98E+04	No	1.84E+04	No	Morning Dove Herbivore	No
Beryllium	1.1	10	No	40	No	N/A	N/A	N/A	N/A	N/A	N/A	1.60E+02	No	6.82E+00	No	2.11E+02	No	8.96E+02	No	1.07E+03	No	1.03E+02	No	2.92E+01	No	Deer Mouse Insectivore	No
Boron	5.1	0.5	**Yes**	N/A	N/A	3.03E+01	No	1.15E+02	No	1.67E+02	No	6.21E+01	No	4.22E+02	No	2.37E+02	No	3.14E+02	No	9.29E+02	No	6.07E+03	No	1.82E+03	No	Terrestrial Plants	**Yes**
Cadmium	0.27	32	No	140	No	2.81E+01	No	7.05E-01	No	1.50E+01	No	5.99E+01	No	1.56E+00	No	1.98E+02	No	7.23E+02	No	1.36E+03	No	5.12E+01	No	9.75E+00	No	Morning Dove Insectivore	No
Calcium	6900	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Chromium	19	1	**Yes**	0.4	**Yes**	2.46E+01	No	1.34E+00	**Yes**	1.40E+01	**Yes**	2.81E+02	No	1.59E+01	**Yes**	7.03E+02	No	1.46E+03	No	4.17E+03	No	2.50E+02	No	6.85E+01	No	Terrestrial Invertebrates	**Yes**
Cobalt	6.5	13	No	N/A	N/A	2.78E+02	No	8.70E+01	No	4.40E+02	No	1.48E+03	No	3.63E+02	No	2.46E+03	No	7.90E+03	No	3.78E+03	No	2.49E+03	No	1.52E+03	No	Terrestrial Plants	No
Copper	250	100	**Yes**	50	**Yes**	2.89E+01	**Yes**	8.25E+00	**Yes**	1.64E+02	**Yes**	2.95E+02	No	6.05E+02	No	8.38E+02	No	4.12E+03	No	5.46E+03	No	3.00E+03	No	4.64E+03	No	Morning Dove Insectivore	**Yes**
Iron	18000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Lead	650	110	**Yes**	1700	No	4.99E+01	**Yes**	1.21E+01	**Yes**	9.58E+01	**Yes**	1.34E+03	No	2.42E+02	**Yes**	1.85E+03	No	9.80E+03	No	8.93E+03	No	3.07E+03	No	1.39E+03	No	Morning Dove Insectivore	**Yes**
Lithium	14	2	**Yes**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.88E+03	No	6.10E+02	No	3.18E+03	No	1.02E+04	No	1.84E+04	No	5.61E+03	No	2.56E+03	No	Terrestrial Plants	**Yes**
Magnesium	3800	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Manganese	260	500	No	N/A	N/A	1.03E+03	No	2.63E+03	No	9.92E+03	No	4.86E+02	No	4.08E+03	No	2.21E+02	**Yes**	2.51E+03	No	1.41E+04	No	1.09E+04	No	1.91E+04	No	Prarie Dog	**Yes**
Mercury	0.34	0.3	**Yes**	0.1	**Yes**	1.97E-01	**Yes**	1.00E-04	**Yes**	1.57E+00	No	4.39E-01	No	1.79E-01	**Yes**	3.15E+00	No	7.56E+00	No	8.18E+00	No	8.49E+00	No	3.73E+01	No	Morning Dove Insectivore	**Yes**
Molybdenum	0.59	2	No	N/A	N/A	4.44E+01	No	6.97E+00	No	7.67E+01	No	8.68E+00	No	1.90E+00	No	2.71E+01	No	4.43E+01	No	2.75E+02	No	2.89E+01	No	8.18E+00	No	Deer Mouse Insectivore	No
Nickel	16	30	No	200	No	4.41E+01	No	1.24E+00	**Yes**	1.31E+01	**Yes**	1.64E+01	No	4.31E-01	**Yes**	3.83E+01	No	1.24E+02	No	9.09E+01	No	6.02E+00	**Yes**	1.86E+00	**Yes**	Deer Mouse Insectivore	**Yes**
Potassium	3700	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Silica	1100	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Sodium	270	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Strontium	28	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	9.40E+02	No	1.36E+04	No	3.52E+03	No	4.70E+03	No	5.84E+05	No	1.45E+05	No	5.73E+04	No	Deer Mouse Herbivore	No
Thallium	5.8	1	**Yes**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.80E+02	No	7.24E+00	No	2.04E+02	No	1.04E+03	No	2.12E+02	No	8.16E+01	No	3.08E+01	No	Terrestrial Plants	**Yes**
Tin	22	50	No	N/A	N/A	2.61E+01	No	2.90E+00	**Yes**	1.90E+01	**Yes**	4.50E+01	No	3.77E+00	**Yes**	8.06E+01	No	2.42E+02	No	7.00E+01	No	3.61E+01	No	1.62E+01	**Yes**	Morning Dove Insectivore	**Yes**
Titanium	290	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Vanadium	37	2	**Yes**	N/A	N/A	5.03E+02	No	2.74E+02	No	1.51E+03	No	6.37E+01	No	2.99E+01	**Yes**	8.35E+01	No	3.58E+02	No	3.41E+02	No	1.64E+02	No	1.21E+02	No	Terrestrial Plants	**Yes**
Zinc	43	50	No	200	No	1.09E+02	No	6.46E-01	**Yes**	1.13E+02	No	1.71E+02	No	5.29E+00	**Yes**	1.17E+03	No	2.77E+03	No	1.65E+04	No	3.89E+03	No	4.31E+02	No	Morning Dove Insectivore	**Yes**

UT = Uncertain toxicity; no ESLs available (assessed in Section 4).
N/A = ESL not available.

Table 2.4

Summary of Non-PMJM NOAEL ESL Screening Results for Surface Soil in the North Firing Range

Analyte	Terrestrial Plant Exceedance?	Terrestrial Invertebrate Exceedance?	Terrestrial Vertebrate Exceedance?
Inorganics			
Aluminum	**Yes**	UT	UT
Antimony	No	No	**Yes**
Arsenic	No	No	**Yes**
Barium	No	No	No
Beryllium	No	No	No
Boron	**Yes**	UT	No
Cadmium	No	No	No
Calcium	UT	UT	UT
Chromium	**Yes**	**Yes**	**Yes**
Cobalt	No	UT	No
Copper	**Yes**	**Yes**	**Yes**
Iron	UT	UT	UT
Lead	**Yes**	No	**Yes**
Lithium	**Yes**	UT	No
Magnesium	UT	UT	UT
Manganese	No	UT	**Yes**
Mercury	**Yes**	**Yes**	**Yes**
Molybdenum	No	UT	No
Nickel	No	No	**Yes**
Potassium	UT	UT	UT
Silica	UT	UT	UT
Sodium	UT	UT	UT
Strontium	UT	UT	No
Thallium	**Yes**	UT	No
Tin	No	UT	**Yes**
Titanium	UT	UT	UT
Vanadium	**Yes**	UT	**Yes**
Zinc	No	No	**Yes**

UT = Uncertain toxicity; no ESLs available (assessed in Section 4).

Table 2.5
Statistical Distribution and Comparison to Background for Surface Soil - North Firing Range

Analyte	Units	Statistical Distribution Testing Results						Background Comparison Test		
		Background			North Firing Range					
		Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1 - p	Retain as PCOC?
Aluminum	mg/kg	20	NORMAL	100	21	NORMAL	100	t-Test_N	0.000	Yes
Antimony	mg/kg	20	NONPARAMETRIC	0	21	GAMMA	81	N/A	N/A	N/A
Arsenic	mg/kg	20	NORMAL	100	21	NORMAL	100	t-Test_N	0.995	No
Boron	mg/kg	N/A	N/A	N/A	21	NORMAL	100	N/A	N/A	N/A
Chromium	mg/kg	20	NORMAL	100	21	NORMAL	100	t-Test_N	0.005	Yes
Copper	mg/kg	20	NONPARAMETRIC	100	21	NONPARAMETRIC	100	WRS	0.000	Yes
Lead	mg/kg	20	NORMAL	100	21	GAMMA	100	WRS	0.000	Yes
Lithium	mg/kg	20	NORMAL	100	21	NORMAL	100	t-Test_N	0.030	Yes
Manganese	mg/kg	20	NORMAL	100	21	NORMAL	100	t-Test_N	1.000	No
Mercury	mg/kg	20	NONPARAMETRIC	40	21	NONPARAMETRIC	100	WRS	1.000	No
Nickel	mg/kg	20	NORMAL	100	21	NORMAL	100	t-Test_N	0.017	Yes
Thallium	mg/kg	14	NORMAL	0	21	NONPARAMETRIC	29	N/A	N/A	N/A
Tin	mg/kg	20	NORMAL	0	21	NONPARAMETRIC	19	N/A	N/A	N/A
Vanadium	mg/kg	20	NORMAL	100	21	NORMAL	100	t-Test_N	0.450	No
Zinc	mg/kg	20	NORMAL	100	21	NORMAL	100	t-Test_N	1.000	No

Test: WRS = Wilcoxon Rank Sum, t-Test_N = Student's t-test using normal data, t-Test-LN = Student's t-test using log-transformed data, N/A = not applicable; site and/or background detection frequency less than 20%.
CRA Dataset ID: 062305_A1
N/A = Not applicable

Table 2.6

Statistical Concentrations in Surface Soil North Firing Range

Analyte	Units	Total Samples	UCL Recommended by ProUCL	Distribution Recommended by ProUCL	Mean	Median	75th percentile	95th percentile	UCL[a]	UTL[b]	MDC[c]
Aluminum	mg/kg	21	95% Student's-t UCL	NORMAL	14,967	15,000	17,310	20,682	16300	21600	22,000
Antimony	mg/kg	21	95% Approximate Gamma UCL	GAMMA	1.05	0.69	1.5	2.4	1.40	3.40	3.4
Boron	mg/kg	21	95% Student's-t UCL	NORMAL	3.64	3.4	4.13	4.84	3.91	5.03	5.1
Chromium	mg/kg	21	95% Student's-t UCL	NORMAL	13.65	14	15.6	18.4	14.7	19.2	19
Copper	mg/kg	21	95% Chebyshev (Mean, Sd) UCL	NONPARAMETRIC	40.67	21	78.3	132.4	93.7	250	250
Lead	mg/kg	21	95% Approximate Gamma UCL	GAMMA	192.9	120	314	489	285	650	650
Lithium	mg/kg	21	95% Student's-t UCL	NORMAL	8.92	9.2	10.44	12.6	9.77	13.2	14
Nickel	mg/kg	21	95% Student's-t UCL	NORMAL	11.38	12	13.1	15.7	12.40	16.3	16
Thallium	mg/kg	21	95% Chebyshev (Mean, Sd) UCL	NONPARAMETRIC	0.589	0.16	1.417	2.608	1.76	5.8	5.8
Tin	mg/kg	21	95% Chebyshev (Mean, Sd) UCL	NONPARAMETRIC	2.15	1	5.22	9.65	6.49	22	22

[a] UCL = 95% upper confidence limit on the mean; [b] UTL = 95% upper confidence limit on the 90th percentile value, [c] MDC = maximum detected concentration.

CRA Data Set ID: 062305_A1

Table 2.7
Upper-Bound Exposure Point Concentration Comparison to Limiting ESLs in North Firing Range Surface Soils

Analyte	Small Home Range Receptors			Large Home Range Receptors		
	EPC (95UTL)	Limiting ESL[a]	EPC>ESL?	EPC (95UCL)	Limiting ESL[b]	EPC>ESL?
Inorganics (mg/kg)						
Aluminum	21600	50	**Yes**	16,300	N/A	N/A
Antimony	3.4	0.905	**Yes**	1.40	3.85	No
Boron	5.03	0.5	**Yes**	3.91	314	No
Chromium	19.2	0.4	**Yes**	14.7	68.5	No
Copper	250	8.25	**Yes**	93.7	3,000	No
Lead	650	12.1	**Yes**	285	1,390	No
Lithium	13.2	2	**Yes**	9.77	2,560	No
Nickel	16.3	0.431	**Yes**	12.4	1.84	**Yes**
Thallium	5.8	1	**Yes**	1.76	53.3	No
Tin	22	2.9	**Yes**	6.49	16.2	No

[a]Lowest ESL (threshold if available) for the plant, invertebrate, deer mouse, prairie dog, dove, or kestrel receptors.

[b]Lowest ESL (threshold if available) for the coyote and mule deer receptors.

N/A = Not applicable; ESL not available.

Bold = Chemicals retained for further screening.

Table 2.8

Upper-Bound Exposure Point Concentration Comparison to Receptor-Specific ESLs for Small Home Range Receptors in North Firing Range Surface Soils

Analyte	Small Home Range Receptor UTL	Receptor-Specific ESLs[a]							
		Terrestrial Plant	Terrestrial Invertebrate	American Kestrel	Mourning Dove (herbivore)	Mourning Dove (insectivore)	Deer Mouse (herbivore)	Deer Mouse (insectivore)	Prairie Dog
Inorganics (mg/kg)									
Aluminum	21600	**50**	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Antimony	3.4	5	78	N/A	N/A	N/A	9.89	**0.905**	18.7
Boron	5.03	**0.5**	N/A	167	30.3	115	62.1	422	237
Chromium	19.2	**1**	**0.4**	**14.2**	24.6	**1.34**	281	**15.9**	703
Copper	250	**100**	**50.0**	**164**	**28.8**	**8.25**	295	605	838
Lead	650	**110**	1700	**95.8**	**49.9**	**12.1**	1,340	**242**	1,850
Lithium	13.2	**2**	N/A	N/A	N/A	N/A	1,880	610	3,180
Nickel	16.3	30	200	89.9	320	**7.84**	16.4	**0.431**	38.3
Thallium	5.8	**1**	N/A	N/A	N/A	N/A	312	12.5	350
Tin	22	50	N/A	**19**	26.1	**2.90**	45.0	**3.77**	80.6

[a]Lowest ESL (threshold if available) for that receptor.

N/A = Not applicable; ESL not available.

Bold = Receptors of potential concern.

Table 2.9
Upper-Bound Exposure Point Concentration Comparison to Receptor-Specific ESLs for Large Home Range Receptors In North Firing Range Surface Soils

Analyte	Large Home Range Receptor 95th UCL	Receptor-Specific ESLs[a]			
		Mule Deer	Coyote (carnivore)	Coyote (generalist)	Coyote (insectivore)
Inorganics (mg/kg)					
Nickel	12.4	124	90.9	**6.02**	**1.86**

[a]Lowest ESL (threshold if available) for that receptor.
Bold = Receptors of potential concern

Table 2.10

Summary of ECOPC Screening Steps for Surface Soil - Non-PMJM Receptors

Analyte	Exceed Any NOAEL ESL?	Detection Frequency >5%?	Exceed Background?[3]	Upper-Bound EPC > Threshold ESL?	Professional Judgment - Retain?	Retain as ECOPC for North Firing Range?	Receptor of Potential Concern?
Inorganics							
Aluminum	Yes	Yes	Yes	Yes	N/A	Yes	terrestrial plants
Antimony	Yes	Yes	N/A	Yes	N/A	Yes	deer mouse (insectivore)
Arsenic	Yes	Yes	No	--	--	No	--
Barium	No	--	--	--	--	No	--
Beryllium	No	--	--	--	--	No	--
Boron	Yes	Yes	N/A	Yes	N/A	Yes	terrestrial plants
Cadmium	No	--	--	--	--	No	--
Calcium	N/A	--	--	--	--	No	--
Chromium	Yes	Yes	Yes	Yes	N/A	Yes	terrestrial plants and invertebrates American kestrel mourning dove (insectivore) deer mouse (insectivore)
Cobalt	No	--	--	--	--	No	--
Copper	Yes	Yes	Yes	Yes	N/A	Yes	terrestrial plants and invertebrates American kestrel mourning dove (both receptors)
Iron	N/A	--	--	--	--	No	--
Lead	Yes	Yes	Yes	Yes	N/A	Yes	terrestrial plants American kestrel mourning dove (both receptors) deer mouse (insectivore)
Lithium	Yes	Yes	Yes	Yes	N/A	Yes	terrestrial plants
Magnesium	N/A	--	--	--	--	No	--
Manganese	Yes	Yes	No	--	--	No	--
Mercury	Yes	Yes	No	--	--	No	--
Molybdenum	No	--	--	--	--	No	--
Nickel	Yes	Yes	Yes	Yes	N/A	Yes	mourning dove (insectivore) deer mouse (insectivore)
Potassium	N/A	--	--	--	--	No	--
Silica	N/A	--	--	--	--	No	--
Sodium	N/A	--	--	--	--	No	--
Strontium	No	--	--	--	--	No	--
Thallium	Yes	Yes	N/A	Yes	N/A	Yes	terrestrial plants
Tin	Yes	Yes	N/A	Yes	N/A	Yes	American kestrel mourning dove (insectivore) deer mouse (insectivore)

Table 2.10

Summary of ECOPC Screening Steps for Surface Soil - Non-PMJM Receptors

Analyte	Exceed Any NOAEL ESL?	Detection Frequency >5%?	Exceed Background?[a]	Upper-Bound EPC > Threshold ESL?	Professional Judgment - Retain?	Retain as ECOPC for North Firing Range?	Receptor of Potential Concern?
Titanium	N/A	--	--	--	--	No	--
Vanadium	Yes	Yes	No	--	--	No	--
Zinc	Yes	Yes	No	--	--	No	--

[a] Based on results of statistical analysis at the 0.1 level of significance.

-- = Screen not performed because ECOI was eliminated from further consideration in a previous step.

N/A = Not applicable; ESL not available.

Table 2.11

Comparison of North Firing Range MDCs in Subsurface Soil to NOAEL ESLs for the Burrowing Receptor

Analyte	MDC	Prairie Dog NOAEL ESL[a]	MDC > ESL?
Inorganics (mg/kg)			
Aluminum	35,000	N/A	UT
Antimony	5.30	18.7	No
Arsenic	13.0	9.35	**Yes**
Barium	120	3220	No
Beryllium	1.50	211	No
Boron	5.80	237	No
Cadmium	0.350	198	No
Calcium	4,000	N/A	UT
Chromium	28.0	703	No
Cobalt	16.0	2460	No
Copper	1,000	838	**Yes**
Iron	26,000	N/A	UT
Lead	990	1850	No
Lithium	18.0	3180	No
Magnesium	3,400	N/A	UT
Manganese	570	1519	No
Mercury	0.082	3.15	No
Molybdenum	0.950	27.1	No
Nickel	23.0	38.3	No
Potassium	2,700	N/A	UT
Selenium	0.820	2.8	No
Silica	980	N/A	UT
Sodium	260	N/A	UT
Strontium	30.0	3520	No
Thallium	0.310	204	No
Titanium	240	N/A	UT
Uranium	1.60	1230	No
Vanadium	69.0	83.5	No
Zinc	1,400	1170	**Yes**

UT = Uncertain toxicity; no ESLs available (assessed in Section 4).

N/A = ESL not available.

Table 2.12
Statistical Distribution and Comparison to Background for Subsurface Soil North Firing Range

Analyte	Units	Statistical Distribution Testing Results						Background Comparison Test		
		Background			North Firing Range			Test	1 - p	Retain as PCOC?
		Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Arsenic	mg/kg	45	NONPARAMETRIC	93.3	17	GAMMA	100.00	WRS	0.082	Yes
Copper	mg/kg	45	NORMAL	95.6	17	LOGNORMAL	100.00	WRS	0.000	Yes
Manganese	mg/kg	45	GAMMA	100.0	17	GAMMA	100.00	WRS	0.621	No
Zinc	mg/kg	44	NORMAL	100.0	17	NONPARAMETRIC	100.00	WRS	0.193	No

Test: WRS = Wilcoxon Rank Sum, t-Test_N = Student's t-test using normal data, t-Test-LN = Student's t-test using log-transformed data, N/A = not applicable; site and/or background detection frequency less than 20%.
CRA Data Set: 062305_A1

Table 2.13

Upper-Bound Exposure Point Concentration Comparison to Limiting ESLs in North Firing Range Subsurface Soils

Analyte	Small Home Range Receptors		
	EPC (95UTL)	Prairie Dog tESL	EPC>ESL?
Inorganics (mg/kg)			
Arsenic	13	35.9	No
Copper	777	838	No

N/A = Not applicable; ESL not available.

Bold = Chemicals retained for further screening.

Table 2.14

Summary of ECOPC Screening Steps for Subsurface Soil

Analyte	Exceed Any NOAEL ESL?	Detection Frequency >5%?	Exceed Background?[a]	Upper Bound EPC > Limiting ESL?	Professional Judgment - Retain?	Retain as ECOPC?
Inorganics						
Aluminum	N/A	--	--	--	--	No
Antimony	No	--	--	--	--	No
Arsenic	Yes	Yes	Yes	No	--	No
Barium	No	--	--	--	--	No
Beryllium	No	--	--	--	--	No
Boron	No	--	--	--	--	No
Cadmium	No	--	--	--	--	No
Calcium	N/A	--	--	--	--	No
Chromium	No	--	--	--	--	No
Cobalt	No	--	--	--	--	No
Copper	Yes	Yes	Yes	No	--	No
Iron	N/A	--	--	--	--	No
Lead	No	--	--	--	--	No
Lithium	No	--	--	--	--	No
Magnesium	N/A	--	--	--	--	No
Manganese	Yes	Yes	No	--	--	No
Mercury	No	--	--	--	--	No
Molybdenum	No	--	--	--	--	No
Nickel	No	--	--	--	--	No
Potassium	N/A	--	--	--	--	No
Selenium	No	--	--	--	--	No
Silica	N/A	--	--	--	--	No
Sodium	N/A	--	--	--	--	No
Strontium	No	--	--	--	--	No
Thallium	No	--	--	--	--	No
Titanium	N/A	--	--	--	--	No
Uranium	No	--	--	--	--	No
Vanadium	No	--	--	--	--	No
Zinc	Yes	Yes	No	--	--	No

[a] Based on results of statistical analysis at the 0.1 level of significance.

-- = Screen not performed because ECOI did not pass the previous screen.

N/A = Not applicable; ESL not available.

Table 3.1
Statistical Distribution and Comparison to Background for Surface Soil NNEU

Analyte	Units	Statistical Distribution Testing Results						Background Comparison Test		
		Background			NNEU (excluding background samples)			Test	1 - p	
		Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			Retain as PCOC?
Aluminum	mg/kg	20	NORMAL	100	356	NONPARAMETRIC	100	WRS	0.349	No
Antimony	mg/kg	20	NONPARAMETRIC	0	338	NONPARAMETRIC	18	N/A	N/A	N/A
Boron	mg/kg	N/A	N/A	N/A	30	NORMAL	100	N/A	N/A	N/A
Chromium	mg/kg	20	NORMAL	100	356	NONPARAMETRIC	100	WRS	0.204	No
Copper	mg/kg	20	NONPARAMETRIC	100	356	NONPARAMETRIC	91	WRS	0.035	Yes
Lead	mg/kg	20	NORMAL	100	356	NONPARAMETRIC	100	WRS	0.995	No
Lithium	mg/kg	20	NORMAL	100	186	GAMMA	80	WRS	0.878	No
Nickel	mg/kg	20	NORMAL	100	356	NONPARAMETRIC	97	WRS	0.054	Yes
Thallium	mg/kg	14	NORMAL	0	351	NONPARAMETRIC	7	N/A	N/A	N/A
Tin	mg/kg	20	NORMAL	0	186	NONPARAMETRIC	14	N/A	N/A	N/A

Test: WRS = Wilcoxon Rank Sum, t-Test_N = Student's t-test using normal data, t-Test-LN = Student's t-test using log-transformed data, N/A = not applicable; site and/or background detection frequency less than 20%.
CRA Dataset ID: 042705_C4

Table 3.2

NNEU Upper-Bound Exposure Point Concentration Comparison to Receptor-Specific ESLs for Small Home Range Receptors

Analyte	Small Home Range Receptor UTL	Receptor-Specific ESLs[a]							
		Terrestrial Plant	Terrestrial Invertebrate	American Kestrel	Mourning Dove (herbivore)	Mourning Dove (insectivore)	Deer Mouse (herbivore)	Deer Mouse (insectivore)	Prairie Dog
Inorganics (mg/kg)									
Antimony	10.1	**5**	78	N/A	N/A	N/A	**9.89**	**0.905**	18.7
Boron	6.47	**0.5**	N/A	167	30.3	115	62.1	422	237
Copper	29	100	50.0	164	**28.8**	**8.25**	295	605	838
Nickel[b]	16.6	30	200	89.9	320	**7.84**	**16.4**	**0.431**	38.3
Thallium	0.41	1	N/A	N/A	N/A	N/A	312	12.5	350
Tin	10.9	50	N/A	19	26.1	**2.90**	45.0	**3.77**	80.6

[a]Lowest ESL (threshold if available) for that receptor.

[b]The UCL for nickel (12.2 mg/kg) also exceeds the tESLs for Coyote (generalist and insectivore)

N/A = Not applicable; ESL not available.

Bold = Receptors of potential concern.

Table 3.3

Statistical Concentrations in Surface Soil (including background samples) NNEU

Analyte	Units	Total Samples	UCL Recommended by ProUCL	Distribution Recommended by ProUCL	Mean	Median	75th percentile	95th percentile	UCL[a]	UTL[b]	MDC[c]
Antimony	mg/kg	338	95% Chebyshev (Mean, Sd) UCL	NONPARAMETRIC	5.23	3.05	4.95	14.4	9.78	10.1	348
Boron	mg/kg	30	95% Student's-t UCL	NORMAL	3.99	3.70	4.63	6.40	4.42	6.47	7.90
Copper	mg/kg	356	95% Chebyshev (Mean, Sd) UCL	NONPARAMETRIC	19.6	14.5	17.0	38.3	28.3	29.0	640
Nickel	mg/kg	356	95% Student's-t UCL	NONPARAMETRIC	11.6	10.8	13.7	17.2	12.2	16.6	93.4
Thallium	mg/kg	351	95% Student's-t UCL	NONPARAMETRIC	0.291	0.215	0.353	0.443	0.329	0.410	5.80
Tin	mg/kg	186	97.5% Chebyshev (Mean, Sd) UCL	NONPARAMETRIC	4.64	1.78	6.79	11.2	8.62	10.9	72.3

[a] UCL = 95% upper confidence limit on the mean; [b] UTL = 95% upper confidence limit on the 90th percentile value; [c] MDC = maximum detected concentration.

CRA Dataset ID: 042705_C4

Table 3.4
Summary of ECOPC/Receptor Pairs

ECOPC	Receptors of Potential Concern
Surface Soil	
Antimony	Terrestrial plant Deer mouse (herbivore) Deer mouse (insectivore)
Boron	Terrestrial plant
Copper	Mourning dove (herbivore) Mourning dove (insectivore)
Nickel	Mourning dove (insectivore) Deer mouse (herbivore) Deer mouse (insectivore) Coyote (generalist) Coyote (insectivore)
Tin	Mourning dove (insectivore) Deer mouse (insectivore)
Subsurface Soil	
None	None

Table 3.5

NNEU Surface Soil Exposure Point Concentrations

ECOPC	Tier I Exposure Point Concentrations (mg/kg)		Tier II Exposure Point Concentrations (mg/kg)	
	UTL	UCL	UTL	UCL
Inorganics				
Antimony	10.1	9.78	3.57	2.57
Boron	6.5	4.4	5.4	4.8
Copper	29	28.3	20.6	17.9
Nickel	16.6	12.2	13.3	12.9
Tin	10.9	8.62	3.7	2.75

Table 3.6
NNEU Surface Water Exposure Point Concentrations

ECOPC	UTL	UCL
Inorganics (mg/L)		
Antimony	0.021	0.012
Copper	0.007	0.003
Nickel	0.017	0.009
Tin	0.036	0.017

Table 3.7
Receptor-Specific Exposure Parameters

Receptor	Body Weight (kg)	Body Weight Reference	Percentage of Diet			Dietary Reference	Food Ingestion Rate (kg/kg BW day^{-1})	Ingestion Rate Reference	Water Ingestion Rate (L/kg BW day^{-1})	Ingestion Rate Reference	Percentage of Diet as Soil	Soil Ingestion Reference
			Plant Tissue	Invertebrate Tissue	Bird or Mammal Tissue							
Non-Wildlife Terrestrial Receptors												
Terrestrial Plants	N/A											
Vertebrate Receptors - Birds												
Mourning Dove (herbivore)	0.113	Average of adult values from CalEPA (2004) Online Database	100	0	0	Cowan (1952)	0.23	EPA (2003)	0.12	EPA (1993) - Estimated using model for all birds - Calder and Braun (1983)	9.3	Beyer et al. (1994) - Wild turkey used as a surrogate.
Mourning Dove (insectivore)	0.113	Average of adult values from CalEPA (2004) Online Database	0	100	0	Generalized Diet	0.23	EPA (2003)	0.12	EPA (1993) - Estimated using model for all birds - Calder and Braun (1983)	9.3	Beyer et al. (1994) - Wild turkey used as a surrogate.
Vertebrate Receptors - Mammals												
Deer Mouse (herbivore)	0.0187	Flake (1973)	100	0	0	Generalized Diet	0.111	Cronin and Bradley (1988)	0.19	Ross (1930); Dice (1922) as cited in EPA (1993).	2	Beyer et al. (1994)
Deer Mouse (insectivore)	0.0187	Flake (1973)	0	100	0	Generalized Diet	0.065	Cronin and Bradley (1988)	0.19	Ross (1930); Dice (1922) as cited in USEPA 1993.	2	Beyer et al. (1994)
Coyote (generalist)	12.75	Bekoff (1977) - Average of male and female weights	0	25	75	Generalized Diet	0.015	Gier (1975)	0.08	EPA (1993) - Estimated using model for all mammals - Calder and Braun (1983)	5	Beyer et al. (1994) - High end estimate for Red Fox
Coyote (insectivore)	12.75	Bekoff (1977) - Average of male and female weights	0	100	0	Generalized Diet	0.015	Gier (1975)	0.08	EPA (1993) - Estimated using model for all mammals - Calder and Braun (1983)	2.8	Beyer et al. (1994) - Red Fox

Receptor parameters for all receptors with the exception of the prairie dog and mourning dove were taken from the Watershed Risk Assessment (DOE 1996) and referenced to the origiN/Al source.

All receptor parameters are estimates of central tendency except where noted.

All values are presented in a dry weight basis.

Table 3.8
Intake Estimates for Antimony in NNEU Surface Soil; Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
lnCp = -3.233 + 0.938(lnCs)	1	BAFsm = ((0.5*BAFsp)+(0.5*BAFsi))*0.003*50)				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
10.1	Tier 1 UTL	0.35	10.1	0.78	0.021	
9.78	Tier 1 UCL	0.33	9.8	0.76	0.012	
3.57	Tier 2 UTL	0.13	3.6	0.28	0.021	
2.57	Tier 2 UCL	0.10	2.6	0.20	0.012	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	$IR_{(water)}$ (kg/kg BW day)	$IR_{(soil)}$ (kg/kg BW day)	P_{plant}	P_{invert}	P_{mammal}
Deer Mouse - Herbivore	0.111	0.19	0.002	1	0	0
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Deer Mouse - Herbivore						
Tier 1 UTL	3.83E-02	N/A	N/A	2.24E-02	3.99E-03	6.47E-02
Tier 1 UCL	3.72E-02	N/A	N/A	2.17E-02	2.28E-03	6.12E-02
Tier 2 UTL	1.44E-02	N/A	N/A	7.93E-03	3.99E-03	2.64E-02
Tier 2 UCL	1.06E-02	N/A	N/A	5.71E-03	2.28E-03	1.86E-02
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	6.57E-01	N/A	1.31E-02	3.99E-03	6.74E-01
Tier 1 UCL	N/A	6.36E-01	N/A	1.27E-02	2.28E-03	6.51E-01
Tier 2 UTL	N/A	2.32E-01	N/A	4.64E-03	3.99E-03	2.41E-01
Tier 2 UCL	N/A	1.67E-01	N/A	3.34E-03	2.28E-03	1.73E-01

N/A = Not applicable

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Table 3.9

Intake Estimates for Copper in NNEU Surface Soil; Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
lnCp = 0.669 + 0.394(lnCs)	lnCi = 1.675 + 0.264(lnCs)	lnCsm = 2.042 + .1444(lnCs)				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
29	Tier 1 UTL	7.36	12.99	12.53	0.007	
28.3	Tier 1 UCL	7.29	12.90	12.49	0.003	
20.6	Tier 2 UTL	6.43	11.87	11.93	0.007	
17.9	Tier 2 UCL	6.08	11.43	11.69	0.003	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	$IR_{(water)}$ (kg/kg BW day)	$IR_{(soil)}$ (kg/kg BW day)	P_{plant}	P_{invert}	P_{mammal}
Mourning Dove - Hervibore	0.23	0.12	0.021	1	0	0
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Mourning Dove - Herbivore						
Tier 1 UTL	1.69E+00	N/A	N/A	6.20E-01	8.40E-04	2.31E+00
Tier 1 UCL	1.68E+00	N/A	N/A	6.05E-01	3.60E-04	2.28E+00
Tier 2 UTL	1.48E+00	N/A	N/A	4.41E-01	8.40E-04	1.92E+00
Tier 2 UCL	1.40E+00	N/A	N/A	3.83E-01	3.60E-04	1.78E+00
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	2.99E+00	N/A	6.20E-01	8.40E-04	3.61E+00
Tier 1 UCL	N/A	2.97E+00	N/A	6.05E-01	3.60E-04	3.57E+00
Tier 2 UTL	N/A	2.73E+00	N/A	4.41E-01	8.40E-04	3.17E+00
Tier 2 UCL	N/A	2.63E+00	N/A	3.83E-01	3.60E-04	3.01E+00

N/A = Not applicable

Table 3.10
Intake Estimates for Nickel in NNEU Surface Soil; Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
lnCp = -2.224+0.748(lnCs)	4.73	lnCm = -0.2462 + 0.4658(lnCs)				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
16.6	Tier 1 UTL	0.88	78.5	2.89	0.017	
12.2	Tier 1 UCL	0.70	57.7	2.51	0.009	
13.3	Tier 2 UTL	0.75	62.9	2.61	0.017	
12.9	Tier 2 UCL	0.73	61.0	2.57	0.009	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	$IR_{(water)}$ (kg/kg BW day)	$IR_{(soil)}$ (kg/kg BW day)	P_{plant}	P_{invert}	P_{mammal}
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
Deer Mouse - Herbivore	0.111	0.19	0.002	1	0	0
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0
Coyote - Generalist	0.015	0.08	0.001	0	0.25	0.75
Coyote - Insectivore	0.015	0.08	0.0004	0	1	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	1.81E+01	N/A	3.55E-01	2.04E-03	1.84E+01
Tier 1 UCL	N/A	1.33E+01	N/A	2.61E-01	1.08E-03	1.35E+01
Tier 2 UTL	N/A	1.45E+01	N/A	2.84E-01	2.04E-03	1.48E+01
Tier 2 UCL	N/A	1.40E+01	N/A	2.76E-01	1.08E-03	1.43E+01
Deer Mouse - Herbivore						
Tier 1 UTL	9.82E-02	N/A	N/A	3.69E-02	3.23E-03	1.38E-01
Tier 1 UCL	7.80E-02	N/A	N/A	2.71E-02	1.71E-03	1.07E-01
Tier 2 UTL	8.32E-02	N/A	N/A	2.95E-02	3.23E-03	1.16E-01
Tier 2 UCL	8.13E-02	N/A	N/A	2.86E-02	1.71E-03	1.12E-01
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	5.10E+00	N/A	2.16E-02	3.23E-03	5.13E+00
Tier 1 UCL	N/A	3.75E+00	N/A	1.59E-02	1.71E-03	3.77E+00
Tier 2 UTL	N/A	4.09E+00	N/A	1.73E-02	3.23E-03	4.11E+00
Tier 2 UCL	N/A	3.97E+00	N/A	1.68E-02	1.71E-03	3.98E+00
Coyote - Generalist						
Tier 1 UTL	N/A	2.94E-01	3.26E-02	1.25E-02	1.36E-03	3.41E-01
Tier 1 UCL	N/A	2.16E-01	2.82E-02	9.15E-03	7.20E-04	2.54E-01
Tier 2 UTL	N/A	2.36E-01	2.94E-02	9.98E-03	1.36E-03	2.77E-01
Tier 2 UCL	N/A	2.29E-01	2.89E-02	9.68E-03	7.20E-04	2.68E-01
Coyote - Insectivore						
Tier 1 UTL	N/A	1.18E+00	N/A	6.97E-03	1.36E-03	1.19E+00
Tier 1 UCL	N/A	8.66E-01	N/A	5.12E-03	7.20E-04	8.71E-01
Tier 2 UTL	N/A	9.44E-01	N/A	5.59E-03	1.36E-03	9.51E-01
Tier 2 UCL	N/A	9.15E-01	N/A	5.42E-03	7.20E-04	9.21E-01

N/A = Not applicable

Table 3.11

Intake Estimates for Nickel in NNEU Surface Soil; Alternative Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
lnCp = -2.224+0.748(lnCs)	1.059	lnCm = -0.2462 + 0.4658(lnCs)				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
16.6	Tier 1 UTL	0.88	17.6	2.89	0.017	
12.2	Tier 1 UCL	0.70	12.9	2.51	0.009	
13.3	Tier 2 UTL	0.75	14.1	2.61	0.017	
12.9	Tier 2 UCL	0.73	13.7	2.57	0.009	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	$IR_{(water)}$ (kg/kg BW day)	$IR_{(soil)}$ (kg/kg BW day)	P_{plant}	P_{invert}	P_{mammal}
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0
Coyote - Generalist	0.015	0.08	0.001	0	0.25	0.75
Coyote - Insectivore	0.015	0.08	0.0004	0	1	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	4.04E+00	N/A	3.55E-01	2.04E-03	4.40E+00
Tier 1 UCL	N/A	2.97E+00	N/A	2.61E-01	1.08E-03	3.23E+00
Tier 2 UTL	N/A	3.24E+00	N/A	2.84E-01	2.04E-03	3.53E+00
Tier 2 UCL	N/A	3.14E+00	N/A	2.76E-01	1.08E-03	3.42E+00
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	1.14E+00	N/A	2.16E-02	3.23E-03	1.17E+00
Tier 1 UCL	N/A	8.40E-01	N/A	1.59E-02	1.71E-03	8.57E-01
Tier 2 UTL	N/A	9.16E-01	N/A	1.73E-02	3.23E-03	9.36E-01
Tier 2 UCL	N/A	8.88E-01	N/A	1.68E-02	1.71E-03	9.06E-01
Coyote - Generalist						
Tier 1 UTL	N/A	6.59E-02	3.26E-02	1.25E-02	1.36E-03	1.12E-01
Tier 1 UCL	N/A	4.84E-02	2.82E-02	9.15E-03	7.20E-04	8.65E-02
Tier 2 UTL	N/A	5.28E-02	2.94E-02	9.98E-03	1.36E-03	9.35E-02
Tier 2 UCL	N/A	5.12E-02	2.89E-02	9.68E-03	7.20E-04	9.06E-02
Coyote - Insectivore						
Tier 1 UTL	N/A	2.64E-01	N/A	6.97E-03	1.36E-03	2.72E-01
Tier 1 UCL	N/A	1.94E-01	N/A	5.12E-03	7.20E-04	2.00E-01
Tier 2 UTL	N/A	2.11E-01	N/A	5.59E-03	1.36E-03	2.18E-01
Tier 2 UCL	N/A	2.05E-01	N/A	5.42E-03	7.20E-04	2.11E-01

N/A = Not applicable

Table 3.12
Intake Estimates for Tin in NNEU Surface Soil; Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
0.03	1	0.21				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
10.9	Tier 1 UTL	0.33	10.90	2.29	0.036	
8.62	Tier 1 UCL	0.26	8.62	1.81	0.017	
3.7	Tier 2 UTL	0.11	3.70	0.78	0.036	
2.75	Tier 2 UCL	0.08	2.75	0.58	0.017	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	$IR_{(water)}$ (kg/kg BW day)	$IR_{(soil)}$ (kg/kg BW day)	P_{plant}	P_{invert}	P_{mammal}
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	2.51E+00	N/A	2.33E-01	4.32E-03	2.74E+00
Tier 1 UCL	N/A	1.98E+00	N/A	1.84E-01	2.04E-03	2.17E+00
Tier 2 UTL	N/A	8.51E-01	N/A	7.91E-02	4.32E-03	9.34E-01
Tier 2 UCL	N/A	6.33E-01	N/A	5.88E-02	2.04E-03	6.93E-01
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	7.09E-01	N/A	1.42E-02	6.84E-03	7.30E-01
Tier 1 UCL	N/A	5.60E-01	N/A	1.12E-02	3.23E-03	5.75E-01
Tier 2 UTL	N/A	2.41E-01	N/A	4.81E-03	6.84E-03	2.52E-01
Tier 2 UCL	N/A	1.79E-01	N/A	3.58E-03	3.23E-03	1.86E-01

N/A = Not applicable

Table 3.13
TRVs for Terrestrial Vertebrate Receptors

ECOPC	NOAEL (mg/kg day)	NOAEL Endpoint	Lowest Bounded LOAEL (mg/kg day)	LOAEL Endpoint	TRV Source	Uncertainty Factor	FiN/Al NOAEL (mg/kg day)	Threshold (mg/kg day)	RatioN/Ale For Calculation	TRV Confidence
Birds										
Antimony	*No Values Available*									N/A
Copper	2.3	No effects noted	52.3	Increase in chicken gizzard erosion	PRC (1994)	1	2.3	11	The N/Ature of the effect is not likely to cause a significant effect on growth, reproduction, or survival. Thus, the data satisfy the requirements described in the text for calculating a threshold.	High
Nickel	1.38	No increase in tremors or toe and leg joint edema	55.26	Increase in tremors and toe and knee joint edema in mallard	PRC (1994)	1	1.38	8.7	The N/Ature of the effect is not likely to cause a significant effect on growth, reproduction or survival. Thus, the data satisfy the requirements described in the text for calculating a threshold.	High
Nickel	77.4	No increase in mortality or reduction in growth	107	Increase in mortality and reduction in growth	Sample et al. (1996)	1	77.4	N/A	Threshold was not calculated	High
Tin (Butyltins)	0.73	No change in Japanese quail growth and reproduction	18.34	Decrease in Japanese quail reproduction	PRC (1994)	1	0.73	N/A	Threshold was not calculated	High
Mammals										
Antimony	0.06	No change to rat progeny weight	0.59	Decrease in rat progeny weight	EPA (2003)	1	0.06	N/A	Threshold was not calculated	Very high
Nickel	0.133	NOAEL was estimated from LOAEL	1.33	Increase in pup mortality in rats	PRC (1994)	1	0.133	N/A	NOAEL was estimated from LOAEL	High
Nickel	40	No reduction in offspring bodyweight	80	Reduction in offspring bodyweight	Sample et al. (1996)	1	40	N/A	Threshold was not calculated	High
Tin (Butyltins)	0.25	No systemic effects	15	Midrange of effects less than mortality	PRC (1994)	1	0.25	N/A	Threshold was not calculated	High
Tin (Butyltins)	23.4	No reproductive effects.	35	Reduced fetal weight and fetal survival.	Sample et al. (1996)	1	23.4	N/A	Threshold was not calculated	High

Threshold TRVs were independently calculated using the procedures outline in the CRA Methodology, Section 3.1.4 and provide a geometric midpoint between the NOAEL and LOAEL TRV..

TRV Confidence:

N/A = No TRV has been identified or the TRV has been deemed uN/Acceptable for use in ECOPC selection.

Low = TRVs that have data for only one species looking at one endpoint (non-mortality) and from one primary literature source.

Moderate = TRVs that have multiple primary literature sources looking at one endpoint (non-mortality or mortality) but with only one species evaluated.

Good = For TRVs that have either multiple species with one endpoint from multiple studies or those TRVs with multiple species and multiple endpoints from only one study.

High = For TRVs that have multiple study sources looking at multiple endpoints and more than one species.

Very High = All EcoSSLs (EPA 2003a) will be assigned this level of confidence by default.

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Table 3.14
TRVs for Terrestrial Plant Receptors

ECOPC	Soil Concentration (mg/kg)	Endpoint	Effect Measured/Observed	Reference	Notes
Terrestrial Plants					
Antimony	5	Screening ESL	Value based on unspecified effects.	Efroymsom et al. 1997a	Low confidence in value.
Boron	0.5	Screening ESL	Value based on unspecified effects.	Efroymsom et al. 1997a	Low confidence in value.

Table 3.15
Hazard Quotients for Surface Soils in NNEU; Antimony

	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)				Hazard Quotients			
		NOAEL	LOAEL	Geometric Mean NOAEL	Geometric Mean LOAEL	NOAEL	LOAEL	Geometric Mean NOAEL	Geometric Mean LOAEL
Antimony (Default Exposure)									
Deer Mouse - Herbivore									
Tier 1 UTL	6.47E-02	6.00E-02	5.90E-01	1.33E+01	5.43E+01	1	0.1	0.005	0.001
Tier 1 UCL	6.12E-02	6.00E-02	5.90E-01	1.33E+01	5.43E+01	1	0.1	0.005	0.001
Tier 2 UTL	2.64E-02	6.00E-02	5.90E-01	1.33E+01	5.43E+01	0.4	0.04	0.002	0.0005
Tier 2 UCL	1.86E-02	6.00E-02	5.90E-01	1.33E+01	5.43E+01	0.3	0.03	0.001	0.0003
Deer Mouse - Insectivore									
Tier 1 UTL	6.74E-01	6.00E-02	5.90E-01	1.33E+01	5.43E+01	10	1	0.1	0.01
Tier 1 UCL	6.51E-01	6.00E-02	5.90E-01	1.33E+01	5.43E+01	10	1	0.05	0.01
Tier 2 UTL	2.41E-01	6.00E-02	5.90E-01	1.33E+01	5.43E+01	4	0.4	0.02	0.004
Tier 2 UCL	1.73E-01	6.00E-02	5.90E-01	1.33E+01	5.43E+01	3	0.3	0.01	0.003

N/A = Not applicable
Geometric Mean NOAEL and LOAEL represent the geometric mean of all NOAEL or LOAEL values presented in USEPA (2003) for growth, reproduction and mortality endpoints.

Table 3.16

Hazard Quotients for Surface Soil in NNEU; Copper

	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)			Hazard Quotients		
		NOAEL	Threshold	LOAEL	NOAEL	Threshold	LOAEL
Copper (Default Exposure)							
Mourning Dove - Herbivore							
Tier 1 UTL	2.31E+00	2.30E+00	1.10E+01	5.23E+01	1	0.2	0.04
Tier 1 UCL	2.28E+00	2.30E+00	1.10E+01	5.23E+01	1	0.2	0.04
Tier 2 UTL	1.92E+00	2.30E+00	1.10E+01	5.23E+01	0.8	0.2	0.04
Tier 2 UCL	1.78E+00	2.30E+00	1.10E+01	5.23E+01	0.8	0.2	0.03
Mourning Dove - Insectivore							
Tier 1 UTL	3.61E+00	2.30E+00	1.10E+01	5.23E+01	2	0.3	0.1
Tier 1 UCL	3.57E+00	2.30E+00	1.10E+01	5.23E+01	2	0.3	0.1
Tier 2 UTL	3.17E+00	2.30E+00	1.10E+01	5.23E+01	1	0.3	0.1
Tier 2 UCL	3.01E+00	2.30E+00	1.10E+01	5.23E+01	1	0.3	0.1

Table 3.17
Hazard Quotients for Surface Soil in NNEU; Nickel

	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)					Hazard Quotients				
		NOAEL	Threshold	LOAEL	Sample et al. (1996) NOAEL	Sample et al. (1996) LOAEL	NOAEL	Threshold	LOAEL	Sample et al. (1996) NOAEL	Sample et al. (1996) LOAEL
Nickel (Default Exposure)											
Mourning Dove - Insectivore											
Tier 1 UTL	1.84E+01	1.38E+00	8.70E+00	5.53E+01	7.74E+01	1.07E+02	13	2	0.3	0.2	0.2
Tier 1 UCL	1.35E+01	1.38E+00	8.70E+00	5.53E+01	7.74E+01	1.07E+02	10	2	0.2	0.2	0.1
Tier 2 UTL	1.48E+01	1.38E+00	8.70E+00	5.53E+01	7.74E+01	1.07E+02	11	2	0.3	0.2	0.1
Tier 2 UCL	1.43E+01	1.38E+00	8.70E+00	5.53E+01	7.74E+01	1.07E+02	10	2	0.3	0.2	0.1
Deer Mouse - Herbivore											
Tier 1 UTL	1.38E-01	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	1	N/A	0.1	0.003	0.002
Tier 1 UCL	1.07E-01	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	0.8	N/A	0.1	0.003	0.001
Tier 2 UTL	1.16E-01	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	0.9	N/A	0.1	0.003	0.001
Tier 2 UCL	1.12E-01	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	0.8	N/A	0.1	0.003	0.001
Deer Mouse - Insectivore											
Tier 1 UTL	5.13E+00	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	39	N/A	4	0.1	0.06
Tier 1 UCL	3.77E+00	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	28	N/A	3	0.1	0.05
Tier 2 UTL	4.11E+00	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	31	N/A	3	0.1	0.05
Tier 2 UCL	3.98E+00	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	30	N/A	3	0.1	0.05
Coyote - Generalist											
Tier 1 UTL	3.41E-01	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	3	N/A	0.3	0.01	0.004
Tier 1 UCL	2.54E-01	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	2	N/A	0.2	0.01	0.003
Tier 2 UTL	2.77E-01	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	2	N/A	0.2	0.01	0.003
Tier 2 UCL	2.68E-01	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	2	N/A	0.2	0.01	0.003
Coyote - Insectivore											
Tier 1 UTL	1.19E+00	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	9	N/A	0.9	0.03	0.01
Tier 1 UCL	8.71E-01	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	7	N/A	0.7	0.02	0.01
Tier 2 UTL	9.51E-01	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	7	N/A	0.7	0.02	0.01
Tier 2 UCL	9.21E-01	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	7	N/A	0.7	0.02	0.01

Table 3.17
Hazard Quotients for Surface Soil in NNEU; Nickel

	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)					Hazard Quotients				
		NOAEL	Threshold	LOAEL	Sample et al. (1996) NOAEL	Sample et al. (1996) LOAEL	NOAEL	Threshold	LOAEL	Sample et al. (1996) NOAEL	Sample et al. (1996) LOAEL
Nickel (AlterN/Ative Exposure SceN/Ario; Median BAFs)											
Mourning Dove - Insectivore											
Tier 1 UTL	4.40E+00	1.38E+00	8.70E+00	5.53E+01	7.74E+01	1.07E+02	3	0.5	0.1	0.1	0.01
Tier 1 UCL	3.23E+00	1.38E+00	8.70E+00	5.53E+01	7.74E+01	1.07E+02	2	0.4	0.1	0.04	0.01
Tier 2 UTL	3.53E+00	1.38E+00	8.70E+00	5.53E+01	7.74E+01	1.07E+02	3	0.4	0.1	0.05	0.01
Tier 2 UCL	3.42E+00	1.38E+00	8.70E+00	5.53E+01	7.74E+01	1.07E+02	2	0.4	0.1	0.04	0.01
Deer Mouse - Insectivore											
Tier 1 UTL	1.17E+00	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	9	N/A	0.9	0.03	0.01
Tier 1 UCL	8.57E-01	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	6	N/A	0.6	0.02	0.01
Tier 2 UTL	9.36E-01	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	7	N/A	0.7	0.02	0.01
Tier 2 UCL	9.06E-01	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	7	N/A	0.7	0.02	0.01
Coyote - Generalist											
Tier 1 UTL	1.12E-01	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	0.8	N/A	0.1	0.003	0.001
Tier 1 UCL	8.65E-02	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	0.7	N/A	0.1	0.002	0.001
Tier 2 UTL	9.35E-02	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	0.7	N/A	0.1	0.002	0.001
Tier 2 UCL	9.06E-02	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	0.7	N/A	0.1	0.002	0.001
Coyote - Insectivore											
Tier 1 UTL	2.72E-01	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	2	N/A	0.2	0.01	0.003
Tier 1 UCL	2.00E-01	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	2	N/A	0.2	0.005	0.002
Tier 2 UTL	2.18E-01	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	2	N/A	0.2	0.01	0.003
Tier 2 UCL	2.11E-01	1.33E-01	N/A	1.33E+00	4.00E+01	8.00E+01	2	N/A	0.2	0.01	0.003

N/A = Not applicable.

Table 3.18

Non-PMJM Receptor Hazard Quotients for Surface Soils in the NNEU - Tin

Receptor/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Tin (Default Exposure)					
Mourning Dove - Insectivore					
Tier 1 95th UTL	2.74E+00	7.30E-01	1.83E+01	4	0.1
Tier 1 95th UCL	2.17E+00	7.30E-01	1.83E+01	3	0.1
Tier 2 95th UTL	9.34E-01	7.30E-01	1.83E+01	1	0.1
Tier 2 95th UCL	6.93E-01	7.30E-01	1.83E+01	0.9	0.04
Deer Mouse - Insectivore					
Tier 1 95th UTL	7.30E-01	2.50E-01	1.50E+01	3	0.05
Tier 1 95th UCL	5.75E-01	2.50E-01	1.50E+01	2	0.04
Tier 2 95th UTL	2.52E-01	2.50E-01	1.50E+01	1	0.02
Tier 2 95th UCL	1.86E-01	2.50E-01	1.50E+01	0.7	0.01

N/A = Not applicable

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Table 5.1
Summary of Risk Characterization Results for the North Firing Range

Analyte	Ecological Receptors	Result of Risk Characterization	Unacceptable Risk?
Surface Soil Non-PMJM Receptors			
Antimony	Terrestrial plants	Screening HQs > 1	No
	Terrestrial invertebrate	Not an ECOPC.	
	American kestrel	Not an ECOPC[a].	
	Mourning dove (herbivore)	Not an ECOPC[a].	
	Mourning dove (insectivore)	Not an ECOPC[a].	
	Deer mouse (herbivore)	NOAEL HQ <= 1 All other HQs < 1	
	Deer mouse (Insectivore)	NOAEL HQs > 1 LOAEL and Mean NOAEL/LOAEL HQs < 1	
	Prairie dog	Not an ECOPC.	
	Coyote (carnivore)	Not an ECOPC.	
	Coyote (generalist)	Not an ECOPC.	
	Coyote (insectivore)	Not an ECOPC.	
	Mule Deer	Not an ECOPC.	
Boron	Terrestrial plants	Screening HQs > 1	No
	Terrestrial invertebrate	Not an ECOPC[a].	
	American kestrel	Not an ECOPC[a].	
	Mourning dove (herbivore)	Not an ECOPC[a].	
	Mourning dove (insectivore)	Not an ECOPC[a].	
	Deer mouse (herbivore)	Not an ECOPC.	
	Deer mouse (Insectivore)	Not an ECOPC.	
	Prairie dog	Not an ECOPC.	
	Coyote (carnivore)	Not an ECOPC.	
	Coyote (generalist)	Not an ECOPC.	
	Coyote (insectivore)	Not an ECOPC.	
	Mule Deer	Not an ECOPC.	
Copper	Terrestrial plants	Not an ECOPC.	No
	Terrestrial invertebrate	Not an ECOPC.	
	American kestrel	Not an ECOPC.	
	Mourning dove (herbivore)	NOAEL HQs <= 1 for default exposures and TRVs. All LOAEL HQs <1	
	Mourning dove (insectivore)	NOAEL HQs >= 1 for default exposure scenarios. All LOAEL HQs <1	
	Deer mouse (herbivore)	Not an ECOPC.	
	Deer mouse (Insectivore)	Not an ECOPC.	
	Prairie dog	Not an ECOPC.	
	Coyote (carnivore)	Not an ECOPC.	
	Coyote (generalist)	Not an ECOPC.	
	Coyote (insectivore)	Not an ECOPC.	
	Mule Deer	Not an ECOPC.	
Nickel	Terrestrial plants	Not an ECOPC.	No
	Terrestrial invertebrate	Not an ECOPC.	
	American kestrel	Not an ECOPC.	
	Mourning dove (herbivore)	Not an ECOPC.	

Table 5.1

Summary of Risk Characterization Results for the North Firing Range

Analyte	Ecological Receptors	Result of Risk Characterization	Unacceptable Risk?
	Mourning dove (insectivore)	NOAEL HQs > 1 for default and alternative exposures and default TRVs. Threshold HQs >1 for default exposures and TRVs. Threshold HQ < 1 for alternative exposures and default TRVs LOAEL HQs <1 for all exposures and TRVs. All HQs < 1 for default exposures and TRVs	
	Deer mouse (herbivore)	NOAEL HQs <= 1 for default exposures and TRVs. LOAEL HQs <1 for default exposures and TRVs. All HQs < 1 for default exposures and alternative TRVs.	
	Deer mouse (insectivore)	NOAEL HQs > 1 for all exposures and default TRVs. LOAEL HQs >1 for default exposures and TRVs. LOAEL HQs < 1 for alternative exposures and default TRVs. All HQs < 1 for all exposures and alternative TRVs.	
	Prairie dog	Not an ECOPC.	
	Coyote (carnivore)	Not an ECOPC.	
	Coyote (generalist)	NOAEL HQs >1 for default exposures and TRVs. LOAEL HQs <1 for default exposures and TRVs. All HQs < 1 for alternative exposures and all TRVs.	
	Coyote (insectivore)	NOAEL HQs >1 for all exposures and default TRVs. LOAEL HQs < 1 for all exposures and all TRVs. All HQs < 1 for all exposures and alternative TRVs.	
	Mule Deer	Not an ECOPC.	
Tin	Terrestrial plants	Not an ECOPC.	No
	Terrestrial invertebrate	Not an ECOPC[a].	
	American kestrel	Not an ECOPC.	
	Mourning dove (herbivore)	Not an ECOPC.	
	Mourning dove (insectivore)	Tier 1 NOAEL HQs > 1 Tier 2 NOAEL HQs <= 1 LOAEL HQs < 1	
	Deer mouse (herbivore)	Not an ECOPC.	
	Deer mouse (Insectivore)	Tier 1 NOAEL HQs > 1 Tier 2 NOAEL HQs <= 1 LOAEL HQs < 1	
	Prairie dog	Not an ECOPC.	
	Coyote (carnivore)	Not an ECOPC.	
	Coyote (generalist)	Not an ECOPC.	
	Coyote (insectivore)	Not an ECOPC.	
	Mule Deer	Not an ECOPC.	
Subsurface Soil			
None	Prairie dog	No ECOPCs.	No

[a] No ESL was available for the receptor. Risks to this receptor are uncertain and discussed in Section 4.3

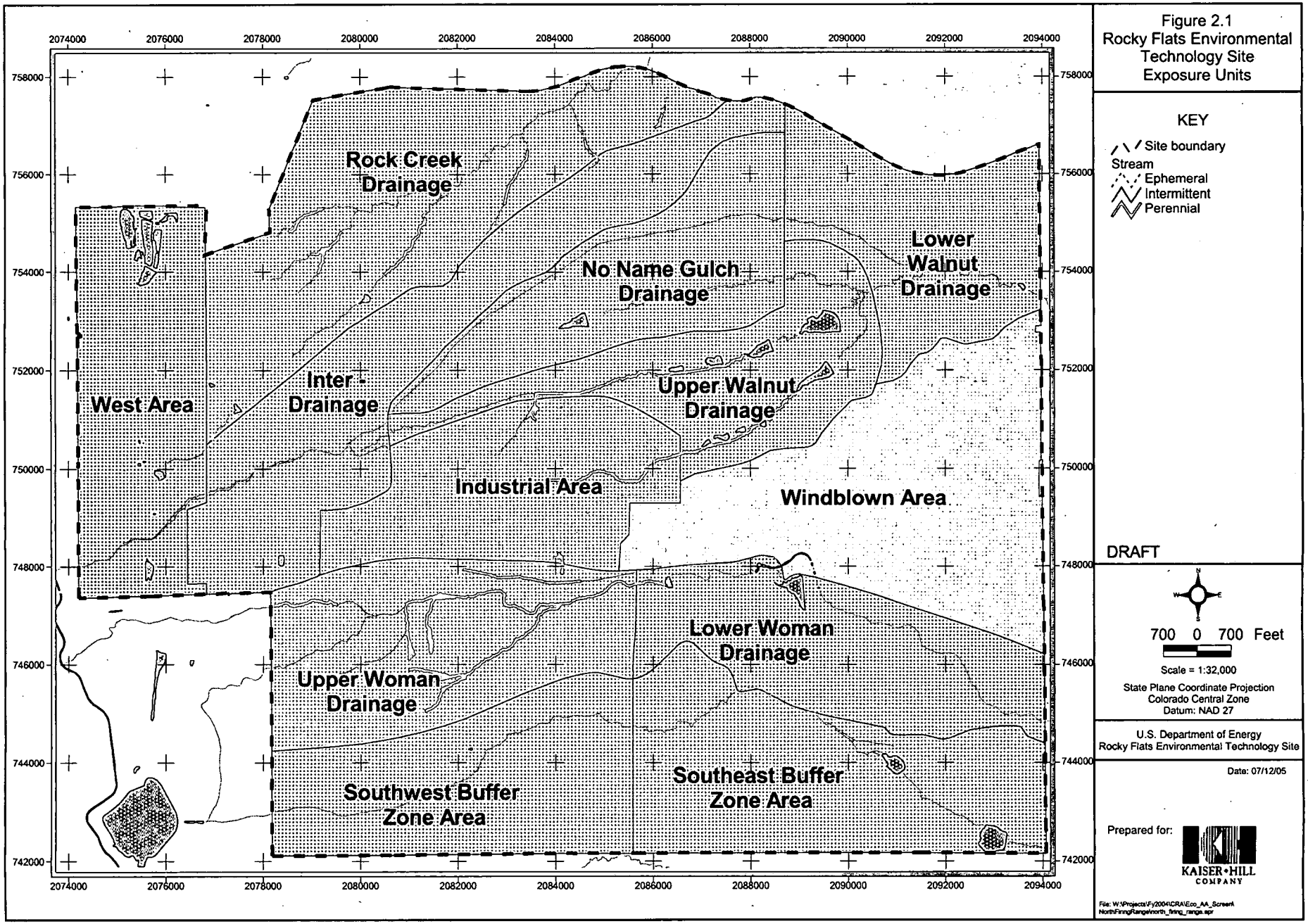

Figure 2.1
Rocky Flats Environmental Technology Site
Exposure Units

KEY

Site boundary

Stream
Ephemeral
Intermittent
Perennial

DRAFT

700 0 700 Feet

Scale = 1:32,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Date: 07/12/05

Prepared for: KAISER•HILL COMPANY

File: W:\Projects\Fy2004\CRA\Eco_AA_Screen\NorthFiringRange\north_firing_range.apr

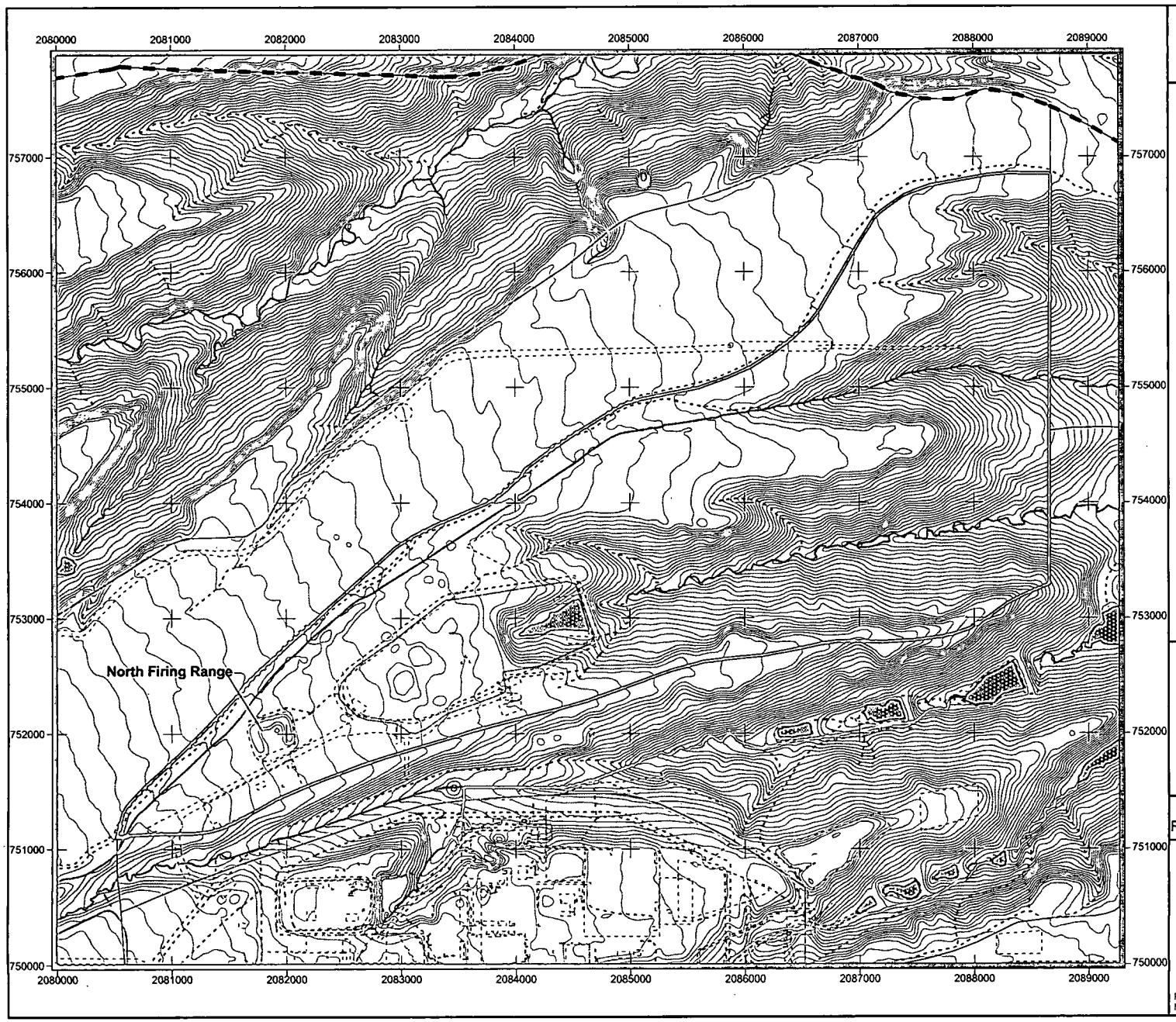

Figure 2.2
Topography and IHSS Locations in the No Name Gulch Drainage Exposure Unit

KEY

- No Name Gulch Drainage EU
- Exposure unit
- Pond
- Historic IHSS/PAC
- Site boundary

Stream

- Ephemeral
- Intermittent
- Perennial

Topographic contour interval = 5 ft.

DRAFT

N
W
E
S

500 0 500 1000 Feet

Scale 1: 13,500
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Date: 07/12/05

Prepared for: KAISER•HILL COMPANY

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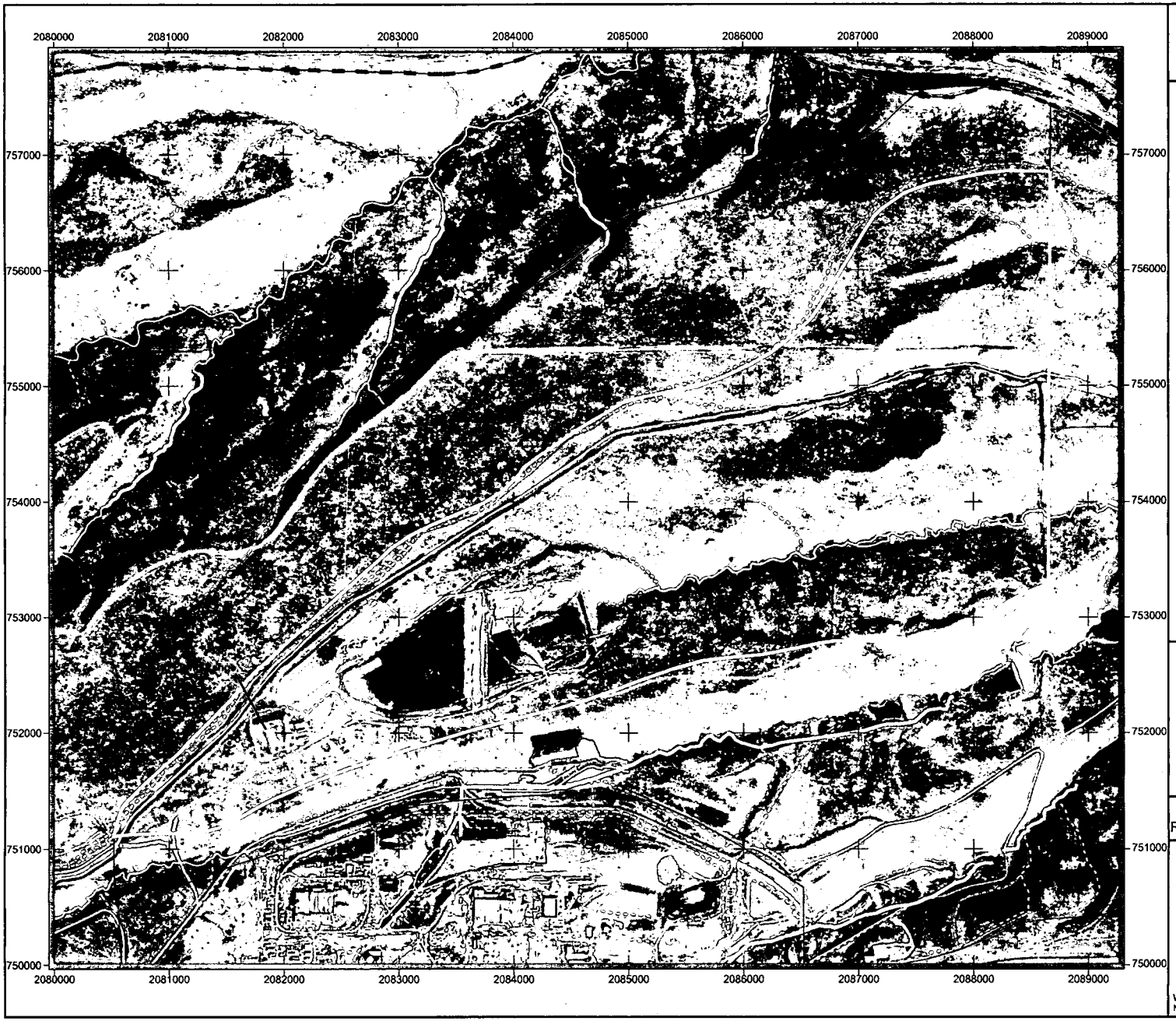

Figure 2.3
Aerial Photograph of No Name Gulch Drainage Exposure Unit
January 2005

KEY

- No Name Gulch Drainage EU
- Exposure unit
- North Firing Range
- Site boundary

Stream

- Ephemeral
- Intermittent
- Perennial

DRAFT

N
W E
S

500 0 500 1000 Feet

Scale 1: 13,500
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Date: 07/12/05

Prepared for: KAISER•HILL COMPANY

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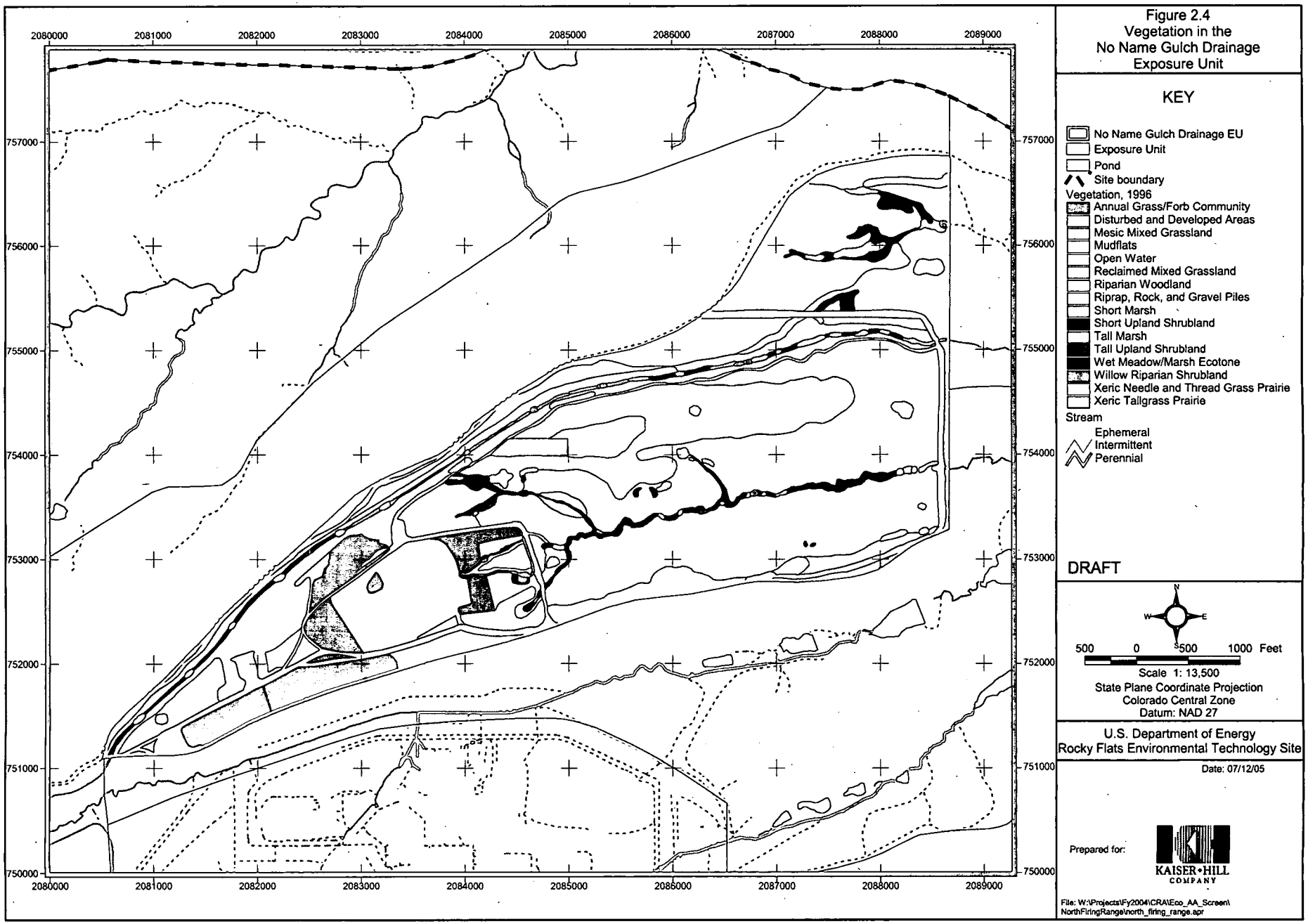

Figure 2.4
Vegetation in the
No Name Gulch Drainage
Exposure Unit

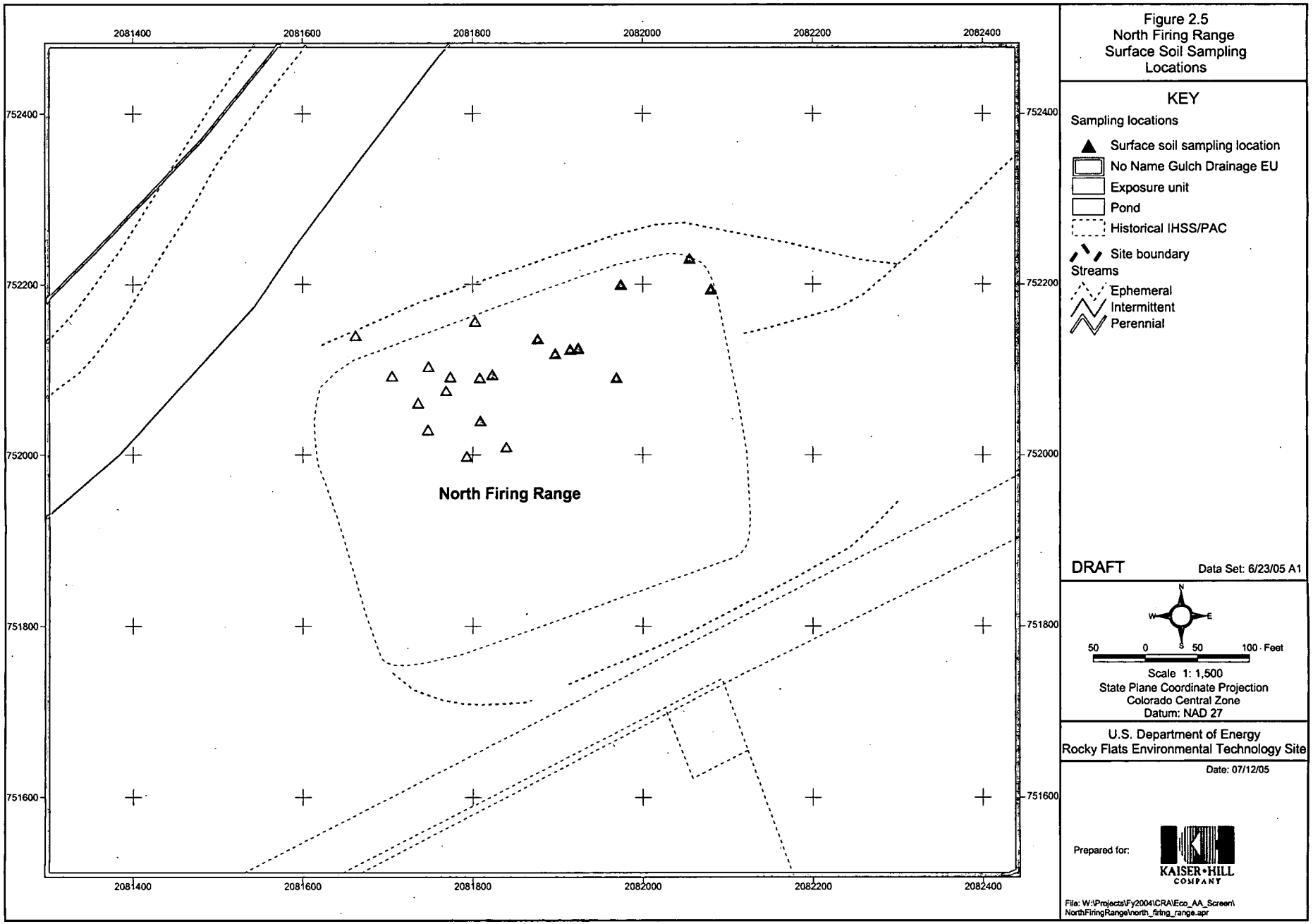

Figure 2.5
North Firing Range
Surface Soil Sampling
Locations

KEY

Sampling locations

- Surface soil sampling location
- No Name Gulch Drainage EU
- Exposure unit
- Pond
- Historical IHSS/PAC
- Site boundary

Streams

- Ephemeral
- Intermittent
- Perennial

DRAFT

Data Set: 6/23/05 A1

N
W
E
S
50 0 50 100 Feet

Scale 1: 1,500
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Date: 07/12/05

Prepared for: KAISER•HILL COMPANY

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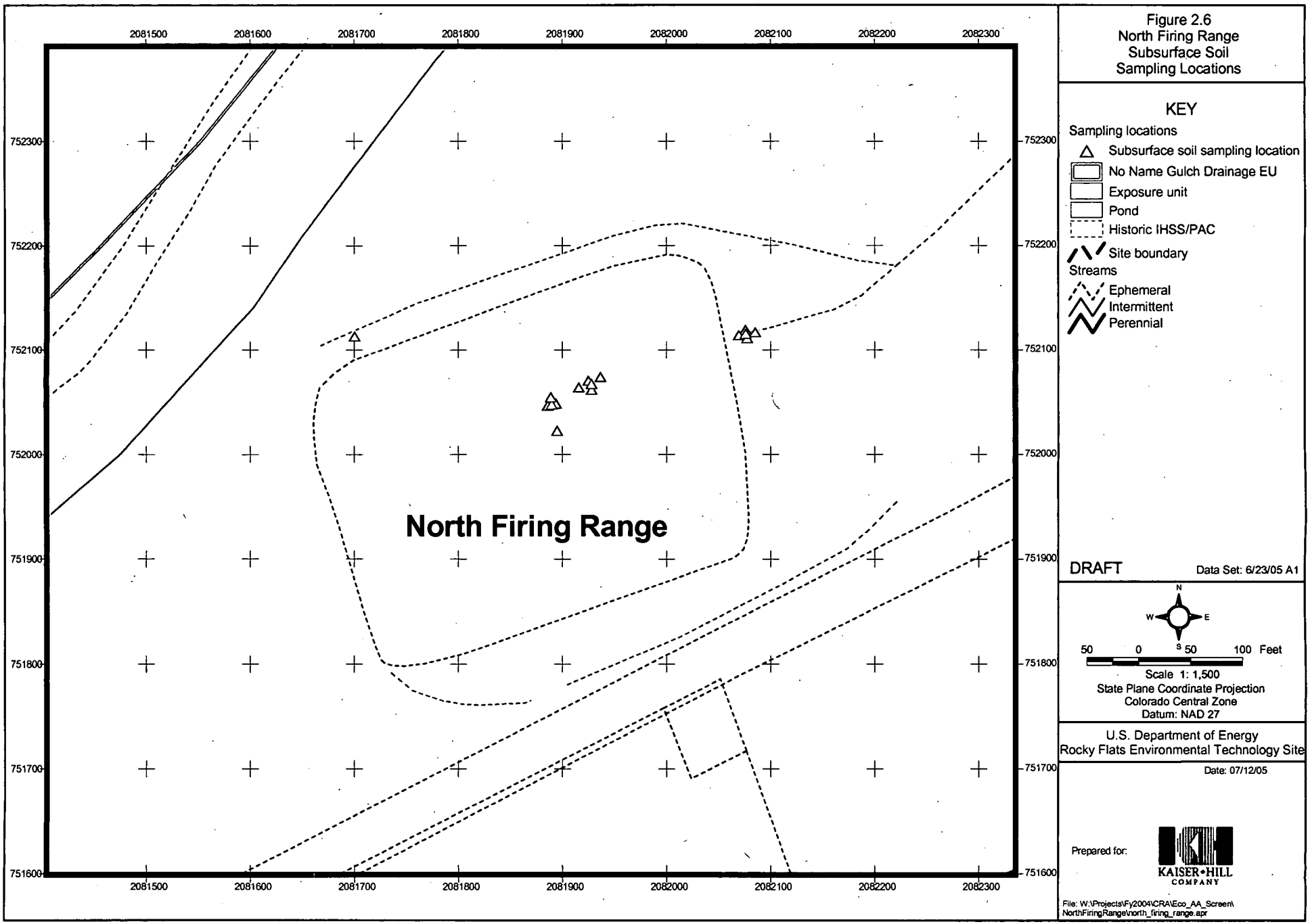

Figure 2.6
North Firing Range
Subsurface Soil
Sampling Locations

KEY

Sampling locations

- Subsurface soil sampling location
- No Name Gulch Drainage EU
- Exposure unit
- Pond
- Historic IHSS/PAC
- Site boundary

Streams

- Ephemeral
- Intermittent
- Perennial

DRAFT

Data Set: 6/23/05 A1

N
W E
S

50 0 50 100 Feet

Scale 1: 1,500
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Date: 07/12/05

Prepared for: KAISER•HILL COMPANY

File: W:\Projects\Fy2004\CRA\Eco_AA_Screen\NorthFiringRange\north_firing_range.apr

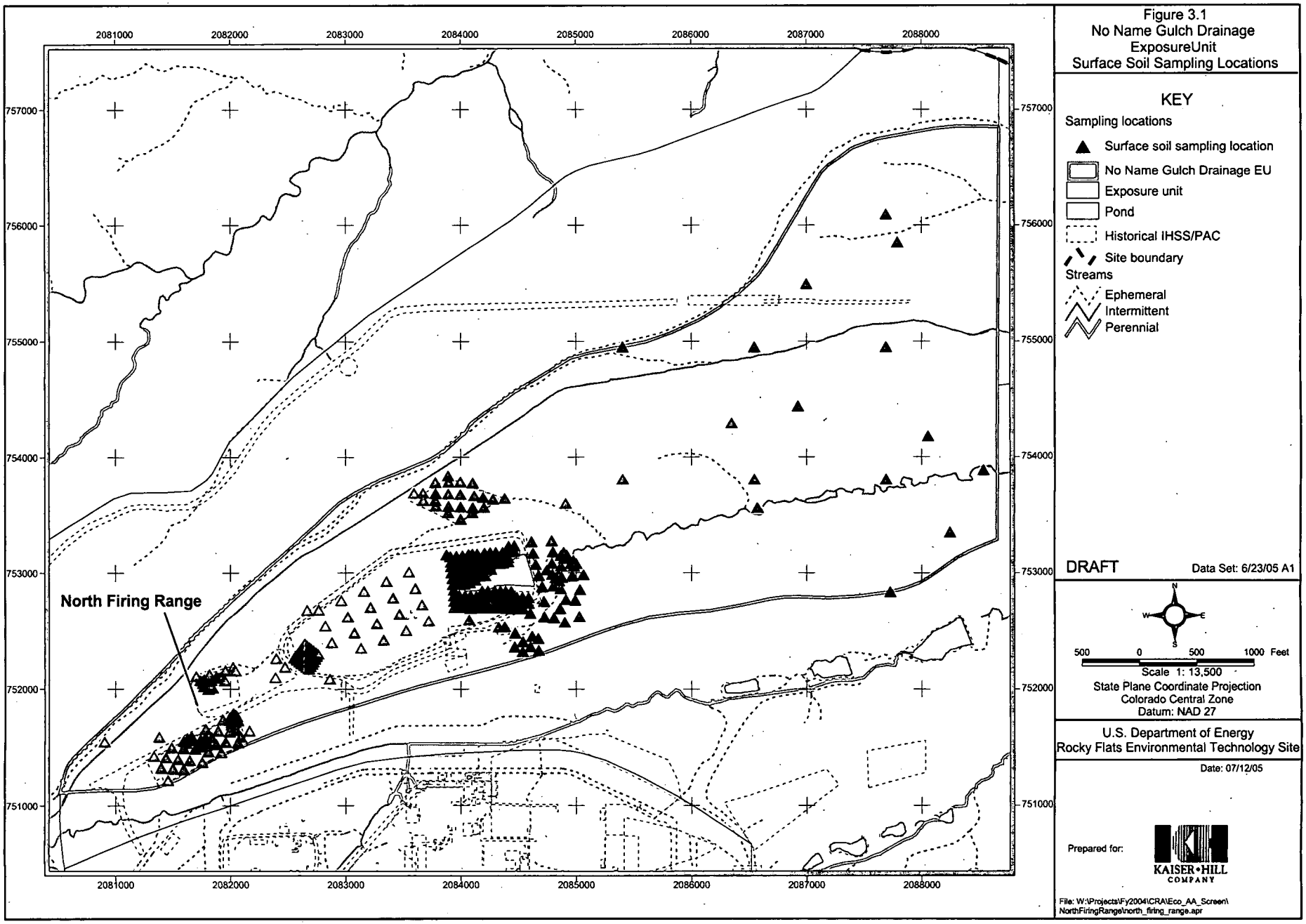

Figure 3.1
No Name Gulch Drainage
ExposureUnit
Surface Soil Sampling Locations

KEY

Sampling locations

- Surface soil sampling location
- No Name Gulch Drainage EU
- Exposure unit
- Pond
- Historical IHSS/PAC
- Site boundary

Streams

- Ephemeral
- Intermittent
- Perennial

DRAFT

Data Set: 6/23/05 A1

N
W
E
S

500 0 500 1000 Feet

Scale 1: 13,500
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Date: 07/12/05

Prepared for: KAISER•HILL COMPANY

File: W:\Projects\Fy2004\CRA\Eco_AA_Screen\NorthFiringRange\north_firing_range.apr

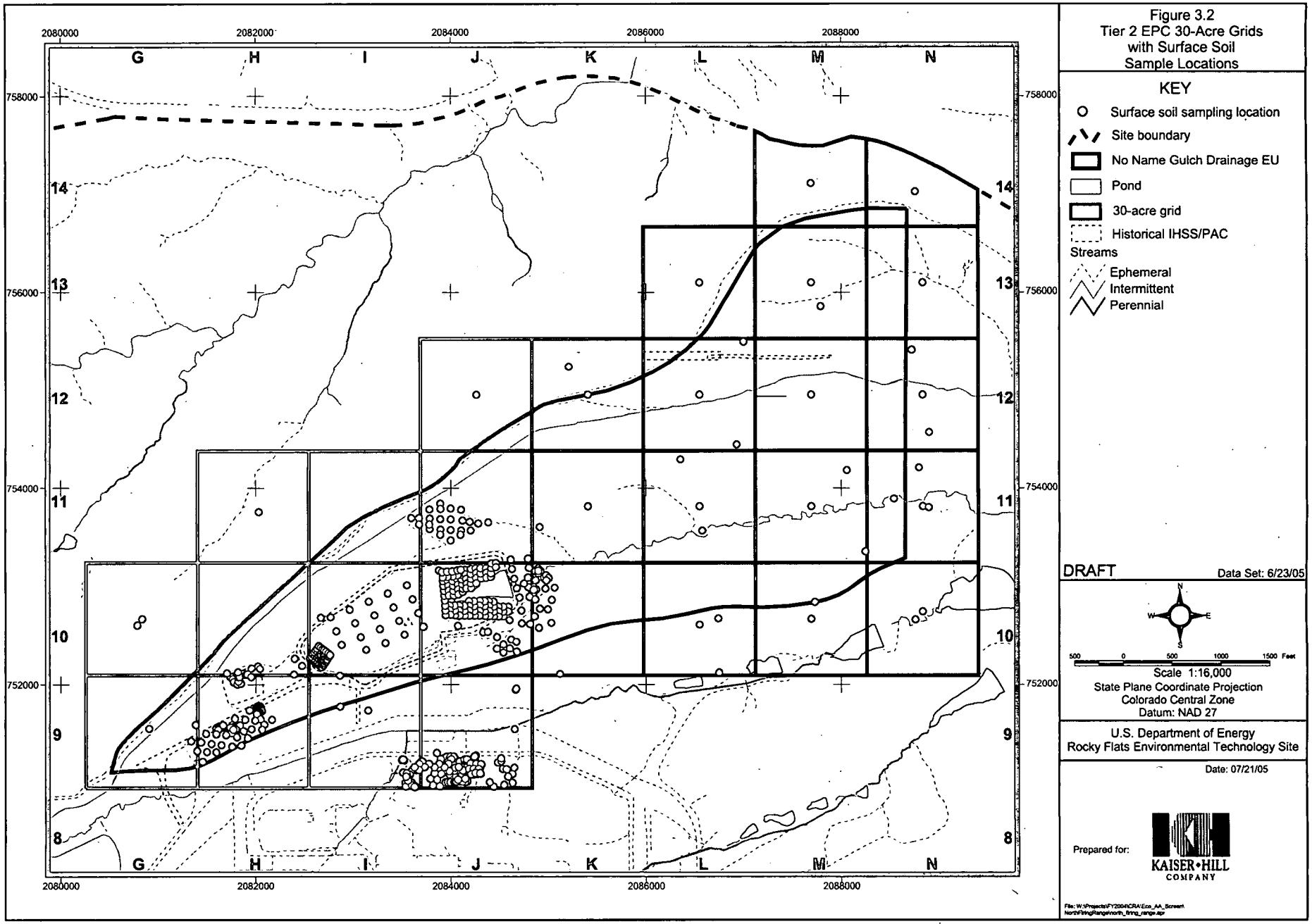

Figure 3.2
Tier 2 EPC 30-Acre Grids
with Surface Soil
Sample Locations

KEY

- Surface soil sampling location
- Site boundary
- No Name Gulch Drainage EU
- Pond
- 30-acre grid
- Historical IHSS/PAC

Streams

- Ephemeral
- Intermittent
- Perennial

DRAFT

Data Set: 6/23/05

N
W
E
S

500 0 500 1000 1500 Feet

Scale 1:16,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Date: 07/21/05

Prepared for: KAISER•HILL COMPANY

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