Via FedEx

August 26, 2016
In reply, refer to SHEA-115544

Mr. Mark Malinowski, P.G.
SSFL Program Manager
Department of Toxic Substances Control
8800 Cal Center Drive
Sacramento, CA 95826-3200

Dear Mr. Malinowski:

Subject: Former Rocketdyne-Atoms International Rifle and Pistol Club Shooting Range Area Investigation Work Plan, Santa Susana Field Laboratory, Ventura County, California

The Boeing Company (Boeing) is pleased to present the attached Former Rocketdyne-Atoms International Rifle and Pistol Club Shooting Range Area Investigation Work Plan, Santa Susana Field Laboratory, Ventura, California. If you have any questions regarding this document, please contact me at (818) 466-8776.

Sincerely,

Michael O. Bower, P.E.
Associate Technical Fellow
The Boeing Company

Cc: Roger Paulson, DTSC (4 copies)
Richard Andrachek, MWH (electronic only)
Dixie Hambrick, MWH (electronic only)
FORMER ROCKETDYNE-ATOMICS INTERNATIONAL RIFLE AND PISTOL CLUB SHOOTING RANGE AREA INVESTIGATION WORK PLAN

SANTA SUSANA FIELD LABORATORY
VENTURA COUNTY, CALIFORNIA

Prepared For:
THE BOEING COMPANY

Prepared By:
MWH
300 North Lake Avenue Suite 400
Pasadena, CA  91101

August 2016

Benjamin F. Stewart, P.G. 8012
Project Manager
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Investigation Work Plan  
August 2016

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C  Former Shooting Range ISM Investigation Health and Safety Plan Addendum
# LIST OF ACRONYMS AND ABBREVIATIONS

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<thead>
<tr>
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<th>Description</th>
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<tbody>
<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials</td>
</tr>
<tr>
<td>bgs</td>
<td>below ground surface</td>
</tr>
<tr>
<td>BaP</td>
<td>benzo(a)pyrene</td>
</tr>
<tr>
<td>Boeing</td>
<td>The Boeing Company</td>
</tr>
<tr>
<td>Cal-EPA</td>
<td>California Environmental Protection Agency</td>
</tr>
<tr>
<td>COPC</td>
<td>constituents of potential concern</td>
</tr>
<tr>
<td>CPEC</td>
<td>constituents of potential ecological concern</td>
</tr>
<tr>
<td>DoD</td>
<td>Department of Defense</td>
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<tr>
<td>DQO</td>
<td>data quality objective</td>
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<tr>
<td>DTSC</td>
<td>Department of Toxic Substances Control</td>
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<tr>
<td>ELAP</td>
<td>Environmental Laboratory Accreditation Program</td>
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<tr>
<td>ERA</td>
<td>ecological risk assessment</td>
</tr>
<tr>
<td>ERDC</td>
<td>Engineer Research and Development Center</td>
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<tr>
<td>ft</td>
<td>feet</td>
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<tr>
<td>GIS</td>
<td>geographical information system</td>
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<tr>
<td>GPS</td>
<td>global positioning system</td>
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<tr>
<td>HAI</td>
<td>Haley and Aldrich, Inc.</td>
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<tr>
<td>HASP</td>
<td>Health and Safety Plan</td>
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<tr>
<td>HI</td>
<td>hazard index</td>
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<tr>
<td>HQ</td>
<td>hazard quotient</td>
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<tr>
<td>HHERA</td>
<td>human health and ecological risk assessment</td>
</tr>
<tr>
<td>HHRA</td>
<td>human health risk assessment</td>
</tr>
<tr>
<td>ISE/RA</td>
<td>Imminent and Substantial Endangerment Determination and Order and Remedial Action</td>
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<td>ISM</td>
<td>Incremental Sampling Methodology</td>
</tr>
<tr>
<td>ITRC</td>
<td>Interstate Technology and Regulatory Council</td>
</tr>
<tr>
<td>kg</td>
<td>kilogram</td>
</tr>
<tr>
<td>LOX</td>
<td>Liquid Oxygen</td>
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<tr>
<td>mg/kg</td>
<td>milligrams per kilogram</td>
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<tr>
<td>MS/MSD</td>
<td>matrix spike/matrix spike duplicate</td>
</tr>
<tr>
<td>MSL</td>
<td>mean sea level</td>
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<td>MWH</td>
<td>MWH Americas, Inc.</td>
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<td>MRCA</td>
<td>Mountains Recreation &amp; Conservation Authority</td>
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LIST OF ACRONYMS AND ABBREVIATIONS (continued)

NASA       National Aeronautics and Space Administration
PAH        polynuclear aromatic hydrocarbons
QA         quality assurance
QAPP       Quality Assurance Project Plan
QC         quality control
QSM        Quality Systems Manual
RBSL       risk-based screening level
RCRA       Resource Conservation and Recovery Act
RWQCB      Regional Water Quality Control Board
RFA        RCRA Facility Assessment
RFI        RCRA Facility Investigation
RL         reporting limit
Rocketdyne Rocketdyne Propulsion and Power Division
RSD        relative standard deviation
SAIC       Science Applications International Corporation
SCL        soil characterization levels
SCM        Site Conceptual Model
SIM        selective ion monitoring
SMMMC      Santa Monica Mountains Conservancy
SOF        sum-of-fractions
SOP        standard operating procedure
SRAM       Standardized Risk Assessment Methodology
SSFL       Santa Susana Field Laboratory
SWMU       Solid Waste Management Unit
TEQ        Toxic Equivalence Quotient
TRW        Technical Review Workgroup
µm         micrometer
USACE      United States Army Corps of Engineers
UCL        Upper Confidence Limit
USEPA      United States Environmental Protection Agency
XRF        X-ray fluorescence
1.0 INTRODUCTION

This work plan presents proposed characterization activities for The Boeing Company’s (Boeing’s) investigation of the former Rocketdyne-Atomics International Rifle and Pistol Club, Inc. Trap and Skeet shooting range area (Former Shooting Range), located on the Mountains Recreation Conversancy Authority (MRCA) Sage Ranch property, north of the Santa Susana Field Laboratory (SSFL), Ventura County, California (Figures 1 and 2). The Former Shooting Range was used by former Rocketdyne-Atomics International employees for recreational shooting and target practice using lead shot and clay pigeons.

This work plan has been revised to address the Department of Toxic Substances Control (DTSC) review comments provided in earlier drafts of this document (MWH, 2013 and 2014b). It describes the field investigation, sampling and analytical procedures, data evaluation methods, and reporting for the Former Shooting Range ‘Overshot Area’ north of the Northern Drainage (Figure 2). The Northern Drainage is the southern limit of the investigation proposed in this work plan since Boeing previously implemented an extensive soil and debris cleanup action in the area north of Shooting Range Firing Platform including the Northern Drainage. This southern portion of the Former Shooting Range is being investigated separately under the Resource Conservation and Recovery Act (RCRA) Corrective Action Program, and is not part of this characterization work plan. Additional information regarding prior cleanup actions in the Former Shooting Range is provided in Section 2.6.

Because former trap and skeet shooting ranges present a specific type of potential contaminant release, where lead shot and clay target fragments are dispersed over a wide area, an ‘Incremental Sampling Methodology’ (ISM) is proposed for the characterization of the Former Shooting Range Overshot Area. The ISM process, as described in the Interstate Technology and Regulatory Council’s (ITRC) 2012 Regulatory Guidance (ITRC, 2012) is a structured composite sampling and processing protocol that reduces data variability and provides an unbiased estimate of mean contaminant concentrations in a volume of soil targeted for sampling. ISM provides representative samples of specific soil volumes, within defined areas called decision units, by collecting numerous increments of soil that are combined, processed, and subsampled according to specific protocols. The basis and approach for the ISM process is further described in Section 3.0, with additional details regarding proposed field screening, soil sampling procedures, and laboratory
protocol details presented in a Standard Operating Procedures (SOP) attached as appendices.

1.1 OBJECTIVES AND SCOPE

The objectives of the proposed activities are to:

- Define the extent of lead shot and clay target debris for potential impacts in the Former Shooting Range Overshot Area using field inspection surveys and screening techniques.
- Characterize soil for lead, arsenic, and antimony concentrations (associated with lead shot), and polynuclear aromatic hydrocarbon (PAH) concentrations (associated with clay targets) for potential impacts associated with historical activities at the Former Shooting Range.
- Assess potential health risks in the Overshot Area using DTSC-approved risk assessment methodologies.
- Identify locations that may require further study and/or potential remedial action based on the results of the characterization and risk assessment evaluation.

As described above, trap and skeet shooting ranges represent a specific type of contaminant release mechanism and ISM sampling is proposed to characterize the Overshot Area north of the Northern Drainage (ISM Investigation Area). The investigation scope and approach for the ISM Investigation Area includes the following tasks:

- Estimating the potential extent of the Former Shooting Range shotfall zones;
- Conducting field surveys and screening to refine the estimated extent of the shotfall zones and determine the extent of ISM sampling;
- Implementing ISM sampling and analysis for lead, arsenic, antimony and PAHs;
- Evaluating the survey and sampling results, and performing ecological and human health risk assessment; and,
- Summarizing the investigation findings, preparing recommendations, and reporting.

As applicable, these activities are proposed using guidance in the following documents:

- *Master Resource Conservation and Recovery Act Facility Investigation Data Gap Work Plan, RCRA Facility Investigation, Santa Susana Field Laboratory, Ventura County, California* (Master RFI Data Gap Work Plan) (CH2M Hill, 2013a)
• Boeing’s *Standard Operating Procedures (SOPs) for Areas I and III of the Santa Susana Field Laboratory* (Boeing, 2013)

• Interstate Technology and Regulatory Council’s (IRTC’s) *Characterization and Remediation of Soils at Closed Small Arms Firing Ranges* (IRTC, 2003)

• ITRC’s *Environmental Management at Operating Outdoor Small Arms Firing Ranges* (ITRC, 2005)

• ITRC’s *ISM Technical and Regulatory Guidance* (ITRC, 2012)

• US Army Corps of Engineers’ (USACE) Engineer Research and Development Center (ERDC) *Incremental Sampling Methodology for Metallic Residues* (USACE, 2013)

• U.S. Environmental Protection Agency’s (USEPA) Short Sheet: TRW Recommendations for Sampling and Analysis of Soil at Lead (Pb) Sites (USEPA, 2000)

• USEPA’s TRW Recommendations for Performing Human Health Risk Analysis on Small Arms Shooting Ranges (USEPA, 2003)

1.2 DOCUMENT ORGANIZATION

Information included in this work plan is organized as follows:

• **Section 1 – Introduction.** This section provides an overview of the proposed work, describes the objectives and scope of the investigation, and specifies the guidance documents used.

• **Section 2 – Site Description and History.** This section describes the Former Shooting Range investigation location, site conditions, operational history, and provides a summary of the removal actions performed by Boeing.

• **Section 3 – ISM Investigation Approach.** This section provides background information for the selection of an ISM investigation approach for the Former Shooting Range, and defines ‘decision units’ that serve as the basis for the incremental sampling to be performed. It also discusses sampling location selection, laboratory sample processing, and replicate sampling requirements to assess error.

• **Section 4 – Proposed Investigation for Overshot Area.** This section describes the details of the Former Shooting Range Overshot Area investigation using an ISM approach. This section identifies shotfall zones and presents planned field reconnaissance activities (including X-ray fluorescence [XRF] screening techniques and biological and archeological surveys), decision unit design, quality
assurance / quality control (QA/QC) sample requirements, laboratory processing and analysis, and field documentation, and health and safety requirements.

- **Section 5 – Data Evaluation and Reporting.** This section describes the data evaluation process, including human health and ecological risk assessment procedures to be performed. Investigation findings and risk assessment results will be presented in a Shooting Range Overshot Area Report, and used to make recommendations for remedial action if warranted.

- **Section 6 – Schedule.** This section provides information regarding the schedule for this proposed work.

- **Section 7 – References Cited.** This section lists the documents referenced in this work plan.

- **Appendix A – SOP 22 – Former Shooting Range Soil Sampling and Analysis.** This SOP provides details regarding the collection and analysis of soil samples as proposed in this work plan.

- **Appendix B – SOP 23 – Field Portable X-Ray Fluorescence Screening for Metals in Soil.** This SOP provides details regarding the field screening techniques using XRF as proposed in this work plan.

- **Appendix C - Former Shooting Range ISM Investigation Health and Safety Plan Addendum.** This document provides the health and safety requirements for the implementation of the field work described in this work plan.
2.0 SITE DESCRIPTION AND HISTORY

2.1 SITE LOCATION
The Former Shooting Range is part of the MRCA-Sage Ranch property adjacent to the northeastern portion of the SSFL, near the Main Gate. The SSFL is approximately 29 miles northwest of downtown Los Angeles, California, in the southeast corner of Ventura County (Figure 1). The SSFL occupies approximately 2,850 acres of hilly terrain, with approximately 1,100 feet of topographic relief near the crest of the Simi Hills. The SSFL is divided into four administrative areas (Areas I, II, III, and IV), with undeveloped land along its northern and southern margins.

The Former Shooting Range is comprised of the Firing Platform area (approximately 3.5 acres) and an Overshot Area that extends to the north (Figure 2). As described briefly above in Section 1.0 and in more detail in Section 4.1 below, the investigation proposed in this work plan is for the portion of the Overshot Area north of the Northern Drainage streambed as shown in Figure 2.

2.2 SITE DESCRIPTION
The Former Shooting Range Firing Platform currently consists of a dirt flat area that was formerly an asphalt parking lot. Three firing locations, identified using historical aerial photographs, were located on the Firing Platform. The Former Shooting Range Overshot Area is a partially vegetated area bounded by bedrock outcrops to the north and west. No buildings or other structures currently exist at the Former Shooting Range. The Northern Drainage roughly bisects the Former Shooting Range area, extending east to west. An unpaved hiking trail (Sage Ranch trail) generally parallels the drainage on the north side. North of the Sage Ranch trail, the Overshot Area is characterized by relatively steep outcrops of the Chatsworth Formation.

2.3 SITE CONDITIONS
The elevation of the Former Shooting Range Firing Platform area is approximately 1,850 feet above mean sea level (MSL). Elevations at the downrange areas range from approximately 2,040 feet above MSL north of the asphalt parking lot to approximately 1,820 feet above MSL west of the parking lot; with the downrange areas are primarily exposed soil vegetated with annual and perennial grasses, weeds, shrubs, and small trees. Vegetation is dense in some areas. Large bedrock outcrops occupy the western portion of the Overshot Area and form the hills in the northern portion of the area. Surface water
discharge is ephemeral, resulting from rainfall, and flows into the Northern Drainage which extends east to west through the Former Shooting Range.

The Northern Drainage descends from an elevation of approximately 1,900 feet MSL east of the Former Shooting Range to approximately 1,610 feet MSL at Outfall No. 009, located near the SSFL boundary approximately 1.5 miles to the west-northwest. Surface water in the drainage flows west to Outfall No. 009, then north into Meier Canyon and subsequently to Arroyo Simi in the Calleguas Watershed, entering the Pacific Ocean at Mugu Lagoon.

2.4 SITE HISTORY

In 1972, the Rocketdyne – Atomics International Rifle and Pistol Club, Inc. entered into a lease with John A. Dundas, et. al., care of Mr. Orrin G. Sage; for the purpose of operating a trap/skeet shooting range within land north of the SSFL (measuring approximately 450 feet by 450 feet). The shooting range was operated by the Rocketdyne – Atomics International Rifle and Pistol Club, Inc., independent of Boeing or its predecessor companies.

A succession of 5-year lease extensions were entered into in 1977, 1982, and 1987 between the Rocketdyne – Atomics International Rifle and Pistol Club, Inc., and Mr. Orrin G. Sage, an officer of the Geopac Corporation, the successor to John A. Dundas, et. al. In July 1990, the property foreclosed and was sold to the Santa Monica Mountains Conservancy (SMMC), through the MRCA. Due to SMMC’s efforts to turn the Sage property into a public park and a wildlife corridor preservation area, the range was closed in April 1991.

An extensive review was conducted of historical documentation, aerial photographs, and site observations made during previously conducted surveys and cleanup activities. This review confirmed the historical use of lead shot and clay targets; no evidence was found in documents or surveys to suggest historical rifle and/or pistol use (e.g., soil berms, stationary targets, bullet fragments or casing) within the Former Shooting Range and proposed ISM investigation area.

2.5 REGULATORY HISTORY

The Former Shooting Range is identified as solid waste management unit (SWMU) 4.20, the Former Rocketdyne Employees Shooting Range, in the RCRA Facility Assessment (RFA) by USEPA (SAIC, 1994), and is listed as such in the 2007 Consent Order for Corrective Action signed by Boeing and DTSC. The 2007 Consent Order describes the
RCRA Corrective Action investigation and closure activities, and provides the regulatory requirements for Boeing’s cleanup activities at the site. In the 2007 Consent Order, Attachment 4, the Former Shooting Range is listed as a SWMU but noted as “NA” (Not Applicable) for ‘Regulatory Jurisdiction’, “Current Regulatory Program”, and “Current Status” with the comment ‘Included in RFA but property belongs to SMMC.”

In May 2016, DTSC informed Boeing that characterization and cleanup of the Former Shooting Range would be done as part of the RCRA Corrective Action program pursuant to the 2007 Consent Order (DTSC, 2016). Boeing agrees to perform the characterization of the former Shooting Range consistent with the requirements stipulated in the 2007 Consent Order, and as specified in this work plan. However, as the property is owned by the MRCA, if additional work is required for the investigation and cleanup for the Former Shooting Range, some other form of agreement between MRCA, DTSC, and Boeing may be necessary.

2.6 PREVIOUS REMOVAL ACTIONS
This section summarizes previous removal actions at the Former Shooting Range and Overshot Area.

2.6.1 Voluntary Maintenance / Removal Activities
Visible lead shot in the former shooting range area has been addressed through several voluntary cleanup operations from 1992 through 2013. Approximately 374 tons of visible lead shot, soil, and debris were removed during initial lead shot cleanup activities performed by Rockwell International Corporation (Rockwell), Rocketdyne Division from 1992 through 1994 (Rockwell, 1993). Boeing continued to conduct voluntary lead shot cleanup and removed an additional 37.37 tons of visible lead shot and soil between 1998 and 2013 (HAI, 2013). Documentation does not specify the amount of lead shot removed, or the lead shot percentage of the total removed material, but it is expected that soil and lead shot were the primary waste constituents of the above-stated removal activities.

In 1992, Rocketdyne and MRCA agreed to participate in voluntary maintenance cleanup activities to remove visible lead shot in the Former Shooting Range (Rockwell, 1992). In subsequent years, Boeing and MRCA personnel observed additional lead shot in the former shooting range area and Boeing volunteered to assist with cleanup. The scope of work implemented to accomplish this objective included the following:
- A field survey to identify visible lead shot debris within the former shooting range
- A biological survey within the work areas to identify sensitive and/or endangered species/habitats, and mark the locations of protect-in-place plant/animal habitats
- A cultural resources survey to identify and protect-in-place archeological locations
- Installation and maintenance of erosion and sediment control best management practices (BMPs)
- Visible lead shot removal from the former shooting range area and rock outcrop area to the immediate north using manual equipment such as shovels, buckets, brooms, and a sieve to separate the lead shot from the soil
- A vacuum truck removal for larger areas of visible lead shot accumulation in proximity to the Sage Ranch trail
- Waste management, including containerization and characterization of material removed prior to off-site disposal
- Visible lead shot cleanup documentation in a summary report.

Below is a summary of visible lead shot cleanup activities performed since 1992 (HAI, 2013):

- 34,000 pounds (17 tons) removed in the winter of 1992
- 714,085 pounds (357 tons) in 1993/1994
- 13,007 pounds (6.5 tons) in November/December 1998
- 33,450 pounds (16.7 tons) in 2006
- 14,513 pounds (7.3 tons) removed in November/December 2009
- 9,573 pounds (4.8 tons) removed in May 2010
- 2,908 pounds (1.5 tons) removed in May 2011
- 321 pounds (0.15 tons) removed in August 2012
- 837 pounds (0.42 tons) removed in June 2013

Voluntary cleanup activities conducted by Boeing in or after 2009 were completed in accordance with the DTSC-approved *Former Shooting Range Overshot Area Visible Lead Shot Removal Work Plan* (HAI, 2009a).
2.6.2 ISE/RA Order Removal Actions

On November 1, 2007, the DTSC issued to Boeing and the National Aeronautics and Space Administration (NASA) an Imminent and Substantial Endangerment Determination and Order and Remedial Action Order (ISE/RA Order) ordering the cleanup of the Northern Drainage area of the SSFL (DTSC, 2007). Additionally, on November 6, 2007, the California Regional Water Quality Control Board (RWQCB) issued to Boeing a Cleanup and Abatement Order (RWQCB Order) requiring Boeing to clean up the Northern Drainage area (RWQCB, 2007). Both orders applied to property encompassed within the Northern Drainage, including a debris field in the drainage east of the NASA-owned former Liquid Oxygen (LOX) Plant, located in Area I, and the Former Shooting Range, located on MCRA property and formerly leased by Rockwell.

Soil and debris samples collected at the LOX debris area between June and September 2007 indicated asbestos (up to 80% chrysotile) and antimony (up to 465 milligrams per kilogram [mg/kg]) were present in the LOX debris area. As described in the Northern Drainage Former Liquid Oxygen (LOX) Plant, Debris/Asbestos Removal Action Report (MWH, 2008), measures taken to achieve cleanup during the LOX Debris Removal Action included the following:

- Debris and soil containing asbestos and antimony were removed, confirmation samples collected, and erosion control measures installed at the LOX debris area between November 13 and December 21, 2007. Approximately 2,500 cubic yards of debris and soil were transported offsite.

- Confirmation sample analysis was performed for asbestos and antimony. Sample results were below cleanup goals, with the exception of one split sample collected by DTSC that contained trace amounts of asbestos (<1 percent). Since this sample was collected on top of bedrock sandstone, no further removal was possible. The co-located sample at this location was non-detect for asbestos. Also, the trace asbestos detection was less than the California Environmental Protection Agency (Cal-EPA) definition of asbestos containing materials as 1 percent or greater (Title 22, California Code of Regulations, section 66261.24).

- Down-gradient from the former LOX Plant area, sediment sampling in the Northern Drainage was also conducted prior to and during this removal action to evaluate the potential migration of both asbestos and antimony. Asbestos was not detected and antimony was not detected above its DTSC-approved background concentration.
Pursuant to the ISE/RA Order, Boeing conducted additional clay target debris and soil removal activities at the Former Shooting Range in 2008. During these removal activities, a buried debris field was discovered in the Former Shooting Range area, investigated, and removed. Upon excavation, the debris was found to include glass, partially burnt wood, concrete pieces, metal scraps, plastic, possible transite pipe and siding, metal culverts, igniters, a 55-gallon metal drum, rubber tires, dishware and metal utensils, and miscellaneous industrial and residential trash.

The extent of the soil and debris removal area is shown in Figure 2. Approximately 3,970 cubic yards of soil and debris were excavated and transported offsite to appropriate disposal facilities (HAI, 2009b). Excavation and soil removal activities extended to the top of bedrock in many locations. During and following soil and debris removal, 91 confirmation samples were collected and analyzed to evaluate the extent and completeness of debris removal activities.

Based on field observations and the results of the laboratory analysis of the confirmation soil samples, buried debris in the Former Shooting Range was removed laterally and vertically to the extent it was detected and the results from the confirmation sampling met the DTSC ISE/RA Order cleanup goals for antimony and PAHs (HAI, 2009b). Clay target debris removal activities were suspended during the 2008-2009 rainy season, and resumed June 2009.

Boeing resumed focused excavations between June and November 2009 at specific locations where 2008 and 2009 sample results indicated concentrations above the PAH or antimony ISE/RA cleanup goals. Two more rounds of bank soil excavation were required along the Northern Drainage based on confirmation sampling results above interim cleanup goals in two areas:

- The “plateau” area west of the Former Shooting Range, extending up to about 20 feet into the bank/plateau (Figure 2); and
- Between the box culvert and former Liquid Oxygen (LOX) Plant, located in NASA-owned property outside the ISM Investigation Area described in this work plan.
A total of 575 tons (approximately 552 cubic yards) of debris, impacted soil, and incidental sediment and soil were removed from the Northern Drainage in the 2009 removal action (HAI, 2010). An additional 10 tons (approximately 11 cubic yards) of impacted soil were removed from near the Northern Drainage plateau area in 2010.

Approximately 323 confirmation samples were collected during the 2009/2010 clay target debris removal action. Analytical results of confirmation sampling from soil left in place indicated the following results:

1. The cleanup action had removed PAH concentrations for recreational receptors. More specifically, the post-removal in-place soil benzo(a)pyrene (BaP) toxic equivalence quotient (TEQ) results had a mean of 0.12 mg/kg, compared to the ISE/RA cleanup goal of 0.723 mg/kg. Following cleanup activities, only ten samples (out of the 323 confirmation samples) scattered in various locations along the Northern Drainage exceeded the ISE/RA cleanup goal for BaP TEQ, ranging up to 1.57 mg/kg.

2. The cleanup action reduced antimony concentrations for recreational receptors. More specifically, the post-removal antimony results had a mean of 0.128 mg/kg, compared to the ISE/RA cleanup goal of 30 mg/kg. Following cleanup activities, no antimony results exceeded the cleanup goals, with a maximum detected value of 5.13 mg/kg.

3. The cleanup action reduced PAH concentrations for ecological receptors. More specifically, post-removal, in-place low molecular weight PAHs had been successfully reduced to a mean concentration of 0.027 mg/kg, and high molecular weight PAHs to 0.58 mg/kg, compared to the ISE/RA cleanup goal of 1 mg/kg.

Soil confirmation samples were also analyzed for lead to gain a better understanding of lead concentrations in soil during the 2009 Northern Drainage clay target removal action. Lead, however, was not a constituent of concern in the ISE/RA Order (HAI, 2010), but was included in the cleanup actions where it was co-located with PAHs and antimony.

ISE/RA confirmation sampling results show lead, antimony, and PAH concentrations exceeding current background levels (DTSC, 2012). The highest concentrations, and most frequent detections, are in the former Shooting Range area north and west of the Firing Platform. Lead was detected at concentrations up to 1,600 mg/kg in confirmation sampling.
northeast of the Firing Platform. Antimony was detected at concentrations up to 6.6 mg/kg in confirmation sampling, collocated with the aforementioned lead detection. Benzo(a)pyrene was detected at concentrations up to 1.2 mg/kg in confirmation sampling east of the Plateau Area. Concentrations of all three constituents decrease, and are less frequent, further west along the Northern Drainage to Outfall 009.
3.0 SHOOTING RANGE AND ISM INVESTIGATION BACKGROUND INFORMATION

This section provides background information for the investigation approach proposed for the Former Shooting Range north of the SSFL, including identification of potential shotfall zones, XRF survey methodology, and additional details regarding ISM approaches.

3.1 SHOTFALL ZONES

The primary characteristic of all shotgun ranges from an environmental perspective is the wide distribution of shot. This results in a widely scattered deposition of very small pellets (of a consistent size and shape) within an area no more than approximately 770 feet from the shooting position, with the majority of the lead being deposited at a distance between 375 and 600 feet from the shooter (ITRC, 2005). The pellets will typically be found within inches of the surface, unless tilling or digging has physically disturbed the area.

The full extent of the total shotfall zone must be known before effective lead management practices can be implemented. Because clay targets are thrown at different angles for each of the different shotgun shooting venues, the type of venue will determine the dispersion of the spent shot. For the skeet range layout, the positions of the shooters and the angles at which skeet targets are thrown results in a “fan-shaped” shotfall zone. Depending on the load, the angle at which the shot was fired, and the wind direction, typical lead skeet loads can reach about 680 feet from the shooter. To ensure completeness of characterization, the ISM Investigation area has been extended to approximately 1,000 feet (adjusting for elevation changes) from the Firing Platform.

3.2 X-RAY FLUORESCENCE SURVEY

During the initial phase of the site characterization, it is necessary to define the boundaries of the area potentially affected by shotfall for the shooting range given the specifics of firing locations and topography. Lead shot chemical constituents of potential concern include lead, arsenic, and antimony; clay target chemical constituents of potential concern are PAHs (ITRC, 2003). A portable multi-element XRF analyzer can be used in field surveys to approximate the extent of elevated lead, arsenic, and other metallic elements in situ to establish and identify locations for further characterization, sampling and laboratory analysis. Since potential contamination patterns tend to be heterogeneous, the large number of data points gathered with in situ field screening can be a time- and cost-saving means of delineating the potential extent of impacts (ITRC, 2003).
3.3 SHOOTING RANGE SOIL SAMPLE COLLECTION ANALYSIS

As described in the USEPA’s Technical Review Group (TRW) Recommendations for Performing Human Health Risk Analysis on Small Arms Shooting Ranges (USEPA, 2003), sieving of soil samples collected from small arms firing ranges is recommended to evaluate risks for two reasons:

- The fine particle size fraction (<250 μm) is the primary source of soil ingestion (US EPA, 2000) and should be used in predicting risk to humans for the incidental soil ingestion pathway;
- Sieving will remove lead shot and large clay target fragments from the sample, which are not likely to be ingested inadvertently by humans.

The soil sample sieving procedure described in Appendix A of this work plan has been developed in accordance with the USEPA’s TRW recommendations (USEPA, 2003) to separate the coarse particle size fraction from the fine particle size fraction of soil samples collected from small arms firing ranges, and to prepare the fine fraction for further lab processing for analysis.

3.4 INCREMENTAL SAMPLING METHODOLOGY

As described in the IRTC’s 2012 Regulatory Guidance, ISM is a structured composite sampling and processing protocol having specific elements designed to reduce data variability and increase sample representativeness for a specified volume of soil under investigation (IRTC, 2012). Variability in measured contaminant concentrations between discrete soil samples is due primarily to the particulate nature of soil and heterogeneity in the distribution of contaminants. The elements of ISM that control data variability are incorporated into (a) the field collection of soil samples and (b) laboratory processing and subsampling procedures. ISM is designed to obtain a single aliquot for analysis that has all constituents in the same proportion as an explicitly defined volume of soil. ISM provides unbiased, reproducible estimates of the mean concentration of analytes in the specified volume of soil.

As such, ISM is particularly useful when the type of environmental contamination being investigated is heterogeneously distributed throughout the study area and may limit the ability to realistically assess potential impacts. ISM characterization is preferable in these cases since it minimizes variability and improves precision to provide more reproducible
results when compared to traditional sampling methodology. Compared to ISM sampling, the main limitation associated with performing discrete, composite, or other commonly used sampling methods is the extreme difference between the mass of the subsample analyzed by the laboratory and the mass of the ‘target’ population (i.e., the area to be investigated or sample volume collected). This increases the chance that the sample misses contamination, which will consequently not be represented in the analytical results at all.

A large portion of traditional method sampling error is a result of both compositional and distributional heterogeneity. Compositional heterogeneity describes the variability of contaminant concentrations between the particles that make up the population. This type of heterogeneity results in fundamental error. Fundamental error is a result of not representing proportional concentrations of all of the particles in the population. To minimize fundamental error, it is imperative that enough mass be collected and analyzed to represent all particles in the exact proportion found in the population (sampling area).

Distributional heterogeneity occurs when particles are not randomly distributed across the population due to spatial variations. Spatial variability will be missed if all samples are collected from one place. This type of heterogeneity results in grouping and segregation error. To minimize grouping and segregation error, it is imperative to collect sample increments randomly and in enough locations to capture the spatial variability of the population.

ISM procedures are intended to control these two major types of sampling error in most situations. Fundamental error is managed by collecting and analyzing sufficient sample mass to adequately address compositional heterogeneity. Grouping and segregation error is controlled by collecting multiple randomly located sample increments to address distributional heterogeneity. The number of increments required to represent a sampling area is not directly related to the size of the area, but depends only on the degree of variability within the sampling area (USACE, 2009). In general, a minimum of 30 to 50 increments are required to address grouping and segregation error; however, if greater distributional heterogeneity is expected, more increments may be required.

ISM is not the same as simple composite sampling. An ISM sample is collected within a defined sampling area or “decision unit” (explained below), whereas a composite may be collected without regard to a specific decision unit. Unlike ISM, simple composite sampling does not adequately address sampling for either a fundamental error or grouping
and segregation error. An ISM sample is a representative sample for a decision unit. Although the physical process of collection is similar, the information derived from each process is different (DEC, 2009).

### 3.4.1 Decision Units

As described in IRTC (2012), decision units may be defined in regularly spaced and equal volumes as established by exposure areas, or they may be based on irregular features of the site which define contaminant transport or receptor exposure. Alternatively, decision units may be based on an understanding of the contaminant distributions, for example, in and around source areas, or based on the anticipated remedial approach (ITRC, 2012). For the ISM Investigation Area, an approach involving approximately 35 decision units within four shotfall zones was identified based on the nature of the contamination, optimization of risk assessment procedures and risk management decisions, and consideration of future remedial planning if required (refer to Figure 3 and Section 4.1).

Based on the nature of the activities that resulted in contamination in the ISM Investigation Area (i.e., trap and skeet shooting), metals associated with lead shot and PAHs associated with clay pigeon fragments are anticipated to have impacted shallow soils in a fan shape extending outward from the Firing Platform. The highest contaminant concentrations are expected in the center of the fan and closer to the Firing Platform, and lower contaminant concentrations are expected on the outer portions of the fan and further from the Firing Platform. Potential risks to human and ecological receptors will be estimated for each decision unit. If human health or ecological risk estimates for a given decision unit exceed an acceptable risk threshold, the decision unit will be proposed for further investigation or recommended for further evaluation for remediation. The relatively high number (35) and low size (approximately 40,000 square feet) of the decision units is intended to maximize information for ‘first-time through’ decisions for areas where characterization is complete and areas where evaluation of potential remedial action is necessary.

### 3.4.2 Sample Locations and Field Sampling Procedures

One of the basic principles of ISM sampling is to collect the increments from random locations (IRTC, 2012). As sample mass is used to address compositional heterogeneity, random sampling addresses distributional heterogeneity and eliminates error through the collection of samples from multiple, randomly selected locations. There are several types of random sampling techniques, including simple random, stratified random, and systematic random sampling depending on the project objectives.
Field sampling procedures that distinguish ISM from conventional composite sampling include:

- Collecting increments from a single decision unit specifically delineated to meet a project objective;
- Collecting a sufficiently large number of increments (typically between 30 and 50) to address the distributional heterogeneity of analytes;
- Ensuring that the increments are of equal mass;
- Ensuring that the increments are collected from throughout the entire decision unit in an unbiased manner; and,
- Collecting an adequate total sample mass (typically between 1 and 2 kilograms [kg]) to overcome effects of compositional heterogeneity due to inherent particulate nature of soil and sediment (USACE, 2009).

### 3.4.3 Laboratory Selection and Sample Processing

ISM sample processing is intended to occur under controlled conditions in a laboratory. To ensure the quality of the results, the selected laboratory must demonstrate compliance with the Department of Defense (DoD) *Quality Systems Manual (QSM)* through the DoD *Environmental Laboratory Accreditation Program* (ELAP), and the SOPs should be in accordance with the EPA *Guidance for Obtaining Representative Laboratory Analytical Subsamples from Particulate Laboratory Samples* (USEPA, 2003).

USEPA SW-846 Method 8330B applies incremental sampling procedures for explosive residue field sample collection and laboratory analysis that can be applied to the processing of samples for the analysis of constituents other than explosives. The selected laboratory should be assessed and approved for ISM sample processing in accordance with USACE’s *Incremental Sampling-based Laboratory Requirements for the Analysis of Explosives (Method 8330B) and Metals in Solid Matrices* (USACE, 2008). In addition, the selected laboratory should follow the guidance provided in American Society for Testing and Materials (ASTM) D6323, *Standard Guide for Laboratory Subsampling of Media Related to Waste Management Activities* (ASTM, 2003), on sample splitting, particle size reduction, and the mass of subsample necessary to reduce the fundamental error to less than 15 percent (USACE, 2009).
Method 8330B requires that a 1- to 2-kg sample be air-dried, then sieved to remove particulates larger than 2 millimeters (equivalent to very coarse sand). The smaller the particles, the lower the variability between subsamples from a given mass of sample (USEPA, 1992). Using the ISM approach, a large number of small aliquots (typically 30 or more) are taken in an unbiased manner from the processed sample and composited until a sufficient sample mass is obtained for extraction and analysis. USEPA Method 8330B recommends processing 10 grams of soil for solvent extraction, rather than the 1 to 2 grams typically analyzed by other methods (USACE, 2009). The primary reason for the increased mass is that it decreases the variability that results from a 1 gram mass. A secondary advantage of this increased mass is a decrease in MRLs.

Laboratory processing and subsampling procedures that enhance representativeness include:

- Air drying of the entire field sample to achieve uniform dry weights;
- Particle size reduction by sieving; and
- Multi-incremental laboratory subsampling from the entire processed sample to obtain an aliquot for analysis having sufficient mass to reduce the fundamental error to less than 15 percent.

### 3.4.4 Error Analysis

ISM includes the collection of both field and laboratory replicate samples (ITRC, 2012). Field replicates consist of separate ISM samples (in addition to the initial ISM sample) taken by the field team from the decision unit. They are not field splits—they are collected and processed as separate samples. The collection of data from triplicate field samples (i.e., one primary ISM sample and two field replicate samples from the same decision unit) allows for the calculation of 95% upper confidence limit (UCL) on the mean concentrations, and allow for statistical comparison between site and background results (DTSC, 2012).

Laboratory replicates are samples taken from a single ISM sample, usually in the laboratory. They can be taken from the bulk ISM sample at a number of points during sample processing, depending on the process step(s) being evaluated. Replicates taken at the beginning of laboratory processing of the bulk ISM sample are used to evaluate potential overall error resulting from laboratory processing and analysis.
4.0 FORMER SHOOTING RANGE OVERSHOT AREA INVESTIGATION APPROACH

This section describes the methods and procedures of the proposed investigation for the Former Shooting Range Overshot Area north of the Northern Drainage (ISM Investigation Area). All investigation activities will require coordination with the MCRA-Sage Ranch property management since the scope of this work is located on that property.

4.1 IDENTIFICATION OF ISM INVESTIGATION AREA AND SHOTFALL ZONES

As described in Section 2.6, Boeing previously conducted an extensive soil and debris removal action in the area north of the former Firing Platform, generally extending to and including the Northern Drainage. Much of this area was excavated down to the top of bedrock prior to restoration activities. Boeing has continued to characterize this area as part of the RCRA Facility Investigation (RFI), using a comprehensive data quality objective (DQO) process to assess the nature and extent, and transport and fate of potential releases from facility operations (e.g., operational waste found buried and subsequently removed from this location). Also, several other RFI sites are located up-gradient of this portion of the Overshot Area, with potential contaminant migration from those sites into the Northern Drainage by surface water transport. For these reasons, the portion of the Overshot Area including the Northern Drainage and south of the Northern Drainage is excluded from further investigation described in this work plan. This area will continue to be evaluated for characterization and closure requirements under the RFI and CMS processes as specified in the 2007 Consent Order.

Separation of the ISM area from other RFI sites is consistent with ISM guidance (IRTC, 2012) since the site conceptual model (SCM) for potential chemical release from the Former Shooting Range was distinctly different from historical operations at RFI sites. At the Former Shooting Range, potential chemical release would have occurred by unique release mechanism – firing of lead shot and clay pigeon targets into the northern hillside, with shotfall dispersed over a wide area. Given the nature of this release mechanism, the medium most likely impacted would be soil. Although surface water migration of lead shot and clay targets into the Northern Drainage has been documented, potential impacts of these chemicals would be potentially co-mingled with release of other contaminants from the up-gradient RFI sites. Thus, the Northern Drainage will be evaluated for potential contaminant migration from the Former Shooting Range as part of the RFI, and is not
included in this investigation work plan. Additionally, activities and features not related to Former Shooting Range activities (e.g., debris areas) falling within the ISM Investigation Area will be characterized following the DTSC-approved DQO process (CH2M Hill, 2013b), and included in the Boeing Subarea 1A North RFI reporting. Evaluation of contaminant migration to the vadose zone or groundwater is not included in this work plan; the need and scope of that evaluation will be determined following completion of characterization of soil in the ISM Investigation Area.

Using the guidance from ITRC’s *Characterization and Remediation of Soils at Closed Small Arms Firing Ranges* described in Section 3.1 (ITRC, 2003), the Former Shooting Range and Overshot Area is divided into the following shotfall zones during the lead shot investigation:

- Zone 1 – Firing Platform Area
- Zone 2 – Maximum Fragment Accumulation Area (less than approximately 375 ft from the Firing Platform)
- Zone 3 – Maximum Lead Shotfall Area (approximately 375 to 770 ft from the Firing Platform)
- Zone 4 – Estimated Maximum Extent of Lead Shotfall (greater than approximately 770 ft from the Firing Platform). The extent of Zone 4 will be finalized after the XRF and visual surveys.

The ISM Investigation Area consists of the portions of Zone 2 north of the Northern Drainage, and Zones 3 and 4 (Figure 3).

**4.2 FIELD RECONNAISSANCE AND SURVEYS**

As suggested by guidance provided in ITRC’s *Characterization and Remediation of Soils at Closed Small Arms Firing Ranges* (ITRC, 2003), during the initial phase of the site characterization, field screening may be an effective way to define the boundaries of the area affected by the chemical constituents of concern. As such, prior to sampling a field reconnaissance and surveys of the Former Shooting Range Overshot Area will be conducted to finalize the ISM design and protect sensitive biological and/or cultural areas prior to sampling. The reconnaissance and screening surveys include:
Mark sensitive species, habitats (e.g., active bird nests), or cultural sites close to work areas to alert workers of their presence and to facilitate their protection during sampling;

Perform archeological and cultural resource surveys of the portions of the ISM Investigation Area to be sampled;

Identify areas requiring brush clearance/weed abatement to allow for future field sampling access;

Conduct a visual survey for lead shot and clay target debris, perform XRF screening, and collect global positioning system (GPS) data (e.g., XRF survey points, observed shotfall debris) in Zone 4 to finalize the extent of ISM sampling; and

Survey the final ISM Investigation Area to field identify GPS coordinates of the four corners of each proposed decision unit.

As noted above, the ISM Investigation Area will be finalized based on observations made during the visual survey and the results of XRF screening. The visual survey will consist of two individuals walking the entirety of Zone 4. During this walk, any observed lead shot, clay target debris, or other shooting range-related materials will be photographed and noted in the field log book, and location information will be collected using a hand-held GPS unit. Additionally, any features not related to former Shooting Range activities that potentially require characterization under the DQO process will similarly be noted for inclusion in the RFI. In situ field data will be collected by performing XRF sampling at 25-foot intervals in Zone 4. The extent of Zone 4 will be re-drawn so that all areas in the Overshot Area with observed shooting range-related materials (e.g., lead shot or pellets, clay target debris), or XRF analyzer readings above background concentrations (DTSC, 2012), will be included in the ISM Investigation Area.

An SOP for performing the proposed XRF survey in Zone 4 is included as Appendix B of this work plan. Additional information regarding biological and cultural surveys is provided in the following sections.

4.2.1 Biological Survey

Prior to sampling activities, a biological survey of the ISM Investigation Area will be performed to identify the presence of special-status plants and wildlife.
Sensitive plants (e.g., Santa Susana tar plant, Braunton’s milk-vetch, and Plummer’s Mariposa lily) will be flagged to alert workers of their presence and to facilitate their protection during sampling activities. The potential presence of special-status birds, reptiles and mammals will be determined and documented. Sensitive species will be protected during field work, and a biologist contacted during sampling activities if necessary to revise a field sampling location or move a special-status species (e.g., legless lizard).

4.2.2 Archeological Resource Survey
Prior to sampling activities, a cultural resource survey will be performed for the portions of the ISM Investigation Area to be sampled. Identified cultural resources will be avoided and protected-in-place prior to work activities. If warranted, a cultural resource specialist will be present during implementation of field sampling activities to screen for any subsurface resources. Archaeological monitors will have the authority to stop work should items of cultural significance be discovered.

4.2.3 Cultural Monitoring
Native American monitors will be present during activities that disturb subsurface soil. Monitors will work with field sampling crews to screen shallow soil samples for objects of cultural significance. Native American monitors will have the authority to stop work should items of Native American heritage be unearthed.

4.3 ISM IMPLEMENTATION
Using the ISM and Shooting Range guidance described in Section 3 and the results of the field reconnaissance and surveys, the ISM design will be implemented as described below.

4.3.1 Decision Unit Design and Sampling Grids
Consistent with ITRC (2012) guidance, the ground surface of the ISM Investigation Area will be segmented into approximately 40,000 square foot decision units. As shown based on the projected extent of the Overshot Area, the ISM Investigation Area will consist of 35 decision units (Figure 3). The number of decision units may change if revisions are made to the ISM investigation area based on the proposed XRF and visual surveys. Each decision unit will be assigned a unique number identifier.
Incremental soil sampling will be conducted at each decision unit within the ISM Investigation Area with sufficient area and soil to collect at least 30 sample increments. The 40,000 square foot size of the decision unit was selected to increase the likelihood that all decision units would contain sufficient soil areas for sampling due to the prevalence of bedrock outcrops in the area. Incremental sampling will be performed using a systematic grid sampling method where soil sample increments are collected at points evenly distributed throughout the decision unit. This method provides an unbiased representative sample across the entire decision unit. Each decision unit will be subdivided into 30 to 50 subgrids measuring approximately 30-ft by 30-ft to visually aid sample collection. The systematic sampling pattern will consist of sampling at a random location (selected in the field) within the first subgrid cell and continuing that pattern in the remaining subgrid cells, resulting in 30 to 50 sample increments. The total weight of the sample increments representing the grid will be approximately 1 kg.

A specialized multi-increment sampling tool (CRREL MIS tool, EVC incremental sampler, or equivalent) will be used to collect an equal volume of soil for each incremental sample with a representative particle size distribution for the localized geological strata, thereby ensuring the sample increments are of equal mass, reducing the heterogeneity of the sample. The individual sample increments will be combined together in a single plastic bag or glass container for each decision unit for submittal to the analytical laboratory.

The following decision rules will apply in those cases where an ISM sample cannot be collected as described above.

- If the presence of bedrock outcrops prevents the collection of at least 30 sample increments, the decision unit area may be revised, merged with adjacent decision units or not sampled, depending on field conditions. For example, if only a portion (say 50%) of Decision Unit ‘A’ is able to be sampled due to rock outcrops and it is merged with Decision Unit ‘B’, which is entirely accessible, then the 15 increments from Decision Unit ‘A’ would be combined with the 30 increments collected from Decision Unit ‘B’. This would result in an unbiased sample.

- The location of the sample increment may also be adjusted to an area other than the randomly selected location, based on field conditions. In these cases, the soil location closest to the random location will be selected.
4.3.2 Vertical Definition of Decision Units

As described in Section 3.1, the shotfall within the ISM Investigation Area is expected to have been deposited within inches of the surface. Additionally, due to the presence of relatively steep bedrock outcrops in the area, it is expected depth to refusal in the ISM Investigation Area will be relatively shallow (<2 ft below ground surface [bgs]). Since the highest concentrations of lead at shooting ranges are typically found in the top 0.5 feet of soil (ITRC, 2003), the extent of the vertical exposure areas for all decision units in the ISM Investigation Area will be defined at 0.5 ft bgs, and only surface sampling will be performed under this work plan. If field information and data collected under this work plan indicate that further vertical definition of the decision units in the ISM Study is required, an amendment to this work plan will be prepared for approval by DTSC.

4.3.3 Quality Assurance / Quality Control Samples

Per ISM guidance (ITRC, 2012), three field replicate samples (i.e., the initial ISM sample plus two additional samples) will be collected from decision units. Field replicate samples will be collected at 100% of the decision units sampled. Within the designated decision units, replicate samples will be collected by marking the original sample location with a flag or stake, then moving an approximately one-third the size of the subgrid to the east and west of the original location for the second and third samples. This process will be repeated for the remainder of the approximately 30 to 50 incremental samples within each decision unit slated for field replicate sampling. The distance to the east and west of the original sample may be adjusted to ensure that replicate sample increments are collected from within the same subgrid. This distance will ensure adequate variability between increment samples. In the case of limited soil due to bedrock, the replicate sample spacing and directions will be adjusted and deviations documented.

In addition to the collection of field replicate samples, and in accordance with the DTSC-approved SSFL Quality Assurance Project Plan (QAPP; MECx, 2013), matrix spike/matrix spike duplicates (MS/MSD), representing at least 5 percent of the total number of initial ISM samples collected, will be submitted for laboratory analysis. Laboratory splits (rather than field splits) will be conducted at the laboratory after initial sample processing and homogenization has been conducted. These laboratory splits will be transferred to a third laboratory as a quality assurance measure of the laboratory analysis. An equipment rinsate will be collected once per day of sampling per analytical method.
4.3.4 SAMPLE IDENTIFICATION

Each ISM sample collected from the ISM Investigation Area will be assigned a 12-character designator for sample identification. These sample identifiers are associated with the site location near the Northern Drainage, the ISM sample collection/matrix type, a unique identifier associated with each decision unit, sample type, and sampling number. The sample identifiers will be used in field documentation, laboratory analysis, and reporting. Each sample identifier as NDISXXXXYZZZ, where each component of the sample identifier is described below:

- **ND**: Site identification (ND for Northern Drainage)
- **IS**: Sample collection/matrix type (“IS” for ISM)
- **XXXX**: Decision Unit Identifier (0000 – 0035)
- **Y**: Sample type (“S” for initial ISM sample, “R” for field replicate, “D” for laboratory replicate)
- **ZZZ**: Sample number or numerical identifier associated with the number of samples collected from the decision unit (“000” for initial ISM sample and “001” or “002” for replicates)

4.3.5 LABORATORY PROCESSING AND ANALYSIS

As noted above, ISM samples will be submitted to California-certified laboratory approved for ISM sample processing in accordance with USACE’s *Incremental Sampling-based Laboratory Requirements for the Analysis of Explosives (Method 8330B) and Metals in Solid Matrices* (USACE, 2008) for analysis of lead, arsenic, antimony, and PAHs. Specific laboratory procedures for the analysis of soil samples collected for the Boeing investigation of the Former Shooting Range area are provided in Appendix A. This appendix provides SOP 22, “Former Outdoor Shooting Range Soil Sampling and Analysis”, which was prepared for this investigation based on ITRC (2012) and EPA (2003) guidance documents. A summary of the laboratory methods is provided in this section.

Following protocols outlined in the DTSC-approved SOP 21 for RFI (Boeing, 2013), “*Laboratory Homogenization of Soil Samples*,” and consistent with the USEPA publication of SW846 Method 8330B, the selected analytical laboratory will homogenize and sieve the sample. Note, that although grinding of samples is described in Method 8330B (the EPA Method most cited for ISM guidance), sample grinding will not be performed on samples collected from the ISM Investigation Area since the target analytes include metals (potentially subject to smearing and retention on the grinding equipment) and PAHs.
(potentially semi-volatile upon grinding). To compensate for the lack of grinding, a laboratory analysis sample of at least 10 grams (or multiple smaller subsamples totaling 10 grams of material) will be used to prepare the digestate. This modification of sample homogenization procedures is discussed and allowed for in the ITRC guidance document (IRTC, 2012).

After homogenization and sieving has been completed, the laboratory will collect the appropriate aliquot of soil for analysis by performing the sub-sampling procedures described in SOP 22.

Following these laboratory procedures, the homogenized soil sample will be representative of the entire decision unit. All ISM samples collected will be analyzed for lead, arsenic, and antimony using USEPA Method 6020A, and for PAHs by USEPA Method 8270C using selective ion monitoring (SIM).

Analysis for lead, antimony, arsenic, and PAHs will be conducted as these constituents are most commonly associated with lead shot and clay targets. Additionally, they are the Shooting Range-related constituents most frequently detected above background levels (DTSC, 2012) in extensive sampling conducted in the shotfall area adjacent to, and south of the Northern Drainage. Copper and tin are also identified as being associated with lead shot (ITRC, 2003); however, these metals are not included in the analytical suite as copper has not been detected above background concentrations in the Northern Drainage shotfall area, and tin would be expected to be collocated with elevated lead concentrations associated with lead shot. Also, review of other shooting range cleanups at the Chatsworth Range (California Environmental, 2010), Brentwood Rod and Gun Club (DTSC, 2006), Otay Skeet and Trap Shooting Range (TRC, 2007), and Alameda Naval Station Skeet Range (Battelle, 2005), indicates that other shooting range-related site investigations and cleanups have been primarily focused on lead and PAHs, with occasional characterization for antimony, arsenic, perchlorate, copper, and zinc; the final three constituents at sites with rifle and pistol use in addition to lead shot. Copper and tin will be addressed as uncertainties in the final risk assessment documentation.

### 4.4 FIELD DOCUMENTATION

Practical limitations and unforeseen field conditions may require modifying the delineation of decision units as defined during planning. For example, areas may have limited or difficult access due to steep terrain or exposed bedrock surface without soil. DTSC will
be consulted following completion of the field surveys and finalization of the ISM Investigation Area boundary and decision unit design. If unforeseen circumstances arise during sampling that are not accounted for in this work plan, DTSC will also be consulted to discuss how to address the deviation.

All information pertinent to the sampling efforts will be entered directly into a field logbook and on project-specific field forms. All data generated to document any deviations from the project plans will be recorded in detail in the field logbook. Detailed descriptions of the samples collected, modifications to decision units, and any unusual conditions encountered during the investigation will be recorded in the logbook.

### 4.5 HEALTH AND SAFETY

Health and safety procedures related to the ISM investigation activities in the Former Shooting Range Overshot Area are provided in Appendix C. This appendix provides a site-specific addendum to the SSFL RFI Health and Safety Plan (HASP) (Ogden, 1996 and 2000) for the field tasks described in this work plan, including the visual survey for lead shot, biological survey, vegetation clearance, and XRF screening.
5.0 DATA EVALUATION AND REPORTING

This section describes the data validation, data evaluation, and human health and ecological risk assessment (HHERA) methods and procedures to be used on data collected from the ISM Investigation Area, and the information to be provided in a report summarizing this investigation.

5.1 DATA EVALUATION

The ISM data will be validated according to data validation procedures described in the Boeing RFI QAPP (MECx, 2013). Field replicates will be evaluated against a criterion of a relative standard deviation (RSD) < 30%.

Following validation, the ISM sampling results and field survey information will be evaluated using the Geographical Information System (GIS) developed for Boeing investigations at the SSFL, and screened using risk-based RFI soil characterization levels (SCLs) approved by DTSC. The lateral and vertical extent of SCL exceedances (if any) will be evaluated to determine if additional sampling is needed to complete characterization, or if further evaluation of deeper media (vadose zone bedrock or groundwater) is warranted. DTSC will be contacted following completion of this phase of data evaluation to review results and discuss if any further sampling or evaluation is needed prior to risk assessment.

5.2 HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

An HHERA will be performed for the ISM Investigation Area using the sum-of-fractions (SOF) approach for evaluation of potential risks associated with decision units, in accordance with the DTSC-approved Final SRAM Rev. 2 Addendum (SRAM) (MWH, 2014a). Risk assessment methods common to the evaluation of potential risks to human and ecological receptors are described below. Methods and procedures specific to the evaluation of potential risks to human health are described in Section 6.3.1, and those methods and procedures specific to the evaluation of potential risks to ecological receptors are described in Section 6.3.2.

COPC/CPEC Selection

The first step in the HHERA process is the identification of constituents of potential concern (COPCs) for human receptors and constituents of potential ecological concern
(CPECs) for ecological receptors within a given exposure medium. The exposure medium for the ISM Investigation Area is surficial soils. The SRAM (MWH, 2014a) defines surficial soil as soil or ephemeral sediment within the depth interval 0 – 2 ft bgs. As described in Section 4.3.2 of this work plan, ISM samples will be collected from the depth interval, 0 – 0.5 ft bgs, because the highest concentrations of lead at shooting ranges are typically found in the top 0.5 feet of soil. The use of data collected from 0 – 0.5 ft bgs to estimate surficial exposures and risks for human and ecological receptors is conservative because it likely represents the most contaminated portion of the 0 – 2 ft bgs surficial soil depth interval.

COPCs to be evaluated in the human health risk assessment (HHRA) will be identified based on a comparison of analyte concentrations in ISM samples collected from 0 – 0.5 ft bgs to background data established for the SSFL (DTSC, 2012) using the Wilcoxon Rank Sum (WRS) test, or the Gehan test for datasets with multiple reporting limits (RLs), to determine if the mean concentrations over the ISM Investigation Area are significantly different from the mean of background concentrations. CPECs for soil samples will be identified in a similar manner for the same soil depth interval (0 – 0.5 ft bgs). Analytes that fail the background comparison evaluation will be identified as COPCs and CPECs for all decision units. Also, although not currently planned, if deeper samples are collected as part of this study, they will be evaluated in accordance with the SRAM (MWH, 2014a).

**Risk Assessment Calculations**

As described in Sections 4.3.1 and 4.3.3, one primary SMP sample and two replicate samples will be collected from each decision unit. An exposure point concentration (EPC) for each COPC/CPEC in each decision unit will be calculated as the 95 percent (%)UCL on the mean concentration using the primary and replicate ISM samples for the decision unit, in accordance with ITRC (2012). Decision unit-specific EPCs for each COPC/CPEC will be calculated using the most recent version of USEPA’s ProUCL software.

Potential human health and ecological risk estimates for the each decision unit will be calculated as incremental risk estimates above background. First, total human health and ecological risk estimates will be calculated for each COPC/CPEC using the 95% UCL on the mean concentration derived for each decision unit. Next, background human health and ecological risk estimates will be calculated for each COPC/CPEC using the 95% UCL on the mean concentration derived from the DTSC Chemical Soil Background Study.
(DTSC, 2012). The difference between the total risk estimate and the background risk estimate for each COPC/CPEC is the incremental risk estimate for the decision unit.

5.2.1 Human Health Risk Assessment

The HHRA for the ISM Investigation Area will evaluate potential risks for a suburban resident and a recreator exposed to residual contaminants in soil. The HHRA for these receptors will be performed in accordance with the methods and assumptions presented in the SRAM (MWH, 2014a). As per the SOF methodology presented in the SRAM (MWH, 2014a), cancer risk estimates will be calculated as the ratio of the 95% UCL on the mean concentration of each COPC in a decision unit to the corresponding carcinogenic risk-based screening level (RBSL) for a suburban resident or a recreator, multiplied by 1 x 10^-6. Cancer risk estimates for individual COPCs will be summed to a cumulative cancer risk estimate for each receptor. Noncancer hazard quotients (HQs) will be calculated as the ratio of the 95% UCL on the mean concentration of each COPC in a decision unit to the corresponding noncancer RBSL for a suburban resident or a recreator. Noncancer HQs for individual COPCs will be summed to a cumulative noncancer hazard index (HI) for each receptor for PAHs, only.

5.2.2 Ecological Risk Assessment

The ecological risk assessment (ERA) for the ISM Investigation Area will evaluate potential ecological risks for the deer mouse, hermit thrush and soil invertebrates exposed to contaminants in soil. Large home-range ecological receptors (i.e., the bobcat, mule deer and red-tailed hawk) will not be included in the ERA for the ISM Investigation Area since these evaluations are done over much larger aerial footprints (MWH, 2014a).

The ERA for small home range receptors will be performed in accordance with the methods and assumptions presented in the SRAM (MWH, 2014a). As per the SOF methodology presented in the SRAM (MWH, 2014a), ecological HQs for small home range receptors will be calculated as the ratio of the 95% UCL on the mean concentration of each COPC in a decision unit to the corresponding Eco RBSL for each receptor. Ecological HQs are summed to a cumulative HI for each receptor for PAHs, only, as per the SRAM (MWH, 2014a). Therefore, ecological HQs for individual PAHs will be summed to a cumulative, PAH-specific HI for each receptor; HQs for antimony, arsenic and lead will be excluded from cumulative HI estimates, as per the SRAM (MWH, 2014a).
In accordance with the ERA methodology presented in the SRAM, ecological HQs and HIs will be calculated using both Low and High Eco RBSLs to present a range of potential hazard estimates for ecological receptors.

5.3 REPORTING

Results of the ISM field investigation, data evaluation, and risk assessment will be presented in a report for DTSC review and approval. The report will summarize the field sampling and data evaluation tasks performed, the lateral and vertical extent of lead shot or clay target impacts, and the results of the HHERA. As warranted based on the results of the risk assessment, areas identified for further study and/or potential remedial action will be identified and described.
6.0 SCHEDULE

Boeing will implement the ISM sampling, data evaluation, and risk assessment tasks for the Former Shooting Range Overshot Area as described in this work plan following DTSC approval. A detailed schedule for these tasks will be determined once the plan is approved, and in coordination with the MCRA.
7.0 REFERENCES


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USACE, Engineer Research Development Center (ERDC), 2013. Incremental Sampling Methodology for Metallic Residues, August.


Figure 2
Former Shooting Range and Overshot Area Site Plan

Base Map Legend

- SSFL Property Boundary
- RFI Sites
- Firing Locations
- Former Shooting Range Debris Removal (2008)
- Approximate Voluntary Maintenance/Removal Areas (1992 - 2013)
- Approximate Voluntary Maintenance/Removal Areas (2009 - 2013)
- Extent of ISE/RA Removal Action Areas
- Drainage

Source:

2015 Aerial Imagery
Figure 3
Former Shooting Range
Overshot Area ISM Design

Base Map Legend

- **SSFL Property Boundary**
- **Decision Units**
- **ISM Investigation Area (Overshot Area)**
- **Drainage**

**Zone 1 - Former Shooting Range Platform**

**Zone 2 - Max Fragment Accumulation (less than approximately 375 feet from the firing platform)**

**Zone 3 - Max Lead Shotfall (approximately 375 to 770 feet from the firing platform)**

**Zone 4 - Estimated Max Extent of Lead Shotfall (XRF Screening Area) (approximately 770 to 1000 feet from the firing platform)**

Note 1: The ISM Investigation Area (Overshot Area) shown is estimated as described in this work plan and will be refined based on field surveys and the XRF Survey of Zone 4.

Note 2: The Northern Drainage is the southern limit of the area proposed for the ISM investigation. Further investigation of the Northern Drainage and the area to its south, including the Former Shooting Range Platform, is being conducted separately as part of the RCRA Corrective Action Program.

2015 Aerial Imagery

Date: August 24, 2016

Document: C:\Rocketdyne\ShootingRange\ShootingRangeGrid_Fig3_Aug2016.mxd
APPENDIX A

STANDARD OPERATING PROCEDURE 22 – FORMER OUTDOOR SHOOTING RANGE SOIL SAMPLING AND ANALYSIS
STANDARD OPERATING PROCEDURE 22

Former Outdoor Shooting Range Soil Sampling and Analysis

1.0 Purpose and Scope

This standard operating procedure (SOP) provides a general procedure for collection and preparation of surface and subsurface soil samples for metals analyses at outdoor shooting ranges using hand auger methods and using Incremental Sampling Methodology (ISM). These procedures were developed in accordance with United States Environmental Protection Agency (USEPA) Technical Review Group (TRW) Recommendations for Sampling and Analysis of Soil at Lead Sites (USEPA 2000), USEPA’s Recommendations for Performing Human Health Risk Analysis on Small Arms Shooting Ranges (USEPA, 2003), and the Interstate Technology and Regulatory Council’s (ITRC) 2012 Regulatory Guidance (ITRC, 2012). This SOP also describes abandonment procedures for boreholes. Based on the type of work being conducted, the following Boeing Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Santa Susana Field Laboratory (SSFL) SOPs should be consulted as appropriate:

- SOP 2, Surveying of Sampling Locations
- SOP 5, Soil and Sediment Sampling
- SOP 7, Borehole and Trench Logging, Soil and Rock Classification
- SOP 10, Field Quality Control Sampling,
- SOP 11, Equipment and Personnel Decontamination
- SOP 12, Investigation-Derived Waste Management
- SOP 13, Sampling Handling, Storage, Packaging and Shipping
- SOP 14, Sample Labeling and Chain-of-Custody Procedures
- SOP 15, Field Logbooks, Documentation and Records, and Data Management
- SOP 21 for the RFI, Laboratory Homogenization of Soil Samples

This procedure applies to all field personnel involved in the management or performance of soil sampling activities and laboratory procedures for particle size fractionation. As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment to accommodate unforeseen circumstances. Deviances from this procedure in planning, or in the execution of planned activities, must be approved by the Project Manager.
2.0 Definitions

Coarse fraction: the portion of the total sample that passes through the No. 4 or No. 10 sieve, but does not pass through a No. 60 (250 μm) sieve.

Fine fraction: the portion of the total sample that passes through a No. 60 (250 μm) sieve. United Stated Environmental Protection Agency lead models consider this fraction to be the primary source of ingested soil and dust (USEPA 2000; 2003).

Total soil sample: the soil that passes through a No. 10 (2.0 mm) sieve to remove large debris. The total soil sample consists of the coarse and fine fractions.

3.0 Responsibilities

The Project Manager is responsible for ensuring that these outdoor shooting range soil sampling procedures are utilized during field projects and that they are conducted or supervised by a California-professional geologist (PG), certified engineering geologist (CEG), or professional engineer (PE). If soil and rock classification is not conducted by a PG, CEG or PE, it will be performed by a qualified individual under the direct supervision of a PG, CEG, or PE. Supervision is defined as onsite monitoring of the individual conducting soil classification, which will occur on a daily basis. A qualified individual for soil/sediment sampling is defined as a person with a degree in geology, hydrogeology, or geotechnical/civil engineering or similar degree with sufficient training and experience to accomplish the objectives of the sampling program. The Project Manager will also ensure that soil classification during all types of soil sampling is conducted by a qualified person as defined in SOP 7, Borehole and Trench Logging, Soil and Rock Classification.

The Field Team Leader is responsible for ensuring that all project field staff utilize these procedures.

4.0 Equipment and Materials

- Field logbook, boring logs, sample tracker, Chain-of-Custody (COC) record form, photo log, and other necessary field forms as discussed in SOP-15 Field Logbooks, Documentation and Records, and Data Management
- Permanent marker
- Hand lens
- Hand auger, scoop, grab sampler, or other device that can be used to remove and sample the soil and sediment from the ground. For ISM sample collection, a CRREL MIS Tool, EVC incremental sampler, or equivalent device will be used. Only stainless-steel, Teflon, or glass materials should be used
- Rubber mallet
- GPS Unit with sub-meter horizontal accuracy
- Fiberglass measuring tape (at least 100 feet long)
- Unpainted wooden stakes, stake chasers, or white marking paint
- Decontamination solutions and equipment, further discussed in Section 5.2
- 4-mil gallon-size or larger resealable polyethylene bags
- Bucket for soil cuttings
- Paper towels
- Munsell Soil Color Chart
- Camera
- Cooler with ice
- Sample shipping materials (e.g., sample labels, packaging [e.g., bubble wrap, packing tape], custody seals, large plastic bags to contain ice in the coolers, laboratory recipient information, and account numbers). Sample packaging and shipping are further discussed in SOP 13
- Stainless steel sleeves, Teflon sheets, end caps
- Glass jars
- 5-gram EnCore® samplers
- Personal protective equipment (PPE) such as hard hat, safety vest, steel-toed boots, sleeved shirt, chemical resistant (e.g., latex or nitrile) gloves, and/or other PPE as specified in the site-specific Health and Safety Plan (HSP).

Additional equipment for sieving of soil sample includes:

- US standard stainless steel sieves with epoxy set screens: No. 4 (4.75 mm), No. 10 (2.0 mm), and No. 60 (250 μm)
- Stainless receiving pan and lid
- Laboratory scale
- Paper plates or equivalent for drying soil
- Soft, fine-bristled nylon brush

Equipment specific to ISM sampling includes:

- CRREL MIS Tool, EVC incremental sampler, or equivalent device
- Measuring tape
- Masonry string to lay out Decision Unit (DU) and sampling unit (SU) grids
5.0 Procedures

The purpose of soil sampling at outdoor shooting ranges is to acquire accurate, representative information about surface and/or subsurface soil conditions. This is accomplished by logging soil information, classifying soil materials, and preparing soil samples for chemical analysis.

The collection of reliable samples of surface and subsurface material depends partially on the type of sample that can be collected and how it is prepared when using various techniques. The procedures described below were developed to collect soil for particle size fractionation and subsequent analysis performed by an analytical laboratory.

In order to ensure that cross-contamination does not occur, all equipment used for borehole drilling, soil sampling, and sample preparation shall be thoroughly decontaminated as described in the procedure on decontamination (see SOP 11, Equipment and Personnel Decontamination). At a minimum, all equipment shall be undergo the wash and rinse process. All wash and rinse water shall be collected in approved containers and labeled for proper disposal. Clean equipment (e.g., direct push rods and samplers) shall not come into contact with contaminated soils or other contaminated materials. Equipment shall be kept on plastic or protected in another suitable fashion.

5.1 Surface Soil and Hand-Auger Sampling

1. Wear the required PPE, as specified in the project HSP.

2. To locate samples, identify the correct location using the stakes, painted markings, or stake chasers (a.k.a. feathers, whiskers) on the ground surface. Proceed to collect a sample from the undisturbed soil adjacent to the marker following Steps 4 through 6 below. If markers are not present, the following procedures will be used.
   a. Use a measuring tape to position sampling point at the location described in the sample and analysis plan (SAP) by taking two measurements from fixed landmarks (e.g., parking lot, large rock outcrops, large oak trees, etc.) or by using a GPS unit.
   b. Note measurements, landmarks, and sampling point on a sketch in the field logbook, and on a site location map.
   c. Proceed to sample as described in Step 3 below.
   d. Repeat steps a through c above until all samples are collected from the area.

3. Replicate samples will be collected in accordance with SOP 10, Field Quality Control Sampling, or Section 4 of the Former Shooting Range ISM Work Plan (ISM sampling only). Replicate surface soil samples will be collected at a location adjacent to the original sample location. Replicate subsurface soil samples will be collected at either the same location if enough sample volume is present or at a location adjacent to the original location if there is not enough sample volume. Samples will be collected following Step 2 (above) and Steps 4 through 6 (below).

4. To the extent possible, differentiate between fill and natural soil. If both are
encountered at a boring location, sample as prescribed in the SAP. For bulk sampling, do not locate samples in debris (e.g., lead shot, clay target fragments, concrete, asphalt, electrical wiring, etc.), tree roots, or standing water. ISM sample locations are selected as described below in Section 5.2, and will not be moved based on the presence of debris. Any debris not related to shooting range activities falling within the ISM Investigation Area will be characterized following the DTSC-approved DQO process (CH2M HILL, 2013), and included in the Boeing Subarea 1A North RFI reporting.

5. To collect samples:

a. Use a decontaminated stainless-steel or disposable hand trowel to scrape away surficial organic material (grass, leaves, etc.) adjacent to the stake.

b. Obtain soil sample by using a hand auger to remove soil until the prescribed depth in the SAP is reached. Retrieve soil at the desired depth in the hand auger bucket and bring it to the surface. Collect approximately 1 kg of soil. Transfer the soil into a clean, large polyethylene plastic bag and seal. Samples may be sieved by the laboratory or in the field. Refer to Section 5.2.1 for ISM sample collection methodology. Refer to Section 7.0 for sieving procedures of soil prior to chemical analysis.

c. Record lithologic description and any pertinent observations, such as discoloration, debris, or observed lead shot, in the field logbook and soil boring or trench log as described in SOP 7, Borehole and Trench Logging, Soil and Rock Classification.

d. Stained soil encountered during drilling should be sampled and submitted for chemical analyses. Notify the Field Team Leader immediately when staining is encountered and if there is any question whether soil is stained or not. Bulk samples for lead analysis shall be collected for sieving as described in Step 5b; the field task manager will provide the quantity and types of sample containers required for other organic and inorganic chemical analyses if necessary. Soil staining will be noted on the boring logs, and the COC record form for benefit of the laboratory. If needed, additional photographs should be collected for documentation purposes.

e. If debris such as lead shot or clay target fragments is encountered during hand augering then it should be noted on boring logs. The Field Team Leader should be immediately notified if debris is encountered during drilling and sampling activities.

f. To the extent possible, return appearance of sampling area to its pre-sampled condition by backfilling the boring with cuttings that are not impacted.

g. Samples will be handled under COC procedures, as outlined in SOP 14, Sample Labeling and Chain-of-Custody Procedures. For laboratory prepared samples, specific instruction should be included on the COC for laboratory soil particle size fraction according to procedures identified in this SOP.

h. All samples will be documented as described in SOP 15, Field Logbooks, Documentation and Records, and Data Management. The sample depth listed on the borehole log form, field logbook, sample labels, and/or COC will either list the entire sample interval (if listing top and bottom sample depths) or just the bottom depth (if listing only one sample depth). All samples will be packaged and shipped in accordance with SOP 13, Sampling Handling, Storage, Packaging andShipping.
i. All equipment will be decontaminated as described in SOP 11, Equipment and Personnel Decontamination prior to using again. For ISM sampling, decontamination is required between sample replicates and decision units, but is not required between collections of increments of an individual ISM sample.

6. After sampling is complete, coordinates will be collected for each sample location with a GPS unit and photographs taken for project records (see SOP 2, Surveying of Sampling Locations). Additionally, ISM decision unit boundary coordinates will be recorded with a GPS unit.

5.2 Incremental Soil Sampling

Using the ISM and Shooting Range guidance described in the ITRC Guidance (ITRC 2012), the ISM design will be implemented as described below. Prior to implementing an ISM sampling grid design, an X-ray fluorescence (XRF) and visual survey will be conducted to confirm the maximum shotfall distance from the firing range. The procedures for performing an XRF survey are described in Boeing RFI SSFL SOP 23; the visual survey will be conducted as described in the Former Shooting Range ISM work plan.

5.2.1 Decision Unit Design and Sampling Grids

The ground surface of the ISM Investigation Area will be segmented into defined areas known as decision units (DUs) that serve as the basis for incremental sampling to be performed. If warranted, DUs may be further divided into smaller areas known as sampling units (SUs). Each DU will be assigned a unique number identifier.

Incremental soil sampling will be conducted at each DU within the ISM Investigation Area with sufficient area and soil to collect at least 30 sample increments. Incremental sampling will typically be performed using a systematic grid method where soil sample increments are collected at points evenly distributed throughout the DU. This method provides an unbiased representative sample across the entire DU. Each DU will be subdivided into 30 subgrids in accordance with dimensions specified in the work plan. The systematic sampling pattern will consist of selecting a random sampling location within the first subgrid, and sampling at that relative location in each subgrid, resulting in 30 sample increments. The total weight of the sample increments representing the grid will be approximately 1.0 kilogram, with each sample increment weighing approximately 0.033 kilograms.

A specialized multi-increment sampling tool will be used to collect an equal volume of soil for each incremental sample, thereby ensuring the sample increments are of equal mass, and reducing the heterogeneity of the sample. The individual sample increments will be combined together in a single plastic bag or glass container for each DU for submittal to the analytical laboratory.

If the presence of bedrock outcrops prevents the collection of at least 30 sample increments, the DU area may be revised, merged with adjacent DUs, or not sampled, depending on field conditions. For example, if only a portion (e.g., 50%) of a DU is able to be sampled due to rock outcrops and it is merged with a second DU, which is entirely accessible, then the 15 increments
from the first DU would be combined with the 30 increments collected from the second DU. This would result in an unbiased sample.

The location of the sample increment may also be adjusted to an area other than the randomly selected location, based on field conditions. In these cases, the soil location closest to the random location will be selected.

### 5.2.2 Quality Assurance / Quality Control Samples

Per ISM guidance (ITRC 2012), three field replicate samples (i.e., the initial ISM sample plus two additional samples) will be collected from DUs. Field replicate samples will be collected at 100% of the DUs sampled. Within the designated DUs, replicate samples will be collected by marking the original sample location with a flag or stake, then moving approximately one-third the size of the subgrid to the east and west of the original location for the second and third samples. This process will be repeated for the remainder of the approximately 30 incremental samples within each DU slated for field replicate sampling. This distance will ensure adequate variability between increment samples. In the case of limited soil due to bedrock, the replicate sample spacing and directions will be adjusted and deviations documented; the distance to the east and west of the original sample may be adjusted to ensure that replicate sample increments are collected from within the same subgrid.

In addition to the collection of field replicate samples, and in accordance with the DTSC-approved Santa Susana QAPP (MECx 2013), matrix spike/matrix spike duplicates (MS/MSD), representing at least 5 percent of the total number of initial ISM samples collected, will be submitted for laboratory analysis. Laboratory splits (rather than field splits) will be conducted at the laboratory after initial sample processing and homogenization has been conducted. These laboratory splits will be transferred to a third laboratory as a quality assurance measure of the laboratory analysis. An equipment rinsate will be collected once per day of sampling per analytical method.

### 5.2.3 Sample Identification

Each ISM sample collected from the ISM Investigation Area will be assigned a 12-character designator for sample identification. These sample identifiers are associated with the site location, the ISM sample collection/matrix type, a unique identifier associated with each DU, sample type, and sampling number. The sample identifiers will be used in field documentation, laboratory analysis, and reporting. Each sample identifier as AAISBBBBCDCDD, where each component of the sample identifier is described below:

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA</td>
<td>Site identification code</td>
</tr>
<tr>
<td>IS</td>
<td>Sample collection/matrix type (“IS” for ISM)</td>
</tr>
<tr>
<td>BBBB</td>
<td>DU Identifier (0000 – 9999)</td>
</tr>
<tr>
<td>C</td>
<td>Sample type (“S” for initial ISM sample, “R” for field replicate, “D” for laboratory replicate)</td>
</tr>
<tr>
<td>DDD</td>
<td>Sample number or numerical identifier associated with the number of</td>
</tr>
</tbody>
</table>
samples collected from the DU (“000” for initial ISM sample and “001” or “002” for replicates)

5.2.4 Laboratory Processing and Analysis

As noted above, ISM samples will be submitted to California-certified laboratory approved for ISM sample processing in accordance with USACE’s Incremental Sampling-based Laboratory Requirements for the Analysis of Explosives (Method 8330B) and Metals in Solid Matrices (USACE, 2008) for analysis of constituents described in the site-specific work plan.

Following protocols outlined in the DTSC-approved SOP 21 for the RFI (Boeing, 2013), “Laboratory Homogenization of Soil Samples,” and consistent with the USEPA publication of SW846 Method 8330B, the selected analytical laboratory will homogenize and sieve the sample. Note, that although grinding of samples is described in Method 8330B (the EPA Method most cited for ISM guidance), sample grinding will not be performed on samples collected from the ISM Investigation Area since the target analytes include metals (potentially subject to smearing and retention on the grinding equipment) and PAHs (potentially semi-volatile upon grinding). A laboratory analysis sample of at least 10 grams (or multiple smaller subsamples totaling 10 grams of material) will be used to prepare the digestate. (The 10 gram mass decreases the variability that results from a 1 gram mass and also decreases MRLs.) This modification of sample homogenization procedures is discussed and allowed for in the ITRC guidance document (IRTC, 2012).

After homogenization and sieving has been completed, the laboratory will collect the appropriate aliquot of soil for analysis by performing the following steps:

1. Spread the homogenized and sieved sample in a flat clean tray;
2. Divide the soil in the tray into 30 approximately equal-sized grids;
3. Scoop approximately one gram of soil aliquot from the center of each grid and placing into a properly labeled beaker. For each aliquot, scoop down to the bottom of the tray to obtain appropriate particle size representativeness.

Following these laboratory procedures, the homogenized soil sample will be representative of the entire DU. ISM samples collected will be analyzed for chemicals identified in the site-specific work plan.
6.0  Soil Boring Abandonment and Waste Disposal

6.1  Borehole Abandonment

For subsurface sampling, the borehole will be abandoned by placing non-stained, non-odorous soil cuttings back in the borehole and compacting the soil. If needed, any remaining portion of the boring will be filled with bentonite chips poured from the surface.

6.2  Decontamination and Waste Disposal

Prior to sampling at new locations, decision units, replicates, and sample depths, decontamination of equipment will be performed according to the procedures identified in SOP 11, Equipment and Personnel Decontamination. Decontamination will not be performed between collections of increments of a single ISM sample. Decontamination shall consist of a triple stage rinse with an initial scrub in Liquinox® solution followed by two distilled water rinses. Buckets used for decontamination shall be UN Rated and checked for leaks and damage on a daily basis. Brushes will be made with non-metallic bristles and remain relatively clear of debris to reduce smearing of fine grained sediment on equipment. Decontamination water will be replaced as soon as the final rinse becomes too turbid to see the bottom of the bucket. Equipment decontamination shall be performed on level ground and away from drainages to minimize the odds of buckets tipping over and spilling their contents into ephemeral streams. Clear the location to be sampled of debris and trash and note the location and the type of surface debris in the field logbook or the boring log. Store and manage the soil cuttings as described in SOP 12, Investigation-Derived Waste Management.

7.0  Documentation and Records

7.1  Surface Soil and Hand Auger Sampling

Soil classification information collected during soil sampling should be documented onto borehole logs. All logs, labels, and field forms will be filled out with indelible ink. Information concerning sampling activities will be recorded on sample log forms and on daily field reports. Procedures for these activities are contained in SOP 7, Borehole and Trench Logging, Soil and Rock Classification. Copies of this information should be sent to the Project Manager and to the project files.

7.2  ISM Sampling

Practical limitations and unforeseen field conditions may require modifying the delineation of DUs as defined during planning. For example, areas may have limited or difficult access due to steep terrain or exposed bedrock surface without soil. DTSC will be consulted following completion of planned field surveys and finalization of the ISM Investigation Area boundary and
DU design. If unforeseen circumstances arise during sampling that are not accounted for in this SOP or the site-specific work plan, DTSC will also be consulted to discuss how to address the deviation.

All information pertinent to the sampling efforts will be entered directly into a field logbook and on project-specific field forms. All data generated to document any deviations from the project plans will be recorded in detail in the field logbook. Detailed descriptions of the samples collected, modifications to DUs, and any unusual conditions encountered during the investigation will be recorded in the logbook.

**8.0 Soil Sample Sieving**

Laboratory preparation of soil samples is preferred for quality control purposes. Particle size fraction will be determined using the procedure described herein, which was developed with guidance from EPA Method 8330B, Appendix A (USEPA 2006).

The total sample weight will be recorded prior to air drying. The sample will be dried until a consistent weight is achieved.

The dried sample will be carefully sieved through a No. 4 (4.75 mm) sieve, a No. 10 (2.0 mm) sieve, and a No. 60 (250 µm) sieve. The sieve assembly will be stainless steel US Standard sieves (ASTM 1999) with screens set in epoxy (i.e., no solder). The preparer will carefully weigh and record the mass remaining on each sieve and final fraction collection vessel. The sample portion passing through the No. 4 or No. 10 sieve, but retained by the No. 60 sieve is considered the ‘coarse’ fraction. The sample passing through the No. 60 sieve is considered the ‘fine’ fraction. The mass remaining on the No. 4 sieve should be detritus but should be examined by the preparer. Any lead shot, clay target fragments, or other shooting range related materials retained on the Nos. 4 and 10 sieves will be recorded, and the approximate percent composition of the total detritus will be reported. Locations containing observable lead shot and clay target fragments will be reported to Boeing for planning of future removal actions. When combined the coarse fraction and the fine fraction represent the ‘total’ soil sample.

The preparer will photograph each particle size fraction and note the composition of each fraction to the best of their ability. Observations will include the presence or absence of suspected lead shot or bullet fragments.

Decontamination of sieves will be performed in accordance with laboratory procedures for cleaning laboratory equipment. The analytical laboratory shall collect one equipment blank for every batch of samples and test for lead, arsenic, and antimony using EPA Method 6020, and polycyclic aromatic hydrocarbons using EPA Method 8270C using selective ion monitoring.

Unless otherwise instructed on the COC, the laboratory will perform analysis on the fine fraction and on the coarse fraction of each soil sample. In some cases, only the fine fraction will be requested for analytical analysis. If only the fine fraction is to be analyzed, then the COC will specify this requirement. All particle size fractions must be retained until disposal is approved by the project manager or designee.
9.0 Health and Safety

All sampling activities should be conducted in accordance with an appropriate site-specific HSP. Site-specific safety hazards in shooting ranges include dermal contact with lead shot and ingestion of lead if proper hygiene is not maintained. Contractors are responsible for the implementation of an overall site-specific HASP (for the contractor they are working for) or their own site-specific HSP, and to ensure all field crews assisting with the field sampling in their areas are following the appropriate site-specific HSP.

10.0 References

CH2M HILL. 2013. Comprehensive Data Quality Objectives, RCRA Facility Investigation, Santa Susana Field Laboratory, Ventura County, California. March.


MECx, 2013. Quality Assurance Project Plan Santa Susana Field Laboratory (SSFL) RCRA Facility Investigation Surficial Media Operable Unit, March 2013, Revision 5


APPENDIX B

STANDARD OPERATING PROCEDURE 23 – FIELD PORTABLE XRF SCREENING FOR METALS IN SOIL
1.0 Purpose and Scope

This standard operating procedure (SOP) establishes the requirements for the field screening of in situ environmental samples using field portable x-ray fluorescence (XRF) technologies at the Santa Susana Field Laboratory (SSFL) in Ventura County, California. The procedure is applicable to all Boeing contractors conducting XRF analysis of in situ environmental samples to produce real time screening data.

A detailed work plan must be provided prior to any XRF sample analyses. Based on the work proposed, other SOPs that should be consulted include SOP 5, Soil and Sediment Sampling and SOP 7, Borehole and Trench Logging, Soil and Rock Classification.

As professional guidance for specific activities, this procedure is not intended to remove the need for professional judgment to accommodate unforeseen circumstances. Deviances from these procedures in planning or in execution of planned activities must be approved by the Project Manager and fully documented.

2.0 Definitions

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Batch</td>
<td>A group of samples (up to a maximum of 20 samples) prepared at the same time in the same location using the same method and reagents.</td>
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<tr>
<td>Calibration</td>
<td>The establishment of an analytical curve based on response of known standards.</td>
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<td>Calibration Check Standard</td>
<td>The standard used to verify the instrument is within the calibration criteria between periodic re-calibrations.</td>
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<tr>
<td>Check Standard</td>
<td>A material of known composition that is analyzed concurrently with test samples to evaluate the measurement process. One check standard should be analyzed with each analytical batch, or every 20 samples, whichever is greater.</td>
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<tr>
<td>Continuing Calibration Standards</td>
<td>An analytical standard analyzed every ten samples or every 2 hours, whichever is more frequent, to verify calibration of the analytical system.</td>
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</table>
Instrument Blank

An instrument blank is used to verify that no contamination exists in the spectrometer or on the probe window. The instrument blank can be silicon dioxide, a polytetrafluoroethylene (PTFE) block, a quartz block, "clean" sand, or lithium carbonate.

Split Confirmation Sample

Split confirmation samples are samples taken from the same source and analyzed independently at a fixed based laboratory.

3.0 Responsibilities

The Project Manager is responsible for ensuring that these standard operation procedures are utilized during field investigations, and that they are conducted by properly trained personnel under the supervision of a licensed California professional geologist (PG), certified engineering geologist (CEG), certified hydrogeologist (CHG), or professional civil engineer (PE) in accordance with the SSFL Quality Assurance Project Plan (QAPP), subcontractor Health and Safety Plans (HSP) and relevant HSP addenda.

The Field Team Leader is responsible for ensuring that project staff perform all sample analysis activities in compliance with the requirements of these procedures and for advising the Project Manager and project quality assurance (QA) representatives of any observed problems that may affect the acceptability of the data, may require acquisition of additional samples, or that indicate quality problems with sample acquisition procedures or other areas.

The Site Safety Officer prepares site and activity specific Activity Hazard Analysis and HSP Addenda to be followed by personnel present, conducts pre-job tailgate safety meetings and performs site safety observations and inspections. The Field Team Leader may also act as the Site Safety Officer.

4.0 Equipment and Materials

- Work Plan and Health and Safety Plan
- Modified Level D PPE
- Log book and field forms
- Pens, sharpies and other necessary writing tools
- Clipboards
- Maps
- Camera (digital preferred)
- Ring and clip-on dosimeters
- XRF analyzer, factory calibrated to project requirements
- XRF analyzer user manual
5.0 Procedures

XRF spectrometry can be used to determine the elemental composition of soil. This method will be used to screen for elevated concentrations of metals in in situ soil along the perimeter of areas with high concentrations of metallic debris. This SOP was developed in accordance with EPA Method 6200 for field portable x-ray spectrometry. The following sections below outline general soil testing procedures applicable for all XRF analyzers. Field crews shall refer to manufacturer specific user manuals for safe and proper operation of XRF analyzers.

5.1 Safety Information

Radiation dosimeters are required for all critical personnel. This includes the operator of the XRF and field personnel stationed within 3 feet of the analyzer. The operator shall have both a ring and clip type dosimeter, with the ring being worn on a finger of the hand opposite to the one holding the analyzer.

Soil should be analyzed in situ with the analyzer placed firmly on the soil to minimize gaps where radiation may leak. Samples should never be analyzed by holding soil in the palm of the hand. To minimize exposure to x-rays, passersby should be kept a minimum of 3 feet away from the analyzer when a sample is being shot.

5.2 Check Standards

Complete a check standard after each calibration and periodically throughout the day for a minimum period of one minute. Elemental concentrations for elements of interest (in the range expected at the site, plus or minus the standard deviation) should be within 20 percent of the standard value. Operators shall review the user manual for recommended quality assurance considerations in detail.

The standards provided with the analyzer are placed in XRF sample cups. These containers have a film window on one side through which the soil can be viewed, and a solid cap on the other side. Always ensure that samples are measured through the film window.

5.3 Sampling Procedure

Samples will be analyzed in situ with the analyzer placed flush against the ground surface for soil testing. XRF analyses shall be performed in “Soil Mode” (review user manual for soil testing
modes) with default testing times between 30 and 120 seconds.

Prepare the sample by removing any plant growth or other foreign object to ensure that the analyzer probe is flush with the soil; no other preparation is necessary.

After the sampling location has been verified, note the soil moisture. If soil feels damp (>20% moisture), relocate the sample to a location where soil is mostly dry to the touch.

Place a plastic sheet or plastic sandwich bag over the area to be analyzed. The plastic sheet is used to protect the x-ray window from being scratched when placed on the ground.

If the analyzer passed energy calibration checks and check standard readings are within acceptable limits as described in Section 5.5, place the analyzer directly on the plastic sheet and begin XRF analysis of soil. Refer to the device specific user manual for other XRF analyzers.

After the XRF analysis is complete, record easting and northing coordinates using a sub-meter accuracy GPS unit, complete photo documentation, and fill out all applicable field forms prior to moving on to the next sample location. Plastic sheets used to protect the x-ray window should be discarded as PPE.

5.4 Quality Assurance / Quality Control

Detailed quality assurance requirements for proper operation of the analyzer and proper verification of data quality for in situ testing are provided. All operators should perform the quality control (QC) procedure, regardless of their data quality objectives.

5.5 Verification of Instrument Operation

Quality assurance in this context consists of testing known standards to verify calibration, in addition to testing blank standards to determine limits of detection, and check for sample cross-contamination or instrument contamination. Verification procedures may include:

- An energy calibration check sample at least twice daily
- An instrument blank for every batch of soil samples (20 samples)
- A calibration verification check sample for every 20 samples
- A precision sample at least once per day
- A confirmatory sample for every 20 environmental samples

5.5.1 Energy calibration check

Depending on the manufacturer, the XRF analyzer may perform energy calibration checks automatically; this is often the purpose of the standardization check when the analyzer is started. Operators shall refer to the user manual to confirm if energy calibration checks are required prior to analyzing a sample. The analyzer’s software typically does not allow the analyzer to be used if the standardization is not completed.
5.5.2 Instrument blank

The operator should use the SiO2 (silicon dioxide) blank provided with the analyzer. The purpose of this test is to verify that there is no contamination on the analyzer window or any other component penetrated by the X-rays. Instrument blanks shall be analyzed at least once per day, preferably every 20 samples. For in situ testing, the operator should test the SiO2 blank to ensure that there are no reported contaminant metals.

5.5.3 Method blank

Since samples will be analyzed in situ, samples will not be prepared and this QC step is not required.

5.5.4 Cal Check

Standard reference samples shall be used for Cal Checks performed by the operator. The operator should perform a two-minute test on a standard. The difference between the XRF result for a given element and the value of the standard should be 20% or less. A Cal Check should be performed at instrument start-up, and periodically during testing.

5.5.5 Precision verification

A minimum of one precision sample shall be run per day by conducting 7 to 10 replicate measurements of the sample. The precision is assessed by calculating a relative standard deviation (RSD) of the replicate measurements for the analyte. The RSD values should be less than 20 % for most analytes, with the exception of chromium, for which the value should be less than 30 %.

5.5.6 Confirmation Split Sample

One confirmation split sample shall be collected for every 20 samples analyzed. Confirmation split samples shall be collected from the same sample material being analyzed in situ, and sent to an off-site laboratory for analysis in accordance with EPA Method 6020. The purpose of a confirmation split sample is to judge the accuracy of the data obtained through on-site analysis, and to allow for any necessary corrections.

5.6 HANDHELD XRF CALIBRATION

XRF analyzers are calibrated from the factory to project specific requirements provided by the user. Calibration checks using manufacturer supplied check standards are recommended every 4 hours or as requested by the handheld unit.

5.7 TRAINING

All personnel training relative to the use of this procedure shall be conducted at the direction of the Project Manager. At a minimum, field personnel selected for these assignments shall have 40-hour Hazardous Waste and Emergency Operations (HAZWOPER) training and operators shall be properly trained for the XRF device selected.
6.0 DOCUMENTATION AND RECORDS

A field book or field daily reports detailing all activities conducted during XRF analyses shall be kept. Logs should be filled out with indelible ink and copies should be sent to the Project Manager and archived in project folders.

7.0 HEALTH AND SAFETY

All sampling activities should be conducted in accordance with the appropriate site-specific HSP and relevant HSP addenda. Each contractor is responsible for the implementation of an overall site-specific HASP (for the contractor they are working for) or their own site-specific HSP, and to ensure all field crews assisting with the field sampling in their areas are following the appropriate site-specific HSP.

8.0 KEY CHECK ITEMS

- XRF operators and field team members working within 3 feet of the analyzer should wear radiological dosimeters.
- Ensure that all field personnel are properly trained to operate the XRF analyzer and understand the potential hazards of improper operation.
- Perform calibration checks regularly for quality assurance.
- Ground surface should be cleared free of leaves and branches and other foreign debris prior to analyses.
- Avoid matrix interference by analyzing soil with less than 20% soil moisture.

9.0 REFERENCES

APPENDIX C
FORMER SHOOTING RANGE ISM
INVESTIGATION HEALTH AND SAFETY PLAN
ADDENDUM
This site-specific Health and Safety Plan has been developed in accordance with OSHA 29 CFR 1910.120 and Cal-OSHA Title 8 CCR Section 5192, and has been streamlined to avoid duplication of existing documents.
HEALTH AND SAFETY ADDENDUM NUMBER 36

This Health and Safety Plan (HSP) Addendum Number 36, prepared September 2014, amends the existing HSP titled “Health and Safety Plan, Resource Conservation and Recovery Act (RCRA) Corrective Action Program Activities, Santa Susana Field Laboratory (SSFL), Ventura County, California” (Health and Safety Plan, Revision 4, April 2010). This addendum addresses a new scope of work for the use of a hand held portable x-ray fluorescence (XRF) instrument to be used in survey mode at the former Rocketdyne-Atomics International Rifle and Pistol Club, Inc. shooting range area (Former Shooting Range), located on the Mountains Recreation Conversancy Authority (MRCA) Sage Ranch property, north and adjacent to the Santa Susana Field Laboratory (SSFL), Ventura County, California. This addendum describes specific health and safety measures to be taken during the use of the XRF instrument.

Site Description

The Former Shooting Range firing platform currently consists of a flat dirt area, formerly a paved asphalt parking lot (aka the Lower Parking Lot). The Former Shooting Range Overshot Area (Overshot Area) is a partially vegetated area bounded by bedrock outcrops to the north and west. No buildings or other structures currently exist at the site. The Northern Drainage flows from east to west and roughly bisects the Former Shooting Range area. An unpaved hiking trail (Sage Ranch trail) generally parallels the drainage on the north side. North of the Sage Ranch trail, the Overshot Area is characterized by relatively steep outcrops of the Chatsworth Formation.

Historical shooting range activities have deposited fragments of clay target debris and visible lead shot. Numerous voluntary manual clean up and maintenance activities have occurred since 1993 by Boeing (formerly Rockwell International) along with agreements from Mountains Recreation Conversancy Authority (MRCA) and the California Conservation Corps (CCC).

SCOPE OF WORK

A portable multi-element XRF analyzer will be used in field survey mode to approximate the extent of lead, arsenic, and other metallic elements and identify locations for further
characterization. This investigation is being performed in a phased approach. The XRF survey will be performed first and then, an Incremental Sampling Methodology (ISM) approach will determine where the soil sampling will be conducted. One confirmation sample will be collected for laboratory analysis (EPA Method 6020) during the XRF survey. The XRF will be used in ground survey mode only.

A team of two (2) personnel will hike the Overshot Area and conduct visual observations in addition to XRF soil surveys. All field work will be completed in accordance with Boeing Standard Operation Procedures (SOP) – 23, Field Portable XRF Screening for Metals in Soil (Boeing, 2014).

HAZARD ANALYSIS

The sections below provide an evaluation of the chemical, radiological, biological, and physical hazards anticipated during this project’s fieldwork. These hazards are summarized in the Activity Hazard Analysis (AHA) in Attachment 1. Risks of chemical exposure due to handling and contact of impacted soil is expected to be minimal since the scope of work primarily consists of visual surveying and in situ soil analysis. Intrusive contact with subsurface soil is not anticipated. Risks to radiological exposure (x-rays) can be minimized with proper operation of the portable XRF analyzer. All field personnel shall review the AHA in Attachment 1 prior to fieldwork.

Chemical

Constituents of potential concern at the Overshot Area include lead, arsenic, and antimony, the main components of lead shot. Heavy metals can be absorbed through skin with dermal contact, ingested with poor hygiene practice, and inhaled if soil with elevated concentrations of heavy metals is disturbed. PAHs from clay target deposits are not expected in the Overshot Area where XRF surveys are proposed.

Radiological

The most important component of a field portable XRF analyzer are the x-ray tubes. X-ray tubes can emit potentially dangerous levels of ionizing radiation if not used properly. It is up to the operator to refer to the manufacturer user manuals for safe and proper operation of the XRF analyzer. Radiation dosimeters will be required for all critical personnel. This includes
the operator of the XRF and field personnel stationed within 3 feet of the analyzer. The operator shall have both a ring and clip type dosimeter, with the ring being worn on a finger of the hand opposite to the one holding the analyzer.

Soil will be analyzed in situ with the analyzer placed firmly on a sheet of plastic placed directly on the soil to minimize gaps where radiation may leak. The plastic is only used to prevent cross contamination and protect the x-ray window when shooting multiple samples with a single XRF analyzer. Plastic does not provide protection from x-rays. Samples should never be analyzed by holding soil in the palm of the hand. To minimize exposure to x-rays, passersby should be kept a minimum of 3 feet away from the analyzer when a sample is being shot.

**Biological**

Biological hazards associated with the fieldwork will be discussed during the daily tailgate meetings so that all team members will be informed of location specific hazards. Poison oak is the primary biological hazard that will be encountered. Vegetation within the working area will be trimmed or removed prior to initiation of the investigation tasks described in this plan. Field personnel at SSFL are accustomed to donning disposable coveralls and barrier creams (e.g., Ivy Block) to help prevent direct contact with poison oak. Tecnu and Zanfel soaps can be used to clean items that had direct contact with the plant. Other hazards include, direct lacerations from sharp sticks, grasses, or hidden objects encountered during the clearing and grubbing activities. Rattle snakes, scorpions, black widows or brown recluse spiders may also be encountered during this field work. All MWH field personnel shall wear snake gaiters while performing field work. Level D clothing should be sufficient to protect against incidental contact, but heavy gloves and boots with strong tread may be needed when walking in the vegetated area.

**Physical**

*Heat Related Illness.* Summers are hot in Southern California, and although winters are typically mild, the SSFL area can experience hot, dry weather year-round. If temperatures peak above 80 or 85 degrees Fahrenheit, personnel should review the signs of heat stress presented in MWH Americas, Inc., Heat Stress Illness Prevention Plan found in the SSFL Site-Wide HSP, Revision 4, April 2010. If temperatures become elevated above 85 to 90 degrees Fahrenheit, a shaded area for breaks and regular hydration breaks should be scheduled by the project safety officer.
Uneven and muddy terrain. The terrain may include ruts from the removal of plants and if there is a rain prior to fieldwork, the mud can create a slip/trip/fall hazard as well as suction on the boot that can lead to a twisted or broken ankle. Wear shoes with strong tread and be mindful of the suction when stepping in mud. Ensure that site personnel and equipment maintain a minimum of a 5-foot clearance from the edge of slopes at the Site. This is greater than the Cal-OSHA specified 2-foot clearance for drilling and trenching work. This will help to control the risk of soil subsidence and the field staff will continuously evaluate the soil stability and increase the distance from the edge as necessary. Field work will not be conducted during rainy conditions.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

All of the work conducted at the Overshot Area is anticipated to be completed in Modified Level D PPE. Conditions that may require upgrade to Level C PPE will require work to stop until the situation is evaluated and a HSP addendum prepared for work to continue safely.

Modified Level D PPE

Personnel will wear impervious gloves (e.g., nitrile) and Modified Level D PPE during all surveys using the portable XRF analyzer.

The following items must be available for use during all field programs. Individual items may not be necessary if the hazard is not present (e.g., no overhead machinery or hazards means no hard hat required, unless posted signs state the area as hard hat required, or moving heavy equipment is present).
<table>
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<tr>
<th>Item</th>
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<tr>
<td><strong>Boots</strong></td>
<td>Full leather safety-toed work boots or safety-toed rubber or polyvinyl chloride (PVC) boots meeting ASTM F2412-11 and F2413-05.</td>
</tr>
<tr>
<td><strong>Clothing</strong></td>
<td>Dedicated work clothing includes long pants, long sleeve shirts, or coveralls. Can be cotton, poly-cotton blend or Tyvek.</td>
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<tr>
<td><strong>Snake Gaiters</strong></td>
<td>Snake bite-proof gaiters shall be worn by all MWH field personnel while performing field work in areas with limited visibility. Areas with limited visibility at SSFL include all unpaved surfaces or paved areas with overgrown brush that may conceal rattlesnakes.</td>
</tr>
<tr>
<td><strong>Gloves</strong></td>
<td>Thin nitrile gloves (e.g., N-Dex) when handling potentially contaminated soil, water, debris, equipment or articles. Heavy work gloves are to be available for handling sharp objects or when using a sharp cutting tool.</td>
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<tr>
<td><strong>Safety glasses</strong></td>
<td>Side shields (plain or sun glass tint depending on brightness).</td>
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<tr>
<td><strong>Hard hat</strong></td>
<td>When overhead hazard or working around heavy equipment.</td>
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<tr>
<td><strong>Sun hat</strong></td>
<td>When overhead hazards are absent, a full brimmed hat is recommended for sun protection.</td>
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<tr>
<td><strong>Safety vest</strong></td>
<td>Brightly colored traffic-type safety vest when working in roadways or around moving heavy equipment.</td>
</tr>
<tr>
<td><strong>Hearing protection</strong></td>
<td>When working in areas where noise levels exceed 85 decibels on the “A” weighted scale (dBA). If unsure, have the task or area tested. A rule of thumb is having to shout to be heard at a distance of 3 feet.</td>
</tr>
<tr>
<td><strong>Dosimeter</strong></td>
<td>The XRF analyzer operator shall have both a ring and clip type dosimeter, with the ring being worn on a finger of the hand opposite to the one holding the analyzer. All other critical personnel shall wear badge type dosimeters.</td>
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</table>
DECONTAMINATION

This investigation is not expected to encounter excessive contamination or result in contamination exposure to personnel, equipment, or clothing. However, the following decontamination protocols shall be followed:

**Personnel**

- Wash hands with soapy water or a moist towelette when leaving the work zone.
- Discard disposable gloves, and coveralls in a trash container acceptable to Boeing. These items will be discarded in a properly labeled and secured receptacle by the Boeing waste management contractor.
- Use a brush, if necessary, to ensure that potentially contaminated soil does not leave the site stuck to the bottom of worker’s shoes.

**Equipment**

- When used properly, soil should not come in contact with the XRF analyzer and decontamination is not necessary. Plastic sheets used to protect the x-ray window shall be treated as contaminated wasted and disposed of as directed by Boeing’s waste management coordinator.
- Ensure that any monitoring equipment, clipboards and the like are wiped clean at the end of each day’s use. Either use a paper towel with soap and water or a moist towelette.

**PROJECT PERSONNEL**

Boeing Project Manager: Michael Bower: (818) 466-8776
Boeing Contractor Coordinator: Mark Spenard (818) 466-8713
Boeing Project Safety Officer: Robert Mako (818) 466-8735
Boeing Waste Management Coordinator: Kevin Ruddick (818) 466-8089
MWH Field Manager and Project Safety Officer (PSO): Van Vathanasin (626) 568-6050
Back-up MWH PSO: Shelby Valenzuela (626) 568-6365
MWH Project Manager: Benjamin Stewart (818) 266-0305
MWH SSFL On-site Safety Officer OSO: Eric Vander Velde (626) 568-6035
To ensure that all site personnel are apprised of changes and daily work tasks, daily tailgate safety meetings will be conducted. The PSO will direct the meeting and all site workers are expected to attend.

REFERENCES


Boeing, Standard Operating Procedures for Areas I and III of the Santa Susana Field Laboratory (1-21), Ventura County, California, 2013.

Boeing, Standard Operating Procedures – 23 Field Portable XRF Screening for Metals in Soil, Santa Susana Field Laboratory, Ventura County, California, 2014
## ADDENDUM

### HEALTH AND SAFETY PLAN ACCEPTANCE

I have had the opportunity to read and ask questions about this HSP Addendum. My signature certifies that I understand the procedures, equipment, and restrictions of this plan and agree to abide by them.

<table>
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<tr>
<th>Signature*</th>
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</table>
* This acceptance form is required for all routine site staff and subcontracting personnel.
ATTACHMENT 1
ACTIVITY HAZARD ANALYSIS
### Activity Hazard Analysis Form

**Field Portable XRF Screening for Metals in Soil**

**ACTIVITY:** Use of portable XRF analyzer  
**CERTIFIED BY:** Mark Harris  
**REVIEWED BY:** Van Vathanasin  
**DATE:** September 30, 2014

<table>
<thead>
<tr>
<th>PRINCIPAL STEPS</th>
<th>POTENTIAL HAZARDS</th>
<th>RECOMMENDED CONTROLS</th>
</tr>
</thead>
</table>
| Identify the principal steps and sequence. List equipment below. | Analyze each principal step for its potential chemical/toxicological, radiological, biological and physical hazards. | Develop specific controls for each potential hazard. Also:  
• List inspection requirements for the equipment / machinery listed  
• Specify worker training requirements |
| 1. Access XRF surveying locations on foot.  
2. Conduct XRF survey. | Chemical/Toxicological Hazards:  
• Lead, arsenic, and antimony from lead shot residue, and PAHs from clay target debris  
Radiological Hazards:  
• The most important component of a field portable XRF analyzer is the x-ray tubes.  
• X-ray tubes emit potentially dangerous levels of ionizing radiation if not used properly. | Chemical/Toxicological Hazards:  
• Monitoring Requirements – none recommended  
• Administrative Controls – make sure personnel are aware of the challenges;  
• Engineering and Work Practice Controls – use appropriate Personal Protective Equipment (PPE):  
• PPE: Modified Level D with chemical resistant gloves and safety glasses or goggles; avoid touching soil with bare hands.  
• Review MSDSs for the chemicals that are listed and provided in the Boeing Impact Checklist.  
• Decontamination: Personnel and equipment decontamination when leaving the exclusion zone (See HSP Addendum 36).  
Radiological Hazards:  
• The operator should refer to the manufacturer user manuals for safe and proposer operation of the XRF analyzer.  
• Radiation dosimeters will be required for all critical personnel. This includes the operator of the XRF and field personnel stationed within 3 feet of the analyzer.  
• The operator shall have both a ring and clip type dosimeter, with the ring being worn on a finger of the hand opposite to the one holding the analyzer. Soil will be analyzed in situ with the analyzer placed firmly on the soil to minimize gaps where radiation may leak.  
• Samples should never be analyzed by holding soil in the palm of the hand.  
• To minimize exposure to x-rays, passersby should be kept a minimum of 3 feet away from the analyzer when a sample is being shot. |
<table>
<thead>
<tr>
<th>PRINCIPAL STEPS</th>
<th>POTENTIAL HAZARDS</th>
<th>RECOMMENDED CONTROLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Hazards:</td>
<td>• Poison Oak</td>
<td>• PPE: Long pants, light colored clothing, full leather ankle high steel-toed boots, snakeproof gaiters, chemical resistant gloves and Tyvek (optional).</td>
</tr>
<tr>
<td></td>
<td>• Poisonous snakes</td>
<td>• First Aid Kit: Insect repellent with the active ingredient N,N-Diethyl-meta-toluamide (DEET) at no more than 30%; bug bite supplies.</td>
</tr>
<tr>
<td></td>
<td>• Spiders</td>
<td>• Conduct self-inspection for ticks or insect bites or poison oak.</td>
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<tr>
<td></td>
<td>• Bees</td>
<td>• Conduct posterior tick check for your work buddy.</td>
</tr>
<tr>
<td></td>
<td>• Mosquitoes</td>
<td>• Learn how to identify poison oak.</td>
</tr>
<tr>
<td></td>
<td>• Ticks</td>
<td>• Avoid hiking on deer trails which typically have larger tick populations.</td>
</tr>
<tr>
<td>Physical Hazards:</td>
<td>• Slip/Trip/Fall</td>
<td>• Communicate new biological hazards or recent biological hazard sightings during daily tailgate.</td>
</tr>
<tr>
<td></td>
<td>• Heat stress, sunburn</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Injury due to improper heavy lifting</td>
<td></td>
</tr>
<tr>
<td>Physical Hazards:</td>
<td>• Due to unimproved backcountry conditions, project personnel should be physically capable of hiking off-trail while carrying loads of up to 20 pounds for the duration of an 8 hour shift.</td>
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</tr>
<tr>
<td></td>
<td>• Observe terrain for holes and trip hazards. Wear boots with significant tread. Ensure boots are appropriate for hiking and walking involved in tasks. Workers are prohibited from climbing rock outcrops where handholds and fall protection are a necessity.</td>
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<tr>
<td></td>
<td>• On hot days (e.g., over 80 °F) wear light colored clothing. It is recommended that sunscreen be used if working in direct sunlight. Refer to the HSP for Heat Illness Prevention and work/rest schedules and methods of monitoring for heat stress.</td>
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<tr>
<td></td>
<td>• Hydrate often and pay attention of symptoms of heat stress.</td>
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<tr>
<td></td>
<td>• Practice safe lifting and ergonomics, refer to the SSFL Site-wide HASP Sections 2.14.2 and 2.14.10 for specific reminders.</td>
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<tr>
<td></td>
<td>• Wear knee pads when kneeling.</td>
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<td></td>
<td>• Avoid pack mule mentality. Share the load and make multiple trips to decrease the stress of carrying one heavy load. Use backpacks to carry miscellaneous sampling equipment.</td>
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<tr>
<td></td>
<td>• Housekeeping – keep areas free of debris to prevent accidents</td>
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<tr>
<td></td>
<td>• Wear safety glasses or goggles when sampling and bushwhacking.</td>
<td></td>
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<tr>
<td></td>
<td>• As a standard rule of practice ensure that items being hauled in vehicles are secured in sturdy containers and held from sliding with bungee cords, ties, or compartments.</td>
<td></td>
</tr>
<tr>
<td>Principal Steps</td>
<td>Potential Hazards</td>
<td>Recommended Controls</td>
</tr>
<tr>
<td>----------------</td>
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<td>----------------------</td>
</tr>
</tbody>
</table>
| 3. Visual survey for lead shot | Chemical/Toxicological Hazards: Lead, arsenic, and antimony from lead shot residue, and PAHs from clay target debris | Chemical/Toxicological Hazards:  
- Monitoring Requirements – none recommended  
- Administrative Controls – make sure personnel are aware of the challenges; personnel decontamination when leaving the exclusion zone.  
- Engineering and Work Practice Controls – use appropriate PPE  
- Personal Protective Equipment (PPE): chemical resistant gloves and safety glasses or goggles; avoid touching soil with bare hands  
- Review MSDSs for the chemicals that are listed and provided in the Boeing Impact Checklist.  
- Decontamination: Personnel and equipment decontamination when leaving the exclusion zone (See HSP Addendum 36). |
| Biological Hazards:  
- Poison Oak  
- Poisonous snakes  
- Spiders  
- Bees  
- Mosquitoes  
- Ticks | Radiological Hazards: None |
| Physical Hazards: None | Protection from Biological Hazards:  
- Check surroundings for biological hazards prior to performing visual survey for lead  
- PPE: Long pants, light colored clothing, full leather ankle high steel-toed boots, snakeproof gaiters, chemical resistant gloves and Tyvek (optional).  
- First Aid Kit: Insect repellent with the active ingredient DEET at no more than 30%; bug bite supplies.  
- Conduct self-inspection for ticks or insect bites or Poison oak. |
| 4. Analyze soil with portable XRF analyzer | Chemical/Toxicological Hazards: Lead, arsenic, and antimony from lead shot residue, and PAHs from clay target debris | Chemical/Toxicological Hazards:  
- Monitoring Requirements – none recommended  
- Administrative Controls – none.  
- Engineering and Work Practice Controls – use appropriate PPE  
- Personal Protective Equipment (PPE): chemical resistant gloves and safety glasses or goggles; avoid touching soil with bare hands  
- Review MSDSs for the chemicals that are listed and provided in the Boeing Impact Checklist.  
- Decontamination: Personnel and equipment decontamination when leaving the exclusion zone (See HSP Addendum 36). |
<table>
<thead>
<tr>
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</tr>
</thead>
</table>
| Radiological Hazards: X-ray tubes emit potentially dangerous ionizing radiation when energized | Radiological Hazards:  
- Monitoring Requirements – none recommended  
- Administrative Controls – implement dosimetry program for field personnel; XRF operator must have appropriate training; non-critical personnel must be 3 feet away from the XRF analyzer when samples are analyzed.  
- Engineering and Work Practice Controls – review user manual and be familiar with radiation safeguards built into the XRF analyzer.  
- PPE: chemical resistant gloves and safety glasses or goggles to avoid contact with soil.  
- Review MSDSs for the chemicals that are listed and provided in the Boeing Impact Checklist. Perimeter Controls: XRF analyzer will only be used when unmonitored personnel are a minimum of 3 feet away. |  |
| Biological Hazards:  
- Poison Oak  
- Poisonous snakes  
- Spiders  
- Bees  
- Mosquitoes  
- Ticks | Protection from Biological Hazards:  
- Check surroundings for biological hazards prior to performing XRF analysis.  
- PPE: Long pants, light colored clothing, full leather ankle high steel-toed boots, snakeproof gaiters, chemical resistant gloves and Tyvek (optional).  
- First Aid Kit: Insect repellent with the active ingredient DEET at no more than 30%; bug bite supplies.  
- Conduct self-inspection for ticks or insect bites or Poison oak. |  |
<p>| Physical Hazards: None | Physical Hazards: None |  |</p>
<table>
<thead>
<tr>
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<th>RECOMMENDED CONTROLS</th>
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<tbody>
<tr>
<td>Equipment List:</td>
<td>Training: • Instrument specific training to operating XRF analyzer.</td>
<td>Inspections: • The XRF operator shall always wear both a ring dosimeter and badge dosimeter when operating the analyzer. • Never point the XRF analyzer at yourself or any other person during operation. • All samples are to be analyzed in situ; never use your fingers or the palm of your hand to hold a sample during analysis. • With the analyzer powered off, inspect the x-ray window regularly and note any chips, cracks, and/or scratches that may compromise the integrity of the window. Replace window as needed. • Check the condition of the probe and note any cracks that may lead to x-ray leaks. Do not use if there is damage to any of the components. • Pay attention to all warning messages on the liquid crystal display (LCD) display. Contact the manufacturer immediately for repairs if necessary. • Continuous observation of site to identify safety hazards</td>
</tr>
</tbody>
</table>

1. XRF analyzer
**Rattlesnakes**

Never approach, handle or remove a rattlesnake. Contact SSFL Security (818-466-8911) if immediate assistance is required.

As the outside temperatures begin to warm this time of year, rattlesnakes are beginning to come out of their hibernation. Good seasons of rain have led to an increase in the rattlesnake population. Rain has produced lots of vegetation that provides food for rodents and therefore food for snakes. High shrubs and grass have provided the rattlesnake plenty of space to reside. At SSFL, as in the past, we need to take special precautions to avoid being bitten by these venomous snakes. All personnel at SSFL, including those who visit on occasion, must be aware of the following basic precautions to avoid serious injury:

1. Do not go into potentially snake-infested areas without protective gear and a reliable means of communication.

2. Most rattlesnakes seek cover in crevices of rocks, under surface objects, beneath dense vegetation, and in rodent burrows. When approaching such areas, poke around with a long stick before proceeding.

3. Snakes are best avoided by never putting your hands or feet where you can't see. If you should sustain a snake bite, keep as quiet as possible and get emergency medical aid immediately. Do not apply ice, do not slash or cut, do not apply suction, and do not apply a tourniquet. Please call Security.

4. Do not handle or transport a freshly killed snake by hand, as they may bite by reflex action.

5. If you hear a rattlesnake, STAY CALM! Stop walking and determine the snake's location, slowly move away from the snake and give it room to slither away. Never make sudden moves. A fast motion can easily be misinterpreted by the snake as a threat.

6. Rattlesnakes can strike up to half their length, so keep at least five feet away.

Rattlesnakes add to the diversity of our wildlife and are important members of our ecosystem; and should be left alone whenever possible. Security should only be contacted if the rattlesnake poses a hazard to immediate personnel or a worksite.

If you should have any questions or comments concerning this Safety Bulletin or others, please contact the Health & Safety office at extension 68817 or 68735.

HEALTH & SAFETY

May 5, 2006

BULLETIN #06-06

SAFETY AWARENESS IS FOR EVERYONE
Mountain Lion Behavior

A Person Is 1,000 Times More Likely To Be Struck By Lightning Than Attacked By A Mountain Lion

That said, mountain lions are wild animals and, like any wildlife, can be dangerous. Mountain lions are very powerful and normally prey upon large animals, such as deer, bighorn sheep and elk. However, they can survive preying on small animals as well. They prefer to ambush their prey, often from behind. They usually kill with a powerful bite below the base of the skull, breaking the neck. They often cover the carcass with dirt, leaves or snow and may come back to feed on it over the course of a few days.

What causes a mountain lion to display unusually bold behavior toward humans?

Sometimes disease will cause an animal to behave strangely. Some mountain lions killed for public safety reasons have tested positive for feline leukemia. A mountain lion that attacked a man in Mendocino County in 1994 tested positive for rabies.

Additionally, hunger may play a role in the lion's willingness to venture beyond its normal prey. A mountain lion that had attacked a hiker in Santa Monica's was found to weigh only 58 pounds, severely underweight for a 2-year-old which should normally weigh about 80 to 100 pounds. However, there is usually no apparent explanation for why a mountain lion seems to abandon its instinctive wariness of humans. Mountain lions are typically solitary and elusive. Studies of collared mountain lions show that they often co-exist around people, unseen and unheard.

What should you do if you encounter a mountain lion?

- Do not approach a mountain lion: Most mountain lions will try to avoid a confrontation.
- Give them a way to escape.
- Do not run from a mountain lion: Running may stimulate a mountain lion's instinct to chase.
- Stand and face the animal. Make eye contact.
- Do not crouch or bend over: A person squatting or bending over looks a lot like a four-legged prey animal.
- Appear larger: Raise and waive your arms. Open your jacket, if you are wearing one.
- Throw stones, branches, or whatever you can reach without crouching or turning your back.
- The attack may happen within seconds. If you have any chances of averting it, it is by acting aggressively toward the lion.
- Fight back if attacked: Many potential victims have fought back successfully with rocks, sticks, caps, jackets, garden tools and their bare hands.
- Since a mountain lion usually tries to bite the head or neck, try to remain standing and face the animal.

About half of California is prime mountain lion country. Their generally secretive and solitary nature is what makes it possible for humans to live in mountain lion country without ever seeing a mountain lion. These large, powerful predators have always lived here, preying on deer and other wildlife, and playing an important role in the ecosystem.
ATTACHMENT 3
HEAT STRESS
MWH AMERICAS, INC.

HEAT STRESS ILLNESS PREVENTION PLAN

March 2009

Prepared by:

MWH AMERICAS, INC.
ARCADIA, CA
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## APPENDICES

APPENDIX A – PERSONAL HEAT STRESS ASSESSMENT FORM
APPENDIX B – HEAT INDEX CHART AND TABLE
I. INTRODUCTION

California Employers with any outdoor places of employment must comply with the Heat Illness Prevention Standard T8 CCR 3395. Outdoor work environments involving high air temperatures, radiant heat sources, high humidity, direct physical contact with hot objects, or strenuous physical activities in high heat have a possibility for inducing heat stress in employees engaged in such operations.

The purpose of this heat stress illness prevention plan is to provide strategies for:

- Recognizing the symptoms of heat related illnesses (HRI)
- Assessing the risk of HRI
- An acclimation program for new employees or employees returning to work from three day or greater absence
- Specific procedures to be followed for heat related emergencies; and
- First aid for HRI

MWH is committed to preventing HRI. HRI can occur to employees working in indoor or outdoor environments. MWH recognizes that exposure to extreme temperatures, humidity, and other environmental factors can lead or contribute to serious illnesses including heat fatigue, heat rash, fainting, heat cramps, heat exhaustion, and heat stroke. This Heat Stress Illness Prevention Plan (HSIPP) has been developed to protect employees from the hazards posed by working in an outdoor environment.

II. HEAT RELATED ILLNESSES (HRI)

There are two sources of heat exposure, the outside environment and internal muscle activity (80% of muscle energy is turned into body heat). High temperatures and high levels of physical work create heat stress. The body defends itself by sweating and evaporating. Caution should be noted, because the higher the humidity levels the more difficult it is for sweat to evaporate from the skin.
The human body will get used to working in a hot environment gradually over time. This process of the body becoming more efficient at cooling itself down is known as “acclimatization”. Acclimation and cooling occurs through one of the following methods:

- The body redirects blood to the skin’s surface
- The heart tries to pump blood more efficiently
- Sweating starts sooner, and there is more of it; and
- Sweat contains less salt

During this adjustment period, symptoms of fatigue, dizziness, heat rash, and stomach discomfort are common. Acclimatized workers will generally be able to work longer in a hot environment than un-acclimatized workers. It should be noted, however, that dehydration can cancel the benefits of acclimatization.

The heating and cooling balance in the body depends on the following factors:

- Air temperature
- Humidity (moisture in the air)
- Radiant heat load (sun, furnaces, molten material, steam, etc.)
- Physical activity (how hard you’re working)
- Cooling (by the evaporation of sweat)
- Body adjustments (acclimatization)

Several casual factors that can lead to HRI that can affect a person’s sensitivity to heat include the following: age, weight, degree of physical fitness, degree of acclimatization, metabolism, use of alcohol or drugs, and a variety of medical conditions such as hypertension. However, even the type of clothing worn must be considered a contributing factor to body heat loading. Prior heat injury also predisposes an individual to additional injury.

It is difficult to predict just who will be affected and when, because individual susceptibility varies. In addition, as previously mentioned, environmental factors include more than the ambient air temperature. Radiant heat, air movement, conduction, and relative humidity all affect an individual's response to heat.

**Causes, Symptoms, and Treatment of HRI**

Heat stress symptoms are a set of natural body signals indicating that something needs to be done to balance the body’s heating and cooling. As the body heats up, it tries to rid itself of excess heat through the evaporation of sweat. If it is unable to cool itself this way, your body temperature will increase. When body temperature gets above 100.4 to 102.2°F, the brain starts to overheat, leading to a shutdown of the body’s cooling system (sweating stops). The internal temperature continues to rise even faster, leading to heat stroke and possibly death. The causes, symptoms, and treatment of various heat-related illnesses are listed below:
<table>
<thead>
<tr>
<th>Heat-Related Illness (HRI)</th>
<th>Signs and Symptoms</th>
<th>First Aid and Emergency Response Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunburn</td>
<td>Red, hot skin; May blister</td>
<td>Move to shade, loosen clothes to reduce temperature; Apply cool compress or water to cool burn; Get medical evaluation if severe</td>
</tr>
<tr>
<td>Heat Rash</td>
<td>Red, itchy skin; Bumpy skin; Skin infection</td>
<td>Apply cool water or compress to cool rash; Keep affected area dry to minimize infection; Control itching and infection with prescribed medication</td>
</tr>
<tr>
<td>Heat Cramps</td>
<td>Muscle cramps or spasms; Grasping the affected area; Abnormal body posture</td>
<td>Drink water or sports drinks to re-hydrate body; Rest, cool down in shaded area; Massage affected muscle to release body toxins; and Get medical evaluation if cramps persist</td>
</tr>
<tr>
<td>Heat Exhaustion</td>
<td>High pulse rate Extreme sweating Pale face Insecure gait Headache Clammy and moist skin Weakness Fatigue Dizziness</td>
<td>Move to shade and loosen clothing to cool down; Initiate rapid cooling with fan, water mister, or ice packs; Lay flat and elevate feet to reduce heart rate and blood pressure; Monitor recovery (is body cooling?); Drink small amounts of water to cool body and re-hydrate Evaluate mental status (ask Who? Where? When? Q’s) If no improvement call 911</td>
</tr>
<tr>
<td>Heat Stroke</td>
<td>The above but more severe; Hot, dry skin (25-50% of cases); Altered mental status with confusion and agitation; Can progress to loss of consciousness and seizures; Can be fatal</td>
<td>Call 911 Provide EMS with directions to work site; Immediately remove from work activity to slow/stop body temp rise; Start rapid cooling with fan, water mister, or ice packs; Lay flat and elevate feet to reduce heart rate and blood pressure; If conscious give sips of water to cool body and re-hydrate; Monitor airway and breathing-administer CPR if needed</td>
</tr>
</tbody>
</table>
Another cause of heat stroke occurs when a person’s body has used up all its water and salt reserves, resulting in the cessation of sweating, causing the body temperature to rise rapidly; resulting in heat stroke or heat exhaustion.

The most serious heat related illness is heat stroke. The symptoms include confusion, irrational behavior, convulsions, coma, and death. While over 20% of heat stroke victims die regardless of health or age, children seem to be more susceptible to heat strain than adults. In some cases, the side effects of heat stroke are heat sensitivity and varying degrees of brain and kidney damage.

**Signs and symptoms of heat stroke and heat exhaustion**

<table>
<thead>
<tr>
<th>Heat Stroke</th>
<th>Heat Exhaustion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dry, hot skin</td>
<td>1. Moist clammy skin</td>
</tr>
<tr>
<td>2. Very high body temperature</td>
<td>2. Normal or subnormal temperature</td>
</tr>
</tbody>
</table>

Signs and symptoms of heat stroke included a high body temperature above 105.8°F and any of the following: the person is weak, confused, upset, or acting strangely; has hot, dry, red skin; a fast pulse; headache or dizziness; in later stages, a person may pass out and have convulsions **THIS IS AN IMMEDIATE MEDICAL EMERGENCY. PROMPT ACTION MAY SAVE THE PERSON’S LIFE, CALL AN AMBULANCE.**

This condition can kill a person quickly; before emergency medical personnel arrive remove excess clothing; fan and spray the person with cool water; offer sips of cool water, if the person is conscious.

**III. PREVENTION OF HRI**

HRI can be avoided by understanding the risk associated with hot work environments; environmental monitoring techniques; and personal monitoring of fluid intake, heart rate and core body temperature. MWH will encourage personnel, co-workers and supervisors to routinely evaluate potential HRI hazards by checking one or more of the following:
The elements reflected within this HSIPP consist of the following:

- Provision for Water
- Access to Shade
- Heat Index Chart
- Personal Monitoring
- Training

**PROVISION FOR WATER:**

Water is a key preventive measure to minimize the risk of heat related illnesses. Employees shall have access to potable drinking water. Where the supply of water is not plumbed or otherwise continuously supplied, water shall be provided in sufficient quantity at the beginning of the work shift to provide one quart per employee per hour for drinking for the entire shift. Work crews may begin the shift with smaller quantities of water if they have effective procedures for replenishment during the shift as needed to allow all crew members to drink one quart or more per hour. The frequent drinking of water shall be encouraged.

**To ensure access to sufficient quantities of potable drinking water, the following steps will be taken:**

- Bring at least 2 quarts per employee at the start of the shift, and
- Supervisor/designated person will monitor water containers every 30 minutes, and employees are encouraged to report to supervisor/designated person low levels or dirty water.
- Supervisor will provide frequent reminders to employees to drink frequently, and more water breaks will be provided.
- Every morning there will be short tailgate meetings to remind workers about the importance of frequent consumption of water throughout the shift.
- Place water containers as close as possible to the workers, not away from them.
- When drinking water levels within a container drop below 50%, the water shall be replenished immediately; or water levels should not fall below the point that will allow for adequate water during the time necessary to effect replenishment.
- Disposable/single use drinking cups will be provided to employees, or provisions will be made to issue employees their own cups each day.
• Noise making devices, such as air horns, may be used to remind employee’s to take their water break.

ACCESS TO SHADE:

Access to rest and shade or other cooling measures (e.g., an air-conditioned vehicle) are important preventive steps to minimize the risk of heat related illnesses. Employees suffering from heat illness or believing a preventative recovery period is needed shall be provided access to an area with shade that is either open to the air or provided with ventilation or cooling for a period of no less than five minutes. Such access to shade shall be permitted at all times.

Sample procedures include but are not limited to the following:

• Supervisor will set-up an adequate number of; umbrellas, canopies or other portable devices, at the start of the shift and will relocate them to be closer to the crew, as needed. Equipment should be placed in close proximity (i.e., no more than 50-100 yards) to the work activity.

• Employees have access to office or construction trailer, or other building with air conditioning.

• Every morning there will be short tailgate meetings (in the employees’ language) to remind workers about the importance of rest breaks and the location of shade.

• Non-agricultural employers can use other cooling measures (e.g., an air-conditioned vehicle) if they demonstrate that these methods are as effective as shade.

• Whenever possible, provide areas for employees to take their breaks which are:
  1. Readily accessible
  2. In the shade and open to the air, and ventilated or cooled
  3. Near sufficient supplies of drinking water

Heat Index Chart

The heat index chart has devised by meteorologists to describe how hot, humid weather feels to the average person. The heat index chart combines the temperature and humidity into one number to reflect the perceived temperature. Because it takes into account the two most important factors that affect comfort in hot work environments, it can be a quick measure of how stifling the air feels rather than relying exclusively on temperature or humidity alone.
Calculating the heat index requires an electronic thermal hygrometer that is designed to measure temperature and relative humidity. Measure the temperature and humidity readings and then refer to the chart in Appendix C to determine the heat index. The color coded heat index chart corresponds to the caution and danger warnings of the accompanying Table.

**Personal Monitoring**

MWH employees should be instructed to monitor their personal heat stress load by checking their heart rate, recovery heart rate, ear temperature and extent of body water loss. During the summer months employees should be encouraged to keep a personal record of these parameters. When employees are working in hot and humid conditions they should check these parameters at the beginning of their shift, during breaks and at the end of the shift. One or more of the following measures may mark excessive heat strain, and the employee’s exposure to heat stress should be discontinued when any of the following occur:

- Employee heart rate should be measured by taking the employees radial pulse for 30 seconds at the beginning of the work shift and during breaks or rest periods. The heart rate should not exceed 180 beats per minute (bpm) minus the individual’s age (180 bpm – 30 = 150 for a maximum heart rate).

- The recovery heart rate should be measured during breaks. The employee should take a pulse rate at 30 seconds ($P_1$) with a second pulse rate taken at 2.5 minutes ($P_3$) after the initial pulse was counted. The pulse rate should not exceed 120 bpm after 3-minutes of recovery time.

- The body core temperature should not exceed 101.3°F for acclimated personnel or 100.4°F for un-acclimated workers.

- Employee, body water loss can be measured by weighing on a scale at the beginning and end of each work day. Weight loss should not exceed 1.5% of total body weight in a work day.

**IV. GENERAL PROCEDURES FOR CONTROLLING HRI**

MWH will implement the following general controls to help reduce HRI:

- Provide accurate verbal and written instructions, annual training programs, and other information about heat stress and heat strain

- Encourage employees to drink small volumes of cool water (approximately 1 cup) or a acceptable fluid replacement drink every 20-minutes
• Permit self-limitation of exposure and encourage co-worker observation to detect signs and symptoms of heat strain in others

• Provide contact with medical providers for employees with medical conditions that can compromise their ability to tolerate heat exposure

• Encourage healthy lifestyles and ideal body weight

• Retrain employees returning to work after more than one week absence about the hazards associated with hot work environments and exposure situations

• Provide access to medical practitioners to evaluate employees prior to heat exposures

• Monitor the heat stress conditions and reports of heat related disorders

V. HSIPP TRAINING

Prior to assignment of any outdoor work activities, all MWH employees will receive training in MWH HSIPP procedures and the elements outlined below:

Employee Training

• Recognizing the environmental causes of HRI and personal factors that can increase the risk of HRI

• Methods employed to identify, evaluate, and control HRI exposure

• Importance to remove personal protective equipment during all breaks

• Frequently consuming water when HRI hazards are present

• Methods and importance of acclimatization (Getting used to hot weather)

• Different types of HRI and the common signs and symptoms

• Importance of immediately reporting HRI symptoms of self and co-workers

• Company response to HRI symptoms and emergencies

• The purpose and requirements of the HRI rules

Supervisor Training

• How to implement the provisions of the HRI rule
• How to recognize and what to do when an employee exhibits signs or symptoms of HRI, including emergency response

• How to safely move employees to a place that is easily reached by emergency medical providers

• How to provide clear directions to emergency medical providers so they can find the work site
APPENDIX A

PERSONAL HEAT STRESS ASSESSMENT FORM
PERSONAL HEAT STRESS MONITORING FORM

EMPLOYEE NAME: ________________________________

WORK LOCATION: ______________________________

<table>
<thead>
<tr>
<th>Name &amp; Work Station</th>
<th>Line</th>
<th>Time</th>
<th>Temp</th>
<th>Pulse</th>
<th>P₁</th>
<th>P₃</th>
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</tbody>
</table>

**Instructions:** Use this page to track your personal exposures to heat. Record your name and work location at the top of the page. Then record the date and your work task for the day. Use line #1 to record the start time for your shift, your body temperature and resting pulse. Use the additional lines #2 through #10 to record your body temperature and resting pulse rates when you take a break. P₁ – represents your resting pulse rate 1-minute after you begin your break. P₂ – represents your resting pulse rate 3-minutes into your break. P₃ – is the difference between P₁ and P₂.

**Note:** Do not smoke before you have recorded your body temperature and resting heart rates (P₁ and P₂) at each rest break.
APPENDIX B

HEAT INDEX CHART AND TABLE
Extreme Danger:
Heat Stroke likely to occur when working under these conditions. President (or designee) will issue Heat Stroke Alert requiring UT Tyler employees to be removed from such an environment.

Danger:
Heat Exhaustion or Heat Cramps likely. Heat Stroke may occur upon prolonged exertion. Appropriate Vice-President will approve any employees who are requested to continue working in such an environment.

Extreme Caution:
Heat Cramps or Heat Exhaustion likely to occur. Supervisors will implement adjusted schedules and procedures.

Caution:
Heat Fatigue may occur. Normal summer working conditions should be observed.

Note: Information from National Weather Service, USAF, Texas A&M University
MWH AMERICAS, INC.

HEAT STRESS ILLNESS PREVENTION PLAN

EMPLOYEE & SUPERVISOR AWARENESS TRAINING
I. INTRODUCTION

Outdoor work environments involving high air temperatures, radiant heat sources, high humidity, direct physical contact with hot objects, or strenuous physical activities in high heat have a possibility for inducing heat stress in employees engaged in such operations.

MWH has implemented a Heat Stress Illness Prevention Plan to help protect you from Heat Illnesses. This training session will outline critical areas of the plan, advise you of the content of the plan, that it is available for you to review in its entirety and steps each employee can take to prevent heat illness.

The purpose of this heat stress illness prevention plan training is to provide strategies for:

- Recognizing the symptoms of heat related illnesses (HRI).
- Assessing the risk of HRI.
- An acclimation program for new employees or employees returning to work from three day or greater absence.
- Specific procedures to be followed for heat related emergencies.
- First aid for HRI, and;
- To make you aware of the plan.

MWH is committed to preventing HRI. HRI can occur to employees working in indoor or outdoor environments. MWH recognizes that exposure to extreme temperatures, humidity, and other environmental factors can lead or contribute to serious illnesses including heat fatigue, heat rash, fainting, heat cramps, heat exhaustion, and heat stroke.

Employee Training

Prior to assignment of any outdoor work activities, all MWH employees will receive training in MWH HSIPP procedures and the elements outlined below:

- Recognizing the environmental causes of HRI and personal factors that can increase the risk of HRI.
- Methods employed to identify, evaluate, and control HRI exposure.
- Importance to remove personal protective equipment during all breaks.
- Frequently consuming water when HRI hazards are present.
- Different types of HRI and the common signs and symptoms.
- Importance of immediately reporting HRI symptoms of self and co-workers.
- Company response to HRI symptoms and emergencies.
- The purpose and requirements of the HRI rules.

**Supervisor Training**

- How to implement the provisions of the HRI rule.
- How to recognize and what to do when an employee exhibits signs or symptoms of HRI, including emergency response.
- How to safely move employees to a place that is easily reached by emergency medical providers.
- How to provide clear directions to emergency medical providers so they can find the work site.

**II. HEAT RELATED ILLNESSES (HRI)**

**Causes, Symptoms, and Treatment of HRI**

Heat stress symptoms are a set of natural body signals indicating that something needs to be done to balance the body’s heating and cooling. As the body heats up, it tries to rid itself of excess heat through the evaporation of sweat. If it is unable to cool itself this way, your body temperature will increase. When body temperature gets above 100.4 to 102.2°F, the brain starts to overheat, leading to a shutdown of the body’s cooling system (sweating stops). The internal temperature continues to rise even faster, leading to heat stroke and possibly death.

The causes, symptoms, and treatment of various heat-related illnesses are listed below:

<table>
<thead>
<tr>
<th>Heat-Related Illness (HRI)</th>
<th>Signs and Symptoms</th>
<th>First Aid and Emergency Response Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunburn</td>
<td>Red, hot skin; May blister</td>
<td>Move to shade, loosen clothes to reduce temperature; Apply cool compress or water to cool burn; Get medical evaluation if severe</td>
</tr>
<tr>
<td>Heat Rash</td>
<td>Red, itchy skin; Bumpy skin; Skin infection</td>
<td>Apply cool water or compress to cool rash; Keep affected area dry to minimize infection; Control itching and infection with prescribed medication</td>
</tr>
<tr>
<td>Heat-Related Illness (HRI)</td>
<td>Signs and Symptoms</td>
<td>First Aid and Emergency Response Procedures</td>
</tr>
<tr>
<td>---------------------------</td>
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</tr>
<tr>
<td><strong>Heat Cramps</strong></td>
<td>Muscle cramps or spasms; Grasping the affected area; Abnormal body posture</td>
<td>Drink water or sports drinks to re-hydrate body; Rest, cool down in shaded area; Massage affected muscle to release body toxins; and Get medical evaluation if cramps persist</td>
</tr>
<tr>
<td><strong>Heat Exhaustion</strong></td>
<td>High pulse rate Extreme sweating Pale face Insecure gait Headache Clammy and moist skin Weakness Fatigue Dizziness</td>
<td>Move to shade and loosen clothing to cool down; Initiate rapid cooling with fan, water mister, or ice packs; Lay flat and elevate feet to reduce heart rate and blood pressure; Monitor recovery (is body cooling?); Drink small amounts of water to cool body and re-hydrate Evaluate mental status (ask Who? Where? When? Q’s) If no improvement call 911</td>
</tr>
<tr>
<td><strong>Heat Stroke</strong></td>
<td>The above but more severe; Hot, dry skin (25-50% of cases); Altered mental status with confusion and agitation; Can progress to loss of consciousness and seizures; Can be fatal</td>
<td>Call 911 Provide EMS with directions to work site; Immediately remove from work activity to slow/stop body temp rise; Start rapid cooling with fan, water mister, or ice packs; Lay flat and elevate feet to reduce heart rate and blood pressure; If conscious give sips of water to cool body and re-hydrate; Monitor airway and breathing-administer CPR if needed</td>
</tr>
</tbody>
</table>

The most serious heat related illness is heat stroke. The symptoms include confusion, irrational behavior, convulsions, coma, and death. While over 20% of heat stroke victims die regardless of health or age, children seem to be more susceptible to heat strain than adults.
Signs and symptoms of heat stroke included a high body temperature above 105.8°F and any of the following: the person is weak, confused, upset, or acting strangely; has hot, dry, red skin; a fast pulse; headache or dizziness; in later stages, a person may pass out and have convulsions. THIS IS AN IMMEDIATE MEDICAL EMERGENCY. PROMPT ACTION MAY SAVE THE PERSON’S LIFE, CALL AN AMBULANCE.

Before emergency medical personnel arrive remove excess clothing; fan and spray the person with cool water; offer sips of cool water, if the person is conscious.

III. PREVENTION OF HRI

MWH will encourage personnel, co-workers and supervisors to routinely evaluate potential HRI hazards by checking one or more of the following:

- Provision for Water.
- Access to Shade.
- Heat Index Chart.
- Personnel Monitoring (by co-workers and supervisors).
- General Awareness Training.

PROVISION FOR WATER:

Water is a key preventive measure to minimize the risk of heat related illnesses. Employees should drink one quart or more per hour. The frequent drinking of water shall be encouraged. To ensure access to sufficient quantities of potable drinking water, the following steps will be taken:
-5-

- Supervisor will provide frequent reminders to employees to drink frequently, and more water breaks will be provided.

- Every morning there will be short tailgate meetings to remind workers about the importance of frequent consumption of water throughout the shift.

- Drinking water will be available at all times during the work shift at the work site.

- Place water containers as close as possible to the workers.

- Disposable/single use drinking cups will be provided to employees, or provisions will be made to issue employees their own cups each day.

ACCESS TO SHADE:

Employees suffering from heat illness or believing a preventative recovery period is needed shall be provided access to an area with shade that is either open to the air or provided with ventilation or cooling for a period of no less than five minutes.

Sample procedures include but are not limited to the following:

- Supervisor will set-up an adequate number of; umbrellas, canopies or other portable devices, at the start of the shift and will relocate them to be closer to the crew, as needed. Equipment should be placed in close proximity (i.e., no more than 50-100 yards) to the work area, or;

- Employees will have access to office or construction trailer, or other building with air conditioning no more than 50-100 yards from the work area.

- Every morning there will be short tailgate meetings (in the employees’ language) to remind workers about the importance of rest breaks and the location of shade.

- Non-agricultural employers can use other cooling measures (e.g., an air-conditioned vehicle) if they demonstrate that these methods are as effective as shade.

- Provide areas for employees to take their breaks which are:
  1. Readily accessible.
  2. In the shade and open to the air, and ventilated or cooled.
  3. Near sufficient supplies of drinking water.
Heat Index Chart

The heat index chart has been devised by meteorologists to describe how hot, humid weather feels to the average person. The heat index chart combines the temperature and humidity into one number to reflect the perceived temperature. It can be a quick measure of how stifling the air feels rather than relying exclusively on temperature or humidity alone.

Personnel Monitoring

Co-workers and supervisors will monitor each other for symptoms of heat stress and:

- Encourage co-workers to take a break if they exhibit even the most minor symptoms of heat illness.
- Report concerns for a co-worker to supervision.
- Supervisors will observe employees for symptoms of heat stress.
- Supervisors will provide for any employee to take a break if the employee or a co-worker expresses a concern without retribution.

IV. GENERAL PROCEDURES FOR CONTROLLING HRI

MWH will implement the following general controls to help reduce HRI:

- Provide accurate verbal and written instructions, annual training programs, and other information about heat stress and heat strain
- Encourage employees to drink small volumes of cool water (approximately 1 cup) or a acceptable fluid replacement drink every 20-minutes
- Permit self-limitation of exposure and encourage co-worker observation to detect signs and symptoms of heat strain in others
- Provide contact with medical providers for employees with medical conditions that can compromise their ability to tolerate heat exposure
- Encourage healthy lifestyles and ideal body weight
- Retrain employees returning to work after more than one week absence about the hazards associated with hot work environments and exposure situations
- Provide access to medical practitioners to evaluate employees prior to heat exposures
- Monitor the heat stress conditions and reports of heat related disorders
HEAT INDEX CHART AND TABLE

**HEAT INDEX CHART**

<table>
<thead>
<tr>
<th>TEMPERATURE °F</th>
<th>RELATIVE HUMIDITY</th>
<th>10%</th>
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</table>

**Directions:** Locate the current temperature on the left column and then locate the relative humidity on the top row. Follow the temperature across and the humidity down until they meet; this measurement is the heat index. The heat index will increase 10 degrees in direct sunlight.

<table>
<thead>
<tr>
<th>Extreme Danger:</th>
<th>Heat Stroke likely to occur when working under these conditions. President (or designee) will issue Heat Stroke Alert requiring UT Tyler employees to be removed from such an environment.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Danger:</td>
<td>Heat Exhaustion or Heat Cramps likely. Heat Stroke may occur upon prolonged exertion. Appropriate Vice-President will approve any employees who are requested to continue working in such an environment.</td>
</tr>
<tr>
<td>Extreme Caution:</td>
<td>Heat Cramps or Heat Exhaustion likely to occur. Supervisors will implement adjusted schedules and procedures.</td>
</tr>
<tr>
<td>Caution:</td>
<td>Heat Fatigue may occur. Normal summer working conditions should be observed.</td>
</tr>
</tbody>
</table>

Note: Information from National Weather Service, USAF, Texas A&M University
PROTECT YOURSELF FROM HEAT ILLNESS

WHAT CAUSES HEAT ILLNESS?

Heat illness occurs when your body keeps in more heat than it loses and your temperature rises. You are at greater risk of heat illness when you:

- Are dehydrated. Dehydration is your worst enemy during hot weather.
- Are not used to working in the heat.
- Are in poor health.
- Have had heat illness before.

WHAT YOU CAN DO TO PREVENT HEAT ILLNESS

Your two best defenses against the heat are:
- Getting out of the sun or finding a cool resting place when you are starting to overheat and need to cool down.

OTHER THINGS YOU CAN DO

- Drinking cool, fresh water throughout the day (four 8-oz cups per hour) during hot weather.
- You are better off avoiding alcohol altogether. The more you drink, even beer, the more dehydrated you will get.
- Always know who and how to call for help when you start a new work day.
- Know the symptoms to watch for: discomfort, excessive sweating, headache, poor concentration, muscle pain, cramping, dizziness, fatigue, irritability, loss of coordination, throwing-up, blurry vision, confusion, lack of sweating, fainting, seizures.
- If you are new to working in the heat, tell your employer. Your employer should have procedures to allow you to adjust during your first two weeks of hot weather work.
- Get your doctor’s advice if you know you have risk factors for heat illness, such as: illnesses like diabetes, taking medications or over-the-counter drugs, being on a low salt diet.

YOUR RIGHTS

- Keep track of your coworkers. You all need to watch out for each other. If anyone looks like they are not okay, check them out.
- After work take a cold bath or shower.
- If you are working outdoors, by law, your employer must guarantee you all of the following:
  - access to fresh, cool drinking water throughout the day.
  - access to shade (all employees) or an equally cool spot (if you are not an agricultural worker) for 5 minutes at a time to rest and cool down.
  - training on how to work safely in the heat, including how to call for emergency services if someone is overcome by the heat.

For more information, call 1-800-963-9424
PROTEJASE DE LAS ENFERMEDADES CAUSADAS POR EL CALOR

En la investigación de un año, de 25 casos, en que se sospecha que fueron ocasionados por las enfermedades causadas por el calor, Cal/OSHA encontró que más de la mitad de las víctimas murieron y casi un tercio de ellas necesitaron hospitalización. Las enfermedades causadas por el calor pueden matarlo. En clima caliente, tome las siguientes precauciones.

QUE OCASIONAN LAS ENFERMEDADES CAUSADAS POR EL CALOR?

Las enfermedades causadas por el calor ocurren cuando su cuerpo produce y conserva más calor que lo que pierde, elevando su temperatura. Usted está en gran riesgo de sufrir enfermedades causadas por el calor cuando:
• Se deshidrata. La deshidratación es su peor enemigo durante el clima caliente.
• No está acostumbrado a trabajar en el calor.
• Se encuentra en condiciones de mala de salud.
• Anteriormente ha sufrido de enfermedades causadas por el calor.

Como puede prevenir estas enfermedades

Sus dos mejores defensas contra el calor son:
• Buscar un lugar sombreado y fresco para descansar cuando se sienta sobrecalentado y necesite enfriarse.
• En clima caliente, beber agua fresca durante todo el día (cuatro vasos de 8 onzas de agua por hora). Esta es la cantidad de agua que su cuerpo pierde cuando sufre. No espere a sentir sed para beber agua.

Otras cosas que usted puede hacer

• De inmediato informe a su supervisor si usted piensa que se está enfermando a causa del calor.
• Sepa donde están las provisiones de agua más cercanas a usted.
• Elija agua en lugar de sodas u otras bebidas cafeinadas o azucaradas.
• Evite tomar bebidas alcohólicas. Cuanto más tome, incluso cerveza, más se deshidratará.
• Cuando empece un día nuevo de trabajo, siempre sepa a quién y cómo llamar para pedir auxilio.
• Conozca los síntomas a los que debe estar alerta - Incomodidad, sudor excesivo, dolor de cabeza, falta de concentración, dolor muscular, calambres, mareos, fatiga, irritabilidad, incoordinación, vómito, visión borrosa, confusión, ausencia de sudor, desmayo y convulsiones.
• Si usted no está acostumbrado a trabajar en temperaturas altas, informe a su supervisor. Su empleador debe tener procedimientos para permitirle que usted se adapte al calor durante las dos primeras semanas de trabajo.
• Consulte a su médico si sabe que tiene cualquier factor de riesgo que cause enfermedades causadas por el calor tales como: enfermedades como la diabetes, - tomar medicinas de prescripción o “sin prescripción” médica, - una dieta baja en sal

SUS DERECHOS

Si usted trabaja al aire libre, por ley, su empleador debe garantizarle todo lo siguiente:
• acceso a agua fresca de beber durante todo el día.
• Acceso a la sombra (para todos los trabajadores) o a un ambiente igualmente fresco (si usted no es un trabajador agrícola) durante 5 minutos cada vez para descansar y enfriarse.
• Entrenamiento para trabajar de forma segura en el calor incluyendo como llamar a los servicios de emergencia si alguien sufre al calor.

Para más información, llame 1-800-963-9424
# Emergency Assistance Information
Santa Susana Field Laboratory  
5800 Woolsey Canyon Road  
Canoga Park, CA 91304

<table>
<thead>
<tr>
<th>NAME</th>
<th>TITLE</th>
<th>PHONE</th>
<th>ALT. PHONE</th>
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</tr>
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<tr>
<td>BOEING – SSFL 5800</td>
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<tr>
<td>Michael Bower (Mike)</td>
<td>Project Manager</td>
<td>818-466-8776</td>
<td>818-312-8523</td>
<td><a href="mailto:michael.o.bower@boeing.com">michael.o.bower@boeing.com</a></td>
</tr>
<tr>
<td>Mark Spenard</td>
<td>Contract Coordinator</td>
<td>818-466-8713</td>
<td></td>
<td><a href="mailto:mark.spenard@boeing.com">mark.spenard@boeing.com</a></td>
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<tr>
<td>Robert Mako (Bob)</td>
<td>EHS Officer</td>
<td>818-466-8735</td>
<td>818-702-7603</td>
<td><a href="mailto:Robert.r.mako@boeing.com">Robert.r.mako@boeing.com</a></td>
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<tr>
<td>Bill Gruener</td>
<td>SSFL Maintenance Mgr</td>
<td>818-466-8810</td>
<td></td>
<td><a href="mailto:william.r.gruener@boeing.com">william.r.gruener@boeing.com</a></td>
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| EMERGENCY CONTACTS        |                              |               |               |                                            |
| Ambulance, Fire, Police & Sheriff | Boeing SSFL Security Dept Control Ctr | 818-466-8900  | 562-797-2222 |
| Fire Department           | LAFD (West Valley Devision)  | 818-756-8561  |               |                                            |
| First Aid Kit, Fire Extinguishers, and Eye Lavages | Field Vehicle and Field Command Center | 818-466-8900  | 562-797-2222 |
| Hospital                  | West Hills Hospital & Medical Center | 818-676-4000  |               | See the following page for directions and map |
| Poison Control            |                              | 800-876-4766  |               |                                            |
| Police                    | West Valley Division         | 818-756-8542  |               |                                            |
| State Highway Patrol      | Woodland Hills Division      | 818-888-0980  |               |                                            |

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<thead>
<tr>
<th>MWH 618 Michillinda Avenue, Suite 200, Arcadia, CA 91007</th>
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<tr>
<td>Mark Harris H&amp;S Practice Leader</td>
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<tr>
<td>Benjamin Stewart Project Manager</td>
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<td>Eric VanderVelde SSFL Site Safety Officer</td>
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<td>Van Vathanasin Field Team Leader</td>
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<tr>
<td>Roger Paulson Cal EPA DTSC</td>
<td>916-255-3702  <a href="mailto:roger.paulson@dtsc.ca.gov">roger.paulson@dtsc.ca.gov</a></td>
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<th>Sage Ranch MRCA</th>
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<tr>
<td>Tim Miller Ranger, Sage Ranch MRCA</td>
<td>323-496-9709</td>
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<tr>
<td>DigAlert Underground Service Alert</td>
<td>800-227-2600</td>
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<td>Gas Company Dean Jaedtke</td>
<td>805-520-7529 805-523-4777</td>
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<td>Sewer Boeing controlled treatment plant</td>
<td>818-586-9052</td>
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<tr>
<td>Water Calleguas Water District</td>
<td>805-526-9323</td>
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FIGURE B-1: HOSPITAL ROUTE MAP

1: Start out going EAST on WOOLSEY CANYON RD toward VALLEY CIRCLE BLVD.

2: Turn RIGHT onto VALLEY CIRCLE BLVD. 1.6 miles

3: Turn LEFT onto INGOMAR ST. 0.5 miles

4: Stay STRAIGHT to go onto SATICOY ST. 0.4 miles

5: Turn RIGHT onto WOODLAKE AVE. 0.3 miles

6: Turn LEFT onto MEDICAL CENTER DR. 0.1 miles

7: End at 7300 Medical Center Dr
   West Hills, CA 91307-1902, US
ATTACHMENT 5
TAILGATE SAFETY MEETING FORM
TAILGATE SAFETY MEETING FORM

Date: ___________  Time: ______  Job Number: _____________________________

Client: The Boeing Co.

Site Specific Location: Former Shooting Range, Sage Ranch MRCA, SSFL, Canoga Park, CA

Safety Topics Presented

Protective Clothing/Equipment: eye protection, safety vest, steel toes, snake gaiters, and nitrile gloves during sampling.

Biohazards: Rattlesnakes, bees, ants, ticks, and poison oak.

Sensitive Species: Legless lizard, tar plant, and oak trees.

Physical Hazards: Slips, trips, and falls, warm/cold weather conditions, road traffic, heavy equipment, heavy lifting, pinch points, traffic.

Chemical Hazards: Metals, dioxins, VOCs, SVOCs, pesticides.

Special Equipment: XRF analyzer

SSFL Emergency Phone:
Two-way radio; Boeing phone x6-8911; Cell or outside phone (562) 797-2222

Hospital: West Hills Hospital and Medical Center  Phone: (818) 676-4999

Hospital Address and Route: Exit Boeing SSFL onto Woolsey Canyon Road and head down the hill. Turn right on Valley Circle Blvd., Turn left on Roscoe Blvd., Turn right on Woodlake Ave., and Turn left on Medical Center Drive. End at 7300 Medical Center Dr., West Hills, CA 91307.

ATTENDEES

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<tr>
<th>Names Printed</th>
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Meeting Conducted By:

Name Printed: ____________________________________  Signature: _____________________________

Onsite Safety Officer: E.VanderVelde    Field Project Manager: __________________________