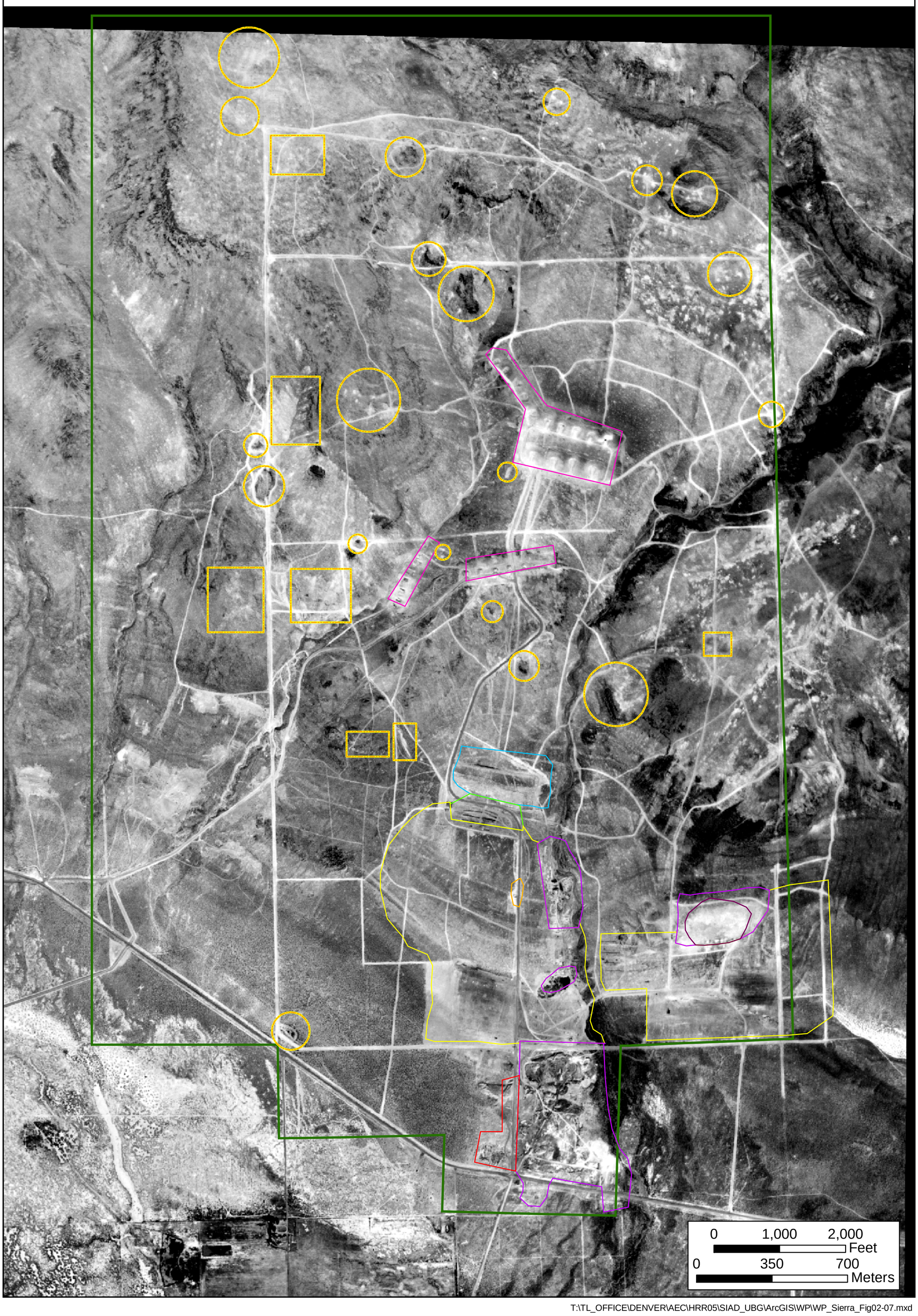
Site Inspection Work Plan
Upper Burning Ground
Sierra Army Depot, CA

TLI Solutions

Figure 2-7
1990 Aerial Photograph of the Upper Burning Ground



Legend

- Installation Boundary
- Possible Areas of Interest

FEATURES (TEC)

- Disturbed Ground
- Bunker
- Excavation
- Graded Area
- Ground Scar
- Open Storage
- Pit
- Trench

Aerial Source:
Source: TEC
Date: 1990

Note: TEC provided the georeferenced aerials and their aerial interpretations. The data is presented in its original format.

Edition: Final Report

Date: April 2007

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- Determination of types of MEC and MC at the sites,

- Possible elimination of site areas or features from further investigation; as well as clarifying areas of concern, and

- Identifying potential RI/FS data gaps and minimizing duplicative studies as applicable. The specific criteria for meeting these objectives are outlined in the attached FSP.

A TPP Summary Table is provided as Table 3-1. This table summarizes the MC and MEC activities and project objectives for the sites.

The results of the SI activities will be summarized in a Draft SI Report, which will be submitted to the stakeholders for review.

4.0 DATA GAPS

The following data gaps have been identified for the MR sites at SIAD:

- The specific origin of the bomblets found at the BLM-Administered Public Lands site is unknown.

- It is uncertain if a MEC hazard still exists at the BLM property.

- It is unclear if certain areas located outside the UBG boundary were utilized for military purposes.

- The exact boundary of the Gravel Pit (Stacy) site is unknown.

5.0 DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) were developed in accordance with USACE guidance for developing DQOs as presented in EM-200-1-2, *Technical Project Planning (TPP) Process*, August 1998.

As indicated in Section 4.0 of the Generic Work Plan, the purpose of the site-specific investigation is not to fully characterize the nature and extent of all MEC and MC contamination. Therefore, the DQO thresholds for this project will be lower than for a typical RI/FS project.

The generic DQO for this project is to collect an appropriate amount of data at each site to determine if the primary and secondary Project Objectives defined in Section 3.0 of this Work Plan have been met. In order to provide the information necessary to determine if the project objectives are obtained, the following site-specific DQOs will be implemented.

Table 3-1: TPP Summary Table

MMRP Site	*MEC SI Activities*	*MEC SI Purpose*	*MC SI Activities*	*MC SI Purpose*
Upper Burning Ground (3,915 acres)	Depending on physical site conditions, visual surveys will be conducted at a distance of 50 line miles utilizing a meandering path approach. Visual surveys will be focused in the impact area in order to determine the presence of MEC located within the site. An estimated 1 acre of digital geophysical mapping (DGM) will be conducted over the Upper Burning Ground MR Site. Additionally, areas identified as possible impact areas adjacent to the MR site will also be evaluated.	To determine the presence of MEC on site. If no scrap or MEC is identified, this information will be used to help delineate smaller areas contained within the UBG MR site that may qualify for No Further Action (NFA) for MEC.	Not more than 40 samples will be collected. Sample collection will be biased based on the presence of munitions or suspected areas of military activity.	Results will be used to determine the need for further investigation or NFA for MC at each site, for Cost to Complete analysis, and to complete the Site Prioritization Protocol.
BLM-Administered Public Lands (1,773 acres)	Visual surveys will be conducted at a distance of 10 line miles utilizing a meandering path approach. Additionally, areas identified as possible impact areas adjacent to the MR site will also be evaluated.	To determine the presence of MEC on the non-DoD property. If no scrap or MEC is identified, this information will be used to help delineate smaller areas contained within the UBG MR site that may qualify for No Further Action (NFA) for MEC.	Not more than 15 samples will be collected. Sample collection will be biased based on the presence of munitions or suspected areas of military activity.	
Gravel Pit (Stacy) (41 acres)	Visual surveys will be conducted at a distance of 10 line miles utilizing a meandering path approach. Based on the results of the visual survey, a geophysical survey may be conducted at the Gravel Pit (Stacy) site.	To determine the presence of MEC within the site. If no scrap or MEC is identified, the site will move to NFA for MEC.	Not more than 15 samples will be collected. Sample collection will be biased based on the presence of munitions or suspected areas of military activity.	

5.1 DATA QUALITY OBJECTIVES FOR MUNITIONS AND EXPLOSIVES OF CONCERN

Each MR site, including the AOIs, at SIAD UBG will be evaluated to determine if it has been impacted by the use, storage, or disposal of military munitions resulting in the potential for contamination by MEC.

- Visual surveys will be conducted to determine the presence of MEC at each site. An appropriate portion of the site will be covered by the survey in a meandering path to determine the presence of MEC with an emphasis on known areas of interest, such as firing points, target areas, and previously identified MEC.
- If MEC is identified at a site, it will be recommended for further investigation of MEC.
- The line miles of visual survey for each site are listed in Table 3-1 of this Work Plan and Section 2.2 of the FSP in Appendix A.
- Limited geophysical surveys will be conducted to supplement the information obtained through the visual surveys to determine the presence of subsurface anomalies in certain areas. Geophysical surveys will be conducted over an appropriate portion of a site in a meandering path with emphasis on known areas of interest, such as demolition areas or areas of interest identified on historic aerial photographs. Geophysical survey results will be evaluated in conjunction with site history information and Conceptual Site Model data to determine if subsurface anomalies could potentially be MEC. The presence of a significant number of subsurface anomalies will warrant further investigation of the site for MEC. Additional information regarding the DQOs for geophysical surveys is included in Section 4.1.1 of the Field Sampling Plan in Appendix A.
- If no evidence of MEC is observed on the surface, but subsurface anomalies are identified in an area where historic or visual evidence reflects military use of munitions, this will also warrant a recommendation for further investigation.

5.2 DATA QUALITY OBJECTIVES FOR MUNITIONS CONSTITUENTS

Each MR site at SIAD will be evaluated to determine if they have been impacted by the use, storage, or disposal of military munitions resulting in the potential for contamination by MC.

- Surface soil samples will be collected from each site to evaluate for the presence of MC.
- Collection of surface soil samples will be biased based on the presence of military munitions or the location of known areas of interest, such as target areas, detonation areas, and disposal areas.
- Samples will be collected based on the criteria and procedures outlined in Section 3.2 of the Field Sampling Plan in Appendix A.
- Samples will be analyzed for analytes defined in Table 3-2 of the Field Sampling Plan in Appendix A.

- The number of samples to be collected at each site is listed in Table 3-1 of this Work Plan and Section 3.2.1.2 of the FSP in Appendix A.
- Any exceedance of the screening levels discussed in Section 3.0 of this Work Plan and as defined in Table 3-2 of the FSP in Appendix A will warrant a recommendation for further investigation of MC at a site. Site specific background levels will be used in conjunction with the screening criteria to make appropriate recommendations.

6.0 SAMPLING AND ANALYSIS PLAN

The Field Sampling Plan, which includes the procedures for conducting visual surveys, geophysical surveys, and surface soil sample collection, is provided as Appendix A to this Work Plan. Additionally, the Quality Assurance Project Plan, a general Accident Prevention Plan, MEC Work Plan, and TLI Standard Operating Procedures are provided as appendices to the Generic Work Plan, provided electronically as Appendix E.

7.0 ACCIDENT PREVENTION PLAN

An Accident Prevention Plan (APP) is included as Appendix C to this Work Plan. The APP provides specific details relating to the procedures that will be used during the SI at SIAD to ensure worker safety throughout the process. This plan addresses exposure to the elements, vehicle safety, explosive hazards, and chemical hazards.

8.0 ANOMALY AVOIDANCE

Anomaly avoidance refers to techniques used by personnel at sites with known or suspected MEC. The purpose of anomaly avoidance is to avoid any potential surface MEC and subsurface anomalies during sampling activities. SI activities that have the potential for encountering MEC include geophysical and visual surveys, and surface soil sampling. Intrusive anomaly investigation is not permitted during anomaly avoidance operations.

For anomaly avoidance during SI field activities on MR sites, compliance with anomaly avoidance procedures will be the responsibility of the UXO Safety Officer (UXOSO). The UXOSO will be responsible for conducting safety briefings for all site personnel and visitors. In addition, a Senior UXO Supervisor (SUXOS) will provide support to the UXOSO and the field teams.

Prior to the initiation of SI field activities, the UXOSO will provide the field teams with information to aid in the recognition of items that may be anticipated at each site. The UXOSO will emphasize that although the potential for certain MEC items may exist at a site, the field teams must be prepared to recognize all potential MEC. Additionally each field team leader will be provided with a field guide that contains data sheets and photos for potential MEC.

SI field activities will be conducted by a field team consisting of a minimum of two members. One of these members will be a UXO Technician III, who will act as the team

leader. The other members of the team may be additional UXO-qualified personnel, geophysicists, or any other team member. The UXO technician is responsible for providing MEC recognition, location, and safety functions during geophysical and visual surveys and surface soil sampling. Team members must be escorted by the UXO technician at all times. Hand-held electromagnetic (EM) devices will be used to enhance visual sweep procedures and to identify potential MEC items to ensure worker safety. Transect courses will be tracked using a hand-held Global Positioning System (GPS) instrument. If GPS initialization is lost or horizontal error exceeds acceptable accuracy due to lack of satellites, poor radio link to the base, or poor satellite geometry, visual survey activities will cease until the issue is resolved.

Any munitions-related materials discovered will be marked as GPS waypoints and recorded in a field log. The location of the item will be marked with flagging to facilitate relocating the item and to avoid further contact. Digital photographs will be taken of any identified munitions-related material. No UXO/MEC removal actions will be conducted as part of this SI. In the event a UXO item is discovered, the SUXOS will be notified, who will verify the type of munition and fuze type by function and condition. At no time will any team member, including the SUXOS, attempt to handle, rotate, or excavate an item. This information will be reported to the UXOSO and the TLI PM who will notify Risk Management (RIE); the SIAD Safety Office; and the SIAD Installation POC, who in-turn will notify the local EOD support unit for appropriate action. If the item is located on one of the off-site properties, TLI will notify BLM and local law enforcement for appropriate action.

Information regarding MEC identified during SI field activities will be documented on an Ordnance Contact Report (Appendix D). The information on the form will assist EOD in locating and identifying the MEC item. Forms will be provided to the installation Point of Contact (POC) as needed. If MEC items are identified, the survey will be halted and the UXO technician will select an alternate route around the item.

Prior to surface soil sampling, the UXO technician will visually survey the proposed sampling site for indication of MEC. In addition, the area will be swept with the hand-held EM device to identify potential MEC. If anomalies are detected within the proposed sampling location, an alternate location will be selected. Soil sampling procedures will be conducted after surface clearance actions are completed and safe corridors are established. Once the intended soil sample site has been determined to be clear of anomalies, soil will be excavated from the cleared point.

9.0 INSTALLATION SECURITY

SIAD is a secure facility and access to the installation must be obtained through the main gate. The TLI field team will coordinate with the SIAD Installation POC or a designee to gain access to the installation and the MR sites. The adjacent BLM site is fenced. The TLI field team will coordinate with the BLM office and the Installation POC regarding access.

10.0 COMMUNICATION

Communication with the SIAD Installation POC will include an in-brief meeting the first day of field activities and an out-brief meeting the last day. Additionally, during field activities, TLI will inform the SIAD Safety Office and the Installation POC of any discoveries of UXO or MEC items. TLI will contact SIAD security on a daily basis to inform them of the location of field activities for that day.

Communication among TLI team members while conducting field activities will include the use of hand held radios and cellular phones when necessary, as well as the use of hand and audible signals. Communications will be checked at the start of each work day and after breaks when work resumes. Regular communication checks will be conducted throughout the day by the UXOSO.

11.0 PROJECT SCHEDULE

The following provides a tentative schedule for the activities to be conducted under this SI project:

- Site Inspection Field Work – July 16, 2007
- Draft SI Report – October 1, 2007
- Final TPP Session – November 5, 2007
- Final SI Report – December 3, 2007

A specific schedule will be developed and provided to the installation detailing day-to-day activities for the field work so that notification can be provided to appropriate offices and individuals throughout the installation. It should be noted that this schedule may change depending on field conditions and the SIAD POC will be provided daily updates on the field activities.

12.0 REFERENCES

29 CFR 1910, *Occupational Safety and Health Standards*

29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response*

29 CFR 1926.65, *Safety and Health Regulations for Construction*

Data Item Descriptions (DID) MR-001, *Type I Work Plan*
MR-005-01, *Type II Work Plan*
MR-005-04, *Explosives Siting Plan*
MR-005-05, *Geophysical Investigation Plan*
MR-005-06, *Accident Prevention Plan*
MR-005-07, *Geospatial Information and Electronic Submittals*

MR-005-10, *Munitions Constituents Chemical Data Quality Deliverables*
MR-005-11, *Quality Control Plan*
OE-005-14.01, *Geographic Information System Plan*

DoD Directive 4715.11, *Environmental and Explosives Safety Management on Department of Defense (DoD) Active and Inactive Ranges within the United States*

EM-200-1-2, *Technical Project Planning (TPP) Process, August 1998*

EM-200-1-3, *Requirements for the Preparation of Sampling and Analysis Plans, February 2001*

AR 385-10, *The Army Safety Program, February 2000*

EM 385-1-1, *Safety and Health Requirements*
Environmental Data Quality Management Program Specifications, United States Army Corps of Engineers (USACE) – Sacramento District, 3 November 2003

EM 1110-1-4009, *Ordnance and Explosives Response, June 23, 2000*

ER 385-1-92, *Safety and Occupational Health Requirements for Hazardous, Toxic, and Radioactive Waste (HTRW) Activities, July 2003*

EP 75-1-2, *Munitions and Explosives of Concern (MEC) Support During Hazardous, Toxic, and Radioactive Waste (HTRW) and Construction Activities, August 1, 2004*

EPA QA/G-4, *Guidance for the Data Quality Objectives Process, Final, August 2000*

ER 385-1-92, *Safety and Occupational Health Document Requirements for Hazardous Waste Site Remedial Actions*

ERDC/CCREL TR-02-01, *Guide for Characterization of Sites Contaminated with Energetic Materials, 2002*

Interim Guidance Document 01-02 and ER 1110-1-2, *Implementation of Technical Project Planning (TPP) for Ordnance and Explosives (OE) Formerly Used Defense Sites (FUDS) Projects, and Engineering Design Quality Management*

Appendix A

APPENDIX A

FIELD SAMPLING PLAN

APPENDIX A
DRAFT FIELD SAMPLING PLAN

Site Inspection
Upper Burning Ground
Sierra Army Depot
Herlong, California

Prepared For:

U.S. Army Corps of Engineers
Sacramento District
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APRIL 2007

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1.0 INTRODUCTION

1.1 PROJECT ORGANIZATION, RESPONSIBILITIES, AND TRAINING

Earth Tech has been subcontracted to conduct three specific tasks of the Site Inspection (SI) process: 1) perform a limited visual survey, and report results, 2) perform limited geophysical survey of the site, and report results, and, 3) collect, analyze, and report results for soil sampling conducted at three Munitions Response (MR) Sites associated with the Upper Burning Ground, Sierra Army Depot, Herlong, California, that were determined to have the potential for munitions and explosives of concern (MEC) and munitions constituents (MC).

Subcontractors working for Earth Tech will include an analytical laboratory responsible for sample analyses. The activities associated with the aforementioned tasks are outlined in this Field Sampling Plan (FSP) which supports the overall Site Specific Work Plan.

Earth Tech will coordinate all field activities with the TLI Solutions Project Manager (PM). The Earth Tech PM is supported by a Project Geophysicist who will coordinate all geophysical activities for the site and review all geophysical mapping data collected, a Project Chemist who will assist in overseeing the soil sampling activities and analyze all soil sampling results, and an Ordnance and Explosives (OE) Technical Manager who will provide oversight on all MEC activities.

Field survey teams will consist of the following personnel:

- **Visual Survey Team.** The Visual Survey Team will consist of an Environmental Professional and an Unexploded Ordnance (UXO) Technician. The UXO Technician will act as the OE escort for the visual survey team. The Environmental Professional and/or the UXO Technician will also be qualified to act as an on-site surveyor and qualified to use Global Position System (GPS) equipment. The Environmental Professional will be responsible for the collection of visual survey data in accordance with the FSP (see Section 2.0). Other field personnel (discussed below) could augment the Visual Survey Team as they are available.

- **Soil Sampling Team.** The Soil Sampling Team will consist of an Environmental Professional and a UXO Technician. The UXO Technician will be responsible for inspecting/clearing the sampling location prior to taking a sample. The Environmental Professional will be responsible for collection of the soil sample in accordance with the FSP (see Section 3.0). Other field personnel (discussed below) could augment the Soil Sample Team as they are available.

- **Geophysical Mapping Team.** The Geophysical Mapping Team will consist of a Staff Geophysicist and a UXO Technician for digital geophysical mapping and, if necessary, an Environmental

Professional for compass navigation in areas of the project site where a GSP signal is not available. The UXO Technician will act as the OE escort for the geophysical mapping team. The Staff Geophysicist will be responsible for collection of the geophysical mapping data in accordance with the FSP (see Section 4.0). Other field personnel (discussed below) could augment the Geophysical Mapping Team as they are available.

The following Earth Tech personnel will conduct the SI field activities and be responsible for the collection of the data described in this FSP:

- Senior Level Environmental Professional (On-Site Manager)
- Staff Geophysicist
- UXO Technician III (Earth Tech Safety Representative and OE Escort)

The SI sampling and analysis element of the project will be implemented using a three-phase quality control system: Preparatory, Field, and Follow-up. The Preparatory Phase includes preparation and approval of this FSP, laboratory procurements, and training and orientation of personnel. The Field Phase will include visual surveys, soil sampling, and geophysical mapping at the three MR Sites at the Upper Burning Ground. The Follow-up Phase will include analysis and evaluation of all data collected and documentation of all field activities conducted.

1.1.1 Qualifications and Training of Project Personnel

All Earth Tech and subcontractor project personnel will be qualified and adequately trained to perform the work to which they are assigned. Earth Tech's PM will determine the minimum qualifications and training required for project personnel. UXO Technicians will at least meet the minimum requirements, as specified in Department of Defense Explosives Safety Board (DDESB) Technical Paper (TP) 18, for their assigned position. The Earth Tech PM may request documentation of qualifications from subcontractors prior to their starting work.

All Earth Tech field personnel assigned to the project will receive the appropriate guidance plans, including this FSP, in time for thorough review prior to commencing work in the field. The Earth Tech PM will document, prior to the start of work, that all field personnel have received, read, and understood all procedures pertinent to the work that project personnel are assigned to perform.

Earth Tech will maintain training files for Earth Tech project personnel as part of the project files.

Training will include:

- Briefings on site-specific technical and quality issues and procedures as they relate to each worker's duties. Examples include project mission, objectives and quality requirements, sampling and shipping protocols, chain-of-custody (COC) requirements, project safety and

biological/cultural resources issues, and management of investigative derived waste (IDW),

- Site specific orientation/training for all field personnel (to be provided by TLI Solutions' UXO Safety Officer [UXOSO]), and,

- Daily morning "tailgate" meetings to discuss planned activities for the day, health and safety issues specific to the MR Site to be surveyed that day, and quality control (QC) and quality assurance (QA) concerns related to specific daily work assignments.

The PM will review personnel qualifications for each staff member to ensure that the following training has been completed, as required,

- 40-hour Occupational Safety and Health Administration (OSHA) and a current annual 8-hour refresher for all workers, including respirator training, fit test, and medical doctor approval for respirator use (if necessary),

- Three days of on-the-job training for field personnel,

- Current first aid and cardiopulmonary resuscitation (CPR) training for most workers (at least 1 team member will have current training),

- Documentation of experience or training for specific field equipment to be operated by workers. This includes equipment operation, field calibration (as applicable), and maintenance/repair

Personnel training will be periodically reviewed by an Earth Tech Health and Safety (H&S) Manager to verify that the training is appropriate, adequate, and current.

Personnel who have allowed their training to expire (e.g., OSHA 8-hour refresher, etc.) will not be allowed to conduct any type of field activities for the three MR Sites at the Upper Burning Ground until their training is updated. The PM will verify that this periodic review of personnel training is being performed and documented by an Earth Tech H&S Manager prior to initiation of on-site activities.

Project analytical laboratories will provide training and maintain training files for all laboratory personnel. Severn Trent Laboratories (STL) Sacramento, a National Environmental Laboratory Accreditation Program (NELAP), Environmental Laboratory Accreditation Program (ELAP), and California certified laboratory has been retained for sample analysis (see Section 3.0). Copies of training for laboratory personnel are available upon request.

1.2 PROJECT BACKGROUND

The Work Plan is written to provide guidance to support the activities associated with the identification of MEC and munitions related contamination (i.e., MC) from three MR Sites located at the Upper Burning Ground (Figure A-1, Attachment 1).

This FSP supports the Work Plan through its specific discussions regarding the SI field activities. Specific information regarding the installation history, MR Sites to be investigated, and information regarding previous site investigations is provided in Section 2.0 of the Work Plan.

Section 2.0 of this FSP provides the Visual Survey Plan which includes the procedures and data quality objectives (DQOs) for the approximately forty-seven miles of visual surveys that will be conducted over the three MR Sites located at the Upper Burning Ground. The purpose of the visual surveys are to identify areas that may have been affected by past military munitions operations.

Section 3.0 of this FSP provides the Soil Sampling Plan which includes the procedures and DQOs for the soil sampling activities to be completed at the Upper Burning Ground. Soil samples will be collected from areas that may have been impacted by military munitions, from drainages located down gradient from the suspected impacted areas, and from areas identified through the visual surveys that may have been impacted by past military activities. A maximum of 70 soil samples will be collected from the three MR Sites located at the Upper Burning Ground, with a minimum of one soil sample being collected from each MR Site.

Section 4.0 of this FSP provides the Geophysical Mapping Plan which includes the procedures and DQOs for the geophysical mapping to be completed at the Upper Burning Ground MR Sites. A geophysical survey will be conducted over approximately 1 acre at the Upper Burning Ground MR Site (see Section 4.0). The purpose of the geophysical mapping will be to identify the location and density of subsurface anomalies across a project site.

2.0 VISUAL SURVEY PLAN

2.1 INTRODUCTION

Visual survey data will be collected over the ground surface to evaluate and document the presence of MEC or Munitions Debris (MD) or other munitions-related finds at the three MR Sites located at the Upper Burning Ground and as listed in Section 2.2.

The working assumption is that any surface MEC present will be of the same type and condition as subsurface finds. Figures A-2 to A-4 (Attachment 1) shows the location and extent of the MR Sites subject to this investigation.

Earth Tech will furnish all required labor, equipment, and materials (except where specified otherwise) to perform approximately 47 miles of visual inspections (see Section 2.2.1). All work will be conducted in accordance with this FSP and the Project Work Plan. The work will be performed consistent with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (Section 104) and the National Contingency Plan (NCP) (Sections 300.120(c) and 300.400(e)). The provisions of 29 Code of Federal Regulations (CFR) 1910.120 will apply to all site activities.

2.2 DESCRIPTION OF WORK

The MR Sites to be visually surveyed as part of the Upper Burning Ground SI field activities are listed below and shown on Figure A-1 (Attachment 1). The estimated amount of visual survey miles to be conducted at each site has been provided as well as the corresponding figures (Figures A-2 to A-4) found in Attachment 1 of this FSP. The distances of visual surveys may change based on site conditions and/or the presence of MEC identified at a particular site. For example, if a number of MEC items are quickly identified at a particular MR Site the field crew could determine that sufficient data has been collected to recommend that site for further evaluation. Consequently, field crews may spend more time at an MR Site that contains little or no evidence of past military use in order to establish a site specific recommendation. Furthermore, terrain and vegetation can also determine the extent of a visual survey at any particular MR Site. High level/high density visual surveys (i.e., survey of a higher percentage of an MR Site's surface area) will be conducted over a smaller MR Site (i.e., the Gravel Pit) identified below, while the number of visual survey miles to be conducted at the two larger sites have been determined to be adequate for visual characterizations. No changes in visual survey will be conducted without permission from the TLI Solutions PM.

The MR Sites associated with the Upper Burning Ground include:

- **Upper Burning Ground** = 30 miles (Figure A-2),

- **Bureau of Land Management (BLM) Administered Public Lands** = 12 miles (Figure A-3).

- **Gravel Pit (Stacy)** = 5 miles (Figure A-4).

The surveys will be focused on known training areas (munitions disposal areas, etc.). However, some transects will be completed in open areas to ensure complete coverage of each site. Terrain and site features will dictate actual transect paths and may cause resulting meanders from the primary bearings.

2.2.1 General Description of Work

The field inspection team will be comprised of a UXO-qualified individual (UXO Technician), a Senior Environmental Professional who will act as Earth Tech's On-Site Manager, and a Project Environmental Professional/Geophysicist. During the visual survey, each team member will walk individual transects, nominally spaced at 10 to 25-foot apart with the separation distance dictated by site conditions (e.g., terrain and vegetation cover). Visual Survey Teams will identify, locate, and record all MEC, MD, or other evidence of military munitions observed along their path. GPS units accurate to within 10 meters will be used to record the track of each individual transect. Additionally, in the event of dense ground cover (e.g., vegetation or leaves) field personnel will be equipped with hand-held electromagnetic (EM) or magnetometer metal detectors as a safety measure to aid in their search for munitions and related debris on the ground surface. The handheld metal detectors will be deployed in advance of an individual so that any hidden MEC items can be identified to preclude the possibility of disturbing the item. If visual evidence suggests that MEC, MD, or past military activities extend beyond the initial search area boundary, the TLI Solutions PM will be consulted to determine if the search area should be extended. Survey personnel will only remove ground cover deadfall to determine if anomaly sources can be identified as necessary. Intrusive investigation of subsurface anomalies will not be pursued, but the approximate location of any areas where numerous subsurface anomalies have been encountered will be recorded.

Soil samples will be collected, handled, and analyzed in accordance with the protocols defined in the Soil Sampling Plan, Section 3.0 of this FSP. All samples will be preserved, COCs maintained, and delivered to STL Sacramento, a NELAP, ELAP, and California certified laboratory.

2.2.2 Mobilization/Demobilization

After receipt of approval of this plan from the United States Army Corps of Engineers (USACE), Earth Tech will mobilize the requisite personnel, equipment, and logistical support to conduct visual surveys. Most of the required equipment will be shipped to the site with the balance to be procured locally upon the team's arrival.

Upon completion of visual surveys, field equipment and personnel will remain in place at the site until the determination has been made by the TLI Solutions PM

that no additional visual survey work is necessary, or that no additional visual surveys will be conducted at this time. After this determination, the Visual Survey Teams will demobilize and equipment will be shipped from the site.

2.2.3 Locate Survey Control Point

Whenever possible, a suitable benchmark will be identified within each area and used as a spatial reference point. GPS units will be checked against these points at the beginning and end of each workday. The relative position of the unit will be in universal transverse Mercator coordinates, unless otherwise specified, and compared to the known benchmark (if provided by the installation).

2.3 GENERAL FIELD WORK PROCEDURES

Detailed maps of the areas will be provided to members of the Visual Survey Teams to record the relative frequency/density of MEC and/or MD at a specific MR Site, to mark all relevant finds, and to identify potential soil sample locations (see Section 3.0). The map will be of sufficient scale to allow survey crews to track their locations using terrain features such as roads, buildings, structures, drainages, hillsides, or other recognizable topographic or cultural features.

Each team member will use a handheld metal detector in areas with dense ground cover to assist in the identification of metal items at the surface that may be MEC or MD. The position of such munitions related materials or other related points of interest will be captured as GPS points and recorded in a field log. If GPS coordinates can not be acquired the team will record the location of the find along with a bearing to, and approximate distance from an identifiable terrain/cultural features. Digital photographs will be taken of any significant munitions related material identified in the field. Periodic checks of the EM devices against metallic sources will be conducted at the beginning of each work day, mid-day, and at the end of the work day to ensure the devices are working properly.

Should any MEC items be located in the field, the item will not be moved and UXO Technicians and the UXOSO will collect as much information (e.g., type, model, etc.) on the item prior to the UXOSO contacting the installation point of contact and/or the appropriate law enforcement agency as to the presence of the MEC item. These reporting procedures are detailed in Section 11.8 of the Accident Prevention Plan.

If Improved Conventional Munitions (ICMs) are identified, the SUXSO will notify the UXOSO and escort the team from the area. The UXOSO and Earth Tech UXO Technician will determine an alternate location to continue the visual survey. Additionally, if ICMs are encountered all anomaly avoidance procedures and reporting procedures outlined in Section TBD of the Accident Prevention Plan (APP) (Section TBD of this document) and the MEC Work Plan will be followed.

The Senior Environmental Professional will determine if the soils near a discovered MEC/MD or other munitions-related find should be sampled based on the following criteria (see Section 3.0):

- Are MC likely to be present in the soil?
- Have sufficient samples been collected in the area to meet project DQOs?

GPS data will be downloaded and archived each evening at the conclusion of the daily survey activities. A field map showing the locations of all MEC, MD and related points of interest will be compiled from the GPS data as the investigative field work progresses. Digital photographs will also be downloaded, correlated with the field map, and archived daily. The team members will review and compare their field logs with the digital photographs taken in the field and the flagged data points to resolve any discrepancies of field data so that each item listed in the field log is tied to a flagged GPS point and digital photograph.

As the SI field investigation(s) proceeds, the field crew will compile a field log documenting any MEC items, MD items, and points of interest identified, and note any issues encountered while conducting the visual survey. The log will also contain sketches, images, or survey maps indicating areas covered and any inaccessible areas encountered. These maps and images will be included as part of the survey record.

2.4 DELIVERABLES

Daily deliverables will be turned over to the On-Site Manager and include field logs, sketches and maps, digital photographs, and GPS data. A map of the field data (discovery/sample way-points) will be delivered to the On-Site Manager following data collection. A final discussion, including a list of all MEC, MD, and other points of interest, will be delivered after data collection has been completed. These data will be included in a letter report detailing the site investigation results.

List of Deliverables. The following is a list of deliverables that will be provided to the On-Site Manager:

- Field Logs, including any sketches and maps utilized during the field survey
- Map showing survey track and points showing locations of MEC, MD, and other points of interest (following visual surveys)
- Digital photographs
- List of MEC, MD, and other munitions related items identified during visual surveys (following visual surveys).

3.0 SOIL SAMPLING PLAN

3.1 PROJECT PURPOSE AND SCOPE

The purpose of this Soil Sampling Plan addresses the procedures associated with the collection, analysis, and evaluation of soil samples to determine if soil contamination from previous military munitions activities, in the form of MC, has occurred.

The location of sampling events will be determined in the field by applying the DQO process presented in this Soil Sampling Plan. Total number of samples to be collected (including QC and QA samples) will not exceed 70 samples for the three MR Sites at the Upper Burning Ground. Samples will be collected from each of the following areas/sites:

- Shallow subsurface composite soil samples (less than 6 inches below ground surface [bgs]) will be collected from areas suspected of being impacted by military munitions. Based on visual site inspections (e.g., disturbed areas that are clearly evident). Soil sample locations will be selected in the field to target these areas.

- Shallow subsurface composite sediment samples (less than 6 inches bgs) will be collected from the bottom of drainage areas transecting and exiting the MR Sites. Sediment sample locations will be determined in the field to target these areas.

3.1.1 Applicable Regulation/Standards

The guidance used in the development of this Soil Sampling Plan is the U.S. Army Corps of Engineers, "Requirement for Preparation of Sampling and Analysis Plans," EM 200-1-3.

3.1.2 Project Schedule

A project schedule is presented in Section 11.0 of the Work Plan. Once mobilized to the field, the following schedule will be followed:

- Approximately one week prior to mobilizing to the field, the project chemist will coordinate with laboratory to obtain appropriate sampling containers and coordinate delivery of samples. The project staff will go through appropriate preparatory phase QC checks to assure all equipment necessary to collect samples is in working order, personnel protective equipment (PPE) is available, and to review all sampling procedures described in this Soil Sampling Plan.

- A maximum of 70 soil samples will be collected over a period of several days. If necessary, soil samples will be shipped daily to the laboratory for analysis.

- Typical turn around time for analysis is 21 to 30 days depending on the available resources at the laboratory.

- Approximately 30 days will be required to complete the validation process for all sample results prior to incorporation into a summary report.

3.1.3 Data Quality Objectives

DQOs are presented in Section 9.0 of the Work Plan. The DQO development process used for soil sample investigations is described in the following documents:

- *Technical Project Planning (TPP) Process, Engineering Manual (EM) 200-1-2* (USACE, 1998).

- Guidance for the Data Quality Objectives Process, U.S. Environmental Protection Agency (EPA) QA/G-4, Final. (August 2000).

- *Implementation of Technical Project Planning for Ordnance and Explosives at Formerly Used Defense Sites Projects* (Interim Guidance Document 01-02 and Engineering Report [ER] 1110-1-2).

3.1.4 Problem Statement

Soils at the Upper Burning Ground may have been impacted by explosives. The site inspection for the project has been designed to identify areas of potential soil impact from past military operations and to determine if further investigation is required to delineate the nature and extent of the contamination. The Upper Burning Ground was used for munitions disposal, the BLM Administered Public Lands qualifies as an MR site because it may contain “kick-out” from the adjacent munitions disposal areas, and the Gravel Pit was potentially used as an open burn/open detonation (OB/OD) area. Within these areas, if a munitions disposal or contamination area can be identified, it will be evaluated for kickout and MC deposition and the following features will be assessed for soil impacts:

- Potential impact points
- Drainages traversing and exiting the area.

The purpose of the sampling outlined in this Soil Sampling Plan is to determine if the use of military munitions at the MR Sites have impacted the near surface soils. This is a preliminary study to determine if further assessment of the site and its soils is necessary. This plan is not designed to define the full extent of contamination, but rather will:

- Provide limited data to assess whether former military munitions activities have impacted the near surface soils

- Assess the nature of contamination with respect to explosives and/or heavy metals.

3.1.5 Decision Statements

The primary decision statement of the project is:

- Have past military munitions activities resulted in evidence of metals or explosives contamination in shallow soils that indicates further study is warranted?

3.1.6 Decision Inputs

The field crew will assess existing data to determine the probable locations of soil samples to be collected. Soil sampling locations will be biased to try and capture "worst case scenario" sample locations (i.e., locations with the highest probability of detecting MC). The worst-case scenario sites will consist of locations where munitions were used and drainage areas where MC may have accumulated. Soil samples will be taken at locations suspected to have had MEC, MD, or other munitions related items present, areas known to have had high levels of military munitions activities, and /or other area of interest. Examples of these other areas of interest include, but are not limited to, areas that have ground disturbance but no record of past activities (i.e., not identified in the Historic Record Search), or areas where of no evidence of military activities occurred and may be considered for a no further action recommendation.

Soil sample analysis methods for metals and explosives are provided in Table 3-1. Soil sampling results will be compared to metals background levels, if available, or U.S. EPA Region IX Preliminary Remediation Goals (PRGs). The PRGs for the analytes to be tested for and that are most likely associated with the munitions used at the Upper Burning Ground in the past are presented in Table 3-2, while the quality control criteria is provided in Table 3-3. Soil sample results will also be compared against any background levels received from the installation. These action levels will be used to evaluate whether a soil sample location has been impacted with respect to metals and/or explosive residues. Soil sample analysis for MC will be assessed at three levels; (1) are metals and explosives present, (2) compare against EPA Region IX PRGs (Table 3-2), and (3) if available, compare against background analytical results provided by the installation to assess whether the metals, if present, present a potential risk to human health and the environment. The background levels, PRGs provide a tool to quickly assess if the levels of common contaminants detected pose a risk. If contaminants are present at a site below the levels presented in Table 3-2, they are generally not considered to present a risk. However, PRGs are designed to be used as a guide in an investigation and do not necessarily mean that a particular contaminant or suite of contaminants do or do not present a risk to the environment.

Table 3-1: Planned Laboratory Analysis Methods

Analyte Group	Analytical Method(s)
Explosives	SW8330
Metals	SW6010/SW7471A

Table 3-2: Project Analyte List and Action Level Concentrations

Analyte	Action Level (mg/kg)		Background Levels (mg/kg)[(d)(e)]
	U.S. EPA Region IX PRG[(a)]	CHHSL[(b)(c)]	
Explosives			
1,3-Dinitrobenzene	6.1	--	--
1,3,5-Trinitrobenzene (sym-TNB)	1,800	--	--
2,4,6-Trinitrotoluene (TNT)	16	--	--
4-Amino-2,6-dinitrotoluene (4-Am-DNT)	12	--	--
2-Amino-4,6-dinitrotoluene (2-Am-DNT)	12	--	--
2,4-Dinitrotoluene	12	--	--
2,6-Dinitrotoluene	61	--	--
2-Nitrotoluene (o-Nitrotoluene)	0.88	--	--
3-Nitrotoluene (m-Nitrotoluene)	730	--	--
4-Nitrotoluene (p-Nitrotoluene)	12	--	--
HMX (Octogen)	3,100	--	--
Nitrobenzene	20	--	--
RDX (Cyclonite)	4.4	--	--
Tetryl	610	--	--
Nitroglycerin (NG)	35	--	--
Pentaerythritol tetranitrate (PETN)	--	--	--
Metals			
Aluminum	76,000	--	--
Antimony	31	30	11.4
Barium	5,400	5,200	628.1
Beryllium	150	150	3.2
Cadmium	37	1.7	ND
Calcium	--	--	--
Chromium	210	--	37.4
Copper	3,100	3,000	ND
Iron	23,000	--	--
Lead	150	150	15.7
Magnesium	--	--	--
Manganese	1,800	--	--
Mercury	23	18	ND
Nickel	1,600	1,600	31.9
Potassium	--	--	--
Silver	390	380	ND
Sodium	--	--	ND
Zinc	23,000	23,000	128.3

Notes:
(a) U.S. EPA Region IX PRGs Residential Soil (October 2004).
(b) California EPA CHHSLs, Residential Land Use (January 2005)
(c) Comparison of analytical results only for those areas recommended for no further action
(d) *Group II Remedial Investigation/Feasibility Study, Sierra Army Depot, Final Remedial Investigation Report*, July 1992.
(e) 95th percentile confidence limit-upper bound (calculated background level)
CHHSL = California Human Health Screening Level
EPA = U.S. Environmental Protection Level
mg/kg = milligrams per kilogram
ND = non-detect
PRG = preliminary remediation goal

Table 3-3: Quality Control Criteria for Soil Samples

Analyte	Reporting Limit Required (ppm)	Precision (RPD)	Accuracy (%R)[(a)]	
			MS/MSD	LCS
Explosives: Nitroaromatics and Nitramines (Extraction & Analysis: 8330) (mg/kg)				
1,3-Dinitrobenzene	0.25	50	80-125	80-125
1,3,5-Trinitrobenzene (sym-TNB)	0.25	50	75-125	75-125
2,4,6-Trinitrotoluene (TNT)	0.25	50	55-140	55-140
4-Amino-2,6-dinitrotoluene (4-Am-DNT)	0.25	50	80-125	80-125
2-Amino-4,6-dinitrotoluene (2-Am-DNT)	0.3	50	80-125	80-125
2,4-Dinitrotoluene	0.25	50	80-125	80-125
2,6-Dinitrotoluene	0.25	50	80-120	80-120
2-Nitrotoluene (o-Nitrotoluene)	0.25	50	80-125	80-125
3-Nitrotoluene (m-Nitrotoluene)	0.25	50	75-120	75-120
4-Nitrotoluene (p-Nitrotoluene)	0.25	50	75-125	75-125
HMX (Octogen)	0.25	50	75-125	75-125
Nitrobenzene	0.25	50	75-125	75-125
RDX (Cyclonite)	0.25	50	70-135	70-135
Tetryl	0.25	50	75-125	75-125
Nitroglycerin (NG)*	0.5	50	75-125	75-125
Pentaerythritol tetranitrate (PETN)*	0.5	50	75-125	75-125
Surrogate Matrix for Explosives				
3,4-Dinitrotoluene	87-127			
Metals (Preparation: SW 3050B; Analysis: Mercury SW 7471, all other metals SW 6010) (mg/kg)				
Aluminum	10	30	75–125	80–120
Antimony	3.6	30	75–125	80–120
Barium	5	30	75–125	80–120
Beryllium	5	30	75–125	80–120
Cadmium	5	30	75–125	80–120
Calcium	50	30	75–125	80–120
Chromium	5	30	75–125	80–120
Copper	2.5	30	75–125	80–120
Iron	10	30	75–125	80–120
Lead	2	30	75–125	80–120
Magnesium	5	30	75–125	80–120
Manganese	5	30	75–125	80–120
Mercury	0.04	30	75–120	75-125
Nickel	5	30	75–125	80–120
Potassium	20	30	75–125	80–120
Silver	5	30	75–125	80–120
Sodium	5	30	75–125	80–120
Zinc	3	30	75–125	80–120

Notes:
(a) Laboratory-specific performance criteria may be used when the laboratory is procured.
* Analytical laboratory will expand equipment calibration to include analyte.

%R = percent recovery
LCS = laboratory control sample
mg/kg = milligrams per kilogram
MS = matrix spike
MSD = matrix spike duplicate
ppm = parts per million
RPD = relative percentage of difference
SW = Test Method Solid Waste (EPA 1997)

Should an MR Site or a portion of a site be recommended for no further action, a second more conservative action level criteria will be utilized to compare to that area's analytical results. California Human Health Screening Levels (CHHSLs) are concentrations of a selected number of chemicals in the soil or soil gas considered to be below thresholds of concern for risk to human health. The CHHSLs were developed by the State of California and based on standard exposure assumptions and chemical toxicity values published by the U.S. Environmental Protection Agency (EPA) and the California EPA. CHHSLs provide a tool to quickly assess if the levels of contaminants detected pose a risk to human health. Detection of an analyte in concentrations above a CHHSL does not indicate that an adverse impact to human health has or will occur, but suggests rather that further evaluation of the potential health hazard concerns may be warranted. The action levels for the CHHSL to be analyzed at the Upper Burning Ground are presented in Table 3-2.

3.1.7 Study Boundaries

The study area boundary is presented in Section 2.0 of the Work Plan. The On-Site Manager will determine soil sample locations during the field investigation. The soil sampling outlined in the Soil Sampling Plan is designed to assess if past military munitions activities have impacted the soil.

3.1.8 Decision Rules

The following are the Decision Rules to be applied in the course of this investigation:

If geophysical investigations (Section 4.0) indicate the potential of subsurface MEC, the proposed sampling location will not be sampled,

If a MEC item is identified during visual surveys, a soil sample will be taken immediately adjacent in a manner so that the MEC item will not be disturbed,

If site conditions (i.e., discolored soil or disturbed locations) indicate that the area has sustained an impact or there is other evidence of military activity, the location may be sampled,

If a drainage is present adjacent to an area suspected of being a range area, sediments from the bottom of the drainage will be sampled.

3.1.9 Characterization of Potential Decision Errors

Decision errors possible in this investigation are one of two alternatives:

- Making the determination that contamination is present when none exists
- Making the determination that contamination is not present when it does exist.

These errors will be controlled through the use of standard and approved sampling and analysis procedures, clearly documented rationale for decision making in the field, and independent supervision of field and laboratory procedures for collecting the data required for the decisions.

3.1.10 Sampling Design

The sampling design utilizes a dynamic approach to selecting locations for sampling. Field observations and characterization of potential locations will be used to determine whether sufficient assessment of the different types of releases has been performed. Samples will be collected in accordance with procedures presented in Section 3.2. The samples will be analyzed for the analytical methods identified in Table 3-1. The lists of analytes for each method are presented in Table 3-2 and reporting limits are provided in Table 3-3. The purpose of the sampling is simply to determine if explosives are or are not present in the MR Site soils. Metals will be assessed by comparison to EPA Region IX PRGs, for residential areas.

3.2 FIELD ACTIVITIES

Soil samples will be collected from areas potentially impacted by military munitions and drainages that pass through or start within MR Site boundaries. The location and number of soil samples collected will be determined in the field based primarily on field observations followed by a review of historical aerial photographs, previous site walks, and areas of noticeable changes in the soil or landscape. Samples from drainage locations will be down gradient from areas suspected of being impacted by military munitions and other drainages that form or pass through MR Sites. The number of samples collected from a given area will vary depending on the number of areas impacted by munitions.

Sampling procedures for the various sites will be generally similar and are to be in conformance with EM 200-1-3 and *Guide for Characterization of Sites contaminated with Energetic Materials*, 2002, Technical Report, ERDC/CRREL TR-02-1. Sampling equipment will consist of disposable and pre-cleaned tools. Appropriate PPE will be used by the sampling team. Please see the Accident Prevention Plan (APP) (Appendix C of the Work Plan) for further detail regarding levels of PPE required for the site. The Soil Sampling Team will include a UXO Technician who will act as an OE escort and a Senior Environmental Professional who will collect the samples and act as the On-Site Manager. The On-Site Manager will inspect all samples prior to shipment.

This Soil Sampling Plan is intended to include sampling of metals and secondary explosives only (explosive residues) and is not to include sampling of primary explosives and propellants. Soil samples that contain 10 percent or greater explosive residue are considered explosive, present a safety hazard, and will not be shipped off site. Although explosive residue at or above this level is not anticipated, if the Soil Sampling Team or UXO specialists have reason to believe the level of explosive residue in the soil sample is elevated (i.e., explosive is visible in the soil), a field screening test will be performed using a EnSys Soil Test System Rapid Field Screen kit for 2,4,6-trinitrotoluene (TNT) or Cyclonite

(RDX). Most ordnance items of concern either have TNT explosive filler or Composition B explosive fillers that contain mixtures of RDX, TNT and other explosives. The kits are to be used to determine if a sample has an explosive content greater than 10%. If the explosive content of the soils is in excess of 10%, the U.S. Army OE Mandatory Center of Expertise (MCX) is to be contacted. The OE MCX will assess the situation and determine the appropriate course of action in accordance with ER1110-1-8153 - Ordnance and Explosive Response, which establishes the roles and responsibilities for the management and execution of OE response actions.

The EnSys test kit will be available during field activities. Because the test kits results are much more sensitive than required to determine if the explosives content is greater than 10%, the method in the User's Guide requires modification to serially dilute the samples for determination in the range of interest. EnSys Soil Test System Standard Operating Procedure (SOP) included as Attachment 2 to this FSP will be followed for collecting and analysis of samples suspected of containing more than 10% explosives. Should the test kit be utilized, the Project Chemist will be available to assist with the soil testing process to ensure that proper readings are achieved.

3.2.1 Rationale/Design

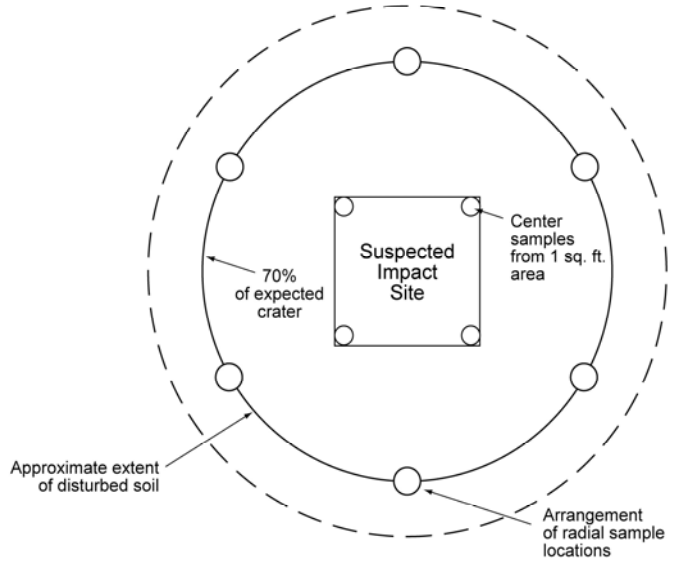
Biased strategy sampling will be conducted based on direct observation of disturbed surface material. Drainage samples will be collected down gradient from areas where areas suspected to be impacted by military munitions have been identified. A shallow subsurface composite sample will be collected from the suspected impact area/drainage sediment. Actual sample locations will be determined in the field by the On-Site Manager.

3.2.1.1 Sample Location.

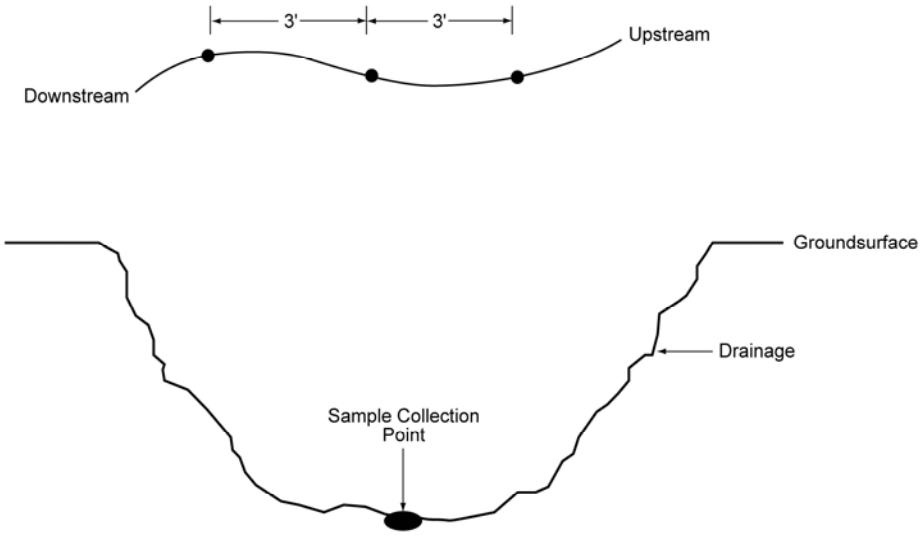
Soil sampling of areas suspected to be impacted by military munitions and drainage areas should only take place after an OE Escort has swept the areas with a handheld metal detector and determined the area is safe to conduct the sampling activities. Should a subsurface anomaly (i.e., metallic object) be detected at that location an alternate sample location will be identified. No soil sampling activities will be conducted directly over a subsurface anomaly. Field notes will document all areas selected for sampling locations, the rationale for selecting the location, and a determination of whether the site was safe for sampling.

Composite surface soil samples will be taken using a spoke and hub layout (radial perimeter method), centered on the impact site. The center sample will be composited from five discrete locations within a 1-square-foot grid at the center of the impact site. The radial perimeter sample will be composited from six discrete locations within the area of the suspected site. The general sampling locations and strategy is presented in Figure 3-1. The six perimeter samples are collected along a periphery of the impacted area. All samples will be thoroughly homogenized prior to containerization.

Berm and Undisturbed Area Samples



Drainages



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Sampling Location Strategy **Figure 3-1**

Soil samples from drainages will consist of three discrete sampling locations, one from the primary locations and one sample located three feet upstream and one sample located three feet down stream from the primary location. Figure 3-1 shows the proposed sampling location strategy.

3.2.1.2 Sample Collection.

A near surface soil sample will be taken from the suspected impact sites and drainage sediment as shown in Figure 3-1. Total number of estimated samples to be collected from each MR Site is provided in Table 3-4.

Table 3-4: Estimated Soil Samples By MR Site, Upper Burning Ground, Sierra Army Depot

Location	Approximate Number of Samples	Analytical Method(s)
Upper Burning Ground	40 samples	Metals SW6010/7471A Explosives SW8330
BLM Administered Public Lands	15 samples	Metals SW6010/7471A Explosives SW8330
Gravel Pit (Stacy)	15 samples	Metals SW6010/7471A Explosives SW8330

Procedures for collection of the samples are as follows:

1) Layout the intended sample location and record in the field log. Prior to the collection of the sample, the sampler will don clean nitrile gloves and will not allow the disposable sampling equipment to come in contact with potential sources of cross contamination.

2) At each sampling location, carefully dig down approximately 3-6 inches using a disposable spoon or similar disposable item. From the center of sampling location collect five discrete samples within a 1-square-foot grid and mix with 1 scoop of soil from each of the 6 remaining pinwheel-sampling points to composite (Figure 3-1). The radius of the pinwheel should be approximately 1-foot or the outer edge of the disturbed area.

3) For each drainage sample select a center point in the bottom of the drainage. Locate a point three feet up stream and three feet down stream. Collect 1 scoop of soil from each of three locations. Be sure the total sample amount (total of three scoops) is enough to fill an 8-ounce sample jar. Sample preservation requirements and size are presented in Table 3-5.

4) Transfer each scoop of sample onto a disposable plastic bag.

Table 3-5: Requirements for Soil Sample Preservation, Maximum Holding Time, and Containers

Analyte	Analytical Method(s)	Preservation	Maximum Holding Time	Number × Sample Container Type
Metals	**SW6010/7000**	--	6 months	One 8-oz glass jar or stainless steel liner with Teflon-lined lid/end caps
Explosives	**SW8330**	Cool to 4°C	14 days from sample collection to extraction/ 40 days from extraction to analysis	

5) Thoroughly mix the sample in the plastic bag with the disposable scoop or trowel used to collect the sample. The sample should be completely homogenized.

6) Transfer sample into an appropriate sample jar with the disposable scoop or trowel used to collect the samples.

7) Secure the lid of the jar tightly. Do not interchange the container lids. The chemical preservation of soil is not required.

8) Fill out the sample label in accordance with the requirements in Section 3.3.3.2 and affix the label to the sample container. Be sure to label the tag carefully and clearly. Complete all COC documents and record in the field logbook. Table 3-5 provides the requirements for sample preservation. Attachment 3 provides an example of a COC form.

9) Place each sample jar in a cooler with ice for temperature preservation. Soil samples should be kept at 4°Celsius $\pm$ 2 until arrival at laboratory.

10) Document the sample location with a minimum of one photograph.

Soil samples will be collected, labeled, packaged and shipped in accordance with Sections 3.3.3.2, 3.3.3.3, and 3.5 of this Soil Sampling Plan.

The collection frequency of QC and QA samples (i.e., field replicates and equipment blanks) will be at the frequency shown below:

- QC samples will be collected at a frequency of 5% field samples
- QA samples will be collected at a frequency of 5% field samples
- Equipment blanks, if necessary, will be collected once per day of sample collection

3.2.2 Quality Assurance and Quality Control Sample Collection

3.2.2.1 Rationale/Design.

QC and QA samples will be collected at a frequency of at least 10% (5% QC and 5% QA) of the total field samples. It is proposed that a maximum of 70 field

samples will be collected at the Upper Burning Ground; therefore a maximum of 4 QC and 4 QA samples shall be collected. QA and QC sample locations will be chosen in the field and a minimum of one QC and one QA soil sample shall be obtained from each MR Site.

3.2.2.2 QA and QC Sample Collection.

QC samples will be collected and shipped to STL Sacramento, while QA samples will be collected and analyzed for explosives and metals at a laboratory chosen by the Corps of Engineers. The following sampling methods apply:

1) Obtain QA and QC samples from the thoroughly mixed and homogenized sample collected at the chosen location (see Section 3.2.1.2). Enough sample at the chosen location should be obtained so that two sample containers (8 ounce glass jars) can be filled (One for the field sample and one each for the appropriate QA or QC sample).

2) Transfer sample into an appropriate sample jar.

3) Secure the lid of the jar tightly. Do not interchange the container lids. Chemical preservation of the soil is not required. Temperature preservation is required.

4) Fill out the sample label in accordance with the requirements in Section 3.3.3.2 and affix the label to the sample containers. Be sure to label the tag carefully and clearly. QC samples will be given a sequential sampling ID as described in Section 3.7. QA samples will be given a separate sample ID number. QC samples may be placed in the same shipment container as all other field samples. Place all sealed sample containers in the sample cooler, on ice (Table 3-5). QA samples will be placed in a separate container and shipped to the Corps designated laboratory. Complete all COC documents and record in the field logbook.

QC and QA samples will be collected, labeled, packaged, and shipped in accordance with Section 3.7 of this Soil Sampling Plan. The list of analytes will be provided to both laboratories during the contract set-up.

3.3 FIELD OPERATIONS DOCUMENTATION

3.3.1 Field Log Book and Data Sheets

All field measurements, observations, and sampling activities will be recorded by field personnel in daily field logbooks, on field data forms, or in similar permanent records. Field data will be recorded directly and legibly in indelible ink, with all entries signed and dated. Field data documentation will be collected and reviewed daily by the On-Site Manager or his designee. The field data records will be sufficiently detailed to allow the reconstruction of Earth Tech's field activities by an independent party at a later date. If an entry must be changed, the change will not obscure the original entry, and will be initialed and dated by

the individual making the change. Field data records will be organized into standard formats whenever possible and retained in Earth Tech's field office's field files or in the project files at the home office. At a minimum, the following data should be recorded in the field logbook.

- Date, time, unique identifier, and brief description of the location of each sample collected.

- General weather conditions, description of soil conditions such as any visible evidence of impact or discolored soil indicating potential contamination.
- ID number of photographs taken, GPS point location ID number.

3.3.2 Photographic Records

Photographs of the sampling sites will be taken and logged into the field logbook. The photograph number (i.e., as indicated on the camera, if available) will be recorded in the logbook and referenced to the sample ID number.

3.3.3 Sample Documentation

3.3.3.1 Sample Numbering System.

The sample numbering system for each soil sample will be coded to the installation name (i.e., Upper Burning Ground), a location identifier, and a sequential sample identifier based on the matrix type (SO001 for soil and SED001 for sediment).

The sample identification (ID) for the Upper Burning Ground MR Sites will be in the following format:

SIAD-UBG-SO001

Unique Field Sample ID's are as follows:

Upper Burning Ground	UBG
BLM Administered Public Lands	BLM
Gravel Pit (Stacy)	GPS

Different analytical methods may require different sample containers or different preservatives, each of which requires a separate line on the COC record, so the field sample ID may be entered multiple times on different lines for a given sample.

3.3.3.2 Sample Labels.

A sample label identifies samples with the following information recorded:

- Project identifier (SIAD)
- Unique field sample ID (e.g., UBG)

- Date and time of collection
- Analyses requested
- Type of preservative used (if any)
- Sampler's name or initials.

Sample labels will be affixed by the sampler to the sample containers used. Labels will be affixed by the laboratory to the sample containers specifying the type of preservatives used, where applicable.

3.3.3.3 Chain of Custody Records.

In order to maintain and document sample custody, the following COC procedures will be strictly followed. A sample is considered to be under custody if:

- It is in actual possession of the responsible person
- It is in view, following physical possession
- It is in the possession of a responsible person and is locked or sealed to prevent tampering
- It is in a secure area.

Sample custody is maintained by the COC record. The COC record is completed by the individual designated by the On-Site Manager as being responsible for sample shipment and must be completed at the sampling site. The information recorded on the COC record will be provided as follows:

Chain of Custody Procedures:

Laboratory	The laboratory name and address where the samples are being sent.
Contact	The primary contact at the laboratory along with the phone and facsimile numbers.
Client	Army Corps of Engineers
Shipment Number	A unique identifier applied to the shipment.
Method of Shipment	e.g., FedEx, Courier.
Air Bill Number	Shipper's unique identifier for the shipment.
Cooler Number	A unique identifier for the cooler in which the samples are sent to the laboratory.
Custody Seal No.	A unique identifier for the seal on the cooler.
Project Number	The Earth Tech project task number under which the samples were collected.
Project Name	A description of the Earth Tech project task number.
Project Contact	The Earth Tech On-Site Manager's name along with the phone and facsimile numbers.
Sampler's Signature	Signature of the person responsible for the collection of the samples and filling out the COC form.

Chain of Custody Procedures:

Lab Job	This field is filled in by laboratory personnel after the samples have been logged in.
Ship Date	The date the samples are shipped to the laboratory.
Page	The page number of the COC form (e.g., page 1 of 2).
Sample	A unique sample number is generated for each field sample ID listed, which helps to distinguish samples across multiple lines and pages of the COC form.
Field Sample ID	The unique sample identifier.
Sampling Date	The date the sample was collected.
Sampling Time	The time the sample was collected.
Matrix Type	The matrix type of the sample (e.g., SO for solid or SED for sediment).
Type/Size of Container	e.g., 8-ounce glass jar.
Preservation - Temp	e.g., 4 degrees (°) Celsius (C)
Preservation - Chemical	e.g., HCl
Filtered	Check box if sample was filtered in the field.
No. of Containers	Enter the number of sample containers.
Analyses Requested	List all analyses that are to be performed on the samples listed and then check the boxes under each analysis on the lines for each sample.
Remarks	Enter any sample or analysis-specific remarks (e.g., MS/MSD requests, short holding time).
Relinquished By - Signature	Signature of the person relinquishing the shipment of samples.
Relinquished By - Printed	Printed name of the person relinquishing the shipment of samples.
Relinquished By - Company	Company the person that is relinquishing the shipment of samples works for.
Relinquished By - Reason	Reason the samples are being relinquished.
Relinquished By -Date/ Time	Date and time the samples are relinquished.
Received By - Signature	Signature of the person receiving the shipment of samples.
Received By - Printed	Printed name of the person receiving the shipment of samples.
Received By - Company	Company the person that is receiving the shipment of samples works for.
Condition of Sample	Brief statement as to the condition of the sample container.
Received By - Date/Time	Date and time the samples are received.
Comments	Enter any shipment related comments (e.g., level of data requested, QC sample designation, special sample handling instructions, high concentration sample information, turnaround time, etc.).

A copy of the completed and signed original COC form will be a permanent part of the project records. Final COC form distribution is as follows:

White Copy	-	Analytical Laboratory Report
Yellow (Canary) Copy	-	Laboratory File
Pink Copy	-	Courier/Delivery Service or Field Office
Golden (Goldenrod) Copy	-	Project Office File.

The white original and yellow (canary) copy will accompany the samples to the laboratory to document transfer. The laboratory will eventually return the white original in the laboratory data report, and retain the yellow copy for its records. The courier will retain the pink copy or by the delivery service if they require it, otherwise the pink copy may be retained by the Soil Sampling Team. The golden (goldenrod) copy of the COC form should be retained by the Soil Sampling Team, and forwarded to and stored in the project files at the home office. If the samples are transported to the laboratory by the sampler, no transfer need be recorded on the pink or yellow copies. If a courier or person other than the sampler takes custody in order to transport the samples to the laboratory, the pink and yellow copies should be annotated to show this transfer prior to separation from the white original.

Field personnel initially taking the sample are responsible for the care and custody of the sample(s) until it is properly transferred or delivered to laboratory personnel. All samples will be accompanied by a COC form. When transferring the possession of samples, the individuals relinquishing and receiving the samples will sign, date, and note the time on the record. The company from which the sample is relinquished and to which it is delivered and the reason for transfer will be noted. This record documents the transfer of samples from the custody of the sampler to that of another person, or the permanent laboratory.

The relinquishing individual will record specific shipping data (air bill number, company, time, and date) on the original and duplicate custody records. It is the On-Site Manager's responsibility to verify that all shipping data are consistent and are made part of the permanent project files. Finally, all custody records will be reviewed by TLI Solutions field personnel prior to shipping samples.

The QA laboratory will also be required to provide a facsimile or a scanned electronic copy of the COC and cooler receipt form to the attention of USACE QA personnel at the following address:

CESPK-PM-H
Attention: Ms. Young Chong
1325 'J' Street
Sacramento, CA 95814-2922

Young.S.Chong@usace.army.mil

3.3.4 Documentation Procedures/Data Management and Retention

Field data records will be collected by the Soil Sampling Team(s) and verified daily by Earth Tech's On-Site Manager or designee, who will review the data for completeness, accuracy, legibility, comparability with other data collected, and verify the field data records have been signed and dated. The On-Site Manager will direct field staff to make necessary corrections to the record and to initial and date the corrections. Any omissions or inconsistencies discovered would be resolved by the On-Site Manager, who will seek clarification from the field personnel responsible for data collection. After data reduction and entry into the Earth Tech database, field data will be verified by qualified personnel for completeness, consistency with hardcopy records, and anomalous values.

Field data, including both electronic and hardcopy documentation, will be reviewed by Earth Tech's On-Site Manager prior to inclusion in technical reports, and may be reviewed by the Project QA Manager or technical designee as part of ongoing QA review of project activities.

All project records, documents, and files will be stored or archived in secure locations at Earth Tech's project office. The integrity of files and databases will be assured by limited access. Non-laboratory project data (e.g., field data) may be temporarily stored at Earth Tech's field office, although such data will be archived at Earth Tech's project office. Project data will be stored for a period of not less than 3 years after the final report is issued at Earth Tech’s project office or at a secure off-site storage facility.

3.3.5 Field Analytical Records

There are presently no field activities that require field analytical records. However, should the EnSys Soil Test Kit be utilized during the field activities, all results and sample locations will be noted in the field log book. Additionally, the Soil Test Kit worksheet will be completed in the field and will be scanned and added to the analytical results in the SI Report. Analytical records required for the EnSys Soil Test Kit are presented in the test kit SOP included as Attachment 2 of this FSP.

3.4 SAMPLE PACKING AND SHIPPING REQUIREMENTS

All samples sent to an off-site laboratory will be packaged carefully to avoid breakage or contamination, and will be shipped to the laboratory at proper temperatures. The following sample packaging requirements will be followed:

- Sample bottle lids will not be mixed. All sample lids will stay with the original containers.
- If the sample volume level is low because of limited sample availability, the level will be marked on the outside of the container with a grease pencil. This procedure will help the laboratory determine if any leakage occurred during shipment.

- Custody seals will be utilized on sample containers or on plastic bags containing multiple sample containers when there is a chance that custody seals or sample containers may be tampered with, such as if the sample container must be stored for any period of time in an unsecured location or refrigerator, or if the sample container must leave the custody of Earth Tech for any reason either unpackaged or in a cooler or shipping container not otherwise custody sealed.

- All glass sample bottles will be wrapped in bubble pack or equivalent and sealed in self-sealing plastic bags to minimize the potential for contamination and breakage during shipment. Plastic bottles will not be wrapped, but will be sealed in self-sealing plastic bags. Soil samples contained in stainless steel liners will be sealed in self-sealing plastic bags.

- All samples will be cooled unless "no cooling" has been specified. The sample containers will be packed in coolers. The coolers will then be filled with ice within self-sealing bags. Sufficient ice shall be included for the samples to arrive at $4^0C \pm 2^0C$. A temperature blank will be included in each cooler for temperature determination upon receipt at the laboratory.

- Empty space in the cooler will be filled in with inert packing material such as vermiculite or bubble wrap. Under no circumstances will locally obtained material (sawdust, sand, etc.) be used.

- The original COC record will be sealed in a self-sealing plastic bag, taped to the inside lid of the cooler, and transported along with the coolers to the laboratory. Also included with the COC should be a table identifying the samples at a minimum by number and location that allows the collector to indicate the desired analysis.

- All samples should be shipped upright.

- All shipping containers will be locked and custody sealed for shipment to the laboratory. The custody seal will consist of a custody seal or filament tape wrapped around the shipping container at least twice, with the tape end signed before the sample is shipped. The shipping containers will be transported as environmental samples to the laboratory as expeditiously as possible, most likely by Federal Express overnight delivery service or courier.

Due to the analytical holding times, identified in Table 3-5, it is possible that two shipments of soil samples will be made. The first shipment may be mid-way through the SI field effort and the second/final shipment will be made at the end of the conclusion of field activities and will be part of the demobilization process.

3.5 INVESTIGATION DERIVED WASTE

No IDW are expected to be generated by the soil sampling procedures. All PPE and disposal sampling equipment is considered non-hazardous. PPE will be placed in a plastic bag and disposed of in an appropriate refuse container. If IDW is generated it will be properly containerized and characterized prior to

disposal. For non-explosive soil, containerization would consist of plastic or steel drums or pails with secure covers. For liquids (i.e., water), containerization would consist of plastic drums or pails with secure covers. Characterization of the wastes will be as required by the receptor site.

3.6 FIELD DATA QUALITY CONTROL ASSESSMENT

Earth Tech's data quality assessment of field data will include QC assessment of field data associated with environmental samples submitted for analysis. Specific field data QC assessment activities performed in support of data quality assessment include checking the completeness of associated field data forms, daily field logbooks or other documentation, adherence to sample collecting and testing procedures, and confirmation that required numbers of field duplicates/replicates, equipment blanks, and ambient condition blanks were prepared or collected. COCs will be checked for signature and date at each transfer of custody, consistency with daily field logbooks/data sheets, preservation documentation, and analyses requests. Field data QC assessment will be performed by Earth Tech's PM or an Earth Tech chemist experienced in performing data quality assessments. Earth Tech's Project QA Manager has final authority over Earth Tech's field data QC assessment.

All analytical data will be collected in accordance with USACE Chemical Data Quality Management (CDQM) Program requirements and guidance specified in *Engineering and Design Requirements for the Preparation of Sampling and Analysis Plans* (EM 200-1-3, February 2001), the *Environmental Data Quality Management Program Specifications, United States Army Corps Of Engineers (ACE) – Sacramento District, Version 1.08* (Draft, January 1999), *Implementation of Technical Project Planning (TPP) for Ordnance and Explosives (OE) Formerly Used Defense Sites (FUDS) Projects* (Interim Guidance Document 01-02), and *Department of Defense Quality System Manual (DOD QSM) for Environmental Laboratories – Version 1. (October 2000).*

All reporting limits and control limits are based on review of the regulatory limits and currently established laboratory capabilities for similar samples. These reporting and control limits will be confirmed with the selected analytical laboratory prior to start of the project. The use of programmatic limits allows for a more uniform data product from analytical laboratories and for more uniform data assessment for the project. All primary and QC samples will be sent to ST Lab Sacramento, a NELAP, ELAP, and California certified laboratory and all QA will be sent to a USACE designated laboratory.

3.7 CORRECTIVE ACTION PROCESS

The corrective action process is built around the Earth Tech Nonconformance Report (NCR). The NCR and the laboratory anomaly reporting system are used to centralize the reporting of all conditions that adversely impact the quality of project data, and to document the corrective actions taken to address these conditions for Earth Tech's corrective action program.

When Earth Tech Project Team members identify conditions that may adversely impact project data quality, they will initiate the NCR process. Earth Tech's Project QA Manager is ultimately responsible for the documentation, tracking, response to, and closure of all NCRs, but will typically seek input and concurrence from Earth Tech personnel and USACE when developing or closing out a corrective action. NCRs and corrective action documentation will be included in the permanent project files. A copy of all NCRs shall be provided to the USACE PM and USACE Project Chemist.

3.7.1 Field Activities

For the duration of the project, it will be the responsibility of Earth Tech's PM, On-Site Manager, and Soil Sampling Team members to see that all procedures are followed as specified in the Soil Sampling Plan, and that measurement data meet the prescribed acceptance criteria. In the event that a problematic or potentially problematic condition arises, it is imperative that prompt action be taken to correct the condition. Potentially problematic conditions include deviation from, or nonconformance with:

- Contract specifications
- Applicable U.S. EPA, USACE, or Department of Energy (DOE) guidance
- Investigation program requirements, QA program requirements, or field method procedures specified in this Soil Sampling Plan or this Work Plan.

Problematic conditions also include major errors in documented analysis, data or results, and deficiencies in documentation or any other aspect of the project that affect quality. Earth Tech personnel who identify existing or potentially problematic conditions will report the conditions by completing the NCR, and distributing it to Earth Tech's On-Site Manager, PM, and Project QA Manager. The number of samples, known or estimated, affected by the condition should be noted on the NCR. The NCR will be used to document the condition, the corrective actions taken, the resolution of the problem, and the return to field program control.

Upon initiation, Earth Tech's PM and Project QA Manager will review the NCR to determine if:

- Ongoing work should be stopped
- The condition involves a major deviation from the contract or client-approved work plans, may significantly impact the cost or schedule of the work, or may significantly impact the quality of the resulting data, in which case the condition will be reported to the client
- The condition has any impact on previously obtained data or reports submitted to the client or other organizations. If previous data or reports are impacted, Earth Tech's PM will note the impact in the

remarks section of the NCR and notify in writing all individuals and organizations that may be affected by the problem, explaining resulting impacts to project data.

The evaluation will be documented by completing Part B of the NCR.

The supervisor will recommend corrective action to resolve the problem by completing Part C of the NCR, and the recommended corrective action will be reviewed and approved by Earth Tech's PM, or Project QA Manager.

The approved corrective action will be implemented by appropriate personnel, and reviewed and approved by Earth Tech's PM and Project QA Manager. The approval will be documented on Part D of the NCR.

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4.0 GEOPHYSICAL MAPPING PLAN

Geophysical data will be obtained to evaluate and document the potential presence of subsurface features, including material potentially presenting an explosive hazard (MPPEH), of which MEC is a subset, and other munitions-related items at the Upper Burning Ground. Earth Tech will furnish all labor, equipment, and materials (except where specified otherwise) necessary to perform the work. All work will be conducted in accordance with this Geophysical Mapping Plan and the project SSHP.

The geophysical investigation entails: (1) establishing positional survey control, (2) validating instrument response parameters, and (3) a geophysical detection and mapping investigation of one MR site, including preparation of a letter report of activities and results.

An estimated 1 acre of digital geophysical mapping (DGM) will be conducted over the Upper Burning Ground MR Site. Based on the results of the visual survey, a geophysical survey may be conducted at the Gravel Pit (Stacy) site. Earth Tech will present the results of the visual surveys conducted at this MR Site to the TLI PM and the USACE PM, who will then evaluate the information and determine if a geophysical survey is warranted.

4.1 DESCRIPTION OF WORK

Mapping will be completed along meandering paths. Collection of data will be biased toward known areas of interest (munitions disposal area, “kick-out” areas, etc.) and less data will be acquired in the open areas between designated munitions training areas.

A Time Domain EM (TEM) mapping system (Genoincs EM-61®) with GPS system capable of ± 1-meter precision will be used to locate metallic sources in the subsurface. Instrument performance will be determined via a portable geophysical instrument validation system and verified during data collection with quality control checks including instrument standardization checks and detection of seed items placed in the survey area.

The Geophysical Mapping Team will consist of a Geophysicist and an appropriately qualified and certificated UXO Technician who meets the qualification requirements of DDESB TP 18. If necessary, a Staff Scientist and a UXO Technician could be utilized for providing compass navigation in forested areas of the project site when GPS can not be used. The UXO Technician will provide escort duties and perform other duties as required.

4.1.1 Data Quality Objectives

Completeness of coverage – All areas identified in Section 4.1 of this FSP will be mapped utilizing transects spaced to ensure that all areas are adequately investigated. Fences, obstacles, and other inaccessible areas will be noted in

the project geographic information system (GIS). The geophysical system to be used has a detection footprint width of 3.28 feet (1-meter). Mapped transects with holidays (continuous navigational data drop-outs) in the GPS data greater than 6 seconds will also not be used in the calculation of mapping coverage.

Minimum detection standard – All geophysical mapping must meet minimum detection standards. Seed items will be placed on the surface in the survey area. Data collected over a seed item that does not identify the seed item will be reviewed to identify the source issue. If the source issue is identified with equipment problems the affected data will be reworked and/or remapped until suitable data is obtained.

Consistent quality – Data collected over the site must be of consistent quality. This will be verified by instrument standardization checks, repeating portions of the previous day's work, and/or passing over a portable test strip at regular intervals.

Documentation standard – All geophysical field activities will be documented. Field logs will be maintained on a daily basis, showing quality check results, daily activities, list of acquisition files with data type description, obstacles identified, and a sketch map of area covered. Additionally, all raw data will be archived digitally on a daily basis. All processing steps will be documented and processed data archived.

4.1.2 Mobilization/Demobilization

After the review and approval of this FSP, Earth Tech will mobilize personnel and equipment constituting the Geophysical Mapping Team and its support to the site. Most of the necessary equipment will be shipped out to the site if not already present, with the balance to be procured in the area of the Sierra Army Depot upon or before the geophysical team's arrival.

Upon completion of field activities, data will be reviewed to determine if additional work or rework needs to be conducted. Field equipment and personnel will remain in place at the site until the determination has been made by the Earth Tech On-Site Manager and the TLI Solutions PM that no additional geophysical mapping is necessary, or that no more mapping will be conducted at this time. After this determination, the geophysical team will demobilize and equipment will be shipped from the site.

4.1.3 Locate Survey Control Point(s) for GPS Base Station

To attain the necessary GPS precision it will be necessary to calibrate the GPS to known control points in or near the survey area. This will also allow any outside surveyors to accurately relocate any of our GPS locations by calibrating to the same known points. Optimal calibration requires a minimum of three known, non-collinear points. Additional points will improve the accuracy of the calibration, and will be used as well, if identified and available. Control points will be identified and acquired for calibration purposes before field mapping is initiated.

If less than three known control points are available, additional control points will be established using GPS. This entails collecting GPS data for several minutes to several hours at the new control point and is generally considered to result in a less accurate geodic model. This loss of accuracy is small, typically on the order of a few inches, but cumulative to any work that follows.

4.1.4 Equipment Validation Area

A portable validation apparatus would be constructed and used to verify the ability of the geophysical array to consistently detect metallic sources. A portable apparatus allows for an immediate validation of a geophysical array without returning to an established buried validation plot. The validation apparatus would consist of a seeded/fitted metallic sources placed at regular intervals. The metallic seed items would consist of common metallic items that can easily be found at a local hardware store (e.g., rebar and piping) and that would be of similar dimension and density of MEC items anticipated to be found at the MR Sites to be investigated. The geophysical array can then be elevated to a predetermined height above the ground and the apparatus passed beneath it to evaluate potential depth of detection performance. Any failure to geophysically detect a seed item would be reviewed with the Earth Tech On-Site Manager and reasons for the detection failure identified and resolved.

4.1.5 Equipment Validation Results

The results of the first run using the portable equipment validation apparatus will be reviewed prior to collection of geophysical data over the project area on following days. Effective maximum depths for reliable detection will be identified based on results. An Equipment Validation memo will be submitted to the Earth Tech On-Site Manager after a satisfactory run with the equipment validation apparatus has been completed. If the equipment or approach is deemed unsuitable for the project objectives no work will be initiated.

4.1.6 Geophysical Detection and Mapping

Geophysical data will be collected using a multi-time gate EM system with a 3.28-foot (1-meter) wide footprint. Continuous tracking, checks, and adjustments of the field data will be performed for QC and to establish efficient field procedures. Navigation and instrument position within the investigation area shall be tracked and recorded using state-of-the-art GPS instrumentation with 1-meter precision. The GPS system will be integrated with the geophysical survey instrumentation to simultaneously record GPS position along with geophysical survey data. Survey speed will be constrained to ensure measurements are recorded at no more than 0.5-foot intervals along the survey lanes. Geophysical data will be correlated with the GPS navigation data. Position dilution of precision or horizontal error calculations will be provided as part of the data stream.

The State Plane grid coordinate system will be used and referenced to the North American Datum (NAD) 83 geodic.

At the completion of each survey day, copies of the field notes, maps, standardization documentation, and digital survey data will be delivered to the Earth Tech On-Site Manager. The data will be annotated with survey mission identifications and date.

Standardization of each system will be performed periodically each day to ensure proper operation and function of the system. Standardization will be accomplished using a portable source in a fixed geometry with each receiver antenna. The portable source is used to eliminate the need to return to one location several times each day. Standardization consists of comparing the residual anomaly to the acceptance range and recording the values in the daily logs. Acceptance range is specified at ± 20 percent of the standard response (calculated mean residual anomaly).

The standardization response and acceptance range will be recorded in a bound geophysical survey field log. If a system component does not respond within the acceptance range, the standardization measurements will be repeated. Three sequential failures will cause the system to be removed from service. Any failed component must be replaced or repaired and a new standard response (with a new standard deviation and acceptance range) calculated before being redeployed to the field.

GPS location checks will be made at the beginning and end of each day, except under the following condition: No location checks will be made in conditions of high horizontal location error due to satellite locations. This may prevent an end-of-day check, but no mapping can occur until a check has been made at the beginning of the day. GPS values will be recorded over a fixed point and compared to the initially measured GPS value for the fixed point. The acceptance range for GPS location error is 1 foot. If the GPS does not repeat the initial location, the GPS check will be repeated. Three sequential failures will cause the GPS to be removed from service. Any failed component must be replaced or repaired and a new measured value for the location check must be established.

Validated software will be used to process the data. Software “validation” will be understood to exist for commercially available programs or through submittal of software documentation sufficient for the reviewing geophysicist to understand the logic and algorithms used in the processing.

The geophysical field data will be checked, corrected, and processed into ASCII files. Data shall be corrected for navigation errors, instrument bias, and measurement drift. Data collected by different receivers will be demoded (if necessary) to set background levels for each system equal to the same datum. The data will be presented in delineated fields as x, y, z, and v1 . . . vn, where x and y are coordinates, z is the instrument elevation above sea level, and v is the channel (time gate) response.

All corrections, edits, filtering, or normalization of the data used to identify potential MEC anomaly locations will be fully documented in a data processing log. Field processing will include a symbol posting of the measurement stations

along the survey lanes and generation of response profiles versus time of the data measured at each of the geophysical receivers of the array. Processing of digital data will include a symbol posting of centerline locations of the sensor array and production of image plots of the data over the survey area. An inspection of the data will be performed to identify single-point anomalies, steps in response, incoherent signal, or excessive noise response range. All such events will be noted and described in the data processing logbooks.

The project geophysicist will review field data daily to assess usefulness of the data for detecting and resolving MEC anomalies. Noise levels in the data will be analyzed to ensure that they are sufficiently low to allow adequate signal-to-noise differentiation of pertinent anomalies. Unusable or incomplete data delivered for any survey lane will not be used for coverage calculations. Any variations or results not compatible with prior results or expectations will be evaluated to determine causative features that may be present.

The State Plane coordinates recorded for each survey segment (discrete survey lanes or transects) will be reviewed to ensure that the sampling data are accurately located within the study area. The field logs will be reviewed each day to verify that data were collected following a continuous progression along the survey lanes. If the survey progression was interrupted for a particular segment because of terrain or other considerations, the reviewer will verify that the causes of the deviation and the actual mode of progression are fully described in the field logbook notes. The landmarks, fiducials, and anomaly locations represented in the processed geophysical data will be compared to geophysically referenced spatial data (GIS base maps). The features of the GIS that are reflected in the geophysical data should be coincident with respect to location to within 1-meter. Any discrepancies in positional or locational accuracy of the data noted during the field review will be described, including steps taken to correct or resolve these issues.

Field notes will be compared to the downloaded digital file data to assure correspondence between lanes surveyed and lanes recorded. Unavoidable obstacles will have been mapped on the field sketches and should result in direct correspondence with missing data. Data drop-outs or inexplicable data shortages, if not detected during the field review and scheduled for reacquisition, will be evaluated to identify the root problem and steps needed for resolution. Missed areal coverage will be flagged and fill-in data will be collected, as necessary, to ensure coverage sufficient to meet the mapping objectives. The physical footprint of the transmitter coil will define the coverage area.

4.1.7 Data Quality Validation

Geophysical personnel will perform a review and verification of 10 percent of the geophysical data. Data processing will be performed using *Geosoft Oasis montaj* or *Golden Software SURFER for Windows* software to perform quality checks, validate data, and make the required plots. Duplicate processing should result in identification of similar anomalies. QA processing of digital data will include production of representative profiles. The profile images will be used as

a tool to compare discriminated locations with those anomaly locations previously identified by the target picking routines used to generate the anomaly “dig” lists.

QA will comprise the following activities:

- Review of daily field documentation (e.g., maps, field notes)
- Review of daily standardization results (instrument precision)
- Derivation of data statistics and measurement coordinates for audit sample (location accuracy)
- Posting of data for audit sample (survey/coverage completeness)
- Generation of contour/image/profile plots of audited data (representativeness/reasonableness)

A quality summary report will be prepared and submitted to the project manager after the data have been reviewed and verified as acceptable by a California Licensed Geophysicist.

4.1.8 Deliverables

The categories of deliverables include those resulting from data collection, data processing, and a final discussion of the work.

4.1.8.1 Data Collection.

- Field notes, including sketch map and any obstacles or dropouts
- Standardization documentation
- Map showing progress of field mapping effort
- Data files containing the raw instrument and GPS output.

4.1.8.2 Data Processing.

- Spatially referenced, edited/corrected data, in files giving interpolated easting and northing, a timestamp, and the instrument response for each reading collected
- Spatially-referenced color image plots of the data, showing position of each anomaly relative to coordinate system and symbol posting of the centerline track of the sensor receivers along the transects
- A tabulated listing of anomalies with unique identifiers, State Plane coordinates, and anomaly peak response

4.1.8.3 Letter Report.

A letter report will be prepared containing the

- Data deliverables listed above,
- Documentation of quality management activities,
- QA summary,
- Description of the equipment used,
- Data collection/processing methodology, and
- Discussion of the data and interpreted results.

4.1.9 Typical Daily Work Sequence

- Mobilize to site
- Tailgate safety meeting
- Debrief previous days work, logs, and any relevant safety issues
- Receive mapping assignments
- Power on equipment/move equipment to test area
- Run static and standardization check, verify GPS location – document results
- Perform mapping activities
- Complete end-of-mission standardization check
- Power down/store equipment
- Download/archive data: finish, sign, and copy field logs
- Demobilize from site

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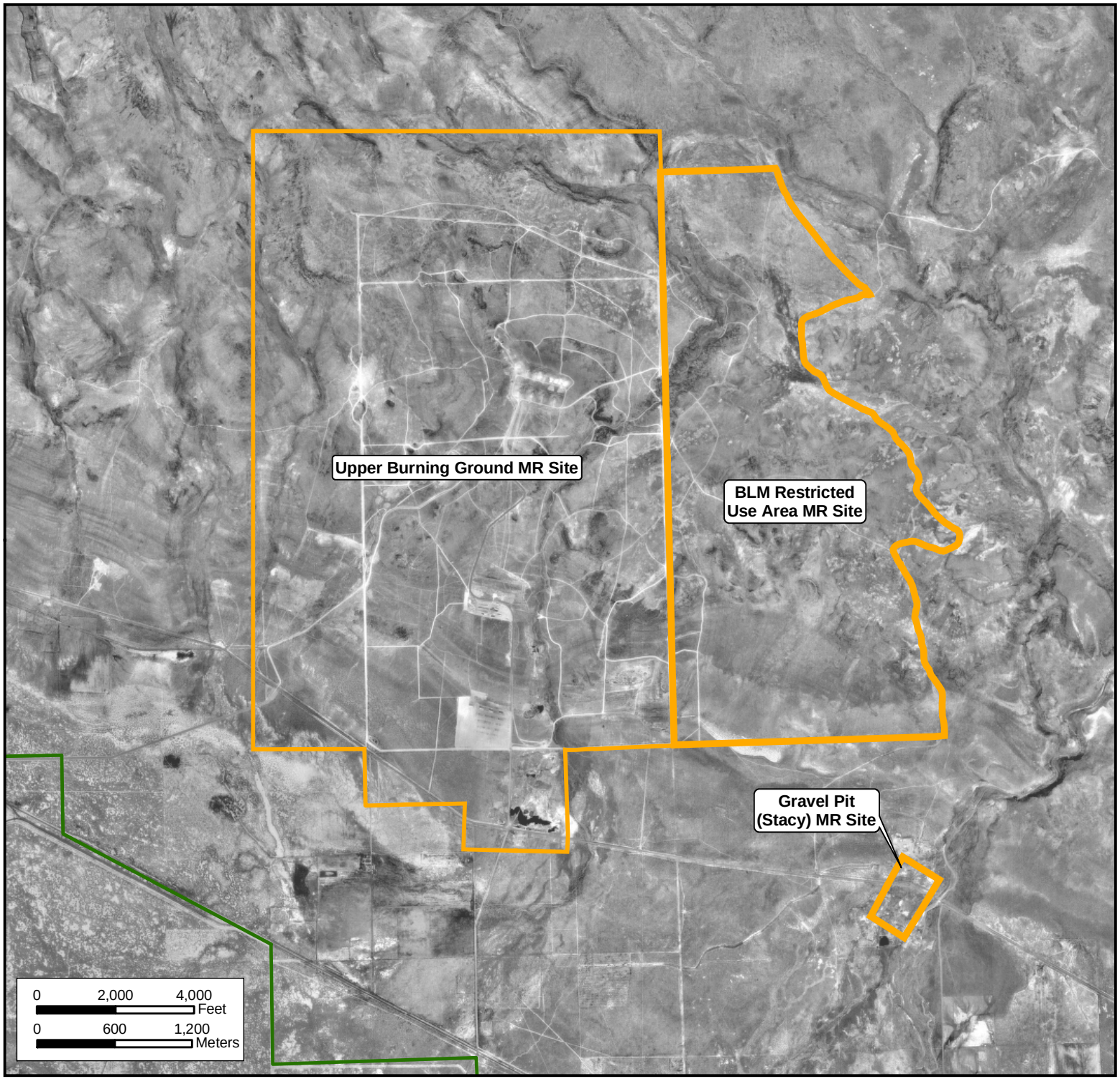
ATTACHMENT 1

MR SITE FIGURES



Legend

- Upper Burning Ground Project Boundary
- Sierra Army Depot Installation Boundary

Notes and Source Data

1) Survey datum is NAD 83 UTM Meters Zone 17
2) Aerial Photogrammetry USGS July 27, 1993

TLI Solutions

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Figure A-1
MR Site Locations
Upper Burning Ground
Sierra Army Depot, CA
April **2007**

Z:\Sierra_UBG\ArcGIS\Installation_Map.mxd