DRAFT
SCOPING DOCUMENT FOR DEVELOPMENT OF RADIATION SURVEY OF A BACKGROUND REFERENCE AREA AND AREA IV/BUFFER ZONE

SANTA SUSANA FIELD LABORATORY

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LIST OF ACRONYMS

AEC	Atomic Energy Commission
ANL	Argonne National Laboratory
ARARs	Applicable or Relevant and Appropriate Requirements
CalEPA	California Environmental Protection Agency
CBG	The Committee to Bridge the Gap
CDM	Camp Dresser McKee
CEDE	Committed Effective Dose Equivalent
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
D&D	Decontamination and Decommissioning
DCGL	Derived Concentration Guideline Level
DPH	Department of Public Health
DOD	Department of Defense
DOE	Department of Energy
DQA	Data Quality Assessment
DQOs	Data Quality Objectives
DTSC	Department of Toxic Substances Control
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ERGS	Enhanced Radiological Ground Scanner
ETEC	Energy Technology Engineering Center
FONSI	Finding of No Significant Impact
FSP	Field Sampling Plan
FSS	Final Status Survey
GPS	Global Positioning System
HSA	Historical Site Assessment
IAG	Interagency Agreement
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDL	Method Detection Limit
NASA	National Aeronautics and Space Administration
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
ORAU	Oak Ridge Associated Universities
ORIA	Office of Radiation and Indoor Air (EPA)
ORISE	Oak Ridge Institute for Science and Education
PRGs	Preliminary Remediation Goals
RCRA	Resource Conservation and Recovery Act
RMDF	Radioactive Materials Disposal Facility
RSSI	Radiation Survey and Site Investigation
SMMC	Santa Monica Mountains Conservancy
SOPs	Standard Operating Procedures

SSFL	Santa Susana Field Laboratory
TBC	To-Be-Considered
TEDE	Total Effective Dose Equivalent
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance / Quality Control

EXECUTIVE SUMMARY

Introduction

The 2008 Appropriations Law (HR2764) directed the Department of Energy (DOE) to use a portion of DOE funding for the Santa Susana Field Lab (SSFL) site to enter into an interagency agreement (IAG) with the Environmental Protection Agency (EPA) to conduct a joint comprehensive radioactive site characterization of Area IV of the SSFL in accordance with the Comprehensive, Environmental, Response, Compensation and Liability Act (CERCLA). In July 2008, an IAG was signed whereby DOE gave EPA $1.5 million to:

(1) Conduct a **background radiological study** for the SSFL site (the "Background Study") and,
(2) Develop a preliminary **scope of work** ("SOW") including a schedule and cost estimate for a comprehensive radiological study of Area IV and adjacent buffer zone (hereafter referred to as the "Area IV SOW").

The Background Study is currently moving forward and is scheduled to be completed in the fall of 2009.

This document is EPA's draft Area IV SOW and will serve as an outline upon which a work plan will be developed. The work plan will include specific sampling locations, number of samples to be collected, procedures to be followed during sample collection and analysis, equipment to be used, laboratory detection limits, and a process for how data will be evaluated. EPA has not been provided funding to prepare the work plan or conduct the radiological study itself.

Basis for the Study

The Multi-Agency Radiation and Survey and Site Investigation Manual (MARSSIM) guides the approach in this Area IV SOW. EPA decided to base the study on MARSSIM principles because it is a generally agreed upon technique for assessing radiological impacts at sites across the country. MARSSIM's use has been agreed to by a wide variety of agencies including DOE and EPA.

It is important to note that MARSSIM allows for interpretation depending on site-specific circumstances and data quality objectives. Since EPA has not completed a thorough Historical Site Assessment (HSA), this Area IV SOW makes very conservative assumptions (e.g. number of samples to be collected in the surface and subsurface).

Goals

Background Study. The goal of the Background Study is to determine ambient values for radiological contaminants in the vicinity of the SSFL site and is a necessary first step to determine risk posed by the site itself. Upon completion of the Background Study, we will be able to tell the difference between background levels and actual radiological contamination associated with the past operations at the SSFL site. In order to determine the background levels, EPA plans to sample areas that have not been impacted by site operations at SSFL, yet are within the same soil and rock formations found at the SSFL site.

Area IV SOW. This document outlines an approach for identification of areas with elevated radiological contamination in Area IV and adjacent buffer zone. Areas with elevated radiological levels may require additional work (i.e. additional testing, feasibility studies, etc) prior to determining the appropriate cleanup action.

Technical Approach for the Area IV Radiological Study

Key data collection activities for the Area IV Radiological Study consist of conducting:

- a new Historical Site Assessment[1]
- a surface gamma scan in accessible areas;
- surface soil sampling;
- groundwater sampling;
- surface water sampling (i.e. seeps, streams (if available), etc); and
- subsurface soil sampling.

However, the final scope of data collection activities will be determined during the work plan development process.

Preliminary Cost Estimates

Preliminary costs for the **Background Study** are estimated at $1.5 million. The preliminary cost estimate for the **Area IV Radiological Study** is summarized in the table below. This cost estimate is a preliminary estimate only and will be further refined during work plan development.

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[1] The HSA will provide a complete evaluation of past radiological activities at the SSFL site. This analysis will help identify the potential radiological release areas in Area IV/ Buffer Zone using historical site operations information and data.

Activity	**Cost**:
Historical Site Assessment	$174,000
Scoping Survey	$82,000
Radiological Characterization (gamma scan survey)	$960,000
Radiation Survey (surface soil and groundwater/seep sampling and analyses)	$11,000,000
QA/QC Monitoring Requirements-(EPA estimate for oversight of entire Study)	$2,750,000
Subtotal	**$14,966,000**
Radiation Survey (subsurface soil sampling and analyses)	$25,000,000*
Total Estimated Cost (not including Background Study)	**$39,966,000**

* This cost estimate assumes two subsurface samples per surface sample location. This is a conservative estimate and the actual number of subsurface samples will be determined during the work plan development process.

Factors Affecting Area IV Radiological Study Technical Approach and Costs

As noted earlier, this SOW provides the basis for a detailed work plan for the Area IV radiological study. However, there is a significant amount of information that needs to be collected and analyzed prior to finalization of a work plan and commencement of the data collection. The following are major factors that will need to be considered during the work plan development process and are significant cost drivers:

- List of radionuclides of potential concern may be reduced thereby lowering the analytical costs;
- Analytical detection limits are likely to be adjusted based primarily on what is found during the Background Study;
- Number of acres in the MARSSIM Class I, II, and III survey units may be adjusted;
- Grid size within the Survey Unit may be adjusted resulting in fewer number of samples;

- Incorporating the results of Historical Site Assessment will streamline investigation, especially with regard to subsurface sampling;

- Use of real-time field instrumentation such as down-hole gamma logging to streamline the subsurface investigation and allow for fewer samples needing to go to the lab for analysis.

EPA Expertise and Stakeholder Participation

This project is being managed by the EPA Region IX Office in San Francisco. Staff from EPA's laboratory in Las Vegas is providing technical assistance and will continue to do so during work plan development, sample collection, and preparation of the data report.

In order to ensure thorough and successful radiological studies at the SSFL site, EPA believes that it is essential that the community be fully involved. In addition, EPA policy establishes a strong program of public participation in the site cleanup process nationwide. If EPA is provided funding to develop the work plan for the Area IV radiological study, EPA envisions multiple opportunities for community participation including participation in small technical workgroup meetings, site tours, and in larger EPA community meetings for the general public.

Other technical team members include representatives from California Department of Toxic Substances Control (DTSC), California Department Public Health (DPH), DOE, Boeing, and National Aeronautics and Space Administration (NASA).

Schedule

If appropriate funding is identified for the Area IV/Buffer Zone Study, the first phase of the Area IV radiological study (e.g. the HSA) could commence in late 2009. Once initiated, the Area IV radiological study is estimated to be completed in approximately 2.5 years.

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1.0 INTRODUCTION

Past operations in Area IV of the Santa Susana Field Laboratory (SSFL) site has resulted in radionuclide and chemical contamination of environmental media. The Department of Energy (DOE) and its contractors operated several experimental reactors at SSFL in a portion of the site known as the Energy Technology Engineering Center or ETEC. Those reactors are among the reasons why many believe that radioactive contamination remains onsite. Contamination is also suspected due to reports of historic poor management practices with respect to hazardous materials on site as well as documented releases of hazardous substances on site. The purpose of this document is to establish general requirements for the development of plans to determine 1) radiological characteristics of uncontaminated (background or reference) areas, and 2) radiological characteristics of surface and subsurface soil in one specific portion of the SSFL, Area IV, and the adjacent northwest Buffer Zone. In 2001, the U.S. Environmental Protection Agency (EPA) generated a Scoping Document intended to outline a characterization approach for SSFL Area IV (EPA, 2001) and to provide a cost estimate for these activities. The basis of this 2008 Scoping Document is the 2001 EPA document. The format of this Scoping Document and some technical contents are based on the 2001 EPA document, however this document contains more specifics as well as updated cost estimates.

Note that this effort is the first in what EPA anticipates to be several phases of investigation in order to fully characterize the Santa Susana Field Lab. See Attachment A for a summary of how the effort described in this document could fit into a comprehensive radiological study for the site. The work described in Attachment A could be conducted over several years but in overlapping phases if adequate funding is available or if SSFL is placed on the National Priorities List (NPL).

In addition, work described in this scope could be altered significantly based on the results of the Historical Site Assessment (HSA) which EPA will conduct prior to beginning field work at SSFL. For example, information obtained from the HSA could result in different sample numbers for both surface and subsurface soil, adjusted detection limits and other potential adjustments. Section 5.2 provides a discussion of assumptions made in order to develop this scope and adjustments that could be made as part of the work-planning process.

1.1 Introduction and Project History

The Santa Susana Field Laboratory (SSFL) is located in the Simi Hills of eastern Ventura County, California (Figure 1). The 2,850 acre site is divided into four administrative

areas (Area I, II, III, and IV) and buffer zones. Area IV is the westernmost 290 acres of SSFL.

In 1946, the SSFL was constructed by the U.S. Government, who began using the site for rocket engine testing. In the early 1950s, the predecessor to the Department of Energy (DOE) began using Area IV to conduct various nuclear programs including nuclear engineering, nuclear research and development, and nuclear manufacturing operations. DOE began phasing out nuclear operations in Area IV in the mid 1960s and ended them in 1988. In addition, Rocketdyne, its predecessors, and Boeing conducted experiments and other activities at Area IV. Camp Dresser McKee (CDM), 2008 provides summary information regarding historical contractor activities at Area IV. EPA will conduct its own HSA in support of the study at SSFL.

1.1.1 Regulatory Authority and Demonstration of Regulatory Compliance

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), enacted by Congress in 1980, and reauthorized in 1986, 1996, and 2002 (collectively referred to as the Superfund Amendments and Reauthorization Act or SARA), provides the statutory requirements for remediation of sites in which hazardous substance releases have occurred or a potential exists for hazardous substances to be released into the environment. Cleanup levels for response actions under CERCLA are set based on screening-level or site-specific risk assessments, or are determined by adopting regulatory guidance enacted from other EPA-directed environmental programs which have been determined to be applicable or relevant and appropriate requirements (ARARs). Additionally, to-be-considered (TBC) standards may be used to guide the remedial action process under CERCLA. EPA also directs responses to release of hazardous substances through the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) which is the directive for responding to both oil spills and hazardous substance releases. The NCP, as codified in 40 CFR §300.415(b) authorizes the lead agency to initiate an appropriate removal action in the event of a hazardous substance release. Under CERCLA and the NCP, decisions of action are based on threats to human or animal populations, contamination of drinking water supplies or sensitive ecosystems, high levels of hazardous substances in soils, or other significant factors affecting the health or welfare or the public or the environment.

1.1.2 Regulatory History of SSFL

Since the 1980s, the DOE has been conducting decontamination and decommissioning (D&D) of the facilities previously used for nuclear programs. This D&D project involved the characterization, clean-up, and release of buildings or land where radiological materials were used. DOE policies, orders, and regulations guided the D&D process for these nuclear facilities. DOE committed, at that time, to meet cleanup standards in accordance with CERCLA. This goal is consistent with the Policy of Decommissioning Department of Energy Facilities under CERCLA, which the DOE and the EPA jointly issued on May 22, 1995.

In 1994, Boeing/Rocketdyne conducted a radiological characterization survey of Area IV (Rockwell International, 1996). This survey covered areas used by both DOE and Rocketdyne for nuclear activities. The purpose of the study was to locate and characterize any unknown areas of elevated radioactivity by surveying areas of the property that had not been previously characterized and/or areas that had not been previously identified as locations of nuclear activities. The survey used an action level of 35-44 millirem per year [(mrem/yr) about 4-5 microrem per hour (µrem/hr)] over background levels. The study identified three localized areas requiring remediation, which has been performed. Otherwise, the study concluded that "the radioactivity in Area IV is predominantly from naturally-occurring radioisotopes and radioactive fallout from weapons testing. Ambient radiation levels and soil concentrations of most isotopes were, in general, found to be statistically indistinguishable from local background levels, and the result of factors not related to radiological operations performed in Area IV." The survey found that there was "no significant, widespread contamination of Area IV as a result of radiological operations at the Santa Susana Field Laboratory."

In 1996, EPA was asked by some members of the community to perform an independent, technical examination of the DOE's/Boeing/Rocketdyne's D&D activities and radiological characterization work at Area IV. The DOE agreed to EPA's involvement, recognizing that the Agency's independent review might help build public confidence in the DOE's cleanup and closure activities at Area IV. The draft scope of work was developed by EPA's Resource Conservation and Recovery Act (RCRA) program, but was never implemented.

In 2000, DOE changed its policy regarding site clean up (CERCLA), and prepared an Environmental Assessment (EA). DOE published a draft EA in 2002 that the public/ stakeholders (collectively referred to as stakeholders) questioned. Specifically, the stakeholders believed that the cleanup should address CERCLA risk-based considerations and that adequate characterization of Area IV had not been performed. The DOE disagreed, and prepared a Finding of No Significant Impact (FONSI), followed by a final EA in 2003. DOE continued its own D&D of facilities. In October 2004, environmental groups challenged this action and in 2007, the court ruled that DOE's decision to issue a FONSI was in violation of the National Environmental Policy Act (NEPA). As part of this ruling, DOE elected to conduct a Data Gaps analysis, whereby available data was assessed to determine sampling and analysis needs with respect to completion of an Environmental Impact Statement (EIS). In the case of soils, both CERCLA risk-based and Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)-based sample number scenarios were provided in the Data Gap Report.

In December, 2007, EPA considered possible placement of the SSFL on the NPL (U.S. EPA, 2007b, 2008). The state responded by stating they agreed with the need for a comprehensive clean-up of this site. However, the California Environmental Protection Agency (CalEPA) requested a deferral of time to provide EPA with its position on proposal of the site to the NPL for six months because in August 2007, the State, DOE and NASA had entered into an Agreement regarding investigation and clean-up of the site and CalEPA had also signed a letter of intent with Boeing in which Boeing agreed to

clean up SSFL and then turn the site over to the State for use as open space or parkland. Because the state intended to negotiate the details of this later agreement in early 2008, it requested that EPA allow the state additional time to respond with its position on proposal of the site to the NPL. EPA agreed to a six month deferral. In July 2008, the State requested a second 6 month deferral and EPA agreed. This deferral will result in the state providing its position to EPA on January 15, 2009. Therefore, EPA will not pursue proposal of the site to the NPL until spring 2009 at the earliest.

In addition, the 2008 Appropriation Law HR 2764 appropriated 13 million dollars to the DOE for environmental remediation activities at SSFL, and required that DOE use a portion of this funding to enter into an interagency agreement (IAG) with EPA to conduct a "joint comprehensive radioactive site characterization of Area IV." In early 2008, EPA and DOE entered into discussion as required by HR 2764 regarding Area IV.

DOE and EPA entered into an IAG on July 28, 2008. Under the terms of this IAG, the U.S. EPA will perform a radiological background study for the Santa Susana Field Lab site, using $1.5 million provided by the U.S. Department of Energy. Additionally, EPA developed this Scope of Work, Schedule, and Cost Estimate for a radiological study of Area IV and the adjacent northwestern Buffer Zone. (See Figure 2) It is anticipated that characterization of this Area IV/Buffer Zone will occur in stages, the first dealing with surface contamination and the second dealing with subsurface contamination.

1.2 Purpose of 2008 Scoping Document

As indicated above, the purpose of this 2008 Scoping Document is to satisfy portions of the requirements of the July, 2008 EPA-DOE IAG wherein EPA shall conduct a background radiological survey pertinent to Area IV/Buffer Zone, as well as provide DOE with a Scope of Work, Schedule, and preliminary Cost Estimate for a radiological study of Area IV/Buffer Zone. This 2008 Scoping Document focuses on characterization of a reference or background area and a generalized characterization of Area IV/Buffer Zone. The approach described herein proposes a characterization approach based on MARSSIM to design and perform the site radiological characterization survey.

In addition, this scoping document will serve as an outline upon which a work plan can be developed. Work plans would include specific sampling locations and numbers as well as procedures to be followed during sample collection and would identify equipment that will be used. In addition, work plans would discuss the process for how data will be evaluated once it is collected and analyzed. The work plans will be developed with the assistance of the State of California and DOE as well as the community. In addition, there will be opportunities for public involvement and comment prior to any field work occurring. Any comments received on this scope would be addressed in the work plans. As noted in the introduction, the information collected as part of the HSA may result in significant changes to the number of samples assumed for this scope.

1.2.1 Definitions and Considerations

Work described herein shall be detailed in work plan(s) and other documents that will be based on the general guidance and information presented in this 2008 Scoping Document. To support development of the Radiological Surveys, the following definitions and considerations should be taken into account as the project moves forward.

Work Plans

The requirements presented in this document will be presented in a variety of documents that will define the work to be performed. For example, Work Plans may be developed to describe the overall process and schedule, while Quality Assurance Project Plans and Field Sampling Plans may also be written to detail proposed activities in each area. For simplicity, development of any of these documents are described generically as a "Plan," with the understanding that the specific type of Plan to be developed will be determined as part of project planning and implementation.

Use of MARSSIM and CERCLA

EPA will use the MARSSIM as a starting point to guide the design of the surface survey (U.S. EPA, DOE, DOD, NRC, 2000, "The Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)," [U.S. EPA et. al., 2000]). MARSSIM is a decision framework that has been prepared jointly by EPA, the Nuclear Regulatory Commission (NRC), DOE and the Department of Defense (DOD) to provide a nationally consistent methodology for designing radiation surveys and investigations at radiologically-contaminated sites. The MARSSIM process can be applied under programs like CERCLA and RCRA, and MARSSIM Appendices C and F describe how MARSSIM is related to specific activities and processes under these EPA programs. That is, MARSSIM provides a process that has been jointly developed by multiple government agencies that can be applied to regulatory processes like CERCLA for investigating radiologically-contaminated sites. Note that there are several EPA guidance documents that address radiological contamination that are of use in this process. (e.g., U.S. EPA 1996, 2000, 2002 a, b)

Background Reference Area

Key to any analysis is an accurate and acceptable reference or background value determination. MARSSIM, Chapter 2 states "The Background Reference Area is a geographical area from which representative reference measurements are performed for comparison with measurements performed in specific survey units. MARSSIM defines the Background Reference Area as an area that has similar physical, chemical, radiological, and biological characteristics as the survey unit(s) being investigated but has not been contaminated by site activities (i.e., non-impacted)."

EPA also recognizes that determination of appropriate Background Reference Areas for further characterization is complicated by not only intense public interest, but also by the

rugged site topography, complex area geology, and indeterminate SSFL site activities and history. Specifically, identification of areas that have no potential for contamination that originated from SSFL will be complicated by the site history and the requirement to decipher known and suspected site releases with potential release pathways. Further, global fallout from nuclear testing as well as the presence of natural radionuclides may be difficult to differentiate from site releases, without detailed knowledge of radionuclides managed at the site, release dates, and isotopic distributions associated with site material. EPA will follow the guidance in MARSSIM to identify Background Reference Areas that meet the specific criteria - a location(s) that remains uncontaminated by site (SSFL) activities. Background location(s) selected will be vetted with study partners and the community. EPA plans to choose background locations that are not located on the SSFL property. Any approach used to characterize the identified Background Reference Area(s) will follow the data quality objectives (DQOs) process. EPA will develop appropriate field sampling and data collection approaches and protocols designed to meet identified DQOs, with the goal being to obtain radionuclide-specific background values at surface and depth. Data collected at SSFL can be compared to background study results to determine whether radiological constituents found on-site are above those found in background areas.

Area IV/Buffer Zone

In addition to determination of the Background Reference Areas, this 2008 Scoping Document presents a general approach to characterize radiological contamination in both Area IV and the northwestern Buffer Zone abutting this area. For the purposes of this document, Area IV and this Buffer Zone will be referred to as a single area: Area IV/Buffer Zone. EPA's process to characterize the radiological composition of soils in Area IV/Buffer Zone, will start with an unbiased and thorough assessment of information pertaining to site activities and releases including but not limited to historical information and release history, photographic evidence, chemical data obtained through soil sampling and analysis, and other sources including input and information from the public and other sources. While all site information, including previous characterization assessments, will be available to EPA, the approach that will be followed shall make no assumptions regarding elimination of data, and EPA's HSA will include and document any evaluation criteria that are used to rank data, particularly when data sources indicate contradictory results. Figure 2 presents the location of Area IV and the Buffer Zone. In addition to Area IV, the northwestern Buffer Zone, shown in Figure 2 will be characterized as part of this effort.

Planning and Technology Considerations

The Background Reference radiological survey will be performed prior to the Area IV/Buffer Zone characterization activities. Therefore, a new understanding of Background Reference Area values will be used as a basis of comparison when assessing data Area IV/Buffer Zone activities and results.

EPA expects that the radiological characterization surveys for both the Background Reference Areas and Area IV/Buffer Zone will include detailed information pertaining to the characterization technologies beyond the general criteria set forth in this scoping document. Specifically, EPA expects this plan to develop surface scan technologies, recognizing that a combination of technologies will be required due to the complex and rugged topography and other factors. Further, while the surface gamma scanning will identify gamma anomalies, radionuclides with low or non-existent gamma signatures (radionuclides that only emit alpha or beta) will require characterization by means other than the surface gamma scans. The work plan shall detail these potential technologies for detecting primary alpha-emitting and beta-emitting radionuclides, and will include soil sampling. Finally, the approach proposed in this scoping document is intended to be flexible to take into account field conditions or other unknowns. If, for example, seep/runoff sampling is required, the work plan and activities should be flexible enough to take into account the need to sample these areas, as appropriate.

Derived Concentration Guideline Level

The MARSSIM process requires development of a Derived Concentration Guideline Level (DCGL) that is the benchmark for comparisons. Due to the current zoning at SSFL, which supports large-lot residential use, as well as to be sensitive to State and community concerns, EPA used its Agricultural Preliminary Remediation Goals (PRGs) as the basis for DCGLs in this scope. The PRGs are available online at *http://epa-prgs/ornl.gov/radionuclide*.

For many radionuclides of concern, it will not be feasible to achieve these low method detection limits. EPA's intention is to achieve the lowest possible detection limits during the Background Study. The DCGLs that will be used for the radiological study in Area IV and the Buffer Zone, would be a sum of the Background mean concentrations plus the radionuclide-specific Agricultural PRGs for each radionuclide.

EPA has obtained commercially-quoted costs for three different detection limits described as 1) the Best Practical Detection Limits 2) Typical Detection Limits, and 3) and intermediate Extended Detection Limit. The latter methods can, in most cases, achieve the Residential PRGs while the first method reflects the best possible detection limit that can be obtained. Attachment C provides the values for the 3 detection limits, how they compare to Agricultural and Residential PRGs, and associated costs.

EPA has chosen to use the "Extended Detection Limit" for estimating costs associated with the radiological study at Area IV and the Buffer Zone. EPA chose the "Extended Detection Limit" because it is likely that background values for many radionuclides may in fact be higher than EPA's Agricultural PRGs.

1.2.2 EPA's Approach

EPA has prepared this 2008 Scoping Document to provide (1) a conceptual approach and rationale for the development and implementation of a radiological investigation work

plan for both the reference or background area and Area IV/Buffer Zone, and (2) an estimate of the projected costs associated with that conceptual approach. As indicated above, EPA will follow the general approach in MARSSIM to perform the radiological survey at the Background Reference Area and Area IV/Buffer Zone. EPA based this scoping document on a limited review of available information on historical site use and data, thus, EPA does not expect that this 2008 Scoping Document provides final and definitive technical guidance for the development of the eventual site survey work plan; instead, this document strictly serves to conceptually describe work needed at Area IV/Buffer Zone, and to provide a rough cost estimate as the basis for funding negotiations with DOE**.**

For this survey, EPA anticipates:

- Conducting a new HSA to support the Area IV radiological characterization classification. This analysis will help identify potential release areas in Area IV/ Buffer Zone.

- As necessary, limited field scoping or data collection efforts prior to the background and Area IV/Buffer Zone characterization surveys could be performed to collect additional information.

- Conducting a thorough and complete Background Reference Area radiological survey. The Background Reference Area will be selected such that the geographical location is unaffected by SSFL activities, but will have comparable physical, chemical and geological conditions as the Area IV/Buffer Zone so that the background radiological constituents are closely approximated in composition and concentration to those found at the SSFL. Radiological surveys within the Background Reference Area will include a nearly 100-percent surface gamma scan of accessible areas and collection and analysis of surface and sub-surface soil samples. The approach implemented must result in thorough characterization of radiological constituents using the appropriate survey unit sizes, measurement techniques, and statistical applications to ensure accuracy and defensibility of the results. EPA assumes that a minimum of two areas will be characterized to determine Background Reference Area values. The background study shall address surface and subsurface radionuclide occurrence, including evaluations in undisturbed areas for the development of Background Reference Area values for a suite of radionuclides (U.S. EPA et. al., 2000; CDM and DOE, 2008).

- Conducting an Area IV/Buffer Zone radiological survey that will include 100-percent surface gamma scan of accessible areas in each survey unit and surface and subsurface soil sample collection and analysis. The survey will be designed using the appropriate survey unit sizes and land use classifications to guide the number and types of surveys that will be conducted throughout the Area IV and Buffer Zone. Measurement techniques will be selected based on the detection limits required to demonstrate whether radiological constituents are above or

below the DCGLs.

- Results shall be presented in Draft and Final Characterization Reports

This approach shall be documented and followed through work plans that will be developed based on this scoping guidance and information gained from the HSA and/or the scoping survey.

EPA will hire an independent contractor familiar with MARSSIM studies to conduct the survey. The contractor will develop a work plan(s) and a quality assurance project plan (QAPP), which will include appropriate DQOs. EPA Region 9 along with EPA's Office of Radiation and Indoor Environments National Laboratory, located in Las Vegas, Nevada, will direct and approve the contractor's work and provide Quality Assurance / Quality Control (QA/QC) oversight. EPA fully recognizes that the actual cost for the radiological survey will not be known until the completion of the HSA and development of Plan(s).

This 2008 Scoping Document was also prepared to provide information to the community surrounding SSFL and elected public officials about EPA's technical approach to characterizing the radiological content of Background Reference Area and Area IV/Buffer Zone soils. Comprehensive groundwater sampling and analysis is outside the scope of this initial survey. However, EPA acknowledges that the evaluation of potential groundwater radiological contamination is critical to fully determine the environmental status of the site, and that conclusions on the appropriateness of the site for future unrestricted use scenarios cannot be made without quality groundwater radiological monitoring data. The existing groundwater monitoring system and ongoing enhancements planned at SSFL are the primary source of information and data. A single groundwater sampling event of approximately 30 existing monitoring wells will be included in this initial characterization survey of Area IV/Buffer Zone, with more extensive groundwater characterization to be performed during future survey phases.

As is true for other off-site parcels contiguous with the 290-acre Area IV footprint, if survey data collected within the scope of the current Area IV/Buffer Zone-wide survey indicate the need for further examination of these parcels (including Brandeis-Bardin parcel), EPA recognizes that additional environmental investigations may need to be conducted at such areas.

Based in part on concerns raised by the State and DOE, EPA has included subsurface sampling in this scope. However, it should be noted that the number of subsurface samples could change significantly once EPA's Historical Site Assessment is completed and on what is found during surface scanning and sampling. See section 5.2 for a more detailed discussion of possibilities EPA will explore when developing the work plan.

2.0 HISTORICAL AND SUPPORTING INFORMATION

SSFL has been either in use or under remediation for the past 62 years. Nuclear operations and clean-up activities are complex, and the following synopsis provides only the basic information pertaining to the site, recognizing that the EPA's HSA will thoroughly assemble and assess nuclear operations and clean-up information as they pertain to potential and actual releases at SSFL and in the local area.

2.1 Summary of Nuclear Operations and Cleanup Activities in Area IV

Nuclear operations at Area IV have been addressed in numerous documents, the most recent being the Environmental Impact Statement Data Gap Analysis prepared jointly by CDM and DOE (CDM and DOE, 2008). The discussion in this section is generalized in nature and draws upon information presented in historic documentation, noting that nuclear operations will be definitively identified and assessed during the HSA.

The intent of this section is to provide a conceptual basis for further analysis. Critical inputs to the design of the radiological survey are information on the types of nuclear operations conducted at the site, information on where the various operations were conducted and any information regarding incidents involving the release of radioactive materials into the environment. Again, this information will be assembled and assessed during EPA's HSA.

The SSFL is separated into four "administrative" areas: Areas I, II, III, and IV. Area IV and Buffer Zone are the subject of this scoping document. Boeing currently owns and operates Area IV. The Energy Technology Engineering Center (ETEC), located in Area IV, is a group of buildings used for nuclear research and experimentation. DOE (2007) states that the ETEC in Area IV included 10 nuclear research reactors, 7 criticality facilities, the Hot Laboratory, the Nuclear Materials Development Facility, the Radioactive Materials Handling Facility, and numerous testing and radioactive waste storage area. The types of nuclear operations conducted at the site included (Rockwell International, 1989; pp. 16-17, as referenced in U.S. EPA 2001):

1) Operation of nuclear reactors
2) Operation of criticality test facilities
3) Manufacture of nuclear reactor fuel assemblies
4) Disassembly and inspection of nuclear reactors and used nuclear reactor fuel assemblies
5) Fabrication, use, and storage of radioactive sources
6) Preparation of radioactive material for disposal
7) Research on reprocessing of used nuclear reactor fuel
8) Operation of particle accelerators
9) Research using radioisotopes
10) Miscellaneous operations
11) Activities involving commercial items that use radioactive materials.

The locations of specific historical Area IV buildings and their associated building numbers are presented in Figure 3. The nuclear reactors were located along a northeast-southwest trend in the northern portion of the site. Most of the criticality test facilities were also located in the northern portion of the site. The fuel fabrication facilities were generally located south of the reactor locations. The hot laboratory in the southwestern portion of the site was the location for various operations, including disassembly and inspection of nuclear reactors and fuel, and fabrication of radioactive sources including cutting and machining of cobalt-60. Research on fuel reprocessing was conducted in Building 003 in the northeast portion of the site. Preparation and storage of radioactive material for disposal was carried out in the Radioactive Materials Disposal Facility (RMDF) – now known as the Radioactive Materials Handling Facility (U.S. EPA, 2001).

Nuclear operations (other than the nuclear reactors) conducted in Area IV could have resulted in environmental releases if radioactive materials used in the operations were spilled, or otherwise dispersed (i.e., as gas releases, in leach fields, or as particulates). Documented environmental releases of radioactivity include but are not limited to: 1) a release of radioactive gases from the Sodium Reactor Experiment in 1959, 2) a release of a dilute solution of fission products to a septic tank leach field at the RMDF in 1962, 3) releases of radioactivity from drums or other containers in storage yards, and 4) radioactivity released in the Sodium Burn Pit. According to Boeing/Rocketdyne, "radioactive waste has never been buried at the SSFL" (Rockwell International, 1989; p. 54). Process wastes were shipped offsite for proper disposal.

2.2 Radionuclides of Concern

Radionuclides of concern are those remaining in Area IV that resulted from site operations. A list of radionuclides of concern is being developed by the EPA and its study partners based on historical site information and sampling and analysis data (CDM and DOE, 2008). This listing includes not only typical fuel, activation and fission products related to nuclear reactions at the site, but also includes radionuclides that may be present due to natural occurrences and/or fallout. The list presented in Table 1 of this document is as comprehensive as possible based on available data, but EPA expects the list to be examined and modified based on results of the HSA or other forthcoming agreements.

For the purpose of this 2008 Scoping Document, the list in Table 1 is a starting point for Background Reference Area soil analyses, and will also be used to select the subset of radionuclides that can act as indicators for the suite of radionuclides present at Area IV/Buffer Zone. Indicator parameters selected are those that can be readily detected and whose presence can be linked to other radionuclides by processes information, radionuclide decay, or other relationships. It is important to emphasize that a more definitive list of radionuclides of concern at Area IV/Buffer Area will be developed during the actual survey work plan development based on the HSA and other information regarding the use of radioactive materials at the site**.**

2.2.1 Radionuclide Associations and Area IV/Buffer Zone Indicator Radionuclide Analysis

Table 1 presents the radionuclides and potential indicator parameters as identified in EPA's 2001 scoping document. New radionuclides added to the list after the 2001 Scoping Document are identified as "TBD," in that EPA expects that the viability of these radionuclides to be used as indicator parameters shall be assessed as part of the Area IV/Buffer Zone radiological characterization survey. It is important to note that the Background Reference Area survey shall attempt to identify radionuclides present within the survey area. The presence or absence of these radionuclides will define the radiological characteristics of areas unimpacted by SSFL activities, specifically the lateral and vertical radiological soil composition. This information will be used to modify the indicator listing presented in Table 1 for use in the Area IV/Buffer Zone radiological investigation. Some analytical methods, notably gamma spectroscopy, can identify a broad range of gamma-emitting radionuclides not included on the list, and EPA will request information on information on these radionuclides even if they are not in Table 1.

The radionuclides listed on Table 1 can be grouped according to the processes in which they were generated or used. By grouping the radionuclides in this way, the radionuclide that is most readily detectable can be used as an indicator for the group (see Table 1). Indicator radionuclides will be refined based on results of the historical site assessment and could be further refined for use in the Area IV/Buffer analysis based on background determinations.

The following analysis was presented in the previous scoping document and is provided as a starting point for determining indicator radionuclides at Area IV/Buffer Zone. EPA expects that the assumptions presented on Table 1 may be revised in light of new data pertaining to radionuclides and activities performed on-site, and those conclusions regarding associations and indicator radionuclides may also be revised based on new information.

Table 1: Radionuclides of Concern and Associated Analytical Indicators

Radionuclides of Concern	Analytical Indicator
Radionuclides Contained in Nuclear Fuel	
Americium 241	The presence of Pu-238 or Pu-239 may indicate presence; absence of Pu-238 and Pu239 indicates absence
Plutonium 238	*Indicator Radionuclide; may be present alone*
Plutonium 239	*Indicator Radionuclide; may be present alone*
Plutonium 240	The presence of U-235 may indicate presence; absence of U-235 indicates absence
Plutonium 241	The presence of U-235 may indicate presence; the absence of U-235 indicates absence
Plutonium 242	The presence of U-235 may indicate presence; the absence of U-235 indicates absence
Thorium 228	*Indicator Radionuclide*
Thorium 232	*Indicator Radionuclide; may be present alone*
Uranium 235	*Indicator Radionuclide; all fuels likely enriched with U-235; presence indicates possible presence of other fuel radionuclides*
Uranium 238	The presence of U-235 may indicate presence
Neptunium 237	TBD
Thorium 230	TBD
Fission Product Radionuclides	
Cesium 134	The presence of Cs-137 may indicate presence; absence of Cs-137 indicates absence
Cesium 137	*Indicator Radionuclide; its presence indicates other fission products may be present; absence indicates they are not*
Europium 152	The presence of Cs-137 may indicate presence; absence of Cs-137 indicate absence
Europium 154	The presence of Cs-137 may indicate presence; absence of Cs-137 indicates absence
Strontium 90	*Sr-90 to be analyzed independently*
Barium-133	TBD
Curium 243	TBD
Europium 155	TBD
Iodine 129	TBD
Tin 125	TBD
Technetium 99	TBD
Activation Product Radionuclides	
Cobalt 60	*Indicator Radionuclide; its presence indicates other activation products may be present; absence indicates they are not present*
Iron 55	Presence of Co-60 may indicate presence; absence of Co-60 indicates absence
Manganese 54	Presence of Co-60 may indicate presence; absence of Co-60 indicates absence
Nickel 59	Presence of Co-60 may indicate presence; absence of Co-60 indicates absence
Nickel 63	Presence of Co-60 may indicate presence; absence of Co-60 indicates absence
Sodium 22	*Indicator Radionuclide – concern mainly in subsurface soil*
Hydrogen 3 (Tritium)	Of concern in groundwater, recommended analyses in groundwater investigations
Naturally Occurring Radionuclides and Fallout	
Potassium 40	*Indicator Radionuclide-very high in site soils*
Radium 226	*Indicator Radionuclide*
Thorium 232	*Indicator Radionuclide*
Thorium 228	*Indicator Radionuclide*
Uranium 234	*Indicator Radionuclide*
Uranium 235	*Indicator Radionuclide*
Uranium 238	The presence of U-235 may indicate presence
Carbon 14	TBD
Lead 210	TBD
Radium 228	TBD

Radionuclides Associated with Nuclear Fuel

Facilities for the production and storage of new fuel for the nuclear reactors would potentially be contaminated only with the radionuclides contained in the fuel (i.e., isotopes of Pu, Th, and U). Such contamination is difficult to identify with gamma surveys because these radionuclides are primarily alpha-emitters (U-235, U-238, Th-228, Th-232, Pu-238 and Pu-239) with only weak gamma-ray signatures. They would not be evident in typical gamma-ray surveys except at relatively high concentrations. At concentrations corresponding to the proposed DCGL, the presence or absence of these radionuclides will be determined by laboratory analysis of soil samples. All the nuclear fuels fabricated and used at the site contained some fraction of uranium (generally enriched in U-235) with the other component(s) being isotopes of either plutonium or thorium. This suggests that analyses of U-235 concentrations in soils could be used to identify areas contaminated with fuel components. However, the raw materials from which fuels were fabricated may have been composed of single elements (i.e., U, Pu, and Th). Therefore, the main plutonium (Pu-238, Pu-239) and thorium (Th-228, Th-232) isotopes are included on the list of "indicator radionuclides" (Table 1).

Fission and Activation Products

Reactor operations and, to a much smaller degree, criticality tests produced fission products and activation products. Contamination resulting from reactor operations or from criticality tests could contain the original fuel constituents, fission products and activation products, and may have entered the environment through a variety of pathways, including both planned and unplanned aerosol releases. Contamination associated with facilities in which used reactor fuel assemblies were inspected, reprocessed or prepared for shipment (hot cell, "Hot Cave," and RMDF, respectively) could also be expected to contain these radionuclides. Contamination containing fission products and/or activation products can be identified on the basis of the detection of energetic gamma rays emitted by certain fission products in the fuels or in the activation products present in the materials used to house the reactors.

For example, Cs-137 is a fission product normally produced in nuclear fuel during reactor operations. It emits an energetic gamma-ray that is readily detected by standard detection methods and surveys. Therefore, the gamma-ray signal associated with Cs-137 could potentially be used as an indicator of the presence of other radioactivity derived from used nuclear fuels. The element Cs binds strongly to clay particles in the soil (EPA, 1999) and its migration rate through soil is low. Therefore, if Cs-137 was released to surface soils at some time over the operational history of the site, it should still be in the surface soils at this time. If Cs-137 is not detected above background or some other applicable limit at a given location or in a given sample from Area IV/Buffer Area, it may be safe to assume the other fission products associated with used nuclear fuels (e.g. Cs-134, Eu-152, Eu-154) were absent as well. However, if Cs-137 were detected in a given area, its presence would not necessarily imply the presence of other radionuclides associated with used nuclear fuels. This is because Cs-137 could have been used independently to fabricate radioactive sources or in some other operation. The fission products Cs-134, Eu-152, and Eu-154 do not appear to have been used independently at

the site (Rockwell International, 1989), and they are not included on the list of "indicator radionuclides" (Table 1). However, the laboratory will analyze and report on the full suite of radionuclides that are detected.

Contaminated soils containing activation products associated with reactor operations or criticality tests may not contain Cs-137. To detect activation product contamination in soils, the activity of the activation product Co-60 will be measured. This radionuclide is readily detected using standard gamma counting methods in the field or in the laboratory. As in the case of Cs-137 and other fission products, the absence of Co-60 can be used to infer the absence of other activation products (i.e., Na-22, Mn-54, Fe-55, Ni-59, and Ni-63) listed in Table 1. As the exception to this rule, the absence of Co-60 will not necessarily indicate the absence of H-3 and possibly Na-22. These two radionuclides are mobile in the sub-surface environment and can be separated from the other activation products by common physical processes such as infiltration of rain into the sub-surface soils. Na-22 is included in Table 1 as an indicator radionuclide. H-3 is mainly of concern in groundwater and should be analyzed for in groundwater monitoring investigations. Gamma emitting radionuclides on the list will have special consideration in broad scope testing like in gamma spectroscopic analyses.

The fission product Sr-90 is a beta emitter, and does not emit gamma radiation. Laboratory analysis of this radionuclide (specific radiochemistry) is required. Therefore, Sr-90 is included in Table 1.

Naturally Occurring Radionuclides and Fallout

In addition to radionuclides which may remain in Area IV from site operations, the soils contain naturally occurring radionuclides and radionuclides that resulted from world-wide nuclear fallout. The naturally occurring radionuclides include K-40, Ra-226, U-234, U-238, Th-228, Th-232 (Table 1) and other shorter lived daughter products in the uranium and thorium decay chains. The radionuclides associated with world-wide nuclear fallout include Cs-137, Sr-90, and various other radionuclides that are normally present at very low levels of activity. Many of these radionuclides were also produced during operations in Area IV and are listed in Table 1.

2.3 Natural Characteristics of the SSFL Area

SSFL is located atop the Simi Hills that lie due west of the San Fernando Valley and due south of the Simi Valley (Figure 3). Area IV is morphologically complex with a central area of low topographic relief ("mesa") surrounded by rocky areas. The southwest portion of Area IV contains large rock outcrops and is at a higher elevation than the central area. The area to the north is dominated by a rocky slope several hundred feet in height that leads into a series of densely vegetated gullies and ravines. On more level terrain further to the north is located the Brandeis-Bardin Institute. To the south and east there are ravines and rocky terrain associated with Areas I-III and undeveloped land owned by Boeing, Inc.

Area IV occurs in the Transverse Ranges of southern California, dominated by north-south compressional forces that resulted in geologic features like faults and folds. The SSFL occurs on the southern flank of an east-west trending syncline (basin), so beds below Area IV dip to the north-northwest. Units underlying the SSFL facility are predominantly Cretaceous-Eocene in age, and include the Santa Susana and Chatsworth Formations (DOE 2007). Figure 4 presents a geologic column for the area and Figure 5 is a geology map showing the subcrop locations of the above formations in and around SSFL. The Santa Susana Formation sub/outcrops in the southwestern portion of Area IV, and is composed of mudstones and fractured claystones with interbedded sandstones and conglomerates. The Chatsworth Formation underlies the remaining portion of Area IV and is described as a deep-water siliciclastic unit composed primarily of sandstones with interbedded shale, silt, and conglomeratic units. Area IV is cross cut by the Burro Flats Fault which juxtaposes the Santa Susana and Chatsworth formation. Note that the geologic characteristics of areas surrounding Area IV must be thoroughly evaluated to identify locations that are geologically similar to Area IV. The selected contractor shall define the geologic setting surrounding SSFL. Because this part of eastern Ventura County and western Los Angeles County is geologically complex, an expert evaluation of the local geology will be required to select appropriate offsite areas to be surveyed for background naturally occurring radioactivity (U.S. EPA, 2001, CDM, 2008, EPA, 2007a).

Vegetation in Area IV includes stands of oak trees and scrub brush with local concentrations of poison oak. The presence of poison oak must be factored into the survey design. Where possible, areas containing dense concentrations of poison oak must be cleared (if possible), worked around, or avoided altogether. During development of the work plan for the Area IV survey, consideration should be given to the protection of any endangered or protected species that may reside on the site. The "Biological Conditions Report, Santa Susana Field Laboratory, Ventura County, California," is a source of data on endangered and protected species at the site. Protection of potential cultural resources in Area IV will be considered as well.

2.4 Previous Surveys of Area IV

The discussion in this section is provided as a brief overview of some of the major radiological investigations and cleanup activities that have been carried out at the site. Radiological monitoring of the environment at Area IV has been ongoing since 1954. Oversight/inspection activities for the monitoring program were initiated by the Atomic Energy Commission (AEC) and successor organizations (DOE and NRC) in 1956 and 1974, respectively. The results of this monitoring program have been reported to the public in annual Environmental Monitoring and Facility Effluent Reports.

D&D of Area IV buildings and facilities have been ongoing since the early 1980's. These activities resulted in closeout radiological surveys by various organizations including Argonne National Laboratory (ANL), Oak Ridge Associated Universities (ORAU), Oak Ridge Institute for Science and Education (ORISE), and the California

Department of Public Health (DPH). Some of these buildings have not been demolished and are currently being used for non-radiological work.

In 1985, a Radiological Survey Plan for the SSFL was prepared (Rocketdyne, 1985) "to determine if any man-made radioactive contamination existed in areas it was not known to be, and to locate and quantify any such contamination if it existed." This targeted survey included 25 locations within Area IV. Most of these locations were buildings although salvage yards, storage yards, landfills, and open fields were also included. Contamination exceeding regulatory limits in force at the time was found in 6 of the 25 locations surveyed (Rockwell International, 1989; Table 4). The contaminated areas identified in this survey have since been remediated to cleanup levels in force at the time of remediation.

Boeing/Rocketdyne conducted a Radiological Characterization Survey in 1994-1995 to provide "comprehensive coverage" of the land in Area IV. The survey did not include buildings, facilities in the process of being remediated, inaccessible areas (i.e. steep rock slopes or thick brush areas), or "areas previously characterized in earlier programs" (Rockwell International, 1996). The survey included an ambient gamma survey, a walk-about gamma survey, and soil and water sampling with laboratory analysis of H-3, Cs-137, Sr-90, U-234, U-235, U-238, Th-228, Th-230, Th-232, Pu-238, and Pu-239; and this survey has received critical comment.

The 1994-95 Area IV soil sampling data (149 soil samples) identified 27 samples "as having possibly higher than local background radioisotope concentrations" (Rockwell International, 1996; p. 61). Of these, Rockwell stated that a total of 24 samples "have isotope concentrations well below regulatory cleanup levels, in most cases within the range of U.S. background and do not require any further remediation." Of the three remaining locations, one was considered by Rockwell to be a natural deposit and the other two locations contained Cs-137 resulting from site operations. All three of these locations have since been remediated to levels enforced at the time. Section 2.5, below, addresses historical Background Reference Area studies.

A local stakeholder group called The Committee to Bridge the Gap (CBG) submitted comments on the Area IV Radiological Survey (Rockwell International, 1996). Several of the comments submitted concerned the manner in which background values were obtained. Several other comments concerned areas with contamination or areas that had been remediated but still showed readings above background. Comments submitted by the EPA also noted problems with the determination of background. In addition, EPA had concerns with survey grid distances, gamma detector calibrations, detection of radionuclides at depth, the follow-up on anomalies, inconsistent presentation of laboratory data in different parts of the report, and the fact that areas under remediation were excluded from the survey.

Rockwell International responded to the comments from the CBG and the EPA on the Area IV Radiological Survey (letter dated June 5, 1997 to Tom Kelly, EPA, from P. Rutherford, Boeing, Inc.). However, it appears that this letter did not resolve all of

EPA's comments. In a letter dated July 11, 1997, EPA relayed to Rockwell International its outstanding concerns regarding the overall quality of the survey and suggested that Boeing redo the survey.

2.5 Previous Background Reference Studies

Determination of Background Reference values that represent radiological characteristics in unaffected areas has been a topic of intense interest over the past several years. Many data sources are available that include radiological data in offsite area, and this information may be useful as part of the EPA's HSA process for the Background Reference Area(s). The goal of the detailed and thorough Background Reference Area radiological survey shall be to provide final determination of Background Reference Area values. It is noted that a number of studies have been performed since the early 1990s that provide information potentially useful to EPA's reference site selection process.

In 1993 and 1994 soil sampling took place at the Brandeis-Bardin Institute and Santa Monica Mountains Conservancy (SMMC) to establish values for Cs-137 and Sr-90. Samples were collected from several locations and in some cases over 10 miles distance from SSFL. The data set was linked together and there was controversy regarding how statistics were applied (CDM and DOE, 2008).

Background concentrations of naturally-occurring radionuclides for the 1994-95 ambient gamma survey were derived from a combination of data obtained in separate surveys. Rocketdyne surveyed selected background locations in 1992 and 1994 (McLaren/Hart, 1993; 1994). In 1995, Rocketdyne resurveyed three (3) locations utilized in the earlier survey (i.e., those locations closest to Area IV). A mean value of 15.6±3.6 µR/hr was derived for the background gamma level appropriate to Area IV. For soil samples analyzed in the laboratory, the results of the McLaren/Hart (1993, 1994) background soil sample analyses were used. These were augmented with the results for uranium and thorium analysis on six additional samples obtained by Rockwell International to fill gaps in the earlier survey (U.S. EPA, 2001).

For the 1994-95 ambient gamma survey, a radiation level of 5 microroentgen per hour (µR/hr) above the average of the background data set was used to identify "locations with elevated gamma" (Rockwell International, 1996). A total of 12 locations were identified as having "elevated gamma" readings. Soil samples were taken at these 12 locations and four others and all of these were analyzed for the radionuclides listed above. According to the survey report (Rockwell International, 1996), "Six (6) of these locations showed no unusual soil isotope levels. Seven (7) locations exhibited slightly elevated soil radioisotopes concentrations above background, but nevertheless well below regulatory cleanup levels. Three (3) locations exhibited radionuclide levels above background and above cleanup levels." The latter three locations have since been remediated to enforced levels. The results of the walk-about survey were not detailed in the survey report (U.S. EPA, 2001).

A Radiological Characterization Survey was performed in 1996 which sampled "local background" locations at and near Area IV. This study included information for additional radionuclides present in reactor fuel (U, Th, Pu), as well as fallout/fission products Cs-137 and Sr-90. In 1998, sampling took place in Bell Canyon, near SSFL, which included all of the previous radionuclides as well as additional naturally occurring radionuclides (Ra-226 and K-40). DOE's 2005 Historic Site Assessment attempted to assemble and assess these and many other data sets that contain potential "background" information, and at that time DOE concluded that the sum total of information assembled could not be used as a "MARSSIM reference dataset" because of none of the studies were specifically designed to obtain MARSSIM reference data, the data exhibited inconsistent analysis (different analytical suites), and laboratory method detection limit (MDL) variations were apparent. DOE stated that "for situations where mean background is much smaller than the DCGL, knowledge of background is not very important. Background can be conservatively assumed to be zero and the gross soil concentration measurement can be directly compared to the net DCGL using the Sign Test." They reasoned this was possible for a "majority" of radionuclides including Cs-137, Sr-90, Co-60, uranium, plutonium, etc

In conclusion, several offsite investigations have taken place that may prove useful to EPA when determining the Background Reference Area location and anticipated radiological characteristics of this area(s). However, this information will only be used as part of the overall site determination process, and a complete "clean slate" approach to determining Background Reference values will commence once appropriate areas are selected.

3.0 PROPOSED SCOPE OF EPA'S BACKGROUND REFERENCE AREA AND AREA IV/BUFFER ZONE RADIOLOGICAL SURVEYS

The purpose of this 2008 Scoping Document is to establish scoping criteria and direction for the development of characterization studies to 1) develop and determine accurate Background Reference Area radionuclide values and 2) perform initial scoping, followed by more detailed characterization of the nature and extent of radionuclide occurrence at Area IV including Buffer areas. The surveys will include but not be limited to surface gamma scans, and surface and subsurface soil sampling in the Background Reference Area and surface gamma scans and surface and subsurface soil sampling in the Area IV/Buffer areas as well as targeted groundwater and surface water sampling.

3.1 Assumptions

For the purposes of this 2008 Scoping Document, the following primary assumptions have been made:

1) The Background Reference Area Survey will assess radiological contamination in surface soils and subsurface soils. The Background Reference Area Survey is assumed to include, at a minimum, two different locations.
2) The Area IV/Buffer Zone Survey will include only Area IV and the northwestern Buffer Zone. The northwestern Buffer Zone is a two segment, 180 acre parcel adjacent to Area IV as shown in Figure 2.
3) The Area IV/Buffer Zone Survey will include surface and subsurface soil sampling and gamma scanning surveys.
4) A single event of groundwater sampling and analyses will be conducted; seeps will be sampled if they are accessible and have water in them.
5) Radiological surveys of buildings as addressed by D&D activities are excluded from consideration.
6) DCGLs shall be based on the results of the Background Study plus the agricultural PRGs for each radionuclide of concern. For purposes of estimating costs for this scope, EPA has assumed that the DCGLs will be equivalent to the Extended Detection Limits as described section 4.2.

The design of the surface soil investigation will follow MARSSIM guidance (U.S. EPA et. al., 2000) and will require surface gamma scans over as much of the Background Reference Area and Area IV/Buffer Zone as possible, as well as surface and subsurface soil sampling. Some areas may be excluded because they are inaccessible to the surveying equipment, for example, rock outcroppings, dense vegetation, and existing buildings. The portions of Background Reference Areas and Area IV/Buffer Zone that are accessible will be considered for 100% coverage.

MARSSIM does not address investigations of subsurface soils. Therefore, for purposes of estimating costs, EPA assumed that 2 subsurface samples would be collected at each surface location. Note that, both the number of surface and in particular the number of

subsurface samples collected could likely be reduced based on information obtained from the Historical Site Assessment and surface scanning and surface samples.

The radiological survey of subsurface soils in background locations will be designed considering the nature of geologic material present at the site, and the presence or absence of disturbed soils at the reference areas. Subsurface surveys of the Background Reference Area and Area IV/Buffer Zone will use the DQO process to ensure data are of the quality and quantity needed to support project decision-making.

The MARSSIM processes relies on the use of a standard that is the release limit as a benchmark for comparing radiological data for making decisions about further actions. A release limit is a regulatory limit expressed as a dose or risk–based concentration that has been determined to result in acceptable exposure to a specified target population and is generally based on a specified land-use. However, use of dose or risk-based limits can also provide benchmarks for site investigations or remedial activities.

Dose can be expressed as the total effective dose equivalent (TEDE) or the committed effective dose equivalent (CEDE), or can be based on a site-specific risk assessment, and is determined using exposure pathway modeling. Exposure pathway modeling considers various exposure pathways and scenarios to convert a dose or risk to a concentration. The radionuclide-specific concentration, surface area concentration, or concentration derived from a risk assessment is termed the DCGL. A DCGL may function as a specific investigation level or as final release criteria.

The purpose of the scoping surveys of the Area IV/Buffer Zone is not to establish a release criteria, but rather to investigate what contamination exists and whether the level of contamination, if found at the site warrants further investigation. MARSSIM uses the term 'investigation level' to describe a radionuclide-specific level that if exceeded, triggers a response, such as remediation or further investigation. For the Background Reference Area and Area IV/Buffer Zone investigations, the DCGL will be an investigation level and not necessarily a release criteria.

3.2 Program Design and MARSSIM

MARSSIM requires a performance-based approach for demonstrating that the objectives of the project have been met. As such, MARSSIM requires use of the DQO process to define measurement performance indicators and project goals to ensure the data is useable and defensible. Therefore, the design for the Area IV/Buffer Zone and Background Reference Area surveys for the SSFL will incorporate the DQO process to ensure the data generated are of the highest quality and are sufficient for decision-making. As stated previously, the objectives for this project have been stated to include the quantitation of accurate and representative Background Reference Area radionuclide values for comparison to the Area IV/Buffer Zone areas at SSFL, and to perform initial scoping surveys to identify areas within the Area IV/Buffer Zone that warrant further investigation by a more detailed characterization to determine the nature and extent of radionuclide occurrence at Area IV, including the adjacent Buffer area.

3.2.1 Background Reference Area Determination under MARSSIM

The Background Reference Area(s) are selected based upon a determination that 1) the area was uncontaminated by site radiological activities (i.e., the area is non-impacted) and 2) the area would have similar physical, chemical, radiological and biological characteristics as on-site SSFL survey units. The MARSSIM (U.S. EPA et. al., 2000) defines a reference area as follows: "Geographical area from which representative reference measurements are performed for comparison with measurements performed in specific survey units at a remediation site. A site radiological reference area (background area) is defined as an area that has similar physical, chemical, radiological, and biological characteristics as the site area being remediated, but which has not been contaminated by site activities. The distribution and concentration of background radiation in the reference area should be the same as that which would be expected on the site if that site had never been contaminated. More than one reference area may be necessary for valid comparisons if a site exhibits considerable physical, chemical, radiological, or biological variability."

The MARSSIM NUREG-1575, EPA 402-R-97-016, DOE/EH-0624, Rev. 1, August 2000, (Glossary) defines a Background Reference Area as follows:

> "Geographical area from which representative reference measurements are performed for comparison with measurements performed in specific survey units at a remediation site. A site radiological reference area (background area) is defined as an area that has similar physical, chemical, radiological, and biological characteristics as the site area being remediated, but which has not been contaminated by site activities. The distribution and concentration of background radiation in the reference area should be the same as that which would be expected on the site if that site had never been contaminated. More than one reference area may be necessary for valid comparisons if a site exhibits considerable physical, chemical, radiological, or biological variability."

NUREG-1505, A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys, also defines a <u>reference area</u> (or background area) as a geographical area from which representative samples of background will be selected for comparison with samples collected in specific survey units at a remediation site. NUREG-1505 and MARSSIM (NUREG-1575) provide the same definitions and the same recommendations, however, MARSSIM also states "Background Reference Areas are normally selected from non-impacted areas, but are not limited to natural areas undisturbed by human activities." (MARSSIM Section 4.5, page 4-13)

Another factor to consider when selecting the reference area is the potential impact of surface disruption on the site. Activities that disturb soils can affect radionuclide distributions in the soils, especially for nuclides originating from fallout. Construction activities and other activities involving soil movement can result in soil mixing/removal and thus changes and differences in radionuclide distribution in the soil. Soil

disturbances must be understood and considered when evaluating a site for use as a reference area.

The identification and characterization of Background Reference Area radiological characteristics is imperative to obtain accurate background values for comparison to the DCGLs (agricultural PRGs). The concentration limits associated with agricultural PRGs are significantly lower than residential PRGs and are likely less than local "background." The PRG for radionuclides with a background concentration greater than the PRG will require adjustment to account for this natural occurrence to avoid not being able to release a survey unit because the PRG is unachievable.

3.2.2 MARSSIM Survey Units

Under MARSSIM, survey units are areas subject to the release criteria established for the site. Survey units may be derived to identify a physical structure or land area for which separate decisions are made for the purpose of demonstrating compliance with a regulatory standard. Survey units are determined by evaluating the likelihood that a specific land area has been contaminated. This process uses information gathered during the historical site assessment to provide a more streamlined and efficient approach to characterization by identifying areas where greater effort is required to identify and quantify contaminants, and defining areas where a smaller number of measurements may be needed to demonstrate regulatory compliance. Areas identified from the HSA will be divided into three categories in accordance with MARSSIM for a graded approach to performing assessments by focusing on areas based on Class 1, Class 2, or Class 3 designations as defined below:

- Class 1 areas are areas of known contamination that may or may not exceed specific DCGLs.
- Class 2 areas may or may not be contaminated or adjacent to known contamination.
- Class 3 areas are believed to be unaffected by site activities.

Class I sites shall receive highest scrutiny during Final Status Survey (FSS) investigations, followed by Class 2 and Class 3 sites. EPA's evaluation shall include assembly and evaluation of information through the HSA to determine potential Class identifications not only in Area IV, but in the adjacent Buffer Zone, as well.

3.2.3 MARSSIM Data Life Cycle

MARSSIM defines the data life cycle as the "process of planning a survey, implementing a survey plan, and assessing the survey results prior to making a decision." The purpose of this 2008 Scoping Document is to set the stage for forthcoming Background Reference Area and Area IV/Buffer Zone radiological characterization surveys, so implementation of the MARSSIM data life cycle concept is pertinent to this process.

Planning is the first phase of the process, and includes use of the DQO process to help design the survey. That is, planning shall include development of the scope and objectives, as well as the QAPP and Field Sampling Plans (FSPs). EPA shall develop a detailed plan for performing field activities associated with both Background Reference Area and Area IV/Buffer Zone radiological characterization surveys, noting that the DQOs for each area my differ. DQOs for the Background Reference Area shall center around the objective of determining accurate and representative radiological characterization of an area as nearly identical to SSFL as possible from a geologic, biologic, etc. perspective, but unimpacted by SSFL activities. DQOs for the Radiological characterization of Area IV/Buffer Zone, on the other hand, shall center on determination of the nature and extent of radiological constituent and contaminant occurrence at the surface, assessment of which will include comparison of the values with background and DCGLs, the process for which is described in MARSSIM. While MARSSIM principles (i.e. final status survey criteria) will act as starting place for the study DQOs, other DQOs (e.g. site characterization, risk assessment, feasibility study and remediation technology assessment) may need to be considered during the development of the QAPP and FSP to ensure maximum usefulness of the data that is ultimately acquired for this study. All programs must be designed and scoped to meet DQOs—i.e., to obtain data necessary to meet the intended purpose of the analysis. This section of the report shall address the DQO determination process and how it impacts survey design for both the Area IV and Background analyses. It is expected that the contractor performing the work shall define the detailed DQOs, but these should be based upon the following:

- Statement of the Problem
- Decisions to Be Made
- Inputs to the Decisions
- Boundaries of the Study
- Decision Rules
- Limits on Decision Errors
- Sample Design

It is expected that separate work plans/QAPP/FSPs shall be developed for the Background Reference and Area IV/Buffer Zone characterization efforts. The following key elements will be included in any QAPP/FSP: Introduction; Project Scope; DQO; identification including decisions to be made; study boundaries; decision rule; errors; instrumentation; and sampling/data collection designs; project organization; sampling and analysis procedures; soil sampling; data analysis procedures; and documentation.

Implementation is the actual performance of work described in the work plan and QAPP/FSPs, and the collection of raw data. It should be noted that the proposed plan may include real-time assessment of information to a certain extent to focus additional sampling and analysis and identify elevated areas of contamination that may undergo additional field characterization to fully understand the nature and extent of radiological contamination.

Data Assessment

MARSSIM primarily provides a process to reach a FSS, after which a site or survey area would be released if compliance with the release criteria is met. However, this study will primarily contribute to site characterization and may guide future evaluation and/or cleanup. Data assessment is a formal evaluation of the data quality and a reconciliation of the data collection process and results with the project DQOs. This process is also referred to as the data quality assessment (DQA) process. The data generated during the Implementation Phase are first verified to ensure that the Standard Operating Procedures (SOPs) specified in the QAPP were actually followed and that the measurement systems performed in accordance with the criteria specified in the QAPP and/or other Plans. Then the data are validated to ensure that the results of data collection activities support the objectives of the survey as documented in the QAPP, or permit a determination that these objectives should be modified. The DQA process is then applied using the validated data to determine if the quality of the data satisfies the data user's needs. The data evaluation process for this end use is described in Chapter 8 of MARSSIM, and it is anticipated that the plans developed for the full Radiological Characterization Process shall address the data evaluation process in detail for both the Background Reference Area and Area IV/Buffer Zone radiological characterization surveys. The work plan will provide a general outline of report results. See Section 4.3 for anticipate data analyses.

3.2.4 MARSSIM Radiation Survey and Site Investigation (RSSI) Processes

MARSSIM guidance, in accordance with the DQO process recommends using a series of surveys to demonstrate compliance with dose or risk-based regulatory requirement, which will ultimately be defined in the CERCLA regulatory process for release of the property for some pre-defined land use. MARSSIM defines the process by which a final regulatory limit is established for site cleanup as the Radiation Survey and Site Investigation (RSSI) Process. There are six steps in the MARSSIM RSSI Process, four of which are applicable to this 2008 Scoping Document:

- Site Identification
- Historical Site Assessment
- Scoping Survey
- Characterization Survey

Historical Site Assessment

A significant amount of data and interpretations, including an HSA performed by DOE, are available. This information will be important to EPA's assessment process, but the intent of the EPA's HSA is to independently assess existing Area IV data to focus characterization data collection in the Area IV/Buffer Zone. EPA's HSA will build on the work that has begun in technical meetings held with study partners and input from the community. The primary purpose of the HSA is to collect existing information concerning the site and its surroundings.

The primary objectives of the Background Reference Area are:

- Identification of sites unaffected by SSFL activities by assessing location/extent of known or suspected releases

- Identification of Background Reference Areas separate from those areas that are unaffected by SSFL Activities AND have similar physical, geological, topographical, and other natural considerations, including the same geologic formations, etc.

- Evaluation of other area uses, e.g. from other entities, etc., that could impact site separate from the SSFL activities

- Evaluation of potential radionuclide presence or occurrence in the Background Reference Area(s), starting with the radionuclide listing presented in Section 2.0 and determining, based on available data and results of the Area IV/Buffer Zone HSA, which if these are due to contamination from SSFL and which are ubiquitous in the background area due to natural conditions and/or fallout.

- Identification of the need for a scoping survey to further assess site conditions.

The primary objectives of the HSA in the Area IV/Buffer Zone are:

- Identification of potential sources of contamination and to help assign Class designations.

- Assessment of radiological materials managed at the facility and determine if associated radionuclides can be attributed to activities at SSFL vs. those occurring naturally and/or from fallout, etc. It is recognized that these groupings may overlap, and it is therefore important to understand anticipated radionuclide distributions, decay products, and other factors that will help delineate and identify radionuclide occurrences attributable to SSFL releases.

- Determination of whether or not sites pose a threat to human health and the environment.

- Identification of the need for a scoping survey to further assess site conditions.

- Provision of an assessment of the likelihood of contaminant migration.

- Identification of additional potential radiation sites related to the site being investigated.

Scoping Survey

The Scoping Survey, if performed, is basically a limited field investigation performed to augment HSA discoveries and to verify/assess any initial Class designations. MARSSIM states that if the data collected during the HSA indicate an area is impacted, a scoping survey could be performed. Therefore, the scoping survey would be performed, in accordance with MARSSIM, only in Area IV/Buffer Zone. Scoping surveys are conducted after the HSA is completed and consist of professional judgment, according to MARSSIM.

Radiological Characterization Survey

The purpose of the Radiological Characterization Survey(s) is to:

- Identify radiological constituents and characteristics of the Background Reference Area(s).
- Determine the nature and extent of the contamination.
- Collect data to support evaluation of remedial alternatives and technologies.
- Evaluate whether the survey plan can be optimized for use in the final status survey.
- Support Remedial Investigation/Feasibility Study requirements (CERCLA sites only) or Facility Investigation/Corrective Measures Study requirements (RCRA sites only).
- Provide input to the final status survey design.

The radiological characterization survey is a comprehensive survey type that will generate a significant amount of data; it involves systematic and judgmental sampling approaches, etc. MARSSIM states that the decision regarding which media to survey is a site-specific decision addressed through the HSA process.

3.3 Background Reference Area and Area IV/ Buffer Zone Evaluations under MARSSIM

The purpose of the Background Reference Area investigation is to determine the concentration of the radionuclides of potential concern in soil not affected by SSFL activities. The data would represent the concentrations of naturally occurring radionuclides and manmade radionuclides from non-SSFL related events, like nuclear weapons testing, in background surface and subsurface soil. The background data would be used for comparison to the SSFL soil sample results obtained from the Area IV/Buffer Zone investigations to provide information regarding areas of potential elevated

contamination. Future uses of the background data could be for developing DCGLs and for the statistical tests required for evaluation of Final Status Survey results.
Area IV/Buffer Zone investigation data will be used to determine the radionuclides of concern, to locate areas of potential contamination, to determine the classifications of areas into Class 1, 2, or 3, and to determine if specific areas are ready for a Final Status Survey. Potentially the investigation results could be used in part or whole for Final Status Survey data sets if the data quality objectives for the Final Status Survey were met.

4.0 RADIOLOGICAL CHARACTERIZATION SURVEY APPROACH

As indicated in Section 3.0, the Survey has two components: 1) Background Reference Area establishment and radiological characterization, and 2) Area IV/Buffer Zone surface and subsurface soil radiological characterization.

The process will begin with performance of EPA's HSA (see Sections 1.2 and 3.0). This assessment shall include evaluation of data pertinent to both the Background Reference Area survey as well as the Area IV/Buffer Zone survey. As discussed in Section 1.2 and Section 3.0, a Scoping Survey could occur prior to the Radiological Characterization Survey. The Radiological Characterization Survey approach follows MARSSIM guidance, with the overall design flexible enough to allow modifications to the characterization process if and as new information is added through the process. It is noted that Background Reference Area characterization is a key portion of this effort. The approach and methodology for obtaining these measurements will include a review of existing data and will include input from stakeholders. However, EPA will make the final determination regarding background measurements.

EPA will conduct oversight of the contractors throughout the work plan and/or field sampling and analysis plan development and the implementation of the Background Reference and Area IV/Buffer Zone surveys. The EPA will maintain a review and approval role in the development of the survey plans by contractors. EPA will also conduct QA/QC activities associated with the survey as defined further in Section 6.0.

4.1 Background Reference Area Characterization Survey

It is assumed that a minimum of two sites or areas will be identified for characterization as Background Reference Areas. The purpose of this evaluation is to determine the radiological composition of soils, both surface and subsurface. The following assumptions are made, noting these may be modified:

- A gamma scan survey shall be performed over 100% of accessible areas.
- Gamma scan surveys will identify gamma "hot spots" that will be further evaluated by surface soil sampling and analyses and/or additional scanning surveys.
- Surface soil sampling will take place on a grid determined by the MARSSIM principles and the DQO processes, and shall include sampling and analyses of alpha, beta, and gamma emitting radionuclides.
- Subsurface sampling will occur at about half of the surface sampling locations to a total depth of about 10 feet or auger refusal.
- The survey will include identification of specific radionuclides that may be present, with a listing of nuclides directly attributable to SSFL also available;

the full spectrum of radionuclides will be included in the survey to ensure that the areas are unimpacted and that a complete radiological characterization of these areas is obtained.

As indicated above, the Background Reference Area Radiological Survey shall include a gamma surface soil survey using, as possible, truck mounted detection systems. The scanning system will be equipped with a Global Positioning System (GPS). EPA will survey 100% of the accessible areas using the Enhanced Radiological Ground Scanner (ERGS) or similar/compatible gamma scanning technology to be identified in the work plan. In areas pre-determined to be inaccessible via vehicle mounted systems, a hand-held gamma survey shall be performed following MARSSIM principles to ensure comparability of data obtained through the two data collection methodologies. The EPA Office of Radiation and Indoor Air (ORIA) ERGS equipment and hand scanning equipment may be suitable for this purpose, but the QAPP/FSP will specify the instrumentation and approach based upon the HSA and site characteristics.

It is noted that selection of the detection technology and measurement accuracy may be impacted by various factors such as soil density, soil moisture content, geologic lithography, and gamma energy of the radionuclide(s) of potential concern. It is expected that all of the information pertaining to the site, including potential reference area radionuclides, will be taken into account when determining the appropriate survey technologies. Also, the FSPs shall identify the appropriate location, grid, sampling frequency, etc. of the survey based on DQOs and MARSSIM principles.

The gamma scanning survey will identify areas of elevated gamma measurements that will be further assessed to determine the reason for the anomaly and will include sample collection and analysis. It is also noted that alpha and/or beta emitters may not have an accompanying gamma signature that would be readily detected through the surface gamma survey. Therefore, EPA shall also conduct surface soil sampling on a grid, and surface soil samples will be analyzed for the full spectrum of radionuclides, irrespective of surface gamma survey results.

In addition to the surface study, EPA shall perform sampling and analysis at depth to assess any vertical radiological characteristics that may be present. For example, it is anticipated that naturally occurring radionuclides within a geologic unit may be universally dispersed throughout the unit. However, if surface disruption occurred then the vertical distribution of naturally occurring (i.e., present due to factors other than SSFL) radionuclides could vary at depth. The FSP shall determine the sampling number but it is anticipated that the samples may be collected at depth at the same location as both the “hot spot” surface and grid surface soil sample locations

For the purposes of planning, the number of samples estimated to be collected and analyzed for the background determination is about 50 samples per reference area. An additional 30 samples could be required to assess gamma scan anomalies. A total of 130 soil samples could therefore be collected in the Background Reference Area(s). The

actual number of samples to be collected will be determined based on field conditions and the application of MARSSIM principles.

The Background Reference Area Radiological Characterization Survey approach shall be documented in detail in a QAPP/FSP, or similar document, and shall include but not be limited to the following:

- Project Scope
- Project Organization
- DQOs
- Sampling and Analysis Procedures to include instrumentation and equipment identification, gamma scanning surveys, soil sampling (surface and at depth) and collection of a statistically appropriate number of samples to determine background for the relevant radionuclides.
- Field and Laboratory Quality Control
- Data Validation procedure references
- Data Quality Assessment and Data Analysis Requirements
- Required documentation

4.2 Area IV/Buffer Zone Radiological Characterization Survey

The Area IV characterization survey will include both Area IV and the Buffer Zone as presented in Figure 2. The purpose of this assessment is to characterize the radiological composition of surface and subsurface soils, so that areas that exceed the DCGLs can be identified. These areas may later undergo further evaluation and/or remediation. Note that all sample numbers provided herein are provided for cost estimation purposes only, and likely will be revised during detailed project development.

This 2008 Scoping Document requires the development of a QAPP/FSP that will detail and consider requirements for sample collection; instrumentation; methodologies; data validation; and DQA and analysis (statistical comparison of results to applicable background/reference samples), as presented in MARSSIM. The QAPP/FSP shall take into account the MARSSIM classifications made as part of the HSA, and shall define detailed methodologies for determining the sample location and methodologies to fully characterize surface soil contamination. The FSP shall include but not be limited to performance of a surface gamma scanning survey over the entire accessible area and both grid and targeted soil sampling. The following assumptions are made; noting these can be modified based on the results of the HSA and work plan development activities:

- All sample numbers and the basis for estimating these sample numbers (acreage assumptions, etc) are provided to support cost estimates, and may be revised during detailed survey planning.

- The total acreage shall include 290 acres in Area IV and approximately 180 acres in the Buffer Zone for a total of approximately 470 acres.

- For the purposes of this document, EPA assumed 40 acres of Class I, 50 acres of Class II, and 150 acres of Class III areas within Area IV. However, this allocation will likely be revised based on EPA's HSA and/or scoping survey.

- Area IV topography will include areas accessible to truck mounted systems as well as areas inaccessible to truck mounted systems. It is assumed that approximately 20% of Area IV (50 acres) will be inaccessible, and 80% will be accessible.

- A gamma scanning survey shall be performed in accessible areas.

- Gamma scanning surveys will identify gamma "hot spots" that will be further evaluated by surface soil sampling and analyses.

- Surface soil sampling shall take place over a grid determined by MARSSIM processes, and shall include sampling and analyses of alpha, beta, and gamma emitters—this sampling shall take place throughout the Area IV and Buffer Zone regardless of the classification.

- It is assumed, for costing purposes, that 50 samples/acre will be collected in Class I areas, 50 samples/5 acres will be collected in Class II, and 50 samples/10 acres will be collected in Class III areas. This results in a total of 2000 Class I area samples, 500 Class II area samples, and 750 Class III area samples.

- It is assumed, for cost estimating purposes, that 200 samples will be collected in the Buffer Zone.

- It is assumed that 2 subsurface samples will be collected for each surface sample location in Area IV, which results in a total of 6500 subsurface samples.

- It is assumed that as a contingency, an additional 5% of the total samples may be required to obtain better sample distribution over the entire area. This results in an additional 160 surface samples and 325 subsurface samples.

- A total of 3250 + 200 + 6500 + 485 soil samples are assumed required to adequately characterize surface and subsurface soils in Area IV and the Buffer Zone.

- In addition to soil sampling, limited groundwater sampling and seep sampling will be performed. Existing monitoring wells will be sampled, and seeps will be identified during the initial HSA and/or Scoping Survey designed to identify these features. It is assumed that approximately 30 existing monitoring wells in Area IV and the Buffer Zone will be sampled and will be characterized for the same analytes present in soil. Both the groundwater

monitoring well and seep sample numbers may be modified based on HSA and Scoping Survey results. MARSSIM does not address groundwater and seep investigations therefore these investigations will follow standard EPA guidance.

- The survey shall include identification through the HSA of specific radionuclides that may be present. It is anticipated that the list of radionuclides of potential concern may be refined to include detection of indicator radionuclides rather than the full spectrum of radionuclides that may be present to simplify and streamline the characterization process.

The Area IV/Buffer Zone survey will include a 100% gamma scanning survey of all accessible areas, with hand-held measurements taken in those areas that are not accessible by truck or vehicular-mounted equipment. The scanning system will be equipped with a GPS. It is anticipated that the EPA ORIA ERGS equipment and hand scanning equipment may be suitable for this purpose, but the QAPP/FSP will specify the instrumentation and approach based upon the HSA and site characteristics. It is noted that the HSA shall identify potential Class I, Class II, and Class III areas. The surface scan will include 100% of all accessible areas, as well as the entire Buffer Zone to the northwest of Area IV irrespective of classification. The gamma survey will be used to identify potentially elevated areas of contamination. As potential contamination areas are detected, targeted surface soil sampling and analysis will be performed to identify the contamination. The appropriate sampling grid spacing and configuration should be based on a specified probability of finding a hot spot, which will be determined based on the operational history of specific areas. According to the report on the 1993-94 survey (Rockwell International, 1996), approximately 70% of Area IV should be accessible to the mobile gamma scanning. This implies, for cost estimating purposes, that approximately 240 acres may be scanned.

Note that the Class 1-3 areas may or may not contain radionuclides that are detectable gamma emitters via field based instrumentation; it is also possible that primary alpha/beta emitters may be presented in these areas based on the HSA. As such, the gamma scanning survey would not detect these radionuclides. Also, the HSA may not identify all areas of potential release. Therefore, the survey may include an additional broad Area IV/Buffer Zone-wide surface soil sampling program that will include alpha and beta emitter analyses as well as gamma emitters to ensure that all potential radionuclides present in soil are evaluated. For the purpose of providing conservative estimates for costing, it is assumed that approximately 5% of the total number of samples determined using the assumptions stated herein for the Area IV/Buffer Zone radiological surveys required to characterize the surface soils in Area IV and the Buffer Zone will be added to the total number of samples. Therefore 5% of the total 3,250 samples equates to approximately 160 surface soil samples to be collected over the grid area, bringing the total number of surface samples to 3410.

It should be noted that indicator radionuclides shall be identified by the contractor based on the listing presented in Chapter 2, and include input from stakeholders in technical

meetings. It is possible that analysis would be performed only for the indicator radionuclides, with sufficient sample volume collected to perform more detailed analysis if the indicator species is identified.

Based on the above, and assuming the acreage and classifications stated above, up to 3410 surface soil samples are assumed for costing purposes only, to encompass the MARSSIM survey areas, noting that all sample numbers will be determined as part of the radiological characterization HSA and radiological survey. This number does not include additional QA/QC samples. The soil sampling will follow EPA established procedures and will include QA/QC sampling by EPA. Each of the samples obtained will be analyzed for the indicator radionuclide or full list of radionuclides of potential concern, as appropriate.

As noted earlier, MARSSIM is not intended to be used as guidance for characterization of subsurface soils. Since there is suspicion of unauthorized subsurface releases at SSFL, for purposes of this scope, EPA has assumed that 2 subsurface soil samples will be needed for each surface sample location. This is a very conservative estimate that will likely be adjusted once a thorough Historical Site Assessment is completed. After that time, a more targeted subsurface sampling program can be developed.

Based on the assumption that 2 subsurface samples will be required for each surface sample location, the cost estimate accounts for 6500 subsurface samples and additional 5% contingency samples, for a total of 6825 subsurface samples.

In addition, EPA has assumed the "Extended Detection Limit" referenced in Attachment C as the DCGL for the investigation at SSFL. The "Extended Detection Limit" represents a detection limit that falls between EPA's residential PRG and EPA's agricultural PRG. EPA chose this detection for purposes of this scope because it is likely that levels of naturally occurring radionuclides could be higher than EPA's Agricultural PRGs. However, EPA is sensitive to the current large-lot zoning at SSFL and to State and community concerns regarding the use of low detection limits.

The Area IV/Buffer Zone Radiological Survey shall include the development of DQOs, Sample Design as presented in Chapter 5 of MARSSIM, measurement survey an instrumentation, and data analysis. The QAPP/FSP shall include but not be limited to the following:

- Project Scope
- Project Organization
- DQOs
- Sampling and Analysis Procedures to include instrumentation and equipment identification, gamma scanning surveys and soil sampling and analysis
- Field and Laboratory Quality Control
- Data Validation procedure references
- Data Quality Assessment and Data Analysis Requirements
- Required documentation

4.3 Data Quality Assessment and Analysis

Data obtained from the Background Reference Radiological Characterization Survey shall be used to obtain a detailed understanding of radionuclides present in unimpacted surface and subsurface soil. This information will be compared to radiological characteristics of suspected impacted areas to determine whether further characterization is warranted to define the nature and extent of contamination in Area IV and the Buffer Zone that is suspected as originating from SSFL activities. This section shall address the general DQA to ensure that a consistent and defensible data evaluation and interpretation occurs. This will include providing data validation results, reconciling the results of the surveys/characterization to the project DQOs; providing a formal assessment that states how the Precision, Accuracy, Representativeness, Comparability, Completeness, and Sensitivity objectives for the data were met, and summarizing how the data meets the requirements for project decision making.

4.3.1 Background Reference Area Data Analysis

Background Reference Area data shall be collected and presented in hard copy and electronically. Maps and/or databases will be prepared showing survey parameters including MARSSIM-defined sample locations, grid systems, locations of elevated activity, identification of radionuclides from laboratory measurements including lateral and vertical distribution of radionuclides. Once the data are validated and assessed in the DQA process, the background (reference area) data determined to be usable shall be evaluated to derive appropriate statistical parameters (i.e., type of distribution, mean, median, standard deviation, standard deviation of the mean, etc.). These data shall be presented for each radionuclide of concern in each background area sampled. The statistical data derived for the two Background Reference Areas shall be compared to tests for statistical differences [between the two areas] and to derive statistical parameters to define radiological characteristics of the Background Reference Area that can be applied during assessments of the Area IV analyses. Appropriate graphics will be included to depict statistical results. If appropriate, statistical differences between background (reference) areas shall be evaluated in terms of differences in geological, topographical or other parameters.

Several important elements must be addressed as part of Background Reference Area data analyses. These include but are not limited to the following:

- Identification of anomalous readings/measurements
- Development of appropriate summary statistics
- Develop, for background, Individual Target Radionuclide Data Sets including population distinctions, outlier identification, data set combinations, etc.
- Quality control measurement analysis methodologies

Information shall be presented in draft and final Characterization Reports that shall address the following, at a minimum:

- Summary of field and analytical activities performed including the survey design, sample locations, and gamma scanning survey, surface soil (lab) and subsurface soil (lab) analysis.

- DQA performed for all measurements/data

- Data analysis performed for individual radionuclides and/or radionuclide sets to assess location and elements that impact the lateral and vertical occurrence

- Statistical evaluation of data needed to determine true populations, distribution, or others as appropriate to determine the mean, median, or range of values that quantifies the true background concentration(s)

- Data evaluation and the assessment of each radionuclide detected with respect to lateral and vertical occurrence, and potential sources of radionuclides detected including recommended uses and limitations associated with the Background Reference data

4.3.2 Area IV/Buffer Zone Data Analysis

Results of the assessment shall be presented in characterization reports. As with Background Reference data, all the data obtained shall be presented in hard-copy and electronic media. Maps showing survey parameters including MARSSIM class locations, grid systems, sampling locations, areas of elevated activity, and other parameters of interest will be presented. A formal DQO report will be presented that will include the data validation results, reconciliation to project DQOs, data quality criteria analyses, and conclusions regarding the applicability and sufficiency for project decision making. This process will start early in the analysis phase and continue until the end. The results of laboratory analyses of onsite samples shall also be evaluated for compliance with DQOs by EPA. Once the data are qualified, these data can be evaluated in relation to the DCGLs derived for Area IV/Buffer Zone soils. This evaluation will include full statistical analysis in accordance with MARSSIM that provides a comparison of the data to the background concentrations. This comparison should illustrate whether the Area IV/Buffer Zone data is statistically significantly different or elevated above background, and if so, whether Area IV/Buffer Zone data exceeds the DCGLs with a specified level of confidence. The results of these evaluations will be presented in appropriate tabular and graphical formats.

5.0 COST ESTIMATE AND SCHEDULE

EPA estimates the cost of the Background Reference Area study to be $1,500,000. Rough cost estimates for the Area IV/Buffer Zone Characterization program activities are presented in Attachment B. Estimates are based upon quantities and level of efforts provided in the 2001 scoping document that were revised and updated to include changes in item cost and scope modifications. This budget includes costs to conduct the HSA, perform scoping surveys, conduct site radiological characterization activities, and perform data evaluation and report preparation. The costs are estimated based on fiscal year (FY) 2008 dollars and funding would be required over multiple fiscal years. Attachments D and E provide an estimated project performance schedule for both the Background Reference Area survey and Area IV/Buffer Zone survey, respectively.

5.1 Quality Assurance / Quality Control Requirements

EPA will evaluate whether the sampling and analysis activities proposed meet the required DQOs. An auditor, field technician, and principal scientist will perform the required oversight and onsite audit functions. The program will need their support during the actual sample collection and analysis, although the complete time period required to perform every tasks is yet to be determined. The combined efforts of this EPA staff are estimated to be 2.25 full time employees.

5.2 Assumptions for this Scope and Potential Future Cost-Saving Measures

The following factors can each have an impact on the cost estimate for the Area IV/Buffer Zone Survey:

1. Number of Acres in the MARSSIM Class 1, 2, and 3 Survey Units:
The number of acres of MARSSIM Class 1 survey units has been estimated at 40 acres for the purpose of this document. However, once the HSA is completed, 40 acres may be an overestimation. If so, the difference between the new number and the estimated number could correspond to significant cost savings. Alternatively, if more Class I acreage is identified, then costs could be underestimated.

2. Grid Size within the Survey Units:
This scope assumes an approximate grid size within class I survey units of 30’x30’. This equates to approximately 50 samples per acre within a Class I survey unit. It is possible that the grid size could be increased and still allow for adequate characterization. In this case, the number of samples would be proportionately reduced in all Class areas.

3. Number of Analytes per sample:
There also exists a potential for significant cost savings in the number of analytes that are considered when characterizing the Area IV/Buffer Zone. This cost-savings would be assessed following the HSA for Area IV/Buffer Zone, during

which the full analytical suite and indicator radionuclides will be refined or redefined. However, cost saving associated with analytical suite modification for the Background Reference Area are not anticipated, because the purpose of this survey is to fully assess background radiological characteristics, not define the nature and extent of a radiological release, per se. Results of the background survey could be used to assess and refine the radiological indicator parameters specific to Area IV/Buffer Zone, also potentially resulting in a cost savings.

4. Adjustment of Detection Limits:
If results of the Background Study show that background values for radionuclides are higher than the "Extended Detection Limit" assumed for this scope, DCGLs can be adjusted and allow for higher detection limits. As noted on Attachment C, this would result in significantly lower analytical costs.

5. Results of Historical Site Assessment:
Based on operational information gathered as part of the Historical Site Assessment, it is likely the number of subsurface samples could be reduced. EPA may choose to sample the subsurface only in those areas where surface soils are thought to be disturbed as documented in the HSA, particularly based on analysis of aerial photography.

6. Technical Adjustments:
As an alternative to collecting so many subsurface samples, consideration will be given to gamma logging technology. This would involve lowering a gamma probe into a drilled and lined hole and logging the hole via a gamma scan. This could quickly determine whether there are anomalies downhole, and could serve to direct where subsurface soil samples could be collected. Such an approach would be targeted based on HSA results and would require a high density of borings from which to collect the readings.

Additionally, if the standard deviation of results for radionuclides of concern is low (determined from literature and/or results of the Background Study), EPA may determine that the number of surface samples could be reduced and still achieve the same statistical rigor. In the case of fewer samples per area, EPA and stakeholders would need to agree on the appropriate grid spacing (see no. 2 above).

7. Future Land Use:
In accordance with CERCLA, an evaluation of current and reasonably anticipated future land use will be considered during the work plan development process.

6.0 CONTRACTOR MONITORING AND OVERSIGHT BY EPA

The contractor shall prepare a work plan that identifies each of the work elements presented in Sections 3.0 and 4.0, above. As part of this work plan, additional documents will be prepared to 1) specify work to be performed in more detail and 2) document the results of these efforts. For example, a QAPP will be prepared, as well as a FSP that presents detailed presentation of anticipated field activities. Some of these documents are presented in Sections 6.1 through 6.3, below, noting that the contractor can and shall identify additional work products that may be provided to EPA.

6.1 Radiological Survey Quality Assurance Project Plan and Field Sampling Plan

The contractor shall prepare a QAPP for collection and analysis of radiological survey data in accordance with EPA QA/R-5 (EPA 2001) and EPA QA/G-5 (EPA 1998); for this project it is strongly recommended that the Uniform Federal Policy for Quality Assurance Plans (UFP-QAPP, 2005) be followed. Procedures to be used by the contractor shall be referenced, performance based, or have a detailed basis in the scientific literature prior to being approved by EPA for this project. EPA shall approve the QAPP and monitor compliance with it. This document shall include, as necessary any scoping survey activities that may be performed. Further, field activities shall be detailed in site-specific FSPs for the Background Reference Areas and Area IV/Buffer Zone.

6.2 Radiological Characterization Report

The results of the Field Radiological Survey for both the Background Reference Area and Area IV/Buffer Zone shall be documented in draft and final characterization reports. This report shall include, as necessary, all data, graphics and text necessary to convey full understanding of the nature and extent of radiological constituent occurrence in the Background Reference Area, and shall identify detailed radiological background values for individual radionuclides at surface and at depth.

The characterization report for the Area IV/Buffer Zone shall identify the nature and lateral extent of contamination in Area IV/Buffer Zone surface soil. The report shall include all data, graphics, and text necessary to convey a complete understanding of the radiological characteristics of sampled material in Area IV/Buffer Zone. Further, the document shall clearly identify any data gaps, and shall be sufficient to determine future at-depth soil characterization activities.

6.3 EPA Personnel On Site During Survey

EPA will monitor contractor activities during the ground survey and during the soil sample collection process by on site audits and direct work inspection. Audits will be conducted to assure compliance with the QAPP. EPA will be on site for announced and

unannounced audits. Direct work inspection will be formalized by EPA procedure and documented in a contractor oversight record, further reviewed by senior EPA project leaders.

6.4 EPA Quality Control Samples

EPA will split certain samples, both surface and subsurface, with the contractor. EPA will use the same performance-based DQO as the contractor in its analysis. EPA will also perform duplicate analysis on some samples in the laboratory (percentage to be determined), produce spiked samples with off-site soil and analyze them (percentage to be determined). In the case of sample locations where random samples per class unit are to be collected, collect them at the next location given in the random number calculation (percentage to be determined).

EPA will also prepare spike samples from off-site soil and have the onsite contractor mark and place the samples in the laboratory contractor sample queue. These samples will appear to be legitimate samples and will not follow a predictable pattern (blind to the laboratory contractor). This percentage will be determined, but more emphasis will be placed on the higher MARSSIM survey unit classifications than the lower ones. Blind samples would also be introduced as QC samples into the EPA lab as part of contractor monitoring.

6.5 Laboratory Oversight and Quality Assurance / Quality Control

Both the contract laboratory and the EPA laboratory verifying the performance of the contract laboratory would be subject to audit. EPA will perform audits on contract laboratories directly, using guidance from Superfund and National Environmental Laboratory Accreditation Conference as a basis for the audit.

6.6 Assessment of Assumptions

EPA will review technology and applicability of technology to handle remote or inaccessible areas of the site which might have been affected by spills, runoff, or dumping. EPA will review and concur on any assumptions, methodologies, or models used to predict contamination or lack thereof on inaccessible locations.

6.7 Data Validation

The contractor will be required to validate its own work – data packages will be electronic, backed up by a complete paper trail. EPA will validate a representative set of contractor data (percentage to be determined). EPA will internally validate its own data and outside auditors will review this for accuracy.

6.8 Data Quality Assessment

DQA is the formal evaluation of the data collection and analysis process that assesses whether the data generated are of the right type, quality and quantity to support their intended use. The DQA provides objective information that illustrates the following:

- The sampling design accurately represented field conditions and contaminant distribution.
- Implementation of sampling was done in accordance with appropriate procedures and in accordance with the QAPP.
- Sample collection and analysis procedures maintained custody of the samples through proper implementation of chain of custody, and the integrity of the samples was maintained through proper preservation and sample handling.
- Laboratory analysis was completed in accordance with all procedural requirements and provided accurate results.
- Data met the data quality criteria objectives in accordance with the project DQOs.

This process requires that the data be validated by qualified scientists and in accordance with approved data validation procedures, and then reviewed by the project manager to assess these above mentioned objectives. A formal DQA report should be generated in accordance with these objectives.

7.0 REFERENCES

California Environmental Protection Agency Correspondence to EPA, "Santa Susana Field Laboratory, Ventura County," January 15, 2008.

CDM and DOE, 2008, "Area IV Santa Susana Field Laboratory Environmental Impact Statement (EIS), Preliminary Draft Data Gap Analysis Report,"
Task Order DE-AT30-08CC60021/ET17, April (subsequently updated in June 2008).

DOE, " The Risk Assessment: How it Fits Into the EIS," DOE EM Presentation to EPA, undated

UFP-QAPP, 2005. Uniform Federal Policy for Quality Assurance Project Plans, EPA-505-B-04-900A

U.S. EPA, 1989, "Risk Assessment Guidance for Superfund Volume I, Human Health Evaluation Manual (Part A) Interim Final," EPA/540/1-89/002, December.

U.S. EPA, 1991, “Risk Assessment Guidance for Superfund: Volume I (Part B, Development of Risk-based Preliminary Remediation Goals),” EPA/540/R-92/003, December.

U.S. EPA, 1996, “Technology Screening Guide for Radioactively Contaminated Sites,” EPA-402-R-96-017, November.

U.S. EPA, DOE, DOD, NRC, 2000, “The Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM),” EPA 402-R-97-016, DOE/EH-0624, Rev. 1.

U.S. EPA, 2000, “Soil Screening Guidance for Radionuclides: Technical Background Document,” EPA/540-R-00-006, October.

U.S. EPA, 2001, “Draft Scoping Document for Development of WorkPlan for a Soil Radiation Survey of Santa Susana Field Laboratory Area IV,” Document Control No: REPAA2:-0914- 002v1.

U.S. EPA, 2002a, “Role of Background in the CERCLA Cleanup Program,” OSWER 9285.6-07P.

U.S. EPA, 2002b, “Distribution of OSWER of Radionuclide Preliminary Remediation Goals (PRGs) for Superfund Electronic Calculator,” OSWER No: 9355.01-83A,

U.S. EPA,2006, “Data Quality Assessment: A Reviewer’s Guide,” EPA/240/B-06/002, February.

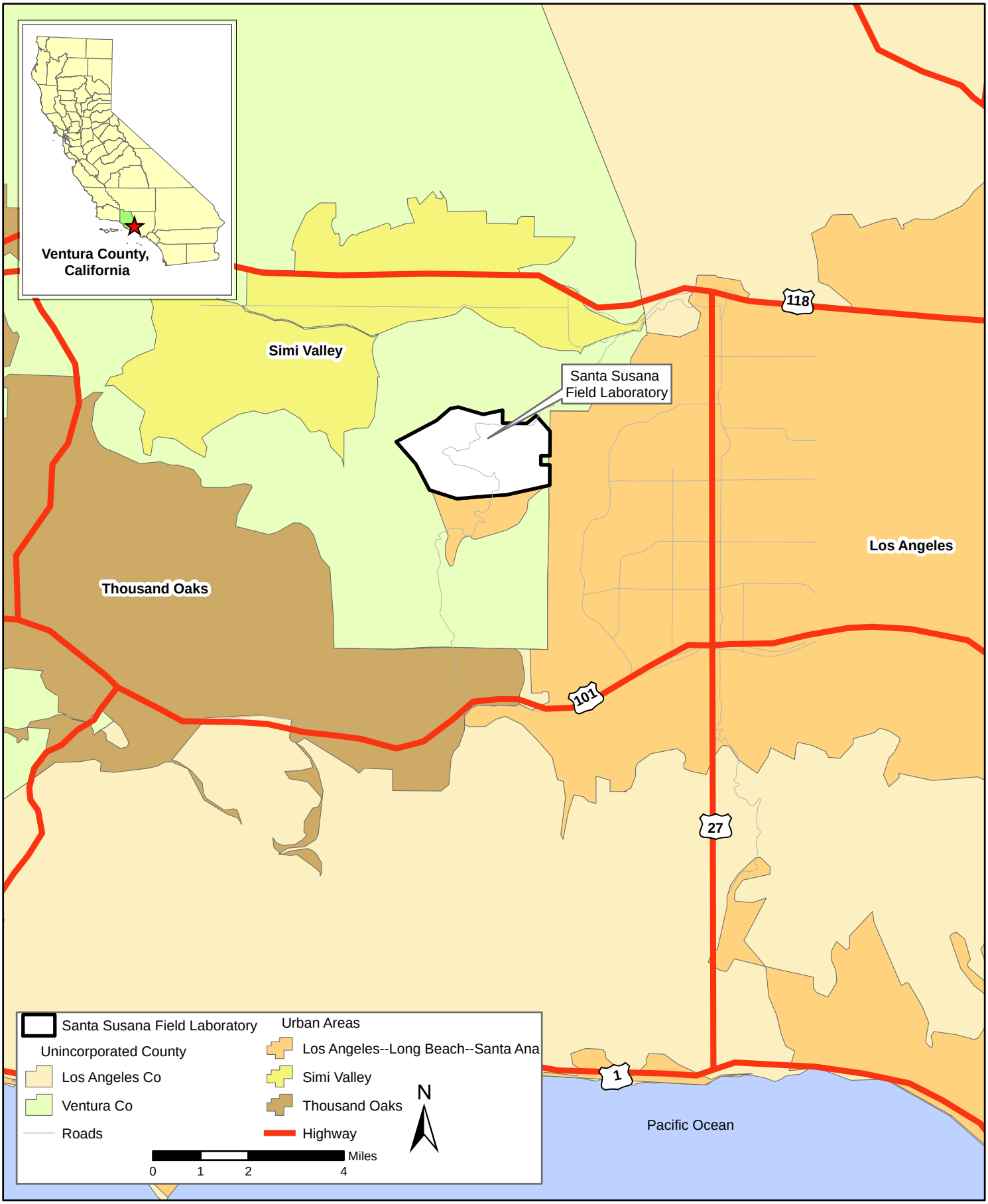
U.S. EPA, 2007a, “Remedial Site Assessment Decision, Region IX, Santa Susana Field Laboratory,” EPA for 9100-3.

U.S. EPA, 2007b, “Preliminary Assessment/Site Inspection Report, Santa Susana Field Laboratory, Simi Valley, California,” Document Control No: 12767.063.419.1650, November.

U.S. EPA, Correspondence to DOE, “Santa Susana Field Laboratory Implementation of H.R.2764,” July 2, 2008.

Website address for radionuclide Preliminary Remediation Goals (PRGs): http://epa-prgs/ornl.gov/radionuclides/

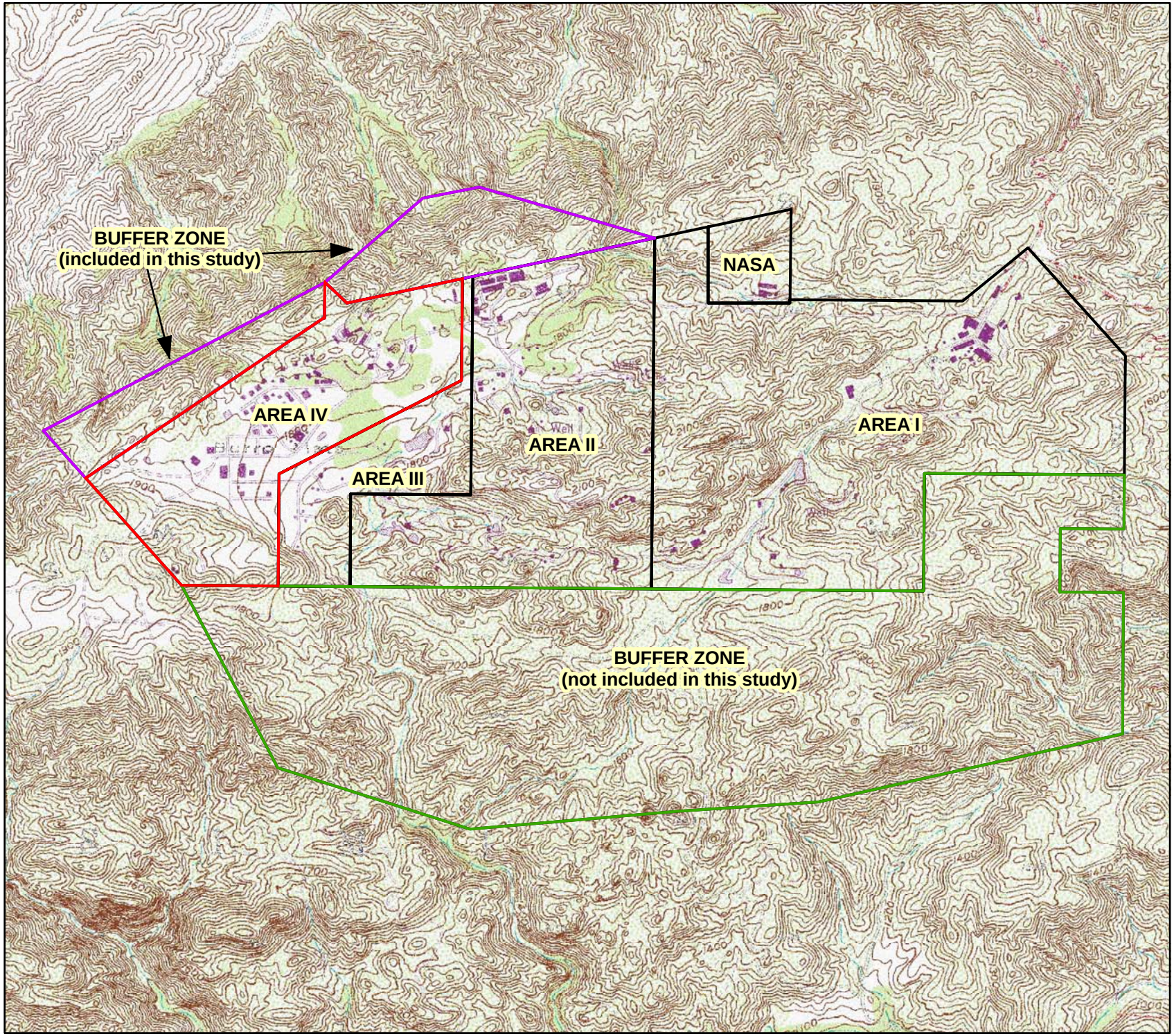
FIGURES



Source: National Transportation Atlas (2007)
SSFL Data CD
Project: SSFL
Date: 09/04/2008
By: MKS

Figure 1
Santa Susana Vicinity Map
Santa Susana Field Laboratory
Ventura County, California

Figure 2
Location and Topography of SSFL Areas and Buffer Zones, Santa Susana Field Laboratory, Ventura California



Area IV

Buffer Zone (included in study)

Buffer Zone (not included in study)

Other Site Areas

N

Feet
0 1,000 2,000

Source: USGS DRG (1999)
SSFL Data CD
Project: SSFL
Date: 09/26/2008
By: MKS

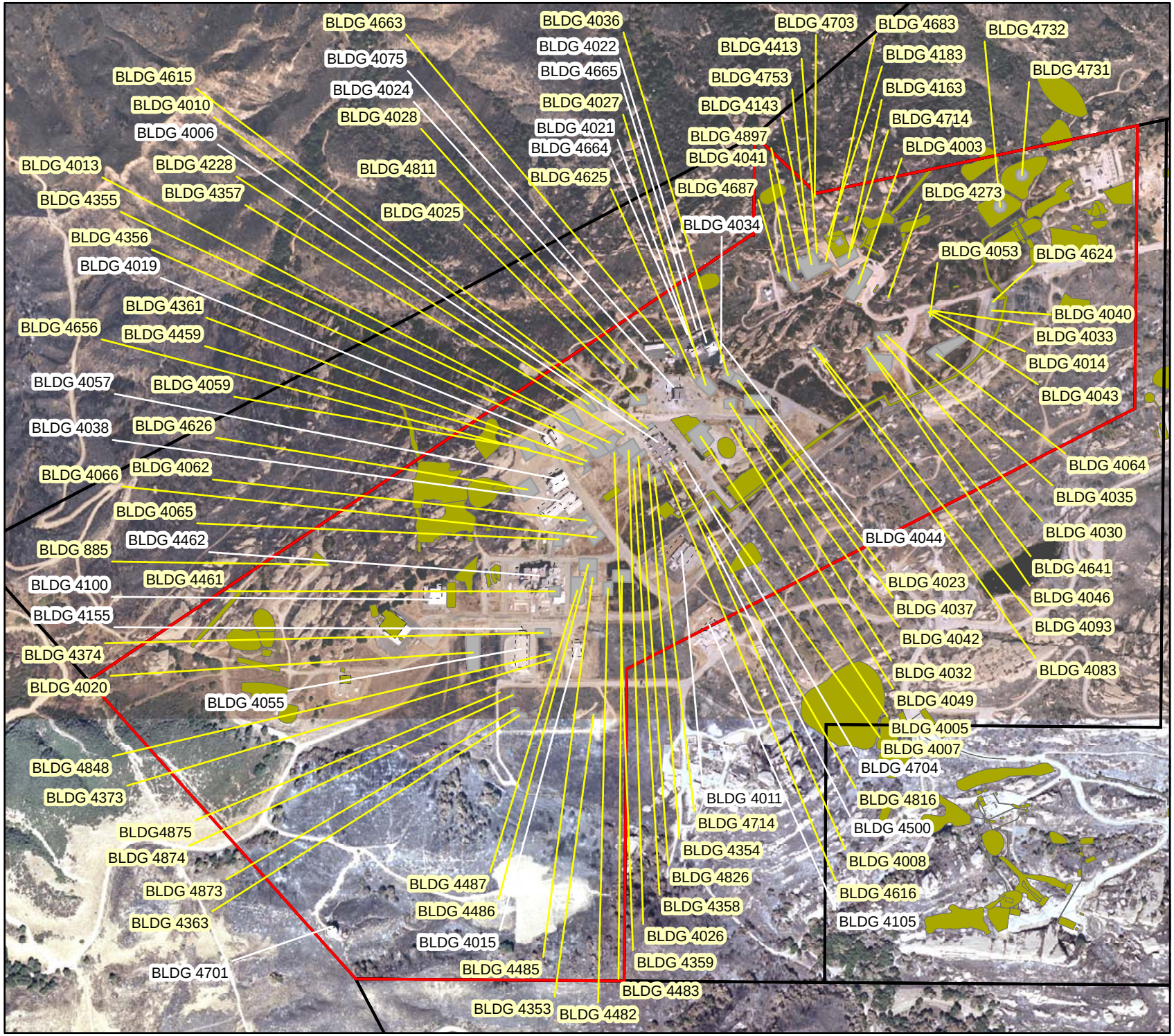


Figure 3
Historical Building Number Location Map
Area IV/Buffer Zone
Santa Susana Field Laboratory
Ventura, California

Chemical Use Areas

Area IV

Other Sites

Buildings

Existing

Removed

N

Note: Removed buidings shown with yellow label

Feet
0 500 1,000

Source: 2005 Aerial Photo
SSFL Data CD
Project: SSFL
Date: 11/26/2008
By: MKS

Formation	Age	Description
Monterey Formation	Tertiary-Miocene	Mudstone to shale with minor sand and conglomorates
Sespe Formation	Tertiary-Oligocene	Fine sands and shales verigated
Llajas Formation	Tertiary-Eocene	Fossiliferous sands, silts and shales, with some conglomerate.
Chatsworth Formation	Cretaceous	Deep Sea Turbidite with sands interbedded with shale silts and conglomerate.
Santa Susana Formation	Triassic	Mudstone fractured clays with inter-bedded sandstone and conglomerate

Source: SSFL Data Gap Report
Project: SSFL
Date: 09/04/2008
By: MKS

Figure 4
General Geologic Column of
Santa Susana Vicinity
Santa Susana Field Laboratory
Ventura County, California

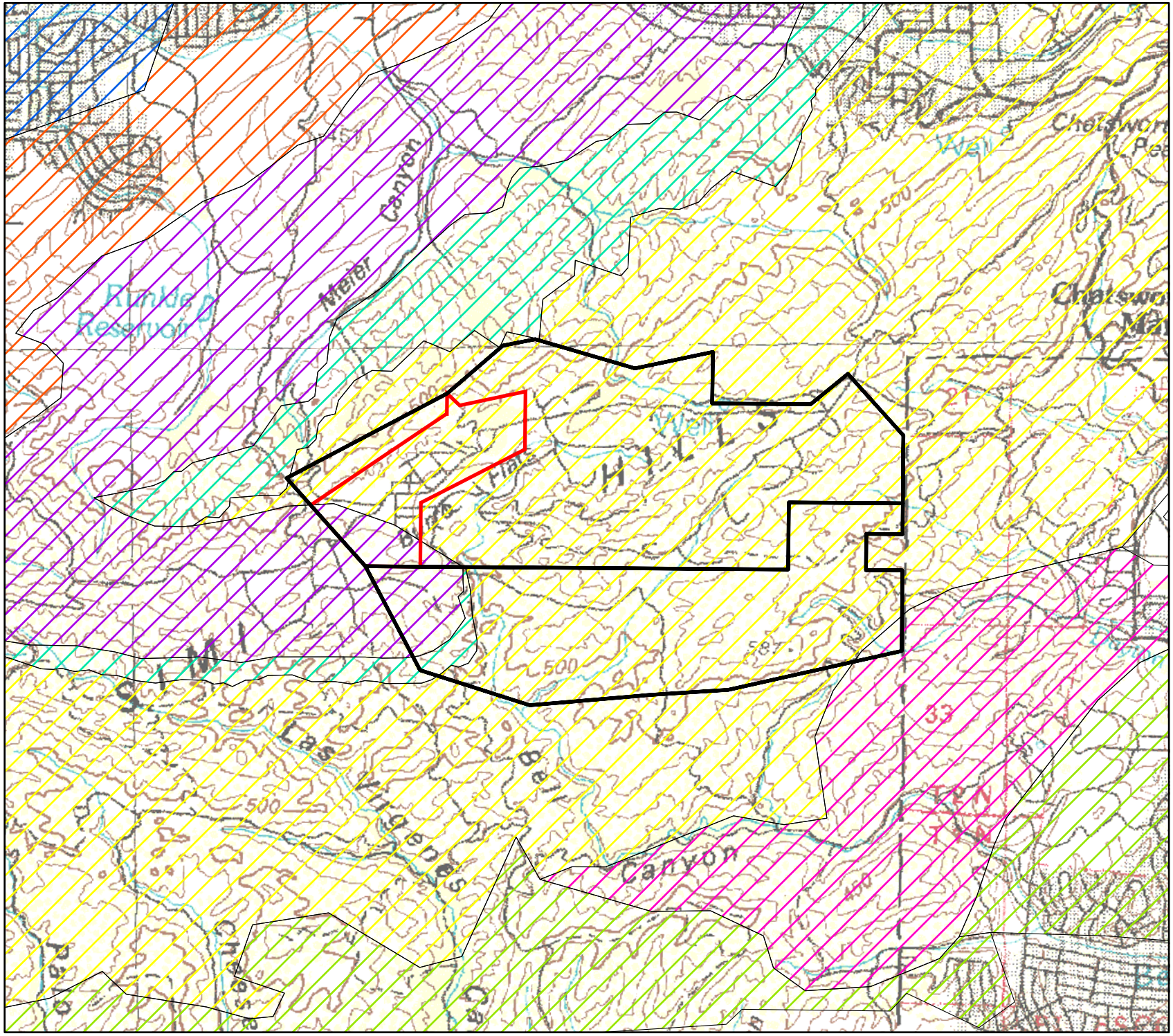


Figure 5
Bedrock Geology Map
Santa Susana Field Laboratory
and Surrounding Areas,
Ventura California

Area IV

Property Boundary

Geologic Formation

- Kcs-Chatsworth
- Tll-Llajas
- Tls-Lindero Canyon
- Tm-Monterey
- Tsu-Santa Susana Upper
- Tsi-Santa Susana
- Tsp- Sespe

N

0 2,000 4,000 Feet

Source: USGS DRG (1999)
SSFL Data CD
Project: SSFL
Date: 09/05/2008
By: MKS

ATTACHMENTS

ATTACHMENT A: POSSIBLE PATH TOWARD A COMPREHENSIVE RADIOLOGICAL STUDY OF SSFL

The work described below would be conducted over several years but in overlapping phases if adequate funding is provided:

I. Radiological Background Reference Area Study for Entire Site (Study has begun, with anticipated completion in Fall, 2009)

II. Radiological Survey for Area IV and Buffer Zones

Phase 1: Surface Scan with Real Time Monitors and Surface Soil Sampling/ Baseline Groundwater Sampling/Sampling of Seeps

Phase 2: Soil Sampling at Depth

III. Radiological Survey for Areas 1, 2, and 3 (Surface soil sampling and sampling at depth)

IV. Ground Water Radiological Investigation for Entire Site

ATTACHMENT B: ESTIMATED COSTS FOR SSFL AREA IV/BUFFER ZONE STUDY

Activity	Estimated Cost
Historical Site Assessment	$174,000
Scoping Survey	$82,000
Radiological Characterization (gamma scan survey)	$960,000
Radiation Survey (surface soil and groundwater/seep sampling and analyses)	$11,000,000
QA/QC Monitoring Requirements (EPA estimate for oversight of entire Study)	$2,750,000
Subtotal	**$14,966,000**
Radiation Survey (subsurface soil sampling and analyses)	$25,000,000*
Total Estimated Cost	**$39,966,000****

* As discussed in text, this cost estimate assumes two subsurface samples per surface sample location. This is considered a preliminary, conservative estimate and will likely change during the work plan development process.

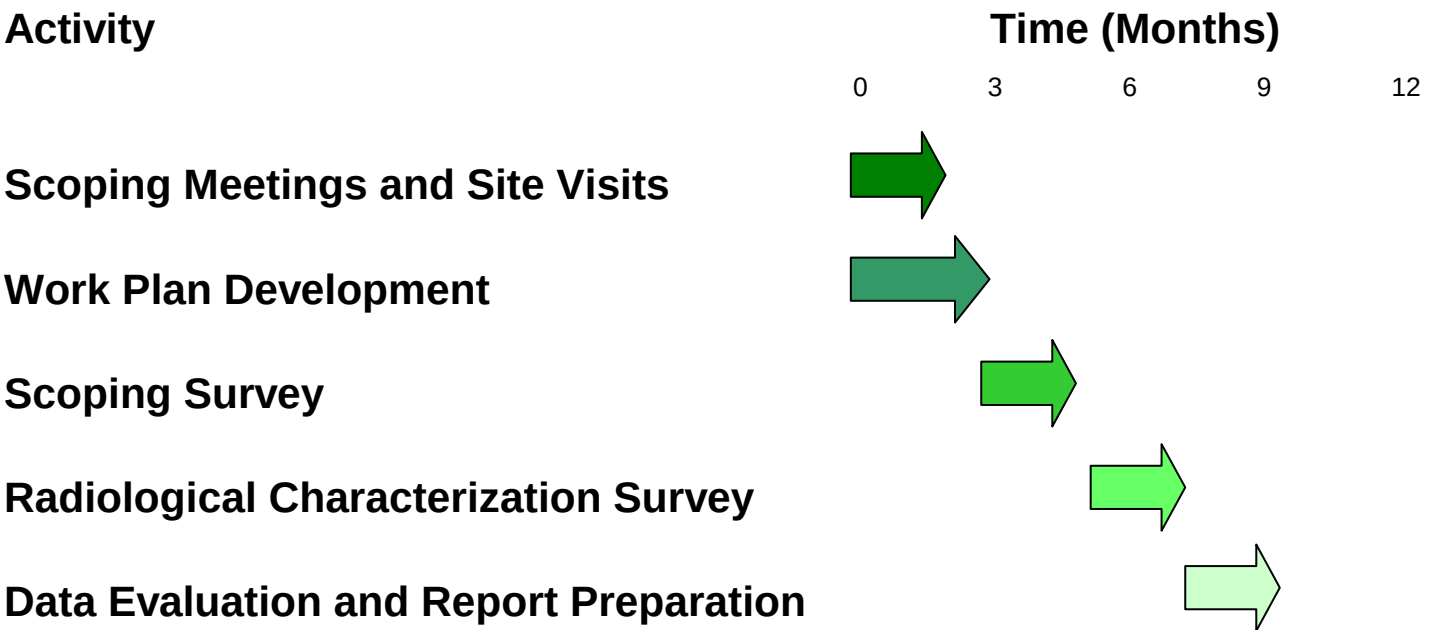
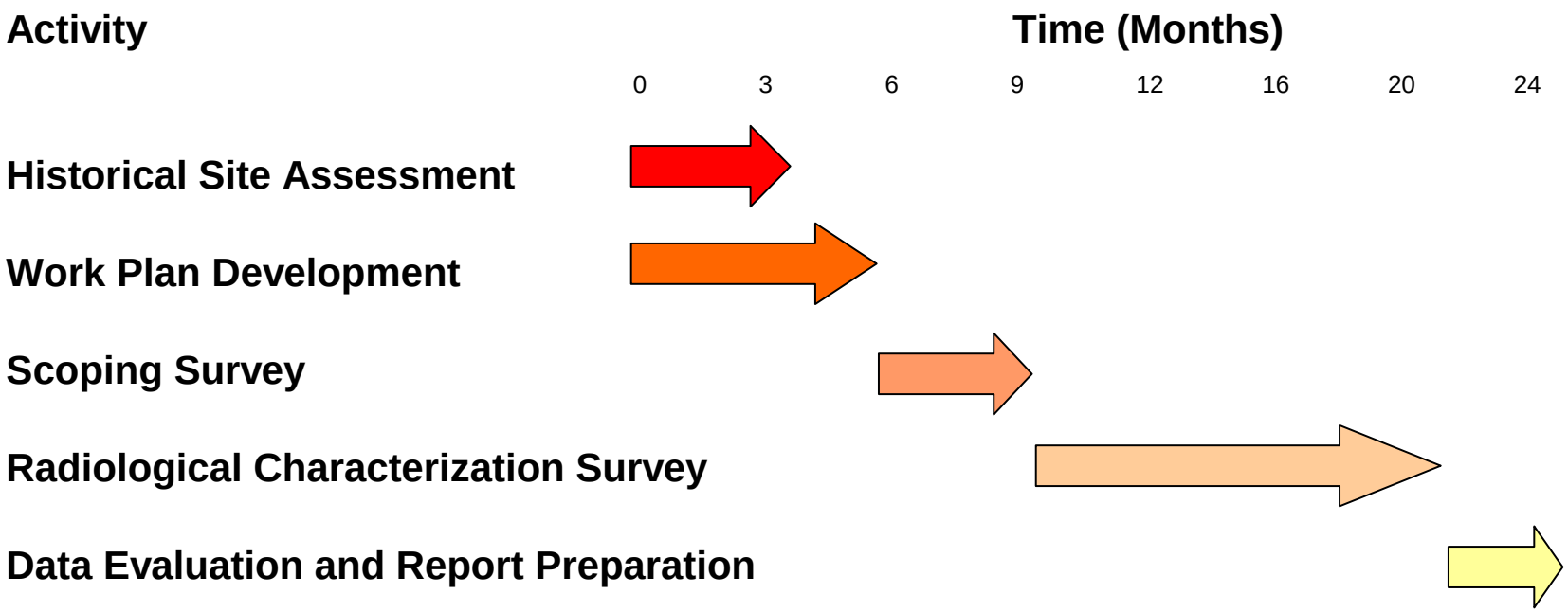
** Total cost estimates considered conservative maximum. Total costs subject to change as new information is obtained by EPA during work plan development.

ATTACHMENT C: COMPARISON OF AGRICULTURAL PRGS AND RESIDENTIAL PRGS WITH SEVERAL AVAILABLE METHOD DETECTION LIMITS

Isotope	Agricultural PRG	Residential PRG	Typical Detection Limits	PRG met	Extended Detection Limits	PRG met	Best Prac. Detection Limits	PRG met
	pCi/g	pCi/g	pCi/g		pCi/g		pCi/g	
K-40*	0.0445	0.108	**0.5**		**0.1**	**R**	**0.05**	**R**
Co-60*	0.0009	0.0361	**0.2**		**0.03**	**R**	**0.008**	**R**
Na-22*	0.0852	0.0865	**0.2**		**0.1**		**0.02**	**R, A**
Cs-137*	0.0012	0.0597	**0.2**		**0.05**	**R**	**0.004**	**R**
Ra-226*	0.0007	0.193	**0.3**		**0.09**	**R**	**0.01**	**R**
Ra-228*	0.0012	0.26	**1**		**0.5**		**0.1**	**R**
U-235+D EPA 901.1*	0.0019	2.05	**0.7**	**R**	**0.35**	**R**	**0.07**	**R**
U-238+D EPA 901.1*	0.0021	4.46	**8**		**2**	**R**	**0.8**	**R**
Th-228+D EPA 901.1*	0.1230	24.2	**1**	**R**	**0.2**	**R**	**0.1**	**R, A**
Ra-226 EPA 903.1	0.0007	0.193	**0.05**	**R**	**0.02**	**R**	**0.05**	**R**
Ra-228 EPA 904.0	0.0012	0.26	**1**		**0.5**		**0.2**	**R**
Th-228*	0.1230	24.2	**0.2**	**R**	**0.1**	**R, A**	**0.017**	**R, A**
Th-230*	0.0105	349	**0.2**	**R**	**0.1**	**R**	**0.017**	**R**
Th-232*	0.0094	3.1	**0.2**	**R**	**0.1**	**R**	**0.017**	**R**
U-233*	0.0018	3.86	**0.2**	**R**	**0.1**	**R**	**0.02**	**R**
*#U-234**	0.0019	4.01	**0.2**	**R**	**0.1**	**R**	**0.02**	**R**
U-235*	0.0019	2.05	**0.2**	**R**	**0.1**	**R**	**0.02**	**R**
U-238*	0.0021	4.46	**0.2**	**R**	**0.1**	**R**	**0.02**	**R**
Pu-238*	0.0073	2.97	**0.2**	**R**	**0.1**	**R**	**0.008**	**R**
Pu-239*	0.0061	2.59	**0.2**	**R**	**0.1**	**R**	**0.008**	**R**
*#Pu-240**	0.0061	2.6	**0.2**	**R**	**0.1**	**R**	**0.008**	**R**
Pu-242*	0.0064	2.73	**0.2**	**R**	**0.1**	**R**	**0.008**	**R**
Pu-241*	105.0000	406	**6**	**R, A**	**3**	**R, A**	**1**	**R, A**
Sr-90*	0.0019	0.331	**1**		**0.12**	**R**	**0.01**	**R**
Estimated Cost for suite of analyses on single soil sample*			***$1,100***		***$2,100***		***$3,200***	

* indicates radionuclides included in analytical suite used to provide Estimated Cost for single soil sample
# indicates isotope analyses included with above isotope. Per commercial lab quote
PRG met indicates where Detection Limit method meets Residential PRG (R) or Agricultural PRG (A)

ATTACHMENT D. BACKGROUND REFERENCE AREA SCHEDULE



ATTACHMENT E. AREA IV/BUFFER ZONE SCHEDULE