## Impact Area Groundwater Study Program

***DRAFT FINAL***

# T Range
# Soil & Groundwater
# Investigation Report

## Camp Edwards
## Massachusetts Military Reservation
## Cape Cod, Massachusetts

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*Prepared for:*

U.S. Army Environmental Command
Impact Area Groundwater Study Program
Camp Edwards, Massachusetts

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## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AALM | All-Ages Lead Model |
| ALM | Adult Lead Model |
| AMEC | AMEC Earth and Environmental, Inc. |
| ANGB | Air National Guard Base |
| AO1 | Administrative Order Number 1 (SDWA I-97-1019) |
| AO3 | Administrative Order Number 3 (SDWA 1-2000-0014) |
| BBM | Buzzards Bay Moraine |
| BBO | Buzzards Bay Outwash |
| bgs | Below ground surface |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CHPPM | Center for Health Promotion and Preventive Medicine |
| COC | Contaminants of concern |
| COPC | Compounds of potential concern |
| COPEC | Chemicals of potential ecological concern |
| CRREL | Cold Regions Research and Experimental Laboratory |
| CSM | Conceptual Site Model |
| DAF | Dilution attenuation factor |
| ELCR | Estimated Lifetime Cancer Risks |
| ERA | Ecological risk assessment |
| ERDC | Engineer Research and Development Center |
| $^{o}$F | Degrees Fahrenheit |
| FDA | Food and Drug Administration |
| ft | Feet |
| GIS | Geographic Information System |
| HA | Health advisory |
| HEAST | Health effects assessment summary tables |
| HERA | Health and Ecological Risk Assessment |
| HHRA | Human health risk assessment |
| HI | Hazard Index |
| HQ | Hazard quotient |
| IAGWSP | Impact Area Groundwater Study Program |
| IEUBK | Integrated Exposure Uptake Biokinetic Model |
| InhR | Inhalation Rate |
| IR | Ingestion Rate |
| IRIS | Integrated Risk Information System |
| LIDAR | Light Detection and Ranging |
| LOAEL | Lowest observed adverse effect level |

| | |
|---|---|
| MAARNG | Massachusetts Army National Guard |
| MassDEP | Massachusetts Department of Environmental Protection |
| MCL | Maximum contaminant level |
| MCP | Massachusetts Contingency Plan |
| mg/kg | Milligrams per kilogram |
| mg/kg-day | Milligram per kilogram per day |
| µg/kg | Micrograms per kilogram |
| µg/dL | Micrograms per deciliter |
| µg/L | Micrograms per liter |
| µg/$m^3$ | Micrograms per cubic meter |
| mm | Millimeter |
| MMCLs | Massachusetts Maximum Contaminant Levels |
| MMR | Massachusetts Military Reservation |
| MPP | Mashpee Pitted Plain |
| MW | Monitoring well |
| $m^2$ | Square meters |
| | |
| NCEA | National Center for Environmental Assessment |
| ND | Non-detect |
| NGB | National Guard Bureau |
| NGVD | National Geodetic Vertical Datum |
| NOAEL | No observed adverse effect level |
| | |
| PAH | Polynuclear Aromatic Hydrocarbon |
| PE | Performance evaluation |
| PPRTV | Provisional Peer Reviewed Toxicity Values |
| PRG | Preliminary Remediation Goal |
| | |
| QA | Quality assurance |
| | |
| RAGS | Risk Assessment Guidance for Superfund |
| RfC | Reference concentration |
| RfD | Reference dose |
| RL | Reporting limit |
| RME | Reasonable maximum exposure |
| RCRA | Resource Conservation and Recovery Act |
| | |
| SAR | Small arms range |
| SDWA | Safe Drinking Water Act |
| SM | Sandwich Moraine |
| SSL | Soil screening level |
| SVOC | Semi-volatile organic compound |
| | |
| TRV | Toxicity reference values |
| | |
| USACE | U.S. Army Corps of Engineers |
| USCG | United States Coast Guard |
| USDA | U.S. Department of Agriculture |

| | |
|---|---|
| USEPA | U.S. Environmental Protection Agency |
| USGS | U.S. Geological Survey |
| VOC | Volatile organic compound |

# EXECUTIVE SUMMARY

T Range is an active combination .50-caliber machine gun and pistol range located in the northern portion of the Massachusetts Military Reservation (MMR). It is located on the southern side of Gibbs Road just west of the Sierra East and Sierra West Ranges. Records indicate that ammunition used has included 5.56 mm blank and tungsten nylon, 7.62 mm blank, .50-caliber plastic (including tracers), .45-caliber frangible, .40-caliber frangible, 9 mm frangible, 12 gauge shotgun, and M939 AT4 sub-caliber ammunition.

In 2002, 5-point soil grids and discrete soil samples were taken at depths up to one foot at selected points along each of the two firing lines. Samples were analyzed for semi-volatile organic compounds (SVOCs) and metals. Though they were relatively few in number and detected at low concentrations, propellant compounds were detected in soils collected from in front of the mounded firing line. Conversely, all of the elevated concentrations of typical small arms range metals (e.g. lead, antimony, copper, etc.) were detected in soils obtained from in front of the pistol firing line.

In an effort to support the Massachusetts Army National Guard's (MAARNG) range construction plans, additional soil sampling at T Range was conducted under the T Range Sampling Plan Project Note (IAGWSP, 2006). Soil sampling was conducted at the firing line, the target area, and the range floor in several decision units using the U.S. Army Corps of Engineer's (USACE) Engineer Research and Development Center (ERDC)/Cold Regions Research and Experimental Laboratory (CRREL) multi-increment composite sampling method. The highest concentrations of lead and nitroglycerin were detected in the surface soil samples (0-3") in the sample area located in the center of the firing line.

A groundwater monitoring well (MW-467S) was installed down gradient of T Range and sampled in October, 2006. The sample was analyzed for Resource Conservation and Recovery Act (RCRA) 8 total metals, SVOCs and explosives. The only analyte detected in groundwater was tungsten at low concentrations.

As part of the T Range soil investigation, the U.S. Environmental Protection Agency (USEPA) requested that soil impacts to groundwater be investigated for lead, antimony, nitroglycerin and 2,4-dinitrotoluene (DNT). Leaching assessments were carried out by the Idaho National Laboratory for USEPA and by the Impact Area Groundwater Study Program (IAGWSP). Reports and technical memoranda were issued by both parties. Although the modeling procedures/protocols have not been completely resolved, results of preliminary leaching analyses indicated that concentrations of lead, antimony and 2,4-DNT did not pose a leaching risk to groundwater above maximum contaminant levels (MCLs)/health advisories (HAs) and/or risk based concentrations at the T Range. However, concentrations of nitroglycerin within the firing line were elevated compared to other sample locations and were at concentrations greater than preliminary soil levels protective of groundwater as identified in the USEPA report and IAGWSP/USACE technical memoranda. In addition, the findings of the recent Environmental Assessment of Lead report published by CRREL were used to provide information on the leachablility of lead to the groundwater. Based on a number of physical properties of the compound and the site conditions at MMR, lead is not expected to be detected in groundwater.

A Human Health and Ecological Risk Assessment (HERA) was performed for T Range. The objective of the HERA was to identify any Chemicals of Concern (COCs) in soil and groundwater from impacts associated with small arms training and other activities that occurred within T Range. COCs identified in the risk assessment as contributing to an excess risk of harm to potential human and environmental receptors will be further evaluated as the basis for the identification and evaluation of remedies. The HERA consisted of a human health risk assessment (HHRA) and a baseline ecological risk assessment (BERA).

The HERA is focused on direct contact and particulate inhalation exposures related to the site soils. Data from a single down-gradient groundwater monitoring well was compared to risk-based screening criteria. No explosives compounds, SVOCs, or metals were detected in MW-467S. Total tungsten was detected at a concentration of 2.9 µg/L and dissolved tungsten was detected at a concentration of 1.9 µg/L. There are no risk-based screening criteria for tungsten in water. Based on information collected to date, groundwater contamination is not a current risk at the site.

Potential human health risks were estimated for current receptors (military personnel engaged in firearms training, trespassers and recreational hunters), future receptors (trespassers, military personnel training at T Range, recreational hunters, and construction workers) and hypothetical future residents at T Range. Given the conservative assumptions used in this evaluation of potential non-cancer risk, the receptors hazard indices associated with potential exposure to soil are still all less than one for all current receptors and all future receptors except child residents. The calculated HI for future hypothetical child residents in Area 1 exceeds 1 primarily due to ingestion of nitroglycerin in soil. The human health risk assessment indicates that potential non-carcinogenic effects are not expected for any of the likely current site receptors included in the evaluation. Similarly, the human health risk assessment also indicates that potential excess lifetime cancer risks are less than or within USEPA's allowable risk range of $1x10^{-6}$ to $1x10^{-4}$ for all current or future receptors included in the risk assessment and fall within the allowable risk range for future hypothetical residents (between $1.9x10^{-6}$ and $2.3x10^{-6}$). Future residential development is unlikely to occur as the range is part of the Camp Edwards training facility. As such, the range will be used as an active firing range which is not compatible with residential use. Thus, the risk assessment demonstrates that for the most likely and expected current and future uses, the T Range does not pose an unacceptable cancer risk.

The BERA indicated that exposure and associated risk to lead and vanadium appeared low because modeled exposure dosages were below the lowest observed adverse effect level (LOAEL) toxicity reference value (TRV). The maximum and mean concentrations of vanadium were also within the range of published MassDEP background levels.

# 1.0 INTRODUCTION

T Range (Figure 1-1) was among several training areas, ranges, and other sites investigated as part of the second round of Phase 2b investigations in 2002 within the Impact Area Groundwater Study Program (IAGWSP).

As specified in the Final Supplemental Phase 2b Work Plan (AMEC, 2002), T Range was one of 33 supplemental Phase 2b sites evaluated for current and future potential impacts. The investigation was designed to characterize the nature and extent of possible soil and/or groundwater contamination resulting from historical releases associated with past training activities. Investigation results were reported in the Final Technical Team Memorandum 02-2 Small Arms Range Report (AMEC, 2003).

Additional site characterization was proposed and completed at T Range under a project note in 2006 (IAGWSP, 2006) in an effort to support the Massachusetts Army National Guard's (MAARNG) priorities and range construction plans. Groundwater down gradient of T Range was also sampled and analyzed in 2006.

## 1.1 Purpose of Report

The purpose of this report is to provide a summary of the results of the soil and groundwater investigations conducted at T Range to date. This report evaluates the nature and extent of soil and groundwater contamination resulting from past training activities. The purpose of this report is to identify any Contaminants of Potential Concern (COPCs) and to characterize the potential risks to human health and ecological risks so that the need for remedial actions at the site can be determined.

## 1.2 Report Organization

Section 1.0 of this report provides the purpose and objectives of the report. Section 2.0 presents information on the site background, description (to include the physical characteristics of the site), and site history. Section 3.0 provides a summary and description of site investigation activities at the T Range. A conceptual site model (CSM) is presented in Section 4.0. Presentation of the risk characterization is included in Section 5.0. Section 6.0 provides a conclusion.

# 2.0 SITE BACKGROUND

## 2.1 Site Description & History

T Range is an active combination .50-caliber machine gun and pistol range located in the northern portion of the Massachusetts Military Reservation (MMR). It is located on the southern side of Gibbs Road just west of the Sierra East and Sierra West Ranges (Figure 2-1). The range was constructed between 1986 and 1989 at what was formerly P Range. The dimensions of the range are 940 ft long by 420 ft wide with an approximate area of nine acres. Spot elevations of the nearly level range taken from recent Light Detection and Ranging (LIDAR) results show that the elevations range from 57 to 60 meters (m) National Geodetic Vertical Datum (NGVD). Cross sections of the range are depicted in Figures 3-8 and 3-9.

Former P Range was used first in 1967 as a night defense course where only 5.56 mm and 7.62 mm blank ammunition was used and continued to be used as such until the mid-1970s when it was converted to a squad and platoon attack course. At that time, no ammunition was used. In the late-1980s, the range name was changed to the T Range designation and continued to be used as an assault course. Only blank ammunition was used during this period. In 1990 or 1991, T Range was converted to a .50-caliber machine gun range and pistol range. During this time period .50 caliber (cal) plastic, including tracers, 5.56 mm tungsten nylon, .45 cal frangible, .40 cal frangible, 9 mm frangible, 12 gauge shotgun, and M939 AT4 sub-caliber rounds have been used on the range. Table 2-1 below shows what is known about the ammunition usage for the T Range site.

**TABLE 2-1**
**T Range Ammunition Usage**

| TY | 5.56 mm TN | 5.56 mm Blank | 7.62 mm Blank | .50 cal Plastic | .45 cal Frangible | .40 cal Frangible | 9 mm Frangible | 12 Gauge | M939 AT4 Subcal |
|---|---|---|---|---|---|---|---|---|---|
| *1967-1979 | 0 | Unk Qty | Unk Qty | 0 | 0 | 0 | 0 | 0 | 0 |
| *1980-1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986-1991 | 0 | Unk Qty | Unk Qty | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991-1993 | 0 | Unknown | | | | | | | |
| 1994 | 0 | 0 | 0 | 6,400 | 0 | 0 | 0 | 0 | 1,080 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1996 | 0 | 0 | 0 | 2,025 | 0 | 0 | 0 | 0 | 0 |
| 1997 | 0 | 0 | 0 | 13,535 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 0 | 0 | 0 | 16,520 | 0 | 0 | 0 | 0 | 0 |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2001 | 3,200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2002 | 8,400 | 0 | 0 | 5,800 | 3,880 | 3,000 | 1,800 | 250 | 0 |
| 2003 | 10,057 | 0 | 0 | 200 | 0 | 0 | 0 | 0 | 0 |
| 2004 | 6,370 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2006 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

TN: Tungsten Nylon TY: Training Year Unk Qty: Unkown Quantity
* The Range was designated as P Range during this timeframe

There are currently six elevated .50 cal firing points separated by intervals of approximately 50 feet (ft) along a 250-foot long firing line. A series of targets were observed south of the firing points and set at different distances down range, the furthest set measuring 600 feet from the firing line. A second firing line, measuring 144 feet long used for pistol training, is situated on the flat area immediately down range (south) of the .50 cal firing line. There are rows of targets downrange at 25 meters from the pistol firing line. Numerous plastic .50 cal projectiles, including .50 cal tracer rounds, were observed throughout the range. The majority of the rounds were found in a northeast-southwest corridor at the approximate center of the range and extended into the wooded area beyond the targets at the southwest end of the range.

In September, 2006 a backstop berm and bullet collection system (STAPP™) was installed as part of the MAARNG's initiative to test fire tungsten nylon bullets into the STAPP system. There was previously no backstop berm at this range. As a precautionary measure to ensure that any potential remediation would not require the removal of the newly constructed berm and STAPP system, surficial soils were removed by the MAARNG from the footprint of the berm, stockpiled, and covered awaiting further disposition as part of the berm maintenance program prior to construction.

## 2.2 Environmental Setting

### 2.2.1 Geography

The MMR includes both Camp Edwards and Otis Air National Guard Base (ANGB). The MMR is located on the western side of Cape Cod, Massachusetts. The MMR as a whole is a wooded area on the Upper Cape that is largely undeveloped, but fringed with highways, homes, and other development (Cape Cod Commission, 1998). The predominant land use surrounding the MMR is residential or commercial development. The cantonment area at the southern portion of Camp Edwards borders Otis ANGB, United States Coast Guard (USCG) Air Station Cape Cod, USCG Housing, and the Veteran's Affairs Cemetery. The MMR is situated within four towns, Bourne, Sandwich, Falmouth, and Mashpee. Camp Edwards, which includes T Range, lies within the boundaries of Bourne and Sandwich.

### 2.2.2 Cultural Setting

Land use near the MMR is primarily residential and recreational, and secondarily agricultural and industrial. Shawme Crowell State Forest provides camping as well as other recreational activities. Portions of the MMR are opened for deer and turkey hunting by permit from the Massachusetts Division of Fisheries and Wildlife. The major agricultural land use near the MMR is the cultivation of cranberries. Commercial and industrial development in the area includes service industries, landscaping, sand and gravel pit operations, and municipal landfills (USACE, 2002).

An archaeological survey covering 72 percent of Camp Edwards was conducted in 1987 to assess its archaeological sensitivity. A total of one historic site and 26 prehistoric sites were identified within Camp Edwards. Findings from these surveys indicate that humans inhabited the Camp Edwards area up to 10,000 years ago. Knowledge of the precise location of these historic sites is restricted to only the Geographic Information System (GIS) Manager and the MAARNG Regional Cultural Resources Manager to prevent damage or looting (MAARNG, 2001).

### 2.2.3 Ecological Setting

The northern two-thirds of the MMR are characterized as undeveloped open area, while the southern third is characterized as developed land. The dominant vegetation types vary accordingly. The northern portion of the MMR consists of forested uplands dominated by stands of pitch pine (Pinus rigida) and mixed oak species (Quercus spp.) with a diverse shrubby understory. Remnant vegetation in the southern portion of the MMR consists of open grassland fields interspersed with scattered trees and shrubs. The present composition of these forests is a reflection of eighteenth-century logging practices, replanting strategies, and fire suppression activities. Ground cover at T Range is generally grass although there are scrub pine and oak trees toward the back of the range (down range).

There are at least 25 species listed under the Massachusetts Endangered Species Act observed on the MMR. About half of these are lepidoptera (i.e., moths), such as Gerhard's underwing moth (Catocala herodias gerhardi), the barrens daggermoth (Acronicta albarufa), and Melsheimer's sack bearer (Cicinnus melsheimeri). State-listed plant species documented on the MMR include broad tinker's weed (Triosteum perfoliatum), ovate spikerush (Eleocaris obtusa var. ovata), Torrey's beak-sedge (Rhynchospora torreyana), and adder's tongue fern (Ophioglossum pusillum). Rare bird species on MMR include the upland sandpiper (Bartramia longicauda), the grasshopper sparrow (Ammodramus savannarum), the vesper sparrow (Pooecetes gramineus), and the northern harrier (Circus cyaneus). These species are primarily associated with the grassland fields in the southern cantonment area. No threatened or endangered amphibians, reptiles, fish, or mammals are known to inhabit the MMR; however, the MMR does support a number of animals that are listed by the state as species of special concern. These include the eastern box turtle (Terrapene carolina), the Cooper's hawk (Accipiter cooperii), and the sharp-shinned hawk (Accipiter striatus) (USACE, 2002).

### 2.2.4 Climate

The climate for Barnstable County, where the MMR is located, is defined as humid continental. The neighboring Atlantic Ocean has a moderating influence on the temperature extremes of winter and summer. Winds of 30 miles per hour may be expected on an average of at least one day per month. Gale force winds can be common and more severe in winter. Temperatures range from 29.6 degrees Fahrenheit ($^{o}$F) in February to 70.4 $^{o}$F in July, with a yearly average of 49.6 $^{o}$F (USDA, 1993).

Mean annual precipitation is 48 inches per year. The average net recharge to groundwater of this annual rainfall is 27 inches per year. Occasional tropical storms that affect Barnstable County may produce 24-hour rainfall events of five to six inches (NGB, 1990). Average snowfall is 24 inches (MAARNG, 2001). Based upon runoff measurements taken in Yarmouth, MA by Acid Rain Project of the University of Massachusetts, the pH of the rainfall from recent measurements is between 5.6-5.8.

### 2.2.5 Geology

The geology of Upper Cape Cod is comprised of glacial sediments deposited during the retreat of the Wisconsin stage of Holocene glaciation, approximately 15,000 years ago. Four sedimentary units characterize the regional geology: the Buzzards Bay Moraine (BBM), the Sandwich Moraine (SM), the Buzzards Bay Outwash (BBO) and the Mashpee Pitted Plain (MPP). The Buzzards Bay and Sandwich Moraines form the hummocky terrain along the northwest and north side of MMR. Southeast of the moraines is the MPP where 130 to 200 feet of medium- to coarse-grained brown sands overlie fine to very fine sands and silt. South of State Route 151, the sand and gravel outwash overlies fine to very fine sand, sandy silt, and dense sandy till. The till contains lenses of clay, silt, sand, and/or gravel. The glacial deposits overlie crystalline bedrock, which slopes from west to east (NGB, 1990).

The Buzzards Bay and Sandwich Moraines lie along the western and northern edges of Camp Edwards as shown in Figure 2-2. Masterson et al., 1997 indicates that the Buzzards Bay Moraine resulted from the melt water deposition of sorted sediments within a stagnant ice margin overlying a basal till. The surface of the moraine is characterized by an abundance of boulders. The upper part of the Sandwich Moraine resulted from glacial deformation of material; the lower part consists of sandy sediments. Masterson et al., 1997 describes the moraine deposits as generally consisting of gravel, sand, silt and clay with locally poorly to moderately sorted sand and gravel. Numerous discontinuous lenses of fine-grained sediments, including laminated silts and unsorted debris flow deposits are also present in the moraines. The till in the lower part of the Buzzards Bay Moraine is comprised of sand, silt and clay, and scattered gravel in a compacted, unsorted matrix. Both moraines form the hummocky ridges characteristic of the northwest and north side of MMR.

The Mashpee Pitted Plain, in which T Range is located, consists of fine- to coarse-grained sands, forms a broad outwash plain, and lies to the east and south of the moraines, interior to MMR (Figure 2-2). Masterson et al., 1997 reports that the lower part of the Mashpee Pitted Plain consists of fine-grained, glacio-lacustrine sediments comprised of fine sand, silt and clay. This laterally persistent facies can be encountered underlying the moraines. The Buzzard's Bay Outwash can be found along the west of the MMR boundary to the canal and Buzzard's Bay. Like the Mashpee Pitted Plain, the Buzzard's Bay Outwash consists of coarse sand and gravel of deltaic origin with locally interbedded fine sand and silt. Bedrock slopes from west to east (NGB, 1990).

### 2.2.6 Hydrology/Hydrogeology

Surface water resources on Camp Edwards are scarce. Surface water is not retained due to the well drained sandy soils of Camp Edwards. As a result, approximately 60 percent of the annual rainfall on Camp Edwards infiltrates the soil and contributes to the groundwater aquifer (AMEC, 2005a). The 31 wetlands on the training sites of Camp Edwards comprise only 55 acres of land. No large lakes, rivers, or streams exist on the property, only small marshy wetlands and ponds. Most of the wetlands and surface waters in the Sandwich and Buzzards Bay Moraines on Camp Edwards are considered to be perched (MAARNG, 2001). In proximity to T Range are Raccoon and Spruce Swamps. Both of these surface water bodies are located within a mile of the site to the northwest. Similarly, within 1.3 miles of the site to the north is Upper Shawme Lake (Figure 2-3).

The groundwater beneath Camp Edwards is known as the Sagamore Lens, a part of the larger Cape Cod Aquifer (MAARNG, 2001). The sole source of natural fresh water recharge to this groundwater system is rainfall and snowmelt water that averages approximately 48 inches per year (NGB, 1990). Approximately 27 inches of the average annual rainfall infiltrates the soil and recharges groundwater on an annual basis.

The top of the groundwater mound of the Sagamore Lens is located within the J-Range, southeast of the Impact Area within the central portion of the MMR (Figure 2-2). The Sagamore Lens is a single, unconfined aquifer underlain by low permeability crystalline bedrock, which is not a productive source of water. Groundwater flows radially outward: north to either the Cape Cod Canal or the Cape Cod Bay, east to the Bass River, south and southeast to Nantucket Sound, and west and southwest towards Buzzards Bay (MAARNG, 2001). The T Range is located north of the top of the groundwater mound (Figure 2-2). At T Range, groundwater flow is toward the north-northeast as indicated by the equipotential lines shown in Figure 2-3.

The height of the water table in and around the MMR can fluctuate up to seven feet annually due to seasonal variations in groundwater recharge. Groundwater levels are highest in the spring when recharge rates are high; levels are lowest in the late summer/early autumn when rainfall is minimal. In the vicinity of T Range, depth to groundwater is approximately 127 feet.

## 3.0 SUMMARY OF SOIL & GROUNDWATER INVESTIGATION ACTIVITIES

The following sub-sections address the sampling and analysis of soil and groundwater samples that have been conducted at T Range to date.

Throughout the following text, the detected concentrations of the various analytes are compared to several preliminary screening tools including background concentrations, soil screening levels (SSLs), EPA Region IX preliminary remediation goals (PRGs), and MCP Method 1 risk assessment values. These criteria are defined as follows:

- Background values are those that are present in soil or groundwater that are not the result of activities related to range use on MMR. Many of the metals and other analytes are naturally present in the soil and groundwater at detectable concentrations. The background level was not used to eliminate or screen out any possible COPC. However, remedial efforts are typically not conducted for naturally occurring COPCs with concentrations at or below background levels.

- SSLs were developed as initial soil screening values by U.S. Environmental Protection Agency (USEPA) using a dissolution partitioning equation for the migration to groundwater pathway. If the SSL is exceeded, additional leaching analysis can be conducted to determine if the compound is likely to reach the groundwater.

- USEPA Region IX PRGs were derived using current approved or provisional toxicity values, conservative exposure factors, and risk limits (non-cancer hazard quotient [HQ] of 1 or cancer risk equivalent to one in one million). Those constituents whose maximum detected values exceeded this criteria were retained as COPCs in the risk assessment.

- MCP S1/GW1 Method 1 values provide default soil and groundwater concentrations that have been determined to be protective of human health under exposure scenarios including very conservative residential exposures. They can be superseded by site-specific risk assessment that takes into account site-specific potential exposures.

Tables 3-2 and 3-4 include these screening values to facilitate comparison to the detected concentrations.

There is no USEPA approved method for analyzing tungsten in groundwater. The IAGWSP has been working diligently with the U.S. Army Corps of Engineers (USACE) Engineer Research and Development Center (ERDC) lab, a commercial lab, and the MassDEP lab to develop, evaluate, and refine an acceptable analytical method. The method development has included two sets of performance evaluation (PE) samples and quality assurance (QA) split samples being sent to the three different labs. Method improvements have been made and fine tuning of the analytical method will continue until an approved USEPA method is established. The results obtained to date for tungsten concentrations in groundwater should be considered tentative and should not be used for decision making purposes.

## 3.1 Supplemental Phase 2b Soil Sampling

### 3.1.1 Sampling Plan

As part of the second round of Phase 2b investigations in April of 2002, the IAGWSP established three 5-point soil grids on T Range at selected firing points along each of the two firing lines to determine if range-related residual propellant and metal constituents exist in soil there (Figure 3-1). Central grids were positioned near the center of both firing lines and the remaining grids were positioned down range of firing points located near the eastern and western limits of both firing lines. The center nodes for each grid were positioned approximately eight feet down range of the firing line and two feet to the right of their respective lane markers. The grids were sampled at three depth intervals: surface (0 to 3 inches below ground surface [bgs]), intermediate (3 to 6 inches bgs), and deep (6 to 12 inches bgs). One 5-point composite and one discrete soil sample (obtained from the center grid node) were collected at each depth interval. Samples were submitted for analysis of semi-volatile organic compounds (SVOCs) and metals.

### 3.1.2 Analytical Results

Three propellant-related SVOCs (n-nitrosodiphenylamine, 1,3-diethyl-1,3-diphenyl urea, and di-n-butyl phthalate) were detected among the 38 samples collected from the T Range (Table 3-1) (Figure 3-2). Of these compounds, only n-nitrosodiphenylamine, which was detected once at a concentration of 36 J µg/kg, exceeded its SSL of 7.77 µg/kg. Other SVOCs detected include eight polynuclear aromatic hydrocarbons (PAHs), most of which were detected in one discrete sample collected from the intermediate depth at grid 169E. None of the PAHs exceeded their respective MMR background concentrations as established in the Draft Technical Memorandum 01-1 (AMEC, 2001c) and the addendum to TM 01-1 (AMEC, 2001d). Two other SVOCs (benzoic acid and bis (2-ethylhexyl) phthalate) were reported in T Range samples, but neither exceeded an applicable standard.

Fifteen metals were detected at concentrations in excess of background (Table 3-1). Seven of these (magnesium, copper, cobalt, calcium, selenium, zinc, and nickel) did not exceed SSLs or PRGs. Chromium, arsenic, aluminum, manganese, vanadium, and iron exceeded background in only 1 sample each. Chromium had a maximum concentration (21 mg/kg) in the deep discrete sample at grid 169B which exceeded its 7.02 mg/kg SSL. Arsenic had a maximum concentration (23.4 mg/kg) in the deep discrete sample at grid 169A which exceeded its SSL (0.009 mg/kg) and its PRG (0.39 mg/kg). Aluminum had a maximum concentration (20,400 mg/kg) in the deep discrete sample at grid 169B which exceeded its 7614.20 mg/kg PRG. Manganese had a maximum concentration (165 mg/kg) in the deep composite sample at grid 169C which exceeded its 44.15 mg/kg SSL. Vanadium had a maximum concentration (29.3 mg/kg) in the deep discrete sample at grid 169B which exceeded its 7.82 mg/kg PRG. Iron had a maximum concentration (19,300 mg/kg) in the deep discrete sample at grid 169B which exceeded its SSL (2,421.92 mg/kg) and its PRG (2,346.32 mg/kg).

The maximum detected concentrations of antimony (91.9 mg/kg) and lead (5,800 mg/kg) were both reported in the deep discrete sample collected from grid 169A (Figure 3-2). Antimony was detected in 17 of 37 samples with 9 exceeding background (1.90 mg/kg). It exceeded its SSL (0.27 mg/kg) in 17 samples, its PRG (3.13 mg/kg) in six samples, and its S1/GW1 (10 mg/kg) in two samples. Lead exceeded background (19 mg/kg) in 18 samples. It exceeded its SSL (4.05 mg/kg) and its PRG (40 mg/kg) in 16 of those samples. Lead also exceeded its S1/GW1 (300 mg/kg) in seven of those samples.

Though they were relatively few in number and detected at low concentrations, propellant compounds were detected in soils collected from the .50-caliber firing line (i.e., grids 169D, 169E, and 169F). Conversely, the elevated concentrations of typical small arms range metals (e.g. lead, antimony, copper, etc.) were detected in soils obtained from the samples collected in front of the pistol firing line (i.e., 169A, 169B, and 169C). The two highest concentrations of antimony detected in T Range soils exceeded the 10 mg/kg S1/GW1, and the seven highest lead concentrations reported exceeded the 300 mg/kg S1/GW1. No other analyte detected at this range exceeded an S1/GW1. Refer to Table 3-2 for the complete list of analytical results from the 2002 sampling event.

## 3.2 June 2006 Project Note Soil Sampling

### 3.2.1 Sampling Plan

In an effort to support the MAARNG's range construction plans, additional soil sampling for T Range was conducted under the T Range Sampling Plan Project Note dated June 29, 2006 (IAGWSP, 2006).

The range was divided conceptually into the following three decision units based on the known past use of the site (Figure 3-3):

- Area 1 - The area from the top of the machine gun firing points to the 25 meter targets across the entire width of the range,
- Area 2 - The area of the planned new berm (approximately 45 x 220 feet) behind the 25-meter targets, and
- Area 3 - The remainder of the range, down range (south) of Area 2 and Area 1.

Investigation areas 1, 2, and 3 were conceptually divided into three equal sample areas across the width of the Area. The three sample areas are identified as West, Center, and East. This provided for a sample from the most heavily used portion of the range and separate samples from the less frequently used flanks. The center area is likely to have experienced the most intense loading of contaminants because, historically, most of the rounds are fired from the center lanes of a range.

In addition, the center section of Area 1 was divided into north and south sub-sections (Area 1/Center/North and Area 1/Center/South) to determine if there is any difference in contaminant concentrations immediately in front of the firing points and somewhat further down range.

Samples were collected from each of the ten sub-areas as follows:

- Area 1/West - One 100-point composite sample was collected from 0-3 inches below grade and analyzed for metals and tungsten. A replicate sample was collected from this area and analyzed for the same,

- Area 1/Center/North - One 50-point sample was collected from 0-3 inches below grade and analyzed for metals, tungsten, explosives (8330), SVOCs (8270), and perchlorate. A replicate sample was collected from this area and analyzed for the same,

- Area 1/Center/South - One 50-point composite sample was collected from 0-3 inches below grade. Another composite sample was collected from 9-12 inches below grade from the same 50 locations. Both samples were analyzed for metals, tungsten, explosives and perchlorate,

- Area 1/East - One 100-point composite sample was collected from 0-3 inches below grade and analyzed for metals and tungsten. A replicate sample was collected from this area and analyzed for the same,

- Area 2/West - One 100-point composite sample was collected from 0-3 inches below grade and analyzed for metals and tungsten,

- Area 2/Center - One 100 point composite was collected from 0-3 inches below grade and analyzed for metals, tungsten, explosives, and perchlorate. A replicate sample was collected and analyzed for the same,

- Area 2/East - One 100-point composite sample was collected from 0-3 inches below grade and analyzed for metals and tungsten,

- Area 3/West - One 100-point composite sample was collected from 0-3 inches below grade and analyzed for metals and tungsten,

- Area 3/Center - One 100-point composite sample was collected from 0-3 inches below grade and analyzed for metals, tungsten, and perchlorate. A replicate sample was collected and analyzed for the same,

- Area 3/East - One 100-point composite sample was collected from 0-3 inches below grade and analyzed for metals and tungsten.

All samples were collected in accordance with USEPA SW846 Method 8330B (umpromulgated). Samples were collected using a plug extractor except for the deep samples in Area 1/Center/South which were collected using a hand auger. A systematic sampling approach was used to collect representative samples from each grid. Care was taken to ensure that samples were not concentrated in one portion of the sampling area. Samples for SVOC analysis were sent directly to Severn Trent Laboratory (STL) in Burlington Vermont for analysis. All samples for explosives, perchlorate, metals and tungsten were shipped to ERDC/CRREL in Hanover, New Hampshire and ground in a steel puck mill grinder. The samples were then shipped to STL Laboratory in Burlington Vermont for analyses.

### 3.2.2 Analytical Results

Only one propellant-related SVOC (1,3-diethyl-1,3-diphenyl urea) was detected in the two samples collected from Area 1 Center/North at a maximum concentration of 2,300 µg/kg (Table 3-3). There are no established standards for 1,3-diethyl-1,3-diphenyl urea.

Nitroglycerin was detected by the method 8330 analysis in three of the six samples collected with a maximum detected concentration of 36,500 µg/kg (average of primary and replicate samples). Nitroglycerin exceeded its SSL (1.02 µg/kg) in 3 samples and its PRG (34,741 µg/kg) in only one sample. The highest concentrations of nitroglycerin were detected in the surface soil samples (0-3") in the Area 1 Center/North sample area located in the center of the firing line (Table 3-4). Although nitroglycerin was also detected in Area 1 Center/South, the concentrations were a factor of 10 lower than the northern sample area. Nitroglycerin was not detected at the deeper 9-12" soil samples in Area 1 Center/South.

Twelve metals were detected at concentrations in excess of background (Table 3-3). Six of these (beryllium, cobalt, nickel, calcium, sodium, and potassium) did not exceed SSLs or PRGs. Beryllium exceeded background (0.38 mg/kg) in only one of 16 samples with a concentration of 0.4 mg/kg and did not exceed either of its SSL (2.6 mg/kg) or its PRG (15.4 mg/kg). Cobalt exceeded background (4 mg/kg) in only one of 16 samples with a concentration of 5.9 mg/kg and did not exceed either of its SSL (132.38 mg/kg) or its PRG (902.89 mg/kg). Nickel exceeded background (10 mg/kg) in four of 16 samples with a maximum concentration of 12.6 mg/kg and did not exceed either of its SSL (292.13 mg/kg) or its PRG (156.43 mg/kg). Calcium exceeded background (288 mg/kg) in 12 of 16 samples with a maximum concentration of 7,360 mg/kg. There are no established standards for calcium. Sodium exceeded background (196 mg/kg) in only one of 16 samples with a concentration of 197 J mg/kg. There are no established standards for sodium. Potassium exceeded background (766 mg/kg) in six of 16 samples with a maximum concentration of 935 mg/kg. There are no established standards for potassium.

Antimony exceeded background (1.9 mg/kg) in only one of 16 samples with a concentration of 2 J mg/kg in Area 1 Center/North. It exceeded its SSL (0.27 mg/kg) but did not exceed its PRG (3.13 mg/kg). Vanadium exceeded background (28.8 mg/kg) in only two of 16 samples with a maximum concentration of 29.3 mg/kg. It did not exceed its SSL (260.05 mg/kg) but did exceed its PRG (7.82 mg/kg). Copper exceeded background (11 mg/kg) in 14 of 16 samples with a maximum concentration of 742 mg/kg in Area 2 Center. It exceeded its SSL (45.73 mg/kg) in five samples and its PRG (312.86 mg/kg) in two samples. Lead and molybdenum exceeded background in all 16 samples. Lead had a maximum detected concentration of 467 mg/kg in Area 1 Center/North. It exceeded its SSL (4.05 mg/kg) and its PRG (40 mg/kg) in all 16 samples, and its S1/GW1 (300 mg/kg) in three samples. Molybdenum had a maximum detected concentration of 2 mg/kg in Area 1 Center/North. It exceeded its SSL (0.183 mg/kg) in all 16 samples but did not exceed its PRG (39.11 mg/kg) in any of the 16 samples. Tungsten was detected in 22 of 28 samples with a maximum concentration of 77.1 mg/kg in Area 2 Center. There are no established standards or MMR background levels for tungsten.

The highest concentrations of lead were detected in the surface soil samples (0-3") in the Area 1 Center sample area located in the center of the firing line (Table 3-4). Chromium results were qualified with an "R", as rejected during data validation due to the high levels of chromium contamination introduced from the grinder. The new unpromulgated CRREL grinding method,

Method 8330B used for metals preparation has been shown to introduce significantly high levels of total chromium and iron from the grinding equipment. The samples analyzed for metals were ground in a high chromium cast iron steel alloy puck mill grinder prior to acid digestion and analysis to thoroughly homogenize the samples and any contaminants. Chromium levels have been documented to increase by over a factor of 20 between the unground lab blank samples and the ground lab blank samples. The CRREL grinding procedures were developed for explosives and were never intended to be used for metals analyses due to the obvious contamination that is introduced by the grinder.

Perchlorate was not detected in any of the eight samples taken a T Range (Table 3-3).

### 3.2.3 April 2007 Firing Line Soil Sampling

In order to further define the nitroglycerin distribution and to assist in developing leaching models, the firing line area was subdivided into 12 approximately equally sized areas of about 2,900 square feet each. Samples were collected in April 2007 in accordance with the T Range Firing Line Sampling Project Note. Samples were analyzed for explosives, lead and other metals, pH, and total organic carbon (TOC).

Samples were collected from each area from 0-3” below grade. Within sample areas Center 1 and Center 2, soil profile samples were also collected from 3-6”, 6-9”, 9-12”, 12-18”, and 18-24”. All samples were 50-point composites using the CRREL multi-increment sampling method except in areas Center 1 and Center 2 where 30-point samples were collected due to the difficulty of collecting samples to the desired 2-foot depth.

The preliminary data from this sampling was not included in the risk assessment in this report because validated laboratory data was not available during the preparation of this report.

The analytical results of the explosives analyses indicate that elevated concentrations of nitroglycerin are for the most part limited to the area directly in front of the 50-caliber firing line mounds (sample areas Center 1, West 1, and East 1). Low concentrations, barely above the reporting limit of the analysis, were also detected in two other sample areas. Table B-1 in Appendix B summarizes the nitroglycerin data from the samples.

Samples collected 3 inches below grade to a depth of 2 feet in Area Center 1 indicate the presence of low level concentrations of nitroglycerin slightly above the analytical reporting limit. These concentrations are all similar with no apparent trend.

## 3.3 Groundwater Investigation

In September, 2006, a groundwater monitoring well (MW-467S) was installed down gradient of the range (Figure 3-3). MW-467S was located and screened at a depth of 125-135 feet below grade to intercept groundwater that originated as precipitation falling on the range. The monitoring well was sampled and analyzed for explosives (SW8330), Resource Conservation and Recovery Act (RCRA) 8 total metals (SW6010B), total and dissolved Tungsten (SW6020), and SVOCs (SW8270C). Copper, zinc, iron, and antimony have been added to the analysis for subsequent sampling events at MW-467S.

In April, 2007, an additional groundwater monitoring well (MW-489S) was installed down gradient of the range to determine if the low concentrations of tungsten detected on the range floor and if any projectiles that may have landed off-range have had an impact on groundwater (Figure 3-3). MW-489S was located and screened at a depth of 124.58-134.58 feet below grade to intercept groundwater that originated as precipitation falling on the range floor or off-range bullet fall out area. The monitoring well was sampled and analyzed for explosives (SW8330), RCRA 8 metals (SW6010B), copper, zinc, iron, antimony, tungsten (SW6020), and SVOCs (SW8270C). The results of groundwater analysis for MW-489S are not included in this report because validated laboratory data was not available during the preparation of this report. The results will be included as an appendix to the Final Report when submitted.

The particle backtracks in Figure 3-7 show that MW-467S will monitor water from the firing line, the target area, and part of the range floor while MW-489S will monitor water from the range floor and part of the off-range area.

### 3.3.1 Groundwater Analytical Results

No explosives compounds, SVOCs, or metals were detected in MW-467S. Total tungsten was detected at a concentration of 2.9 μg/L and dissolved tungsten was detected at a concentration of 1.9 μg/L (Table 3-5). There is, however, currently some uncertainty in the ability of the various laboratory methods to reliably detect tungsten at these low concentrations.

Lead was not detected in the groundwater sample collected at MW-467S. This finding is consistent with a recent study of the behavior of metallic lead in the environment conducted by the U.S. Army Corps of Engineers Cold Regions Research and Experimental Laboratory (CRREL). The results of this study are published in the report, Environmental Assessment of Lead at Camp Edwards, Massachusetts Small Arms Ranges, 9 May 2007. That study concluded that, corrosion and dissolution processes are sufficiently slow and mechanisms for attenuation, such as precipitation and adsorption, sufficiently robust, that lead has not migrated to groundwater. These conclusions are supported by the following facts:

- Multiple soil profile samples collected prior and post-berm maintenance from six small arms ranges (SARs) indicated little vertical migration of lead,
- Geochemical conditions within the surface soils, (e.g. pH, chloride, resistivity, permeability, and oxygen) are not conducive for significant corrosion, dissolution, and transport of lead,
- Experimental results from other studies with conditions similar to Camp Edwards showed minimal lead movement,
- Geochemical studies found in the literature suggest the propensity to form sparingly soluble precipitates, and not sorptive capacity, may be the most important factor controlling lead migration in the subsurface,
- Unsaturated zone modeling using two different software codes predicted the vertical migration of lead would take centuries to reach groundwater,

- Groundwater data collected to date from across Camp Edwards demonstrated little to no lead contamination as a result of accumulation from small arms training, despite lead being continuously released to soil for more than 60 years,
- Tracer studies conducted by the US Geological Survey (USGS) near Camp Edwards demonstrated an aqueous form of lead was rapidly adsorbed onto the soil, implying the same reactions will attenuate lead movement in the unsaturated zone, and
- Lead introduced into the groundwater near Camp Edwards in a sewage treatment effluent was rapidly and completely attenuated to the soil in the aquifer preventing migration.

### 3.4 Leaching Assessment

As part of the T Range soil investigation, USEPA requested that soil impacts to groundwater be investigated for lead, antimony, nitroglycerin and 2,4-dinitrotoluene (DNT). Leaching assessments were carried out by both Idaho National Laboratory in concert with USEPA (Rood and Hull, 2007) and IAGWSP (USACE, 2007). Reports and technical memoranda were issued by both parties. A leaching summit was held with USEPA, the Massachusetts Department of Environmental Protection (MassDEP), MAARNG, IAGWSP, USACE/CRREL and other parties pertinent to this issue in February, 2007 to discuss the preliminary leaching study results and to identify areas where both parties agreed/disagreed on the conceptual site model and modeling procedures/protocols. Additional teleconferences were subsequently held with USEPA/Idaho National Laboratory, IAGWSP/USACE/CRREL to resolve issues identified at the leaching summit in March, 2007.

Resolution of the issues remains ongoing at this time. Presently, IAGWSP/USACE/CRREL are developing a series of batch and column experiments in order to better define the sorption/desorption process using expended and/or raw propellant on T Range soils in order to better derive modeling parameters for nitroglycerin and DNT in order to better quantify soil concentrations protective of groundwater for the T Range and other Small Arms Ranges. Once the issues are resolved, the modeling procedures and protocols will be presented in an appropriate document.

Although the modeling procedures/protocols have not been completely resolved, results of preliminary leaching analyses indicated that concentrations of lead, antimony and 2,4-DNT did not pose a leaching risk to groundwater above maximum contaminant levels (MCLs)/health advisories (HAs) and/or risk based concentrations at the T Range. However, concentrations of nitroglycerin within the “firing line” were elevated compared to other sample locations and were at concentrations greater than preliminary soil levels protective of groundwater as identified in the USEPA report and IAGWSP/USACE technical memoranda.

Based on the preliminary leaching analyses conducted to date, some level of soil removal at the firing line could be conducted in order to remove concentrations of nitroglycerin that may pose a future problem. As a precautionary measure to ensure that any potential remediation would not require the removal of the newly elevated firing line, surficial soils will be removed by the

MAARNG from the existing firing line, stockpiled, and covered awaiting further disposition as part of the berm maintenance program prior to construction of the elevated firing line.

# 4.0 CONCEPTUAL SITE MODEL

Potential sources of small arms range contaminants include propellant-related compounds deposited on the surface in the vicinity of firing lines and projectile-related residuals deposited on the surface at, and in the vicinity of, the targets and range backstops. Earlier sampling at MMR revealed that propellant-related contamination, in part, consists of a suite of semi-volatile organic compounds (SVOCs) produced by the combustion of small caliber ammunition propellants. These compounds are released to the environment and deposited as surface residue via airborne deposition. Projectile-related residues consist mainly of the metallic constituents of various alloys used in the manufacturing of small caliber rounds. These metals (typically lead, antimony, and copper) are deposited on, and near, the surface as the fragmented remnants of projectiles. Similar metallic residuals, detected in firing line soils, are also presumed to be associated with the firing of metal projectiles. Both the propellant and projectile-related residues represent potential risks to human and ecological receptors through direct contact and ingestion of surface soil, and the inhalation of fugitive dust. In addition, these residues may pose a potential threat to groundwater by the leaching of SVOCs, explosives compounds, and metals from the surface through the unsaturated zone.

# 5.0 RISK ASSESSMENT

This risk assessment can be used to determine the need for remedial actions to prevent risk to several types of potential site users at the range. The assessment also may provide information that may be used to support range management practices in the future.

A Human Health and Ecological Risk Assessment (HERA) was performed for the T Range. The HERA consisted of a human health risk assessment (HHRA) and a baseline ecological risk assessment (BERA). The objective of the HERA was to identify any Contaminants of Concern (COCs) in soil and groundwater from impacts associated with small arms training and other activities that occurred within T Range. COCs identified in the risk assessment as contributing to an excess risk of harm to potential human and environmental receptors will be further evaluated as the basis for the identification and evaluation of remedies. The HERA is focused on direct contact and particulate inhalation exposures related to the site soils.

## 5.1 Summary of Human Health Risk Assessment

The site-specific HHRA was conducted in accordance with the USEPA Risk Assessment Guidance for Superfund (RAGS), Volume I: Human Health Evaluation Manual, Part A (USEPA, 1989), Part D (USEPA, 2001a), and Part E (USEPA, 2004a) and in accordance with the established MMR risk assessment protocols. The MMR risk assessment protocols have been developed to maintain a consistent technical approach that adhered to the relevant USEPA and MassDEP risk assessment guidance and policies as interpreted for MMR and the IAGWSP.

In addition to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) style tables found in the HERA in Appendix A, summary tables for the HHRA were developed in order to assist the MassDEP's risk assessors review of this portion of the report. Those tables are presented as part of this section (Tables 5-1 through 5-13).

A summary of the frequency of detection, minimum and maximum detected concentration and average for each compound of potential concern (COPC) is provided in Table 5-1. Compounds in soil were identified as COPCs based on a comparison of maximum detected concentrations to risk-based screening criteria protective of direct exposures as follows:

- Area 1 — Aluminum, antimony, arsenic, lead, tungsten, vanadium, 1,3-diethyl-1,3-diphenyl urea, and nitroglycerin; and

- Combined Areas 2 and 3 — Aluminum, arsenic, tungsten, and vanadium.

As shown in Table 5-2, arsenic and vanadium were detected at maximum concentrations that were comparable to background in Area 1 and aluminum, arsenic, and vanadium were comparable to background in the combined Areas 2 and 3. These metals were carried through as COPCs in the risk assessment.

The soil exposure point concentrations for each exposure area of interest were based on the 95% upper confidence limit on the mean in accordance with USEPA guidance (USEPA, 2002b) using the USEPA ProUCL software (USEPA, 2004c). All soil data representing current soil conditions in each of the two exposure areas (Area 1, combined Areas 2 and 3) were used in deriving exposure point concentrations. These concentrations were considered to be representative for the purpose of estimating current and future potential exposures. In calculating exposure point concentrations for soil, a value equal to one-half the limit of detection reported by the laboratory was used as a surrogate concentration for those constituents that were not detected in a particular sample.

The calculated exposure point concentrations for each area of interest are also included in Table 5-1. Chemical-specific properties of the COPCs are listed in Table 5-3.

Data from a single down-gradient groundwater monitoring well was compared to risk-based screening criteria. No explosives compounds, SVOCs, or metals were detected in MW-467S. Total tungsten was detected at a concentration of 2.9 µg/L and dissolved tungsten was detected at a concentration of 1.9 µg/L. There are no risk-based screening criteria for tungsten in water. Based on information collected to date, groundwater contamination is not a current risk at the site. The likelihood of future risk from groundwater contamination is being assessed separately by USEPA and IAGWSP.

### 5.1.1 Toxicity Assessment

The toxicity assessment summarizes the toxicological data (cancer unit risk or slope values, and non-cancer reference doses or reference concentrations) for the identified COPCs. The preferred hierarchy of toxicological information and toxicity values was:

- Tier 1: IRIS (Integrated Risk Information System), which is an on-line USEPA database containing current toxicity values for many chemicals that have gone through a rigorous peer review and USEPA consensus review process (USEPA, 2007);

- Tier 2: Provisional Peer Reviewed Toxicity Values (PPRTVs) developed by the USEPA Office of Research and Development/National Center for Environmental Assessment/ Superfund Health Risk Technical Support Center (NCEA); and

- Tier 3: Additional USEPA and non-USEPA sources of toxicity information, including but not limited to the CalEPA toxicity values, the ATSDR Minimum Risk Levels, and toxicity values published in the Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997).

Carcinogenic toxicity values used in the assessment and other related information are presented in Table 5-4. Non-carcinogenic toxicity values used in the assessment are listed in Table 5-5.

### 5.1.2 Exposure Assessment

The exposure assessment identified the potential human receptors, exposure points for the various media, potential exposure pathways, and quantification of the magnitude and frequency of receptors' potential exposure to the identified COPCs in soil. Reasonable maximum exposure (RME) scenarios were evaluated in this risk assessment, which reflect conservative exposure assumptions for each identified receptor (USEPA 1999). This approach is considered to be conservative because, in reality, most individuals will not be subject to all the conditions that comprise the RME scenario, resulting in lower potential exposures to constituents and, therefore, lower potential risks associated with those exposures.

The following receptors and exposure pathways were considered in the HHRA and are summarized in Table 5-6:

<u>Current / Potential Receptors:</u>

- Military personnel (adults aged 18-28 years) conducting small arms training activities with potential exposures to COPCs in surface soil of the exposure areas of interest at the site (surface soil is defined as soil in the depth range of 0 to 1 ft bgs). The routes of exposure for the non-intrusive military trainee are incidental ingestion, dermal absorption, and the inhalation of particulates related to the surface soil.

- A trespasser (aged 12-18 years) with potential exposures to COPCs in the surface soil of the exposure areas of interest at the site. The routes of exposure for the trespasser are incidental ingestion, dermal absorption, and the inhalation of particulates related to the surface soil.

- A hunter (aged 18+ years) with potential exposures to COPCs in the surface soil of the exposure areas of interest at the site. The routes of exposure for the hunter are incidental ingestion, dermal absorption, and the inhalation of particulates related to the surface soil.

<u>Potential Receptors:</u>

- Construction workers (adults aged 18+ years) with potential exposures to COPCs in both the surface and subsurface soil of the exposure areas of interest at the site. The routes of exposure for the construction worker performing excavation and other intrusive activities are incidental ingestion, dermal absorption, and the inhalation of particulates related to soil. These construction workers are not likely to contact or be exposed to groundwater at the site in any manner, as the depth to groundwater is greater than 100 feet.

- Hypothetical residents (a child aged 1-7 years and an adult aged 18+ years) with potential exposures to COPCs in both the surface and subsurface soil of the exposure areas of interest at the site. The routes of exposure for the hypothetical child and adult residents are incidental ingestion, dermal absorption, and the inhalation of particulates related to soil.

Exposure pathways considered for the site relating to groundwater included drinking or ingesting the groundwater, inhaling volatiles released during water use, and inhaling vapors released from groundwater that may migrate up through the soil into indoor air. These last two pathways were not likely to be significant for T Range due both to the lack of detected volatiles in the overlying soil and the relatively deep depth to groundwater. Given the characteristic depth to groundwater, groundwater is not likely to pool up in near surface trenches or excavations.

Exposure profiles specific to each of the receptors were compiled from USEPA sources and are summarized in Table 5-7.

#### 5.1.3 Risk Assessment

The risk assessment was performed by inputting site-specific data and assumptions into formulae developed by USEPA for calculation of cancer risks and non-cancer hazards. Potential health risks were calculated for baseline conditions and address exposures to contaminant levels at the site as they currently exist. For each receptor, cumulative Estimated Lifetime Cancer Risks (ELCRs) and non-carcinogenic hazards (expressed as Total Hazard Index (HI)) were estimated. The ELCR for each receptor was compared to the MCP ELCR limit of $1 \times 10^{-5}$ (one in one hundred thousand) and the USEPA range of $1 \times 10^{-4}$ (one in ten thousand) to $1 \times 10^{-6}$ (one in one million). The HI for each receptor or target endpoint (total HI) was compared to a HI of 1 (MassDEP, 2003). Total ELCR and total HI for a constituent that does not exceed these risk/hazard limits for a given receptor would indicate that no adverse health effects are expected to occur as a result of that receptor's potential exposure to COPCs.

#### 5.1.4 Results of the HHRA

At each of the two potential soil exposure areas, the total ELCRs for current and future trespassers, current and future military personnel engaged in small arms training or other non-intrusive activities, current and future recreational hunters were within or less than the USEPA and the MassDEP allowable risk benchmarks (range of $1 \times 10^{-4}$ to $1 \times 10^{-6}$ and $1 \times 10^{-5}$, respectively) (see Tables 5-8 and 5-9). The highest risk estimates were for construction workers exposed to vehicle-generated dusts. The risk estimate for this exposure medium and route of exposure (inhalation) was approximately $4.3 \times 10^{-5}$ for Area 1 and $4.2 \times 10^{-5}$ for the combined Areas 2 and 3. Similarly, the risk estimates for military personnel engaged in intrusive training activities exposed to soil particulates were $4.3 \times 10^{-5}$ for Area 1 and $4.2 \times 10^{-5}$ for the combined Areas 2 and 3. These values exceed the MassDEP risk limit of $1 \times 10^{-5}$. Nearly all of this risk was due to the assumed presence of hexavalent chromium.

The total HI from potential soil exposures to current and future trespassers, current and future military personnel involved with small arms or other non-intrusive training activities, current and future recreational hunters, and future construction workers did not exceed 1, as presented Tables 5-8 and 5-9 for Exposure Areas 1 and the combined Areas 2 and 3.

To provide information for evaluating all future-use options, a hypothetical residential scenario was evaluated in the risk characterization. The Total ELCRs for the hypothetical future resident exposed to the soil exposure points were within USEPA's allowable risk range and above MassDEP's risk threshold (see Tables 5-8 and 5-9). The total HI for children exposed to COPCs in Area 1 soils was 2.8, which exceeds 1, primarily due to ingestion of nitroglycerin. The total HI from potential soil exposures for adults in Area 1, and for adults and children in combined Areas 2 and 3 were less than 1.

Lead was selected as a COPC for the Area 1 potential exposure point. Potential hazards associated with exposure to lead were evaluated using the Adult Lead Model (ALM) (USEPA, 2003a) for adult construction workers (Table 5-10) and the adolescent trespasser (Table 11), the All Ages Lead Model (AALM) (USEPA, 2005) for adult residents (Table 5-12), and the Integrated Exposure Uptake Biokinetic Model (IEUBK) Child Lead Model for children (USEPA, 2001b) (Table 5-13).

For the construction worker, the ALM-estimated adult blood lead level concentration associated with exposure to Area 1 soil was less than 2.4 μg Pb/dL (Table 5-10). The associated probability that fetal blood lead levels would exceed 10 μg Pb/dL is approximately 2% (i.e., the fetus of a hypothetical pregnant female construction worker would most likely have a blood lead level less than 10 μg Pb/dL). For the adolescent trespasser, the ALM-estimated blood lead level was less than 1.8 μg Pb/dL (Table 5-11), and, the associated probability that the fetal blood lead level exceeds 10 μg Pb/dL was 1%. These estimates assume that no personal protective equipment will be used, that dust suppression procedures will not be employed, and that other industrial hygiene practices would not be utilized. The ALM does not explicitly consider other sources of lead exposure, such as dietary, but it does assume a non-zero baseline blood lead concentration of 1.5 to 1.7 μg Pb/dL which reflects exposures to other sources.

The blood lead level concentration due to exposure to lead in soil for adult residents as estimated by the AALM was less than 4.2 μg Pb/dL even when non-site related sources were included (Table 5-12). USEPA has determined that blood lead levels at or above 10 μg Pb/dL present risks to children's health (USEPA, 1994). The results of the IEUBK modeling (less than 3.1 μg Pb/dL) were compared to this level and were determined to not present a significant risk to children's health, even when non-site related sources (e.g., dietary) were included with the projected exposures to the Area 1 soil (Table 5-13).

### 5.1.5 Human Health Contaminant of Concern

Contaminants of concern (COCs) are COPCs that were found to contribute most significantly to site risks. Chemicals that were found to individually contribute a carcinogenic risk greater than 1.0 x $10^{-6}$ or an HI greater than 1 to a particular receptor were judged to "contribute significantly" to site risks and are summarized below by exposure area for each highlighted receptor (Note: The associated chemical-specific contribution to the ELCR or HI for that COC is included parenthetically):

- Construction Workers:

  Area 1 - arsenic (ELCR 1.8 x $10^{-6}$);

  Combined Areas 2 and 3 - arsenic (ELCR 1.8 x $10^{-6}$); and

- Hypothetical Residents:

  Area 1 – arsenic (ELCR 1.7 x $10^{-6}$) and nitroglycerin (child HI 2.4); and

  Combined Areas 2 and 3 - arsenic (ELCR 1.7 x $10^{-6}$).

No soil COCs were identified for the trespasser, military personnel engaged in small arms training or other non-intrusive activities, or the hunter. It should be noted that with the exception of one soil sample (23.4 mg/kg arsenic in SS169A 0.5 to 1.0 bgs) the concentrations of arsenic measured in T Range soil samples are comparable to background as measured in the outwash sample and as established by MassDEP for "natural" soil.

In summary, the soil COCs for T Range are limited to arsenic, and nitroglycerin.

### 5.1.6 Uncertainty

All risk assessments contain elements of uncertainty. Most assumptions made in developing the baseline risk estimates were biased toward health protectiveness, that is, toward overestimating rather than underestimating risk. There is, therefore, a reasonable degree of certainty that actual risks to individuals exposed to contamination from T Range will not be higher than those estimated in the human health risk assessment and, in fact, may be much lower. Uncertainties particular to this assessment are discussed below.

As indicated previously, the 2006 Project Note samples were ground in a high chromium cast iron steel alloy puck mill grinder prior to analysis. During the grinding processes small pieces of the high chromium cast iron steel alloy grinder may be introduced into the sample. As evidenced in the Ottowa sand grinding blank samples with and without grinding, the grinding process elevates all of the metals concentrations. The increased surface area of the finely ground soil samples which were ground 5-times for 60 second intervals also allows for more metals to be put into solution during the concentrated nitric acid digestion procedure by Method 3050B. All metals concentrations detected during the 2006 investigation are highly dubious and many appear to be artificially elevated.

Most of the soil samples were composite samples. The 2002 Supplemental Investigation samples were 5-point composite samples and discrete samples, while the 2006 Project Note samples were 50-point or 100-point composite samples. Composite samples are essentially a physical averaging of the soil found at each of the grid nodes or points. Physical averaging reduces inter-sample variability, which results in increased precision of the resulting estimate of the overall average concentration (or grand mean). The principal limitations of sample compositing are loss of discrete information about the individual sample points, and the potential for dilution of the contaminants in a sample with uncontaminated material.

For compounds without toxicity values from either IRIS or HEAST, toxicity values from Tier 3 sources were used in this evaluation without review of the basis of the RfD(s). Provisional toxicity values were obtained for aluminum, nitroglycerin, and vanadium from USEPA and the NCEA (USEPA, 2006a, 2006b, 2006c). The use of these provisional values contributes to some uncertainty in the overall risk estimates. In addition, the oral RfD for tungsten is based on an unpublished no observed adverse effect level (NOAEL) from a Center for Health Promotion and Preventive Medicine (CHPPM) toxicity study (USACHPPM, 2007).

## 5.2 Summary of Ecological Risk Assessment

The purpose of the baseline ecological risk assessment (BERA) is to identify contaminants of potential ecological concern (COPECs) in surface soils which may pose potential risk to terrestrial ecological receptors utilizing habitat present at the T Range. The complete BERA may be found in Appendix A of this report.

### 5.2.1 Identification of Representative Wildlife Receptors

Criteria for the selection of wildlife receptors included two factors specified in USEPA guidance (USEPA, 1997) for determining "key organisms" in an ecological food web: (1) resident communities or species exposed to highest chemical concentrations in surface soil; (2) species or functional groups considered to be essential to, or indicative of, the normal food chain functioning within the affected habitat.

Three avian species and three mammalian species were selected as receptors of interest across the site. The species chosen were selected given that they are all endemic to the terrestrial habitats present in the MMR area, they represent the different foraging behaviors anticipated for avian and mammalian wildlife common to the terrestrial habitats present, and they include upper tropic level receptors:

- Herbivorous Birds. The chipping sparrow (*Spizella passerina*) was selected to represent a largely herbivorous avian species. Chipping sparrows are found in grassy, weedy or brushy habitats, and have been identified at MMR.

- Omnivorous Birds. The American robin (*Turdus migratorius*) was selected to represent omnivorous terrestrial avian receptors; it is a commonly observed species in the MMR. The robin feeds on terrestrial plants, fruits, and soil invertebrates.

- Carnivorous Birds. The red-tailed hawk (*Buteo jamaicensis*) was selected to represent carnivorous terrestrial avian receptors, as a top-level terrestrial predator that preys on small birds, small mammals (e.g., rabbits, ground-dwelling rodents) and snakes identified at MMR.

- Herbivorous Mammals. The white-footed mouse (*Peromyscus leucopus*) was selected to represent a largely herbivorous mammalian species. These mice have been identified at MMR and feed primarily on plant matter (shoots, grasses, and bark), in addition to small amounts of insects. Both avian predators (hawks) and mammalian predators (foxes) prey upon mice.

- Omnivorous Mammals. The short-tailed shrew (*Blarina brevicauda*) was identified as being native to the MMR area and is a species that consumes terrestrial plants, earthworms, and other invertebrates in soil. Because of its small home range, the shrew is potentially exposed to on-site chemicals for its entire lifetime.

- Carnivorous Mammals. The red fox (*Vulpes vulpes*) was selected to represent carnivorous terrestrial mammalian species. This species is a terrestrial predator present throughout the United States and Canada that has been observed at MMR. Red fox prey extensively on mice and voles but also feed on other small mammals, insects, rabbits, game birds, and poultry.

### 5.2.2 Conceptual Site Model

Based upon the results of the ecological receptor selection process, a site visit and the terrestrial habitats present on the site, a site-specific food web conceptual site model (CSM) (Figure 3-1) was created. This CSM was used to identify the exposure pathways and routes through which the identified wildlife receptors may be exposed to contaminants associated with historical range uses. The primary exposure media considered in the BERA for T Range was surface soils (0-1ft. bgs). The primary exposure pathways and routes included ingestion of dietary items that have bioaccumulated contaminants from surface soils and incidental ingestion of surface soils by the receptors during normal behavioral activities in the habitats present. Bioaccumulation was the primary exposure route considered in the dietary component of the CSM. Incidental ingestion of soils occur as part of normal behavioral functions by the wildlife species. These behavioral functions resulting in the incidental ingestion of soils could include ingestion of soil particles during feeding or ingestion of soil particles during grooming or preening.

### 5.2.3 Contaminants of Potential Ecological Concern

Contaminants of potential ecological concern are chemicals that have the potential to present a risk to the representative wildlife receptors identified in Section 5.2.1. The soil screening level assessment described in Appendix A, Section 3.3.3 compares maximum detected concentrations to relevant ecological screening values (USEPA ECO-SSLs) for identification of COPECs.

Table 3.1 of Appendix A presents the soil screening level assessment for identification of COPECs. Macro-elements such as phosphorus, potassium, sodium, calcium, and magnesium have been identified by the Food and Drug Administration (FDA) as essential nutrients and were not considered to be problematic or site related. These detected analytes were, therefore, not evaluated in the COPEC screening process.

A total of nine COPECs were identified in the soil screening level assessment for the Site:

- Nitroglycerin;
- Antimony;
- Arsenic;
- Cadmium;
- Copper;

- Lead;
- Tungsten; and
- Vanadium.

This list of COPECs was carried through the ERA process to assess exposure to the wildlife receptors previously identified. Exposure point concentrations were calculated as the arithmetic mean of the relevant data (setting any undetected results to one-half the reported quantitation limit).

#### 5.2.4 Ecological Risk Characterization

Risk characterization uses the output from the screening process steps of the ERA and involves three principal steps: (1) risk estimation and characterization, (2) risk description, and (3) uncertainty analysis. In this step, the risks associated with estimated exposures were characterized, and the strengths, weaknesses, and assumptions employed in the risk assessment were fully described. The complete ecological risk characterization can be found in Section 3.4 of Appendix A to this report.

#### 5.2.5 Potential Ecological Risks for T Range

The ecological receptor groups where potential risks were identified include herbivorous and omnivorous mammalian and avian species and carnivorous mammal species. For both the herbivorous and omnivorous avian species, the potential ecological risks were attributed to lead exposure at the site. Exposure and associated risk to lead appeared low because modeled exposure dosages to avian receptors were below the LOAEL toxicity reference value (TRV). Predicted exposure to vanadium at T Range exceeded both the NOAEL and LOAEL TRV for herbivorous, omnivorous and carnivorous mammalian receptors. However, this potential risk was determined to be low as the maximum and mean concentration of vanadium was within the range of published MassDEP background levels.

# 6.0 CONCLUSIONS

Small arms firing at T Range has lead to the deposition of detectable levels of several analytes on the soil. These include propellants near the firing line that are likely attributable to deposition of propellants from the bullet cartridges and lead deposited on the range floor near the firing line and lesser concentrations down range. This is consistent with the assumed conceptual site model described in Section 4.0

Potential human health risks were estimated for current receptors (military personnel engaged in firearms training, trespassers and recreational hunters), future receptors (trespassers, military personnel training at T Range, recreational hunters, and construction workers) and hypothetical future residents at T Range. Given the conservative assumptions used in this evaluation of potential non-cancer risk, the receptors hazard indices associated with potential exposure to soil are still all less than one for all current receptors and all future receptors except child residents. The calculated HI for future hypothetical child residents in Area 1 exceeds 1 primarily due to ingestion of nitroglycerin in soil. The human health risk assessment indicates that potential non-carcinogenic effects are not expected for any of the likely current site receptors included in the evaluation. Similarly, the human health risk assessment also indicates that potential excess lifetime cancer risks are less than or within USEPA's allowable risk range of $1x10^{-6}$ to $1x10^{-4}$ for all current or future receptors included in the risk assessment and fall within the allowable risk range for future hypothetical residents (between $1.9x10^{-6}$ and $2.3x10^{-6}$). Future residential development is unlikely to occur. Thus, the risk assessment demonstrates that for the most likely and expected current and future uses, the T Range does not pose an unacceptable cancer or non-cancer risk.

The ecological receptor groups where potential risks were identified include herbivorous and omnivorous mammalian and avian species and carnivorous mammal species. For both the herbivorous and omnivorous avian species, the potential ecological risks were attributed to lead exposure at the site. Exposure and associated risk to lead appeared low because modeled exposure dosages to avian receptors were below the LOAEL toxicity reference value (TRV). Predicted exposure to vanadium at T Range exceeded both the NOAEL and LOAEL TRV for herbivorous, omnivorous and carnivorous mammalian receptors. However, this potential risk was determined to be low as the maximum and mean concentration of vanadium was within the range of published MassDEP background levels.

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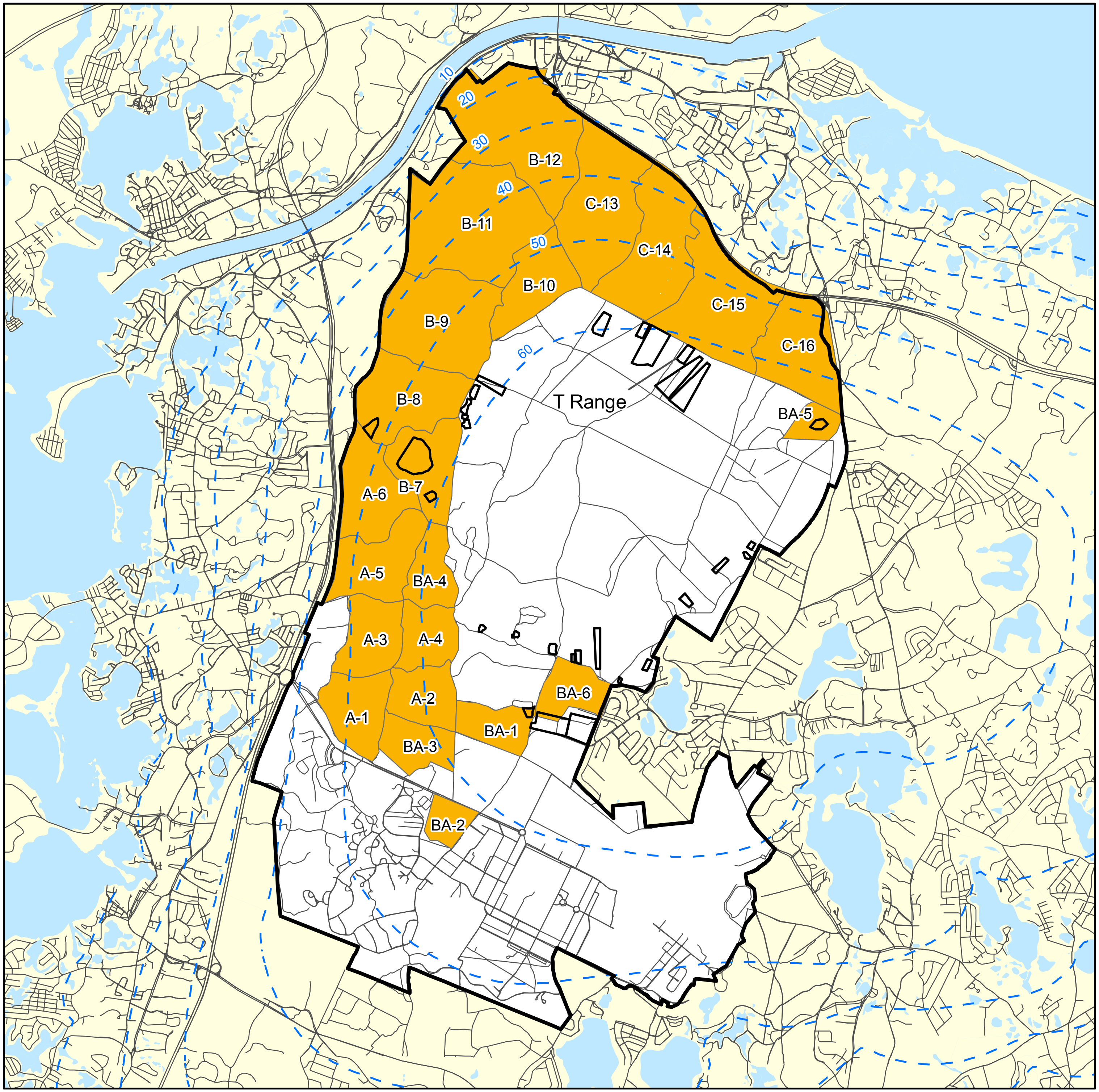



Impact Area
Groundwater Study Program

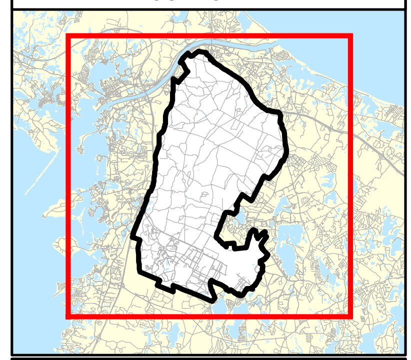
LEGEND

Small Arms Ranges

Military Training Areas

**Groundwater Elevation Contours**
(in feet above NGVD)
Water Level Contours - MMR10

LOCATION MAP



NOTES & SOURCES

Basemap data from US Geological Survey 7 1/2 minute
Topographic Maps: Source: MassGIS
Aerial Photos: Color Digital Orthophotos; Date Flown: 2002
Source: EarthData International

TITLE

T Range
Location of Study Area

0 7,000
Feet

N

US Army Corps
of Engineers®
New England District

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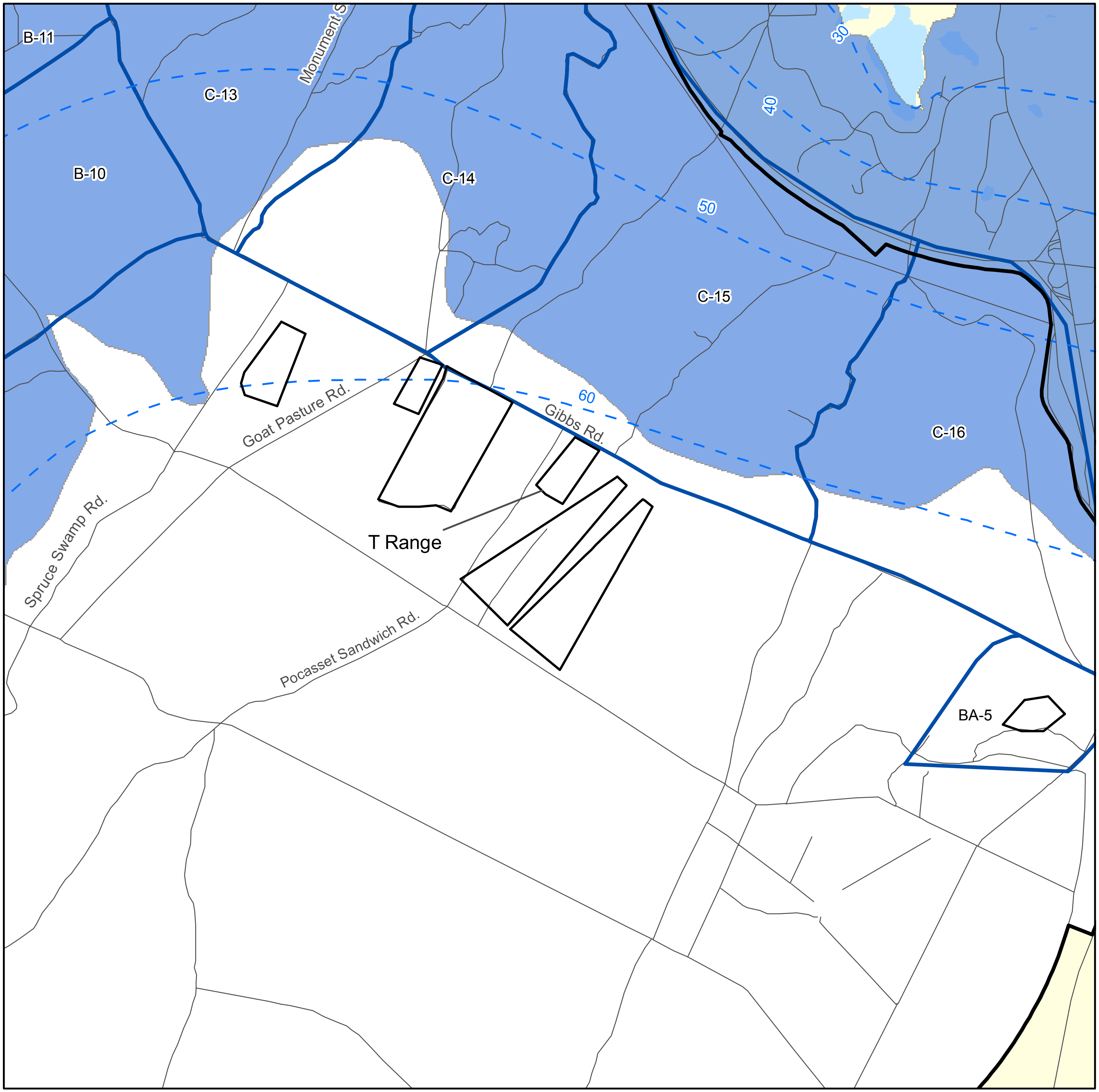
M:\MMR\2006\TangoRange\110706\Fig1-1_110706.mxd
November 7, 2006 DWN: MTW CHKD: MRK SEL

FIGURE
1-1




Impact Area Groundwater Study Program

LEGEND

Small Arms Ranges

Military Training Areas

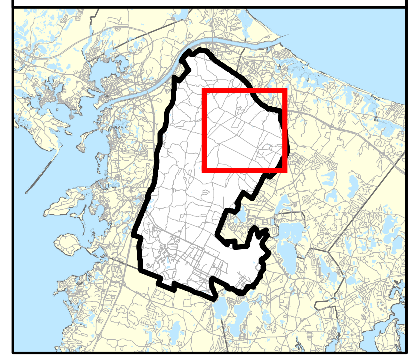
**Groundwater Elevation Contours**
(in feet above NGVD)

Water Level Contours - MMR10

Moraine Deposits

Outwash Deposits

LOCATION MAP



NOTES & SOURCES

Basemap data from US Geological Survey 7 1/2 minute Topographic Maps: Source: MassGIS
Aerial Photos: Color Digital Orthophotos; Date Flown: 2002
Source: EarthData International

TITLE

Location of T Range

0 2,000 Feet

N

US Army Corps of Engineers
New England District

FIGURE 2-1

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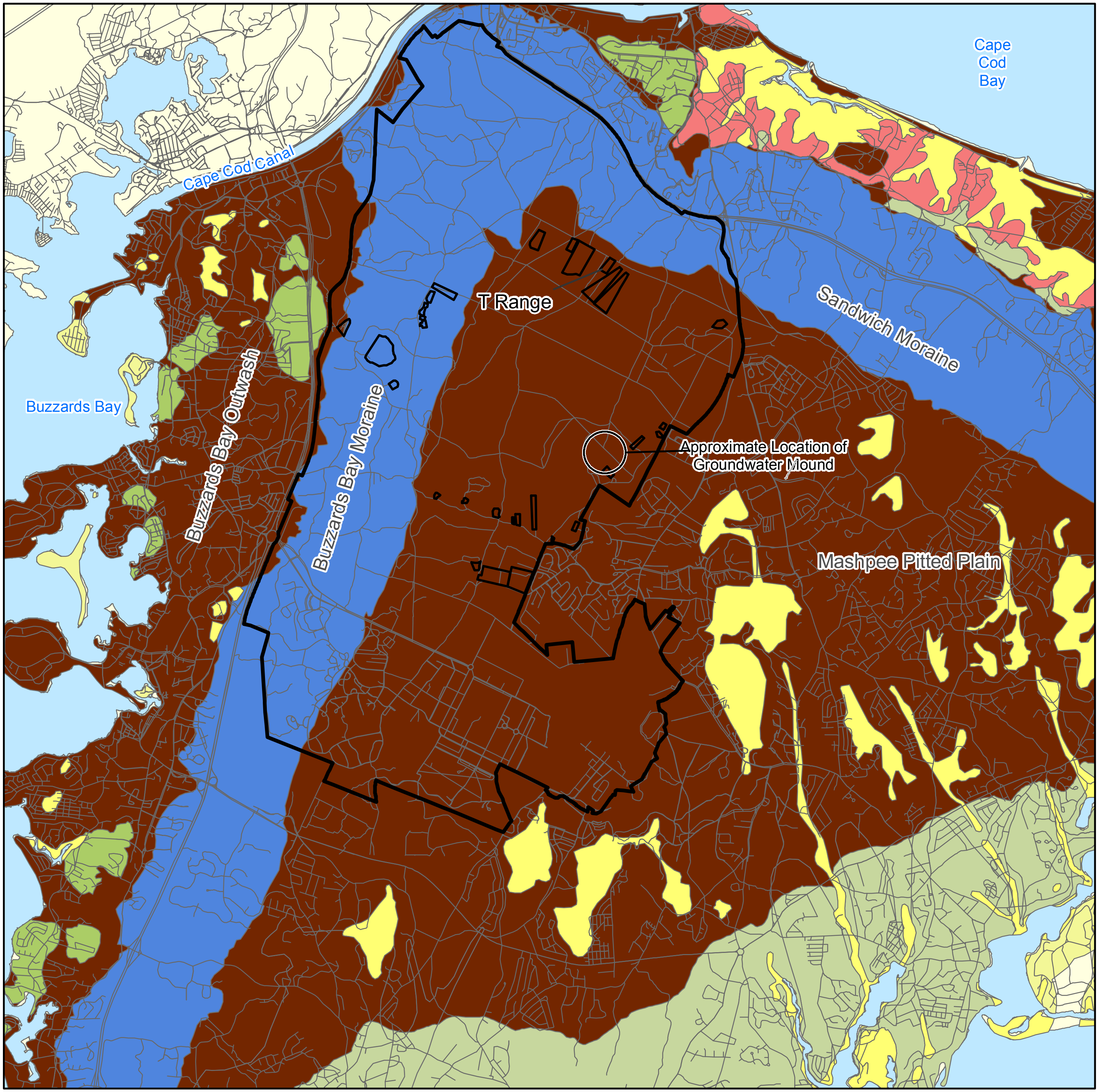
November 7, 2006 DWN: MTW CHKD: MRK SEL




Impact Area
Groundwater Study Program

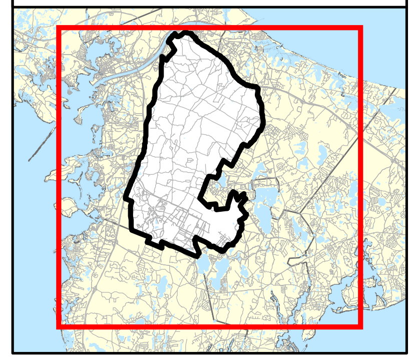
LEGEND

Small Arms Ranges

**Surficial Geology**

- Sand and Gravel Deposits
- Till or Bedrock
- Sandy Till over Sand
- End Moraines
- Large Sand Deposits
- Fine-Grained Deposits
- Floodplain Alluvium

LOCATION MAP



NOTES & SOURCES

Basemap data from US Geological Survey 7 1/2 minute Topographic Maps: Source: MassGIS
Aerial Photos: Color Digital Orthophotos; Date Flown: 2002
Source: EarthData International

TITLE

T Range
Surficial Geology of Western Cape Cod

0 1 Miles

N

US Army Corps of Engineers®
New England District

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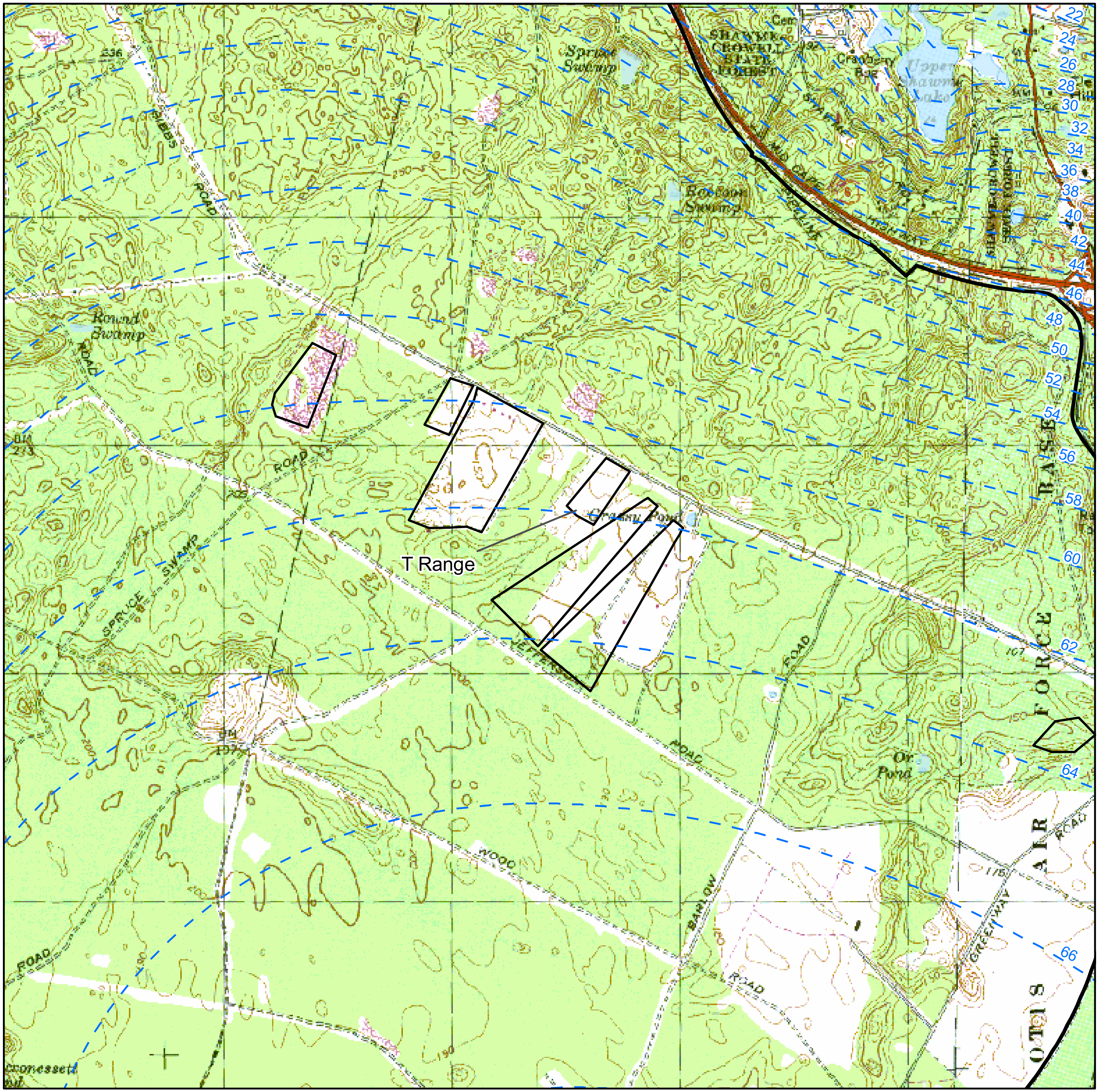
M:\MMR\2006\TangoRange\110706\Fig2-2_110706.mxd
November 7, 2006 DWN: MTW CHKD: MRK SEL

FIGURE 2-2



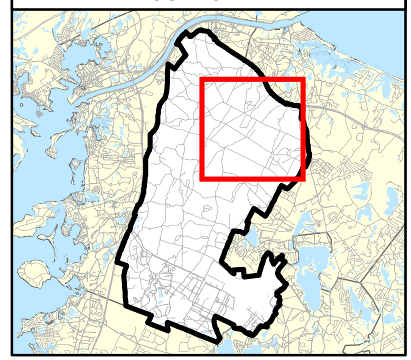

Impact Area
Groundwater Study Program

LEGEND

Small Arms Ranges

**Groundwater Elevation Contours**
(in feet above NGVD)
MMR-10

LOCATION MAP



NOTES & SOURCES

Basemap data from US Geological Survey 7 1/2 minute Topographic Maps: Source: MassGIS
Aerial Photos: Color Digital Orthophotos; Date Flown: 2002
Source: EarthData International

TITLE

Surface Water Bodies
in Proximity to T Range

0 2,000
Feet

N

US Army Corps
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New England District

FIGURE
2-3

M:\MMR\2006\TangoRange\110706\Fig2-3_110706.pdf
M:\MMR\2006\TangoRange\110706\Fig2-3_110706.mxd
November 7, 2006 DWN: MTW CHKD: MRK SEL

# Impact Area Groundwater Study Program

LEGEND

Area of Interest

Soil Grid

Roads

NOTES & SOURCES

Map Coordinates: Stateplane, NAD83, FIPS Zone 2001, Meters

Historical Photo: 1:5000 digital black & white aerial photograph.
Source: MassGIS: 1/2 meter Resolution
Flown: March 1994

150 0 150 300 Feet

TITLE

TM 02-2 T Range
Sampling Locations

FIGURE

3-1


J:\MMR\ReportFigs\7156\7156_Fig41.pdf G:\mmr\mmr\arcvprj\7156_phase2b.apr AMEC March 11, 2003 ALS KEA

# Groundwater Program at Camp Edwards


| 169F | | D3(0.0-0.25)N | C1(0.0-0.25)N | D3(0.25-0.5)N | C1(0.25-0.5)N | D3(0.5-1.0)N | C1(0.5-1.0)N | D3(0.5-1.0)FD |
|---|---|---|---|---|---|---|---|---|
| ANALYTE | Date Sampled | | | | | | | |
| 1,3-DIETHYL-1,3-DIPH | 04/12/2002 | 180 J ug/kg | | | | 38 J ug/kg | | |
| BENZOIC ACID | 04/12/2002 | 31 J ug/kg | 17 J ug/kg | | | | | |
| BIS(2-ETHYLHEXYL) PH | 04/12/2002 | 41 J ug/kg | 22 J ug/kg | 34 J ug/kg | 30 J ug/kg | 52 J ug/kg | 17 J ug/kg | 140 J ug/kg |
| CALCIUM | 04/12/2002 | 305 mg/kg | 294 mg/kg | | | | | |

| 169E | | D3(0.0-0.25)N | C1(0.0-0.25)N | C1(0.25-0.5)N | D3(0.25-0.5)N | C1(0.5-1.0)N | D3(0.5-1.0)N |
|---|---|---|---|---|---|---|---|
| ANALYTE | Date Sampled | | | | | | |
| 1,3-DIETHYL-1,3-DIPH | 04/12/2002 | 6200 ug/kg | 1400 ug/kg | 110 J ug/kg | 820 ug/kg | 49 J ug/kg | 100 J ug/kg |
| BENZOIC ACID | 04/12/2002 | 36 J ug/kg | | 19 J ug/kg | | | |
| BIS(2-ETHYLHEXYL) PH | 04/12/2002 | 18 J ug/kg | 23 J ug/kg | | | | |
| CALCIUM | 04/12/2002 | | 297 mg/kg | | | | |
| DI-N-BUTYL PHTHALATE | 04/12/2002 | 31 J ug/kg | | | | | |

| 169C | | C1(0.0-0.25)N | D3(0.0-0.25)N | D3(0.25-0.5)N | C1(0.25-0.5)N | C1(0.5-1.0)N | D3(0.5-1.0)N |
|---|---|---|---|---|---|---|---|
| ANALYTE | Date Sampled | | | | | | |
| ANTIMONY | 04/12/2002 | 4.0 mg/kg | 4.0 mg/kg | | | | |
| BENZOIC ACID | 04/12/2002 | | 18 J ug/kg | | | | |
| BIS(2-ETHYLHEXYL) PH | 04/12/2002 | | | | 27 J ug/kg | | |
| CALCIUM | 04/12/2002 | 12600 mg/kg | 16500 mg/kg | 540 mg/kg | 720 mg/kg | 2460 mg/kg | 4680 mg/kg |
| COBALT | 04/12/2002 | | | 5.7 mg/kg | 4.1 mg/kg | 6.3 mg/kg | 4.3 mg/kg |
| COPPER | 04/12/2002 | 41.6 mg/kg | 38.3 mg/kg | | | 12.3 mg/kg | 14 mg/kg |
| LEAD | 04/12/2002 | 394 mg/kg | 493 mg/kg | 31.9 mg/kg | 123 mg/kg | 189 mg/kg | 136 mg/kg |
| MAGNESIUM | 04/12/2002 | | | | | 3130 mg/kg | |
| MANGANESE | 04/12/2002 | | | | | 165 mg/kg | |
| NICKEL | 04/12/2002 | | | 14.8 mg/kg | | | 10.1 mg/kg |
| ZINC | 04/12/2002 | | | | | 30.2 mg/kg | |

| 169D | | C1(0.0-0.25)N | D3(0.0-0.25)N | C1(0.25-0.5)N | D3(0.25-0.5)N | C1(0.5-1.0)N |
|---|---|---|---|---|---|---|
| ANALYTE | Date Sampled | | | | | |
| 1,3-DIETHYL-1,3-DIPH | 04/12/2002 | 1100 ug/kg | 820 ug/kg | 160 J ug/kg | 92 J ug/kg | 57 J ug/kg |
| BENZOIC ACID | 04/12/2002 | 46 J ug/kg | 50 J ug/kg | 37 J ug/kg | 30 J ug/kg | |
| BIS(2-ETHYLHEXYL) PH | 04/12/2002 | 23 J ug/kg | | 18 J ug/kg | | |
| CALCIUM | 04/12/2002 | 379 mg/kg | | | | |
| COBALT | 04/12/2002 | | | | | 4.2 mg/kg |
| DI-N-BUTYL PHTHALATE | 04/12/2002 | | | 37 J ug/kg | | |
| N-NITROSODIPHENYLAMI | 04/12/2002 | | | 36 J ug/kg | | |

| 169B | | D3(0.0-0.25)N | C1(0.0-0.25)N | D3(0.25-0.5)N | C1(0.25-0.5)N | D3(0.5-1.0)N | C1(0.5-1.0)N |
|---|---|---|---|---|---|---|---|
| ANALYTE | Date Sampled | | | | | | |
| 1,3-DIETHYL-1,3-DIPH | 04/12/2002 | | 22 J ug/kg | | 18 J ug/kg | | |
| ALUMINUM | 04/12/2002 | | | | | 20400 mg/kg | |
| ANTIMONY | 04/12/2002 | 2.8 J mg/kg | | | | | |
| BENZOIC ACID | 04/12/2002 | | 30 J ug/kg | 20 J ug/kg | | | |
| BIS(2-ETHYLHEXYL) PH | 04/12/2002 | 79 J ug/kg | 34 J ug/kg | 32 J ug/kg | | 25 J ug/kg | |
| CALCIUM | 04/12/2002 | 9220 mg/kg | 6060 mg/kg | 1390 mg/kg | 328 mg/kg | 589 mg/kg | 368 mg/kg |
| CHROMIUM, TOTAL | 04/12/2002 | | | | | 21 mg/kg | |
| COBALT | 04/12/2002 | | | 4.6 mg/kg | | 7.0 mg/kg | 4.6 mg/kg |
| COPPER | 04/12/2002 | 26.2 mg/kg | 18.8 mg/kg | | | | |
| IRON | 04/12/2002 | | | | | 19300 mg/kg | |
| LEAD | 04/12/2002 | 345 J mg/kg | 195 J mg/kg | 111 J mg/kg | 57.9 J mg/kg | 20.7 J mg/kg | 55.2 J mg/kg |
| MAGNESIUM | 04/12/2002 | | | | | 2490 mg/kg | |
| NICKEL | 04/12/2002 | | | | | 14 mg/kg | |
| SELENIUM | 04/12/2002 | | | | | 1.8 mg/kg | |
| VANADIUM | 04/12/2002 | | | | | 29.3 mg/kg | |

| 169A | | C1(0.0-0.25)N | D3(0.0-0.25)N | C1(0.25-0.5)N | D3(0.25-0.5)N | D3(0.5-1.0)N | C1(0.5-1.0)N |
|---|---|---|---|---|---|---|---|
| ANALYTE | Date Sampled | | | | | | |
| ANTIMONY | 04/12/2002 | 3.9 J mg/kg | 11.1 J mg/kg | 2.6 J mg/kg | 5.2 J mg/kg | 91.9 J mg/kg | 2.2 J mg/kg |
| ARSENIC | 04/12/2002 | | | | | 23.4 J mg/kg | |
| BENZOIC ACID | 04/12/2002 | 23 J ug/kg | 21 J ug/kg | | 27 J ug/kg | 20 J ug/kg | |
| BIS(2-ETHYLHEXYL) PH | 04/12/2002 | 20 J ug/kg | 20 J ug/kg | 19 J ug/kg | | 23 J ug/kg | 19 J ug/kg |
| CALCIUM | 04/12/2002 | 15900 mg/kg | 16500 mg/kg | 10100 mg/kg | 17100 mg/kg | 7260 mg/kg | 1800 mg/kg |
| COPPER | 04/12/2002 | 41.2 mg/kg | 40.4 mg/kg | 27.6 mg/kg | 39.8 mg/kg | 20.2 mg/kg | 16.9 mg/kg |
| DI-N-BUTYL PHTHALATE | 04/12/2002 | | | | | | 22 J ug/kg |
| LEAD | 04/12/2002 | 540 J mg/kg | 757 J mg/kg | 276 J mg/kg | 600 J mg/kg | 5800 J mg/kg | 256 J mg/kg |
| ZINC | 04/12/2002 | | | 61.1 mg/kg | | | |

## LEGEND

- Groundwater Wells
- Soil Grid Samples

mg/kg Milligrams Per Kilogram
ug/kg Micrograms Per Kilogram
J Estimated Quantity
FD Field Duplicate
N Normal Environmental Sample
C# Composite Sample
D# Discrete Sample Collected from Point #

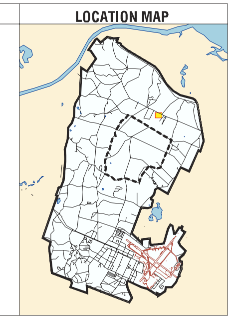
Only detects of metals above background are shown.

IMAGE DATE: 1994
All sample depth measurements are in feet

## BASEMAP LEGEND

- Impact Area Boundary
- Water Bodies
- Roads
- Paths
- Power/Transmission Lines
- 3 Meter Contours

## LOCATION MAP



## NOTES & SOURCES

Chemical database last queried on: February 13, 2003

Map coordinates: Stateplane, NAD83, FIPS Zone 2001, Meters

ORTHOPHOTOGRAPHY: 1:5000 digital black & white orthophotos
Resolution: 1/2 meter; Date Flown: 1994; Source: MASSGIS

TOPOGRAPHY: 3 meter contours generated from digital terrain models (DTMs)
Source: MASSGIS

## TITLE

**Metals in Exceedance of Background and SVOC Detects In Current T Range Soils**
(April 2002)

N

0 100 FEET
0 30 METERS

FIGURE 3-2

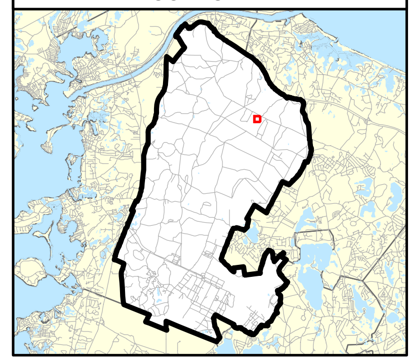
c:/chemmaps/mmrdata/mmr/spatial/ogden/amls/qdmmr.aml MMR3713


Impact Area
Groundwater Study Program

LEGEND

Sampling Grids
GroundwaterFlowDirection
Soil Grid
Monitoring Well

LOCATION MAP



NOTES & SOURCES

Basemap data from US Geological Survey 7 1/2 minute Topographic Maps: Source: MassGIS
Aerial Photos: Color Digital Orthophotos; Date Flown: 2002
Source: EarthData International

TITLE

T Range
Project Note Sampling Locations
(June 2006)

0 100
Feet

N

US Army Corps

FIGURE
3-3

M:\MMR\2006\TangoRange\110706\Fig3-3_051507.pdf
M:\MMR\2006\TangoRange\110706\Fig3-3_051507.mxd
May 15, 2007 DWN: MTW CHKD: MRK SEL

Area 2 Center

| ANALYTE | Date | Units | (0-3") | (0-3") Rep | Backgd | SSL | PRG | S-1/GW-1 | RCS-1 |
|---|---|---|---|---|---|---|---|---|---|
| PERCHLORATE | 4/26/2006 | µg/kg | ND | ND | | 3.1395 | 7821 | | |
| NITROGLYCERIN | 4/26/2006 | µg/kg | ND | ND | | 1.0168 | 34741 | | 50000 |
| LEAD | 4/26/2006 | mg/kg | 123 | 99.1 | 19 | 4.0526 | 40 | 300 | 300 |
| COPPER | 4/26/2006 | mg/kg | 742 | 355 | 11 | 45.727 | 313 | | 1000 |
| ANTIMONY | 4/26/2006 | mg/kg | ND | ND | 1.9 | 0.271 | 3.13 | 20 | 20 |
| ARSENIC | 4/26/2006 | mg/kg | 3.6 | 3.1 | 5.5 | 0.009 | 2.16 | 20 | 20 |
| TUNGSTEN | 4/26/2006 | mg/kg | 77.1 | 46.5 | | | | | |

Area 2 East

| ANALYTE | Date | Units | (0-3") | Backgd | SSL | PRG | S-1/GW-1 | RCS-1 |
|---|---|---|---|---|---|---|---|---|
| LEAD | 4/21/2006 | mg/kg | 78.3 | 19 | 4.0526 | 40 | 300 | 300 |
| COPPER | 4/21/2006 | mg/kg | 174 | 11 | 45.727 | 313 | | 1000 |
| ANTIMONY | 4/21/2006 | mg/kg | ND | 1.9 | 0.271 | 3.13 | 20 | 20 |
| ARSENIC | 4/21/2006 | mg/kg | 2.7 | 5.5 | 0.009 | 2.16 | 20 | 20 |
| TUNGSTEN | 4/21/2006 | mg/kg | 15.5 | | | | | |

Area 2 West

| ANALYTE | Date | Units | (0-3") | Backgd | SSL | PRG | S-1/GW-1 | RCS-1 |
|---|---|---|---|---|---|---|---|---|
| LEAD | 4/21/2006 | mg/kg | 131 | 19 | 4.0526 | 40 | 300 | 300 |
| COPPER | 4/21/2006 | mg/kg | 312 | 11 | 45.727 | 313 | | 1000 |
| ANTIMONY | 4/21/2006 | mg/kg | ND | 1.9 | 0.271 | 3.13 | 20 | 20 |
| ARSENIC | 4/21/2006 | mg/kg | 3.9 | 5.5 | 0.009 | 2.16 | 20 | 20 |
| TUNGSTEN | 4/21/2006 | mg/kg | 25.4 | | | | | |


Area 1 Center North

| ANALYTE | Date | Units | (0-3") | (0-3") Rep | Backgd | SSL | PRG | S-1/GW-1 | RCS-1 |
|---|---|---|---|---|---|---|---|---|---|
| PERCHLORATE | 4/26/2006 | µg/kg | ND | ND | | 3.1395 | 7821 | | |
| NITROGLYCERIN | 4/26/2006 | µg/kg | 26000 | 47000 | | 1.0168 | 34741 | | 50000 |
| 1,3-DIETHYL-1,3-DIPHENYL UREA | 4/26/2006 | µg/kg | 800 | 2300 | | | | | |
| LEAD | 4/26/2006 | mg/kg | 461 | 467 | 19 | 4.0526 | 40 | 300 | 300 |
| COPPER | 4/26/2006 | mg/kg | 31.5 | 30.5 | 11 | 45.727 | 313 | | 1000 |
| ANTIMONY | 4/26/2006 | mg/kg | 1.7 J | 2 J | 1.9 | 0.271 | 3.13 | 20 | 20 |
| ARSENIC | 4/26/2006 | mg/kg | 3 | 2.8 | 5.5 | 0.009 | 2.16 | 20 | 20 |
| TUNGSTEN | 4/26/2006 | mg/kg | 0.86 | 0.9 | | | | | |

Area 1 Center South

| ANALYTE | Date | Units | (0-3") | (9-12") | Backgd | SSL | PRG | S-1/GW-1 | RCS-1 |
|---|---|---|---|---|---|---|---|---|---|
| PERCHLORATE | 4/27/2006 | µg/kg | ND | ND | | 3.1395 | 7821 | | |
| NITROGLYCERIN | 4/27/2006 | µg/kg | 3200 | ND | | 1.0168 | 34741 | | 50000 |
| LEAD | 4/27/2006 | mg/kg | 386 | 100 | 19 | 4.0526 | 40 | 300 | 300 |
| COPPER | 4/27/2006 | mg/kg | 110 | 41.4 | 11 | 45.727 | 313 | | 1000 |
| ANTIMONY | 4/27/2006 | mg/kg | 1.9 J | 0.93 J | 1.9 | 0.271 | 3.13 | 20 | 20 |
| ARSENIC | 4/27/2006 | mg/kg | 3 | 3.7 | 5.5 | 0.009 | 2.16 | 20 | 20 |
| TUNGSTEN | 4/27/2006 | mg/kg | 3.5 | 0.99 | | | | | |

Area 1 East

| ANALYTE | Date | Units | (0-3") | (0-3") Rep | Backgd | SSL | PRG | S-1/GW-1 | RCS-1 |
|---|---|---|---|---|---|---|---|---|---|
| LEAD | 4/26/2006 | mg/kg | 87.4 | 117 | 19 | 4.0526 | 40 | 300 | 300 |
| COPPER | 4/26/2006 | mg/kg | 22.2 | 9 | 11 | 45.727 | 313 | | 1000 |
| ANTIMONY | 4/26/2006 | mg/kg | ND | ND | 1.9 | 0.271 | 3.13 | 20 | 20 |
| ARSENIC | 4/26/2006 | mg/kg | 2.2 | 2.1 | 5.5 | 0.009 | 2.16 | 20 | 20 |
| TUNGSTEN | 4/26/2006 | mg/kg | 1.1 | 0.81 | | | | | |

Area 1 West

| ANALYTE | Date | Units | (0-3") | (0-3") Rep | Backgd | SSL | PRG | S-1/GW-1 | RCS-1 |
|---|---|---|---|---|---|---|---|---|---|
| LEAD | 4/26/2006 | mg/kg | 180 | 243 | 19 | 4.0526 | 40 | 300 | 300 |
| COPPER | 4/26/2006 | mg/kg | 42.7 | 42.8 | 11 | 45.727 | 313 | | 1000 |
| ANTIMONY | 4/26/2006 | mg/kg | 0.83 J | 0.85 J | 1.9 | 0.271 | 3.13 | 20 | 20 |
| ARSENIC | 4/26/2006 | mg/kg | 3 | 2.8 | 5.5 | 0.009 | 2.16 | 20 | 20 |
| TUNGSTEN | 4/26/2006 | mg/kg | 1 | 1.4 | | | | | |

Area 3 Center

| ANALYTE | Date | Units | (0-3") | (0-3") Rep | Backgd | SSL | PRG | S-1/GW-1 | RCS-1 |
|---|---|---|---|---|---|---|---|---|---|
| PERCHLORATE | 4/21/2006 | µg/kg | ND | ND | | 3.1395 | 7821 | | |
| LEAD | 4/21/2006 | mg/kg | 66.2 | 97.1 | 19 | 4.0526 | 40 | 300 | 300 |
| COPPER | 4/21/2006 | mg/kg | 36 | 31.6 | 11 | 45.727 | 313 | | 1000 |
| ANTIMONY | 4/21/2006 | mg/kg | ND | ND | 1.9 | 0.271 | 3.13 | 20 | 20 |
| ARSENIC | 4/21/2006 | mg/kg | 3.2 | 3.2 | 5.5 | 0.009 | 2.16 | 20 | 20 |
| TUNGSTEN | 4/21/2006 | mg/kg | 3 | 3.2 | | | | | |

Area 3 East

| ANALYTE | Date | Units | (0-3") | Backgd | SSL | PRG | S-1/GW-1 | RCS-1 |
|---|---|---|---|---|---|---|---|---|
| LEAD | 4/21/2006 | mg/kg | 82.5 | 19 | 4.0526 | 40 | 300 | 300 |
| COPPER | 4/21/2006 | mg/kg | 29.1 | 11 | 45.727 | 313 | | 1000 |
| ANTIMONY | 4/21/2006 | mg/kg | ND | 1.9 | 0.271 | 3.13 | 20 | 20 |
| ARSENIC | 4/21/2006 | mg/kg | 3.9 | 5.5 | 0.009 | 2.16 | 20 | 20 |
| TUNGSTEN | 4/21/2006 | mg/kg | 11.8 | | | | | |

Area 3 West

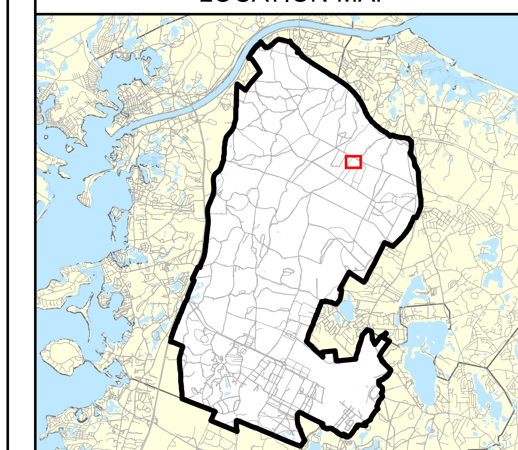
| ANALYTE | Date | Units | (0-3") | Backgd | SSL | PRG | S-1/GW-1 | RCS-1 |
|---|---|---|---|---|---|---|---|---|
| LEAD | 4/21/2006 | mg/kg | 41.4 | 19 | 4.0526 | 40 | 300 | 300 |
| COPPER | 4/21/2006 | mg/kg | 8.4 | 11 | 45.727 | 313 | | 1000 |
| ANTIMONY | 4/21/2006 | mg/kg | ND | 1.9 | 0.271 | 3.13 | 20 | 20 |
| ARSENIC | 4/21/2006 | mg/kg | 3.3 | 5.5 | 0.009 | 2.16 | 20 | 20 |
| TUNGSTEN | 4/21/2006 | mg/kg | 0.69 | | | | | |

# Impact Area Groundwater Study Program

## LEGEND

- Sampling Grids
- GroundwaterFlowDirection
- Soil Grid
- Monitoring Well

## LOCATION MAP



## NOTES & SOURCES

Basemap data from US Geological Survey 7 1/2 minute Topographic Maps: Source: MassGIS
Aerial Photos: Color Digital Orthophotos; Date Flown: 2002
Source: EarthData International

## TITLE

T Range
Project Note Sampling Results
(June 2006)

0 100 Feet

N

US Army Corps of Engineers New England District

DRAFT

FIGURE 3-4

M:\MMR\2006\TangoRange\110706\Fig3-4_051507.pdf
M:\MMR\2006\TangoRange\110706\Fig3-4_051507.mxd
May 15, 2007 DWN: MTW CHKD: SEL

**JE**

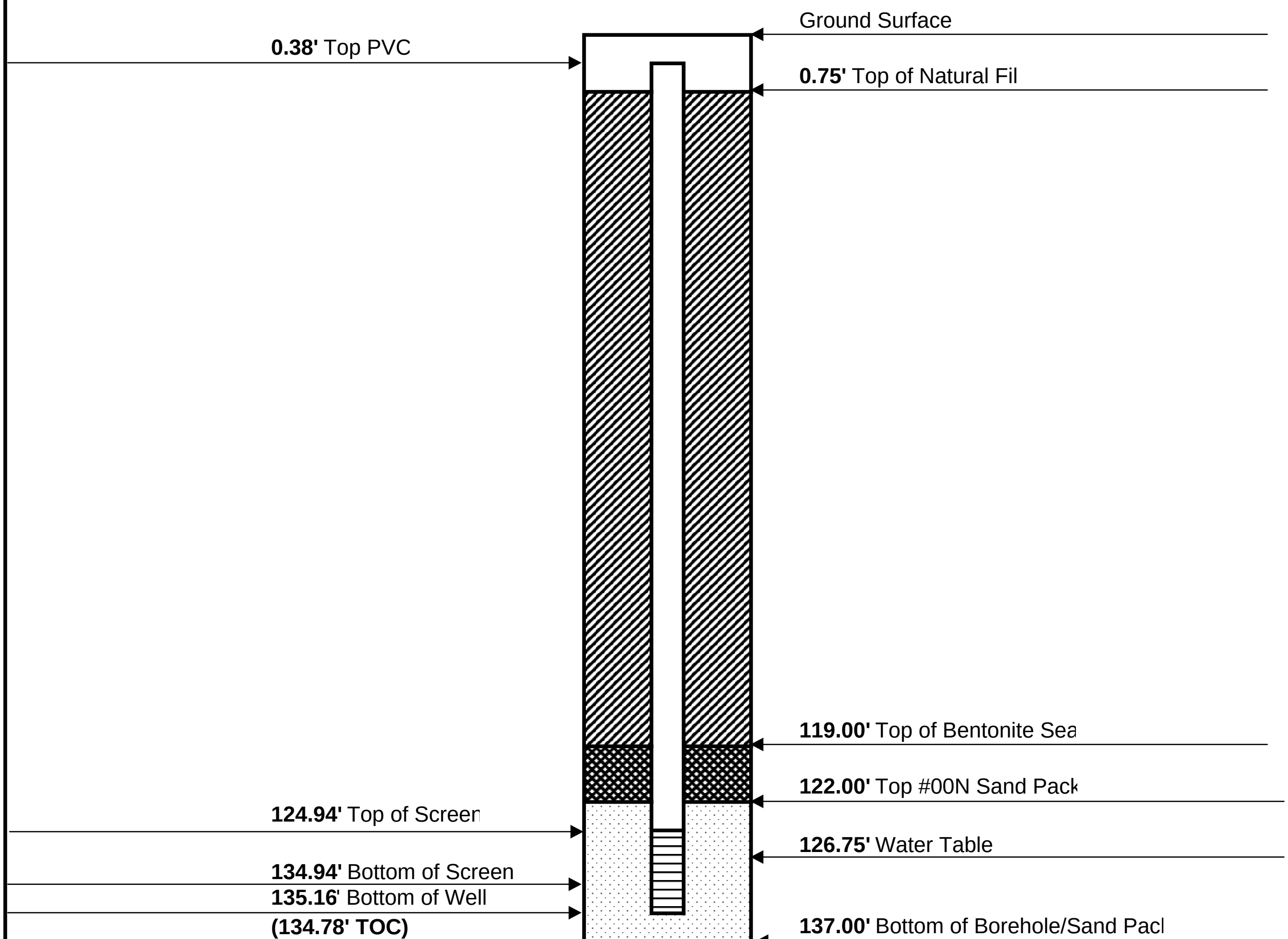
**DRAFT**

# Jacobs Engineering Monitoring Well Construction Diagram

| | |
|---|---|
| Project Name/Number: | **MAARNG Small Arms Ranges/35AY5301** |
| Loc. I.D.: | **MW-467S (T-1)** |
| Location: | **T Range** |
| Drilling Contractor/Driller | **Dragin Drilling / Brett Swiatek** |
| Geologist: | **Don Melcher** |
| Drilling Method: | **Hollow Stem Auger** |
| Sampling Method: | **na** |
| Start Date: | **9/28/2006** |
| Complete Date: | **9/29/2006** |
| Total Drilled Depth: | **137.00'** |
| MW-467S Screen Interval: | **124.94-134.94'** |

**KEY**

- **Bentonite sea**
- **Natural Cave-In**
- **No. 00N; 1 Sand**
- **Schedule 80 PVC (2.5" OD)**
- **10 slot screen**
- **Schedule 40 PVC (2.0" OD)**




| TITLE |
|---|
| Well Construction Diagram<br>MW-467S |

FIGURE

3-5

JE

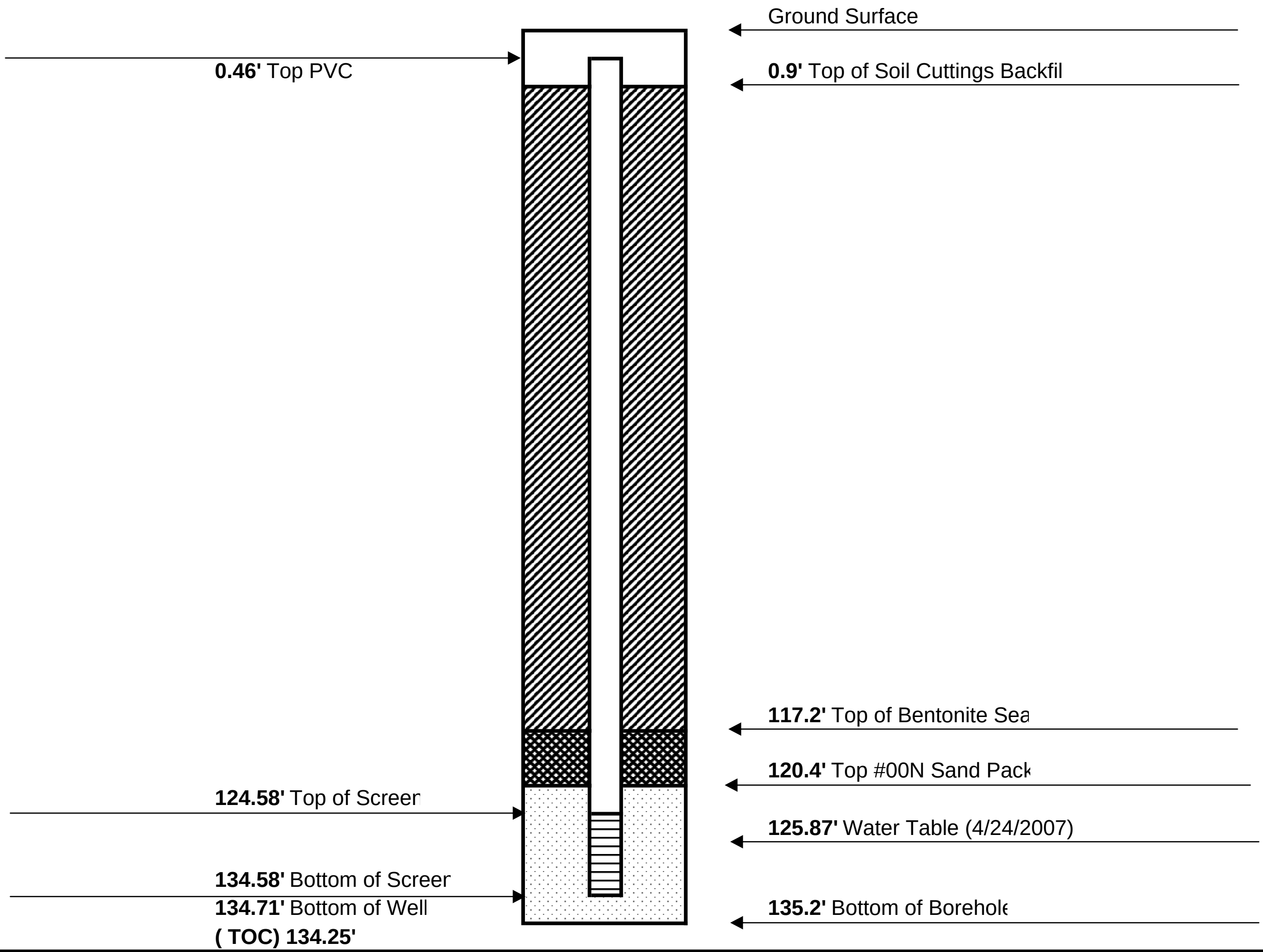
**DRAFT**

# Jacobs Engineering Monitoring Well Construction Diagram

| | |
|---|---|
| Project Name/Number: | **Small Arms Ranges (Tungsten) / 35AY5301** |
| Loc. I.D.: | **MW-489S** |
| Location: | **T Range downrange of berm** |
| Drilling Contractor/Driller | **Dragin Drilling / B. Swiatek** |
| Site Inspector: | **Lou Baerga** |
| Drilling Method: | **Hollow Stem Auger** |
| Sampling Method: | **Dedicated bladder pump** |
| Start Date: | **4/18/2007** |
| Complete Date: | **4/24/2007** |
| Total Drilled Depth: | **135.2'** |
| S Screen Interval: | **124.58-134.58'** |

**KEY**

- **Bentonite sea**
- **Soil Cuttings Backfil**
- **No. 00N Sand**
- **Schedule 40 PVC (2.0" OD)**
- **10 slot screen**




| TITLE |
|---|
| Well Construction Diagram<br>MW-489S |

FIGURE

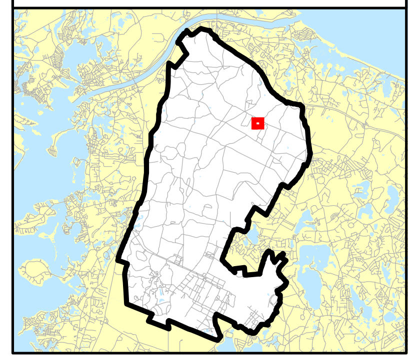
3-6


Impact Area
Groundwater Study Program

LEGEND

- ● Monitoring Wells
- Reverse Particle Track

LOCATION MAP



NOTES & SOURCES

Basemap data from US Geological Survey 7 1/2 minute Topographic Maps: Source: MassGIS
Aerial Photos: Color Digital Orthophotos; Date Flown: 2002
Source: EarthData International

TITLE

T Range
Reverse Particle Tracks
MW-467S and MW-489S

0 150 Feet

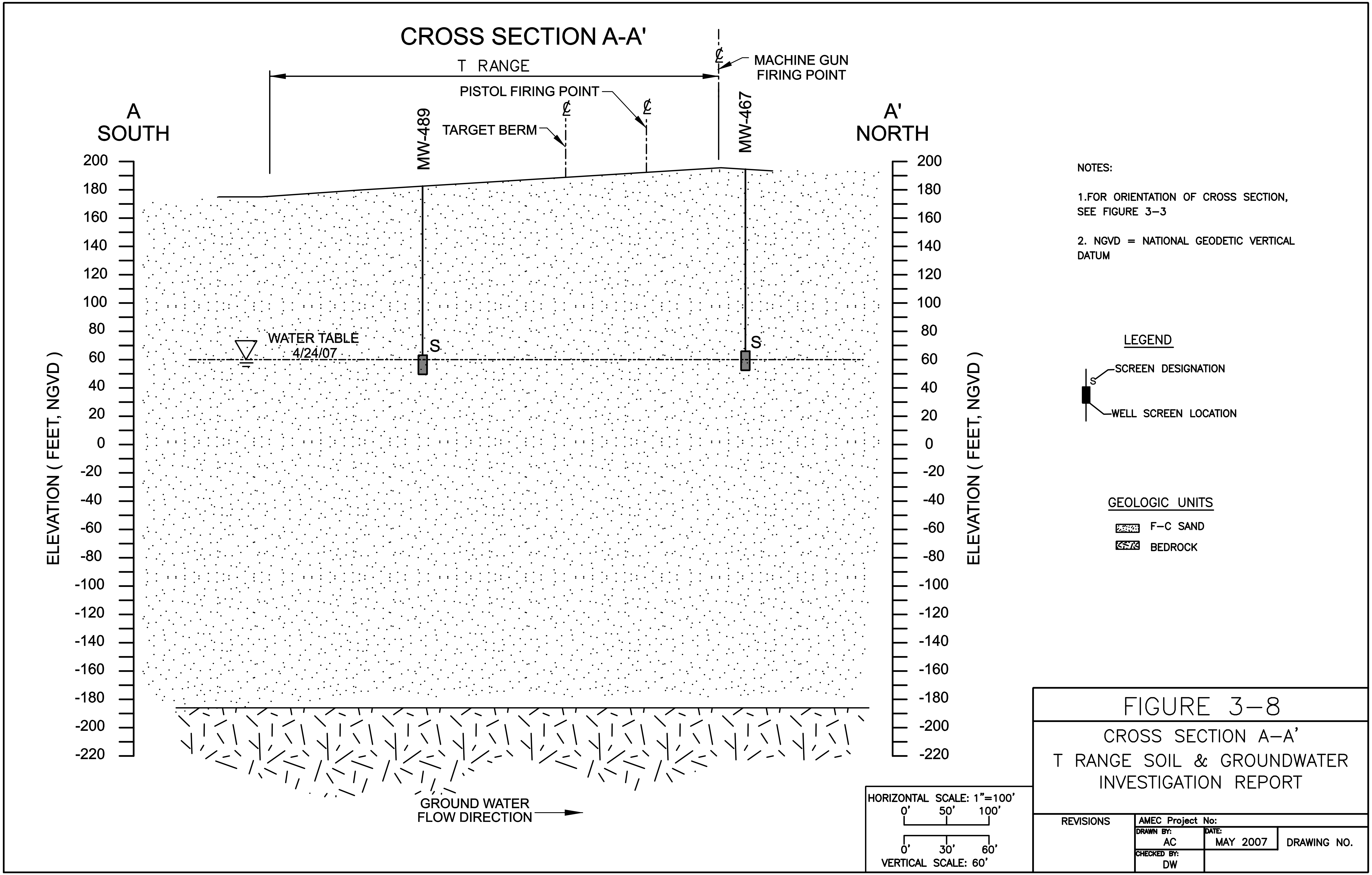
N

US Army Corps of Engineers
New England District

DRAFT

FIGURE 3-7

M:\MMR\2006\TangoRange\110706\Fig3-7_051507.pdf
M:\MMR\2006\TangoRange\110706\Fig3-7_051507.mxd
May 15, 2007 DWN: MTW CHKD: MRK SEL

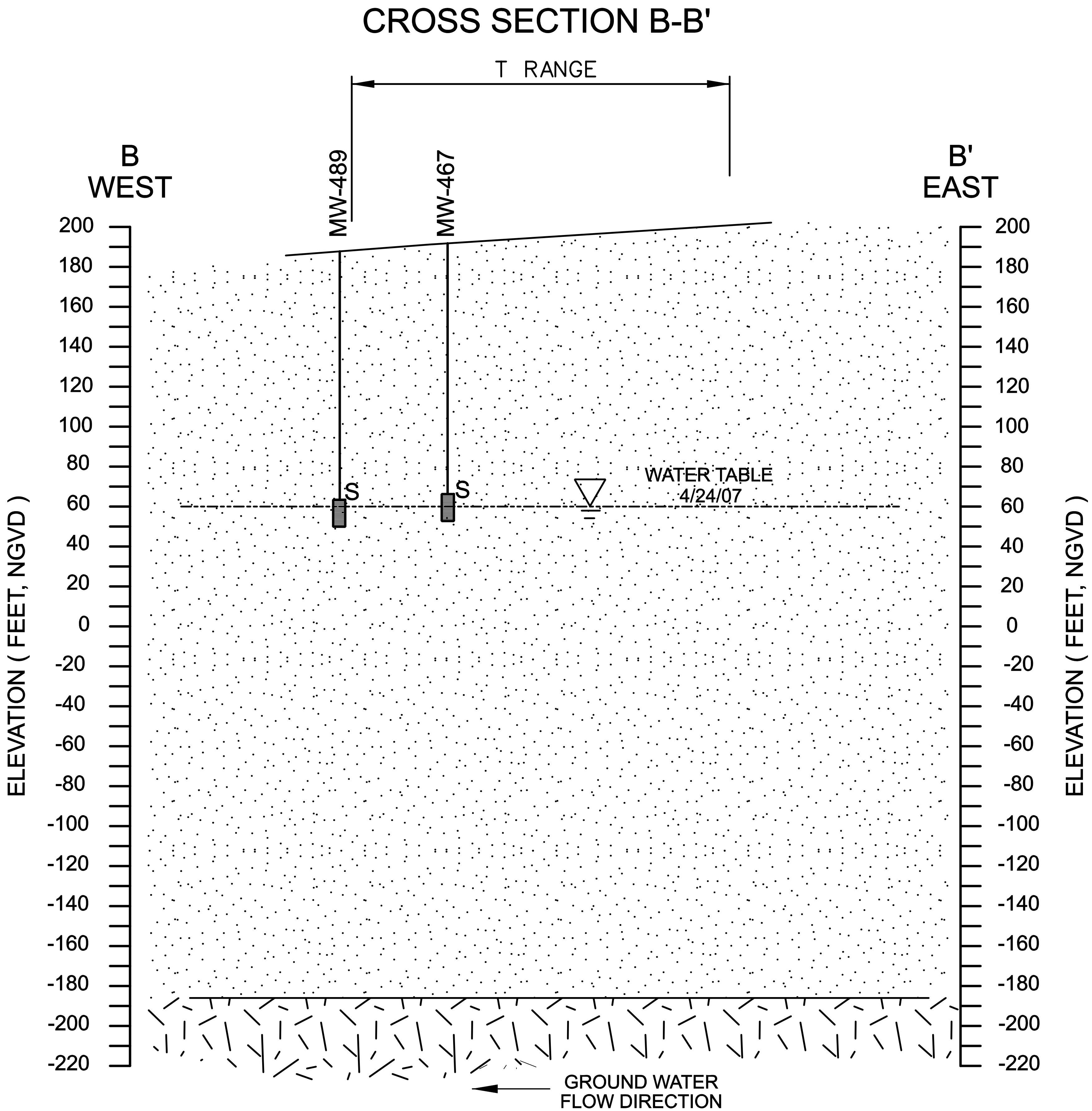



# FIGURE 3-8

CROSS SECTION A-A'
T RANGE SOIL & GROUNDWATER INVESTIGATION REPORT

| REVISIONS | AMEC Project No: | | |
|---|---|---|---|
| | DRAWN BY: AC | DATE: MAY 2007 | DRAWING NO. |
| | CHECKED BY: DW | | |

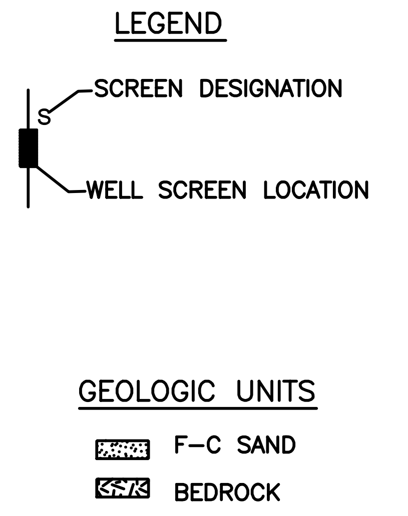
...\TangoRange\Figures\MMRC301.S01 5/30/2007 10:59:27 AM




NOTES:

1.FOR ORIENTATION OF CROSS SECTION, SEE FIGURE 3–3

2. NGVD = NATIONAL GEODETIC VERTICAL DATUM




HORIZONTAL SCALE: 1"=100'
0' 50' 100'
0' 30' 60'
VERTICAL SCALE: 60'

# FIGURE 3–9

CROSS SECTION B–B'
T RANGE SOIL & GROUNDWATER
INVESTIGATION REPORT

| REVISIONS | AMEC Project No: | | |
|---|---|---|---|
| | DRAWN BY: AC | DATE: MAY 2007 | DRAWING NO. |
| | CHECKED BY: DW | | |

...\TangoRange\Figures\MMRC302.S02 5/30/2007 11:00:21 AM

# Table 3-1
# T Range TM 02-2 Data Summary Table (Soils 0-1')

| Analyte | Frequency of Detections | | | Maximum Detected Concentration | | Units | Location of Maximum Detection | Bkgd Outwash (0-1 foot) | No. > Bkgd | SSL | No. > SSL | PRG | No. > PRG | S-1/GW-1 | No. > S-1/GW-1 | RCS1 | No. > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALUMINUM | 37 | of | 37 | 20400 | | MG/KG | HD169B3CAA | 16019 | 1 | 54006 | | 7614.20 | 19 | | | | |
| ANTIMONY | 17 | of | 37 | 91.9 | J | MG/KG | HD169A3CAA | 1.90 | 9 | 0.27 | 17 | 3.13 | 6 | 10 | 2 | 10 | 2 |
| ARSENIC | 28 | of | 37 | 23.4 | J | MG/KG | HD169A3CAA | 5.50 | 1 | 0.009 | 28 | 0.39 | 28 | 30 | | 30 | |
| BARIUM | 37 | of | 37 | 21.1 | | MG/KG | HD169B3CAA | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| BERYLLIUM | 37 | of | 37 | 0.38 | | MG/KG | HD169B3CAA | 0.38 | | 2.60 | | 15.44 | | 0.70 | | 0.70 | |
| BORON | 29 | of | 37 | 3.8 | | MG/KG | HD169D3BAA | 9.60 | | 9.52 | | 1600 | | | | | |
| CADMIUM | 13 | of | 37 | 0.59 | | MG/KG | HD169A3AAA | 0.94 | | 0.40 | 4 | 3.70 | | 30 | | 30 | |
| CALCIUM | 37 | of | 37 | 17100 | | MG/KG | HD169A3BAA | 288 | 22 | | | | | | | | |
| CHROMIUM, TOTAL | 37 | of | 37 | 21 | | MG/KG | HD169B3CAA | 19 | 1 | 7.02 | 36 | 210.68 | | 1000 | | 1000 | |
| COBALT | 37 | of | 37 | 7 | | MG/KG | HD169B3CAA | 4 | 8 | 132.38 | | 902.89 | | | | 500 | |
| COPPER | 37 | of | 37 | 41.6 | | MG/KG | HC169C1AAA | 11 | 12 | 45.73 | | 312.86 | | | | 1000 | |
| IRON | 37 | of | 37 | 19300 | | MG/KG | HD169B3CAA | 17800 | 1 | 2421.92 | 37 | 2346.32 | 37 | | | | |
| LEAD | 37 | of | 37 | 5800 | J | MG/KG | HD169A3CAA | 19 | 18 | 4.05 | 33 | 40 | 16 | 300 | 7 | 300 | 7 |
| MAGNESIUM | 37 | of | 37 | 3130 | | MG/KG | HC169C1CAA | 2010 | 2 | | | | | | | | |
| MANGANESE | 37 | of | 37 | 165 | | MG/KG | HC169C1CAA | 134 | 1 | 44.15 | 37 | 176.24 | | | | | |
| MOLYBDENUM | 28 | of | 37 | 0.98 | | MG/KG | HD169B3CAA | 1.20 | | 0.18 | 28 | 39.11 | | | | | |
| NICKEL | 37 | of | 37 | 14.8 | | MG/KG | HD169C3BAA | 10 | 3 | 292.13 | | 156.43 | | 300 | | 300 | |
| POTASSIUM | 37 | of | 37 | 736 | | MG/KG | HD169B3BAA | 766 | | | | | | | | | |
| SELENIUM | 25 | of | 37 | 1.8 | | MG/KG | HD169B3CAA | 1.70 | 1 | 2.76 | | 39.11 | | 400 | | 400 | |
| SILVER | 3 | of | 37 | 0.57 | | MG/KG | HD169A3AAA | 0.74 | | 16.23 | | 39.11 | | 100 | | 100 | |
| VANADIUM | 37 | of | 37 | 29.3 | | MG/KG | HD169B3CAA | 28.80 | 1 | 260.05 | | 7.82 | 37 | 400 | | 400 | |
| ZINC | 37 | of | 37 | 61.1 | | MG/KG | HC169A1BAA | 25.60 | 2 | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| 1,3-DIETHYL-1,3-DIPHENYL UREA | 15 | of | 38 | 6200 | | UG/KG | HD169E3AAA | | | | | | | | | | |
| BENZO(A)ANTHRACENE | 1 | of | 38 | 100 | J | UG/KG | HD169E3BAA | 460 | | 36.93 | 1 | 621.46 | | 700 | | 700 | |
| BENZO(A)PYRENE | 2 | of | 38 | 47 | J | UG/KG | HD169E3BAA | 460 | | 203.01 | | 62.15 | | 700 | | 700 | |
| BENZO(B)FLUORANTHENE | 1 | of | 38 | 110 | J | UG/KG | HD169E3BAA | 460 | | 114.48 | | 621.46 | | 700 | | 700 | |
| BENZO(K)FLUORANTHENE | 1 | of | 38 | 96 | J | UG/KG | HD169E3BAA | 460 | | 114.48 | | 6214.57 | | 7000 | | 7000 | |
| BENZOIC ACID | 15 | of | 38 | 50 | J | UG/KG | HD169D3AAA | | | | | 1.0E+08 | | | | 1.0E+06 | |
| BIS(2-ETHYLHEXYL) PHTHALATE | 21 | of | 38 | 140 | J | UG/KG | HD169F3CAD | | | 72016 | | 34741 | | 100000 | | 100000 | |
| CHRYSENE | 3 | of | 38 | 140 | J | UG/KG | HD169E3BAA | 460 | | 3403.96 | | 62146 | | 7000 | | 7000 | |
| DI-N-BUTYL PHTHALATE | 3 | of | 38 | 37 | J | UG/KG | HC169D1BAA | | | 150832 | | 611031 | | | | 50000 | |
| FLUORANTHENE | 3 | of | 38 | 180 | J | UG/KG | HD169E3BAA | 460 | | 108129 | | 229361 | | 1.0E+06 | | 1.0E+06 | |
| INDENO(1,2,3-C,D)PYRENE | 1 | of | 38 | 18 | J | UG/KG | HD169E3BAA | 460 | | 316.99 | | 621.46 | | 700 | | 700 | |
| N-NITROSODIPHENYLAMINE | 1 | of | 38 | 36 | J | UG/KG | HC169D1BAA | | | 7.77 | 1 | 99261 | | | | 100000 | |
| PYRENE | 5 | of | 38 | 240 | J | UG/KG | HD169E3BAA | 460 | | 19028 | | 231595 | | 700000 | | 700000 | |

SSL - MMR Soil Screening Level
PRG - Preliminary Remediation Goal
BKGD - MMR Background Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1 - MCP Reportable Concentration for S1 Soil
J - Estimated value

# Table 3-2
# T Range TM 02-2 Soil Analytical Results (Grids 169A - 169F)

| Sample ID | Date Sampled | Method | Analyte | Concentration | | Units | Bkgd Outwash (0-1 Foot) | > Bkgd | SSL | > SSL | PRG | > PRG | S-1/GW-1 | > S-1/GW-1 | RCS1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HC169A1AAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HC169A1AAA | 4/12/2002 | IM40MB | ALUMINUM | 5970 | | MG/KG | 16019 | | 54006 | | 7614.20 | | | | | |
| HC169A1AAA | 4/12/2002 | IM40MB | ANTIMONY | 3.9 | J | MG/KG | 1.9 | X | 0.27 | X | 3.13 | X | 10 | | 10 | |
| HC169A1AAA | 4/12/2002 | IM40MB | ARSENIC | 3.4 | J | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HC169A1AAA | 4/12/2002 | IM40MB | BARIUM | 9.9 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HC169A1AAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.25 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HC169A1AAA | 4/12/2002 | IM40MB | BORON | 2.9 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HC169A1AAA | 4/12/2002 | IM40MB | CADMIUM | 0.52 | | MG/KG | 0.94 | | 0.40 | X | 3.70 | | 30 | | 30 | |
| HC169A1AAA | 4/12/2002 | IM40MB | CALCIUM | 15900 | | MG/KG | 288 | X | | | | | | | | |
| HC169A1AAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 11.1 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HC169A1AAA | 4/12/2002 | IM40MB | COBALT | 2 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HC169A1AAA | 4/12/2002 | IM40MB | COPPER | 41.2 | | MG/KG | 11 | X | 45.73 | | 312.86 | | | | 1000 | |
| HC169A1AAA | 4/12/2002 | IM40MB | IRON | 7230 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HC169A1AAA | 4/12/2002 | IM40MB | LEAD | 540 | J | MG/KG | 19 | X | 4.05 | X | 40 | X | 300 | X | 300 | X |
| HC169A1AAA | 4/12/2002 | IM40MB | MAGNESIUM | 961 | | MG/KG | 2010 | | | | | | | | | |
| HC169A1AAA | 4/12/2002 | IM40MB | MANGANESE | 58.9 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HC169A1AAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.47 | J | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HC169A1AAA | 4/12/2002 | IM40MB | NICKEL | 4.1 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HC169A1AAA | 4/12/2002 | IM40MB | POTASSIUM | 513 | | MG/KG | 766 | | | | | | | | | |
| HC169A1AAA | 4/12/2002 | IM40MB | SELENIUM | 0.67 | J | MG/KG | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| HC169A1AAA | 4/12/2002 | IM40MB | VANADIUM | 11.7 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HC169A1AAA | 4/12/2002 | IM40MB | ZINC | 25.3 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HC169A1AAA | 4/12/2002 | SW8270 | BENZOIC ACID | 23 | J | UG/KG | | | | | 1.0E+08 | | | | 1.0E+06 | |
| HC169A1AAA | 4/12/2002 | SW8270 | BIS(2-ETHYLHEXYL) PHTHALATE | 20 | J | UG/KG | | | 72016 | | 34741 | | 100000 | | 100000 | |
| HC169A1AAA | 4/12/2002 | SW8270 | PYRENE | 19 | J | UG/KG | 460 | | 19028 | | 231595 | | 700000 | | 700000 | |
| HC169A1AAA | 4/12/2002 | D2216M | MOISTURE | 10.1 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HC169A1BAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HC169A1BAA | 4/12/2002 | IM40MB | ALUMINUM | 8140 | | MG/KG | 16019 | | 54006 | | 7614.20 | X | | | | |
| HC169A1BAA | 4/12/2002 | IM40MB | ANTIMONY | 2.6 | J | MG/KG | 1.9 | X | 0.27 | X | 3.13 | | 10 | | 10 | |
| HC169A1BAA | 4/12/2002 | IM40MB | ARSENIC | 2.9 | J | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HC169A1BAA | 4/12/2002 | IM40MB | BARIUM | 13.5 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HC169A1BAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.27 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HC169A1BAA | 4/12/2002 | IM40MB | BORON | 2.9 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HC169A1BAA | 4/12/2002 | IM40MB | CADMIUM | 0.35 | | MG/KG | 0.94 | | 0.40 | | 3.70 | | 30 | | 30 | |
| HC169A1BAA | 4/12/2002 | IM40MB | CALCIUM | 10100 | | MG/KG | 288 | X | | | | | | | | |
| HC169A1BAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 11.5 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HC169A1BAA | 4/12/2002 | IM40MB | COBALT | 2.9 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HC169A1BAA | 4/12/2002 | IM40MB | COPPER | 27.6 | | MG/KG | 11 | X | 45.73 | | 312.86 | | | | 1000 | |
| HC169A1BAA | 4/12/2002 | IM40MB | IRON | 8820 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HC169A1BAA | 4/12/2002 | IM40MB | LEAD | 276 | J | MG/KG | 19 | X | 4.05 | X | 40 | X | 300 | | 300 | |
| HC169A1BAA | 4/12/2002 | IM40MB | MAGNESIUM | 1300 | | MG/KG | 2010 | | | | | | | | | |

SSL- MMR Soil Screening Level
PRG- Peliminary Remediation Goal
BKGD- MMR Backfround Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1- MCP Reportable Concentration for S1 Soil

*=not validated
J - Estimated value

## Table 3-2
## T Range TM 02-2 Soil Analytical Results (Grids 169A - 169F)

| Sample ID | Date Sampled | Method | Analyte | Concentration | | Units | Bkgd Outwash (0-1 Foot) | > Bkgd | SSL | > SSL | PRG | > PRG | S-1/GW-1 | > S-1/GW-1 | RCS1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HC169A1BAA | 4/12/2002 | IM40MB | MANGANESE | 75.9 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HC169A1BAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.47 | J | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HC169A1BAA | 4/12/2002 | IM40MB | NICKEL | 5.2 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HC169A1BAA | 4/12/2002 | IM40MB | POTASSIUM | 623 | | MG/KG | 766 | | | | | | | | | |
| HC169A1BAA | 4/12/2002 | IM40MB | SELENIUM | 0.76 | J | MG/KG | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| HC169A1BAA | 4/12/2002 | IM40MB | VANADIUM | 14.3 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HC169A1BAA | 4/12/2002 | IM40MB | ZINC | 61.1 | | MG/KG | 25.6 | X | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HC169A1BAA | 4/12/2002 | SW8270 | BIS(2-ETHYLHEXYL) PHTHALATE | 19 | J | UG/KG | | | 72016 | | 34741 | | 100000 | | 100000 | |
| HC169A1BAA | 4/12/2002 | D2216M | MOISTURE | 14.8 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HC169A1CAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HC169A1CAA | 4/12/2002 | IM40MB | ALUMINUM | 11900 | | MG/KG | 16019 | | 54006 | | 7614.20 | X | | | | |
| HC169A1CAA | 4/12/2002 | IM40MB | ANTIMONY | 2.2 | J | MG/KG | 1.9 | X | 0.27 | X | 3.13 | | 10 | | 10 | |
| HC169A1CAA | 4/12/2002 | IM40MB | ARSENIC | 4.5 | J | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HC169A1CAA | 4/12/2002 | IM40MB | BARIUM | 13 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HC169A1CAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.27 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HC169A1CAA | 4/12/2002 | IM40MB | BORON | 2.8 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HC169A1CAA | 4/12/2002 | IM40MB | CADMIUM | 0.18 | J | MG/KG | 0.94 | | 0.40 | | 3.70 | | 30 | | 30 | |
| HC169A1CAA | 4/12/2002 | IM40MB | CALCIUM | 1800 | | MG/KG | 288 | X | | | | | | | | |
| HC169A1CAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 13 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HC169A1CAA | 4/12/2002 | IM40MB | COBALT | 4 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HC169A1CAA | 4/12/2002 | IM40MB | COPPER | 16.9 | | MG/KG | 11 | X | 45.73 | | 312.86 | | | | 1000 | |
| HC169A1CAA | 4/12/2002 | IM40MB | IRON | 12300 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HC169A1CAA | 4/12/2002 | IM40MB | LEAD | 256 | J | MG/KG | 19 | X | 4.05 | X | 40 | X | 300 | | 300 | |
| HC169A1CAA | 4/12/2002 | IM40MB | MAGNESIUM | 1340 | | MG/KG | 2010 | | | | | | | | | |
| HC169A1CAA | 4/12/2002 | IM40MB | MANGANESE | 81 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HC169A1CAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.66 | J | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HC169A1CAA | 4/12/2002 | IM40MB | NICKEL | 7.3 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HC169A1CAA | 4/12/2002 | IM40MB | POTASSIUM | 603 | | MG/KG | 766 | | | | | | | | | |
| HC169A1CAA | 4/12/2002 | IM40MB | SELENIUM | 1.5 | | MG/KG | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| HC169A1CAA | 4/12/2002 | IM40MB | VANADIUM | 20.8 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HC169A1CAA | 4/12/2002 | IM40MB | ZINC | 16.8 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HC169A1CAA | 4/12/2002 | SW8270 | BIS(2-ETHYLHEXYL) PHTHALATE | 19 | J | UG/KG | | | 72016 | | 34741 | | 100000 | | 100000 | |
| HC169A1CAA | 4/12/2002 | SW8270 | DI-N-BUTYL PHTHALATE | 22 | J | UG/KG | | | 150832 | | 611031 | | | | 50000 | |
| HC169A1CAA | 4/12/2002 | D2216M | MOISTURE | 12.2 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HC169B1AAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HC169B1AAA | 4/12/2002 | IM40MB | ALUMINUM | 8850 | | MG/KG | 16019 | | 54006 | | 7614.20 | X | | | | |
| HC169B1AAA | 4/12/2002 | IM40MB | ANTIMONY | 1.4 | J | MG/KG | 1.9 | | 0.27 | X | 3.13 | | 10 | | 10 | |
| HC169B1AAA | 4/12/2002 | IM40MB | ARSENIC | 3.4 | J | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HC169B1AAA | 4/12/2002 | IM40MB | BARIUM | 13.4 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HC169B1AAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.27 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |

SSL- MMR Soil Screening Level
PRG- Peliminary Remediation Goal
BKGD- MMR Backfround Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1- MCP Reportable Concentration for S1 Soil

*=not validated
J - Estimated value

# Table 3-2
# T Range TM 02-2 Soil Analytical Results (Grids 169A - 169F)

| Sample ID | Date Sampled | Method | Analyte | Concentration | | Units | Bkgd Outwash (0-1 Foot) | > Bkgd | SSL | > SSL | PRG | > PRG | S-1/GW-1 | > S-1/GW-1 | RCS1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HC169B1AAA | 4/12/2002 | IM40MB | BORON | 2.5 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HC169B1AAA | 4/12/2002 | IM40MB | CADMIUM | 0.24 | | MG/KG | 0.94 | | 0.40 | | 3.70 | | 30 | | 30 | |
| HC169B1AAA | 4/12/2002 | IM40MB | CALCIUM | 6060 | | MG/KG | 288 | X | | | | | | | | |
| HC169B1AAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 11.4 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HC169B1AAA | 4/12/2002 | IM40MB | COBALT | 3.3 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HC169B1AAA | 4/12/2002 | IM40MB | COPPER | 18.8 | | MG/KG | 11 | X | 45.73 | | 312.86 | | | | 1000 | |
| HC169B1AAA | 4/12/2002 | IM40MB | IRON | 9780 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HC169B1AAA | 4/12/2002 | IM40MB | LEAD | 195 | J | MG/KG | 19 | X | 4.05 | X | 40 | X | 300 | | 300 | |
| HC169B1AAA | 4/12/2002 | IM40MB | MAGNESIUM | 1320 | | MG/KG | 2010 | | | | | | | | | |
| HC169B1AAA | 4/12/2002 | IM40MB | MANGANESE | 80.4 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HC169B1AAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.39 | J | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HC169B1AAA | 4/12/2002 | IM40MB | NICKEL | 5.9 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HC169B1AAA | 4/12/2002 | IM40MB | POTASSIUM | 647 | | MG/KG | 766 | | | | | | | | | |
| HC169B1AAA | 4/12/2002 | IM40MB | SELENIUM | 0.71 | J | MG/KG | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| HC169B1AAA | 4/12/2002 | IM40MB | VANADIUM | 15.3 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HC169B1AAA | 4/12/2002 | IM40MB | ZINC | 21 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HC169B1AAA | 4/12/2002 | SW8270 | 1,3-DIETHYL-1,3-DIPHENYL UREA | 22 | J | UG/KG | | | | | | | | | | |
| HC169B1AAA | 4/12/2002 | SW8270 | BENZOIC ACID | 30 | J | UG/KG | | | | | 1.0E+08 | | | | 1.0E+06 | |
| HC169B1AAA | 4/12/2002 | SW8270 | BIS(2-ETHYLHEXYL) PHTHALATE | 34 | J | UG/KG | | | 72016 | | 34741 | | 100000 | | 100000 | |
| HC169B1AAA | 4/12/2002 | SW8270 | PYRENE | 20 | J | UG/KG | 460 | | 19028 | | 231595 | | 700000 | | 700000 | |
| HC169B1AAA | 4/12/2002 | D2216M | MOISTURE | 11.3 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HC169B1BAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HC169B1BAA | 4/12/2002 | IM40MB | ALUMINUM | 10100 | | MG/KG | 16019 | | 54006 | | 7614.20 | X | | | | |
| HC169B1BAA | 4/12/2002 | IM40MB | ARSENIC | 3.6 | J | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HC169B1BAA | 4/12/2002 | IM40MB | BARIUM | 11 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HC169B1BAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.25 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HC169B1BAA | 4/12/2002 | IM40MB | BORON | 2.8 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HC169B1BAA | 4/12/2002 | IM40MB | CALCIUM | 328 | | MG/KG | 288 | X | | | | | | | | |
| HC169B1BAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 11.4 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HC169B1BAA | 4/12/2002 | IM40MB | COBALT | 3.7 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HC169B1BAA | 4/12/2002 | IM40MB | COPPER | 6.5 | | MG/KG | 11 | | 45.73 | | 312.86 | | | | 1000 | |
| HC169B1BAA | 4/12/2002 | IM40MB | IRON | 10900 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HC169B1BAA | 4/12/2002 | IM40MB | LEAD | 57.9 | J | MG/KG | 19 | X | 4.05 | X | 40 | X | 300 | | 300 | |
| HC169B1BAA | 4/12/2002 | IM40MB | MAGNESIUM | 1170 | | MG/KG | 2010 | | | | | | | | | |
| HC169B1BAA | 4/12/2002 | IM40MB | MANGANESE | 75.6 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HC169B1BAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.49 | J | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HC169B1BAA | 4/12/2002 | IM40MB | NICKEL | 6.8 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HC169B1BAA | 4/12/2002 | IM40MB | POTASSIUM | 562 | | MG/KG | 766 | | | | | | | | | |
| HC169B1BAA | 4/12/2002 | IM40MB | SELENIUM | 0.82 | J | MG/KG | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| HC169B1BAA | 4/12/2002 | IM40MB | VANADIUM | 18.1 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HC169B1BAA | 4/12/2002 | IM40MB | ZINC | 14.2 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |

SSL- MMR Soil Screening Level
PRG- Peliminary Remediation Goal
BKGD- MMR Backfround Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1- MCP Reportable Concentration for S1 Soil

*=not validated
J - Estimated value

# Table 3-2
## T Range TM 02-2 Soil Analytical Results (Grids 169A - 169F)

| Sample ID | Date Sampled | Method | Analyte | Concentration | | Units | Bkgd Outwash (0-1 Foot) | > Bkgd | SSL | > SSL | PRG | > PRG | S-1/GW-1 | > S-1/GW-1 | RCS1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HC169B1BAA | 4/12/2002 | SW8270 | 1,3-DIETHYL-1,3-DIPHENYL UREA | 18 | J | UG/KG | | | | | | | | | | |
| HC169B1BAA | 4/12/2002 | D2216M | MOISTURE | 13.7 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HC169B1CAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HC169B1CAA | 4/12/2002 | IM40MB | ALUMINUM | 14800 | | MG/KG | 16019 | | 54006 | | 7614.20 | X | | | | |
| HC169B1CAA | 4/12/2002 | IM40MB | ARSENIC | 4.3 | J | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HC169B1CAA | 4/12/2002 | IM40MB | BARIUM | 15.6 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HC169B1CAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.3 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HC169B1CAA | 4/12/2002 | IM40MB | BORON | 2.5 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HC169B1CAA | 4/12/2002 | IM40MB | CALCIUM | 368 | | MG/KG | 288 | X | | | | | | | | |
| HC169B1CAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 15.4 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HC169B1CAA | 4/12/2002 | IM40MB | COBALT | 4.6 | | MG/KG | 4 | X | 132.38 | | 902.89 | | | | 500 | |
| HC169B1CAA | 4/12/2002 | IM40MB | COPPER | 6.1 | | MG/KG | 11 | | 45.73 | | 312.86 | | | | 1000 | |
| HC169B1CAA | 4/12/2002 | IM40MB | IRON | 16600 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HC169B1CAA | 4/12/2002 | IM40MB | LEAD | 55.2 | J | MG/KG | 19 | X | 4.05 | X | 40 | X | 300 | | 300 | |
| HC169B1CAA | 4/12/2002 | IM40MB | MAGNESIUM | 1800 | | MG/KG | 2010 | | | | | | | | | |
| HC169B1CAA | 4/12/2002 | IM40MB | MANGANESE | 104 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HC169B1CAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.7 | J | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HC169B1CAA | 4/12/2002 | IM40MB | NICKEL | 9.3 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HC169B1CAA | 4/12/2002 | IM40MB | POTASSIUM | 596 | | MG/KG | 766 | | | | | | | | | |
| HC169B1CAA | 4/12/2002 | IM40MB | SELENIUM | 1.3 | | MG/KG | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| HC169B1CAA | 4/12/2002 | IM40MB | VANADIUM | 24.8 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HC169B1CAA | 4/12/2002 | IM40MB | ZINC | 19 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HC169B1CAA | 4/12/2002 | SW8270 | {ND on all 78} analytes | | | | | | | | | | | | | |
| HC169B1CAA | 4/12/2002 | D2216M | MOISTURE | 15.8 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HC169C1AAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HC169C1AAA | 4/12/2002 | IM40MB | ALUMINUM | 8280 | | MG/KG | 16019 | | 54006 | | 7614.20 | X | | | | |
| HC169C1AAA | 4/12/2002 | IM40MB | ANTIMONY | 4 | | MG/KG | 1.9 | X | 0.27 | X | 3.13 | X | 10 | | 10 | |
| HC169C1AAA | 4/12/2002 | IM40MB | ARSENIC | 3.1 | | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HC169C1AAA | 4/12/2002 | IM40MB | BARIUM | 10.6 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HC169C1AAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.28 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HC169C1AAA | 4/12/2002 | IM40MB | CADMIUM | 0.29 | J | MG/KG | 0.94 | | 0.40 | | 3.70 | | 30 | | 30 | |
| HC169C1AAA | 4/12/2002 | IM40MB | CALCIUM | 12600 | | MG/KG | 288 | X | | | | | | | | |
| HC169C1AAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 13.5 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HC169C1AAA | 4/12/2002 | IM40MB | COBALT | 3.8 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HC169C1AAA | 4/12/2002 | IM40MB | COPPER | 41.6 | | MG/KG | 11 | X | 45.73 | | 312.86 | | | | 1000 | |
| HC169C1AAA | 4/12/2002 | IM40MB | IRON | 9810 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HC169C1AAA | 4/12/2002 | IM40MB | LEAD | 394 | | MG/KG | 19 | X | 4.05 | X | 40 | X | 300 | X | 300 | X |
| HC169C1AAA | 4/12/2002 | IM40MB | MAGNESIUM | 1440 | | MG/KG | 2010 | | | | | | | | | |
| HC169C1AAA | 4/12/2002 | IM40MB | MANGANESE | 72.4 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HC169C1AAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.86 | | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |

SSL- MMR Soil Screening Level
PRG- Peliminary Remediation Goal
BKGD- MMR Backfround Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1- MCP Reportable Concentration for S1 Soil

*=not validated
J - Estimated value

## Table 3-2
## T Range TM 02-2 Soil Analytical Results (Grids 169A - 169F)

| Sample ID | Date Sampled | Method | Analyte | Concentration | | Units | Bkgd Outwash (0-1 Foot) | > Bkgd | SSL | > SSL | PRG | > PRG | S-1/GW-1 | > S-1/GW-1 | RCS1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HC169C1AAA | 4/12/2002 | IM40MB | NICKEL | 7.1 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HC169C1AAA | 4/12/2002 | IM40MB | POTASSIUM | 543 | | MG/KG | 766 | | | | | | | | | |
| HC169C1AAA | 4/12/2002 | IM40MB | SELENIUM | 0.42 | J | MG/KG | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| HC169C1AAA | 4/12/2002 | IM40MB | VANADIUM | 16 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HC169C1AAA | 4/12/2002 | IM40MB | ZINC | 24.4 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HC169C1AAA | 4/12/2002 | SW8270 | {ND on all 78} analytes | | | | | | | | | | | | | |
| HC169C1AAA | 4/12/2002 | D2216M | MOISTURE | 11.3 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HC169C1BAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HC169C1BAA | 4/12/2002 | IM40MB | ALUMINUM | 10100 | | MG/KG | 16019 | | 54006 | | 7614.20 | X | | | | |
| HC169C1BAA | 4/12/2002 | IM40MB | ANTIMONY | 1.3 | | MG/KG | 1.9 | | 0.27 | X | 3.13 | | 10 | | 10 | |
| HC169C1BAA | 4/12/2002 | IM40MB | ARSENIC | 2.4 | | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HC169C1BAA | 4/12/2002 | IM40MB | BARIUM | 10.2 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HC169C1BAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.25 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HC169C1BAA | 4/12/2002 | IM40MB | CALCIUM | 720 | | MG/KG | 288 | X | | | | | | | | |
| HC169C1BAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 11.3 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HC169C1BAA | 4/12/2002 | IM40MB | COBALT | 4.1 | | MG/KG | 4 | X | 132.38 | | 902.89 | | | | 500 | |
| HC169C1BAA | 4/12/2002 | IM40MB | COPPER | 5.7 | | MG/KG | 11 | | 45.73 | | 312.86 | | | | 1000 | |
| HC169C1BAA | 4/12/2002 | IM40MB | IRON | 10100 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HC169C1BAA | 4/12/2002 | IM40MB | LEAD | 123 | | MG/KG | 19 | X | 4.05 | X | 40 | X | 300 | | 300 | |
| HC169C1BAA | 4/12/2002 | IM40MB | MAGNESIUM | 1380 | | MG/KG | 2010 | | | | | | | | | |
| HC169C1BAA | 4/12/2002 | IM40MB | MANGANESE | 62.4 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HC169C1BAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.73 | | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HC169C1BAA | 4/12/2002 | IM40MB | NICKEL | 7.9 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HC169C1BAA | 4/12/2002 | IM40MB | POTASSIUM | 479 | | MG/KG | 766 | | | | | | | | | |
| HC169C1BAA | 4/12/2002 | IM40MB | SELENIUM | 0.47 | J | MG/KG | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| HC169C1BAA | 4/12/2002 | IM40MB | VANADIUM | 16 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HC169C1BAA | 4/12/2002 | IM40MB | ZINC | 14.6 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HC169C1BAA | 4/12/2002 | SW8270 | BIS(2-ETHYLHEXYL) PHTHALATE | 27 | J | UG/KG | | | 72016 | | 34741 | | 100000 | | 100000 | |
| HC169C1BAA | 4/12/2002 | D2216M | MOISTURE | 12.1 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HC169C1CAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HC169C1CAA | 4/12/2002 | IM40MB | ALUMINUM | 11800 | | MG/KG | 16019 | | 54006 | | 7614.20 | X | | | | |
| HC169C1CAA | 4/12/2002 | IM40MB | ANTIMONY | 1.3 | | MG/KG | 1.9 | | 0.27 | X | 3.13 | | 10 | | 10 | |
| HC169C1CAA | 4/12/2002 | IM40MB | ARSENIC | 2.8 | | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HC169C1CAA | 4/12/2002 | IM40MB | BARIUM | 14 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HC169C1CAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.28 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HC169C1CAA | 4/12/2002 | IM40MB | CALCIUM | 2460 | | MG/KG | 288 | X | | | | | | | | |
| HC169C1CAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 11 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HC169C1CAA | 4/12/2002 | IM40MB | COBALT | 6.3 | | MG/KG | 4 | X | 132.38 | | 902.89 | | | | 500 | |
| HC169C1CAA | 4/12/2002 | IM40MB | COPPER | 12.3 | | MG/KG | 11 | X | 45.73 | | 312.86 | | | | 1000 | |
| HC169C1CAA | 4/12/2002 | IM40MB | IRON | 15000 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |

SSL- MMR Soil Screening Level
PRG- Peliminary Remediation Goal
BKGD- MMR Backfround Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1- MCP Reportable Concentration for S1 Soil

*=not validated
J - Estimated value

# Table 3-2
# T Range TM 02-2 Soil Analytical Results (Grids 169A - 169F)

| Sample ID | Date Sampled | Method | Analyte | Concentration | | Units | Bkgd Outwash (0-1 Foot) | > Bkgd | SSL | > SSL | PRG | > PRG | S-1/GW-1 | > S-1/GW-1 | RCS1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HC169C1CAA | 4/12/2002 | IM40MB | LEAD | 189 | | MG/KG | 19 | X | 4.05 | X | 40 | X | 300 | | 300 | |
| HC169C1CAA | 4/12/2002 | IM40MB | MAGNESIUM | 3130 | | MG/KG | 2010 | X | | | | | | | | |
| HC169C1CAA | 4/12/2002 | IM40MB | MANGANESE | 165 | | MG/KG | 134 | X | 44.15 | X | 176.24 | | | | | |
| HC169C1CAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.52 | J | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HC169C1CAA | 4/12/2002 | IM40MB | NICKEL | 8.1 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HC169C1CAA | 4/12/2002 | IM40MB | POTASSIUM | 608 | | MG/KG | 766 | | | | | | | | | |
| HC169C1CAA | 4/12/2002 | IM40MB | SELENIUM | 0.7 | J | MG/KG | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| HC169C1CAA | 4/12/2002 | IM40MB | VANADIUM | 22.2 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HC169C1CAA | 4/12/2002 | IM40MB | ZINC | 30.2 | | MG/KG | 25.6 | X | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HC169C1CAA | 4/12/2002 | SW8270 | {ND on all 78} analytes | | | | | | | | | | | | | |
| HC169C1CAA | 4/12/2002 | D2216M | MOISTURE | 9.9 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HC169D1AAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HC169D1AAA | 4/12/2002 | IM40MB | ALUMINUM | 9030 | | MG/KG | 16019 | | 54006 | | 7614.20 | X | | | | |
| HC169D1AAA | 4/12/2002 | IM40MB | ARSENIC | 3.3 | | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HC169D1AAA | 4/12/2002 | IM40MB | BARIUM | 13.8 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HC169D1AAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.23 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HC169D1AAA | 4/12/2002 | IM40MB | BORON | 3.7 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HC169D1AAA | 4/12/2002 | IM40MB | CALCIUM | 379 | | MG/KG | 288 | X | | | | | | | | |
| HC169D1AAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 10.8 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HC169D1AAA | 4/12/2002 | IM40MB | COBALT | 2.6 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HC169D1AAA | 4/12/2002 | IM40MB | COPPER | 4.1 | | MG/KG | 11 | | 45.73 | | 312.86 | | | | 1000 | |
| HC169D1AAA | 4/12/2002 | IM40MB | IRON | 9830 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HC169D1AAA | 4/12/2002 | IM40MB | LEAD | 12.5 | | MG/KG | 19 | | 4.05 | X | 40 | | 300 | | 300 | |
| HC169D1AAA | 4/12/2002 | IM40MB | MAGNESIUM | 970 | | MG/KG | 2010 | | | | | | | | | |
| HC169D1AAA | 4/12/2002 | IM40MB | MANGANESE | 59.5 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HC169D1AAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.84 | | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HC169D1AAA | 4/12/2002 | IM40MB | NICKEL | 5.2 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HC169D1AAA | 4/12/2002 | IM40MB | POTASSIUM | 541 | | MG/KG | 766 | | | | | | | | | |
| HC169D1AAA | 4/12/2002 | IM40MB | VANADIUM | 19.2 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HC169D1AAA | 4/12/2002 | IM40MB | ZINC | 15.6 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HC169D1AAA | 4/12/2002 | SW8270 | 1,3-DIETHYL-1,3-DIPHENYL UREA | 1100 | | UG/KG | | | | | | | | | | |
| HC169D1AAA | 4/12/2002 | SW8270 | BENZOIC ACID | 46 | J | UG/KG | | | | | 1.0E+08 | | | | 1.0E+06 | |
| HC169D1AAA | 4/12/2002 | SW8270 | BIS(2-ETHYLHEXYL) PHTHALATE | 23 | J | UG/KG | | | 72016 | | 34741 | | 100000 | | 100000 | |
| HC169D1AAA | 4/12/2002 | D2216M | MOISTURE | 18.3 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HC169D1BAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HC169D1BAA | 4/12/2002 | IM40MB | ALUMINUM | 8850 | | MG/KG | 16019 | | 54006 | | 7614.20 | X | | | | |
| HC169D1BAA | 4/12/2002 | IM40MB | ANTIMONY | 0.45 | J | MG/KG | 1.9 | | 0.27 | X | 3.13 | | 10 | | 10 | |
| HC169D1BAA | 4/12/2002 | IM40MB | ARSENIC | 3.3 | | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HC169D1BAA | 4/12/2002 | IM40MB | BARIUM | 13.5 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HC169D1BAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.24 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |

SSL- MMR Soil Screening Level
PRG- Peliminary Remediation Goal
BKGD- MMR Backfround Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1- MCP Reportable Concentration for S1 Soil

*=not validated
J - Estimated value

# Table 3-2
# T Range TM 02-2 Soil Analytical Results (Grids 169A - 169F)

| Sample ID | Date Sampled | Method | Analyte | Concentration | | Units | Bkgd Outwash (0-1 Foot) | > Bkgd | SSL | > SSL | PRG | > PRG | S-1/GW-1 | > S-1/GW-1 | RCS1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HC169D1BAA | 4/12/2002 | IM40MB | BORON | 3.4 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HC169D1BAA | 4/12/2002 | IM40MB | CALCIUM | 270 | | MG/KG | 288 | | | | | | | | | |
| HC169D1BAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 10.8 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HC169D1BAA | 4/12/2002 | IM40MB | COBALT | 3.1 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HC169D1BAA | 4/12/2002 | IM40MB | COPPER | 5.7 | | MG/KG | 11 | | 45.73 | | 312.86 | | | | 1000 | |
| HC169D1BAA | 4/12/2002 | IM40MB | IRON | 9640 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HC169D1BAA | 4/12/2002 | IM40MB | LEAD | 11.3 | | MG/KG | 19 | | 4.05 | X | 40 | | 300 | | 300 | |
| HC169D1BAA | 4/12/2002 | IM40MB | MAGNESIUM | 1060 | | MG/KG | 2010 | | | | | | | | | |
| HC169D1BAA | 4/12/2002 | IM40MB | MANGANESE | 68.6 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HC169D1BAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.79 | | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HC169D1BAA | 4/12/2002 | IM40MB | NICKEL | 6 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HC169D1BAA | 4/12/2002 | IM40MB | POTASSIUM | 539 | | MG/KG | 766 | | | | | | | | | |
| HC169D1BAA | 4/12/2002 | IM40MB | SELENIUM | 0.48 | J | MG/KG | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| HC169D1BAA | 4/12/2002 | IM40MB | VANADIUM | 18.2 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HC169D1BAA | 4/12/2002 | IM40MB | ZINC | 17.4 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HC169D1BAA | 4/12/2002 | SW8270 | 1,3-DIETHYL-1,3-DIPHENYL UREA | 160 | J | UG/KG | | | | | | | | | | |
| HC169D1BAA | 4/12/2002 | SW8270 | BENZOIC ACID | 37 | J | UG/KG | | | | | 1.0E+08 | | | | 1.0E+06 | |
| HC169D1BAA | 4/12/2002 | SW8270 | BIS(2-ETHYLHEXYL) PHTHALATE | 18 | J | UG/KG | | | 72016 | | 34741 | | 100000 | | 100000 | |
| HC169D1BAA | 4/12/2002 | SW8270 | DI-N-BUTYL PHTHALATE | 37 | J | UG/KG | | | 150832 | | 611031 | | | | 50000 | |
| HC169D1BAA | 4/12/2002 | SW8270 | N-NITROSODIPHENYLAMINE | 36 | J | UG/KG | | | 7.77 | X | 99261 | | | | 100000 | |
| HC169D1BAA | 4/12/2002 | D2216M | MOISTURE | 14.9 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HC169D1CAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HC169D1CAA | 4/12/2002 | IM40MB | ALUMINUM | 8050 | | MG/KG | 16019 | | 54006 | | 7614.20 | X | | | | |
| HC169D1CAA | 4/12/2002 | IM40MB | ARSENIC | 2.5 | | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HC169D1CAA | 4/12/2002 | IM40MB | BARIUM | 11.8 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HC169D1CAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.31 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HC169D1CAA | 4/12/2002 | IM40MB | BORON | 3.1 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HC169D1CAA | 4/12/2002 | IM40MB | CALCIUM | 181 | | MG/KG | 288 | | | | | | | | | |
| HC169D1CAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 10.7 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HC169D1CAA | 4/12/2002 | IM40MB | COBALT | 4.2 | | MG/KG | 4 | X | 132.38 | | 902.89 | | | | 500 | |
| HC169D1CAA | 4/12/2002 | IM40MB | COPPER | 4.4 | | MG/KG | 11 | | 45.73 | | 312.86 | | | | 1000 | |
| HC169D1CAA | 4/12/2002 | IM40MB | IRON | 9240 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HC169D1CAA | 4/12/2002 | IM40MB | LEAD | 5.5 | | MG/KG | 19 | | 4.05 | X | 40 | | 300 | | 300 | |
| HC169D1CAA | 4/12/2002 | IM40MB | MAGNESIUM | 1420 | | MG/KG | 2010 | | | | | | | | | |
| HC169D1CAA | 4/12/2002 | IM40MB | MANGANESE | 81.4 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HC169D1CAA | 4/12/2002 | IM40MB | NICKEL | 7 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HC169D1CAA | 4/12/2002 | IM40MB | POTASSIUM | 671 | | MG/KG | 766 | | | | | | | | | |
| HC169D1CAA | 4/12/2002 | IM40MB | VANADIUM | 14.9 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HC169D1CAA | 4/12/2002 | IM40MB | ZINC | 16.1 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HC169D1CAA | 4/12/2002 | SW8270 | 1,3-DIETHYL-1,3-DIPHENYL UREA | 57 | J | UG/KG | | | | | | | | | | |
| HC169D1CAA | 4/12/2002 | D2216M | MOISTURE | 10.5 | * | PERCENT | | | | | | | | | | |

SSL- MMR Soil Screening Level
PRG- Peliminary Remediation Goal
BKGD- MMR Backfround Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1- MCP Reportable Concentration for S1 Soil

*=not validated
J - Estimated value

## Table 3-2
## T Range TM 02-2 Soil Analytical Results (Grids 169A - 169F)

| Sample ID | Date Sampled | Method | Analyte | Concentration | | Units | Bkgd Outwash (0-1 Foot) | > Bkgd | SSL | > SSL | PRG | > PRG | S-1/GW-1 | > S-1/GW-1 | RCS1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | |
| HC169E1AAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HC169E1AAA | 4/12/2002 | IM40MB | ALUMINUM | 7160 | | MG/KG | 16019 | | 54006 | | 7614.20 | | | | | |
| HC169E1AAA | 4/12/2002 | IM40MB | ARSENIC | 3.4 | | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HC169E1AAA | 4/12/2002 | IM40MB | BARIUM | 14.6 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HC169E1AAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.35 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HC169E1AAA | 4/12/2002 | IM40MB | BORON | 3.4 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HC169E1AAA | 4/12/2002 | IM40MB | CALCIUM | 297 | | MG/KG | 288 | X | | | | | | | | |
| HC169E1AAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 9.5 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HC169E1AAA | 4/12/2002 | IM40MB | COBALT | 2.7 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HC169E1AAA | 4/12/2002 | IM40MB | COPPER | 3.8 | | MG/KG | 11 | | 45.73 | | 312.86 | | | | 1000 | |
| HC169E1AAA | 4/12/2002 | IM40MB | IRON | 8750 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HC169E1AAA | 4/12/2002 | IM40MB | LEAD | 11.4 | | MG/KG | 19 | | 4.05 | X | 40 | | 300 | | 300 | |
| HC169E1AAA | 4/12/2002 | IM40MB | MAGNESIUM | 955 | | MG/KG | 2010 | | | | | | | | | |
| HC169E1AAA | 4/12/2002 | IM40MB | MANGANESE | 68.1 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HC169E1AAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.65 | J | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HC169E1AAA | 4/12/2002 | IM40MB | NICKEL | 5.1 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HC169E1AAA | 4/12/2002 | IM40MB | POTASSIUM | 556 | | MG/KG | 766 | | | | | | | | | |
| HC169E1AAA | 4/12/2002 | IM40MB | VANADIUM | 15.2 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HC169E1AAA | 4/12/2002 | IM40MB | ZINC | 13.7 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HC169E1AAA | 4/12/2002 | SW8270 | 1,3-DIETHYL-1,3-DIPHENYL UREA | 1400 | | UG/KG | | | | | | | | | | |
| HC169E1AAA | 4/12/2002 | SW8270 | BIS(2-ETHYLHEXYL) PHTHALATE | 23 | J | UG/KG | | | 72016 | | 34741 | | 100000 | | 100000 | |
| HC169E1AAA | 4/12/2002 | D2216M | MOISTURE | 15 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HC169E1BAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HC169E1BAA | 4/12/2002 | IM40MB | ALUMINUM | 7120 | | MG/KG | 16019 | | 54006 | | 7614.20 | | | | | |
| HC169E1BAA | 4/12/2002 | IM40MB | ARSENIC | 1.8 | | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HC169E1BAA | 4/12/2002 | IM40MB | BARIUM | 10.2 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HC169E1BAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.29 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HC169E1BAA | 4/12/2002 | IM40MB | BORON | 3.6 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HC169E1BAA | 4/12/2002 | IM40MB | CALCIUM | 192 | | MG/KG | 288 | | | | | | | | | |
| HC169E1BAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 8.4 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HC169E1BAA | 4/12/2002 | IM40MB | COBALT | 3.8 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HC169E1BAA | 4/12/2002 | IM40MB | COPPER | 4.5 | | MG/KG | 11 | | 45.73 | | 312.86 | | | | 1000 | |
| HC169E1BAA | 4/12/2002 | IM40MB | IRON | 9430 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HC169E1BAA | 4/12/2002 | IM40MB | LEAD | 6.3 | | MG/KG | 19 | | 4.05 | X | 40 | | 300 | | 300 | |
| HC169E1BAA | 4/12/2002 | IM40MB | MAGNESIUM | 1470 | | MG/KG | 2010 | | | | | | | | | |
| HC169E1BAA | 4/12/2002 | IM40MB | MANGANESE | 77.2 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HC169E1BAA | 4/12/2002 | IM40MB | NICKEL | 5.2 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HC169E1BAA | 4/12/2002 | IM40MB | POTASSIUM | 569 | | MG/KG | 766 | | | | | | | | | |
| HC169E1BAA | 4/12/2002 | IM40MB | VANADIUM | 16.2 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HC169E1BAA | 4/12/2002 | IM40MB | ZINC | 17.7 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |

SSL- MMR Soil Screening Level
PRG- Peliminary Remediation Goal
BKGD- MMR Backfround Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1- MCP Reportable Concentration for S1 Soil

*=not validated
J - Estimated value

## Table 3-2
## T Range TM 02-2 Soil Analytical Results (Grids 169A - 169F)

| Sample ID | Date Sampled | Method | Analyte | Concentration | | Units | Bkgd Outwash (0-1 Foot) | > Bkgd | SSL | > SSL | PRG | > PRG | S-1/GW-1 | > S-1/GW-1 | RCS1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HC169E1BAA | 4/12/2002 | SW8270 | 1,3-DIETHYL-1,3-DIPHENYL UREA | 110 | J | UG/KG | | | | | | | | | | |
| HC169E1BAA | 4/12/2002 | SW8270 | BENZOIC ACID | 19 | J | UG/KG | | | | | 1.0E+08 | | | | 1.0E+06 | |
| HC169E1BAA | 4/12/2002 | D2216M | MOISTURE | 13.5 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HC169E1CAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HC169E1CAA | 4/12/2002 | IM40MB | ALUMINUM | 5330 | | MG/KG | 16019 | | 54006 | | 7614.20 | | | | | |
| HC169E1CAA | 4/12/2002 | IM40MB | ARSENIC | 2.1 | | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HC169E1CAA | 4/12/2002 | IM40MB | BARIUM | 10 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HC169E1CAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.28 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HC169E1CAA | 4/12/2002 | IM40MB | BORON | 3.6 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HC169E1CAA | 4/12/2002 | IM40MB | CALCIUM | 200 | | MG/KG | 288 | | | | | | | | | |
| HC169E1CAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 7.8 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HC169E1CAA | 4/12/2002 | IM40MB | COBALT | 3.8 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HC169E1CAA | 4/12/2002 | IM40MB | COPPER | 4.1 | | MG/KG | 11 | | 45.73 | | 312.86 | | | | 1000 | |
| HC169E1CAA | 4/12/2002 | IM40MB | IRON | 7340 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HC169E1CAA | 4/12/2002 | IM40MB | LEAD | 4.6 | | MG/KG | 19 | | 4.05 | X | 40 | | 300 | | 300 | |
| HC169E1CAA | 4/12/2002 | IM40MB | MAGNESIUM | 1190 | | MG/KG | 2010 | | | | | | | | | |
| HC169E1CAA | 4/12/2002 | IM40MB | MANGANESE | 97.6 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HC169E1CAA | 4/12/2002 | IM40MB | NICKEL | 5.3 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HC169E1CAA | 4/12/2002 | IM40MB | POTASSIUM | 619 | | MG/KG | 766 | | | | | | | | | |
| HC169E1CAA | 4/12/2002 | IM40MB | VANADIUM | 11.5 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HC169E1CAA | 4/12/2002 | IM40MB | ZINC | 13.7 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HC169E1CAA | 4/12/2002 | SW8270 | 1,3-DIETHYL-1,3-DIPHENYL UREA | 49 | J | UG/KG | | | | | | | | | | |
| HC169E1CAA | 4/12/2002 | D2216M | MOISTURE | 17.6 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HC169F1AAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HC169F1AAA | 4/12/2002 | IM40MB | ALUMINUM | 6000 | | MG/KG | 16019 | | 54006 | | 7614.20 | | | | | |
| HC169F1AAA | 4/12/2002 | IM40MB | ARSENIC | 3.7 | J | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HC169F1AAA | 4/12/2002 | IM40MB | BARIUM | 11 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HC169F1AAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.26 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HC169F1AAA | 4/12/2002 | IM40MB | BORON | 2.7 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HC169F1AAA | 4/12/2002 | IM40MB | CALCIUM | 294 | | MG/KG | 288 | X | | | | | | | | |
| HC169F1AAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 9.5 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HC169F1AAA | 4/12/2002 | IM40MB | COBALT | 2.9 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HC169F1AAA | 4/12/2002 | IM40MB | COPPER | 3.5 | | MG/KG | 11 | | 45.73 | | 312.86 | | | | 1000 | |
| HC169F1AAA | 4/12/2002 | IM40MB | IRON | 7740 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HC169F1AAA | 4/12/2002 | IM40MB | LEAD | 5.9 | J | MG/KG | 19 | | 4.05 | X | 40 | | 300 | | 300 | |
| HC169F1AAA | 4/12/2002 | IM40MB | MAGNESIUM | 1170 | | MG/KG | 2010 | | | | | | | | | |
| HC169F1AAA | 4/12/2002 | IM40MB | MANGANESE | 93.5 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HC169F1AAA | 4/12/2002 | IM40MB | NICKEL | 5.7 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HC169F1AAA | 4/12/2002 | IM40MB | POTASSIUM | 734 | | MG/KG | 766 | | | | | | | | | |
| HC169F1AAA | 4/12/2002 | IM40MB | VANADIUM | 14.4 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |

SSL- MMR Soil Screening Level
PRG- Peliminary Remediation Goal
BKGD- MMR Backfround Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1- MCP Reportable Concentration for S1 Soil

*=not validated
J - Estimated value

# Table 3-2
# T Range TM 02-2 Soil Analytical Results (Grids 169A - 169F)

| Sample ID | Date Sampled | Method | Analyte | Concentration | | Units | Bkgd Outwash (0-1 Foot) | > Bkgd | SSL | > SSL | PRG | > PRG | S-1/GW-1 | > S-1/GW-1 | RCS1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HC169F1AAA | 4/12/2002 | IM40MB | ZINC | 14 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HC169F1AAA | 4/12/2002 | SW8270 | BENZOIC ACID | 17 | J | UG/KG | | | | | 1.0E+08 | | | | 1.0E+06 | |
| HC169F1AAA | 4/12/2002 | SW8270 | BIS(2-ETHYLHEXYL) PHTHALATE | 22 | J | UG/KG | | | 72016 | | 34741 | | 100000 | | 100000 | |
| HC169F1AAA | 4/12/2002 | D2216M | MOISTURE | 9.7 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HC169F1BAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HC169F1BAA | 4/12/2002 | IM40MB | ALUMINUM | 5140 | | MG/KG | 16019 | | 54006 | | 7614.20 | | | | | |
| HC169F1BAA | 4/12/2002 | IM40MB | ARSENIC | 3.5 | J | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HC169F1BAA | 4/12/2002 | IM40MB | BARIUM | 9.4 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HC169F1BAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.28 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HC169F1BAA | 4/12/2002 | IM40MB | BORON | 2.5 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HC169F1BAA | 4/12/2002 | IM40MB | CALCIUM | 210 | | MG/KG | 288 | | | | | | | | | |
| HC169F1BAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 10.9 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HC169F1BAA | 4/12/2002 | IM40MB | COBALT | 3.3 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HC169F1BAA | 4/12/2002 | IM40MB | COPPER | 3.8 | | MG/KG | 11 | | 45.73 | | 312.86 | | | | 1000 | |
| HC169F1BAA | 4/12/2002 | IM40MB | IRON | 8060 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HC169F1BAA | 4/12/2002 | IM40MB | LEAD | 4.1 | J | MG/KG | 19 | | 4.05 | X | 40 | | 300 | | 300 | |
| HC169F1BAA | 4/12/2002 | IM40MB | MAGNESIUM | 1210 | | MG/KG | 2010 | | | | | | | | | |
| HC169F1BAA | 4/12/2002 | IM40MB | MANGANESE | 87.2 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HC169F1BAA | 4/12/2002 | IM40MB | NICKEL | 5.1 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HC169F1BAA | 4/12/2002 | IM40MB | POTASSIUM | 625 | | MG/KG | 766 | | | | | | | | | |
| HC169F1BAA | 4/12/2002 | IM40MB | SELENIUM | 0.41 | J | MG/KG | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| HC169F1BAA | 4/12/2002 | IM40MB | VANADIUM | 12.1 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HC169F1BAA | 4/12/2002 | IM40MB | ZINC | 13.7 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HC169F1BAA | 4/12/2002 | SW8270 | BIS(2-ETHYLHEXYL) PHTHALATE | 30 | J | UG/KG | | | 72016 | | 34741 | | 100000 | | 100000 | |
| HC169F1BAA | 4/12/2002 | D2216M | MOISTURE | 7.9 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HC169F1CAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HC169F1CAA | 4/12/2002 | IM40MB | ALUMINUM | 5600 | | MG/KG | 16019 | | 54006 | | 7614.20 | | | | | |
| HC169F1CAA | 4/12/2002 | IM40MB | ARSENIC | 3.4 | J | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HC169F1CAA | 4/12/2002 | IM40MB | BARIUM | 11 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HC169F1CAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.25 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HC169F1CAA | 4/12/2002 | IM40MB | BORON | 2.4 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HC169F1CAA | 4/12/2002 | IM40MB | CALCIUM | 262 | | MG/KG | 288 | | | | | | | | | |
| HC169F1CAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 8.6 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HC169F1CAA | 4/12/2002 | IM40MB | COBALT | 3.1 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HC169F1CAA | 4/12/2002 | IM40MB | COPPER | 3.8 | | MG/KG | 11 | | 45.73 | | 312.86 | | | | 1000 | |
| HC169F1CAA | 4/12/2002 | IM40MB | IRON | 7630 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HC169F1CAA | 4/12/2002 | IM40MB | LEAD | 4.9 | J | MG/KG | 19 | | 4.05 | X | 40 | | 300 | | 300 | |
| HC169F1CAA | 4/12/2002 | IM40MB | MAGNESIUM | 1140 | | MG/KG | 2010 | | | | | | | | | |
| HC169F1CAA | 4/12/2002 | IM40MB | MANGANESE | 86.9 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HC169F1CAA | 4/12/2002 | IM40MB | NICKEL | 5.1 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |

SSL- MMR Soil Screening Level
PRG- Peliminary Remediation Goal
BKGD- MMR Backfround Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1- MCP Reportable Concentration for S1 Soil

*=not validated
J - Estimated value

## Table 3-2
## T Range TM 02-2 Soil Analytical Results (Grids 169A - 169F)

| Sample ID | Date Sampled | Method | Analyte | Concentration | | Units | Bkgd Outwash (0-1 Foot) | > Bkgd | SSL | > SSL | PRG | > PRG | S-1/GW-1 | > S-1/GW-1 | RCS1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HC169F1CAA | 4/12/2002 | IM40MB | POTASSIUM | 664 | | MG/KG | 766 | | | | | | | | | |
| HC169F1CAA | 4/12/2002 | IM40MB | SELENIUM | 0.49 | J | MG/KG | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| HC169F1CAA | 4/12/2002 | IM40MB | VANADIUM | 12 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HC169F1CAA | 4/12/2002 | IM40MB | ZINC | 12.8 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HC169F1CAA | 4/12/2002 | SW8270 | BIS(2-ETHYLHEXYL) PHTHALATE | 17 | J | UG/KG | | | 72016 | | 34741 | | 100000 | | 100000 | |
| HC169F1CAA | 4/12/2002 | D2216M | MOISTURE | 7.9 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HD169A3AAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HD169A3AAA | 4/12/2002 | IM40MB | ALUMINUM | 6820 | | MG/KG | 16019 | | 54006 | | 7614.20 | | | | | |
| HD169A3AAA | 4/12/2002 | IM40MB | ANTIMONY | 11.1 | J | MG/KG | 1.9 | X | 0.27 | X | 3.13 | X | 10 | X | 10 | X |
| HD169A3AAA | 4/12/2002 | IM40MB | ARSENIC | 3.8 | J | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HD169A3AAA | 4/12/2002 | IM40MB | BARIUM | 11.8 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HD169A3AAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.26 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HD169A3AAA | 4/12/2002 | IM40MB | BORON | 2.6 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HD169A3AAA | 4/12/2002 | IM40MB | CADMIUM | 0.59 | | MG/KG | 0.94 | | 0.40 | X | 3.70 | | 30 | | 30 | |
| HD169A3AAA | 4/12/2002 | IM40MB | CALCIUM | 16500 | | MG/KG | 288 | X | | | | | | | | |
| HD169A3AAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 11.8 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HD169A3AAA | 4/12/2002 | IM40MB | COBALT | 2.3 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HD169A3AAA | 4/12/2002 | IM40MB | COPPER | 40.4 | | MG/KG | 11 | X | 45.73 | | 312.86 | | | | 1000 | |
| HD169A3AAA | 4/12/2002 | IM40MB | IRON | 7710 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HD169A3AAA | 4/12/2002 | IM40MB | LEAD | 757 | J | MG/KG | 19 | X | 4.05 | X | 40 | X | 300 | X | 300 | X |
| HD169A3AAA | 4/12/2002 | IM40MB | MAGNESIUM | 995 | | MG/KG | 2010 | | | | | | | | | |
| HD169A3AAA | 4/12/2002 | IM40MB | MANGANESE | 54.5 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HD169A3AAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.49 | J | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HD169A3AAA | 4/12/2002 | IM40MB | NICKEL | 4.1 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HD169A3AAA | 4/12/2002 | IM40MB | POTASSIUM | 529 | | MG/KG | 766 | | | | | | | | | |
| HD169A3AAA | 4/12/2002 | IM40MB | SILVER | 0.57 | | MG/KG | 0.74 | | 16.23 | | 39.11 | | 100 | | 100 | |
| HD169A3AAA | 4/12/2002 | IM40MB | VANADIUM | 12.3 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HD169A3AAA | 4/12/2002 | IM40MB | ZINC | 24.4 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HD169A3AAA | 4/12/2002 | SW8270 | BENZO(A)PYRENE | 17 | J | UG/KG | 460 | | 203.01 | | 62.15 | | 700 | | 700 | |
| HD169A3AAA | 4/12/2002 | SW8270 | BENZOIC ACID | 21 | J | UG/KG | | | | | 1.0E+08 | | | | 1.0E+06 | |
| HD169A3AAA | 4/12/2002 | SW8270 | BIS(2-ETHYLHEXYL) PHTHALATE | 20 | J | UG/KG | | | 72016 | | 34741 | | 100000 | | 100000 | |
| HD169A3AAA | 4/12/2002 | SW8270 | CHRYSENE | 20 | J | UG/KG | 460 | | 3403.96 | | 62146 | | 7000 | | 7000 | |
| HD169A3AAA | 4/12/2002 | SW8270 | FLUORANTHENE | 24 | J | UG/KG | 460 | | 108129 | | 229361 | | 1.0E+06 | | 1.0E+06 | |
| HD169A3AAA | 4/12/2002 | SW8270 | PYRENE | 35 | J | UG/KG | 460 | | 19028 | | 231595 | | 700000 | | 700000 | |
| HD169A3AAA | 4/12/2002 | D2216M | MOISTURE | 11.3 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HD169A3BAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HD169A3BAA | 4/12/2002 | IM40MB | ALUMINUM | 6600 | | MG/KG | 16019 | | 54006 | | 7614.20 | | | | | |
| HD169A3BAA | 4/12/2002 | IM40MB | ANTIMONY | 5.2 | J | MG/KG | 1.9 | X | 0.27 | X | 3.13 | X | 10 | | 10 | |
| HD169A3BAA | 4/12/2002 | IM40MB | ARSENIC | 3.9 | J | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HD169A3BAA | 4/12/2002 | IM40MB | BARIUM | 10.8 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |

SSL- MMR Soil Screening Level
PRG- Peliminary Remediation Goal
BKGD- MMR Backfround Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1- MCP Reportable Concentration for S1 Soil

*=not validated
J - Estimated value

# Table 3-2
# T Range TM 02-2 Soil Analytical Results (Grids 169A - 169F)

| Sample ID | Date Sampled | Method | Analyte | Concentration | | Units | Bkgd Outwash (0-1 Foot) | > Bkgd | SSL | > SSL | PRG | > PRG | S-1/GW-1 | > S-1/GW-1 | RCS1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HD169A3BAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.27 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HD169A3BAA | 4/12/2002 | IM40MB | BORON | 2.5 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HD169A3BAA | 4/12/2002 | IM40MB | CADMIUM | 0.59 | | MG/KG | 0.94 | | 0.40 | X | 3.70 | | 30 | | 30 | |
| HD169A3BAA | 4/12/2002 | IM40MB | CALCIUM | 17100 | | MG/KG | 288 | X | | | | | | | | |
| HD169A3BAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 12.3 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HD169A3BAA | 4/12/2002 | IM40MB | COBALT | 2.6 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HD169A3BAA | 4/12/2002 | IM40MB | COPPER | 39.8 | | MG/KG | 11 | X | 45.73 | | 312.86 | | | | 1000 | |
| HD169A3BAA | 4/12/2002 | IM40MB | IRON | 7750 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HD169A3BAA | 4/12/2002 | IM40MB | LEAD | 600 | J | MG/KG | 19 | X | 4.05 | X | 40 | X | 300 | X | 300 | X |
| HD169A3BAA | 4/12/2002 | IM40MB | MAGNESIUM | 1190 | | MG/KG | 2010 | | | | | | | | | |
| HD169A3BAA | 4/12/2002 | IM40MB | MANGANESE | 65.6 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HD169A3BAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.59 | J | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HD169A3BAA | 4/12/2002 | IM40MB | NICKEL | 4.9 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HD169A3BAA | 4/12/2002 | IM40MB | POTASSIUM | 520 | | MG/KG | 766 | | | | | | | | | |
| HD169A3BAA | 4/12/2002 | IM40MB | SELENIUM | 0.53 | J | MG/KG | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| HD169A3BAA | 4/12/2002 | IM40MB | VANADIUM | 12.2 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HD169A3BAA | 4/12/2002 | IM40MB | ZINC | 24.6 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HD169A3BAA | 4/12/2002 | SW8270 | BENZOIC ACID | 27 | J | UG/KG | | | | | 1.0E+08 | | | | 1.0E+06 | |
| HD169A3BAA | 4/12/2002 | D2216M | MOISTURE | 10.7 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HD169A3CAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HD169A3CAA | 4/12/2002 | IM40MB | ALUMINUM | 8040 | | MG/KG | 16019 | | 54006 | | 7614.20 | X | | | | |
| HD169A3CAA | 4/12/2002 | IM40MB | ANTIMONY | 91.9 | J | MG/KG | 1.9 | X | 0.27 | X | 3.13 | X | 10 | X | 10 | X |
| HD169A3CAA | 4/12/2002 | IM40MB | ARSENIC | 23.4 | J | MG/KG | 5.5 | X | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HD169A3CAA | 4/12/2002 | IM40MB | BARIUM | 14.5 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HD169A3CAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.27 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HD169A3CAA | 4/12/2002 | IM40MB | BORON | 2.9 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HD169A3CAA | 4/12/2002 | IM40MB | CADMIUM | 0.34 | | MG/KG | 0.94 | | 0.40 | | 3.70 | | 30 | | 30 | |
| HD169A3CAA | 4/12/2002 | IM40MB | CALCIUM | 7260 | | MG/KG | 288 | X | | | | | | | | |
| HD169A3CAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 11.3 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HD169A3CAA | 4/12/2002 | IM40MB | COBALT | 3.2 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HD169A3CAA | 4/12/2002 | IM40MB | COPPER | 20.2 | | MG/KG | 11 | X | 45.73 | | 312.86 | | | | 1000 | |
| HD169A3CAA | 4/12/2002 | IM40MB | IRON | 9510 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HD169A3CAA | 4/12/2002 | IM40MB | LEAD | 5800 | J | MG/KG | 19 | X | 4.05 | X | 40 | X | 300 | X | 300 | X |
| HD169A3CAA | 4/12/2002 | IM40MB | MAGNESIUM | 1230 | | MG/KG | 2010 | | | | | | | | | |
| HD169A3CAA | 4/12/2002 | IM40MB | MANGANESE | 76.4 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HD169A3CAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.48 | J | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HD169A3CAA | 4/12/2002 | IM40MB | NICKEL | 5.4 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HD169A3CAA | 4/12/2002 | IM40MB | POTASSIUM | 607 | | MG/KG | 766 | | | | | | | | | |
| HD169A3CAA | 4/12/2002 | IM40MB | SELENIUM | 0.84 | | MG/KG | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| HD169A3CAA | 4/12/2002 | IM40MB | SILVER | 0.43 | J | MG/KG | 0.74 | | 16.23 | | 39.11 | | 100 | | 100 | |
| HD169A3CAA | 4/12/2002 | IM40MB | VANADIUM | 14.2 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |

SSL- MMR Soil Screening Level
PRG- Peliminary Remediation Goal
BKGD- MMR Backfround Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1- MCP Reportable Concentration for S1 Soil

*=not validated
J - Estimated value

# Table 3-2
## T Range TM 02-2 Soil Analytical Results (Grids 169A - 169F)

| Sample ID | Date Sampled | Method | Analyte | Concentration | | Units | Bkgd Outwash (0-1 Foot) | > Bkgd | SSL | > SSL | PRG | > PRG | S-1/GW-1 | > S-1/GW-1 | RCS1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HD169A3CAA | 4/12/2002 | IM40MB | ZINC | 19.5 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HD169A3CAA | 4/12/2002 | SW8270 | BENZOIC ACID | 20 | J | UG/KG | | | | | 1.0E+08 | | | | 1.0E+06 | |
| HD169A3CAA | 4/12/2002 | SW8270 | BIS(2-ETHYLHEXYL) PHTHALATE | 23 | J | UG/KG | | | 72016 | | 34741 | | 100000 | | 100000 | |
| HD169A3CAA | 4/12/2002 | D2216M | MOISTURE | 12.7 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HD169B3AAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HD169B3AAA | 4/12/2002 | IM40MB | ALUMINUM | 8650 | | MG/KG | 16019 | | 54006 | | 7614.20 | X | | | | |
| HD169B3AAA | 4/12/2002 | IM40MB | ANTIMONY | 2.8 | J | MG/KG | 1.9 | X | 0.27 | X | 3.13 | | 10 | | 10 | |
| HD169B3AAA | 4/12/2002 | IM40MB | ARSENIC | 3.7 | J | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HD169B3AAA | 4/12/2002 | IM40MB | BARIUM | 14.1 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HD169B3AAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.27 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HD169B3AAA | 4/12/2002 | IM40MB | BORON | 3.3 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HD169B3AAA | 4/12/2002 | IM40MB | CADMIUM | 0.35 | | MG/KG | 0.94 | | 0.40 | | 3.70 | | 30 | | 30 | |
| HD169B3AAA | 4/12/2002 | IM40MB | CALCIUM | 9220 | | MG/KG | 288 | X | | | | | | | | |
| HD169B3AAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 12.2 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HD169B3AAA | 4/12/2002 | IM40MB | COBALT | 3.4 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HD169B3AAA | 4/12/2002 | IM40MB | COPPER | 26.2 | | MG/KG | 11 | X | 45.73 | | 312.86 | | | | 1000 | |
| HD169B3AAA | 4/12/2002 | IM40MB | IRON | 9640 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HD169B3AAA | 4/12/2002 | IM40MB | LEAD | 345 | J | MG/KG | 19 | X | 4.05 | X | 40 | X | 300 | X | 300 | X |
| HD169B3AAA | 4/12/2002 | IM40MB | MAGNESIUM | 1380 | | MG/KG | 2010 | | | | | | | | | |
| HD169B3AAA | 4/12/2002 | IM40MB | MANGANESE | 84.2 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HD169B3AAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.65 | J | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HD169B3AAA | 4/12/2002 | IM40MB | NICKEL | 5.6 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HD169B3AAA | 4/12/2002 | IM40MB | POTASSIUM | 719 | | MG/KG | 766 | | | | | | | | | |
| HD169B3AAA | 4/12/2002 | IM40MB | SELENIUM | 0.91 | J | MG/KG | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| HD169B3AAA | 4/12/2002 | IM40MB | VANADIUM | 16.3 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HD169B3AAA | 4/12/2002 | IM40MB | ZINC | 21.7 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HD169B3AAA | 4/12/2002 | SW8270 | BIS(2-ETHYLHEXYL) PHTHALATE | 79 | J | UG/KG | | | 72016 | | 34741 | | 100000 | | 100000 | |
| HD169B3AAA | 4/12/2002 | D2216M | MOISTURE | 12.9 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HD169B3BAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HD169B3BAA | 4/12/2002 | IM40MB | ALUMINUM | 14500 | | MG/KG | 16019 | | 54006 | | 7614.20 | X | | | | |
| HD169B3BAA | 4/12/2002 | IM40MB | BARIUM | 15.5 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HD169B3BAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.31 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HD169B3BAA | 4/12/2002 | IM40MB | BORON | 2.8 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HD169B3BAA | 4/12/2002 | IM40MB | CADMIUM | 0.13 | J | MG/KG | 0.94 | | 0.40 | | 3.70 | | 30 | | 30 | |
| HD169B3BAA | 4/12/2002 | IM40MB | CALCIUM | 1390 | | MG/KG | 288 | X | | | | | | | | |
| HD169B3BAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 16.3 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HD169B3BAA | 4/12/2002 | IM40MB | COBALT | 4.6 | | MG/KG | 4 | X | 132.38 | | 902.89 | | | | 500 | |
| HD169B3BAA | 4/12/2002 | IM40MB | COPPER | 8.7 | | MG/KG | 11 | | 45.73 | | 312.86 | | | | 1000 | |
| HD169B3BAA | 4/12/2002 | IM40MB | IRON | 14400 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HD169B3BAA | 4/12/2002 | IM40MB | LEAD | 111 | J | MG/KG | 19 | X | 4.05 | X | 40 | X | 300 | | 300 | |

SSL- MMR Soil Screening Level
PRG- Peliminary Remediation Goal
BKGD- MMR Backfround Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1- MCP Reportable Concentration for S1 Soil

*=not validated
J - Estimated value

# Table 3-2
# T Range TM 02-2 Soil Analytical Results (Grids 169A - 169F)

| Sample ID | Date Sampled | Method | Analyte | Concentration | | Units | Bkgd Outwash (0-1 Foot) | > Bkgd | SSL | > SSL | PRG | > PRG | S-1/GW-1 | > S-1/GW-1 | RCS1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HD169B3BAA | 4/12/2002 | IM40MB | MAGNESIUM | 1630 | | MG/KG | 2010 | | | | | | | | | |
| HD169B3BAA | 4/12/2002 | IM40MB | MANGANESE | 121 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HD169B3BAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.81 | | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HD169B3BAA | 4/12/2002 | IM40MB | NICKEL | 9.3 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HD169B3BAA | 4/12/2002 | IM40MB | POTASSIUM | 736 | | MG/KG | 766 | | | | | | | | | |
| HD169B3BAA | 4/12/2002 | IM40MB | SELENIUM | 1.1 | | MG/KG | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| HD169B3BAA | 4/12/2002 | IM40MB | VANADIUM | 23.8 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HD169B3BAA | 4/12/2002 | IM40MB | ZINC | 19.1 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HD169B3BAA | 4/12/2002 | SW8270 | BENZOIC ACID | 20 | J | UG/KG | | | | | 1.0E+08 | | | | 1.0E+06 | |
| HD169B3BAA | 4/12/2002 | SW8270 | BIS(2-ETHYLHEXYL) PHTHALATE | 32 | J | UG/KG | | | 72016 | | 34741 | | 100000 | | 100000 | |
| HD169B3BAA | 4/12/2002 | D2216M | MOISTURE | 13.9 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HD169B3CAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HD169B3CAA | 4/12/2002 | IM40MB | ALUMINUM | 20400 | | MG/KG | 16019 | X | 54006 | | 7614.20 | X | | | | |
| HD169B3CAA | 4/12/2002 | IM40MB | ANTIMONY | 1.5 | J | MG/KG | 1.9 | | 0.27 | X | 3.13 | | 10 | | 10 | |
| HD169B3CAA | 4/12/2002 | IM40MB | ARSENIC | 4.5 | J | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HD169B3CAA | 4/12/2002 | IM40MB | BARIUM | 21.1 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HD169B3CAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.38 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HD169B3CAA | 4/12/2002 | IM40MB | BORON | 3.5 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HD169B3CAA | 4/12/2002 | IM40MB | CADMIUM | 0.15 | J | MG/KG | 0.94 | | 0.40 | | 3.70 | | 30 | | 30 | |
| HD169B3CAA | 4/12/2002 | IM40MB | CALCIUM | 589 | | MG/KG | 288 | X | | | | | | | | |
| HD169B3CAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 21 | | MG/KG | 19 | X | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HD169B3CAA | 4/12/2002 | IM40MB | COBALT | 7 | | MG/KG | 4 | X | 132.38 | | 902.89 | | | | 500 | |
| HD169B3CAA | 4/12/2002 | IM40MB | COPPER | 6.6 | | MG/KG | 11 | | 45.73 | | 312.86 | | | | 1000 | |
| HD169B3CAA | 4/12/2002 | IM40MB | IRON | 19300 | | MG/KG | 17800 | X | 2421.92 | X | 2346.32 | X | | | | |
| HD169B3CAA | 4/12/2002 | IM40MB | LEAD | 20.7 | J | MG/KG | 19 | X | 4.05 | X | 40 | | 300 | | 300 | |
| HD169B3CAA | 4/12/2002 | IM40MB | MAGNESIUM | 2490 | | MG/KG | 2010 | X | | | | | | | | |
| HD169B3CAA | 4/12/2002 | IM40MB | MANGANESE | 123 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HD169B3CAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.98 | | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HD169B3CAA | 4/12/2002 | IM40MB | NICKEL | 14 | | MG/KG | 10 | X | 292.13 | | 156.43 | | 300 | | 300 | |
| HD169B3CAA | 4/12/2002 | IM40MB | POTASSIUM | 692 | | MG/KG | 766 | | | | | | | | | |
| HD169B3CAA | 4/12/2002 | IM40MB | SELENIUM | 1.8 | | MG/KG | 1.7 | X | 2.76 | | 39.11 | | 400 | | 400 | |
| HD169B3CAA | 4/12/2002 | IM40MB | VANADIUM | 29.3 | | MG/KG | 28.8 | X | 260.05 | | 7.82 | X | 400 | | 400 | |
| HD169B3CAA | 4/12/2002 | IM40MB | ZINC | 24.1 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HD169B3CAA | 4/12/2002 | SW8270 | BIS(2-ETHYLHEXYL) PHTHALATE | 25 | J | UG/KG | | | 72016 | | 34741 | | 100000 | | 100000 | |
| HD169B3CAA | 4/12/2002 | D2216M | MOISTURE | 15.8 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HD169C3AAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HD169C3AAA | 4/12/2002 | IM40MB | ALUMINUM | 6530 | | MG/KG | 16019 | | 54006 | | 7614.20 | | | | | |
| HD169C3AAA | 4/12/2002 | IM40MB | ANTIMONY | 4 | | MG/KG | 1.9 | X | 0.27 | X | 3.13 | X | 10 | | 10 | |
| HD169C3AAA | 4/12/2002 | IM40MB | ARSENIC | 2.8 | | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HD169C3AAA | 4/12/2002 | IM40MB | BARIUM | 10.4 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |

SSL- MMR Soil Screening Level
PRG- Peliminary Remediation Goal
BKGD- MMR Backfround Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1- MCP Reportable Concentration for S1 Soil

*=not validated
J - Estimated value

## Table 3-2
## T Range TM 02-2 Soil Analytical Results (Grids 169A - 169F)

| Sample ID | Date Sampled | Method | Analyte | Concentration | | Units | Bkgd Outwash (0-1 Foot) | > Bkgd | SSL | > SSL | PRG | > PRG | S-1/GW-1 | > S-1/GW-1 | RCS1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HD169C3AAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.27 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HD169C3AAA | 4/12/2002 | IM40MB | CADMIUM | 0.46 | | MG/KG | 0.94 | | 0.40 | X | 3.70 | | 30 | | 30 | |
| HD169C3AAA | 4/12/2002 | IM40MB | CALCIUM | 16500 | | MG/KG | 288 | X | | | | | | | | |
| HD169C3AAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 11.3 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HD169C3AAA | 4/12/2002 | IM40MB | COBALT | 2.5 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HD169C3AAA | 4/12/2002 | IM40MB | COPPER | 38.3 | | MG/KG | 11 | X | 45.73 | | 312.86 | | | | 1000 | |
| HD169C3AAA | 4/12/2002 | IM40MB | IRON | 7490 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HD169C3AAA | 4/12/2002 | IM40MB | LEAD | 493 | | MG/KG | 19 | X | 4.05 | X | 40 | X | 300 | X | 300 | X |
| HD169C3AAA | 4/12/2002 | IM40MB | MAGNESIUM | 1060 | | MG/KG | 2010 | | | | | | | | | |
| HD169C3AAA | 4/12/2002 | IM40MB | MANGANESE | 64.1 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HD169C3AAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.72 | | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HD169C3AAA | 4/12/2002 | IM40MB | NICKEL | 3.9 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HD169C3AAA | 4/12/2002 | IM40MB | POTASSIUM | 537 | | MG/KG | 766 | | | | | | | | | |
| HD169C3AAA | 4/12/2002 | IM40MB | SELENIUM | 0.47 | J | MG/KG | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| HD169C3AAA | 4/12/2002 | IM40MB | VANADIUM | 12 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HD169C3AAA | 4/12/2002 | IM40MB | ZINC | 25.5 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HD169C3AAA | 4/12/2002 | SW8270 | BENZOIC ACID | 18 | J | UG/KG | | | | | 1.0E+08 | | | | 1.0E+06 | |
| HD169C3AAA | 4/12/2002 | SW8270 | CHRYSENE | 42 | J | UG/KG | 460 | | 3403.96 | | 62146 | | 7000 | | 7000 | |
| HD169C3AAA | 4/12/2002 | SW8270 | FLUORANTHENE | 18 | J | UG/KG | 460 | | 108129 | | 229361 | | 1.0E+06 | | 1.0E+06 | |
| HD169C3AAA | 4/12/2002 | SW8270 | PYRENE | 46 | J | UG/KG | 460 | | 19028 | | 231595 | | 700000 | | 700000 | |
| HD169C3AAA | 4/12/2002 | D2216M | MOISTURE | 11.1 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HD169C3BAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HD169C3BAA | 4/12/2002 | IM40MB | ALUMINUM | 9850 | | MG/KG | 16019 | | 54006 | | 7614.20 | X | | | | |
| HD169C3BAA | 4/12/2002 | IM40MB | ANTIMONY | 0.4 | J | MG/KG | 1.9 | | 0.27 | X | 3.13 | | 10 | | 10 | |
| HD169C3BAA | 4/12/2002 | IM40MB | BARIUM | 10.4 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HD169C3BAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.26 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HD169C3BAA | 4/12/2002 | IM40MB | CALCIUM | 540 | | MG/KG | 288 | X | | | | | | | | |
| HD169C3BAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 16.3 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HD169C3BAA | 4/12/2002 | IM40MB | COBALT | 5.7 | | MG/KG | 4 | X | 132.38 | | 902.89 | | | | 500 | |
| HD169C3BAA | 4/12/2002 | IM40MB | COPPER | 6.3 | | MG/KG | 11 | | 45.73 | | 312.86 | | | | 1000 | |
| HD169C3BAA | 4/12/2002 | IM40MB | IRON | 11300 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HD169C3BAA | 4/12/2002 | IM40MB | LEAD | 31.9 | | MG/KG | 19 | X | 4.05 | X | 40 | | 300 | | 300 | |
| HD169C3BAA | 4/12/2002 | IM40MB | MAGNESIUM | 1640 | | MG/KG | 2010 | | | | | | | | | |
| HD169C3BAA | 4/12/2002 | IM40MB | MANGANESE | 56 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HD169C3BAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.68 | | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HD169C3BAA | 4/12/2002 | IM40MB | NICKEL | 14.8 | | MG/KG | 10 | X | 292.13 | | 156.43 | | 300 | | 300 | |
| HD169C3BAA | 4/12/2002 | IM40MB | POTASSIUM | 565 | | MG/KG | 766 | | | | | | | | | |
| HD169C3BAA | 4/12/2002 | IM40MB | SELENIUM | 0.56 | J | MG/KG | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| HD169C3BAA | 4/12/2002 | IM40MB | VANADIUM | 16.6 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HD169C3BAA | 4/12/2002 | IM40MB | ZINC | 15.8 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HD169C3BAA | 4/12/2002 | SW8270 | {ND on all 78} analytes | | | | | | | | | | | | | |

SSL- MMR Soil Screening Level
PRG- Peliminary Remediation Goal
BKGD- MMR Backfround Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1- MCP Reportable Concentration for S1 Soil

*=not validated
J - Estimated value

# Table 3-2
## T Range TM 02-2 Soil Analytical Results (Grids 169A - 169F)

| Sample ID | Date Sampled | Method | Analyte | Concentration | | Units | Bkgd Outwash (0-1 Foot) | > Bkgd | SSL | > SSL | PRG | > PRG | S-1/GW-1 | > S-1/GW-1 | RCS1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HD169C3BAA | 4/12/2002 | D2216M | MOISTURE | 11.9 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HD169C3CAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HD169C3CAA | 4/12/2002 | IM40MB | ALUMINUM | 10200 | | MG/KG | 16019 | | 54006 | | 7614.20 | X | | | | |
| HD169C3CAA | 4/12/2002 | IM40MB | ANTIMONY | 1.5 | | MG/KG | 1.9 | | 0.27 | X | 3.13 | | 10 | | 10 | |
| HD169C3CAA | 4/12/2002 | IM40MB | BARIUM | 10.1 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HD169C3CAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.26 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HD169C3CAA | 4/12/2002 | IM40MB | BORON | 3.6 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HD169C3CAA | 4/12/2002 | IM40MB | CALCIUM | 4680 | | MG/KG | 288 | X | | | | | | | | |
| HD169C3CAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 12.3 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HD169C3CAA | 4/12/2002 | IM40MB | COBALT | 4.3 | | MG/KG | 4 | X | 132.38 | | 902.89 | | | | 500 | |
| HD169C3CAA | 4/12/2002 | IM40MB | COPPER | 14 | | MG/KG | 11 | X | 45.73 | | 312.86 | | | | 1000 | |
| HD169C3CAA | 4/12/2002 | IM40MB | IRON | 10000 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HD169C3CAA | 4/12/2002 | IM40MB | LEAD | 136 | | MG/KG | 19 | X | 4.05 | X | 40 | X | 300 | | 300 | |
| HD169C3CAA | 4/12/2002 | IM40MB | MAGNESIUM | 1720 | | MG/KG | 2010 | | | | | | | | | |
| HD169C3CAA | 4/12/2002 | IM40MB | MANGANESE | 70.5 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HD169C3CAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.76 | | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HD169C3CAA | 4/12/2002 | IM40MB | NICKEL | 10.1 | | MG/KG | 10 | X | 292.13 | | 156.43 | | 300 | | 300 | |
| HD169C3CAA | 4/12/2002 | IM40MB | POTASSIUM | 529 | | MG/KG | 766 | | | | | | | | | |
| HD169C3CAA | 4/12/2002 | IM40MB | VANADIUM | 15 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HD169C3CAA | 4/12/2002 | IM40MB | ZINC | 18.5 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HD169C3CAA | 4/12/2002 | SW8270 | {ND on all 78} analytes | | | | | | | | | | | | | |
| HD169C3CAA | 4/12/2002 | D2216M | MOISTURE | 10.3 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HD169D3AAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HD169D3AAA | 4/12/2002 | IM40MB | ALUMINUM | 6690 | | MG/KG | 16019 | | 54006 | | 7614.20 | | | | | |
| HD169D3AAA | 4/12/2002 | IM40MB | BARIUM | 12.1 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HD169D3AAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.17 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HD169D3AAA | 4/12/2002 | IM40MB | CALCIUM | 277 | | MG/KG | 288 | | | | | | | | | |
| HD169D3AAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 8 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HD169D3AAA | 4/12/2002 | IM40MB | COBALT | 2.2 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HD169D3AAA | 4/12/2002 | IM40MB | COPPER | 3.4 | | MG/KG | 11 | | 45.73 | | 312.86 | | | | 1000 | |
| HD169D3AAA | 4/12/2002 | IM40MB | IRON | 7350 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HD169D3AAA | 4/12/2002 | IM40MB | LEAD | 10.1 | | MG/KG | 19 | | 4.05 | X | 40 | | 300 | | 300 | |
| HD169D3AAA | 4/12/2002 | IM40MB | MAGNESIUM | 726 | | MG/KG | 2010 | | | | | | | | | |
| HD169D3AAA | 4/12/2002 | IM40MB | MANGANESE | 46.9 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HD169D3AAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.72 | | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HD169D3AAA | 4/12/2002 | IM40MB | NICKEL | 3.7 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HD169D3AAA | 4/12/2002 | IM40MB | POTASSIUM | 420 | | MG/KG | 766 | | | | | | | | | |
| HD169D3AAA | 4/12/2002 | IM40MB | VANADIUM | 14.4 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HD169D3AAA | 4/12/2002 | IM40MB | ZINC | 11.1 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HD169D3AAA | 4/12/2002 | SW8270 | 1,3-DIETHYL-1,3-DIPHENYL UREA | 820 | | UG/KG | | | | | | | | | | |

SSL- MMR Soil Screening Level
PRG- Peliminary Remediation Goal
BKGD- MMR Backfround Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1- MCP Reportable Concentration for S1 Soil

*=not validated
J - Estimated value

## Table 3-2
## T Range TM 02-2 Soil Analytical Results (Grids 169A - 169F)

| Sample ID | Date Sampled | Method | Analyte | Concentration | | Units | Bkgd Outwash (0-1 Foot) | > Bkgd | SSL | > SSL | PRG | > PRG | S-1/GW-1 | > S-1/GW-1 | RCS1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HD169D3AAA | 4/12/2002 | SW8270 | BENZOIC ACID | 50 | J | UG/KG | | | | | 1.0E+08 | | | | 1.0E+06 | |
| HD169D3AAA | 4/12/2002 | D2216M | MOISTURE | 14.4 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HD169D3BAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HD169D3BAA | 4/12/2002 | IM40MB | ALUMINUM | 7380 | | MG/KG | 16019 | | 54006 | | 7614.20 | | | | | |
| HD169D3BAA | 4/12/2002 | IM40MB | BARIUM | 12.2 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HD169D3BAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.27 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HD169D3BAA | 4/12/2002 | IM40MB | BORON | 3.8 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HD169D3BAA | 4/12/2002 | IM40MB | CALCIUM | 235 | | MG/KG | 288 | | | | | | | | | |
| HD169D3BAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 10.4 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HD169D3BAA | 4/12/2002 | IM40MB | COBALT | 3.7 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HD169D3BAA | 4/12/2002 | IM40MB | COPPER | 4.3 | | MG/KG | 11 | | 45.73 | | 312.86 | | | | 1000 | |
| HD169D3BAA | 4/12/2002 | IM40MB | IRON | 9060 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HD169D3BAA | 4/12/2002 | IM40MB | LEAD | 7.8 | | MG/KG | 19 | | 4.05 | X | 40 | | 300 | | 300 | |
| HD169D3BAA | 4/12/2002 | IM40MB | MAGNESIUM | 1450 | | MG/KG | 2010 | | | | | | | | | |
| HD169D3BAA | 4/12/2002 | IM40MB | MANGANESE | 81.6 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HD169D3BAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.67 | J | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HD169D3BAA | 4/12/2002 | IM40MB | NICKEL | 7.1 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HD169D3BAA | 4/12/2002 | IM40MB | POTASSIUM | 592 | | MG/KG | 766 | | | | | | | | | |
| HD169D3BAA | 4/12/2002 | IM40MB | SELENIUM | 0.74 | J | MG/KG | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| HD169D3BAA | 4/12/2002 | IM40MB | VANADIUM | 15.8 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HD169D3BAA | 4/12/2002 | IM40MB | ZINC | 15.7 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HD169D3BAA | 4/12/2002 | SW8270 | 1,3-DIETHYL-1,3-DIPHENYL UREA | 92 | J | UG/KG | | | | | | | | | | |
| HD169D3BAA | 4/12/2002 | SW8270 | BENZOIC ACID | 30 | J | UG/KG | | | | | 1.0E+08 | | | | 1.0E+06 | |
| HD169D3BAA | 4/12/2002 | D2216M | MOISTURE | 12.7 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HD169D3CAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HD169D3CAA | 4/12/2002 | IM40MB | ALUMINUM | 5370 | | MG/KG | 16019 | | 54006 | | 7614.20 | | | | | |
| HD169D3CAA | 4/12/2002 | IM40MB | ARSENIC | 2.7 | | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HD169D3CAA | 4/12/2002 | IM40MB | BARIUM | 10.1 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HD169D3CAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.27 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HD169D3CAA | 4/12/2002 | IM40MB | BORON | 3.7 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HD169D3CAA | 4/12/2002 | IM40MB | CALCIUM | 180 | | MG/KG | 288 | | | | | | | | | |
| HD169D3CAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 7.8 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HD169D3CAA | 4/12/2002 | IM40MB | COBALT | 3.6 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HD169D3CAA | 4/12/2002 | IM40MB | COPPER | 3.6 | | MG/KG | 11 | | 45.73 | | 312.86 | | | | 1000 | |
| HD169D3CAA | 4/12/2002 | IM40MB | IRON | 7070 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HD169D3CAA | 4/12/2002 | IM40MB | LEAD | 3.8 | | MG/KG | 19 | | 4.05 | | 40 | | 300 | | 300 | |
| HD169D3CAA | 4/12/2002 | IM40MB | MAGNESIUM | 1180 | | MG/KG | 2010 | | | | | | | | | |
| HD169D3CAA | 4/12/2002 | IM40MB | MANGANESE | 84.1 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HD169D3CAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.56 | J | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HD169D3CAA | 4/12/2002 | IM40MB | NICKEL | 5.3 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |

SSL- MMR Soil Screening Level
PRG- Peliminary Remediation Goal
BKGD- MMR Backfround Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1- MCP Reportable Concentration for S1 Soil

*=not validated
J - Estimated value

# Table 3-2
## T Range TM 02-2 Soil Analytical Results (Grids 169A - 169F)

| Sample ID | Date Sampled | Method | Analyte | Concentration | | Units | Bkgd Outwash (0-1 Foot) | > Bkgd | SSL | > SSL | PRG | > PRG | S-1/GW-1 | > S-1/GW-1 | RCS1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HD169D3CAA | 4/12/2002 | IM40MB | POTASSIUM | 673 | | MG/KG | 766 | | | | | | | | | |
| HD169D3CAA | 4/12/2002 | IM40MB | VANADIUM | 10.8 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HD169D3CAA | 4/12/2002 | IM40MB | ZINC | 14.1 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HD169D3CAA | 4/12/2002 | SW8270 | {ND on all 78} analytes | | | | | | | | | | | | | |
| HD169D3CAA | 4/12/2002 | D2216M | MOISTURE | 8.4 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HD169E3AAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HD169E3AAA | 4/12/2002 | IM40MB | ALUMINUM | 8670 | | MG/KG | 16019 | | 54006 | | 7614.20 | X | | | | |
| HD169E3AAA | 4/12/2002 | IM40MB | ANTIMONY | 0.51 | J | MG/KG | 1.9 | | 0.27 | X | 3.13 | | 10 | | 10 | |
| HD169E3AAA | 4/12/2002 | IM40MB | ARSENIC | 3.3 | | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HD169E3AAA | 4/12/2002 | IM40MB | BARIUM | 18 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HD169E3AAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.21 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HD169E3AAA | 4/12/2002 | IM40MB | BORON | 3.2 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HD169E3AAA | 4/12/2002 | IM40MB | CALCIUM | 232 | | MG/KG | 288 | | | | | | | | | |
| HD169E3AAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 9.7 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HD169E3AAA | 4/12/2002 | IM40MB | COBALT | 2.7 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HD169E3AAA | 4/12/2002 | IM40MB | COPPER | 3.1 | | MG/KG | 11 | | 45.73 | | 312.86 | | | | 1000 | |
| HD169E3AAA | 4/12/2002 | IM40MB | IRON | 8880 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HD169E3AAA | 4/12/2002 | IM40MB | LEAD | 16.9 | | MG/KG | 19 | | 4.05 | X | 40 | | 300 | | 300 | |
| HD169E3AAA | 4/12/2002 | IM40MB | MAGNESIUM | 872 | | MG/KG | 2010 | | | | | | | | | |
| HD169E3AAA | 4/12/2002 | IM40MB | MANGANESE | 62.7 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HD169E3AAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.85 | | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HD169E3AAA | 4/12/2002 | IM40MB | NICKEL | 4.5 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HD169E3AAA | 4/12/2002 | IM40MB | POTASSIUM | 449 | | MG/KG | 766 | | | | | | | | | |
| HD169E3AAA | 4/12/2002 | IM40MB | SELENIUM | 0.86 | J | MG/KG | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| HD169E3AAA | 4/12/2002 | IM40MB | VANADIUM | 16.8 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HD169E3AAA | 4/12/2002 | IM40MB | ZINC | 14.3 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HD169E3AAA | 4/12/2002 | SW8270 | BENZOIC ACID | 36 | J | UG/KG | | | | | 1.0E+08 | | | | 1.0E+06 | |
| HD169E3AAA | 4/12/2002 | SW8270 | BIS(2-ETHYLHEXYL) PHTHALATE | 18 | J | UG/KG | | | 72016 | | 34741 | | 100000 | | 100000 | |
| HD169E3AAA | 4/12/2002 | SW8270 | DI-N-BUTYL PHTHALATE | 31 | J | UG/KG | | | 150832 | | 611031 | | | | 50000 | |
| HD169E3AAA | 4/12/2002 | D2216M | MOISTURE | 8.8 | * | PERCENT | | | | | | | | | | |
| HD169E3AAA | 4/12/2002 | SW8270 | 1,3-DIETHYL-1,3-DIPHENYL UREA | 6200 | | UG/KG | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HD169E3BAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HD169E3BAA | 4/12/2002 | IM40MB | ALUMINUM | 4880 | | MG/KG | 16019 | | 54006 | | 7614.20 | | | | | |
| HD169E3BAA | 4/12/2002 | IM40MB | ARSENIC | 2.1 | | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HD169E3BAA | 4/12/2002 | IM40MB | BARIUM | 8.8 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HD169E3BAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.22 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HD169E3BAA | 4/12/2002 | IM40MB | CALCIUM | 194 | | MG/KG | 288 | | | | | | | | | |
| HD169E3BAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 7 | | MG/KG | 19 | | 7.02 | | 210.68 | | 1000 | | 1000 | |
| HD169E3BAA | 4/12/2002 | IM40MB | COBALT | 2.7 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HD169E3BAA | 4/12/2002 | IM40MB | COPPER | 3 | | MG/KG | 11 | | 45.73 | | 312.86 | | | | 1000 | |

SSL- MMR Soil Screening Level
PRG- Peliminary Remediation Goal
BKGD- MMR Backfround Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1- MCP Reportable Concentration for S1 Soil

*=not validated
J - Estimated value

# Table 3-2
# T Range TM 02-2 Soil Analytical Results (Grids 169A - 169F)

| Sample ID | Date Sampled | Method | Analyte | Concentration | | Units | Bkgd Outwash (0-1 Foot) | > Bkgd | SSL | > SSL | PRG | > PRG | S-1/GW-1 | > S-1/GW-1 | RCS1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HD169E3BAA | 4/12/2002 | IM40MB | IRON | 5550 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HD169E3BAA | 4/12/2002 | IM40MB | LEAD | 4 | | MG/KG | 19 | | 4.05 | | 40 | | 300 | | 300 | |
| HD169E3BAA | 4/12/2002 | IM40MB | MAGNESIUM | 924 | | MG/KG | 2010 | | | | | | | | | |
| HD169E3BAA | 4/12/2002 | IM40MB | MANGANESE | 51.5 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HD169E3BAA | 4/12/2002 | IM40MB | NICKEL | 4.1 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HD169E3BAA | 4/12/2002 | IM40MB | POTASSIUM | 503 | | MG/KG | 766 | | | | | | | | | |
| HD169E3BAA | 4/12/2002 | IM40MB | VANADIUM | 10.3 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HD169E3BAA | 4/12/2002 | IM40MB | ZINC | 10.6 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HD169E3BAA | 4/12/2002 | SW8270 | 1,3-DIETHYL-1,3-DIPHENYL UREA | 820 | | UG/KG | | | | | | | | | | |
| HD169E3BAA | 4/12/2002 | SW8270 | BENZO(A)ANTHRACENE | 100 | J | UG/KG | 460 | | 36.93 | X | 621.46 | | 700 | | 700 | |
| HD169E3BAA | 4/12/2002 | SW8270 | BENZO(A)PYRENE | 47 | J | UG/KG | 460 | | 203.01 | | 62.15 | | 700 | | 700 | |
| HD169E3BAA | 4/12/2002 | SW8270 | BENZO(B)FLUORANTHENE | 110 | J | UG/KG | 460 | | 114.48 | | 621.46 | | 700 | | 700 | |
| HD169E3BAA | 4/12/2002 | SW8270 | BENZO(K)FLUORANTHENE | 96 | J | UG/KG | 460 | | 114.48 | | 6214.57 | | 7000 | | 7000 | |
| HD169E3BAA | 4/12/2002 | SW8270 | CHRYSENE | 140 | J | UG/KG | 460 | | 3403.96 | | 62146 | | 7000 | | 7000 | |
| HD169E3BAA | 4/12/2002 | SW8270 | FLUORANTHENE | 180 | J | UG/KG | 460 | | 108129 | | 229361 | | 1.0E+06 | | 1.0E+06 | |
| HD169E3BAA | 4/12/2002 | SW8270 | INDENO(1,2,3-C,D)PYRENE | 18 | J | UG/KG | 460 | | 316.99 | | 621.46 | | 700 | | 700 | |
| HD169E3BAA | 4/12/2002 | SW8270 | PYRENE | 240 | J | UG/KG | 460 | | 19028 | | 231595 | | 700000 | | 700000 | |
| HD169E3BAA | 4/12/2002 | D2216M | MOISTURE | 7.4 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HD169E3CAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HD169E3CAA | 4/12/2002 | IM40MB | ALUMINUM | 5080 | | MG/KG | 16019 | | 54006 | | 7614.20 | | | | | |
| HD169E3CAA | 4/12/2002 | IM40MB | ARSENIC | 2.3 | | MG/KG | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| HD169E3CAA | 4/12/2002 | IM40MB | BARIUM | 8.9 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HD169E3CAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.24 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HD169E3CAA | 4/12/2002 | IM40MB | CALCIUM | 201 | | MG/KG | 288 | | | | | | | | | |
| HD169E3CAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 8.1 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HD169E3CAA | 4/12/2002 | IM40MB | COBALT | 2.7 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HD169E3CAA | 4/12/2002 | IM40MB | COPPER | 3.6 | | MG/KG | 11 | | 45.73 | | 312.86 | | | | 1000 | |
| HD169E3CAA | 4/12/2002 | IM40MB | IRON | 6360 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HD169E3CAA | 4/12/2002 | IM40MB | LEAD | 4.3 | | MG/KG | 19 | | 4.05 | X | 40 | | 300 | | 300 | |
| HD169E3CAA | 4/12/2002 | IM40MB | MAGNESIUM | 958 | | MG/KG | 2010 | | | | | | | | | |
| HD169E3CAA | 4/12/2002 | IM40MB | MANGANESE | 70.5 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HD169E3CAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.4 | J | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HD169E3CAA | 4/12/2002 | IM40MB | NICKEL | 5.3 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HD169E3CAA | 4/12/2002 | IM40MB | POTASSIUM | 519 | | MG/KG | 766 | | | | | | | | | |
| HD169E3CAA | 4/12/2002 | IM40MB | VANADIUM | 10.8 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HD169E3CAA | 4/12/2002 | IM40MB | ZINC | 12 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HD169E3CAA | 4/12/2002 | SW8270 | 1,3-DIETHYL-1,3-DIPHENYL UREA | 100 | J | UG/KG | | | | | | | | | | |
| HD169E3CAA | 4/12/2002 | D2216M | MOISTURE | 11 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HD169F3AAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HD169F3AAA | 4/12/2002 | IM40MB | ALUMINUM | 8160 | | MG/KG | 16019 | | 54006 | | 7614.20 | X | | | | |

SSL- MMR Soil Screening Level
PRG- Peliminary Remediation Goal
BKGD- MMR Backfround Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1- MCP Reportable Concentration for S1 Soil

*=not validated
J - Estimated value

# Table 3-2
# T Range TM 02-2 Soil Analytical Results (Grids 169A - 169F)

| Sample ID | Date Sampled | Method | Analyte | Concentration | | Units | Bkgd Outwash (0-1 Foot) | > Bkgd | SSL | > SSL | PRG | > PRG | S-1/GW-1 | > S-1/GW-1 | RCS1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HD169F3AAA | 4/12/2002 | IM40MB | BARIUM | 14.7 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HD169F3AAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.24 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HD169F3AAA | 4/12/2002 | IM40MB | BORON | 3 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HD169F3AAA | 4/12/2002 | IM40MB | CADMIUM | 0.14 | J | MG/KG | 0.94 | | 0.40 | | 3.70 | | 30 | | 30 | |
| HD169F3AAA | 4/12/2002 | IM40MB | CALCIUM | 305 | | MG/KG | 288 | X | | | | | | | | |
| HD169F3AAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 9.7 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HD169F3AAA | 4/12/2002 | IM40MB | COBALT | 2.6 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HD169F3AAA | 4/12/2002 | IM40MB | COPPER | 3.6 | | MG/KG | 11 | | 45.73 | | 312.86 | | | | 1000 | |
| HD169F3AAA | 4/12/2002 | IM40MB | IRON | 9200 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HD169F3AAA | 4/12/2002 | IM40MB | LEAD | 12.5 | J | MG/KG | 19 | | 4.05 | X | 40 | | 300 | | 300 | |
| HD169F3AAA | 4/12/2002 | IM40MB | MAGNESIUM | 928 | | MG/KG | 2010 | | | | | | | | | |
| HD169F3AAA | 4/12/2002 | IM40MB | MANGANESE | 64.4 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HD169F3AAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.51 | J | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HD169F3AAA | 4/12/2002 | IM40MB | NICKEL | 4.7 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HD169F3AAA | 4/12/2002 | IM40MB | POTASSIUM | 601 | | MG/KG | 766 | | | | | | | | | |
| HD169F3AAA | 4/12/2002 | IM40MB | SELENIUM | 0.64 | J | MG/KG | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| HD169F3AAA | 4/12/2002 | IM40MB | VANADIUM | 17.1 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HD169F3AAA | 4/12/2002 | IM40MB | ZINC | 13.1 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HD169F3AAA | 4/12/2002 | SW8270 | 1,3-DIETHYL-1,3-DIPHENYL UREA | 180 | J | UG/KG | | | | | | | | | | |
| HD169F3AAA | 4/12/2002 | SW8270 | BENZOIC ACID | 31 | J | UG/KG | | | | | 1.0E+08 | | | | 1.0E+06 | |
| HD169F3AAA | 4/12/2002 | SW8270 | BIS(2-ETHYLHEXYL) PHTHALATE | 41 | J | UG/KG | | | 72016 | | 34741 | | 100000 | | 100000 | |
| HD169F3AAA | 4/12/2002 | D2216M | MOISTURE | 13.7 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HD169F3BAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HD169F3BAA | 4/12/2002 | IM40MB | ALUMINUM | 4560 | | MG/KG | 16019 | | 54006 | | 7614.20 | | | | | |
| HD169F3BAA | 4/12/2002 | IM40MB | BARIUM | 9.1 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HD169F3BAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.24 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HD169F3BAA | 4/12/2002 | IM40MB | BORON | 2.4 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HD169F3BAA | 4/12/2002 | IM40MB | CALCIUM | 213 | | MG/KG | 288 | | | | | | | | | |
| HD169F3BAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 7.1 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HD169F3BAA | 4/12/2002 | IM40MB | COBALT | 2.9 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HD169F3BAA | 4/12/2002 | IM40MB | COPPER | 3.7 | | MG/KG | 11 | | 45.73 | | 312.86 | | | | 1000 | |
| HD169F3BAA | 4/12/2002 | IM40MB | IRON | 6730 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HD169F3BAA | 4/12/2002 | IM40MB | LEAD | 3.7 | J | MG/KG | 19 | | 4.05 | | 40 | | 300 | | 300 | |
| HD169F3BAA | 4/12/2002 | IM40MB | MAGNESIUM | 1020 | | MG/KG | 2010 | | | | | | | | | |
| HD169F3BAA | 4/12/2002 | IM40MB | MANGANESE | 76 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HD169F3BAA | 4/12/2002 | IM40MB | NICKEL | 4.4 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HD169F3BAA | 4/12/2002 | IM40MB | POTASSIUM | 611 | | MG/KG | 766 | | | | | | | | | |
| HD169F3BAA | 4/12/2002 | IM40MB | SELENIUM | 0.61 | J | MG/KG | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| HD169F3BAA | 4/12/2002 | IM40MB | VANADIUM | 10.3 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HD169F3BAA | 4/12/2002 | IM40MB | ZINC | 11.6 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HD169F3BAA | 4/12/2002 | SW8270 | BIS(2-ETHYLHEXYL) PHTHALATE | 34 | J | UG/KG | | | 72016 | | 34741 | | 100000 | | 100000 | |

SSL- MMR Soil Screening Level
PRG- Peliminary Remediation Goal
BKGD- MMR Backfround Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1- MCP Reportable Concentration for S1 Soil

*=not validated
J - Estimated value

# Table 3-2
## T Range TM 02-2 Soil Analytical Results (Grids 169A - 169F)

| Sample ID | Date Sampled | Method | Analyte | Concentration | | Units | Bkgd Outwash (0-1 Foot) | > Bkgd | SSL | > SSL | PRG | > PRG | S-1/GW-1 | > S-1/GW-1 | RCS1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HD169F3BAA | 4/12/2002 | D2216M | MOISTURE | 6.9 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HD169F3CAA | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HD169F3CAA | 4/12/2002 | IM40MB | ALUMINUM | 5290 | | MG/KG | 16019 | | 54006 | | 7614.20 | | | | | |
| HD169F3CAA | 4/12/2002 | IM40MB | BARIUM | 9.9 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HD169F3CAA | 4/12/2002 | IM40MB | BERYLLIUM | 0.25 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HD169F3CAA | 4/12/2002 | IM40MB | BORON | 2.8 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HD169F3CAA | 4/12/2002 | IM40MB | CALCIUM | 225 | | MG/KG | 288 | | | | | | | | | |
| HD169F3CAA | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 8 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HD169F3CAA | 4/12/2002 | IM40MB | COBALT | 3.3 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HD169F3CAA | 4/12/2002 | IM40MB | COPPER | 4 | | MG/KG | 11 | | 45.73 | | 312.86 | | | | 1000 | |
| HD169F3CAA | 4/12/2002 | IM40MB | IRON | 7310 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HD169F3CAA | 4/12/2002 | IM40MB | LEAD | 4 | J | MG/KG | 19 | | 4.05 | | 40 | | 300 | | 300 | |
| HD169F3CAA | 4/12/2002 | IM40MB | MAGNESIUM | 1150 | | MG/KG | 2010 | | | | | | | | | |
| HD169F3CAA | 4/12/2002 | IM40MB | MANGANESE | 78.9 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HD169F3CAA | 4/12/2002 | IM40MB | MOLYBDENUM | 0.34 | J | MG/KG | 1.2 | | 0.18 | X | 39.11 | | | | | |
| HD169F3CAA | 4/12/2002 | IM40MB | NICKEL | 4.8 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HD169F3CAA | 4/12/2002 | IM40MB | POTASSIUM | 658 | | MG/KG | 766 | | | | | | | | | |
| HD169F3CAA | 4/12/2002 | IM40MB | SELENIUM | 0.46 | J | MG/KG | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| HD169F3CAA | 4/12/2002 | IM40MB | SILVER | 0.26 | J | MG/KG | 0.74 | | 16.23 | | 39.11 | | 100 | | 100 | |
| HD169F3CAA | 4/12/2002 | IM40MB | VANADIUM | 11.5 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HD169F3CAA | 4/12/2002 | IM40MB | ZINC | 13 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HD169F3CAA | 4/12/2002 | SW8270 | 1,3-DIETHYL-1,3-DIPHENYL UREA | 38 | J | UG/KG | | | | | | | | | | |
| HD169F3CAA | 4/12/2002 | SW8270 | BIS(2-ETHYLHEXYL) PHTHALATE | 52 | J | UG/KG | | | 72016 | | 34741 | | 100000 | | 100000 | |
| HD169F3CAA | 4/12/2002 | D2216M | MOISTURE | 8.3 | * | PERCENT | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| HD169F3CAD | 4/12/2002 | IM40HG | {ND on all 1} analytes | | | | | | | | | | | | | |
| HD169F3CAD | 4/12/2002 | IM40MB | ALUMINUM | 5610 | | MG/KG | 16019 | | 54006 | | 7614.20 | | | | | |
| HD169F3CAD | 4/12/2002 | IM40MB | BARIUM | 11.9 | | MG/KG | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| HD169F3CAD | 4/12/2002 | IM40MB | BERYLLIUM | 0.27 | | MG/KG | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| HD169F3CAD | 4/12/2002 | IM40MB | BORON | 2.5 | | MG/KG | 9.6 | | 9.52 | | 1600 | | | | | |
| HD169F3CAD | 4/12/2002 | IM40MB | CALCIUM | 215 | | MG/KG | 288 | | | | | | | | | |
| HD169F3CAD | 4/12/2002 | IM40MB | CHROMIUM, TOTAL | 8.5 | | MG/KG | 19 | | 7.02 | X | 210.68 | | 1000 | | 1000 | |
| HD169F3CAD | 4/12/2002 | IM40MB | COBALT | 3.4 | | MG/KG | 4 | | 132.38 | | 902.89 | | | | 500 | |
| HD169F3CAD | 4/12/2002 | IM40MB | COPPER | 4.1 | | MG/KG | 11 | | 45.73 | | 312.86 | | | | 1000 | |
| HD169F3CAD | 4/12/2002 | IM40MB | IRON | 7800 | | MG/KG | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| HD169F3CAD | 4/12/2002 | IM40MB | LEAD | 4.4 | J | MG/KG | 19 | | 4.05 | X | 40 | | 300 | | 300 | |
| HD169F3CAD | 4/12/2002 | IM40MB | MAGNESIUM | 1230 | | MG/KG | 2010 | | | | | | | | | |
| HD169F3CAD | 4/12/2002 | IM40MB | MANGANESE | 101 | | MG/KG | 134 | | 44.15 | X | 176.24 | | | | | |
| HD169F3CAD | 4/12/2002 | IM40MB | NICKEL | 5.5 | | MG/KG | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| HD169F3CAD | 4/12/2002 | IM40MB | POTASSIUM | 707 | | MG/KG | 766 | | | | | | | | | |
| HD169F3CAD | 4/12/2002 | IM40MB | SELENIUM | 0.5 | J | MG/KG | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |

SSL- MMR Soil Screening Level
PRG- Peliminary Remediation Goal
BKGD- MMR Backfround Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1- MCP Reportable Concentration for S1 Soil

*=not validated
J - Estimated value

## Table 3-2
## T Range TM 02-2 Soil Analytical Results (Grids 169A - 169F)

| Sample ID | Date Sampled | Method | Analyte | Concentration | | Units | Bkgd Outwash (0-1 Foot) | > Bkgd | SSL | > SSL | PRG | > PRG | S-1/GW-1 | > S-1/GW-1 | RCS1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HD169F3CAD | 4/12/2002 | IM40MB | VANADIUM | 11.7 | | MG/KG | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| HD169F3CAD | 4/12/2002 | IM40MB | ZINC | 14 | | MG/KG | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| HD169F3CAD | 4/12/2002 | SW8270 | BIS(2-ETHYLHEXYL) PHTHALATE | 140 | J | UG/KG | | | 72016 | | 34741 | | 100000 | | 100000 | |
| HD169F3CAD | 4/12/2002 | D2216M | MOISTURE | 8.1 | * | PERCENT | | | | | | | | | | |

SSL- MMR Soil Screening Level
PRG- Peliminary Remediation Goal
BKGD- MMR Backfround Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1- MCP Reportable Concentration for S1 Soil

*=not validated
J - Estimated value

# Table 3-3
## T Range Project Note Data Summary Table

| Analyte | Frequency of Detections | | | Maximum Detected Concentration | | Units | Location of Maximum Detection | Bkgd Outwash (0-1 foot) | No.> Bkgd | SSL | No.> SSL | PRG | No.> PRG | S-1/GW-1 | No.> S-1/GW-1 | RCS1 | No.> RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALUMINUM | 16 | of | 16 | 14100 | | mg/Kg | SSTR1CS01 | 16019 | | 54006 | | 7614.20 | 13 | | | | |
| ANTIMONY | 6 | of | 16 | 2 | J | mg/Kg | SSTR1CN01 | 1.9 | 1 | 0.27 | 6 | 3.13 | | 10 | | 10 | |
| ARSENIC | 16 | of | 16 | 3.9 | | mg/Kg | SSTR2W01, SSTR3E01 | 5.5 | | 0.009 | 16 | 0.39 | 16 | 30 | | 30 | |
| BARIUM | 16 | of | 16 | 22.1 | | mg/Kg | SSTR1CS01 | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| BERYLLIUM | 16 | of | 16 | 0.4 | | mg/Kg | SSTR1CS01 | 0.38 | 1 | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| BORON | 6 | of | 16 | 1.3 | J | mg/Kg | SSTR2W01 | 9.6 | | 9.52 | | 1600 | | | | | |
| CADMIUM | 8 | of | 16 | 0.14 | J | mg/Kg | SSTR3W01 | 0.94 | | 0.40 | | 3.70 | | 30 | | 30 | |
| CALCIUM | 16 | of | 16 | 7360 | | mg/Kg | SSTR1CN01 | 288 | 12 | | | | | | | | |
| COBALT | 16 | of | 16 | 5.9 | | mg/Kg | SSTR1CS01 | 4 | 1 | 132.38 | | 902.89 | | | | 500 | |
| COPPER | 16 | of | 16 | 742 | | mg/Kg | SSTR2C01 | 11 | 14 | 45.73 | 5 | 312.86 | 2 | | | 1000 | |
| IRON | 16 | of | 16 | 16100 | | mg/Kg | SSTR2W01 | 17800 | | 2421.92 | 16 | 2346.32 | 16 | | | | |
| LEAD | 16 | of | 16 | 467 | | mg/Kg | SSTR1CN01 | 19 | 16 | 4.05 | 16 | 40 | 16 | 300 | 3 | 300 | 3 |
| MAGNESIUM | 16 | of | 16 | 1910 | | mg/Kg | SSTR1CS01 | 2010 | | | | | | | | | |
| MANGANESE | 16 | of | 16 | 125 | | mg/Kg | SSTR1CS01 | 134 | | 44.15 | 16 | 176.24 | | | | | |
| MERCURY | 16 | of | 16 | 0.033 | | mg/Kg | SSTR3E01 | 0.12 | | 0.02 | 12 | 2.35 | | 20 | | 20 | |
| MOLYBDENUM | 16 | of | 16 | 2 | | mg/Kg | SSTR1CN01 | 1.2 | 16 | 0.18 | 16 | 39.11 | | | | | |
| NICKEL | 16 | of | 16 | 12.6 | | mg/Kg | SSTR1CS01 | 10 | 4 | 292.13 | | 156.43 | | 300 | | 300 | |
| POTASSIUM | 16 | of | 16 | 935 | | mg/Kg | SSTR1CS01 | 766 | 6 | | | | | | | | |
| SELENIUM | 6 | of | 16 | 0.72 | J | mg/Kg | SSTR2C01 | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| SILVER | 5 | of | 16 | 0.25 | J | mg/Kg | SSTR1CS01 | 0.74 | | 16.23 | | 39.11 | | 100 | | 100 | |
| SODIUM | 16 | of | 16 | 197 | J | mg/Kg | SSTR2W01 | 196 | 1 | | | | | | | | |
| TUNGSTEN | 22 | of | 28 | 77.1 | | mg/Kg | SSTR2C01 | | | | | | | | | | |
| VANADIUM | 16 | of | 16 | 29.3 | | mg/Kg | SSTR3E01 | 28.8 | 2 | 260.05 | | 7.82 | 16 | 400 | | 400 | |
| ZINC | 16 | of | 16 | 20.8 | | mg/Kg | SSTR1CS01 | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| NITROGLYCERIN | 3 | of | 6 | 47000 | | ug/Kg | SSTR1CN01 | | | 1.02 | 3 | 34741 | 1 | | | 50000 | |
| 1,3-DIETHYL-1,3-DIPHENYL UREA | 2 | of | 2 | 2300 | | ug/Kg | SSTR1CN01 | | | | | | | | | | |

SSL - MMR Soil Screening Level
PRG - Preliminary Remediation Goal
BKGD - MMR Background Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1 - MCP Reportable Concentration for S1 Soil
J- Estimated value

# Table 3-4
# T Range Project Note Soil Analytical Results

| Location | Sample ID | Date | Test | Analyte | Result | Qual | DL | RL | Units | Bkgd Outwash (0-1') | > Bkgd | SSLs | > SSL | PRG | > PRG | S-1/ GW-1 | > S-1/ GW-1 | RSC-1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Area 1 Center North (0-3")** | | | | | | | | | | | | | | | | | | | |
| SSTR1CN01 | SSTR1CN01_C | 4/26/2006 | E331.0 | Non-Detect on PERCHLORATE | ND | U | 0.8 | 0.8 | ug/Kg | | | 3.14 | | 7821 | | | | | |
| SSTR1CN01 | SSTR1CN01_C | 4/26/2006 | SW8330 | NITROGLYCERIN | 26000 | | 660 | 2500 | ug/Kg | | | 1.02 | X | 34741 | | | | 50000 | |
| SSTR1CN01 | SSTR1CN01_C | 4/26/2006 | SW6010B | ALUMINUM | 8330 | | 2.4 | 14.39 | mg/Kg | 16019 | | 54006 | | 7614.20 | X | | | | |
| SSTR1CN01 | SSTR1CN01_C | 4/26/2006 | SW6010B | ANTIMONY | 1.7 | J | 0.5 | 4.32 | mg/Kg | 1.9 | | 0.27 | X | 3.13 | | 10 | | 10 | |
| SSTR1CN01 | SSTR1CN01_C | 4/26/2006 | SW6010B | ARSENIC | 3 | | 0.19 | 0.72 | mg/Kg | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| SSTR1CN01 | SSTR1CN01_C | 4/26/2006 | SW6010B | BARIUM | 20.2 | | 0.68 | 14.39 | mg/Kg | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| SSTR1CN01 | SSTR1CN01_C | 4/26/2006 | SW6010B | BERYLLIUM | 0.31 | J | 0.014 | 0.36 | mg/Kg | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| SSTR1CN01 | SSTR1CN01_C | 4/26/2006 | SW6010B | CALCIUM | 7020 | | 25 | 359.71 | mg/Kg | 288 | X | | | | | | | | |
| SSTR1CN01 | SSTR1CN01_C | 4/26/2006 | SW6010B | COBALT | 3.3 | J | 0.21 | 3.60 | mg/Kg | 4 | | 132.38 | | 902.89 | | | | 500 | |
| SSTR1CN01 | SSTR1CN01_C | 4/26/2006 | SW6010B | COPPER | 31.5 | | 0.16 | 1.80 | mg/Kg | 11 | X | 45.73 | | 312.86 | | | | 1000 | |
| SSTR1CN01 | SSTR1CN01_C | 4/26/2006 | SW6010B | IRON | 12100 | | 2.9 | 14.39 | mg/Kg | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| SSTR1CN01 | SSTR1CN01_C | 4/26/2006 | SW6010B | LEAD | 461 | | 0.17 | 0.72 | mg/Kg | 19 | X | 4.05 | X | 40 | X | 300 | X | 300 | X |
| SSTR1CN01 | SSTR1CN01_C | 4/26/2006 | SW6010B | MAGNESIUM | 1220 | | 19.8 | 359.71 | mg/Kg | 2010 | | | | | | | | | |
| SSTR1CN01 | SSTR1CN01_C | 4/26/2006 | SW6010B | MANGANESE | 97.5 | | 0.072 | 1.08 | mg/Kg | 134 | | 44.15 | X | 176.24 | | | | | |
| SSTR1CN01 | SSTR1CN01_C | 4/26/2006 | SW7471A | MERCURY | 0.018 | J | 0.013 | 0.03 | mg/Kg | 0.12 | | 0.02 | | 2.35 | | 20 | | 20 | |
| SSTR1CN01 | SSTR1CN01_C | 4/26/2006 | SW6010B | MOLYBDENUM | 2 | | 0.093 | 0.72 | mg/Kg | 1.2 | X | 0.18 | X | 39.11 | | | | | |
| SSTR1CN01 | SSTR1CN01_C | 4/26/2006 | SW6010B | NICKEL | 10.7 | | 0.16 | 2.88 | mg/Kg | 10 | X | 292.13 | | 156.43 | | 300 | | 300 | |
| SSTR1CN01 | SSTR1CN01_C | 4/26/2006 | SW6010B | POTASSIUM | 900 | | 32.2 | 359.71 | mg/Kg | 766 | X | | | | | | | | |
| SSTR1CN01 | SSTR1CN01_C | 4/26/2006 | SW6010B | SILVER | 0.22 | J | 0.12 | 0.72 | mg/Kg | 0.74 | | 16.23 | | 39.11 | | 100 | | 100 | |
| SSTR1CN01 | SSTR1CN01_C | 4/26/2006 | SW6010B | SODIUM | 132 | J | 40.6 | 359.71 | mg/Kg | 196 | | | | | | | | | |
| SSTR1CN01 | SSTR1CN01_C | 4/26/2006 | SW6020 | TUNGSTEN | 0.86 | | 0.0072 | 0.14 | mg/Kg | | | | | | | | | | |
| SSTR1CN01 | SSTR1CN01_C | 4/26/2006 | SW6010B | VANADIUM | 19.4 | | 0.24 | 3.60 | mg/Kg | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| SSTR1CN01 | SSTR1CN01_C | 4/26/2006 | SW6010B | ZINC | 19.8 | | 0.46 | 1.44 | mg/Kg | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| SSTR1CN01 | SSTR1CN01_C | 4/26/2006 | SW8270C | 1,3-DIETHYL-1,3-DIPHENYL UREA | 800 | | 41.6 | 390 | ug/Kg | | | | | | | | | | |
| SSTR1CN01 | SSTR1CN01_C | 4/26/2006 | SW8270C | NITROGLYCERIN | 460 | NJ | | | ug/Kg | | | 1.02 | X | 34741 | | | | 50000 | |
| **Area 1 Center North Replicate (0-3")** | | | | | | | | | | | | | | | | | | | |
| SSTR1CN01 | SSTR1CN01_C (REP) | 4/26/2006 | E331.0 | Non-Detect on PERCHLORATE | ND | U | 0.8 | 0.8 | ug/Kg | | | 3.14 | | 7821 | | | | | |
| SSTR1CN01 | SSTR1CN01_C (REP) | 4/26/2006 | SW8330 | NITROGLYCERIN | 47000 | | 660 | 2500 | ug/Kg | | | 1.02 | X | 34741 | X | | | 50000 | |
| SSTR1CN01 | SSTR1CN01_C (REP) | 4/26/2006 | SW6010B | ALUMINUM | 7330 | | 2.4 | 14.29 | mg/Kg | 16019 | | 54006 | | 7614.20 | | | | | |
| SSTR1CN01 | SSTR1CN01_C (REP) | 4/26/2006 | SW6010B | ANTIMONY | 2 | J | 0.5 | 4.29 | mg/Kg | 1.9 | X | 0.27 | X | 3.13 | | 10 | | 10 | |
| SSTR1CN01 | SSTR1CN01_C (REP) | 4/26/2006 | SW6010B | ARSENIC | 2.8 | | 0.19 | 0.71 | mg/Kg | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| SSTR1CN01 | SSTR1CN01_C (REP) | 4/26/2006 | SW6010B | BARIUM | 18.1 | | 0.67 | 14.29 | mg/Kg | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| SSTR1CN01 | SSTR1CN01_C (REP) | 4/26/2006 | SW6010B | BERYLLIUM | 0.29 | J | 0.014 | 0.36 | mg/Kg | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| SSTR1CN01 | SSTR1CN01_C (REP) | 4/26/2006 | SW6010B | CALCIUM | 7360 | | 24.9 | 357.14 | mg/Kg | 288 | X | | | | | | | | |
| SSTR1CN01 | SSTR1CN01_C (REP) | 4/26/2006 | SW6010B | COBALT | 2.9 | J | 0.21 | 3.57 | mg/Kg | 4 | | 132.38 | | 902.89 | | | | 500 | |
| SSTR1CN01 | SSTR1CN01_C (REP) | 4/26/2006 | SW6010B | COPPER | 30.5 | | 0.16 | 1.79 | mg/Kg | 11 | X | 45.73 | | 312.86 | | | | 1000 | |
| SSTR1CN01 | SSTR1CN01_C (REP) | 4/26/2006 | SW6010B | IRON | 10800 | | 2.8 | 14.29 | mg/Kg | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| SSTR1CN01 | SSTR1CN01_C (REP) | 4/26/2006 | SW6010B | LEAD | 467 | | 0.16 | 0.71 | mg/Kg | 19 | X | 4.05 | X | 40 | X | 300 | X | 300 | X |
| SSTR1CN01 | SSTR1CN01_C (REP) | 4/26/2006 | SW6010B | MAGNESIUM | 1120 | | 19.7 | 357.14 | mg/Kg | 2010 | | | | | | | | | |
| SSTR1CN01 | SSTR1CN01_C (REP) | 4/26/2006 | SW6010B | MANGANESE | 90.6 | | 0.071 | 1.07 | mg/Kg | 134 | | 44.15 | X | 176.24 | | | | | |

SSL - MMR Soil Screening Level
PRG - Preliminary Remediation Goal
BKGD - MMR Background Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1 - MCP Reportable Concentration for S1 Soil

J - Estimated value
NJ - TIC

# Table 3-4
# T Range Project Note Soil Analytical Results

| Location | Sample ID | Date | Test | Analyte | Result | Qual | DL | RL | Units | Bkgd Outwash (0-1') | > Bkgd | SSLs | > SSL | PRG | > PRG | S-1/ GW-1 | > S-1/ GW-1 | RSC-1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SSTR1CN01 | SSTR1CN01_C (REP) | 4/26/2006 | SW7471A | MERCURY | 0.018 | J | 0.014 | 0.03 | mg/Kg | 0.12 | | 0.02 | | 2.35 | | 20 | | 20 | |
| SSTR1CN01 | SSTR1CN01_C (REP) | 4/26/2006 | SW6010B | MOLYBDENUM | 1.8 | | 0.093 | 0.71 | mg/Kg | 1.2 | X | 0.18 | X | 39.11 | | | | | |
| SSTR1CN01 | SSTR1CN01_C (REP) | 4/26/2006 | SW6010B | NICKEL | 7.6 | | 0.16 | 2.86 | mg/Kg | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| SSTR1CN01 | SSTR1CN01_C (REP) | 4/26/2006 | SW6010B | POTASSIUM | 797 | | 32 | 357.14 | mg/Kg | 766 | X | | | | | | | | |
| SSTR1CN01 | SSTR1CN01_C (REP) | 4/26/2006 | SW6010B | SELENIUM | 0.25 | J | 0.24 | 2.50 | mg/Kg | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| SSTR1CN01 | SSTR1CN01_C (REP) | 4/26/2006 | SW6010B | SODIUM | 109 | J | 40.3 | 357.14 | mg/Kg | 196 | | | | | | | | | |
| SSTR1CN01 | SSTR1CN01_C (REP) | 4/26/2006 | SW6020 | TUNGSTEN | 0.9 | | 0.0071 | 0.14 | mg/Kg | | | | | | | | | | |
| SSTR1CN01 | SSTR1CN01_C (REP) | 4/26/2006 | SW6010B | VANADIUM | 17.3 | | 0.24 | 3.57 | mg/Kg | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| SSTR1CN01 | SSTR1CN01_C (REP) | 4/26/2006 | SW6010B | ZINC | 20.2 | | 0.46 | 1.43 | mg/Kg | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| SSTR1CN01 | SSTR1CN01_C (REP) | 4/26/2006 | SW8270C | 1,3-DIETHYL-1,3-DIPHENYL UREA | 2300 | | 39.8 | 370 | ug/Kg | | | | | | | | | | |
| SSTR1CN01 | SSTR1CN01_C (REP) | 4/26/2006 | SW8270C | NITROGLYCERIN | 1100 | NJ | | | ug/Kg | | | 1.02 | X | 34741 | | | | 50000 | |
| **Area 1 Center South (0-3")** | | | | | | | | | | | | | | | | | | | |
| SSTR1CS01 | SSTR1CS01_C | 4/27/2006 | E331.0 | Non-Detect on PERCHLORATE | ND | U | 0.8 | 0.8 | ug/Kg | | | 3.14 | | 7821 | | | | | |
| SSTR1CS01 | SSTR1CS01_C | 4/27/2006 | SW8330 | NITROGLYCERIN | 3200 | | 660 | 2500 | ug/Kg | | | 1.02 | X | 34741 | | | | 50000 | |
| SSTR1CS01 | SSTR1CS01_C | 4/27/2006 | SW6010B | ALUMINUM | 8950 | | 2.6 | 15.04 | mg/Kg | 16019 | | 54006 | | 7614.20 | X | | | | |
| SSTR1CS01 | SSTR1CS01_C | 4/27/2006 | SW6010B | ANTIMONY | 1.9 | J | 0.53 | 4.51 | mg/Kg | 1.9 | | 0.27 | X | 3.13 | | 10 | | 10 | |
| SSTR1CS01 | SSTR1CS01_C | 4/27/2006 | SW6010B | ARSENIC | 3 | | 0.2 | 0.75 | mg/Kg | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| SSTR1CS01 | SSTR1CS01_C | 4/27/2006 | SW6010B | BARIUM | 17.5 | | 0.71 | 15.04 | mg/Kg | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| SSTR1CS01 | SSTR1CS01_C | 4/27/2006 | SW6010B | BERYLLIUM | 0.3 | J | 0.015 | 0.38 | mg/Kg | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| SSTR1CS01 | SSTR1CS01_C | 4/27/2006 | SW6010B | CALCIUM | 6260 | | 26.2 | 375.94 | mg/Kg | 288 | X | | | | | | | | |
| SSTR1CS01 | SSTR1CS01_C | 4/27/2006 | SW6010B | COBALT | 3.1 | J | 0.22 | 3.76 | mg/Kg | 4 | | 132.38 | | 902.89 | | | | 500 | |
| SSTR1CS01 | SSTR1CS01_C | 4/27/2006 | SW6010B | COPPER | 110 | | 0.17 | 1.88 | mg/Kg | 11 | X | 45.73 | X | 312.86 | | | | 1000 | |
| SSTR1CS01 | SSTR1CS01_C | 4/27/2006 | SW6010B | IRON | 11900 | | 3 | 15.04 | mg/Kg | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| SSTR1CS01 | SSTR1CS01_C | 4/27/2006 | SW6010B | LEAD | 386 | | 0.17 | 0.75 | mg/Kg | 19 | X | 4.05 | X | 40 | X | 300 | X | 300 | X |
| SSTR1CS01 | SSTR1CS01_C | 4/27/2006 | SW6010B | MAGNESIUM | 1120 | | 20.7 | 375.94 | mg/Kg | 2010 | | | | | | | | | |
| SSTR1CS01 | SSTR1CS01_C | 4/27/2006 | SW6010B | MANGANESE | 89.7 | | 0.075 | 1.13 | mg/Kg | 134 | | 44.15 | X | 176.24 | | | | | |
| SSTR1CS01 | SSTR1CS01_C | 4/27/2006 | SW7471A | MERCURY | 0.023 | J | 0.014 | 0.03 | mg/Kg | 0.12 | | 0.02 | X | 2.35 | | 20 | | 20 | |
| SSTR1CS01 | SSTR1CS01_C | 4/27/2006 | SW6010B | MOLYBDENUM | 1.6 | | 0.098 | 0.75 | mg/Kg | 1.2 | X | 0.18 | X | 39.11 | | | | | |
| SSTR1CS01 | SSTR1CS01_C | 4/27/2006 | SW6010B | NICKEL | 8.2 | | 0.17 | 3.01 | mg/Kg | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| SSTR1CS01 | SSTR1CS01_C | 4/27/2006 | SW6010B | POTASSIUM | 751 | | 33.7 | 375.94 | mg/Kg | 766 | | | | | | | | | |
| SSTR1CS01 | SSTR1CS01_C | 4/27/2006 | SW6010B | SILVER | 0.21 | J | 0.12 | 0.75 | mg/Kg | 0.74 | | 16.23 | | 39.11 | | 100 | | 100 | |
| SSTR1CS01 | SSTR1CS01_C | 4/27/2006 | SW6010B | SODIUM | 127 | J | 42.4 | 375.94 | mg/Kg | 196 | | | | | | | | | |
| SSTR1CS01 | SSTR1CS01_C | 4/27/2006 | SW6020 | TUNGSTEN | 3.5 | | 0.0075 | 0.15 | mg/Kg | | | | | | | | | | |
| SSTR1CS01 | SSTR1CS01_C | 4/27/2006 | SW6010B | VANADIUM | 18.4 | | 0.25 | 3.76 | mg/Kg | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| SSTR1CS01 | SSTR1CS01_C | 4/27/2006 | SW6010B | ZINC | 19.6 | | 0.48 | 1.50 | mg/Kg | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| **Area 1 Center South (9-12")** | | | | | | | | | | | | | | | | | | | |
| SSTR1CS01 | SSTR1CS02_C | 4/27/2006 | E331.0 | Non-Detect on PERCHLORATE | ND | U | 0.8 | 0.8 | ug/Kg | | | 3.14 | | 7821 | | | | | |
| SSTR1CS01 | SSTR1CS02_C | 4/27/2006 | SW8330 | Non-Detect on all 19 analytes | ND | U | | | ug/Kg | | | | | | | | | | |
| SSTR1CS01 | SSTR1CS02_C | 4/27/2006 | SW6010B | ALUMINUM | 14100 | | 2.6 | 15.04 | mg/Kg | 16019 | | 54006 | | 7614.20 | X | | | | |
| SSTR1CS01 | SSTR1CS02_C | 4/27/2006 | SW6010B | ANTIMONY | 0.93 | J | 0.53 | 4.51 | mg/Kg | 1.9 | | 0.27 | X | 3.13 | | 10 | | 10 | |
| SSTR1CS01 | SSTR1CS02_C | 4/27/2006 | SW6010B | ARSENIC | 3.7 | | 0.2 | 0.75 | mg/Kg | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |

SSL - MMR Soil Screening Level
PRG - Preliminary Remediation Goal
BKGD - MMR Background Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1 - MCP Reportable Concentration for S1 Soil

J - Estimated value
NJ - TIC

# Table 3-4
# T Range Project Note Soil Analytical Results

| Location | Sample ID | Date | Test | Analyte | Result | Qual | DL | RL | Units | Bkgd Outwash (0-1') | > Bkgd | SSLs | > SSL | PRG | > PRG | S-1/ GW-1 | > S-1/ GW-1 | RSC-1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SSTR1CS01 | SSTR1CS02_C | 4/27/2006 | SW6010B | BARIUM | 22.1 | | 0.71 | 15.04 | mg/Kg | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| SSTR1CS01 | SSTR1CS02_C | 4/27/2006 | SW6010B | BERYLLIUM | 0.4 | | 0.015 | 0.38 | mg/Kg | 0.38 | X | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| SSTR1CS01 | SSTR1CS02_C | 4/27/2006 | SW6010B | CALCIUM | 964 | | 26.2 | 375.94 | mg/Kg | 288 | X | | | | | | | | |
| SSTR1CS01 | SSTR1CS02_C | 4/27/2006 | SW6010B | COBALT | 5.9 | | 0.22 | 3.76 | mg/Kg | 4 | X | 132.38 | | 902.89 | | | | 500 | |
| SSTR1CS01 | SSTR1CS02_C | 4/27/2006 | SW6010B | COPPER | 41.4 | | 0.17 | 1.88 | mg/Kg | 11 | X | 45.73 | | 312.86 | | | | 1000 | |
| SSTR1CS01 | SSTR1CS02_C | 4/27/2006 | SW6010B | IRON | 15900 | | 3 | 15.04 | mg/Kg | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| SSTR1CS01 | SSTR1CS02_C | 4/27/2006 | SW6010B | LEAD | 100 | | 0.17 | 0.75 | mg/Kg | 19 | X | 4.05 | X | 40 | X | 300 | | 300 | |
| SSTR1CS01 | SSTR1CS02_C | 4/27/2006 | SW6010B | MAGNESIUM | 1910 | | 20.7 | 375.94 | mg/Kg | 2010 | | | | | | | | | |
| SSTR1CS01 | SSTR1CS02_C | 4/27/2006 | SW6010B | MANGANESE | 125 | | 0.075 | 1.13 | mg/Kg | 134 | | 44.15 | X | 176.24 | | | | | |
| SSTR1CS01 | SSTR1CS02_C | 4/27/2006 | SW7471A | MERCURY | 0.02 | J | 0.015 | 0.04 | mg/Kg | 0.12 | | 0.02 | | 2.35 | | 20 | | 20 | |
| SSTR1CS01 | SSTR1CS02_C | 4/27/2006 | SW6010B | MOLYBDENUM | 1.7 | | 0.098 | 0.75 | mg/Kg | 1.2 | X | 0.18 | X | 39.11 | | | | | |
| SSTR1CS01 | SSTR1CS02_C | 4/27/2006 | SW6010B | NICKEL | 12.6 | | 0.17 | 3.01 | mg/Kg | 10 | X | 292.13 | | 156.43 | | 300 | | 300 | |
| SSTR1CS01 | SSTR1CS02_C | 4/27/2006 | SW6010B | POTASSIUM | 935 | | 33.7 | 375.94 | mg/Kg | 766 | X | | | | | | | | |
| SSTR1CS01 | SSTR1CS02_C | 4/27/2006 | SW6010B | SILVER | 0.25 | J | 0.12 | 0.75 | mg/Kg | 0.74 | | 16.23 | | 39.11 | | 100 | | 100 | |
| SSTR1CS01 | SSTR1CS02_C | 4/27/2006 | SW6010B | SODIUM | 159 | J | 42.4 | 375.94 | mg/Kg | 196 | | | | | | | | | |
| SSTR1CS01 | SSTR1CS02_C | 4/27/2006 | SW6020 | TUNGSTEN | 0.99 | | 0.0075 | 0.15 | mg/Kg | | | | | | | | | | |
| SSTR1CS01 | SSTR1CS02_C | 4/27/2006 | SW6010B | VANADIUM | 25 | | 0.25 | 3.76 | mg/Kg | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| SSTR1CS01 | SSTR1CS02_C | 4/27/2006 | SW6010B | ZINC | 20.8 | | 0.48 | 1.50 | mg/Kg | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| **Area 1 East (0-3")** | | | | | | | | | | | | | | | | | | | |
| SSTR1E01 | SSTR1E01_C | 4/26/2006 | SW6010B | ALUMINUM | 6700 | | 2.5 | 14.93 | mg/Kg | 16019 | | 54006 | | 7614.20 | | | | | |
| SSTR1E01 | SSTR1E01_C | 4/26/2006 | SW6010B | ARSENIC | 2.2 | | 0.2 | 0.75 | mg/Kg | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| SSTR1E01 | SSTR1E01_C | 4/26/2006 | SW6010B | BARIUM | 15.4 | | 0.7 | 14.93 | mg/Kg | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| SSTR1E01 | SSTR1E01_C | 4/26/2006 | SW6010B | BERYLLIUM | 0.22 | J | 0.015 | 0.37 | mg/Kg | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| SSTR1E01 | SSTR1E01_C | 4/26/2006 | SW6010B | CALCIUM | 1500 | | 26 | 373.13 | mg/Kg | 288 | X | | | | | | | | |
| SSTR1E01 | SSTR1E01_C | 4/26/2006 | SW6010B | COBALT | 2.9 | J | 0.22 | 3.73 | mg/Kg | 4 | | 132.38 | | 902.89 | | | | 500 | |
| SSTR1E01 | SSTR1E01_C | 4/26/2006 | SW6010B | COPPER | 22.2 | | 0.16 | 1.87 | mg/Kg | 11 | X | 45.73 | | 312.86 | | | | 1000 | |
| SSTR1E01 | SSTR1E01_C | 4/26/2006 | SW6010B | IRON | 9580 | | 3 | 14.93 | mg/Kg | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| SSTR1E01 | SSTR1E01_C | 4/26/2006 | SW6010B | LEAD | 87.4 | | 0.17 | 0.75 | mg/Kg | 19 | X | 4.05 | X | 40 | X | 300 | | 300 | |
| SSTR1E01 | SSTR1E01_C | 4/26/2006 | SW6010B | MAGNESIUM | 954 | | 20.6 | 373.13 | mg/Kg | 2010 | | | | | | | | | |
| SSTR1E01 | SSTR1E01_C | 4/26/2006 | SW6010B | MANGANESE | 93.6 | | 0.075 | 1.12 | mg/Kg | 134 | | 44.15 | X | 176.24 | | | | | |
| SSTR1E01 | SSTR1E01_C | 4/26/2006 | SW7471A | MERCURY | 0.025 | J | 0.014 | 0.03 | mg/Kg | 0.12 | | 0.02 | X | 2.35 | | 20 | | 20 | |
| SSTR1E01 | SSTR1E01_C | 4/26/2006 | SW6010B | MOLYBDENUM | 1.7 | | 0.097 | 0.75 | mg/Kg | 1.2 | X | 0.18 | X | 39.11 | | | | | |
| SSTR1E01 | SSTR1E01_C | 4/26/2006 | SW6010B | NICKEL | 7.3 | | 0.16 | 2.99 | mg/Kg | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| SSTR1E01 | SSTR1E01_C | 4/26/2006 | SW6010B | POTASSIUM | 645 | | 33.4 | 373.13 | mg/Kg | 766 | | | | | | | | | |
| SSTR1E01 | SSTR1E01_C | 4/26/2006 | SW6010B | SODIUM | 119 | J | 42.1 | 373.13 | mg/Kg | 196 | | | | | | | | | |
| SSTR1E01 | SSTR1E01_C | 4/26/2006 | SW6020 | TUNGSTEN | 1.1 | | 0.0075 | 0.15 | mg/Kg | | | | | | | | | | |
| SSTR1E01 | SSTR1E01_C | 4/26/2006 | SW6010B | VANADIUM | 16.6 | | 0.25 | 3.73 | mg/Kg | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| SSTR1E01 | SSTR1E01_C | 4/26/2006 | SW6010B | ZINC | 15.1 | | 0.48 | 1.49 | mg/Kg | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| **Area 1 East Replicate (0-3")** | | | | | | | | | | | | | | | | | | | |
| SSTR1E01 | SSTR1E01_C (REP) | 4/26/2006 | SW6010B | ALUMINUM | 7250 | | 2.5 | 14.49 | mg/Kg | 16019 | | 54006 | | 7614.20 | | | | | |
| SSTR1E01 | SSTR1E01_C (REP) | 4/26/2006 | SW6010B | ARSENIC | 2.1 | | 0.2 | 0.72 | mg/Kg | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |

SSL - MMR Soil Screening Level
PRG - Preliminary Remediation Goal
BKGD - MMR Background Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1 - MCP Reportable Concentration for S1 Soil

J - Estimated value
NJ - TIC

## Table 3-4
## T Range Project Note Soil Analytical Results

| Location | Sample ID | Date | Test | Analyte | Result | Qual | DL | RL | Units | Bkgd Outwash (0-1') | > Bkgd | SSLs | > SSL | PRG | > PRG | S-1/ GW-1 | > S-1/ GW-1 | RSC-1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SSTR1E01 | SSTR1E01_C (REP) | 4/26/2006 | SW6010B | BARIUM | 13.8 | J | 0.68 | 14.49 | mg/Kg | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| SSTR1E01 | SSTR1E01_C (REP) | 4/26/2006 | SW6010B | BERYLLIUM | 0.22 | J | 0.015 | 0.36 | mg/Kg | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| SSTR1E01 | SSTR1E01_C (REP) | 4/26/2006 | SW6010B | CALCIUM | 1100 | | 25.2 | 362.32 | mg/Kg | 288 | X | | | | | | | | |
| SSTR1E01 | SSTR1E01_C (REP) | 4/26/2006 | SW6010B | COBALT | 2.8 | J | 0.21 | 3.62 | mg/Kg | 4 | | 132.38 | | 902.89 | | | | 500 | |
| SSTR1E01 | SSTR1E01_C (REP) | 4/26/2006 | SW6010B | COPPER | 9 | | 0.16 | 1.81 | mg/Kg | 11 | | 45.73 | | 312.86 | | | | 1000 | |
| SSTR1E01 | SSTR1E01_C (REP) | 4/26/2006 | SW6010B | IRON | 9640 | | 2.9 | 14.49 | mg/Kg | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| SSTR1E01 | SSTR1E01_C (REP) | 4/26/2006 | SW6010B | LEAD | 117 | | 0.17 | 0.72 | mg/Kg | 19 | X | 4.05 | X | 40 | X | 300 | | 300 | |
| SSTR1E01 | SSTR1E01_C (REP) | 4/26/2006 | SW6010B | MAGNESIUM | 862 | | 20 | 362.32 | mg/Kg | 2010 | | | | | | | | | |
| SSTR1E01 | SSTR1E01_C (REP) | 4/26/2006 | SW6010B | MANGANESE | 75.7 | | 0.072 | 1.09 | mg/Kg | 134 | | 44.15 | X | 176.24 | | | | | |
| SSTR1E01 | SSTR1E01_C (REP) | 4/26/2006 | SW7471A | MERCURY | 0.026 | J | 0.016 | 0.04 | mg/Kg | 0.12 | | 0.02 | X | 2.35 | | 20 | | 20 | |
| SSTR1E01 | SSTR1E01_C (REP) | 4/26/2006 | SW6010B | MOLYBDENUM | 1.5 | | 0.094 | 0.72 | mg/Kg | 1.2 | X | 0.18 | X | 39.11 | | | | | |
| SSTR1E01 | SSTR1E01_C (REP) | 4/26/2006 | SW6010B | NICKEL | 7.5 | | 0.16 | 2.90 | mg/Kg | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| SSTR1E01 | SSTR1E01_C (REP) | 4/26/2006 | SW6010B | POTASSIUM | 590 | | 32.4 | 362.32 | mg/Kg | 766 | | | | | | | | | |
| SSTR1E01 | SSTR1E01_C (REP) | 4/26/2006 | SW6010B | SELENIUM | 0.32 | J | 0.25 | 2.54 | mg/Kg | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| SSTR1E01 | SSTR1E01_C (REP) | 4/26/2006 | SW6010B | SILVER | 0.14 | J | 0.12 | 0.72 | mg/Kg | 0.74 | | 16.23 | | 39.11 | | 100 | | 100 | |
| SSTR1E01 | SSTR1E01_C (REP) | 4/26/2006 | SW6010B | SODIUM | 82.4 | J | 40.9 | 362.32 | mg/Kg | 196 | | | | | | | | | |
| SSTR1E01 | SSTR1E01_C (REP) | 4/26/2006 | SW6020 | TUNGSTEN | 0.81 | | 0.0072 | 0.14 | mg/Kg | | | | | | | | | | |
| SSTR1E01 | SSTR1E01_C (REP) | 4/26/2006 | SW6010B | VANADIUM | 16.7 | | 0.24 | 3.62 | mg/Kg | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| SSTR1E01 | SSTR1E01_C (REP) | 4/26/2006 | SW6010B | ZINC | 11.8 | | 0.46 | 1.45 | mg/Kg | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| **Area 1 West (0-3")** | | | | | | | | | | | | | | | | | | | |
| SSTR1W01 | SSTR1W01_C | 4/26/2006 | SW6010B | ALUMINUM | 10300 | | 2.4 | 14.39 | mg/Kg | 16019 | | 54006 | | 7614.20 | X | | | | |
| SSTR1W01 | SSTR1W01_C | 4/26/2006 | SW6010B | ANTIMONY | 0.83 | J | 0.5 | 4.32 | mg/Kg | 1.9 | | 0.27 | X | 3.13 | | 10 | | 10 | |
| SSTR1W01 | SSTR1W01_C | 4/26/2006 | SW6010B | ARSENIC | 3 | | 0.19 | 0.72 | mg/Kg | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| SSTR1W01 | SSTR1W01_C | 4/26/2006 | SW6010B | BARIUM | 18.6 | | 0.68 | 14.39 | mg/Kg | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| SSTR1W01 | SSTR1W01_C | 4/26/2006 | SW6010B | BERYLLIUM | 0.3 | J | 0.014 | 0.36 | mg/Kg | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| SSTR1W01 | SSTR1W01_C | 4/26/2006 | SW6010B | CALCIUM | 3270 | | 25 | 359.71 | mg/Kg | 288 | X | | | | | | | | |
| SSTR1W01 | SSTR1W01_C | 4/26/2006 | SW6010B | COBALT | 3.5 | J | 0.21 | 3.60 | mg/Kg | 4 | | 132.38 | | 902.89 | | | | 500 | |
| SSTR1W01 | SSTR1W01_C | 4/26/2006 | SW6010B | COPPER | 42.7 | | 0.16 | 1.80 | mg/Kg | 11 | X | 45.73 | | 312.86 | | | | 1000 | |
| SSTR1W01 | SSTR1W01_C | 4/26/2006 | SW6010B | IRON | 13500 | | 2.9 | 14.39 | mg/Kg | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| SSTR1W01 | SSTR1W01_C | 4/26/2006 | SW6010B | LEAD | 180 | | 0.17 | 0.72 | mg/Kg | 19 | X | 4.05 | X | 40 | X | 300 | | 300 | |
| SSTR1W01 | SSTR1W01_C | 4/26/2006 | SW6010B | MAGNESIUM | 1200 | | 19.8 | 359.71 | mg/Kg | 2010 | | | | | | | | | |
| SSTR1W01 | SSTR1W01_C | 4/26/2006 | SW6010B | MANGANESE | 91.8 | | 0.072 | 1.08 | mg/Kg | 134 | | 44.15 | X | 176.24 | | | | | |
| SSTR1W01 | SSTR1W01_C | 4/26/2006 | SW7471A | MERCURY | 0.02 | J | 0.016 | 0.04 | mg/Kg | 0.12 | | 0.02 | | 2.35 | | 20 | | 20 | |
| SSTR1W01 | SSTR1W01_C | 4/26/2006 | SW6010B | MOLYBDENUM | 1.7 | | 0.093 | 0.72 | mg/Kg | 1.2 | X | 0.18 | X | 39.11 | | | | | |
| SSTR1W01 | SSTR1W01_C | 4/26/2006 | SW6010B | NICKEL | 9.7 | | 0.16 | 2.88 | mg/Kg | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| SSTR1W01 | SSTR1W01_C | 4/26/2006 | SW6010B | POTASSIUM | 786 | | 32.2 | 359.71 | mg/Kg | 766 | X | | | | | | | | |
| SSTR1W01 | SSTR1W01_C | 4/26/2006 | SW6010B | SELENIUM | 0.25 | J | 0.24 | 2.52 | mg/Kg | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| SSTR1W01 | SSTR1W01_C | 4/26/2006 | SW6010B | SILVER | 0.15 | J | 0.12 | 0.72 | mg/Kg | 0.74 | | 16.23 | | 39.11 | | 100 | | 100 | |
| SSTR1W01 | SSTR1W01_C | 4/26/2006 | SW6010B | SODIUM | 111 | J | 40.6 | 359.71 | mg/Kg | 196 | | | | | | | | | |
| SSTR1W01 | SSTR1W01_C | 4/26/2006 | SW6020 | TUNGSTEN | 1 | | 0.0072 | 0.14 | mg/Kg | | | | | | | | | | |
| SSTR1W01 | SSTR1W01_C | 4/26/2006 | SW6010B | VANADIUM | 21.6 | | 0.24 | 3.60 | mg/Kg | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |

SSL - MMR Soil Screening Level
PRG - Preliminary Remediation Goal
BKGD - MMR Background Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1 - MCP Reportable Concentration for S1 Soil

J - Estimated value
NJ - TIC

# Table 3-4
# T Range Project Note Soil Analytical Results

| Location | Sample ID | Date | Test | Analyte | Result | Qual | DL | RL | Units | Bkgd Outwash (0-1') | > Bkgd | SSLs | > SSL | PRG | > PRG | S-1/ GW-1 | > S-1/ GW-1 | RSC-1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SSTR1W01 | SSTR1W01_C | 4/26/2006 | SW6010B | ZINC | 17.1 | | 0.46 | 1.44 | mg/Kg | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| **Area 1 West Replicate (0-3")** | | | | | | | | | | | | | | | | | | | |
| SSTR1W01 | SSTR1W01_C (REP) | 4/26/2006 | SW6010B | ALUMINUM | 8900 | | 2.5 | 14.71 | mg/Kg | 16019 | | 54006 | | 7614.20 | X | | | | |
| SSTR1W01 | SSTR1W01_C (REP) | 4/26/2006 | SW6010B | ANTIMONY | 0.85 | J | 0.51 | 4.41 | mg/Kg | 1.9 | | 0.27 | X | 3.13 | | 10 | | 10 | |
| SSTR1W01 | SSTR1W01_C (REP) | 4/26/2006 | SW6010B | ARSENIC | 2.8 | | 0.2 | 0.74 | mg/Kg | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| SSTR1W01 | SSTR1W01_C (REP) | 4/26/2006 | SW6010B | BARIUM | 16.9 | | 0.69 | 14.71 | mg/Kg | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| SSTR1W01 | SSTR1W01_C (REP) | 4/26/2006 | SW6010B | BERYLLIUM | 0.27 | J | 0.015 | 0.37 | mg/Kg | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| SSTR1W01 | SSTR1W01_C (REP) | 4/26/2006 | SW6010B | CALCIUM | 3060 | | 25.6 | 367.65 | mg/Kg | 288 | X | | | | | | | | |
| SSTR1W01 | SSTR1W01_C (REP) | 4/26/2006 | SW6010B | COBALT | 3.3 | J | 0.21 | 3.68 | mg/Kg | 4 | | 132.38 | | 902.89 | | | | 500 | |
| SSTR1W01 | SSTR1W01_C (REP) | 4/26/2006 | SW6010B | COPPER | 42.8 | | 0.16 | 1.84 | mg/Kg | 11 | X | 45.73 | | 312.86 | | | | 1000 | |
| SSTR1W01 | SSTR1W01_C (REP) | 4/26/2006 | SW6010B | IRON | 11900 | | 2.9 | 14.71 | mg/Kg | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| SSTR1W01 | SSTR1W01_C (REP) | 4/26/2006 | SW6010B | LEAD | 243 | | 0.17 | 0.74 | mg/Kg | 19 | X | 4.05 | X | 40 | X | 300 | | 300 | |
| SSTR1W01 | SSTR1W01_C (REP) | 4/26/2006 | SW6010B | MAGNESIUM | 1100 | | 20.3 | 367.65 | mg/Kg | 2010 | | | | | | | | | |
| SSTR1W01 | SSTR1W01_C (REP) | 4/26/2006 | SW6010B | MANGANESE | 82.8 | | 0.073 | 1.10 | mg/Kg | 134 | | 44.15 | X | 176.24 | | | | | |
| SSTR1W01 | SSTR1W01_C (REP) | 4/26/2006 | SW7471A | MERCURY | 0.027 | J | 0.015 | 0.04 | mg/Kg | 0.12 | | 0.02 | X | 2.35 | | 20 | | 20 | |
| SSTR1W01 | SSTR1W01_C (REP) | 4/26/2006 | SW6010B | MOLYBDENUM | 1.8 | | 0.096 | 0.74 | mg/Kg | 1.2 | X | 0.18 | X | 39.11 | | | | | |
| SSTR1W01 | SSTR1W01_C (REP) | 4/26/2006 | SW6010B | NICKEL | 8.4 | | 0.16 | 2.94 | mg/Kg | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| SSTR1W01 | SSTR1W01_C (REP) | 4/26/2006 | SW6010B | POTASSIUM | 726 | | 32.9 | 367.65 | mg/Kg | 766 | | | | | | | | | |
| SSTR1W01 | SSTR1W01_C (REP) | 4/26/2006 | SW6010B | SELENIUM | 0.4 | J | 0.25 | 2.57 | mg/Kg | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| SSTR1W01 | SSTR1W01_C (REP) | 4/26/2006 | SW6010B | SODIUM | 79.6 | J | 41.5 | 367.65 | mg/Kg | 196 | | | | | | | | | |
| SSTR1W01 | SSTR1W01_C (REP) | 4/26/2006 | SW6020 | TUNGSTEN | 1.4 | | 0.0074 | 0.15 | mg/Kg | | | | | | | | | | |
| SSTR1W01 | SSTR1W01_C (REP) | 4/26/2006 | SW6010B | VANADIUM | 19.9 | | 0.24 | 3.68 | mg/Kg | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| SSTR1W01 | SSTR1W01_C (REP) | 4/26/2006 | SW6010B | ZINC | 16 | | 0.47 | 1.47 | mg/Kg | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| **Area 2 Center (0-3")** | | | | | | | | | | | | | | | | | | | |
| SSTR2C01 | SSTR2C01_C | 4/21/2006 | E331.0 | Non-Detect on PERCHLORATE | ND | U | 0.8 | 0.8 | ug/Kg | | | 3.14 | | 7821 | | | | | |
| SSTR2C01 | SSTR2C01_C | 4/21/2006 | SW8330 | Non-Detect on all 19 analytes | ND | U | | | ug/Kg | | | | | | | | | | |
| SSTR2C01 | SSTR2C01_C | 4/21/2006 | SW6010B | ALUMINUM | 12900 | | 2.7 | 15.87 | mg/Kg | 16019 | | 54006 | | 7614.20 | X | | | | |
| SSTR2C01 | SSTR2C01_C | 4/21/2006 | SW6010B | ARSENIC | 3.6 | | 0.21 | 0.79 | mg/Kg | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| SSTR2C01 | SSTR2C01_C | 4/21/2006 | SW6010B | BARIUM | 18.8 | | 0.75 | 15.87 | mg/Kg | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| SSTR2C01 | SSTR2C01_C | 4/21/2006 | SW6010B | BERYLLIUM | 0.29 | J | 0.016 | 0.40 | mg/Kg | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| SSTR2C01 | SSTR2C01_C | 4/21/2006 | SW6010B | CADMIUM | 0.13 | J | 0.064 | 0.40 | mg/Kg | 0.94 | | 0.40 | | 3.7 | | 30 | | 30 | |
| SSTR2C01 | SSTR2C01_C | 4/21/2006 | SW6010B | CALCIUM | 335 | J | 27.6 | 396.83 | mg/Kg | 288 | X | | | | | | | | |
| SSTR2C01 | SSTR2C01_C | 4/21/2006 | SW6010B | COBALT | 2.8 | J | 0.23 | 3.97 | mg/Kg | 4 | | 132.38 | | 902.89 | | | | 500 | |
| SSTR2C01 | SSTR2C01_C | 4/21/2006 | SW6010B | COPPER | 742 | | 0.17 | 1.98 | mg/Kg | 11 | X | 45.73 | X | 312.86 | X | | | 1000 | |
| SSTR2C01 | SSTR2C01_C | 4/21/2006 | SW6010B | IRON | 14500 | | 3.2 | 15.87 | mg/Kg | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| SSTR2C01 | SSTR2C01_C | 4/21/2006 | SW6010B | LEAD | 123 | | 0.18 | 0.79 | mg/Kg | 19 | X | 4.05 | X | 40 | X | 300 | | 300 | |
| SSTR2C01 | SSTR2C01_C | 4/21/2006 | SW6010B | MAGNESIUM | 1150 | | 21.9 | 396.83 | mg/Kg | 2010 | | | | | | | | | |
| SSTR2C01 | SSTR2C01_C | 4/21/2006 | SW6010B | MANGANESE | 76.2 | | 0.079 | 1.19 | mg/Kg | 134 | | 44.15 | X | 176.24 | | | | | |
| SSTR2C01 | SSTR2C01_C | 4/21/2006 | SW7471A | MERCURY | 0.025 | J | 0.015 | 0.04 | mg/Kg | 0.12 | | 0.02 | X | 2.35 | | 20 | | 20 | |
| SSTR2C01 | SSTR2C01_C | 4/21/2006 | SW6010B | MOLYBDENUM | 1.5 | | 0.1 | 0.79 | mg/Kg | 1.2 | X | 0.18 | X | 39.11 | | | | | |
| SSTR2C01 | SSTR2C01_C | 4/21/2006 | SW6010B | NICKEL | 8.5 | | 0.17 | 3.17 | mg/Kg | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |

SSL - MMR Soil Screening Level
PRG - Preliminary Remediation Goal
BKGD - MMR Background Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1 - MCP Reportable Concentration for S1 Soil

J - Estimated value
NJ - TIC

# Table 3-4
# T Range Project Note Soil Analytical Results

| Location | Sample ID | Date | Test | Analyte | Result | Qual | DL | RL | Units | Bkgd Outwash (0-1') | > Bkgd | SSLs | > SSL | PRG | > PRG | S-1/ GW-1 | > S-1/ GW-1 | RSC-1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SSTR2C01 | SSTR2C01_C | 4/21/2006 | SW6010B | POTASSIUM | 706 | | 35.5 | 396.83 | mg/Kg | 766 | | | | | | | | | |
| SSTR2C01 | SSTR2C01_C | 4/21/2006 | SW6010B | SELENIUM | 0.72 | J | 0.27 | 2.78 | mg/Kg | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| SSTR2C01 | SSTR2C01_C | 4/21/2006 | SW6010B | SODIUM | 137 | J | 44.8 | 396.83 | mg/Kg | 196 | | | | | | | | | |
| SSTR2C01 | SSTR2C01_C | 4/21/2006 | SW6020 | TUNGSTEN | 77.1 | | 0.37 | 7.46 | mg/Kg | | | | | | | | | | |
| SSTR2C01 | SSTR2C01_C | 4/21/2006 | SW6010B | VANADIUM | 27.7 | | 0.26 | 3.97 | mg/Kg | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| SSTR2C01 | SSTR2C01_C | 4/21/2006 | SW6010B | ZINC | 16.3 | | 0.51 | 1.59 | mg/Kg | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| **Area 2 Center Replicate (0-3")** | | | | | | | | | | | | | | | | | | | |
| SSTR2C01 | SSTR2C01_C (REP) | 4/21/2006 | E331.0 | Non-Detect on PERCHLORATE | ND | U | 0.8 | 0.8 | ug/Kg | | | 3.14 | | 7821 | | | | | |
| SSTR2C01 | SSTR2C01_C (REP) | 4/21/2006 | SW8330 | Non-Detect on all 19 analytes | ND | U | | | ug/Kg | | | | | | | | | | |
| SSTR2C01 | SSTR2C01_C (REP) | 4/21/2006 | SW6010B | ALUMINUM | 12800 | | 2.6 | 15.50 | mg/Kg | 16019 | | 54006 | | 7614.20 | X | | | | |
| SSTR2C01 | SSTR2C01_C (REP) | 4/21/2006 | SW6010B | ARSENIC | 3.1 | | 0.21 | 0.78 | mg/Kg | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| SSTR2C01 | SSTR2C01_C (REP) | 4/21/2006 | SW6010B | BARIUM | 17.6 | | 0.73 | 15.50 | mg/Kg | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| SSTR2C01 | SSTR2C01_C (REP) | 4/21/2006 | SW6010B | BERYLLIUM | 0.29 | J | 0.015 | 0.39 | mg/Kg | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| SSTR2C01 | SSTR2C01_C (REP) | 4/21/2006 | SW6010B | CADMIUM | 0.1 | J | 0.062 | 0.39 | mg/Kg | 0.94 | | 0.40 | | 3.7 | | 30 | | 30 | |
| SSTR2C01 | SSTR2C01_C (REP) | 4/21/2006 | SW6010B | CALCIUM | 243 | J | 27 | 387.60 | mg/Kg | 288 | | | | | | | | | |
| SSTR2C01 | SSTR2C01_C (REP) | 4/21/2006 | SW6010B | COBALT | 2.7 | J | 0.22 | 3.88 | mg/Kg | 4 | | 132.38 | | 902.89 | | | | 500 | |
| SSTR2C01 | SSTR2C01_C (REP) | 4/21/2006 | SW6010B | COPPER | 355 | | 0.17 | 1.94 | mg/Kg | 11 | X | 45.73 | X | 312.86 | X | | | 1000 | |
| SSTR2C01 | SSTR2C01_C (REP) | 4/21/2006 | SW6010B | IRON | 13800 | | 3.1 | 15.50 | mg/Kg | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| SSTR2C01 | SSTR2C01_C (REP) | 4/21/2006 | SW6010B | LEAD | 99.1 | | 0.18 | 0.78 | mg/Kg | 19 | X | 4.05 | X | 40 | X | 300 | | 300 | |
| SSTR2C01 | SSTR2C01_C (REP) | 4/21/2006 | SW6010B | MAGNESIUM | 1110 | | 21.4 | 387.60 | mg/Kg | 2010 | | | | | | | | | |
| SSTR2C01 | SSTR2C01_C (REP) | 4/21/2006 | SW6010B | MANGANESE | 65.4 | | 0.077 | 1.16 | mg/Kg | 134 | | 44.15 | X | 176.24 | | | | | |
| SSTR2C01 | SSTR2C01_C (REP) | 4/21/2006 | SW7471A | MERCURY | 0.031 | J | 0.015 | 0.04 | mg/Kg | 0.12 | | 0.02 | X | 2.35 | | 20 | | 20 | |
| SSTR2C01 | SSTR2C01_C (REP) | 4/21/2006 | SW6010B | MOLYBDENUM | 1.3 | | 0.1 | 0.78 | mg/Kg | 1.2 | X | 0.18 | X | 39.11 | | | | | |
| SSTR2C01 | SSTR2C01_C (REP) | 4/21/2006 | SW6010B | NICKEL | 8.9 | | 0.17 | 3.10 | mg/Kg | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| SSTR2C01 | SSTR2C01_C (REP) | 4/21/2006 | SW6010B | POTASSIUM | 691 | | 34.7 | 387.60 | mg/Kg | 766 | | | | | | | | | |
| SSTR2C01 | SSTR2C01_C (REP) | 4/21/2006 | SW6010B | SELENIUM | 0.45 | J | 0.26 | 2.71 | mg/Kg | 1.7 | | 2.76 | | 39.11 | | 400 | | 400 | |
| SSTR2C01 | SSTR2C01_C (REP) | 4/21/2006 | SW6010B | SODIUM | 110 | J | 43.7 | 387.60 | mg/Kg | 196 | | | | | | | | | |
| SSTR2C01 | SSTR2C01_C (REP) | 4/21/2006 | SW6020 | TUNGSTEN | 46.5 | | 0.37 | 7.41 | mg/Kg | | | | | | | | | | |
| SSTR2C01 | SSTR2C01_C (REP) | 4/21/2006 | SW6010B | VANADIUM | 25.4 | | 0.26 | 3.88 | mg/Kg | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| SSTR2C01 | SSTR2C01_C (REP) | 4/21/2006 | SW6010B | ZINC | 14.3 | | 0.5 | 1.55 | mg/Kg | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| SSTR2C01 | SSTR2C01_PE | 5/18/2006 | SW6020 | Non-Detect on TUNGSTEN | ND | U | 0.32 | 0.32 | mg/Kg | | | | | | | | | | |
| SSTR2C01 | SSTR2C01_PEREP1 | 5/18/2006 | SW6020 | Non-Detect on TUNGSTEN | ND | U | 0.12 | 0.17 | mg/Kg | | | | | | | | | | |
| SSTR2C01 | SSTR2C01_PEREP2 | 5/18/2006 | SW6020 | Non-Detect on TUNGSTEN | ND | U | 0.16 | 0.17 | mg/Kg | | | | | | | | | | |
| SSTR2C01 | SSTR2C01G_PE | 5/18/2006 | SW6020 | TUNGSTEN | 0.47 | | 0.0074 | 0.15 | mg/Kg | | | | | | | | | | |
| SSTR2C01 | SSTR2C01G_PEREP1 | 5/18/2006 | SW6020 | TUNGSTEN | 0.3 | | 0.0074 | 0.15 | mg/Kg | | | | | | | | | | |
| SSTR2C01 | SSTR2C01G_PEREP2 | 5/18/2006 | SW6020 | TUNGSTEN | 0.52 | | 0.0072 | 0.14 | mg/Kg | | | | | | | | | | |
| **Area 2 East (0-3")** | | | | | | | | | | | | | | | | | | | |
| SSTR2E01 | SSTR2E01_C | 4/21/2006 | SW6010B | ALUMINUM | 10100 | | 2.7 | 15.75 | mg/Kg | 16019 | | 54006 | | 7614.20 | X | | | | |
| SSTR2E01 | SSTR2E01_C | 4/21/2006 | SW6010B | ARSENIC | 2.7 | | 0.21 | 0.79 | mg/Kg | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| SSTR2E01 | SSTR2E01_C | 4/21/2006 | SW6010B | BARIUM | 15.9 | | 0.74 | 15.75 | mg/Kg | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| SSTR2E01 | SSTR2E01_C | 4/21/2006 | SW6010B | BERYLLIUM | 0.23 | J | 0.016 | 0.39 | mg/Kg | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |

SSL - MMR Soil Screening Level
PRG - Preliminary Remediation Goal
BKGD - MMR Background Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1 - MCP Reportable Concentration for S1 Soil

J - Estimated value
NJ - TIC

## Table 3-4
## T Range Project Note Soil Analytical Results

| Location | Sample ID | Date | Test | Analyte | Result | Qual | DL | RL | Units | Bkgd Outwash (0-1') | > Bkgd | SSLs | > SSL | PRG | > PRG | S-1/ GW-1 | > S-1/ GW-1 | RSC-1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SSTR2E01 | SSTR2E01_C | 4/21/2006 | SW6010B | BORON | 0.7 | J | 0.48 | 7.87 | mg/Kg | 9.6 | | 9.52 | | 1600 | | | | | |
| SSTR2E01 | SSTR2E01_C | 4/21/2006 | SW6010B | CADMIUM | 0.091 | J | 0.063 | 0.39 | mg/Kg | 0.94 | | 0.40 | | 3.7 | | 30 | | 30 | |
| SSTR2E01 | SSTR2E01_C | 4/21/2006 | SW6010B | CALCIUM | 329 | J | 27.4 | 393.70 | mg/Kg | 288 | X | | | | | | | | |
| SSTR2E01 | SSTR2E01_C | 4/21/2006 | SW6010B | COBALT | 2.2 | J | 0.23 | 3.94 | mg/Kg | 4 | | 132.38 | | 902.89 | | | | 500 | |
| SSTR2E01 | SSTR2E01_C | 4/21/2006 | SW6010B | COPPER | 174 | | 0.17 | 1.97 | mg/Kg | 11 | X | 45.73 | X | 312.86 | | | | 1000 | |
| SSTR2E01 | SSTR2E01_C | 4/21/2006 | SW6010B | IRON | 11500 | | 3.1 | 15.75 | mg/Kg | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| SSTR2E01 | SSTR2E01_C | 4/21/2006 | SW6010B | LEAD | 78.3 | | 0.18 | 0.79 | mg/Kg | 19 | X | 4.05 | X | 40 | X | 300 | | 300 | |
| SSTR2E01 | SSTR2E01_C | 4/21/2006 | SW6010B | MAGNESIUM | 833 | | 21.7 | 393.70 | mg/Kg | 2010 | | | | | | | | | |
| SSTR2E01 | SSTR2E01_C | 4/21/2006 | SW6010B | MANGANESE | 61.7 | | 0.079 | 1.18 | mg/Kg | 134 | | 44.15 | X | 176.24 | | | | | |
| SSTR2E01 | SSTR2E01_C | 4/21/2006 | SW7471A | MERCURY | 0.031 | J | 0.015 | 0.04 | mg/Kg | 0.12 | | 0.02 | X | 2.35 | | 20 | | 20 | |
| SSTR2E01 | SSTR2E01_C | 4/21/2006 | SW6010B | MOLYBDENUM | 1.4 | | 0.1 | 0.79 | mg/Kg | 1.2 | X | 0.18 | X | 39.11 | | | | | |
| SSTR2E01 | SSTR2E01_C | 4/21/2006 | SW6010B | NICKEL | 7.4 | | 0.17 | 3.15 | mg/Kg | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| SSTR2E01 | SSTR2E01_C | 4/21/2006 | SW6010B | POTASSIUM | 622 | | 35.2 | 393.70 | mg/Kg | 766 | | | | | | | | | |
| SSTR2E01 | SSTR2E01_C | 4/21/2006 | SW6010B | SODIUM | 132 | J | 44.4 | 393.70 | mg/Kg | 196 | | | | | | | | | |
| SSTR2E01 | SSTR2E01_C | 4/21/2006 | SW6020 | TUNGSTEN | 15.5 | | 0.036 | 0.73 | mg/Kg | | | | | | | | | | |
| SSTR2E01 | SSTR2E01_C | 4/21/2006 | SW6010B | VANADIUM | 24 | | 0.26 | 3.94 | mg/Kg | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| SSTR2E01 | SSTR2E01_C | 4/21/2006 | SW6010B | ZINC | 12.5 | | 0.5 | 1.57 | mg/Kg | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| SSTR2E01 | SSTR2E01_PE | 5/18/2006 | SW6020 | Non-Detect on TUNGSTEN | ND | U | 0.15 | 0.18 | mg/Kg | | | | | | | | | | |
| SSTR2E01 | SSTR2E01G_PE | 5/18/2006 | SW6020 | TUNGSTEN | 0.52 | | 0.0074 | 0.15 | mg/Kg | | | | | | | | | | |
| **Area 2 West (0-3")** | | | | | | | | | | | | | | | | | | | |
| SSTR2W01 | SSTR2W01_C | 4/21/2006 | SW6010B | ALUMINUM | 13400 | | 2.6 | 15.50 | mg/Kg | 16019 | | 54006 | | 7614.20 | X | | | | |
| SSTR2W01 | SSTR2W01_C | 4/21/2006 | SW6010B | ARSENIC | 3.9 | | 0.21 | 0.78 | mg/Kg | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| SSTR2W01 | SSTR2W01_C | 4/21/2006 | SW6010B | BARIUM | 21.7 | | 0.73 | 15.50 | mg/Kg | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| SSTR2W01 | SSTR2W01_C | 4/21/2006 | SW6010B | BERYLLIUM | 0.33 | J | 0.015 | 0.39 | mg/Kg | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| SSTR2W01 | SSTR2W01_C | 4/21/2006 | SW6010B | BORON | 1.3 | J | 0.47 | 7.75 | mg/Kg | 9.6 | | 9.52 | | 1600 | | | | | |
| SSTR2W01 | SSTR2W01_C | 4/21/2006 | SW6010B | CADMIUM | 0.13 | J | 0.062 | 0.39 | mg/Kg | 0.94 | | 0.40 | | 3.7 | | 30 | | 30 | |
| SSTR2W01 | SSTR2W01_C | 4/21/2006 | SW6010B | CALCIUM | 365 | J | 27 | 387.60 | mg/Kg | 288 | X | | | | | | | | |
| SSTR2W01 | SSTR2W01_C | 4/21/2006 | SW6010B | COBALT | 3.5 | J | 0.22 | 3.88 | mg/Kg | 4 | | 132.38 | | 902.89 | | | | 500 | |
| SSTR2W01 | SSTR2W01_C | 4/21/2006 | SW6010B | COPPER | 312 | | 0.17 | 1.94 | mg/Kg | 11 | X | 45.73 | X | 312.86 | | | | 1000 | |
| SSTR2W01 | SSTR2W01_C | 4/21/2006 | SW6010B | IRON | 16100 | | 3.1 | 15.50 | mg/Kg | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| SSTR2W01 | SSTR2W01_C | 4/21/2006 | SW6010B | LEAD | 131 | | 0.18 | 0.78 | mg/Kg | 19 | X | 4.05 | X | 40 | X | 300 | | 300 | |
| SSTR2W01 | SSTR2W01_C | 4/21/2006 | SW6010B | MAGNESIUM | 1370 | | 21.4 | 387.60 | mg/Kg | 2010 | | | | | | | | | |
| SSTR2W01 | SSTR2W01_C | 4/21/2006 | SW6010B | MANGANESE | 91.6 | | 0.077 | 1.16 | mg/Kg | 134 | | 44.15 | X | 176.24 | | | | | |
| SSTR2W01 | SSTR2W01_C | 4/21/2006 | SW7471A | MERCURY | 0.025 | J | 0.013 | 0.03 | mg/Kg | 0.12 | | 0.02 | X | 2.35 | | 20 | | 20 | |
| SSTR2W01 | SSTR2W01_C | 4/21/2006 | SW6010B | MOLYBDENUM | 1.9 | | 0.1 | 0.78 | mg/Kg | 1.2 | X | 0.18 | X | 39.11 | | | | | |
| SSTR2W01 | SSTR2W01_C | 4/21/2006 | SW6010B | NICKEL | 11.3 | | 0.17 | 3.10 | mg/Kg | 10 | X | 292.13 | | 156.43 | | 300 | | 300 | |
| SSTR2W01 | SSTR2W01_C | 4/21/2006 | SW6010B | POTASSIUM | 826 | | 34.7 | 387.60 | mg/Kg | 766 | X | | | | | | | | |
| SSTR2W01 | SSTR2W01_C | 4/21/2006 | SW6010B | SODIUM | 197 | J | 43.7 | 387.60 | mg/Kg | 196 | X | | | | | | | | |
| SSTR2W01 | SSTR2W01_C | 4/21/2006 | SW6020 | TUNGSTEN | 25.4 | | 0.076 | 1.53 | mg/Kg | | | | | | | | | | |
| SSTR2W01 | SSTR2W01_C | 4/21/2006 | SW6010B | VANADIUM | 29.2 | | 0.26 | 3.88 | mg/Kg | 28.8 | X | 260.05 | | 7.82 | X | 400 | | 400 | |
| SSTR2W01 | SSTR2W01_C | 4/21/2006 | SW6010B | ZINC | 17.4 | | 0.5 | 1.55 | mg/Kg | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |

SSL - MMR Soil Screening Level
PRG - Preliminary Remediation Goal
BKGD - MMR Background Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1 - MCP Reportable Concentration for S1 Soil

J - Estimated value
NJ - TIC

## Table 3-4
## T Range Project Note Soil Analytical Results

| Location | Sample ID | Date | Test | Analyte | Result | Qual | DL | RL | Units | Bkgd Outwash (0-1') | > Bkgd | SSLs | > SSL | PRG | > PRG | S-1/ GW-1 | > S-1/ GW-1 | RSC-1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SSTR2W01 | SSTR2W01_PE | 5/18/2006 | SW6020 | Non-Detect on TUNGSTEN | ND | U | 0.092 | 0.17 | mg/Kg | | | | | | | | | | |
| SSTR2W01 | SSTR2W01G_PE | 5/18/2006 | SW6020 | TUNGSTEN | 0.35 | | 0.0074 | 0.15 | mg/Kg | | | | | | | | | | |
| **Area 3 Center (0-3")** | | | | | | | | | | | | | | | | | | | |
| SSTR3C01 | SSTR3C01_C | 4/21/2006 | E331.0 | Non-Detect on PERCHLORATE | ND | U | 0.8 | 0.8 | ug/Kg | | | 3.14 | | 7821 | | | | | |
| SSTR3C01 | SSTR3C01_C | 4/21/2006 | SW6010B | ALUMINUM | 10900 | | 2.7 | 16 | mg/Kg | 16019 | | 54006 | | 7614.20 | X | | | | |
| SSTR3C01 | SSTR3C01_C | 4/21/2006 | SW6010B | ARSENIC | 3.2 | | 0.22 | 0.8 | mg/Kg | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| SSTR3C01 | SSTR3C01_C | 4/21/2006 | SW6010B | BARIUM | 16.7 | | 0.75 | 16 | mg/Kg | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| SSTR3C01 | SSTR3C01_C | 4/21/2006 | SW6010B | BERYLLIUM | 0.26 | J | 0.016 | 0.4 | mg/Kg | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| SSTR3C01 | SSTR3C01_C | 4/21/2006 | SW6010B | BORON | 0.97 | J | 0.49 | 8 | mg/Kg | 9.6 | | 9.52 | | 1600 | | | | | |
| SSTR3C01 | SSTR3C01_C | 4/21/2006 | SW6010B | CADMIUM | 0.11 | J | 0.064 | 0.4 | mg/Kg | 0.94 | | 0.40 | | 3.7 | | 30 | | 30 | |
| SSTR3C01 | SSTR3C01_C | 4/21/2006 | SW6010B | CALCIUM | 228 | J | 27.8 | 400 | mg/Kg | 288 | | | | | | | | | |
| SSTR3C01 | SSTR3C01_C | 4/21/2006 | SW6010B | COBALT | 2.7 | J | 0.23 | 4 | mg/Kg | 4 | | 132.38 | | 902.89 | | | | 500 | |
| SSTR3C01 | SSTR3C01_C | 4/21/2006 | SW6010B | COPPER | 36 | | 0.18 | 2 | mg/Kg | 11 | X | 45.73 | | 312.86 | | | | 1000 | |
| SSTR3C01 | SSTR3C01_C | 4/21/2006 | SW6010B | IRON | 13200 | | 3.2 | 16 | mg/Kg | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| SSTR3C01 | SSTR3C01_C | 4/21/2006 | SW6010B | LEAD | 66.2 | | 0.18 | 0.8 | mg/Kg | 19 | X | 4.05 | X | 40 | X | 300 | | 300 | |
| SSTR3C01 | SSTR3C01_C | 4/21/2006 | SW6010B | MAGNESIUM | 934 | | 22.1 | 400 | mg/Kg | 2010 | | | | | | | | | |
| SSTR3C01 | SSTR3C01_C | 4/21/2006 | SW6010B | MANGANESE | 87.4 | | 0.08 | 1.2 | mg/Kg | 134 | | 44.15 | X | 176.24 | | | | | |
| SSTR3C01 | SSTR3C01_C | 4/21/2006 | SW7471A | MERCURY | 0.032 | J | 0.014 | 0.03 | mg/Kg | 0.12 | | 0.02 | X | 2.35 | | 20 | | 20 | |
| SSTR3C01 | SSTR3C01_C | 4/21/2006 | SW6010B | MOLYBDENUM | 1.4 | | 0.1 | 0.8 | mg/Kg | 1.2 | X | 0.18 | X | 39.11 | | | | | |
| SSTR3C01 | SSTR3C01_C | 4/21/2006 | SW6010B | NICKEL | 8.3 | | 0.18 | 3.2 | mg/Kg | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| SSTR3C01 | SSTR3C01_C | 4/21/2006 | SW6010B | POTASSIUM | 589 | | 35.8 | 400 | mg/Kg | 766 | | | | | | | | | |
| SSTR3C01 | SSTR3C01_C | 4/21/2006 | SW6010B | SODIUM | 85 | J | 45.1 | 400 | mg/Kg | 196 | | | | | | | | | |
| SSTR3C01 | SSTR3C01_C | 4/21/2006 | SW6020 | TUNGSTEN | 3 | | 0.037 | 0.74 | mg/Kg | | | | | | | | | | |
| SSTR3C01 | SSTR3C01_C | 4/21/2006 | SW6010B | VANADIUM | 24.4 | | 0.26 | 4 | mg/Kg | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| SSTR3C01 | SSTR3C01_C | 4/21/2006 | SW6010B | ZINC | 14.4 | | 0.51 | 1.6 | mg/Kg | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| **Area 3 Center Replicate (0-3")** | | | | | | | | | | | | | | | | | | | |
| SSTR3C01 | SSTR3C01_C (REP) | 4/21/2006 | E331.0 | Non-Detect on PERCHLORATE | ND | U | 0.8 | 0.8 | ug/Kg | | | 3.14 | | 7821 | | | | | |
| SSTR3C01 | SSTR3C01_C (REP) | 4/21/2006 | SW6010B | ALUMINUM | 12000 | | 2.5 | 14.93 | mg/Kg | 16019 | | 54006 | | 7614.20 | X | | | | |
| SSTR3C01 | SSTR3C01_C (REP) | 4/21/2006 | SW6010B | ARSENIC | 3.2 | | 0.2 | 0.75 | mg/Kg | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| SSTR3C01 | SSTR3C01_C (REP) | 4/21/2006 | SW6010B | BARIUM | 17.1 | | 0.7 | 14.93 | mg/Kg | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| SSTR3C01 | SSTR3C01_C (REP) | 4/21/2006 | SW6010B | BERYLLIUM | 0.29 | J | 0.015 | 0.37 | mg/Kg | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| SSTR3C01 | SSTR3C01_C (REP) | 4/21/2006 | SW6010B | BORON | 0.85 | J | 0.46 | 7.46 | mg/Kg | 9.6 | | 9.52 | | 1600 | | | | | |
| SSTR3C01 | SSTR3C01_C (REP) | 4/21/2006 | SW6010B | CADMIUM | 0.13 | J | 0.06 | 0.37 | mg/Kg | 0.94 | | 0.40 | | 3.7 | | 30 | | 30 | |
| SSTR3C01 | SSTR3C01_C (REP) | 4/21/2006 | SW6010B | CALCIUM | 213 | J | 26 | 373.13 | mg/Kg | 288 | | | | | | | | | |
| SSTR3C01 | SSTR3C01_C (REP) | 4/21/2006 | SW6010B | COBALT | 2.8 | J | 0.22 | 3.73 | mg/Kg | 4 | | 132.38 | | 902.89 | | | | 500 | |
| SSTR3C01 | SSTR3C01_C (REP) | 4/21/2006 | SW6010B | COPPER | 31.6 | | 0.16 | 1.87 | mg/Kg | 11 | X | 45.73 | | 312.86 | | | | 1000 | |
| SSTR3C01 | SSTR3C01_C (REP) | 4/21/2006 | SW6010B | IRON | 14300 | | 3 | 14.93 | mg/Kg | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| SSTR3C01 | SSTR3C01_C (REP) | 4/21/2006 | SW6010B | LEAD | 97.1 | | 0.17 | 0.75 | mg/Kg | 19 | X | 4.05 | X | 40 | X | 300 | | 300 | |
| SSTR3C01 | SSTR3C01_C (REP) | 4/21/2006 | SW6010B | MAGNESIUM | 1020 | | 20.6 | 373.13 | mg/Kg | 2010 | | | | | | | | | |
| SSTR3C01 | SSTR3C01_C (REP) | 4/21/2006 | SW6010B | MANGANESE | 76.9 | | 0.075 | 1.12 | mg/Kg | 134 | | 44.15 | X | 176.24 | | | | | |
| SSTR3C01 | SSTR3C01_C (REP) | 4/21/2006 | SW7471A | MERCURY | 0.031 | J | 0.015 | 0.04 | mg/Kg | 0.12 | | 0.02 | X | 2.35 | | 20 | | 20 | |

SSL - MMR Soil Screening Level
PRG - Preliminary Remediation Goal
BKGD - MMR Background Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1 - MCP Reportable Concentration for S1 Soil

J - Estimated value
NJ - TIC

# Table 3-4
# T Range Project Note Soil Analytical Results

| Location | Sample ID | Date | Test | Analyte | Result | Qual | DL | RL | Units | Bkgd Outwash (0-1') | > Bkgd | SSLs | > SSL | PRG | > PRG | S-1/ GW-1 | > S-1/ GW-1 | RSC-1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SSTR3C01 | SSTR3C01_C (REP) | 4/21/2006 | SW6010B | MOLYBDENUM | 1.5 | | 0.097 | 0.75 | mg/Kg | 1.2 | X | 0.18 | X | 39.11 | | | | | |
| SSTR3C01 | SSTR3C01_C (REP) | 4/21/2006 | SW6010B | NICKEL | 8.7 | | 0.16 | 2.99 | mg/Kg | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| SSTR3C01 | SSTR3C01_C (REP) | 4/21/2006 | SW6010B | POTASSIUM | 609 | | 33.4 | 373.13 | mg/Kg | 766 | | | | | | | | | |
| SSTR3C01 | SSTR3C01_C (REP) | 4/21/2006 | SW6010B | SODIUM | 84.7 | J | 42.1 | 373.13 | mg/Kg | 196 | | | | | | | | | |
| SSTR3C01 | SSTR3C01_C (REP) | 4/21/2006 | SW6020 | TUNGSTEN | 3.2 | | 0.037 | 0.74 | mg/Kg | | | | | | | | | | |
| SSTR3C01 | SSTR3C01_C (REP) | 4/21/2006 | SW6010B | VANADIUM | 26.7 | | 0.25 | 3.73 | mg/Kg | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| SSTR3C01 | SSTR3C01_C (REP) | 4/21/2006 | SW6010B | ZINC | 14.4 | | 0.48 | 1.49 | mg/Kg | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| **Area 3 East (0-3")** | | | | | | | | | | | | | | | | | | | |
| SSTR3E01 | SSTR3E01_C | 4/21/2006 | SW6010B | ALUMINUM | 13400 | | 2.6 | 15.38 | mg/Kg | 16019 | | 54006 | | 7614.20 | X | | | | |
| SSTR3E01 | SSTR3E01_C | 4/21/2006 | SW6010B | ARSENIC | 3.9 | | 0.21 | 0.77 | mg/Kg | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| SSTR3E01 | SSTR3E01_C | 4/21/2006 | SW6010B | BARIUM | 20.1 | | 0.72 | 15.38 | mg/Kg | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| SSTR3E01 | SSTR3E01_C | 4/21/2006 | SW6010B | BERYLLIUM | 0.33 | J | 0.015 | 0.38 | mg/Kg | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| SSTR3E01 | SSTR3E01_C | 4/21/2006 | SW6010B | BORON | 1.2 | J | 0.47 | 7.69 | mg/Kg | 9.6 | | 9.52 | | 1600 | | | | | |
| SSTR3E01 | SSTR3E01_C | 4/21/2006 | SW6010B | CADMIUM | 0.096 | J | 0.061 | 0.38 | mg/Kg | 0.94 | | 0.40 | | 3.7 | | 30 | | 30 | |
| SSTR3E01 | SSTR3E01_C | 4/21/2006 | SW6010B | CALCIUM | 248 | J | 26.8 | 384.62 | mg/Kg | 288 | | | | | | | | | |
| SSTR3E01 | SSTR3E01_C | 4/21/2006 | SW6010B | COBALT | 3.6 | J | 0.22 | 3.85 | mg/Kg | 4 | | 132.38 | | 902.89 | | | | 500 | |
| SSTR3E01 | SSTR3E01_C | 4/21/2006 | SW6010B | COPPER | 29.1 | | 0.17 | 1.92 | mg/Kg | 11 | X | 45.73 | | 312.86 | | | | 1000 | |
| SSTR3E01 | SSTR3E01_C | 4/21/2006 | SW6010B | IRON | 15600 | | 3.1 | 15.38 | mg/Kg | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| SSTR3E01 | SSTR3E01_C | 4/21/2006 | SW6010B | LEAD | 82.5 | | 0.18 | 0.77 | mg/Kg | 19 | X | 4.05 | X | 40 | X | 300 | | 300 | |
| SSTR3E01 | SSTR3E01_C | 4/21/2006 | SW6010B | MAGNESIUM | 1190 | | 21.2 | 384.62 | mg/Kg | 2010 | | | | | | | | | |
| SSTR3E01 | SSTR3E01_C | 4/21/2006 | SW6010B | MANGANESE | 82.8 | | 0.077 | 1.15 | mg/Kg | 134 | | 44.15 | X | 176.24 | | | | | |
| SSTR3E01 | SSTR3E01_C | 4/21/2006 | SW7471A | MERCURY | 0.033 | | 0.013 | 0.03 | mg/Kg | 0.12 | | 0.02 | X | 2.35 | | 20 | | 20 | |
| SSTR3E01 | SSTR3E01_C | 4/21/2006 | SW6010B | MOLYBDENUM | 1.6 | | 0.1 | 0.77 | mg/Kg | 1.2 | X | 0.18 | X | 39.11 | | | | | |
| SSTR3E01 | SSTR3E01_C | 4/21/2006 | SW6010B | NICKEL | 10.6 | | 0.17 | 3.08 | mg/Kg | 10 | X | 292.13 | | 156.43 | | 300 | | 300 | |
| SSTR3E01 | SSTR3E01_C | 4/21/2006 | SW6010B | POTASSIUM | 778 | | 34.4 | 384.62 | mg/Kg | 766 | X | | | | | | | | |
| SSTR3E01 | SSTR3E01_C | 4/21/2006 | SW6010B | SODIUM | 150 | J | 43.4 | 384.62 | mg/Kg | 196 | | | | | | | | | |
| SSTR3E01 | SSTR3E01_C | 4/21/2006 | SW6020 | TUNGSTEN | 11.8 | | 0.038 | 0.77 | mg/Kg | | | | | | | | | | |
| SSTR3E01 | SSTR3E01_C | 4/21/2006 | SW6010B | VANADIUM | 29.3 | | 0.25 | 3.85 | mg/Kg | 28.8 | X | 260.05 | | 7.82 | X | 400 | | 400 | |
| SSTR3E01 | SSTR3E01_C | 4/21/2006 | SW6010B | ZINC | 16.5 | | 0.49 | 1.54 | mg/Kg | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |
| **Area 3 West (0-3")** | | | | | | | | | | | | | | | | | | | |
| SSTR3W01 | SSTR3W01_C | 4/21/2006 | SW6010B | ALUMINUM | 11200 | | 2.6 | 15.50 | mg/Kg | 16019 | | 54006 | | 7614.20 | X | | | | |
| SSTR3W01 | SSTR3W01_C | 4/21/2006 | SW6010B | ARSENIC | 3.3 | | 0.21 | 0.78 | mg/Kg | 5.5 | | 0.009 | X | 0.39 | X | 30 | | 30 | |
| SSTR3W01 | SSTR3W01_C | 4/21/2006 | SW6010B | BARIUM | 18.5 | | 0.73 | 15.50 | mg/Kg | 24 | | 120.35 | | 537.49 | | 1000 | | 1000 | |
| SSTR3W01 | SSTR3W01_C | 4/21/2006 | SW6010B | BERYLLIUM | 0.27 | J | 0.015 | 0.39 | mg/Kg | 0.38 | | 2.60 | | 15.44 | | 0.7 | | 0.7 | |
| SSTR3W01 | SSTR3W01_C | 4/21/2006 | SW6010B | BORON | 1.3 | J | 0.47 | 7.75 | mg/Kg | 9.6 | | 9.52 | | 1600 | | | | | |
| SSTR3W01 | SSTR3W01_C | 4/21/2006 | SW6010B | CADMIUM | 0.14 | J | 0.062 | 0.39 | mg/Kg | 0.94 | | 0.40 | | ` | | 30 | | 30 | |
| SSTR3W01 | SSTR3W01_C | 4/21/2006 | SW6010B | CALCIUM | 297 | J | 27 | 387.60 | mg/Kg | 288 | X | | | | | | | | |
| SSTR3W01 | SSTR3W01_C | 4/21/2006 | SW6010B | COBALT | 2.9 | J | 0.22 | 3.88 | mg/Kg | 4 | | 132.38 | | 902.89 | | | | 500 | |
| SSTR3W01 | SSTR3W01_C | 4/21/2006 | SW6010B | COPPER | 8.4 | | 0.17 | 1.94 | mg/Kg | 11 | | 45.73 | | 312.86 | | | | 1000 | |
| SSTR3W01 | SSTR3W01_C | 4/21/2006 | SW6010B | IRON | 13500 | | 3.1 | 15.50 | mg/Kg | 17800 | | 2421.92 | X | 2346.32 | X | | | | |
| SSTR3W01 | SSTR3W01_C | 4/21/2006 | SW6010B | LEAD | 41.4 | | 0.18 | 0.78 | mg/Kg | 19 | X | 4.05 | X | 40 | X | 300 | | 300 | |

SSL - MMR Soil Screening Level
PRG - Preliminary Remediation Goal
BKGD - MMR Background Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1 - MCP Reportable Concentration for S1 Soil

J - Estimated value
NJ - TIC

## Table 3-4
## T Range Project Note Soil Analytical Results

| Location | Sample ID | Date | Test | Analyte | Result | Qual | DL | RL | Units | Bkgd Outwash (0-1') | > Bkgd | SSLs | > SSL | PRG | > PRG | S-1/ GW-1 | > S-1/ GW-1 | RSC-1 | > RCS1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SSTR3W01 | SSTR3W01_C | 4/21/2006 | SW6010B | MAGNESIUM | 996 | | 21.4 | 387.60 | mg/Kg | 2010 | | | | | | | | | |
| SSTR3W01 | SSTR3W01_C | 4/21/2006 | SW6010B | MANGANESE | 80.2 | | 0.077 | 1.16 | mg/Kg | 134 | | 44.15 | X | 176.24 | | | | | |
| SSTR3W01 | SSTR3W01_C | 4/21/2006 | SW7471A | MERCURY | 0.03 | J | 0.015 | 0.04 | mg/Kg | 0.12 | | 0.02 | X | 2.35 | | 20 | | 20 | |
| SSTR3W01 | SSTR3W01_C | 4/21/2006 | SW6010B | MOLYBDENUM | 1.6 | | 0.1 | 0.78 | mg/Kg | 1.2 | X | 0.18 | X | 39.11 | | | | | |
| SSTR3W01 | SSTR3W01_C | 4/21/2006 | SW6010B | NICKEL | 9.2 | | 0.17 | 3.10 | mg/Kg | 10 | | 292.13 | | 156.43 | | 300 | | 300 | |
| SSTR3W01 | SSTR3W01_C | 4/21/2006 | SW6010B | POTASSIUM | 682 | | 34.7 | 387.60 | mg/Kg | 766 | | | | | | | | | |
| SSTR3W01 | SSTR3W01_C | 4/21/2006 | SW6010B | SODIUM | 132 | J | 43.7 | 387.60 | mg/Kg | 196 | | | | | | | | | |
| SSTR3W01 | SSTR3W01_C | 4/21/2006 | SW6020 | TUNGSTEN | 0.69 | | 0.007 | 0.14 | mg/Kg | | | | | | | | | | |
| SSTR3W01 | SSTR3W01_C | 4/21/2006 | SW6010B | VANADIUM | 25.8 | | 0.26 | 3.88 | mg/Kg | 28.8 | | 260.05 | | 7.82 | X | 400 | | 400 | |
| SSTR3W01 | SSTR3W01_C | 4/21/2006 | SW6010B | ZINC | 14.2 | | 0.5 | 1.55 | mg/Kg | 25.6 | | 2201.92 | | 2346.32 | | 2500 | | 2500 | |

SSL - MMR Soil Screening Level
PRG - Preliminary Remediation Goal
BKGD - MMR Background Soil Concentration
S-1/GW-1 - MCP Method 1 value
RCS1 - MCP Reportable Concentration for S1 Soil

J - Estimated value
NJ - TIC

# Table 3-5
# T Range Groundwater Analytical Results

| Location | Sample ID | Date | Northing Coordinate on Surface (N83UTM m) | Easting Coordinate on Surface (N83UTM m) | Depth to Screen top (ft bgl) | Depth to Screen bot (ft bgl) | Test | Analyte | Result | Qual | DL | RL | Units |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-467S | MW-467S-01 | 10/9/2006 | 4621080.3 | 373707.6 | 124.75 | 134.75 | SW8330 | Non-Detect on all 19 analytes | ND | U | | | µg/L |
| MW-467S | MW-467S-01 | 10/9/2006 | 4621080.3 | 373707.6 | 124.75 | 134.75 | SW6010B | ARSENIC (TOTAL) | ND | U | 4.3 | 4.3 | µg/L |
| MW-467S | MW-467S-01 | 10/9/2006 | 4621080.3 | 373707.6 | 124.75 | 134.75 | SW6010B | BARIUM (TOTAL) | ND | U | 6.4 | 6.4 | µg/L |
| MW-467S | MW-467S-01 | 10/9/2006 | 4621080.3 | 373707.6 | 124.75 | 134.75 | SW6010B | CADMIUM (TOTAL) | ND | U | 0.5 | 0.5 | µg/L |
| MW-467S | MW-467S-01 | 10/9/2006 | 4621080.3 | 373707.6 | 124.75 | 134.75 | SW6010B | CHROMIUM (TOTAL) | ND | UJ | 0.7 | 0.7 | µg/L |
| MW-467S | MW-467S-01 | 10/9/2006 | 4621080.3 | 373707.6 | 124.75 | 134.75 | SW6010B | LEAD (TOTAL) | ND | U | 2.8 | 2.8 | µg/L |
| MW-467S | MW-467S-01 | 10/9/2006 | 4621080.3 | 373707.6 | 124.75 | 134.75 | SW6010B | SELENIUM (TOTAL) | ND | U | 4.5 | 4.5 | µg/L |
| MW-467S | MW-467S-01 | 10/9/2006 | 4621080.3 | 373707.6 | 124.75 | 134.75 | SW6010B | SILVER (TOTAL) | ND | UJ | 1.4 | 1.4 | µg/L |
| MW-467S | MW-467S-01 | 10/9/2006 | 4621080.3 | 373707.6 | 124.75 | 134.75 | SW7470A | MERCURY (TOTAL) | ND | U | 0.1 | 0.1 | µg/L |
| MW-467S | MW-467S-01 | 10/9/2006 | 4621080.3 | 373707.6 | 124.75 | 134.75 | SW6020 | TUNGSTEN (TOTAL) | 2.9 | | 0.2 | 2 | µg/L |
| MW-467S | MW-467S-01 | 10/9/2006 | 4621080.3 | 373707.6 | 124.75 | 134.75 | SW6020 | TUNGSTEN (DISSOLVED) | 1.9 | J | 0.2 | 2 | µg/L |
| MW-467S | MW-467S-01 | 10/9/2006 | 4621080.3 | 373707.6 | 124.75 | 134.75 | SW8270C | Non-Detect on all 78 analytes | ND | U | | | µg/L |
| | | | | | | | | | | | | | |
| MW-467S | MW-467S-01 FD | 10/9/2006 | 4621080.3 | 373707.6 | 124.75 | 134.75 | SW8330 | Non-Detect on all 19 analytes | ND | U | | | µg/L |
| MW-467S | MW-467S-01 FD | 10/9/2006 | 4621080.3 | 373707.6 | 124.75 | 134.75 | SW6010B | ARSENIC (TOTAL) | ND | U | 4.3 | 4.3 | µg/L |
| MW-467S | MW-467S-01 FD | 10/9/2006 | 4621080.3 | 373707.6 | 124.75 | 134.75 | SW6010B | BARIUM (TOTAL) | ND | U | 6.4 | 6.4 | µg/L |
| MW-467S | MW-467S-01 FD | 10/9/2006 | 4621080.3 | 373707.6 | 124.75 | 134.75 | SW6010B | CADMIUM (TOTAL) | ND | U | 0.5 | 0.5 | µg/L |
| MW-467S | MW-467S-01 FD | 10/9/2006 | 4621080.3 | 373707.6 | 124.75 | 134.75 | SW6010B | CHROMIUM (TOTAL) | ND | UJ | 0.7 | 0.7 | µg/L |
| MW-467S | MW-467S-01 FD | 10/9/2006 | 4621080.3 | 373707.6 | 124.75 | 134.75 | SW6010B | LEAD (TOTAL) | ND | U | 2.8 | 2.8 | µg/L |
| MW-467S | MW-467S-01 FD | 10/9/2006 | 4621080.3 | 373707.6 | 124.75 | 134.75 | SW6010B | SELENIUM (TOTAL) | ND | U | 4.5 | 4.5 | µg/L |
| MW-467S | MW-467S-01 FD | 10/9/2006 | 4621080.3 | 373707.6 | 124.75 | 134.75 | SW6010B | SILVER (TOTAL) | ND | UJ | 1.4 | 1.4 | µg/L |
| MW-467S | MW-467S-01 FD | 10/9/2006 | 4621080.3 | 373707.6 | 124.75 | 134.75 | SW7470A | MERCURY (TOTAL) | ND | U | 0.1 | 0.1 | µg/L |
| MW-467S | MW-467S-01 FD | 10/9/2006 | 4621080.3 | 373707.6 | 124.75 | 134.75 | SW6020 | TUNGSTEN (TOTAL) | 2.2 | | 0.2 | 2 | µg/L |
| MW-467S | MW-467S-01 FD | 10/9/2006 | 4621080.3 | 373707.6 | 124.75 | 134.75 | SW8270C | Non-Detect on all 78 analytes | ND | U | | | µg/L |

DL - Instrument Detection Limit
RL - Reporting Limit
ND - Non Detect
UJ - Non detect at RL, estimated value
U - Non detect at RL

**Table 5-1**
**Contaminants of Potential Concern, Summary of Sampling Results, and Calculated Exposure Point Concentrations for the T Range Exposure Areas**

| Contaminant of Potential Concern | Area 1 | | | | | Area 2 (Post-Excavation) + Area 3 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Frequency of Detection (Detects/ Samples) | Minimum Detected Conc. (mg/kg) | Mean Detected Conc. (mg/kg) | Maximum Detected Conc. (mg/kg) | Exposure Point Conc. (mg/kg) | Frequency of Detection (Detects/ Samples) | Minimum Detected Conc. (mg/kg) | Mean Detected Conc. (mg/kg) | Maximum Detected Conc. (mg/kg) | Exposure Point Conc. (mg/kg) |
| | | | | | | | | | | |
| Aluminum | 44 / 44 | 4,560 | 8,449 | 20,400 | 9,213 | 4 / 4 | 10,900 | 11,875 | 13,400 | 13,190 |
| Antimony | 23 / 44 | 0.4 J | 3.51 | 91.9 J | 24.17 | Not a Contaminant of Potential Concern | | | | |
| Arsenic | 36 / 44 | 1.8 | 3.27 | 23.4 J | 4.09 | 4 / 4 | 3.2 | 3.4 | 3.9 | 3.9 |
| Lead | 44 / 44 | 3.7 | 285.4 | 5,800 | 285.4 | Not a Chemical of Potential Concern | | | | |
| Tungsten | 8 / 8 | 0.81 | 1.32 | 3.5 | 1.92 | 9 / 14 | 0.3 | 1.525 | 11.8 | 6.83 |
| Vanadium | 44 / 44 | 10.3 | 16.3 | 29.3 | 17.4 | 4 / 4 | 24.4 | 26.55 | 29.3 | 28.98 |
| 1,3-diethyl-1,3-diphenyl urea | 17 / 38 | 0.018 J | 0.513 | 6.2 | 0.76 | Not a Contaminant of Potential Concern | | | | |
| Nitroglycerin | 3 / 4 | 3.2 | 19.4 | 47 | 44.8 | Not a Contaminant of Potential Concern | | | | |

**Notes:**
J = Estimated value
**Samples used to generate the Exposure Pont Concentrations for Area 1:**
Includes samples from locations 169A, 169B, 169C, 169D, 169E, 169F, SSTR1CN01, SSTR1CS01, SSTR1E01, SSTR1W01, SSTR2C01 (post-excavation), SSTR2E01 (post-excavation), SSTR2W01 (post-excavation), SSTR3C01, SSTR3E01, SSTR3W01 including Field Replicates; Field Duplicate samples from Location 169F were averaged.
**Samples used to generate the Exposure Pont Concentrations for Areas 2 (post-excavation) and 3:**
Includes samples from locations SSTR3C01, SSTR3E01, SSTR3W01 and post-excavation samples from SSTR2C01, SSTR2E01, and SSTR2W01 including Field Replicates.

## Table 5-2
## Comparison of Soil Sampling Results to Natural and Anthropogenic Concentrations for the T Range Exposure Areas

| Contaminant of Potential Concern | Area 1 | | Area 2 (Post-Excavation) + Area 3 | | Reference Concentrations | |
|---|---|---|---|---|---|---|
| | Range of Detected Conc. | Mean Detected Conc. | Range of Detected Conc. | Mean Detected Conc. | MMR Outwash Background Concentration [1] | MassDEP Background Concentrations in Natural Soils [2] |
| | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) |
| | | | | | | |
| Aluminum | 4,560 - 20,400 | 8,449 | 10,900 - 13,400 | 11,875 | 16,019 | 10,000 |
| Antimony | 0.4 J - 91.9 J | 3.51 | Not a Contaminant of Potential Concern | | 1.9 | 1.0 |
| Arsenic | 1.8 - 23.4 J | 3.27 | 3.2 - 3.9 | 3.4 | 5.5 | 20 |
| Lead | 3.7 - 5,800 | 285.4 | Not a Contaminant of Potential Concern | | 19 | 100 |
| Tungsten | 0.81 - 3.5 | 1.32 | 0.3 - 11.8 | 1.525 | No Value | No Value |
| Vanadium | 10.3 - 29.3 | 16.3 | 24.4 - 29.3 | 26.55 | 29 | 30 |
| 1,3-diethyl-1,3-diphenyl urea | 0.018 J - 6.2 | 0.513 | Not a Contaminant of Potential Concern | | No Value | No Value |
| Nitroglycerin | 3.2 - 47 | 19.4 | Not a Contaminant of Potential Concern | | No Value | No Value |

**Notes:**

J = Estimated value

[1] The Background Values listed are the values detected from Outwash 0-1'.

[2] The Background Values listed are the those reported for natural soils by MassDEP, 2002. Technical Update: Levels of Polycyclic Aromatic Hydrocarbons and Metals in Soils.

## Table 5-3
## Chemical-Specific Properties of the Contaminants of Potential Concern

| Contaminant of Potential Concern | Dermal Absorption Factor (unitless) | Ref. | Gastro-Intestinal Absorption Efficiency (%) | Ref. | |
|---|---|---|---|---|---|
| Aluminum | No Value | [1] | 100 | [2] | |
| Antimony | No Value | [1] | 15 | [2] | |
| Arsenic | 0.03 | [1] | 95 | [2] | |
| Lead | No Value | [1] | No Value | [2] | |
| Tungsten | No Value | [1] | 100 | [2] | |
| Vanadium | No Value | [1] | 2.6 | [2] | |
| 1,3-diethyl-1,3-diphenyl urea | 0.1 | [1] | No Value | [2] | |
| Nitroglycerin | 0.1 | [1] | 100 | [2] | |

**References:**

[1] USEPA, 2004a. RAGS Part E, Supplemental Guidance for Dermal Risk Assessment, Exhibit 3-4.

[2] USEPA, 2004a. RAGS Part E, Supplemental Guidance for Dermal Risk Assessment, Exhibit 4-1.

**Table 5-4**
**Toxicity Values for the Carcinogenic Contaminants of Potential Concern**

| Contaminant of Potential Concern | Oral Cancer Slope Factor (mg/kg-day)$^{-1}$ | Ref. | Absorbed Dermal Cancer Slope Factor (mg/kg-day)$^{-1}$ | Ref. | Inhalation Unit Risk (mg/m$^3$)$^{-1}$ | Ref. | Inhalation Cancer Slope Factor (mg/kg-day)$^{-1}$ | Ref. | Cancer Guideline Weight of Evidence | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| Aluminum | No Value | - | No Value | - | No Value | - | No Value | - | D | |
| Antimony | No Value | - | No Value | - | No Value | - | No Value | - | - | |
| Arsenic | 1.5E+00 | [1] | 1.5E+00 | [A] | 4.3E+00 | [1] | 1.5E+01 | [C] | A | |
| Lead | No Value | - | No Value | - | No Value | - | No Value | - | B2 | |
| Tungsten | No Value | - | No Value | - | No Value | - | No Value | - | - | |
| Vanadium | No Value | - | No Value | - | No Value | - | No Value | - | - | |
| 1,3-diethyl-1,3-diphenyl urea | No Value | - | No Value | - | No Value | - | No Value | - | - | |
| Nitroglycerin | 1.7E-02 | [2] | 1.7E-02 | [B] | No Value | - | No Value | - | - | |

**Notes:**

[A] Converted from the Oral CSF using an Oral-to-Dermal Adjustment Factor of 95%

[B] Converted from the Oral CSF using an Oral-to-Dermal Adjustment Factor of 100%

[C] Converted from the Inhalation UR using an Inhalation Rate of 20 m$^3$/day and a Body Weight of 70 kg

**References:**


[1] EPA, 2007a. Integrated Risk Information System (IRIS), On-line database accessed 1/31/2007.

[2] EPA, 2007b. Region III Human Health Risk Assessment Risk Based Concentration Table Home Page. http://www.epa.gov/reg3hwmd/risk/human/ (4/6/2007)

**Table 5-5**
**Toxicity Values for the Non-Carcinogenic Contaminants of Potential Concern**

| Contaminant of Potential Concern | Oral Reference Dose - Chronic (mg/kg-day) | Ref. | Absorbed Dermal Reference Dose - Chronic (mg/kg-day) | Ref. | Target Organ / Critical Effect | Uncertainty Factors - Modifying Factor Product | Inhalation Reference Concentration - Chronic ($mg/m^3$) | Ref. | Inhalation Reference Dose - Chronic (mg/kg-day) | Ref. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| Aluminum | 1.0E+00 | [1] | 1.0E+00 | [D] | Neurotoxicity | UFs*MF = 100 | 4.9E-03 | [1] | 1.4E-03 | [E] |
| Antimony | 4.0E-04 | [2] | 6.0E-05 | [A] | Blood | UFs*MF = 1000 | No Value | - | No Value | - |
| Arsenic | 3.0E-04 | [2] | 3.0E-04 | [C] | Pigmentation, Keratosis | UFs*MF = 3 | No Value | - | No Value | - |
| Lead | No Value | - | No Value | - | - | - | No Value | - | No Value | - |
| Tungsten | 2.0E-02 | [3] | 2.0E-02 | [D] | - | UFs*MF = 1000 | No Value | - | No Value | - |
| Vanadium | 1.0E-03 | [4] | 3.0E-05 | [B] | - | - | No Value | - | No Value | - |
| 1,3-diethyl-1,3-diphenyl urea | No Value | - | No Value | - | - | - | No Value | - | No Value | - |
| Nitroglycerin | 1.0E-04 | [5] | 1.0E-04 | [D] | Tachycardia | UFs*MF = 300 | No Value | - | No Value | - |

**Notes:**

[A] Converted from the Oral RfD using an Oral-to-Dermal Adjustment Factor of 15%

[B] Converted from the Oral RfD using an Oral-to-Dermal Adjustment Factor of 2.6%

[C] Converted from the Oral CSF using an Oral-to-Dermal Adjustment Factor of 95%

[D] Converted from the Oral RfD using an Oral-to-Dermal Adjustment Factor of 100%

[E] Converted from the Inhalation RfC using an Inhalation Rate of 20 $m^3$/day and a Body Weight of 70 kg

**References:**


[1] EPA, 2006b. Provisional Peer Reviewed Toxicity Values for Aluminum (CASRN 7429-90-5). Superfund Health Risk Technical

[2] EPA, 2007a. Integrated Risk Information System (IRIS), On-line database accessed 1/27/2007.

[3] USACHPPM, 2007. E-mail correspondence from Larry Cain, USACE, to Ron Marnicio, TetraTechEC regarding Toxicity Factors for Tungsten. January 31.

[4] EPA. 2006a. Region III Risk-Based Concentration Table. http://www.epa.gov/reg3hwmd/risk/human/index.htm. October.

[5] EPA, 2006c. Provisional Peer Reviewed Toxicity Values for Nitroglycerin (CASRN 55-63-0), Derivation of Subchronic and Chronic Oral RfDs. Superfund Health Risk Technical Support Center. August 22.

**Table 5-6**
**Exposure AssessmentSummary/Conceptual Site Model**

| *Scenario Timeframe* | | *Exposure Medium* | *Exposure Point(s)* | *Receptor Population* | *Receptor Age* | *Exposure Route* | *Type of Analysis* | *Rationale for Selection or Exclusion of Exposure Pathway* |
|---|---|---|---|---|---|---|---|---|
| Current / Potential | Soil | Surface Soil (0 to 1 ft bgs) | Area 1 or Area 2 (post-excavation) + Area 3 | Military Pesonnel (Non-Intrusive Training) | Adult (aged 18-28 years) | Dermal Absorption | Quantitative | Training activities may be conducted when they are not incompatible with the uses and preservation objectives specified in Chapter 47 of the Acts of 2002. Current use is small arms range. [Actual Exposure] |
| | | | | | | Incidential Ingestion | Quantitative | |
| | | | | | | Inhalation of Particulates | Quantitative | |
| | | | | | | Inhalation of Volatiles | Not Applicable[A] | |
| | | | | Trespasser | Adolescent (aged 12-18 years) | Dermal Absorption | Quantitative | Access to the site is not completely restricted. There are no physical barriers to access to the site for an individual already on MMR. The site is accessible by vehicle via one road on base. The outer perimeter of MMR is fenced and patrolled. However, trespassers and unauthorized hunters are periodically observed on MMR. By agreement, trespassing is considered to represent a potential current activity across all MMR sites, although the presence of UXO and corresponding signage warning of such dangers is assumed to severely limit such current use. [Actual Exposure] |
| | | | | | | Incidential Ingestion | Quantitative | |
| | | | | | | Inhalation of Particulates | Quantitative | |
| | | | | | | Inhalation of Volatiles | Not Applicable[A] | |
| | | | | Hunter | Adult (aged 18+ years) | Dermal Absorption | Quantitative | Hunting may be authorized for the site if it is determined that the action would not be incompatible with the uses and preservation objectives specified in Chapter 47 of the Acts of 2002. Unauthorized hunting also may occur as there are no physical barriers to access to the site to anyone already on MMR. [Actual Exposure] |
| | | | | | | Incidential Ingestion | Quantitative | |
| | | | | | | Inhalation of Particulates | Quantitative | |
| | | | | | | Inhalation of Volatiles | Not Applicable[A] | |

**Notes:** [A] No volatile organic compounds have been detected in Tango Range soils or monitoring wells.

**Table 5-6**
**Exposure AssessmentSummary/Conceptual Site Model**

| *Scenario Timeframe* | | *Exposure Medium* | *Exposure Point(s)* | *Receptor Population* | *Receptor Age* | *Exposure Route* | *Type of Analysis* | *Rationale for Selection or Exclusion of Exposure Pathway* |
|---|---|---|---|---|---|---|---|---|
| Potential | Soil | All Soil (0 to 10 ft bgs) | Area 1 or Area 2 (post-excavation) + Area 3 | Construction Worker | Adult (aged 18+ years) | Dermal Absorption | Quantitative | Construction activities may be performed to maintain the site or to prepare the site for a new mission or to modify the site for reuse or redevelopment provided they are determined to not incompatible with the uses and preservation objectives specified in Chapter 47 of the Acts of 2002. [Likely Future Exposure] |
| | | | | | | Incidential Ingestion | Quantitative | |
| | | | | | | Inhalation of Particulates | Quantitative | |
| | | | | | | Inhalation of Volatiles | Not Applicable[A] | |
| | | | | Resident | Adult (aged 18+ years) | Dermal Absorption | Quantitative | By agreement, residential redevelopment of the site was evaluated for risk management purposes only. Residential redevelopment activities may be performed to prepare the site for a new mission or to modify the site for reuse or redevelopment provided they are determined to not incompatible with the uses and preservation objectives specified in Chapter 47 of the Acts of 2002. [Hypothetical Future Exposure] |
| | | | | | | Incidential Ingestion | Quantitative | |
| | | | | | Child (aged 1-7 years) | Inhalation of Particulates | Quantitative | |
| | | | | | | Inhalation of Volatiles | Not Applicable[A] | |
| | | Groundwater | Tap Water | Resident | Adult (aged 18+ years) | Dermal Absorption | To Be Determined | By agreement, residential redevelopment of the site was evaluated for risk management purposes only. Residential redevelopment activities may be performed to prepare the site for a new mission or to modify the site for reuse or redevelopment provided they are determined to not incompatible with the uses and preservation objectives specified in Chapter 47 of the Acts of 2002. [Hypothetical Future Exposure] |
| | | | | | | Ingestion (Drinking) | To Be Determined | |
| | | | | | Child (aged 1-7 years) | Dermal Absorption | To Be Determined | |
| | | | | | | Ingestion (Drinking) | To Be Determined | |
| | | | Indoor Air Volatiles Released at the Showerhead | Resident | Adult (aged 18+ years) | Inhalation of Volatiles | To Be Determined | By agreement, residential redevelopment of the site was evaluated for risk management purposes only. Potential exposure pathway if volatile compounds are found to be present in the groundwater at site and the groundwater is used for domestic or consumptive purposes. Groundwater exposures are to be evaluated in a future assessment. No volatile compounds have been detected in Tango Range soil or groundwater. [Hypothetical Future Exposure] |
| | | | | | Child (aged 1-7 years) | Inhalation of Volatiles | To Be Determined | |
| | | | Indoor Air (Volatiles Migrating from Groundwater Up Into Habitable Space) | Resident | Adult (aged 18+ years) | Inhalation of Volatiles | To Be Determined | By agreement, residential redevelopment of the site was evaluated for risk management purposes only. Potential exposure pathway if volatile compounds are found to be present in the groundwater at site that could pose a threat of migration. Very few residential buildings exist at MMR investigation sites (none at the Tango Range). The depth to groundwater is generally more than 100 feet bgs and unlikely to represent a source of vapors to indoor air. No volatile compounds have been observed at the Tango Range. Groundwater exposures are to be evaluated in a future assessment. [Hypothetical Future Exposure] |
| | | | | | Child (aged 1-7 years) | Inhalation of Volatiles | To Be Determined | |
| | | | Tap Water | Military Pesonnel (Non-Intrusive Training) | Adult (aged 18-28 years) | Dermal Absorption | None | Groundwater is not currently used as a source of drinking water or water for general consumptive use (e.g., washing) at the Tango Range site. It is considered to be unlikely that it would be in the future. [Hypothetical Future Exposure] |
| | | | | | | Ingestion (Drinking) | None | |
| | | | Indoor Air (Volatiles Released at the | Military Pesonnel (Non-Intrusive Training) | Adult (aged 18-28 years) | Inhalation of Volatiles | None | Groundwater is not currently used as a source of drinking water or water for general consumptive use (e.g., washing) at the Tango Range site. It is considered to be unlikely that it would be in the future. No volatile compounds have been detected at the Tango Range. [Hypothetical Future Exposure] |
| | | | Indoor Air (Volatiles Migrating from | Military Pesonnel (Non-Intrusive Training) | Adult (aged 18-28 years) | Inhalation of Volatiles | To Be Determined | |
| | | | Pooled Water in Trench or Excavation | Construction Worker | Adult (aged 18+ years) | Dermal Absorption | None | Groundwater is at depths generally greater than 100 feet bgs. Therefore, groundwater is unlikely to infiltrate a future trench or excavation associated with any future military training or construction activities. No volatile compounds have been detected in soil or groundwater at the Tango Range. [Unlikely Future Exposure] |
| | | | | | | Incidential Ingestion | None | |
| | | | Ambient Air In or At a Trench or Excavation | Construction Worker | Adult (aged 18+ years) | Inhalation of Volatiles | None | Groundwater is at depths generally greater than 100 feet bgs. Therefore, groundwater is unlikely to infiltrate a future trench or excavation associated with any future military training or construction activities. No volatile compounds have been detected in soil or groundwater at the Tango Range. [Unlikely Future Exposure] |

**Notes:** [A] No volatile organic compounds have been detected in Tango Range soils or monitoring wells.

**Table 5-7**
**Exposure Profiles**

| **Receptor** | **Trespasser** | **Military Personnel (Firearms Training)** | **Hunter** | **Construction Worker** | **Resident (Child)** | **Resident (Adult)** |
|---|---|---|---|---|---|---|
| **Time Frame** | Current / Potential | Current / Potential | Current / Potential | Potential | Potential | Potential |
| **Potential** | Actual | Actual | Actual | Hypothetical | Hypothetical | Hypothetical |
| **Location** | Both Exposure Areas | Both Exposure Areas | Both Exposure Areas | Both Exposure Areas | Both Exposure Areas | Both Exposure Areas |
| **Age** | 12-18 years | 18-28 years | 18+ years | 18+ years | 1-7 years | 18+ years |
| **Body Weight (kg)** | 56 | 67.2 | 70 | 70 | 15 | 70 |
| **Lifetime (yr)** | 70 | 70 | 70 | 70 | 70 | 70 |
| **Soil Exposure** | | | | | | |
| **Incidental Ingestion** | | | | | | |
| Ingestion Rate (mg/day) | 50 | 50 | 100 | 330 | 100 | 50 |
| Absorption Adjustment Factor (unitless) | 1 | 1 | 1 | 1 | 1 | 1 |
| Fraction of Area Contaminated (unitless) | 1 | 1 | 1 | 1 | 1 | 1 |
| Exposure Frequency (day/yr) | 65 | 5 | 12 | 13 | 190 | 190 |
| Exposure Duration (years) | 6 | 10 | 6 | 1 | 6 | 24 |
| **Dermal Absorption** | | | | | | |
| Skin Surface Area Available for Contact ($cm^2$) | 5,262 | 3,300 | 3,300 | 3,300 | 2,800 | 5,700 |
| Soil to Skin Adherence Factor ($mg/cm^2$) | 0.07 | 0.25 | 0.25 | 0.25 | 0.20 | 0.07 |
| Absorption Factor (unitless) | [A] | [A] | [A] | [A] | [A] | [A] |
| Exposure Frequency (day/yr) | 65 | 5 | 12 | 13 | 190 | 190 |
| Exposure Duration (years) | 6 | 10 | 6 | 1 | 6 | 24 |
| **Inhalation and Ingestion of Dust** | | | | | | |
| Particulate Emission Factor ($m^3/kg$) | | | | | | |
| Area 1 | 1.94E+09 | 1.94E+09 | 1.94E+09 | 9.60E+06 | 1.94E+09 | 1.94E+09 |
| Areas 2 (post-excavation) + 3 | 1.51E+09 | 1.51E+09 | 1.51E+09 | 7.78E+06 | 1.51E+09 | 1.51E+09 |
| Particulate Concentration in Air ($ug/m^3$) | | | | | | |
| Area 1 | 0.52 | 0.52 | 0.52 | 105 | 0.52 | 0.52 |
| Areas 2 (post-excavation) + 3 | 0.52 | 0.52 | 0.52 | 105 | 0.52 | 0.52 |

**Notes:** [A] Chemical-specific

**Table 5-8**
**Risk Characterization Results for Exposure Area 1**

| Receptor | Exposure Medium / Route | | Non-Carcinogenic Hazard Index | Excess Lifetime Cancer Risk |
|---|---|---|---|---|
| **Trespasser** | Incidental Ingestion of Surface Soil | | 8.7E-02 | 9.4E-08 |
| | Dermal Absorption from Surface Soil | | 5.3E-02 | 2.6E-08 |
| | Inhalation of Particulates from Surface Soil | | 9.7E-04 | 9.1E-09 |
| | | **Receptor Total** | 1E-01 | 1E-07 |
| | Lead Exposure | | 1.6 - 1.8 ug/dL (Acceptable); (Target Level = 10 ug/dL); Prob. Exceeds Target = 0.5%-1.5% | |
| **Military Personnel (Firearms Training)** | Incidental Ingestion of Surface Soil | | 5.6E-03 | 1.0E-08 |
| | Dermal Absorption from Surface Soil | | 7.6E-03 | 6.2E-09 |
| | Inhalation of Particulates from Surface Soil | | 9.7E-04 | 9.1E-09 |
| | | **Receptor Total** | 1E-02 | 3E-08 |
| **Hunter** | Incidental Ingestion of Surface Soil | | 2.6E-02 | 2.8E-08 |
| | Dermal Absorption from Surface Soil | | 1.8E-02 | 8.6E-09 |
| | Inhalation of Particulates from Surface Soil | | 9.7E-04 | 9.1E-09 |
| | | **Receptor Total** | 4E-02 | 5E-08 |
| **Construction Worker** | Incidental Ingestion of Surface and Subsurface Soil | | 9.2E-02 | 1.7E-08 |
| | Dermal Absorption from Surface and Subsurface Soil | | 1.9E-02 | 1.6E-09 |
| | Inhalation of Particulates from Surface and Subsurface Soil | | 2.0E-01 | 1.8E-06 |
| | | **Receptor Total** | 3E-01 | 2E-06 |
| | Lead Exposure | | 2.2 - 2.4 ug/dL (Acceptable); (Target Level = 10 ug/dL); Prob. Exceeds Target = 1.3%-3.1% | |
| **Resident (Child)** | Incidental Ingestion of Surface Soil | | 1.9E+00 | - |
| | Dermal Absorption from Surface Soil | | 8.8E-01 | - |
| | Inhalation of Particulates from Surface Soil | | 9.7E-04 | - |
| | | **Receptor Total** | **3E+00** | - |
| | Lead Exposure (All Sources) | | 3.2 - 4.6 ug/dL (Acceptable); (Target Level = 10 ug/dL) | |
| **Resident (Adult)** | Incidental Ingestion of Surface Soil | | 2.0E-01 | - |
| | Dermal Absorption from Surface Soil | | 1.3E-01 | - |
| | Inhalation of Particulates from Surface Soil | | 9.7E-04 | - |
| | | **Receptor Total** | 3E-01 | - |
| | Lead Exposure (All Sources) | | 2.4 - 4.2 ug/dL (Acceptable); (Target Level = 10 ug/dL) | |
| **Resident (Child + Adult)** | Incidental Ingestion of Surface Soil | | - | 1.6E-06 |
| | Dermal Absorption from Surface Soil | | - | 4.8E-07 |
| | Inhalation of Particulates from Surface Soil | | - | 9.1E-09 |
| | | **Receptor Total** | - | 2E-06 |
| **NOTE:** | The results shown in bold font indicates an HI that exceeds 1, and a cancer risk estimate that exceeds the MassDEP but not the CERCLA cancer risk limit. | | | |

**Table 5-9**
**Risk Characterization Results for Exposure Areas 2 (Post-Excavation) and 3**

| Receptor | Exposure Medium / Route | Non-Carcinogenic Hazard Index | Excess Lifetime Cancer Risk |
|---|---|---|---|
| **Trespasser** | Incidental Ingestion of Surface Soil | 8.8E-03 | 8.0E-08 |
| | Dermal Absorption from Surface Soil | 4.6E-04 | 1.8E-08 |
| | Inhalation of Particulates from Surface Soil | 1.4E-03 | 8.6E-09 |
| | **Receptor Total** | 1.1E-02 | 1.1E-07 |
| **Military Personnel (Firearms Training)** | Incidental Ingestion of Surface Soil | 5.7E-04 | 8.5E-09 |
| | Dermal Absorption from Surface Soil | 6.6E-05 | 4.2E-09 |
| | Inhalation of Particulates from Surface Soil | 1.4E-03 | 8.6E-09 |
| | **Receptor Total** | 2E-03 | 2E-08 |
| **Hunter** | Incidental Ingestion of Surface Soil | 2.6E-03 | 2.4E-08 |
| | Dermal Absorption from Surface Soil | 1.5E-04 | 5.8E-09 |
| | Inhalation of Particulates from Surface Soil | 1.4E-03 | 8.6E-09 |
| | **Receptor Total** | 4E-03 | 4E-08 |
| **Construction Worker** | Incidental Ingestion of Surface and Subsurface Soil | 9.3E-03 | 1.4E-08 |
| | Dermal Absorption from Surface and Subsurface Soil | 1.6E-04 | 1.1E-09 |
| | Inhalation of Particulates from Surface and Subsurface Soil | 2.8E-01 | 1.7E-06 |
| | **Receptor Total** | 3E-01 | 2E-06 |
| **Resident (Child)** | Incidental Ingestion of Surface Soil | 1.9E-01 | - |
| | Dermal Absorption from Surface Soil | 7.6E-03 | - |
| | Inhalation of Particulates from Surface Soil | 1.4E-03 | - |
| | **Receptor Total** | 2E-01 | - |
| **Resident (Adult)** | Incidental Ingestion of Surface Soil | 2.1E-02 | - |
| | Dermal Absorption from Surface Soil | 1.2E-03 | - |
| | Inhalation of Particulates from Surface Soil | 1.4E-03 | - |
| | **Receptor Total** | 2E-02 | - |
| **Resident (Child + Adult)** | Incidental Ingestion of Surface Soil | - | 1.3E-06 |
| | Dermal Absorption from Surface Soil | - | 3.3E-07 |
| | Inhalation of Particulates from Surface Soil | - | 8.6E-09 |
| | **Receptor Total** | - | 2E-06 |
| **NOTE:** | The results shown in bold font indicates that a cancer risk estimate exceeds the MassDEP but not the CERCLA cancer risk limit. | | |

**Table 5-10**
**Area 1 - Values Used and Results for Adult Lead Model - Construction Worker**

**Version date 05/19/03**

| Exposure Variable | PbB Equation1 1* | PbB Equation1 2** | Description of Exposure Variable | Units | Using Equation 1: GSDi = Hom | Using Equation 1: GSDi = Het | Using Equation 2: GSDi = Hom | Using Equation 2: GSDi = Het |
|---|---|---|---|---|---|---|---|---|
| PbS | X | X | Soil lead concentration | ug/g or ppm | 285.4 | 285.4 | 285.4 | 285.4 |
| Rfetal/maternal | X | X | Fetal/maternal PbB ratio | -- | 0.9 | 0.9 | 0.9 | 0.9 |
| BKSF | X | X | Biokinetic Slope Factor | ug/dL per ug/day | 0.4 | 0.4 | 0.4 | 0.4 |
| GSDi | X | X | Geometric standard deviation PbB | -- | 2.1 | 2.3 | 2.1 | 2.3 |
| PbB0 | X | X | Baseline PbB | ug/dL | 1.5 | 1.7 | 1.5 | 1.7 |
| IRS | X | | Soil ingestion rate (including soil-derived indoor dust) | g/day | 0.330 | 0.330 | -- | -- |
| IRS+D | | X | Total ingestion rate of outdoor soil and indoor dust | g/day | -- | -- | 0.330 | 0.330 |
| WS | | X | Weighting factor; fraction of IRS+D ingested as outdoor soil | -- | -- | -- | 1.0 | 1.0 |
| KSD | | X | Mass fraction of soil in dust | -- | -- | -- | 0.7 | 0.7 |
| AFS, D | X | X | Absorption fraction (same for soil and dust) | -- | 0.12 | 0.12 | 0.12 | 0.12 |
| EFS, D | X | X | Exposure frequency (same for soil and dust) | days/yr | 13 | 13 | 13 | 13 |
| ATS, D | X | X | Averaging time (same for soil and dust) | days/yr | 90 | 90 | 90 | 90 |
| **PbBadult** | | | **PbB of adult worker, geometric mean** | **ug/dL** | **2.2** | **2.4** | **2.2** | **2.4** |
| **PbBfetal, 0.95** | | | **95th percentile PbB among fetuses of adult workers** | **ug/dL** | **6.6** | **8.3** | **6.6** | **8.3** |
| **PbBt** | | | **Target PbB level of concern (e.g., 10 ug/dL)** | **ug/dL** | **10.0** | **10.0** | **10.0** | **10.0** |
| **P(PbBfetal > PbBt)** | | | **Probability that fetal PbB > PbBt, assuming lognormal distribution** | **%** | **1.3%** | **3.1%** | **1.3%** | **3.1%** |

Values for Non-Residential Exposure Scenario (columns 6–9).

[1] Equation 1 does not apportion exposure between soil and dust ingestion (excludes $W_S$, $K_{SD}$).
When $IR_S = IR_{S+D}$ and $W_S = 1.0$, the equations yield the same $PbB_{fetal,0.95}$.

***Equation 1, based on Eq. 1, 2 in USEPA (1996).**

| | |
|---|---|
| **$PbB_{adult}$ =** | $(PbS*BKSF*IR_{S+D}*AF_{S,D}*EF_S/AT_{S,D}) + PbB_0$ |
| **$PbB_{fetal,\,0.95}$ =** | $PbB_{adult} * (GSD_i^{1.645} * R)$ |

****Equation 2, alternate approach based on Eq. 1, 2, and A-19 in USEPA (1996).**

| | |
|---|---|
| **$PbB_{adult}$ =** | $PbS*BKSF*([(IR_{S+D})*AF_S*EF_S*W_S]+[K_{SD}*(IR_{S+D})*(1-W_S)*AF_D*EF_D])/365+PbB_0$ |
| **$PbB_{fetal,\,0.95}$ =** | $PbB_{adult} * (GSD_i^{1.645} * R)$ |

Sources:
USEPA, 2003a. Recommendations of the Technical Work Group for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil. Technical Review Workgroup for Lead. EPA-540-R-03-001. January.

**Table 5-11**
**Area 1 - Values Used and Results for Adult Lead Model - Trespasser**

**Version date 05/19/03**

| Exposure Variable | PbB Equation1 | | Description of Exposure Variable | Units | Values for Non-Residential Exposure Scenario | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Using Equation 1 | | Using Equation 2 | |
| | 1* | 2** | | | GSDi = Hom | GSDi = Het | GSDi = Hom | GSDi = Het |
| PbS | X | X | Soil lead concentration | ug/g or ppm | 285.4 | 285.4 | 285.4 | 285.4 |
| Rfetal/maternal | X | X | Fetal/maternal PbB ratio | -- | 0.9 | 0.9 | 0.9 | 0.9 |
| BKSF | X | X | Biokinetic Slope Factor | ug/dL per ug/day | 0.4 | 0.4 | 0.4 | 0.4 |
| GSDi | X | X | Geometric standard deviation PbB | -- | 2.1 | 2.3 | 2.1 | 2.3 |
| PbB0 | X | X | Baseline PbB | ug/dL | 1.5 | 1.7 | 1.5 | 1.7 |
| IRS | X | | Soil ingestion rate (including soil-derived indoor dust) | g/day | 0.050 | 0.050 | -- | -- |
| IRS+D | | X | Total ingestion rate of outdoor soil and indoor dust | g/day | -- | -- | 0.050 | 0.050 |
| WS | | X | Weighting factor; fraction of IRS+D ingested as outdoor soil | -- | -- | -- | 1.0 | 1.0 |
| KSD | | X | Mass fraction of soil in dust | -- | -- | -- | 0.7 | 0.7 |
| AFS, D | X | X | Absorption fraction (same for soil and dust) | -- | 0.12 | 0.12 | 0.12 | 0.12 |
| EFS, D | X | X | Exposure frequency (same for soil and dust) | days/yr | 65 | 65 | 65 | 65 |
| ATS, D | X | X | Averaging time (same for soil and dust) | days/yr | 365 | 365 | 365 | 365 |
| **PbBadult** | **PbB of adult worker, geometric mean** | | | **ug/dL** | **1.6** | **1.8** | **1.6** | **1.8** |
| **PbBfetal, 0.95** | **95th percentile PbB among fetuses of adult workers** | | | **ug/dL** | **4.9** | **6.5** | **4.9** | **6.5** |
| **PbBt** | **Target PbB level of concern (e.g., 10 ug/dL)** | | | **ug/dL** | **10.0** | **10.0** | **10.0** | **10.0** |
| **P(PbBfetal > PbBt)** | **Probability that fetal PbB > PbBt, assuming lognormal distribution** | | | **%** | **0.5%** | **1.5%** | **0.5%** | **1.5%** |

[1] Equation 1 does not apportion exposure between soil and dust ingestion (excludes $W_S$, $K_{SD}$).
When $IR_S = IR_{S+D}$ and $W_S = 1.0$, the equations yield the same $PbB_{fetal,0.95}$.

***Equation 1, based on Eq. 1, 2 in USEPA (1996).**

| | |
|---|---|
| **$PbB_{adult}$ =** | $(PbS*BKSF*IR_{S+D}*AF_{S,D}*EF_S/AT_{S,D}) + PbB_0$ |
| **$PbB_{fetal, 0.95}$ =** | $PbB_{adult} * (GSD_i^{1.645} * R)$ |

****Equation 2, alternate approach based on Eq. 1, 2, and A-19 in USEPA (1996).**

| | |
|---|---|
| **$PbB_{adult}$ =** | $PbS*BKSF*([(IR_{S+D})*AF_S*EF_S*W_S]+[K_{SD}*(IR_{S+D})*(1-W_S)*AF_D*EF_D])/365+PbB_0$ |
| **$PbB_{fetal, 0.95}$ =** | $PbB_{adult} * (GSD_i^{1.645} * R)$ |

Sources:
USEPA, 2003a. Recommendations of the Technical Work Group for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil. Technical Review Workgroup for Lead. EPA-540-R-03-001. January.

## Table 5-12
## Input Parameters and Results from the All-Ages Lead Model for the Adult Resident in Area 1

| Resident Age (yr) | Soil Ingestion Rate (mg/day) | Lead Concentration in Soil (1) (mg/kg) | Associated Outdoor Air Concentration ($mg/m^3$) | All Sources Maximum Blood Lead Level (2) (ug Pb/dL) | Site-Related Maximum Blood Lead Level (3) (ug Pb/dL) | Target Blood Lead Level (ug Pb/dL) |
|---|---|---|---|---|---|---|
| 19-40 | 50 | 285.4 | 1.47E-07 | 4.160 | 1.878 | 10 |
| 40-65 | 50 | 285.4 | 1.47E-07 | 2.602 | 1.173 | 10 |
| 65-82 | 50 | 285.4 | 1.47E-07 | 2.477 | 1.169 | 10 |
| 82-90 | 50 | 285.4 | 1.47E-07 | 2.395 | 1.169 | 10 |

Notes:

(1) See Table 1 for soil exposure point concentrations.

(2) Sources include air (outdoor, residential, school, occupational), diet, dust, drinking water, plus site-related sources.

(3) Sources include air (outdoor and residential only), soil ingestion, and dermal contact with soil.

Sources:

U.S. Environmental Protection Agency, 2005. All-Ages Lead Model (AALM) Version 1.05 (External Review Draft). U.S. Environmental Protection Agency, Washington, DC, EPA/600/C-05/013, 2005.

## Table 5-13
## Input Parameters and Results from the IEUBK Child Lead Model for the Child Resident in Area 1

| Child Age (yr) | Soil Ingestion Rate (mg/day) | Lead Concentration in Soil (1) (mg/kg) | Associated Outdoor Air Concentration ($mg/m^3$) | All Sources Blood Lead Level (ug/dL) | Site-Related Blood Lead Level (2) (ug/dL) | Target Blood Lead Level (ug/dL) |
|---|---|---|---|---|---|---|
| 0.5 - 1 | NA | 285.4 | 1.47E-07 | 4.6 | 3.1 | 10 |
| 1 - 2 | 100 | 285.4 | 1.47E-07 | 4.4 | 2.9 | 10 |
| 2 - 3 | 100 | 285.4 | 1.47E-07 | 4 | 2.6 | 10 |
| 3 - 4 | 100 | 285.4 | 1.47E-07 | 3.8 | 2.4 | 10 |
| 4 - 5 | 100 | 285.4 | 1.47E-07 | 3.6 | 2.3 | 10 |
| 5 - 6 | 100 | 285.4 | 1.47E-07 | 3.4 | 2.1 | 10 |
| 6 - 7 | 100 | 285.4 | 1.47E-07 | 3.2 | 2.0 | 10 |

Notes:

(1) See Table 1 for soil exposure point concentrations.
(2) Site-related sources include soil and dust ingestion, inhalation of particulates coupled with maternal baseline of 2.5 ug Pb/dL.

Sources:
EPA, 2001b. User's Guide for the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK). Windows Version. EPA9285.7-42. October

# APPENDIX A

# HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

## Impact Area Groundwater Study Program

# Human Health and Ecological Risk Assessment (HERA) for Tango Range

## Massachusetts Military Reservation
## Cape Cod, Massachusetts

### May 2007

*Prepared for:*

U.S. Army Corps of Engineers
New England District
Concord, Massachusetts
for
U.S. Army Environmental Command
Impact Area Groundwater Study Program
Camp Edwards, Massachusetts

*Prepared by:*

Tetra Tech EC, Inc.
133 Federal St., Boston, MA 02110
Contract No. DACW33-03-D-0006

# IMPACT AREA GROUNDWATER STUDY PROGRAM

## Human Health and Ecological Risk Assessment (HERA)
## For
## Tango Range

**Camp Edwards**
**Massachusetts Military Reservation**
**Cape Cod, Massachusetts**

**May 2007**

| *Prepared For:* | |
|---|---|
| | **U.S. Army Corps of Engineers**<br>**New England District**<br>**Concord, Massachusetts** |
| | **U.S. Army Environmental Command**<br>**Impact Area Groundwater Study Program**<br>**Camp Edwards, Massachusetts** |

| *Prepared By:* | |
|---|---|
| | **Tetra Tech EC, Inc.**<br>**133 Federal Street, 6th Floor**<br>**Boston, Massachusetts  02110** |

2007-O-JV04-0019

# Human Health and Ecological Risk Assessment (HERA) For Tango Range

## Camp Edwards
## Massachusetts Military Reservation
## Cape Cod, Massachusetts

## May 2007

CERTIFICATION:

*I hereby certify that the enclosed Human Health and Ecological Risk Assessment (HERA) for Tango Range, shown and marked in this submittal, is that proposed to be incorporated with Contract Number DACW33-03-D-0006. This Document has been prepared in accordance with USACE Scope of Work and is hereby submitted for Government approval.*

**Prepared by:**

______________________________ ______________
Elizabeth Ubinger Date
TtEC Senior Risk Assessor

______________________________ ______________
John Schaffer Date
TtEC Senior Risk Assessor

**Approved by:**

______________________________ ______________
Ronald J. Marnicio, Ph.D., PE Date
TtEC Consulting Risk Assessor

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Charles Collet, P.E. Date
TtEC Project Manager

______________________________ ______________
Richard J. Gleason, P.G. Date
TtEC Program Manager

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## ACRONYM LIST

| | |
|---|---|
| AALM | All Ages Lead Model |
| ADD | Average daily dose |
| AF | Adherence factor |
| AFCEE | Air Force Center for Environmental Excellence |
| ALM | Adult Lead Model |
| AMEC | AMEC Earth and Environmental, Inc. |
| ANGB | Air National Guard Base |
| AO | Administrative Order |
| AOC | Area of concern |
| ARAMS | Army Risk Assessment Modeling System |
| ARAR | Applicable or Relevant and Appropriate Requirement |
| AT123D | Analytical Transient 1-, 2-, and 3-Dimensional Simulation of Waste Transport in the Aquifer System |
| atm | atmosphere |
| ATSDR | Agency for Toxic Substances and Disease Registry |
| AUF | Area use factor |
| BERA | Baseline Ecological Risk Assessment |
| bgs | Below ground surface |
| BW | Body weight |
| CA | Concentration of contaminant in air |
| CDC | Centers for Disease Control |
| CDI | Chronic daily intake |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CHPPM | Center for Health Promotion and Preventive Medicine |
| CLT | Central Limit Theorem |
| cm | Centimeter |
| COC | Chemical of concern |
| COPEC | Chemical of potential ecological concern |
| COPC | Chemical of potential concern |
| CRREL | U.S. Army Corps of Engineers Cold Regions Research and Experimental Laboratory |
| Cr III | Trivalent chromium |
| Cr VI | Hexavalent chromium |
| CSF | Cancer slope factor |
| CSM | Conceptual Site Model |
| df | degree of freedom |
| dL | deciliter |
| ECC | Environmental Chemical Corporation |
| Eco-SSLs | Ecological Soil Screening Levels |
| ED | Exposure duration |
| EDMS | Environmental Data Management System |
| EF | Exposure frequency |
| ELCR | Excess Lifetime Cancer Risk |
| EPC | Exposure point concentration |
| ERAGS | Ecological Risk Assessment Guidance for Superfund |
| ERDC | U.S. Army Corps of Engineers Engineer Research and Development Center |
| ºF | Fahrenheit degrees |
| FDA | United States Food and Drug Administration |
| FOD | Frequency of detection |
| FS | Feasibility Study |

| | |
|---|---|
| ft | feet |
| g | gram |
| GC/MS | Gas Chromatography / Mass Spectrometry |
| GI | Gastrointestinal |
| GIS | Geographic Information System |
| GSC | General Sciences Corporation |
| Ha | hectares |
| HEAST | Health Effects Assessment Summary Tables |
| HERA | Human Health and Ecological Risk Assessment |
| HERD | Human Ecological Risk Division |
| HHRA | Human Health Risk Assessment |
| HI | Hazard Index |
| HPLC | High Performance Liquid Chromatography |
| HQ | Hazard Quotient |
| hr | hour |
| HSDB | Hazardous Substances Data Bank |
| IAGWSP | Impact Area Groundwater Study Program |
| IEUBK | Integrated Exposure Uptake Biokinetic Model |
| IR | Ingestion rate |
| IRIS | Integrated Risk Information System |
| kg | kilogram |
| km | kilometer |
| L | liter |
| $LD_{50}$ | Lethal dose for 50 percent of a study population |
| LOAEL | Lowest Observed Adverse Effect Level |
| m | meter |
| MAARNG | Massachusetts Army National Guard |
| MassDEP | Massachusetts Department of Environmental Protection |
| MCP | Massachusetts Contingency Plan |
| MDC | Maximum detected concentration |
| MDFW | Massachusetts Division of Fish and Wildlife |
| mg | milligram |
| mm | millimeter |
| MMR | Massachusetts Military Reservation |
| mol | mole (chemical quantity) |
| MVUE | Minimum variance unbiased estimater |
| NCEA | National Center for Environmental Assessment |
| NGB | National Guard Bureau |
| NOAEL | No observed adverse effect level |
| PAH | Polycyclic aromatic hydrocarbons |
| PEF | Particulate emission factor |
| pH | Acidity measurement |
| PPRTV | Provisional Peer Reviewed Toxicity Value |
| PRG | Preliminary Remediation Goal |
| RA | Remedial Action |
| RAGS | Risk Assessment Guidance for Superfund |
| RD | Remedial Design |
| RfC | Reference concentration |
| RfD | Reference dose |
| RI | Remedial Investigation |
| RME | Reasonable maximum exposure |

| | |
|---|---|
| SDWA | Safe Drinking Water Act |
| s | second |
| SESOIL | Seasonal Soil Compartment Model |
| SLERA | Screening level ecological risk assessment |
| SOP | Standard Operating Procedure |
| SQL | Sample quantitation limit |
| SRF | Standard Reporting Format (i.e., RAGS Part D Format) |
| SSL | Soil Screening Level |
| SUF | Seasonal use factor |
| SVOC | Semivolatile organic compound |
| TRV | Toxicity reference value |
| TRW | Technical Review Workgroup |
| TtEC | Tetra Tech EC, Inc. |
| UCL | Upper confidence limit |
| µg | microgram |
| UR | Unit risk |
| USACE | United States Army Corps of Engineers |
| USACHPPM | United States Army Center for Health Promotion and Preventive Medicine |
| USCG | United States Coast Guard |
| USFWS | United States Fish and Wildlife Service |
| USEPA | United States Environmental Protection Agency |
| VF | Volatilization factor |
| VOC | Volatile organic compound |
| WHO | World Health Organization |
| yr | year |

# EXECUTIVE SUMMARY

A Human Health and Ecological Risk Assessment (HERA) was performed for the Tango Range, located on Camp Edwards at the MMR. The objective of the HERA is to identify any chemicals of concern (COCs) in soil and groundwater from impacts associated with small arms training and other activities that occurred within Tango Range (also referred to as the "Site"). This objective is a requirement of the Administrative Orders that exist for Camp Edwards. COCs represent contaminants that contribute to an excess risk of harm to potential human and environmental receptors. COCs identified in this risk assessment will be further evaluated as the basis for the identification and evaluation of remedies. The HERA consisted of a human health risk assessment (HHRA) and a baseline ecological risk assessment (BERA).

## Human Health Risk Assessment

The site-specific HHRA was conducted in accordance with the United States Environmental Protection Agency (USEPA) Risk Assessment Guidance for Superfund (RAGS), Volume I: Human Health Evaluation Manual, Part A (USEPA, 1989), Part D (USEPA, 2001a), and Part E (USEPA, 2004b), EPA's Ecological Risk Assessment Guidance for Superfund (USEPA, 1997) and in accordance with the established MMR risk assessment protocols. The MMR risk assessment protocols have been developed in an attempt to maintain a consistent technical approach that adhered to the relevant USEPA and Massachusetts Department of Environmental Protection (MassDEP) risk assessment protocols and policies as interpreted for MMR and the IAGWSP.

The HHRA approach follows a four step process comprised of:

- Data Evaluation;
- Exposure Assessment;
- Toxicity Assessment; and
- Risk Characterization.

Finally, sources or uncertainty associated with each of these steps are reviewed with emphasis on their implications relative to interpreting the results of the risk assessment.

## Data Evaluation

Based on the site history and the site investigations conducted to date, Tango Range (collectively referred to as the "Site" in this risk assessment) was divided into three contiguous areas:

Area 1 - The area from the top of the machine gun firing points to the 25 meter targets across the entire width of the range,

Area 2 - The area of the planned new berm (approximately 45 x 220 feet) behind the 25-meter targets. This area was subsequently excavated to a depth of 6-inches prior to construction of the berm; and

Area 3 - The remainder of the range, down range (south) of Area 2 and Area 1.

Samples collected from Area 2 prior to construction of the backstop berm were not used in this HHRA because this area was excavated to a depth of 6 inches in preparation for berm construction. Areas 2 (post-excavation) and Area 3 were combined into a single area of interest for the chemicals of potential concern (COPC) screening process. The available sampling results were evaluated to assess data quality and usability (in consideration of the analytical methods used, the magnitude of the sample quantitation limits achieved, the assignment of data qualifiers, and the presence of indicators of either field or laboratory contamination). Thereafter, a database of the qualified analytical results was developed and the COPCs for the potential exposure media at the site were selected for the different areas of interest. The approach to COPC selection was based on USEPA guidance and followed established MMR risk assessment protocols.

Compounds in soil were identified as COPCs based on separate evaluations of direct exposure (i.e. ingestion, dermal absorption, and inhalation) and migration to groundwater used as a source of drinking water. The soil COPCs for direct exposure based on a comparison of maximum detected concentrations to risk-based screening criteria protective of direct exposures were:

- Area 1 — Aluminum, antimony, arsenic, lead, tungsten, vanadium, n,n'-diethylcarbanilide (also known as 1,3-diethyl-1,3-diphenylurea), and nitroglycerin; and
- Combined Areas 2 and 3 — Aluminum, arsenic, tungsten, and vanadium.

Groundwater monitoring results were also compared to risk-based screening criteria. No explosives compounds, SVOCs, or metals were detected in MW-467S. Total tungsten was detected at a concentration of 2.9 μg/L and dissolved tungsten was detected at a concentration of 1.9 μg/L. There are no risk-based screening criteria for tungsten.

### Exposure Assessment

The exposure assessment identifies the potential human receptors, exposure points for the various media, potential exposure pathways, and quantification of the magnitude and frequency of receptors' potential exposure to COPCs. Reasonable maximum exposure (RME) scenarios are evaluated in this risk assessment, which employed conservative exposure assumptions for each identified receptor (USEPA 1999, 1997b). This approach is considered conservative because, in reality, most individuals will not be subject to all the conditions that comprise the RME scenario, resulting in lower potential exposures to constituents and, therefore, lower potential risks associated with those exposures.

The following receptors and exposure pathways were considered in the HHRA:

Current / Potential Receptors:

- Military personnel (adults aged 18-28 years) conducting small arms training activities with potential exposures to COPCs in surface soil of the exposure areas of interest at the site (surface soil is defined as soil in the depth range of 0 to 1 ft bgs). The routes of exposure for the non-intrusive military trainee are dermal absorption, incidental ingestion, and the inhalation of particulates related to soil.

- A trespasser (aged 12-18 years) with potential exposures to COPCs in the surface soil of the exposure areas of interest at the site. The routes of exposure for the trespasser are dermal absorption, incidental ingestion, and the inhalation of particulates related to soil.

- A hunter (aged 18+ years) with potential exposures to COPCs in the surface soil of the exposure areas of interest at the site. The routes of exposure for the hunter are dermal absorption, incidental ingestion, and the inhalation of particulates related to soil.

Future Potential Receptors:

- Intrusive activities by military trainees that would involve exposure to deeper soils are not anticipated under the foreseeable future land use at this small arms range.

- Construction workers (adults aged 18+ years) with potential exposures to COPCs in both the surface and subsurface soil of the exposure areas of interest at the site. The routes of exposure for the construction worker performing excavation and other intrusive activities are dermal absorption, incidental ingestion, and the inhalation of particulates related to soil. These construction workers are not likely to contact or be exposed to groundwater at the site in any manner as the depth to groundwater is greater than 100 feet.

- Hypothetical residents (a child aged 1-7 years and an adult aged 18+ years) with potential exposures to COPCs in both the surface and subsurface soil of the exposure areas of interest at the site. The routes of exposure for the hypothetical child and adult residents are dermal absorption, incidental ingestion, and the inhalation of particulates related to soil.

Exposure pathways considered for the Site included drinking or ingesting the groundwater, inhaling volatiles released during water use, and inhaling vapors released from groundwater that may migrate up through the soil into indoor air. These last two pathways were not likely to be significant for Tango Range due both to the lack of detected volatiles in the overlying soil and the relatively deep depth to groundwater. Given the characteristic depth to groundwater, groundwater is not likely to pool up in near surface trenches or excavations. A full assessment of groundwater-related risks is to be performed at a later date.

The soil exposure point concentrations at each exposure point were based on the 95% upper confidence limit on the mean in accordance with USEPA guidance (USEPA, 2002) using USEPA's ProUCL software (USEPA, 2004). All soil data representing current soil conditions in each of the two exposure areas (Area 1, combined Areas 2 and 3) were used in deriving exposure point concentrations and considered representative of current and future potential exposures (see Appendix C). In calculating exposure point concentrations for soil, a value equal to one-half the limit of detection reported by the laboratory was used as a surrogate concentration for those constituents that were not detected in any particular sample.

**Toxicity Assessment**

The toxicity assessment summarizes the toxicological data (cancer unit risk or slope values, and non-cancer reference doses or concentrations) for the identified COPCs. The preferential hierarchy of sources from which toxicological information and toxicity values were:

- Tier 1: IRIS (Integrated Risk Information System), which is an on-line USEPA database containing current toxicity values for many chemicals that have gone through a rigorous peer review and USEPA consensus review process (USEPA, 2006a);
- Tier 2: Provisional Peer Reviewed Toxicity Values (PPRTVs) developed by the USEPA Office of Research and Development/National Center for Environmental Assessment/Superfund Health Risk Technical Support Center (NCEA); and
- Tier 3: Additional USEPA and non-USEPA sources of toxicity information, including but not limited to the CalEPA toxicity values, the ATSDR minimum risk levels, and toxicity values published in HEAST (USEPA, 1997a).

**Risk Characterization**

The risk characterization was performed by inputting site-specific data and assumptions into formulae developed by USEPA for calculation of cancer risks and non-cancer hazards. Potential health risks were calculated for baseline conditions and address exposures to contaminant levels at the Site as they currently exist. For each receptor, cumulative Estimated Lifetime Cancer Risks (ELCRs) and non-carcinogenic hazards (expressed as Total Hazard Index (HI)) were estimated. The ELCR for each receptor was compared to ELCR limit range of $1 \times 10^{-4}$ (one in ten thousand) to $1 \times 10^{-6}$ (one in one million). The HI for each receptor or target endpoint (total HI) was compared to a HI of 1 (USEPA 1991). Total ELCR and total HI for a constituent that does not exceed these risk/hazard limits for a given receptor would indicate that no adverse health effects are expected to occur as a result of that receptor's potential exposure to COPCs.

**Results of the HHRA**

At each of the two soil exposure areas, the Total ELCRs for current and future trespassers, current and future military personnel engaged in small arms training or other non-intrusive activities, current and future recreational hunters, and future construction workers are within or less than USEPA's allowable risk range (i.e., $1 \times 10^{-6}$).

| Summary of Calculated Excess Lifetime Cancer Risks by Area and | | |
|---|---|---|
| **Exposure Scenario** | **Area 1** | **Areas 2 and 3** |
| Trespasser | 1E-07 | 1E-07 |
| Military Personnel – Small Arms | 3E-08 | 2E-08 |
| Hunter | 5E-08 | 4E-08 |
| Construction Worker | 2E-06 | 2E-06 |
| Resident (Hypothetical) | 2E-06 | 2E-06 |

To assess the need for institutional controls and to provide information for evaluating all future-use options in a Feasibility Study, a hypothetical residential scenario was evaluated in the risk characterization. The total ELCRs for the hypothetical future resident exposed to the soil exposure points are within USEPA's allowable risk range.

The total HI from potential soil exposures by current and future trespassers, current and future military personnel involved with small arms or other non-intrusive training activities, current and future recreational hunters, future construction workers, and future hypothetical residents do not exceed 1.

| | | |
|---|---|---|
| **Exposure Scenario** | **Area 1** | **Areas 2 and 3** |
| Trespasser | 0.1 | 0.01 |
| Military Personnel – Small Arms | 0.01 | 0.002 |
| Hunter | 0.04 | 0.004 |
| Construction Worker | 0.3 | 0.3 |
| Resident - adult | 0.3 | 0.02 |
| Resident - child | 3 | 0.2 |

Lead was selected as a COPC for the Area 1 exposure point Potential hazards associated with exposure to lead are evaluated using the ALM (USEPA, 2003b) for adult construction workers and the adolescent trespasser, the AALM for adult residents, and the IEUBK Child Lead Model for children (USEPA, 2001b). EPA has determined that childhood blood lead levels at or above 10 μg Pb/dL present risks to children's health (USEPA, 1994). The results of the IEUBK modeling were compared to this level and were determined to not present a significant risk to children's health even when non-site related sources (e.g., dietary) were included. The blood lead level concentration due to exposure to lead in soil for adult residents as estimated by the AALM is less than 4.2 μg Pb/dL even when non-site related sources were included.

For the construction worker, the ALM-estimated adult blood lead level concentration associated with exposure to Area 1 soil is less than 2.4 μg Pb/dL. The associated probability that fetal blood lead levels would exceed 10 μg Pb/dL is approximately 2% (i.e., the fetus of a pregnant female construction worker would most likely have a blood lead level less than 10 μg Pb/dL). For the adolescent, the ALM-estimated blood lead level is less than 1.8 μg Pb/dL, and, the associated probability that the fetal blood lead level exceeds 10 µg Pb/dL is 1%. These estimates assume that neither personal protective equipment nor dust suppression or other industrial hygiene is utilized. The ALM does not explicitly consider other sources of lead exposure such as dietary, but it does assume a non-zero baseline blood lead concentration of 1.5 to 1.7 µg Pb/dL.

### Human Health Chemical of Concern

Chemicals of concern (COCs) are COPCs that were found to contribute most significantly to site risks. In some cases, chemicals with cancer risks less than 1 x $10^{-4}$ may contribute to a carcinogenic risk of greater than 1 x $10^{-4}$ for a particular receptor and may be judged to "contribute significantly" to site cancer risks. In order to determine any such instances, COPCs with incremental cancer risks of greater than 1 x $10^{-6}$ are reported below for each highlighted receptor (Note: The associated ELCR for a given COC is included parenthetically):

- Construction Workers: Area 1 – arsenic (ELCR 2x$10^{-6}$), Areas 2 and 3 – arsenic (ELCR 2x$10^{-6}$).
- Hypothetical Residents: Area 1 – arsenic (ELCR 2x$10^{-6}$) and nitroglycerin (child HI 3); and arsenic (ELCR 2x$10^{-6}$).

There appear to be no COCs identified for the trespasser soil exposures, military personnel engaged in small arms training or other non-intrusive activities, or the hunter. It should be noted that with the exception of one soil sample (23.4 mg/kg arsenic in SS169A 0.5 to 1.0 bgs), the concentrations of arsenic measured in Tango Range soil samples are comparable to background as measured in the outwash sample and as established by MassDEP "natural levels" for soil. The implication for risk management purposes is that the observed levels of arsenic in soil may not warrant any need for a remedy.

### Ecological Risk Assessment

A BERA was performed for the Massachusetts Military Reservation (MMR) Tango Firing Range (the Site) located in Cape Cod, Massachusetts. The purpose of the BERA is to identify contaminants of potential ecological concern (COPECs) in surface soils which may pose potential risk to terrestrial ecological receptors utilizing habitat present at the Site.

Habitat at the Site included field and forested areas with sandy soils. Other than several common songbird species, no direct wildlife observations were made at the Site, However, 25 species listed under the Massachusetts Endangered Species Act have been observed in the habitats found across the entire area of MMR.

Problem formulation for estimating ecological risk included:

- Review of available data on ecological communities and selection of representative ecological receptor species;
- Development of a CSM for ecological receptors for application at the Site;

- Review of existing data on chemical concentrations in soil and selection of chemicals of potential ecological concern (COPECs); and
- Develop assessment and objective measurement endpoints for use in the ecological risk assessment.

Three avian species and three mammalian species were selected as representative ecological receptor species for the Site. These species represented herbivorous, omnivorous, and carnivorous trophic guilds. A site-specific conceptual site food web model was developed to identify the exposure pathways and routes through which the identified wildlife receptors may be exposed to contaminants associated with historical range uses. The primary exposure media was surface soils and the primary exposure pathways and routes included ingestion of dietary items that have bioaccumulated contaminants from surface soils and incidental ingestion of surface soils.

Site COPECs were identified utilizing a three step soil screening level assessment consistent with the comprehensive BERA Site assessment process at MMR ranges. This process identified eight COPECs for the Site:

- Nitroglycerin
- Antimony
- Arsenic
- Cadmium
- Copper
- Lead
- Tungsten
- Vanadium

The ecological risk characterization evaluated exposure of six representative wildlife receptors to the nine COPECs identified using the hazard quotient (HQ) method. The risk characterization identified NOAEL HQs > 1 for the chipping sparrow and American robin. These exceedances were for lead (chipping sparrow and American robin) exposure in the Site. Risk to birds from soil could not be evaluated for nitroglycerin or tungsten as TRVs were unavailable for these constituents. Based upon a NOAEL HQ >1 potential risk may exist for avian receptors from lead at the Site, however, LOAEL HQs <1 suggests this risk is minimal.

The risk characterization identified NOAEL and LOAEL HQs >1 for all three mammalian receptors. NOAEL exceedances included antimony (red fox) exposure. Exposure to vanadium resulted in NOAEL and LOAEL HQs >1 for all mammalian receptors. Risk to mammals from soil could not be evaluated for nitroglycerin or tungsten as TRVs were unavailable for these constituents. Based upon a NOAEL HQ >1 potential risk may exist for avian receptors from antimony at the Site, however, LOAEL HQs <1 suggests this risk is minimal. NOAEL and LOAEL HQs >1 for vanadium suggest potential risk for mammalian receptors in the Site. This risk however is considered minimal given the concentrations of vanadium in on-site soils are comparable to MADEP background concentrations for natural soils. As note previously, the implication for risk management purposes is that the observed levels of arsenic in soil may not indicate the need for a remedy.

# 1.0 Introduction

A Human Health and Ecological Risk Assessment (HERA) was prepared for Tango Range Area of Concern (AOC) located at Camp Edwards at the Massachusetts Military Reservation (MMR). This work represents efforts completed pursuant to the United States Environmental Protection Agency (USEPA) Administrative Orders under the Safe Drinking Water Act (SDWA) 1-97-1019 (AO1) and 1-2000-0914 (AO3). Under AO1, the National Guard Bureau (NGB) is required to complete investigations of the Impact Area and Training Ranges at MMR, and under AO3 the NGB is required to conduct a Feasibility Study (FS), Remedial Design (RD) and Remedial Action (RA) in AOCs identified by the USEPA. Contaminants of Concern (COC) are to be identified for evaluation within the FS and RA phases under AO3. This HERA was prepared using the available data as part of the Remedial Investigation (RI) performed for Tango Range.

An HERA risk assessment may consist of two separate components that are performed in successive phases when and as warranted:

- A screening level human health risk assessment (HHRA) and a screening level ecological risk assessment (SLERA), and
- A site-specific human health and/or a site-specific ecological risk assessment.

Both the initial screening and the more site-specific follow-up risk assessments were performed for the human health and ecological components for Tango Range. The human health risk assessment methodology and results are presented in Section 2, while the ecological risk assessment methodology and results are presented in Section 3.

As specified in the administrative order, the objective of this HERA is to identify the COCs in soil and groundwater from impacts associated with training and other activities that occurred within Tango Range AOC (also referred to in this Appendix as the "Site"). COCs represent contaminants that contribute to an excess risk of harm to potential human and environmental receptors. Any identified COCs from this risk assessment will be further evaluated within the FS and RA phases.

The identification of human health-related COCs in soil is based on the potential risk of harm from two possible routes: direct exposure to that soil by people associated with both current and potential future uses (including hypothetical future residential use); and indirect exposure via drinking and inhalation of volatile contaminants that may leached from that soil into the groundwater. The human health-related COCs were identified using a different process and criteria than was used for the ecological-related COCs.

## 1.1 Site Description

MMR is a 21,000-acre facility located at the western end of Cape Cod (Figure 2-1 of the RI Report) and includes Camp Edwards. Information about the Site history and a description of the Site vicinity is based on information presented in Section 2 of the RI, to which this HERA is appended. The Massachusetts Army National Guard (MAARNG) conducts training operations at Camp Edwards under the direction of the NGB.

Tango Range is an active combination .50-caliber machine gun and pistol range located in the northern portion of MMR. It is located on the southern side of Gibbs Road just west of the Sierra East and Sierra WesTango Ranges within Camp Edwards. Records indicate that ammunition used has included 5.56 mm, 7.62 mm, .50-caliber ammunition, and several types of pistol ammunition.

The most densely populated area surrounding Camp Edwards is within the Town of Sandwich, which is roughly 2 miles north and east of Tango Range. The Town of Sagamore lies approximately 2 miles north of Tango Range, and the Town of Bourne is located approximately 3 miles due west of the Site. These distances are characteristic of the distances to the nearest residences and schools in these communities.

## 1.2 Site History

Tango Range was constructed sometime between 1986 and 1989 at what was formerly P Range.

Former P Range was used first in 1967 as a night defense course (where only blank ammunition was used) and continued to be used as such until the mid-1970s when it was converted to a squad and platoon attack course. At that time, no ammunition was used. In the late-1980s, the range name was changed to Tango Range designation and continued to be used as an assault course. Only blank ammunition was used during this period. In 1990 or 1991, Tango Range was converted to a .50-caliber machine gun range and pistol range.

There are currently six elevated .50-caliber firing points separated by intervals of approximately 50 feet along a 250-foot long firing line. There are rows of targets downrange at 25 meters from the pistol firing line and approximately 45 meters from the .50 cal firing line. Numerous plastic .50-caliber projectiles were observed throughout the range.

In September, 2006 a backstop berm and bullet collection system was installed as part of the MAARNG's initiative to return to firing lead bullets at the range. There was previously no backstop berm at this range. Surficial soils were removed from the footprint of the berm by MAARNG prior to construction.

## 1.3 Areas of Interest

Pursuant to the 2006 Project Note investigation, the range was divided conceptually into the following three areas of interest based on the known past use of the Site:

- Area 1 - The area from the top of the machine gun firing points to the 25 meter targets across the entire width of the range,
- Area 2 - The area of the planned new berm (approximately 45 x 220 feet) behind the 25-meter targets. This area was subsequently excavated to a depth of 6-inches prior to construction of the berm; and
- Area 3 - The remainder of the range, down range (south) of Area 2 and Area 1.

## 2.0 Human Health Risk Assessment

This site-specific HHRA was conducted in accordance with the USEPA Risk Assessment Guidance for Superfund (RAGS), Volume I: Human Health Evaluation Manual, Part A (USEPA, 1989), Part D (USEPA, 2001a), and Part E (USEPA, 2004b), and in accordance with established MMR protocols. The Draft Work Plan and the subsequent comment resolution instructions were developed and issued in an attempt to maintain a consistent technical approach that adhered to the relevant USEPA and Massachusetts Department of Environmental Protection (MassDEP) risk assessment protocols and policies as interpreted for MMR and the Impact Area Groundwater Study Program (IAGWSP).

The risk assessment methodology involved a four-step process: (1) data evaluation; (2) exposure assessment; (3) toxicity assessment; and (4) risk characterization (Figure 2.1). The HHRA is divided into the following sections and supporting attachments:

- Section 2.1: Data Evaluation – Evaluates the analytical investigation data, identifies the chemicals of potential concern (COPCs), and calculates appropriate exposure point concentrations (EPCs) in each impacted medium;
- Section 2.2: Exposure Assessment – Identifies the potential receptors and complete pathways of exposure in terms of a conceptual site model and establishes the basis for quantifying those exposures (i.e., develops the receptor-specific exposure parameters);
- Section 2.3: Toxicity Assessment - Evaluates the toxicity of the identified COPCs relative to the identified exposure routes for both carcinogenic and non-cancer health endpoints;
- Section 2.4: Risk Characterization – Quantifies the various contaminant intakes for each receptor, calculates the corresponding estimates of health risks, and identifies COCs that contribute most to the projected risks; and
- Section 2.5: Uncertainty Analysis - Analyzes the principal uncertainties associated with the various components of the risk assessment and their implications relative to interpreting the results of the risk assessment.

A brief summary of the findings of both the HHRA and the SLERA (i.e., the HERA) is provided in Section 4, and the references cited in the HERA are listed in Section 5.

Risk assessment data summaries and calculations are presented in USEPA's Standard Reporting Format (SRF) RAGS Part D tables. These tables are referred to as "SRF Table (number)" when cited within this report. It should be noted that the numbering of tables follows the RAGS-D format. Consequently, there are no tables numbered as "SRF Table 8" as SRF Table 8 is reserved for radiological risk characterization, which is not applicable to this HHRA. Non-RAGS format tables with calculations to support RAGS Part D Table 4 series are presented after the RAGS Part D 4 series tables in Attachment A. These tables (i.e., Tables 4.7 – 4.13) are labeled without the SRF prefix for distinction. In addition, non-RAGS format tables presented within the text are also labeled without the SRF prefix and are numbered in sequential order, starting with Table 2.1.

## 2.1 Data Evaluation

This section summarizes results of the data evaluation step of the risk assessment process performed for Tango Range. In this step, the existing sampling results were evaluated to assess data quality and usability (in consideration of the analytical methods used, the magnitude of the sample quantitation limits achieved, the assignment of data qualifiers, and the presence of indicators of either field or laboratory contamination). Thereafter, a database of the qualified analytical results was developed and the COPCs for the potential exposure media at the Site were selected for the different areas of interest. The approach to COPC selection was based on USEPA guidance and followed the established MMR protocol.

### 2.1.1 Data Sources

As specified in the Final Supplemental Phase 2b Work Plan (AMEC, 2002), Tango Range was one of33 supplemental Phase 2b sites evaluated for current and future potential impacts. The investigation was designed to characterize the nature and extent of possible soil and/or groundwater contamination resulting from historical releases associated with past training activities. Investigation results were reported in the Final Technical Team Memorandum 02-2 Small Arms Range Report (AMEC, 2003).

Additional site characterization was proposed and completed at Tango Range under a Project Note in 2006 in an effort to support MAARNG's priorities and range construction plans. Groundwater downgradient of Tango Range also was sampled and analyzed in 2006.

Laboratory analytical data for the Site characterization and additional investigation were uploaded electronically into an Access© database from the MMR Environmental Data Management System (EDMS). The Access© database was used by TtEC remedial investigation and risk assessment personnel to create output files, prepare summary statistics tables using Excel© and MiniTab©, and calculate exposure point concentration estimates using ProUCL Version 3.

### 2.1.2 Summary of the Data Collected at Tango Range

The HHRA for Tango Range made use of the available soil and groundwater data collected previously at the range. These prior sampling events, and the data produced, are summarized below.

#### Supplemental Phase 2b Soil Sampling

As part of the second round of Phase 2b investigations in April of 2002, the IAGWSP established three 5-point soil grids on Tango Range at selected firing points along each of the two firing lines to determine if residual propellant compounds exist in soil there. Central grids were positioned near the center of both firing lines and the remaining grids were positioned down range of firing points located near the eastern and western limits of both firing lines. The center nodes for each grid were positioned approximately eight feet down range of the firing line and two feet to the right of their respective lane markers. The grids were sampled at three depth intervals: surface (0 to 3 inches below ground surface (bgs)), intermediate (3 to 6 inches bgs), and deep (6 to 12 inches bgs). One 5-point composite and one discrete soil sample (obtained from the center grid node) were collected at each depth interval. Samples were submitted for analysis of semivolatile organic compounds (SVOCs) (Method 8270) and metals.

### June 2006 Project Note Soil Sampling

Investigation Areas 1, 2, and 3 (as defined in Section 1.3) were divided into three equal sample areas across the width of each Area. The three sample areas are identified as West, Center, and East. This delineation provided for the collection of samples from the most heavily used central portion of the range and separate samples from the less frequently used flanks. The center area is likely to have experienced the most intense loading of contaminants because, historically, most of the rounds are fired from the center lanes of a range.

In addition, the center section of Area 1 was divided into north and south sub-sections (Area 1/Center/North and Area 1/Center/South) to determine if there is any difference in contaminant concentrations immediately in front of the firing points and somewhat further down range.

Samples were collected from each of these ten sub-areas as follows:

- Area 1/West - One 100-point composite sample was collected from 0-3 inches below grade and analyzed for metals and tungsten. A replicate sample was collected from this area and analyzed for the same constituents;
- Area 1/Center/North - One 50-point sample was collected from 0-3 inches below grade and analyzed for metals, tungsten, explosives (Method 8330), SVOCs (Method 8270), and perchlorate. A replicate sample was collected from this area and analyzed for the same constituents;
- Area1/Center/South - One 50-point composite sample was collected from 0-3 inches below grade. Another composite sample was collected from 9-12 inches below grade from the same 50 locations. Both samples were analyzed for metals, tungsten, explosives and perchlorate;
- Area 1/East - One 100-point composite sample was collected from 0-3 inches below grade and analyzed for metals and tungsten. A replicate sample was collected from this area and analyzed for the same;
- Area 2/West - One 100-point composite sample was collected from 0-3 inches below grade and analyzed for metals and tungsten;
- Area 2/Center - One 100 point composite was collected from 0-3 inches below grade and analyzed for metals, tungsten, explosives, and perchlorate. A replicate sample was collected and analyzed for the same constituents;
- Area 2/East - One 100-point composite sample was collected from 0-3 inches below grade and analyzed for metals and tungsten;
- Area 3/West - One 100-point composite sample was collected from 0-3 inches below grade and analyzed for metals and tungsten;
- Area 3/Center - One 100-point composite sample was collected from 0-3 inches below grade and analyzed for metals, tungsten, and perchlorate. A replicate sample was collected and analyzed for the same constituents; and

- Area 3/East - One 100-point composite sample was collected from 0-3 inches below grade and analyzed for metals and tungsten.

All samples were collected using the approach developed by ERDC/CRREL (USACE, 2004). Samples were collected using a plug extractor except for the deep samples in Area 1/Center/North which were collected using a hand auger. A systematic sampling approach was used to collect representative samples from each grid. Care was taken to ensure that samples were not concentrated in one portion of the sampling area. Samples for SVOC analysis were sent directly to STL Laboratory in Burlington Vermont for analysis. All samples for explosives, perchlorate, metals and tungsten were shipped to ERDC/CRREL in Hanover, New Hampshire and ground in a steel puck mill grinder. The samples were then shipped to STL Laboratory in Burlington Vermont for analyses.

The samples from Area 2/West, Area 2/Center, and Area 2/East were not used in this HHRA because this area was excavated to a depth of 6 inches prior to construction of the backstop berm. Areas 2 (post-excavation) and Area 3 were combined into a single area of interest.

### Groundwater Investigation

In September, 2006 a groundwater monitoring well (MW-467S) was installed downgradient of the range (Figure 3-3). MW-467S was located and screened at a depth to intercept groundwater that originated as precipitation falling on the range. The monitoring well was sampled and analyzed for explosives (Method 8330), 8 total RCRA metals (Method 6010B), total and dissolved tungsten (Method 6020), and SVOCs (Method 8270C).

### 2.1.3 Summary of the Detected Compounds by Environmental Medium and Chemical Group

**Surface Soil:**

<u>Explosives:</u>

Explosives were detected in multiple surface soil samples from Area 1. Specifically, there were 3 detections of nitroglycerin. There were no explosives detected in the Area 2 (post-excavation) or Area 3 samples.

<u>Polycyclic Aromatic Hydrocarbons (PAHs):</u>

PAHs were detected in Area 1. The maximum detected concentration for each PAH compound was associated with soil samples collected from grid location SS169E. However, for point of comparison, the PAH concentrations detected in the soil samples from Area 1 were less than those detected in the outwash surface soil sample (an indicator of local background levels) and established concentrations for natural soils in Massachusetts (MassDEP, 2002).

<u>Metals/Inorganics:</u>

Several metals were detected in excess of the cited background levels, particularly the central portion of Area 1. Antimony, calcium, and lead all were detected in this area at concentrations more than two times greater than those reported in the outwash sample or MassDEP "natural soils."

Semivolatile Organic Compounds:

Phthalate esters were detected in Area 1. Other detected SVOCs include benzoic acid, n,n'-diethylcarbanilide, and n-nitrosodiphenylamine. Phthalates as well as n-nitrosodiphenylamine are considered propulsive, explosive or pyrotechnic compounds.

**Groundwater:**

No explosives compounds, SVOCs, or metals were detected in MW-467S. Total tungsten was detected at a concentration of 2.9 µg/Land dissolved tungsten was detected at a concentration of 1.9 µg/L. There is, however, currently some uncertainty in the ability of the various laboratory methods to reliably detect tungsten at these low concentrations.

Lead was not detected in the groundwater sample collected at MW-467S. This finding is consistent with a recent study of the behavior of metallic lead in the environment conducted by the CRREL. That study concluded that, based on a literature search, a review of geochemical properties and existing site data, it is highly unlikely that lead can migrate to groundwater and result in detectable concentrations at small arms ranges.

### 2.1.4 Data Usability

The site characterization soil sampling results used in this HHRA were submitted to a data quality review by Environmental Chemical Corporation (ECC) via the MMR EDMS database. This review consisted of a combination of automated data review and supplemental manual review. The following quality control elements were evaluated during this review:

- technical holding times;
- method blank contamination;
- field blank contamination;
- blank spike accuracy;
- blank spike precision;
- matrix spike accuracy;
- matrix spike precision;
- surrogate recovery;
- laboratory duplicate precision; and
- field duplicate precision.

Based on this data quality review, the following qualifiers were assigned to the data (as appropriate):

Data Qualifier Codes Related to Identification:

"U" – The analyte was analyzed for, but was not detected above the reported sample quantitation limit (SQL). For practical purposes, "U" means "Not Detected."

"B" – For organic data, analyte not detected substantially above the level reported in laboratory or field blanks.

"R" – The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified. "R" data is generally considered to be unreliable. Rejected data were not used in the risk assessment.

"N" – The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification."

Data Qualifier Codes Related to Quantitation:

"J" – The "J" qualifier denotes that the analyte was identified. The associated numerical value is the estimated concentration of the analyte in the sample.

"UJ" – The analysis was not detected above reported sample quantitation limit. However, the reported quantitation limit is approximate and may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. "UJ" non-detects are not definite; the analyte may be present. The result can be used to document non-detects in background samples under certain conditions.

"B" – For inorganic data, the reported value is less than the reporting limit but greater than the instrument detection limit.

Other Data Qualifier codes:

"NJ" – The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.

Based on the data quality review performed, all data were acceptable for use (as qualified).

For purposes of this risk assessment pursuant to USEPA guidance (1989, 1992), analytical values reported as "Not Detected" were assigned a value of one-half the SQL for that constituent. Duplicate samples were taken periodically for sampling quality control purposes. Duplicate samples are generally obtained at the same time and location as the original sample, and were analyzed via the same laboratory method(s). When paired primary and duplicate samples had detected values, the results were averaged and treated as one data point. When the results from both samples were reported as non-detect, the lower reporting limit was used as the sample result. When only one of the paired primary and duplicate samples had a detected value, the detected value was used as the data point. Laboratory replicates are not included in the frequency tally or range of detected concentrations presented in SRF Tables 2.1 and 2.2 in Attachment A.

### 2.1.5 Compound-Specific Issues

Nitorglycerin was detected by both Method 8270 (SVOCs) and Method 8330 (Explosives). Because High Performance Liquid Chromatography (HPLC) methods such as Method 8330 are known to generate false positive results, Gas Chromatography/Mass Spectrometry (GC/MS) Method 8270 can be used as a confirmation of the presence of the explosive. In addition, the HPLC is coupled with a Photo Diode Array detector for more accurate identification of the explosive compounds. In all instances where nitroglycerin was detected by Method 8330, it was also detected by Method 8270. The Method 8330 results were utilized in the HHRA as the quantitation using this analytical method is more accurate.

### 2.1.6 Identification of Chemicals of Potential Concern

COPCs are defined as those compounds that are potentially related to the Site and whose data are of sufficient quality for use in the quantitative risk assessment (USEPA, 1989). The MMR risk assessment protocols modify the standard USEPA COPC selection process in some significant ways. The following summarizes the key elements of the MMR protocol instructions relative to COPC selection:

- Unless it is impractical, all detected constituents should be considered as COPCs for an HHRA.
- Data reduction is an option when identifying COPCs for larger data sets, provided the screening or filtering is done in a transparent manner.
- A detected constituent should not generally be eliminated as a COPC on the basis of low frequency of detection (FOD) for HHRAs. If FOD is used as a justification for screening out a constituent, it should be used in conjunction with other lines of evidence as well and only after a checking for hot spots of that constituent.
- Constituents that are not "mission-related" should not be screened out of the HHRA (i.e., prior to the feasibility study).
- Exceedances of promulgated standards identified during comparisons made during the COPC selection process should be flagged and discussed (as appropriate), but should not be used as a justification for deciding if a constituent is or is not a COPC.

In accordance with USEPA guidance, COPCs are identified as compounds that are detected in an exposure medium at concentrations greater than their respective risk-based screening criteria (USEPA, 1999a). Compound-, media-, and pathway-specific risk-based criteria are used as a screening tool to identify COPCs for baseline risk assessments and eliminate chemicals that pose insignificant risk or hazard to human health.

The process for selecting COPCs is defined in USEPA RAGS Part A (USEPA, 1989). This process was applied for Tango Range, consistent with the previously noted instructions. The candidate COPC list was first generated as the list of all chemicals detected in each exposure medium (in this case, surface soil) for each exposure area of interest. Detected chemicals are those constituents that were detected above the SQL, including those that were reported with selected qualifiers that imply uncertain concentration but not uncertain identity. Working from this initial list, chemicals were eliminated, only when certain criteria were met. These criteria were as follows:

Field and Laboratory Contamination:

Chemicals attributable to field or laboratory contamination (e.g., organic chemicals qualified as B) based on guidance in the *Functional Guidelines for Organic Data Review* (USEPA, 1999e) may be eliminated because these are not indicators of site-related contamination. However, no organic compounds were B qualified. Consequently, no chemicals were eliminated as possible COPCs using this criterion.

Essential Nutrients:

Chemicals that are essential nutrients may be eliminated from the COPC list if on-site concentrations were consistent with naturally occurring levels or were below safe nutritive levels. Naturally occurring elements considered essential for human nutrition (i.e., calcium, copper, iron, magnesium, phosphorous, potassium, and sodium) were evaluated as follows. An essential nutrient was eliminated as a COPC only if its maximum concentration was below the safe nutritive level. Although USEPA Region 9 Preliminary Remediation Goals (PRGs) do exist for iron and copper, the iron PRG is based on provisional toxicity information that is not approved for use in USEPA Region I and the copper PRG is not based on toxicity / risk thresholds, but rather on taste and odor thresholds in water. The published safe nutritive level was converted to an equivalent maximum acceptable soil concentration as shown in Table 2.1.

| Chemical | Essential Nutrient Acceptable Daily Dose[1] (mg/kg-day) | Corresponding Maximum Acceptable Soil Concentration[2] (mg/kg) | Maximum Site-Wide Soil Concentration (mg/kg) | Average Site-Wide Soil Concentration (mg/kg) |
|---|---|---|---|---|
| Calcium | 14 | >1,000,000 | 3,490 | Not Applicable |
| Phosphorous | 14 | >1,000,000 | 75.6 | Not Applicable |
| Magnesium | 5.7 | >1,000,000 | 1,750 | Not Applicable |
| Iron | 0.26 | 55,152 | 42,000 | 10, 965 |
| Copper | 0.037 | 7,850 | 7,220 | 980 |
| Sodium | 7.14 | >1,000,000 | 2,630 | Not Applicable |
| Potassium | 0.57 | 121,000 | 720 | 356 |

Notes:
1 USEPA 1994b; sodium value is 1/10th the Recommended Dietary Allowance
2 Conversion uses highest soil ingestion rate at the Site (i.e., construction worker): The expression is: Acceptable Soil Concentration = Acceptable Dose $*((70)(10^6)/(330))$; Where 70 = 70 kg body weight, $(10^6) = 10^6$ mg/kg, and (330) = 330 mg/day soil ingestion rate.

This evaluation indicates that no physically possible concentration of calcium, phosphorus, magnesium, and sodium in soil could lead to an intake that exceeds the Acceptable Daily Dose of even assuming the relatively high soil ingestion rate of 330 mg/day. For the other three essential nutrients (i.e., iron, copper and potassium), the Acceptable Daily Doses correspond to maximum acceptable soil concentrations that are physically possible but that are greater than the highest concentration for that chemical measured anywhere at Tango Range. Although this evaluation considered only ingestion of soil and does not consider potential dermal absorption or inhalation exposures, dermal absorption and inhalation exposures are not likely to be significant for these chemicals. In general, these compounds are not readily absorbed through the skin and as they are not volatile, the only potential inhalation exposure would be from particulates. As a result, the intake of these essential nutrients due to exposure to the soil at Tango Range is unlikely to contribute significantly to total risk, and no further evaluation of these compounds is necessary.

Background:

Information is provided in the SRF Tables 2.1 and 2.2 (Attachment A) regarding background soil concentrations that may be associated with the Site. However, it should be noted that this information was not used to eliminate or screen out any possible COPCs. The background levels are based on the results from an outwash surface soil sample described as “Moraine background” (AMEC, 2001b) and background "natural" soil data from across Massachusetts (MassDEP, 2002). In general, remedial efforts are typically not required for naturally occurring COPCs with concentrations at or below background levels (USEPA, 1999a; MassDEP, 2002; MassDEP 2003). This information on background levels will be utilized in future risk management decisions.

#### 2.1.6.1 Selection of Chemicals of Potential Concern in Soil

In accordance with established MMR risk assessment protocols, COPCs for the soils in the areas of interest were identified for this HHRA based on consideration of multiple possible exposure pathways:

1. direct contact (ingestion and dermal absorption) or inhalation exposure (particulates or volatile vapors) to contaminants in soil; and
2. direct contact (ingestion and dermal absorption) or inhalation exposure to groundwater potentially impacted by constituents that may leach from contaminated soil.

The screening process to identify COPCs was conducted in accordance with CERCLA guidance (e.g., *Supplemental Guidance for Developing Soil Screening Levels* (USEPA, 2002a), RAGS Part A (USEPA, 1989), and USEPA regional guidance (Region I guidance (USEPA, 1995), Region 9 guidance (USEPA, 2004a), Region 3 guidance (USEPA, 2006b), and Region 8 guidance (USEPA, 1994b)).

In accordance with MMR risk assessment protocols, the identification of COPCs relative to the direct exposure and inhalation pathways should be accomplished by comparing the maximum detected concentrations of the constituents in soil to risk-based criteria developed to be protective of these exposures. For MMR in general, and for Tango Range specifically, the risk-based criteria used for this screening were the USEPA Region 9 PRGs for residential soil (USEPA, 2004a). Region 9 PRGs are conservative risk-based concentrations reflecting current USEPA toxicity values, conservative residential exposure factors (adult and child), and conservative risk goals (non-cancer hazard quotient [HQ] of 1 or an excess lifetime cancer risk of $1x10^{-6}$). The Region 9 PRG values for residential soil assume exposure via incidental ingestion, dermal absorption, and inhalation of both particulates and volatiles. In accordance with USEPA Region I guidance, when a Region 9 PRG to be used for screening in this evaluation was based on a non-cancer health effect the published value was first divided by 10 to obtain a value reflective of a more stringent HQ of 0.1 (USEPA, 1995, 1999a). USEPA recommends using one-tenth of the PRG for non-carcinogens to protect against underestimation of non-cancer hazards from exposure to multiple non-carcinogens potentially impacting the same targer organ or system (USEPA, 2004a). Those constituents whose maximum detected values exceeded this criterion were retained as COPCs.

To identify the COPCs in soil based on their potential to migrate from soil to groundwater, an evaluation was conducted of both soil and groundwater conditions at the Site. This evaluation initially involved comparing the maximum detected concentrations of the constituents in soil to site-specific Phase I MMR Soil Screening Levels (SSLs). The MMR SSLs were developed specifically in consideration of the conditions present at MMR for the USEPA by the Idaho National Engineering and Environmental Laboratory. The MMR SSLs are based on site-specific measurements and conservative assumptions, such as reflecting a dilution-attenuation factor of one. Those soil constituents that were detected at a concentration greater than their respective Phase I MMR SSL were further evaluated using the phased approach described in Section 2.1.7.2 and detailed in Appendix B.

The soil COPCs identified from these two separate considerations are presented in the following subsections.

#### 2.1.6.2 Soil Screening Criteria Based on Direct Contact/Inhalation Pathways

The maximum detected concentrations of each compound in surface soil (0 to 1 ft bgs) were compared to the risk-based screening concentrations. As was noted above, the USEPA Region 9 PRGs developed to be protective of residential exposures to soil (i.e., incidental ingestion, dermal absorption, and inhalation of particulates or volatiles) were used for this screening (USEPA, 2004a). Risk-based criteria based on a non-cancer health effect were adjusted by dividing by 10 to obtain a screening criterion that was representative of an HQ of 0.1 prior to being used in this evaluation. Constituents with maximum detected concentrations exceeding the risk-based screening criteria for either depth interval were retained as COPCs for both surface and subsurface soil. No federal or state applicable or relevant and appropriate requirements (ARARs) were used to select COPCs for soil.

Several detected constituents in soil did not have published Region 9 PRGs. For these chemicals, appropriate surrogate values were utilized for COPC screening or in the absence of an appropriate surrogate, the chemical was retained as a COPC. No surrogate relationships were adopted for the COPC screening process.

#### 2.1.6.3 Groundwater Screening Based on Groundwater Monitoring Data

No explosives compounds, SVOCs, or metals were detected in MW-467S. Total tungsten was detected at a concentration of 2.9 μg/L and dissolved tungsten was detected at a concentration of 1.9 μg/L.

### 2.1.7 COPC Selection by Area of Interest

The following sections summarize the results of the COPC screening process for each of the exposure areas of interest.

#### 2.1.7.1 Area 1

There were 126 target analytes for the surface soil in this exposure area of interest.

- Of these 126 target analytes, there were 39 detected compounds:
    - Of the 39 detected compounds, 9 were selected as COPCs for direct contact to be evaluated in the risk assessment.
    - Of the 39 detected compounds, 13 were COPCs for leaching from soil to groundwater based on the Phase I evaluation that should be further evaluated in the groundwater RI (i.e., their maximum detected concentration exceeded their respective MMR SSL).

The following compounds were identified as COPCs in Area 1 surface soil based on a comparison of maximum detected concentrations to risk-based screening criteria protective of direct exposures: aluminum, antimony, arsenic, lead, tungsten, vanadium, n,n'-diethylcarbinalide (also known as 1,3-diethyl-1,3-diphenyl urea), and nitroglycerin (see Attachment A SRF Table 2.1). Cancer and non-cancer risks associated with all COPCs were quantified in the HHRA, including those present at concentrations consistent with background. Two of the 9 COPCs for direct contact exposure (i.e., arsenic and vanadium) were detected at maximum concentrations that were comparable to background (i.e., the outwash surface sample and the MassDEP published "natural soil" values (MassDEP, 2002).

#### 2.1.7.2 Area 2 (post-excavation) & Area 3

There were 27 target analytes for the surface soil in this exposure area of interest.

- Of these 27 target analytes, there were 22 detected compounds:
  - Of the 22 detected compounds, 5 were selected as COPCs for direct contact to be evaluated in the risk assessment.
  - Of the 22 detected compounds, 7 were COPCs for leaching from soil to groundwater based on the Phase I evaluation that should be further evaluated in the groundwater RI.

The following compounds were identified as COPCs in Area 2 (post-excavation) and Area 3 surface soil based on a comparison of maximum detected concentrations to risk-based screening criteria protective of direct exposures: aluminum, arsenic, tungsten, and vanadium (see Attachment A SRF Table 2.2. Three of the 5 COPCs for direct contact exposure (i.e., aluminum, arsenic, and vanadium) were detected at concentrations that were comparable to background (i.e., the outwash surface sample and the MassDEP published "natural soil" values (MassDEP, 2002). Cancer and non-cancer risks associated with these 5 COPCs were quantified in the HHRA, including those present at concentrations consistent with background.

### 2.1.8 Exposure Point Concentrations

In order to quantify the magnitude of exposure that may be expected to occur to a receptor, the concentrations of the identified COPCs in the exposure media must first be estimated from the available applicable data. The EPC is the estimated concentration of the COPC in a medium to which a receptor would be exposed. It is used in conjunction with other exposure factors to calculate the daily intakes or absorbed doses of the COPCs.

EPCs were calculated using the USEPA software, ProUCL (Version 3.0 USEPA, 2004c). After the COPCs were identified for each exposure medium associated with the exposure areas of interest at the Site, the 95 percent upper confidence limit (UCL) on the mean was calculated for each COPC based on the statistical distribution of its sampling data set. The UCL is an upper-bound estimate of the average or mean concentration of a data set. One-half the SQL for that constituent was used as the concentration for that constituent in that sample for purposes of statistical evaluation when that constituent was not detected in a particular sample. In addition, samples with field duplicate samples were averaged together to develop the concentration at that location to be used in the statistical evaluations.

Several parametric and non-parametric methods are included in ProUCL, as listed below.

The five parametric UCL computation methods include (USEPA, 2004c):

1. Student's-t UCL;
2. Approximate gamma UCL using the chi-square approximation;
3. Adjusted gamma UCL (adjusted for level significance);
4. Land's H-UCL; and

5. Chebyshev inequality based UCL (using minimum variance unbiased estimates (MVUEs) of the parameters of a lognormal distribution).

The ten non-parametric methods for calculating a UCL included in ProUCL are (USEPA, 2004c):

1. The Central Limit Theorem (CLT) based UCL;
2. Modified-t statistic based UCL (adjusted for skewness);
3. Adjusted CLT based UCL (adjusted for skewness);
4. Chebyshev inequality based UCL (using sample mean and sample standard deviation);
5. Jackknife method based UCL;
6. UCL based upon standard bootstrap;
7. UCL based upon percentile bootstrap;
8. UCL based upon bias-corrected accelerated bootstrap;
9. UCL based upon bootstrap-t; and
10. UCL based upon Hall's bootstrap.

Three parametric distributions were most often observed to be associated with the sampling data sets for this Site: normal, lognormal, and gamma.

The relationship for calculating the 95% UCL of the arithmetic mean for a normal distribution is as follows (USEPA, 2004c, Equation 32):

$$95\%\ UCL = \bar{x} + t_{0.05,n-1} \cdot \frac{S_x}{\sqrt{n}}$$

where:

| | | |
|---|---|---|
| $\bar{x}$ | = | Arithmetic mean of the samples; |
| $t_{0.05,n-1}$ | = | Student's t distribution parameter; depends on the probability confidence level (1 – confidence level, or 0.05 for a 95% UCL) and the degrees of freedom (df), here n-1; |
| $S_x$ | = | Standard deviation of the samples; and |
| n | = | Number of sample analyses. |

The relationship for calculating the 95% UCL of the geometric mean for a log-normal distribution is as follows (USEPA, 2004c, Equation. 36):

$$Lognormal\,95\%UCL = \exp\left(\bar{y} + 0.5S_y^2 + \frac{S_y H_{0.95}}{\sqrt{n-1}}\right)$$

where:

| | | |
|---|---|---|
| $\bar{y}$ | = | Arithmetic mean of the transformed values ($y_i = \ln X_i$); |
| $S_y$ | = | Standard Deviation of the transformed values; |
| $H_{0.95}$ | = | H statistic depends on Sy and n for the 95% confidence level; and |
| n | = | Number of sample analyses. |

The algorithms for the calculation of the approximate or adjusted gamma distribution UCLs, the modified-t Statistic UCL, and the Chebyshev inequality based UCLs are not as easy to present in a concise manner. The relationships for calculating the 95% UCLs using these approaches are presented in the ProUCL Version 3.0 User Guide (USEPA, 2004c) in reference to the following Equation numbers:

- Approximate Gamma Distribution — Equation 34
- Adjusted Gamma Distribution — Equation 35
- Modified-t Statistic for Asymmetrical Distributions — Equation 37
- Chebyshev Theorem (Using Sample Mean and Standard Deviation) — Equation 46

Additional details on these approaches are presented in Appendix A of the ProUCL User's Guide (USEPA, 2004c).

Using the ProUCL software, a statistical test was performed to determine if the distribution of the sampling data for a COPC exhibited a normal, lognormal, or gamma distribution. Based on this determination, the 95% UCL was calculated by one of the above equations. If a data set was found to be neither normally or lognormally distributed, ProUCL recommends a UCL calculation approach based on the standard deviation of the lognormally transformed data set or an approximate non-parametric measure of the UCL (USEPA, 2004c). If the calculated 95% UCL using the approach recommended by the software was greater than the maximum detected concentration in the data set, the maximum detected concentration was used as the EPC. The outputs from ProUCL for soil data sets are presented in Attachment B to this HERA.

EPCs were derived for each of the COPCs in the surface soil data set in the impacted areas of interest for the identified receptors based on the assumed interaction of those receptors with the land. Surface soil (0 to 1 foot bgs) was defined as the exposure point at this Site for current and future trespassers, future recreational users (e.g., hunters), and future military personnel involved in non-intrusive small arms training activities. The exposure point for future construction workers also is the soil from 0 to 10 feet bgs. Finally, to accommodate a future hypothetical resident at the Site, the entire area would need to be re-graded and/or fill material would need to be added to provide a suitable foundation for construction of new buildings or other redevelopment features. As a result, current conditions would likely be altered to a great extent and the current surface and subsurface soil would be mixed. Therefore, soil from 0 to 10 feet bgs also is defined as the exposure point for the hypothetical future residents. In summary, two soil exposure points (strata) are defined for current and future exposures—surface soil and the combined surface and subsurface soil.

No activity or surface feature has been identified that would suggest preferential use or exposure to any one area within the Site over that of any other under future Site conditions. However, given the different COPCs in each of the exposure areas of interest that comprise Tango Range, the two separate exposure point areas were defined for this risk assessment:

- Area 1 exposure point: COPCs include inorganics and explosives;
- Combined Areas 2 & 3 exposure point: COPCs include inorganics.

SRF Tables 3.1 and 3.2 (presented in Attachment A) summarize the EPCs for each COPC identified in the surface soil (0 to 1 foot bgs) of Area 1 (SRF Table 3.1), and Area 2 (post-excavation) & Area 3

(SRF Table 3.2). There is no subsurface soil data available for either area, therefore, the surface soil EPCs were assumed to be representative of the combined surface and subsurface soil exposure point for Area 1 and the combined Areas 2 & 3. This assumption is believed to be conservative (i.e., not likely to lead to an underestimation of risk) due to the largely durface depositional model of release of the Site contaminants.

## 2.2 Exposure Assessment

The exposure assessment describes, both qualitatively and quantitatively, the most significant potential exposure pathways through which people may contact contamination in the soil at the Site. The exposure assessment considers site conditions and receptor behavior associated with both current and reasonably foreseeable future land uses. A complete human exposure pathway is composed of the following elements (USEPA, 1989):

- A source and mechanism of chemical release to the environment;
- An environmental transport medium for the released chemical or mechanisms of transfer of the chemical from one medium to another;
- A point of potential contact by humans with the contaminated medium; and
- An effective route of exposure (i.e., ingestion, dermal absorption, or inhalation) for that chemical.

This section presents the exposure assessment step of the HHRA for Tango Range. The purpose of the exposure assessment is to identify the populations that may come into contact with the COPCs at the Site and the pathways by which they may be exposed. The extent of the exposure is then quantified for each exposure pathway determined to be complete or potentially complete.

Section 2.2.1 reviews the environmental setting and land use at Tango Range. Section 2.2.2 presents the conceptual site model of potential human exposures for the Site, with Section 2.2.3 summarizing the potential source areas, release mechanisms, receptor populations and exposure pathways that were addressed in the risk assessment and Section 2.2.4 summarizing the receptors and human exposure routes that were assessed. Section 2.2.5 discusses the assumptions and parameters used to estimate the extent, frequency, and duration of exposure for the various receptor populations. Section 2.2.6 presents the chronic daily intake (CDI) calculations relative to both non-cancer and carcinogenic health endpoints (i.e., the amount of COPCs that an individual would be exposed to each day). Intakes were calculated for each route of exposure using receptor-specific exposure factors.

### 2.2.1 Exposure Setting and Land Use

The MMR includes both Camp Edwards and Otis Air National Guard Base (Otis ANGB). The MMR is located on the western side of Cape Cod, Massachusetts. The MMR as a whole is a wooded area on the Upper Cape that is largely undeveloped, but fringed with highways, homes, and other development (Cape Cod Commission, 1998). The predominant land use surrounding the MMR is residential or commercial development. The cantonment area at the southern portion of Camp Edwards borders Otis ANGB, United States Coast Guard (USCG) Air Station Cape Cod, USCG Housing, and the Veteran's Affairs Cemetery. The MMR is situated within four towns, Bourne, Sandwich, Falmouth, and Mashpee. Camp Edwards, which includes Tango Range, lies within the boundaries of Bourne and Sandwich.

Land use near the MMR is primarily residential and recreational, and secondarily agricultural and industrial. Shawme Crowell State Forest provides camping as well as other recreational activities. Portions of the MMR are opened for deer and turkey hunting by permit from the Massachusetts Division of Fisheries and Wildlife. The major agricultural land use near the MMR is the cultivation of cranberries. Commercial and industrial development in the area includes service industries, landscaping, sand and gravel pit operations, and municipal landfills (USACE, 2002).

An archaeological survey covering 72 percent of Camp Edwards was conducted in 1987 to assess its archaeological sensitivity. A total of one historic site and 26 prehistoric sites were identified within Camp Edwards. Findings from these surveys indicate that humans inhabited the Camp Edwards area up to 10,000 years ago. Knowledge of the precise location of these historic sites is restricted to only the Geographic Information System (GIS) Manager and the MAARNG Regional Cultural Resources Manager to prevent damage or looting (MAARNG, 2001).

The Central Impact Area and Training Ranges (including Tango Range) sit above a sole source aquifer. This aquifer contains zones of contribution for a number of public water supply wells and is a potential future source of drinking water. The Central Impact Area, located south of Tango Range, is within the Upper Cape Water Supply Reserve, a 15,000 acre parcel of land reserved for the protection of the natural resources of the sensitive Cape Cod environs (e.g., water supply, wildlife habitat). Military use and training are allowed within the Central Impact Area to the extent that the activities involved are compatible with those natural resource preservation objectives. Chapter 47 of the Acts of 2002, an act relative to the environmental protection of MMR, states that:

> "The Upper Cape Water Supply Reserve shall be public conservation land and shall be dedicated to: (a) the natural resource purposes of water supply and wildlife habitat protection and the development and construction of public water supply systems; and (b) the use and training of the military forces of the Commonwealth; provided that, such military use and training is compatible with the natural resource purposes of water supply and wildlife habitat protection."

This Act was approved on March 5, 2002. Future Site uses and activities must be compatible with those legislated by Chapter 47.

### 2.2.2 Conceptual Site Model

Designing an appropriate human health risk assessment that supports site management decision-making requires an understanding of the pathways through which identified receptors are or may be exposed to the Site's COPCs. In turn, the identification of key exposure pathways requires an understanding of the sources and releases of environmental contaminants and the fate of these substances once released into the environment. This section identifies the key exposure pathways and receptor groups applicable to Tango Range.

A conceptual site model (CSM) is used to identify pathways of contaminant migration and potential exposure. As was noted above, only those pathways with that are complete (i.e., where all four elements are present) provide the potential for exposure and risk. SRF Table 1 (Attachment A) shows the potential pathways for contaminant migration to human receptors for the principal contaminant sources. These direct exposure pathways for soil include incidental ingestion and dermal absorption of COPCs from soil, and potentially the inhalation of airborne particulate-bound COPCs emitted from the soil. For purposes of completeness, the potential indirect exposure pathways for soil that are associated with the transfer of contamination from soil to groundwater also are shown on SRF Table 1. These potential exposure pathways include: ingestion of groundwater; dermal absorption during bathing in groundwater; inhalation of volatiles released from groundwater into the indoor air during consumptive use; inhalation of volatiles in indoor air due to vapor intrusion from subsurface emissions from groundwater into the soil vapor; direct contact (i.e., dermal absorption and incidental ingestion) with groundwater pooling at the surface; and inhalation of volatiles emitted from pooled groundwater into the ambient air. Groundwater in the vicinity of Tango Range has not been sampled for VOCs. An assessment of these exposures is outside the scope of this risk assessment as potential groundwater exposures are to be evaluated in a future risk assessment.

The pathway screening step involves the systematic examination of each contaminated source medium, contaminant transport pathway, and exposed population to define which combinations are linked and should be quantitatively or qualitatively evaluated. The combinations associated with soil exposure that were addressed in this risk assessment were those that represented currently complete pathways or plausible future pathways. The following sections discuss the results of the pathway analysis steps in terms of potential source areas and release mechanisms (Section 2.2.3) and exposure pathways and receptors (Section 2.2.4).

### 2.2.3 Potential Source Areas and Release Mechanisms

Potential sources of small arms range contaminants include propellant-related compounds deposited on the surface in the vicinity of firing lines and projectile-related residuals deposited on the surface at, and in the vicinity of, the targets and range backstops. Propellant-related contamination, in part, consists of a suite of explosives and SVOCs produced by the combustion of small caliber ammunition propellants during past training activities. These compounds are released to the environment and are deposited as surface residue via airborne deposition. Projectile-related residues consist mainly of the metallic constituents of various alloys used in the manufacturing of small caliber rounds. These metals (typically lead, antimony, and copper) are deposited on, and near, the surface as the fragmented remnants of projectiles.

The current sources of COPCs are contaminated surface and/or near subsurface soils found within each of the two exposure areas of interest. The principal exposure medium is the in-place soil. During times of excavation activity when the ground surface may be disturbed and larger areas of exposed soil created, it is possible that soil particulates containing COPCs could be generated by the intrusive activities and be entrained into the ambient air. When intrusive activities are not being performed, a lesser opportunity and potential exists for soil dust to be entrained into the ambient air by the wind. Therefore, airborne soil dusts are a secondary exposure medium.

None of the COPCs meet the “volatile” criteria of having a Henry’s Law Constant greater than $1x10^{-5}$ (atm-$m^3$/mol) and a molecular weight less than 200 g/mol. Therefore, transport from soil to ambient air through volatilization is not considered to be a plausible migration route and exposure pathway.

The potential inter-media transfers of contaminants at the areas of interest of Tango Range were identified to include:

- leaching from soil to groundwater; and

- particulate transfers from soil to ambient air.

The evaluation of leaching from soil to groundwater is summarized below and discussed more extensively in Section 2.2.3.1. The approaches used to estimate transfers from soil to ambient air are summarized below.

#### 2.2.3.1 Soil Particulates to Ambient Air

Soil particles may be released into the ambient air as the result of wind erosion and entrainment where they may then be subsequently inhaled by a person. In order for wind erosion to occur, the soils would need to become exposed for a sufficient length of time such that they would dry out. Wind erosion was modeled using the quantitative approach described in USEPA's *Supplemental Soil Screening Guidance* (USEPA, 2002a). This approach uses a particulate emission factor (PEF) to define the relationship between the concentration of a chemical in exposed soil and the concentration of wind-entrained dust particles in the air. The reciprocal of the PEF is coupled with the concentration of the contaminant in soil to estimate a resulting contaminant concentration in air. Consequently, lower PEFs are associated with higher air concentrations. Two types of PEFs were calculated for the Tango Range exposure assessment: a PEF related to wind-generated soil dust and a PEF related to vehicle-generated soil dust.

The relationship used to calculate a site-specific PEF related to wind-generated soil dust is the following:

$$PEF_{wind} = \frac{Q}{C_{wind}} x \frac{3{,}600 \sec/hr}{0.036 x (1-V) x \left( U_m / U_t \right)^3 x F(x)}$$

where:

| | | |
|---|---|---|
| $PEF_{wind}$ | = | Particulate Emission Factor (Wind) ($m^3$/kg); |
| $Q/C_{wind}$ | = | Inverse of the ratio of the geometric mean air concentration to the emission flux at the center of a square source [$g/m^2$-sec per kilogram per cubic meter ($kg/m^3$)]; |
| V | = | Fraction of the ground surface that is vegetated or paved (i.e., (1-V) is the fraction of the ground surface that has exposed soil) [unitless]; (Values of V were established in consideration of photographs from the site visit and future use scenarios); |
| $U_m$ | = | Mean annual wind speed at that location [m/s]; |
| $U_t$ | = | Equivalent threshold value of wind speed at 10 m [m/s]; and |
| F(x) | = | Function dependent on $U_m/U_t$ [unitless]. |

Additionally:

$$\frac{Q}{C_{wind}} = A\,x \exp\left[ \frac{(\ln A_{Site} - B)^2}{C} \right]$$

where:

$A_{Site}$ = Areal extent of the Site or contamination [acres] (Area 1 was assumed to be approximately 0.9 acres in size, while the combined Area 2 (post-excavation) and Area 3 were assumed to be 3.95 acres ); and

A, B and C = Constants based on air dispersion modeling for specific climate zones [unitless] (Values for A, B and C used to calculate Q/C were based on values for Portland, Maine).

Further details on these parameters are presented in (USEPA, 2002a) and *Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites* (USEPA, 1985). One estimate of $PEF_{wind}$ was developed for the current and future small arms military trainee, trespasser and hunter receptors and the hypothetical future residential receptors for Area 1. Another estimate of $PEF_{wind}$ was developed for these same receptors for combined Areas 2 and 3 (given the difference in their size). Details of the development of these two PEFs are presented in Table 4.7 of Attachment A.

USEPA also has provided an approach for estimating a PEF for construction scenario exposures to be applied to risk assessments of construction workers (USEPA, 2002a). The PEF applicable to on-site soil dust concentrations generated by construction vehicle traffic (typically the greatest source of particulate emissions) was judged to be most applicable to Tango Range. The equation for estimating the PEF associated with dust resuspended by construction vehicle traffic on unpaved dirt surfaces is:

$$PEF_{Road} = \frac{Q}{C_{SR}} \; x \; \frac{1}{F_d} \; x \; \frac{T \; x \; A_r}{\dfrac{(2.6\, x\, (\frac{s}{12})^{0.8} \, (\frac{W}{3})^{0.4}}{(\frac{M_{dry}}{0.2})^{0.3}} \; x \; \dfrac{(365-p)}{365} \; x \; 281.9 \; x \, SumVKT}$$

where:

$PEF_{Road}$ = Particulate Emission Factor (Unpaved Road Traffic) [$m^3$/kg];

$Q/C_{SR}$ = Inverse of the ratio of the geometric mean air concentration to the emission flux at the center of a square source [g/$m^2$-sec per kilogram per cubic meter (kg/$m^3$)];

$F_d$ = Dispersion correction factor [unitless];

T = Time of construction [s];

$A_r$ = Surface area of contaminated road segment [$m^2$];

s = Road surface silt content [%, default is 8.5%];

W = Mean vehicle weight [tons];

$M_{dry}$ = Road surface material moisture content under dry conditions [%, default = 0.2%];

p = Days of year with at least 0.01 inches of precipitation [days/yr];

SumVKT = Sum of fleet vehicle kilometers traveled during exposure duration (expressed in terms of Lr and Wr [km]);

$L_r$ = Length of road segment [ft]; and

$W_r$ = Width of road segment [ft].

When the default values for the road surface silt and moisture contents are plugged into this equation, it simplifies to:

$$PEF_{Road} = \frac{Q}{C_{SR}} x \frac{1}{F_d} x \frac{T\,x\,A_r}{556\,x\,(\frac{W}{3})^{0.4}\,x \frac{(365-p)}{365}\,x\,SumVKT}$$

Area 1 was conservatively assumed to be approximately 140 feet long and 285 feet wide and the combined Areas 2 and 3 were assumed to be approximately 460 feet long and 375 feet wide for the PEF calculations. Additionally:

$$\frac{Q}{C_{SR}} = A\,x\,\exp\left[\frac{(\ln A_{Site} - B)^2}{C}\right]$$

where:

| | | |
|---|---|---|
| $A_{Site}$ | = | Areal extent of the Site or contamination [acres]. (Area 1 was assumed to be approximately 0.9 acres in size, while the combined Areas 2 and 3 were assumed to be 3.95 acres); and |
| A, B and C | = | Constants based on air dispersion modeling [unitless]. (The default constant values for A, B and C used to calculate Q/C). |

One estimate of $PEF_{Road}$ was developed for the construction worker for Area 1. Another estimate of $PEF_{Road}$ was developed for the combined Areas 2 and 3 (given the difference in their size). Details of the development of these two PEFs are presented in Table 4.8.

### 2.2.4 Receptors and Exposure Routes

A summary of the potential exposure scenarios for current and future conditions, including the exposure areas and receptors, is presented in Attachment A SRF Table 1. Please refer to the CSM presented in SRF Table 1 in relation to the following discussion.

Tango Range is currently used for small arms training. Therefore, the typical current receptor is a military trainee involved in small arms training.

A trespasser is identified as a current receptor for Tango Range. Access to MMR is controlled by means of a fence. Although warning signs are posted around the perimeter which notes the presence of unexploded ordnance, trespassing is possible, although unlikely. As a result, trespassers are identified as possible current receptors. The trespasser is assumed to represent an older child or adolescent (minimum age 12) who may trespass onto the MMR property and then gain access into Tango Range Site.

Recreational use, including hunting, also is considered a current and likely future use for this Site.

In addition to military personnel, tresspassers, and recreational hunters, potential future receptors include construction workers and hypothetical residents (adult and children). These receptors would primarily be associated with a future redevelopment scenario. However, modifications also could be made to Tango Range involving excavation and new construction to enable it to be used for other military training and mission-related purposes. Although residential reuse is not a likely future land use within Camp Edwards, hypothetical residents are identified as future receptors in the risk characterization to establish a baseline for determining the need for institutional controls and to provide information for evaluating all future-use options in the Feasibility Study. The closest residential homes to Tango Range are located more than 1 mile to the northeast in Sandwich, adjacent to the MMR boundary and outside of the study area. The most densely populated area surrounding Camp Edwards is the town of Sandwich, generally north and east of the MMR and the Tango Range Site. The nearest school is located about 3 miles northwest of Tango Range, along the Cape Cod Canal. Land use in Bourne, which borders Camp Edwards to the west, is primarily residential, but also includes the Bourne Municipal Landfill and the Upper Cape Vocational Technical High School (ECC, 2005).

Camp Good News and all the private homes in the area (with a few exceptions) rely on public water sources for potable water. Currently there is no use of groundwater at Tango Range as a source of drinking water (i.e., no private or public water supply wells). The Upper Cape Water Supply Consortium operates a number of public water supply wells in the general vicinity of Tango Range. Two such wells are located approximately 0.5 miles north of Tango Range on the Base. Another public water supply well (the Weeks Pond Well) operated by the Town of Sandwich is approximately 3.5 miles south of Tango Range. A public supply well located off the Base about 3 miles northwest of the Site is no longer in operation. The nearest private water supply wells are believed to be located in the Wings Neck area of Bourne, approximately 9 miles west of the Site.

As depicted in SRF Table 1, the soil exposure scenarios addressed in this risk assessment were:

Current/Potential Receptors:

- Military personnel (adults aged 18-28 years) conducting small arms training activities with potential exposures to COPCs in the surface soil of the exposure areas of interest (surface soil is defined as soil in the depth range of 0 to 1 ft bgs). The routes of exposure for the firearms military trainee are dermal absorption, incidental ingestion, and the inhalation of wind-borne soil particulates.
- A trespasser (aged 12-18 years) with potential exposures to COPCs in the surface soil of the exposure areas of interest at the Site. The routes of exposure for the trespasser are dermal absorption, incidental ingestion, and the inhalation of wind-borne soil particulates.
- A hunter (aged 18+ years) with potential exposures to COPCs in the surface soil of the exposure areas of interest at the Site. The routes of exposure for the hunter are dermal absorption, incidental ingestion, and the inhalation of wind-borne soil particulates.

Future Potential Receptors:

- Construction workers (adults aged 18+ years) with potential exposures to COPCs in both the surface and subsurface soil of the exposure areas of interest. The routes of exposure for the construction worker performing excavation and other intrusive activities are dermal absorption, incidental ingestion, and the inhalation of particulates during construction activities. These construction workers are not likely to contact or be exposed to groundwater at the Site, as the depth to groundwater is greater than 100 feet.

- Hypothetical future residents (a child aged 1-7 years and an adult aged 18+ years) with potential exposures to COPCs in both the surface and subsurface soil of the exposure areas of interest at the Site. The routes of exposure for the hypothetical child and adult residents are dermal absorption, incidental ingestion, and the inhalation of wind-borne soil particulates.

Exposure pathways associated with direct and indirect potential exposures to groundwater also are shown in SRF Table 1. These include drinking or ingesting the groundwater, inhaling volatiles released during water use (e.g., showering or bathing), and inhaling vapors released from groundwater that may migrate up through the soil into indoor air. These last two pathways are not likely to be significant for Tango Range due both to the lack of detected volatiles in the overlying soil and the relatively deep depth to the groundwater table. Given the characteristic depth to groundwater, groundwater is not likely to pool up in near-surface trenches or excavations.

### 2.2.5 Exposure Parameters

The calculation of chemical intakes or doses for each of the identified receptors and routes of exposure identified in the CSM requires the specification of parameters that define the scenarios of potential current or future exposure for each receptor. Reasonable maximum exposure (RME) assumptions were specified for the HHRA. The RME assessment parameter values were conservatively selected so that risk estimates were likely to result in an overestimate, rather than an underestimate, of risk. These parameter assumptions are summarized in the sections that follow.

Exposure parameter values used in the risk assessment are presented in Attachment A, SRF Tables 4.1 through 4.6, for the identified receptors. A discussion of the exposure parameter values adopted for this risk assessment is presented below.

#### 2.2.5.1 Trespasser

For the purposes of this assessment, the current and future trespasser was defined as an adolescent or young adult (aged 12 to 18 years) who may reside in an area near MMR. The trespasser was assumed to be potentially exposed to surface soil (0-1 ft bgs) via incidental ingestion, dermal contact, and inhalation of soil dust particulates. For the purposes of this evaluation, trespassing was assumed to occur 1 to 2 days per week over an exposure duration (ED) of six years (based on the trespasser’s age range). It was assumed the trespasser would access Tango Range 2 days per week from June through August and 1 day per week from September through May. This scenario results in an exposure frequency (EF) of 65 days per year (see Attachment A SRF Table 4.1).

An incidental soil ingestion rate (IR) of 50 mg/day was assumed for the trespasser. This is the incidental soil IR recommended by USEPA (1997b; 1999b) for older children and adults. It was also assumed the trespasser's head, forearms, hands, and lower legs would be exposed to soil at the Site, representing an age-adjusted surface area of 5,262 $cm^2$ (USEPA, 2004b, 1997b; 1999b). A soil adherence factor (AF) of 0.07 $mg/cm^2$ was used for the trespasser. This value represents the AF for adult residents (USEPA, 2004b). The trespasser was assumed to weigh 56 kg, representing age-adjusted 50 percentile values for males and females in this age range (USEPA, 1997b; 1999b).

#### 2.2.5.2 Military Personnel

Tango Range is an active combination .50-caliber machine gun and pistol range. A back-stop and bullet collection system were recently installed (Fall 2006) in an effort to support the continued use of Tango Range for small arms training. Therefore military personnel engaged in small arms training are current and future recptors that could involve the following activity:

- Small arms training that would entail non-intrusive activities involving little disturbance of the ground surface and the soil (e.g., walking).

For the military personnel conducting small arms training, it was assumed they would contact only the surface soil (0 to 1 ft bgs). Potential exposure pathways for this group of military personnel included incidental ingestion, dermal contact, and the inhalation of soil dust particulates. Site-specific assumptions modify the frequency of exposure at the small arms ranges to a more realistic five days per year because a trainee does not spend all of their annual training time on small arms ranges. Averaging times, which normalize annual exposures relative to lifetime or part of a lifetime, were 10 years (3,650 days) for non-carcinogenic compounds and 70 years (25,550 days) for carcinogenic compounds.

For military personnel engaged in firearms training activities, an incidental soil IR of 50 mg/day was assumed (USEPA, 1997b; 1999b). It was assumed that the surface area of the hands, forearms, and face were exposed during training activities. The default surface area (3,300 $cm^2$/event) and AF defined for an outdoor worker (0.25) were used for both of these receptors (USEPA, 2002a). It is noted that the AF presented in USEPA (2002a) is incorrect as presented. The correct adherence value is 0.25 based on the cited data. The military personnel were assumed to weigh 67.2 kg, the USEPA age-adjusted value for male and female adults 18 to 25 years old (USEPA, 1997b; 1999b). The exposure parameters for the military trainee involved in firearms training are presented in SRF Table 4.2 (see Attachment A).

#### 2.2.5.3 Hunter

The current and future uses anticipated for Tango Range includes recreational use, most likely for purposes of hunting. A hunter was conservatively defined (relative to potential exposure) as an avid sportsperson who would hunt all types of seasonal wild game during permitted hunting seasons. The MMR default EF for the hunter is 28 days, which represents 7 days/year for turkey season and 21 days/year during deer season (7 days/year each for shotgun, archery and primitive) For the purposes of this risk assessment, the EF was modified to 3 days for each season, for a total of 12 days per year due to the limited size of Tango Range. It was assumed that a local resident would hunt for a total duration of 6 years (MDFW, 2005).

It was assumed that the hunter receptor would contact the COPCs in the surface soil (0 to 1 ft bgs) via incidental ingestion, dermal contact, and the inhalation of soil dust particulates. The hunter was assumed to be an adult who resided off-site and off-MMR. Averaging times were 70 years for carcinogens and 6 years for non-carcinogens, respectively (see SRF Table 4.4 in Attachment A).

The default incidental soil IR for an outdoor worker of 100 mg/day (USEPA, 2002a) was assumed for the recreational hunter. It was assumed that the hunters head, forearms and hands would be exposed while hunting, which corresponds to the default surface area (3,300 $cm^2$) defined by USEPA for the Outdoor Worker (USEPA, 2002a). The hunter was assumed to weigh 70 kg, which represents the default value for male and female adults (USEPA, 1997b; 1999b). For dermal exposure, the recommended soil AF of 0.25 $mg/cm^2$ representing Outdoor Workers (USEPA, 2002a) was applied to this receptor.

#### 2.2.5.4 Construction Worker

It is assumed that a future construction worker in Tango Range would be exposed to both the surface and subsurface soils should the Site be redeveloped (e.g., during excavation and regrading activities). As such, exposure to all soil in the depth range of 0 to 10 ft. bgs was considered to be possible. Potential exposure pathways relative to the COPCs identified for these soils were incidental ingestion, dermal contact, and the inhalation of fugitive dust from soil released into the air by construction vehicle traffic.

The MMR default EF for the construction worker is 130 days with an associated ED of 1 year. Due to the small size of the two exposure areas of interest at Tango Range, the ED was limited to 90-days with an associated EF of 1 day per week, for a total EF of 13 days. This represents the minimum frequency and duration of exposure for the Adult Lead Model (ALM). Averaging times, which normalize annual exposures relative to lifetime or part of a lifetime, were 1 year (365 days) for non-carcinogenic compounds and 70 years (25,550 days) for carcinogenic compounds.

The default construction worker incidental soil IR of 330 mg/day was assumed for the future construction worker (USEPA, 2002a). It was assumed that the surface area of the hands, forearms, and face are exposed during excavation work, which is the scenario associated with the default surface area of 3,300 $cm^2$/event. The default AF defined for an outdoor worker was used for construction worker (USEPA, 2002a). It is noted that the AF presented in USEPA (2002a) is incorrect as presented. The correct adherence factor value of 0.25 was applied, based on the cited data. The construction worker was assumed to weigh 70 kg (USEPA, 1997b; 1999b). The exposure parameters for the construction worker are presented in SRF Table 4.5 (see Attachment A).

#### 2.2.5.5 Future Resident (Hypothetical)

This future use scenario is not anticipated to occur at Tango Range Site. However, this receptor represents the receptor with the longest potential duration of exposure to the Site soils. In reality, should future residential development occur in this area, significant cut and fill work would need to be performed and the eventual surface soil available for contact would likely be landscape fill. In addition, residential redevelopment would likely involve considerable paving and vegetative ground cover that would reduce the potential for direct contact exposure. Nonetheless, this hypothetical future scenario was evaluated to provide a baseline for comparison for other scenarios that may incorporate use or access restrictions as an aid to site management decision-making.

The hypothetical future residential scenario considers both a 15 kg child and a 70 kg adult receptor, each with an EF to soil of 190 days/year. This value was selected based on climactic data for Cape Cod. The assumption is that a hypothetical child resident would contact surface soil at Tango Range during the course of their outdoor play activities. While children may play outdoors throughout the year, their activities are likely to be in areas other than their primary residence on some of those days (e.g., school and/or public playgrounds, friends' homes, day care centers). In addition, it is neither likely that they will play outdoors or come into contact with the soil on days of heavy precipitation or when the ground is frozen. Direct exposure would be prevented on other occasions by protective clothing (rain gear or heavy winter clothing) and the fact that the soil is either frozen or snow covered.

Based on general climactic conditions across Massachusetts, the use of 150 days/year is often used to evaluate residential exposures to outdoor soils (MassDEP, 1996). This is based on the assumption that exposure will occur 5 days/week during the months of April through October (30 weeks) when the soil is not frozen or covered with snow. This was also the EF value used by USEPA Region I to develop Residential Protectiveness Standards in Pittsfield, Massachusetts (USEPA, 1999c). Meteorological and climatic data for Hyannis, Massachusetts, indicate, however, that the ground may not be frozen or snow-covered for as many months of the year as it is in other regions of Massachusetts. Temperature data representing May 1999 through April 2004 (Weather Underground, Inc., 2005) indicate that the average temperature in Hyannis is at or below 32°F for 60 days of the year. Therefore, it is reasonable to assume that the ground may be frozen and the soil inaccessible relative to direct contact and inhalation exposure routes for approximately 2 months of the year. In addition, the precipitation statistics from this same time period for Hyannis, Massachusetts indicate that precipitation in amounts greater than or equal to 0.5 inches occurs 28.8 days per year or approximately 1 month of the year during the warmer part of the year. Therefore, it is assumed that climatic conditions at the Cape (including MMR) limit contact with outdoor soils for a total of 3 months of the year. By extension, outdoor exposures to soil were assumed to be likely to occur at MMR (and the Cape) for only a total of 9 months per year based on these considerations.

It was assumed that children play outdoors and have access to surface soils at their homes 5 days/week (USEPA, 1999a) for 38.7 weeks of the year (or 9 months x 4.3 weeks/month). This scenario, equates to an EF of approximately 190 days/year (see Attachment A, SRF Table 4.6). The ED was assumed to be 6 years for a child and 24 years as an adult (USEPA, 1991; 2004a). Averaging times were 6 years for evaluating non-carcinogenic health effects (representing the cumulative exposures of a child from 1 to 7 years of age) and 70 years (e.g., a lifetime) for the assessment of carcinogens (see SRF Table 4.6).

An incidental soil IR of 50 mg/day was assumed for the future adult resident and a value of 100 mg/day was assumed for the future child resident (USEPA, 1997b; 1999b). For the child, the default age-adjusted exposed skin surface area of 2,800 $cm^2$ per exposure event was used (USEPA, 2004b), while for the adult the exposed skin surface area assumed was 5,700 $cm^2$/event (USEPA, 2004b). These values correspond to the 50th percentile surface area value published for both children and adults. The child receptor BW was assumed to be 15 kg and the adult resident was assumed to weigh 70 kg representing 50th percentile values for males and females (USEPA, 2004b). For dermal exposure, soil AFs of 0.2 and 0.07 were assumed for the child and adult residents, respectively (USEPA, 2004b).

### 2.2.6 Estimation of Average Daily Dose or Chronic Daily Intake

Exposure pathways are the means by which potential receptors may be exposed to and impacted by COPCs in the Site soil. The potential exposure pathways addressed in this risk assessment were selected as the most likely mechanisms of exposure based on observations made at the Site. The rationale for the selection or exclusion of an exposure pathway for this assessment is presented in SRF Table 1 in Attachment A. Although not evaluated in this HHRA, the relevant exposure pathways for groundwater at this Site could include potential contact with groundwater used as a potable and/or domestic water supply.

Conservative exposure assumptions were used to construct a RME scenario for this risk assessment (USEPA, 1999b, 1997b). In general, upper bound (90th or 95th percentile) values were used for exposure variables for the RME scenario (USEPA, 1991). Most individuals who may be actually exposed at the Site would not likely be subject to all the conditions that comprise the RME scenario. Individuals who do not meet all conditions in the RME scenario would have lower potential exposures to the COPCs and, therefore, lower potential risks relative to the RME levels. According to USEPA (1989), the intake or dose should be calculated as an average over the period of time for which the potential receptor is assumed to be exposed. The average CDI of a COPC over the period of the ED was calculated for compounds with potential non-carcinogenic effects. For COPCs with potential carcinogenic effects, the CDI was averaged over the course of a lifetime (e.g., 70 years).

The CDI equations that were used in this risk assessment were consistent with equations presented by USEPA (1989, 2002a, 2004b) and are presented in the following subsections. A summary of the exposure parameters and equations used to estimate intake for the exposure pathways for each receptor are provided in SRF Tables 4.1 through 4.6. It should be noted that the cancer risks for the hypothetical future child and adult resident also were combined to estimate a total residential cancer risk for a combined 30-year exposure period.

The equations for estimating a receptor's potential intake (both lifetime and chronic daily) of COPCs from soil are presented and the exposure parameters used are discussed in the following paragraphs. The calculations of CDI for all receptors evaluated in this risk assessment are presented in the series of SRF Tables 7.1a to 7.6b presented in Attachment A (Note: The letter “a” signifies a table relating to Area 1, while the letter “b” signifies a table relating to the combined Areas 2 and 3).

### 2.2.6.1 Incidental Ingestion of Soil

The equation that was used to calculate intakes associated with the incidental ingestion of soil was:

$$CDI = \frac{\left(CS \, x \, IR_{ing} \; x \, F_A \; x \; CF \; x \, EF \; x \; ED\right)}{\left(BW \, x \, AT\right)}$$

where:

| | | |
|---|---|---|
| CDI | = | Chronic Daily Intake due to soil ingestion (mg/kg-day); |
| CS | = | Chemical Concentration in Soil (mg/kg); |
| $IR_{ing}$ | = | Soil Ingestion Rate (mg/day); |
| $F_A$ | = | Fraction of area contaminated (unitless); |
| CF | = | Unit Conversion Factor ($1x\ 10^{-6}$ kg/mg); |
| EF | = | Exposure Frequency (days/year); |
| ED | = | Exposure Duration (years); |
| BW | = | Body Weight (kg); and |
| AT | = | Averaging Time (days). |

### 2.2.6.2 Dermal Absorption from Soil

The equation that was used to calculate intakes associated with dermal absorption from soil was:

$$CDI = \frac{(CS\ x\ SA\ x\ AF\ x\ ABS\ x\ F_A\ x\ CF\ x\ EV\ x\ EF\ x\ ED)}{(BW\ x\ AT)}$$

where:

CDI = Chronic Daily Intake due to dermal absorption from soil (mg/kg-day);

CS = Chemical Concentration in Soil (mg/kg);

SA = Skin Surface Area Exposed ($cm^2$/event);

AF = Soil to Skin Adherence Factor ($mg/cm^2$);

ABS = Dermal-Soil Absorption Adjustment Factor (unitless);

$F_A$ = Fraction of area contaminated (unitless);

CF = Unit Conversion Factor ($1x10^{-6}$ kg/mg);

EV = Event Frequency (events/day);

EF = Exposure Frequency (days/year);

ED = Exposure Duration (years);

BW = Body Weight (kg); and

AT = Averaging Time (days).

#### 2.2.6.3 Inhalation Exposure to Dust Particulates and Volatiles

The equation that was used to calculate exposure (expressed as an equivalent airborne concentration) to airborne COPCs associated with soil was:

$$Exposure = CA = CS\ x \left(\frac{1}{PEF}\right)$$

where:

Exposure = Inhalation dose expressed as an effective airborne concentration (CA) of the COPC in particulate or vapor form ($mg/m^3$);

CS = Chemical concentration in soil (mg/kg); and

PEF = Particulate Emission Factor (if applicable to COPC) ($m^3$/kg).

As was described in Section 2.2.3.2, two types of PEFs were derived: a PEF related to wind-generated soil dust and a PEF related to vehicle-generated soil dust. Exposures to respirable soil particulates generated by wind were quantitatively evaluated for the trespasser, military personnel (firearms training /non-intrusive), hunter, and the adult and child residents. For the construction worker, respirable soil particulates may be generated by wind as well as by construction vehicle traffic and other construction activities such as excavation. A separate PEF was developed to account for the additional dust generated from these construction-related activities.

## 2.3 Toxicity Assessment

This section describes the process used to identify intake route-specific toxicity criteria for each COPC selected for evaluation relative to Tango Range. Toxicity values are used in conjunction with the information presented in the exposure assessment to calculate the risks presented in the risk characterization.

USEPA has performed toxicity assessments for numerous chemicals and has published the corresponding toxicity values that have undergone peer review. These toxicity values include reference doses (RfDs) and reference concentrations (RfCs) for evaluating the non-carcinogenic health effects associated with exposure, and carcinogenic slope factors (CSFs) and unit risk factors (URs) for evaluating the carcinogenic health effects associated with exposure. Section 2.3.1 presents information regarding the non-carcinogenic toxicity values and Section 2.3.2 presents the information regarding the carcinogenic toxicity values used in this HHRA. Section 2.3.3 addresses some special cases and considerations that are relevant to the Site (i.e., lead).

The preferential hierarchy of sources from which toxicological information and toxicity values were drawn from USEPA, 2003a:

- Tier 1: Integrated Risk Information System (IRIS), which is an on-line USEPA database containing current toxicity values for many chemicals that have gone through a rigorous peer review and USEPA consensus review process (USEPA, 2006a);
- Tier 2: Provisional Peer Reviewed Toxicity Values (PPRTVs) developed by the USEPA Office of Research and Development/National Center for Environmental Assessment/Superfund Health Risk Technical Support Center (NCEA); and
- Tier 3: Additional USEPA and non-USEPA sources of toxicity information, including but not limited to the California EPA toxicity values, the Agency for Toxic Substances and Disease Registry (ATSDR) minimum risk levels, and toxicity values published in Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997a).

A summary of the toxicity data for each identified non-carcinogenic and carcinogenic COPC is presented in SRF Tables 5.1, 5.2, 6.1, and 6.2 (Attachment A) for oral/dermal and inhalation exposures, respectively.

### 2.3.1 Non-Carcinogenic Effects

For non-carcinogens, the USEPA publishes RfDs that are the chemical-specific doses below which no significant adverse health effects are expected. For chemicals that have non-carcinogenic effects, many authorities consider organisms to have repair and detoxification capabilities that must be exceeded by some critical level (threshold) before the health effect is manifested. For example, an organ can have a large number of cells performing the same or similar functions that must be significantly depleted before an effect on the organ is seen. This threshold view holds that a range of exposures from just above zero to some finite value can be tolerated by the organism without an appreciable risk of adverse effects.

The non-carcinogenic toxicological factors are based on this assumption that there is a level of chemical dose or intake below which no adverse health effects would be expected. RfDs and RfCs that are associated with threshold effects provide the estimate of the daily dose of the chemical to which an individual may be exposed without an appreciable risk of adverse health effects, including organ damage or reproductive effects. The chronic RfD and RfC are derived from either an available No Observable Adverse Effects Level (NOAEL) or the Lowest Observable Adverse Effects Level (LOAEL). Uncertainty and modifying factors are applied to the NOAEL and LOAEL to account for interspecies differences, the duration of the critical study, protection of sensitive subpopulations, and any additional uncertainties associated with the principal study on which the toxicological factor was based. RfDs are expressed in terms of milligrams of compound per kilogram of body weight (BW) per day (mg/kg-day) and are used to evaluate estimated oral and/or inhalation exposures.

Chronic RfDs apply to lifetime or other long-term exposures and may be overly protective if used to evaluate the potential for adverse health effects resulting from substantially less-than-lifetime exposures. Subchronic RfDs are typically applied to exposure durations of 2 weeks to 7 years. EPA's ECAO develops subschronic RfDs and although they have been peer-reviewed, subchronic RfDs are considered interim rather than verified toxicity values and consequently are not placed in IRIS. If suchronic toxicity data is not available or is insufficient to develop a subchronic RfD, then the chronic RfD is adopted as the subchronic RfD (USEPA, 1989). For the purposes of this risk assessment chronic RfDs were utilized for all exposure scenarios including those of shorter duration (i.e., for the trespasser, hunter, and construction worker.

#### 2.3.1.1 Oral/Dermal Non-Carcinogenic Effects

The chronic oral/dermal RfD values selected for use in this risk assessment were compiled from the hierarchy of sources listed above. These values were checked to insure that the most up-to-date values were used from the primary sources. An RfD, expressed in units of mg chemical/kg body weight-day, is an estimate of a daily exposure level for humans (including sensitive individuals) that is likely to be without an appreciable risk of deleterious effects during the period of exposure. The purpose of the RfD is to provide a benchmark value against which estimated doses (e.g., those projected for human exposures to various environmental media) might be compared. Doses that are higher than the RfD may indicate that an inadequate margin of safety could exist for exposure to that substance and that an adverse health effect could occur. The RfD is derived using uncertainty and modifying factors (e.g., to adjust exposures from animals to humans and to protect sensitive sub-populations) to ensure that it is unlikely to underestimate the potential for adverse non-carcinogenic effects to occur. The chronic oral RfD values are listed in SRF Table 5.1.

The chronic dermal RfD values also are listed in SRF Table 5.1 (Attachment A). There are, at present, no USEPA-derived RfDs for the dermal route of exposure. Dermal RfDs were calculated from the oral RfD value using an oral-to-dermal adjustment factor. The oral-to-dermal adjustment factor is based on chemical-specific gastrointestinal absorption efficiencies listed in USEPA RAGS Part E, Exhibit 4.1 (USEPA, 2004b). The methodologies developed for evaluating dermal absorption are based on an estimation of absorbed dose. The IRIS-verified RfDs are typically based on an administered dose. Therefore, an adjustment of the oral toxicity value to represent an absorbed rather than an administered dose is necessary. The adjustment accounts for the absorption efficiency in the critical clinical or epidemiological study forming the basis of the published toxicity factor. The magnitude of the toxicity factor adjustment is inversely proportional to the absorption fraction in the critical study. As the absorption efficiency decreases the difference between the absorbed dose and administered dose increases. Consistent with RAGS Part E (USEPA, 2004b), an adjustment was made to establish a dermal RfD when the following conditions were met:

- The toxicity value derived from the critical study was based on an administered dose (e.g., delivery in diet or by gavage) in its study design; and
- A scientifically defensible database demonstrates that the gastrointestinal (GI) absorption of the chemical in question from a medium (e.g., water, feed) similar to the one employed in the critical study is significantly less than 100% (i.e., <50%).

If these conditions were not met, complete (i.e., 100%) absorption was assumed and no adjustment of the oral toxicity value was made to obtain a toxicity value to be used for the dermal absorption route.

#### 2.3.1.2 Inhalation Non-Carcinogenic Effects

Non-carcinogenic toxicity factors for the inhalation route are typically expressed as reference concentrations (RfCs). The inhalation RfC is analogous to the RfD and is an estimate of the air

$$RfD_i\left[{}^{mg}\!/\!_{kg-day}\right] = RfC\left[{}^{mg}\!/\!_{m^3}\right] x \frac{20\left[{}^{m^3}\!/\!_{day}\right]}{70\left[kg\right]}$$

The chronic inhalation RfC and $RfD_i$ values used in this risk assessment are presented in SRF Table 5.2 (Attachment A).

### 2.3.2 Carcinogenic Effects

The underlying assumption used by USEPA for regulatory risk assessment for constituents with known or assumed potential carcinogenic effects is that no threshold dose exists. In other words, USEPA assumes that some level of potential risk is associated with any dose of a contaminant.

In April of 2005, USEPA released new guidelines that it will follow when assessing the risks posed by carcinogenic chemicals (USEPA, 2005a; 2005b). These guidelines revise the methods that USEPA has used since 1986 to calculate cancer risks from exposure to chemicals. The older guidelines made use of a number of default assumptions and fallback positions to protect public health when applicable data was lacking. The new guidelines allow for the analysis of all available data before resorting to the use of the default assumptions or fallback positions. The new guidelines also address the assessment of childhood cancer and cancer later in life for adults exposed to a carcinogen as a child. As USEPA prepares cancer assessments under the IRIS program, as well as in other USEPA programs, the Agency intends to begin to use the new guidelines and supplemental guidance.

However, at this time, the assessments summarized in the current IRIS database were almost entirely developed using the prior cancer risk guidelines. As such, the old guidelines provide the framework within which the current cancer toxicity factors and quantitative methods must be interpreted and applied. Under the prior cancer risk guidelines, USEPA used a system for classifying chemicals according to their likelihood as a human carcinogen. This system was based on five categories that made up the weight-of-evidence system of carcinogenicity that was used to classify each compound. That weight-of-evidence classification system is presented in Table 2.2.

| Group | Classification |
|---|---|
| A | This category indicates there is sufficient evidence from epidemiological studies to support a causal association between an agent and human cancer. |
| B1 | This category generally indicates there is at least limited evidence from epidemiologic studies of carcinogenicity to humans. |
| B2 | This category generally indicates, in the absence of data on humans, there is sufficient evidence of carcinogenicity in animals. |
| C | This category indicates that there is limited evidence of carcinogenicity in animals in the absence of data on humans. |
| D | This category indicates that the evidence for carcinogenicity in animals is inadequate, or no data are available. |
| E | This category indicates that there is evidence of noncarcinogenicity in at least two adequate animal tests in different species or in both epidemiologic and animal studies. |

As was previously noted, the toxicity values used to evaluate carcinogenicity are CSFs (for oral or dermal exposure) and URs (for inhalation exposure). These values reflect the relative probability that the incidence of cancer is increased in target populations exposed to that chemical. Only COPCs with an USEPA weight-of-evidence classification of A, B1, or B2 were evaluated as carcinogens in this risk assessment.

#### 2.3.2.1 Oral/Dermal Carcinogenic Effects

A CSF is a numerical estimate of the potency of a chemical, which, when multiplied by the average lifetime dose, gives the probability of an individual developing cancer over a lifetime as a result of exposure to that chemical. CSFs are expressed in units of the inverse of milligrams of chemical per kilogram of body weight per day [$(mg/kg\text{-}day)^{-1}$]. They have traditionally been derived by USEPA (under the old cancer guidelines) by means of a linearized multistage model and reflect the upper-bound limit of cancer potency of that chemical. As a result, the calculated carcinogenic risk is likely to represent a plausible upper limit to the risk. The actual risk is unknown but is likely to be lower than the predicted risk, and may be as low as zero (USEPA, 1989). The oral CSFs used in this risk assessment are listed in SRF Table 6.1 (Attachment A). These values were compiled from the hierarchy of sources listed in Section 4.

There are, at present, no USEPA-derived CSFs for the dermal route of exposure. Dermal CSF values were calculated from the oral CSF value using an oral-to-dermal adjustment factor as prescribed by current dermal risk assessment guidance. This adjustment for the oral CSFs was performed using the same general process applied for the oral RfDs, as described above. It is noted, however, that adjustment of the RfD required its multiplication with the oral-to-dermal adjustment factor, while adjustment of the CSF requires its division by the oral-to dermal adjustment factor. The oral and dermal CSF values selected for use in this risk assessment are listed in SRF Table 6.1 (Attachment A).

#### 2.3.2.2 Inhalation Carcinogenic Effects

Carcinogenic toxicity values for the inhalation pathway are typically expressed as URs. The URs were compiled from the hierarchy of sources listed previously. Inhalation CSF ($CSF_i$) values may be calculated from URs using a standard inhalation rate of 20 $m^3$/day and a standard body weight of 70 kg. This relationship is shown below:

$$CSF_i\left[\left({}^{mg}\!/_{kg-day}\right)^{-1}\right] = UR\left[\left({}^{mg}\!/_{m^3}\right)^{-1}\right] x \frac{70\,[kg]}{20\left[{}^{m^3}\!/_{day}\right]}$$

The inhalation UR and $CSF_i$ values for the carcinogenic COPCs associated with this risk assessment are listed in SRF Table 6.2 (Attachment A).

### 2.3.3 Special Cases

The potential risks associated with lead are not assessed in the same manner as the rest of the COPCs in soil. The approach for evaluating exposures to lead is summarized below.

#### 2.3.3.1 Evaluation of Lead

Due to the absence of established numerical toxicity values for lead, adult and child exposures were assessed via three models.

Young child exposures to lead in Area 1 soil were evaluated using the Integrated Exposure Uptake Biokinetic (IEUBK) Model for Lead in Children. The IEUBK Model calculates the probability that a child's blood lead concentration will exceed the benchmark of 10 µg/dL established by the USEPA and Centers for Disease Control and Prevention (USEPA, 1994a; 1998a; CDC, 1991). The IEUBK model allows for multiple sources of lead exposure to children (i.e., soil and water). There are over 100 input parameters for the IEUBK, 46 of which can be modified by the user. For this assessment, only exposure to lead in Site soil was considered along with default levels for lead in air, diet, drinking water, and from prenatal exposure. The non-default parameters used in the IEUBK Model for the hypothetical future child resident are presented in Tables 4.10.

The All Ages Lead Model (AALM) was used to evaluate adult residential exposure to lead. The purpose of the AALM is to mathematically provide an exposure, absorption, and biokinetic infrastructure that allocates, by simulation, the simultaneous distribution of absorbed lead in several major body components and thereby predict at any point in time the concentration of lead in these components (USEPA, 2005c). Although this model is only available in draft form, the original model developed for the purpose, the IEUBK, only makes predictions up through age six. There are approximately 190 input parameters to the AALM. The only non-default parameters used were the air lead concentration (calculated using the PEF presented in Table 4.7), the soil and dust lead concentration, and the adult resident soil ingestion rate (50 mg/day as presented in Table 4.6). The non-default parameters used in the AALM for the hypothetical future adult resident are presented in Table 4.11.

Adult non-residential exposures were evaluated (when appropriate) using methodologies established in Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil, as published in a January 2003 Technical Review Workgroup (TRW) Report (USEPA, 2003b). The Adult Lead Model (ALM) uses a simplified representation of lead biokinetics to predict quasi-steady state blood lead concentrations among adults who have relatively steady patterns of site exposures. The TRW believes that this approach will prove useful for assessing most sites where places of employment are (or will be) situated on lead contaminated soils. The ALM focuses on the estimation of the blood lead concentrations in fetuses carried by women exposed to lead contaminated soils (only). The blood lead concentration calculated using the ALM is then compared to blood lead concentration of 10 µg/dL. Thus, the ultimate receptor in this model is a potential fetus of a woman exposed to lead in a non-residential scenario. The ALM was applied for the future construction worker and the trespasser receptors exposed to lead in Area 1 soil. The ALM inputs and outputs for this evaluation are presented in Table 4.12 for the adolescent trespasser and in Table 4.13 for the future construction worker, respectively. Due to an insufficient exposure period and frequency, the ALM could not be defensibly applied for the hunter, nor military personnel.

The results of the IEUBK, AALM, and ALM modeling are discussed in Section 2.4.2.3.

## 2.4 Risk Characterization

The final step in the risk assessment process is human health risk characterization. Risk characterization is performed by inputting site-specific data and assumptions into formulae developed by USEPA for calculation of cancer risks and non-cancer hazards. Potential health risks were calculated for baseline conditions and address exposures to contaminant levels at the Site as they currently exist.

### 2.4.1 Risk Characterization Methods

Quantitative evaluation of risk involves combining exposure point concentrations, exposure scenarios, chemical intake models, and toxicity values using methods defined by USEPA to calculate potential carcinogenic and non-carcinogenic risks associated with present and future use RME scenarios.

Quantitative assessment of potential risks to human health associated with present and future use scenarios was performed by calculating intakes for each ingestion, dermal absorption, and inhalation exposure pathway. Formula for each exposure pathway are shown on SRF Tables 4.1 through 4.6 and in Section 2.2.6. Intakes for ingestion and dermal contact are expressed as the amount of a chemical an individual would be exposed to per unit body weight per day (i.e., mg/kg-day), while intakes for inhalation are expressed as the amount of chemical an individual would be exposed to per volume of air (i.e., $mg/m^3$). The CDIs are averaged over a lifetime (70 years) for carcinogens, and over the exposure duration for non-carcinogens (USEPA, 1989).

For current and future military personnel involved with small arms training, trespassers, future recreational hunters, and future construction workers, groundwater exposures are not considered complete exposure pathways.

### 2.4.1.1 Calculation of Non-Cancer Health Effects

For non-carcinogens, exposure pathways were evaluated by comparing chemical-specific CDIs to their associated RfDs for the oral and dermal pathways and chemical-specific modeled air concentrations (CAs) to RfCs for the inhalation pathways. Potential non-carcinogenic effects are evaluated as the ratio of the CDI to the RfD or the CA to the RfC. The sum of all CDI/RfD and CA/RfC ratios, which are referred to as HQs, for the COPCs for each receptor in each medium is called the Hazard Index (HI) and is calculated as shown below:

$$HI = \sum_{i=1}^{n} \frac{CDI_i}{RfD_i} \qquad \text{(oral and dermal pathways)}$$

$$HI = \sum_{i=1}^{n} \frac{CA_i}{RfC_i} \qquad \text{(inhalation pathways)}$$

where:

| | | |
|---|---|---|
| HI | = | Hazard Index [unitless]; |
| $CDI_i$ | = | Chronic daily intake for chemical i (mg/kg-day); |
| $RfD_i$ | = | Reference dose for chemical i (mg/kg-day); |
| n | = | Number of COPCs in each medium [unitless]; |
| $CA_i$ | = | Air concentration for chemical i (mg/m$^3$); and |
| $RfC_i$ | = | Reference concentration for chemical i (mg/m$^3$). |

An HI less than 1.0 is unlikely to be associated with adverse health effects and is therefore less likely to be of concern than an HI greater than 1. However, a conclusion should not be categorically drawn that all HIs less than 1 are “acceptable.” This is a consequence of uncertainties inherent in derivation of the RfD in the exposure assessment and uncertainties associated with adding individual terms in the HI calculation. In addition, for HIs greater than 1.0, the health effect/target organ-specific HIs were evaluated (assuming that chemicals that produce adverse effects on the same target organ are dose additive). HIs should not be summed across age groups. SRF Tables 7.1a through 7.6b (Attachment A) present the EPC, intake/air concentration, RfD/RfC and individual hazard quotients for each receptor, exposure medium, and pathway combination. SRF Tables 9.1a to 9.6b present the HI’s segregated by health effect/target organ.

### 2.4.1.2 Calculation of Cancer Health Effects

The potential incremental lifetime cancer risk due to exposure to a specific carcinogenic compound is calculated by combining chemical-specific CDIs with their associated CSFs for the oral and dermal pathways and CAs with their associated URs for the inhalation pathways. Potential carcinogenic effects are evaluated as the product of the CDI and the CSF or the product of the CA and the UR. The sum of all CDI x CSF products and CA x UR products for the COPCs for each receptor in each medium is called the Excess Lifetime Cancer Risk (ELCR), and is calculated as shown below:

$$ELCR = \sum_{i=1}^{n} CDI_i \; x \; SF_i \qquad \text{(oral and dermal pathways)}$$

$$ELCR = \sum_{i=1}^{n} CA_i \ x \ UR_i \qquad \text{(inhalation pathways)}$$

where:

ELCR = Excess lifetime cancer risk (unitless);

$CDI_i$ = Chronic daily intake for chemical i (mg/kg-day);

$CSF_i$ = Cancer slope factor for chemical i $(mg/kg\text{-}day)^{-1}$;

n = Number of COPCs in each medium [unitless];

$CA_i$ = Air concentration for chemical i ($mg/m^3$); and

$UR_i$ = Unit carcinogenic risk for chemical i $(mg/m^3)^{-1}$.

For the purposes of this assessment, cancer risks for exposure to multiple carcinogenic contaminants were assumed to be additive. USEPA has determined that the acceptable risk range is between $1x10^{-6}$ and $1x10^{-4}$. An ELCR below or within this range is unlikely to be associated with significant risk of cancer effects and is less likely to be of concern than an ELCR exceeding this range. SRF Tables 7.1a through 7.6b present the EPC intake or air concentration, CSF or UR, and the calculated risks for each receptor, exposure medium, and pathway combination. It should be noted that HIs and ELCRs should not be summed across the various exposure areas of interest as intakes were computed for each area as if 100% of the assumed exposure occurred with that area. SRF Tables 9.1a to 9.6b summarize the total HQ and ELCR for each COPC for each route of exposure (ingestion, inhalation, dermal absorption).

### 2.4.2 Results

#### 2.4.2.1 Hazard Indices

The estimated hazard indices associated with potential exposures to COPCs in the soil exposure points by current and future trespassers, military personnel involved with firearms training recreational hunters, construction workers and hypothetical residents are presented in Attachment A.

The calculated HIs for each exposure point by receptor are summarized below. The HI for total non-carcinogenic hazards from potential soil exposures at all soil exposure points by current and future trespassers, military personnel involved with firearms training activities, recreational hunters, construction workers, and hypothetical future adult residents do not exceed 1. Total HIs that do not exceed 1 indicate minimal potential adverse non-carcinogenic health effects are expected to occur for current or future receptors assuming current Site conditions. The calculated HI for future hypothetical child residents in Area 1 exceeds 1 primarily due to ingestion of nitroglycerin in soil. The oral provisional RfD (p-RfD) for nitroglycerin is based on the LOAEL for acute vasodilatory effects observed at the lowest prescribed oral dose for therapeutic control of angina pectoris in patients. The p-RfD is based on the LOAEL which is further reduced by a uncertainty factor of 300. According to the PPRTV documentation, adverse effects related to vasodilation will not occur over the course of subchronic and chronic exposures (USEPA, 2006d). No other COPCs are associated with cardiovascular effects.

| | | |
|---|---|---|
| **Receptor** | **Area 1** | **Area 2 (post-excavation) & Area 3** |

| | | |
|---|---|---|
| Trespasser | 0.1 | 0.01 |
| Military Personnel - Firearms | 0.01 | 0.002 |
| Hunter | 0.04 | 0.004 |
| Construction Worker | 0.3 | 0.3 |
| Resident - adult | 0.3 | 0.02 |
| Resident - child | 3 | 0.2 |

### 2.4.2.2 Cancer Risk Estimates

The calculated carcinogenic risk estimates are summarized below and are presented in detail for each receptor in Attachment A. The Total ELCRs associated with potential exposures to COPCs in each of the soil exposure points (Area 1, Areas 2 and 3) by the current and future trespassers, military personnel involved with firearms training activities, recreational hunters, construction workers and hypothetical residents are summarized below. As shown in this table, the Total ELCRs at each exposure point for current and future trespassers, military personnel involved with firearms training activities, recreational hunters, and construction workers are below or within USEPA's allowable risk range of $1x10^{-6}$ to $1x10^{-4}$.

| **Receptor** | **Area 1** | **Areas 2 (post-excavation) & 3** |
|---|---|---|
| Trespasser | 1E-07 | 1E-07 |
| Military Personnel – Firearms | 3E-08 | 2E-08 |
| Hunter | 5E-08 | 4E-08 |
| Construction Worker | 2E-06 | 2E-06 |
| Resident | 2E-06 | 2E-06 |

To assess the need for institutional controls and to provide information for evaluating all future use options in the FS, a hypothetical residential scenario was evaluated in the risk characterization. The ELCR for the hypothetical resident exposed to COPCs in each of the soil exposure points is as follows:

- Area 1 – 2 x $10^{-6}$
- Areas 2 (post-excavation) and 3 – 2 x $10^{-6}$

Each of these residential ELCRs falls within the low end of USEPA's allowable risk range.

### 2.4.2.3 Evaluation of Lead

Lead was selected as a soil COPC for Area 1. Potential hazards associated with exposure to lead were evaluated using the IEUBK Child Lead Model for Child Residents (USEPA, 2001b), the AALM for Adult Residents, and the ALM (USEPA, 2003b) for the trespasser and the construction worker.

The IEUBK Child Lead Model (USEPA, 2001b) is designed to predict the probable blood lead levels for children between six months and seven years of age who have been exposed to lead through environmental media (i.e., air, water, soil, dust, and diet). The Area 1 soil EPC (285.4 mg/kg for lead) and the child resident soil ingestion rates (100 mg/day) were entered into the model and blood lead levels were calculated for each age between 0.5 and 7 years. Table 4.10 (Attachment A) presents the results of this analysis. USEPA has determined that childhood blood lead levels at or above 10 µg Pb/dL present risks to children's health (USEPA, 1994). The results presented in Table 4.10 were compared to this level and were determined to not present a significant risk to children's health even when non-site related sources are included.

Outputs from the AALM for the adult resident are presented in Table 4.11 (Attachment A). The adult blood lead level concentration due to exposure to lead in soil as estimated by the AALM is between approximately 2.4 and 4.2 µg Pb/dL when considering non-site related sources, and between 1.2 and 1.9 µg Pb/dL when considering only Site-related soil sources.

Outputs from the ALM for the adolescent trespasser and the adult construction worker are presented in Tables 4.12 and 4.13 (Attachment A). For the trespasser, the estimated blood lead level concentration associated with exposure to lead in Area 1 soil is between 1.6 and 1.8 µg Pb/dL. The associated probability that fetal blood lead levels would exceed 10 µg Pb/dL is approximately 1%. For the construction worker, the estimated blood lead level concentration associated with exposure to lead in Area 1 soil is between 2.2 and 2.4 µg Pb/dL. The associated probability that fetal blood lead levels would exceed 10 µg Pb/dL is approximately 2%.

## 2.5 Uncertainty Analysis

All risk assessments contain elements of uncertainty. Sources and characteristics of uncertainties are examined in this section to provide perspective on the accuracy and level of conservatism inherent in the risk estimates and the underlying assumptions. The purpose of discussion of uncertainty is to assist in risk management decisions.

Most assumptions made in developing the baseline risk estimates were biased toward health protectiveness, that is, toward overestimating rather than underestimating risk. There is, therefore, a reasonable degree of certainty that actual risks to individuals exposed to contamination from Tango Range will not be higher than those estimated in the human health risk assessment and are likely to be much lower. Specific uncertainties are discussed in subsequent sections.

### 2.5.1 Uncertainty in the Data and COPC Selection Methodology

All of the soil samples were composite samples. The 2002 Supplemental Investigation samples were 5-point composite samples, while the 2006 Project Note samples were 50-point or 100-point composite samples. Composite samples are essentially a physical averaging of the soil found at each of the grid nodes or points. Physical averaging reduces inter-sample variability, which results in increased precision of the resulting estimate of the overall average concentration (or grand mean). It also reduces the sampling and analytical costs (ASTM, 2003). The principal limitations of sample compositing are loss of discrete information about the individual sample points, and the potential for dilution of the contaminants in a sample with uncontaminated material. Consequently, unless contaminant benchmarks are adjusted, hot spots may not be identified or adequately delineated. Composite samples provide less information on maximum exposure concentrations, and therefore, may not be appropriate for situations where maximum exposure is used (e.g., assessing potential acute exposures, initial screening of COPCs). In addition, composite sampling may not provide sufficient detail for delineating the extent of unacceptable contamination that is necessary to determine the volume of material to be remediated.

A major concern of any risk assessment is the reliability of COPC identification, both in terms of ensuring that all contaminants have been correctly identified as COPCs, and ensuring that concentrations are adequately quantified. The accuracy of COPC identification is directly related to the quality of COPC characterization data, including information on contaminant identification, location, and concentrations.

Conservative screening criteria were selected from the federal and state risk-based criteria. The screening process was designed to identify those constituents that were Site-specific and likely to exceed conservative risk-based criteria for residential use. In other words, the screening criteria reflect the more sensitive land use, as if exposure to soil was occurring 350 days per year for 30 years.

During the data evaluation step, compounds were selected for inclusion in the quantitative risk characterization. Eight chemicals (aluminum, antimony, arsenic, lead, tungsten, vanadium, n,n'-diethylcarbanilide, and nitroglycerin) were considered soil COPCs and were evaluated in the risk characterization.

### 2.5.2 Exposure and Intake Uncertainties

Selected exposure parameters are generally designed to be conservative so that no actual exposed population will receive greater exposures than those estimated. Exposure parameters were used to bound the upper and best estimate levels of reasonable maximum exposures. Potential exposure pathways were evaluated for all identified potential receptors. All pathways that could reasonably be complete now or in the future under the land use scenarios were evaluated quantitatively for their potential to be associated with adverse health effects. There is a high degree of certainty that total exposures are not underestimated for any actual exposed population.

During the exposure assessment, average daily doses of COPCs to which receptors are potentially exposed were estimated, which involves assumptions about how often exposure occurs. Such assumptions include location, exposure concentrations, current and future accessibility, and use of an area, which can vary considerably from those considered in this risk characterization. As a result, there is some degree of uncertainty with regard to the risk estimates presented in this document relative to those associated with actual exposures.

### 2.5.3 Exposure Point Concentrations

To the extent possible, exposure point concentrations have been derived in a manner that ensures that concentrations in the media and exposure areas of concern are not underestimated. The 95% UCL of the arithmetic mean has been used to derive the EPCs, these upper bound estimates of average concentrations are influenced by biased sampling approaches which could overestimate average concentrations for the exposure area. Conversely, many of the samples in the data set are multi-point compositie samples, which are effectively a mechanical averaging or smoothing of the spatial variability in contaminant concentrations. All though this method provides an unbiased estimate of the average concentration it will tend to minimize the variability and resulting confidence interval estimates of the average. In addition, when a COPC was not detected in some samples, it was assumed that it was present at a concentration equal to one-half the reported quantitation limit. The actual concentration may have fallen anywhere between zero and the SQL.

Uncertainties associated with exposure point concentrations are largely a reflection of limitations in the underlying dataset. The construction worker was assumed to contact soils from 0 to 10 feet bgs. The available data extends only to a depth of 1 foot bgs. Consequently, the surface soil EPC was assumed to be representative of the whole 0 to 10 feet interval. This assumption is likely to result in an overestimate of the subsurface soil concentration as there is little indication that contamination extends much below 1 foot bgs.

Inter-media transfers also were considered. Specifically, PEFs were estimated for wind-generated dusts as well as vehicle-generated dust along unpaved roads using default EPA methods (USEPA, 2002). Both models used to estimate PEFs include a combination of default and site-specific parameters. For the wind-generated PEF, the most sensitive site-specific parameter is the fraction of the site-covered by vegetation, roadways, or buildings. A value of 75% was conservatively assumed based on site observations. Nearly the entire site is either gravel covered or vegetated. For the vehicle-generated dust PEF, the soil silt and moisture content are the most sensitive parameters for which default values have been assigned. Site-specific parameters include the total distance traveled by construction vehicles, mean vehicle weight, average vehicle speed, and the total area of soil disturbance. The values assumed for these parameters were selected such that actual values would likely result in lower dust concentrations than was estimated. In particular, the total area of soil disturbance was very large relative to the size of the exposure areas of interest.

### 2.5.4 Exposure Frequency and Exposure Duration

The parameters used were conservative default values obtained from USEPA guidance documents and are typically used to estimate “reasonable maximum exposure.” These conservative values may overestimate the risks for actual receptors.

Uncertainty may be associated with some of the assumptions used to estimate how often exposure occurs. Exposure assumptions were based on literature-reported values for upper bound estimates for exposure frequency and duration, as well as incidental soil ingestion rates. Furthermore, the locations where certain activities were assumed to take place have been purposely selected because compound concentrations and frequency of exposure are expected to be high (i.e., use of the maximally affected areas). However, actual frequencies of exposure are likely to be much lower than assumed. In these cases, the receptor's potential exposure would be reduced, and the health risks discussed here would be overestimated. The conservative assumptions were made to provide assurance that the evaluation of risks from exposure to soil is not understated. Each conservative assumption tends to overestimate, rather than underestimate, potential risks.

The potential intake rates and exposure frequencies and durations assumed in the risk assessment were conservative. For example, trespassers were assumed to be present at Tango Range 65 days per year for 6 years and a recreational user was assumed to hunt 12 days per year for 6 years. Such assumptions certainly do not underestimate actual exposures that may potentially occur at the Site. It is more likely that individuals might only enter Tango Range area once or twice during a year, if at all, and it is highly unlikely that they would sustain trespassing activities for a period of six years. If more realistic and reasonable potential exposure assumptions were employed in the risk assessment, the estimated risks would likely be substantially lower.

The risk assessment used soil adherence factors derived from studies that measured actual soil loading onto skin during various types of activities. The adherence factors were selected based upon similarity of the activities conducted by the study participants to the assumed activities of the receptors evaluated in the risk assessment. It was assumed, therefore, that the soil adherence for receptors in the risk assessment would be similar to soil adherence observed in the studies. It was also assumed that absorption of constituents from soil adhered to skin would be similar to absorption from soil observed in studies used to derive the absorption adjustment factors. However, such studies typically measure absorption by applying enough soil to the skin so that an “infinite source” of compound is available for absorption. This risk assessment assumes that the amount of soil assumed to adhere to receptors’ skin approximates the “infinite source” amount used to estimate dermal absorption of constituents from soil. However, rates of absorption measured in studies may not be representative of absorption that occurs when lower degrees of adherence occur.

USEPA (2004b) states that dermal absorption from soil tends to increase as the thickness of the soil layer decreases until a “monolayer” (the point where the skin is not uniformly covered by soil), at which the absorption remains relatively constant. Because the risk assessment assumed dermal absorption rates for soil loadings that were thicker than a monolayer, it would be possible that dermal absorption has been overestimated because actual soil loading maybe less than assumed and would not achieve the assumption of a “monolayer.” Thus, there is some uncertainty regarding the amount of dermal absorption from soil. However, this uncertainty is minimized by the assumption of soil loading thicker than a monolayer. If the dermal absorption were increased (above the rates assumed in the risk assessment) because a monolayer of soil were assumed to be loaded onto skin, then the soil adherence factor assumed in the risk assessment would also need to be decreased to account for the reduced amount of soil assumed to be loaded onto skin. Consequently, although there is some uncertainty associated with the increased dermal absorption that occurs when a monolayer of soil is loaded onto skin, the approach used in the risk assessment is not likely to underestimate potential exposure because the soil adherence assumed in the dermal absorption factors used in the risk assessment “match” the dermal absorption rates used in the risk assessment. Permeability coefficients and dermal absorption factors for several of the COPCs (Table 4.9, Attachment A) were not available in the RAGS Part E (Dermal Risk Assessment) (USEPA, 2004b). Therefore, hazards and risks could not be calculated. This results in an underestimate of risk or hazard for these chemicals.

Although USEPA (1997b; 1999b) recommends an upper bound soil ingestion rate for young children of 200 mg/day, this risk assessment used a soil ingestion rate for a resident child based on more current information provided by the authors of the study upon which that estimate is derived. It appears that a more reasonable upper bound ingestion rate for young children is 100 mg/day (Stanek et al., 2000). Similarly, USEPA (1997b; 1999b) does not specifically recommend an upper bound estimate of soil ingestion for older children and adults, but does recommend an average ingestion rate for these age groups of 50 mg/day. More current information provided by Stanek et al., (1997), however, indicates that 50 mg/day is a more reasonable upper bound estimate for these age groups.

### 2.5.5 Toxicological Information and Models

As discussed in Section 2.4.2.3, exposures to lead were evaluated using biokinetic models, the IEUBK model for children, the AALM for adult residents, and the ALM for the adolescent trespasser and the adult construction worker. All of these models require both general and site-specific input parameters. General input parameters include estimates of the baseline blood lead level due to exposure to lead in other media (e.g., air, drinking water), uptake factors (e.g., gastrointestinal absorption rates), and biokinetic components (e.g., transfer factors within the body). The default values assumed for these general input parameters are typically considered conservative in the sense that they are unlikely to underestimate the resulting blood lead level and associated statistical probabilities. Site-specific input parameters include the EPC and soil ingestion rate. Consistent with EPA guidance, the arithmetic average soil lead concentration was utilized. Uncertainties associated with the estimated EPC were discussed previously (Section 2.5.3), but it should be noted that in the case of lead in Area 1 there was 1 sample detected at a concentration greater than 1,000 mg/kg lead (5,800 mg/kg at SS169A 0.5-1.0) out of a total of 44 samples. This sample had a substantial effect on the EPC.

RfDs and CSFs obtained from USEPA were used in this HHRA, so the toxicological evaluations upon which the risk assessment is based contribute no more uncertainty than in comparable CERCLA documents. However, the level of uncertainty in the toxicological data and models associated with a particular COPC can be substantial.

Considerable uncertainty can be associated with qualitative (hazard assessment) and quantitative (dose-response) evaluations. Hazard assessment characterizes the nature and strength of the evidence of causation or the likelihood that a chemical that induces adverse effects in animals will induce adverse effects in humans. Hazard assessment of carcinogenicity is currently evaluated as a weight-of-evidence determination, using USEPA (1989) classifications. Positive results in animal cancer tests suggest humans may also manifest a carcinogenic response, but animal data cannot necessarily be used to predict target tissues in humans. In the hazard assessment of noncarcinogenic effects, positive animal test results may suggest the nature of possible human effects (i.e., target tissues and type of effects) (USEPA, 1989).

There are many sources of uncertainty in dose-response evaluation of carcinogenic (i.e., CSF or UR calculations) and noncarcinogenic effects (i.e., RfD or RfC calculations). The major sources are:

- Interspecies extrapolations;
- Variability between species and between individuals of the same species;
- Key study and database quality;
- Extrapolation from high doses in animals to the dose range expected for environmentally exposed humans;
- Endpoint extrapolation to NOAEL from LOAEL; and
- Wide variation in the quality and amounts of toxicological data for different chemicals.

The degree of over-conservatism in the toxicological factors is difficult to estimate because of the number of factors involved. An estimate of the overall uncertainty contributed by toxicological estimates could be a factor ranging from 10 to 100.

Chronic toxicity values were used to evaluate the trespasser, hunter, and construction worker scenarios, which represents a subchronic exposure scenario (USEPA, 1989; 2002a), which likely results in overestimates in the hazard estimates for these receptors.

USEPA has recently released guidance on the need for additional safety factors for children exposed to genotoxic compounds (USEPA, 2005b). The child receptor groups included in the risk assessment include a child resident aged 0 to 6 and a child trespasser aged 12 to 18. Both of these receptor groups fall within ages 2 to 15, which is associated with a three-fold risk adjustment for mutagenic agents. Therefore, risk estimates for some COPCs may be underestimates. USEPA is recommending age-dependent adjustment facts only for carcinogens acting through a mutagenic mode of action. Not all carcinogens that will be “officially” considered mutagens have been identified. Currently, none of the COPCsfor this risk assessment have been identified as mutagens.

For compounds without toxicity values from either IRIS or Health Effects Assessment Summary Tables (HEAST), toxicity values from Tier 3 sources were used in this evaluation without review of the basis of the RfD(s). Provisional toxicity values were obtained for aluminum, nitroglycerin, and vanadium from USEPA and NCEA (USEPA, 2004a, 2006c, 2006d). The use of these provisional values contributes to some uncertainty in the overall risk estimates. In addition, the oral RfD for tungsten is based on an unpublished NOAEL from a CHPPM toxicity study (CHPPM, 2007).

### 2.5.6 Risk Characterization

The risk characterization bridges the gap between potential exposure and the possibility of systemic or carcinogenic human health effects, ultimately providing impetus for the remediation of the Site or providing a basis for no remedial action.

Uncertainties associated with risk characterization include the assumption of chemical additivity and the inability to predict synergistic or antagonistic interactions between COPCs. These uncertainties are inherent in any inferential risk assessment. USEPA-promulgated inputs to the quantitative risk assessment and toxicological indices are calculated to be protective of the human receptor and to err conservatively, so as not to underestimate the potential human health risks.

The risk and hazards of potential adverse human health effects depends on estimated levels of exposure and on dose-response relationships. Once exposure to, and hazard from, each of the selected constituents is calculated, the total potential hazard posed by potential exposure to site-related COPCs is determined by combining the hazard quotients contributed by each constituent. Where COPCs do not interact, do not affect the same target organ, or do not have the same mechanism of action, summing the hazard quotients for multiple COPC results in an overestimate of hazard posed by the Site. However, in order not to understate the hazard, it was initially assumed that the potential effects of different constituents are additive. Unlike the hazard index approach, cancer risks are statistical probabilities, and if probabilities are assumed to be independent, then the cumulative probability is the sum of the individual probabilities. Probabilities would not be independent if the exposure to one chemical affects the body's response to exposure to another chemical. Neither synergism nor antagonism is quantitatively evaluated in this risk assessment due to a lack of developed methods.

The health risks estimated in the risk characterization generally apply to the hypothetical receptors whose activities and locations were described in the exposure assessment. Some people will always be more sensitive than the average person and, therefore, will be at greater risk. In evaluating these receptor groups assuming many upper-bound exposure assumptions, this risk assessment estimates potential risks, and likely overstates any actual risks to over 99% of the exposed population. In addition, the toxicity values used to calculate risk are derived by governmental health agencies specifically to be protective of sensitive members of the population, which includes the developing fetus, children, the elderly, and people with impaired health status. RfDs assume that sensitive members of the population are a factor of ten times more sensitive than a healthy adult. As mentioned previously, the estimated dose that both adults and children receive in this risk assessment most likely represent "worst-case" scenarios and therefore calculated values are biased high yet still are unlikely to be associated with adverse health effects.

This HHRA considered only potential risks from soil exposures. For current and future military personnel engaged in small arms training, current and future trespassers, current and future recreational hunters, and future construction workers, groundwater exposures are not considered complete exposure pathways. Therefore, the risks and hazards for these receptors presented herein represent cumulative risks and non-cancer hazards. No evaluation was conducted in this report of potential future exposures to groundwater COPCs used as a source of potable water by hypothetical residents.

# 3.0 Ecological Risk Assessment

## 3.1 Introduction

The purpose of the baseline ecological risk assessment (BERA) is to identify contaminants of potential ecological concern (COPECs) in surface soils which may pose potential risk to terrestrial ecological receptors utilizing habitat present at the Tango Firing Range (the Site).

## 3.2 Environmental Setting

A Site reconnaissance was performed on January 17, 2007 to identify environmentally sensitive areas and potential chemical migration pathways at the MMR Tango Firing Range (the Site) located in Cape Cod Massachusetts. A Site sketch and photographic log are provided in Attachment C.

### 3.2.1 Topography

The northern portion of the Site consists of an entrance and vehicle access road; parking, and mowed grass areas. Topography of the entire Site is relatively flat, except for an earthen berm constructed near the center, running east to west. The berm measures roughly 220 feet long and 16 feet tall. A vehicle access road runs east to west along the northern portion of the firing range adjacent to the firing line. The firing range is located immediately south of the firing line and the main berm is approximately 200 feet south of the firing line. The access road runs along the perimeter of the firing range and along the southern bank of the berm. There are six mounds of soil (approximately 6 to 8 feet in height), just north of the firing line, that are set adjacent to each other and run along the edge of the access road (one is located in front of the tower).

### 3.2.2 Soils

The vehicle access road and parking area along the northern end of the Site are constructed of loose gravel. The remainder of the access road is dirt with visible tire ruts and some degree of soil compaction, potentially due to range construction and periodic road use. Substrate on the remainder of the vegetated and un-vegetated portions of the Site consists of sandy, unconsolidated soils. Two areas with impervious ground surfaces were identified; one moderately-sized slab beneath the storage shed and several smaller slabs (approximately 8 in total) beneath support beams and staircase for the tower. The six mounds of soil lying parallel to the access road on the north end of the Site appear to be native soils, potentially excavated during range construction.

### 3.2.3 Vegetation

Vegetation within the firing range, the main berm, and beside the entrance road consists of mowed grass. The cleared area located south of the berm consists of dense underbrush including sumac (*Rhus* sp.), multifora rose (*Rosa multifora*), goldenrods (*Solidago* sp.), green briar (*Smilax* sp.) and juvenile pines (*Pinus* sp.). The southern, eastern, and western perimeters of the Site are forested with white pines (*Pinus stroba*), pitch pines (*Pinus rigida*), and aspens (*Populus* sp.).

### 3.2.4 Wildlife Observations

No direct wildlife observations were made at the Site. However, several flocks of song birds, juncos (*Junco* sp.), and seagulls (*Larus* sp.) were observed while driving along the MMR access roads. White-tailed deer (*Odocoileus virginianus)* are very prevalent throughout the MMR (Greg Pierce, USACE personal communication).

### 3.2.5 Threatened and Endangered Species

There are at least 25 species listed under the Massachusetts Endangered Species Act that have been observed on the MMR. About half of these are lepidoptera (i.e., moths), such as Gerhard's underwing moth (*Catocala herodias gerhardi*), the barrens daggermoth (*Acronicta albarufa*), and Melsheimer's sack bearer (*Cicinnus melsheimeri*). State-listed plant species documented on the MMR include broad tinker's weed (*Triosteum perfoliatum*), ovate spikerush *(Eleocaris obtusa var. ovata*), Torrey's beak-sedge (*Rhynchospora torreyana*), and adder's tongue fern (*Ophioglossum pusillum*). Rare bird species on MMR include the upland sandpiper (*Bartramia longicauda*), the grasshopper sparrow (*Ammodramus savannarum*), the vesper sparrow (*Pooecetes gramineus*), and the northern harrier (*Circus cyaneus*). These species are primarily associated with the grassland fields in the southern cantonment area. No threatened or endangered amphibians, reptiles, fish, or mammals are known to inhabit the MMR; however, the MMR does support a number of animals that are listed by the state as species of special concern. These include the eastern box turtle (*Terrapene carolina*), the Cooper's hawk (*Accipiter cooperii*), and the sharp-shinned hawk (*Accipiter striatus*) (USACE, 2002).

## 3.3 Problem Formulation

Problem formulation included the following steps:

- Review of available data on ecological communities and selection of representative ecological receptor species;
- Development of a conceptual site model for ecological receptors for application at the Site;
- Review existing data on chemical concentrations in soil and selection of COPECs; and
- Develop assessment and objective measurement endpoints for use in the ecological risk assessment.

### 3.3.1 Identification of Representative Wildlife Receptors

Criteria for the selection of wildlife receptors included two factors specified in USEPA guidance (USEPA, 1997) for determining "key organisms" in an ecological food web: (1) resident communities or species exposed to highest chemical concentrations in surface soil; (2) species or functional groups considered to be essential to, or indicative of, the normal food chain functioning within the affected habitat.

Three avian species and three mammalian species were selected as receptors of interest across the Site. The species chosen were selected given that they are all endemic to the terrestrial habitats present in the MMR area, they represent the different foraging behaviors anticipated for avian and mammalian wildlife common to the terrestrial habitats present, and they include upper tropic level receptors:

- Herbivorous Birds. The chipping sparrow (*Spizella passerina*) was selected to represent a largely herbivorous avian species. Chipping sparrows are found in grassy, weedy or brushy habitats, and have been identified at MMR.
- Omnivorous Birds. The American robin (*Turdus migratorius*) was selected to represent omnivorous terrestrial avian receptors; it is a commonly observed species in the MMR. The robin feeds on terrestrial plants, fruits, and soil invertebrates.
- Carnivorous Birds. The red-tailed hawk (*Buteo jamaicensis*) was selected to represent carnivorous terrestrial avian receptors, as a top-level terrestrial predator that preys on small birds, small mammals (e.g., rabbits, ground-dwelling rodents) and snakes identified at MMR.
- Herbivorous Mammals. The white-footed mouse (*Peromyscus leucopus*) was selected to represent a largely herbivorous mammalian species. These mice have been identified at MMR and feed primarily on plant matter (shoots, grasses, and bark), in addition to small amounts of insects. Both avian predators (hawks) and mammalian predators (foxes) prey upon mice.
- Omnivorous Mammals. The short-tailed shrew (*Blarina brevicauda*) was identified as being native to the MMR area and is a species that consumes terrestrial plants, earthworms, and other invertebrates in soil. Because of its small home range, the shrew is potentially exposed to on-site chemicals for its entire lifetime.
- Carnivorous Mammals. The red fox (*Vulpes vulpes*) was selected to represent carnivorous terrestrial mammalian species. This species is a terrestrial predator present throughout the United States and Canada that has been observed at MMR. Red fox prey extensively on mice and voles but also feed on other small mammals, insects, rabbits, game birds, and poultry.

### 3.3.2 Conceptual Site Model

Based upon the results of the ecological receptor selection process, the Site visit and the terrestrial habitats present on the Site, a site-specific food web conceptual site model (CSM) (Figure 3.1) was created. This CSM was used to identify the exposure pathways and routes through which the identified wildlife receptors may be exposed to contaminants associated with historical range uses. The primary exposure media considered in the BERA for the Site was surface soils (0-1ft. bgs). The primary exposure pathways and routes included ingestion of dietary items that have bioaccumulated contaminants from surface soils and incidental ingestion of surface soils by the receptors during normal behavioral activities in the habitats present. Bioaccumulation was the primary exposure route considered in the dietary component of the CSM. Incidental ingestion of soils occur as part of normal behavioral functions by the wildlife species. These behavioral functions resulting in the incidental ingestion of soils could include ingestion of soil particles during feeding or ingestion of soil particles during grooming or preening.

### 3.3.3 Screening Process for Identification of Chemicals of Potential Ecological Concern

Chemicals of potential ecological concern are chemicals that have the potential to present a risk to the representative wildlife receptors identified in Section 3.3.1. The soil screening level assessment described in this section compares maximum detected concentrations to relevant ecological screening values (USEPA ECO-SSLs) for identification of COPECs.

USEPA ECO-SSLs (USEPA, 2005a-2005m) are available for a limited group of inorganic metals and organic compounds Therefore, if a USEPA ECO-SSL was not available for comparison, a series of steps were applied consistent with the comprehensive BERA Site assessment process at MMR ranges.

The three following screening steps were applied for identifying a contaminant as a COPEC at the Site:

STEP 1: If the constituent was a risk driver in Demo 1, it is retained as a COPEC;
If the maximum detection concentration (MDC) exceeds the USEPA ECO-SSL, the constituent is retained as a COPEC;
If the MDC does not exceed the USEPA ECO-SSL, the constituent is eliminated as a COPEC; and
If no USEPA ECO-SSL is available, STEP 2 is applied.

STEP 2: If the MDC is less than the MDC in Demo 1, the constituent is eliminated as a COPEC;
If the MDC is greater than the MDC in Demo 1 but the frequency of detection is < 5%, the constituent is eliminated as a COPEC; and
If the MDC is greater than the MDC in Demo 1 but the frequency of detection is ≥ 5%, STEP 3 is applied.

STEP 3: If the MDC is less than the background value the constituent is eliminated as a COPEC; and
If the MDC is greater than the background value the constituent is retained as a COPEC.

USEPA has developed ecological soil screening levels (USEPA ECO-SSLs) for twelve metals: aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, and vanadium. The USEPA ECO-SSL for aluminum (USEPA, 2005a) states that aluminum is of concern only when the soil pH is less than 5.5. The MMR soils typically have a neutral pH (or slightly higher). The USEPA ECO-SSL for iron (USEPA 2005i) states that identifying a specific benchmark for iron in soil is difficult since iron bioavailability to plants (and subsequent toxicity) are dependent upon site-specific soil conditions. USEPA concluded that in well-aerated soils with a pH between 6 to 8, similar to those present on MMR, iron and aluminum bioavailability and toxicity are expected to be low and not problematic. Aluminum and iron were therefore dropped as COPECs and not evaluated further.

Table 3.1 presents the soil screening level assessment for identification of COPECs. Macro-elements such as phosphorus, potassium, sodium, calcium, and magnesium have been identified by the Food and Drug Administration (FDA) as essential nutrients and were not considered to be problematic for Site related. These detected analytes were, therefore, not evaluated in the COPEC screening process.

A total of eight COPECs were identified in the soil screening level assessment for the Site:

- Nitroglycerin;
- Antimony;
- Arsenic;
- Cadmium;
- Copper;
- Lead;
- Tungsten; and
- Vanadium.

This list of COPECs was carried through the ERA process to assess exposure to the wildlife receptors previously identified. Exposure point concentrations were calculated as the arithmetic mean of the relevant data (setting any undetected results to one-half the reported quantitation limit).

### 3.3.4 Development of Assessment and Measurement Endpoints

Based upon the identification of seven COPECs in the soil screening level assessment the BERA must proceed with the ecological risk characterization which estimates risk to wildlife receptors. Assessment endpoints are discrete expressions of an ecological or natural resource value deemed important to the community or ecosystem being protected. Based upon the results of the soil screening level assessment the following assessments were developed:

1. Protection and sustainability of herbivorous avian and mammalian populations utilizing terrestrial habitat present in the Site.

2. Protection and sustainability of omnivorous avian and mammalian populations utilizing terrestrial habitat present in the Site.

3. Protection and sustainability of carnivorous avian and mammalian populations utilizing terrestrial habitat present in the Site.

Measurement endpoints are “measurable responses that are related to the assessment endpoint” (USEPA, 1998). Measurement endpoints often are expressed as the statistical or arithmetic summaries of observations that make up the measurement. The following measurement endpoints were selected to evaluate the above corresponding assessment endpoints.

<u>Measurement Endpoints selected to evaluate Assessment Endpoint #1</u>

1. Comparison of predicted average daily dosage (ADDs) for herbivorous avian receptors to toxicity reference values (TRVs).
2. Comparison of predicted ADDs for herbivorous mammalian receptors to TRVs.

Measurement Endpoints selected to evaluate Assessment Endpoint #2

1. Comparison of predicted ADDs for omnivorous avian receptors to TRVs.
2. Comparison of predicted ADDs for omnivorous mammalian receptors to TRVs.

Measurement Endpoints selected to evaluate Assessment Endpoint #3

1. Comparison of predicted ADDs for carnivorous avian receptors to TRVs.
2. Comparison of predicted ADDs for carnivorous mammalian receptors to TRVs.

The above measurement endpoints will be used to evaluate and characterize risks to wildlife receptors.

## 3.4 Ecological Risk Characterization

Risk characterization uses the output from the preceding steps of the ERA and involves three principal steps: (1) risk estimation and characterization, (2) risk description, and (3) uncertainty analysis. In this step, the risks associated with estimated exposures were characterized, and the strengths, weaknesses, and assumptions employed in the risk assessment were fully described.

### 3.4.1 Risk Estimation and Characterization

Exposure assessment is the process of estimating the magnitude, frequency, duration, and types of potential exposures to COPECs in food webs assumed to be present (USEPA, 1997). This includes the development of equations and exposure assumptions used to estimate potential exposure for selected ecological receptors; and the calculation of soil EPCs.

Average Daily Dosage Derivation

The equation used to calculate the receptor's ADD, or intake, was as follows:

ADD (mg/kg-day) = [Σ(Cprey x Frprey) x IRfood + (Csoil x IRsoil)] x AUF x SUF ÷ BW

Where:

| | |
|---|---|
| ADD | = Average daily dose (mg/kg-day) |
| Cprey | = Concentration of COPEC in prey summed over all prey types (mg/kg wet weight) |
| Frprey | = Fraction of diet comprised of prey summed over all prey types including both plant and animal food items (unitless) |
| IRfood | = Ingestion Rate of food (wet weight) (kg/day) |
| Csoil | = Concentration of COPEC in soil (mg/kg wet weight) |
| IRsoil | = Incidental ingestion rate of soil (kg/day) |
| AUF | = Area Use Factor (unitless) |
| SUF | = Seasonal Use Factor (unitless), and |
| BW | = Body Weight (kg). |

The parameters used in the above equation were provided for each receptor selected, and their derivations are discussed below.

Dietary Intake Rate and Body Weight

The dietary composition of the wildlife receptor was estimated or assumed using life history data summarized in the USEPA Wildlife Exposure Factors Handbook (USEPA, 1993). Body weight and wet weight ingestion rates were derived from values listed in USEPA (1993), where available. When wet weight ingestion rates are not available, the wet weight food ingestion rate of the receptor, in kg/day, was be calculated based on the body weight using the equation in Sample *et al*. (1997). Concentrations of COPECs in dietary/prey organisms (e.g., plants, invertebrates, small birds and mammals) were estimated from soil concentrations and bioaccumulation factors.

Area and Seasonal Use Factors

Area use factors (AUFs) and seasonal use factors (SUFs) were applied to exposure estimations when it could be reasonably assumed that only a portion of the exposure dosage ingested by the receptor was from the contaminated soils present. This was typically the case when the home range of the receptor was greater than the area of the site, or at least the area of available habitat within the site. The AUF is then defined by the ratio of the habitat area of the site to the animal's home range area. It should be noted that the AUF cannot exceed 1; therefore, when the AUF is 1 for a particular exposure scenario, then the receptor's home range is assumed to be within the habitat area on the site (i.e., the receptor and/or progeny spend 100% of their life cycle on-site).

For this risk assessment the chipping sparrow was assumed to be at MMR from April until September, or 5 months. Therefore the SUF is 5/12 or 0.42. The robin exhibits seasonal movement or migration, leaving the breeding grounds in September to November and returning between February and April. For this risk assessment the robin was assumed to be at MMR from March through September, or 7 months. Therefore the SUF is 7/12 or 0.58.

All other wildlife receptor species were considered to be resident to the habitats present on a year round basis.

Hazard Quotient and Hazard Index

Potential risks to the ecological receptors were estimated using the hazard quotient (HQ) method. In this method, the estimated exposure (the ADD) is compared to the toxicity reference value (i.e., the NOAEL and/or LOAEL) using the following equation:

$$HQ = ADD \div TRV$$

Where:

HQ = hazard quotient (unitless)

ADD = average daily dose (mg/kg-day), and

TRV = toxicity reference value (mg/kg-day).

These calculations are performed for each individual wildlife receptor considered in the BERA. Wildlife exposure parameters applied in the calculation of the ADD are provided in Table 3.2 (Attachment D). Dietary uptake factors used to estimate ADD via specific dietary exposure routes are provided in Table 3.3 (Attachment D).

When the HQ is less than 1.0, the estimated potential exposure is less than the TRV indicating that no potential risk exists. When the HQ is greater than 1.0, the estimated potential exposure exceeds the TRV and a potential risk may exist for the endpoint evaluated. The HQ is calculated separately for each individual compound for each of the assessment endpoints identified. The individual hazard quotients were summed to estimate a hazard index (HI). The HI represents a qualitative assessment of risk from COPECs for a common toxicological effect endpoint. The HI is only for interpretative measure and does not carry a definitive definition of risk as defined by a LOAEL HQ equal to or greater than one as defined under the Massachusetts Contingency Plan (MCP) or Ecological Risk Assessment Guidance for Superfund (ERAGS). Four categories of effects were evaluated in the HI summary: reproductive, survival, growth and other (i.e., histological effects or organ specific tissue effects). The HI was calculated as follows:

Hazard Index for Endpoint =∑HQs for Endpoints 1, 2 and 3

Where:

∑HQs = Sum of hazard quotients for a common endpoint (i.e., survival, growth and reproduction);

HI = Cumulative hazard index for survival (endpoint 1), growth (endpoint 2), and reproduction (endpoint 3).

The measurement endpoints used to determine whether or not there is an adverse impact to each assessment endpoint are listed separately, along with the results for each endpoint. Under the MCP, a NOAEL HQ <1.0 may be interpreted as a basis for no potential risk of biologically significant harm and a LOAEL HQ >1.0 may be considered as a basis for the potential for biologically significant harm. A risk estimate that has a NOAEL HQ >1.0 but below a LOAEL HQ <1.0 is considered inconclusive and will need to be carefully considered in light of the exposure assessment and risk characterization uncertainties.

Each Assessment Endpoint is discussed individually based upon the measurement endpoints used in each risk characterization.

Assessment Endpoint 1: Adverse effects to herbivorous bird (chipping sparrow) and mammal (white-footed mouse) populations resulting from exposures to COPECs in surface soil and/or diet items.

*Measurement Endpoint:* Comparison of predicted ADDs for avian and mammalian receptors to TRVs.

For the chipping sparrow, the exposure assessment identified one COPEC, lead, with a NOAEL HQ >1.0 (Tables 3.4 and 3.5 in Attachment D). For the white-footed mouse, the exposure assessment identified one COPEC, vanadium, with NOAEL and/or LOAEL HQs ≥1.0 (Tables 3.6 and 3.7 in Attachment D). All other COPECs had corresponding NOAEL and LOAEL HQs <1.0.

Assessment Endpoint 2: Adverse effects on omnivorous bird (American robin) and mammal (short-tailed shrew) populations resulting from exposures to COPECs in surface soil and/or diet items.

*Measurement Endpoint:* Comparison of predicted ADDs for avian and mammalian receptors to TRVs.

For the American robin, the exposure assessment identified one COPEC, lead, with NOAEL HQs >1.0 (Tables 3.8 and 3.9 in Attachment D). For the short-tailed shrew, the exposure assessment identified one COPECs, vanadium, with NOAEL and/or LOAEL HQs >1.0 (Tables 3.10 and 3.11 in Attachment D). All other COPECs had corresponding NOAEL and LOAEL HQs <1.0.

Assessment Endpoint 3: Adverse effects on carnivorous bird (red-tailed hawk) and mammal (red fox) populations resulting from exposures to COPECs in surface soil and/or diet items.

*Measurement Endpoint:* Comparison of predicted ADDs for avian and mammalian receptors to TRVs.

For the red-tailed hawk, no COPECs with a NOAEL or LOAEL HQ >1.0 were identified (Tables 3.12 and 3.13 in Attachment D). For the red fox, the exposure assessment identified three COPECs, antimony, and vanadium, with NOAEL and/or LOAEL HQs >1.0 (Tables 3.14 and 3.15 in Attachment D). All other COPECs had corresponding NOAEL and LOAEL HQs <1.0.

### 3.4.2 Risk Description

The risk description component of the Risk Characterization includes: a summary of all the risk estimate(s); (2) a discussion of the evidence supporting the risk estimate(s) using a weight-of-evidence approach; and (3) an interpretation of the ecological significance and relevance of the estimate(s).

### 3.4.3 Summary of HazardQuotients and Hazard Indices

*White-footed mouse*

Table 3.16 (Attachment D) summarizes the results of the exposure assessment for the white-footed mouse. NOAEL HQs ranged from <1.0 to 37, while LOAEL HQs ranged from <1.0 to 3.7 (maximum: vanadium). Risk to this receptor could not be characterized for one COPEC, tungsten, due to a lack of corresponding toxicity values for a representative mammalian test species.

The exposure assessment identified one COPEC, vanadium, with NOAEL and LOAEL HQs >1.0. All other COPECs had corresponding NOAEL and LOAEL HQs <1.0. The toxicological endpoint for vanadium is reproduction (endpoint = reduced fertility in male rats). The LOAEL HQ for vanadium (3.7) contributed to the majority of the LOAEL HI for reproduction (3.7) (Table 3.16 in Attachment D).

The maximum concentration of vanadium exceeded the USEPA ECO-SSL value but was below the observed range of this metal in Demo 1 soils and Massachusetts Department of Environmental Protection (MassDEP) background for natural soils. Based upon this observation, risks from vanadium were overstated because of the conservativeness of the screening value and the failure to consider local conditions consistent with background ranges of this element. This observation suggests that the potential for risk of biologically significant harm is the product of the conservative nature of the exposure assessment and risk characterization.

*Short-tailed shrew*

Table 3.16 (in Attachment D) summarizes the results of the exposure assessment for the short-tailed shrew. NOAEL HQs ranged from <1.0 to 46, while LOAEL HQs ranged from <1.0 to 4.6 (maximum: vanadium). Risk to this receptor could not be characterized for one COPEC, tungsten due to a lack of corresponding toxicity values for a representative mammalian test species.

The exposure assessment identified one COPEC, vanadium, with NOAEL and LOAEL HQs >1. All other COPECs had corresponding NOAEL and LOAEL HQs <1.0. The toxicological endpoint for vanadium is reproduction (endpoint = reduced fertility in male rats). The LOAEL HQ for vanadium (4.6) contributed to the majority of the LOAEL HI for reproduction (4.6) (Table 3.16 in Attachment D). NOAEL and LOAEL HQs >1 for vanadium suggest potential risk for the short-tailed shrew at the Site.

The maximum concentration of vanadium exceeded the USEPA ECO-SSL value but was below the observed range of this metal in Demo 1 soils and MassDEP background for natural soils. Based upon this observation, risks from vanadium were overstated because of the conservativeness of the screening value and did not consider local conditions consistent with background ranges of this element. This suggests that the potential for risk of biologically significant harm is the product of the conservative nature of the exposure assessment and risk characterization.

*Red Fox*

Table 3.16 (Attachment D) summarizes the results of the exposure assessment for the red fox. NOAEL HQs ranged from <1.0 to 47, while LOAEL HQs ranged from <1.0 to 4.7 (maximum: vanadium). Risk to this receptor could not be characterized for one COPEC, tungsten, due a lack of corresponding toxicity values for a representative mammalian test species.

The exposure assessment identified one COPEC, antimony, with a NOAEL HQs >1.0. It also identified one COPEC, vanadium, with both NOAEL and LOAEL HQs >1. All other COPECs had corresponding NOAEL and LOAEL HQs <1.0. The toxicological endpoint for vanadium is reproduction (endpoint = reduced fertility in male rats). The LOAEL HQ for vanadium (4.7) contributed to the majority of the LOAEL HI for reproduction (4.9) (Table 3.16 in Attachment D).

Based upon a NOAEL HQ >1 potential risk may exist for the red fox from antimony at the Site, however, a LOAEL HQ <1 suggests this risk in minimal. NOAEL and LOAEL HQs >1 for vanadium suggest potential risk for the red fox in the Site.

The maximum concentration of vanadium exceeded the USEPA ECO-SSL value but was below the observed range of this metal in Demo 1 soils and MassDEP background for natural soils. Based upon this observation, risks from vanadium were overstated because of the conservativeness of the screening value and the failure to consider local conditions consistent with background ranges of this element. This suggests that the potential for risk of biologically significant harm is the product of the conservative nature of the exposure assessment and risk characterization.

*Chipping Sparrow*

Table 3.17 (Attachment D) summarizes the results of the exposure assessment for the chipping sparrow. NOAEL HQs ranged from <1.0 to 1.7 (maximum: lead), while all LOAEL HQs were <1. NOAEL risks to this receptor could not be characterized for two COPECs, nitroglycerin and tungsten, due to a lack of corresponding toxicity values for representative mammalian test species. LOAEL risks to this receptor could not be characterized for four COPECs, nitroglycerin, antimony, tungsten, and vanadium, due to a lack of corresponding toxicity values for representative mammalian test species.

The exposure assessment identified one COPEC, lead, with a NOAEL HQ >1.0. All other COPECs had corresponding NOAEL and LOAEL HQs <1.0. The toxicological endpoint for lead is reproduction (endpoint = reduced hatching success). The LOAEL HQ for lead (1.7) contributed to the majority of the LOAEL HI for reproduction (1.7) (Table 3.17 in Attachment D). Based upon a NOAEL HQ =1 potential risk may exist for the chipping sparrow from lead at the Site, however, a LOAEL HQ <1 suggests this risk in minimal.

*American Robin*

Table 3.17 (Attachment D) summarizes the results of the exposure assessment for the American robin. NOAEL HQs ranged from <1.0 to 4.7 (maximum: lead), while LOAEL HQs were all <1.0. NOAEL risks to this receptor could not be characterized for two COPECs, nitroglycerin and tungsten, due a lack of corresponding toxicity values for representative mammalian test species. LOAEL risks to this receptor could not be characterized for four COPECs, nitroglycerin, antimony, tungsten, and vanadium, due to a lack of corresponding toxicity values for representative mammalian test species.

The exposure assessment identified one COPEC, lead, with NOAEL HQs >1. The LOAEL HQs for all COPECs were <1.0 for this receptor. The toxicological endpoint for lead is reproduction (endpoint = reduced egg hatching success). The LOAEL HQ for lead (4.7) contributed to the majority of the LOAEL HI for reproduction (4.9) (Table 3.17 in Attachment D). Based upon NOAEL HQs >1 potential risk may exist for the American robin lead at the Site, however, LOAEL HQs <1 suggests this risk in minimal.

*Red-tailed Hawk*

Table 3.17 (Attachment D) summarizes the results of the exposure assessment for the red-tailed hawk. The exposure assessment identified no COPECs with NOAEL or LOAEL HQs >1.0. NOAEL risks to this receptor could not be characterized for two COPECs, nitroglycerin and tungsten, due to a lack of corresponding toxicity values for representative mammalian test species. LOAEL risks to this receptor could not be characterized for four COPECs, nitroglycerin, antimony, tungsten, and vanadium, due to a lack of corresponding toxicity values for representative mammalian test species. Based on these findings, the potential for biologically significant harm does not exist for the red-tailed hawk.

### 3.4.4 Weight-of-Evidence

The weight-of-evidence approach applies a significance level to the lines of evidence applied as measurement endpoints to the assessment endpoints considered. It is a crucial element of the interpretation of the BERA results, and is integral to the risk management evaluation. The following factors are some of the key considerations in the weight-of-evidence evaluation of the various risk estimates:

- The relevance of the evidence to the assessment endpoint:

  The avian and mammalian wildlife species chosen as measurement endpoints (white-footed mouse, short-tailed shrew, red fox, chipping sparrow, American robin, and red-tailed hawk) were selected given that all six species are endemic to the terrestrial habitats present in the MMR area. These species also represented upper (consumer rather than producer) trophic level receptors so that potential food web effects would be considered for individual COPECs with bioaccumulating potential in the local food chain.

- The relevance of the evidence to the CSM describing the physical fate and transport processes and their direct relevance to the assessment endpoints:

  The exposure pathways and primary and secondary sources of contaminants identified in the CSM, as well as chemical fate and transport properties of the identified COPECs, suggest that the presence of these contaminants in soil is due to the past military operations performed at the Site.

  Soil samples collected to evaluate potential effects of COPECs were selected based on the evidence provided by the historical use of the Site. Soil samples collected therefore included depths and locations determined to be important in relation to these past uses and as relevant to exposure pathways and routes for the ecological receptors evaluated.

- The confidence in the risk estimate or other information:

  The BERA used receptors known to inhabit areas represented by the Site and conservative exposure assumptions. Because of the conservative nature of the exposure assumptions, the potential risks for estimating adverse effects, are much more likely to overestimate rather than underestimate risk of effect to the individual receptors considered. Based upon this information, COPECs that exhibited HQs less than unity can be eliminated from further consideration with a high degree of confidence. The representativeness and confidence in the risk estimations for the COPECs that exhibited HQs exceeding unity are further discussed in the Uncertainty Analysis section.

### 3.4.5 Ecological Significance and Relevance

The potential for various adverse effects arising from COPEC exposures to wildlife receptors included consideration of the following:

The HQ/HI approach was used to assess potential risk. When the HQ is greater than 1.0, the estimated potential exposure exceeds the TRV and a potential for risk cannot be excluded.

### 3.4.6 Risk Description

USEPA ERAGS identifies three major types of uncertainty for evaluating ecological risks. These types include: conceptual model uncertainty, parameter values, and model error. Each of these is discussed below along with their relevance to the risk conclusions for the COPECs that showed HQs greater than unity.

Conceptual Model Uncertainty

The CSM for the Site presented the pathways and exposure routes identified for the soils present in the habitats of the Site. The CSM formed the basis for the development of the field investigations, the selection of exposure pathways, the selection of receptors of concern, and the selection of assessment and measurement endpoints that were used in the ecological risk assessment. This CSM was developed not as a comprehensive integration of all possible exposure pathways or receptors but a simplified version to allow for the quantification of exposure to representative receptors. Because this is a simplification of the complex relationships and processes present in an ecological food web it not capture all of the potential exposure routes for each wildlife receptor assessed.

Parameter Value Uncertainty

Uncertainty in parameter values includes the exposure assumptions that were used for dose calculations and the TRVs that were used to estimate and characterize the risks. These are described in the following paragraphs.

*EPCs*: Exposure point concentrations were calculated for surficial soil using samples that encompassed depths (i.e., 0 to 1 ft bgs) that would likely be encountered by receptors incidentally ingesting the soil, as well as depths that are likely to be encountered by soil invertebrates or roots of plants that they ingest. In addition, the sampling locations were located in areas of the Site that were used for military activities, and therefore, the number of COPECs and their concentrations are likely biased toward higher concentrations rather than being inclusive of non-use areas present at the Site.

Sampling of surface soils from the Site used composite sampling. This sampling strategy employs the collection of multiple random grabs from across a discrete area and combing the individual grabs into a single discrete soil sample. While this approach does allow for the assessment of contamination across a large spatial area it does not provide for the basis for assessing variability across individual sample points. This loss of variation may result in missing of hotspots or underestimation of exposure due to lack of discrete data for individual points that may identify an area of higher concentrations of contaminants.

*Conservative exposure assumptions*: The exposure assumptions, such as food and soil ingestion rates, dietary composition, seasonality, and home range, were based on field studies performed by others and presented in the scientific literature but were assumed to be representative of the behavior of these receptors in the habitats present on the Site. In general, the exposure assumptions represent best professional judgment with regard to providing a conservative estimation of exposure for representative ecological receptors that may actually inhabit the site.

Another exposure pathway uncertainty was the conservative assumption of a bioavailability factor of 1 (except for avian exposures to lead). The simplified food-chain exposure models assumed that COPECs were in a chemical form that was 100% bioavailable to the exposed receptor. Because bioavailability of any compound is less than 100 percent, the receptors would therefore be exposed and assimilate lower COPEC concentrations that would result in an even lower probability of an adverse effect.

Finally, soil invertebrates were included in the modeled diets of two receptor species: the short tailed shrew and the American robin. Both of these included earthworms and “other soil invertebrates” as a dietary item. However, the biota transfer factors for all soil invertebrates (earthworms and “others”) were based on earthworm transfer factors. Earthworms ingest soils resulting in a greater exposure potential to this receptor group. Epi-faunal insects such as crickets and grasshoppers ingest vegetative matter as part of their diet and thus do not have the same exposure pattern as earthworms. The use of earthworm transfer factors to model the contaminant concentrations in their tissues is probably highly conservative and thus prone to overestimate exposure to insectivorous wildlife.

*Toxicity Reference Values*: NOAELs are considered conservative estimates of the actual toxicity threshold of exposure. In some cases, the NOAEL is estimated from a LOAEL or median lethal dose of laboratory test organisms. This is done through the application of appropriate uncertainty factors to extrapolate to the anticipated comparable chronic effect in the receptor of interest. The uncertainty values used in TRV development are well established (e.g., USEPA 1997).

*Population Risk Estimate:* The HQ/HI approach used in this evaluation was based on a sensitive individual receptor. Because conservative exposure assumptions were combined with conservative toxicity assumptions, the resulting risks overestimate potential effects to the populations. Rather, they represent potential effects to highly exposed, sensitive individuals within the population.

Model Error Uncertainty

The most common example for model error uncertainty is the method used to derive indirect (food-chain) uptake. Although these were based on established fate and transport processes and food web models, they are generic and may not be representative of the processes that may be occurring at the Site. Finally, some uncertainty remains associated with wildlife exposure to nitroglycerin and tungsten due to a lack of corresponding TRV data for avian and mammalian species.

# 4.0 Summary

## 4.1 Potential Human Health Risks

Potential human health risks were estimated for current receptors (military personnel engaged in firearms training, trespassers and recreational hunters), future receptors (trespassers, military personnel training at Tango Range, recreational hunters, and construction workers) and hypothetical future residents at Tango Range Site. Given the conservative assumptions used in this evaluation of potential non-cancer risk, the receptors hazard indices associated with potential exposure to soil are still all less than one for all current receptors and all future receptors except child residents. The calculated HI for future hypothetical child residents in Area 1 exceeds 1 primarily due to ingestion of nitroglycerin in soil. The human health risk assessment indicates that potential noncarcinogenic effects are not expected for any of the likely current Site receptors included in the evaluation. Similarly, this human health risk assessment also indicates that potential excess lifetime cancer risks are less than or within USEPA's allowable risk range of $1x10^{-6}$ to $1x10^{-4}$ for all current or future receptors included in the risk assessment and fall within the allowable risk range for future hypothetical residents (between $1.9x10^{-6}$ and $2.3x10^{-6}$). Currently, the future use of Tango Range area has not been determined. However, future residential development is extremely unlikely to occur. Thus, the risk assessment demonstrates that for the most likely and expected current and future uses, the Site does not pose an unacceptable cancer risk.

## 4.2 Summary Potential Ecological Risks

The ERA for the Tango Firing Range determined that there are potential ecological risks to ecological receptors. The primary receptor species identified were omnivorous avian species. The primary ecological risk was attributed to concentrations of lead to avian receptors. Risks associated with lead however appeared limited as modeled exposure dosages to avian receptors were below the LOAEL TRV indicating that the potential risk was low. The range wide mean lead concentration in surface soils was within the range of published MADEP background levels and further supporting the low risk determination.

## 4.3 Summary Potential Ecological Risks for the Tango Firing Range

The ERA for the Tango Firing Range identified that there are potential risks to ecological receptors. The ecological receptor groups where potential risks were identified include herbivorous and omnivorous mammalian and avian species and carnivorous mammal species. For both the herbivorous and omnivorous avian species, the potential ecological risks were attributed to lead exposure at the Site. Exposure and associated risk to lead appeared low as modeled exposure dosages to avian receptors were below the LOAEL TRV. Lack of a LOAEL TRV exceedance indicated that the potential risk was low. Predicted exposure to vanadium at the Tango Firing Range exceeded both the NOAEL and LOAEL TRV for herbivorous, omnivorous and carnivorous mammalian receptors. However, this potential risk was determined to be low as the maximum and mean concentration of vanadium was within the range of published MADEP background levels.

Based upon a NOAEL HQ >1 potential risk may exist for avian receptors from lead at the Site, however, LOAEL HQs <1 suggests this risk is minimal.

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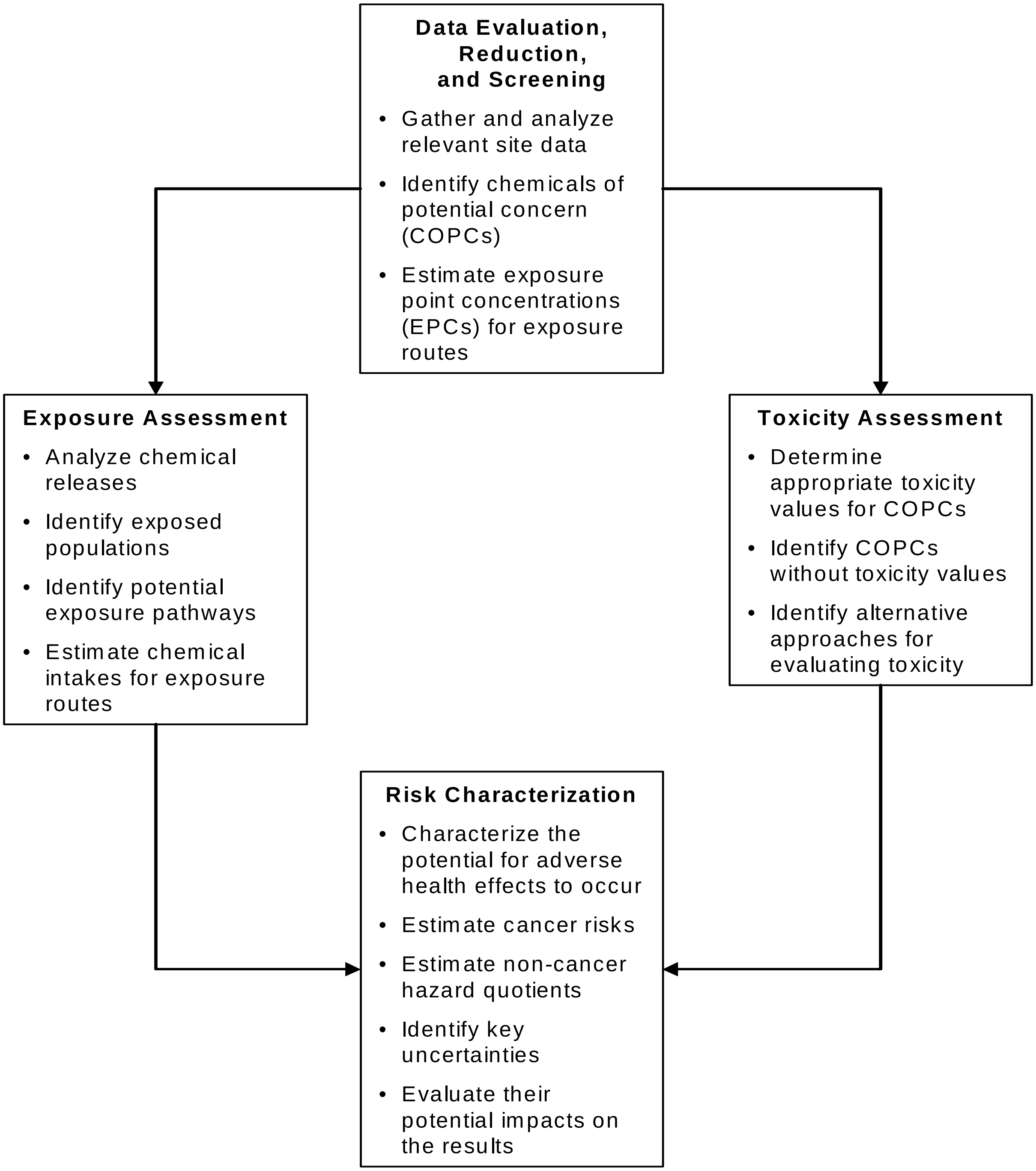
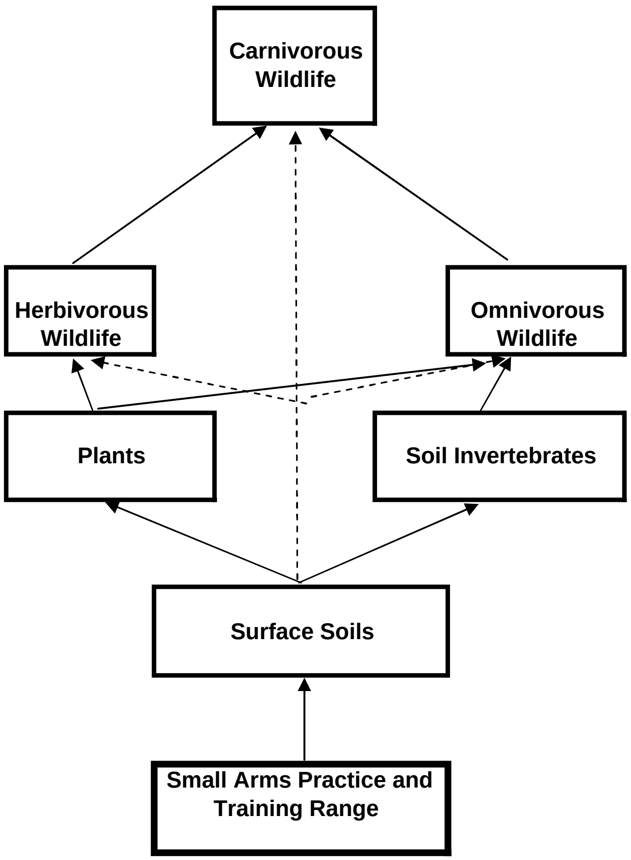
# FIGURES

**Figure 2.1**
**Human Health Risk Assessment Process**

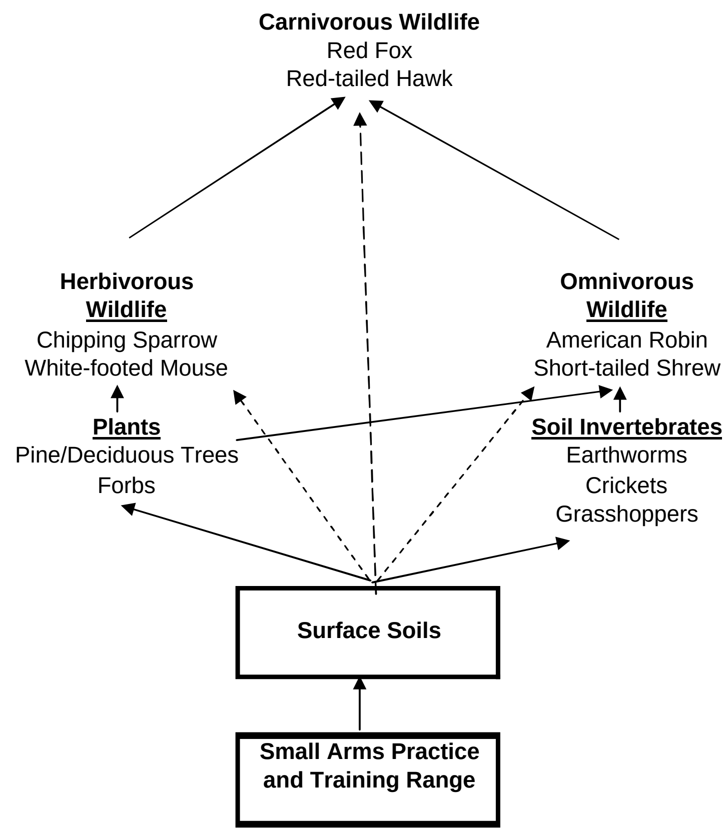



(Source: USEPA, 1989)

**Figure 3.1**
**Baseline Ecological Risk Assessment**
**Tango Range**
**Conceptual Site Model for the Terrestrial Food Chain**




**GENERAL FOOD WEB**




**REPRESENTATIVE SPECIES**

Direct Pathway / Route of Exposure
Incidental Exposure Pathway / Route of Exposure
"Wildlife" includes mammals and birds

# ATTACHMENT A

# USEPA RAGS PART D AND SUPPORTING TABLES FOR THE HUMAN HEALTH RISK ASSESSMENT

**SRF Table 1**
**Selection of Exposure Pathways**

| *Scenario Timeframe* | | *Exposure Medium* | *Exposure Point(s)* | *Receptor Population* | *Receptor Age* | *Exposure Route* | *Type of Analysis* | *Rationale for Selection or Exclusion of Exposure Pathway* |
|---|---|---|---|---|---|---|---|---|
| Current/Potential | Soil | Surface Soil (0 to 1 ft bgs) | Area 1<br>Area 2 (post-excavation)<br>Area 3 | Military Pesonnel (Non-Intrusive Training) | Adult (aged 18-28 years) | Dermal Absorption | Quantitative | Training activities may be conducted when they are not incompatible with the uses and preservation objectives specified in Chapter 47 of the Acts of 2002. Current use is small arms range. [Actual Exposure] |
| | | | | | | Incidential Ingestion | Quantitative | |
| | | | | | | Inhalation of Particulates | Quantitative | |
| | | | | | | Inhalation of Volatiles | Not Applicable[1] | |
| | | | | Trespasser | Adolescent (aged 12-18 years) | Dermal Absorption | Quantitative | Access to the site is not completely restricted. There are no physical barriers to access to the site for an individual already on MMR. The site is accessible by vehicle via one road on base. The outer perimeter of MMR is fenced and patrolled. However, trespassers and unauthorized hunters are periodically observed on MMR. By agreement, trespassing is considered to represent a potential current activity across all MMR sites, although the presence of UXO and corresponding signage warning of such dangers is assumed to severely limit such current use. [Actual Exposure] |
| | | | | | | Incidential Ingestion | Quantitative | |
| | | | | | | Inhalation of Particulates | Quantitative | |
| | | | | | | Inhalation of Volatiles | Not Applicable[1] | |
| | | | | Hunter | Adult (aged 18+ years) | Dermal Absorption | Quantitative | Hunting may be authorized for the site if it is determined that the action would not be incompatible with the uses and preservation objectives specified in Chapter 47 of the Acts of 2002. Unauthorized hunting also may occur as there are no physical barriers to access to the site to anyone already on MMR. [Actual Exposure] |
| | | | | | | Incidential Ingestion | Quantitative | |
| | | | | | | Inhalation of Particulates | Quantitative | |
| | | | | | | Inhalation of Volatiles | Not Applicable[1] | |
| Future Potential | Soil | All Soil (0 to 10 ft bgs) | Area 1<br>Area 2 (post-excavation)<br>Area 3 | Construction Worker | Adult (aged 18+ years) | Dermal Absorption | Quantitative | Construction activities may be performed to maintain the site or to prepare the site for a new mission or to modify the site for reuse or redevelopment provided they are determined to not incompatible with the uses and preservation objectives specified in Chapter 47 of the Acts of 2002. [Likely Future Exposure] |
| | | | | | | Incidential Ingestion | Quantitative | |
| | | | | | | Inhalation of Particulates | Quantitative | |
| | | | | | | Inhalation of Volatiles | Not Applicable[1] | |
| | | | | Resident | Adult (aged 18+ years) | Dermal Absorption | Quantitative | By agreement, residential redevelopment of the site was evaluated for risk management purposes only. Residential redevelopment activities may be performed to prepare the site for a new mission or to modify the site for reuse or redevelopment provided they are determined to not incompatible with the uses and preservation objectives specified in Chapter 47 of the Acts of 2002. [Hypothetical Future Exposure] |
| | | | | | | Incidential Ingestion | Quantitative | |
| | | | | | Child (aged 1-7 years) | Inhalation of Particulates | Quantitative | |
| | | | | | | Inhalation of Volatiles | Not Applicable[1] | |
| | | Groundwater | Tap Water | Resident | Adult (aged 18+ years) | Dermal Absorption | To Be Determined | By agreement, residential redevelopment of the site was evaluated for risk management purposes only. Residential redevelopment activities may be performed to prepare the site for a new mission or to modify the site for reuse or redevelopment provided they are determined to not incompatible with the uses and preservation objectives specified in Chapter 47 of the Acts of 2002. Groundwater exposures are to be evaluated in a future assessment. [Hypothetical Future Exposure] |
| | | | | | | Ingestion (Drinking) | To Be Determined | |
| | | | | | Child (aged 1-7 years) | Dermal Absorption | To Be Determined | |
| | | | | | | Ingestion (Drinking) | To Be Determined | |
| | | | Indoor Air Volatiles Released at the Showerhead | Resident | Adult (aged 18+ years) | Inhalation of Volatiles | To Be Determined | By agreement, residential redevelopment of the site was evaluated for risk management purposes only. Potential exposure pathway if volatile compounds are found to be present in the groundwater at site and the groundwater is used for domestic or consumptive purposes. Groundwater exposures are to be evaluated in a future assessment. No volatile compounds have been detected in Tango Range soil or groundwater. [Hypothetical Future Exposure] |
| | | | | | Child (aged 1-7 years) | Inhalation of Volatiles | To Be Determined | |
| | | | Indoor Air (Volatiles Migrating from Groundwater Up Into Habitable Space) | Resident | Adult (aged 18+ years) | Inhalation of Volatiles | To Be Determined | By agreement, residential redevelopment of the site was evaluated for risk management purposes only. Potential exposure pathway if volatile compounds are found to be present in the groundwater at site that could pose a threat of migration. Very few residential buildings exist at MMR investigation sites (none at the Tango Range). The depth to groundwater is generally more than 100 feet bgs and unlikely to represent a source of vapors to indoor air. No volatile compounds have been observed at the Tango Range. Groundwater exposures are to be evaluated in a future assessment. [Hypothetical Future Exposure] |
| | | | | | Child (aged 1-7 years) | Inhalation of Volatiles | To Be Determined | |
| | | | Tap Water | Military Pesonnel (Non-Intrusive Training) | Adult (aged 18-28 years) | Dermal Absorption | None | Groundwater is not currently used as a source of drinking water or water for general consumptive use (e.g., washing) at the Tango Range site. It is considered to be unlikely that it would be in the future. [Hypothetical Future Exposure] |
| | | | | | | Ingestion (Drinking) | None | |
| | | | Indoor Air (Volatiles Released at the Showerhead) | Military Pesonnel (Non-Intrusive Training) | Adult (aged 18-28 years) | Inhalation of Volatiles | None | Groundwater is not currently used as a source of drinking water or water for general consumptive use (e.g., washing) at the Tango Range site. It is considered to be unlikely that it would be in the future. No volatile compounds have been detected at the Tango Range. [Hypothetical Future Exposure] |
| | | | Indoor Air (Volatiles Migrating from Groundwater Up Into Habitable Space) | Military Pesonnel (Non-Intrusive Training) | Adult (aged 18-28 years) | Inhalation of Volatiles | To Be Determined | Very few residential buildings currently exist at MMR investigation sites (none at the Tango Range). Potential future exposure pathway if volatile compounds are found to be present in the groundwater at site and an enclosed, habitable building is constructed at the site for use in training in the future. The depth to groundwater is generally more than 100 feet bgs and unlikely to represent a source of vapors to indoor air. No volatile compounds have been detected at the Tango Range. Groundwater exposures are to be evaluated in a future assessment. [Hypothetical Future Exposure] |
| | | | Pooled Water in Trench or Excavation | Construction Worker | Adult (aged 18+ years) | Dermal Absorption | None | Groundwater is at depths generally greater than 100 feet bgs. Therefore, groundwater is unlikely to infiltrate a future trench where an individual conducting future military training or construction activities could come in contact with it. [Unlikely Future Exposure] |
| | | | | | | Incidential Ingestion | None | |
| | | | Ambient Air In or At a Trench or Excavation | Construction Worker | Adult (aged 18+ years) | Inhalation of Volatiles | None | Groundwater is at depths generally greater than 100 feet bgs. Therefore, groundwater is unlikely to infiltrate a future trench or excavation associated with any future military training or construction activities. No volatile compounds have been detected in soil or groundwater at the Tango Range. [Unlikely Future Exposure] |

(1) No volatile organic compounds have been detected in Tango Range soils or monitoring well.

**SRF Table 2.1**
**Occurrence, Distribution, and Selection of Chemicals of Potential Concern**

| |
|---|
| Scenario Timeframe: Current/Potential |
| Medium: Surface Soil (0-1 ft bgs) |
| Exposure Medium: Area 1 |

| Exposure Point | CAS # | Chemical | Minimum Concentration (Qualifier) (1) | Maximum Concentration (Qualifier) (1) | Units | Location of Maximum | Detection Frequency | Range of Detection Limits | Concentration Used for Screening (2) | Background Value Outwash (3) | Background Value MassDEP (4) | Screening Toxicity Value (5) | MMR SSL (6) | Exceeds SSL? (Y/N) | COPC Flag (Y/N) | Rationale for Selection or Deletion (7) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7429-90-5 | Aluminum | 4,560 | 20,400 | mg/kg | SS169B 0.5-1 | 44 / 44 | 3.5 - 15.04 | 20,400 | 16,019 | 10,000 | 7,614 | 54,006.279 | NO | YES | ASL |
| Surface Soil (0-1' bgs) | 7440-36-0 | Antimony | 0.4 J | 91.9 J | mg/kg | SS169A 0.5-1 | 23 / 44 | 0.36 - 4.51 | 91.9 | 1.9 | 1.0 | 3.1 | 0.271 | YES | YES | ASL |
| | 7440-38-2 | Arsenic | 1.8 | 23.4 J | mg/kg | SS169A 0.5-1 | 36 / 44 | 0.48 - 3.4 | 23.4 | 5.5 | 20 | 0.4 | 0.009 | YES | YES | ASL |
| | 7440-39-3 | Barium | 8.8 | 22.1 | mg/kg | SSTR1CS01 0.75-1 | 44 / 44 | 0.7 - 15.04 | 22.1 | 24 | 50 | 537 | 120.349 | NO | NO | BKG,BSL |
| | 7440-41-7 | Beryllium | 0.17 | 0.4 | mg/kg | SSTR1CS01 0.75-1 | 44 / 44 | 0.02 - 0.38 | 0.4 | 0.38 | 0.40 | 15.4 | 2.601 | NO | NO | BSL |
| | 7440-42-8 | Boron | 2.4 | 3.8 | mg/kg | SS169D 0.25-0.5 | 28 / 44 | 0.37 - 7.52 | 3.8 | 9.6 | - | 1,600 | 9.523 | NO | NO | BKG,BSL |
| | 7440-43-9 | Cadmium | 0.13 J | 0.59 | mg/kg | SS169A 0-0.25, 0.25-0.5 | 13 / 44 | 0.1 - 0.38 | 0.59 | 0.94 | 2.0 | 3.7 | 0.401 | YES | NO | BKG,BSL |
| | 7440-70-2 | Calcium | 180 | 17,100 | mg/kg | SS169A 0.25-0.5 | 44 / 44 | 24.8 - 375.94 | 17100 | 288 | - | 1,000,000 | - | NO | NO | NUT,BSL |
| | 7440-47-3 | Chromium | 7 | 21 | mg/kg | SS169B 0.5-1 | 36 / 36 | 0.27 - 0.75 | 21 | 19 | 30 | 211 | 7.017 | YES | NO | BKG,BSL |
| | 7440-48-4 | Cobalt | 2 | 7 | mg/kg | SS169B 0.5-1 | 44 / 44 | 0.56 - 3.76 | 7 | 4.0 | 4.0 | 903 | 132.384 | NO | NO | BSL |
| | 7440-50-8 | Copper | 3 | 110 | mg/kg | SSTR1CS01 0-0.25 | 44 / 44 | 0.27 - 1.88 | 110 | 11 | 40 | 7,850 | 45.727 | YES | NO | BSL |
| | 7439-89-6 | Iron | 5,550 | 19,300 | mg/kg | SS169B 0.5-1 | 44 / 44 | 3.4 - 15.04 | 19,300 | 17,800 | 20,000 | 55,152 | 2,421.919 | YES | NO | NUT,BSL |
| | 7439-92-1 | Lead | 3.7 | 5,800 | mg/kg | SS169A 0.5-1 | 44 / 44 | 0.15 - 16.2 | 5,800 | 19 | 100 | 400 | 4.053 | YES | YES | ASL |
| | 7439-95-4 | Magnesium | 726 | 3,130 | mg/kg | SS169C 0.5-1 | 44 / 44 | 25.5 - 375.94 | 3,130 | - | 5,000 | 1,000,000 | - | NO | NO | NUT,BSL |
| | 7439-96-5 | Manganese | 46.9 | 165 | mg/kg | SS169C 0.5-1 | 44 / 44 | 0.15 - 1.13 | 165 | 134 | 300 | 176 | 44.154 | YES | NO | BSL |
| | 7439-97-6 | Mercury | 0.018 J | 0.027 J | mg/kg | SSTR1W01 0-0.25 | 8 / 44 | 0.03 - 0.06 | 0.027 | 0.12 | 0.30 | 2.3 | 0.02 | YES | NO | BKG,BSL |
| | 7439-98-7 | Molybdenum | 0.34 J | 2 | mg/kg | SSTR1CN01 0-0.25 | 36 / 44 | 0.31 - 0.75 | 2 | 1.2 | - | 39.1 | 0.183 | YES | NO | BSL |
| | 7440-02-0 | Nickel | 3.7 | 14.8 | mg/kg | SS169C 0.25-0.5 | 44 / 44 | 0.46 - 3.01 | 14.8 | 10 | 20 | 156 | 292.127 | NO | NO | BSL |
| | 7440-09-7 | Potassium | 420 | 935 | mg/kg | SSTR1CS01 0.75-1 | 44 / 44 | 24 - 375.94 | 935 | 766 | - | 121,000 | - | NO | NO | NUT,BSL |
| | 7782-49-2 | Selenium | 0.25 J | 1.8 | mg/kg | SS169B 0.5-1 | 28 / 44 | 0.39 - 2.63 | 1.8 | 1.7 | 0.5 | 39.1 | 2.759 | NO | NO | BSL |
| | 7440-22-4 | Silver | 0.14 J | 0.57 | mg/kg | SS169A 0-0.25 | 8 / 44 | 0.23 - 0.75 | 0.57 | 0.7 | 0.6 | 39.1 | 16.231 | NO | NO | BKG,BSL |
| | 7440-23-5 | Sodium | 79.6 J | 159 J | mg/kg | SSTR1CS01 0.75-1 | 8 / 44 | 67.6 - 375.94 | 159 | 196 | - | 1,000,000 | - | NO | NO | NUT,BSL |
| | 7440-33-7 | Tungsten | 0.81 | 3.5 | mg/kg | SSTR1CS01 0-0.25 | 8 / 8 | 0.14 - 0.15 | 3.5 | - | - | - | - | NO | YES | No value |
| | 7440-62-2 | Vanadium | 10.3 | 29.3 | mg/kg | SS169B 0.5-1 | 44 / 44 | 0.39 - 3.76 | 29.3 | 29 | 30 | 7.8 | 260.045 | NO | YES | ASL, BKG |
| | 7440-66-6 | Zinc | 10.6 | 61.1 | mg/kg | SS169A 0.25-0.5 | 44 / 44 | 0.17 - 1.5 | 61.1 | 26 | 100 | 2,346 | 2,201.919 | NO | NO | BSL |
| | 56-55-3 | Benzo(a)anthracene | 0.1 J | 0.1 J | mg/kg | SS169E 0.25-0.5 | 1 / 38 | 0.35 - 0.41 | 0.1 | 0.46 | 2.0 | 0.6 | 0.037 | YES | NO | BKG,BSL |
| | 50-32-8 | Benzo(a)pyrene | 0.017 J | 0.047 J | mg/kg | SS169E 0.25-0.5 | 2 / 38 | 0.35 - 0.41 | 0.047 | 0.46 | 2.0 | 0.1 | 0.203 | NO | NO | BKG,BSL |
| | 205-99-2 | Benzo(b)fluoranthene | 0.11 J | 0.11 J | mg/kg | SS169E 0.25-0.5 | 1 / 38 | 0.35 - 0.41 | 0.11 | 0.46 | 2.0 | 0.6 | 0.114 | NO | NO | BKG,BSL |
| | 207-08-9 | Benzo(k)fluoranthene | 0.096 J | 0.096 J | mg/kg | SS169E 0.25-0.5 | 1 / 38 | 0.35 - 0.41 | 0.096 | 0.46 | 1.0 | 6.2 | 0.114 | NO | NO | BKG,BSL |
| | 65-85-0 | Benzoic acid | 0.017 J | 0.05 J | mg/kg | SS169D 0-0.25 | 15 / 38 | 0.89 - 1 | 0.05 | - | - | 24,441 | - | NO | NO | BSL |
| | 117-81-7 | bis(2-Ethylhexyl) Phthalate | 0.018 J | 0.079 J | mg/kg | SS169B 0-0.25 | 20 / 38 | 0.35 - 0.41 | 0.079 | - | - | 34.7 | 72.016 | NO | NO | BSL |
| | 218-01-9 | Chrysene | 0.02 J | 0.14 J | mg/kg | SS169E 0.25-0.5 | 3 / 38 | 0.35 - 0.41 | 0.14 | 0.46 | 2.0 | 62.1 | 3.404 | NO | NO | BKG,BSL |
| | 84-74-2 | Di-n-Butyl Phthalate | 0.022 J | 0.037 J | mg/kg | SS169D 0.25-0.5 | 3 / 38 | 0.35 - 0.41 | 0.037 | - | - | 611 | 150.832 | NO | NO | BSL |
| | 206-44-0 | Fluoranthene | 0.018 J | 0.18 J | mg/kg | SS169E 0.25-0.5 | 3 / 38 | 0.35 - 0.41 | 0.18 | 0.46 | 4.0 | 229 | 108.129 | NO | NO | BKG,BSL |
| | 193-39-5 | Indeno(1,2,3-c,d)pyrene | 0.018 J | 0.018 J | mg/kg | SS169E 0.25-0.5 | 1 / 38 | 0.35 - 0.41 | 0.018 | 0.46 | 1.0 | 0.6 | 0.317 | NO | NO | BKG,BSL |
| | 85-98-3 | n,n'-Diethylcarbanilide | 0.018 J | 6.2 | mg/kg | SS169E 0-0.25 | 17 / 38 | 0.35 - 0.81 | 6.2 | - | - | - | - | NO | YES | No value |
| | 55-63-0 | Nitroglycerin | 3.2 | 47 | mg/kg | SSTR1CN01 0-0.25 | 3 / 4 | 2.5 - 2.5 | 47 | - | - | 34.7 | 0.001 | YES | YES | No value |
| | 86-30-6 | n-Nitrosodiphenylamine | 0.036 J | 0.036 J | mg/kg | SS169D 0.25-0.5 | 1 / 38 | 0.35 - 0.41 | 0.036 | - | - | 99.3 | 0.008 | YES | NO | BSL |
| | 129-00-0 | Pyrene | 0.019 J | 0.24 J | mg/kg | SS169E 0.25-0.5 | 5 / 38 | 0.35 - 0.41 | 0.24 | 0.46 | 4.0 | 231.6 | 19.028 | NO | NO | BKG,BSL |

Includes samples from locations 169A, 169B, 169C, 169D, 169E, 169F, SSTR1CN01, SSTR1CS01, SSTR1E01, SSTR1W01, SSTR2C01 (post-excavation), SSTR2E01 (post-excavation), SSTR2W01 (post-excavation), SSTR3C01, SSTR3E01, SSTR3W01 including Field Replicates; Field Duplicate samples from Location 169F were averaged.

Footnotes:

(1) Qualifier Definitions: J - Positive Result is Estimated

(2) The maximum detected concentration is the concentration used for screening.

(3) The Background Values listed are the values detected from Outwash 0-1'.

(4) The Background Values listed are the those reported for natural soils by MassDEP, Technical Update: Levels of Polycyclic Aromatic Hydrocarbons and Metals in Soils.

(5) The Screening Toxicity Value is the USEPA Region 9 Preliminary Remediation Goal (PRG) for Residential Soil for carcinogens and 1/10th the PRG for non-carcinogens.

(6) The SSL are site-specific screening values for the potential impacts from soil to groundwater.

(7) Rationale Codes:

Selection Reason: Above Screening Levels (ASL)

Deletion Reason: Background Levels (BKG) - Not sufficient reason alone

Essential Nutrient (NUT)

Below Screening Levels (BSL)

# SRF Table 2.2
## Occurrence, Distribution, and Selection of Chemicals of Potential Concern

Scenario Timeframe: Current/Potential
Medium: Surface Soil (0-1 ft bgs)
Exposure Medium: Area 2 (post-excavation) + Area 3

| Exposure Point | CAS # | Chemical | Minimum Concentration (Qualifier) (1) | Maximum Concentration (Qualifier) (1) | Units | Location of Maximum | Detection Frequency | Range of Detection Limits | Concentration Used for Screening (2) | Background Value Outwash (3) | Background Value MassDEP (4) | Screening Toxicity Value (5) | MMR SSL (6) | Exceeds SSL? (Y/N) | COPC Flag (Y/N) | Rationale for Selection or Deletion (7) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Surface Soil (0-1' bgs) | 7429-90-5 | Aluminum | 10,900 | 13,400 | mg/kg | SSTR3E01 0-0.25 | 4 / 4 | 14.93 - 16 | 13,400.0 | 16,019 | 10,000 | 7,614 | 54,006.279 | NO | YES | ASL, BKG |
| | 7440-38-2 | Arsenic | 3.2 | 3.9 | mg/kg | SSTR3E01 0-0.25 | 4 / 4 | 0.75 - 0.8 | 3.9 | 6 | 20 | 0.39 | 0.009 | YES | YES | ASL, BKG |
| | 7440-39-3 | Barium | 16.7 | 20.1 | mg/kg | SSTR3E01 0-0.25 | 4 / 4 | 14.93 - 16 | 20.1 | 24 | 50 | 537 | 120.349 | NO | NO | BKG,BSL |
| | 7440-41-7 | Beryllium | 0.26 J | 0.33 J | mg/kg | SSTR3E01 0-0.25 | 4 / 4 | 0.37 - 0.4 | 0.3 | 0.38 | 0.40 | 15.4 | 2.601 | NO | NO | BKG,BSL |
| | 7440-42-8 | Boron | 0.85 J | 1.3 J | mg/kg | SSTR3W01 0-0.25 | 4 / 4 | 7.46 - 8 | 1.3 | 9.6 | - | 1,600 | 9.523 | NO | NO | BKG,BSL |
| | 7440-43-9 | Cadmium | 0.096 J | 0.14 J | mg/kg | SSTR3W01 0-0.25 | 4 / 4 | 0.37 - 0.4 | 0.1 | 0.94 | 2.0 | 3.7 | 0.401 | NO | NO | BKG,BSL |
| | 7440-70-2 | Calcium | 213 J | 297 J | mg/kg | SSTR3W01 0-0.25 | 4 / 4 | 373.13 - 400 | 297.0 | 288 | - | 1,000,000 | - | NO | NO | NUT,BSL |
| | 7440-48-4 | Cobalt | 2.7 J | 3.6 J | mg/kg | SSTR3E01 0-0.25 | 4 / 4 | 3.73 - 4 | 3.6 | 4.0 | 4.0 | 903 | 132.384 | NO | NO | BKG,BSL |
| | 7440-50-8 | Copper | 8.4 | 36 | mg/kg | SSTR3C01 0-0.25 | 4 / 4 | 1.87 - 2 | 36.0 | 11 | 40 | 7,850 | 45.727 | NO | NO | BSL |
| | 7439-89-6 | Iron | 13,200 | 15,600 | mg/kg | SSTR3E01 0-0.25 | 4 / 4 | 14.93 - 16 | 15,600.0 | 17,800 | 20,000 | 55,152 | 2,421.919 | YES | NO | NUT,BKG,BSL |
| | 7439-92-1 | Lead | 41.4 | 97.1 | mg/kg | SSTR3C01 0-0.25 | 4 / 4 | 0.75 - 0.8 | 97.1 | 19 | 100 | 400 | 4.053 | YES | NO | BKG, BSL |
| | 7439-95-4 | Magnesium | 934 | 1190 | mg/kg | SSTR3E01 0-0.25 | 4 / 4 | 373.13 - 400 | 1,190.0 | - | 5,000 | 1,000,000 | - | NO | NO | NUT,BSL |
| | 7439-96-5 | Manganese | 76.9 | 87.4 | mg/kg | SSTR3C01 0-0.25 | 4 / 4 | 1.12 - 1.2 | 87.4 | 134 | 300 | 176 | 44.154 | YES | NO | BKG,BSL |
| | 7439-97-6 | Mercury | 0.03 J | 0.033 | mg/kg | SSTR3E01 0-0.25 | 4 / 4 | 0.03 - 0.04 | 0.033 | 0.12 | 0.30 | 2.3 | 0.02 | YES | NO | BKG,BSL |
| | 7439-98-7 | Molybdenum | 1.4 | 1.6 | mg/kg | SSTR3E01 0-0.25, SSTR3W01 0-0.25 | 4 / 4 | 0.75 - 0.8 | 1.6 | 1.20 | - | 39.1 | 0.183 | YES | NO | BSL |
| | 7440-02-0 | Nickel | 8.3 | 10.6 | mg/kg | SSTR3E01 0-0.25 | 4 / 4 | 2.99 - 3.2 | 10.6 | 10 | 20 | 156.4 | 292.127 | NO | NO | BSL |
| | 7440-09-7 | Potassium | 589 | 778 | mg/kg | SSTR3E01 0-0.25 | 4 / 4 | 373.13 - 400 | 778.0 | 766 | - | 121,000 | - | NO | NO | NUT,BSL |
| | 7440-23-5 | Sodium | 84.7 J | 150 J | mg/kg | SSTR3E01 0-0.25 | 4 / 4 | 373.13 - 400 | 150.0 | 196 | - | 1,000,000 | - | NO | NO | NUT,BKG,BSL |
| | 7440-33-7 | Tungsten | 0.3 | 11.8 | mg/kg | SSTR3E01 0-0.25 | 9 / 14 | 0.14 - 0.77 | 11.8 | - | - | - | - | NO | YES | No value |
| | 7440-62-2 | Vanadium | 24.4 | 29.3 | mg/kg | SSTR3E01 0-0.25 | 4 / 4 | 3.73 - 4 | 29.3 | 29 | 30 | 7.8 | 260.045 | NO | YES | ASL, BKG |
| | 7440-66-6 | Zinc | 14.2 | 16.5 | mg/kg | SSTR3E01 0-0.25 | 4 / 4 | 1.49 - 1.6 | 16.5 | 26 | 100 | 2,346 | 2,201.919 | NO | NO | BKG, BSL |

Includes samples from locations SSTR3C01, SSTR3E01, SSTR3W01and post-excavation samples from SSTR2C01, SSTR2E01, and SSTR2W01 including Field Replicates.

Footnotes:

(1) Qualifier Definitions: J - Positive Result is Estimated

(2) The maximum detected concentration is the concentration used for screening.

(3) The Background Values listed are the values detected from Outwash 0-1'.

(4) The Background Values listed are the those reported for natural soils by MassDEP, Technical Update: Levels of Polycyclic Aromatic Hydrocarbons and Metals in Soils.

(5) The Screening Toxicity Value is the USEPA Region 9 Preliminary Remediation Goal (PRG) for Residential Soil for carcinogens and 1/10th the PRG for non-carcinogens.

(6) The SSL are site-specific screening values for the potential impacts from soil to groundwater.

(7) Rationale Codes:

Selection Reason: Above Screening Levels (ASL)

Deletion Reason: Background Levels (BKG) - Not sufficient reason alone
Essential Nutrient (NUT)
Below Screening Levels (BSL)

**SRF Table 3.1**
**Exposure Point Concentration Summary**
**Area 1 - T Range**

| |
|---|
| Scenario Timeframe: Current/Potential |
| Medium: Soil |
| Exposure Medium: Area 1 |

| Exposure Point | Chemical of Potential Concern | Units | Arithmetic Mean | 95% UCL | Maximum Concentration (Qualifier) | Reasonable Maximum Exposure | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | EPC Value | EPC Units | EPC Statistic |
| Surface Soil (0-1 ft bgs) | Aluminum | mg/kg | 8,449 | 9,213 | 20,400 | 9,213 | mg/kg | 95% UCL-G |
| | Antimony | mg/kg | 3.51 | 24.17 | 91.9 J | 24.17 | mg/kg | 99% UCL-C |
| | Arsenic | mg/kg | 3.27 | 4.09 | 23.4 J | 4.09 | mg/kg | 95% UCL-N |
| | Lead | mg/kg | 285.4 | 1,595 | 5,800 | 285.4 | mg/kg | Mean-N (1) |
| | Tungsten | mg/kg | 1.32 | 1.92 | 3.5 | 1.92 | mg/kg | 95% UCL-N |
| | Vanadium | mg/kg | 16.3 | 17.4 | 29.3 | 17.4 | mg/kg | 95% UCL-G |
| | 1,3-diethyl-1,3-diphenyl urea | mg/kg | 0.513 | 0.760 | 6.2 | 0.76 | mg/kg | 95% UCL-H |
| | Nitroglycerin | mg/kg | 19.4 | 44.8 | 47 | 44.8 | mg/kg | 95% UCL-N |

Notes:

Codes used for the "EPC Statistic":
- 95% UCL of Normal Data (95% UCL-N)
- 95% UCL of Lognormal Data (95% UCL-H)
- 95% UCL of Gamma Data (95% UCL-G)
- Mean of Normal Data (Mean-N)
- 99% Chebyshev UCL (Mean, Sd) (99% UCL-C)

(1) The TRW recommends that the soil contribution to dust lead be evaluated by comparing the average or arithmetic mean of soil lead concentrations

**SRF Table 3.2**
**Exposure Point Concentration Summary**
**Areas 2 and 3 - T Range**

| |
|---|
| Scenario Timeframe: Current/Potential |
| Medium: Soil |
| Exposure Medium: Area 2 (post-excavation) + Area 3 |

| Exposure Point | Chemical of Potential Concern | Units | Arithmetic Mean | 95% UCL | Maximum Concentration (Qualifier) | Reasonable Maximum Exposure | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | EPC Value | EPC Units | EPC Statistic |
| Surface Soil (0-1 ft bgs) | Aluminum | mg/kg | 11,875 | 13,190 | 13,400 | 13,190 | mg/kg | 95% UCL-N |
| | Arsenic | mg/kg | 3.4 | 3.92 | 3.9 | 3.9 | mg/kg | Maximum |
| | Tungsten | mg/kg | 1.525 | 6.83 | 11.8 | 6.83 | mg/kg | 99% UCL-C |
| | Vanadium | mg/kg | 26.55 | 28.98 | 29.3 | 28.98 | mg/kg | 95% UCL-N |

Notes:

Codes used for the "EPC Statistic":
95% UCL of Normal Data (95% UCL-N)
99% Chebyshev UCL (MVUE) (99% UCL-C)

## SRF Table 4.1
## Values for Daily Intake Calculations - Trespasser

| |
|---|
| Scenario Timeframe: Current/ Potential |
| Medium: Surface Soil |
| Exposure Medium: Soil |
| Exposure Point: Area 1 / Area 2 (post-excavation) and Area 3 |
| Receptor Population: Trespasser |
| Receptor Age: Older child (12-18 yrs) |

| Exposure Route | Parameter Code | Parameter Definition | Units | RME Value | RME Rationale/ Reference | Intake Equation/ Model Name |
|---|---|---|---|---|---|---|
| Ingestion | CS | Chemical Concentration in Soil | mg/kg | Chemical specific | Exposure point concentration (1) | Chronic Daily Intake (CDI) (mg/kg-day) = |
| | IR | Ingestion Rate of Soil | mg soil/day | 50 | Older child; EPA, 1997: Table 4-11 | CS x IR x AAFing x $F_A$ x CF x EF x ED x 1/BW x 1/AT |
| | AAF ing | Absorption Adjustment Factor | unitless | Chemical specific | Value set to 1 (2) | |
| | $F_A$ | Fraction of Area | unitless | 1 | Assumed 100% of media contacted is contaminated | |
| | CF | Conversion Factor | kg/mg | 1.00E-06 | - | |
| | EF | Exposure Frequency | days/year | 65 | Site-specific assumption (3) | |
| | ED | Exposure Duration | years | 6 | Ages 12-18 | |
| | BW | Body Weight | kg | 56 | Average of age-specific male and female 50% body weight values; EPA, 1997 | |
| | AT-C | Averaging Time (cancer) | days | 25,550 | 70 yr x 365 d/yr; EPA, 1989 | |
| | AT-N | Averaging Time (non-cancer) | days | 2,190 | ED x 365 d/yr; EPA, 1989 | |
| Dermal | CS | Chemical Concentration in Soil | mg/kg | Chemical specific | Exposure point concentration (1) | CDI (mg/kg-day) = |
| | SA | Skin Surface Area Available for Contact | $cm^2$/day | 5,262 | Average of age-specific surface area of head, forearms, hands, and lower legs (EPA, 2004: Exhibit C-1) | CS x SA x AF x ABS x $F_A$ x CF x EF x ED x 1/BW x 1/AT |
| | AF | Soil to Skin Adherence Factor | $mg/cm^2$ | 0.07 | Recommended loading value for adult residents; EPA, 2004: Exhibit 3-5 | |
| | ABS | Absorption Factor | unitless | Chemical specific | See Table 4.9 | |
| | $F_A$ | Fraction of Area | unitless | 1 | Assumed 100% of media contacted is contaminated | |
| | CF | Conversion Factor | kg/mg | 1.00E-06 | - | |
| | EF | Exposure Frequency | days/year | 65 | Site-specific assumption (3) | |
| | ED | Exposure Duration | years | 6 | Ages 12-18 | |
| | BW | Body Weight | kg | 56 | Average of age-specific male and female 50% body weight values; EPA, 1997 | |
| | AT-C | Averaging Time (cancer) | days | 25,550 | 70 yr x 365 d/yr; EPA, 1989 | |
| | AT-N | Averaging Time (non-cancer) | days | 2,190 | ED x 365 d/yr; EPA, 1989 | |
| Inhalation of Particulates | CA | Chemical Concentration in Air from Particulates | $mg/m^3$ | Chemical specific | Particulate CA = CS x 1/PEF | |
| | PEF | Particulate Emission Factor | | | | |
| | | Area 1 | $m^3$/kg | 1.94E+09 | See Table 4.7 | |
| | | Area 2 (post-excavation) and Area 3 | $m^3$/kg | 1.51E+09 | See Table 4.7 | |

Notes:

(1) For exposure point concentrations see Tables 3.1 and 3.2.

(2) In accordance with MMR Site-wide risk assessment protocol.

(3) Assumed 2 day/ week for June-August and 1 day/week September-May, which totals 65 days/year.

Sources :

EPA, 1989: Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, Part A OERR. EPA/540-1-89-002.

EPA, 1997. Exposure Factors Handbook. http://www.epa.gov/ncea/efh/. August 1997.

EPA, 2003. Assessing Intermittent or Variable Exposures at Lead Sites. Technical Review Workgroup for Lead. EPA-540-R-03-008. November.

EPA, 2004: RAGs Volume 1, Human Health Evaluation Manual, Part E: Supplemental Guidance for Dermal Risk Assessment, EPA/540/R/99/005, July 2004.

## SRF Table 4.2
## Values Used for Daily Intake Calculations - Military Personnel Firearms Training

Scenario Timeframe: Current /Potential
Medium: Surface Soil
Exposure Medium: Soil
Exposure Point: Area 1 / Area 2 (post-excavation) and Area 3
Receptor Population: Military Personnel - Firearms Training
Receptor Age: Adult (18 to 28 yrs)

| Exposure Route | Parameter Code | Parameter Definition | Units | RME Value | RME Rationale/ Reference | Intake Equation/ Model Name |
|---|---|---|---|---|---|---|
| Ingestion | CS | Chemical Concentration in Soil | mg/kg | Chemical specific | Exposure point concentration (1) | Chronic Daily Intake (CDI) (mg/kg-day) = |
| | IR | Ingestion Rate of Soil | mg soil/day | 50 | EPA, 1997: Table 4-23 | CS x IR x AAFing x $F_A$ x CF x EF x ED x 1/BW x 1/AT |
| | AAF ing | Absorption Adjustment Factor | unitless | Chemical specific | Value set to 1 (2) | |
| | $F_A$ | Fraction of Area | unitless | 1 | Assumed 100% of media contacted is contaminated | |
| | CF | Conversion Factor | kg/mg | 1.00E-06 | - | |
| | EF | Exposure Frequency | days/year | 5 | Site-specific assumption (3) | |
| | ED | Exposure Duration | years | 10 | Site-specific assumption (3) | |
| | BW | Body Weight | kg | 67.2 | Average of 18-25 year male and females, 50% body weight EPA, 1997: Table 7-2 | |
| | AT-C | Averaging Time (cancer) | days | 25,550 | 70 yr x 365 d/yr; EPA, 1989 | |
| | AT-N | Averaging Time (non-cancer) | days | 3,650 | ED x 365 d/yr; EPA, 1989 | |
| Dermal | CS | Chemical Concentration in Soil | mg/kg | Chemical specific | Exposure point concentration (1) | CDI (mg/kg-day) = |
| | SA | Skin Surface Area Available for Contact | $cm^2$/day | 3,300 | Industrial scenario (hands, forearms, and face); EPA, 2004: Exhibit 3-5 | CS x SA x AF x ABS x $F_A$ x CF x EF x ED x 1/BW x 1/AT |
| | AF | Soil to Skin Adherence Factor | mg/$cm^2$ | 0.25 | Industrial scenario; EPA, 2004: Exhibit 3-5 (4) | |
| | ABS | Absorption Factor | unitless | Chemical specific | See Table 4.9 | |
| | $F_A$ | Fraction of Area | unitless | 1 | Assumed 100% of media contacted is contaminated | |
| | CF | Conversion Factor | kg/mg | 1.00E-06 | - | |
| | EF | Exposure Frequency | days/year | 5 | Site-specific assumption (3) | |
| | ED | Exposure Duration | years | 10 | Site-specific assumption (3) | |
| | BW | Body Weight | kg | 67.2 | Average of 18-25 year male and females, 50% body weight EPA, 1997: Table 7-2 | |
| | AT-C | Averaging Time (cancer) | days | 25,550 | 70 yr x 365 d/yr; EPA, 1989 | |
| | AT-N | Averaging Time (non-cancer) | days | 3,650 | ED x 365 d/yr; EPA, 1989 | |
| Inhalation of Particulates | CA | Chemical Concentration in Air from Particulates | $mg/m^3$ | Chemical specific | Particulate CA = CS x 1/PEF | |
| | PEF | Particulate Emission Factor | | | | |
| | | Area 1 | $m^3$/kg | 1.94E+09 | See Table 4.7 | |
| | | Area 2 (post-excavation) and Area 3 | $m^3$/kg | 1.51E+09 | See Table 4.7 | |

Notes:

(1) For exposure point concentrations see Tables 3.1 and 3.2.

(2) In accordance with MMR Site-wide risk assessment protocol.

(3) Based on USARNG, 2005 (see text), assumed 1 weekend/month and 2 weeks/year, totalling 38 days/year and assumed a 8 year enlistment and 2 year re-enlistment (i.e., 10 years) for total time at MMR, 5 days per year spent on small arms training. The Adult Lead Model was not applied as the TRW has recommended 3 months as the minimum duration of exposure that is appropriate for modeling exposures that occur no less often than once every 7 days (EPA, 2003).

(4) Recalculated from outdoor worker; value in EPA 2004 is incorrectly calculated.

Sources :

EPA, 1989: Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, Part A OERR. EPA/540-1-89-002.

EPA, 1997. Exposure Factors Handbook. http://www.epa.gov/ncea/efh/. August 1997.

EPA, 2003. Assessing Intermittent or Variable Exposures at Lead Sites. Technical Review Workgroup for Lead. EPA-540-R-03-008. November.

EPA, 2004: RAGs Volume 1, Human Health Evaluation Manual, Part E: Supplemental Guidance for Dermal Risk Assessment, EPA/540/R/99/005, July 2004.

**SRF Table 4.3**
**Values Used for Daily Intake Calculations - Hunter**

Scenario Timeframe: Current/Potential
Medium: Surface Soil
Exposure Medium: Soil
Exposure Point: Area 1 / Area 2 (post-excavation) and Area 3
Receptor Population: Hunter
Receptor Age: Adult (18+ years)

| Exposure Route | Parameter Code | Parameter Definition | Units | RME Value | RME Rationale/ Reference | Intake Equation/ Model Name |
|---|---|---|---|---|---|---|
| Ingestion | CS | Chemical Concentration in Soil | mg/kg | Chemical specific | Exposure point concentration (1) | Chronic Daily Intake (CDI) (mg/kg-day) = |
| | IR | Ingestion Rate of Soil | mg soil/day | 100 | Outdoor worker; EPA, 2002: Exhibit 1-2 | CS x IR x AAFing x $F_A$ x CF x EF x ED x 1/BW x 1/AT |
| | AAF ing | Absorption Adjustment Factor | unitless | Chemical specific | Value set to 1 (2) | |
| | $F_A$ | Fraction of Area | unitless | 1 | Assumed 100% of media contacted is contaminated | |
| | CF | Conversion Factor | kg/mg | 1.00E-06 | - | |
| | EF | Exposure Frequency | days/year | 12 | Site-specific assumption (3) | |
| | ED | Exposure Duration | years | 6 | Professional judgement (3) | |
| | BW | Body Weight | kg | 70 | EPA, 2004; Exhibit 3-5 | |
| | AT-C | Averaging Time (cancer) | days | 25,550 | 70 yr x 365 d/yr; EPA, 1989 | |
| | AT-N | Averaging Time (non-cancer) | days | 2,190 | ED x 365 d/yr; EPA, 1989 | |
| Dermal | CS | Chemical Concentration in Soil | mg/kg | Chemical specific | Exposure point concentration (1) | CDI (mg/kg-day) = |
| | SA | Skin Surface Area Available for Contact | $cm^2$/day | 3,300 | Industrial scenario (hands, forearms, and face); EPA, 2004: Exhibit 3-5 | CS x SA x AF x ABS x $F_A$ x CF x EF x ED x 1/BW x 1/AT |
| | AF | Soil to Skin Adherence Factor | mg/$cm^2$ | 0.25 | Industrial scenario; EPA, 2004: Exhibit 3-5 (4) | |
| | ABS | Absorption Factor | unitless | Chemical specific | See Table 4.9 | |
| | $F_A$ | Fraction of Area | unitless | 1 | Assumed 100% of media contacted is contaminated | |
| | CF | Conversion Factor | kg/mg | 1.00E-06 | - | |
| | EF | Exposure Frequency | days/year | 12 | Site-specific assumption (3) | |
| | ED | Exposure Duration | years | 6 | Professional judgement (3) | |
| | BW | Body Weight | kg | 70 | EPA, 2004; Exhibit 3-5 | |
| | AT-C | Averaging Time (cancer) | days | 25,550 | 70 yr x 365 d/yr; EPA, 1989 | |
| | AT-N | Averaging Time (non-cancer) | days | 2,190 | ED x 365 d/yr; EPA, 1989 | |
| Inhalation of Particulates | CA | Chemical Concentration in Air from Particulates | mg/$m^3$ | Chemical specific | Particulate CA = CS x 1/PEF | |
| | PEF | Particulate Emission Factor | | | | |
| | | Area 1 | $m^3$/kg | 1.94E+09 | See Table 4.7 | |
| | | Area 2 (post-excavation) and Area 3 | $m^3$/kg | 1.51E+09 | See Table 4.7 | |

Notes:

(1) For exposure point concentrations see Tables 3.1 and 3.2.

(2) In accordance with MMR Site-wide risk assessment protocol.

(3) Based on Mass Dept of Fish & Wildlife, 2005 (see text) assumed 7 days/year for each 4 hunting seasons, totalling 28 days for a duration of 6 years for total time spent hunting at MMR; adjusted to 12 days per year at small arms range. The Adult Lead Model not applied as the TRW has recommended 3 months as the minimum duration of exposure that is appropriate for modeling exposures that occur no less than once every 7 days (EPA, 2003).

(4) Recalculated from outdoor worker; value in EPA 2004 is incorrectly calculated.

Sources :


EPA, 1989: Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, Part A OERR. EPA/540-1-89-002.

EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December 2002.

EPA, 2003. Assessing Intermittent or Variable Exposures at Lead Sites. Technical Review Workgroup for Lead. EPA-540-R-03-008. November.

EPA, 2004: RAGs Volume 1, Human Health Evaluation Manual, Part E: Supplemental Guidance for Dermal Risk Assessment, EPA/540/R/99/005, July 2004.

**SRF Table 4.4**
**Values Used for Daily Intake Calculations - Construction Worker**

Scenario Timeframe: Future Potentia
Medium: Surface and Subsurface Soil (0 to 10 ft bgs)
Exposure Medium: Soil/Ambient Ai
Exposure Point: Area 1 / Area 2 (post-excavation) and Area 3
Receptor Population: Construction Worker
Receptor Age: Adult (18+ years)

| Exposure Route | Parameter Code | Parameter Definition | Units | RME Value | RME Rationale/ Reference | Intake Equation/ Model Name |
|---|---|---|---|---|---|---|
| Ingestion | CS | Chemical Concentration in Soil | mg/kg | Chemical specific | Exposure point concentration (1) | Chronic Daily Intake (CDI) (mg/kg-day) = CS x IR x AAFing x $F_A$ x CF x EF x ED x 1/BW x 1/AT |
| | IR | Ingestion Rate of Soil | mg soil/day | 330 | EPA, 2002: Exhibit 1-2 | |
| | AAF ing | Absorption Adjustment Factor | unitless | Chemical specific | Value set to 1 (2) | |
| | $F_A$ | Fraction of Area | unitless | 1 | Assumed 100% of media contacted is contaminated | |
| | CF | Conversion Factor | kg/mg | 1.00E-06 | - | |
| | EF | Exposure Frequency | days/year | 13 | EPA, 2004b (3) | |
| | ED | Exposure Duration | years | 1 | EPA, 2002: Exhibit 5-1 | |
| | BW | Body Weight | kg | 70 | EPA, 2002: Exhibit 1-2 | |
| | AT-C | Averaging Time (cancer) | days | 25,550 | 70 yr x 365 d/yr; EPA, 1989 | |
| | AT-N | Averaging Time (non-cancer) | days | 365 | ED x 365 d/yr; EPA, 1989 | |
| Dermal | CS | Chemical Concentration in Soil | mg/kg | Chemical specific | Exposure point concentration (1) | CDI (mg/kg-day) = CS x SA x AF x ABS x $F_A$ x CF x EF x ED x 1/BW x 1/AT |
| | SA | Skin Surface Area Available for Contact | $cm^2$/day | 3,300 | Industrial scenario (hands, forearms, and face); EPA, 2004a: Exhibit 3-5 | |
| | AF | Soil to Skin Adherence Factor | $mg/cm^2$ | 0.25 | Industrial scenario; EPA, 2004a: Exhibit 3-5 (4) | |
| | ABS | Absorption Factor | unitless | Chemical specific | See Table 4.9 | |
| | $F_A$ | Fraction of Area | unitless | 1 | Assumed 100% of media contacted is contaminated | |
| | CF | Conversion Factor | kg/mg | 1.00E-06 | - | |
| | EF | Exposure Frequency | days/year | 13 | EPA, 2004b (3) | |
| | ED | Exposure Duration | years | 1 | EPA, 2002: Exhibit 5-1 | |
| | BW | Body Weight | kg | 70 | EPA, 2002: Exhibit 1-2 | |
| | AT-C | Averaging Time (cancer) | days | 25,550 | 70 yr x 365 d/yr; EPA, 1989 | |
| | AT-N | Averaging Time (non-cancer) | days | 365 | ED x 365 d/yr; EPA, 1989 | |
| Inhalation of Particulates | CA | Chemical Concentration in Air from Particulates | $mg/m^3$ | Chemical specific | Particulate CA = CS x 1/PEF | |
| | PEF | Particulate Emission Factor | | | | |
| | | Area 1 | $m^3$/kg | 9.60E+06 | See Table 4.8 | |
| | | Area 2 (post-excavation) and Area 3 | $m^3$/kg | 7.78E+06 | See Table 4.8 | |

Notes:

(1) For exposure point concentrations see Tables 3.1 and 3.2.
(2) In accordance with MMR Site-wide risk assessment protocol.
(3) Assumed to be 13 work days over 90-day exposure period to meet requirements of the Adult Lead Model. Exposure limited to 13-days due to limited size of small arms range.
(4) Recalculated from outdoor worker; value in EPA 2004a is incorrectly calculated.

Sources :

EPA, 1989: Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, Part A OERR. EPA/540-1-89-002.
EPA, 1997. Exposure Factors Handbook. http://www.epa.gov/ncea/efh/. August 1997.
EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December 2002.
EPA, 2004a: RAGs Volume 1, Human Health Evaluation Manual, Part E: Supplemental Guidance for Dermal Risk Assessment, EPA/540/R/99/005, July 2004.
EPA, 2004b:Adult Lead Methodology Frequently Asked Questions (FAQs)- http:www.epa.gov/superfund/programs/lead/almfaq.htm - last updated April 2004.

## SRF Table 4.5
## Values Used for Daily Intake Calculations - Residential Scenario

Scenario Timeframe: Future Potential
Medium: Surface Soil
Exposure Medium: Surface Soil/Ambient Air
Exposure Point: Area 1 / Area 2 (post-excavation) and Area 3
Receptor Population: Resident
Receptor Age: Child (1-7 years) & Adult (18+ years)

| Exposure Route | Parameter Code | Parameter Definition | Units | RME Value | RME Rationale/ Reference | Intake Equation/ Model Name |
|---|---|---|---|---|---|---|
| Ingestion | CS | Chemical Concentration in Soil | mg/kg | Chemical specific | Exposure point concentration (1) | Chronic Daily Intake (CDI) (mg/kg-day) = |
| | IR (child) | Ingestion Rate of Soil | mg soil/ day | 100 | EPA, 1997: Table 4-23 | CS x IR x AAFing x $F_A$ x CF x EF x ED x 1/BW x 1/AT |
| | IR (adult) | Ingestion Rate of Soil | mg soil/ day | 50 | EPA, 1997: Table 4-23 | |
| | AAF ing | Absorption Adjustment Factor | unitless | Chemical specific | Value set to 1 (2) | |
| | $F_A$ | Fraction of Area | unitless | 1 | Assumed 100% of media contacted is contaminated | |
| | CF | Conversion Factor | kg/mg | 1.00E-06 | - | |
| | EF | Exposure Frequency | days/year | 190 | Site-specific assumption (3) | |
| | ED (child) | Exposure Duration | years | 6 | EPA, 1989 | |
| | ED (adult) | Exposure Duration | years | 24 | EPA, 1989 | |
| | BW (child) | Body Weight | kg | 15 | EPA, 2002: Exhibit 1-2 | |
| | BW (adult) | Body Weight | kg | 70 | EPA, 2002: Exhibit 1-2 | |
| | AT-C | Averaging Time (cancer) | days | 25,550 | 70 yr x 365 d/yr; EPA, 1989 | |
| | AT-N (child) | Averaging Time (non-cancer) | days | 2,190 | ED x 365 d/yr; EPA, 1989 | |
| | AT-N (adult) | Averaging Time (non-cancer) | days | 8,760 | ED x 365 d/yr; EPA, 1989 | |
| Dermal | CS | Chemical Concentration in Soil | mg/kg | Chemical specific | Exposure point concentration (1) | CDI (mg/kg-day) = |
| | SA (child) | Skin Surface Area Available for Contact | $cm^2$/day | 2,800 | Head, hands, forearms, lower legs and feet; EPA, 2004: Exhibit 3-5 | CS x SA x AF x ABS x $F_A$ x CF x EF x ED x 1/BW x 1/AT |
| | SA (adult) | Skin Surface Area Available for Contact | $cm^2$/day | 5,700 | Head, hands, forearms, lower legs; EPA, 2004: Exhibit 3-5 | |
| | AF (child) | Soil to Skin Adherence Factor | $mg/cm^2$ | 0.2 | EPA, 2004: Exhibit 3-5 | |
| | AF (adult) | Soil to Skin Adherence Factor | $mg/cm^2$ | 0.07 | EPA, 2004: Exhibit 3-5 | |
| | ABS | Absorption Factor | unitless | Chemical specific | See Table 4.9 | |
| | $F_A$ | Fraction of Area | unitless | 1 | Assumed 100% of media contacted is contaminated | |
| | CF | Conversion Factor | kg/mg | 1.00E-06 | - | |
| | EF | Exposure Frequency | days/year | 190 | Site-specific assumption (3) | |
| | ED (child) | Exposure Duration | years | 6 | EPA, 1989 | |
| | ED (adult) | Exposure Duration | years | 24 | EPA, 1989 | |
| | BW (child) | Body Weight | kg | 15 | EPA, 2002: Exhibit 1-2 | |
| | BW (adult) | Body Weight | kg | 70 | EPA, 2002: Exhibit 1-2 | |
| | AT-C | Averaging Time (cancer) | days | 25,550 | 70 yr x 365 d/yr; EPA, 1989 | |
| | AT-N (child) | Averaging Time (non-cancer) | days | 2,190 | ED x 365 d/yr; EPA, 1989 | |
| | AT-N (adult) | Averaging Time (non-cancer) | days | 8,760 | ED x 365 d/yr; EPA, 1989 | |
| Inhalation of Particulates | CA | Chemical Concentration in Air from Particulates | $mg/m^3$ | Chemical specific | Particulate CA = CS x 1/PEF | |
| | PEF | Particulate Emission Factor | | | | |
| | | Area 1 | $m^3$/kg | 1.94E+09 | See Table 4.7 | |
| | | Area 2 (post-excavation) and Area 3 | $m^3$/kg | 1.51E+09 | See Table 4.7 | |

Notes:
(1) For exposure point concentrations see Tables 3.1 and 3.2.
(2) In accordance with MMR Site-wide risk assessment protocol.
(3) Based on climatic data for Cape Cod, assumed 5 days/week for 9 months/yr, totalling 190 days (using 4.3 weeks/month).

Sources :

EPA, 1989: Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, Part A OERR. EPA/540-1-89-002.
EPA, 1997. Exposure Factors Handbook. http://www.epa.gov/ncea/efh/. August 1997.
EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December 2002.
EPA, 2004: RAGs Volume 1, Human Health Evaluation Manual, Part E: Supplemental Guidance for Dermal Risk Assessment, EPA/540/R/99/005, July 2004.

# SRF Table 4.6
# Particulate Emission Factor Development for Wind Resuspension

| Parameter Code | Parameter Definition | Units | Value | Rationale/ Reference |
|---|---|---|---|---|
| PEF | Particulate Emission Factor | | | EPA,1996; EPA,2002 (2) |
| | Area 1 | $m^3/kg$ | 1.94E+09 | |
| | Area 2 (post-excavation) and Area 3 | $m^3/kg$ | 1.51E+09 | |
| Q/Cwind | Inverse of Ratio Mean Air Conc. to Emission Flux at Center of Square Source | | | EPA,1996; EPA,2002 (3) |
| | Area 1 | $g/m^2$-s per $kg/m^3$ | 66.90 | |
| | Area 2 (post-excavation) and Area 3 | $g/m^2$-s per $kg/m^3$ | 52.00 | |
| A | Constant Based on Air Modeling for specific climate zones | unitless | 10.47 | Portland, ME: EPA, 2002 Exhibit D-2 |
| B | Constant Based on Air Modeling for specific climate zones | unitless | 20.91 | Portland, ME: EPA, 2002 Exhibit D-2 |
| C | Constant Based on Air Modeling for specific climate zones | unitless | 238.03 | Portland, ME: EPA, 2002 Exhibit D-2 |
| $A_{site}$ | Areal extent of the site or contamination | | | |
| | Area 1 | acres | 0.90 | |
| | Area 2 (post-excavation) and Area 3 | acres | 3.95 | |
| V | Fraction of Vegetative Cover/Gravel | unitless | 0.75 | Based on site observations (4) |
| $U_m$ | Mean Annual Wind Speed | m/s | 4.69 | EPA,1996; EPA,2002 |
| $U_t$ | Equivalent Threshold Value of Wind Speed at 10 m | m/s | 11.32 | EPA,1996; EPA,2002 |
| F(x) | Function Dependent on x | unitless | 0.194 | EPA,1996; EPA,2002 |

Notes:

(1) The PEFs for wind resuspension developed were apprpriate for the following receptors: trespassers, military personnel (non-intrusive), hunter, the and adult and child resident.

(2) The equation used to calculate the particulate emission factor is shown below:

$$PEF = \frac{Q}{C} \bullet \frac{3{,}600\, s/hr}{0.036 \bullet (1-V) \bullet \left(\frac{U_m}{U_t}\right)^3 \bullet F(x)}$$

(3) The equation used to calculate the Inverse of the Ratio of the Geometric Mean Air Concentration to the Emission Flux at the Center of the Square Source is shown below:

$$\frac{Q}{C_{wind}} = A \bullet e^{\left[(\ln A_{site} - B)^2 / C\right]}$$

(4) Observations made during site reconnaisance (Winter 2007). Value shown is minimum observed.

Sources:

EPA, 1996. Soil Screening Guidance: User's Guide. July.

EPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24. December.

**SRF Table 4.7**
**Particulate Emission Factor Development for Fugitive Dust from Construction Operations**

| Parameter Code | Parameter Definition | Units | Value | Rationale/ Reference |
|---|---|---|---|---|
| PEFsc | Subchronic Road Particulate Emission Factor | | | EPA, 2002; Equation 5-5 (1) |
| | Area 1 | $m^3$/kg | 9.60E+06 | |
| | Area 2 (post-excavation) and Area 3 | $m^3$/kg | 7.78E+06 | |
| Q/Csr | Inverse of the Ratio of the 1-Hour Geometric Mean Air Concentration to the Emission Flux Along a Straight Road Segment Bisecting a Square Site | | | EPA, 2002; Equation 5-6 (2) |
| | Area 1 | $g/m^2$-s per $kg/m^3$ | 2.08E+01 | |
| | Area 2 (post-excavation) and Area 3 | $g/m^2$-s per $kg/m^3$ | 1.69E+01 | |
| $A_{site}$ | Areal extent of the site or contamination | | | |
| | Area 1 | acres | 0.9 | |
| | Area 2 (post-excavation) and Area 3 | acres | 3.95 | |
| A | First Constant in the Q/Csr Equation | unitless | 12.9351 | (2) |
| B | Second Constant in the Q/Csr Equation | unitless | 5.7383 | (2) |
| C | Third Constant in the Q/Csr Equation | unitless | 71.7711 | (2) |
| Fd | Dispersion Correction Factor | unitless | 0.188 | EPA,2002; Equation E-16 (3) |
| T | Total Time (seconds) | seconds | 7.78E+06 | (4) |
| tc | Total Time (hours) | hours | 2160 | (4) |
| Ar | Surface Area of Contaminated Road Segment | | | EPA, 2002; Equation 5-5 (5) |
| | Area 1 | $m^2$ | 457 | |
| | Area 2 (post-excavation) and Area 3 | $m^2$ | 549 | |
| Lr | Length of Road Segment | | | (6) |
| | Area 1 | m | 152 | |
| | Area 2 (post-excavation) and Area 3 | m | 183 | |
| Wr | Width of Road Segment | m | 3.00 | (7) |
| W | Mean Construction Vehicle Weight | tons | 20 | (8) |
| p | Number of Days with at Least 0.01 inches of Precipitation | days/year | 135 | EPA, 2002; Exhibit 5-2 |
| SumVKT | Sum of Fleet Kilometers Traveled During the Exposure Duration | | | (9) |
| | Area 1 | km | 54.864 | |
| | Area 2 (post-excavation) and Area 3 | km | 65.8368 | |

Notes:
(1) The equation used to calculate the road particulate emission factor is shown below (EPA, 2002)

$$PEF_{sc} = \frac{Q}{Csr} \bullet \frac{1}{Fd} \bullet \frac{T \bullet Ar}{556 \bullet (W/3)^{0.4} \bullet \frac{(365-p)}{365} \bullet SumVKT}$$

(2) The equation used to calculate the Q/Csr factor is shown below (EPA, 2002):

$$\frac{Q}{C_{sr}} = A \bullet e^{\left[(\ln A_r - B)^2 / C\right]}$$

(3) The equation used to calculate the Fd factor shown below. (EPA, 2002):

$$F_d = 0.1852 + \frac{5.3537}{t_c} + \frac{-9.6318}{t_c^{\,2}}$$

(4) Based on duration of exposure for the construction worker (13 days of exposure over 90-day period).
(5) The equation used to calculate the Ar factor is shown below (EPA, 2002).

$$A_r = L_r \bullet W_r$$

(6) Assumed construction road length equals the largest diagonal through the area.
(7) Assumed construction road 10 feet wide.
(8) Based on assumption of 2 trucks @ 20 tons/truck. EPA, 2002; Page 5-12
(9) Based on 2 vehicle fleet, 2*Lr distance per vehicle trip, for 130 days.

Sources:
EPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24. December.

**SRF Table 4.8**
**Chemical-Specific Dermal Absorption Factors**

| Contaminant of Potential Concern | Absorption Factor (ABS) | Source/ Notes |
|---|---|---|
| Aluminum | - | (1) |
| Antimony | - | (1) |
| Arsenic | 0.03 | EPA, 2004; Exhibit 3-4 |
| Lead | - | (1) |
| 1,3-diethyl-1,3-diphenyl urea | 0.1 | EPA, 2004; Exhibit 3-4 |
| Nitroglycerin | 0.1 | EPA, 2004; Exhibit 3-4 |
| Tungsten | - | (1) |
| Vanadium | - | (1) |

Notes:
(1) In accordance with MMR Site-wide risk assessment protocol, dermal exposure risk not be quantified if no absorption adjustment factors were available in RAGS Part E. No factors were available for these COPCs.

Sources:
EPA, 2004. Risk Assessment Guidance for Superfund, Vol I: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment.

**SRF Table 4.9**
**Values Used and Results for IEUBK Child Lead Model - Area 1**

| Child Age (yr) | Soil Ingestion Rate (mg/day) | Lead Concentration in Soil (1) (mg/kg) | Associated Outdoor Air Concentration ($mg/m^3$) | All Sources Blood Lead Level (ug/dL) | Site-Related Blood Lead Level (2) (ug/dL) | Target Blood Lead Level (ug/dL) |
|---|---|---|---|---|---|---|
| 0.5 - 1 | NA | 285.4 | 1.47E-07 | 4.6 | 3.1 | 10 |
| 1 - 2 | 100 | 285.4 | 1.47E-07 | 4.4 | 2.9 | 10 |
| 2 - 3 | 100 | 285.4 | 1.47E-07 | 4 | 2.6 | 10 |
| 3 - 4 | 100 | 285.4 | 1.47E-07 | 3.8 | 2.4 | 10 |
| 4 - 5 | 100 | 285.4 | 1.47E-07 | 3.6 | 2.3 | 10 |
| 5 - 6 | 100 | 285.4 | 1.47E-07 | 3.4 | 2.1 | 10 |
| 6 - 7 | 100 | 285.4 | 1.47E-07 | 3.2 | 2.0 | 10 |

Notes:

(1) See Table 3.1 for soil exposure point concentrations.

(2) Site-related sources include soil and dust ingestion, inhalation of particulates coupled with maternal baseline of 2.5 ug Pb/dL.

Sources:

EPA, 2001. User's Guide for the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK). Windows Version. EPA9285.7-42. October

**SRF Table 4.10**
**Values Used and Results for AALM Lead Model - Area 1**

| Resident Age (yr) | Soil Ingestion Rate (mg/day) | Lead Concentration in Soil (1) (mg/kg) | Associated Outdoor Air Concentration (mg/m$^3$) | All Sources Maximum Blood Lead Level (2) (ug Pb/dL) | Site-Related Maximum Blood Lead Level (3) (ug Pb/dL) | Target Blood Lead Level (ug Pb/dL) |
|---|---|---|---|---|---|---|
| 19-40 | 50 | 285.4 | 1.47E-07 | 4.160 | 1.878 | 10 |
| 40-65 | 50 | 285.4 | 1.47E-07 | 2.602 | 1.173 | 10 |
| 65-82 | 50 | 285.4 | 1.47E-07 | 2.477 | 1.169 | 10 |
| 82-90 | 50 | 285.4 | 1.47E-07 | 2.395 | 1.169 | 10 |

Notes:

(1) See Table 3.1 for soil exposure point concentrations.

(2) Sources include air (outdoor, residential, school, occupational), diet, dust, drinking water, plus site-related sources.

(3) Sources include air (outdoor and residential only), soil ingestion, and dermal contact with soil.

Sources:

U.S. Environmental Protection Agency. All-Ages Lead Model (AALM) Version 1.05 (External Review Draft). U.S. Environmental Protection Agency, Washington, DC, EPA/600/C-05/013, 2005.

**SRF Table 4.11**
**Values Used and Results for Adult Lead Model - Trespasser**

**Version date 05/19/03**

| Exposure Variable | PbB Equation1 1* | PbB Equation1 2** | Description of Exposure Variable | Units | Values for Non-Residential Exposure Scenario: Using Equation 1 GSDi = Hom | Using Equation 1 GSDi = Het | Using Equation 2 GSDi = Hom | Using Equation 2 GSDi = Het |
|---|---|---|---|---|---|---|---|---|
| PbS | X | X | Soil lead concentration | ug/g or ppm | 285.4 | 285.4 | 285.4 | 285.4 |
| Rfetal/maternal | X | X | Fetal/maternal PbB ratio | -- | 0.9 | 0.9 | 0.9 | 0.9 |
| BKSF | X | X | Biokinetic Slope Factor | ug/dL per ug/day | 0.4 | 0.4 | 0.4 | 0.4 |
| GSDi | X | X | Geometric standard deviation PbB | -- | 2.1 | 2.3 | 2.1 | 2.3 |
| PbB0 | X | X | Baseline PbB | ug/dL | 1.5 | 1.7 | 1.5 | 1.7 |
| IRS | X | | Soil ingestion rate (including soil-derived indoor dust) | g/day | 0.050 | 0.050 | -- | -- |
| IRS+D | | X | Total ingestion rate of outdoor soil and indoor dust | g/day | -- | -- | 0.050 | 0.050 |
| WS | | X | Weighting factor; fraction of IRS+D ingested as outdoor soil | -- | -- | -- | 1.0 | 1.0 |
| KSD | | X | Mass fraction of soil in dust | -- | -- | -- | 0.7 | 0.7 |
| AFS, D | X | X | Absorption fraction (same for soil and dust) | -- | 0.12 | 0.12 | 0.12 | 0.12 |
| EFS, D | X | X | Exposure frequency (same for soil and dust) | days/yr | 65 | 65 | 65 | 65 |
| ATS, D | X | X | Averaging time (same for soil and dust) | days/yr | 365 | 365 | 365 | 365 |
| **PbBadult** | **PbB of adult worker, geometric mean** | | | **ug/dL** | **1.6** | **1.8** | **1.6** | **1.8** |
| **PbBfetal, 0.95** | **95th percentile PbB among fetuses of adult workers** | | | **ug/dL** | **4.9** | **6.5** | **4.9** | **6.5** |
| **PbBt** | **Target PbB level of concern (e.g., 10 ug/dL)** | | | **ug/dL** | **10.0** | **10.0** | **10.0** | **10.0** |
| **P(PbBfetal > PbBt)** | **Probability that fetal PbB > PbBt, assuming lognormal distribution** | | | **%** | **0.5%** | **1.5%** | **0.5%** | **1.5%** |

[1] Equation 1 does not apportion exposure between soil and dust ingestion (excludes $W_S$, $K_{SD}$).
When $IR_S = IR_{S+D}$ and $W_S = 1.0$, the equations yield the same $PbB_{fetal,0.95}$.

***Equation 1, based on Eq. 1, 2 in USEPA (1996).**

| | |
|---|---|
| **PbB** $_{adult}$ = | $(PbS*BKSF*IR_{S+D}*AF_{S,D}*EF_S/AT_{S,D}) + PbB_0$ |
| **PbB** $_{fetal,\ 0.95}$ = | $PbB_{adult} * (GSD_i^{1.645} * R)$ |

****Equation 2, alternate approach based on Eq. 1, 2, and A-19 in USEPA (1996).**

| | |
|---|---|
| **PbB** $_{adult}$ = | $PbS*BKSF*([(IR_{S+D})*AF_S*EF_S*W_S]+[K_{SD}*(IR_{S+D})*(1-W_S)*AF_D*EF_D])/365+PbB_0$ |
| **PbB** $_{fetal,\ 0.95}$ = | $PbB_{adult} * (GSD_i^{1.645} * R)$ |

Sources:
EPA, 2003. Recommendations of the Technical Work Group for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil. Technical Review Workgroup for Lead. EPA-540-R-03-001. January.

**SRF Table 4.12**
**Values Used and Results for Adult Lead Model - Construction Worker**

**Version date 05/19/03**

| Exposure Variable | PbB Equation1 | | Description of Exposure Variable | Units | Values for Non-Residential Exposure Scenario | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Using Equation 1 | | Using Equation 2 | |
| | 1* | 2** | | | GSDi = Hom | GSDi = Het | GSDi = Hom | GSDi = Het |
| PbS | X | X | Soil lead concentration | ug/g or ppm | 285.4 | 285.4 | 285.4 | 285.4 |
| Rfetal/maternal | X | X | Fetal/maternal PbB ratio | -- | 0.9 | 0.9 | 0.9 | 0.9 |
| BKSF | X | X | Biokinetic Slope Factor | ug/dL per ug/day | 0.4 | 0.4 | 0.4 | 0.4 |
| GSDi | X | X | Geometric standard deviation PbB | -- | 2.1 | 2.3 | 2.1 | 2.3 |
| PbB0 | X | X | Baseline PbB | ug/dL | 1.5 | 1.7 | 1.5 | 1.7 |
| IRS | X | | Soil ingestion rate (including soil-derived indoor dust) | g/day | 0.330 | 0.330 | -- | -- |
| IRS+D | | X | Total ingestion rate of outdoor soil and indoor dust | g/day | -- | -- | 0.330 | 0.330 |
| WS | | X | Weighting factor; fraction of IRS+D ingested as outdoor soil | -- | -- | -- | 1.0 | 1.0 |
| KSD | | X | Mass fraction of soil in dust | -- | -- | -- | 0.7 | 0.7 |
| AFS, D | X | X | Absorption fraction (same for soil and dust) | -- | 0.12 | 0.12 | 0.12 | 0.12 |
| EFS, D | X | X | Exposure frequency (same for soil and dust) | days/yr | 13 | 13 | 13 | 13 |
| ATS, D | X | X | Averaging time (same for soil and dust) | days/yr | 90 | 90 | 90 | 90 |
| **PbBadult** | **PbB of adult worker, geometric mean** | | | **ug/dL** | **2.2** | **2.4** | **2.2** | **2.4** |
| **PbBfetal, 0.95** | **95th percentile PbB among fetuses of adult workers** | | | **ug/dL** | **6.6** | **8.3** | **6.6** | **8.3** |
| **PbBt** | **Target PbB level of concern (e.g., 10 ug/dL)** | | | **ug/dL** | **10.0** | **10.0** | **10.0** | **10.0** |
| **P(PbBfetal > PbBt)** | **Probability that fetal PbB > PbBt, assuming lognormal distribution** | | | **%** | **1.3%** | **3.1%** | **1.3%** | **3.1%** |

[1] Equation 1 does not apportion exposure between soil and dust ingestion (excludes $W_S$, $K_{SD}$).
When $IR_S = IR_{S+D}$ and $W_S = 1.0$, the equations yield the same $PbB_{fetal,0.95}$.

***Equation 1, based on Eq. 1, 2 in USEPA (1996).**

| | |
|---|---|
| **$PbB_{adult}$ =** | $(PbS*BKSF*IR_{S+D}*AF_{S,D}*EF_S/AT_{S,D}) + PbB_0$ |
| **$PbB_{fetal, 0.95}$ =** | $PbB_{adult} * (GSD_i^{1.645} * R)$ |

****Equation 2, alternate approach based on Eq. 1, 2, and A-19 in USEPA (1996).**

| | |
|---|---|
| **$PbB_{adult}$ =** | $PbS*BKSF*([(IR_{S+D})*AF_S*EF_S*W_S]+[K_{SD}*(IR_{S+D})*(1-W_S)*AF_D*EF_D])/365+PbB_0$ |
| **$PbB_{fetal, 0.95}$ =** | $PbB_{adult} * (GSD_i^{1.645} * R)$ |

Sources:
EPA, 2003. Recommendations of the Technical Work Group for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil. Technical Review Workgroup for Lead. EPA-540-R-03-001. January.

**SRF Table 5.1**
**Non-Cancer Toxicity Data - Oral/Dermal**

| Contaminant of Potential Concern | Chronic/ Subchronic | Oral RfD | | Oral to Dermal Adjustment Factor (Gastro-Intestinal Absorption Efficiency) (1) | Absorbed RfD for Dermal | | Primary Target Organ(s) | Combined Uncertainty / Modifying Factors | RfD:Target Organ(s) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Value | Units | | Value (2) | Units | | | Source(s) (3) | Date(s) (MM/DD/YYYY) |
| Aluminum | Chronic | 1.0 | mg/kg-day | 100% | 1.0 | mg/kg-day | Neurotoxicity | 100 | PPRTV (EPA, 2006e) | 10/23/2006 |
| Antimony | Chronic | 0.0004 | mg/kg-day | 15% | 0.00006 | mg/kg-day | Blood | 1000 | IRIS | 1/31/2007 |
| Arsenic | Chronic | 0.0003 | mg/kg-day | 95% | 0.0003 | mg/kg-day | Pigmentation/keratosis | 3 | IRIS | 1/31/2007 |
| Lead | - | - | mg/kg-day | - | - | mg/kg-day | - | - | - | - |
| 1,3-diethyl-1,3-diphenyl urea | - | - | mg/kg-day | - | - | mg/kg-day | - | - | - | - |
| Nitroglycerin | Chronic | 0.0001 | mg/kg-day | 100% | 0.00010 | mg/kg-day | Tachycardia | 300 | PPRTV (EPA, 2006d) | 8/22/2006 |
| Tungsten | Chronic | 0.02 | mg/kg-day | 100% | 0.02 | mg/kg-day | - | 1000 | CHPPM, 2007 | 1/31/2007 |
| Vanadium | - | 0.001 | mg/kg-day | 2.6% | 0.00003 | mg/kg-day | - | - | NCEA (EPA, 2006b) | 10/31/2006 |

Notes:
- = No published value
(1) USEPA, 2004b. Exhibit 4.1. Supplemental Guidance for Dermal Risk Assessment; When no value presented, no adjustment (i.e., 100%) was made.
(2) $$RfD_D\left({mg}/{kg-day}\right) = RfD_O\left({mg}/{kg-day}\right) \bullet OraltoDermalAdjustmentFactor$$

(3) IRIS = Integrated Risk Information System
PPRTV = Provisional Peer Reviewed Toxicity Values
NCEA = National Center for Environmental Assessment
CHPPM = Army Center for Health Promotion and Preventive Medicine

Sources:

CHPPM, 2007. E-mail correspondence from Larry Cain, USACE, to Ronald Marnicio, TetraTech-EC reagarding Toxicity Factors for Tungsten. January 31.
EPA. 2004a. Region 9 Preliminary Remediation Goals (PRGs) Table Users Guide/Technical Background Document. October 1, 2004.
EPA. 2006b. Region III Risk-Based Concentration Table. http://www.epa.gov/reg3hwmd/risk/human/index.htm. October.
EPA, 2006d. Provisional Peer Reviewed Toxicity Values for Nitroglycerin (CASRN 55-63-0), Derivation of Subchronic and Chronic Oral RfDs. Superfund Health Risk Technical Support Center. August 22.
EPA, 2006e. Provisional Peer Reviewed Toxicity Values for Aluminum (CASRN 7429-90-5). Superfund Health Risk Technical Support Center. October 23.

## SRF Table 5.2
## Non-Cancer Toxicity Data - Inhalation

| Contaminant of Potential Concern | Chronic/ Subchronic | Inhalation RfC | | Extrapolated RfD | | Primary Target Organ(s) | Combined Uncertainty / Modifying Factors | RfC : Target Organ(s) Uncertainty / | |
|---|---|---|---|---|---|---|---|---|---|
| | | Value | Units | Value (1) | Units | | | Source(s) | Date(s) (MM/DD/YYYY) |
| Aluminum | Chronic | 0.0049 | $mg/m^3$ | 0.0014 | mg/kg-day | Neurotoxicity | - | PPRTV (EPA, 2006e) | 10/23/2006 |
| Antimony | - | - | $mg/m^3$ | - | mg/kg-day | - | - | - | - |
| Arsenic | - | - | $mg/m^3$ | - | mg/kg-day | - | - | - | - |
| Lead | - | - | $mg/m^3$ | - | mg/kg-day | - | - | - | - |
| 1,3-diethyl-1,3-diphenyl urea | - | - | $mg/m^3$ | - | mg/kg-day | - | - | - | - |
| Nitroglycerin | - | - | $mg/m^3$ | - | mg/kg-day | - | - | - | - |
| Tungsten | - | - | $mg/m^3$ | - | mg/kg-day | - | - | - | - |
| Vanadium | - | - | $mg/m^3$ | - | mg/kg-day | - | - | - | - |

Notes:

- = No published value

(1)

$$RfD_i\left[{}^{mg}\!/\!{}_{kg-day}\right] = RfC\left[{}^{mg}\!/\!{}_{m^3}\right] \cdot \frac{20\left[{}^{m^3}\!/\!{}_{day}\right]}{70[kg]}$$

PPRTV = Provisional Peer Reviewed Toxicity Values

Sources:

EPA. 2004a. Region 9 Preliminary Remediation Goals (PRGs) Table Users Guide/Technical Background Document. October 1, 2004.

EPA, 2006e. Provisional Peer Reviewed Toxicity Values for Aluminum (CASRN 7429-90-5). Superfund Health Risk Technical Support Center. October 23.

## SRF Table 6.1
## Cancer Toxicity Data - Oral/Dermal

| Contaminant of Potential Concern | Oral Cancer Slope Factor | | Oral to Dermal Adjustment Factor (Gastro-Intestinal Absorption Efficiency) (1) | Absorbed Cancer Slope Factor for Dermal | | Weight of Evidence/ Cancer Guideline Description | Oral CSF | |
|---|---|---|---|---|---|---|---|---|
| | Value | Units | | Value (2) | Units | | Source(s) (3) | Date(s) (MM/DD/YYYY) |
| Aluminum | - | $(mg/kg\text{-}day)^{-1}$ | - | - | $(mg/kg\text{-}day)^{-1}$ | D | PPRTV (EPA, 2006e) | 10/23/2006 |
| Antimony | - | $(mg/kg\text{-}day)^{-1}$ | 15% | - | $(mg/kg\text{-}day)^{-1}$ | - | - | - |
| Arsenic | 1.5E+00 | $(mg/kg\text{-}day)^{-1}$ | 95% | 1.5E+00 | $(mg/kg\text{-}day)^{-1}$ | A | IRIS | 1/31/2007 |
| Lead | - | $(mg/kg\text{-}day)^{-1}$ | - | - | $(mg/kg\text{-}day)^{-1}$ | B2 | - | 1/31/2007 |
| 1,3-diethyl-1,3-diphenyl urea | - | $(mg/kg\text{-}day)^{-1}$ | - | - | $(mg/kg\text{-}day)^{-1}$ | - | - | - |
| Nitroglycerin | 1.7E-02 | $(mg/kg\text{-}day)^{-1}$ | 100% | 1.7E-02 | $(mg/kg\text{-}day)^{-1}$ | - | PPRTV (EPA, 2007) | 1/31/2007 |
| Tungsten | - | $(mg/kg\text{-}day)^{-1}$ | - | - | $(mg/kg\text{-}day)^{-1}$ | - | - | - |
| Vanadium | - | $(mg/kg\text{-}day)^{-1}$ | - | - | $(mg/kg\text{-}day)^{-1}$ | - | - | - |

Notes:
- = No published value
(1) USEPA, 2004b. Exhibit 4.1. When no value presented, no adjustment (i.e., 100%) was made.
(2)

$$CSF_D\left(\frac{kg-day}{mg}\right) = \frac{CSF_O\left(\frac{kg-day}{mg}\right)}{(Oral to Dermal Adjustment Factor)}$$

(3) IRIS = Integrated Risk Information System
PPRTV = Provisional Peer Reviewed Toxicity Values
Weight of Evidence - USEPA Group:
A - Human carcinogen
B1 - Probable human carcinogen - indicates that limited human data are available
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
C - Possible human carcinogen
D - Not classifiable as a human carcinogen
C - Possible human carcinogen
D - Not classifiable as a human carcinogen
E - Evidence of noncarcinogenicity

Sources:
EPA. 2004a. Region 9 Preliminary Remediation Goals (PRGs) Table Users Guide/Technical Background Document. October 1, 2004.
EPA, 2004b. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).
EPA, 2006e. Provisional Peer Reviewed Toxicity Values for Aluminum (CASRN 7429-90-5). Superfund Health Risk Technical Support Center. October 23.
EPA, 2007. Region III Human Health Risk Assessment Risk Based Concentration Table Home Page. http://www.epa.gov/reg3hwmd/risk/human/

**SRF Table 6.2**
**Cancer Toxicity Data - Inhalation**

| Contaminant of Potential Concern | Unit Risk | | Inhalation Cancer Slope Factor | | Weight of Evidence/ Cancer Guideline Description | Unit Risk : Inhalation CSF | |
|---|---|---|---|---|---|---|---|
| | Value | Units | Value (1) | Units | | Source(s) (2) | Date(s) (MM/DD/YYYY) |
| Aluminum | - | $(mg/m^3)^{-1}$ | - | $(mg/kg\text{-}day)^{-1}$ | D | PPRTV (EPA, 2004a) | 10/23/2006 |
| Antimony | - | $(mg/m^3)^{-1}$ | - | $(mg/kg\text{-}day)^{-1}$ | - | - | - |
| Arsenic | 4.3E+00 | $(mg/m^3)^{-1}$ | 1.5E+01 | $(mg/kg\text{-}day)^{-1}$ | A | IRIS | 1/31/2007 |
| Lead | - | $(mg/m^3)^{-1}$ | - | $(mg/kg\text{-}day)^{-1}$ | B2 | IRIS | 1/31/2007 |
| 1,3-diethyl-1,3-diphenyl urea | - | $(mg/m^3)^{-1}$ | - | $(mg/kg\text{-}day)^{-1}$ | - | - | - |
| Nitroglycerin | - | $(mg/m^3)^{-1}$ | - | $(mg/kg\text{-}day)^{-1}$ | - | - | - |
| Tungsten | - | $(mg/m^3)^{-1}$ | - | $(mg/kg\text{-}day)^{-1}$ | - | - | - |
| Vanadium | - | $(mg/m^3)^{-1}$ | - | $(mg/kg\text{-}day)^{-1}$ | - | - | - |

Notes:
- = No published value

(1) $$SF_I\left[\left(\frac{mg}{kg-day}\right)^{-1}\right] = UR\left[\left(\frac{mg}{m^3}\right)^{-1}\right]\cdot\frac{70[kg]}{20\left[\frac{m^3}{day}\right]}$$

(2) IRIS = Integrated Risk Information System
PPRTV = Provisional Peer Reviewed Toxicity Values

Weight of Evidence - USEPA Group:
A - Human carcinogen
B1 - Probable human carcinogen - indicates that limited human data are
B2 - Probable human carcinogen - indicates sufficient evidence in animal inadequate or no evidence in humans
C - Possible human carcinogen
D - Not classifiable as a human carcinogen
E - Evidence of noncarcinogenicity

Sources:

EPA. 2004a. Region 9 Preliminary Remediation Goals (PRGs) Table Users Guide/Technical Background Document. October 1, 2004.

EPA, 2006e. Provisional Peer Reviewed Toxicity Values for Aluminum (CASRN 7429-90-5). Superfund Health Risk Technical Support Center. October 23.

## SRF Table 7.1a
## Calculation of Chemical Cancer Risks and Non-Cancer Hazards
## Area 1 - Trespasser - Reasonable Maximum Exposure

| |
|---|
| Scenario Timeframe: Current/Potential |
| Receptor Population: Trespasser |
| Receptor Age: Older child (12-18 yrs) |

| Medium | Exposure Medium | Exposure Point | Exposure Route | Contaminant of Potential Concern | EPC | | Cancer Risk Calculations | | | | | Non-Cancer Hazard Calculations | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Intake/Exposure Concentration | | CSF / Unit Risk | | Cancer Risk | Intake/Exposure Concentration | | RfD / RfC | | Hazard Quotient |
| | | | | | Value | Units | Value | Units | Value | Units | | Value | Units | Value | Units | |
| Soil | Surface Soil (0-1 ft bgs) | Area 1 | Ingestion | Aluminum | 9,213 | mg/kg | 1.3E-04 | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | 1.5E-03 | mg/kg-day | 1.0E+00 | mg/kg-day | 1.5E-03 |
| | | | | Antimony | 24.17 | mg/kg | 3.3E-07 | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | 3.8E-06 | mg/kg-day | 4.0E-04 | mg/kg-day | 9.6E-03 |
| | | | | Arsenic | 4.09 | mg/kg | 5.6E-08 | mg/kg-day | 1.5E+00 | (mg/kg-day)$^{-1}$ | 8.4E-08 | 6.5E-07 | mg/kg-day | 3.0E-04 | mg/kg-day | 2.2E-03 |
| | | | | Lead | 285.4 | mg/kg | 3.9E-06 | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | 4.5E-05 | mg/kg-day | - | mg/kg-day | - |
| | | | | Tungsten | 1.92 | mg/kg | 2.6E-08 | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | 3.1E-07 | mg/kg-day | 2.0E-02 | mg/kg-day | 1.5E-05 |
| | | | | Vanadium | 17.4 | mg/kg | 2.4E-07 | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | 2.8E-06 | mg/kg-day | 1.0E-03 | mg/kg-day | 2.8E-03 |
| | | | | 1,3-diethyl-1,3-diphenyl urea | 0.76 | mg/kg | 1.0E-08 | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | 1.2E-07 | mg/kg-day | - | mg/kg-day | - |
| | | | | Nitroglycerin | 44.8 | mg/kg | 6.1E-07 | mg/kg-day | 1.7E-02 | (mg/kg-day)$^{-1}$ | 1.0E-08 | 7.1E-06 | mg/kg-day | 1.0E-04 | mg/kg-day | 7.1E-02 |
| | | | Exposure Route Total | | | | | | | | 9.4E-08 | | | | | 8.7E-02 |
| | | | Dermal Absorption | Aluminum | 9,213 | mg/kg | | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | | mg/kg-day | 1.0E+00 | mg/kg-day | - |
| | | | | Antimony | 24.17 | mg/kg | | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | | mg/kg-day | 6.0E-05 | mg/kg-day | - |
| | | | | Arsenic | 4.09 | mg/kg | 1.2E-08 | mg/kg-day | 1.5E+00 | (mg/kg-day)$^{-1}$ | 1.8E-08 | 1.4E-07 | mg/kg-day | 3.0E-04 | mg/kg-day | 4.8E-04 |
| | | | | Lead | 285.4 | mg/kg | | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | | mg/kg-day | - | mg/kg-day | - |
| | | | | Tungsten | 1.92 | mg/kg | | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | | mg/kg-day | 2.0E-02 | mg/kg-day | |
| | | | | Vanadium | 17.4 | mg/kg | | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | | mg/kg-day | 2.6E-05 | mg/kg-day | |
| | | | | 1,3-diethyl-1,3-diphenyl urea | 0.76 | mg/kg | 7.6E-09 | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | 8.9E-08 | mg/kg-day | - | mg/kg-day | - |
| | | | | Nitroglycerin | 44.8 | mg/kg | 4.5E-07 | mg/kg-day | 1.7E-02 | (mg/kg-day)$^{-1}$ | 7.6E-09 | 5.2E-06 | mg/kg-day | 1.0E-04 | mg/kg-day | 5.2E-02 |
| | | | Exposure Route Total | | | | | | | | 2.6E-08 | | | | | 5.3E-02 |
| | | | Inhalation of Particulates | Aluminum | 9,213 | mg/kg | 4.8E-06 | mg/m$^3$ | - | (mg/m$^3$)$^{-1}$ | - | 4.8E-06 | mg/m$^3$ | 4.9E-03 | mg/m$^3$ | 9.7E-04 |
| | | | | Antimony | 24.17 | mg/kg | 1.2E-08 | mg/m$^3$ | - | (mg/m$^3$)$^{-1}$ | - | 1.2E-08 | mg/m$^3$ | - | mg/m$^3$ | - |
| | | | | Arsenic | 4.09 | mg/kg | 2.1E-09 | mg/m$^3$ | 4.3E+00 | (mg/m$^3$)$^{-1}$ | 9.1E-09 | 2.1E-09 | mg/m$^3$ | - | mg/m$^3$ | - |
| | | | | Lead | 285.4 | mg/kg | 1.5E-07 | mg/m$^3$ | - | (mg/m$^3$)$^{-1}$ | - | 1.5E-07 | mg/m$^3$ | - | mg/m$^3$ | - |
| | | | | Tungsten | 1.92 | mg/kg | 9.9E-10 | mg/m$^3$ | - | (mg/m$^3$)$^{-1}$ | - | 9.9E-10 | mg/m$^3$ | - | mg/m$^3$ | - |
| | | | | Vanadium | 17.4 | mg/kg | 9.0E-09 | mg/m$^3$ | - | (mg/m$^3$)$^{-1}$ | - | 9.0E-09 | mg/m$^3$ | - | mg/m$^3$ | - |
| | | | | 1,3-diethyl-1,3-diphenyl urea | 0.76 | mg/kg | 3.9E-10 | mg/m$^3$ | - | (mg/m$^3$)$^{-1}$ | - | 3.9E-10 | mg/m$^3$ | - | mg/m$^3$ | - |
| | | | | Nitroglycerin | 44.8 | mg/kg | 2.3E-08 | mg/m$^3$ | - | (mg/m$^3$)$^{-1}$ | - | 2.3E-08 | mg/m$^3$ | - | mg/m$^3$ | - |
| | | | Exposure Route Total | | | | | | | | 9.1E-09 | | | | | 9.7E-04 |
| | | Exposure Point Total | | | | | | | | | 1.3E-07 | | | | | 1.4E-01 |
| | Exposure Medium Total | | | | | | | | | | 1.3E-07 | | | | | 1.4E-01 |
| Medium Total | | | | | | | | | | | 1.3E-07 | | | | | 1.4E-01 |

**SRF Table 7.1b**
**Calculation of Chemical Cancer Risks and Non-Cancer Hazards**
**Area 2 (Post Excavation) and Area 3 - Trespasser - Reasonable Maximum Exposure**

Scenario Timeframe: Current/Potential
Receptor Population: Trespasser
Receptor Age: Older child (12-18 yrs)

| Medium | Exposure Medium | Exposure Point | Exposure Route | Contaminant of Potential Concern | EPC Value | EPC Units | Cancer Intake/Exposure Concentration Value | Cancer Intake/Exposure Concentration Units | CSF / Unit Risk Value | CSF / Unit Risk Units | Cancer Risk | Non-Cancer Intake/Exposure Concentration Value | Non-Cancer Intake/Exposure Concentration Units | RfD / RfC Value | RfD / RfC Units | Hazard Quotient |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Soil | Surface Soil (0-1 ft bgs) | Areas 2 & 3 | Ingestion | Aluminum | 13,190 | mg/kg | 1.8E-04 | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | 2.1E-03 | mg/kg-day | 1.0E+00 | mg/kg-day | 2.1E-03 |
| | | | | Arsenic | 3.9 | mg/kg | 5.3E-08 | mg/kg-day | 1.5E+00 | $(mg/kg\text{-}day)^{-1}$ | 8.0E-08 | 6.2E-07 | mg/kg-day | 3.0E-04 | mg/kg-day | 2.1E-03 |
| | | | | Tungsten | 6.83 | mg/kg | 9.3E-08 | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | 1.1E-06 | mg/kg-day | 2.0E-02 | mg/kg-day | 5.4E-05 |
| | | | | Vanadium | 28.98 | mg/kg | 3.9E-07 | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | 4.6E-06 | mg/kg-day | 1.0E-03 | mg/kg-day | 4.6E-03 |
| | | | Exposure Route Total | | | | | | | | 8.0E-08 | | | | | 8.8E-03 |
| | | | Dermal Absorption | Aluminum | 13,190 | mg/kg | | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | | mg/kg-day | 1.0E+00 | mg/kg-day | |
| | | | | Arsenic | 3.9 | mg/kg | 1.2E-08 | mg/kg-day | 1.5E+00 | $(mg/kg\text{-}day)^{-1}$ | 1.8E-08 | 1.4E-07 | mg/kg-day | 3.0E-04 | mg/kg-day | 4.6E-04 |
| | | | | Tungsten | 6.83 | mg/kg | | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | | mg/kg-day | 2.0E-02 | mg/kg-day | |
| | | | | Vanadium | 28.98 | mg/kg | | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | | mg/kg-day | 2.6E-05 | mg/kg-day | |
| | | | Exposure Route Total | | | | | | | | 1.8E-08 | | | | | 4.6E-04 |
| | | | Inhalation of Particulates | Aluminum | 13,190 | mg/kg | 6.8E-06 | $mg/m^3$ | - | $(mg/m^3)^{-1}$ | - | 6.8E-06 | $mg/m^3$ | 4.9E-03 | $mg/m^3$ | 1.4E-03 |
| | | | | Arsenic | 3.9 | mg/kg | 2.0E-09 | $mg/m^3$ | 4.3E+00 | $(mg/m^3)^{-1}$ | 8.6E-09 | 2.0E-09 | $mg/m^3$ | - | $mg/m^3$ | - |
| | | | | Tungsten | 6.83 | mg/kg | 3.5E-09 | $mg/m^3$ | - | $(mg/m^3)^{-1}$ | - | 3.5E-09 | $mg/m^3$ | - | $mg/m^3$ | - |
| | | | | Vanadium | 28.98 | mg/kg | 1.5E-08 | $mg/m^3$ | - | $(mg/m^3)^{-1}$ | - | 1.5E-08 | $mg/m^3$ | - | $mg/m^3$ | - |
| | | | Exposure Route Total | | | | | | | | 8.6E-09 | | | | | 1.4E-03 |
| | | Exposure Point Total | | | | | | | | | 1.1E-07 | | | | | 1.1E-02 |
| | Exposure Medium Total | | | | | | | | | | 1.1E-07 | | | | | 1.1E-02 |
| Medium Total | | | | | | | | | | | 1.1E-07 | | | | | 1.1E-02 |

**SRF Table 7.2a**
**Calculation of Chemical Cancer Risks and Non-Cancer Hazards**
**Area 1 Military Personnel Firearms Training - Reasonable Maximum Exposure**

Scenario Timeframe: Current/Potential
Receptor Population: Military Personnel Firearms Training
Receptor Age: Adult (18 to 28 yrs)

| Medium | Exposure Medium | Exposure Point | Exposure Route | Contaminant of Potential Concern | EPC | | Cancer Risk Calculations | | | | | Non-Cancer Hazard Calculations | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Intake/Exposure Concentration | | CSF / Unit Risk | | Cancer Risk | Intake/Exposure Concentration | | RfD / RfC | | Hazard Quotient |
| | | | | | Value | Units | Value | Units | Value | Units | | Value | Units | Value | Units | |
| Soil | Surface Soil (0-1 ft bgs) | Area 1 | Ingestion | Aluminum | 9,213 | mg/kg | 1.3E-05 | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | 9.4E-05 | mg/kg-day | 1.0E+00 | mg/kg-day | 9.4E-05 |
| | | | | Antimony | 24.17 | mg/kg | 3.5E-08 | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | 2.5E-07 | mg/kg-day | 4.0E-04 | mg/kg-day | 6.2E-04 |
| | | | | Arsenic | 4.09 | mg/kg | 5.9E-09 | mg/kg-day | 1.5E+00 | (mg/kg-day)$^{-1}$ | 8.9E-09 | 4.2E-08 | mg/kg-day | 3.0E-04 | mg/kg-day | 1.4E-04 |
| | | | | Lead | 285.4 | mg/kg | 4.2E-07 | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | 2.9E-06 | mg/kg-day | - | mg/kg-day | - |
| | | | | Tungsten | 1.92 | mg/kg | 2.8E-09 | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | 2.0E-08 | mg/kg-day | 2.0E-02 | mg/kg-day | 9.8E-07 |
| | | | | Vanadium | 17.4 | mg/kg | 2.5E-08 | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | 1.8E-07 | mg/kg-day | 1.0E-03 | mg/kg-day | 1.8E-04 |
| | | | | 1,3-diethyl-1,3-diphenyl urea | 0.76 | mg/kg | 1.1E-09 | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | 7.7E-09 | mg/kg-day | - | mg/kg-day | - |
| | | | | Nitroglycerin | 44.8 | mg/kg | 6.5E-08 | mg/kg-day | 1.7E-02 | (mg/kg-day)$^{-1}$ | 1.1E-09 | 4.6E-07 | mg/kg-day | 1.0E-04 | mg/kg-day | 4.6E-03 |
| | | | Exposure Route Total | | | | | | | | 1.0E-08 | | | | | 5.6E-03 |
| | | | Dermal Absorption | Aluminum | 9,213 | mg/kg | | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | | mg/kg-day | 1.0E+00 | mg/kg-day | - |
| | | | | Antimony | 24.17 | mg/kg | | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | | mg/kg-day | 6.0E-05 | mg/kg-day | - |
| | | | | Arsenic | 4.09 | mg/kg | 2.9E-09 | mg/kg-day | 1.5E+00 | (mg/kg-day)$^{-1}$ | 4.4E-09 | 2.1E-08 | mg/kg-day | 3.0E-04 | mg/kg-day | 6.9E-05 |
| | | | | Lead | 285.4 | mg/kg | | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | | mg/kg-day | - | mg/kg-day | - |
| | | | | Tungsten | 1.92 | mg/kg | | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | | mg/kg-day | 2.0E-02 | mg/kg-day | |
| | | | | Vanadium | 17.4 | mg/kg | | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | | mg/kg-day | 2.6E-05 | mg/kg-day | |
| | | | | 1,3-diethyl-1,3-diphenyl urea | 0.76 | mg/kg | 1.8E-09 | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | 1.3E-08 | mg/kg-day | - | mg/kg-day | - |
| | | | | Nitroglycerin | 44.8 | mg/kg | 1.1E-07 | mg/kg-day | 1.7E-02 | (mg/kg-day)$^{-1}$ | 1.8E-09 | 7.5E-07 | mg/kg-day | 1.0E-04 | mg/kg-day | 7.5E-03 |
| | | | Exposure Route Total | | | | | | | | 6.2E-09 | | | | | 7.6E-03 |
| | | | Inhalation of Particulates | Aluminum | 9,213 | mg/kg | 4.8E-06 | $mg/m^3$ | - | $(mg/m^3)^{-1}$ | - | 4.8E-06 | $mg/m^3$ | 4.9E-03 | $mg/m^3$ | 9.7E-04 |
| | | | | Antimony | 24.17 | mg/kg | 1.2E-08 | $mg/m^3$ | - | $(mg/m^3)^{-1}$ | - | 1.2E-08 | $mg/m^3$ | - | $mg/m^3$ | - |
| | | | | Arsenic | 4.09 | mg/kg | 2.1E-09 | $mg/m^3$ | 4.3E+00 | $(mg/m^3)^{-1}$ | 9.1E-09 | 2.1E-09 | $mg/m^3$ | - | $mg/m^3$ | - |
| | | | | Lead | 285.4 | mg/kg | 1.5E-07 | $mg/m^3$ | - | $(mg/m^3)^{-1}$ | - | 1.5E-07 | $mg/m^3$ | - | $mg/m^3$ | - |
| | | | | Tungsten | 1.92 | mg/kg | 9.9E-10 | $mg/m^3$ | - | $(mg/m^3)^{-1}$ | - | 9.9E-10 | $mg/m^3$ | - | $mg/m^3$ | - |
| | | | | Vanadium | 17.4 | mg/kg | 9.0E-09 | $mg/m^3$ | - | $(mg/m^3)^{-1}$ | - | 9.0E-09 | $mg/m^3$ | - | $mg/m^3$ | - |
| | | | | 1,3-diethyl-1,3-diphenyl urea | 0.76 | mg/kg | 3.9E-10 | $mg/m^3$ | - | $(mg/m^3)^{-1}$ | - | 3.9E-10 | $mg/m^3$ | - | $mg/m^3$ | - |
| | | | | Nitroglycerin | 44.8 | mg/kg | 2.3E-08 | $mg/m^3$ | - | $(mg/m^3)^{-1}$ | - | 2.3E-08 | $mg/m^3$ | - | $mg/m^3$ | - |
| | | | Exposure Route Total | | | | | | | | 9.1E-09 | | | | | 9.7E-04 |
| | | Exposure Point Total | | | | | | | | | 2.5E-08 | | | | | 1.4E-02 |
| | Exposure Medium Total | | | | | | | | | | 2.5E-08 | | | | | 1.4E-02 |
| Medium Total | | | | | | | | | | | 2.5E-08 | | | | | 1.4E-02 |

# SRF Table 7.2b
## Calculation of Chemical Cancer Risks and Non-Cancer Hazards
## Area 2 (Post-Excavation) and Area 3 - Military Personnel Firearms Training - Reasonable Maximum Exposure

Scenario Timeframe: Current/Potential
Receptor Population: Military Personnel Firearms Training
Receptor Age: Adult (18 to 28 yrs)

| Medium | Exposure Medium | Exposure Point | Exposure Route | Contaminant of Potential Concern | EPC | | Cancer Risk Calculations | | | | | Non-Cancer Hazard Calculations | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Intake/Exposure Concentration | | CSF / Unit Risk | | Cancer Risk | Intake/Exposure Concentration | | RfD / RfC | | Hazard Quotient |
| | | | | | Value | Units | Value | Units | Value | Units | | Value | Units | Value | Units | |
| Soil | Surface Soil (0-1 ft bgs) | Areas 2 & 3 | Ingestion | Aluminum | 13,190 | mg/kg | 1.9E-05 | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | 1.3E-04 | mg/kg-day | 1.0E+00 | mg/kg-day | 1.3E-04 |
| | | | | Arsenic | 3.9 | mg/kg | 5.7E-09 | mg/kg-day | 1.5E+00 | $(mg/kg\text{-}day)^{-1}$ | 8.5E-09 | 4.0E-08 | mg/kg-day | 3.0E-04 | mg/kg-day | 1.3E-04 |
| | | | | Tungsten | 6.83 | mg/kg | 9.9E-09 | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | 7.0E-08 | mg/kg-day | 2.0E-02 | mg/kg-day | 3.5E-06 |
| | | | | Vanadium | 28.98 | mg/kg | 4.2E-08 | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | 3.0E-07 | mg/kg-day | 1.0E-03 | mg/kg-day | 3.0E-04 |
| | | | Exposure Route Total | | | | | | | | 8.5E-09 | | | | | 5.7E-04 |
| | | | Dermal Absorption | Aluminum | 13,190 | mg/kg | | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | | mg/kg-day | 1.0E+00 | mg/kg-day | |
| | | | | Arsenic | 3.9 | mg/kg | 2.8E-09 | mg/kg-day | 1.5E+00 | $(mg/kg\text{-}day)^{-1}$ | 4.2E-09 | 2.0E-08 | mg/kg-day | 3.0E-04 | mg/kg-day | 6.6E-05 |
| | | | | Tungsten | 6.83 | mg/kg | | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | | mg/kg-day | 2.0E-02 | mg/kg-day | |
| | | | | Vanadium | 28.98 | mg/kg | | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | | mg/kg-day | 2.6E-05 | mg/kg-day | |
| | | | Exposure Route Total | | | | | | | | 4.2E-09 | | | | | 6.6E-05 |
| | | | Inhalation of Particulates | Aluminum | 13,190 | mg/kg | 6.8E-06 | $mg/m^3$ | - | $(mg/m^3)^{-1}$ | - | 6.8E-06 | $mg/m^3$ | 4.9E-03 | $mg/m^3$ | 1.4E-03 |
| | | | | Arsenic | 3.9 | mg/kg | 2.0E-09 | $mg/m^3$ | 4.3E+00 | $(mg/m^3)^{-1}$ | 8.6E-09 | 2.0E-09 | $mg/m^3$ | - | $mg/m^3$ | - |
| | | | | Tungsten | 6.83 | mg/kg | 3.5E-09 | $mg/m^3$ | - | $(mg/m^3)^{-1}$ | - | 3.5E-09 | $mg/m^3$ | - | $mg/m^3$ | - |
| | | | | Vanadium | 28.98 | mg/kg | 1.5E-08 | $mg/m^3$ | - | $(mg/m^3)^{-1}$ | - | 1.5E-08 | $mg/m^3$ | - | $mg/m^3$ | - |
| | | | Exposure Route Total | | | | | | | | 8.6E-09 | | | | | 1.4E-03 |
| | | Exposure Point Total | | | | | | | | | 2.1E-08 | | | | | 2.0E-03 |
| | Exposure Medium Total | | | | | | | | | | 2.1E-08 | | | | | 2.0E-03 |
| Medium Total | | | | | | | | | | | 2.1E-08 | | | | | 2.0E-03 |

# SRF Table 7.4a
## Calculation of Chemical Cancer Risks and Non-Cancer Hazards
## Area 1 - Hunter- Reasonable Maximum Exposure

| |
|---|
| Scenario Timeframe: Current/Potential |
| Receptor Population: Hunter |
| Receptor Age: Adult (18+ years) |

| Medium | Exposure Medium | Exposure Point | Exposure Route | Contaminant of Potential Concern | EPC | | Cancer Risk Calculations | | | | | Non-Cancer Hazard Calculations | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Intake/Exposure Concentration | | CSF / Unit Risk | | Cancer Risk | Intake/Exposure Concentration | | RfD / RfC | | Hazard Quotient |
| | | | | | Value | Units | Value | Units | Value | Units | | Value | Units | Value | Units | |
| Soil | Surface Soil (0-1 ft bgs) | Area 1 | Ingestion | Aluminum | 9,213 | mg/kg | 3.7E-05 | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | 4.3E-04 | mg/kg-day | 1.0E+00 | mg/kg-day | 4.3E-04 |
| | | | | Antimony | 24.17 | mg/kg | 9.7E-08 | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | 1.1E-06 | mg/kg-day | 4.0E-04 | mg/kg-day | 2.8E-03 |
| | | | | Arsenic | 4.09 | mg/kg | 1.6E-08 | mg/kg-day | 1.5E+00 | (mg/kg-day)$^{-1}$ | 2.5E-08 | 1.9E-07 | mg/kg-day | 3.0E-04 | mg/kg-day | 6.4E-04 |
| | | | | Lead | 285.4 | mg/kg | 1.1E-06 | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | 1.3E-05 | mg/kg-day | - | mg/kg-day | - |
| | | | | Tungsten | 1.92 | mg/kg | 7.7E-09 | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | 9.0E-08 | mg/kg-day | 2.0E-02 | mg/kg-day | 4.5E-06 |
| | | | | Vanadium | 17.4 | mg/kg | 7.0E-08 | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | 8.2E-07 | mg/kg-day | 1.0E-03 | mg/kg-day | 8.2E-04 |
| | | | | 1,3-diethyl-1,3-diphenyl urea | 0.76 | mg/kg | 3.1E-09 | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | 3.6E-08 | mg/kg-day | - | mg/kg-day | - |
| | | | | Nitroglycerin | 44.8 | mg/kg | 1.8E-07 | mg/kg-day | 1.7E-02 | (mg/kg-day)$^{-1}$ | 3.1E-09 | 2.1E-06 | mg/kg-day | 1.0E-04 | mg/kg-day | 2.1E-02 |
| | | | Exposure Route Total | | | | | | | | 2.8E-08 | | | | | 2.6E-02 |
| | | | Dermal Absorption | Aluminum | 9,213 | mg/kg | | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | | mg/kg-day | 1.0E+00 | mg/kg-day | - |
| | | | | Antimony | 24.17 | mg/kg | | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | | mg/kg-day | 6.0E-05 | mg/kg-day | - |
| | | | | Arsenic | 4.09 | mg/kg | 4.1E-09 | mg/kg-day | 1.5E+00 | (mg/kg-day)$^{-1}$ | 6.1E-09 | 4.7E-08 | mg/kg-day | 3.0E-04 | mg/kg-day | 1.6E-04 |
| | | | | Lead | 285.4 | mg/kg | | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | | mg/kg-day | - | mg/kg-day | - |
| | | | | Tungsten | 1.92 | mg/kg | | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | | mg/kg-day | 2.0E-02 | mg/kg-day | |
| | | | | Vanadium | 17.4 | mg/kg | | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | | mg/kg-day | 2.6E-05 | mg/kg-day | |
| | | | | 1,3-diethyl-1,3-diphenyl urea | 0.76 | mg/kg | 2.5E-09 | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | 2.9E-08 | mg/kg-day | - | mg/kg-day | - |
| | | | | Nitroglycerin | 44.8 | mg/kg | 1.5E-07 | mg/kg-day | 1.7E-02 | (mg/kg-day)$^{-1}$ | 2.5E-09 | 1.7E-06 | mg/kg-day | 1.0E-04 | mg/kg-day | 1.7E-02 |
| | | | Exposure Route Total | | | | | | | | 8.6E-09 | | | | | 1.8E-02 |
| | | | Inhalation of Particulates | Aluminum | 9,213 | mg/kg | 4.8E-06 | mg/m$^3$ | - | (mg/m$^3$)$^{-1}$ | - | 4.8E-06 | mg/m$^3$ | 4.9E-03 | mg/m$^3$ | 9.7E-04 |
| | | | | Antimony | 24.17 | mg/kg | 1.2E-08 | mg/m$^3$ | - | (mg/m$^3$)$^{-1}$ | - | 1.2E-08 | mg/m$^3$ | - | mg/m$^3$ | - |
| | | | | Arsenic | 4.09 | mg/kg | 2.1E-09 | mg/m$^3$ | 4.3E+00 | (mg/m$^3$)$^{-1}$ | 9.1E-09 | 2.1E-09 | mg/m$^3$ | - | mg/m$^3$ | - |
| | | | | 2.8E-08 | 285.4 | mg/kg | 1.5E-07 | mg/m$^3$ | - | (mg/m$^3$)$^{-1}$ | - | 1.5E-07 | mg/m$^3$ | - | mg/m$^3$ | - |
| | | | | Tungsten | 1.92 | mg/kg | 9.9E-10 | mg/m$^3$ | - | (mg/m$^3$)$^{-1}$ | - | 9.9E-10 | mg/m$^3$ | - | mg/m$^3$ | - |
| | | | | Vanadium | 17.4 | mg/kg | 9.0E-09 | mg/m$^3$ | - | (mg/m$^3$)$^{-1}$ | - | 9.0E-09 | mg/m$^3$ | - | mg/m$^3$ | - |
| | | | | 1,3-diethyl-1,3-diphenyl urea | 0.76 | mg/kg | 3.9E-10 | mg/m$^3$ | - | (mg/m$^3$)$^{-1}$ | - | 3.9E-10 | mg/m$^3$ | - | mg/m$^3$ | - |
| | | | | Nitroglycerin | 44.8 | mg/kg | 2.3E-08 | mg/m$^3$ | - | (mg/m$^3$)$^{-1}$ | - | 2.3E-08 | mg/m$^3$ | - | mg/m$^3$ | - |
| | | | Exposure Route Total | | | | | | | | 9.1E-09 | | | | | 9.7E-04 |
| | | Exposure Point Total | | | | | | | | | 4.5E-08 | | | | | 4.4E-02 |
| | Exposure Medium Total | | | | | | | | | | 4.5E-08 | | | | | 4.4E-02 |
| Medium Total | | | | | | | | | | | 4.5E-08 | | | | | 4.4E-02 |

**SRF Table 7.4b**
**Calculation of Chemical Cancer Risks and Non-Cancer Hazards**
**Area 2 (Post-Excavation) and Area 3 - Hunter- Reasonable Maximum Exposure**

Scenario Timeframe: Current/Potential
Receptor Population: Hunter
Receptor Age: Adult (18+ years)

| Medium | Exposure Medium | Exposure Point | Exposure Route | Contaminant of Potential Concern | EPC Value | EPC Units | Cancer Intake/Exposure Concentration Value | Cancer Intake/Exposure Concentration Units | CSF / Unit Risk Value | CSF / Unit Risk Units | Cancer Risk | Non-Cancer Intake/Exposure Concentration Value | Non-Cancer Intake/Exposure Concentration Units | RfD / RfC Value | RfD / RfC Units | Hazard Quotient |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Soil | Surface Soil (0-1 ft bgs) | Areas 2 & 3 | Ingestion | Aluminum | 13,190 | mg/kg | 5.3E-05 | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | 6.2E-04 | mg/kg-day | 1.0E+00 | mg/kg-day | 6.2E-04 |
| | | | | Arsenic | 3.9 | mg/kg | 1.6E-08 | mg/kg-day | 1.5E+00 | $(mg/kg\text{-}day)^{-1}$ | 2.4E-08 | 1.8E-07 | mg/kg-day | 3.0E-04 | mg/kg-day | 6.1E-04 |
| | | | | Tungsten | 6.83 | mg/kg | 2.7E-08 | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | 3.2E-07 | mg/kg-day | 2.0E-02 | mg/kg-day | 1.6E-05 |
| | | | | Vanadium | 28.98 | mg/kg | 1.2E-07 | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | 1.4E-06 | mg/kg-day | 1.0E-03 | mg/kg-day | 1.4E-03 |
| | | | Exposure Route Total | | | | | | | | 2.4E-08 | | | | | 2.6E-03 |
| | | | Dermal Absorption | Aluminum | 13,190 | mg/kg | | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | | mg/kg-day | 1.0E+00 | mg/kg-day | |
| | | | | Arsenic | 3.9 | mg/kg | 3.9E-09 | mg/kg-day | 1.5E+00 | $(mg/kg\text{-}day)^{-1}$ | 5.8E-09 | 4.5E-08 | mg/kg-day | 3.0E-04 | mg/kg-day | 1.5E-04 |
| | | | | Tungsten | 6.83 | mg/kg | | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | | mg/kg-day | 2.0E-02 | mg/kg-day | |
| | | | | Vanadium | 28.98 | mg/kg | | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | | mg/kg-day | 2.6E-05 | mg/kg-day | |
| | | | Exposure Route Total | | | | | | | | 5.8E-09 | | | | | 1.5E-04 |
| | | | Inhalation of Particulates | Aluminum | 13,190 | mg/kg | 6.8E-06 | $mg/m^3$ | - | $(mg/m^3)^{-1}$ | - | 6.8E-06 | $mg/m^3$ | 4.9E-03 | $mg/m^3$ | 1.4E-03 |
| | | | | Arsenic | 3.9 | mg/kg | 2.0E-09 | $mg/m^3$ | 4.3E+00 | $(mg/m^3)^{-1}$ | 8.6E-09 | 2.0E-09 | $mg/m^3$ | - | $mg/m^3$ | - |
| | | | | Tungsten | 6.83 | mg/kg | 3.5E-09 | $mg/m^3$ | - | $(mg/m^3)^{-1}$ | - | 3.5E-09 | $mg/m^3$ | - | $mg/m^3$ | - |
| | | | | Vanadium | 28.98 | mg/kg | 1.5E-08 | $mg/m^3$ | - | $(mg/m^3)^{-1}$ | - | 1.5E-08 | $mg/m^3$ | - | $mg/m^3$ | - |
| | | | Exposure Route Total | | | | | | | | 8.6E-09 | | | | | 1.4E-03 |
| | | Exposure Point Total | | | | | | | | | 3.8E-08 | | | | | 4.1E-03 |
| | Exposure Medium Total | | | | | | | | | | 3.8E-08 | | | | | 4.1E-03 |
| Medium Total | | | | | | | | | | | 3.8E-08 | | | | | 4.1E-03 |

# SRF Table 7.5a
## Calculation of Chemical Cancer Risks and Non-Cancer Hazards
## Area 1 - Construction Worker - Reasonable Maximum Exposure

Scenario Timeframe: Future Potential
Receptor Population: Construction Worker
Receptor Age: Adult (18+ years)

| Medium | Exposure Medium | Exposure Point | Exposure Route | Contaminant of Potential Concern | EPC | | Cancer Risk Calculations | | | | | Non-Cancer Hazard Calculations | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Intake/Exposure Concentration | | CSF / Unit Risk | | Cancer Risk | Intake/Exposure Concentration | | RfD / RfC | | Hazard Quotient |
| | | | | | Value | Units | Value | Units | Value | Units | | Value | Units | Value | Units | |
| Soil | Surface and Subsurface Soil (0-10 ft bgs) | Area 1 | Ingestion | Aluminum | 9,213 | mg/kg | 2.2E-05 | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | 1.5E-03 | mg/kg-day | 1.0E+00 | mg/kg-day | 1.5E-03 |
| | | | | Antimony | 24.17 | mg/kg | 5.8E-08 | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | 4.1E-06 | mg/kg-day | 4.0E-04 | mg/kg-day | 1.0E-02 |
| | | | | Arsenic | 4.09 | mg/kg | 9.8E-09 | mg/kg-day | 1.5E+00 | $(mg/kg\text{-}day)^{-1}$ | 1.5E-08 | 6.9E-07 | mg/kg-day | 3.0E-04 | mg/kg-day | 2.3E-03 |
| | | | | Lead | 285.4 | mg/kg | 6.8E-07 | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | 4.8E-05 | mg/kg-day | - | mg/kg-day | - |
| | | | | Tungsten | 1.92 | mg/kg | 4.6E-09 | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | 3.2E-07 | mg/kg-day | 2.0E-02 | mg/kg-day | 1.6E-05 |
| | | | | Vanadium | 17.4 | mg/kg | 4.2E-08 | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | 2.9E-06 | mg/kg-day | 1.0E-03 | mg/kg-day | 2.9E-03 |
| | | | | 1,3-diethyl-1,3-diphenyl urea | 0.76 | mg/kg | 1.8E-09 | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | 1.3E-07 | mg/kg-day | - | mg/kg-day | - |
| | | | | Nitroglycerin | 44.8 | mg/kg | 1.1E-07 | mg/kg-day | 1.7E-02 | $(mg/kg\text{-}day)^{-1}$ | 1.8E-09 | 7.5E-06 | mg/kg-day | 1.0E-04 | mg/kg-day | 7.5E-02 |
| | | | Exposure Route Total | | | | | | | | 1.7E-08 | | | | | 9.2E-02 |
| | | | Dermal Absorption | Aluminum | 9,213 | mg/kg | | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | | mg/kg-day | 1.0E+00 | mg/kg-day | - |
| | | | | Antimony | 24.17 | mg/kg | | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | | mg/kg-day | 6.0E-05 | mg/kg-day | - |
| | | | | Arsenic | 4.09 | mg/kg | 7.4E-10 | mg/kg-day | 1.5E+00 | $(mg/kg\text{-}day)^{-1}$ | 1.1E-09 | 5.1E-08 | mg/kg-day | 3.0E-04 | mg/kg-day | 1.7E-04 |
| | | | | Lead | 285.4 | mg/kg | | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | | mg/kg-day | - | mg/kg-day | - |
| | | | | Tungsten | 1.92 | mg/kg | | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | | mg/kg-day | 2.0E-02 | mg/kg-day | |
| | | | | Vanadium | 17.4 | mg/kg | | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | | mg/kg-day | 2.6E-05 | mg/kg-day | |
| | | | | 1,3-diethyl-1,3-diphenyl urea | 0.76 | mg/kg | 4.6E-10 | mg/kg-day | - | $(mg/kg\text{-}day)^{-1}$ | - | 3.2E-08 | mg/kg-day | - | mg/kg-day | - |
| | | | | Nitroglycerin | 44.8 | mg/kg | 2.7E-08 | mg/kg-day | 1.7E-02 | $(mg/kg\text{-}day)^{-1}$ | 4.6E-10 | 1.9E-06 | mg/kg-day | 1.0E-04 | mg/kg-day | 1.9E-02 |
| | | | Exposure Route Total | | | | | | | | 1.6E-09 | | | | | 1.9E-02 |
| | | | Inhalation o Particulates | Aluminum | 9,213 | mg/kg | 9.6E-04 | mg/m$^3$ | - | $(mg/m^3)^{-1}$ | - | 9.6E-04 | mg/m$^3$ | 4.9E-03 | mg/m$^3$ | 2.0E-01 |
| | | | | Antimony | 24.17 | mg/kg | 2.5E-06 | mg/m$^3$ | - | $(mg/m^3)^{-1}$ | - | 2.5E-06 | mg/m$^3$ | - | mg/m$^3$ | - |
| | | | | Arsenic | 4.09 | mg/kg | 4.3E-07 | mg/m$^3$ | 4.3E+00 | $(mg/m^3)^{-1}$ | 1.8E-06 | 4.3E-07 | mg/m$^3$ | - | mg/m$^3$ | - |
| | | | | Lead | 285.4 | mg/kg | 3.0E-05 | mg/m$^3$ | - | $(mg/m^3)^{-1}$ | - | 3.0E-05 | mg/m$^3$ | - | mg/m$^3$ | - |
| | | | | Tungsten | 1.92 | mg/kg | 2.0E-07 | mg/m$^3$ | - | $(mg/m^3)^{-1}$ | - | 2.0E-07 | mg/m$^3$ | - | mg/m$^3$ | - |
| | | | | Vanadium | 17.4 | mg/kg | 1.8E-06 | mg/m$^3$ | - | $(mg/m^3)^{-1}$ | - | 1.8E-06 | mg/m$^3$ | - | mg/m$^3$ | - |
| | | | | 1,3-diethyl-1,3-diphenyl urea | 0.76 | mg/kg | 7.9E-08 | mg/m$^3$ | - | $(mg/m^3)^{-1}$ | - | 7.9E-08 | mg/m$^3$ | - | mg/m$^3$ | - |
| | | | | Nitroglycerin | 44.8 | mg/kg | 4.7E-06 | mg/m$^3$ | - | $(mg/m^3)^{-1}$ | - | 4.7E-06 | mg/m$^3$ | - | mg/m$^3$ | - |
| | | | Exposure Route Total | | | | | | | | 1.8E-06 | | | | | 2.0E-01 |
| | | Exposure Point Total | | | | | | | | | 1.8E-06 | | | | | 3.1E-01 |
| | Exposure Medium Total | | | | | | | | | | 1.8E-06 | | | | | 3.1E-01 |
| Medium Total | | | | | | | | | | | 1.8E-06 | | | | | 3.1E-01 |

# SRF Table 7.5b
## Calculation of Chemical Cancer Risks and Non-Cancer Hazards
## Area 2 (Post-Excavation) and Area 3 - Construction Work - Reasonable Maximum Exposure

Scenario Timeframe: Future Potential
Receptor Population: Construction Worker
Receptor Age: Adult (18+ years)

| Medium | Exposure Medium | Exposure Point | Exposure Route | Contaminant of Potential Concern | EPC | | Cancer Risk Calculations | | | | | Non-Cancer Hazard Calculations | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Intake/Exposure Concentration | | CSF / Unit Risk | | Cancer Risk | Intake/Exposure Concentration | | RfD / RfC | | Hazard Quotient |
| | | | | | Value | Units | Value | Units | Value | Units | | Value | Units | Value | Units | |
| Soil | Surface and Subsurface Soil (0-10 ft bgs) | Areas 2 & 3 | Ingestion | Aluminum | 13,190 | mg/kg | 3.2E-05 | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | 2.2E-03 | mg/kg-day | 1.0E+00 | mg/kg-day | 2.2E-03 |
| | | | | Arsenic | 3.9 | mg/kg | 9.4E-09 | mg/kg-day | 1.5E+00 | (mg/kg-day)$^{-1}$ | 1.4E-08 | 6.5E-07 | mg/kg-day | 3.0E-04 | mg/kg-day | 2.2E-03 |
| | | | | Tungsten | 6.83 | mg/kg | 1.6E-08 | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | 1.1E-06 | mg/kg-day | 2.0E-02 | mg/kg-day | 5.7E-05 |
| | | | | Vanadium | 28.98 | mg/kg | 7.0E-08 | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | 4.9E-06 | mg/kg-day | 1.0E-03 | mg/kg-day | 4.9E-03 |
| | | | Exposure Route Total | | | | | | | | 1.4E-08 | | | | | 9.3E-03 |
| | | | Dermal Absorption | Aluminum | 13,190 | mg/kg | | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | | mg/kg-day | 1.0E+00 | mg/kg-day | |
| | | | | Arsenic | 3.9 | mg/kg | 7.0E-10 | mg/kg-day | 1.5E+00 | (mg/kg-day)$^{-1}$ | 1.1E-09 | 4.9E-08 | mg/kg-day | 3.0E-04 | mg/kg-day | 1.6E-04 |
| | | | | Tungsten | 6.83 | mg/kg | | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | | mg/kg-day | 2.0E-02 | mg/kg-day | |
| | | | | Vanadium | 28.98 | mg/kg | | mg/kg-day | - | (mg/kg-day)$^{-1}$ | - | | mg/kg-day | 2.6E-05 | mg/kg-day | |
| | | | Exposure Route Total | | | | | | | | 1.1E-09 | | | | | 1.6E-04 |
| | | | Inhalation of Particulates | Aluminum | 13,190 | mg/kg | 1.4E-03 | mg/m$^3$ | - | (mg/m$^3$)$^{-1}$ | - | 1.4E-03 | mg/m$^3$ | 4.9E-03 | mg/m$^3$ | 2.8E-01 |
| | | | | Arsenic | 3.9 | mg/kg | 4.1E-07 | mg/m$^3$ | 4.3E+00 | (mg/m$^3$)$^{-1}$ | 1.7E-06 | 4.1E-07 | mg/m$^3$ | - | mg/m$^3$ | - |
| | | | | Tungsten | 6.83 | mg/kg | 7.1E-07 | mg/m$^3$ | - | (mg/m$^3$)$^{-1}$ | - | 7.1E-07 | mg/m$^3$ | - | mg/m$^3$ | - |
| | | | | Vanadium | 28.98 | mg/kg | 3.0E-06 | mg/m$^3$ | - | (mg/m$^3$)$^{-1}$ | - | 3.0E-06 | mg/m$^3$ | - | mg/m$^3$ | - |
| | | | Exposure Route Total | | | | | | | | 1.7E-06 | | | | | 2.8E-01 |
| | | Exposure Point Total | | | | | | | | | 1.8E-06 | | | | | 2.9E-01 |
| | Exposure Medium Total | | | | | | | | | | 1.8E-06 | | | | | 2.9E-01 |
| Medium Total | | | | | | | | | | | 1.8E-06 | | | | | 2.9E-01 |

## SRF Table 7.6a
## Calculation of Chemical Cancer Risks and Non-Cancer Hazards
## Area 1 - Hypothetical Resident - Reasonable Maximum Exposure

| |
|---|
| Scenario Timeframe: Future Potential |
| Receptor Population: Hypothetical Resident |
| Receptor Age: Child (1-7 years) & Adult (18+ years) |

| Medium | Exposure Medium | Exposure Point | Exposure Route | Contaminant of Potential Concern | EPC | | Cancer Risk Calculations | | | | | Non-Cancer Hazard Calculations | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Intake/Exposure Concentration | | CSF / Unit Risk | | Cancer Risk | Intake/Exposure Concentration | | | RfD / RfC | | Hazard Quotient | Hazard Quotient |
| | | | | | Value | Units | Value | Units | Value | Units | | Child Value | Adult Value | Units | Value | Units | Child | Adult |
| Soil | Surface and Subsurface Soil (0-10 ft bgs) | Area 1 | Ingestion | Aluminum | 9,213 | mg/kg | 2.1E-03 | mg/kg-day | - | $(mg/kg-day)^{-1}$ | - | 3.2E-02 | 3.4E-03 | mg/kg-day | 1.0E+00 | mg/kg-day | 3.2E-02 | 3.4E-03 |
| | | | | Antimony | 24.17 | mg/kg | 5.5E-06 | mg/kg-day | - | $(mg/kg-day)^{-1}$ | - | 8.4E-05 | 9.0E-06 | mg/kg-day | 4.0E-04 | mg/kg-day | 2.1E-01 | 2.2E-02 |
| | | | | Arsenic | 4.09 | mg/kg | 9.3E-07 | mg/kg-day | 1.5E+00 | $(mg/kg-day)^{-1}$ | 1.4E-06 | 1.4E-05 | 1.5E-06 | mg/kg-day | 3.0E-04 | mg/kg-day | 4.7E-02 | 5.1E-03 |
| | | | | Lead | 285.4 | mg/kg | 6.5E-05 | mg/kg-day | - | $(mg/kg-day)^{-1}$ | - | 9.9E-04 | 1.1E-04 | mg/kg-day | - | mg/kg-day | - | - |
| | | | | Tungsten | 1.92 | mg/kg | 4.4E-07 | mg/kg-day | - | $(mg/kg-day)^{-1}$ | - | 6.7E-06 | 7.1E-07 | mg/kg-day | 2.0E-02 | mg/kg-day | 3.3E-04 | 3.6E-05 |
| | | | | Vanadium | 17.4 | mg/kg | 4.0E-06 | mg/kg-day | - | $(mg/kg-day)^{-1}$ | - | 6.0E-05 | 6.5E-06 | mg/kg-day | 1.0E-03 | mg/kg-day | 6.0E-02 | 6.5E-03 |
| | | | | 1,3-diethyl-1,3-diphenyl urea | 0.76 | mg/kg | 1.7E-07 | mg/kg-day | - | $(mg/kg-day)^{-1}$ | - | 2.6E-06 | 2.8E-07 | mg/kg-day | - | mg/kg-day | - | - |
| | | | | Nitroglycerin | 44.8 | mg/kg | 1.0E-05 | mg/kg-day | 1.7E-02 | $(mg/kg-day)^{-1}$ | 1.7E-07 | 1.6E-04 | 1.7E-05 | mg/kg-day | 1.0E-04 | mg/kg-day | 1.6E+00 | 1.7E-01 |
| | | | Exposure Route Total | | | | | | | | 1.6E-06 | | | | | | 1.9E+00 | 2.0E-01 |
| | | | Dermal Absorption | Aluminum | 9,213 | mg/kg | | mg/kg-day | - | $(mg/kg-day)^{-1}$ | - | | | mg/kg-day | 1.0E+00 | mg/kg-day | - | - |
| | | | | Antimony | 24.17 | mg/kg | | mg/kg-day | - | $(mg/kg-day)^{-1}$ | - | | | mg/kg-day | 6.0E-05 | mg/kg-day | - | - |
| | | | | Arsenic | 4.09 | mg/kg | 2.3E-07 | mg/kg-day | 1.5E+00 | $(mg/kg-day)^{-1}$ | 3.4E-07 | 2.4E-06 | 3.6E-07 | mg/kg-day | 3.0E-04 | mg/kg-day | 7.9E-03 | 1.2E-03 |
| | | | | Lead | 285.4 | mg/kg | | mg/kg-day | - | $(mg/kg-day)^{-1}$ | - | | | mg/kg-day | - | mg/kg-day | - | - |
| | | | | Tungsten | 1.92 | mg/kg | | mg/kg-day | - | $(mg/kg-day)^{-1}$ | - | | | mg/kg-day | 2.0E-02 | mg/kg-day | | |
| | | | | Vanadium | 17.4 | mg/kg | | mg/kg-day | - | $(mg/kg-day)^{-1}$ | - | | | mg/kg-day | 2.6E-05 | mg/kg-day | | |
| | | | | 1,3-diethyl-1,3-diphenyl urea | 0.76 | mg/kg | 1.4E-07 | mg/kg-day | - | $(mg/kg-day)^{-1}$ | - | 1.5E-06 | 2.3E-07 | mg/kg-day | - | mg/kg-day | - | - |
| | | | | Nitroglycerin | 44.8 | mg/kg | 8.3E-06 | mg/kg-day | 1.7E-02 | $(mg/kg-day)^{-1}$ | 1.4E-07 | 8.7E-05 | 1.3E-05 | mg/kg-day | 1.0E-04 | mg/kg-day | 8.7E-01 | 1.3E-01 |
| | | | Exposure Route Total | | | | | | | | 4.8E-07 | | | | | | 8.8E-01 | 1.3E-01 |
| | | | Inhalation of Particulates | Aluminum | 9,213 | mg/kg | 4.8E-06 | $mg/m^3$ | - | $(mg/m^3)^{-1}$ | - | 4.8E-06 | 4.8E-06 | $mg/m^3$ | 4.9E-03 | $mg/m^3$ | 9.7E-04 | 9.7E-04 |
| | | | | Antimony | 24.17 | mg/kg | 1.2E-08 | $mg/m^3$ | - | $(mg/m^3)^{-1}$ | - | 1.2E-08 | 1.2E-08 | $mg/m^3$ | - | $mg/m^3$ | - | - |
| | | | | Arsenic | 4.09 | mg/kg | 2.1E-09 | $mg/m^3$ | 4.3E+00 | $(mg/m^3)^{-1}$ | 9.1E-09 | 2.1E-09 | 2.1E-09 | $mg/m^3$ | - | $mg/m^3$ | - | - |
| | | | | Lead | 285.4 | mg/kg | 1.5E-07 | $mg/m^3$ | - | $(mg/m^3)^{-1}$ | - | 1.5E-07 | 1.5E-07 | $mg/m^3$ | - | $mg/m^3$ | - | - |
| | | | | Tungsten | 1.92 | mg/kg | 9.9E-10 | $mg/m^3$ | - | $(mg/m^3)^{-1}$ | - | 9.9E-10 | 9.9E-10 | $mg/m^3$ | - | $mg/m^3$ | - | - |
| | | | | Vanadium | 17.4 | mg/kg | 9.0E-09 | $mg/m^3$ | - | $(mg/m^3)^{-1}$ | - | 9.0E-09 | 9.0E-09 | $mg/m^3$ | - | $mg/m^3$ | - | - |
| | | | | 1,3-diethyl-1,3-diphenyl urea | 0.76 | mg/kg | 3.9E-10 | $mg/m^3$ | - | $(mg/m^3)^{-1}$ | - | 3.9E-10 | 3.9E-10 | $mg/m^3$ | - | $mg/m^3$ | - | - |
| | | | | Nitroglycerin | 44.8 | mg/kg | 2.3E-08 | $mg/m^3$ | - | $(mg/m^3)^{-1}$ | - | 2.3E-08 | 2.3E-08 | $mg/m^3$ | - | $mg/m^3$ | - | - |
| | | | Exposure Route Total | | | | | | | | 9.1E-09 | | | | | | 9.7E-04 | 9.7E-04 |
| | | Exposure Point Total | | | | | | | | | 2.1E-06 | | | | | | 2.8E+00 | 3.4E-01 |
| | Exposure Medium Total | | | | | | | | | | 2.1E-06 | | | | | | 2.8E+00 | 3.4E-01 |
| Medium Total | | | | | | | | | | | 2.1E-06 | | | | | | 2.8E+00 | 3.4E-01 |

# SRF Table 7.6b
## Calculation of Chemical Cancer Risks and Non-Cancer Hazards
## Area 2 (Post-Excavation) and Area 3 - Hypothetical Resident - Reasonable Maximum Exposure

Scenario Timeframe: Future Potential
Receptor Population: Hypothetical Resident
Receptor Age: Child (1-7 years) & Adult (18+ years)

| Medium | Exposure Medium | Exposure Point | Exposure Route | Contaminant of Potential Concern | EPC | | Cancer Risk Calculations | | | | | Non-Cancer Hazard Calculations | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Intake/Exposure Concentration | | CSF / Unit Risk | | Cancer Risk | Intake/Exposure Concentration | | | RfD / RfC | | Hazard Quotient | Hazard Quotient |
| | | | | | Value | Units | Value | Units | Value | Units | | Child Value | Adult Value | Units | Value | Units | Child | Adult |
| Soil | Surface and Subsurface Soil (0-10 ft bgs) | Areas 2 & 3 | Ingestion | Aluminum | 13,190 | mg/kg | 3.0E-03 | mg/kg-day | - | $(mg/kg-day)^{-1}$ | - | 4.6E-02 | 4.9E-03 | mg/kg-day | 1.0E+00 | mg/kg-day | 4.6E-02 | 4.9E-03 |
| | | | | Arsenic | 3.9 | mg/kg | 8.8E-07 | mg/kg-day | 1.5E+00 | $(mg/kg-day)^{-1}$ | 1.3E-06 | 1.4E-05 | 1.5E-06 | mg/kg-day | 3.0E-04 | mg/kg-day | 4.5E-02 | 4.8E-03 |
| | | | | Tungsten | 6.83 | mg/kg | 1.5E-06 | mg/kg-day | - | $(mg/kg-day)^{-1}$ | - | 2.4E-05 | 2.5E-06 | mg/kg-day | 2.0E-02 | mg/kg-day | 1.2E-03 | 1.3E-04 |
| | | | | Vanadium | 28.98 | mg/kg | 6.6E-06 | mg/kg-day | - | $(mg/kg-day)^{-1}$ | - | 1.0E-04 | 1.1E-05 | mg/kg-day | 1.0E-03 | mg/kg-day | 1.0E-01 | 1.1E-02 |
| | | | Exposure Route Total | | | | | | | | 1.3E-06 | | | | | | 1.9E-01 | 2.1E-02 |
| | | | Dermal Absorption | Aluminum | 13,190 | mg/kg | | mg/kg-day | - | $(mg/kg-day)^{-1}$ | - | | | mg/kg-day | 1.0E+00 | mg/kg-day | | |
| | | | | Arsenic | 3.9 | mg/kg | 2.2E-07 | mg/kg-day | 1.5E+00 | $(mg/kg-day)^{-1}$ | 3.3E-07 | 2.3E-06 | 3.5E-07 | mg/kg-day | 3.0E-04 | mg/kg-day | 7.6E-03 | 1.2E-03 |
| | | | | Tungsten | 6.83 | mg/kg | | mg/kg-day | - | $(mg/kg-day)^{-1}$ | - | | | mg/kg-day | 2.0E-02 | mg/kg-day | | |
| | | | | Vanadium | 28.98 | mg/kg | | mg/kg-day | - | $(mg/kg-day)^{-1}$ | - | | | mg/kg-day | 2.6E-05 | mg/kg-day | | |
| | | | Exposure Route Total | | | | | | | | 3.3E-07 | | | | | | 7.6E-03 | 1.2E-03 |
| | | | Inhalation of Particulates | Aluminum | 13,190 | mg/kg | 6.8E-06 | $mg/m^3$ | - | $(mg/m^3)^{-1}$ | - | 6.8E-06 | 6.8E-06 | $mg/m^3$ | 4.9E-03 | $mg/m^3$ | 1.4E-03 | 1.4E-03 |
| | | | | Arsenic | 3.9 | mg/kg | 2.0E-09 | $mg/m^3$ | 4.3E+00 | $(mg/m^3)^{-1}$ | 8.6E-09 | 2.0E-09 | 2.0E-09 | $mg/m^3$ | - | $mg/m^3$ | - | - |
| | | | | Tungsten | 6.83 | mg/kg | 3.5E-09 | $mg/m^3$ | - | $(mg/m^3)^{-1}$ | - | 3.5E-09 | 3.5E-09 | $mg/m^3$ | - | $mg/m^3$ | - | - |
| | | | | Vanadium | 28.98 | mg/kg | 1.5E-08 | $mg/m^3$ | - | $(mg/m^3)^{-1}$ | - | 1.5E-08 | 1.5E-08 | $mg/m^3$ | - | $mg/m^3$ | - | - |
| | | | Exposure Route Total | | | | | | | | 8.6E-09 | | | | | | 1.4E-03 | 1.4E-03 |
| | | Exposure Point Total | | | | | | | | | 1.7E-06 | | | | | | 2.0E-01 | 2.3E-02 |
| | Exposure Medium Total | | | | | | | | | | 1.7E-06 | | | | | | 2.0E-01 | 2.3E-02 |
| Medium Total | | | | | | | | | | | 1.7E-06 | | | | | | 2.0E-01 | 2.3E-02 |

**SRF Table 9.1a**
**Summary of Receptor Risks and Hazards for COPCs**
**Area 1 - Trespasser - Reasonable Maximum Exposure**

Scenario Timeframe: Current/Potential
Receptor Population: Trespasser
Receptor Age: Older child (12-18 yrs)

| Medium | Exposure Medium | Exposure Point | Contaminant of Potential Concern | Carcinogenic Risk | | | | | Non-Carcinogenic Hazard Quotient | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal Absorption | External (Radiation) | Exposure Routes Total | Primary Target Organ(s) | Ingestion | Inhalation | Dermal Absorption | Exposure Routes Total |
| Soil | Surface Soil (0-1 ft bgs) | Area 1 | Aluminum | - | - | - | - | - | Neurotoxicity | 1.5E-03 | 9.7E-04 | - | 2.4E-03 |
| | | | Antimony | - | - | - | - | - | Blood | 9.6E-03 | - | - | 9.6E-03 |
| | | | Arsenic | 8.4E-08 | 9.1E-09 | 1.8E-08 | - | 1.1E-07 | Pigmentation/keratosis | 2.2E-03 | - | 4.8E-04 | 2.6E-03 |
| | | | Lead | - | - | - | - | - | - | - | - | - | - |
| | | | Tungsten | - | - | - | - | - | - | 1.5E-05 | - | | 1.5E-05 |
| | | | Vanadium | - | - | - | - | - | - | 2.8E-03 | - | | 2.8E-03 |
| | | | 1,3-diethyl-1,3-diphenyl urea | - | - | - | - | - | - | - | - | - | - |
| | | | Nitroglycerin | 1.0E-08 | - | 7.6E-09 | - | 1.8E-08 | Tachycardia | 7.1E-02 | - | 5.2E-02 | 1.2E-01 |
| | | | Chemical Total | | | | | 1.3E-07 | | | | | 1.4E-01 |
| | | Exposure Point Total | | | | | | 1.3E-07 | | | | | 1.4E-01 |
| | Exposure Medium Total | | | | | | | 1.3E-07 | | | | | 1.4E-01 |
| Medium Total | | | | | | | | 1.3E-07 | | | | | 1.4E-01 |
| Receptor Total | | | | | | | Receptor Risk Total | 1.3E-07 | | | | Receptor HI Total | 1.4E-01 |

## SRF Table 9.1b
## Summary of Receptor Risks and Hazards for COPCs
## Area 2 (Post-Excavation) and Area 3 - Trespasser - Reasonable Maximum Exposure

Scenario Timeframe: Current/Potential
Receptor Population: Trespasser
Receptor Age: Older child (12-18 yrs)

| Medium | Exposure Medium | Exposure Point | Contaminant of Potential Concern | Carcinogenic Risk: Ingestion | Carcinogenic Risk: Inhalation | Carcinogenic Risk: Dermal Absorption | Carcinogenic Risk: External (Radiation) | Carcinogenic Risk: Exposure Routes Total | Non-Carcinogenic Hazard Quotient: Primary Target Organ(s) | Non-Carcinogenic Hazard Quotient: Ingestion | Non-Carcinogenic Hazard Quotient: Inhalation | Non-Carcinogenic Hazard Quotient: Dermal Absorption | Non-Carcinogenic Hazard Quotient: Exposure Routes Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Soil | Surface Soil (0-1 ft bgs) | Areas 2 & 3 | Aluminum | - | - | - | - | - | Neurotoxicity | 2.1E-03 | 1.4E-03 | | 3.5E-03 |
| | | | Arsenic | 8.0E-08 | 8.6E-09 | 1.8E-08 | - | 1.1E-07 | Pigmentation/keratosis | 2.1E-03 | - | 4.6E-04 | 2.5E-03 |
| | | | Tungsten | - | - | - | - | - | - | 5.4E-05 | - | | 5.4E-05 |
| | | | Vanadium | - | - | - | - | - | - | 4.6E-03 | - | | 4.6E-03 |
| | | | Chemical Total | | | | | 1.1E-07 | | | | | 1.1E-02 |
| | | Exposure Point Total | | | | | | 1.1E-07 | | | | | 1.1E-02 |
| | Exposure Medium Total | | | | | | | 1.1E-07 | | | | | 1.1E-02 |
| Medium Total | | | | | | | | 1.1E-07 | | | | | 1.1E-02 |
| Receptor Total | | | | | | | Receptor Risk Total | 1.1E-07 | | | | Receptor HI Total | 1.1E-02 |

## SRF Table 9.2a
## Summary of Receptor Risks and Hazards for COPCs
## Area 1 - Military Personnel Firearms Training - Reasonable Maximum Exposure

| |
|---|
| Scenario Timeframe: Current / Potential |
| Receptor Population: Military Personnel Firearms Training |
| Receptor Age: Adult (18 to 28 yrs) |

| Medium | Exposure Medium | Exposure Point | Contaminant of Potential Concern | Carcinogenic Risk | | | | | Non-Carcinogenic Hazard Quotient | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal Absorption | External (Radiation) | Exposure Routes Total | Primary Target Organ(s) | Ingestion | Inhalation | Dermal Absorption | Exposure Routes Total |
| Soil | Surface Soil (0-1 ft bgs) | Area 1 | Aluminum | - | - | - | - | - | Neurotoxicity | 9.4E-05 | 9.7E-04 | - | 1.1E-03 |
| | | | Antimony | - | - | - | - | - | Blood | 6.2E-04 | - | - | 6.2E-04 |
| | | | Arsenic | 8.9E-09 | 9.1E-09 | 4.4E-09 | - | 2.2E-08 | Pigmentation/keratosis | 1.4E-04 | - | 6.9E-05 | 2.1E-04 |
| | | | Lead | - | - | - | - | - | - | - | - | - | - |
| | | | Tungsten | - | - | - | - | - | - | 9.8E-07 | - | | 9.8E-07 |
| | | | Vanadium | - | - | - | - | - | - | 1.8E-04 | - | | 1.8E-04 |
| | | | 1,3-diethyl-1,3-diphenyl urea | - | - | - | - | - | - | - | - | - | - |
| | | | Nitroglycerin | 1.1E-09 | - | 1.8E-09 | - | 2.9E-09 | Tachycardia | 4.6E-03 | - | 7.5E-03 | 1.2E-02 |
| | | | Chemical Total | | | | | 2.5E-08 | | | | | 1.4E-02 |
| | | Exposure Point Total | | | | | | 2.5E-08 | | | | | 1.4E-02 |
| | Exposure Medium Total | | | | | | | 2.5E-08 | | | | | 1.4E-02 |
| Medium Total | | | | | | | | 2.5E-08 | | | | | 1.4E-02 |
| Receptor Total | | | | | | | Receptor Risk Total | 2.5E-08 | | | | Receptor HI Total | 1.4E-02 |

## SRF Table 9.2b
## Summary of Receptor Risks and Hazards for COPCs
## Area 2 (Post-Excavation) and Area 3 - Military Personnel Firearms Training - Reasonable Maximum Exposure

Scenario Timeframe: Current / Potential
Receptor Population: Military Personnel Firearms Training
Receptor Age: Adult (18 to 28 yrs)

| Medium | Exposure Medium | Exposure Point | Contaminant of Potential Concern | Carcinogenic Risk | | | | | Non-Carcinogenic Hazard Quotient | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal Absorption | External (Radiation) | Exposure Routes Total | Primary Target Organ(s) | Ingestion | Inhalation | Dermal Absorption | Exposure Routes Total |
| Soil | Surface Soil (0-1 ft bgs) | Areas 2 & 3 | Aluminum | - | - | - | - | - | Neurotoxicity | 1.3E-04 | 1.4E-03 | | 1.5E-03 |
| | | | Arsenic | 8.5E-09 | 8.6E-09 | 4.2E-09 | - | 2.1E-08 | Pigmentation/keratosis | 1.3E-04 | - | 6.6E-05 | 2.0E-04 |
| | | | Tungsten | - | - | - | - | - | - | 3.5E-06 | - | | 3.5E-06 |
| | | | Vanadium | - | - | - | - | - | - | 3.0E-04 | - | | 3.0E-04 |
| | | | Chemical Total | | | | | 2.1E-08 | | | | | 2.0E-03 |
| | | Exposure Point Total | | | | | | 2.1E-08 | | | | | 2.0E-03 |
| | Exposure Medium Total | | | | | | | 2.1E-08 | | | | | 2.0E-03 |
| Medium Total | | | | | | | | 2.1E-08 | | | | | 2.0E-03 |
| Receptor Total | | | | | | | Receptor Risk Total | 2.1E-08 | | | | Receptor HI Total | 2.0E-03 |

# SRF Table 9.3a
## Summary of Receptor Risks and Hazards for COPCs
## Area 1 - Hunter - Reasonable Maximum Exposure

Scenario Timeframe: Current/Potential
Receptor Population: Hunter
Receptor Age: Adult (18+ years)

| Medium | Exposure Medium | Exposure Point | Contaminant of Potential Concern | Carcinogenic Risk | | | | | Non-Carcinogenic Hazard Quotient | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal Absorption | External (Radiation) | Exposure Routes Total | Primary Target Organ(s) | Ingestion | Inhalation | Dermal Absorption | Exposure Routes Total |
| Soil | Surface Soil (0-1 ft bgs) | Area 1 | Aluminum | - | - | - | - | - | Neurotoxicity | 4.3E-04 | 9.7E-04 | - | 1.4E-03 |
| | | | Antimony | - | - | - | - | - | Blood | 2.8E-03 | - | - | 2.8E-03 |
| | | | Arsenic | 2.5E-08 | 9.1E-09 | 6.1E-09 | - | 4.0E-08 | Pigmentation/keratosis | 6.4E-04 | - | 1.6E-04 | 8.0E-04 |
| | | | Lead | - | - | - | - | - | - | - | - | - | - |
| | | | Tungsten | - | - | - | - | - | - | 4.5E-06 | - | | 4.5E-06 |
| | | | Vanadium | - | - | - | - | - | - | 8.2E-04 | - | | 8.2E-04 |
| | | | 1,3-diethyl-1,3-diphenyl urea | - | - | - | - | - | - | - | - | - | - |
| | | | Nitroglycerin | 3.1E-09 | - | 2.5E-09 | - | 5.6E-09 | Tachycardia | 2.1E-02 | - | 1.7E-02 | 3.8E-02 |
| | | | Chemical Total | | | | | 4.5E-08 | | | | | 4.4E-02 |
| | | Exposure Point Total | | | | | | 4.5E-08 | | | | | 4.4E-02 |
| | Exposure Medium Total | | | | | | | 4.5E-08 | | | | | 4.4E-02 |
| Medium Total | | | | | | | | 4.5E-08 | | | | | 4.4E-02 |
| Receptor Total | | | | | | | Receptor Risk Total | 4.5E-08 | | | | Receptor HI Total | 4.4E-02 |

**SRF Table 9.3b**
**Summary of Receptor Risks and Hazards for COPCs**
**Area 2 (Post-Excavation) and Area 3 - Hunter - Reasonable Maximum Exposure**

Scenario Timeframe: Current/Potential
Receptor Population: Hunter
Receptor Age: Adult (18+ years)

| Medium | Exposure Medium | Exposure Point | Contaminant of Potential Concern | Carcinogenic Risk | | | | | Non-Carcinogenic Hazard Quotient | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal Absorption | External (Radiation) | Exposure Routes Total | Primary Target Organ(s) | Ingestion | Inhalation | Dermal Absorption | Exposure Routes Total |
| Soil | Surface Soil (0-1 ft bgs) | Areas 2 & 3 | Aluminum | - | - | - | - | - | Neurotoxicity | 6.2E-04 | 1.4E-03 | | 2.0E-03 |
| | | | Arsenic | 2.4E-08 | 8.6E-09 | 5.8E-09 | - | 3.8E-08 | Pigmentation/keratosis | 6.1E-04 | - | 1.5E-04 | 7.6E-04 |
| | | | Tungsten | - | - | - | - | - | - | 1.6E-05 | - | | 1.6E-05 |
| | | | Vanadium | - | - | - | - | - | - | 1.4E-03 | - | | 1.4E-03 |
| | | | Chemical Total | | | | | 3.8E-08 | | | | | 4.1E-03 |
| | | Exposure Point Total | | | | | | 3.8E-08 | | | | | 4.1E-03 |
| | Exposure Medium Total | | | | | | | 3.8E-08 | | | | | 4.1E-03 |
| Medium Total | | | | | | | | 3.8E-08 | | | | | 4.1E-03 |
| Receptor Total | | | | | | | Receptor Risk Total | 3.8E-08 | | | | Receptor HI Total | 4.1E-03 |

# SRF Table 9.4a
# Summary of Receptor Risks and Hazards for COPCs
# Area 1 - Construction Worker - Reasonable Maximum Exposure

Scenario Timeframe: Future Potential
Receptor Population: Construction Worker
Receptor Age: Adult (18+ years)

| Medium | Exposure Medium | Exposure Point | Contaminant of Potential Concern | Carcinogenic Risk | | | | | Non-Carcinogenic Hazard Quotient | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal Absorption | External (Radiation) | Exposure Routes Total | Primary Target Organ(s) | Ingestion | Inhalation | Dermal Absorption | Exposure Routes Total |
| Soil | Surface Soil (0-1 ft bgs) | Area 1 | Aluminum | - | - | - | - | - | Neurotoxicity | 1.5E-03 | 2.0E-01 | - | 2.0E-01 |
| | | | Antimony | - | - | - | - | - | Blood | 1.0E-02 | - | - | 1.0E-02 |
| | | | Arsenic | 1.5E-08 | 1.8E-06 | 1.1E-09 | - | 1.8E-06 | Pigmentation/keratosis | 2.3E-03 | - | 1.7E-04 | 2.5E-03 |
| | | | Lead | - | - | - | - | - | - | - | - | - | - |
| | | | Tungsten | - | - | - | - | - | - | 1.6E-05 | - | | 1.6E-05 |
| | | | Vanadium | - | - | - | - | - | - | 2.9E-03 | - | | 2.9E-03 |
| | | | 1,3-diethyl-1,3-diphenyl urea | - | - | - | - | - | - | - | - | - | - |
| | | | Nitroglycerin | 1.8E-09 | - | 4.6E-10 | - | 2.3E-09 | Tachycardia | 7.5E-02 | - | 1.9E-02 | 9.4E-02 |
| | | | Chemical Total | | | | | 1.8E-06 | | | | | 3.1E-01 |
| | | Exposure Point Total | | | | | | 1.8E-06 | | | | | 3.1E-01 |
| | Exposure Medium Total | | | | | | | 1.8E-06 | | | | | 3.1E-01 |
| Medium Total | | | | | | | | 1.8E-06 | | | | | 3.1E-01 |
| Receptor Total | | | | | | | Receptor Risk Total | 1.8E-06 | | | | Receptor HI Total | 3.1E-01 |

**SRF Table 9.4b**
**Summary of Receptor Risks and Hazards for COPCs**
**Area 2 (Post-Excavation) and Area 3 - Construction Worker - Reasonable Maximum Exposure**

Scenario Timeframe: Future Potential
Receptor Population: Construction Worker
Receptor Age: Adult (18+ years)

| Medium | Exposure Medium | Exposure Point | Contaminant of Potential Concern | Carcinogenic Risk | | | | | Non-Carcinogenic Hazard Quotient | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal Absorption | External (Radiation) | Exposure Routes Total | Primary Target Organ(s) | Ingestion | Inhalation | Dermal Absorption | Exposure Routes Total |
| Soil | Surface Soil (0-1 ft bgs) | Areas 2 & 3 | Aluminum | - | - | - | - | - | Neurotoxicity | 2.2E-03 | 2.8E-01 | | 2.8E-01 |
| | | | Arsenic | 1.4E-08 | 1.7E-06 | 1.1E-09 | - | 1.8E-06 | Pigmentation/keratosis | 2.2E-03 | - | 1.6E-04 | 2.3E-03 |
| | | | Tungsten | - | - | - | - | - | - | 5.7E-05 | - | | 5.7E-05 |
| | | | Vanadium | - | - | - | - | - | - | 4.9E-03 | - | | 4.9E-03 |
| | | | Chemical Total | | | | | 1.8E-06 | | | | | 2.9E-01 |
| | | Exposure Point Total | | | | | | 1.8E-06 | | | | | 2.9E-01 |
| | Exposure Medium Total | | | | | | | 1.8E-06 | | | | | 2.9E-01 |
| Medium Total | | | | | | | | 1.8E-06 | | | | | 2.9E-01 |
| Receptor Total | | | | | | | Receptor Risk Total | 1.8E-06 | | | | Receptor HI Total | 2.9E-01 |

## SRF Table 9.5a
## Summary of Receptor Risks and Hazards for COPCs
## Area 1 - Hypothetical Resident - Reasonable Maximum Exposure

Scenario Timeframe: Future Potential
Receptor Population: Hypothetical Resident
Receptor Age: Child (1-7 years) & Adult (18+ years)

| Medium | Exposure Medium | Exposure Point | Contaminant of Potential Concern | Carcinogenic Risk | | | | | Non-Carcinogenic Hazard Quotient | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal Absorption | External (Radiation) | Exposure Routes Total | Primary Target Organ(s) | Ingestion | | Inhalation | | Dermal Absorption | | Exposure Routes Total | |
| | | | | | | | | | | Child | Adult | Child | Adult | Child | Adult | Child | Adult |
| Soil | Surface Soil (0-1 ft bgs) | Area 1 | Aluminum | - | - | - | - | - | Neurotoxicity | 3.2E-02 | 3.4E-03 | 9.7E-04 | 9.7E-04 | - | - | 3.3E-02 | 4.4E-03 |
| | | | Antimony | - | - | - | - | - | Blood | 2.1E-01 | 2.2E-02 | - | - | - | - | 2.1E-01 | 2.2E-02 |
| | | | Arsenic | 1.4E-06 | 9.1E-09 | 3.4E-07 | - | 1.7E-06 | Pigmentation/keratosis | 4.7E-02 | 5.1E-03 | - | - | 7.9E-03 | 1.2E-03 | 5.5E-02 | 6.3E-03 |
| | | | Lead | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | | Tungsten | - | - | - | - | - | - | 3.3E-04 | 3.6E-05 | - | - | | | 3.3E-04 | 3.6E-05 |
| | | | Vanadium | - | - | - | - | - | - | 6.0E-02 | 6.5E-03 | - | - | | | 6.0E-02 | 6.5E-03 |
| | | | 1,3-diethyl-1,3-diphenyl urea | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | | Nitroglycerin | 1.7E-07 | - | 1.4E-07 | - | 3.1E-07 | Tachycardia | 1.6E+00 | 1.7E-01 | - | - | 8.7E-01 | 1.3E-01 | 2.4E+00 | 3.0E-01 |
| | | | Chemical Total | | | | | 2.1E-06 | | | | | | | | 2.8E+00 | 3.4E-01 |
| | | Exposure Point Total | | | | | | 2.1E-06 | | | | | | | | 2.8E+00 | 3.4E-01 |
| | Exposure Medium Total | | | | | | | 2.1E-06 | | | | | | | | 2.8E+00 | 3.4E-01 |
| Medium Total | | | | | | | | 2.1E-06 | | | | | | | | 2.8E+00 | 3.4E-01 |
| Receptor Total | | | | | | | Receptor Risk Total | 2.1E-06 | | | | | | | Receptor HI Total | 2.8E+00 | 3.4E-01 |

## SRF Table 9.5b
## Summary of Receptor Risks and Hazards for COPCs
## Area 2 (Post-Excavation) and Area 3 - Hypotheitcal Resident - Reasonable Maximum Exposure

Scenario Timeframe: Future Potential
Receptor Population: Hypothetical Resident
Receptor Age: Child (1-7 years) & Adult (18+ years)

| Medium | Exposure Medium | Exposure Point | Contaminant of Potential Concern | Carcinogenic Risk | | | | | Non-Carcinogenic Hazard Quotient | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal Absorption | External (Radiation) | Exposure Routes Total | Primary Target Organ(s) | Ingestion | | Inhalation | | Dermal Absorption | | Exposure Routes Total | |
| | | | | | | | | | | Child | Adult | Child | Adult | Child | Adult | Child | Adult |
| Soil | Surface Soil (0-1 ft bgs) | Areas 2 & 3 | Aluminum | - | - | - | - | - | Neurotoxicity | 4.6E-02 | 4.9E-03 | 1.4E-03 | 1.4E-03 | | | 4.7E-02 | 6.3E-03 |
| | | | Arsenic | 1.3E-06 | 8.6E-09 | 3.3E-07 | - | 1.7E-06 | Pigmentation/keratosis | 4.5E-02 | 4.8E-03 | - | - | 7.6E-03 | 1.2E-03 | 5.3E-02 | 6.0E-03 |
| | | | Tungsten | - | - | - | - | - | - | 1.2E-03 | 1.3E-04 | - | - | | | 1.2E-03 | 1.3E-04 |
| | | | Vanadium | - | - | - | - | - | - | 1.0E-01 | 1.1E-02 | - | - | | | 1.0E-01 | 1.1E-02 |
| | | | Chemical Total | | | | | 1.7E-06 | | | | | | | | 2.0E-01 | 2.3E-02 |
| | | Exposure Point Total | | | | | | 1.7E-06 | | | | | | | | 2.0E-01 | 2.3E-02 |
| | Exposure Medium Total | | | | | | | 1.7E-06 | | | | | | | | 2.0E-01 | 2.3E-02 |
| Medium Total | | | | | | | | 1.7E-06 | | | | | | | | 2.0E-01 | 2.3E-02 |
| Receptor Total | | | | | | | Receptor Risk Total | 1.7E-06 | | | | | | Receptor HI Total | | 2.0E-01 | 2.3E-02 |

# ATTACHMENT B

# PROUCL OUTPUTS FOR THE DERIVATION OF SOIL EXPOSURE POINT CONCENTRATIONS FOR THE HUMAN HEALTH RISK ASSESSMENT

General Statistics

| | | | |
|---|---|---|---|
| Data File | | Variable: | Aluminum |
| | | | |
| Raw Statistics | | Normal Distribution Test | |
| Number of Valid Samples | 44 | Shapiro-Wilk Test Statisitic | 0.864398 |
| Number of Unique Samples | 42 | Shapiro-Wilk 5% Critical Value | 0.944 |
| Minimum | 4560 | Data not normal at 5% significance level | |
| Maximum | 20400 | | |
| Mean | 8448.977 | 95% UCL (Assuming Normal Distribution) | |
| Median | 8095 | Student's-t UCL | 9234.637 |
| Standard Deviation | 3100.095 | | |
| Variance | 9610590 | Gamma Distribution Test | |
| Coefficient of Variation | 0.36692 | A-D Test Statistic | 0.625839 |
| Skewness | 1.72346 | A-D 5% Critical Value | 0.749007 |
| | | K-S Test Statistic | 0.12685 |
| Gamma Statistics | | K-S 5% Critical Value | 0.133305 |
| k hat | 9.242366 | Data follow gamma distribution | |
| k star (bias corrected) | 8.627357 | at 5% significance level | |
| Theta hat | 914.1574 | | |
| Theta star | 979.324 | 95% UCLs (Assuming Gamma Distribution) | |
| nu hat | 813.3282 | Approximate Gamma UCL | 9212.878 |
| nu star | 759.2074 | Adjusted Gamma UCL | 9239.879 |
| Approx.Chi Square Value (.05) | 696.2565 | | |
| Adjusted Level of Significance | 0.044545 | Lognormal Distribution Test | |
| Adjusted Chi Square Value | 694.2219 | Shapiro-Wilk Test Statisitic | 0.964693 |
| | | Shapiro-Wilk 5% Critical Value | 0.944 |
| Log-transformed Statistics | | Data are lognormal at 5% significance level | |
| Minimum of log data | 8.425078 | | |
| Maximum of log data | 9.92329 | 95% UCLs (Assuming Lognormal Distribution) | |
| Mean of log data | 8.986728 | 95% H-UCL | 9212.933 |
| Standard Deviation of log data | 0.325552 | 95% Chebyshev (MVUE) UCL | 10260.74 |
| Variance of log data | 0.105984 | 97.5% Chebyshev (MVUE) UCL | 11056.9 |
| | | 99% Chebyshev (MVUE) UCL | 12620.8 |
| | | | |
| | | 95% Non-parametric UCLs | |
| | | CLT UCL | 9217.711 |
| | | Adj-CLT UCL (Adjusted for skewness) | 9347.46 |
| | | Mod-t UCL (Adjusted for skewness) | 9254.875 |
| | | Jackknife UCL | 9234.637 |
| | | Standard Bootstrap UCL | 9247.423 |
| | | Bootstrap-t UCL | 9445.57 |
| RECOMMENDATION | | Hall's Bootstrap UCL | 9551.473 |
| Data follow gamma distribution (0.05) | | Percentile Bootstrap UCL | 9218.864 |
| | | BCA Bootstrap UCL | 9276.136 |
| Use Approximate Gamma UCL | | 95% Chebyshev (Mean, Sd) UCL | 10486.14 |
| | | 97.5% Chebyshev (Mean, Sd) UCL | 11367.62 |
| | | 99% Chebyshev (Mean, Sd) UCL | 13099.12 |

| | | | |
|---|---|---|---|
| Data File | | Variable: | Antimony |
| | | | |
| Raw Statistics | | Normal Distribution Test | |
| Number of Valid Samples | 44 | Shapiro-Wilk Test Statisitic | 0.234625 |
| Number of Unique Samples | 36 | Shapiro-Wilk 5% Critical Value | 0.944 |
| Minimum | 0.18 | Data not normal at 5% significance level | |
| Maximum | 91.9 | | |
| Mean | 3.51472 | 95% UCL (Assuming Normal Distribution) | |
| Median | 0.67 | Student's-t UCL | 7.004621 |
| Standard Deviation | 13.77062 | | |
| Variance | 189.63 | Gamma Distribution Test | |
| Coefficient of Variation | 3.917985 | A-D Test Statistic | 4.587137 |
| Skewness | 6.438218 | A-D 5% Critical Value | 0.821998 |
| | | K-S Test Statistic | 0.231858 |
| Gamma Statistics | | K-S 5% Critical Value | 0.141668 |
| k hat | 0.463785 | Data do not follow gamma distribution | |
| k star (bias corrected) | 0.447315 | at 5% significance level | |
| Theta hat | 7.578341 | | |
| Theta star | 7.857377 | 95% UCLs (Assuming Gamma Distribution) | |
| nu hat | 40.81307 | Approximate Gamma UCL | 5.323537 |
| nu star | 39.3637 | Adjusted Gamma UCL | 5.4003 |
| Approx.Chi Square Value (.05) | 25.98881 | | |
| Adjusted Level of Significance | 0.044545 | Lognormal Distribution Test | |
| Adjusted Chi Square Value | 25.61939 | Shapiro-Wilk Test Statisitic | 0.900146 |
| | | Shapiro-Wilk 5% Critical Value | 0.944 |
| Log-transformed Statistics | | Data not lognormal at 5% significance level | |
| Minimum of log data | -1.714798 | | |
| Maximum of log data | 4.520701 | 95% UCLs (Assuming Lognormal Distribution) | |
| Mean of log data | -0.128796 | 95% H-UCL | 3.538081 |
| Standard Deviation of log data | 1.306612 | 95% Chebyshev (MVUE) UCL | 4.150448 |
| Variance of log data | 1.707235 | 97.5% Chebyshev (MVUE) UCL | 5.083112 |
| | | 99% Chebyshev (MVUE) UCL | 6.915149 |
| | | | |
| | | 95% Non-parametric UCLs | |
| | | CLT UCL | 6.929435 |
| | | Adj-CLT UCL (Adjusted for skewness) | 9.08245 |
| | | Mod-t UCL (Adjusted for skewness) | 7.340448 |
| | | Jackknife UCL | 7.004621 |
| | | Standard Bootstrap UCL | 6.93337 |
| | | Bootstrap-t UCL | 30.30753 |
| RECOMMENDATION | | Hall's Bootstrap UCL | 20.18382 |
| Data are Non-parametric (0.05) | | Percentile Bootstrap UCL | 7.630202 |
| | | BCA Bootstrap UCL | 9.926223 |
| Use 99% Chebyshev (Mean, Sd) UCL | | 95% Chebyshev (Mean, Sd) UCL | 12.56379 |
| | | 97.5% Chebyshev (Mean, Sd) UCL | 16.47933 |
| | | 99% Chebyshev (Mean, Sd) UCL | 24.17065 |
| | | | |

General Statistics

| | | | |
|---|---|---|---|
| Data File | | Variable: | Arsenic |
| | | | |
| Raw Statistics | | Normal Distribution Test | |
| Number of Valid Samples | 44 | Shapiro-Wilk Test Statisitic | 0.397447 |
| Number of Unique Samples | 25 | Shapiro-Wilk 5% Critical Value | 0.944 |
| Minimum | 1 | Data not normal at 5% significance level | |
| Maximum | 23.4 | | |
| Mean | 3.265909 | 95% UCL (Assuming Normal Distribution) | |
| Median | 2.95 | Student's-t UCL | 4.086131 |
| Standard Deviation | 3.23647 | | |
| Variance | 10.47474 | Gamma Distribution Test | |
| Coefficient of Variation | 0.990986 | A-D Test Statistic | 2.620834 |
| Skewness | 5.822302 | A-D 5% Critical Value | 0.75507 |
| | | K-S Test Statistic | 0.214007 |
| Gamma Statistics | | K-S 5% Critical Value | 0.134205 |
| k hat | 3.128638 | Data do not follow gamma distribution | |
| k star (bias corrected) | 2.930473 | at 5% significance level | |
| Theta hat | 1.043876 | | |
| Theta star | 1.114465 | 95% UCLs (Assuming Gamma Distribution) | |
| nu hat | 275.3201 | Approximate Gamma UCL | 3.799079 |
| nu star | 257.8816 | Adjusted Gamma UCL | 3.818622 |
| Approx.Chi Square Value (.05) | 221.6901 | | |
| Adjusted Level of Significance | 0.044545 | Lognormal Distribution Test | |
| Adjusted Chi Square Value | 220.5555 | Shapiro-Wilk Test Statisitic | 0.865543 |
| | | Shapiro-Wilk 5% Critical Value | 0.944 |
| Log-transformed Statistics | | Data not lognormal at 5% significance level | |
| Minimum of log data | 0 | | |
| Maximum of log data | 3.152736 | 95% UCLs (Assuming Lognormal Distribution) | |
| Mean of log data | 1.015294 | 95% H-UCL | 3.610702 |
| Standard Deviation of log data | 0.499023 | 95% Chebyshev (MVUE) UCL | 4.188097 |
| Variance of log data | 0.249024 | 97.5% Chebyshev (MVUE) UCL | 4.65186 |
| | | 99% Chebyshev (MVUE) UCL | 5.562833 |
| | | | |
| | | 95% Non-parametric UCLs | |
| | | CLT UCL | 4.06846 |
| | | Adj-CLT UCL (Adjusted for skewness) | 4.526068 |
| | | Mod-t UCL (Adjusted for skewness) | 4.157508 |
| | | Jackknife UCL | 4.086131 |
| | | Standard Bootstrap UCL | 4.061763 |
| | | Bootstrap-t UCL | 5.445907 |
| RECOMMENDATION | | Hall's Bootstrap UCL | 7.349159 |
| Data are Non-parametric (0.05) | | Percentile Bootstrap UCL | 4.221591 |
| | | BCA Bootstrap UCL | 4.763636 |
| Use Student's-t UCL | | 95% Chebyshev (Mean, Sd) UCL | 5.392687 |
| or Modified-t UCL | | 97.5% Chebyshev (Mean, Sd) UCL | 6.312945 |
| | | 99% Chebyshev (Mean, Sd) UCL | 8.120615 |
| | | | |

General Statistics

| Data File | | | Variable: | Chromium |
|---|---|---|---|---|
| | | | | |
| Raw Statistics | | | Normal Distribution Test | |
| Number of Valid Samples | 44 | | Shapiro-Wilk Test Statisitic | 0.525327 |
| Number of Unique Samples | 34 | | Shapiro-Wilk 5% Critical Value | 0.944 |
| Minimum | 7 | | Data not normal at 5% significance level | |
| Maximum | 406 | | | |
| Mean | 61.79886 | | 95% UCL (Assuming Normal Distribution) | |
| Median | 11.3 | | Student's-t UCL | 90.07447 |
| Standard Deviation | 111.5713 | | | |
| Variance | 12448.15 | | Gamma Distribution Test | |
| Coefficient of Variation | 1.805393 | | A-D Test Statistic | 9.159187 |
| Skewness | 1.90593 | | A-D 5% Critical Value | 0.809313 |
| | | | K-S Test Statistic | 0.422332 |
| Gamma Statistics | | | K-S 5% Critical Value | 0.14056 |
| k hat | 0.542549 | | Data do not follow gamma distribution | |
| k star (bias corrected) | 0.520708 | | at 5% significance level | |
| Theta hat | 113.9047 | | | |
| Theta star | 118.6823 | | 95% UCLs (Assuming Gamma Distribution) | |
| nu hat | 47.7443 | | Approximate Gamma UCL | 90.50253 |
| nu star | 45.82234 | | Adjusted Gamma UCL | 91.69835 |
| Approx.Chi Square Value (.05) | 31.28939 | | | |
| Adjusted Level of Significance | 0.044545 | | Lognormal Distribution Test | |
| Adjusted Chi Square Value | 30.88135 | | Shapiro-Wilk Test Statisitic | 0.63002 |
| | | | Shapiro-Wilk 5% Critical Value | 0.944 |
| Log-transformed Statistics | | | Data not lognormal at 5% significance level | |
| Minimum of log data | 1.94591 | | | |
| Maximum of log data | 6.006353 | | 95% UCLs (Assuming Lognormal Distribution) | |
| Mean of log data | 2.967742 | | 95% H-UCL | 77.53796 |
| Standard Deviation of log data | 1.30184 | | 95% Chebyshev (MVUE) UCL | 91.05093 |
| Variance of log data | 1.694787 | | 97.5% Chebyshev (MVUE) UCL | 111.4646 |
| | | | 99% Chebyshev (MVUE) UCL | 151.5634 |
| | | | | |
| | | | 95% Non-parametric UCLs | |
| | | | CLT UCL | 89.4653 |
| | | | Adj-CLT UCL (Adjusted for skewness) | 94.62931 |
| | | | Mod-t UCL (Adjusted for skewness) | 90.87995 |
| | | | Jackknife UCL | 90.07447 |
| | | | Standard Bootstrap UCL | 88.82706 |
| | | | Bootstrap-t UCL | 100.4089 |
| RECOMMENDATION | | | Hall's Bootstrap UCL | 90.51794 |
| Data are Non-parametric (0.05) | | | Percentile Bootstrap UCL | 90.41364 |
| | | | BCA Bootstrap UCL | 94.34545 |
| Use 99% Chebyshev (Mean, Sd) UCL | | | 95% Chebyshev (Mean, Sd) UCL | 135.1155 |
| | | | 97.5% Chebyshev (Mean, Sd) UCL | 166.8397 |
| | | | 99% Chebyshev (Mean, Sd) UCL | 229.1558 |

General Statistics

| | | | |
|---|---|---|---|
| Data File | | Variable: | Lead |
| | | | |
| Raw Statistics | | Normal Distribution Test | |
| Number of Valid Samples | 44 | Shapiro-Wilk Test Statisitic | 0.312175 |
| Number of Unique Samples | 42 | Shapiro-Wilk 5% Critical Value | 0.944 |
| Minimum | 3.7 | Data not normal at 5% significance level | |
| Maximum | 5800 | | |
| Mean | 285.3511 | 95% UCL (Assuming Normal Distribution) | |
| Median | 72.65 | Student's-t UCL | 506.5983 |
| Standard Deviation | 873.0079 | | |
| Variance | 762142.8 | Gamma Distribution Test | |
| Coefficient of Variation | 3.059416 | A-D Test Statistic | 1.810684 |
| Skewness | 6.129769 | A-D 5% Critical Value | 0.840665 |
| | | K-S Test Statistic | 0.153998 |
| Gamma Statistics | | K-S 5% Critical Value | 0.143199 |
| k hat | 0.385522 | Data do not follow gamma distribution | |
| k star (bias corrected) | 0.374388 | at 5% significance level | |
| Theta hat | 740.168 | | |
| Theta star | 762.1802 | 95% UCLs (Assuming Gamma Distribution) | |
| nu hat | 33.92595 | Approximate Gamma UCL | 451.5119 |
| nu star | 32.94615 | Adjusted Gamma UCL | 458.734 |
| Approx.Chi Square Value (.05) | 20.82165 | | |
| Adjusted Level of Significance | 0.044545 | Lognormal Distribution Test | |
| Adjusted Chi Square Value | 20.49384 | Shapiro-Wilk Test Statisitic | 0.908201 |
| | | Shapiro-Wilk 5% Critical Value | 0.944 |
| Log-transformed Statistics | | Data not lognormal at 5% significance level | |
| Minimum of log data | 1.308333 | | |
| Maximum of log data | 8.665613 | 95% UCLs (Assuming Lognormal Distribution) | |
| Mean of log data | 3.936658 | 95% H-UCL | 1039.595 |
| Standard Deviation of log data | 1.967113 | 95% Chebyshev (MVUE) UCL | 898.5917 |
| Variance of log data | 3.869532 | 97.5% Chebyshev (MVUE) UCL | 1150.718 |
| | | 99% Chebyshev (MVUE) UCL | 1645.971 |
| | | | |
| | | 95% Non-parametric UCLs | |
| | | CLT UCL | 501.8318 |
| | | Adj-CLT UCL (Adjusted for skewness) | 631.7859 |
| | | Mod-t UCL (Adjusted for skewness) | 526.8685 |
| | | Jackknife UCL | 506.5983 |
| | | Standard Bootstrap UCL | 495.1366 |
| | | Bootstrap-t UCL | 1100.023 |
| RECOMMENDATION | | Hall's Bootstrap UCL | 1304.986 |
| Data are Non-parametric (0.05) | | Percentile Bootstrap UCL | 539.975 |
| | | BCA Bootstrap UCL | 698.3545 |
| Use 99% Chebyshev (Mean, Sd) UCL | | 95% Chebyshev (Mean, Sd) UCL | 859.0297 |
| | | 97.5% Chebyshev (Mean, Sd) UCL | 1107.261 |
| | | 99% Chebyshev (Mean, Sd) UCL | 1594.863 |

General Statistics

| | | | |
|---|---|---|---|
| Data File | | Variable: | Tungsten |
| | | | |
| Raw Statistics | | Normal Distribution Test | |
| Number of Valid Samples | 8 | Shapiro-Wilk Test Statisitic | 0.593747 |
| Number of Unique Samples | 8 | Shapiro-Wilk 5% Critical Value | 0.818 |
| Minimum | 0.81 | Data not normal at 5% significance level | |
| Maximum | 3.5 | | |
| Mean | 1.32 | 95% UCL (Assuming Normal Distribution) | |
| Median | 0.995 | Student's-t UCL | 1.92267 |
| Standard Deviation | 0.89973 | | |
| Variance | 0.809514 | Gamma Distribution Test | |
| Coefficient of Variation | 0.681614 | A-D Test Statistic | 1.187389 |
| Skewness | 2.609262 | A-D 5% Critical Value | 0.718623 |
| | | K-S Test Statistic | 0.325688 |
| Gamma Statistics | | K-S 5% Critical Value | 0.29532 |
| k hat | 4.106139 | Data do not follow gamma distribution | |
| k star (bias corrected) | 2.64967 | at 5% significance level | |
| Theta hat | 0.32147 | | |
| Theta star | 0.498175 | 95% UCLs (Assuming Gamma Distribution) | |
| nu hat | 65.69823 | Approximate Gamma UCL | 1.96594 |
| nu star | 42.39472 | Adjusted Gamma UCL | 2.184926 |
| Approx.Chi Square Value (.05) | 28.46528 | | |
| Adjusted Level of Significance | 0.01946 | Lognormal Distribution Test | |
| Adjusted Chi Square Value | 25.61233 | Shapiro-Wilk Test Statisitic | 0.728395 |
| | | Shapiro-Wilk 5% Critical Value | 0.818 |
| Log-transformed Statistics | | Data not lognormal at 5% significance level | |
| Minimum of log data | -0.210721 | | |
| Maximum of log data | 1.252763 | 95% UCLs (Assuming Lognormal Distribution) | |
| Mean of log data | 0.150949 | 95% H-UCL | 1.985601 |
| Standard Deviation of log data | 0.476262 | 95% Chebyshev (MVUE) UCL | 2.233204 |
| Variance of log data | 0.226826 | 97.5% Chebyshev (MVUE) UCL | 2.644405 |
| | | 99% Chebyshev (MVUE) UCL | 3.45213 |
| | | | |
| | | 95% Non-parametric UCLs | |
| | | CLT UCL | 1.843232 |
| | | Adj-CLT UCL (Adjusted for skewness) | 2.156792 |
| | | Mod-t UCL (Adjusted for skewness) | 1.971579 |
| | | Jackknife UCL | 1.92267 |
| | | Standard Bootstrap UCL | 1.794855 |
| | | Bootstrap-t UCL | 4.630962 |
| RECOMMENDATION | | Hall's Bootstrap UCL | 4.428619 |
| Data are Non-parametric (0.05) | | Percentile Bootstrap UCL | 1.8825 |
| | | BCA Bootstrap UCL | 2.2175 |
| Use Student's-t UCL | | 95% Chebyshev (Mean, Sd) UCL | 2.706577 |
| or Modified-t UCL | | 97.5% Chebyshev (Mean, Sd) UCL | 3.30655 |
| | | 99% Chebyshev (Mean, Sd) UCL | 4.485081 |
| | | | |

General Statistics

| Data File | | | Variable: | Vanadium |
|---|---|---|---|---|
| | | | | |
| Raw Statistics | | | Normal Distribution Test | |
| Number of Valid Samples | 44 | | Shapiro-Wilk Test Statisitic | 0.933578 |
| Number of Unique Samples | 38 | | Shapiro-Wilk 5% Critical Value | 0.944 |
| Minimum | 10.3 | | Data not normal at 5% significance level | |
| Maximum | 29.3 | | | |
| Mean | 16.29886 | | 95% UCL (Assuming Normal Distribution) | |
| Median | 16 | | Student's-t UCL | 17.39963 |
| Standard Deviation | 4.343459 | | | |
| Variance | 18.86564 | | Gamma Distribution Test | |
| Coefficient of Variation | 0.266488 | | A-D Test Statistic | 0.433176 |
| Skewness | 0.88241 | | A-D 5% Critical Value | 0.748111 |
| | | | K-S Test Statistic | 0.106613 |
| Gamma Statistics | | | K-S 5% Critical Value | 0.133134 |
| k hat | 15.43749 | | Data follow gamma distribution | |
| k star (bias corrected) | 14.40009 | | at 5% significance level | |
| Theta hat | 1.055797 | | | |
| Theta star | 1.131859 | | 95% UCLs (Assuming Gamma Distribution) | |
| nu hat | 1358.499 | | Approximate Gamma UCL | 17.42169 |
| nu star | 1267.208 | | Adjusted Gamma UCL | 17.46094 |
| Approx.Chi Square Value (.05) | 1185.536 | | | |
| Adjusted Level of Significance | 0.044545 | | Lognormal Distribution Test | |
| Adjusted Chi Square Value | 1182.872 | | Shapiro-Wilk Test Statisitic | 0.965006 |
| | | | Shapiro-Wilk 5% Critical Value | 0.944 |
| Log-transformed Statistics | | | Data are lognormal at 5% significance level | |
| Minimum of log data | 2.332144 | | | |
| Maximum of log data | 3.377588 | | 95% UCLs (Assuming Lognormal Distribution) | |
| Mean of log data | 2.758357 | | 95% H-UCL | 17.45723 |
| Standard Deviation of log data | 0.256507 | | 95% Chebyshev (MVUE) UCL | 19.07129 |
| Variance of log data | 0.065796 | | 97.5% Chebyshev (MVUE) UCL | 20.27524 |
| | | | 99% Chebyshev (MVUE) UCL | 22.64014 |
| | | | | |
| | | | 95% Non-parametric UCLs | |
| | | | CLT UCL | 17.37592 |
| | | | Adj-CLT UCL (Adjusted for skewness) | 17.46899 |
| | | | Mod-t UCL (Adjusted for skewness) | 17.41415 |
| | | | Jackknife UCL | 17.39963 |
| | | | Standard Bootstrap UCL | 17.36181 |
| | | | Bootstrap-t UCL | 17.4697 |
| RECOMMENDATION | | | Hall's Bootstrap UCL | 17.59905 |
| Data follow gamma distribution (0.05) | | | Percentile Bootstrap UCL | 17.33977 |
| | | | BCA Bootstrap UCL | 17.46364 |
| Use Approximate Gamma UCL | | | 95% Chebyshev (Mean, Sd) UCL | 19.15308 |
| | | | 97.5% Chebyshev (Mean, Sd) UCL | 20.3881 |
| | | | 99% Chebyshev (Mean, Sd) UCL | 22.81405 |
| | | | | |

## General Statistics

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Data File | | | | | Variable: | n,n'-Diethylcarbanilide | | |
| | | | | | | | | |
| Raw Statistics | | | | Normal Distribution Test | | | | |
| Number of Valid Samples | | | 38 | Shapiro-Wilk Test Statisitic | | | | 0.431318 |
| Number of Unique Samples | | | 24 | Shapiro-Wilk 5% Critical Value | | | | 0.938 |
| Minimum | | | 18 | Data not normal at 5% significance level | | | | |
| Maximum | | | 6200 | | | | | |
| Mean | | | 512.7895 | 95% UCL (Assuming Normal Distribution) | | | | |
| Median | | | 190 | Student's-t UCL | | | | 798.939 |
| Standard Deviation | | | 1045.552 | | | | | |
| Variance | | | 1093180 | Gamma Distribution Test | | | | |
| Coefficient of Variation | | | 2.038951 | A-D Test Statistic | | | | 2.556751 |
| Skewness | | | 4.724985 | A-D 5% Critical Value | | | | 0.788207 |
| | | | | K-S Test Statistic | | | | 0.25757 |
| Gamma Statistics | | | | K-S 5% Critical Value | | | | 0.148744 |
| k hat | | | 0.757383 | Data do not follow gamma distribution | | | | |
| k star (bias corrected) | | | 0.715133 | at 5% significance level | | | | |
| Theta hat | | | 677.0545 | | | | | |
| Theta star | | | 717.0544 | 95% UCLs (Assuming Gamma Distribution) | | | | |
| nu hat | | | 57.5611 | Approximate Gamma UCL | | | | 725.6369 |
| nu star | | | 54.35013 | Adjusted Gamma UCL | | | | 736.292 |
| Approx.Chi Square Value (.05) | | | 38.40788 | | | | | |
| Adjusted Level of Significance | | | 0.0434 | Lognormal Distribution Test | | | | |
| Adjusted Chi Square Value | | | 37.85207 | Shapiro-Wilk Test Statisitic | | | | 0.943198 |
| | | | | Shapiro-Wilk 5% Critical Value | | | | 0.938 |
| Log-transformed Statistics | | | | Data are lognormal at 5% significance level | | | | |
| Minimum of log data | | | 2.890372 | | | | | |
| Maximum of log data | | | 8.732305 | 95% UCLs (Assuming Lognormal Distribution) | | | | |
| Mean of log data | | | 5.450514 | 95% H-UCL | | | | 760.0493 |
| Standard Deviation of log data | | | 1.171018 | 95% Chebyshev (MVUE) UCL | | | | 898.475 |
| Variance of log data | | | 1.371282 | 97.5% Chebyshev (MVUE) UCL | | | | 1092.938 |
| | | | | 99% Chebyshev (MVUE) UCL | | | | 1474.923 |
| | | | | | | | | |
| | | | | 95% Non-parametric UCLs | | | | |
| | | | | CLT UCL | | | | 791.7747 |
| | | | | Adj-CLT UCL (Adjusted for skewness) | | | | 930.6878 |
| | | | | Mod-t UCL (Adjusted for skewness) | | | | 820.6067 |
| | | | | Jackknife UCL | | | | 798.939 |
| | | | | Standard Bootstrap UCL | | | | 791.9979 |
| | | | | Bootstrap-t UCL | | | | 1344.506 |
| RECOMMENDATION | | | | Hall's Bootstrap UCL | | | | 1823.14 |
| Data are lognormal (0.05) | | | | Percentile Bootstrap UCL | | | | 815.3158 |
| | | | | BCA Bootstrap UCL | | | | 995.7632 |
| Use H-UCL | | | | 95% Chebyshev (Mean, Sd) UCL | | | | 1252.107 |
| | | | | 97.5% Chebyshev (Mean, Sd) UCL | | | | 1572.01 |
| | | | | 99% Chebyshev (Mean, Sd) UCL | | | | 2200.398 |
| | | | | | | | | |

General Statistics

| | | | |
|---|---|---|---|
| Data File | | Variable: | Nitroglycerin |
| | | | |
| Raw Statistics | | Normal Distribution Test | |
| Number of Valid Samples | 4 | Shapiro-Wilk Test Statisitic | 0.889992 |
| Number of Unique Samples | 4 | Shapiro-Wilk 5% Critical Value | 0.748 |
| Minimum | 1250 | Data are normal at 5% significance level | |
| Maximum | 47000 | | |
| Mean | 19362.5 | 95% UCL (Assuming Normal Distribution) | |
| Median | 14600 | Student's-t UCL | 44756.09 |
| Standard Deviation | 21580.68 | | |
| Variance | 4.7E+008 | Gamma Distribution Test | |
| Coefficient of Variation | 1.11456 | A-D Test Statistic | 0.336849 |
| Skewness | 0.74547 | A-D 5% Critical Value | 0.671689 |
| | | K-S Test Statistic | 0.27381 |
| Gamma Statistics | | K-S 5% Critical Value | 0.40568 |
| k hat | 0.717278 | Data follow gamma distribution | |
| k star (bias corrected) | 0.345986 | at 5% significance level | |
| Theta hat | 26994.41 | | |
| Theta star | 55963.21 | 95% UCLs (Assuming Gamma Distribution) | |
| nu hat | 5.738226 | Approximate Gamma UCL | 174590.8 |
| nu star | 2.76789 | Adjusted Gamma UCL | N/A |
| Approx.Chi Square Value (.05) | 0.306965 | | |
| Adjusted Level of Significance | N/A | Lognormal Distribution Test | |
| Adjusted Chi Square Value | N/A | Shapiro-Wilk Test Statisitic | 0.918765 |
| | | Shapiro-Wilk 5% Critical Value | 0.748 |
| Log-transformed Statistics | | Data are lognormal at 5% significance level | |
| Minimum of log data | 7.130899 | | |
| Maximum of log data | 10.7579 | 95% UCLs (Assuming Lognormal Distribution) | |
| Mean of log data | 9.03139 | 95% H-UCL | 1.3E+011 |
| Standard Deviation of log data | 1.712916 | 95% Chebyshev (MVUE) UCL | 85451.36 |
| Variance of log data | 2.934082 | 97.5% Chebyshev (MVUE) UCL | 113286.7 |
| | | 99% Chebyshev (MVUE) UCL | 167963.9 |
| | | | |
| | | 95% Non-parametric UCLs | |
| | | CLT UCL | 37111.03 |
| | | Adj-CLT UCL (Adjusted for skewness) | 41408.52 |
| | | Mod-t UCL (Adjusted for skewness) | 45426.41 |
| | | Jackknife UCL | 44756.09 |
| | | Standard Bootstrap UCL | N/R |
| | | Bootstrap-t UCL | N/R |
| RECOMMENDATION | | Hall's Bootstrap UCL | N/R |
| Data are normal (0.05) | | Percentile Bootstrap UCL | N/R |
| | | BCA Bootstrap UCL | N/R |
| Use Student's-t UCL | | 95% Chebyshev (Mean, Sd) UCL | 66396.5 |
| | | 97.5% Chebyshev (Mean, Sd) UCL | 86748.14 |
| | | 99% Chebyshev (Mean, Sd) UCL | 126725 |
| | | | |

General Statistics

| Data File | | | | Variable: | Aluminum | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| Raw Statistics | | | | Normal Distribution Test | | | |
| Number of Valid Samples | | | 4 | Shapiro-Wilk Test Statisitic | | | 0.915409 |
| Number of Unique Samples | | | 4 | Shapiro-Wilk 5% Critical Value | | | 0.748 |
| Minimum | | | 10900 | Data are normal at 5% significance level | | | |
| Maximum | | | 13400 | | | | |
| Mean | | | 11875 | 95% UCL (Assuming Normal Distribution) | | | |
| Median | | | 11600 | Student's-t UCL | | | 13190.13 |
| Standard Deviation | | | 1117.661 | | | | |
| Variance | | | 1249167 | Gamma Distribution Test | | | |
| Coefficient of Variation | | | 0.094119 | A-D Test Statistic | | | 0.32098 |
| Skewness | | | 1.105007 | A-D 5% Critical Value | | | 0.65652 |
| | | | | K-S Test Statistic | | | 0.256484 |
| Gamma Statistics | | | | K-S 5% Critical Value | | | 0.39399 |
| k hat | | | 155.1635 | Data follow gamma distribution | | | |
| k star (bias corrected) | | | 38.95754 | at 5% significance level | | | |
| Theta hat | | | 76.53218 | | | | |
| Theta star | | | 304.8191 | 95% UCLs (Assuming Gamma Distribution) | | | |
| nu hat | | | 1241.308 | Approximate Gamma UCL | | | 13618.8 |
| nu star | | | 311.6603 | Adjusted Gamma UCL | | | N/A |
| Approx.Chi Square Value (.05) | | | 271.7542 | | | | |
| Adjusted Level of Significance | | | N/A | Lognormal Distribution Test | | | |
| Adjusted Chi Square Value | | | N/A | Shapiro-Wilk Test Statisitic | | | 0.926211 |
| | | | | Shapiro-Wilk 5% Critical Value | | | 0.748 |
| Log-transformed Statistics | | | | Data are lognormal at 5% significance level | | | |
| Minimum of log data | | | 9.296518 | | | | |
| Maximum of log data | | | 9.50301 | 95% UCLs (Assuming Lognormal Distribution) | | | |
| Mean of log data | | | 9.378965 | 95% H-UCL | | | N/A |
| Standard Deviation of log data | | | 0.092069 | 95% Chebyshev (MVUE) UCL | | | 14255.61 |
| Variance of log data | | | 0.008477 | 97.5% Chebyshev (MVUE) UCL | | | 15285.95 |
| | | | | 99% Chebyshev (MVUE) UCL | | | 17309.87 |
| | | | | | | | |
| | | | | 95% Non-parametric UCLs | | | |
| | | | | CLT UCL | | | 12794.19 |
| | | | | Adj-CLT UCL (Adjusted for skewness) | | | 13124.1 |
| | | | | Mod-t UCL (Adjusted for skewness) | | | 13241.59 |
| | | | | Jackknife UCL | | | 13190.13 |
| | | | | Standard Bootstrap UCL | | | N/R |
| | | | | Bootstrap-t UCL | | | N/R |
| RECOMMENDATION | | | | Hall's Bootstrap UCL | | | N/R |
| Data are normal (0.05) | | | | Percentile Bootstrap UCL | | | N/R |
| | | | | BCA Bootstrap UCL | | | N/R |
| Use Student's-t UCL | | | | 95% Chebyshev (Mean, Sd) UCL | | | 14310.89 |
| | | | | 97.5% Chebyshev (Mean, Sd) UCL | | | 15364.9 |
| | | | | 99% Chebyshev (Mean, Sd) UCL | | | 17435.29 |
| | | | | | | | |

General Statistics

| | | | |
|---|---|---|---|
| Data File | | Variable: Arsenic | |
| | | | |
| Raw Statistics | | Normal Distribution Test | |
| Number of Valid Samples | 4 | Shapiro-Wilk Test Statisitic | 0.728867 |
| Number of Unique Samples | 3 | Shapiro-Wilk 5% Critical Value | 0.748 |
| Minimum | 3.2 | Data not normal at 5% significance level | |
| Maximum | 3.9 | | |
| Mean | 3.4 | 95% UCL (Assuming Normal Distribution) | |
| Median | 3.25 | Student's-t UCL | 3.79613 |
| Standard Deviation | 0.33665 | | |
| Variance | 0.113333 | Gamma Distribution Test | |
| Coefficient of Variation | 0.099015 | A-D Test Statistic | 0.698408 |
| Skewness | 1.887105 | A-D 5% Critical Value | 0.65652 |
| | | K-S Test Statistic | 0.378795 |
| Gamma Statistics | | K-S 5% Critical Value | 0.39399 |
| k hat | 144.0401 | Data follow approximate gamma distibution | |
| k star (bias corrected) | 36.1767 | at 5% significance level | |
| Theta hat | 0.023605 | | |
| Theta star | 0.093983 | 95% UCLs (Assuming Gamma Distribution) | |
| nu hat | 1152.321 | Approximate Gamma UCL | 3.920316 |
| nu star | 289.4136 | Adjusted Gamma UCL | N/A |
| Approx.Chi Square Value (.05) | 251.0017 | | |
| Adjusted Level of Significance | N/A | Lognormal Distribution Test | |
| Adjusted Chi Square Value | N/A | Shapiro-Wilk Test Statisitic | 0.73696 |
| | | Shapiro-Wilk 5% Critical Value | 0.748 |
| Log-transformed Statistics | | Data not lognormal at 5% significance level | |
| Minimum of log data | 1.163151 | | |
| Maximum of log data | 1.360977 | 95% UCLs (Assuming Lognormal Distribution) | |
| Mean of log data | 1.2203 | 95% H-UCL | N/A |
| Standard Deviation of log data | 0.094899 | 95% Chebyshev (MVUE) UCL | 4.102331 |
| Variance of log data | 0.009006 | 97.5% Chebyshev (MVUE) UCL | 4.406377 |
| | | 99% Chebyshev (MVUE) UCL | 5.003618 |
| | | | |
| | | 95% Non-parametric UCLs | |
| | | CLT UCL | 3.67687 |
| | | Adj-CLT UCL (Adjusted for skewness) | 3.846575 |
| | | Mod-t UCL (Adjusted for skewness) | 3.822601 |
| | | Jackknife UCL | 3.79613 |
| | | Standard Bootstrap UCL | N/R |
| | | Bootstrap-t UCL | N/R |
| RECOMMENDATION | | Hall's Bootstrap UCL | N/R |
| Assuming gamma distribution (0.05) | | Percentile Bootstrap UCL | N/R |
| | | BCA Bootstrap UCL | N/R |
| Use Approximate Gamma UCL | | 95% Chebyshev (Mean, Sd) UCL | 4.133712 |
| | | 97.5% Chebyshev (Mean, Sd) UCL | 4.45119 |
| | | 99% Chebyshev (Mean, Sd) UCL | 5.074813 |
| Recommended UCL exceeds the maximum observation | | | |

General Statistics

| | | | |
|---|---|---|---|
| Data File | | Variable: Chromium | |
| | | | |
| Raw Statistics | | Normal Distribution Test | |
| Number of Valid Samples | 4 | Shapiro-Wilk Test Statisitic | 0.849672 |
| Number of Unique Samples | 4 | Shapiro-Wilk 5% Critical Value | 0.748 |
| Minimum | 176 | Data are normal at 5% significance level | |
| Maximum | 226 | | |
| Mean | 204.25 | 95% UCL (Assuming Normal Distribution) | |
| Median | 207.5 | Student's-t UCL | 233.8995 |
| Standard Deviation | 25.19755 | | |
| Variance | 634.9167 | Gamma Distribution Test | |
| Coefficient of Variation | 0.123366 | A-D Test Statistic | 0.465738 |
| Skewness | -0.259011 | A-D 5% Critical Value | 0.65636 |
| | | K-S Test Statistic | 0.328657 |
| Gamma Statistics | | K-S 5% Critical Value | 0.393943 |
| k hat | 86.24165 | Data follow gamma distribution | |
| k star (bias corrected) | 21.72708 | at 5% significance level | |
| Theta hat | 2.368345 | | |
| Theta star | 9.400711 | 95% UCLs (Assuming Gamma Distribution) | |
| nu hat | 689.9332 | Approximate Gamma UCL | 245.9937 |
| nu star | 173.8166 | Adjusted Gamma UCL | N/A |
| Approx.Chi Square Value (.05) | 144.321 | | |
| Adjusted Level of Significance | N/A | Lognormal Distribution Test | |
| Adjusted Chi Square Value | N/A | Shapiro-Wilk Test Statisitic | 0.855296 |
| | | Shapiro-Wilk 5% Critical Value | 0.748 |
| Log-transformed Statistics | | Data are lognormal at 5% significance level | |
| Minimum of log data | 5.170484 | | |
| Maximum of log data | 5.420535 | 95% UCLs (Assuming Lognormal Distribution) | |
| Mean of log data | 5.313536 | 95% H-UCL | 244.522 |
| Standard Deviation of log data | 0.124975 | 95% Chebyshev (MVUE) UCL | 259.8284 |
| Variance of log data | 0.015619 | 97.5% Chebyshev (MVUE) UCL | 283.8735 |
| | | 99% Chebyshev (MVUE) UCL | 331.1056 |
| | | | |
| | | 95% Non-parametric UCLs | |
| | | CLT UCL | 224.9731 |
| | | Adj-CLT UCL (Adjusted for skewness) | 223.2297 |
| | | Mod-t UCL (Adjusted for skewness) | 233.6276 |
| | | Jackknife UCL | 233.8995 |
| | | Standard Bootstrap UCL | N/R |
| | | Bootstrap-t UCL | N/R |
| RECOMMENDATION | | Hall's Bootstrap UCL | N/R |
| Data are normal (0.05) | | Percentile Bootstrap UCL | N/R |
| | | BCA Bootstrap UCL | N/R |
| Use Student's-t UCL | | 95% Chebyshev (Mean, Sd) UCL | 259.1668 |
| | | 97.5% Chebyshev (Mean, Sd) UCL | 282.9293 |
| | | 99% Chebyshev (Mean, Sd) UCL | 329.6062 |
| Recommended UCL exceeds the maximum observation | | | |

General Statistics

| | | | | |
|---|---|---|---|---|
| Data File | | Variable: | Tungsten | |
| | | | | |
| Raw Statistics | | Normal Distribution Test | | |
| Number of Valid Samples | 14 | Shapiro-Wilk Test Statisitic | | 0.511749 |
| Number of Unique Samples | 13 | Shapiro-Wilk 5% Critical Value | | 0.874 |
| Minimum | 0.08315 | Data not normal at 5% significance level | | |
| Maximum | 11.8 | | | |
| Mean | 1.525129 | 95% UCL (Assuming Normal Distribution) | | |
| Median | 0.41 | Student's-t UCL | | 3.006919 |
| Standard Deviation | 3.130752 | | | |
| Variance | 9.801607 | Gamma Distribution Test | | |
| Coefficient of Variation | 2.052779 | A-D Test Statistic | | 1.172352 |
| Skewness | 3.131965 | A-D 5% Critical Value | | 0.792723 |
| | | K-S Test Statistic | | 0.289193 |
| Gamma Statistics | | K-S 5% Critical Value | | 0.241532 |
| k hat | 0.506042 | Data do not follow gamma distribution | | |
| k star (bias corrected) | 0.445223 | at 5% significance level | | |
| Theta hat | 3.01384 | | | |
| Theta star | 3.425537 | 95% UCLs (Assuming Gamma Distribution) | | |
| nu hat | 14.16917 | Approximate Gamma UCL | | 3.435202 |
| nu star | 12.46625 | Adjusted Gamma UCL | | 3.852819 |
| Approx.Chi Square Value (.05) | 5.534648 | | | |
| Adjusted Level of Significance | 0.03122 | Lognormal Distribution Test | | |
| Adjusted Chi Square Value | 4.934733 | Shapiro-Wilk Test Statisitic | | 0.897356 |
| | | Shapiro-Wilk 5% Critical Value | | 0.874 |
| Log-transformed Statistics | | Data are lognormal at 5% significance level | | |
| Minimum of log data | -2.487109 | | | |
| Maximum of log data | 2.4681 | 95% UCLs (Assuming Lognormal Distribution) | | |
| Mean of log data | -0.830784 | 95% H-UCL | | 7.081915 |
| Standard Deviation of log data | 1.536054 | 95% Chebyshev (MVUE) UCL | | 3.673732 |
| Variance of log data | 2.359462 | 97.5% Chebyshev (MVUE) UCL | | 4.736979 |
| | | 99% Chebyshev (MVUE) UCL | | 6.825523 |
| | | | | |
| | | 95% Non-parametric UCLs | | |
| | | CLT UCL | | 2.901425 |
| | | Adj-CLT UCL (Adjusted for skewness) | | 3.649797 |
| | | Mod-t UCL (Adjusted for skewness) | | 3.12365 |
| | | Jackknife UCL | | 3.006919 |
| | | Standard Bootstrap UCL | | 2.86346 |
| | | Bootstrap-t UCL | | 5.886056 |
| RECOMMENDATION | | Hall's Bootstrap UCL | | 6.763124 |
| Data are lognormal (0.05) | | Percentile Bootstrap UCL | | 2.972679 |
| | | BCA Bootstrap UCL | | 3.791654 |
| Use 99% Chebyshev (MVUE) UCL | | 95% Chebyshev (Mean, Sd) UCL | | 5.172344 |
| | | 97.5% Chebyshev (Mean, Sd) UCL | | 6.750497 |
| | | 99% Chebyshev (Mean, Sd) UCL | | 9.850473 |
| | | | | |

General Statistics

| | | | |
|---|---|---|---|
| Data File | | Variable: | Vanadium |
| | | | |
| Raw Statistics | | Normal Distribution Test | |
| Number of Valid Samples | 4 | Shapiro-Wilk Test Statisitic | 0.969288 |
| Number of Unique Samples | 4 | Shapiro-Wilk 5% Critical Value | 0.748 |
| Minimum | 24.4 | Data are normal at 5% significance level | |
| Maximum | 29.3 | | |
| Mean | 26.55 | 95% UCL (Assuming Normal Distribution) | |
| Median | 26.25 | Student's-t UCL | 28.97769 |
| Standard Deviation | 2.063169 | | |
| Variance | 4.256667 | Gamma Distribution Test | |
| Coefficient of Variation | 0.077709 | A-D Test Statistic | 0.23777 |
| Skewness | 0.79251 | A-D 5% Critical Value | 0.65652 |
| | | K-S Test Statistic | 0.207494 |
| Gamma Statistics | | K-S 5% Critical Value | 0.39399 |
| k hat | 224.6263 | Data follow gamma distribution | |
| k star (bias corrected) | 56.32323 | at 5% significance level | |
| Theta hat | 0.118196 | | |
| Theta star | 0.471386 | 95% UCLs (Assuming Gamma Distribution) | |
| nu hat | 1797.01 | Approximate Gamma UCL | 29.73214 |
| nu star | 450.5858 | Adjusted Gamma UCL | N/A |
| Approx.Chi Square Value (.05) | 402.3611 | | |
| Adjusted Level of Significance | N/A | Lognormal Distribution Test | |
| Adjusted Chi Square Value | N/A | Shapiro-Wilk Test Statisitic | 0.978348 |
| | | Shapiro-Wilk 5% Critical Value | 0.748 |
| Log-transformed Statistics | | Data are lognormal at 5% significance level | |
| Minimum of log data | 3.194583 | | |
| Maximum of log data | 3.377588 | 95% UCLs (Assuming Lognormal Distribution) | |
| Mean of log data | 3.276802 | 95% H-UCL | N/A |
| Standard Deviation of log data | 0.076763 | 95% Chebyshev (MVUE) UCL | 30.98932 |
| Variance of log data | 0.005893 | 97.5% Chebyshev (MVUE) UCL | 32.91044 |
| | | 99% Chebyshev (MVUE) UCL | 36.6841 |
| | | | |
| | | 95% Non-parametric UCLs | |
| | | CLT UCL | 28.24681 |
| | | Adj-CLT UCL (Adjusted for skewness) | 28.68358 |
| | | Mod-t UCL (Adjusted for skewness) | 29.04582 |
| | | Jackknife UCL | 28.97769 |
| | | Standard Bootstrap UCL | N/R |
| | | Bootstrap-t UCL | N/R |
| RECOMMENDATION | | Hall's Bootstrap UCL | N/R |
| Data are normal (0.05) | | Percentile Bootstrap UCL | N/R |
| | | BCA Bootstrap UCL | N/R |
| Use Student's-t UCL | | 95% Chebyshev (Mean, Sd) UCL | 31.04657 |
| | | 97.5% Chebyshev (Mean, Sd) UCL | 32.99224 |
| | | 99% Chebyshev (Mean, Sd) UCL | 36.81414 |

General Statistics

| | | | | |
|---|---|---|---|---|
| Data File | | Variable: | Lead | |
| | | | | |
| Raw Statistics | | Normal Distribution Test | | |
| Number of Valid Samples | 4 | Shapiro-Wilk Test Statisitic | | 0.983489 |
| Number of Unique Samples | 4 | Shapiro-Wilk 5% Critical Value | | 0.748 |
| Minimum | 41.4 | Data are normal at 5% significance level | | |
| Maximum | 97.1 | | | |
| Mean | 71.8 | 95% UCL (Assuming Normal Distribution) | | |
| Median | 74.35 | Student's-t UCL | | 99.89371 |
| Standard Deviation | 23.87537 | | | |
| Variance | 570.0333 | Gamma Distribution Test | | |
| Coefficient of Variation | 0.332526 | A-D Test Statistic | | 0.259687 |
| Skewness | -0.531519 | A-D 5% Critical Value | | 0.657099 |
| | | K-S Test Statistic | | 0.213947 |
| Gamma Statistics | | K-S 5% Critical Value | | 0.394886 |
| k hat | 10.63313 | Data follow gamma distribution | | |
| k star (bias corrected) | 2.82495 | at 5% significance level | | |
| Theta hat | 6.752477 | | | |
| Theta star | 25.41638 | 95% UCLs (Assuming Gamma Distribution) | | |
| nu hat | 85.06507 | Approximate Gamma UCL | | 126.8969 |
| nu star | 22.5996 | Adjusted Gamma UCL | | N/A |
| Approx.Chi Square Value (.05) | 12.78716 | | | |
| Adjusted Level of Significance | N/A | Lognormal Distribution Test | | |
| Adjusted Chi Square Value | N/A | Shapiro-Wilk Test Statisitic | | 0.943405 |
| | | Shapiro-Wilk 5% Critical Value | | 0.748 |
| Log-transformed Statistics | | Data are lognormal at 5% significance level | | |
| Minimum of log data | 3.723281 | | | |
| Maximum of log data | 4.575741 | 95% UCLs (Assuming Lognormal Distribution) | | |
| Mean of log data | 4.226125 | 95% H-UCL | | 162.1459 |
| Standard Deviation of log data | 0.370157 | 95% Chebyshev (MVUE) UCL | | 129.5331 |
| Variance of log data | 0.137016 | 97.5% Chebyshev (MVUE) UCL | | 154.4177 |
| | | 99% Chebyshev (MVUE) UCL | | 203.2986 |
| | | | | |
| | | 95% Non-parametric UCLs | | |
| | | CLT UCL | | 91.43575 |
| | | Adj-CLT UCL (Adjusted for skewness) | | 88.04583 |
| | | Mod-t UCL (Adjusted for skewness) | | 99.36495 |
| | | Jackknife UCL | | 99.89371 |
| | | Standard Bootstrap UCL | | N/R |
| | | Bootstrap-t UCL | | N/R |
| RECOMMENDATION | | Hall's Bootstrap UCL | | N/R |
| Data are normal (0.05) | | Percentile Bootstrap UCL | | N/R |
| | | BCA Bootstrap UCL | | N/R |
| Use Student's-t UCL | | 95% Chebyshev (Mean, Sd) UCL | | 123.8352 |
| | | 97.5% Chebyshev (Mean, Sd) UCL | | 146.3508 |
| | | 99% Chebyshev (Mean, Sd) UCL | | 190.5785 |
| Recommended UCL exceeds the maximum observation | | | | |

# ATTACHMENT C

# SITE SKETCH AND PHOTOGRAPHIC LOG FOR TANGO RANGE

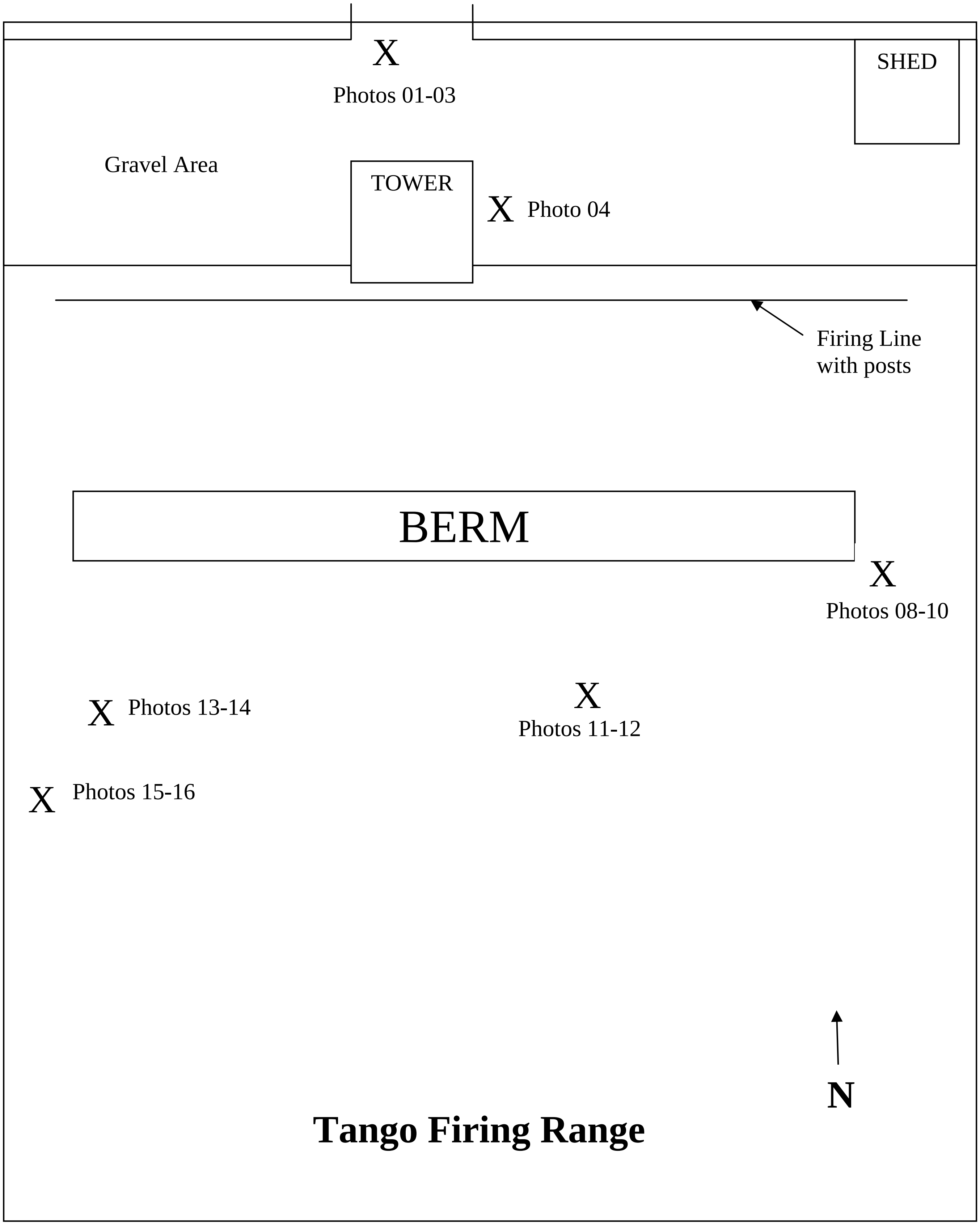

X
Photos 01-03
SHED
Gravel Area
TOWER
X Photo 04
Firing Line
with posts
BERM
X
Photos 08-10
X Photos 13-14
X
Photos 11-12
X Photos 15-16
N
Tango Firing Range

Photo 01: Facing southeast at the firing range from the northern access road. Photos 01-03 are a panoramic view.

Photo 02: Facing south at the firing range from the northern access road. Note the tower and berm built August/September 2006.

Photo 03: Facing southwest at the firing range from the northern access road.

Photo 04: The storage shed located at the northeastern corner of the gravel drive.

Photo 05: Facing southeast at the eastern portion of the berm. Photos 05-07 are a panoramic of the entire berm.

Photo 06: Facing south at the central portion of berm.

Photo 07: Facing southwest at the western portion of the berm.

Photo 08: Facing south at the eastern portion of the Site located south of the berm. Photos 08-10 are a panoramic of the southern portion of the Site.

Photo 09: Facing southwest at the southern portion of the Site.

Photo 10: Facing west along a dirt access road located along the southern side of the berm.

Photo 11: Moss found in the overgrown area located south of the berm.

Photo 12: Vegetation found in the overgrown area located south of the berm.

Photo 13: Vegetation on the eastern side of the access road shown in Photo 10.

Photo 14: Facing west at the forested area located along the western boundary of the Site.

Photo 15: Facing west at the forested area located along the western boundary of the Site.

Photo 16: Facing southwest at the forested area located along the western boundary of the Site. Note one of five old targets.

# ATTACHMENT D

# BASELINE ECOLOGICAL RISK ASSESSMENT (BERA) TABLES

**Table 3.1**
**Baseline Ecological Risk Assessment**
**Tango Range**
**Soil Screening Level Assessment**

| Constituent Detected at Tango Range | SAMPLING RESULTS | | | | | STEP 1 | | | STEP 2 | | | | | STEP 3 | | Retain as COPEC?[3] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of Detections | Number of Results | FOD (%) | Tango Range Min (mg/kg) | Tango Range Max (mg/kg) | Demo 1 Risk Driver[1] | USEPA ECO-SSL (mg/kg) | Exceeds USEPA ECO-SSL | Demo Area 1 Min (mg/kg) | Demo Area 1 Max (mg/kg) | Exceeds DEMO 1 MDC | ≥ 5% FOD | Exceeds Demo 1 MDC and ≥ 5% FOD | Background Value[2] (mg/kg) | Exceeds Background | |
| *Explosives* | | | | | | | | | | | | | | | | |
| **Nitroglycerin** | 3 | 4 | 75 | 3.2 | 47 | NO | NA | **-** | 0.56 | **10** | **YES** | **YES** | **YES** | **NA** | **-** | **YES** |
| *Metals/Inorganics* | | | | | | | | | | | | | | | | |
| Aluminum | 48 | 48 | 100 | 4,560 | 20,400 | NO | pH<5.5[a] | NO | 1,400 | 25,000 | NO | YES | NO | 10,000 | YES | NO |
| **Antimony** | 23 | 48 | 48 | 0.4 J | 91.9 J | NO | **0.27** | **YES** | 0.41 | 5.8 | YES | YES | YES | 1 | YES | **YES** |
| **Arsenic** | 40 | 48 | 83 | 1.8 | 23.4 J | NO | **18** | **YES** | 0.81 | 8.7 | YES | YES | YES | 20 | YES | **YES** |
| Barium | 48 | 48 | 100 | 8.8 | 22.1 | NO | 330 | NO | 4.9 | 173 | NO | YES | NO | 50 | NO | NO |
| Beryllium | 48 | 48 | 100 | 0.17 | 0.4 | NO | 21 | NO | 0.62 | 0.62 | NO | YES | NO | 0.4 | YES | NO |
| Boron | 32 | 48 | 67 | 0.85 | 3.8 | NO | NA | - | 1.2 | 22.8 | NO | YES | NO | NA | YES | NO |
| **Cadmium** | 17 | 48 | 35 | 0.096 J | 0.59 | NO | **0.36** | **YES** | 0.08 | 9.6 | NO | YES | NO | 2 | NO | **YES** |
| Chromium | 48 | 48 | 100 | 7 | 21 | NO | 26 | NO | 2.9 | 28.1 | NO | YES | NO | 30 | NO | NO |
| Cobalt | 48 | 48 | 100 | 2 | 7 | NO | 13 | NO | 0.75 | 6.9 | YES | YES | YES | 4 | YES | NO |
| **Copper** | 48 | 48 | 100 | 3 | 110 | NO | **28** | **YES** | 2.1 | 405 | NO | YES | NO | 40 | YES | **YES** |
| Iron | 48 | 48 | 100 | 5,550 | 19,300 | NO | pH<5.5[a] | NO | 3,920 | 25,500 | NO | YES | NO | 20,000 | NO | NO |
| **Lead** | 48 | 48 | 100 | 3.7 | 5,800 | **YES** | 11 | YES | 2.3 | 542 | YES | YES | YES | 100 | YES | **YES** |
| Manganese | 48 | 48 | 100 | 46.9 | 165 | NO | NA | - | 17.8 | 1,060 | NO | YES | NO | 300 | NO | NO |
| Mercury | 12 | 48 | 25 | 0.018 J | 0.033 | NO | NA | - | 0.024 | 12.2 | NO | YES | NO | 0.3 | NO | NO |
| Molybdenum | 40 | 48 | 83 | 0.34 J | 2 | NO | NA | - | 0.32 | 12.4 | NO | YES | NO | NA | - | NO |
| Nickel | 48 | 48 | 100 | 3.7 | 14.8 | NO | NA | - | 1.3 | 13.7 | YES | YES | YES | 20 | NO | NO |
| Selenium | 28 | 48 | 58 | 0.25 J | 1.8 | NO | NA | - | 0.42 | 1.8 | NO | YES | NO | 1 | YES | NO |
| Silver | 8 | 48 | 17 | 0.14 J | 0.57 | NO | 4.2 | NO | 0.26 | 4.6 | NO | YES | NO | 0.6 | NO | NO |
| **Tungsten** | 17 | 22 | 77 | 0.3 | 11.8 | NO | **NA** | **-** | ND | **ND** | **YES** | **YES** | **YES** | **NA** | **-** | **YES** |
| **Vanadium** | 48 | 48 | 100 | 10.3 | 29.3 | NO | **7.8** | **YES** | 5.7 | 39.7 | NO | YES | NO | 30 | NO | **YES** |
| Zinc | 48 | 48 | 100 | 10.6 | 61.1 | NO | NA | - | 7.4 | 168 | NO | YES | NO | 100 | NO | NO |
| *Semi-Volatile Organic Compounds* | | | | | | | | | | | | | | | | |
| Benzo(a)anthracene | 1 | 38 | 3 | 0.1 J | 0.1 J | NO | NA | - | 0.018 | 0.56 | NO | NO | NO | 2 | NO | NO |
| Benzo(a)pyrene | 2 | 38 | 5 | 0.017 J | 0.047 J | NO | NA | - | 0.017 | 0.23 | NO | YES | NO | 2 | NO | NO |
| Benzo(b)fluoranthene | 1 | 38 | 3 | 0.11 J | 0.11 J | NO | NA | - | 0.018 | 0.56 | NO | NO | NO | 2 | NO | NO |
| Benzo(k)fluoranthene | 1 | 38 | 3 | 0.096 J | 0.096 J | NO | NA | - | 0.014 | 0.46 | NO | NO | NO | 1 | NO | NO |
| Benzoic acid | 15 | 38 | 39 | 0.017 J | 0.05 J | NO | NA | - | 0.027 | 0.72 | NO | YES | NO | NA | - | NO |
| bis(2-Ethylhexyl) Phthalate | 20 | 38 | 53 | 0.018 J | 0.079 J | NO | NA | - | 0.012 | 0.3 | NO | YES | NO | NA | - | NO |
| Chrysene | 3 | 38 | 8 | 0.02 J | 0.14 J | NO | NA | - | 0.019 | 0.088 | YES | YES | YES | 2 | NO | NO |
| Di-n-Butyl Phthalate | 3 | 38 | 8 | 0.022 J | 0.037 J | NO | NA | - | 0.018 | 1.2 | NO | YES | NO | NA | - | NO |
| Fluoranthene | 3 | 38 | 8 | 0.018 J | 0.18 J | NO | NA | - | 0.019 | 1.2 | NO | YES | NO | 4 | NO | NO |
| Indeno(1,2,3-c,d)pyrene | 1 | 38 | 3 | 0.018 J | 0.018 J | NO | NA | - | ND | ND | YES | NO | NO | 1 | NO | NO |
| Nitrosodiphenylamine, n- | 1 | 38 | 3 | 0.036 J | 0.036 J | NO | NA | - | 0.02 | 1.3 | NO | NO | NO | NA | - | NO |
| Pyrene | 5 | 38 | 13 | 0.019 J | 0.24 J | NO | NA | - | 0.018 | 0.88 | NO | YES | NO | 4 | NO | NO |

**Bolded values and chemicals identify COPECs and decision source**.
FOD = Frequency of detection
MDC - Maximum Detected Concentration
J = Estimated value
NA = USEPA ECO-SSL or background value not available for the consituent.
\- = USEPA ECO-SSL or background value not available, therefore the next step will be applied.
a = USEPA ECO-SSL states that bioavailability and subsequent toxicity is dependant upon soil pH as listed.
ND = Compound not detected at Demo 1 Soil Area therefore considered to exceed the MDC.

STEP 1 - If the constituent was a risk driver in Demo 1 it is retained as a COPEC;
If the maximum detected concentration (MDC) exceeds the USEPA ECO-SSL the constiuent is retained as a COPEC;
If the MDC does not exceed the USEPA ECO-SSL the constituent is eliminated as a COPEC.
If no USEPA ECO-SSL is available STEP 2 is applied.
STEP 2 - If the MDC is less than the MDC in Demo 1 the constituent is eliminated as a COPEC;
If the MDC is greater than the MDC in Demo 1 the constituent but the frequncy of detection (FOD) is < 5% the constituent is eliminated as a COPEC;
If the MDC is greater than the MDC in Demo 1 the constituent but the FOD is ≥ 5% STEP 3 is applied.
STEP 3 - If the MDC is less than the background value the constiuent is eliminated as a COPEC;
If the MDC is greater than the background value the constituent is retained as a COPEC.

1 Chemical identified as contributing to a risk to one of the assessment endpoints evaluated in the Demo Area 1 ERA.
2 The background values listed are those reported for natural soils by MADEP, Technical Update: Levels of Polycyclic Aromatic Hydrocarbons and Metals in Soils.
3 Chemical to be retained as a COPEC for the Tango Range.

# Table 3.2
## Baseline Ecological Risk Assessment
## Tango Range
## Exposure Parameters for Wildlife Receptors

| General Receptor | Receptor of Interest | Wet Weight Food Ingestion1 (kg/day) | Dietary Fraction Percent of Items in Diet [2] | | | | | | Soil Ingestion Rate (kg/day) 3,4 | Body Weight (kg) | Home Range (Ha) | Area Use Factor[5] (Unitless) | Seasonal Use Factor[6] (Unitless) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Terrestrial Plants | Earth-worms | Other Inverte-brates | Small Mammals | Small Birds | Total Diet | | | | | |
| Herbivorous Mammal | White-footed Mouse | 4.29E-03 | 54% | 0% | 46% | 0% | 0% | 100% | 8.58E-05 | 2.20E-02 | 0.062 | 1 | 1 |
| Omnivorous Mammal | Short-tailed Shrew | 1.04E-02 | 12% | 28% | 60% | 0% | 0% | 100% | 2.08E-04 | 1.70E-02 | 0.39 | 1 | 1 |
| Carnivorous Mammal | Red Fox | 9.89E-02 | 0% | 0% | 0% | 88% | 12% | 100% | 1.30E-02 | 1.13E+00 | 60 | 1 | 1 |
| Herbivorous Bird | Chipping Sparrow | 5.13E-03 | 60% | 0% | 40% | 0% | 0% | 100% | 5.13E-04 | 1.50E-02 | 3 | 1 | 0.42 |
| Omnivorous Bird | American Robin | 7.84E-02 | 29% | 15% | 56% | 0% | 0% | 100% | 7.84E-03 | 8.10E-02 | 0.25 | 1 | 0.58 |
| Carnivorous Bird | Red-tailed Hawk | 3.24E-01 | 7% | 0% | 3% | 74% | 16% | 100% | 9.72E-03 | 4.50E+00 | 57 | 1 | 1 |

Notes:

1 Wet weight food ingestion rate (kg/day) calculated from measured values for receptors of interest as reported in USEPA (1993) except for chipping sparrow where the ingestion rate of the mourning dove, a similar species that ingests grit (USEPA, 1993) was applied.

2 Estimated percentage of dietary food items based upon USEPA (1993) or available scientific literature.

3 Soil ingestion rate based upon reference in Beyer et al. (1994).

4 Soil ingestion rate based upon estimate from species occupying a similar trophic level in Beyer et al. (1994).

5 Area use factor (AUF) defined as home range/available habitat, where AUF can not exceed 1.0.

6 Seasonal use factor as cited in AMEC (2005).

**Table 3.3**
**Baseline Ecological Risk Assessment**
**Tango Range**
**Dietary Uptake Factors for Wildlife Receptors**

| Contaminant of Potential Ecological Concern | Kow | Log Kow | Small Mammal Uptake Factor | | Small Bird Uptake Factor | | Soil Invertebrate Uptake Factor | | Terrestrial Plant Uptake Factor | |
|---|---|---|---|---|---|---|---|---|---|---|
| *Explosives* | | | | | | | | | | |
| Nitroglycerin | 1.00E+02 | 2.00E+00 | 1.00E+00 | 3 | 1.00E+00 | 3 | 3.10E+00 | 4 | 2.70E+00 | 4 |
| *Metals* | | | | | | | | | | |
| Antimony | N/A | N/A | 8.11E-02 | 1 | 1.00E+00 | 3 | 1.71E-01 | 1 | 0.00E+00 | 1 |
| Arsenic | N/A | N/A | 1.49E-02 | 6 | 1.00E+00 | 3 | 5.23E-01 | 5 | 1.00E+00 | 3 |
| Cadmium | N/A | N/A | 7.53E-01 | 1 | 7.43E-04 | 1 | 4.61E+00 | 1 | 2.29E+00 | 1 |
| Copper | N/A | N/A | 6.02E-02 | 1 | 1.00E+00 | 3 | 2.32E-01 | 1 | 2.52E-01 | 1 |
| Lead | N/A | N/A | 4.50E-03 | 1 | 1.00E+00 | 3 | 1.15E-01 | 1 | 2.20E-02 | 1 |
| Tungsten | N/A | N/A | 0.00E+00 | 1 | 1.00E+00 | 3 | 1.00E+00 | 3 | 2.00E+00 | 2 |
| Vanadium | N/A | N/A | 1.20E-02 | 6 | 1.00E+00 | 3 | 1.00E+00 | 3 | 5.50E-03 | 2 |

1 MMR specific uptake factor as derived from Draft Final Environmental Risk Characterization Demo 1 Soil Operable Unit (AMEC, 2004)

2 Baes, C.F., R. D. Sharp, A. L. Sjoreen and R.W. Shor. 1984. A Review and Analysis of Parameters for AssessingTransport of Enviornmentally Released Readionuclides Through Agriculture. Oak Ridge National Laboratory, Health and Safety Research Division. ORNL 5786.

3 Lack of corresponding data prevented BAF uptake factor from being estimated. A value of 1.0 is applied to estimate body burden.

4 Technical approach or BAF value applied in USEPA (1999) used to estimate or identify BAF.

5 BAF reported in Sample et al. (1999).

6 BAF reported in Sample et al. (1998).

**Table 3.4**
**Baseline Ecological Risk Assessment**
**Tango Range**
**Calculated Hazard Quotients for the Chipping Sparrow Exposed to COPECs in Surface Soils**

| Tango Range COPECs | Mean Soil Conc. (mg/kg) | Ingestion Rate | | Body Weight (kg) | Dietary Dosage | | | Total Daily Dietary Dosage (mg/kg/day) | Toxicity Reference Values | | NOAEL HQ | LOAEL HQ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Wet Wt. (kg/day) | Dry Wt. (kg/day) | | Terrestrial Plants (mg/kg/day) 1 | Other Invertebrates (mg/kg/day) 2 | Soil (mg/kg/day) | | NOAEL Dosage (mg/kg/day) | LOAEL Dosage (mg/kg/day) | | |
| *Explosives* | | | | | | | | | | | | |
| Nitroglycerin | 1.94E+01 | 5.13E-03 | 5.13E-04 | 1.50E-02 | 1.61E+00 | 2.55E-01 | 6.62E-01 | 1.06E+00 | NC | NC | - | - |
| *Metals* | | | | | | | | | | | | |
| Antimony | 3.40E+00 | 5.13E-03 | 5.13E-04 | 1.50E-02 | 0.00E+00 | 2.47E-03 | 1.16E-01 | 4.99E-02 | 8.40E+02 | NC | <1 | - |
| Arsenic | 3.30E+00 | 5.13E-03 | 5.13E-04 | 1.50E-02 | 1.02E-01 | 7.32E-03 | 1.13E-01 | 9.31E-02 | 5.14E+00 | 1.28E+01 | <1 | <1 |
| Cadmium | 2.00E-01 | 5.13E-03 | 5.13E-04 | 1.50E-02 | 1.41E-02 | 3.91E-03 | 6.84E-03 | 1.04E-02 | 1.45E+00 | 2.00E+01 | <1 | <1 |
| Copper | 7.37E+01 | 5.13E-03 | 5.13E-04 | 1.50E-02 | 5.72E-01 | 7.25E-02 | 2.52E+00 | 1.33E+00 | 4.70E+01 | 6.17E+01 | <1 | <1 |
| **Lead** | 1.31E+02 | 5.13E-03 | 5.13E-04 | 1.50E-02 | 8.84E-02 | 6.37E-02 | 4.46E+00 | 1.94E+00 | 1.13E+00 | 1.13E+01 | **1.7** | <1 |
| Tungsten | 1.50E+00 | 5.13E-03 | 5.13E-04 | 1.50E-02 | 9.23E-02 | 6.36E-03 | 5.13E-02 | 6.30E-02 | NC | NC | - | - |
| Vanadium | 1.72E+01 | 5.13E-03 | 5.13E-04 | 1.50E-02 | 2.91E-03 | 7.29E-02 | 5.88E-01 | 2.79E-01 | 1.14E+01 | NC | <1 | - |

1 Based upon a percent moisture content of 85% in plants.

2 Based upon a percent moisture content of 69% in crickets/grasshoppers.

NC = No criteria or value available.

**Table 3.5**
**Baseline Ecological Risk Assessment**
**Tango Range**
**Toxicity Reference Values for the Chipping Sparrow**

| Contaminants of Potential Ecological Concern | Test Species | Body Weight (kg) | | Test Species (mg/kg) | | Chipping Sparrow (mg/kg) | | Toxicological Endpoint | Reference |
|---|---|---|---|---|---|---|---|---|---|
| | | Test Species | Wildlife Species | NOAEL | LOAEL | NOAEL[1] | LOAEL[2] | | |
| *Explosives* | | | | | | | | | |
| Nitroglycerin | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| *Metals* | | | | | | | | | |
| Antimony | bobwhite quail | 0.15 | 0.015 | 8.40E+02 | NC | 8.40E+02 | NC | Max. dose with no reproductive effect | Damron and Wilson (1975) |
| Arsenic | Mallard | 1.0 | 0.015 | 5.14E+00 | 1.28E+01 | 5.14E+00 | 1.28E+01 | Duckling mortality | USFWS (1964) In Sample et al. (1996) |
| Cadmium | mallard duck | 1.15 | 0.015 | 1.45E+00 | 2.00E+01 | 1.45E+00 | 2.00E+01 | Reproductive impairment | White and Finley (1978) In Sample et al. (1978) |
| Copper | domestic chicken | 1.5 | 0.015 | 4.70E+01 | 6.17E+01 | 4.70E+01 | 6.17E+01 | Juvenile mortality | Mehring et al. (1960) In Sample et al. (1996) |
| Lead | bobwhite quail | 0.15 | 0.015 | 1.13E+00 | 1.13E+01 | 1.13E+00 | 1.13E+01 | Reduced egg hatching success | Edens et al. (1976) In Sample et al. (1996) |
| Tungsten | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| Vanadium | mallard duck | 2 | 0.015 | 1.14E+01 | NC | 1.14E+01 | NC | Max. dose with no reproductive effect | Formigli et al. (1986) In Sample et al. (1996) |

[1] NOAEL(wildlife sp.) = (NOAELtest sp.)1)

[2] LOAEL(wildlife sp.) = (LOAELtest sp.)1)

NC = No TRV available for compound or surrogate compound.

**Table 3.6**
**Baseline Ecological Risk Assessment**
**Tango Range**
**Calculated Hazard Quotients for the Whitefooted Mouse Exposed to COPECs in Surface Soils**

| Tango Range COPECs | Mean Soil Conc. (mg/kg) | Ingestion Rate | | Body Weight (kg) | Dietary Dosage | | | | Total Daily Dietary Dosage | Toxicity Reference Values | | NOAEL HQ | LOAEL HQ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Wet Wt. (kg/day) | Dry Wt. (kg/day) | | Terrestrial Plants (mg/kg/day) 1 | Earthworms (mg/kg/day) 2 | Other Invertebrates (mg/kg/day) 3 | Soil (mg/kg/day) | (mg/kg/day) | NOAEL Dosage (mg/kg/day) | LOAEL Dosage (mg/kg/day) | | |
| *Explosives* | | | | | | | | | | | | | |
| Nitroglycerin | 1.94E+01 | 4.29E-03 | 8.58E-05 | 2.20E-02 | 8.27E-01 | 0.00E+00 | 1.67E+00 | 7.55E-02 | 2.57E+00 | 5.99E+00 | 6.39E+01 | <1 | <1 |
| *Metals* | | | | | | | | | | | | | |
| Antimony | 3.40E+00 | 4.29E-03 | 8.58E-05 | 2.20E-02 | 0.00E+00 | 0.00E+00 | 1.62E-02 | 1.33E-02 | 2.94E-02 | 1.35E-01 | 1.35E+00 | <1 | <1 |
| Arsenic | 3.30E+00 | 4.29E-03 | 8.58E-05 | 2.20E-02 | 5.21E-02 | 0.00E+00 | 4.80E-02 | 1.29E-02 | 1.13E-01 | 1.36E-01 | 1.36E+00 | <1 | <1 |
| Cadmium | 2.00E-01 | 4.29E-03 | 8.58E-05 | 2.20E-02 | 7.23E-03 | 0.00E+00 | 2.56E-02 | 7.80E-04 | 3.37E-02 | 2.00E+00 | 2.00E+01 | <1 | <1 |
| Copper | 1.84E+01 | 4.29E-03 | 8.58E-05 | 2.20E-02 | 7.32E-02 | 0.00E+00 | 1.19E-01 | 7.18E-02 | 2.64E-01 | 8.52E+00 | 3.40E+01 | <1 | <1 |
| Lead | 1.31E+02 | 4.29E-03 | 8.58E-05 | 2.20E-02 | 4.54E-02 | 0.00E+00 | 4.17E-01 | 5.09E-01 | 9.72E-01 | 1.60E+01 | 1.60E+02 | <1 | <1 |
| Tungsten | 1.50E+00 | 4.29E-03 | 8.58E-05 | 2.20E-02 | 4.74E-02 | 0.00E+00 | 4.17E-02 | 5.85E-03 | 9.49E-02 | NC | NC | - | - |
| **Vanadium** | 1.72E+01 | 4.29E-03 | 8.58E-05 | 2.20E-02 | 1.49E-03 | 0.00E+00 | 4.78E-01 | 6.71E-02 | 5.47E-01 | 1.48E-02 | 1.48E-01 | 37 | 3.7 |

1 Based upon a percent moisture content of 85% in plants.

2 Based upon a percent moisture content of 84% in earthworms.

3 Based upon a percent moisture content of 69% in crickets/grasshoppers.

NC = No criteria or value available.

**Table 3.7**
**Baseline Ecological Risk Assessment**
**Tango Range**
**Toxicity Reference Values for the Whitefooted Mouse**

| Contaminants of Potential Ecological Concern | Test Species | Body Weight (kg) | | Test Species (mg/kg) | | Whitefooted Mouse (mg/kg) | | Toxicological Endpoint | Reference |
|---|---|---|---|---|---|---|---|---|---|
| | | Test Species | Wildlife Species | NOAEL | LOAEL | NOAEL[1] | LOAEL[2] | | |
| *Explosives* | | | | | | | | | |
| Nitroglycerin | rat | 0.35 | 0.022 | 3.00E+00 | 3.20E+01 | 5.99E+00 | 6.39E+01 | Weight loss, hepatic lesions, and reproduction. | Ellis et al. (1978a) in USACHPPM (2001) |
| *Metals* | | | | | | | | | |
| Antimony | mouse | 0.03 | 0.022 | 1.25E-01 | 1.25E+00 | 1.35E-01 | 1.35E+00 | Reduction in life span of treated adults | Schroeder et al. (1976) In Sample et al. (1996) |
| Arsenic | mouse | 0.03 | 0.022 | 1.26E-01 | 1.26E+00 | 1.36E-01 | 1.36E+00 | Declining litter sizes over multiple generations | Schroeder and Mitchner (1971) In Sample et al. (1996) |
| Cadmium | rat | 0.35 | 0.022 | 1.00E+00 | 1.00E+01 | 2.00E+00 | 2.00E+01 | Embryo toxicity | Sutuo et al. (1980) In Sample et al. (1996) |
| Copper | mink | 1.0 | 0.022 | 3.28E+00 | 1.31E+01 | 8.52E+00 | 3.40E+01 | Increased kit mortality | Aluerich et al. (1996) in Sample et al. (1996) |
| Lead | rat | 0.35 | 0.022 | 8.00E+00 | 8.00E+01 | 1.60E+01 | 1.60E+02 | Reduced body wt., increased kidney damage | Azar et la. (1973) In Sample et al. (1996) |
| Tungsten | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| Vanadium | rat | 0.35 | 0.022 | 7.40E-03 | 7.40E-02 | 1.48E-02 | 1.48E-01 | Reduced fertility in male rats | Formigli et al. (1986) In Sample et al. (1996) |

[1] NOAEL(wildlife sp.) = (NOAELtest sp.)(bwtsp)/(bwwsp)0.25

[2] LOAEL(wildlife sp.) = (LOAELtest sp.)(bwtsp)/(bwwsp)0.25

NC = No mammalian Toxicity Reference Value was available and therefore the HQ was not calculated.

**Table 3.8**
**Baseline Ecological Risk Assessment**
**Tango Range**
**Calculated Hazard Quotients for the American Robin Exposed to COPECs in Surface Soils**

| Tango Range COPECs | Mean Soil Conc. (mg/kg) | Ingestion Rate | | Body Weight (kg) | Dietary Dosage | | | | Total Daily Dietary Dosage | Toxicity Reference Values | | NOAEL HQ | LOAEL HQ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Wet Wt. (kg/day) | Dry Wt. (kg/day) | | Terrestrial Plants (mg/kg/day) 1 | Earthworms (mg/kg/day) 2 | Other Invertebrates (mg/kg/day) 3 | Soil (mg/kg/day) | (mg/kg/day) | NOAEL Dosage (mg/kg/day) | LOAEL Dosage (mg/kg/day) | | |
| *Explosives* | | | | | | | | | | | | | |
| Nitroglycerin | 1.94E+01 | 7.84E-02 | 7.84E-03 | 8.10E-02 | 2.20E+00 | 1.40E+00 | 1.01E+00 | 1.87E+00 | 3.76E+00 | NC | NC | - | - |
| *Metals* | | | | | | | | | | | | | |
| Antimony | 3.40E+00 | 7.84E-02 | 7.84E-03 | 8.10E-02 | 0.00E+00 | 1.35E-02 | 9.77E-03 | 3.29E-01 | 2.04E-01 | 8.40E+02 | NC | <1 | - |
| Arsenic | 3.30E+00 | 7.84E-02 | 7.84E-03 | 8.10E-02 | 1.39E-01 | 4.01E-02 | 2.90E-02 | 3.19E-01 | 3.06E-01 | 5.14E+00 | 1.28E+01 | <1 | <1 |
| Cadmium | 2.00E-01 | 7.84E-02 | 7.84E-03 | 8.10E-02 | 1.93E-02 | 2.14E-02 | 1.55E-02 | 1.94E-02 | 4.38E-02 | 1.45E+00 | 2.00E+01 | <1 | <1 |
| Copper | 7.37E+01 | 7.84E-02 | 7.84E-03 | 8.10E-02 | 7.82E-01 | 3.97E-01 | 2.87E-01 | 7.13E+00 | 4.99E+00 | 4.70E+01 | 6.17E+01 | <1 | <1 |
| **Lead** | 1.31E+02 | 7.84E-02 | 7.84E-03 | 8.10E-02 | 1.21E-01 | 3.49E-01 | 2.52E-01 | 1.26E+01 | 5.35E+00 | 1.13E+00 | 1.13E+01 | **4.7** | <1 |
| Tungsten | 1.50E+00 | 7.84E-02 | 7.84E-03 | 8.10E-02 | 1.26E-01 | 3.48E-02 | 2.52E-02 | 1.45E-01 | 1.92E-01 | NC | NC | - | - |
| Vanadium | 1.72E+01 | 7.84E-02 | 7.84E-03 | 8.10E-02 | 3.98E-03 | 4.00E-01 | 2.89E-01 | 1.66E+00 | 1.37E+00 | 1.14E+01 | NC | <1 | - |

1 Based upon a percent moisture content of 85% in plants.

2 Based upon a percent moisture content of 84% in earthworms.

3 Based upon a percent moisture content of 69% in crickets/grasshoppers.

NC = No criteria or value available.

**Table 3.9**
**Baseline Ecological Risk Assessment**
**Tango Range**
**Toxicity Reference Values for the American Robin**

| Contaminants of Potential Ecological Concern | Test Species | Body Weight (kg) | | Test Species (mg/kg) | | American Robin (mg/kg) | | Toxicological Endpoint | Reference |
|---|---|---|---|---|---|---|---|---|---|
| | | Test Species | Wildlife Species | NOAEL | LOAEL | NOAEL[1] | LOAEL[2] | | |
| *Explosives* | | | | | | | | | |
| Nitroglycerin | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| *Metals* | | | | | | | | | |
| Antimony | bobwhite quail | 0.15 | 0.081 | 8.40E+02 | NC | 8.40E+02 | NC | Max. dose with no reproductive effect | Damron and Wilson (1975) |
| Arsenic | Mallard | 1.0 | 0.015 | 5.14E+00 | 1.28E+01 | 5.14E+00 | 1.28E+01 | Duckling mortality | USFWS (1964) In Sample et al. (1996) |
| Cadmium | mallard duck | 1.15 | 0.081 | 1.45E+00 | 2.00E+01 | 1.45E+00 | 2.00E+01 | Reproductive impairment | White and Finley (1978) In Sample et al. (1978) |
| Copper | domestic chicken | 1.5 | 0.081 | 4.70E+01 | 6.17E+01 | 4.70E+01 | 6.17E+01 | Juvenile mortality | Mehring et al. (1960) In Sample et al. (1996) |
| Lead | bobwhite quail | 0.15 | 0.081 | 1.13E+00 | 1.13E+01 | 1.13E+00 | 1.13E+01 | Reduced egg hatching success | Edens et al. (1976) In Sample et al. (1996) |
| Tungsten | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| Vanadium | mallard duck | 2 | 0.081 | 1.14E+01 | NC | 1.14E+01 | NC | Max. dose with no reproductive effect | Formigli et al. (1986) In Sample et al. (1996) |

[1] NOAEL(wildlife sp.) = (NOAELtest sp.)1)

[2] LOAEL(wildlife sp.) = (LOAELtest sp.)1)

NC = No TRV available for compound or surrogate compound.

**Table 3.10**
**Baseline Ecological Risk Assessment**
**Tango Range**
**Calculated Hazard Quotients for the Short-tailed Shrew Exposed to COPECs in Surface Soils**

| Tango Range COPECs | Mean Soil Conc. (mg/kg) | Ingestion Rate | | Body Weight (kg) | Dietary Dosage | | | | Total Daily Dietary Dosage | Toxicity Reference Values | | NOAEL HQ | LOAEL HQ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Wet Wt. (kg/day) | Dry Wt. (kg/day) | | Terrestrial Plants (mg/kg/day) 1 | Earthworms (mg/kg/day) 2 | Other Invertebrates (mg/kg/day) 3 | Soil (mg/kg/day) | (mg/kg/day) | NOAEL Dosage (mg/kg/day) | LOAEL Dosage (mg/kg/day) | | |
| *Explosives* | | | | | | | | | | | | | |
| Nitroglycerin | 1.94E+01 | 1.04E-02 | 2.08E-04 | 1.70E-02 | 5.77E-01 | 1.65E+00 | 1.37E-01 | 2.37E-01 | 2.60E+00 | 6.39E+00 | 6.82E+01 | <1 | <1 |
| *Metals* | | | | | | | | | | | | | |
| Antimony | 3.40E+00 | 1.04E-02 | 2.08E-04 | 1.70E-02 | 0.00E+00 | 1.59E-02 | 1.32E-03 | 4.16E-02 | 5.89E-02 | 1.44E-01 | 1.44E+00 | <1 | <1 |
| Arsenic | 3.30E+00 | 1.04E-02 | 2.08E-04 | 1.70E-02 | 3.63E-02 | 4.73E-02 | 3.93E-03 | 4.04E-02 | 1.28E-01 | 1.45E-01 | 1.45E+00 | <1 | <1 |
| Cadmium | 2.00E-01 | 1.04E-02 | 2.08E-04 | 1.70E-02 | 5.04E-03 | 2.53E-02 | 2.10E-03 | 2.45E-03 | 3.49E-02 | 2.13E+00 | 2.13E+01 | <1 | <1 |
| Copper | 1.84E+01 | 1.04E-02 | 2.08E-04 | 1.70E-02 | 5.11E-02 | 1.17E-01 | 9.71E-03 | 2.25E-01 | 4.03E-01 | 9.08E+00 | 3.63E+01 | <1 | <1 |
| Lead | 1.31E+02 | 1.04E-02 | 2.08E-04 | 1.70E-02 | 3.16E-02 | 4.11E-01 | 3.42E-02 | 1.60E+00 | 2.07E+00 | 1.70E+01 | 1.70E+02 | <1 | <1 |
| Tungsten | 1.50E+00 | 1.04E-02 | 2.08E-04 | 1.70E-02 | 3.30E-02 | 4.11E-02 | 3.41E-03 | 1.84E-02 | 9.59E-02 | NC | NC | - | - |
| **Vanadium** | 1.72E+01 | 1.04E-02 | 2.08E-04 | 1.70E-02 | 1.04E-03 | 4.71E-01 | 3.91E-02 | 2.10E-01 | 7.22E-01 | 1.58E-02 | 1.58E-01 | **46** | **4.6** |

1 Based upon a percent moisture content of 85% in plants.
2 Based upon a percent moisture content of 84% in earthworms.
3 Based upon a percent moisture content of 69% in crickets/grasshoppers.
NC = No criteria or value available.

**Table 3.11**
**Baseline Ecological Risk Assessment**
**Tango Range**
**Toxicity Reference Values for the Shortailed Shrew**

| Contaminants of Potential Ecological Concern | Test Species | Body Weight (kg) | | Test Species (mg/kg) | | Shortailed Shrew (mg/kg) | | Toxicological Endpoint | Reference |
|---|---|---|---|---|---|---|---|---|---|
| | | Test Species | Wildlife Species | NOAEL | LOAEL | NOAEL[1] | LOAEL[2] | | |
| *Explosives* | | | | | | | | | |
| Nitroglycerin | rat | 0.35 | 0.017 | 3.00E+00 | 3.20E+01 | 6.39E+00 | 6.82E+01 | Weight loss, hepatic lesions, and reproduction. | Ellis et al. (1978a) in USACHPPM (2001) |
| *Metals* | | | | | | | | | |
| Antimony | mouse | 0.03 | 0.017 | 1.25E-01 | 1.25E+00 | 1.44E-01 | 1.44E+00 | Reduction in life span of treated adults | Schroeder et al. (1976) In Sample et al. (1996) |
| Arsenic | mouse | 0.03 | 0.017 | 1.26E-01 | 1.26E+00 | 1.45E-01 | 1.45E+00 | Declining litter sizes over multiple generations | Schroeder and Mitchner (1971) In Sample et al. (1996) |
| Cadmium | rat | 0.35 | 0.017 | 1.00E+00 | 1.00E+01 | 2.13E+00 | 2.13E+01 | Embryo toxicity | Sutuo et al. (1980) In Sample et al. (1996) |
| Copper | mink | 1.0 | 0.017 | 3.28E+00 | 1.31E+01 | 9.08E+00 | 3.63E+01 | Increased kit mortality | Aluerich et al. (1996) in Sample et al. (1996) |
| Lead | rat | 0.35 | 0.017 | 8.00E+00 | 8.00E+01 | 1.70E+01 | 1.70E+02 | Reduced body wt., increased kidney damage | Azar et la. (1973) In Sample et al. (1996) |
| Tungsten | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| Vanadium | rat | 0.35 | 0.017 | 7.40E-03 | 7.40E-02 | 1.58E-02 | 1.58E-01 | Reduced fertility in male rats | Formigli et al. (1986) In Sample et al. (1996) |

[1] NOAEL(wildlife sp.) = (NOAELtest sp.)(bwtsp)/(bwwsp)0.25

[2] LOAEL(wildlife sp.) = (LOAELtest sp.)(bwtsp)/(bwwsp)0.25

NC = Toxicity reference value not available.

**Table 3.12**
**Baseline Ecological Risk Assessment**
**Tango Range**
**Calculated Hazard Quotients for the Red-tailed Hawk Exposed to COPECs in Surface Soils**

| Tango Range COPECs | Mean Soil Conc. (mg/kg) | Ingestion Rate | | Body Weight (kg) | Dietary Dosage | | | | | Total Daily Dietary Dosage | Toxicity Reference Values | | NOAEL HQ | LOAEL HQ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Wet Wt. (kg/day) | Dry Wt. (kg/day) | | Terrestrial Plants (mg/kg/day) 1 | Other Invertebrates (mg/kg/day) 2 | Small Mammals (mg/kg/day) | Birds (mg/kg/day) | Soil (mg/kg/day) | (mg/kg/day) | NOAEL Dosage (mg/kg/day) | LOAEL Dosage (mg/kg/day) | | |
| *Explosives* | | | | | | | | | | | | | | |
| Nitroglycerin | 1.94E+01 | 3.24E-01 | 9.72E-03 | 4.50E+00 | 3.96E-02 | 4.03E-02 | 3.30E-01 | 7.14E-02 | 4.18E-02 | 5.23E-01 | NC | NC | - | - |
| *Metals* | | | | | | | | | | | | | | |
| Antimony | 3.40E+00 | 3.24E-01 | 9.72E-03 | 4.50E+00 | 0.00E+00 | 3.89E-04 | 4.70E-03 | 1.25E-02 | 7.34E-03 | 2.50E-02 | 8.40E+02 | NC | <1 | - |
| Arsenic | 3.30E+00 | 3.24E-01 | 9.72E-03 | 4.50E+00 | 2.49E-03 | 1.16E-03 | 8.38E-04 | 1.22E-02 | 7.13E-03 | 2.38E-02 | 5.14E+00 | 1.28E+01 | <1 | <1 |
| Cadmium | 2.00E-01 | 3.24E-01 | 9.72E-03 | 4.50E+00 | 3.46E-04 | 6.17E-04 | 2.57E-03 | 5.48E-07 | 4.32E-04 | 3.96E-03 | 1.45E+00 | 2.00E+01 | <1 | <1 |
| Copper | 7.37E+01 | 3.24E-01 | 9.72E-03 | 4.50E+00 | 1.40E-02 | 1.14E-02 | 7.56E-02 | 2.72E-01 | 1.59E-01 | 5.32E-01 | 4.70E+01 | 6.17E+01 | <1 | <1 |
| Lead | 1.31E+02 | 3.24E-01 | 9.72E-03 | 4.50E+00 | 2.17E-03 | 1.01E-02 | 1.00E-02 | 4.81E-01 | 2.82E-01 | 7.85E-01 | 1.13E+00 | 1.13E+01 | <1 | <1 |
| Tungsten | 1.50E+00 | 3.24E-01 | 9.72E-03 | 4.50E+00 | 2.27E-03 | 1.00E-03 | 0.00E+00 | 5.53E-03 | 3.24E-03 | 1.20E-02 | NC | NC | - | - |
| Vanadium | 1.72E+01 | 3.24E-01 | 9.72E-03 | 4.50E+00 | 7.15E-05 | 1.15E-02 | 3.52E-03 | 6.34E-02 | 3.72E-02 | 1.16E-01 | 1.14E+01 | NC | <1 | - |

1 Based upon a percent moisture content of 85% in plants.

2 Based upon a percent moisture content of 84% in earthworms.

NC = No criteria or value available.

**Table 3.13**
**Baseline Ecological Risk Assessment**
**Tango Range**
**Toxicity Reference Values for the Red-tailed Hawk**

| Contaminants of Potential Ecological Concern | Test Species | Body Weight (kg) | | Test Species (mg/kg) | | Red-tailed Hawk (mg/kg) | | Toxicological Endpoint | Reference |
|---|---|---|---|---|---|---|---|---|---|
| | | Test Species | Wildlife Species | NOAEL | LOAEL | NOAEL[1] | LOAEL[2] | | |
| *Explosives* | | | | | | | | | |
| Nitroglycerin | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| *Metals* | | | | | | | | | |
| Antimony | bobwhite quail | 0.15 | 4.50 | 8.40E+02 | NC | 8.40E+02 | NC | Max. dose with no reproductive effect | Damron and Wilson (1975) |
| Arsenic | Mallard | 1.0 | 0.015 | 5.14E+00 | 1.28E+01 | 5.14E+00 | 1.28E+01 | Duckling mortality | USFWS (1964) In Sample et al. (1996) |
| Cadmium | mallard duck | 1.15 | 4.50 | 1.45E+00 | 2.00E+01 | 1.45E+00 | 2.00E+01 | Reproductive impairment | White and Finley (1978) In Sample et al. (1978) |
| Copper | domestic chicken | 1.5 | 4.50 | 4.70E+01 | 6.17E+01 | 4.70E+01 | 6.17E+01 | Juvenile mortality | Mehring et al. (1960) In Sample et al. (1996) |
| Lead | bobwhite quail | 0.15 | 4.50 | 1.13E+00 | 1.13E+01 | 1.13E+00 | 1.13E+01 | Reduced egg hatching success | Edens et al. (1976) In Sample et al. (1996) |
| Tungsten | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| Vanadium | mallard duck | 2 | 4.50 | 1.14E+01 | NC | 1.14E+01 | NC | Max. dose with no reproductive effect | Formigli et al. (1986) In Sample et al. (1996) |

[1] NOAEL(wildlife sp.) = (NOAELtest sp.)1)

[2] LOAEL(wildlife sp.) = (LOAELtest sp.)1)

NC = No TRV available for compound or surrogate compound.

**Table 3.14**
**Baseline Ecological Risk Assessment**
**Tango Range**
**Calculated Hazard Quotients for the Red Fox Exposed to COPECs in Surface Soils**

| Tango Range COPECs | Mean Soil Conc. (mg/kg) | Ingestion Rate | | Body Weight (kg) | Dietary Dosage | | | Total Daily Dietary Dosage (mg/kg/day) | Toxicity Reference Values | | NOAEL HQ | LOAEL HQ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Wet Wt. (kg/day) | Dry Wt. (kg/day) | | Small Mammals (mg/kg/day) | Birds (mg/kg/day) | Soil (mg/kg/day) | | NOAEL Dosage (mg/kg/day) | LOAEL Dosage (mg/kg/day) | | |
| *Explosives* | | | | | | | | | | | | |
| Nitroglycerin | 1.94E+01 | 9.89E-02 | 1.30E-02 | 1.13E+00 | 4.77E-01 | 6.51E-02 | 2.23E-01 | 7.65E-01 | 1.130E+00 | 2.39E+01 | <1 | <1 |
| *Metals* | | | | | | | | | | | | |
| **Antimony** | 3.40E+00 | 9.89E-02 | 1.30E-02 | 1.13E+00 | 6.80E-03 | 1.14E-02 | 3.91E-02 | 5.73E-02 | 5.05E-02 | 5.05E-01 | **1.1** | <1 |
| Arsenic | 3.30E+00 | 9.89E-02 | 1.30E-02 | 1.13E+00 | 1.21E-03 | 1.11E-02 | 3.80E-02 | 5.03E-02 | 5.09E-02 | 5.09E-01 | <1 | <1 |
| Cadmium | 2.00E-01 | 9.89E-02 | 1.30E-02 | 1.13E+00 | 3.71E-03 | 4.99E-07 | 2.30E-03 | 6.01E-03 | 7.46E-01 | 7.46E+00 | <1 | <1 |
| Copper | 1.84E+01 | 9.89E-02 | 1.30E-02 | 1.13E+00 | 2.73E-02 | 6.18E-02 | 2.12E-01 | 3.01E-01 | 3.18E+00 | 1.27E+01 | <1 | <1 |
| Lead | 1.31E+02 | 9.89E-02 | 1.30E-02 | 1.13E+00 | 1.45E-02 | 4.39E-01 | 1.50E+00 | 1.95E+00 | 5.97E+00 | 5.97E+01 | <1 | <1 |
| Tungsten | 1.50E+00 | 9.89E-02 | 1.30E-02 | 1.13E+00 | 3.70E-02 | 5.04E-03 | 1.73E-02 | 5.93E-02 | NC | NC | - | - |
| **Vanadium** | 1.72E+01 | 9.89E-02 | 1.30E-02 | 1.13E+00 | 5.09E-03 | 5.78E-02 | 1.98E-01 | 2.61E-01 | 5.52E-03 | 5.52E-02 | **47** | **4.7** |

NC = No criteria or value available.

**Table 3.15**
**Baseline Ecological Risk Assessment**
**Tango Range**
**Toxicity Reference Values for the Red Fox**

| Contaminants of Potential Ecological Concern | Test Species | Body Weight (kg) | | Test Species (mg/kg) | | Red Fox (mg/kg) | | Toxicological Endpoint | Reference |
|---|---|---|---|---|---|---|---|---|---|
| | | Test Species | Wildlife Species | NOAEL | LOAEL | NOAEL[1] | LOAEL[2] | | |
| *Explosives* | | | | | | | | | |
| Nitroglycerin | rat | 0.35 | 1.130 | 3.00E+00 | 3.20E+01 | 2.24E+00 | 2.39E+01 | Weight loss, hepatic lesions, and reproduction. | Ellis et al. (1978a) in USACHPPM (2001) |
| *Metals* | | | | | | | | | |
| Antimony | mouse | 0.03 | 1.130 | 1.25E-01 | 1.25E+00 | 5.05E-02 | 5.05E-01 | Reduction in life span of treated adults | Schroeder  et al. (1976) In Sample et al. (1996) |
| Arsenic | mouse | 0.03 | 1.130 | 1.26E-01 | 1.26E+00 | 5.09E-02 | 5.09E-01 | Declining litter sizes over multiple generations | Schroeder and Mitchner (1971) In Sample et al. (1996) |
| Cadmium | rat | 0.35 | 1.130 | 1.00E+00 | 1.00E+01 | 7.46E-01 | 7.46E+00 | Embryo toxicity | Sutuo et al. (1980) In Sample et al. (1996) |
| Copper | mink | 1.0 | 1.130 | 3.28E+00 | 1.31E+01 | 3.18E+00 | 1.27E+01 | Increased kit mortality | Aluerich et al. (1996) in Sample et al. (1996) |
| Lead | rat | 0.35 | 1.130 | 8.00E+00 | 8.00E+01 | 5.97E+00 | 5.97E+01 | Reduced body wt., increased kidney damage | Azar et la. (1973) In Sample et al. (1996) |
| Tungsten | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| Vanadium | rat | 0.35 | 1.130 | 7.40E-03 | 7.40E-02 | 5.52E-03 | 5.52E-02 | Reduced fertility in male rats | Formigli et al. (1986) In Sample et al. (1996) |

[1] NOAEL(wildlife sp.) = (NOAELtest sp.)(bwtsp)/(bwwsp)0.25

[2] LOAEL(wildlife sp.) = (LOAELtest sp.)(bwtsp)/(bwwsp)0.25

NC = Toxicity reference value not available.

**Table 3.16**
**Baseline Ecological Risk Assessment**
**Tango Range**
**Summary of Hazard Quotients (HQs) and Hazard Indices (HIs) to Mammals from Soil**

| **Tango Range COPECs** | **White-footed Mouse** | | **Short-tailed Shrew** | | **Red Fox** | |
|---|---|---|---|---|---|---|
| | **NOAEL HQ** | **LOAEL HQ** | **NOAEL HQ** | **LOAEL HQ** | **NOAEL HQ** | **LOAEL HQ** |
| *Explosives* | | | | | | |
| Nitroglycerin | 4.3E-01 | 4.0E-02 | 4.1E-01 | 3.8E-02 | 6.8E-01 | 3.2E-02 |
| *Metals* | | | | | | |
| **Antimony** | 2.2E-01 | 2.2E-02 | 4.1E-01 | 4.1E-02 | **1.1E+00** | 1.1E-01 |
| Arsenic | 2.2E-01 | 2.2E-02 | 8.8E-01 | 8.8E-02 | 9.9E-01 | 1.1E-01 |
| Cadmium | 1.7E-02 | 1.7E-03 | 1.6E-02 | 1.6E-03 | 8.1E-03 | 8.1E-04 |
| Copper | 3.1E-02 | 7.8E-03 | 4.4E-02 | 1.1E-02 | 9.5E-02 | 2.4E-02 |
| Lead | 6.1E-02 | 6.1E-03 | 1.2E-01 | 1.2E-02 | 3.3E-01 | 3.3E-02 |
| Tungsten | - | - | - | - | - | - |
| **Vanadium** | **3.7E+01** | **3.7E+00** | **4.6E+01** | **4.6E+00** | **4.7E+01** | **4.7E+00** |
| | | | | | | |
| **Reproductive HI** | **3.8E+01** | **3.8E+00** | **4.7E+01** | **4.7E+00** | **4.9E+01** | **4.9E+00** |
| **Growth HI** | 6.1E-02 | 6.1E-03 | 1.2E-01 | 1.2E-02 | 3.3E-01 | 3.3E-02 |
| **Survival HI** | 2.2E-01 | 2.2E-02 | 4.1E-01 | 4.1E-02 | **1.1E+00** | 1.1E-01 |

-- = Risk not calculated because of a lack of toxicity data

HQs >1, HIs>1, and COPECs with at least one HQ > 1 are in bold

Reproductive HI = ∑ (nitroglycerin HQ + arsenic HQ + cadmium HQ + copper HQ + vanadium HQ)

Growth HI = ∑ (lead HQ)

Survival HI = ∑ (antimony HQ)

**Table 3.17**
**Baseline Ecological Risk Assessment**
**Tango Range**
**Summary of Hazard Quotients (HQs) and Hazard Indices (HIs) to Birds from Soil**

| **Tango Range COPECs** | **Chipping Sparrow** | | **American Robin** | | **Red-tailed Hawk** | |
|---|---|---|---|---|---|---|
| | **NOAEL HQ** | **LOAEL HQ** | **NOAEL HQ** | **LOAEL HQ** | **NOAEL HQ** | **LOAEL HQ** |
| *Explosives* | | | | | | |
| Nitroglycerin | - | - | - | - | - | - |
| *Metals* | | | | | | |
| Antimony | 5.9E-05 | - | 2.4E-04 | - | 3.0E-05 | - |
| Arsenic | 1.8E-02 | 7.3E-03 | 6.0E-02 | 2.4E-02 | 4.6E-03 | 1.9E-03 |
| Cadmium | 7.2E-03 | 5.2E-04 | 3.0E-02 | 2.2E-03 | 2.7E-03 | 2.0E-04 |
| Copper | 2.8E-02 | 2.2E-02 | 1.1E-01 | 8.1E-02 | 1.1E-02 | 8.6E-03 |
| **Lead** | **1.7E+00** | 1.7E-01 | **4.7E+00** | 4.7E-01 | 7.0E-01 | 7.0E-02 |
| Tungsten | - | - | - | - | - | - |
| Vanadium | 2.4E-02 | - | 1.2E-01 | - | 1.0E-02 | - |
| | | | | | | |
| **Reproductive HI** | **1.7E+00** | 1.7E-01 | **4.9E+00** | 4.8E-01 | 7.1E-01 | 7.0E-02 |
| **Growth HI** | - | - | - | - | - | - |
| Survival HI | 4.6E-02 | 2.9E-02 | 1.7E-01 | 1.0E-01 | 1.6E-02 | 1.0E-02 |

-- = Risk not calculated because of a lack of toxicity data

HQs >1, HIs>1, and COPECs with at least one HQ > 1 are in bold

Reproductive HI = ∑ (antimony HQ + cadmium HQ + lead HQ + vanadium HQ)

Growth HI = No Growth Endpoint Applicable

Survival HI = ∑ (arsenic HQ + copper HQ)

# APPENDIX B

## T Range April 2007 Firing Line Preliminary Soil Results

Data has NOT been validated

**Table B-1**
**T Range April 2007 Soil Data Preliminary Results**

| Area of Concern | Location | Sample ID | Date | Top of Sampling Interval (inches) | Bottom of Sampling Interval (inches) | Method | Analyte | Result | Qual | RL | Units |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Tango Range | W-1 | SSTRW1S-0-3-01 | 4/18/2007 | 0 | 3 | SW8330 | Nitroglycerin | 33000 | | 2500 | ug/Kg |
| Tango Range | W-1 | SSTRW1S-0-3-01 | 4/18/2007 | 0 | 3 | SW9045 | pH | 6.1 | | 0 | SU |
| Tango Range | W-1 | SSTRW1S-0-3-01 | 4/18/2007 | 0 | 3 | TOC - LK | Total Organic Carbon | 25700 | | 500 | mg/Kg |
| Tango Range | W-1 | SSTRW1S-0-3-02 | 4/18/2007 | 0 | 3 | SW8330 | Nitroglycerin | 30000 | | 2500 | ug/Kg |
| Tango Range | W-1 | SSTRW1S-0-3-02 | 4/18/2007 | 0 | 3 | SW9045 | pH | 6.2 | | 0 | SU |
| Tango Range | W-1 | SSTRW1S-0-3-02 | 4/18/2007 | 0 | 3 | TOC - LK | Total Organic Carbon | 25300 | | 500 | mg/Kg |
| Tango Range | W-1 | SSTRW1S-0-3-03 | 4/18/2007 | 0 | 3 | SW8330 | Nitroglycerin | 33000 | | 2500 | ug/Kg |
| Tango Range | W-1 | SSTRW1S-0-3-03 | 4/18/2007 | 0 | 3 | SW9045 | pH | 5.9 | | 0 | SU |
| Tango Range | W-1 | SSTRW1S-0-3-03 | 4/18/2007 | 0 | 3 | TOC - LK | Total Organic Carbon | 26800 | | 500 | mg/Kg |
| Tango Range | W-1 | SSTRW1S-0-3-04 | 4/18/2007 | 0 | 3 | SW8330 | Nitroglycerin | 30000 | | 2500 | ug/Kg |
| Tango Range | W-1 | SSTRW1S-0-3-04 | 4/18/2007 | 0 | 3 | SW9045 | pH | 5.9 | | 0 | SU |
| Tango Range | W-1 | SSTRW1S-0-3-04 | 4/18/2007 | 0 | 3 | TOC - LK | Total Organic Carbon | 30500 | | 500 | mg/Kg |
| | | | | | | | | | | | |
| Tango Range | W-2 | SSTRW2S-0-3-01 | 4/17/2007 | 0 | 3 | SW8330 | Nitroglycerin | ND | U | 2500 | ug/Kg |
| Tango Range | W-2 | SSTRW2S-0-3-01 | 4/17/2007 | 0 | 3 | SW9045 | pH | 7.1 | | 0 | SU |
| Tango Range | W-2 | SSTRW2S-0-3-01 | 4/17/2007 | 0 | 3 | TOC - LK | Total Organic Carbon | 18700 | | 500 | mg/Kg |
| | | | | | | | | | | | |
| Tango Range | W-3 | SSTRW3S-0-3-01 | 4/18/2007 | 0 | 3 | SW8330 | Nitroglycerin | ND | U | 2500 | ug/Kg |
| Tango Range | W-3 | SSTRW3S-0-3-01 | 4/18/2007 | 0 | 3 | SW9045 | pH | 6.1 | | 0 | SU |
| Tango Range | W-3 | SSTRW3S-0-3-01 | 4/18/2007 | 0 | 3 | TOC - LK | Total Organic Carbon | 42600 | | 500 | mg/Kg |
| | | | | | | | | | | | |
| Tango Range | W-3 Duplicate | SSTRW3S-0-3-01D | 4/18/2007 | 0 | 3 | SW8330 | Nitroglycerin | ND | U | 2500 | ug/Kg |
| Tango Range | W-3 Duplicate | SSTRW3S-0-3-01D | 4/18/2007 | 0 | 3 | SW9045 | pH | 6.4 | | 0 | SU |
| Tango Range | W-3 Duplicate | SSTRW3S-0-3-01D | 4/18/2007 | 0 | 3 | TOC - LK | Total Organic Carbon | 44500 | | 500 | mg/Kg |
| | | | | | | | | | | | |
| Tango Range | W-4 | SSTRW4S-0-3-01 | 4/17/2007 | 0 | 3 | SW8330 | Nitroglycerin | 3300 | | 2500 | ug/Kg |
| Tango Range | W-4 | SSTRW4S-0-3-01 | 4/17/2007 | 0 | 3 | SW9045 | pH | 7.1 | | 0 | SU |
| Tango Range | W-4 | SSTRW4S-0-3-01 | 4/17/2007 | 0 | 3 | TOC - LK | Total Organic Carbon | 16300 | | 500 | mg/Kg |
| | | | | | | | | | | | |
| Tango Range | C-1 | SSTRC1S-0-3-01 | 4/20/2007 | 0 | 3 | SW8330 | Nitroglycerin | 50000 | | 2500 | ug/Kg |
| Tango Range | C-1 | SSTRC1S-0-3-01 | 4/20/2007 | 0 | 3 | SW9045 | pH | 6.7 | | 0 | SU |
| Tango Range | C-1 | SSTRC1S-0-3-01 | 4/20/2007 | 0 | 3 | TOC - LK | Total Organic Carbon | 19400 | | 500 | mg/Kg |
| Tango Range | C-1 | SSTRC1S-0-3-01 | 4/20/2007 | 0 | 3 | SW6010 | Antimony | 0.62 | B | 0.16 | mg/Kg |
| Tango Range | C-1 | SSTRC1S-0-3-01 | 4/20/2007 | 0 | 3 | SW6010 | Copper | 12.8 | | 1.6 | mg/Kg |
| Tango Range | C-1 | SSTRC1S-0-3-01 | 4/20/2007 | 0 | 3 | SW6010 | Lead | 137 | | 1.6 | mg/Kg |
| Tango Range | C-1 | SSTRC1S-0-3-01 | 4/20/2007 | 0 | 3 | SW6010 | Zinc | 19.6 | | 0.5 | mg/Kg |
| | | | | | | | | | | | |

## Table B-1
## T Range April 2007 Soil Data Preliminary Results

Data has NOT been validated

| Area of Concern | Location | Sample ID | Date | Top of Sampling Interval (inches) | Bottom of Sampling Interval (inches) | Method | Analyte | Result | Qual | RL | Units |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Tango Range | C-1 | SSTRC1D-3-6-01 | 4/24/2007 | 3 | 6 | SW8330 | Nitroglycerin | 3800 | | 2500 | ug/Kg |
| Tango Range | C-1 | SSTRC1D-3-6-01 | 4/24/2007 | 3 | 6 | SW9045 | pH | 6.5 | | 0 | SU |
| Tango Range | C-1 | SSTRC1D-3-6-01 | 4/24/2007 | 3 | 6 | TOC - LK | Total Organic Carbon | 8030 | | 500 | mg/Kg |
| Tango Range | C-1 | SSTRC1D-3-6-01 | 4/24/2007 | 3 | 6 | SW6010 | Antimony | ND | U | 0.16 | mg/Kg |
| Tango Range | C-1 | SSTRC1D-3-6-01 | 4/24/2007 | 3 | 6 | SW6010 | Copper | 12.7 | | 1.6 | mg/Kg |
| Tango Range | C-1 | SSTRC1D-3-6-01 | 4/24/2007 | 3 | 6 | SW6010 | Lead | 45.9 | | 1.6 | mg/Kg |
| Tango Range | C-1 | SSTRC1D-3-6-01 | 4/24/2007 | 3 | 6 | SW6010 | Zinc | 22.3 | | 0.5 | mg/Kg |
| | | | | | | | | | | | |
| Tango Range | C-1 | SSTRC1D-6-9-01 | 4/24/2007 | 6 | 9 | SW8330 | Nitroglycerin | ND | U | 2500 | ug/Kg |
| Tango Range | C-1 | SSTRC1D-6-9-01 | 4/24/2007 | 6 | 9 | SW9045 | pH | 6.4 | | 0 | SU |
| Tango Range | C-1 | SSTRC1D-6-9-01 | 4/24/2007 | 6 | 9 | TOC - LK | Total Organic Carbon | 7830 | | 500 | mg/Kg |
| Tango Range | C-1 | SSTRC1D-6-9-01 | 4/24/2007 | 6 | 9 | SW6010 | Antimony | ND | U | 0.16 | mg/Kg |
| Tango Range | C-1 | SSTRC1D-6-9-01 | 4/24/2007 | 6 | 9 | SW6010 | Copper | 8.2 | | 1.6 | mg/Kg |
| Tango Range | C-1 | SSTRC1D-6-9-01 | 4/24/2007 | 6 | 9 | SW6010 | Lead | 49.9 | | 1.6 | mg/Kg |
| Tango Range | C-1 | SSTRC1D-6-9-01 | 4/24/2007 | 6 | 9 | SW6010 | Zinc | 22.1 | | 0.5 | mg/Kg |
| | | | | | | | | | | | |
| Tango Range | C-1 | SSTRC1D-9-12-01 | 4/24/2007 | 9 | 12 | SW8330 | Nitroglycerin | 2600 | | 2500 | ug/Kg |
| Tango Range | C-1 | SSTRC1D-9-12-01 | 4/24/2007 | 9 | 12 | SW9045 | pH | 6.4 | | 0 | SU |
| Tango Range | C-1 | SSTRC1D-9-12-01 | 4/24/2007 | 9 | 12 | TOC - LK | Total Organic Carbon | 6780 | | 500 | mg/Kg |
| Tango Range | C-1 | SSTRC1D-9-12-01 | 4/24/2007 | 9 | 12 | SW6010 | Antimony | ND | U | 0.16 | mg/Kg |
| Tango Range | C-1 | SSTRC1D-9-12-01 | 4/24/2007 | 9 | 12 | SW6010 | Copper | 7.8 | | 1.6 | mg/Kg |
| Tango Range | C-1 | SSTRC1D-9-12-01 | 4/24/2007 | 9 | 12 | SW6010 | Lead | 26.4 | | 1.6 | mg/Kg |
| Tango Range | C-1 | SSTRC1D-9-12-01 | 4/24/2007 | 9 | 12 | SW6010 | Zinc | 24.9 | | 0.5 | mg/Kg |
| | | | | | | | | | | | |
| Tango Range | C-1 | SSTRC1D-12-18-01 | 4/24/2007 | 12 | 18 | SW8330 | Nitroglycerin | 3800 | | 2500 | ug/Kg |
| Tango Range | C-1 | SSTRC1D-12-18-01 | 4/24/2007 | 12 | 18 | SW9045 | pH | 6.2 | | 0 | SU |
| Tango Range | C-1 | SSTRC1D-12-18-01 | 4/24/2007 | 12 | 18 | TOC - LK | Total Organic Carbon | 5900 | | 500 | mg/Kg |
| Tango Range | C-1 | SSTRC1D-12-18-01 | 4/24/2007 | 12 | 18 | SW6010 | Antimony | 0.2 | B | 0.16 | mg/Kg |
| Tango Range | C-1 | SSTRC1D-12-18-01 | 4/24/2007 | 12 | 18 | SW6010 | Copper | 7.4 | | 1.6 | mg/Kg |
| Tango Range | C-1 | SSTRC1D-12-18-01 | 4/24/2007 | 12 | 18 | SW6010 | Lead | 10.4 | | 1.6 | mg/Kg |
| Tango Range | C-1 | SSTRC1D-12-18-01 | 4/24/2007 | 12 | 18 | SW6010 | Zinc | 22.6 | | 0.5 | mg/Kg |
| | | | | | | | | | | | |
| Tango Range | C-1 | SSTRC1D-18-24-01 | 4/24/2007 | 18 | 24 | SW8330 | Nitroglycerin | 3700 | | 2500 | ug/Kg |
| Tango Range | C-1 | SSTRC1D-18-24-01 | 4/24/2007 | 18 | 24 | SW9045 | pH | 6.2 | | 0 | SU |
| Tango Range | C-1 | SSTRC1D-18-24-01 | 4/24/2007 | 18 | 24 | TOC - LK | Total Organic Carbon | 5050 | | 500 | mg/Kg |
| Tango Range | C-1 | SSTRC1D-18-24-01 | 4/24/2007 | 18 | 24 | SW6010 | Antimony | ND | U | 0.16 | mg/Kg |
| Tango Range | C-1 | SSTRC1D-18-24-01 | 4/24/2007 | 18 | 24 | SW6010 | Copper | 8.2 | | 1.6 | mg/Kg |
| Tango Range | C-1 | SSTRC1D-18-24-01 | 4/24/2007 | 18 | 24 | SW6010 | Lead | 10.9 | | 1.6 | mg/Kg |
| Tango Range | C-1 | SSTRC1D-18-24-01 | 4/24/2007 | 18 | 24 | SW6010 | Zinc | 23.4 | | 0.5 | mg/Kg |
| | | | | | | | | | | | |

Data has NOT been validated

**Table B-1**
**T Range April 2007 Soil Data Preliminary Results**

| Area of Concern | Location | Sample ID | Date | Top of Sampling Interval (inches) | Bottom of Sampling Interval (inches) | Method | Analyte | Result | Qual | RL | Units |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Tango Range | C-2 | SSTRC2S-0-3-01 | 4/20/2007 | 0 | 3 | SW8330 | Nitroglycerin | ND | U | 2500 | ug/Kg |
| Tango Range | C-2 | SSTRC2S-0-3-01 | 4/20/2007 | 0 | 3 | SW9045 | pH | 7.2 | | 0 | SU |
| Tango Range | C-2 | SSTRC2S-0-3-01 | 4/20/2007 | 0 | 3 | TOC - LK | Total Organic Carbon | 12300 | | 500 | mg/Kg |
| Tango Range | C-2 | SSTRC2S-0-3-01 | 4/20/2007 | 0 | 3 | SW6010 | Antimony | 2.7 | B | 0.16 | mg/Kg |
| Tango Range | C-2 | SSTRC2S-0-3-01 | 4/20/2007 | 0 | 3 | SW6010 | Copper | 35 | | 1.6 | mg/Kg |
| Tango Range | C-2 | SSTRC2S-0-3-01 | 4/20/2007 | 0 | 3 | SW6010 | Lead | 518 | | 1.6 | mg/Kg |
| Tango Range | C-2 | SSTRC2S-0-3-01 | 4/20/2007 | 0 | 3 | SW6010 | Zinc | 23.1 | | 0.5 | mg/Kg |
| | | | | | | | | | | | |
| Tango Range | C-2 | SSTRC2D-3-6-01 | 4/24/2007 | 3 | 6 | SW8330 | Nitroglycerin | ND | U | 2500 | ug/Kg |
| Tango Range | C-2 | SSTRC2D-3-6-01 | 4/24/2007 | 3 | 6 | SW9045 | pH | 7.0 | | 0 | SU |
| Tango Range | C-2 | SSTRC2D-3-6-01 | 4/24/2007 | 3 | 6 | TOC - LK | Total Organic Carbon | 9740 | | 500 | mg/Kg |
| Tango Range | C-2 | SSTRC2D-3-6-01 | 4/24/2007 | 3 | 6 | SW6010 | Antimony | 0.83 | B | 0.16 | mg/Kg |
| Tango Range | C-2 | SSTRC2D-3-6-01 | 4/24/2007 | 3 | 6 | SW6010 | Copper | 19.2 | | 1.6 | mg/Kg |
| Tango Range | C-2 | SSTRC2D-3-6-01 | 4/24/2007 | 3 | 6 | SW6010 | Lead | 206 | | 1.6 | mg/Kg |
| Tango Range | C-2 | SSTRC2D-3-6-01 | 4/24/2007 | 3 | 6 | SW6010 | Zinc | 28 | | 0.5 | mg/Kg |
| | | | | | | | | | | | |
| Tango Range | C-2 | SSTRC2D-6-9-01 | 4/24/2007 | 6 | 9 | SW8330 | Nitroglycerin | ND | U | 2500 | ug/Kg |
| Tango Range | C-2 | SSTRC2D-6-9-01 | 4/24/2007 | 6 | 9 | SW9045 | pH | 6.8 | | 0 | SU |
| Tango Range | C-2 | SSTRC2D-6-9-01 | 4/24/2007 | 6 | 9 | TOC - LK | Total Organic Carbon | 11500 | | 500 | mg/Kg |
| Tango Range | C-2 | SSTRC2D-6-9-01 | 4/24/2007 | 6 | 9 | SW6010 | Antimony | 0.72 | B | 0.16 | mg/Kg |
| Tango Range | C-2 | SSTRC2D-6-9-01 | 4/24/2007 | 6 | 9 | SW6010 | Copper | 9.7 | | 1.6 | mg/Kg |
| Tango Range | C-2 | SSTRC2D-6-9-01 | 4/24/2007 | 6 | 9 | SW6010 | Lead | 193 | | 1.6 | mg/Kg |
| Tango Range | C-2 | SSTRC2D-6-9-01 | 4/24/2007 | 6 | 9 | SW6010 | Zinc | 31.7 | | 0.5 | mg/Kg |
| | | | | | | | | | | | |
| Tango Range | C-2 | SSTRC2D-9-12-01 | 4/24/2007 | 9 | 12 | SW8330 | Nitroglycerin | ND | U | 2500 | ug/Kg |
| Tango Range | C-2 | SSTRC2D-9-12-01 | 4/24/2007 | 9 | 12 | SW9045 | pH | 6.5 | | 0 | SU |
| Tango Range | C-2 | SSTRC2D-9-12-01 | 4/24/2007 | 9 | 12 | TOC - LK | Total Organic Carbon | 9450 | | 500 | mg/Kg |
| Tango Range | C-2 | SSTRC2D-9-12-01 | 4/24/2007 | 9 | 12 | SW6010 | Antimony | ND | U | 0.16 | mg/Kg |
| Tango Range | C-2 | SSTRC2D-9-12-01 | 4/24/2007 | 9 | 12 | SW6010 | Copper | 8.3 | | 1.6 | mg/Kg |
| Tango Range | C-2 | SSTRC2D-9-12-01 | 4/24/2007 | 9 | 12 | SW6010 | Lead | 96.3 | | 1.6 | mg/Kg |
| Tango Range | C-2 | SSTRC2D-9-12-01 | 4/24/2007 | 9 | 12 | SW6010 | Zinc | 31 | | 0.5 | mg/Kg |
| | | | | | | | | | | | |
| Tango Range | C-2 | SSTRC2D-12-18-01 | 4/24/2007 | 12 | 18 | SW8330 | Nitroglycerin | ND | U | 2500 | ug/Kg |
| Tango Range | C-2 | SSTRC2D-12-18-01 | 4/24/2007 | 12 | 18 | SW9045 | pH | 6.2 | | 0 | SU |
| Tango Range | C-2 | SSTRC2D-12-18-01 | 4/24/2007 | 12 | 18 | TOC - LK | Total Organic Carbon | 7520 | | 500 | mg/Kg |
| Tango Range | C-2 | SSTRC2D-12-18-01 | 4/24/2007 | 12 | 18 | SW6010 | Antimony | ND | U | 0.16 | mg/Kg |
| Tango Range | C-2 | SSTRC2D-12-18-01 | 4/24/2007 | 12 | 18 | SW6010 | Copper | 10.4 | | 1.6 | mg/Kg |
| Tango Range | C-2 | SSTRC2D-12-18-01 | 4/24/2007 | 12 | 18 | SW6010 | Lead | 40.7 | | 1.6 | mg/Kg |
| Tango Range | C-2 | SSTRC2D-12-18-01 | 4/24/2007 | 12 | 18 | SW6010 | Zinc | 32.4 | | 0.5 | mg/Kg |
| | | | | | | | | | | | |

Data has NOT been validated

**Table B-1**
**T Range April 2007 Soil Data Preliminary Results**

| Area of Concern | Location | Sample ID | Date | Top of Sampling Interval (inches) | Bottom of Sampling Interval (inches) | Method | Analyte | Result | Qual | RL | Units |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Tango Range | C-2 | SSTRC2D-18-24-01 | 4/24/2007 | 18 | 24 | SW8330 | Nitroglycerin | ND | U | 2500 | ug/Kg |
| Tango Range | C-2 | SSTRC2D-18-24-01 | 4/24/2007 | 18 | 24 | SW9045 | pH | 6.2 | | 0 | SU |
| Tango Range | C-2 | SSTRC2D-18-24-01 | 4/24/2007 | 18 | 24 | TOC - LK | Total Organic Carbon | 5330 | | 500 | mg/Kg |
| Tango Range | C-2 | SSTRC2D-18-24-01 | 4/24/2007 | 18 | 24 | SW6010 | Antimony | ND | U | 0.16 | mg/Kg |
| Tango Range | C-2 | SSTRC2D-18-24-01 | 4/24/2007 | 18 | 24 | SW6010 | Copper | 21.8 | | 1.6 | mg/Kg |
| Tango Range | C-2 | SSTRC2D-18-24-01 | 4/24/2007 | 18 | 24 | SW6010 | Lead | 37.9 | | 1.6 | mg/Kg |
| Tango Range | C-2 | SSTRC2D-18-24-01 | 4/24/2007 | 18 | 24 | SW6010 | Zinc | 33.1 | | 0.5 | mg/Kg |
| | | | | | | | | | | | |
| Tango Range | C-3 | SSTRC3S-0-3-01 | 4/18/2007 | 0 | 3 | SW8330 | Nitroglycerin | 2700 | | 2500 | ug/Kg |
| Tango Range | C-3 | SSTRC3S-0-3-01 | 4/18/2007 | 0 | 3 | SW9045 | pH | 7.1 | | 0 | SU |
| Tango Range | C-3 | SSTRC3S-0-3-01 | 4/18/2007 | 0 | 3 | TOC - LK | Total Organic Carbon | 29900 | | 500 | mg/Kg |
| | | | | | | | | | | | |
| Tango Range | C-4 | SSTRC4S-0-3-01 | 4/17/2007 | 0 | 3 | SW8330 | Nitroglycerin | ND | U | 2500 | ug/Kg |
| Tango Range | C-4 | SSTRC4S-0-3-01 | 4/17/2007 | 0 | 3 | SW9045 | pH | 7.2 | | 0 | SU |
| Tango Range | C-4 | SSTRC4S-0-3-01 | 4/17/2007 | 0 | 3 | TOC - LK | Total Organic Carbon | 11000 | | 500 | mg/Kg |
| | | | | | | | | | | | |
| Tango Range | C-4 Duplicate | SSTRC4S-0-3-01D | 4/17/2007 | 0 | 3 | SW8330 | Nitroglycerin | ND | U | 2500 | ug/Kg |
| Tango Range | C-4 Duplicate | SSTRC4S-0-3-01D | 4/17/2007 | 0 | 3 | SW9045 | pH | 7.4 | | 0 | SU |
| Tango Range | C-4 Duplicate | SSTRC4S-0-3-01D | 4/17/2007 | 0 | 3 | TOC - LK | Total Organic Carbon | 10100 | | 500 | mg/Kg |
| | | | | | | | | | | | |
| Tango Range | E-1 | SSTRE1S-0-3-01 | 4/18/2007 | 0 | 3 | SW8330 | Nitroglycerin | 4300 | | 2500 | ug/Kg |
| Tango Range | E-1 | SSTRE1S-0-3-01 | 4/18/2007 | 0 | 3 | SW9045 | pH | 6.0 | | 0 | SU |
| Tango Range | E-1 | SSTRE1S-0-3-01 | 4/18/2007 | 0 | 3 | TOC - LK | Total Organic Carbon | 18300 | | 500 | mg/Kg |
| Tango Range | E-1 | SSTRE1S-0-3-02 | 4/18/2007 | 0 | 3 | SW8330 | Nitroglycerin | 8200 | | 2500 | ug/Kg |
| Tango Range | E-1 | SSTRE1S-0-3-02 | 4/18/2007 | 0 | 3 | SW9045 | pH | 6.0 | | 0 | SU |
| Tango Range | E-1 | SSTRE1S-0-3-02 | 4/18/2007 | 0 | 3 | TOC - LK | Total Organic Carbon | 18900 | | 500 | mg/Kg |
| Tango Range | E-1 | SSTRE1S-0-3-03 | 4/18/2007 | 0 | 3 | SW8330 | Nitroglycerin | 6900 | | 2500 | ug/Kg |
| Tango Range | E-1 | SSTRE1S-0-3-03 | 4/18/2007 | 0 | 3 | SW9045 | pH | 5.9 | | 0 | SU |
| Tango Range | E-1 | SSTRE1S-0-3-03 | 4/18/2007 | 0 | 3 | TOC - LK | Total Organic Carbon | 18500 | | 500 | mg/Kg |
| Tango Range | E-1 | SSTRE1S-0-3-04 | 4/18/2007 | 0 | 3 | SW8330 | Nitroglycerin | 5300 | | 2500 | ug/Kg |
| Tango Range | E-1 | SSTRE1S-0-3-04 | 4/18/2007 | 0 | 3 | SW9045 | pH | 5.9 | | 0 | SU |
| Tango Range | E-1 | SSTRE1S-0-3-04 | 4/18/2007 | 0 | 3 | TOC - LK | Total Organic Carbon | 20100 | | 500 | mg/Kg |
| | | | | | | | | | | | |
| Tango Range | E-2 | SSTRE2S-0-3-01 | 4/18/2007 | 0 | 3 | SW8330 | Nitroglycerin | ND | U | 2500 | ug/Kg |
| Tango Range | E-2 | SSTRE2S-0-3-01 | 4/18/2007 | 0 | 3 | SW9045 | pH | 6.0 | | 0 | SU |
| Tango Range | E-2 | SSTRE2S-0-3-01 | 4/18/2007 | 0 | 3 | TOC - LK | Total Organic Carbon | 41100 | | 500 | mg/Kg |
| | | | | | | | | | | | |
| Tango Range | E-3 | SSTRE3S-0-3-01 | 4/18/2007 | 0 | 3 | SW8330 | Nitroglycerin | ND | U | 2500 | ug/Kg |
| Tango Range | E-3 | SSTRE3S-0-3-01 | 4/18/2007 | 0 | 3 | SW9045 | pH | 6.1 | | 0 | SU |
| Tango Range | E-3 | SSTRE3S-0-3-01 | 4/18/2007 | 0 | 3 | TOC - LK | Total Organic Carbon | 37000 | | 500 | mg/Kg |

**Table B-1**
**T Range April 2007 Soil Data Preliminary Results**

| Area of Concern | Location | Sample ID | Date | Top of Sampling Interval (inches) | Bottom of Sampling Interval (inches) | Method | Analyte | Result | Qual | RL | Units |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |
| Tango Range | E-4 | SSTRE4S-0-3-01 | 4/19/2007 | 0 | 3 | SW8330 | Nitroglycerin | ND | U | 2500 | ug/Kg |
| Tango Range | E-4 | SSTRE4S-0-3-01 | 4/19/2007 | 0 | 3 | SW9045 | pH | 6.5 | | 0 | SU |
| Tango Range | E-4 | SSTRE4S-0-3-01 | 4/19/2007 | 0 | 3 | TOC - LK | Total Organic Carbon | 15800 | | 500 | mg/Kg |
| | | | | | | | | | | | |
| Tango Range | | CRREL Blank 1 | 4/24/2007 | | | SW8330 | Nitroglycerin | ND | U | 2500 | ug/Kg |
| Tango Range | | CRREL Blank 1 | 4/24/2007 | | | SW9045 | pH | 8.3 | | 0 | SU |
| Tango Range | | CRREL Blank 1 | 4/24/2007 | | | TOC - LK | Total Organic Carbon | ND | U | 500 | mg/Kg |
| | | | | | | | | | | | |
| Tango Range | | CRREL Blank 2 | 4/24/2007 | | | SW8330 | Nitroglycerin | ND | U | 2500 | ug/Kg |
| Tango Range | | CRREL Blank 2 | 4/24/2007 | | | SW9045 | pH | 8.2 | | 0 | SU |
| Tango Range | | CRREL Blank 2 | 4/24/2007 | | | TOC - LK | Total Organic Carbon | ND | U | 500 | mg/Kg |
| | | | | | | | | | | | |
| Tango Range | | CRREL Blank 4-24-07 | 4/27/2007 | | | SW8330 | Nitroglycerin | ND | U | 2500 | ug/Kg |
| Tango Range | | CRREL Blank 4-24-07 | 4/27/2007 | | | SW9045 | pH | 8.2 | | 0 | SU |
| Tango Range | | CRREL Blank 4-24-07 | 4/27/2007 | | | TOC - LK | Total Organic Carbon | ND | U | 500 | mg/Kg |
| Tango Range | | CRREL Blank 4-24-07 | 4/27/2007 | | | SW6010 | Antimony | ND | U | 0.16 | mg/Kg |
| Tango Range | | CRREL Blank 4-24-07 | 4/27/2007 | | | SW6010 | Copper | 4.2 | | 1.6 | mg/Kg |
| Tango Range | | CRREL Blank 4-24-07 | 4/27/2007 | | | SW6010 | Lead | 3.7 | | 1.6 | mg/Kg |
| Tango Range | | CRREL Blank 4-24-07 | 4/27/2007 | | | SW6010 | Zinc | 15.4 | | 0.5 | mg/Kg |
| | | | | | | | | | | | |
| Tango Range | | CRREL Blank 4-25-07 | 4/27/2007 | | | SW8330 | Nitroglycerin | ND | U | 2500 | ug/Kg |
| Tango Range | | CRREL Blank 4-25-07 | 4/27/2007 | | | SW9045 | pH | 8.0 | | 0 | SU |
| Tango Range | | CRREL Blank 4-25-07 | 4/27/2007 | | | TOC - LK | Total Organic Carbon | ND | U | 500 | mg/Kg |
| Tango Range | | CRREL Blank 4-25-07 | 4/27/2007 | | | SW6010 | Antimony | 0.39 | B | 0.16 | mg/Kg |
| Tango Range | | CRREL Blank 4-25-07 | 4/27/2007 | | | SW6010 | Copper | 8.3 | | 1.6 | mg/Kg |
| Tango Range | | CRREL Blank 4-25-07 | 4/27/2007 | | | SW6010 | Lead | 68.4 | | 1.6 | mg/Kg |
| Tango Range | | CRREL Blank 4-25-07 | 4/27/2007 | | | SW6010 | Zinc | 16.2 | | 0.5 | mg/Kg |

| | | |
|---|---|---|
| FLDSAMPID Scheme - | SS | Soil Sample |
| | TR | Tango Range |
| | W, C, E | West, Center, or East section |
| | 1, 2, 3, 4 | Section distance from Firing Line |
| | S, D | Surfical or Depth Sample |
| | -0-3- | Depth of sample interval in inches from surface (ex. 0-3 inches) |
| | -01, -02, etc. | Sequential sample number |

Notes:
* Data has NOT been validated
All samples were ground at CRREL prior to extraction and analysis
CRREL BLANK - Two blanks are provided by CRREL with each Sample Delivery Group (SDG)