DOE/EIS-0402
January 2017

Draft Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory

Volume 2

Appendices A through K

U.S. Department of Energy
Office of Environmental Management

AVAILABILITY OF THE

DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR REMEDIATION OF AREA IV AND THE NORTHERN BUFFER ZONE OF THE SANTA SUSANA FIELD LABORATORY

(*Draft SSFL Area IV EIS*)

For further information on this *Draft SSFL Area IV EIS,* or to request a copy, please contact:

Ms. Stephanie Jennings, NEPA Document Manager
SSFL Area IV EIS
U.S. Department of Energy
4100 Guardian Street, Suite 160
Simi Valley, CA 93063
Telephone: 1-805-842-3864

Printed with soy ink on recycled paper

COVER SHEET

Lead Agency: U.S. Department of Energy (DOE), Office of Environmental Management

Cooperating Agencies: National Aeronautics and Space Administration (NASA), U.S. Army Corps of Engineers, and the Santa Ynez Band of Chumash Indians

Title: *Draft Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory (Draft SSFL Area IV EIS)* (DOE/EIS-0402)

Location: Ventura County, California

For further information or for copies of this Draft SSFL Area IV EIS, contact:

Ms. Stephanie Jennings
NEPA Document Manager
SSFL Area IV EIS
U.S. Department of Energy
4100 Guardian Street, Suite 160
Simi Valley, CA 93063
Telephone: 1-805-842-3864

For general information on the DOE National Environmental Policy Act (NEPA) process, contact:

Carol M. Borgstrom, Director
Office of NEPA Policy and Compliance, GC-54
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0103
Telephone: 202-586-4600, or leave a message at 1-800-472-2756

This document is available on the SSFL Area IV EIS website (http://SSFLAreaIVEIS.com) and the DOE NEPA website (http://energy.gov/nepa) for viewing and downloading.

Abstract:

This *Draft SSFL Area IV EIS* analyzes the potential environmental impacts of alternatives for conducting cleanup activities in Area IV of the Santa Susana Field Laboratory (SSFL) and the adjoining Northern Buffer Zone (NBZ), located in Ventura County, California. Remediation is needed to clean up residual chemicals and radionuclides from historical DOE operations at the Energy Technology Engineering Center (ETEC) in Area IV, in compliance with regulations, orders, and agreements. The alternatives analyzed in this draft environmental impact statement (EIS) involve the disposition of remaining DOE facilities and support buildings, remediation of soil and groundwater, and disposal of all resulting waste at existing licensed or permitted facilities in a manner that is protective of the environment and the health and safety of the public and workers. The information in this EIS will inform decision-makers and the public about the potential impacts of the proposed cleanup of both chemicals and radionuclides and will be considered along with other relevant factors in making decisions regarding cleanup of Area IV and the adjoining NBZ. DOE is proposing three sets of alternatives. Each set was developed to address a component of the SSFL Area IV and NBZ cleanup effort: soil remediation, building demolition, and groundwater remediation.

Preferred Alternative: DOE has no preferred alternative at this time.

Public Involvement:

DOE conducted a number of activities to encourage public input and assist the public in its role in the NEPA process. Following issuance of an Advance Notice of Intent to prepare a draft EIS in October 2007 (72 *Federal Register* [FR] 58834), DOE held informal discussions with the public and stakeholders to gather information used in preparing the Notice of Intent (NOI) published in May 2008 (73 FR 28437). During this first scoping period, DOE held six scoping public meetings to present the proposed alternatives and receive comments from agencies, organizations, and the public. DOE held scoping meetings in Simi Valley, Northridge, and Sacramento, California. In spring 2012, DOE sponsored three Community Alternative Development Workshops, in which community members were asked to articulate their preferences for alternatives that they would like to see included in this EIS. In consideration of site characterization activities conducted by DOE and the U.S. Environmental Protection Agency and changes in cleanup requirements (as a result of the 2010 *Administrative Order on Consent for Remedial Action* between DOE and the California Department of Toxic Substances Control), DOE published an Amended NOI in February 2014 (79 FR 7439), announcing a second scoping period from February to April 2014. During this second scoping period, DOE held two public scoping meetings, one each in Simi Valley and Agoura Hills, California, and a scoping meeting with Native American tribal members. DOE considered comments provided during both scoping periods, as well as input received from the 2012 Community Alternatives Development Workshops, in the preparation of this draft EIS.

Comments on this *Draft SSFL Area IV EIS* should be submitted within 60 days of the publication of the U.S. Environmental Protection Agency's Notice of Availability of this draft EIS in the *Federal Register* to ensure consideration in preparation of the *Final SSFL Area IV EIS*. DOE will consider comments received after the 60-day comment period to the extent practicable. Written comments may be submitted to Ms. Stephanie Jennings via U.S. mail to the address provided above or electronically, via a comment portal on the SSFL Area IV EIS website (http://SSFLAreaIVEIS.com). DOE will hold public hearings on this draft EIS during the comment period. DOE will announce the dates, times, and locations of these hearings via newspaper advertisements, the SSFL Area IV EIS website, the DOE NEPA website, and notifications to persons on the mailing list. Information on this EIS can be found at http://SSFLAreaIVEIS.com or http://energy.gov/nepa.

TABLE OF CONTENTS

TABLE OF CONTENTS

Volume 2
(Appendices A through K)

Appendix D Detailed Project Information D-1

Appendix E Consultations E-1

Appendix F Cultural Resources F-1

Appendix G
Human Health G-1

Appendix I
Wetlands Assessment

Appendix J

Appendix K
Contractor Disclosure Statements

LIST OF FIGURES

Appendix D

Appendix F

Appendix G

Appendix H

Appendix I

LIST OF TABLES

Appendix B

Appendix C

Appendix D

Appendix E

Appendix F

Appendix G

Appendix H

Appendix I

This page left blank intentionally

Acronyms, Abbreviations, and Conversion Charts

ACRONYMS, ABBREVIATIONS, AND CONVERSION CHARTS

AASHTO	American Association of State Highway Transportation Officials
AOC	*Administrative Order on Consent for Remedial Action*
APE	area of potential effects
B.C.E.	before common era
BMP	best management practice
Boeing	The Boeing Company
BTV	background threshold level
ca	circa
CAAQS	California Ambient Air Quality Standards
cal	calibrated
CDFW	California Department of Fish and Wildlife
C.E.	common era
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CESA	California Endangered Species Act
CFR	*Code of Federal Regulations*
CNEL	Community Noise Equivalent Level
CNPPA	California Native Plant Protection Act
CO	*Consent Order for Corrective Action*
CRPR	California Rare Plant Rank
dB	decibels
dBA	decibels A-weighted
D&D	decontamination and decommissioning
DHS	Department of Homeland Security
DNL	day-night average sound level
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DTSC	Department of Toxic Substances Control
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESAL	equivalent single-axle load
ETEC	Energy Technology Engineering Center
FAL	field action level
FEMA	Federal Emergency Management Agency
FGR	Federal Guidance Reports
FHWA	Federal Highway Administration
FR	*Federal Register*
GHG	greenhouse gas
GIS	geographic information system
GVWR	gross vehicle weight rating

GWP	global warming potential
HCM	Highway Capacity Manual
ICRP	International Commission on Radiation Protection
IDA	intentional destructive act
JD	jurisdictional determination
ISRA	interim soil removal action
LARWQCB	Los Angeles Regional Water Quality Control Board
LCF	latent cancer fatality
LLW	low-level radioactive waste
LOS	level of service
LUT	Look-Up Table
MCL	maximum contaminant levels
MDC	minimal detectable concentration
MEI	maximally exposed individual
MLLW	mixed low-level radioactive waste
MWH	MWH Americas, Inc.
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NBZ	Northern Buffer Zone
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRHP	*National Register of Historic Places*
NNSS	Nevada National Security Site
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo-p-dioxins
PM_n	particulate matter less than or equal to *n* microns in aerodynamic diameter
PRA	preliminary remediation area
RADTRAN	Radioactive Material Transportation Risk Assessment
RBSL	risk-based screening level
RCRA	Resource Conservation and Recovery Act
rem	roentgen equivalent man
RESRAD	RESidual RADioactive modeling software
RFI	RCRA Facility Investigation
RISKIND	Risks and Consequences of Radioactive Materials Transport
RMHF	Remote Materials Handling Facility
ROD	Record of Decision
ROI	region of influence
RPW	Relatively Permanent Waters
SHPO	State Historic Preservation Officer
SNAP	Systems for Nuclear Auxiliary Power

SRAM	*Final Standardized Risk Assessment Methodology Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California*
SRE	Sodium Reactor Experiment
SSFL	Santa Susana Field Laboratory
SWPPP	stormwater pollution prevention plan
SWRCB	California State Water Resources Control Board
TCDD	2,3,7,8 tetrachlorodibenzo-p-dioxin
TCE	trichloroethylene (
TEQ	toxicity equivalent
TNW	Traditional Navigable Waters
TPH	total petroleum hydrocarbons
TRAGIS	Transportation Routing Analysis Geographic Information System
U.S.C.	*United States Code*
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound

CONVERSIONS

METRIC TO ENGLISH			ENGLISH TO METRIC		
Multiply	**by**	**To get**	**Multiply**	**by**	**To get**
Area					
Square meters	10.764	Square feet	Square feet	0.092903	Square meters
Square kilometers	247.1	Acres	Acres	0.0040469	Square kilometers
Square kilometers	0.3861	Square miles	Square miles	2.59	Square kilometers
Hectares	2.471	Acres	Acres	0.40469	Hectares
Concentration					
Kilograms/square meter	0.16667	Tons/acre	Tons/acre	0.5999	Kilograms/square meter
Milligrams/liter	1 [a]	Parts/million	Parts/million	1 [a]	Milligrams/liter
Micrograms/liter	1 [a]	Parts/billion	Parts/billion	1 [a]	Micrograms/liter
Micrograms/cubic meter	1 [a]	Parts/trillion	Parts/trillion	1 [a]	Micrograms/cubic meter
Density					
Grams/cubic centimeter	62.428	Pounds/cubic feet	Pounds/cubic feet	0.016018	Grams/cubic centimeter
Grams/cubic meter	0.0000624	Pounds/cubic feet	Pounds/cubic feet	16,018.5	Grams/cubic meter
Length					
Centimeters	0.3937	Inches	Inches	2.54	Centimeters
Meters	3.2808	Feet	Feet	0.3048	Meters
Kilometers	0.62137	Miles	Miles	1.6093	Kilometers
Radiation					
Sieverts	100	Rem	Rem	0.01	Sieverts
Temperature					
Absolute					
Degrees C + 17.78	1.8	Degrees F	Degrees F - 32	0.55556	Degrees C
Relative					
Degrees C	1.8	Degrees F	Degrees F	0.55556	Degrees C
Velocity/Rate					
Cubic meters/second	2118.9	Cubic feet/minute	Cubic feet/minute	0.00047195	Cubic meters/second
Grams/second	7.9366	Pounds/hour	Pounds/hour	0.126	Grams/second
Meters/second	2.237	Miles/hour	Miles/hour	0.44704	Meters/second
Volume					
Liters	0.26418	Gallons	Gallons	3.7854	Liters
Liters	0.035316	Cubic feet	Cubic feet	28.316	Liters
Liters	0.001308	Cubic yards	Cubic yards	764.54	Liters
Cubic meters	264.17	Gallons	Gallons	0.0037854	Cubic meters
Cubic meters	35.314	Cubic feet	Cubic feet	0.028317	Cubic meters
Cubic meters	1.3079	Cubic yards	Cubic yards	0.76456	Cubic meters
Cubic meters	0.0008107	Acre-feet	Acre-feet	1233.49	Cubic meters
Weight/Mass					
Grams	0.035274	Ounces	Ounces	28.35	Grams
Kilograms	2.2046	Pounds	Pounds	0.45359	Kilograms
Kilograms	0.0011023	Tons (short)	Tons (short)	907.18	Kilograms
Metric tons	1.1023	Tons (short)	Tons (short)	0.90718	Metric tons
ENGLISH TO ENGLISH					
Acre-feet	325,850.7	Gallons	Gallons	0.000003046	Acre-feet
Acres	43,560	Square feet	Square feet	0.000022957	Acres
Square miles	640	Acres	Acres	0.0015625	Square miles

a. This conversion is only valid for concentrations of contaminants (or other materials) in water.

METRIC PREFIXES

Prefix	Symbol	Multiplication factor
exa-	E	1,000,000,000,000,000,000 = 10^{18}
peta-	P	1,000,000,000,000,000 = 10^{15}
tera-	T	1,000,000,000,000 = 10^{12}
giga-	G	1,000,000,000 = 10^{9}
mega-	M	1,000,000 = 10^{6}
kilo-	k	1,000 = 10^{3}
deca-	D	10 = 10^{1}
deci-	d	0.1 = 10^{-1}
centi-	c	0.01 = 10^{-2}
milli-	m	0.001 = 10^{-3}
micro-	μ	0.000 001 = 10^{-6}
nano-	n	0.000 000 001 = 10^{-9}
pico-	p	0.000 000 000 001 = 10^{-12}

Appendix A
Federal Register Notices

APPENDIX A
FEDERAL REGISTER NOTICES

A.1 Advance Notice of Intent – October 17, 2007

58834 Federal Register / Vol. 72, No. 200 / Wednesday, October 17, 2007 / Notices

DEPARTMENT OF ENERGY

Office of Environmental Management; Advance Notice of Intent To Prepare an Environmental Impact Statement for Area IV of the Santa Susana Field Laboratory and Public Involvement Activities

AGENCY: Department of Energy.

ACTION: Advance Notice of Intent.

SUMMARY: The U.S. Department of Energy (DOE) is providing an Advance Notice of its Intent (ANOI) to prepare an Environmental Impact Statement (EIS) for remediation of Area IV of the Santa Susana Field Laboratory (SSFL). DOE is preparing the EIS in response to a May 2, 2007, decision by the U.S. District Court of Northern California that a 2003 DOE decision to prepare a Finding of No Significant Impact (FONSI) and conduct remediation of Area IV on the basis of an environmental assessment, rather than prepare an EIS, violated the National Environmental Policy Act (NEPA). DOE is also requesting early comments from the public and other stakeholders on the scope of the EIS and issues to be considered in EIS analysis. To facilitate collaboration on these EIS issues, DOE also is announcing plans for public involvement activities to be held this fall, to provide information to its stakeholders and to receive comments from them.

DOE is issuing this ANOI, pursuant to 10 CFR 1021.311(b), in order to inform and request early comments and assistance from Federal and State agencies, State and local governments, natural resource trustees, the general public, and other interested parties on the appropriate scope of the EIS, possible environmental issues, and the potential environmental impacts related to DOE's proposed activities for Area IV. Following the issuance of this ANOI, DOE intends to collect updated information that it will incorporate into the EIS analysis.

DOE will conduct community and regulator interviews through November 2007. These public involvement opportunities will focus on consultation with the public about the process for EIS scoping, the development of the range of reasonable alternatives to be analyzed in the EIS, and related public concerns about the remediation. If, based on community input, DOE decides to hold a public meeting, DOE will notify the community through local media. Early comments on the scope of the EIS and issues to be considered are due by December 14, 2007. Though DOE will attempt to consider comments received after this date, it will only be able to do so to the extent practicable. DOE plans to issue a Notice of Intent (NOI) for this EIS in the spring of calendar year 2008.

ADDRESSES: Please direct requests to be notified of interviews or a public meeting, comments on the scope of the EIS, and questions concerning the proposed project to: Stephanie Jennings, NEPA Document Manager, Office of Site Support and Small Projects (EM–3.2), U.S. Department of Energy, Energy Technology Engineering Center, P.O. Box 10300, Canoga Park, CA 91309, telephone: 818–466–8162, fax: 818–466–8730, or e-mail to: *Stephanie.Jennings@em.doe.gov* (use ''ANOI comments'' for the subject).

FOR FURTHER INFORMATION CONTACT: To request further information about this EIS or about the public involvement activities, or to be placed on the EIS distribution list, use any of the methods listed under **ADDRESSES** above. For general information concerning the DOE NEPA process, contact Carol Borgstrom, Director, Office of NEPA Policy and Compliance (GC–20), U.S. Department of Energy, 1000 Independence Avenue, SW., Washington, DC 20585–0119, e-mail to: *AskNEPA@hq.doe.gov,* telephone: 202–586–4600, leave a message at 1–800–472–2756, or fax: 202–586–7031.

This Advance Notice of Intent (ANOI) will be available on the Internet at: *http://www.eh.doe.gov/NEPA.* Further information about Area IV and the Energy Technology Engineering Center (ETEC) can be found at *http://apps.em.doe.gov/etec/.*

SUPPLEMENTARY INFORMATION:

Background

Santa Susana Field Laboratory (SSFL), located on approximately 2,850 acres in the hills between Chatsworth and Simi Valley, CA, was developed as a remote site to test rocket engines and conduct nuclear research. The Atomics International Unit of Rockwell International's Canoga Park-based Rocketdyne Division began testing in 1947, and conducted an estimated 17,000 open-air rocket tests in support of the space program. In 1996, Rockwell International sold its aerospace and defense business, including the SSFL to The Boeing Company (Boeing).

SSFL is divided in four administrative areas—Area I, Area II, Area III, and Area IV—along with two buffer zones. Area I is about 713 acres, of which 671 acres is owned and operated by Boeing and 42 acres is owned by the National Aeronautics and Space Administration (NASA) and operated for it by Boeing. Area II, about 410 acres, is owned by NASA and operated for it by Boeing. Area III, about 114 acres, is owned and operated by Boeing. Area IV, about 290 acres, is owned by Boeing, which operates it for DOE. Boeing also owns a contiguous buffer zone of 1143 acres to the south and a contiguous buffer zone of 182 acres to the north.

Starting in the mid-1950s, the Atomic Energy Commission (AEC), a predecessor agency of DOE, funded nuclear energy research on a 90-acre parcel of Area IV leased from Rocketdyne. The Energy Technology and Engineering Center (ETEC) was established by the AEC on this parcel in the early 1960s as a ''center of excellence'' for liquid metals technology.

The AEC built a small nuclear power plant to deliver energy to the commercial grid at the ETEC. Research also included testing of nuclear powered systems, for example, using liquid metals for space vehicles and a sodium coolant medium in 10 small reactors. All reactor operations ended in 1980 and nuclear research work was completed in 1988. Cleanup of ETEC began in the 1960s and was performed in an ongoing manner as unnecessary facilities were decommissioned when there was no longer a use for them. DOE continues to lease the 90 acre parcel in Area IV from Boeing.

In March 2003, DOE issued an Environmental Assessment (EA), *Environmental Assessment for Cleanup and Closure of the Energy Technology Engineering Center,* DOE/EA–1345. Based on the results of the EA, DOE determined that an EIS was not required and issued a FONSI in March 2003.

DOE is now preparing an SSFL Area IV EIS in response to the U.S. District Court of Northern California's May 2, 2007, ruling in the case *Natural Resources Defense Council* v. *Department of Energy Slip Op.* WL2349288 (N.D. Cal. Aug.15, 2007), which held that DOE's decision to issue a FONSI and conduct cleanup and closure on the basis of DOE/EA–1345 was in violation of NEPA. The Court ordered DOE to prepare an EIS for Area IV in accordance with NEPA. The Court further permanently enjoined the DOE from transferring ownership or possession, or otherwise relinquishing control over any portion of Area IV, until DOE completes the EIS and issues a Record of Decision pursuant to NEPA. In addition, the Court retained jurisdiction until it is satisfied that the DOE has met its legal obligations as they relate to the remediation of Area IV.

Because of the Court's decision, DOE suspended the physical demolition and removal activities for the remaining facilities at ETEC except for those activities necessary to maintain the site in a safe and stable configuration. DOE has discontinued planned decontamination and decommission activities, but is continuing surveillance, maintenance, and environmental monitoring work, including soil and groundwater characterization required under the State of California Department of Toxic Substances Control (DTSC) regulations, while it prepares the EIS.

In August 2007, DTSC issued a Consent Order to DOE, NASA and Boeing under its Resource Conservation and Recovery Act (RCRA) authority. This Order requires cleanup of all chemically contaminated soils at SSFL by 2017 or earlier, provides the option for DTSC to require more work to be conducted offsite of Area IV to assess air, soil and water contamination, and requires the preparation of an Environmental Impact Report, pursuant to the California Environmental Quality Act.

Early Public Involvement and Related Activities

DOE is issuing this ANOI, pursuant to 10 CFR 1021.311(b), in order to inform and request early comments and assistance from Federal and State agencies, State and local governments, natural resource trustees, the general public, and other interested parties on the scope of the EIS, proposed environmental issues, and the potential environmental impacts related to DOE's potential activities at this site. Following the issuance of this ANOI, DOE intends to collect updated information that it will incorporate into the EIS analysis.

Purpose and Need for Agency Action

DOE needs to complete remediation of Area IV to comply with applicable regulations and allow for an evaluation of the range of reasonable alternatives. The remediation will include cleanup of radiological and hazardous contaminants both onsite and offsite of Area IV and maintain surface and groundwater protection in accordance with applicable requirements.

Proposed Action and EIS Scope

DOE's proposed action includes demolition of radiological facilities, demolition of most support buildings, cleanup of solid waste management units, groundwater remediation, mitigation measures, and disposal of all waste offsite at approved facilities.

The EIS will evaluate the remediation of Area IV under current action plans and alternatives to them. The EIS will characterize environmental media, analyze the environmental impact of decontaminating and decommissioning or dismantling government buildings and structures, and analyzing environmental restoration activities for environmental contamination associated with DOE's activities. Waste management activities to be analyzed include operation, maintenance, and closure of RCRA-permitted facilities. The facilities that are to be included in the EIS include former radiological facilities, former sodium facilities, and administrative facilities. The EIS will consider the effects of possible contamination by non-radiological toxic or otherwise hazardous materials and address multiple exposures (chemical and radiological), as well as exposures to multiple radionuclides. The EIS will consider the suitability of Area IV for a range of future land uses, and assess possible radiological contamination of groundwater.

The EIS may be used in the preparation of the Environmental Impact Report that is required by the DTSC Consent Order.

Preliminary Identification of Issues

DOE is requesting input on the best methods to obtain accurate information on radiological and hazardous contamination in Area IV. It is also seeking input from stakeholders to resolve current and potential issues associated with RCRA constituents and to determine the extent of groundwater contamination both onsite and offsite of Area IV.

Preliminary Environmental Impacts for Analysis

DOE has tentatively identified the following environmental impacts for analysis in the Area IV EIS. This list is presented to facilitate early comment during the public involvement activities on the scope of the EIS.

- Potential impacts to the general population, workers, and the environment from radiological and non-radiological releases.
- Potential impacts to soils, air, surface water quality, and groundwater quality.
- Potential transportation impacts from the shipment of radiological and non-radiological wastes to disposal sites.
- Potential impacts from postulated accidents.
- Potential impacts from intentional destructive acts.
- Potential disproportionately high and adverse effects on low-income and minority populations (environmental justice).
- Land use impacts.
- Socioeconomic impacts.
- Ecological resources (endangered species and wetlands).
- Cultural and paleontological resources.
- Compliance with applicable Federal, state and local requirements.
- Long-term site suitability, including erosion and seismicity.
- Cumulative impacts from contamination both onsite and offsite of Area IV.
- Mitigation measures to avoid or mitigate potentially significant environmental impacts.

Invitation To Comment

DOE invites the public to provide early assistance in identifying the scope of the Area IV EIS, alternatives, environmental issues to consider, and environmental impacts to analyze through the early public involvement process. DOE will consider public comments and other relevant information in developing the NOI. Comments should be provided by the **DATES** and to the **ADDRESSES** above.

EIS Process

DOE plans to issue the NOI in the spring of calendar year 2008, which will be followed by a public scoping period to assist in further defining the scope of the EIS and identifying significant issues to be addressed. The NOI will propose the range of reasonable alternatives for remediation of the Area IV site. After the NOI is issued, DOE will conduct public scoping meetings.

58836 Federal Register / Vol. 72, No. 200 / Wednesday, October 17, 2007 / Notices

During the scoping period, the dates and locations of meetings will be announced in the local media. DOE will announce the availability of the Draft EIS in the **Federal Register** and other media and provide Federal and State agencies, State and local governments, natural resource trustees, the general public, and other interested parties with an opportunity to submit comments.

DOE will also hold at least one public hearing in order to gather comments on the sufficiency of the Draft EIS once it is published. These comments will be considered and addressed in the Final EIS. DOE will issue a Record of Decision no sooner than 30 days after EPA's notice of availability of the Final EIS.

Issued in Washington, DC, on October 10, 2007.

Ines R. Triay,

(Acting) Assistant Secretary for Environmental Management.

[FR Doc. E7–20449 Filed 10–16–07; 8:45 am]

BILLING CODE 6450–01–P

A.2 Notice of Intent – May 16, 2008

Federal Register / Vol. 73, No. 96 / Friday, May 16, 2008 / Notices 28437

DEPARTMENT OF ENERGY

Notice of Intent To Prepare an Environmental Impact Statement for Remediation of Area IV of the Santa Susana Field Laboratory and Conduct Public Scoping Meetings

AGENCY: Office of Environmental Management, Department of Energy.

ACTION: Notice of Intent To Prepare an Environmental Impact Statement and Conduct Public Scoping Meetings.

SUMMARY: The Department of Energy (DOE) announces its intent to prepare an Environmental Impact Statement (EIS) and conduct public scoping meetings under the National Environmental Policy Act (NEPA) for remediation of Area IV of the Santa Susana Field Laboratory (SSFL Area IV). The SSFL, approximately 2,852 acres in the hills between Chatsworth and Simi Valley, CA, was developed as a remote site to test rocket engines and conduct nuclear research. Area IV was established at the SSFL in 1953 and occupies 290 acres of the SSFL. The DOE Energy Technology Engineering Center (ETEC) is located on 90 acres within SSFL Area IV.

DOE is preparing the EIS in part as a response to a May 2, 2007, decision by the U.S. District Court of Northern California that DOE was in violation of NEPA for its 2003 decision to issue a Finding of No Significant Impact (FONSI), and to conduct remediation of the ETEC site, on the basis of an environmental assessment (EA) rather than an EIS.

DOE recognizes the need to follow the NEPA process and will evaluate the range of reasonable alternatives for remediation of SSFL Area IV. DOE will evaluate alternatives for disposition of radiological facilities and support buildings, remediation of the affected environment, and disposal of all resulting waste at existing, approved sites. DOE will consider the cumulative impacts from exposure to chemical and radiological constituents in SSFL Area IV from future land uses.

DOE invites public comment on the scope of this EIS during a scoping period that will end August 14, 2008. During this period, DOE officials will conduct public scoping meetings in the region surrounding the SSFL and in Sacramento, California, to provide the public and other stakeholders with an opportunity to comment on the scope of the EIS. DOE recognizes the value of the public's perspectives, and will inform, involve, and interact with the public during all phases of the EIS process.

DOE is issuing this Notice of Intent (NOI) in order to inform and request comments and assistance from Federal and state agencies, state and local governments, Tribal Nations, natural resource trustees, the general public, and other interested parties on the appropriate scope of the EIS, alternatives, environmental issues, and the environmental impacts related to DOE's remediation activities for SSFL Area IV. DOE invites those agencies with jurisdiction by law or special expertise to be cooperating agencies.

DATES: The public scoping period starts May 16, 2008 and will continue until August 14, 2008. DOE will consider all comments received or postmarked by August 14, 2008, in defining the scope of this EIS. Comments received or postmarked after that date will be considered to the extent practicable.

28438 Federal Register / Vol. 73, No. 96 / Friday, May 16, 2008 / Notices

ADDRESSES: Public scoping meetings will be held to provide the public with an opportunity to present comments on the scope of the EIS and to learn more about the proposed action from DOE officials. *Public scoping meetings will be held at the following locations on the following days and times:*

- *Simi Valley, California:* Grand Vista Hotel, 999 Enchanted Way, July 22, 2008, 2 p.m. to 4 p.m. and 6:30 p.m. to 9:30 p.m.;
- *Northridge, California:* World Vision Church, 19514 Rinaldi Street, July 23, 2008, 2 p.m. to 4 p.m. and 6:30 p.m. to 9:30 p.m.; and
- *Sacramento, California:* Sacramento Central Library, 828 I Street, July 24, 2008, 2 p.m. to 4 p.m. and 6:30 p.m. to 9:30 p.m.

Written comments on the scope of the EIS should be sent to: Ms. Stephanie Jennings, NEPA Document Manager, U.S. Department of Energy, P.O. Box 10300, Canoga Park, CA 91309, Express Mail Delivery Address: 5800 Woolsey Canyon Road, Canoga Park, CA 91304, telephone number: 818–466–8162, fax: 818–466–8730, or e-mail to *stephanie.jennings@emcbc.doe.gov* (use "Scoping comments" for the subject).

All comments whether offered in person at the scoping meeting, or in writing as described above will be considered.

FOR FURTHER INFORMATION CONTACT: To request further information about this EIS or about the public scoping activities, or to be placed on the EIS distribution list, use any of the methods (mail, express mail, fax, telephone, or e-mail) listed under **ADDRESSES** above. For general information concerning the DOE NEPA process, contact Carol Borgstrom, Director, Office of NEPA Policy and Compliance (GC–20), U.S. Department of Energy, 1000 Independence Avenue, SW., Washington, DC 20585–0119, e-mail to: *AskNEPA@hq.doe.gov,* telephone: 202–586–4600, leave a message at 1–800–472–2756, or fax: 202–586–7031.

This NOI will be available on the internet at: *http://www.eh.doe.gov/NEPA* and at *http://www.etec.energy.gov,* click on the Area IV EIS link on the toolbar. Further information about SSFL Area IV can be found at *http://www.etec.energy.gov* and click on the SSFL Area IV EIS link in the toolbar.

Reading rooms with information about the SSFL Area IV are available to the public and are located in:

- *Simi Valley, California:* Simi Valley Library, 2969 Tapo Canyon Road, (805) 526–1735;
- *Woodland Hills, California:* Platt Branch Library, 23600 Victory Blvd., (818) 340–9386; and
- *Northridge, California:* California State University Northridge Oviatt Library, 2nd Floor, Room 265, (818) 677–2285.

SUPPLEMENTARY INFORMATION:

Background

SSFL, located on approximately 2,852 acres in the hills between Chatsworth and Simi Valley, CA, was developed as a remote site to test rocket engines and conduct nuclear research. The Atomics International Unit of Rockwell International's Canoga Park-based Rocketdyne Division began testing in 1947. An estimated 17,000 open-air rocket tests that supported the space program were conducted at the site. In 1996, Rockwell International sold its aerospace and defense business, including the SSFL, to The Boeing Company (Boeing).

SSFL is divided into four administrative areas, Areas I, II, III, and IV, and two undeveloped land areas. Area I consists of about 713 acres, including 671 acres that are owned and operated by Boeing and 42 acres that are owned by the National Aeronautics and Space Administration (NASA) and operated for it by Boeing. Area II consists of about 410 acres that are owned by NASA and operated for it by Boeing. Area III consists of about 114 acres that are owned and operated by Boeing. Area IV consists of about 290 acres that are owned by Boeing, a portion of which it operated for the DOE. Boeing also owns a contiguous undeveloped land area of 1,143 acres to the south and a contiguous undeveloped land area of 182 acres to the north.

Starting in the mid-1950s, the Atomic Energy Commission (AEC), a predecessor agency of DOE, funded nuclear energy research on a 90-acre parcel of SSFL Area IV leased from Rocketdyne. ETEC was established by the AEC on this parcel in the early 1960s as a "center of excellence" for liquid metals technology.

A total of 10 small reactors were built for various research activities over the years of operation. The most notable of the reactors was the Sodium Reactor Experiment (SRE). SRE was an experimental development-stage sodium-cooled nuclear reactor that operated from April 1957 to February 1964 at the SSFL. SRE was the first commercial nuclear power plant to provide electricity to the public (powering the City of Moorpark in 1957). An accident occurred at the SRE in July 1959 when there was an accidental blockage of sodium coolant in some of the reactor coolant channels resulting in the partial melting of the fuel cladding in 13 of the 43 reactor fuel assemblies. Radioactive gases from the accident were contained within the facility. Over a period of two months, the gases were vented and released to the atmosphere. The controlled releases were always below those levels allowed by requirements in existence both then and today. Following cleanup, the facility was refueled, brought back online, and operated until February 1964. All SSFL reactor operations ended in 1980 and nuclear research work was completed in 1988. Cleanup of ETEC began in the 1960s and was performed in an ongoing manner as unnecessary facilities were decommissioned.

In March 2003, DOE issued an *Environmental Assessment for Cleanup and Closure of the Energy Technology Engineering Center,* DOE/EA–1345. Based on the results of the EA, DOE determined that an EIS was not required and issued a FONSI in March 2003.

Comments on the Environmental Assessment were received by DOE from Federal and State agencies, elected officials, and from local community members. The comments addressed the following concerns:

U.S. Environmental Protection Agency, Region 9 (EPA) said that the EA did not clearly identify the decisions that were to be made, how those decisions related to each other, or how or when the decisions would be made. EPA also expressed concern that the conclusions reached by DOE in the EA were based upon inadequate standards and information. *EPA stated:* "* * * that the [Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)] process should be used to evaluate and select a cleanup alternative."

EPA and the State of California Department of Toxic Substances Control (DTSC) criticized the Rocketdyne survey of radiological contamination, which the EA relied upon, as being insufficient for not addressing multiple exposures to radiological contamination, contamination through combinations of radiological and chemical contamination, and contamination from different radionuclides. They also expressed concern that there was no plan to examine SSFL Area IV beyond the 90 acres of ETEC, that groundwater contamination was not addressed, and that there was a failure to address past releases of contamination.

The City of Los Angeles and local community members expressed concern that DOE did not adequately consider the effects of releases and remediation on the surrounding communities.

Federal Register / Vol. 73, No. 96 / Friday, May 16, 2008 / Notices **28439**

Senator Barbara Boxer expressed concern with proposed waste disposal methods and with the intention to leave a substantial amount of radioactive soil in place. The Committee to Bridge the Gap criticized DOE for assuming the site would be suitable in the future for residential development. Local community members were concerned with what DOE proposed as an acceptable rate of increased cancer risk.

DOE is now preparing an SSFL Area IV EIS in response to the U.S. District Court of Northern California's May 2, 2007, ruling in the case *Natural Resources Defense Council* v. *Department of Energy* Slip Op. 2007 WL 2349288 (N.D. Cal. Aug. 15, 2007), which held that DOE's decision to issue a FONSI and conduct cleanup and closure on the basis of DOE/EA–1345 was in violation of NEPA. The Court ordered DOE to prepare an EIS for SSFL Area IV in accordance with NEPA. The Court further prevented the DOE from transferring ownership or possession, or otherwise relinquishing control over any portion of SSFL Area IV, until DOE completes the EIS and issues a Record of Decision pursuant to NEPA. In response to requests from DTSC and the California Congressional delegation, DOE suspended the physical demolition and removal activities for the remaining facilities at ETEC, except for those activities necessary to maintain the site in a safe and stable configuration. DOE will continue surveillance, maintenance, and environmental monitoring, including soil and groundwater characterization required under the Resource Conservation and Recovery Act (RCRA), the California Health and Safety Code section 25187, and DOE Orders, while it prepares the EIS.

In addition to the investigation and evaluation of individual soils contamination areas under the requirements of RCRA, DOE, Boeing and NASA also are required to investigate and evaluate the groundwater for development of potential cleanup or interim actions. The EIS will address groundwater contamination and contributors to the contamination related to Area IV. All prior and currently planned interim corrective action activities under the DTSC administered Consent Order are located outside of Area IV and will be evaluated to determine if any impact on the groundwater plumes within Area IV exist.

In August 2007, DTSC issued a RCRA Consent Order to DOE, NASA, and Boeing (as respondents) pursuant to its authority over hazardous waste under the California Health and Safety Code section 25187. This Order requires the respondents to clean up all chemically-contaminated soils at SSFL by 2017 or earlier, provides the option for DTSC to require additional work to be conducted offsite of SSFL Area IV to assess air, soil, and water contamination and requires the preparation of an Environmental Impact Report (EIR), pursuant to the California Environmental Quality Act (CEQA). DTSC may use information in the EIS in its preparation of the EIR.

DOE issued an Advance Notice of Intent (ANOI), 72 FR 58834 (October 17, 2007), to prepare an EIS for SSFL Area IV and to conduct Public Involvement Activities in order to inform and request early comments and assistance. Informal discussions resulting from publication of the ANOI with both members of the public and other stakeholders aided in the development of this NOI.

DOE has conducted interviews with interested parties. The purpose of these interviews was to learn about concerns with the proposed remediation of SSFL Area IV as well as the public's preferences for being involved during the development of the EIS. This broad cross section of individuals includes neighbors of the SSFL, individuals who have been active in previous SSFL actions, former employees, elected and appointed local, state, and Federal officials, representatives of local and national environmental groups, members of local neighborhood associations, organizations, and the business community. This sampling of a wide range of perspectives is enhancing the development of future public involvement activities. The report of these interviews and associated recommendations for improvements in public involvement activities will be posted on the Web site listed in the **FOR FURTHER INFORMATION SECTION** of this NOI.

In October 2007, California Senate Bill 990 (SB 990) was signed into law. SB 990 requires the DTSC to certify that the SSFL has been completely remediated so that the cumulative risk of exposure from residual chemical and radiological contamination does not exceed a risk range premised on future land use of either suburban or rural residential. Until this certification is completed, the land at SSFL cannot be transferred or sold.

In December 2007, the EPA announced the results of a Hazard Ranking Survey it had conducted at SSFL beginning in Spring 2007. Although EPA could not reveal the final score, EPA indicated that the score exceeded the threshold for listing SSFL on the National Priority List for cleanup under CERCLA. Consequently, EPA sent a letter dated December 6, 2007, to the Governor of California requesting his concurrence in the listing. In response, the California Environmental Protection Agency, in a letter dated January 15, 2008, asked that EPA defer for six months the decision regarding whether to propose listing for this site. EPA Region 9 agreed to defer listing SSFL until July 2008.

As part of the FY 2008 appropriations, Congress mandated that DOE shall use a portion of the funding for ETEC to enter into an interagency agreement (IAG) with EPA to conduct a joint comprehensive radioactive site characterization of Area IV and ensure that all aspects of the cleanup of the radioactive contamination comply fully with CERCLA. DOE and EPA are negotiating the terms of the IAG, and the associated scope of the site characterization.

DOE is collecting updated information that it will incorporate into the EIS analysis. A data gap analysis was conducted to evaluate the usability and acceptability of existing data, and to identify any additional data that may be needed to support the EIS. Results of the data gaps analysis will be shared with interested parties in June 2008, and will also be made available on the Web site (*http://www.etec.energy.gov,* click on Area IV EIS in the toolbar) . A follow-on field analysis and sampling plan will be developed and will also be shared with interested parties in August 2008. Dates, locations and times for these workshops on the draft gap analysis and availability of the subsequent draft sampling and analysis plans will be announced through the site mailing list, the local media, and on the Web site. The draft gap analysis, field analysis, and sampling plans will all be available in the public reading rooms listed above. Printed copies of documents may be obtained from Ms. Jennings at the location listed in the above **ADDRESSES** section.

Purpose and Need for Agency Action

DOE needs to complete remediation of SSFL Area IV to comply with applicable requirements and for radiological and hazardous contaminants.

Alternatives

In the EIS, DOE will describe the statutory and regulatory requirements for each remediation alternative and whether legislation or regulatory modifications may be needed to implement the alternative under consideration. The EIS will present the health and environmental consequences

28440 Federal Register / Vol. 73, No. 96 / Friday, May 16, 2008 / Notices

of the alternatives in comparative form to provide a clear basis for informed decision making. In summary, DOE proposes to evaluate the alternatives listed below:

- *Alternative 1:* No Action—This alternative involves the cessation of all DOE management and oversight of SSFL Area IV. The buildings would remain and would not be monitored or maintained. Unmitigated natural processes, including erosion, groundwater transport of contamination and concrete degradation, would be assumed to occur. The purposes of evaluating this alternative are to establish the baseline against which the environmental impacts from all other alternatives are compared and to justify the proposed action. NEPA regulations require analysis of a no action alternative.
- *Alternative 2:* No further cleanup or disposition of buildings and no remediation of contaminated media at SSFL Area IV—DOE would continue environmental monitoring and maintain security of SSFL Area IV.
- *Alternative 3:* Onsite Containment at SSFL Area IV—Containment onsite of buildings, wastes, radiological and chemical contaminants, aligned with potential future land use scenarios including, but not limited to, agricultural, residential, and open space.
- *Alternative 4:* Offsite Disposal of SSFL Area IV Materials—Demolition of buildings, removal of contaminated media aligned with potential future land use scenarios including, but not limited to, agricultural, residential, and open space. Transportation of non-radiological wastes to approved disposal or treatment facilities and radiological wastes to an approved out-of-state disposal facility.
- *Alternative 5:* Combination On-Site/Off-Site Disposal Alternative for SSFL Area IV—Demolition of buildings, on-site containment of contaminated media aligned with potential future land use scenarios including, but not limited to, agricultural, residential, and open space. Transportation of non-radiological wastes from building demolition to approved disposal or treatment facilities and radiological waste from building demolition to an approved, out-of-state disposal facility.

These preliminary alternatives will be refined and further developed as part of the scoping process through public and other stakeholder input.

Preliminary Environmental Impacts for Analysis

DOE has tentatively identified the following environmental impacts for analysis in the SSFL Area IV EIS. This list is presented to facilitate comment during the public involvement activities on the scope of the EIS. *These impacts include:*

- Potential health and safety impacts to the general population, and to workers, and to the environment from radiological and non-radiological releases;
- Potential transportation impacts from the shipment of radiological and non-radiological wastes to disposal sites;
- Potential impacts from accidents that might occur (*e.g.*, accidents associated with removal and transportation of contaminated media);
- Potential impacts from intentional destructive acts;
- Land use impacts;
- Socioeconomic impacts;
- Impacts to ecological resources (endangered and protected species [Braunton's milk-vetch, Santa Susana tarplant, Southern California black walnut, Mariposa lily, Coast Horned Lizard], floodplain and wetlands);
- Cultural, historical and paleontological resources impacts;
- Irretrievable and irreversible commitment of resources;
- Potential disproportionately high and adverse effects on low-income and minority populations (environmental justice); and
- Cumulative impacts from radiological and non-radiological contamination both onsite and offsite of SSFL Area IV, and from both radiological and non-radiological contaminants.

Preliminary Identification of Issues

The following issues have been tentatively identified for consideration in the EIS. This list is not intended to be all-inclusive, but is presented to facilitate public comment during the public scoping period:

- Best methods to obtain accurate information on radiological and hazardous contamination;
- Compliance with applicable Federal, state and local requirements;
- Long-term stewardship and institutional controls; and
- Mitigation measures to avoid or mitigate potentially significant environmental impacts.

Scoping Process

DOE issued an Advance Notice of Intent (ANOI), 72 FR 58834 (October 17, 2007), to prepare an EIS for SSFL Area IV and to conduct public involvement activities in order to inform and request early comments and assistance. Informal discussions resulting from publication of the ANOI with both members of the public and other stakeholders aided in the development of this NOI.

DOE is issuing the NOI, pursuant to 40 CFR 1501.7 and 10 CFR 1021.311, in order to inform and request comments and assistance from Federal and state agencies, state and local governments, natural resource trustees, the general public, and other interested parties on the scope of the EIS, environmental issues, alternatives to be analyzed, and the potential environmental impacts related to DOE's potential activities at this site. The NOI is also being issued to notify the public and other stakeholders of the scoping meetings to be held as described. In addition, DOE will provide progress updates to the public and other stakeholders throughout all phases of the EIS process.

DOE will consult with appropriate Federal and state agencies regarding the environmental and regulatory issues germane to the proposed remediation alternatives for analysis in the EIS and the environmental issues to be analyzed. DOE invites those agencies with jurisdiction by law or special expertise to be cooperating agencies.

Public scoping meetings will be held at the locations and times listed in the **ADDRESSES** section of this Notice.

DOE will designate a presiding officer for the scoping meetings. At the opening of each meeting, the presiding officer will announce procedures necessary for the conduct of the meeting. At the beginning of the scoping meetings, a brief presentation by DOE officials will be given explaining DOE's proposed approach to alternatives, issues to be addressed, and impacts that will be analyzed in the EIS. This presentation will be followed by a question and answer session. Following the question and answer session, the public will be given the opportunity to provide comments orally. This part of the scoping meetings will not be conducted as an evidentiary hearing, and there will be no questioning or cross-examination of the speakers. DOE personnel, however, may ask for clarifications to ensure that they fully understand the comments and suggestions. The presiding officer will establish the order of the speakers, and will ensure that everyone who wishes to speak has a chance to do so. Oral comments will be limited in duration at the discretion of the presiding officer based on the number of commenters and the time available. DOE is especially interested in learning from the public any additional issues or alternatives that should be considered. Comment cards will also be available for those who would prefer to submit written

Federal Register / Vol. 73, No. 96 / Friday, May 16, 2008 / Notices **28441**

comments. Persons who wish to speak may sign up to speak before each meeting at the reception desk. Oral and written comments will be considered equally in the preparation of the EIS. See the **ADDRESSES** section of this Notice for the times and locations of these meetings.

DOE will make transcripts of the scoping meetings and other environmental and SSFL Area IV related materials available for public review in the reading rooms listed in the **FOR FURTHER INFORMATION CONTACT** [section of this Notice]. This information will also be available through the project web site at *http://www.etec.energy.gov,* click on Area IV EIS in the toolbar.

Draft EIS Schedule and Availability

DOE will provide a public comment period of at least 45 days from the publication of the EPA's Notice of Availability (NOA) of the Draft EIS in the **Federal Register** and will hold at least one public hearing. DOE will separately announce in the **Federal Register** and local media information on the public hearings schedule and location. DOE expects to issue the Draft EIS in early 2009. Comments on the Draft EIS will be considered and addressed in the Final EIS, which DOE anticipates issuing in the fall 2010. DOE will issue a Record of Decision no sooner than 30 days from EPA's NOA of the Final EIS.

Issued in Washington, DC, on May 13, 2008.

Ines R. Triay,

Acting Assistant Secretary for Environmental Management.

[FR Doc. E8–11033 Filed 5–15–08; 8:45 am]

BILLING CODE 6450–01–P

A.3 Amended Notice of Intent – February 7, 2014

Federal Register / Vol. 79, No. 26 / Friday, February 7, 2014 / Notices 7439

DEPARTMENT OF ENERGY

Amended Notice of Intent To Prepare an Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory and Conduct Public Scoping Meetings

AGENCY: Department of Energy.

ACTION: Amended notice of intent.

SUMMARY: The U.S. Department of Energy (DOE) is amending its 2008 notice of intent (NOI) to prepare an environmental impact statement (EIS) under the National Environmental Policy Act (NEPA) for cleanup of Area IV, including the Energy Technology Engineering Center (ETEC), as well as the Northern Buffer Zone of the Santa Susana Field Laboratory (SSFL) (DOE/EIS–0402) in eastern Ventura County, California, approximately 29 miles north of downtown Los Angeles. (DOE's operations bordered the Northern Buffer Zone. DOE is responsible for soil cleanup in Area IV and the Northern Buffer Zone.) Since DOE's 2008 NOI, extensive studies of the site for radiological and chemical contamination have been ongoing and are nearing completion. DOE is proposing a revised scope for the EIS due to the 2010 Administrative Order on Consent (2010 AOC) that DOE and the California Department of Toxic Substances Control (DTSC) signed for soil cleanup, and due to information now available from site characterization. The scope of the EIS would continue to include groundwater remediation consistent with requirements in the 2007 Consent Order for Corrective Action (2007 Consent Order) issued by DTSC. This Amended NOI describes DOE's proposed action and includes cleanup concepts developed by the local community for remediation of SSFL Area IV and the Northern Buffer Zone. In the EIS, DOE will evaluate reasonable alternatives for disposition of radiological facilities and support buildings, remediation of contaminated soil and groundwater, and disposal of all resulting waste at permitted facilities.

DOE is initiating a 30-day public scoping period, during which public scoping meetings are planned for Calabasas and Simi Valley, California. DOE invites comments from federal and state agencies, state and local governments, Tribal Nations, natural resource trustees, the general public, and other interested parties on the scope of the EIS.

DATES: The public scoping period will extend from the date of publication of this notice in the **Federal Register** through March 10, 2014. DOE plans to hold public scoping meetings at the following dates, times, and locations.

- *Simi Valley, California:* Simi Valley City Council Chambers in City Hall, 2929 Tapo Canyon Road, Simi Valley, on February 27, from 6:30 p.m. to 9:30 p.m.; and
- *Agoura Hills/Calabasas, California:* Community Center, 27040 Malibu Hills Road, Calabasas, on March 1, from 9:30 a.m. to 12:30 p.m.

DOE will consider all comments received or postmarked by the end of the scoping period. Comments submitted after that date will be considered to the extent practicable. DOE will give equal consideration to written comments and oral comments.

ADDRESSES: Written comments on the scope of the EIS should be sent to: Ms. Stephanie Jennings, NEPA Document Manager, U.S. Department of Energy, 4100 Guardian Street, Suite 160, Simi Valley, CA 93063 or by fax: (855) 658–8695. Comments may also be submitted by email to *SSFL_DOE_EIS@emcbc.doe.gov* (use "Scoping comments" for the subject), or on the ETEC Web site at *http://www.etec.energy.gov.*

FOR FURTHER INFORMATION CONTACT: To request further information about the EIS or about the public scoping activities, or to be placed on the EIS distribution list, use any of the methods listed under **ADDRESSES**.

For general information concerning the DOE NEPA process, contact Carol Borgstrom, Director, Office of NEPA Policy and Compliance (GC–54), U.S. Department of Energy, 1000 Independence Avenue SW., Washington, DC 20585–0119, email to: *AskNEPA@hq.doe.gov,* telephone: (202) 586–4600, leave a message at (800) 472–2756, or fax: (202) 586–7031.

This Amended NOI will be available on the internet at: *http://energy.gov/nepa.* This Amended NOI and related information will also be available on the internet at: *http://www.etec.energy.gov,* select the "Characterization & Cleanup" link on the toolbar, and then the "Environmental Impact Statement" link.

Additional information about the SSFL Area IV is available in the following public reading rooms:

• *Simi Valley, California:* Simi Valley Library, 2969 Tapo Canyon Road, (805) 526–1735;
• *Woodland Hills, California:* Platt Branch Library, 23600 Victory Blvd., (818) 340–9386;
• *Northridge, California:* California State University Northridge Oviatt Library, 2nd Floor, Room 265, (818) 677–2832; and
• *Chatsworth, California:* State of California Department of Toxic Substances Control, Regional Records Center, 9211 Oakdale Avenue, (818) 717–6521 or –6522

SUPPLEMENTARY INFORMATION:

Background

Site History. Located on 2,859 acres in the hills between the San Fernando Valley and Simi Valley, CA, SSFL was established in 1947 by North American Aviation (NAA) for the development and testing of liquid propellant rocket engines, first for the U.S. Air Force and subsequently for the National Aeronautics and Space Administration (NASA). In 1955, NAA established the subdivision Atomics International for the purpose of conducting energy research and testing small nuclear reactors for the Atomic Energy Commission (AEC), a predecessor agency to DOE, and commercial clients in the western portion of SSFL, also known as Area IV. Atomics International merged into Rocketdyne in 1984. In 1996, the Boeing Company (Boeing) acquired part of Rocketdyne, and with it SSFL.

SSFL is divided into four administrative areas and two contiguous buffer zones north and south of the administrative areas. Area I consists of about 714 acres, including 672 acres that are owned and operated by Boeing and 42 acres that are owned by the Federal Government and administered by NASA. Area II consists of about 410 acres that are owned by the Federal Government and administered by NASA. Area III consists of about 120 acres that are owned and operated by Boeing. Area IV consists of about 290 acres that are owned by Boeing in which 90 acres have been leased by DOE and its predecessors for work described below. Boeing also owns contiguous buffer zone areas of 1,143 acres to the south (Southern Buffer Zone) and 182 acres to the north (Northern Buffer Zone). DOE has no responsibilities for the Southern Buffer Zone as it adjoins SSFL Areas I, II, and III. DOE does have responsibility for the cleanup of soils in the 290 acres of Area IV and in the 182-acre Northern Buffer Zone. DOE shares responsibilities for groundwater remediation as defined in the 2007 Consent Order. Not all of the energy research conducted in Area IV was performed for DOE. Boeing has responsibility for the decontamination and demolition of the buildings it owns.

Starting in the mid-1950s, the AEC funded nuclear energy research on a 90-acre parcel of SSFL Area IV leased from Atomics International. ETEC was established by the AEC on this parcel in the early 1960s as a ''center of excellence'' for liquid metals technology. Boeing and its predecessors operated ETEC on behalf of DOE. At ETEC, DOE also operated 10 small nuclear reactors built for various research activities. All SSFL reactor operations ended in 1980, and nuclear research work was completed in 1988. Cleanup of ETEC began in the 1960s and was undertaken as unnecessary facilities were decommissioned.

Operation of the research facilities and reactors resulted in localized radiological contamination of soil and groundwater, and the concrete containment that surrounded the reactors became radioactive. Leaks from liquid radioactive waste hold-up tanks contaminated surrounding soil. Releases of hazardous and radioactive wastes into leachfields contaminated groundwater. DOE has removed all nuclear material from Area IV, and all but two of its reactor buildings, and has performed cleanup of radioactive building materials and soil to DOE standards established in the 1980s and 1990s.[1]

Prior NEPA Review: In March 2003, DOE issued an *Environmental Assessment for Cleanup and Closure of the Energy Technology Engineering Center* (DOE/EA–1345). The purpose and need for agency action was based on a DOE determination in 1996 that ETEC was surplus to DOE's needs and that the site should be closed. Based on the results of the environmental assessment (EA), DOE determined that an EIS was not required and issued a finding of no significant impact (FONSI). DOE's FONSI was challenged, and the U.S. District Court for the Northern District of California's May 2, 2007, ruling in the case *Natural Resources Defense Council* v. *Department of Energy* (Slip Op. 2007 WL 2349288 (N.D. Cal. Aug. 15, 2007)) held that DOE's decision to issue a FONSI and conduct cleanup and closure on the basis of the EA was in violation of NEPA. The court enjoined DOE from transferring control of any portion of SSFL Area IV until DOE completes an EIS and issues a Record of Decision pursuant to NEPA.

[1] Cleanup standards used during that time were based on an estimated exposure dose per DOE guidelines.

In accordance with Council on Environmental Quality and DOE NEPA implementing regulations (40 CFR Parts 1500–1508 and 10 CFR Part 1021, respectively), DOE initiated this EIS in October 2007 by issuing an Advance NOI (72 FR 58834; October 17, 2007). Public comments received as a result of the publication of the Advance NOI aided in the preparation of the 2008 NOI announcing DOE's intent to prepare an EIS (73 FR 28437; May 16, 2008). DOE held scoping meetings in July 2008. A summary of comments received during the 2008 scoping period is on the ETEC Web site at *http://www.etec.energy.gov*. DOE did not issue a draft EIS following issuance of the 2008 NOI.

The alternatives identified in the 2008 NOI were:

• Alternative 1: No Action—Cessation of all DOE management activities and oversight of SSFL Area IV
• Alternative 2: No further cleanup or disposition of buildings and no remediation of contaminated media at SSFL Area IV but DOE would continue environmental monitoring and maintain security of SSFL Area IV
• Alternative 3: On-site containment of buildings, wastes, and radiological and chemical contaminants at SSFL Area IV
• Alternative 4: Off-site disposal of SSFL Area IV materials
• Alternative 5: Combination of on-site disposal/off-site disposal for SSFL Area IV

The 2008 Alternatives 1 and 2 were no action baseline scenarios. DOE has determined that analysis of No Action Alternative 1 would not benefit decisionmaking and, thus, proposes not to analyze it in the EIS. DOE proposes that the No Action Alternative in the EIS be based on the 2008 No Action Alternative 2. For the Action Alternatives (Alternatives 3, 4, 5), DOE will continue to evaluate components of the alternatives, insofar as they are consistent with applicable requirements, and after consideration of scoping comments, will determine how they best fit among the range of reasonable alternatives to be analyzed in the EIS.

Recent History: DTSC issued the 2007 Consent Order to DOE, NASA, and Boeing (as respondents) pursuant to its authority over hazardous waste under the California Health and Safety Code section 25187. This 2007 Consent Order required the respondents to clean up all chemically-contaminated soils and groundwater at SSFL to risk-based levels.

Federal Register / Vol. 79, No. 26 / Friday, February 7, 2014 / Notices 7441

Also in 2007, DOE received requests from DTSC and some members of the California congressional delegation to suspend the physical demolition and removal of the facilities still remaining at ETEC, except for those activities necessary to maintain the site in a safe and stable configuration until completion of the EIS. DOE has honored these requests and continued surveillance, maintenance, environmental monitoring, and soil and groundwater characterization activities.

In the Consolidated Appropriations Act, 2008 (Pub. L. 110–161), Congress, among other things, mandated that DOE use a portion of the funding for ETEC to enter into an interagency agreement with the U.S. Environmental Protection Agency (EPA) to conduct a joint comprehensive radioactive site characterization of Area IV and the Northern Buffer Zone. Additionally, in 2009, EPA received $38 million in American Recovery and Reinvestment Act funds from DOE to expand site characterization work. DOE slowed preparation of the EIS until the site characterization could be completed, nevertheless gathering information to support the EIS such as baseline data on traffic and noise. EPA conducted its background and on-site radionuclide investigation of Area IV and the Northern Buffer Zone from the summer of 2009 until the fall of 2012. EPA's final data report for the Area IV and Northern Buffer Zone radiological study was issued in December 2012. EPA's final data report for the radiological study is available on the ETEC Web site at *http://www.etec.energy.gov*.

In December 2010, DOE and DTSC signed the 2010 AOC for soil cleanup. (*http://www.etec.energy.gov/Char_Cleanup/AOC.html*). The 2010 AOC supersedes the 2007 Consent Order relative to soil cleanup and provides the process for DOE to complete soil characterization within Area IV and the Northern Buffer Zone. The 2010 AOC also describes the process for establishing soil cleanup standards for Area IV. The 2010 AOC stipulates that the soils contamination cleanup standard will be local background concentrations or analytical detection limits.[2] The AOC provides a preference for on-site treatment to minimize transportation of soils. The AOC specifies that soil cleanup be completed in 2017. DOE recently completed the AOC-required soil sampling, and its final data report for the Area IV/Northern Buffer Zone chemical study will be issued in 2014. The results of the EPA soil radiological characterization reports and the DOE chemical characterization results will be incorporated into the EIS environmental analyses.

In December 2012, EPA provided to DTSC its cleanup value recommendations to be included in the Look-Up Table for radionuclides, and DTSC released provisional radionuclide Look-Up Table values in January 2013. DOE expects that the radionuclide values will be finalized after a laboratory to test soil samples has been identified. In June 2013, DTSC provided Look-Up Table values for 125 of the most frequently observed chemicals at the site, out of over 400 chemicals; values for those remaining chemicals are expected to be forthcoming.

Preliminary results of DOE's soil chemical investigation conducted under the 2010 AOC and the radionuclide investigation conducted by EPA indicate that soil volumes potentially to be remediated could range from approximately 1 million to 1.7 million cubic yards of chemically contaminated soil, including approximately 82,000 cubic yards of radiologically contaminated soil. These estimates are based on established engineering estimating procedures using available Area IV soil sampling data and the site Geographic Information System (GIS) to estimate rough-order-of-magnitude soil volumes based on the Look-up Table values. These volume estimates assume expansion following excavation. The estimates do not include any reductions due to limiting the areas of cleanup for protection of biological species or archaeological resources that are described in the 2010 AOC, or any on-site soil treatment (e.g., phytoremediation and bioremediation). DOE's ongoing groundwater characterization of Area IV and the Northern Buffer Zone has identified two areas with solvent contamination, one area with tritium contamination, and one location with strontium-90 contamination.

Groundwater investigation and cleanup are still governed by the 2007 Consent Order (the 2010 AOC identifies the provisions of the 2007 Order that are still applicable and incorporates them by reference). The 2007 Consent Order and the 2010 AOC provide the option for DTSC to require additional work to be conducted outside of SSFL Area IV to assess air, soil, and water contamination, and to require remediation should an area of off-site contamination be demonstrated to be emanating from Area IV.

At this time, DTSC is preparing a program Environmental Impact Report (EIR), pursuant to the California Environmental Quality Act (CEQA), that will include cleanup actions for the entirety of SSFL, including those to be conducted by Boeing, NASA, and DOE. DTSC initiated scoping for the CEQA EIR in December 2013 and extended the public comment period through February 10, 2014. Because DOE will be preparing its EIS concurrently, DTSC and DOE plan to share information in the development of both environmental documents.

Purpose and Need for Agency Action

DOE needs to complete remediation of SSFL Area IV and the Northern Buffer Zone to comply with applicable requirements for radiological and hazardous contaminants. These requirements include regulations, orders, and agreements, including the 2007 Consent Order, as applicable, and the 2010 AOC. To this end, DOE needs to remove the remaining DOE structures in Area IV of SSFL and clean up the affected environment in Area IV and the Northern Buffer Zone in a manner that is protective of the environment and the health and safety of the public and workers.

DOE Proposed Action

DOE proposes to demolish remaining DOE-owned buildings and debris and dispose of this waste off site. DOE also proposes to clean up Area IV and the Northern Buffer Zone. Soil cleanup would be performed based on soil concentrations listed in Look-Up Tables for chemicals and radionuclides. Where possible, DOE proposes to use on-site treatment of contaminated soils and natural attenuation [3] to reduce volumes of contaminated soil prior to transport and disposal off site of any soils that cannot be otherwise treated and remain on site. In all remedial actions, steps to protect biological and archaeological (cultural) resources would be taken. Soil that cannot be treated on site would be transported off site to permitted disposal facilities based on the type of waste. Locations where soil excavation is performed would be backfilled, recontoured, and stabilized with new vegetation. In the EIS, DOE will analyze alternatives that can mitigate transportation impacts to the adjacent communities to the extent practicable (e.g., new roadway). DOE proposes to address groundwater contamination through a variety of mechanisms,

[2] The soil cleanup standards (action levels) are to be listed in a "Look-up Table" as not-to-exceed concentrations in the soil.

[3] Natural attenuation takes advantage of organisms and physical properties in the soil to degrade contaminants.

7442 Federal Register / Vol. 79, No. 26 / Friday, February 7, 2014 / Notices

including pump and treat technology, chemically enhanced degradation, and natural attenuation.

Alternatives

DOE is in the early stages of identifying the range of reasonable alternatives for analysis in the EIS. These alternatives will be developed based on current requirements, including the 2010 AOC, results from site characterization, public input received during alternative development workshops held by DOE in 2012 and public scoping comments.

Community-Developed Cleanup Concepts

Community members developed the cleanup concepts summarized below during the 2012 public workshops held by DOE. The concepts are similar in their focus on cleaning up and restoring Area IV and the Northern Buffer Zone to a level that allows use of the site as open space for wildlife or human enjoyment. Each concept calls for minimizing transportation impacts. Preferred use of native plants and measures to prevent spread of invasive, non-native plants are also common components. The approaches to meeting these objectives are different among the concepts. DOE invites comments during this scoping period on these community-developed concepts, as well as other suggestions for how to proceed with cleanup of Area IV and the Northern Buffer Zone. Because the community-based concepts have common elements, they may be formulated into one or more action alternatives for analysis in the EIS.

Concept 1: Minimize Environmental Disturbance—The focus of this concept is cleaning up the environment in such a way as to minimize damage to the existing ecosystem. Cleanup would be approached in a holistic manner, looking to an end state such that Area IV could be integrated with the entirety of SSFL and the surrounding environs as potential national or state park and habitat linkage. Cleanup actions would be intended to minimize the removal of soil and disturbance of the local environment. Structures, except uncontaminated structures that could be repurposed, and roads, would be removed. Preference would be given to in situ and onsite treatment of contaminated soils, materials and groundwater, and to recycling. Building materials would need to be managed off site and would be disposed of or recycled as close to the site as possible to minimize transportation impacts and costs. Treated groundwater would be discharged on-site.

Concept 2: Risk-Based Prioritization—Under this concept, cleanup would be prioritized based on the toxicity of the contaminants to humans and biota, and the efficacy of cleanup methods. Schedule would not be a driver. A cost-benefit analysis may be conducted under this concept. Excavation would be minimized for both soil and groundwater, on-site treatment methods would be preferred, and cleanup levels would correlate to established EPA or California toxicity levels. Tritium would be monitored and reduced through natural attenuation. The existing Groundwater Extraction and Treatment System would be expanded and groundwater would be removed and treated to prevent further contaminant migration. Transportation impacts would be minimized by managing truck routes and schedules, and using more efficient technologies such as hybrid engines and alternative fuels. Protection of endangered species and cultural resources would be emphasized. Backfilling, recontouring, and cleanup impacts for the Northern Buffer Zone, in particular, would be minimized. At transfer, the property would be open space.

Concept 3: Schedule- and Background-Driven Cleanup—The focus of this cleanup concept is meeting the AOC requirements, including the schedule. Cleanup would be to background levels, with the vision for final state as near natural as possible, for use as a wildlife corridor. All contaminated structures would be removed for disposal; uncontaminated foundations and pads would be removed if necessary to facilitate soil sampling after the buildings have been removed. On-site storage of demolition debris would be limited to 30 days. The preferential order of treatment to meet the AOC background standard by 2017 would be in-situ treatment, on-site treatment, and excavation. Tritium would be monitored and reduced through natural attenuation. Metals recycling would be prohibited. Innovative methods for moving materials off the site to minimize truck traffic on existing roadways and associated impacts, such as using a modular conveyor system, or improving an existing fire road are emphasized. Intermodal transportation using ships, rail, and trucks is proposed for transportation to off-site disposal facilities.

Concept 4: Green Cleanup—Under this concept, which emphasizes the use of green cleanup technologies, a point-based system would be developed to prioritize cleanup actions resulting in an open space land use end state. Various methods, activities, and components of each cleanup action would be given a point value based on factors such as cost, efficacy, degree of disturbance, and vendor location (specifically, preference for use of California-based companies). Preference (and therefore more favorable point values) would be given to eco-friendly technologies and locally based capabilities. Off-site disposal would be minimized by on-site sorting, reuse, and recycling, and special attention would be made to avoid contamination or recontamination of waste. Activities, such as truck movement scheduling, would be undertaken to maximize public safety during transportation. Road infrastructure would be evaluated and improved as needed. There are two variations under this concept for management of existing structures. Under the building preservation variation, structures with the potential for reuse would be retained. Under the building demolition variation, all manmade structures would be removed and disposed of without consideration for reuse.

No Action Alternative

Under the No Action Alternative, DOE would undertake no further soil or groundwater cleanup or disposition of its buildings and structures at SSFL Area IV and the Northern Buffer Zone. Removal of buildings and structures not owned by DOE, environmental monitoring, stormwater controls, and security would continue at SSFL Area IV and the Northern Buffer Zone. As required under NEPA, this alternative is to establish the baseline against which the environmental impacts from other analyzed alternatives can be compared.

Preliminary Identification of Environmental Issues

DOE has tentatively identified the following preliminary list of impact areas for evaluation in the EIS:

- Health and safety of the general population and workers from radiological and non-radiological releases, and cleanup operations;
- Transportation of radiological and non-radiological wastes to disposal sites and clean replacement soil to SSFL;
- Waste management;
- Potential accidents;
- Intentional destructive acts;
- Air resources, including air quality, climate change, and greenhouse gases;
- Noise;
- Surface water and groundwater;
- Geology and soils;
- Land use and visual resources;
- Socioeconomics;

Federal Register / Vol. 79, No. 26 / Friday, February 7, 2014 / Notices **7443**

- Biological resources (endangered and protected species, floodplain, and wetlands);
- Cultural, historic, and paleontological resources;
- Native American resources;
- Irretrievable and irreversible commitment of resources;
- Potential disproportionately high and adverse effects on low-income and minority populations (environmental justice); and
- Cumulative impacts.

This list is not intended to be all inclusive or to imply any predetermination of impacts. DOE invites interested parties to suggest specific issues, including possible mitigation measures, within these general categories, or other categories not included above, to be considered in the EIS.

Section 106 of the National Historic Preservation Act (NHPA) requires federal agencies to take into account the effects of their undertakings on historic properties. DOE is coordinating compliance with Section 106 with the preparation of this EIS. Also, DOE is initiating formal consultations with the U.S. Fish and Wildlife Service as required under Section 7 of the Endangered Species Act.

Public Participation and Scoping Process

DOE is issuing this Amended NOI to inform and solicit comments from federal and state agencies, state and local governments, Tribes, natural resource trustees, the general public, and other interested parties on the scope of the EIS (e.g., environmental issues, alternatives to be analyzed, and the potential environmental impacts related to DOE's potential activities within Area IV and the Northern Buffer Zone). DOE invites those agencies with jurisdiction by law or special expertise to be cooperating agencies. Invitations to be a cooperating agency have been sent to the U.S. Army Corps of Engineers, EPA—Region 9, NASA, California DTSC, and the Santa Ynez Band of Chumash Indians.

This Amended NOI also announces scoping meetings to be held as described under ''DATES''. The scoping meetings will offer an opportunity for stakeholders to learn more about the proposed action from DOE officials and to provide comments on the proposed scope of the EIS. The first half hour of each meeting will consist of an open house, allowing members of the public to interact with DOE representatives and view materials on the scope of the EIS and known issues. After the open house, a presiding officer, designated by DOE, will announce procedures necessary for the conduct of the meeting. DOE officials will provide a brief presentation explaining DOE's process for identifying reasonable alternatives and potential environmental impacts to be analyzed in the EIS. Following the presentation, the public will be given the opportunity to provide comments orally. A court reporter will be present to transcribe comments. The presiding officer will establish the order of the speakers, and will ensure that everyone who wishes to speak has a chance to do so. DOE may need to limit speakers to three to five minutes initially, but will provide additional opportunities if time allows. DOE is especially interested in learning from the public any issues or alternatives that should be considered. Comment cards will also be available for those who would prefer to submit written comments. Persons who wish to speak may sign up to speak before each meeting at the reception desk.

Next Steps

DOE expects to issue the Draft EIS in late 2014. DOE will hold a 45-day public comment period beginning with the publication of the EPA's Notice of Availability (NOA) of the Draft EIS in the **Federal Register** and will hold at least one public hearing. DOE will separately announce, in the **Federal Register** and local media, information on the public hearing(s) schedule and location(s). Comments on the Draft EIS will be considered and addressed in the Final EIS, which DOE anticipates issuing in fall of 2015. DOE will issue a Record of Decision no sooner than 30 days after EPA's NOA of the Final EIS in the **Federal Register**.

Issued in Washington, DC on February 3, 2014.

David Huizenga,

Senior Advisor for Environmental Management.

[FR Doc. 2014–02703 Filed 2–6–14; 8:45 am]

BILLING CODE 6450–01–P

Appendix B
Environmental Consequences Methodologies

APPENDIX B
ENVIRONMENTAL CONSEQUENCES METHODOLOGIES

This appendix presents descriptions of the methodologies used to assess the potential environmental consequences of the alternatives proposed in this *Draft Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory (Draft SSFL Area IV EIS)*. Select resource areas that required more-detailed descriptions and supporting information are presented briefly in this appendix, with the detailed analytical methodology presented in separate appendices.

Each resource methodology includes the following subsections: description of resource and region of influence (ROI); description of impact drivers; impact assessment protocol (including identification of primary affected environment information, data and sources, impact assessment assumptions, and methodology for assessing change); and evaluation of impacts (presenting criteria or thresholds for estimating the relative degree of impact).

B.1 Land Resources

B.1.1 Description of Resource and Region of Influence

Land resources include (1) existing land use, including recreation; the existing developed environment, such as buildings and associated utilities infrastructures (municipal water supply, wastewater, and energy); and visual resources and (2) the attributes that make these areas suitable for current, planned, or designated uses. The ROI for land resources includes both land encompassing and adjacent to Santa Susana Field Laboratory (SSFL) Area IV, as well as land along the primary commuter and truck routes to and from the site.

B.1.2 Description of Impact Drivers

Potential impact drivers associated with the proposed activities are discussed below.

Land Use

The proposed activities could cause potential impacts if they displace or cause a change in land use that conflicts with an applicable land use plan, policy, or regulation of Ventura and/or Los Angeles County, including general plans, any specific or area plans, and zoning ordinances, or if the proposed activities physically divide an existing community. An adverse impact would also occur if proposed activities interfered with the landowner's (The Boeing Company [Boeing]) stated intent to maintain its portion of SSFL (including Area IV and the Northern Buffer Zone [NBZ]) as undeveloped open space (Boeing 2016).

Recreation

The proposed activities could cause potential impacts if they increase the use/demand of existing neighborhood and/or regional parks or impede future development of recreation facilities.

Infrastructure

The proposed activities could cause potential impacts if they disrupt or reroute an existing utility facility or increase demand on a utility. This could cause shortages or disruptions to services or the need to expand existing facilities, which could result in potential indirect and secondary environmental impacts. The potential increase in water consumption could cause impacts because California is experiencing drought conditions and is under an order to reduce water consumption.

Aesthetics and Visual Quality

The proposed activities could cause potential impacts if they (1) cause an adverse effect on a scenic vista; (2) damage or alter scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings along a state scenic highway; (3) degrade the existing visual character or quality of the site and its surroundings; or (4) create a new source of light or glare that would adversely affect day or nighttime views in the area.

B.1.3 Impact Assessment Protocol

B.1.3.1 Land Use

Affected Environment

Chapter 3, Section 3.1, Land Resources, describes current designated land uses at Area IV and surrounding areas along the proposed project-related local transportation routes. As stated in Section 3.1, SSFL is currently designated as open space under the *Ventura County General Plan, Goals, Policies and Programs* (Ventura County 2015a), but conducts industrial operations under a special use permit. SSFL is zoned rural agriculture (RA-5 ac), and the NBZ is zoned open space (OS-16) in the *Ventura County Non-Coastal Zoning Ordinance, Division 8, Chapter 1 of the Ventura County Ordinance Code* (Ventura County 2015b). SSFL is not included as part of any specific or area plan. Land uses along the proposed project-related truck routes include a variety of land uses and zoning classifications, as defined by both Ventura and Los Angeles Counties, and must comply with several regulations outlined by specific and area plans. See Chapter 3, Section 3.1.1, of this environmental impact statement (EIS) for additional detail.

Methods Used to Analyze and Quantify Impacts

The land use analysis considers how proposed activities could conflict with any applicable land use plan, policy, or regulation of Ventura and Los Angeles Counties, including general plans, any applicable specific or area plans, and zoning ordinances. Land uses surrounding Area IV were evaluated to determine whether the proposed activities would physically divide or alter an existing community.

B.1.3.2 Recreation

Affected Environment

Chapter 3, Section 3.1, of this EIS also describes current recreation conditions at Area IV and its surroundings. As stated in that section, no recreation resources exist at SSFL; however, several recreation resources surround SSFL.

Methods Used to Analyze and Quantify Impacts

To analyze impacts on recreation, existing recreation resources in the affected area were identified based on information provided in Ventura County's website, general plan, state and regional park district plans and personal communications, and previously prepared environmental documents for the project area, including the National Aeronautics and Space Administration's (NASA) *Final Environmental Impact Statement for Proposed Demolition and Environmental Cleanup Activities at Santa Susana Field Laboratory (SSFL Cleanup EIS)* (NASA 2014). This inventory was used to determine whether the proposed activities would increase use/demand of existing neighborhood and/or regional parks or other recreational facilities or affect access to or the quality of these recreational facilities. This analysis included consideration of truck round trips, as analyzed in detail in Chapter 4, Section 4.8, and their potential effect on neighboring recreation facilities.

B.1.3.3 Infrastructure

Affected Environment

Chapter 3, Section 3.1, Land Resources, describes current infrastructure at SSFL. As stated in Section 3.1, most buildings and utilities on site have been decommissioned and demolished or are planned for demolition under the proposed activities.

Methods Used to Analyze and Quantify Impacts

To analyze the impacts on infrastructure, existing building and public utilities in the area of analysis were identified based on information provided by Ventura County's website, general plan, regional and national utility databases, personal communications, and previously prepared environmental documents for the project area, including the NASA *SSFL Cleanup EIS* (NASA 2014). This inventory was used to determine whether the proposed activities would disrupt or reroute an existing utility facility.

Additionally, information on the Calleguas Municipal Water District's current and projected water supply was considered to determine whether the water requirements for onsite dust suppression related to the proposed activities would increase demand on a utility, thereby resulting in expansion of an existing facility and consequent potential secondary environmental impacts.

B.1.3.4 Aesthetics and Visual Quality

Affected Environment

The existing visual setting for Area IV, including the NBZ, is described in Chapter 3, Section 3.1. As stated in that section, SSFL is situated in a canyon within the Simi Hills, primarily unseen from the public eye, with views of distant vistas and natural outcroppings.

Methods Used to Analyze and Quantify Impacts

Visual resources analysis tends to be subjective and generally expressed qualitatively. This analysis attempts to quantify the visual change from the proposed activities using two components, sensitivity level analysis and visual resource assessment, as outlined in Lawrence Headley's "The Visual Modification Class Approach to Preparing NEPA [National Environmental Policy Act] and CEQA [California Environmental Quality Act] Compliance Visual Impact Assessments" (Headley 2010).

Sensitivity level analysis entails identifying the primary viewer groups (e.g., residents, recreationists) and classifying each group according to its expected sensitivity to changes in visual conditions. Sensitivity is ranked as high, moderate, low, or "no sensitivity." The public sensitivity level for this analysis included only "no sensitivity," as summarized below.

- No sensitivity – Potentially affected views are not accessible to the general public, or there are no indications that the affected views are valued by the public (Headley 2010).

The visual resource assessment entails identifying views potentially affected; describing the existing visual conditions (character and quality) of the potentially affected views; estimating the intensity of the adverse impact; and evaluating the significance of the impact. Prior to initiating visual resource assessment of the area of analysis, a preliminary review of the area was completed to identify similarities in visual resources. The review focused on broad classifications of landscape character. Based on the results of the preliminary review, landscape character types were assigned. These landscape character types were determined by the land use in the foreground distance zone, that is, the zone from 0.5 to 3 miles. The landscape character type for Area IV, including the NBZ, is urban-industrial and is described below.

- Urban-industrial – The urban-industrial character type refers to those areas consisting of or bordered by urban and industrial land uses within the foreground distance zone.

Representative viewing points for Area IV were then identified to represent common views experienced by sensitive viewers in the landscape character type. Selection of the viewing points was based on views to and from Area IV, where a noticeable contrast between the before and after condition would be noticeable. Each viewing point was selected in part to represent a class of views common across the area. Visual resources were quantified at each viewing point using the Bureau of Land Management's visual assessment procedures (BLM 1984) and the visual modification class approach. This approach provided the framework to record broad qualities of the landscape, such as landscape type, character, and analysis factors, as well as information on visual access or the physical conditions under which a view is experienced. Visual access overlaps to some extent with visual sensitivity because it describes viewing conditions such as viewer angle, duration, and distance of the viewer to the focal view. The types of data collected at each viewing point are described below.

- Landscape type – Types of landscapes include panoramic, enclosed, feature, focal, and canopied. The specific landscape type may influence the capacity of the landscape to absorb changes without a reduction in visual quality.
- Landscape character – The character of the landscape is the overall impression created by its unique combination of visual features, including land, vegetation, water, and structures. Landscape character was determined by assessing the basic character elements of form, line, color, and texture of landforms, vegetation, and structures.
- Landscape analysis factors – Landscape analysis factors include contrast, sequence, axis, convergence, co-dominance, enframement, and scale.
- Viewer duration – Viewer duration refers to the amount of time the view is seen. Residents experience prolonged views, whereas roadway travelers experience transient views.
- Viewer angle of observation – The angle of observation refers to the primary angle at which a view is observed. For example, residents may experience views directly in front of them or at a 180-degree arc. Roadway travelers may experience views at a 90-degree angle.
- Distance zones – Distance zones refer to the distance of the viewer from the target view and are classified as immediate foreground (less than 0.5 miles), foreground (0.5 to 3 miles), middle ground (3 to 5 miles), and background (5 to 15 miles).

Visual resources (landforms, vegetation, and structures) at each viewing point are also described below in terms of the basic elements of form, line, color, and texture and were assigned to a visual modification class, based on the overall congruence and coherence of the proposed project area and associated space. Congruence is defined as the degree to which past actions have changed landscape features noticeably and unfavorably or have introduced incompatible features, such that the results appear incongruent with the inherent character of the area. Coherence is defined as the degree of the current internal consistency and harmony of the landscape features that may have been affected by past actions. For example, a landscape may be "intact" relative to the type of features within view, yet past actions may have resulted in little to no discernible pattern, composition, or harmony associated with those features (Headley 2010). Congruence and coherence were scored as follows: (1) not noticeable; (2) noticeable, but subordinate; (3) co-dominant; or (4) dominant. Based on the assessment, each viewing point was assigned to a visual modification class, based on the following criteria:

- Visual modification class 1 – Not Noticeable: Landscapes are of the highest quality. All noticeable features in view appear congruent and are coherently arrayed. Any adverse changes of landscape features in the past would not be noticed unless pointed out.
- Visual modification class 2 – Noticeable, Visually Subordinate: Adverse changes in landscape features that have occurred in the past attract some attention, but do not compete for attention with other features in the field of view.
- Visual modification class 3 – Distracting, Visually Co-Dominant: Adverse changes in landscape features that have occurred in the past appear incongruous or incoherently arrayed, such that they are distracting and compete for attention with other features in view.
- Visual modification class 4 – Visually Dominant, Demands Attention: Landscapes are of the lowest quality. Adverse changes in landscape features that have occurred in the past appear incongruous or incoherently arrayed, such that they are the focus of attention.

The proposed activities were also analyzed to determine whether there would be any increase in light or glare that could affect sensitive receptors near Area IV.

B.1.4 Evaluation of Impacts

Land Resources, Infrastructure, Recreation

Potential land resources impacts were assessed in this EIS by comparing projected changes in land use, recreation, infrastructure, and aesthetic and visual quality generated from the proposed activities to existing conditions. Impact thresholds used to evaluate impacts depend on the degree of change or impact in conjunction with the context (e.g., the comparative size of the affected area) or the assigned or relative value of the altered resource. For the purposes of this EIS, an impact threshold for the land resources area was considered to be whether a change in land use resources would cause or exceed any of the above impact drivers listed in Section B.1.2.

Visual Resources

Evaluation techniques for determining when adverse change to a public view point's aesthetics and visual quality would occur were described in Headley 2010 and are listed below. An adverse change would occur under the following conditions:

- Features are altered, introduced, made less visible, or are removed, such that the resultant effect on public views is perceptibly incongruous with the inherent, established character of the landscape (current visual modification class).
- Access to public views is diminished or eliminated by screening or blocking the affected view, and/or physical access to public viewing positions is restricted or eliminated.

These two indicators of an adverse change have been applied in this EIS to identify potential changes in visual modification class ratings as a metric to characterize potential impacts on aesthetics and visual quality.

Headley 2010 outlined an approach for measuring the visual impact of an action by evaluating the reduction in the visual modification class rating that the action would cause at viewing points in the project area. Under this approach, the potential reduction of visual modification class ratings would then be considered against the public's sensitivity to adverse scenic/visual quality changes at each viewing point. This comparison of magnitude and public sensitivity to adverse change could then be used to determine the intensity of each effect. **Table B–1** below outlines the approach used in this EIS to determine the potential intensity of changes to the three viewing points identified in Area IV. Instances where implementation of the proposed activities or the No Action Alternatives would be expected to generate a beneficial effect by resulting in changes like opened sightlines that improve access to an expansive view were noted in the Chapter 4 impacts analysis.

Table B–1 Impact Intensity[a] and Public Sensitivity as a Measure of Intensity

Impact Magnitude [b]	*Public Sensitivity* [c]			
	High	*Moderate*	*Low*	*None*
None	N	N	N	N
Level 1	SA	A	A	A
Level 2	SA	SA	A	A
Level 3	SA	SA	SA	A

[a] **Intensity:**

SA = Significant Adverse, if the effect persists for an appreciable duration, generally 1 year or more. In some cases, the temporal viewing context may indicate that impacts lasting less than 1 year may represent a substantial (significant) impact.
A = Adverse, but not significantly adverse, regardless of duration.
N = No Effect.

[b] **Magnitude of Impact:**

None = No reduction in visual condition.
Level 1 = A reduction in visual condition by one visual modification class rating.
Level 2 = A reduction in visual condition by two visual modification class ratings.
Level 3 = A reduction in visual condition by three visual modification class ratings.

[c] **Public Sensitivity:**

High = The potential for public concern over adverse changes in scenic/visual quality is great. Affected views are rare, unique, or in other ways special and highly valued in the region or locale. Even the smallest perceptible change in visual conditions (Impact Magnitude Level 1 [see above]) would be considered a substantial (significant) lessening of visual quality.

Moderate = The potential for public concern over adverse changes in scenic/visual quality is appreciable. Affected views are secondary in importance or similar to views commonly found in the region or locale. A moderately to highly intense visual impact (Impact Magnitude Levels 2 or 3) would be perceived as a significant lessening of visual quality.

Low = Generally, there may be some indication that a small minority of the public has a concern over scenic and visual resource impacts on the affected area. Only the greatest intensity of adverse change in the condition of aesthetics and visual resources (Impact Magnitude Level 3) would have the potential to register with the public as a substantial reduction in visual quality.

No Sensitivity (None) = The views are not public, or there are no indications of public concern over or interest in scenic/visual resource impacts on the affected area.

B.2 Geology and Soils

B.2.1 Description of Resource and Region of Influence

Geological resources include the unconsolidated alluvium and weathered and unweathered bedrock material, such as mineral resources (aggregate, petroleum, and ores). Geologic conditions include indicators of potential hazards (faults, sinkholes, landslides, and unstable soils). Soil includes loose surface materials composed of mineral particles and organic material. Soil provides numerous functions, such as serving as habitat for soil organisms (including microorganisms) and providing a substrate for plants to grow, storage and cycling of nutrients, and filtration of pollutants. The uppermost soil layers contain organic matter; seed bank; regenerative structures such as bulbs, corms, and root crowns; and beneficial soil organisms, including mycorrhizae.

The ROI for geological and soil resources is the area within the boundaries of Area IV and the NBZ.

B.2.2 Description of Impact Drivers

The proposed activities could cause potential impacts to geologic resources, as follows:

- loosening of soil during excavation could increase the loss of uncontaminated soils via surface runoff and wind;
- removal and disturbance (loosening) of soil on steep slopes could increase the risk of landslides, including landslides generated during seismic events;
- removal of the uppermost soil layers could impact the ability of the soil to regenerate native plant and support biota, including wildlife;
- removal of Santa Susana Formation could impact paleontological resources; and
- removal of soil and rock could deplete mineral resources (aggregate).

B.2.3 Impact Assessment Protocol

B.2.3.1 Affected Environment

The description of the affected geology and soils found in Chapter 3, Section 3.2, of this EIS was compiled from several published and unpublished resources. The following data were used to describe the affected geologic and soil environment and the corresponding resources:

- The lithology and structure of the bedrock formations (MWH 2009)
- The type, percent of area, and location of soils (USDA 2003)
- The potential for aggregate resources in Area IV (CDMG 1981)
- Information on the petroleum resources in the vicinity of the site (California Department of Conservation 1992)
- Information on the potential for active faults and seismically induced hazards in the site vicinity (California Department of Conservation 1998, 2007)

The distribution and area of site-related radionuclides and chemicals requiring cleanup were derived using a geographical information system.

B.2.3.2 Methods Used to Analyze and Quantify Impact

For the soil remediation alternatives (including the No Action Alternative), the following factors were used to evaluate impacts on geological resources and soils:

- The primary potential mineral resource in Area IV is stone or gravel for aggregate. According to CDMG 1981, there is insufficient information to determine the significance of mineral lands in Area IV; however, as classified, Area IV is a potential *alternative* resource for aggregate.
- Paleontological resources have been identified in the Santa Susana Formation. This formation has a high paleontological sensitivity rating because the local and regional sediments in this formation are known to contain significant fossils.
- No fossil fuel resources have been identified within Area IV (California Department of Conservation 1992).

- The main factor contributing to soil erosion would be the loosening of existing soil structure, including loss of organic matter and vegetation during excavation. Backfilled material would also be loose and without an established root structure to provide some mitigation of erosion until a root system is established. Therefore, the land area disturbed by removal of soils (acreage) would be a semi-quantitative indicator of the relative potential loss of soils due to erosion. Other factors, such as slope and soil composition, would also contribute to the extent of erosion.
- Impacts on soils that support plants and wildlife are addressed in Chapter 4, Section 4.5, of this EIS. The methodology for that evaluation is found in Section B.5 of this appendix.
- Best management practices (BMPs) would be implemented to reduce soil erosion during the proposed remediation activities.
- BMPs would be implemented to reduce the risk to human health from seismically induced landslides or an increased risk of landslides due to destabilization of geological material.
- Backfilling of excavated areas would occur in a relatively short period after excavation so that areas of newly exposed soil would not be open for more than a few weeks.

For the building demolition alternatives (including the No Action Alternative), the following factors were used to evaluate impacts on geological resources and soils:

- All of the buildings that would be demolished are located on the Chatsworth Formation; paleontological resources have not been identified in this formation.
- It was assumed that the equipment for building demolition would be staged on existing concrete or asphalt areas or on previously disturbed soil.
- The soil on which the buildings were constructed was assumed to be disturbed already; therefore, no additional soil would be disturbed by their demolition.
- Nearly all of the 11 buildings, other than sheds, are adjacent to soil that could be removed under one or more of the soil remediation action alternatives (see Chapter 4, Section 4.2.2); therefore, the soil disturbed during building demolition could also be disturbed without building demolition.

For the groundwater remediation alternatives (including the No Action Alternative), the following factors were used to evaluate impacts on geological resources and soil:

- Access roads to treatment facilities and existing and new monitoring wells would already be in place.
- There would be no soil disturbance from the installation of groundwater treatment systems. Treatment systems would be constructed primarily on existing concrete pads and asphalted ground. Any required piping (for groundwater or pressurized air) would be above ground.
- There would be no high-pressure injection of treated groundwater or groundwater amendments.
- The sandstone that would be removed as part of the strontium-90 source removal, part of the Chatsworth Formation, is not likely to be a source of aggregate material. Area IV and the NBZ are located in the California Division of Mines and Geology Simi Production-Consumption Region. In the Simi Production-Consumption Region, aggregate is produced from the Simi Conglomerate member of the Santa Susana Formation and Saugus-San Pedro

Formation (CDMG 1981). In addition, the amount of material that would be removed is inconsequential when compared to the volume of aggregate used in Ventura County.

- The soil immediately above the strontium-90-impacted sandstone would be removed, stockpiled, and replaced as backfill after the contaminated sandstone is removed.

Impacts on mineral resources (aggregate and petroleum) were evaluated by reviewing California Department of Conservation reports and maps of mineral resources in Ventura County to identify potential resources. The only identified potential resource in Area IV and the NBZ is aggregate (CDMG 1981). However, Area IV, the NBZ, and much of the surrounding area were mapped as a potential alternative source of aggregate reserves because there was insufficient information to determine the significance of the mineral resources. Professional judgment was used to evaluate the likelihood that those members of the Chatsworth Formation present in Area IV and the NBZ would be a viable source of aggregate.

The relative potential loss of soil due to erosion was estimated based on the aerial extent of disturbed land. The extent of soil impacted by concentrations of radionuclides or chemicals above Look-Up Table (LUT) values was determined by the U.S. Department of Energy (DOE) (see Appendix D). The areas of soils that would be disturbed during removal of chemically and radiologically impacted soils under the soil remediation action alternatives are discussed in Chapter 2.

Published seismic hazard maps were consulted to determine the presence of active faults and seismically induced landslide potential in Area IV and the NBZ. In addition, the Calabasas Quadrangle Seismic Hazard Zones map (California Department of Conservation 1998) was compared to the areas that would be excavated under the soil remediation action alternatives to identify areas where loosening of soil could exacerbate landslide hazards. Similarly, a study of the seismic landslide susceptibility of the geologic units found in Area IV was reviewed (Parise and Jibson 2000). The study was performed in the Santa Susana 7.5-minute quadrangle (located north of the site), an area with the same geologic units found in Area IV (the Chatsworth Formation and alluvium).

B.2.4 Evaluation of Impacts

Implementation of the soil remediation alternatives would be considered to have an appreciable impact if it results in:

- accelerated erosion from wind or water that could not be mitigated through BMPs;
- an increased geologic hazard to another property or an increased risk to worker safety that cannot be mitigated through BMPs; or
- loss of or loss of access to a known mineral resource.

B.3 Surface Water Resources

B.3.1 Description of Resource and Region of Influence

Water resources are surface water and groundwater suitable for human consumption, aquatic or wildlife propagation, agricultural purposes, irrigation, or industrial/commercial purposes. The analysis of potential impacts on surface water investigated potential changes in surface water quality in an ROI, defined as onsite and adjacent surface-water systems that could be affected by effluent discharges, accidental releases (spills), or stormwater runoff associated with the proposed SSFL cleanup alternatives.

B.3.2 Description of Impact Drivers

Potential impact drivers associated with the proposed activities are discussed below.

Remediation impacts on water bodies in the ROI

Onsite SSFL cleanup-related remediation activities include disturbance of soil, excavation and removal of soil and rock, removal of buildings and other structures, and remediation of groundwater. Rehabilitation of the site would include backfilling with soil in excavated areas and revegetation following completion of demolition and excavation activities. These activities could potentially introduce chemical materials and sediments into surface water and runoff, which may impair water quality relative to standards established by Federal and/or state regulations, existing permits, and stormwater pollution prevention plans. Disturbance of these soils also could potentially increase stormwater runoff volumes and constituent concentrations in stormwater runoff from the site.

Long-term runoff quality impacts

Following implementation of the action alternatives, changes to runoff water quality in the ROI could result from changes to impervious surface density on site and changes to water quality constituent levels in the runoff (as described above).

Flood control capacity during remediation

Proposed SSFL cleanup-related remediation activities include disturbance of soil and temporary removal of vegetation. This could potentially increase surface water runoff volume and velocity, thereby potentially impacting drainage and flood control structure capacity in the ROI.

Long-term flood control capacity

Following implementation of the action alternatives, changes to runoff volume and velocity in the ROI could result from changes to impervious surface density on site.

B.3.3 Impact Assessment Protocol

B.3.3.1 Affected Environment

The affected environment provides information on surface water quality, existing water quality control structures, historic flood occurrence frequency and severity, and flood control structures within the ROI. Data was collected from Boeing, the Los Angeles Regional Water Quality Control Board, the State Water Resources Control Board, and the U.S. Environmental Protection Agency (EPA).

B.3.3.2 Methods Used to Analyze and Quantify Impacts

Remediation site impacts on water bodies in the ROI

The analysis of remediation effects was both quantitative and qualitative. The quantitative analysis used estimates of the total acreage of land disturbed during remediation in the ROI as a proportion of the total SSFL project area to indicate the potential size of impacts on water quality constituent concentrations in runoff from the site. The qualitative analysis anticipated changes in water quality constituent concentrations in runoff from the site, based on the available data on soil contamination in the project area.

Long-term runoff quality impacts

The analysis of long-term effects was both quantitative and qualitative. The quantitative analysis used estimates of the total acreage of land in the ROI that will be converted from currently impervious surface to revegetated pervious land as a proportion of the total SSFL project area to indicate the potential size of impacts on water quality constituent concentrations in runoff from the site. The qualitative analysis anticipated changes in water quality constituent and changes in concentrations already present in runoff from the site, based on the potential for reductions in total runoff volume from the site.

Flood control capacity during remediation

The analysis of remediation effects on flood control capacity was both quantitative and qualitative. The quantitative analysis used estimates of the total acreage of land in the ROI that will be disturbed during remediation as a proportion of the total SSFL project area to indicate the potential scale of changes to runoff volume and velocity from the site. The qualitative analysis anticipated changes in flood control capacity and performance in the ROI, based on the changes to runoff volume and velocity.

Long-term flood control capacity

The analysis of long-term effects on flood control capacity was both quantitative and qualitative. The quantitative analysis used estimates of the total acreage of land in the ROI that would be converted from currently impervious surfaces to revegetated, pervious land as a proportion of the total SSFL project area to indicate the potential size of impacts on runoff from the site. The qualitative analysis evaluated the potential reduction in the severity of the short-term changes in runoff volume and velocity resulting from an increase in permeable surfaces and implementation of BMPs and mitigation measures.

B.3.4 Evaluation of Impacts

Surface water impacts were assessed in this EIS by comparing the projected changes in surface water runoff quality, quantity, and velocity generated by the proposed activities to existing conditions. For the purposes of this EIS, potential impacts were compared to impact thresholds to evaluate the impact severities of the proposed activities and to identify any need for mitigation actions to reduce the severities of these impacts. The impact thresholds utilized in this analysis were:

- a discharge of water to surface water bodies in the ROI that exceeds water quality thresholds established in the State General Permit for stormwater discharges associated with construction activities; and
- an increase in runoff volume and velocity from the project area that adversely impacts or overwhelms a flood control structure in the ROI.

B.4 Groundwater Resources

B.4.1 Description of Resource and Region of Influence

Groundwater provides for the needs of vegetation and wildlife habitat and recharge of groundwater resources in the downgradient groundwater basin (the Simi Valley Regional Basin). The ROI for groundwater resources includes Area IV, the NBZ, and offsite areas to the north of the NBZ, where the groundwater discharges through seeps and springs (see Chapter 3, Figure 3–17, of this EIS).

B.4.2 Description of Impact Drivers

Due to the nature of the soil remediation, building demolition, and groundwater remediation alternatives and the ability of the groundwater to naturally recharge, regardless of the implementation of alternatives, the impacts from the proposed activities will be temporary.

- Within the temporary time frame, the proposed activities would cause the following potential impacts: Withdrawal of groundwater for *ex situ* treatment would result in less water available to recharge the adjacent groundwater basins. Removal of chemicals present at concentrations exceeding LUT values would improve the quality of the groundwater remaining in the aquifer.
- Injection of treated groundwater would replace water removed from the aquifer, negating the loss of water that was withdrawn for treatment.
- Extraction of vapor from the vadose zone would remove volatile organic compounds (VOCs) from soil, thereby decreasing the available source of the VOCs.
- Use of treated groundwater for implementation of various soil remediation, building demolition, and groundwater remediation alternatives would decrease the amount of water from other sources that would be required to implement the alternatives.
- Use of local water sources for onsite remediation technologies may compromise the capacity and/or availability of the local water supply to meet current or future needs.
- Groundwater treatment facilities would be susceptible to damage from seismic ground shaking.

B.4.3 Impact Assessment Protocol

B.4.3.1 Affected Environment

The groundwater and aquifer characteristics needed to assess the impacts of implementing the proposed activities include the use of the groundwater, a description of the occurrence within the aquifer, and those aspects of the aquifer that define how groundwater is recharged, flows underground, and discharges from the ground. The use of groundwater in Ventura County is defined in the *Water Quality Control Plan Los Angeles Region, Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties (Water Quality Control Plan)* (CRWQCB 1994).

In order to assess the potential impacts of the proposed activities on groundwater, it is important to know the aquifer and groundwater characteristics, including how the aquifers are recharged, how groundwater flows through the aquifer, and the quality of the groundwater. Aquifer characteristics within SSFL have been studied and documented in MWH 2009. This study was performed under the 2007 *Consent Order for Corrective Action* (DTSC 2007) and in accordance with California Department of Toxic Substances Control (DTSC)–approved work plans, including the quality assurance project plan. The information in this plan was used to describe the aquifer characteristics (groundwater). However, much of the information in the MWH 2009 report is based on data collected in other areas within SSFL. Therefore, more Area IV-specific data from Resource Conservation and Recovery Act (RCRA) Facility Investigations (RFIs) conducted in Area IV were used in conjunction with MWH 2009. The RFIs were conducted in accordance with DTSC-approved plans and the resulting reports were submitted to DTSC for review. Groundwater quality data are based on data collected over several years and reported in quarterly and yearly reports. Groundwater quality data collected in 2014 and 2015 formed the basis for the definition of trichloroethylene and other solvent plumes, as well as the tritium plume and strontium-90 source, in groundwater.

B.4.3.2 Methods Used to Analyze and Quantify Impacts

Assumptions

The analysis assumed the following:

- Remediation technologies and dust suppression would use water from offsite sources.
- DTSC and the Los Angeles Regional Water Quality Control Board would allow treated water to be re-injected into the aquifers or used for dust suppression and other remediation purposes.

Effects on local public water supply systems and sources are evaluated in the Chapter 4, Section 4.1, of this EIS.

Methodology

The impacts of the groundwater treatment action alternatives on groundwater resources are related to the availability of the groundwater to fulfill the potential beneficial uses designated in the *Water Quality Control Plan* (CRWQCB 1994). Areas, such as Area IV, that do not fall within a defined groundwater basin provide recharge to adjacent basins; therefore, the default beneficial use is that of the adjacent basins. Area IV is primarily located in the recharge area for the Simi Valley groundwater basin. To a much lesser degree, Area IV groundwater recharges the San Fernando Valley basin through Bell Canyon and Bell Creek. Designated beneficial uses for both of these adjacent basins include municipal and domestic water supply, agricultural supply, industrial process supply, and industrial service supply, as defined by the *Water Quality Control Plan* (CRWQCB 1994).

Treatment technologies and alternatives, including pump and treat, chemically enhanced contaminant destruction, soil vapor extraction, natural attenuation, source isolation, and physical source removal, were evaluated to determine whether the groundwater treatment action alternatives would be able to improve groundwater quality. This evaluation was done by determining whether the technology was a proven technology that is commonly used in the groundwater industry in similar geologic and hydrogeologic settings. This information is easily accessible from multiple sources, including textbooks, periodicals, and professional experience. In some cases, site-specific data were required to determine whether the technology would work in conditions specific to those at Area IV. In those cases, the uncertainty and the need for a site-specific treatability study was identified.

The ability of bedrock removal to reduce strontium-90 concentrations in groundwater is based on a conceptual site model and an analysis of concentrations in groundwater versus the groundwater level (CDM Smith 2015). The uncertainty resulting from the unknown depth of strontium-90 in the bedrock could potentially limit the effectiveness of this technology for groundwater treatment.

The impact on the water available to recharge the Simi Valley groundwater basin was evaluated relative to the overall amount of water recharged to the basin from all sources. The sources of recharge to the basin, as well as other pertinent information about the Simi Valley groundwater basin used for this comparison, are listed in *California Groundwater Bulletin 118-Update 2003* (CDWR 2003).

None of the treatment options has been designed; therefore, the following assumptions were made in this EIS concerning the length of time that each treatment technology would be implemented:

- A pump and treat system would have to operate for approximately 5 years to reduce the extractable mass of contaminants from groundwater. Monitoring would follow pump and treat until the cleanup levels are met.
- A soil vapor extraction system would have to operate for approximately 5 years to reduce the threat of VOCs in the soil above the aquifer migrating into the aquifer.
- Monitored natural attenuation would require 25 years of monitoring until constituent concentrations were demonstrated to be below their respective cleanup levels. The amount of time that it would take for the tritium plume to decrease through radioactive decay to concentrations below cleanup levels was estimated from the historic concentrations of tritium and the half-life for tritium (12.3 years). This natural radioactive decay is short enough for natural attenuation to be effective in reducing tritium relatively quickly. It was estimated that the tritium plume concentrations would be below cleanup values in approximately 10 years (CDM Smith 2015).

The amount of water that would be withdrawn from the aquifers during dewatering of Building 4024 was based on the daily rate of water pumped from Building 4059 (2,200 gallons per day) (Groundwater Resources Consultants, Inc., 1999). Building 4024 is of similar size (the footprint of Building 4059 is about 80 percent the size of Building 4024), and both were used as test facilities for small reactors. It was assumed that a similar amount of time would be required to dewater Building 4024.

Some wastes would be generated by the groundwater treatment technologies. Monitored natural attenuation would require sampling of monitoring wells. For this EIS, it was assumed that five new 150-foot-deep monitoring wells would be installed. At a minimum, the wastes would be equal to the volume of unconsolidated materials and rock displaced by the well boreholes. An expansion factor of 30 percent was applied to the in-place volume of unconsolidated material, and an expansion factor of 80 percent was applied to the bored sandstone (The Engineering Toolbox 2015).

During the 2014 Area IV groundwater sampling event, about 250 gallons of purge water was generated. It was assumed that a similar amount would be generated for each sampling event during the monitored natural attenuation alternative.

Groundwater treatment systems were assumed to require granulated activated carbon filters to remove VOCs, as well as resins filters to remove perchlorate and metals. It was assumed for this EIS that spent filter medial would need to be replaced every month.

B.4.4 Evaluation of Impacts

The evaluative criteria applied in this EIS are similar to those developed in the *L.A. CEQA Thresholds Guide: Your Resource for Preparing CEQA Analyses in Los Angeles (L.A. CEQA Thresholds Guide)* (City of Los Angeles 2006). Noticeable impacts to groundwater occurrence, quality, or quantity could result if the proposed activities:

- reduced the ability of a water utility to use the groundwater basin for public water supply or other designated uses;
- reduced the yields of supply wells;
- created a permanent change in the rate or direction of groundwater flow; or
- resulted in a demonstrable and sustained reduction of groundwater recharge capacity.

Reduction of a water utility's ability to use groundwater could result from a decrease in either the quantity or the quality of the groundwater recharge. The quality of groundwater was determined by comparing concentrations of substances in the groundwater against Maximum Contaminant Levels (MCLs) established by EPA through the Primary National Drinking Water Regulations under the Safe Drinking Water Act. An alternative that increased the concentration of a parameter, particularly if the parameter concentration exceeded its MCL, would negatively impact groundwater quality. An alternative that decreased the concentrations of constituents, particularly if the concentration decreased to below the MCL, would positively impact groundwater quality.

B.5 Biological Resources

B.5.1 Description of Resource and Region of Influence

Biological resources include vegetation, wildlife, wetlands, aquatic habitats, and rare, threatened, endangered or sensitive species. The ROI encompasses Area IV and the NBZ, as well as adjacent areas in which biota could be affected by noise, dust, or sediment originating from the cleanup activities.

B.5.2 Description of Impact Drivers

The proposed activities could cause the following potential impacts:

- Short- and long-term effects from direct removal of vegetation and habitat, including:
  - mortality to individual plants (short-term); and
  - loss or degradation of habitat and consequent population reductions due to the reduced ability of remaining habitat to support vegetation and wildlife (long-term).
- Other effects of cleanup operations (e.g., noise, nighttime lighting, dust) that could reduce habitat suitability and cause wildlife avoidance of affected habitat.
- Potential effects on aquatic organisms caused by diminution of water quality, as well as possible sedimentation in offsite habitats resulting from remediation activities, especially in the NBZ outside of the constructed outfalls.

B.5.3 Impact Assessment Protocol

B.5.3.1 Affected Environment

Analysis of the biological resources' affected environment for this EIS included a comprehensive review of data, including a list of relevant studies, assessments, and field surveys undertaken for SSFL and Area IV. The affected environment is described in terms of the vegetation and plant communities and associated wildlife (mammals, fish, birds, and amphibians) present on the site and in surrounding areas; aquatic resources and wetlands; and threatened and endangered species (including rare plants and critical habitats).

B.5.3.2 Methods Used to Analyze and Quantify Impacts

Assumptions

Exemption areas are areas excepted from some of the provisions of the 2010 *Administrative Order on Consent for Remedial Action* (2010 AOC) (DTSC 2010) due to the presence of sensitive biological or cultural resources and certain other circumstances described more fully in Chapter 2, Section 2.3.2, of this EIS. Designation of biological exemption areas requires the approval of the U.S. Fish and

Wildlife Service and DTSC. The proposed biological exemption areas used in this analysis (see Chapter 4, Figure 4–6) included the following sensitive biological resources:

- Braunton's milk-vetch (*Astragalus brauntonii*) (Federal Endangered Species Act [ESA] – Endangered; California Rare Plant Rank [CRPR] 1B.1):
  - Occurrences outside critical habitat
  - Designated critical habitat
- Santa Susana tarplant (*Deinandra minthornii*) (California Endangered Species Act [CESA] – Rare; CRPR 1B.2)
- Malibu baccharis (*Baccharis malibuensis*) (CRPR 1B.1)
- Mariposa lily (*Calochortus clavatus* variety undetermined):
  - Club-haired mariposa (variety *clavatus*) (CRPR 4.3)
  - Slender mariposa lily (variety *gracilis*) (CRPR 1B.2)
- Plummer's mariposa lily (*Calochortus plummerae*) (CRPR 4.2)
- Catalina mariposa lily (*Calochortus catalinae*) (CRPR 4.2)
- California red-legged frog (*Rana draytonii*) (ESA Threatened; designated critical habitat)
- Southern California black walnut (*Juglans californica*) (CRPR 4.2)
- Golden eagle (*Aquila chrysaetos*) nest sites (Bald and Golden Eagle Protection Act; California fully protected species)
- Vernal pools, including vernal pools that form in depressions on sandstone outcrops and are referred to as vernal rock pools (potential habitat for federally listed fairy shrimp)

The species and resources listed above can be tied to specific portions of Area IV or the NBZ and thus can be protected by an exemption area. Other species, such as the California gnatcatcher, have not been documented from the site or cannot be tied to a particular location on the site and it is therefore not practical or feasible to protect them by establishing exemption areas.

The following assumptions were applied to the proposed exemption areas:

- Remediation within the proposed exemption areas would occur via focused removal actions so that impacts within the proposed exemption areas would be less severe and extensive and restoration would be more feasible than in areas remediated to LUT values.
- Proposed exemption areas would not be subjected to large-scale cleanup activities involving heavy equipment.
- Disturbance would be kept to the absolute minimum necessary to access the soil and remove it; for example, balloon-tired, all-terrain vehicles may be used to access the sites and remove the affected soil.

Methodology

The assessment of biological resources used a habitat-based analysis to quantify the amount of habitat that would be removed or severely affected by the remediation activities and to evaluate that effect in the context of the importance of the habitat in terms of species and function, its sensitivity, the ability to restore it (considering both effort and time required), and the amount of similar resources in the region. The analysis placed special focus on the following:

- Sensitive habitats in the project area, including Venturan coastal sage scrub; dipslope grassland; sandstone outcrops; unburned northern mixed chaparral; sandstone outcrops; northern mixed chaparral; California walnut woodland; Coast live oak woodland; savanna; vernal pools; wetlands; and riparian areas.
- Sensitive species, including: (1) species listed, proposed, or active candidates for protection under the ESA, California Native Plant Protection Act (CNPPA), and CESA; (2) CRPR list 1 B and list 4 species; (3) species on the Ventura County list of locally sensitive species; (4) bald and golden eagles protected under the Bald and Golden Eagle Protection Act; (5) California Fully Protected Species; and (6) California Species of Special Concern. For species not protected under ESA, CESA, or CNPPA, emphasis was placed on species known to occur on the site or within the immediate surroundings.
- Onsite designated critical habitat for Braunton's milk-vetch and the California red-legged frog, both protected under ESA.
- Nesting birds protected under the Migratory Bird Treaty Act during their breeding/nesting seasons.

B.5.4 Evaluation of Impacts

The impacts on biological resources were assessed relative to regulatory requirements (NEPA, ESA, Clean Water Act). Under Council on Environmental Quality (CEQ) regulations for NEPA (Title 40, *Code of Federal Regulations*, Part 1508, Section 1508.27 [40 CFR 1508.27]), the degree of an impact on a resource is based on the *intensity* of the impact (how severely the resource is affected) and its *context* (what proportion of the resource is affected); also included within the context is the importance of the resource, which is related to variables including the function, condition, and relative scarcity of the resource.

Additionally, regulatory thresholds may be taken into account. The following are examples of impacts that are addressed by regulatory thresholds and are considered in a NEPA analysis:

- Adverse modification of critical habitat;
- Substantial effects on a listed or otherwise sensitive plant or wildlife species; and
- Cut or fill effects on jurisdictional wetlands and waters sufficient to trigger regulatory mitigation requirements (e.g., habitat replacement ratios) in addition to *in situ* restoration.

With regard to the first and second items, for federally listed species, this would equate to a "may affect and likely to adversely affect" determination in a biological assessment under the ESA and would trigger formal Section 7 (ESA) Consultation with the U.S. Fish and Wildlife Service or National Marine Fisheries Service.

Quantification of impacts was done by intersecting proposed treatment areas under different alternatives with a vegetation/land cover map and by calculating affected acreages using the Geographical Information System. Affected acreages by habitat/land cover type for each alternative were compared to the total acreage of that type on site (including Area IV and the NBZ).

B.6 Air Quality and Climate

B.6.1 Description of Resource and Region of Influence

B.6.1.1 Air Quality

Air quality at a given location can be described by the concentrations of various air pollutants in the atmosphere. Air pollutants are defined as two general types: criteria pollutants and toxic compounds. Criteria pollutants must meet national and/or state ambient air quality standards. EPA establishes the National Ambient Air Quality Standards (NAAQS), while the California Air Resources Board establishes the California Ambient Air Quality Standards (CAAQS). The NAAQS represent maximum acceptable concentrations that generally may not be exceeded more than once per year; the annual standards may never be exceeded. The CAAQS represent state maximum acceptable pollutant concentrations that are not to be equaled or exceeded. The national and state ambient air quality standards are shown in Chapter 3, Table 3–9, of this EIS.

Toxic compounds are toxic air contaminants (termed hazardous air pollutants by EPA) that pose some level of acute or chronic health risk (cancer or noncancer) to the general public. The atmospheric concentrations of both criteria pollutants and toxic compounds are expressed in units such as parts per million or micrograms per cubic meter.

Identifying the ROI for air quality requires knowledge of the pollutant type, source emission rates, proximity of emission sources associated with the proposed activities to other emission sources, and local and regional meteorology. Air emissions produced from the proposed onsite cleanup activities mainly would affect air quality within the immediate project area. The project site lies within the eastern portion of Ventura County, which is in the South Central Coast Air Basin. Due to the project site's proximity to Los Angeles County, emissions generated on site would also affect the western part of this county, which is in the South Coast Air Basin. Emissions generated from truck traffic associated with the hauling of materials from the project site to disposal sites would produce more-dispersed effects as the trucks travel on roadways through western Los Angeles County and portions of Central California, Nevada, Utah, and/or Idaho.

The ROI for inert pollutants (such as carbon monoxide and particulates in the form of dust) generally is limited to a few miles downwind from a source. The area of analysis for reactive pollutants such as ozone could extend much farther downwind than for inert pollutants. Ozone is formed in the atmosphere by photochemical reactions of previously emitted pollutants called precursors. Ozone precursors are mainly nitrogen oxides and photochemically reactive VOCs. In the presence of sunlight, the maximum effect of precursor emissions on ozone levels usually occurs several hours after they are emitted and many miles from their source.

B.6.1.2 Climate Change

It is well documented that the Earth's climate has fluctuated throughout its history. However, scientific evidence indicates a correlation between increasing global temperatures over the past century and the worldwide proliferation of greenhouse gas (GHG) emissions by mankind. Climate change associated with global warming is predicted to produce negative environmental, economic, and social consequences across the globe.

GHGs are gases that trap heat in the atmosphere by absorbing infrared radiation. GHG emissions occur from natural processes and human activities. Water vapor is the most important and abundant GHG in the atmosphere. However, human activities produce only a small amount of the total atmospheric water vapor. The most common GHGs emitted from natural processes and human activities include carbon dioxide, methane, and nitrous oxide. The main source of GHGs from human activities is the combustion of fossil fuels, such as crude oil and coal. Examples of GHGs created and emitted primarily through human activities include fluorinated gases (hydrofluorocarbons and perfluorocarbons) and sulfur hexafluoride.

Each GHG is assigned a global warming potential (GWP), which is the ability of a gas or aerosol to trap heat in the atmosphere. The GWP rating system is normalized to carbon dioxide, which has a value of one. For example, methane has a GWP of 28, which means that it has a global warming effect 28 times greater than carbon dioxide on an equal-mass basis (IPCC 2013). To simplify GHG analyses, total GHG emissions from a source are often expressed as a carbon dioxide equivalent; this value is calculated by multiplying the emissions of each GHG by its GWP and adding the results together to produce a single, combined emission rate representing all GHGs. While methane and nitrous oxide have much higher GWPs than carbon dioxide, the latter is emitted in such higher quantities that it is the overwhelming contributor to carbon dioxide equivalent from both natural processes and human activities.

The direct environmental effect of GHG emissions is an increase in global temperatures, which indirectly causes numerous environmental and social effects. Therefore, the ROI for proposed GHG emissions is global. The cumulative global impacts would manifest as impacts on resources and ecosystems in California.

B.6.2 Description of Impact Drivers

The proposed activities could cause potential impacts such as combustion emissions (from the use of diesel-powered, off-road construction equipment and on-road trucks and worker commuter vehicles) and fugitive dust emissions (from equipment and vehicles traveling on unpaved surfaces and performing grading and earthmoving activities).

B.6.3 Impact Assessment Methodology

B.6.3.1 Affected Environment

Air Quality

The main pollutants of concern considered in this air quality analysis include VOCs, ozone, carbon monoxide, nitrogen oxides, particulate matter less than 10 microns in diameter (PM_{10}), and particulate matter less than 2.5 microns in diameter ($PM_{2.5}$). Although ambient standards have not been established for VOCs or nitrogen oxides (other than nitrogen dioxide), these pollutants are important precursors to ozone formation.

Climate Change

The description of the affected environment for climate change (see Chapter 3, Section 3.6.2) draws from numerous studies that document the recent trend of rising atmospheric concentrations of carbon dioxide. The longest continuous record of carbon dioxide monitoring extends back to 1958 (Keeling 1960; Scripps 2014). These data show that atmospheric carbon dioxide levels have risen an average of 1.5 parts per million per year over the last 56 years (NOAA 2014). As of 2014, carbon dioxide levels are about 30 percent higher than the highest levels estimated for the 800,000 years preceding the industrial revolution, as determined from carbon dioxide concentrations analyzed from air bubbles in Antarctic ice core samples (USGCRP 2014).

Recent observed changes due to global warming include rising temperatures, shrinking glaciers and sea ice, sea level rise, thawing permafrost, a lengthened growing season, and shifts in plant and animal ranges. International, national, and state organizations independently confirm these findings (California Energy Commission 2012; IPCC 2013; USGCRP 2014).

The most recent assessment of climate change impacts in California, which was conducted by the State of California, predicts that temperatures in California will increase between 4.1 and 8.6 degrees Fahrenheit by 2100, based on both low and high global GHG emission scenarios (California Energy Commission 2012). Predictions of long-term negative environmental impacts due to global warming include sea level rise; changing weather patterns with increases in the severity of storms and droughts; changes to local and regional ecosystems, including the potential loss of species; and a substantial reduction in winter snowpack. In California, predicted effects include exacerbation of air quality problems; a reduction in the municipal water supply from the Sierra snowpack; a rise in sea level that would displace coastal businesses and residences; an increase in wild fires; damage to marine and terrestrial ecosystems; and an increase in the incidence of infectious diseases, asthma, and other human health problems (California Energy Commission 2012).

B.6.3.2 Methods Used to Analyze Impacts

The following subsections summarize the methodology used to estimate the potential impacts of the proposed activities to air quality and climate change:

Air Emission Calculations

The analysis estimated daily and calendar year emissions for each type of proposed activity. Equipment and trucking usages and scheduling data needed to calculate daily and annual emissions for proposed activities were developed. The analysis based daily and annual criteria pollutant and/or GHG emissions on the following activity data:

- Horsepower-hours performed by off-road equipment.
- Onsite and offsite miles traveled by project material haul trucks. Several offsite facilities were evaluated for the recycle or disposal of materials or waste from SSFL. To present a range of impacts that could occur from transporting materials and waste by truck to offsite disposal facilities, emissions were determined for transport to both the nearest (nearby) and furthest (distant) facility evaluated for each type of material or waste. As an example, it was assumed that hazardous waste would be trucked to either the Buttonwillow Landfill in California (nearby round trip of 240 miles) or US Ecology in Idaho (distant round trip of 1,800 miles).
- For dust generation: (1) the aerial extent and durations of exposed soils disturbed by equipment and trucks, (2) travel of trucks on paved roads on site, (3) tons of demolished buildings and materials, (4) loading of soils and demolished materials into trucks, and (5) wind erosion on vacated disturbed ground and soil stockpiles.

The analysis obtained emission factors needed to estimate proposed emissions from the following sources:

- The California Air Resources Board OFFROAD2011 model for off-road equipment (Environ 2013).
- The California Air Resources Board EMFAC2014 emissions model for on-road trucks and worker commuter vehicles (ARB 2014).
- The EPA AP-42 document for dust generated by (1) vehicles on exposed soils, (2) loading soils and demolished materials into trucks, and (3) wind erosion (EPA 1995).
- The California Emission Estimator Model for dust generated by building demolition activities (Environ 2013).

The analysis took into consideration the use of measures to minimize the generation of fugitive dust and combustive emissions from proposed activities. For this EIS, potential emissions under each proposed alternative were estimated, and all sources of potential emissions that would be generated by the proposed activities over time were considered.

B.6.4 Evaluation of Impacts

Air Quality

In the case of criteria pollutants for which the project region is in attainment of a NAAQS, the analysis compared the increase in annual air pollutant emissions estimated for each proposed alternative to the EPA Prevention of Significant Deterioration threshold for new major sources of 250 tons per year of a pollutant; the result was used as an indicator of projected air quality impacts. In the case of criteria pollutants for which the project region is not in attainment of a NAAQS, the analysis compared the increase in proposed annual emissions to the applicable pollutant threshold that requires a conformity determination for that region. For example, for Ventura County, the analysis used the following annual thresholds: (1) 50 tons of VOC and nitrogen oxides; (2) 100 tons of PM_{10}; and (3) 250 tons of carbon monoxide, sulfur dioxide, and $PM_{2.5}$.

If proposed emissions exceeded a Prevention of Significant Deterioration or conformity threshold, further analysis was conducted to determine the degree of impacts. In such cases, if proposed emissions would not contribute to exceedance of an ambient air quality standard or would conform to the approved State Implementation Plan, then the impacts would not exceed regulatory thresholds of concern.

Conformity Applicability Analysis

The analysis compared annual conformity-related emissions to the applicable conformity *de minimis* thresholds. To perform an adequate conformity evaluation, the analysis identified the annual emissions that would occur within each nonattainment/maintenance area potentially affected by the proposed activities and for each calendar year of activity.

Climate Change

On August 1, 2016, CEQ released final guidance that describes how Federal departments and agencies should consider the effects of GHGs and climate change in their NEPA reviews (CEQ 2016). This guidance states that Federal agencies (1) should consider the extent to which a proposed action and its reasonable alternatives would contribute to climate change based on projected GHG emissions and (2) take into account ways in which a changing climate may impact the proposed action and any alternative actions, change an action's environmental effects over the lifetime of those effects, and alter the overall environmental implications of such actions. The guidance emphasizes that agency analyses should be commensurate with projected GHG emissions and climate impacts and should employ appropriate quantitative or qualitative analytical methods to ensure useful information is available to inform the public and the decision-making process in distinguishing between alternatives and mitigations. From these analyses, agencies should consider adaptation measures to address potential impacts of climate change on proposed actions, thereby enabling the selection of smarter, more resilient actions. The final guidance does not propose any quantity of GHG emissions that may significantly affect the quality of the human environment.

The analysis estimated GHG emissions generated from proposed activities for informational and comparative purposes among the alternatives. In addition, the analysis determined how future climate change would affect implementation of the proposed alternatives.

B.7 Noise

B.7.1 Description of Resource and Region of Influence

Noise is unwanted sound. Responses to noise vary widely according to the sensitivity and expectations of the receptor, as well as the characteristics of the sound source, the distance between the noise source and the receptors, and the time of day. For this EIS, potential changes in noise due to the proposed alternatives were quantified, and the effects of these changes on affected receptors (e.g., people) were evaluated. Impacts of noise on wildlife are discussed in Chapter 4, Section 4.5.2.

Noise ROIs include SSFL Area IV and the haul routes used to carry materials to and from Area IV. Because noise travels, areas adjacent to Area IV and the haul routes would also be affected.

B.7.2 Description of Impact Drivers

Components of the proposed activities that can cause potential impacts include demolition and remediation noise generated at SSFL Area IV and noise generated by trucks hauling materials to and from SSFL Area IV.

Potential disruption and annoyance among people adjacent to the site and haul routes are the primary impact of concern. Noise levels at locations outside SSFL Area IV would not be sufficiently high to generate hearing loss risk. On SSFL Area IV, workers would wear hearing protection as required in accordance with applicable regulations. Noise impacts would last for the duration of the project.

B.7.3 Impact Assessment Protocol

B.7.3.1 Affected Environment

Existing conditions have been assessed through measurement at several locations along the proposed haul routes (Urban Crossroads 2011). Noise levels in residential areas not directly adjacent to busy roads can be assumed to be similar to measured noise levels in other relatively quiet residential areas.

B.7.3.2 Methods Used to Analyze and Quantify Impacts

Noise levels were quantified using the models and methods described below. Noise intensities and durations under the proposed alternatives were assessed in the context of baseline noise levels to assess the impacts (see Chapter 3, Section 3.7, for a description of the noise metrics used in the analysis).

Noise levels generated by construction equipment in SSFL Area IV were calculated using the Federal Highway Administration (FHWA) Roadway Construction Noise Model (FHWA 2006). Levels were calculated at the closest point along the SSFL boundary, as well as at the closest noise-sensitive locations to the work site, which are residences. A scenario that is expected to slightly overestimate noise levels was assessed. Under this scenario, several pieces of construction equipment considered likely to be involved in the project were assumed to be operating in a single workday at the closest point within the Area IV demolition/excavation area to the SSFL boundary and residences. Impacts were quantified using the equivalent noise level as calculated for hours during the workday. An increase in time-averaged noise levels to above 65 decibels (dB) would exceed an established threshold for an affected population as described in the *L.A. CEQA Thresholds Guide* (City of Los Angeles 2006).

Traffic noise levels along the haul routes were assessed using algorithms replicating FHWA's *Highway Traffic Noise Prediction Model* (FHWA-RD-77-108). In accordance with California

Department of Transportation standard practice, reference noise levels from the California Vehicle Noise data set (CalTrans 1995) were used. To avoid underestimating noise impacts, a scenario was modeled under which all truck trips occurred on all potential haul routes. Noise levels were quantified at representative locations 100 feet from the haul route using the Community Noise Equivalent Level (CNEL). The *L.A. CEQA Thresholds Guide* (City of Los Angeles 2006) indicates that significant noise impacts can occur when the noise level is increased by 3 decibels A-weighted (dBA) CNEL, and the resulting noise level is above the "normally acceptable" 65 dBA CNEL threshold established for residential areas. According to the *L.A. CEQA Thresholds Guide*, significant noise impacts can also occur if a 5 dBA CNEL or greater noise increase were to occur in a noise-sensitive area. The most sensitive land use along the haul routes is residential.

B.7.4 Evaluation of Impacts

In 1974, EPA identified outdoor and indoor noise levels to protect public health and welfare with a margin of safety (EPA 1974). A long-term day-night average sound level (DNL) of 55 dB outdoors and a DNL of 45 dB indoors were identified as preventing activity interference or annoyance in residential areas. The noise levels stated in EPA 1974 are not regulatory, but are intended only as indications of instances where noise would be more likely perceived as problematic.

EPA established 75 dB for an 8-hour exposure and 70 dB for a 24-hour exposure as the average noise level standard requisite to protect 96 percent of the population from greater than a 5 dB permanent shift in hearing threshold (EPA 1978). This threshold noise level described by EPA is protective for a lifetime of exposure and is highly conservative.

Inputs received during scoping were taken into account during consideration of potential mitigation measures and BMPs. Measures considered included use of "quiet tires," use of hybrid internal combustion-electric-powered trucks, other adjustments to trucks used to haul materials to reduce noise (e.g., operation with well-maintained mufflers), and road maintenance to minimize potholes.

B.8 Transportation and Traffic

B.8.1 Description of Resource and Region of Influence

This resource topic addresses the potential impacts of the proposed cleanup activities on traffic and on the public along transportation routes. It includes impacts on the capacity and traffic flow of surface transportation systems serving the SSFL site, including local roadways used by personnel and contractors traveling to and from the site. The area of analysis for transportation includes roadways and rail lines that could be used to transport low-level radioactive waste (LLW), mixed low-level radioactive waste (MLLW), hazardous waste, and nonhazardous waste (including soil, asphalt, concrete, and building materials) to offsite disposal facilities, as well as delivery of materials (such as clean soil) to SSFL for restoration efforts. Information on the methodology is summarized below; see Appendix H, "Evaluation of Transportation and Traffic Impacts," for a detailed description of the methodology.

B.8.2 Description of Impact Drivers

The proposed activities could cause the following potential impacts:

- Transport of waste and other transport activities could increase risks of traffic accidents and of radiological exposure to people along the transportation routes.
- Haul truck and worker commuter trips to and from SSFL can affect the quality of traffic flow.
- Increased traffic on local roadways can degrade the pavement surface and condition of the roadway.

B.8.3 Impact Assessment Protocol

B.8.3.1 Affected Environment

The affected environment section includes data summarizing the roadway daily traffic volumes, as well as the traffic peak hour and directional distribution gathered from traffic records compiled by the City of Los Angeles. Roadway geometric characteristics were obtained from field inspection. Information regarding potential road-to-rail transfer locations was obtained by communications with freight rail operators in the region. Current roadway pavement condition data were obtained from field surveys conducted on local roadways.

B.8.3.2 Methods Used to Analyze and Quantify Impacts

Established methods of analysis, as described in Appendix H, were used to evaluate and quantify impacts. Risks from transportation of materials were quantified with respect to radiological risks associated with incident-free transportation, as well as traffic fatalities and radiological risks associated with accident conditions.

The impact of additional truck traffic on the roadway network was assessed by comparing the amount of increased traffic forecasted for a segment against the carrying capacity of that segment, as determined by procedures contained in the Transportation Research Board's *Highway Capacity Manual* (TRB 2010). The procedures combine traffic volume characteristics (including the vehicle types composing the traffic stream) with roadway geometric, terrain, and traffic control features to quantify the traffic carrying capacity of the highway segment and the quality of flow as measured by level of service (LOS).

Pavement deterioration impacts were determined using the procedures outlined in the American Association of Highway Transportation Officials' *Guide for Design of Pavement Structures* (AASHTO 1993). The added truck traffic was compared to current or baseline loadings and the percentage increase documented. Road-to-rail impacts were assessed by analyzing the impact of added truck traffic on the quality of flow on roadways serving potential intermodal facilities.

Analysis of the impacts on roadways serving offsite disposal facilities (outside the local ROI) was qualitative, based on a review of current roadway service volumes, roadway capacity, and settings (urban or rural). The impact analysis estimated the number of additional truck trips as a percentage increase over current traffic to provide relative context for the potential impact of additional trips.

B.8.4 Evaluation of Impacts

Transportation impacts were evaluated in terms of increased risk from transportation activities (radiological and traffic fatality risks). Traffic impacts were evaluated with respect to the quality of flow, characterized by factors such as travel speed and delay, freedom to maneuver, reliability, and comfort, as determined by transportation system elements called service measures. The *Highway Capacity Manual* (TRB 2010) defines six LOSs, ranging from A to F, for each service measure or multiple service measures for various roadway types (see Appendix H for a definition of the LOSs and an evaluation of the impacts of the alternatives). Analysis of pavement deterioration impacts was based on estimating the number of additional trucks, and therefore equivalent single axle loads (ESALs), associated with material shipments over the roadway network. Baseline ESAL loadings were developed for each roadway. ESAL increases associated with project trucks were then developed and compared to baseline loadings. Potential impacts at intermodal facilities and offsite disposal facilities were evaluated as the quality of flow on the roads near these facilities, based on the percentage increase in traffic resulting from SSFL remediation activities.

B.9 Human Health

B.9.1 Description of Resource and Region of Influence

Public and occupational health and safety analysis examines the potential adverse human health effects of exposure to hazardous chemicals and radionuclides from remediation and surveillance and maintenance activities. In addition, occupational health and safety analysis examines work-related industrial safety issues that determine potential death, illness, or injury resulting from construction and operation activities. A description of the methodology for analysis of human health effects on the public from chemical and radiological exposures is provided in Appendix G.

The human health ROI comprises: (1) Area IV of SSFL, including the NBZ, and (2) offsite areas in the vicinity of SSFL.

Potential impacts on the public along the truck routes to offsite treatment, storage, and disposal facilities identified as candidates for management of the different types of waste generated from the activities evaluated in this EIS are also evaluated. A detailed description of the analysis of human health effects from transportation is provided in Appendix H.

B.9.2 Description of Impact Drivers

The proposed activities could cause the following potential impacts:

- Chemical and radioactive constituents in the soil could pose a threat to a future hypothetical suburban resident on the site or a hypothetical recreational user.
- The proposed activities to demolish buildings and remove soil and bedrock may involve exposure to substances that could affect human health and pose risks to workers. These include chemical and radioactive constituents in buildings, soil, bedrock, and groundwater.
- Reasonably foreseeable upset and accident conditions associated with the proposed activities could involve the release of radioactive and/or hazardous materials into the environment.
- The proposed activities could increase the risk of loss, injury, or death resulting from wildland fires, including in areas where wildlands are adjacent to urban areas or where residences are intermixed with wildlands, due to indirect causes such as an accident or sparks.

B.9.3 Impact Assessment Protocol

B.9.3.1 Affected Environment

The affected environment section describes the potentially affected worker population at Area IV and the chemical and radioactive constituents that have been quantified as a result of extensive characterization efforts conducted by EPA and DOE.

B.9.3.2 Methods Used to Analyze and Quantify Impacts

A comprehensive description of the methodology used and supporting data for the impact assessment of human health effects is provided in Appendix G.

Remediation and Decontamination and Decommissioning Activities

The impacts analysis assumed the following:

- Workers would be protected via implementation of DOE requirements (e.g., 10 CFR Part 835, "Occupational Radiation Protection," and 10 CFR Part 851, "Worker Safety and Health Program and Administration Procedures."
- The offsite public would be protected from chemical and radiological exposure via adherence to DOE (e.g., DOE Order 458.1, *Radiation Protection of the Public and the Environment*) and other requirements (e.g., National Emission Standards for Hazardous Air Pollutants [NESHAPS]).
- Soil removal and decontamination and decommissioning (D&D) are not expected to result in a discharge of contaminants to groundwater.
- Soil removal and D&D would incorporate procedures (e.g., BMPs) to protect against discharge of contaminants via surface runoff.
- Demolition of structures would occur after the structures have been largely decontaminated of radionuclide and chemical contaminants or measures have been taken to immobilize them with fixatives.
- As a result of prior decommissioning activities, hazardous or toxic materials have been removed from structures. Most hazardous or toxic materials are discrete, recognizable items (e.g., lead, polychlorinated biphenyl ballasts, asbestos) that were removed as part of building cleanout. No significant chemical contamination remains in the structures, and D&D would be conducted in a manner that minimizes dispersion.
- Soil removal would occur in the open air, with soil removed by backhoes, front-end loaders, or similar equipment and loaded into boxes or trucks.
- The incidence of industrial accidents would be consistent with prior DOE experience (see Section 4.9.1.1 for incidence rates).

The risk analysis was performed using the following assumptions:

- Potential impacts on hypothetical receptors, an onsite resident and an onsite recreational user, conservatively represent impacts on members of the public; impacts to the onsite recreational user also provide an extremely conservative estimate to a site visitor since a site visitor's exposure time would likely be much less than that assumed for the recreational user.
- Under all action alternatives, radionuclide concentrations would be reduced to AOC LUT values (see Appendix D) or risk-assessment-based values.

- Under the action alternatives, chemical concentrations would be remediated to either AOC LUT values, revised LUT values (risk-based values from the *Final Standardized Risk Assessment Methodology Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California* [MWH 2014]), or risk-assessment-based values.
- For the No Action Alternative, institutional control of the site would be maintained as long as necessary to prevent access to contaminated buildings.
- Water spraying would be utilized for dust control during soil remediation and building D&D work.
- Worker exposure from surveillance and maintenance activities would be comparable to that received in recent years.
- The incidence of industrial accidents would be consistent with prior DOE experience.
- Workers would wear respiratory protection that would provide 99 percent efficiency in particulate removal during some remediation and D&D activities as necessary to meet the occupational exposure limits.

Accidents

A rigorous health and safety program would be instituted to raise worker awareness and to implement procedures and practices to prevent accidents. Nonetheless, for purposes of analysis, it was assumed that some industrial accidents would occur consistent with DOE experience; these were addressed as part of normal operations (above) as "incidence of industrial accidents."

There are no large inventories of chemical and radioactive constituents at SSFL; instead, they are distributed across building surfaces and in the soil, bedrock, or groundwater. Remediation activities do not significantly increase the concentration of the chemical or radioactive constituents; therefore, accidents involving these constituents are not expected to present a risk beyond that associated with operational exposures to workers or members of the public (e.g., site visitors). Accidents presenting the largest consequence to onsite personnel would be unrelated to the presence of chemical and radioactive materials; they would more likely be associated with injuries resulting from a severe earthquake or wildfire. These accidents would pose similar risks to members of the public in the site vicinity. Potential impacts from these accidents were analyzed qualitatively in this EIS.

Intentional Destructive Acts

As discussed with respect to accidents, there are no large inventories of chemical and radioactive constituents at SSFL. Other than fuel for vehicles and machinery, there would be no large energy sources at SSFL. Consequently, SSFL is not considered a major risk for intentional destructive acts; a qualitative analysis of this risk was performed for this EIS (see Chapter 4, Section 4.9). See Appendix H for a discussion of risk from sabotage and terrorism for transportation activities.

B.9.4 Evaluation of Impacts

The following thresholds provide comparative measures for evaluating human health effects related to the proposed activities:

- Potential emission of radioactive material to the public in excess of DOE standards (i.e., DOE Order 458.1), which invoke the NESHAPS limit of 10 millirem per year to the maximally exposed member of the public from DOE activities.
- The lifetime cancer risk range of 1×10^{-6} to 1×10^{-4} (1 chance in 10,000 to 1 million) for carcinogenic constituents and a hazard index of 1 for noncarcinogenic constituents.

- Potential impacts on involved site workers (under normal operations) in excess of DOE's radiological (10 CFR Part 835) and Occupational Safety and Health Administration safety requirements.
- Potential for radiological or chemical accidents that could cause a risk of fatalities or acute or chronic illnesses among members of the public.

Under normal operations, mitigation is incorporated into radiological control procedures to ensure that radiation doses to workers or members of the public are managed to levels as low as reasonably achievable.

B.10 Waste Management

B.10.1 Description of Resource and Region of Influence

The analysis of the waste management resource area considered the types of wastes generated under each of the EIS alternatives and the capacities of offsite waste management sites to accommodate the project needs.

The Waste Management ROI comprises: (1) Area IV of SSFL (including the NBZ), where waste may be generated, treated, or staged for offsite shipment, and (2) offsite treatment or disposal facilities identified as representative facilities for management of the different types of waste generated from the activities evaluated in this EIS.

B.10.2 Description of Impact Drivers

Proposed activities could cause potential impacts if wastes are generated that lack adequate offsite management capacity.

B.10.3 Impact Assessment Protocol

B.10.3.1 Affected Environment

The affected environment for waste management (see Chapter 3, Section 3.10) describes current waste generation and management practices, the principal waste categories requiring offsite disposal, and the offsite facilities evaluated in this EIS as candidates for receipt of waste from DOE's remediation activities. Facility descriptions in Chapter 3, Section 3.10, identify candidate facilities and their locations, estimate the approximate road distances to the facilities, and summarize the wastes that may be received at the facilities, as well as the disposal facility capacities and permit restrictions, if any, on the quantities of wastes that may be received. The sources for this information are cited in Section 3.10 and include annual site environmental reports, facility permits, published facility information, and information obtained from personal communication with facility operators. Section 3.10 also indicates those facilities selected from the candidate facilities as representative for detailed evaluation in this EIS.

B.10.3.2 Methods Used to Analyze and Quantify Impacts

Assumptions

Removal of DOE structures, remediation of contaminated soil in Area IV and the NBZ, and remediation of contaminated groundwater were assumed to produce radioactive and nonradioactive wastes, including LLW, MLLW, hazardous waste, and nonhazardous waste. These classes of radioactive and nonradioactive wastes are defined for the purposes of this EIS in **Table B–2**, which also describes the characteristics of the typical waste streams expected under each waste class.

Table B–2 Waste Class Definitions and Typical Waste Streams

Waste Class	*Waste Class Definition*	*Typical Waste Streams*
LLW	Waste that contains radioactive material and is not classified as HLW, TRU waste, SNF, or the tailings or wastes produced by the extraction or concentration of uranium or thorium from ore processed primarily for its source material. Test specimens of fissionable material irradiated for research and development only, not for the production of power or plutonium, may be classified as LLW, provided the TRU concentration is less than 100 nanocuries per gram of waste (DOE Order 435.1).	Debris from removal of Area IV buildings with a radioactive history that is managed as LLW. Includes nonhazardous building debris and asbestos-containing material assumed to contain or be contaminated with radioactive material. Soil containing radioactive material in concentrations exceeding radionuclide LUT values. The soil may contain chemicals that exceed chemical LUT values, but is not classified as MLLW. Bedrock containing radioactive material that is a source of groundwater contamination.
MLLW	LLW that also contains hazardous components regulated under RCRA (42 U.S.C. 6901 et seq.) or state statute or regulation. State regulations may define a larger spectrum of materials as hazardous waste than the Federal RCRA regulations.	Debris from removal of Area IV buildings with a radioactive history that is managed as MLLW. Includes regulated materials such as lead, lead paint, and mercury switches that were assumed to contain or be contaminated with radioactive material. Soil that contains radioactive material in concentrations exceeding radionuclide LUT values and chemical constituents in concentrations warranting classification as hazardous waste.
Hazardous waste	Waste that is defined as hazardous waste under RCRA (42 U.S.C. 6901 et seq.) or state statute or regulation. State regulations may define a larger spectrum of materials as hazardous waste than the Federal RCRA regulations.	Debris from building removal that contains regulated materials such as lead, lead paint, and mercury switches. Soil containing chemical constituents in concentrations exceeding chemical LUT values and warranting classification as hazardous waste.
Nonhazardous waste	Discarded material, including solid, liquid, semisolid, or contained gaseous material, resulting from industrial, commercial, mining, and agricultural operations or from community activities. This category does not include source, special nuclear, or byproduct material as defined by the Atomic Energy Act (42 U.S.C. 2011 et. seq.).	Nonhazardous debris from building removal that is unsuitable for recycle and would require disposal at a nonhazardous waste facility. Nonhazardous debris from building debris that is suitable for recycle (e.g., asphalt, concrete, steel). Soil that contains chemical constituents in concentrations exceeding chemical LUT values, but is not classified as hazardous waste.

HLW = high-level radioactive waste; LLW = low-level radioactive waste; LUT = Look-Up Table; MLLW = mixed low-level radioactive waste; RCRA= Resource Conservation and Recovery Act; SNF = spent nuclear fuel; TRU = transuranic; U.S.C. = *United States Code.*
Note: Radionuclide and chemical LUT values are included in Appendix D.

Although some soil or waste treatment could occur on site, no waste disposal would occur on site. In addition, it was assumed that waste management capabilities at SSFL (e.g., packaging, staging for offsite shipment) would be commensurate with the activities proposed under each alternative. All contaminated soil that cannot be remediated would be transported to offsite treatment and/or disposal facilities, as would all waste from removal of DOE structures and remediation of contaminated groundwater. Offsite disposal of waste from Area IV remediation and building removal would be in accordance with applicable Records of Decision (RODs) issued for the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997). These RODS include those issued on August 5, 1998, for hazardous waste (63 *Federal Register* [FR] 41810) and on February 18, 2000, for LLW and MLLW (65 FR 10061). Offsite management of hazardous waste would be performed at permitted in- or out-of-state facilities. Offsite management of LLW and MLLW would occur at the Nevada National Security Site or at commercial LLW or MLLW disposal facilities. Nonhazardous waste from Area IV remediation and building removal would be disposed of at permitted offsite nonhazardous or hazardous waste facilities.

Methodology

Potential waste management impacts were assessed by comparing projected waste stream quantities with the capacities (including waste acceptance limitations) of the representative facilities evaluated in this EIS. The impact comparison was performed in a semi-quantitative manner. Although projected waste quantities were compared against capacities (including total available and projected waste capacities and other permitted quantity restrictions, if applicable), all candidate sites would receive waste from multiple sources. Therefore, a judgment was made about whether the projected waste quantities could represent a large fraction of the waste that may be received at a candidate site. If this condition were to occur, mitigative measures may be considered, such as use of alternate facilities, waste storage pending development of capacity, or reduced annual levels of waste generation at SSFL (longer periods of project operations), to reduce the daily or annual quantities of SSFL waste received at an offsite facility.

B.10.4 Evaluation of Impacts

Potential waste management impacts were assessed relative to the capacities of offsite waste management facilities; other environmental impacts of using waste management facilities (that is, on traffic, socioeconomics, and environmental justice) are discussed in other sections of this EIS. For purposes of analysis, an impact threshold for the waste management resource area was considered to be whether offsite waste management capacity may be constrained for one or more waste streams. This qualitative assessment, informed by quantitative comparisons to disposal site capacities and waste receipt restrictions, if any, considers the use of multiple facilities that are identified as representative candidates for disposal of each type of waste (see Chapter 3, Section 3.10). In addition, it is expected that, consistent with standard practice, schedules for deliveries to the facilities would be coordinated with the facility operators to minimize logistical difficulties.

B.11 Cultural Resources

B.11.1 Description of Resource and Region of Influence

Cultural resources are indications of human occupation and use of the landscape as defined and protected by a series of Federal laws, regulations, and guidelines. For this EIS, potential impacts were assessed separately for each of the three general categories of cultural resources: archaeological resources, historic buildings and structures, and traditional cultural resources, including traditional cultural properties.

For background data collection purposes only, the ROI included all of SSFL and adjacent land within 1 mile of the SSFL boundary. The area of potential effects (APE) for cultural resources includes all areas within the boundaries of Area IV and the NBZ at SSFL.

B.11.2 Description of Impact Drivers

The proposed activities have the potential to cause impacts. Potential impact drivers associated with the proposed activities are discussed below.

Building Demolition

Buildings or structures that are also historic properties (i.e., listed or eligible for listing on the *National Register of Historic Places* [NRHP]) could be impacted by demolition. Currently, no buildings or structures within the APE are listed or have been identified as eligible for listing on the NRHP. Facility and infrastructure demolition activities could potentially impact archaeological historic properties or other sensitive cultural resources if such resources are located in an undisturbed context beneath structures. Activities with the potential to impact such resources include foundation removal, subsequent grading or filling, asphalt removal, heavy machinery movement, and soil compaction. If buildings were constructed on an archaeological site, then construction could have acted to preserve that site, particularly if there was no below-grade construction (e.g., no basements).

Soil Removal

Any ground disturbance has the potential to disturb an archaeological site. If an area has been surveyed for the presence of this resource type, the potential for disturbance is reduced, but not eliminated. Excavation for remediation of soil impacted by radionuclides or chemicals could affect archaeological sites through direct destruction, erosion, vibration, or a temporary or long-term change in setting. These effects could also arise from extended sampling of remediation-related excavation walls and floor. Development of access roads or paths to areas of planned soil removal could have the same effects, as could the location of equipment for staging or storage.

Depending on the borrow source for soil to replace that removed for offsite disposal, that area could also require compliance with Section 106 of the National Historic Preservation Act (NHPA), including consultation, identification of historic properties, determination of effects, and mitigation of adverse effects.

***In Situ* Remediation**

Onsite, *in situ* treatment to clean up residual radionuclides or chemicals is a possible source of effects to archaeological sites. Installation of injection wells and capture wells at the leading edge of radionuclide or chemical plumes could be a source of ground disturbance. Temporary and short-term changes to the setting of a resource could arise from the placement of equipment or storage tanks.

If remediation occurred within the boundaries of an archaeological site that is eligible for listing on the NRHP, effects could result from the intrusion of treatment facilities; disturbance to the ground from the circulation of water or other material; and possibly from a change of chemistry and loss of information on otherwise undisturbed deposits (e.g., loss of ability to date or analyze remains).

Traffic and Access

Traffic along established routes is unlikely to affect archaeological sites. Traffic could have a short-term, periodic effect on traditional cultural resources through the introduction of noise, vibration, and a temporary change in setting during the time the route is in use that would last until the project is complete. It is possible that the effect on traditional cultural resources could be mitigated through scheduling protocols established during consultation. However, DTSC is researching possible additional or alternative transportation routes and modes for removing building debris and soils impacted by radionuclides or chemicals from SSFL. Although solutions other than the use of Woolsey Canyon Road are unlikely, any alternative solution that requires ground disturbance has the potential to affect cultural resources. These could include development of fire roads, improvement of existing roads such as Black Canyon Road, rail and intermodal transport, or other systems.

New or improved access routes to an area could result in impacts on historic properties. Historic properties such as archaeological sites, especially rockshelters or rock art, are likely targets for vandalism because these are typically the most visible resources (Hedquist et al. 2014; Nickens et al. 1981). When these historic properties are located near roads, they become more vulnerable. Restricting access to Area IV and the NBZ would protect identified historic properties and traditional cultural resources from damage associated with use, inadvertent trampling, or purposeful vandalism.

Fire

Fire can cause major damage to various types of historic properties, and activities that significantly increase fire risk may have an adverse effect on those resources. Fires can result from maintenance and repair of facilities. Vandalism can also increase fire risk. Necessary and unavoidable fire suppression efforts, including road and fire-break construction, vehicle and foot traffic, and defensive trenching, can be nearly as destructive to cultural resources as the fires themselves. Fire management practices that involve ground disturbance or use of fire retardants delivered by aircraft have the potential to damage rock art sites and archaeological sites.

B.11.3 Impact Assessment Protocol

B.11.3.1 Affected Environment

The affected environment for cultural resources is described in Chapter 3, Section 3.11, and Appendix F. This information provides the context for understanding the significance of the cultural resources in Area IV and the NBZ and the potential impacts of the proposed activities. The setting describes the regional historic background encompassing the earliest known inhabitants, exploration and settlement by Europeans and Americans, and modern history. It also describes the current state of knowledge regarding archaeological, architectural, and traditional cultural resources found in the ROI, which consists of Area IV and the NBZ, as well as the rest of SSFL and an area that extends 1 mile from the SSFL boundary. This area contains the current inventory of all known resources in Area IV and the NBZ, including archaeological and architectural resources, as well as properties of traditional religious and cultural importance to Native American tribes, including traditional cultural properties present within the APE.

Sources of this information are cited in Chapter 3, Section 3.11, as well as ongoing or projected work. The NRHP-eligibility status of resources in Area IV and the NBZ is discussed, and ongoing consultation with the California State Historic Preservation Officer (SHPO) and the federally recognized Santa Ynez Band of Chumash Indians is summarized. Such consultation activity is described in more detail in Appendix E. DOE is consulting with SHPO and the Santa Ynez Band of Chumash Indians, which is a cooperating agency in the NEPA process. DOE also consults with the Santa Susana Field Laboratory Sacred Sites Council (SSFL Sacred Sites Council), which includes the Santa Ynez Band of Chumash Indians and representatives of the Fernandeño Tataviam and Gabrielino Tongva peoples.

B.11.3.2 Methods Used to Analyze and Quantify Impacts

Steps in the evaluation of impacts on cultural resources resulting from implementation of the proposed activities included the following (36 CFR Part 800):

- Establishing the undertaking and beginning consultation with SHPO and Native Americans.
- Determining that the undertaking is the type that might affect historic properties.
- Identifying cultural resources present on the site.
- Identifying historic properties (i.e., those cultural resources that are listed or eligible for listing on the NRHP).
- Identifying those cultural resources that may not meet the criteria for NRHP listing, but may be important for other reasons (e.g., eligible for listing on the *California Register of Historical Resources* or of Native American importance).
- Determining impacts from the proposed activities on specific resources.

- Continuing to consult with SHPO and other parties.
- Considering methods to avoid, minimize, or mitigate adverse effects or impacts.

Analysis of potential impacts on cultural resources considered impacts that may occur by physically altering, damaging, removing, or destroying all or part of a resource; changing the character of the property's use or physical features within the property's setting; altering the characteristics of the surrounding environment that contribute to the resource's significance; introducing atmospheric, visual, or audible elements that are out of character with the property or alter its setting; neglecting the resource to the extent that it deteriorates or is destroyed, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to a Native American tribe; or transfer, lease, or sale of property out of Federal ownership or control without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of the property's historic significance.

Direct impacts were assessed by identifying the types and locations of the proposed activities and determining the exact location of cultural resources that could be affected. Indirect impacts generally occur later, after the proposed activities have been conducted, and result from increased use of an area, potentially accompanied by population increase and improved access to areas near historic properties. All such impacts were considered when evaluating the effects of the proposed activities.

DOE would seek agreement on the finding of effect from the SHPO, Santa Ynez Band of Chumash Indians, and SSFL Sacred Sites Council, as appropriate. Seeking to resolve adverse effects through avoidance and mitigation is part of this process.

Sacred Sites and Traditional Cultural Resources

For sacred sites and traditional cultural resources (including those that may be important but do not meet the NRHP criteria), DOE would consult with the Santa Ynez Band of Chumash Indians and SSFL Sacred Sites Council. The criteria for determining impacts would include those used for historic properties. In addition, Native Americans bring their own cultural perspective to their sacred sites and traditional cultural resources. Some characteristics that are well understood by members of their cultures may be inexpressible or indefinable in the context of NHPA, NEPA, and CEQA; some may be confidential. Nonetheless, it is useful to broadly mention here those key characteristics or features that may be understood (within the context of the undertaking at SSFL) by Native American tribes in the region to be important elements of a sacred site or to delineate a traditional cultural resource.

Based on tribal input received as of June 2015 through written contributions (see Chapter 9, "Native American Histories and Perspectives") and conversations (see Appendix E, "Consultations"), the tribes have expressed concern about the following resources and/or characteristics that may be found within Area IV and NBZ at SSFL. Note that resources and archaeological sites under the jurisdiction of NASA and Boeing are not viewed as separate from those on Area IV or the NBZ, but rather are considered by Native Americans to be part of the whole. SSFL has the potential to contain all the following features, although not all have been documented at the facility (Cohen 2014a, 2014b):

- General characteristics – Any location identified by a Native American tribe as sacred or significant.
- Biological resources – Plants and animals.

- Geographic – Mountain tops, rock outcroppings, flat areas suitable for campsites, forests, and riparian areas that could contain food resources could all be considered part of a sacred site and/or a traditional cultural resource. Areas providing a vista of the surrounding area, including ridgelines, peaks, ledges, outcrops, benches or prominent hills, and viewsheds, are all important.
- Archaeological – This category includes all sites and isolates in the vicinity of and within SSFL, including areas with a relatively high density of sites; areas near but possibly outside the mapped boundaries of known sites, such as cemeteries or areas near known rock art sites; and rocky outcroppings similar to where known rockshelters or rock art are located. Spaces between known cultural resources and currently unidentified archaeological resources are important.
- Event-related – Locations for Native American and/or traditional ceremonies, including but not limited to solstice observances, are important.
- Ethnographic – Evidence for separate areas for different tribes, especially if SSFL was an intertribal gathering place, is important. Known, ethnographically documented village sites; areas with documented place names (even if no archaeological sites are known to be there today); areas near known gathering places; and locations identified in ceremonies, oral history, or other communal aspects of culture are all important.

The Advisory Council on Historic Preservation provides a general statement (ACHP 2012) regarding what may be included in a sacred site or a traditional cultural property, but especially a traditional cultural landscape:

> "…natural features such as mountains, caves, plateaus, and outcroppings; water courses and bodies such as rivers, streams, lakes, bays, and inlets; views and view sheds from them, including the overlook or similar locations; vegetation that contributes to its significance; and, manmade features including archaeological sites; buildings and structures; circulation features such as trails; land use patterns; evidence of cultural traditions, such as petroglyphs and evidence of burial practices; and markers or monuments, such as cairns, sleeping circles, and geoglyphs."

For sacred sites and traditional cultural properties, impacts could arise from changes to any of the following characteristics: viewshed, soil, temporary changes to any characteristics, noise environment, water, watershed, and disruption of the interconnectedness of resources through time and space (e.g., loss of a temporal connection between resources).

B.11.4 Evaluation of Impacts

Evaluation of impacts is based on the application of the criteria of adverse effects specified in regulations in 36 CFR 800.5(a)(1) (see below). Under Federal law, impacts on cultural resources may be considered adverse when:

> "…an undertaking may alter, directly or indirectly, any of the characteristics of a historic property [i.e., a cultural resource that has been determined eligible for listing on the NRHP] that qualify the property for inclusion in the NRHP in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Consideration shall be given to all qualifying characteristics of a historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the National Register. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative."

The definition of impacts/effects under NEPA usually relies on, but is not limited to, these NRHP criteria of adverse impacts. In other words, impacts may be identified on cultural resources that are not eligible for listing in the NRHP, but are considered important under other criteria. For example, the *California Register of Historical Resources* could include cultural resources that are not eligible for the NRHP, but are of local interest (OHP 1995).

Impacts on traditional Native American resources may be determined through application of the NHPA criteria of adverse effects, but also may be determined through consultation with the Santa Ynez Band of Chumash Indians and the SSFL Sacred Sites Council. Information reported in this EIS respects tribal desires and Federal and state requirements for confidentiality.

To resolve adverse impacts/effects, Section 106 of NHPA requires DOE to consult on alternatives or modifications of the undertaking that could avoid, minimize, or mitigate the adverse effects on historic properties (36 CFR 800.6). NEPA requirements are similar, requiring measures to avoid, minimize, rectify, reduce over time, or compensate for impacts (40 CFR 1508.20).

Factors Considered for Determining Impacts

The impact assessment process for historic properties centers on the concept of significance in NHPA (Title 16, *United States Code*, Section 470 [16 U.S.C. 470] et seq.) and defined by its implementing regulations (36 CFR 60.4 and 36 CFR Part 800). Federal laws and regulations require Federal agencies to manage historic properties (i.e., resources that are eligible for inclusion in or are listed in the NRHP). NRHP eligibility criteria are defined in 36 CFR 60.4:

> "National Register criteria for evaluation. The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and
>
> a) that are associated with events that have made a significant contribution to the broad patterns of our history; or
> b) that are associated with the lives of persons significant in our past; or
> c) that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
> d) that have yielded, or may be likely to yield, information important in prehistory or history."

The analysis of effect on cultural resources complies with the implementing regulations of 36 CFR 800.106, which require impacts on historic properties from Federal undertakings be taken into consideration as part of the decision-making process. In accordance with Section 106, once an action is determined to be an undertaking, impacts on historic properties are assessed by (1) identifying the nature and location of all elements of the proposed action and alternatives (determining the APE); (2) comparing those locations with identified historic properties, sensitive areas, and surveyed locations (identification part 1); (3) determining the known or potential significance of historic properties that could be affected (identification part 2); and (4) assessing the extent and intensity of the effects.

DOE has completed the identification phase of Section 106 compliance and applied the criteria for identification of adverse effect (36 CFR 800.5(a)(1)). As of October 2016, DOE was still consulting with SHPO and Native Americans regarding compliance with Section 106. An action results in an adverse effect to a historic property when it alters the qualities of the resource, including the relevant features of its environment or use that make it eligible for inclusion in the NRHP. NEPA and

CEQA have additional requirements that consider cultural resources that are important to Native American tribes, but may not be eligible for listing in the NRHP. For example, additional thresholds could be impacts that (1) cause a substantial adverse change in the significance of a historical or archaeological resource, (2) directly or indirectly destroy a unique site or culturally important and unique geologic feature, or (3) disturb any human remains, including those interred outside of formal cemeteries.

Although Section 106 requires Federal agencies to consider all findings of effect, whether beneficial or not, only adverse effects require mitigation; however, DOE might consider mitigation under NEPA and CEQA even if an impact threshold is not crossed.

B.12 Socioeconomics

NEPA requires an analysis of social, economic, and environmental justice effects; however, there is no standard set of criteria for evaluating socioeconomic impacts. This section presents the methods used to evaluate the economic effects of the proposed activities. Methods to evaluate environmental justice impacts are discussed in Section B.13.

Socioeconomic impacts are defined in terms of changes to the economic characteristics of a region, such as jobs, income, and sales. Project activities can affect a region's economy in both the short- and long-term. Construction/remediation-related activities typically have short-term economic effects related to employment and spending that end when construction is complete and, absent any long-term project effects, the region's economy generally returns to pre-construction conditions. Long-term economic effects can occur from ongoing project operations or the resource impacts of a project, such as changes in population and housing.

B.12.1 Description of Resource and Region of Influence

The proposed alternatives could affect employment, income, expenditures, and revenues within a regional economy. The definition of a regional economy varies, depending on the purpose of the analysis. The scale of a regional economy can include a zip code, city, county, or groups of counties in one or more states. The regional economy should capture trade links among industries, such as the buying and selling of raw materials, industrial and consumer goods and services, and labor. An area that covers a relatively contained and cohesive network of trade is a functioning economic area and is the type of region that works best for economic analysis.

The ROI for the socioeconomic environment is defined as the geographic area that encompasses the regional economy where the proposed activities could occur. More than one ROI was used in this analysis because the proposed activities could cause impacts in the vicinity of the SSFL site and in the vicinities of potential disposal sites. For this analysis, the SSFL ROI included Los Angeles and Ventura Counties. The ROI for the disposal sites included the counties where each potential disposal site is located.

B.12.2 Description of Impact Drivers

The proposed activities have the potential to cause impacts. Potential impact drivers associated with the proposed activities are discussed below. The discussion of impacts is separated by the ROI for the SSFL site and the ROIs for the disposal sites.

Los Angeles and Ventura Counties ROI

- Employment – An economic effect related to employment of construction workers and increased sales in the ROI for construction activities may result.
- Regional Truck Traffic Impacts – Within the Los Angeles and Ventura Counties ROI, the project alternatives could result in economic effects related to truck driver employment and increased truck traffic on the sales volumes and revenues of businesses along truck routes.
- Infrastructure and Municipal Services Impacts – Effects on infrastructure and municipal services could result in economic effects, primarily to local governments if additional expense is needed to repair infrastructure or provide additional services.
- Housing Impacts – Construction activities could affect the availability of local housing if construction workers are brought in from outside the ROI.
- Local Government Revenue Impacts – The project could result in increased revenues or expenses for local governments, which could affect their abilities to pay for services.

Disposal Facility ROI

- Truck Traffic Impacts – Increased truck traffic on local roads near disposal facilities could impact local businesses sales volumes and revenues. There could also be increased fees paid to public or private entities operating disposal facilities.

B.12.3 Impact Assessment Protocol

B.12.3.1 Affected Environment

The affected environment provides information on employment, industries, housing, and populations for counties and cities within the ROI. This data was collected from the U.S. Census Bureau. The affected environment also provides summary information on local government finances for the City of Los Angeles that includes the truck routes from SSFL Area IV to the major freeways and on to the disposal sites.

B.12.3.2 Methods Used to Analyze and Quantify Impacts

Socioeconomic impacts were evaluated by impact category as defined below.

Los Angeles and Ventura Counties ROI

- Employment – The analysis of construction effects was both quantitative and qualitative. The quantitative analysis used the numbers of construction workers to be employed and compared them to regional numbers to assess the economic effect. A qualitative evaluation was made of potential effects of expenditures in the region for purchasing construction equipment or supplies.
- Regional truck traffic impacts – Economic effects related to increased truck driver employment were evaluated based on the number of truck drivers and truck trips for the SSFL alternatives relative to baseline employment data for the transportation industry in the SSFL ROI. The economic effects on local business sales were based on the frequency and duration of trucks along haul routes relative to existing traffic conditions.
- Infrastructure and municipal services impacts – Truck traffic could affect public infrastructure and the demand for municipal services, resulting in economic impacts on local governments. The primary impacts on public infrastructure would be deterioration of roads due to truck traffic. The analysis considers the number of construction workers on site,

number of truck drivers, and number of truck trips to evaluate impacts on public services and infrastructure.

- Housing impacts – This analysis considered the numbers of workers required for site activities and compared them to the total pool of construction workers in the ROI. If workers need to be hired from outside the ROI, there may be an incremental demand for housing.
- Local government revenues impacts – Project activities could indirectly affect tax revenues or expenses to local governments. For example, increased expenditures in the region would increase sales tax revenues, and increased truck traffic may affect roads and expenditures for the city on public services. These impacts are discussed qualitatively based on the effects determined for the above impacts.

Disposal Facility ROI

- Truck traffic impacts – These impacts were evaluated by considering the location of the disposal facilities relative to residential areas, local business, and the types of industries the areas support under existing conditions. The analysis also considered the number of truckloads and the dispersal of truckloads among nine disposal facilities.

B.12.4 Evaluation of Impacts

Socioeconomic impacts were evaluated relative to the regional economy in the defined ROI. Socioeconomic effects can be beneficial or adverse. The socioeconomic impacts were quantified to the extent possible by comparing the data on construction workers and truck trips related to the alternatives to the data provided for the affected environment of the regional economy. Where quantitative information was not available, the socioeconomic impact is discussed qualitatively.

B.13 Environmental Justice

B.13.1 Description of Resource and Region of Influence

NEPA and Executive Order 12898 require an analysis of social, economic, and environmental justice effects; however, there is no standard set of criteria for evaluating environmental justice impacts.

EPA defines environmental justice as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies." Environmental justice entails assessment of the potential for disproportionately high and adverse human health or environmental effects on minority and low-income populations as a result of implementing any of the alternatives analyzed in this EIS.

The ROI for environmental justice encompasses populations that might be affected by implementation of the proposed remediation actions. Because this evaluation was focused on impacts on communities and people, the analysis used census tracts and block groups to describe the affected population located in areas encompassing the SSFL site, areas adjacent to the SSFL property, and areas near waste disposal sites and/or along truck routes from SSFL to the identified disposal sites. This analysis considered two ROIs: the area surrounding SSFL, which includes the census tracts[1] and block groups[2] located within approximately 1 mile of the SSFL boundary or along proposed local truck routes (SSFL ROI), and the census tracts encompassing the planned disposal sites and the major highways from the SSFL project area to the disposal facilities (regional ROI).

B.13.2 Description of Impact Drivers

The proposed activities could cause impacts on or change conditions that affect people. The environmental justice analysis examined whether any identified disproportionately high and adverse effects from project-related activities could occur within or affect an identified minority or low-income population. CEQ recommends that an environmental justice analysis consider the following three factors to determine whether disproportionately high and adverse effects could occur (CEQ 1997a):

- Whether there is or would be an impact on the natural or physical environment that significantly and adversely affects a minority population, low-income population, or Native American tribe. Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities, low-income communities, or Native American tribes when those impacts are interrelated to impacts on the natural environment.
- Whether the environmental effects may have an adverse impact on minority populations, low-income populations, or Native American tribes that appreciably exceeds or is likely to appreciably exceed those on the general population or other appropriate comparison group.
- Whether the environmental effects occur or would occur in a minority population, low-income population, or Native American tribe affected by cumulative or multiple adverse exposures from environmental hazards.

B.13.3 Impact Assessment Protocol

B.13.3.1 Affected Environment

Demographic and economic characteristic data were used to characterize the composition of the population in the SSFL and regional ROIs (described above) and to quantify the proportion of minority and low-income populations. Data from the U.S. Census Bureau, primarily from the *2010 Census and American Community Survey, 2012 1- and 5-Year Estimates* (Census 2012c), were used for this analysis.

Census tracts and block groups selected for analysis were those that encompassed SSFL and the designated local transportation routes (local roads to and from Area IV and major highways) (SSFL ROI), as well as those that encompassed the designated waste disposal facility sites (regional ROI).

In characterizing the affected environment, the following definitions were used:

- Minority – A member of one or more of the following population groups: Hispanic or Latino, American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, or two or more races.

---

[1] A census tract is defined as small permanent statistical subdivisions of a county delineated by local participants as part of the U.S. Census Bureau's Participant Statistical Areas Program. These areas generally consist of between 1,500 and 8,000 people and are designed to be homogeneous with respect to population characteristics, economic status, and living conditions. The size of census tracts can vary widely depending on the density of a settlement (Census 2012a).

[2] A block group is defined as "statistical divisions of census tracts." These areas are generally defined to contain between 600 and 3,000 people and are used to present data and control block numbering. A census tract may contain more than one block group (Census 2012b).

Minority populations are identified where either (1) the total minority[3] population of the affected area exceeds 50 percent or (2) the total minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis (CEQ 1997a). "Meaningfully greater" is defined here as 20 percentage points.

- Low-Income – The U.S. Census Bureau uses a set of money income thresholds that vary by family size and composition to establish who is within the poverty level (low-income). If a family's total income is less than the family's poverty threshold, then that family and every individual in it is considered in poverty. The official poverty thresholds do not vary geographically, but are updated for inflation using the Consumer Price Index. The official poverty definition uses money income before taxes and does not include capital gains or noncash benefits (such as public housing, Medicaid, and food stamps). A "poverty area" or low-income population is where 20 percent or more of the population lives in poverty. An "extreme poverty area" or area of concentrated poverty is where 40 percent or more of the population lives in poverty (Census 1995).

B.13.3.2 Methods Used to Analyze and Quantify Impacts

Assumptions

Because so many communities are located along the major highways that would be used to transport waste from SSFL to the waste disposal facilities, it was assumed that (1) in addition to general populations, both minority and low-income populations exist along the routes between SSFL and the representative waste disposal facilities and (2) these minority and low-income populations would be exposed equally to potential impacts. Based on these assumptions, communities residing along the transport routes were not characterized in this analysis.

Methodology

Disproportionately high and adverse effects occur when the risk or rate of exposure to an environmental hazard for a minority and/or low-income population exceeds the risk or exposure rate for the general population or another appropriate comparison group.

To determine this, the environmental justice investigation comprised the following three steps:

- Identify the project-related impacts that directly or indirectly affect valued resources or people and the location of these effects (compiled from the results of the resource analyses in this EIS).
- Identify the racial and income characteristics of affected populations (using best available census data and local community surveys if applicable) and determine whether these populations are disproportionately minority or low-income compared to a reasonably scaled demographic region of comparison for specific impacts.
- Consider the degree of the impact and the degree of disproportionate composition of the affected population to make an overall assessment of potential environmental justice concerns. This analysis also considered factors such as alternatives development criteria, operational requirements, and goals that influenced the formulation of the proposed activities. For example, do racial or income factors influence the selection of a site? The

[3] "Total Minority" is the aggregation of all non-white racial groups, with the addition of all Hispanics, regardless of race, with the total for "Not Hispanic or Latino: White Alone" subtracted from the total population.

environmental justice analysis additionally considered the mitigations and operational flexibilities identified for each resource topic to reduce impacts and considered the feasibility of implementing those measures.

B.13.4 Evaluation of Impacts

Environmental justice effects were determined using the impacts analysis presented throughout Chapter 4 for the various resource areas to assess the potential for a minority and/or low-income population to bear any disproportionately high and adverse effects.

The findings of effect of all the various resources analyzed in this EIS were reviewed and compared to the environmental justice affected area. The evaluation of environmental justice impacts considered the context and intensity of the impact factors and the potential effectiveness of mitigations to reduce disproportionately high and adverse effects by assessing the severity of each environmental justice situation resulting from the proposed activities.

B.14 Sensitive-aged Populations

B.14.1 Description of Resource and Region of Influence

In addition to the sectors of the general population addressed under B.13, Environmental Justice, this EIS includes an evaluation of potential impacts to sensitive-aged populations (children [under 18 years] and persons 65 years or older).

As discussed in Chapter 3, Section 3.14, Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, children might suffer disproportionately from environmental health and safety risks that may arise because children are still developing which could make them more susceptible. For purposes of this analysis, it was assumed that, due to increasing age and potential declining health, persons 65 years or older may experience similar disadvantages compared to the general population and therefore are also analyzed in this EIS.

The ROIs for sensitive-aged populations are the same as those identified for the environmental justice analysis, including the area surrounding SSFL, which includes the census tracts and block groups located within approximately 1 mile of the SSFL boundary and local truck routes (SSFL ROI), and the census tracts encompassing the representative disposal sites and the major highways from the SSFL project area to the disposal facilities (regional ROIs).

Special consideration is given to truck transport routes in proximity to schools and recreation and open space areas where children are likely to be present. In the SSFL ROI, special consideration is given to Sage Ranch Park located off Woolsey Canyon Road as the nearest recreation area to SSFL.

B.14.2 Description of Impact Drivers

The proposed activities could cause impacts on or change conditions that affect people. The sensitive-aged population analysis examined whether any identified disproportionately high and adverse effects from project-related activities could occur within or affect children or persons 65 years or older. There are no CEQ recommendations for how to analyze sensitive-aged populations in an environmental document; however, this analysis considered factors similar to those identified for the environmental justice analysis. For the purposes of this analysis, the following additional impact drivers were developed to capture the effects on other sensitive-aged communities, specifically children and the elderly:

- Whether the environmental effects would occur in an area with a large population of children or near primary education facilities (elementary, middle, or high schools, including private schools) where effects are significant and may have an adverse impact that appreciably exceeds or is likely to exceed those on the general population or other appropriate comparison group.

- Whether the environmental effects would occur in an area with a large elderly population where effects are significant and may have an adverse impact that appreciably exceeds or is likely to exceed those on the general population or other appropriate comparison group.

B.14.3 Impact Assessment Protocol

B.14.3.1 Affected Environment

Age-characteristic data were used to characterize the composition of the population in the SSFL and regional ROIs and to quantify the proportion of children and persons 65 years or older. Data from the U.S. Census Bureau, primarily from the *2010 Census and American Community Survey, 2012 5-Year Estimates* (Census 2010, 2012c) were used for this analysis.

Census tracts and block groups selected for analysis were those that encompassed SSFL and the designated local transportation routes (local roads to and from Area IV (SSFL ROI) and those that encompassed the designated waste disposal facility sites (regional ROIs).

In characterizing the affected environment, the following definitions were used:

Children – For purposes of this analysis, children were defined as persons under the age of 18. Special consideration was given to persons 5 years and under.

Elderly – For purposes of this analysis, the elderly were defined as persons 65 years or older.

B.14.3.2 Methods Used to Analyze and Quantify Impacts

Assumptions

Because there are so many communities located along the major highways that would be used to transport waste from SSFL to the waste disposal facilities, it was assumed that both general populations and sensitive-aged populations exist along the routes between SSFL and the representative waste disposal facilities, and that they would be exposed and affected equally to potential impacts. Based on this assumption, communities residing along the transport routes outside the SSFL vicinity were not characterized in this analysis.

Methodology

Disproportionately high and adverse effects occur when the risk or rate of exposure or impact to an environmental hazard for a sensitive-aged population exceeds the risk or exposure rate for the general population or another appropriate comparison group. To determine this, the sensitive-age investigation comprised the following three steps:

Identify the project-related impacts that directly or indirectly affect valued resources or people and the location of these effects (compiled from the results of the resource analyses in this EIS).

Identify the age characteristics of affected populations (using best available census data) and determine whether these populations are disproportionately comprised of children or persons 65 years or older compared to a reasonably scaled demographic region of comparison for specific impacts.

Consider the degree of the impact and the degree of disproportionate composition of the affected population to make an overall assessment of potential concerns. This analysis also considered factors such as alternatives development criteria, operational requirements, and goals that influenced the formulation of the proposed activities. For example, do sensitive-age factors influence the selection of a site? The sensitive-age analysis additionally considered the mitigations and operational flexibilities identified for each resource topic to reduce impacts and considered the feasibility of implementing those measures.

B.14.4 Evaluation of Impacts

The sensitive-age analysis impacts were determined using the impacts analysis presented throughout Chapter 4 for the various resource areas to assess the potential for sensitive-aged populations to bear any disproportionately high and adverse effects.

The findings of effect on all of the various resources analyzed in this EIS were reviewed and compared to the affected area. The evaluation of sensitive-aged population impacts considered the context and intensity of the impact factors and the potential effectiveness of mitigations to reduce disproportionately high and adverse effects by assessing the severity of each situation resulting from the proposed activities.

B.15 Cumulative Impacts

B.15.1 Description of Resource and Region of Influence

CEQ regulations for implementing NEPA's procedural provisions (40 CFR Parts 1500-1508) define a cumulative impact as "the impact on the environment which results from the incremental impact of the action when added to the incremental impact of other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7). Thus, the cumulative impacts of an action can be viewed as the total effects on a resource, ecosystem, or human community of that action and all other activities affecting that resource, irrespective of the proponent (EPA 1999). Cumulative impacts can result from individually minor, but collectively significant, actions taken over a period of time. Cumulative impacts can also result from spatial (geographic) and/or temporal (within a span of time) crowding of environmental disturbances (i.e., concurrent human activities and the resulting impacts on the environment are cumulative if there is insufficient time for the environment to recover).

Cumulative impacts include the incremental effects of the proposed remediation alternatives and activities, combined with past, present, and reasonably foreseeable future impacts from other sources or actions, on each resource area evaluated in this EIS.

The ROI for cumulative impacts varies by resource and is defined by the largest area considered in the evaluation of impacts for each resource (see "Description of Resource and Region of Influence" for each resource area in this appendix). The composite of these would be the overall ROI for cumulative effects.

B.15.2 Description of Impact Drivers

Cumulative impacts can result when recent, ongoing, and likely future actions in the ROI could compound, offset, or accumulate the impacts of the proposed DOE activities in SSFL Area IV and the NBZ. In general, this would hold true for actions that have impact drivers similar to the actions in this EIS. The most directly aligned and contributory actions are NASA's and Boeing's ongoing and planned remediation and cleanup activities at SSFL. The range of impact drivers is described in the preceding subsections of this appendix.

B.15.3 Impact Assessment Protocol

B.15.3.1 Affected Environment

The affected environment for cumulative impacts encompasses the widest area of potential influence that this project may have on each resource area. More-specific affected environments for each resource area are described in Chapter 3 of this EIS. These affected environments for cumulative impacts can include conceptual descriptions of natural changes that are expected in the future (i.e., a future baseline). These are discussed in the cumulative impacts subsection for each resource area in Chapter 5 of this EIS. The descriptions draw upon information in Chapter 3 and in other applicable reference documents.

B.15.3.2 Methods Used to Analyze and Quantify Impacts

Chapter 5 and Appendix A of the CEQ publication, *Considering Cumulative Effects under the National Environmental Policy Act* (CEQ 1997b) discuss various methods and techniques for analyzing cumulative effects. Implicit in the different techniques discussed is the idea that there is no one appropriate way to analyze cumulative impacts.

The following steps were used to conduct the cumulative impacts analysis and to comply with the intent of applicable regulations and guidance:

- Define the composite ROI for the resource areas addressed in this EIS − Within this area, identify counties, major towns and cities, and tribal lands.
- Identify and obtain information on relevant recent, ongoing, and future projects; developments, and actions in the ROI – These actions were identified through contacts with local, state, and Federal agencies and EIS cooperating agencies, CEQA document reviews, Internet research, and contacts with the planning agencies of the involved counties, cities, towns, and tribes to obtain pertinent information. To qualify as relevant, an action or project would (1) overlap geographically with the SSFL ROI; (2) have similar effects that may compound, offset, or accumulate with those evaluated in this EIS; and (3) not be already accounted for in the baseline environmental conditions. Actions or projects that do not meet all of these criteria were eliminated from further consideration.
- Extract data from available documents and perform the cumulative impacts analyses for each resource area commensurate with the information available – during this step, impact indicators for the alternative combinations (see Chapter 4) were added to the baseline values and the values for the reasonably foreseeable future actions for the purpose of estimating the cumulative impacts. Steps in this process included the following:
  - Identifying and, to the extent possible, quantifying the baseline conditions. Baseline conditions reflect the effects of past and present actions (i.e., the level of direct/indirect, beneficial/adverse, and short-term/long-term effects that a resource is currently experiencing). These conditions are described in Chapter 3, "Affected Environment," of this EIS.
  - Identifying the impacts of reasonably foreseeable future actions. If quantitative data were available, those values were incorporated into quantitative or semi-quantitative cumulative impact analyses. If quantitative data were not available, qualitative data were used.

- Identifying the impacts of the EIS alternative combinations (described in Chapter 4).
- Aggregating the effects on each resource of past, present, and reasonably foreseeable future actions, including the EIS alternative combinations. The aggregate effects were used to estimate the cumulative impacts on each resource area. The degree of the impacts was largely determined using the same impact measures described in Chapter 4 of this EIS.

As described in Chapter 4, six impact scenarios could result from the potential combinations of the three soil remediation, one building removal, and two groundwater treatment alternatives (not including the No Action Alternatives). For purposes of cumulative impacts analysis, two combinations of action alternatives were chosen to represent the range of actions and associated overall impacts that could result from full implementation of the three sets of proposed activities. The High Impact Combination of alternatives would be the Cleanup to AOC LUT Values Alternative, the Building Removal Alternative, and the Groundwater Treatment Alternative. The Low Impact Combination of alternatives would be the Conservation of Natural Resources Alternative, the Building Removal Alternative, and the Groundwater Monitored Natural Attenuation Alternative. These two combinations of alternatives were selected for cumulative impacts analysis in this EIS only to establish overall cumulative impact reference cases for stakeholders and decision-makers to consider; selection of these combinations does not preclude the selection and implementation of different combinations of the various alternatives in support of final agency decisions.

Identification of Monitoring and Mitigation Requirements. In this step, the cumulative impact estimates were examined to determine whether monitoring and/or mitigation activities would be needed (see Chapter 6, for information on mitigation measures that may be used to reduce impacts.)

B.15.4 Evaluation of Impacts

DOE's *Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements* (DOE 2004) expands on the CEQ instruction in 40 CFR 1502.2(b) by stating that impacts should be discussed in proportion to their importance. For some resource areas, the cumulative impacts analysis is limited due to minimal impact or limited data. In these instances, the text explains how there are no cumulative impacts or why cumulative impacts cannot be estimated. Most cumulative impacts analyses are qualitative in nature due to uncertainties about timing, broader area of effect, and less-detailed understanding about implementation of future actions. Some resource areas (such as traffic) were able to use quantitative information for evaluating cumulative effects. Previous sections of this appendix describe the methods used to evaluate the impacts on each resource area. These same methods were used to evaluate cumulative impacts for each resource area. Overall, the evaluations identify whether cumulative impacts would be beneficial or adverse and, in some cases, whether impacts would be part of a documented trend or change.

B.16 References

AASHTO (American Association of Highway Transportation Officials), 1993, *AASHTO Guide for Design of Pavement Structures*, ISBN 1-56051-055-2, American Association of State Highway and Transportation Officials, Washington, DC.

ACHP (Advisory Council on Historic Preservation), 2012, *Native American Traditional Cultural Landscapes and the Section 106 Review Process: Questions and Answers*, Washington, DC (accessed on July 11, http://www.achp.gov/na_culturallandscapes.html).

ARB (California Air Resources Board), 2014, *Mobile Source Emission Inventory – Categories - EMFAC2014*, California Environmental Protection Agency (available at http://www.arb.ca.gov/msei/categories.htm#emfac2014).

BLM (Bureau of Land Management), 1984, *Manual 8400 - Visual Resource Management*, U.S. Department of the Interior, Washington, DC, April 5.

Boeing (The Boeing Company), 2016, Letter from S. L. Shestag to S. Kuehl, Third District County of Los Angeles; M. Englander, Los Angeles City Council; and F. Pavley, Senator, 27th District, Calabasas, "Re: Letter of December 14, 2015 From Supervisor Kuehl, Councilman Englander, and Senator Pavley to Barbara Lee, Director California Department of Toxic Substances Control," February 22.

California Department of Conservation, 1992, *California Oil & Gas* Fields, Vol. 2, *Southern, Central Coastal, and Offshore California Oil and Gas Fields*, Division of Oil, Gas, and Geothermal Resources, Sacramento, California.

California Department of Conservation, 1998, *State of California Seismic Hazards Zone – Calabasas Quadrangle*, Official Map, Division of Mines and Geology, February 1.

California Department of Conservation, 2007, *Fault-Rupture Hazard Zones in California*, Special Publication 42, Interim Revision (Supplements 1 and 2 added in 2014), California Geological Survey, Sacramento, California.

California Energy Commission, 2012, *Our Changing Climate 2012 – Vulnerability & Adaptation to the Increasing Risks from Climate Change in California,* A Summary Report on the Third Assessment from the California Climate Center (available at http://www.climatechange.ca.gov/adaptation/third_assessment/), July.

Caltrans (California Department of Transportation), 1995, *Use of California Vehicle Noise Reference Energy Mean Emission Levels (Calveno REMELS) in STAMINA 2.0 FHWA Highway Traffic Noise Prediction Program*, TAN 95-03, Environmental Program, September 22.

CDM Smith, 2015, *Final RCRA Facility Investigation (RFI) Groundwater Work Plan, Portions of Area IV under DOE Responsibility*, *Santa Susana Field Laboratory, Ventura County*, November 9.

CDMG (California Division of Mines and Geology), 1981, *Mineral Land Classification of Ventura County*, Special Report 145, Parts I, II, and III, Sacramento, California.

CDWR (California Department of Water Resources), 2003, *California's Groundwater,* Bulletin 118, Update 2003, October.

Census (U.S. Census Bureau), 1995, *Bureau of the Census Statistical Brief - Poverty Areas*, U.S. Department of Commerce Economics and Statistics Administration, June.

Census (U.S. Census Bureau), 2010, 2010 Census Sex by Age Universe: Total Population 2010 Census Summary File 1 (available at www.factfinder.census.gov).

Census (U.S. Census Bureau), 2012a, *Geographic Terms and Concepts - Census Tract* (accessed on June 12, 2015, http://www.census.gov/geo/reference/gtc/gtc_ct.html).

Census (U.S. Census Bureau), 2012b, *Geographic Terms and Concepts - Block Groups* (accessed on June 12, 2015, http://www.census.gov/geo/reference/gtc/gtc_bg.html).

Census (U.S. Census Bureau), 2012c, *American Community Survey, 2012 5-Year Estimates*.

CEQ (Council on Environmental Quality), 1997a, *Environmental Justice Guidance Under the National Environmental Policy Act*, Executive Office of the President, Washington, DC, December 10.

CEQ (Council on Environmental Quality), 1997b, *Considering Cumulative Effects Under the National Environmental Policy Act*, Executive Office of the President, Washington, DC, January.

CEQ (Council on Environmental Quality), 2016, *Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews*, Executive Office of the President, Washington, DC, August 1.

City of Los Angeles, 2006, *L.A. CEQA Thresholds Guide: Your Resource for Preparing CEQA Analyses in Los Angeles* (available at http://www.environmentla.org/programs/Thresholds/Complete%20Threshold%20Guide%202006.pdf).

Cohen, S., 2014a, Santa Ynez Band of Chumash Indians, Letter to S. Jennings, U.S. Department of Energy, "RE: Santa Susana Field Laboratory (SSFL), Area IV and Northern Buffer Zone EIS, Additional Scoping Comments Extended scoping comment deadline: April 2, 2014," March 30.

Cohen, S., 2014b, Santa Ynez Band of Chumash Indians, Personal communication (email) to S. Jennings, U.S. Department of Energy, "RE: Santa Susana Field Laboratory (SSFL), Area IV and Northern Buffer Zone EIS and other issues for Secretary," December 3.

CRWQCB (California Regional Water Quality Control Board), 1994, *Water Quality Control Plan Los Angeles Region Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties*, Monterey Park, California, June.

DOE (U.S. Department of Energy), 1997, *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*, Vol. 1, DOE/EIS-0200-F, Office of Environmental Management, Washington, DC, May.

DOE (U.S. Department of Energy), 2004, *Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements,* Second Edition, Office of NEPA Policy and Compliance, Washington, DC (available at http://energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/G-DOE-greenbook.pdf), December.

DTSC (Department of Toxic Substances Control), 2007, *The State of California Environmental Protection Agency, Department of Toxic Substances Control, The Boeing Company, the National Aeronautics and Space Administration, and the United States Department of Energy, In the Matter of: Santa Susana Field Laboratory, Simi Hills, Ventura County, California, Consent Order for Corrective Action*, Docket No. P3-07/08-003, Health and Safety Code Section 25187, August 16.

DTSC (Department of Toxic Substances Control), 2010, *The State of California Environmental Protection Agency, Department of Toxic Substances Control and the United States Department of Energy, In the Matter of: Santa Susana Field Laboratory, Simi Hills, Ventura County, California, Administrative Order on Consent for Remedial Action*, Docket No. HSA-CO 10/11-037, Health and Safety Code Sections 25355.5(a)(1)(B), 58009 and 58010, December 6.

Environ (Environ International Corporation and the California Air Districts), 2013, *CalEEMod California Emissions Estimator Model User's Guide, Version 2013.2* (available at http://www.caleemod.com), July.

EPA (U.S. Environmental Protection Agency), 1974, *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*, EPA Report 550/9-74-004, Office of Noise Abatement and Control (accessed on July 31, 2014, http://www.nonoise.org/library/levels74/levels74.htm), March.

EPA (U.S. Environmental Protection Agency), 1978, *Protective Noise Levels Condensed Version of EPA Levels Document*, EPA 550/9-79-100, Office of Noise Abatement and Control, Washington, DC, November.

EPA (U.S. Environmental Protection Agency), 1995, *Compilation of Air Pollutant Emission Factors,* Volume I, *Stationary Point and Area Sources,* Section 13.2.3, Heavy Construction Operations, AP-42, Office of Air Quality Planning and Standards (accessed on March 8, 2015, http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s02-3.pdf), January.

EPA (U.S. Environmental Protection Agency), 1999, *Consideration of Cumulative Impacts in EPA Review of NEPA Documents*, EPA 315-R-99-002, Office of Federal Activities, Washington, DC, May.

FHWA (Federal Highway Administration), 2006, *FHWA Roadway Construction Noise Model User's Guide*, FHWA-HEP-05-054, Office of Natural and Human Environment (available at http://www.fhwa.dot.gov/environment/noise/construction_noise/rcnm/rcnm.pdf), January.

Groundwater Resources Consultants, Inc., 1999, *Results of Enhanced Dewatering, Building 059, Boeing North American, Inc., Rocketdyne Propulsion & Power, Ventura County, California*, September 10.

Headley, L., 2010, "The Visual Modification Class Approach to Preparing NEPA and CEQA Compliant Visual Impact Assessments," *Environmental Monitor*, Winter 2010, pp. 11-19.

Hedquist, S. L., L. A. Eillison, and A. Laurenzi, 2014, *Public Lands and Cultural Resources Protection: A Case Study of Unauthorized Damage to Archaeological Sites on the Tonto National Forest, Arizona*, Archaeology Southwest, Tucson, Arizona (available at http://www.archaeologysouthwest.org/pdf/Advances-D-14-00007.pdf), August.

IPCC (Intergovernmental Panel on Climate Change), 2013, *Climate Change 2013, The Physical Science Basis,* Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, New York, New York (available at http://www.climatechange2013.org/images/report/ WG1AR5_ALL_FINAL.pdf).

Keeling, C. D., 1960, "The Concentration and Isotopic Abundances of Carbon Dioxide in the Atmosphere," *Tellus*, Vol. 12, pp. 200-203.

MWH (MWH Americas, Inc.), 2009, *Draft Site-Wide Groundwater Remedial Investigation Report, Santa Susana Field Laboratory, Ventura County, California,* December.

MWH (MWH Americas, Inc.), 2014, *Final Standardized Risk Assessment Methodology Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California*, Pasadena, California, August.

NASA (National Aeronautics and Space Administration), 2014, *Final Environmental Impact Statement for the Proposed Demolition and Environmental Cleanup Activities at Santa Susana Field Laboratory*, Ventura, County, California, George C. Marshall Space Flight Center, Huntsville, Alabama, March.

Nickens, P. R., S. L. Larralde, and G. C. Tucker, Jr., 1981, *A Survey of Vandalism to Archaeological Resources in Southwestern Colorado*, Cultural Resources Series, No. 11, prepared for the Bureau of Land Management, Colorado.

NOAA (National Oceanic and Atmospheric Administration), 2014, *Annual Mean Growth Rate of CO2 at Mauna Loa, Hawaii*, Earth System Research Laboratory, Global Monitoring Division (available at http://www.esrl.noaa.gov/gmd/ccgg/trends), July.

OHP (Office of Historic Preservation), 1995, *Instructions for Recording Historical Resources,* Sacramento, California, March.

Parise, M. and R. W. Jibson, 2000, "A seismic landslide susceptibility rating of geologic units based on analysis of characteristics of landslides triggered by the 17 January, 1994 Northridge, California earthquake," *Engineering Geology*, Vol. 58, pp. 251-270.

Scripps (Scripps Institution of Oceanography), 2014, *CO_2 Concentration at Mauna Loa Observatory, Hawaii* (available at http://scrippsco2.ucsd.edu/), La Jolla, California.

The Engineering ToolBox, 2015, "Soil and Rock Bulking Factors," (accessed on September 17, 2015, http://www.engineeringtoolbox.com/soil-rock-bulking-factor-d_1557.html).

TRB (Transportation Research Board), 2010, *HCM 2010 Highway Capacity Manual,* Fifth Edition, National Academies of Science, Washington, DC.

Urban Crossroads, 2011, *Santa Susana Field Laboratory Area IV Traffic Noise Analysis, County of Los Angeles, California*, Irvine, California, October 12.

USDA (U.S. Department of Agriculture), 2003, *National Cooperative Soil Survey,* "Established Series," Zamora Series, Saugus Series, and Gaviota Series, Natural Resources Conservation Service.

USGCRP (U.S. Global Change Research Program), 2014, *Climate Change Impacts in the United States*, U.S. National Climate Assessment, Washington, DC (available at http://www.globalchange.gov/nca3-downloads-materials), May.

Ventura County, 2015a, *Ventura County General Plan, Goals, Policies, and Programs*, PL 13-0109, Ventura, California (available at http://www.ventura.org/rma/planning/pdf/plans/Goals-Policies-and-Programs.pdf), September 22.

Ventura County, 2015b, *Ventura County Non-Coastal Zoning Ordinance, Division 8, Chapter 1 of the Ventura County Ordinance Code*, Ventura County Planning Division, Ventura, California (available at http://www.ventura.org/rma/planning/pdf/zoning/VCNCZO_ current.pdf), March 24.

Appendix C
Alternatives Development for the Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory

APPENDIX C
ALTERNATIVES DEVELOPMENT FOR THE ENVIRONMENTAL IMPACT STATEMENT FOR REMEDIATION OF AREA IV AND THE NORTHERN BUFFER ZONE OF THE SANTA SUSANA FIELD LABORATORY

C.1 Introduction and Summary

The process for identifying the alternatives analyzed in the U.S. Department of Energy (DOE) *Draft Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory* (*Draft SSFL Area IV EIS*) originally began in 2008, when the Notice of Intent (NOI) was published in the May 16, 2008, *Federal Register* (FR) (73 FR 28437). Scoping was conducted from May 16 through August 14, 2008. Preparation of this environmental impact statement (EIS) was delayed while Area IV was further characterized for radiological and chemical constituents to delineate areas of contamination. Then, in 2010, DOE entered into an agreement with the State of California (*Administrative Order on Consent for Remedial Action* [2010 AOC] [DTSC 2010]) to clean up the soil at Santa Susana Field Laboratory's (SSFL) Area IV and Northern Buffer Zone (NBZ) to background levels or minimum detection limits. Additionally, in accordance with the 2010 AOC, DOE agreed to have no "leave-in-place" alternatives or onsite burial or landfilling of contaminated soil. In 2012, DOE hosted a series of workshops to allow community members to contribute to concepts for possible evaluation in this EIS. Because of the length of time between the 2008 scoping period and the 2010 AOC, DOE published an amended NOI on February 7, 2014, (79 FR 7439) and conducted a second scoping period (February 7, 2014, through April 2, 2014) to obtain public input on the development of alternatives and the issues that should be analyzed in this EIS. DOE considered the stakeholder input from the scoping comments from both scoping periods and the 2012 Community Alternatives Development Workshops (described in Section C.2) and, following the Prime Directives (requirements that all action alternatives must include) and the Screening Criteria (described in Sections C.3 and C.4, respectively), developed alternatives for soil remediation, building demolition, and groundwater remediation (see text box). No action alternatives are included for each category of alternative (as required by the National Environmental Policy Act [NEPA]). The action alternatives include, to the extent practicable, components put forward during the 2012 Community Alternatives Development Workshops and the 2008 and 2014 scoping periods. The screening process is described in Section C.5. A detailed description of the range of reasonable alternatives and the alternatives considered, but eliminated from detailed study, is included in Chapter 2 of this EIS.

SSFL Area IV EIS Alternatives

Soil Remediation Alternatives

- No Action
- Cleanup to AOC Look-Up Table (LUT) Values Alternative
- Cleanup to Revised AOC LUT Values Alternative
- Conservation of Natural Resources Alternative

Building Demolition Alternatives

- No Action
- Building Removal Alternative

Groundwater Remediation Alternatives

- No Action
- Groundwater Monitored Natural Attenuation Alternative
- Groundwater Treatment Alternative

C.2 Community Input into Alternatives

Community preferences have been a major component in developing the alternatives, and DOE has provided extensive opportunities for the public to provide input. The initial opportunity for the public to express their opinions on alternatives occurred with the publication of the October 17, 2007, *Advance Notice of Intent to Prepare an EIS* (72 FR 58834).

The next opportunity for the public to express their opinions occurred in the summer of 2008, during the initial scoping process for this EIS. Preliminary alternatives were presented in the May 2008 NOI (73 FR 28437) (see Appendix A), and the public was invited to comment on the proposed alternatives or suggest other alternatives or alternative concepts. The 2008 NOI alternatives included a No Action Alternative (Alternative 1) and four action alternatives: No further cleanup or disposition of buildings and no remediation of contaminated media at SSFL Area IV (Alternative 2); Onsite Containment at SSFL Area IV (Alternative 3); Offsite Disposal of SSFL Area IV Materials (Alternative 4); and Combination Onsite/Offsite Disposal Alternative for SSFL Area IV (Alternative 5). Because the 2010 AOC (DTSC 2010) required cleanup to Look-Up Table (LUT) values[1] and no onsite land disposal of contaminated soil or debris, the 2008 NOI alternatives are no longer being considered for inclusion in this EIS (with the exception of a No Action Alternative with continued monitoring and security).

More recently, two additional opportunities for public input into development of the alternatives were provided. First, in spring 2012, DOE sponsored a series of three public workshops in which the community was asked to articulate their preferences for alternatives that they would like to see included in this EIS. The second opportunity occurred during the most recent scoping period (February 7, 2014, through April 2, 2014), when public comment was sought on alternatives and issues that should be analyzed in this EIS. These comments are discussed in Section C.2.2 of this appendix.

The community expressed a number of concerns regarding various approaches to cleanup. Some wanted strict 2010 AOC compliance, including adherence to the 2017 deadline and cleanup to LUT values. Others opposed strict 2010 AOC compliance because of overriding concerns about the large number of trucks that would be transporting waste through neighborhoods and/or the possibility of causing extensive damage to biological and cultural resources by cleanup to LUT values. Some commenters that had concerns regarding potential transportation or biological and cultural resources impacts requested that DOE evaluate an alternative that would determine the extent of cleanup based on a risk assessment of the impacts compared to those of the alternatives that would provide more extensive cleanup (to LUT values).

C.2.1 Community Alternatives Development Workshops

Community members developed the cleanup concepts summarized below during the 2012 public workshops held by DOE. The concepts are similar in their focus on cleaning up and restoring Area IV and the NBZ to a level that allows use of the site as open space for wildlife or human enjoyment. Each concept calls for minimizing transportation impacts. Preferred use of native plants and measures to prevent the spread of invasive, non-native plants is a common component. The approaches to meeting these objectives are different among the concepts. To the extent

[1] The 2010 AOC stipulated that the soils cleanup standard would be based on LUT values, which are local background concentrations or laboratory method detection limits for contaminants for which the method detection limits exceed background concentrations.

possible, the concepts developed by the community were incorporated into the alternatives DOE developed for this EIS. The full text of the concepts developed by each of the four groups at the workshops is included in Attachment C1 of this appendix.

Minimize Environmental Disturbance Concept. The focus of this concept is cleaning up the environment in a way that minimizes damage to the existing ecosystem. Cleanup would be approached in a holistic manner, working toward an end state where Area IV is integrated with the entirety of SSFL and the surrounding environs as a potential national or state park and habitat linkage. Cleanup actions would be intended to minimize the removal of soil and disturbance of the local environment. Structures (except uncontaminated structures that could be repurposed) and roads would be removed. Preference would be given to *in situ* and onsite treatment of contaminated soils, materials, and groundwater, as well as recycling. Building materials would need to be managed off site and would be disposed of or recycled as close to the site as possible to minimize transportation impacts and costs. Treated groundwater would be discharged on site.

Risk-Based Prioritization Concept. Under this concept, cleanup would be prioritized based on the toxicity of the contaminants to humans and biota, as well as the efficacy of cleanup methods. The schedule would not be a driver. A cost-benefit analysis may be conducted under this concept. Excavation would be minimized for both soil and groundwater; onsite treatment methods would be preferred; and cleanup levels would correlate to established U.S. Environmental Protection Agency (EPA) or California Toxicity Levels. Tritium would be monitored and reduced through natural attenuation. The existing groundwater extraction and treatment system would be expanded, and groundwater would be removed and treated to prevent further contaminant migration. Transportation impacts would be minimized by managing truck routes and schedules and using emissions-reducing technologies such as hybrid engines and alternative fuels. Protection of endangered species and cultural resources would be emphasized. Backfilling, recontouring, and cleanup impacts for the NBZ, in particular, would be minimized. At transfer, the property would be open space.

Schedule- and Background-Driven Cleanup Concept. The focus of this cleanup concept is on meeting the 2010 AOC (DTSC 2010) requirements, including the schedule. Cleanup would be to LUT values, working toward a final state that is as near natural as possible and can be used as a wildlife corridor. All contaminated structures would be removed for disposal; uncontaminated foundations and pads would be removed, if necessary, to facilitate soil sampling after the buildings have been removed. Onsite storage of demolition debris would be limited to 30 days. The preferential order of treatment to meet the 2010 AOC standard by 2017 would be *in situ* treatment, onsite treatment, and excavation. Tritium would be monitored and reduced through natural attenuation. Metals recycling would be prohibited. Innovative methods for moving materials off the site to minimize truck traffic on existing roadways and associated impacts, such as using a modular conveyor system or improving an existing fire road, would be used. Waste transportation to offsite disposal facilities would be done via intermodal transportation (ships, rail, and trucks).

Green Cleanup Concept. This concept emphasizes the use of green cleanup technologies. A point-based system would be developed to prioritize cleanup actions that would result in an open-space-land-use end state. Various methods, activities, and components of each cleanup action would be given a point value based on factors such as cost, efficacy, degree of disturbance, and vendor location (with specific preference for use of California-based companies). Preference (and therefore more-favorable point values) would be given to eco-friendly technologies and locally based capabilities. Offsite disposal would be minimized by onsite sorting, reuse, and recycling of waste, and special attention would be given to avoiding contamination or recontamination. Activities such as scheduling and planning truck movement would be undertaken to maximize public safety during transportation. Road infrastructure would be evaluated and improved as needed. There are two variations under this concept for management of existing structures. Under the building preservation variation, structures with the potential for reuse would be retained. Under the building demolition variation, all man-made structures would be removed and disposed of without consideration for reuse.

C.2.2 2014 Scoping Comments Concerning Alternatives Development

DOE received comments regarding alternatives during the 2014 scoping period from Federal and state agencies and local governments, community organizations, environmental organizations, Native Americans, other organized groups, and members of the public. The alternatives-related comments ranged from those recommending that DOE analyze a full range of reasonable alternatives to comments demanding that DOE only analyze an alternative that meets the requirements of the 2010 AOC (DTSC 2010). Attachment C2 includes the comments received during the 2014 scoping period that concerned development of the alternatives to be analyzed in this EIS. The 2008 scoping comments were directed to the alternatives originally proposed in the 2008 NOI and therefore are not discussed here. A sampling of the alternative-related comments received during the 2014 scoping is included below to show the community preferences:

- This EIS must not consider alternatives that are in violation of the 2010 AOC, and alternatives must clean up to background levels.
- The 2010 AOC violates the spirit and intent of both the California Environmental Quality Act (CEQA) and NEPA; the entire SSFL should be cleaned up to comply with suburban residential levels stated in the 2007 *Consent Order for Corrective Action* (2007 CO) (DTSC 2007), except those areas where radiological materials were directly used.
- This EIS should examine a range of alternatives that could reduce truck transport and other impacts, while still assuring cleanup to background levels. These alternatives should be in two broad categories: (1) alternatives that propose ways to reduce the volume of soil that needs to be removed from the site and disposed of, while still meeting the background cleanup goal, and (2) alternatives that could reduce, or even eliminate, the impacts from trucking soil that needs to be removed.
- DOE should consider alternative cleanup scenarios based on risk in this EIS so decision-makers can compare the soil volume, truck requirements, and other likely and potential community impacts. These risk-based cleanup scenarios should include:
  - cleanup to the 2010 AOC level;
  - cleanup to a suburban residential standard;
  - cleanup to an industrial/commercial standard; and
  - cleanup to a parkland standard.
- Only by including most, if not all, of the community-developed concepts and approaches in the EIS alternatives can DOE comply with NEPA and provide the decision-makers and the community with the information needed to arrive at a supportable decision.
- DOE should evaluate the No Action Alternative, which would address the residual effects of no action on surrounding offsite communities, as well as identify current onsite risks. This analysis should include the current groundwater extraction and treatment system and its effectiveness.

- The 2010 AOC (DTSC 2010) standard of cleanup of soils to background levels will be responsible for the vast majority of adverse impacts. The standard is unsustainable; consequently, the 2010 AOC should be repealed or renegotiated.
- Reduce transportation impacts, either by minimizing the soil that needed to be transported by *in situ* or onsite soil treatment or reducing the impacts from transporting soil. Suggestions for minimizing transportation impacts included compacting soil in trucks, incorporating multiple truck routes, sealing the trucks, developing fire roads from SSFL, using alternative energy vehicles, incorporating rail transport, and building a conveyor system to connect to an existing rail line.

C.3 Prime Directives

To ensure the alternatives meet the purpose and need and to establish those alternative components that would apply across all alternatives, DOE identified a set of overriding considerations (Prime Directives) for use in developing the alternatives. DOE reviewed public comments and the 2010 AOC to develop the following Prime Directives considered by DOE during the alternatives screening process:

- No "leave-in-place" alternative or landfilling of soil or debris, as specified in the 2010 AOC.
- LUT values are action levels for soils. LUT values define the cleanup level of each contaminant based on background levels or minimum detection limits.
- Cleanup will include soil, groundwater, building debris, and concrete (all concrete from any removed buildings will be disposed of or recycled off site).
- Federal and California protected species (including candidate species) will be evaluated and included in the proposed 2010 AOC exemptions. Inclusion of California protected species (although not in the 2010 AOC requirements) was agreed to by the California Department of Toxic Substances Control (DTSC).
- Remediation of contamination in Area III originating from historical DOE activities in Area IV will be evaluated in the cumulative impacts analysis.

> **Purpose and Need for Agency Action**
>
> *DOE needs to complete cleanup of Area IV and the Northern Buffer Zone (NBZ) to comply with applicable requirements for radiological and hazardous contaminants. These requirements include regulations, orders, and agreements. To this end, DOE needs to remove the remaining structures in Area IV of SSFL and clean up the affected environment in Area IV and the NBZ in a manner that is protective of the environment and the health and safety of the public and workers.*

- Recognized cultural resources will be protected. With input from the California State Historic Preservation Officer (SHPO) and the Santa Susana Field Laboratory Sacred Sites Council (SSFL Sacred Sites Council), the DTSC will define Native American artifacts that are formally recognized as cultural resources, as stated in the 2010 AOC, and the SHPO and SSFL Sacred Sites Council will determine eligibility.
- DOE will evaluate the suitability of available backfill soil.
- All waste will be disposed of at licensed/permitted disposal facilities.
- EPA's Greener Cleanup Approach will be applied under all action alternatives. This includes best management practices to minimize the environmental footprint.

C.4 Criteria Development

The first step in developing the alternatives was to develop screening criteria to evaluate the various concepts proposed both by the community and DOE. DOE reviewed Council on Environmental Quality (CEQ) regulations and CEQ and DOE guidance on developing alternatives. CEQ NEPA regulations in Title 40, *Code of Federal Regulations*, Section 1500.2(e) (40 CFR 1500.2(e)) require Federal agencies to use the NEPA process to identify and assess reasonable alternatives for proposed actions that will avoid or minimize the adverse effects of these actions on the quality of the human environment. In the response to Questions 2a and 2b in its "Memorandum to Agencies: Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," (46 FR 18026) (CEQ 1981), CEQ provides the following guidance:

> Q2a. **Alternatives Outside the Capability of Applicant or Jurisdiction of Agency.** If an EIS is prepared in connection with an application for a permit or other Federal approval, must the EIS rigorously analyze and discuss alternatives that are outside the capability of the applicant or can it be limited to reasonable alternatives that can be carried out by the applicant?
>
> A2a. Section 1502.14 requires the EIS to examine all reasonable alternatives to the proposal. In determining the scope of alternatives to be considered, the emphasis is on what is 'reasonable' rather than on whether the proponent or applicant likes or is itself capable of carrying out a particular alternative. Reasonable alternatives include those that are practical or feasible from the technical and economic standpoint and using common sense, rather than simply desirable from the standpoint of the applicant.

and

> Q2b. Must the EIS analyze **alternatives outside the jurisdiction** or capability of the agency or beyond what Congress has authorized?
>
> A2b. An alternative that is outside the legal jurisdiction of the lead agency must still be analyzed in the EIS if it is reasonable. A potential conflict with local or Federal law does not necessarily render an alternative unreasonable, although such conflicts must be considered. Section 1506.2(d). Alternatives that are outside the scope of what Congress has approved or funded must still be evaluated in the EIS if they are reasonable, because the EIS may serve as the basis for modifying the Congressional approval or funding in light of NEPA's goals and policies.

DOE follows this approach to alternatives development, as described in its *Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements* (DOE 2004) (Section 4.2):

> Identify the range of reasonable alternatives that satisfies the agency's purpose and need. Include alternatives that would respond to the underlying purpose and need under a variety of reasonably foreseeable circumstances.

and

> Address **reasonable** alternatives that are outside DOE's jurisdiction, even if they conflict with lawfully established requirements (e.g., an alternative that could be reasonable if an existing law could be amended or if a regulatory agency granted a waiver).

Additionally, EPA stated the following in their scoping comments for this EIS (EPA 2014):

> The National Environmental Policy Act requires evaluation of reasonable alternatives, including those that may not be within the jurisdiction of the lead agency (40 CFR 1502.14(c)). A robust range of alternatives will include options for avoiding significant environmental impacts.

With this guidance in mind, along with the purpose and need statement and Prime Directives (see Section C.3), DOE began developing the screening criteria for evaluating the concepts. First, the set of initial criteria listed below were compiled from relevant sources, including the purpose and need statement, resource and cooperating agency criteria, Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) alternatives screening criteria, CERCLA criteria for evaluating alternatives, and community-based criteria. Similar criteria found among the sources were then combined into a single criterion to avoid redundancy. Nuances from the different source criteria were retained in each combined criterion. These criteria have alphanumeric designations indicating their origins.

Initial Criteria. The following initial criteria were compiled as described above:

PURPOSE AND NEED CRITERIA (PN)

- **PN-1:** Regulations, orders, and agreements governing hazardous materials radiological cleanup and disposal.
- **PN-2:** Compliance with the 2007 CO (DTSC 2007) (Clean up groundwater to risk-based levels.)
- **PN-3:** Compliance with the 2010 AOC (DTSC 2010) (Clean up soil to LUT values, i.e., background or minimum detection limits.)
- **PN-4:** Protect the environment.
- **PN-5:** Protect worker and public health and safety.

RESOURCE AND COOPERATING AGENCY CRITERIA (RA)

- **RA-1:** Protect cultural resources.
- **RA-2:** Protect biological resources.
- **RA-3:** Protect Native American interests: Preserve land as a sacred site or provide other required protection.

CERCLA ALTERNATIVES SCREENING CRITERIA (CS)

- **CS-1:** Effectiveness
- **CS-2:** Ease of Implementation
- **CS-3:** Cost

CERCLA NINE CRITERIA FOR EVALUATING ALTERNATIVES (PER THE NATIONAL CONTINGENCY PLAN) (CA)

Threshold Criteria:

- **CA-1:** Overall protection of human health and the environment
- **CA-2:** Compliance with applicable or relevant and appropriate requirements (ARARs)

Primary Balancing Criteria:

CA-3: Long-term effectiveness and permanence

CA-4: Reduction of toxicity, mobility, or volume

CA-5: Short-term effectiveness

CA-6: Ease of implementation

CA-7: Cost

Modifying Criteria:

CA-8: State acceptance

CA-9: Community acceptance

COMMUNITY-BASED CRITERIA (CB) (DERIVED FROM COMMUNITY CLEANUP CONCEPTS)

CB-1: After cleanup, the site should be left in as near natural a state as possible, conducive to use as open space, parkland, or wildlife corridor.

- Retain/replace with native flora to the extent possible.
- Remove existing invasive species.

CB-2: Regardless of the cleanup levels, cleanup should be performed in as environmentally sensitive a manner as possible.

- Disturb or remove for offsite disposal as little soil as possible.
- Disturb as little habitat as possible.
- Minimize use of natural resources such as water.

CB-3: Minimize transportation impacts:

- Total distance traveled (i.e., pick the closest appropriate/permitted disposal sites).
- Traffic congestion and safety on local roads.
- Traffic congestion and safety on long-haul routes.
- Air emissions (dust from loading/unloading and traveling; from exhaust).
- Transfer of non-native or nuisance species onto or off the site.

CB-4: Meet 2010 AOC (DTSC 2010) requirements.

CB-5: Include a risk-based cleanup alternative.

CB-6: Base cleanup on final land use (dropped because DOE is not the landowner and cannot determine final land use).

CB-7: Preference for onsite treatment of soils.

Selected Criteria – The initial criteria (described above) were incorporated into the selected criteria. The selected criteria were then divided into the main criteria and balancing criteria, which are described below. Four main criteria were developed that each alternative concept should meet to be incorporated into an alternative for evaluation in this EIS. Other considerations, such as stakeholder requests, also weighed into the selection of alternatives for consideration in this EIS. The remaining criteria were then designated as balancing criteria; those concepts with the largest number of favorable ratings (checkmarks) in the balancing criteria during DOE's review were deemed the most favorable concepts. A full discussion of alternatives considered but dismissed from detailed study is provided in Chapter 2, Section 2.2, of this EIS. The main criteria and balancing criteria are as follows:

Main Criteria

1. **Regulatory Compliance (PN-1,2/CA-2,8)**

   Compliance with regulations, orders, and agreements governing hazardous and radiological materials cleanup and disposal. Includes compliance with the 2007 CO (DTSC 2007) and 2010 AOC (DTSC 2010).

2. **Protect Public and Worker Health and Safety (PN-5/CA-1)**

3. **Effectiveness (CS-1/CA-3,4/CA-5)**

   Cleanup methods should be able to be implemented quickly enough to address any short-term risks and provide reliable protection over time (i.e., How well does the alternative remove or reduce the toxicity or mobility of contaminants or reduce the overall volume of contamination?).

4. **Ease of implementation (CS-2/CA-6)**

   Consider the various components of the proposed alternative and the ease or difficulty with which each could be implemented.

   Balancing Criteria

5. **Protect the Environment (PN-4/CA-1/CB-2)**

   Protect the environment, including biological and cultural resources. Regardless of the cleanup level, cleanup should be performed in as environmentally sensitive a manner as possible. Harm to sensitive species and habitats will be minimized in accordance with applicable laws and regulations, and cultural resources must be protected during cleanup activities.

   Consideration should be given to:

   - disturbing or removing for offsite disposal as little soil as possible;
   - disturbing as little habitat as possible; and
   - minimizing use of natural resources such as water.

6. **Protect Native American Interests (RA-3)**

   Preserve land as sacred site or provide other required protection.

7. **Cost (CS-3/CA-7)**

   Consider the estimated capital, operational, and maintenance costs of implementing each of the alternatives relative to the degree of protection afforded. Cost is generally not included in NEPA analyses of impacts, but is often a factor used in the decision process or as part of determining whether a proposed alternative is feasible.

8. **Community Acceptance (CA-9)**

   Consider whether the community will find this alternative acceptable.

9. **Return to Natural State (CB-1)**

   After cleanup, the site should be left in as near natural a state as possible, conducive to use as open space, parkland, or a wildlife corridor. DOE does not own the land and cannot determine the ultimate land use. Related activities would include:

   - retaining/replacing native flora to the extent possible and
   - removing existing invasive species.

10. Minimize Transportation Impacts (CB-3)

Minimize as much as possible both the onsite and offsite impacts from transporting materials and equipment onto the site for remediation activities and waste and recycle materials off the site for disposal. Consideration should be given to:

- total distance traveled (i.e., pick the closest appropriate/permitted disposal sites);
- traffic congestion and safety on local roads;
- traffic congestion and safety on long-haul routes;
- air emissions (dust from loading/unloading and traveling; exhaust fumes); and
- transfer of non-native or nuisance species onto or off of the site.

11. Preference for Onsite Treatment of Soils (CB-8)

Give preference to alternatives and treatment methodologies that leave soil on site rather than remove it for treatment or disposal.

C.5 Screening Process

Once the above criteria were finalized, concepts for soil cleanup, structure removal, and transportation were placed into a spreadsheet and rated against the four main criteria. Those concepts that passed the main criteria or were included at the request of stakeholders were then further rated against the balancing criteria. Alternative transportation concepts are not included in this EIS because DTSC is conducting a transportation study that evaluates alternative means of transporting debris and soil from SSFL. If DTSC should find other disposal routes or transportation methods potentially viable, their feasibility (including needed permits, land purchases, costs, environmental studies, and impacts to schedule) would be evaluated at that time. Groundwater remediation actions would be conducted based on the 2007 CO (DTSC 2007), which directs cleanup to be completed in accordance with Resource Conservation and Recovery Act (RCRA) requirements, including preparation of a Corrective Measures Study to evaluate remedial actions. The Corrective Measures Study will be completed in 2017 and will include an evaluation of groundwater treatment technologies. Therefore, groundwater treatment options were not put through the screening process. The results of the analysis are shown in **Table C–1** for soil contamination and **Table C–2** for structures and infrastructure. In addition to meeting the screening criteria, the alternatives selected for evaluation meet CEQ and DOE NEPA regulations and related guidance, as well as reflect, to the extent possible, public input submitted during the Community Alternatives Development Workshops held in 2012 and during the EIS scoping period from February 7 through April 2, 2014. Identifying the range of reasonable alternatives was the primary purpose of the alternatives selection process.

As shown in Tables C–1 and C–2, some of the concepts had more favorable balancing criteria; all concepts that passed the main criteria were further evaluated against the balancing criteria. The "Cleanup to AOC Background Levels" concept was retained because of requests from stakeholders, even though it had some failings against the main criteria. The alternatives developed as a result of the screening process are included in Chapter 2, Sections 2.3 and 2.4 of this EIS. Additional details on alternatives or alternative concepts that were considered, but dismissed from detailed study, are included in Section 2.2.3.

Table C–1 Alternatives Development and Selection Criteria
Alternative Component: Soil Contamination

CRITERIA \ PROPOSED ALTERNATIVE CONCEPTS	Using CERCLA balancing criteria, clean up soils consistent with ultimate land use.	*In situ* treatment has the highest priority on the scale, and offsite disposal has the lowest. Highest-risk areas should be cleaned up first.	Prioritize cleanup based on toxicity (use cost-benefit analysis) and minimize excavation (onsite soil treatment is preferred).	Cleanup levels should correlate to established EPA or State of California toxicity levels.	Cleanup to meet 2010 AOC background standard.	Preferential order of cleanup: *in situ* treatment, onsite treatment, and excavation.	Use a point-based system to evaluate and minimize soil removal by treating on site and *in situ* where possible.	Use existing buildings for soil treatment.	Mix uncontaminated soil with minimally contaminated soil to meet required cleanup levels.	Use mules and helicopters in inaccessible areas.	Flush water down inaccessible areas with steep slope. Collect the flushed water in catch basins and treat.
MAIN CRITERIA											
1. Regulatory Compliance	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes
2. Protect Public and Worker Health and Safety	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes
3. Effectiveness	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	??	No
4. Ease of Implementation	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes
Retained for further evaluation?	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
BALANCING CRITERIA											
5. Protect the Environment	–	✓	✓	–	–	✓	✓	–	–	–	–
6. Protect Native American Interests	–	✓	✓	–	–	✓	✓	–	–	–	–
7. Cost	–	–	✓	–	–	–	–	✓	–	–	–
8. Community Acceptance	–	Split [a]	Split [a]	–	Split [a]	✓	✓	✓	–	–	–
9. Return to Natural State	–	–	–	–	–	–	–	–	–	–	–
10. Minimize Transportation Impacts	–	✓	✓	–	–	–	–	–	–	–	–
11. Preference for Onsite Treatment of Soils	–	✓	✓	–	–	✓	✓	✓	–	–	–

AOC = *Administrative Order on Consent for Remedial Action*; CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act; EPA = U.S. Environmental Protection Agency; ✓ = a positive response relative to the criterion (only positive responses were recorded; all others were noted with a "–").

[a] "Split" indicates there were community members who supported the proposed alternative and other community members who opposed the proposed alternative.

Table C–2 Alternatives Development and Selection Criteria
Alternative Component: Structures and Infrastructure

PROPOSED ALTERNATIVE CONCEPTS / **CRITERIA**	**Remove all roads and road beds.**	**Remove all unnecessary or contaminated roads. Retain critical access roads and use existing, uncontaminated roads and parking areas to the extent possible. Remove when cleanup is finished.**	**Remove all contaminated structures and infrastructure (roads, buildings, pads, footings).**	**Remove all structures both above and below grade.**	**Remove all structures both above and below grade, except those that can be appropriately repurposed or that need to be removed to investigate contamination.**	**Develop a process/point system to evaluate structures for beneficial reuse versus demolition.**	**Dispose of uncontaminated demolition debris in onsite landfill.**	**Manage (dispose of or recycle) uncontaminated materials off site.**	**Provide replacement structures for sensitive species.**	**Onsite containerized storage should not exceed 30 days.**
MAIN CRITERIA										
1. Regulatory Compliance	NA	NA	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
2. Protect Public and Worker Health and Safety	NA	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3. Effectiveness	NA	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4. Ease of Implementation	NA	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Retained for further evaluation?	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
BALANCING CRITERIA										
5. Protect the Environment	✓	✓	✓	✓	✓	✓	–	–	✓	✓
6. Protect Native American Interests	–	–	✓	–	✓	✓	–	–	–	–
7. Cost	–	–	–	–	✓	✓	–			
8. Community Acceptance	–	–	✓	–	✓	✓	–	✓	✓	✓
9. Return to Natural State	✓	✓	–	✓	–	–	–	–	–	–
10. Minimize Transportation Impacts	–	–	✓	–	✓	✓	–	–	–	–
11. Preference for Onsite Treatment of Soils	–	–	–	–	–	–	–	–	–	–

✓ = a positive response relative to the criterion (only positive responses were recorded; all others were noted with a "–").

The soil contamination cleanup concept, "Cleanup levels should correlate to established EPA or State of California toxicity levels," was initially eliminated because it proposed a lower cleanup standard than required in the 2010 AOC (DTSC 2010). Because elected neighborhood councils from four neighborhoods in the nearby communities have requested a risk-based cleanup to suburban residential levels, and community members have asked for a comparison of impacts between 2010 AOC-compliant alternatives and other cleanup approaches that might minimize transportation impacts and preserve more of the natural environment at SSFL Area IV, DOE is evaluating a traditional risk-based cleanup to a suburban residential level, as proposed in the *Final Standardized Risk Assessment Methodology Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California* (MWH 2014) (although the ultimate land use envisioned by the landowner for Area IV is open space, which would result in a less stringent cleanup level).

Mixing uncontaminated soil with minimally contaminated soil to meet the required cleanup levels is not allowed by RCRA. Even if it were an appropriate cleanup method, it would not likely bring the contaminant levels down to background levels, given the large volume of clean soil that would be needed. The use of mules and helicopters in inaccessible areas was eliminated for safety considerations of the workers and mules, especially in areas with steep terrain.

Cleanup to the 2010 AOC background standard by 2017 was initially kept as an alternative. Because of delays related to soil sampling for chemicals in accordance with the 2010 AOC, preparation of required documents, review and approval of documents, and the time necessary to haul building debris and excavated soil from the site, it became obvious that the cleanup could not be completed in the 2017 time frame. The alternative was considered and dismissed as unreasonable.

Flushing water down inaccessible areas of the northern drainages to collect soil contaminants and collecting the flushed water in catch basins, where it would be collected for treatment, was also eliminated because it would use water unnecessarily and increase disposal volumes. The National Aeronautics and Space Administration (NASA) and The Boeing Company (Boeing) have demonstrated that surgical removal of contaminated sediment can be performed in the drainages without creating copious amounts of liquid wastes (Haley and Aldrich 2007, 2008; NASA 2009, 2013).

For the structures and infrastructure, the only concept that did not pass the screening process was disposing of uncontaminated demolition debris in an onsite landfill. This action is prohibited by the 2010 AOC. DOE also eliminated a number of concepts that would not be used. However, DOE would not remove the roads because they will be needed in the future for accessing the monitoring wells and evaluating revegetation efforts. DOE will not use existing buildings for soil treatment because the buildings would be removed first to allow sampling of the soil beneath the foundations, and there are no proposed soil treatment processes that would need the use of the existing buildings. The possibilities of retaining one or more structures for possible use after the property is returned to Boeing and building replacement structures for sensitive species were eliminated because the property does not belong to DOE.

As shown in Tables C–1 and C–2, some of the concepts had more favorable balancing criteria; all concepts that passed the screening were further evaluated under the alternatives for this EIS. The alternatives developed as a result of the screening process are described in detail in Chapter 2, Sections 2.3 and 2.4, of this EIS. Additional details on alternatives or alternative concepts that were considered, but dismissed from detailed study, are included in Section 2.2.3.

C.6 References

CEQ (Council on Environmental Quality), 1981, "Memorandum to Agencies: Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," 46 FR 18026, *Federal Register*, Executive Office of the President, Washington, DC, *Federal Register*, Vol. 46, March 23, as amended.

DOE (U.S. Department of Energy), 2004, *Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements*, Second Edition, Office of NEPA Policy and Compliance, Washington, DC (available at http://energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/G-DOE-greenbook.pdf), December.

DTSC (State of California Department of Toxic Substances Control), 2007, *The State of California Environmental Protection Agency, Department of Toxic Substances Control, The Boeing Company, the National Aeronautics and Space Administration, and the United States Department of Energy, In the Matter of: Santa Susana Field Laboratory, Simi Hills, Ventura County, California, Consent Order for Corrective Action*, Docket No. P3-07/08-003, Health and Safety Code Section 25187, August 16.

DTSC (State of California Department of Toxic Substances Control), 2010, *The State of California Environmental Protection Agency, Department of Toxic Substances Control and the United States Department of Energy, In the Matter of: Santa Susana Field Laboratory, Simi Hills, Ventura County, California, Administrative Order on Consent for Remedial Action*, Docket No. HSA-CO 10/11-037, Health and Safety Code Sections 25355.5(a)(1)(B), 58009 and 58010, December 6.

EPA (U.S. Environmental Protection Agency), 2014, Letter from K. Martyn Goforth, to S. Jennings, U.S. Department of Energy, "Amended Notice of Intent to Prepare an Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory, Ventura County, CA," April 2.

Haley and Aldrich (Haley & Aldrich, Inc.), 2007, *Report on Former Shooting Range/Northern Drainage Clay Target Debris Removal Work Plan, Santa Susana Field Laboratory, Ventura County, California*, San Diego, California, August 31.

Haley and Aldrich (Haley & Aldrich, Inc.), 2008, *Former Shooting Range Overshot Area Visible Lead Shot Removal Work Plan, Santa Susana Field Laboratory, Ventura County, California*, San Diego, California, August.

MWH (MWH Americas, Inc.), 2014, *Final Standardized Risk Assessment Methodology Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California*, Pasadena, California, August.

NASA (National Aeronautics and Space Administration), 2009, Fact sheet: *Santa Susana Field Laboratory NASA's Interim Source Removal Action*, November.

NASA (National Aeronautics and Space Administration), 2013, "Stormwater Improvements in Place Ahead of the Rainy Season," *Fieldnote, An Update on NASA's Cleanup Efforts at Santa Susana Field Laboratory,* October.

ATTACHMENT C1
COMMUNITY ALTERNATIVES DEVELOPMENT WORKSHOPS ALTERNATIVE CONCEPTS

In May and June of 2012, DOE conducted at three-session workshop series designed to obtain input on alternative concepts from members of the local community. In Session 1 (May 15, 2012), Sean Hecht, J.D, from the University of California, Los Angeles Law School, provided an overview of applicable environmental laws to 21 members of the community. DOE also provided information on how DOE implements the relevant Federal regulations. For Session 2 (June 7, 2012), DOE provided information to 34 community members regarding the purpose and need for DOE action and the elements that would need to be included for each alternative concept to be considered in this EIS. These elements included: the condition of the property at transfer to Boeing, structures/infrastructure, soil contamination, disposal of contaminated soil and construction debris, transportation of material to disposal sites as well as fill material back to the site, and groundwater. For Session 3 (June 9, 2012), 35 members of the public were divided into four groups, with each group working together to develop alternative concepts for this EIS. A facilitator recorded the alternative concepts for each group, and the groups reviewed the draft alternative concepts and made adjustments. The final alternative concepts for each of the four groups are provided on the following pages.

This page left blank intentionally.

Santa Susana Field Laboratory Area IV Environmental Impact Statement
Alternatives Development Workshop June 9, 2012,
Proposed Alternative Concepts

	Minimize Environmental Disturbance (Blue Group)	**Risk-Based Prioritization (Orange Group)**	**Schedule-and-Background Driven Cleanup (Salmon Group)**	**Green Cleanup (Yellow Group)** *The Yellow Group presents variations on points where participants' preferences diverged, as shown in parallel columns.*	
Summary Statement	Cleanup SSFL Area IV environment in such a way as to not cause damage to the existing ecosystem in excess of need.	Orange Group members believe that DOE should produce a full-scope EIS that takes into consideration a full range of alternatives not limited to the cleanup to background for soils stipulated by the 2010 AOC Agreement in Principle. We would appreciate a sincere effort on the part of the DOE to adopt a comprehensive approach in the EIS that unequivocally covers the potential damage to the natural environment, water, air, and public health resulting from a wholesale removal of soils. The wholesale removal of soils with low to high levels of contaminants is a poorly conceived method intended to clean up the site to an ill-defined or impossible-to-define "background."	We feel strongly that DOE should take all steps necessary to obtain sufficient funds to implement the 2010 AOC on the agreed schedule. DOE should take all steps necessary to meet the 2017 schedule. There should be no back-tracking and DOE should focus on implementing the 2010 AOC. In addition, DOE should work in cooperation with the California Department of Toxic Substances Control to prepare a joint Environmental Impact Statement/ Environmental Impact Report (in compliance with the National Environmental Policy Act and the California Environmental Quality Act).	– At the beginning of the cleanup & throughout the cleanup process, consider the entire SSFL property's condition at transfer & potential end use. – Establish point-based prioritization system (similar to LEED system for Green Construction certification) for all activities. – Minimize creation of new risks and new problems as we solve old ones. – Engage California companies and California residents in any new jobs created. – Minimize soil movement by use of alternative treatment technologies; careful sorting of contaminated materials to keep as much out of disposal facilities as possible; preserving uncontaminated infrastructure, vegetation, and soil. – Establish a place open to the public with potential for one or more museums, research laboratories, etc. that documents the site's history and remediation and provide facilities for research on remediation relevant to the SSFL.	
				Building preservation variation: Preserve uncontaminated structures.	***Building demolition variation:*** Remove all buildings in Area IV, as all structures have been declared NOT significant.

<table>
<tr>
<th rowspan="2"></th>
<th rowspan="2">Minimize Environmental Disturbance
(Blue Group)</th>
<th rowspan="2">Risk-Based Prioritization
(Orange Group)</th>
<th rowspan="2">Schedule-and-Background Driven Cleanup
(Salmon Group)</th>
<th colspan="2">Green Cleanup
(Yellow Group)
The Yellow Group presents variations on points where participants' preferences diverged, as shown in parallel columns.</th>
</tr>
<tr></tr>
<tr>
<td rowspan="2">Condition of the Property at Transfer</td>
<td rowspan="2">– Complete mitigation supportive of native habitat, including cultural resources, flora, and fauna.
– Property should be conducive to integration with open space/parkland.
– Infrastructure should support such open space/parkland use.
– Property should commemorate the history of the site.</td>
<td rowspan="2">At transfer, the property should be open space, highly invasive non-native plant species removed, re-vegetated with native habitat, preserving biological, botanical, cultural, and historical resources. All Federal, state, and local special status species will be protected. In particular, the major population of federally endangered Braunton's milk-vetch (Astragalus brauntonii) growing on the southwestern hills in Area IV will be undisturbed and protected, as will the major populations of Santa Susana tarweed (Deinandra minthornii) growing in the northern portion of Area IV. Smaller populations of Santa Susana tarweed growing on the rock outcrops around Area IV will also be protected from disturbance. The SSFL property will have a visitor's center focusing on history and educational issues relevant to the site. Replacement nesting/roosting structures shall exist on the site. (See Structure/Infrastructure below.)</td>
<td rowspan="2">Clean the property to the 2010 AOC's requirement of background levels. This is not an alternative but a requirement, consistent with the Purpose and Need statement. Following cleanup, Area IV should be clean enough to serve as a wildlife corridor, in a near-natural state similar to the state of property prior to the installation of buildings.</td>
<td colspan="2">– Using a collaborative process, consider the entire SSFL property's condition at transfer and potential end use as cleanup decisions are made and implemented.
– Establish a decision-tree process to preserve and document site history and history of cleanup.
– Maximize sustainability.
– Keep uncontaminated infrastructure wherever possible.
– Don't create new problems as you solve the old ones.
– Establish a space open to the public but with limited private vehicle access to minimize future environmental damage.
– Preserve peripheral slabs for public parking, so shuttles can take people on the site.
– Preserve archeological features.
– Foster the natural state:
• Return the site to the original state as near as possible and practical: try to ascertain and re-establish what was there prior to development, at the same time as you maintain positive features currently in place, like the oak forest.
• Do not create additional damage during cleanup – for example, avoid cutting down existing vegetation and spray painting the rocks, as was done during characterization.
– Minimize soil movement to reduce truck traffic.</td>
</tr>
<tr>
<td>Building preservation variation:
Keep uncontaminated buildings wherever possible.</td>
<td>Building demolition variation:
Remove all buildings in Area IV.
Do not support attempting to save any structures in Area IV. All structures have been declared NOT significant already.</td>
</tr>
</table>

	Minimize Environmental Disturbance (Blue Group)	Risk-Based Prioritization (Orange Group)	Schedule-and-Background Driven Cleanup (Salmon Group)	Green Cleanup (Yellow Group) *The Yellow Group presents variations on points where participants' preferences diverged, as shown in parallel columns.*	
Structure/Infrastructure	– Remove all structures except those that can be appropriately repurposed (for example, keep the million dollar hole [Building 4056 excavation] and the Sodium Pump Test Facility). *Option A* – Leave non-contaminated/stable subsurface structures and footings in place. *Option B* – Remove building foundations, roads and road base for appropriate offsite management. *Option C* – Same as Option B, with onsite management. – Remove roads after the A, B, or C option.	– Remove all contaminated structures and infrastructure that cannot be decontaminated in place on a cost-effective basis. Where possible, consider re-using non-contaminated structures for the visitor center. Removal and decontamination priorities shall be based on toxic risk assessments. – Known or newly discovered historical /cultural sites shall be left undisturbed and be protected. – Short-term (measured in days or weeks, not months) onsite storage of containerized debris shall be confined to unused paved parking lots. No land shall be cleared for the purpose. Sorting of debris shall be done at the site of removal. Recycling shall be given priority. – Remove all unnecessary road paving. Maintain critical access roads and use existing, uncontaminated roads and parking lots to the extent possible. Assess need for remaining uncontaminated infrastructure using best management practices and /or on a case-by-case basis. Uncontaminated debris and slabs may be left in place. – Replacement structures for sensitive species, such as raptors, shall be constructed near existing structures currently used by wildlife prior to their demolition.	– Remove contaminated roads, pads, etc. as required by the 2010 AOC. Remove uncontaminated pads and foundations as needed to investigate for the presence of contamination. This is not an alternative but a requirement, consistent with the Purpose and Need statement. – Short-term, onsite contained storage is acceptable, but should not exceed 30 days.	***Building preservation variation:*** Establish a process for evaluating structures for beneficial use prior to demolition. Avoid unnecessarily filling trucks with non-contaminated structures. Focus on things that must be done. Apply a point system to determine whether it is more cost-effective to keep or demolish each structure. Retain all uncontaminated structures that can potentially be turned to beneficial use (like the Annenberg Foundation Malibu Creek project – see attachment). This would be part of the program to reduce the amount of soil that is moved around. Set aside "appropriate" buildings for future use as museum(s) and related facilities, such as Science of Remediation or Laboratory for Future Projects (such as testing of technologies) and Education. View this as part of making the site self-sustaining cost-wise… "Build it and they will come," meaning colleges and universities.	***Building demolition variation:*** – Remove all buildings in Area IV. – Do not support attempting to save any structures in Area IV. All structures have been declared NOT significant already.

	Minimize Environmental Disturbance (Blue Group)	**Risk-Based Prioritization (Orange Group)**	**Schedule-and-Background Driven Cleanup (Salmon Group)**	**Green Cleanup (Yellow Group)** *The Yellow Group presents variations on points where participants' preferences diverged, as shown in parallel columns.*
Soil Contamination	Remediate soil to level consistent with ultimate land use. Avoid removal to the extent possible. *Step 1*: Develop hierarchy of area's cultural and ecological assets based on balancing criteria in CERCLA. *Step 2*: Select from suite of technologies for soil remediation based on Step 1. Give preference to *in situ* remediation. *Step 3*: Perform soil removal, minimizing the potential for water runoff and migration of contaminants to other areas of SSFL and off site. Make sure room is left for possible future options that are not explored at this time. Work in order of these priorities: 1. *In situ* Treatment 2. Onsite Treatment 3. Onsite Containment 4. Isolate sources of multiple contaminants mixing to prevent further mixing 5. Other Option 6. Other Option 7. Any Other Option 8. Soil Removal to Offsite Location (last resort/last option) ** Remediate highest-risk areas first ** Implement phytoremediation immediately	– Toxicity is a major consideration in development of LUTs. – Conduct toxicity analyses on known areas of contamination. Prioritize cleanup areas by toxicity. Based upon prioritization, select best available treatment(s) for those most toxic areas first. Following that, focus on areas of lower toxicity. Minimize excavation by using a suite of alternative treatments, including onsite treatment, based on priorities (determined by toxicity analyses). This approach includes the assumptions: • That the prioritization process described above is carried forward through the LUT development and application; • LUT numbers should be able to correlate with established EPA or State of California toxicity levels. – The cleanup process should be thoughtfully applied without deadline(s) as the driver. New treatment technologies should be continually sought. Cost-benefit analysis, based on toxic risk, shall be applied proactively and funds budgeted accordingly.	For contaminated soils, cleanup to meet the 2010 AOC standard of background levels by 2017 as stipulated in the 2010 AOC as follows: 1. Remediation *in situ* (in place) using technologies that have been demonstrated to be effective and timely where possible. 2. Excavate and treat on site using technologies that have been demonstrated to be effective and timely where possible for soils that cannot be remediated *in situ*. 3. Excavate no more than necessary (e.g., aiming to not excavate soil to a depth deeper than where the contamination is located) for those soils that cannot be treated using 1 or 2 (above). 4. Remove that which must be removed as soon as possible. 5. For contamination found in relatively inaccessible parts of the northern drainages, consider: a. Installation of catchment basins in more accessible locations downstream and introduction of water at or above the location of the contamination to allow accessible impoundment to remove and/or treat contamination. Flush with water, collect in a catchment, and treat or remove with vacuum trucks for remote disposal. b. Use of mules and/or helicopters to minimize disturbance. 6. Consider use of soil vapor extraction to address volatile organic compounds in the soil.	– To reduce the volume of contaminated soil to be removed, identify and treat the gradients of less contaminated soil surrounding the "pink blobs" so this less contaminated, now treated, soil can remain on site. – Use existing buildings for soil treatment. – Ensure "outlier" contaminated soils (those that occur outside the sphere of the main contaminated areas) are treated or removed. – Evaluate sorting out uncontaminated onsite soil and mixing it with soil that has low levels of contamination to bring the mixed soil within the levels required by the LUTs. – Have a system for making decisions about moving soil. Always use alternate technologies over "muck and truck." Model the system on the U.S. Green Building Council, LEED Certification System. (The highest level is Platinum.) Use a system that already exists and take the emotion out of decision-making. – For remaining characterization of site soils, take samples of plant materials that grow in the soil to be tested and analyze them to see whether they show signs of any of the contaminants of concern. – During remaining characterization and cleanup, ensure that all workers are properly wearing personal protective equipment for all tasks. – Evaluate whether the entire SSFL is a "Traditional Cultural Property" and ensure active on-going consultation with Native American populations in the area. – Have a soil treatment options system that includes a parallel evaluation of the site for areas that have "sensitive" issues, such as archeological or biological or safety issues and therefore call for special treatment. Some areas may call for sequestering, for example, the steep incline in the northern drainages.

	Minimize Environmental Disturbance (Blue Group)	Risk-Based Prioritization (Orange Group)	Schedule-and-Background Driven Cleanup (Salmon Group)	Green Cleanup (Yellow Group) *The Yellow Group presents variations on points where participants' preferences diverged, as shown in parallel columns.*
Disposal	Categorize waste by level of contamination. – Dispose of most contaminated soil first. Only most contaminated soil goes off site to appropriate landfill (closest and least expensive). – Separate waste streams to maximize onsite disposal and minimize offsite disposal. – Recycling of uncontaminated metal and other recyclables should be pursued whenever possible.	– For contaminated material: Subsequent to implementation of all treatment options, remaining contaminated materials would be taken to appropriate, licensed facilities. All other debris would be disposed of by landfill or recycling as appropriate, and include requirements as described in Structure / Infrastructure. Where necessary and feasible, local disposal, for example at Calabasas Landfill, is preferred over long-distance transport. – Priorities should follow the recommendations indicated under Structure / Infrastructure, and cost-benefit analysis should be applied as indicated under Soil Contamination.	– For radiological contamination: The three options identified by DOE for disposal of radiological contamination (Nevada National Security Site in Nevada, Energy*Solutions* in Utah, and Waste Control Specialists in Texas) seem acceptable. DOE should choose between the three based on the following considerations (in order of importance): • Minimize the distance that contamination must be shipped. • Minimize impacts on communities already negatively impacted by environmental hazards (environmental justice considerations). • Select a disposal site that can accept rail shipments (presuming rail transportation is selected for transport to disposal site). • Minimize cost. – For mixed waste (containing both radiological and chemical contaminants): follow the same considerations listed above to select the most appropriate disposal site from among the same three disposal sites identified for radiological contamination. – For waste containing chemical contamination, follow the same considerations listed above for selection from among licensed facilities that can accept chemical contamination. – Before any excavated material can be shipped to a disposal site not licensed to receive radiological or chemical contamination, that waste must be proven to be uncontaminated. – This group prefers that no metals be shipped for recycling based on prior bad experiences. – Minimize the quantity of material to be disposed of (soil and construction debris) by using clean (based on the 2010 AOC) onsite fill material in areas where fill is needed.	– First priority is treatment to reduce need for disposal. – Place high priority on onsite sorting of waste to minimize creation of mixed waste. – Place high priority on using California-based companies, such as disposal sites for nonradioactive waste. – Strive for solutions that are characterized by longevity, with the goal to avoid recontamination. – Develop a matrix system for easier and more efficient decision-making on disposal that recognizes cost, jobs, local impacts, environmental justice, health effects, safety, etc. For example, safety must be a factor in deciding what to do about characterizing and cleaning up the steep inclines in the northern drainages. – Reduce debris by good sorting – concrete slabs can be reused as foundations for shade pavilions. Don't remove the slabs if it is not necessary. – Recycle metals, equipment, building materials. – Use a point system for setting priorities under a constrained budget.

	Minimize Environmental Disturbance (Blue Group)	**Risk-Based Prioritization (Orange Group)**	**Schedule-and-Background Driven Cleanup (Salmon Group)**	**Green Cleanup (Yellow Group)** *The Yellow Group presents variations on points where participants' preferences diverged, as shown in parallel columns.*
Transportation	MINIMIZE!!! Minimize offsite transportation requirements by onsite treatment and containment. – Assess feasibility of improving existing fire roads from northern drainage area to Southern Pacific rail spur – Evenly distribute transportation routes for disposal – Evaluate railroad option – Consider current and projected traffic conditions along suggested routes, especially Woolsey Canyon Road, Lake Manor Drive, Plummer Street, Topanga Canyon Blvd. and State Route 118 (Ronald Reagan Freeway) (e.g., rush hour, overloaded intersections, current traffic impacts, ability for trucks to navigate existing roadways [i.e., – turns]) – Be mindful of invasive species control with vehicles coming on and off site. – Include an appropriate interval between truck shipments (such as one every 5 minutes) leaving SSFL.	– Minimize number of loads and transportation of waste from site by truck by making every effort to treat soil on –site. Follow established routes and select route based upon contaminant types, concentrations, and load weights. For example, Chatsworth route may not be appropriate, because it is a narrow two lane road through a residential and light commercial area, and the road may not be designed to support hours of heavily loaded truck traffic. Look to minimize shipping distances when selecting approved and /or licensed disposal locations. Best management practices should be utilized to protect the public health by minimizing noise and air pollution; trucks should be required to utilize new technologies such as alternate fuels, new hybrid engines, and/or engines with low emissions. – Transportation activities should occur during the hours between 0900 and 1430 to avoid rush hours and school arrivals and departures, and to prevent accidents that could occur by trucks driving on Woolsey Canyon Road after dark.	*Mode of transport:* 1. Off the mountain, consider using a modular conveyor system with dust controls (either an enclosed belt or sealed containers for the materials being conveyed) or (if that won't work) trucks using modular containers. Conveyance system may also be suspended cable – think zip line or ski lift – to which the containers are attached. 2. To the disposal site, consider rail option of transferring onto rail. Evaluate use of transfer points on both sides of the county line (e.g., Simi Valley and Chatsworth). 3. If the Texas disposal site is selected, consider using ship transport relying on Port Hueneme or Los Angeles harbor. 4. If trucks must be used, use electric or natural gas to minimize air emissions. 5. If trucks must be used, employ truck washing/ decontamination (including tires) to avoid moving contamination off the site. *Routes:* 1. Off the mountain, consider developing an existing fire road from Area IV into Simi Valley OR through Ahmanson Ranch (possibly to Van Nuys rail yard for transfer to rail transport) as an alternative to Woolsey Canyon Road. 2. If trucks down Woolsey Canyon Road, consider alternative routes from the bottom of Woolsey Canyon Road and consider spreading out the impact by rotating among multiple route options. 3. Consider upgrading roads to compensate for damages to be incurred. *For fill:* Use onsite material for fill and onsite re-contouring whenever possible. If must use offsite fill, use the same mode of transportation and routes as for excavated materials.	– Ensure road infrastructure from top to bottom of mountain is safe: • Include a bike lane and turnouts on Woolsey Canyon Road/Valley Circle Blvd. so cyclists are not run off the road. • Establish a clear definition of ownership of the road • Use natural gas for fuel and other environmentally protective steps. • Rework/reconstruct the intersection at Woolsey Canyon Road and Valley Circle Blvd. • Incorporate safety measures, including live monitors, strict enforcement of speed limit. – Maximize safety to community and to drivers. – Minimize fill to be brought in. – Minimize bringing new materials to SSFL that will have to be taken away later. – Coordinate transportation among all parties responsible for SSFL cleanup to minimize impacts to community and the environment. – Keep jobs in California for chemical waste disposal – Build temporary treatment plant in Area IV for SSFL chemical waste – then dismantle after cleanup.

	Minimize Environmental Disturbance (Blue Group)	Risk-Based Prioritization (Orange Group)	Schedule-and-Background Driven Cleanup (Salmon Group)	Green Cleanup (Yellow Group) *The Yellow Group presents variations on points where participants' preferences diverged, as shown in parallel columns.*
Groundwater	Priority: Focus on source removal to minimize impacts to groundwater (vadose zone): – Continue SSFL site-wide coordination of groundwater investigation and remediation. This includes Area IV. – Continue monitoring forever, including seeps and springs. – Continue treatment using existing systems. – Explore new technologies as they become available. – Treated groundwater should go back into the ground on site. If this is not possible, it should be retained for discharge during the appropriate season (wet season) in consideration of biological resources. – Groundwater treatment technologies cannot cause a bigger problem than what treatment is trying to fix (i.e., fracking).	– Expand GETS. Pump groundwater to prevent further contaminant migration. Explore data gaps on seeps and springs. Install vapor extraction system where necessary. Continue with tests that are in place, but accelerate groundwater treatability studies to include present and future technologies. Tritium in groundwater: allow natural attenuation with continued monitoring. – Priorities should follow the recommendations indicated under Structure / Infrastructure, and cost-benefit analysis should be applied as indicated under Soil Contamination. – Groundwater and soil treatment must be considered and treated at the same time to prevent recontamination of new soil by groundwater.	– Implement radically enhanced pump and treat system (better than Boeing's current or previous Groundwater Extraction Treatment System) to treat the groundwater and control further spread of contamination. – In parallel, aggressively investigate, test, and implement, in a timely fashion, advanced technologies (that have been demonstrated to be effective) to treat groundwater contamination. – Install long-term monitoring wells, including at the base of the Santa Susana Mountains where they intersect with the Simi Valley alluvium to detect migration of contaminants. – It is possible that Tritium cannot be addressed as it is too difficult to separate from water for treatment; short life means quantity will diminish significantly in relatively short period of time.	– Use phytoremediation and other alternative technologies to reduce soil movement and draw contamination toward "neutralization" points. – Keep native plants and use plants that reduce secondary impacts, i.e., if the plants are non-native, make sure they do not cause other adverse impacts. – Use treated groundwater to irrigate phytoremediation plants; in reusing treated groundwater, store it as close to original location as possible. – In event of constrained funds: • Use funds where they will have the best and most beneficial effects. • Halt contaminant migration patterns.

	Minimize Environmental Disturbance (Blue Group)	Risk-Based Prioritization (Orange Group)	Schedule-and-Background Driven Cleanup (Salmon Group)	Green Cleanup (Yellow Group) *The Yellow Group presents variations on points where participants' preferences diverged, as shown in parallel columns.*
Additional Actions	– *Backfill* – Use locally sourced and similar type and seed bank, reuse onsite soil when possible. – *Re-contour* – return the land, as much as possible, to the original land contours. – *Revegetate* – local natives. – All actions done in consultation with other appropriate state resource agencies including State Parks, Fish and Game, and Santa Monica Mountains Conservancy. – Create and implement SSFL Integrated Restoration and Resource Management Plan before hand-over to Boeing. – Make property accessible for educational opportunities. – Property should be conducive to integration into regional open space parkland and Rim of the Valley planning. – Integrate property into Santa Monica Mountains National Recreation Area or similar national park service entity (i.e., Rim of the Valley). – Create an Endowment. – Must address cumulative impacts with NASA and Boeing. – Bury non-contaminated debris on site. – Conduct a cost-benefit analysis of all possible cleanup levels on the site. – Cleanup visible debris in northern drainage area.	– Backfilling should be minimized, and its placement should be timed to lessen erosion potential. – Backfill soils should be similar to what was taken from the contaminated area. – Any re-contouring should be minimal, should consider natural drainage patterns, and should be performed for remediation purposes only after soil disturbances. – Revegetation should be site-specific, consist of local, native plant species and should allow for re-colonization of Area IV by native plant species from adjacent habitat. – Long-term monitoring will be performed and will include monitoring of soils, drainages, historical, archaeological and biological resources that are protected or listed (or when these resources are discovered during the remediation process). Cleanup impacts to the NBZ should be minimized to the extent possible. – Systematic monitoring of plants growing on contaminated soils should be instituted to evaluate the effectiveness of contaminant uptake, degradation, and potential adverse effects on consumer species. – The group believes its suggestions for conditions at transfer can be accomplished.	– For the Sodium Burn Pit, a permanent remedy is needed for contamination in, near, and beneath (including the bedrock) the former sodium burn pit, including the NBZ, as previous cleanup work was to provide an interim remedy only. A final remedy is needed for long-term protection, consistent with the 2010 AOC. – Backfilling, re-contouring, and revegetation to restore the landscape to the desired condition (wildlife corridor). – Long-term monitoring to assure ongoing effectiveness. – Maintain complete records in a form that will last to memorialize all known information and maintain those records in a form that can be accessed using existing technology in perpetuity.	– Revegetation should include native plant species that are beneficial to erosion control, as well as those that are efficient in uptake of potential remaining contaminants. – Establish responsible contour of land to protect drainages, prevent erosion, etc. – Establish long-term monitoring to ensure no recontamination and to make sure contaminants do not move (as with groundwater). – Long term monitoring should also include phyto-data as far as contaminant uptake, number of cycles, to demonstrate progress and how alternative solutions are applied and their success measured. – Establish mechanism for coordinated decision-making among all parties to ensure cooperation, information sharing, etc. – Provide for active dust suppression by a guy with a hose (meaning a human who can judge how much water is just right – not too much or too little).

	Minimize Environmental Disturbance (Blue Group)	Risk-Based Prioritization (Orange Group)	Schedule-and-Background Driven Cleanup (Salmon Group)	Green Cleanup (Yellow Group) *The Yellow Group presents variations on points where participants' preferences diverged, as shown in parallel columns.*
Total Package	Cleanup SSFL Area IV environment so as to not cause damage to the existing ecosystem in excess of need, *Priority*: Protect, Don't Destroy. *2nd Priority*: Ultimate (best and highest use) – Parkland and Habitat Linkage. *3rd Priority*: Ecological functionality and cultural resource protection: – Contain and treat as much as possible on site. – True cleanup, not relocation. – Regional Coordination. – Site-wide Coordination. – Document historic significance of Area IV. – Scientific decision-making	– Most important: Review results of site assessments and toxicity characterization. Prioritize clean up accordingly based upon toxicity to humans and biota. – Least important: Meeting the 2017 deadline. – Urgent: There is a need for rumor control and a reliable, responsive source of information dissemination to combat exaggerated claims of negative health and safety impacts emanating from the site. – Possible positive impacts: public health and safety will be protected; the SSFL site will be restored to open space; and native habitat will be protected and restored as necessary. – There is a lessening of fear levels in surrounding communities, a growing appreciation of the natural beauty and cultural history of the site, and involvement by local residents in staffing and in volunteering at the onsite Education Center.	Most important – Get started and get finished.	– Make it safe while protecting what's there today. – Least important: the political "win." – Most urgent: identify all potential contaminant pathways so that best priorities can be established. – Positives: we'll have a clean site. – Negatives: Land-use limitations must be detailed for perpetuity, as we believe it is inappropriate to consider any part of Area IV for residential land-use, due to known groundwater impacts likely to exceed the several generations required to complete that cleanup. – The vision: A site that shows it was cleaned up with green technology, striving for a reduced foot print, … (complete with each of the two variations below) ***Building preservation variation:*** …keeping uncontaminated buildings (such as Building 9 with the movable roof) so that they might be used for a museum to showcase site history, remediation technologies, and responsible reuse (as examples). ***Building demolition variation:*** …removing all buildings in Area IV, as all structures have been declared NOT significant already.

	Minimize Environmental Disturbance (Blue Group)	Risk-Based Prioritization (Orange Group)	Schedule-and-Background Driven Cleanup (Salmon Group)	Green Cleanup (Yellow Group) *The Yellow Group presents variations on points where participants' preferences diverged, as shown in parallel columns.*
		– Possible negative impacts: Transportation of hazardous waste and nonhazardous waste and infrastructure and all transportation associated risks and drawbacks, including damage to the site environment, roads, etc., health and safety impacts for the community living in the area which include potential lung and other illnesses associated with traffic, the potential for accidents and spills, and noise. Increased contamination of other areas (other landfills) that may be impacted by Area IV and NBZ remediation. Maintenance and security considerations may impact long-term site access for humans and wildlife. – Weakness to be addressed: There is a potential for failures of treatment methodologies, lack of clarity as to the end state desired, failures or obstruction due to political interference, failures or obstruction from a proliferation of misinformation, and / or deliberate disinformation campaigns.		***Please note that the Yellow Group provided an exhibit to illustrate their vision for the future.***

AOC = *Administrative Order on Consent for Remedial Action*; Blvd. = Boulevard; CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act; EPA = U.S. Environmental Protection Agency; GETS = Groundwater Extraction and Treatment System; LEED = Leadership in Energy and Environmental Design; LUT = Look-Up Table; NASA = National Aeronautics and Space Administration; NBZ = Northern Buffer Zone.

ATTACHMENT C2
SCOPING COMMENTS PERTAINING TO DEVELOPMENT OF ALTERNATIVES FOR THE *DRAFT SSFL AREA IV EIS*

February 7, 2014, through April 2, 2014

Code [a]	*Commenter and Comment Summary*
	AL = Alternatives/Alternative Development
AL-1	*Commenters: Multiple form letters, individuals and organizations* DOE needs to clean up Area IV to background levels as indicated by the legally 2010 AOC. The 2010 AOC requires that DOE's actions be in accordance with applicable Federal, state, and local laws and regulations, including the NEPA.
AL-2	*Commenters: Multiple form letters, individuals and organizations* The NOI includes numerous alternatives and "concepts" that would violate the 2010 AOC (three out of four) and leave behind most of the contamination that was promised to be cleaned up (e.g., *in situ*). The EIS must not include alternatives that would violate the 2010 AOC.
AL-3	*Commenters: Multiple form letters, individuals and organizations* As it prepares for the EIS, DOE appears to be trying to find ways to get out of complying with its cleanup agreement.
AL-4	*Commenters: Multiple form letters, individuals and organizations* DOE expressly promised in 2012 that the EIS alternatives would not include any that would violate the requirements of the cleanup agreement (with the exception of the standard No Action Alternative), yet that seems to be what DOE is now proposing. DOE should live up to the 2010 AOC and its 2012 commitments about the EIS.
AL-5	*Commenters: Individuals* Unable to tell which of the "community-built" alternatives was integrated into the alternatives listed in the NOI. Specific request to incorporate one of these alternatives in the EIS.
AL-6	*Commenters: Multiple individuals and organizations* The proposed deadline for cleanup of 2017 is not feasible; the deadline should be extended. An extension of the cleanup deadline under the 2010 AOC appears necessary, or the use of a risk-based cleanup that can be accomplished by 2017.
AL-7	*Commenters: Multiple individuals and organizations* NEPA and the CEQA both set standards for environmental considerations that must be addressed in environmental documents, and contracts that are inconsistent with those laws do not trump NEPA and CEQA provisions. The NEPA and CEQA analyses must consider all options, not the single path set by the 2010 AOC.
AL-8	*Commenter: Organization* Exclusion of any possible cleanup alternatives, except the expected 2010 AOC-mandated cleanup approach, would be a momentous detriment to the usefulness of the EIS and would likely invalidate it under NEPA. The EIS must not exclude from consideration reasonable alternatives supported by authorized standards of the State of California, including: No Project; Cleanup under the 2010 AOC; Cleanup to Open Space standards; and Cleanup to Suburban Residential standards.
AL-9	*Commenters: Multiple individuals and organizations* DOE's EIS must, for each alternative, present comparison of costs, time durations, and all related effects on transportation, biological resources, cultural resources, soil, water, and air. Every cleanup measure proposed must be subject to a rigorous cost-benefit analysis. A comparison of the benefits of proposed remediations versus the comprehensive and cumulative costs, biological, watershed and environmental costs. The cost must include not only dollar costs, but cost of damage to the environment; the effects on local water resources-streams and canyons; damage to the air and to the health of the surrounding communities; damage to cultural (Chumash) sites and artifacts; damage to the space race history structures; destruction of local roads and bridges; and costs to repair Los Angeles County, Los Angeles City, and state highways from the estimated extremely high volume of truck trips.

Code [a]	***Commenter and Comment Summary***
AL-10	*Commenter: Organization* A discussion of alternatives should include what DOE will do if the Appeals Court supports the lower court decision, which will have the effect of stating that a special, negotiated cleanup standard is not permissible at SSFL under California law. An explanation should be provided to explain why the public should pay for a cleanup that is inconsistent with the law, and why local residents should be subjected to significant environmental contaminants from emissions, disturbed soil and related fugitive dust effects, and surface water runoffs that are greatly increased by unavoidable consequences of a background level cleanup of the site. A District Court decision filed May 5, 2011, prohibits the DTSC from compelling compliance with SB990. DOE's 2010 AOC appears to operate as a substitute for a questionable law, but the justification for its position requiring a "background level cleanup" on this important site is very unclear. That DTSC and political pressure seem to have required signature of the 2010 AOC by DOE shortly before this decision was issued in May 2011 is very significant. We believe all decision-makers and the public are entitled to see the impacts of all alternatives.
AL-11	*Commenter: Organization* There are many environmental cleanup projects in the United States. They all (as far as anyone knows) MUST operate according to Federal and State [U.S. and California] EPA laws that were passed by legislators concerned with protecting the environment. Operating under EPA processes means any toxic cleanup MUST evaluate multiple reasonable alternatives. The DOE SSFL cleanup was forced to be uniquely different from other projects because the 2010 AOC was signed before any EIS-type document. Why the difference? How is the different treatment of these projects explained? We can fathom no reasonable explanation. DOE cleanup based on scientific results, testing, and standards, not political pressures.
AL-12	*Commenters: EPA, and Organizations* NEPA requires evaluation of reasonable alternatives, including those that may not be within the jurisdiction of the lead agency (Title 40, *Code of Federal Regulations*, Section 1502.14(c) [40 CFR 1502.14(c)]). A robust range of alternatives will include options for avoiding significant environmental impacts. The EIS should provide a clear discussion of the reasons for the elimination of alternatives which are not evaluated in detail.
AL-13	*Commenter: EPA* The environmental impacts of DOE's proposed action and alternatives should be presented in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decision-maker and the public (40 CFR 1502.14). The potential environmental impacts of each alternative should be quantified to the greatest extent possible (e.g., acres of wetlands impacted, cubic yards of soil to be transported, tons per year of emissions produced).
AL-14	*Commenter: EPA* The EIS should describe how each alternative was developed, how it addresses cleanup of soil and groundwater contamination, how it would be implemented, and the time frame for cleanup activity completion. The EIS also should clearly describe the rationale used to determine whether impacts of an alternative are significant or not. Thresholds of significance should be determined by considering the context and intensity of an action and its effects (40 CFR 1508.27).
AL-15	*Commenters: Multiple individuals and organizations* DOE's soil volume estimates are inflated. The estimates came from studies done by Boeing, who has fought for decades against cleanup. This represents a potential conflict of interest.
AL-16	*Commenters: Multiple individuals and organizations* DOE's EIS must fully address how appropriate backfill soil will be sourced. DTSC must give guidance on how soils that must match the specific background levels for SSFL will be identified. Source sites from which sufficient quantities of such soils may be obtained must be identified. This is a very important issue because, if adequate replacement soils cannot be located, alternative solutions, including on site treatments, clearly should be allowed, and the overall approach to the cleanup may need to change.
AL-17	*Commenters: Organizations* The 2010 AOC requires replacement soil, not gravel. Since properties of gravel are very different from soil (specifically, little or no plant replacement will be possible, will not absorb water, runoff increases, may affect aquifer replenishment, impacts plant and wildlife unfavorably), we encourage compliance with replacement soil (not gravel). Include in the EIS applicable alternatives for replacement soil and the impacts of what is chosen.

Code [a]	***Commenter and Comment Summary***
AL-18	*Commenter: Organization* The EIS must explain why or how any soil replacement plans may remove significantly more soil from the site as will be backfilled. Can permanent reduction (by non-backfilled removal) of thousands of cubic yards of soil be deemed appropriate mitigation? Will DOE follow NASA's proposal in its EIS to not replace 2/3 of the removed soil? What will happen with soil replacement on the DOE parcel, if not all removed soil needs to be replaced?
AL-19	*Commenter: Organization* Surface water runoff effects resulting from any substantial reduction in surface soils must be reviewed, explained, and disclosed in the EIS, if DOE proposes to replace significantly less soil than it removes. It is well settled that a reduction in permeable surfaces (typically associated with development) causes significantly increased runoffs. What will be the runoff effects of the decreased soil in a year with average rainfall? What is expected when rainfall is significantly over average levels?
AL-20	*Commenters: Organization and individuals* "Onsite" (*ex situ* and *in situ* treatment) soil cleanup is a promising alternative to soil removal, where appropriate. Yet, the 2010 AOC seems to prohibit this and state the only allowable method for soil cleanup is removal. DOE must explain how this seeming contradiction is possible based on the 2010 AOC language. The "leave in place" remediation alternative should be considered in the NEPA and CEQA analysis because such a remediation approach would entail significantly less environmental impact by reducing soil excavation, hauling, and soil replacement.
AL-21	*Commenters: Organizations, and Mitchell Englander (Councilman 12th District)* DOE's EIS must commit to complete protection for all communities along transport routes from the contaminated material that the 2010 AOC requires to be removed. Effective measures for reduced dust from the trucks and containment of all materials, including dust from bumps as the material is trucked, need to be developed and implemented.
AL-22	*Commenter: Organization* Is remediation in a project like this, where buildings are removed, adequate where a flat landscape is left after remediation? Should remediation include providing topographic restoration or variable elevations/topography, such as the site originally had?
AL-23	*Commenters: Multiple individuals and organizations* A "risk-based" and/or health-effects-based assessment is needed. Such an analysis must be based on what is measurable and exists today, not what might have happened or did happen years ago.
AL-24	*Commenter: DTSC* If alternatives are rejected, it would be useful to have a brief statement of why an alternative was not included.
AL-25	*Commenters: Multiple individuals and organizations* Takes issue with use of *Rough Order of Magnitude Estimates for AOC Soil Cleanup Volumes in Area IV, and Associated Truck Transport Estimates Based on DTSC Look-up Table Values*. Methodology of this report is flawed on multiple counts and science is questionable. The report should be withdrawn, and DOE commit itself to honest science for the EIS.
AL-26	*Commenters: Multiple individuals and organizations* Consider an alternative for transporting contaminated soil that utilizes a railroad tunnel and railcars, instead of moving trucks full of contaminated soils through residential areas. This would require the construction of a temporary railroad siding near Corriganville Park in Simi Valley.
AL-27	*Commenters: Individuals and organization* All effort to treat soil at the site needs to be considered. Using land managed by NASA/Boeing to treat DOE soil would greatly reduce the need to truck it away. This will allow for relatively "clean" soil to be redeposited and allow for native plants to become re-established. Without this replacement soil, plants, and animals that use this important wildlife corridor will not be able to survive.
AL-28	*Commenter: Individual* Contaminant mobility should be considered when evaluating the *in situ* treatment of impacted soils. Contaminant migration may result in serious consequences to project scope, cost, and schedule due to the unprecedented 2010 AOC cleanup requirement.

Code [a]	***Commenter and Comment Summary***
AL-29	*Commenters: Individuals* DOE must incorporate all five alternative uses for the SSFL and the NBZ: (1) Do Nothing, (2) Open Space, (3) Urban Residential, (4) Rural Residential, and (5) Look-Up Tables/Detect/Background. Maps that show these five levels of cleanup should be done for the EIS showing contamination (the pink and purple "blobs") from the scoping presentation.
AL-30	*Commenter: Organization* DOE must adequately analyze and mitigate the environmental impacts of the demolition and disposal of remaining buildings in Area IV consistently with the 2010 AOC. For example, the EIS must characterize whether any of the DOE buildings are radiologically impacted and analyze the safe an appropriate disposal of the resultant debris.
AL-31	*Commenters: EPA and individuals* The Amended NOI does not provide an estimate of potential soil volumes that will require transportation to offsite landfills. The EIS should include annual estimates of contaminated soil volumes, chemical and radiological, to be transported off site for each alternative. The EIS should also include the latest soil volume estimates to be removed by NASA and Boeing.
AL-32	*Commenter: EPA* Given the potentially large soil volumes requiring transport from DOE's portion of SSFL, in conjunction with soil volumes from cleanup activities at other portions of the site, the EIS should discuss coordination with solid and hazardous waste facilities, as necessary. While these facilities may have large permitted capacities, the EIS should evaluate the ability of receiving waste disposal facilities to handle the potential volumes of contaminated soil from the proposed alternatives. This evaluation should include information regarding the magnitude of the volume being disposed of relative to the available disposal capacity.
AL-33	*Commenters: EPA and individual* DOE should consider shipment to multiple facilities as a means to reduce impacts at the receiving facilities. To the extent possible, DOE should coordinate with NASA and Boeing on their remediation projects (e.g. schedules, disposal facilities and changes in soil volumes), so that its EIS may contain as comprehensive a discussion of cumulative impacts as possible.
AL-34	*Commenters: EPA and individual* The EIS should discuss the potential for cross-property contamination from DOE's portion of the site onto others (e.g., NASA, Boeing), or vice versa. If such potential exists, the EIS should include a discussion on whether different standards for soil remediation may be used. The EIS should also discuss the timing of the cleanup for any neighboring properties where cross-property contamination may present an issue, as well as measures to prevent cross-contamination (pre-and post-remediation). For example, if one entity completes soil removal prior to DOE, contamination from the DOE property might still migrate onto another's property, or vice versa.
AL-35	*Commenters: EPA and individual* DOE should consider EPA and DTSC resources for Greener Cleanups and take advantage of any aspects of these resources that may be beneficial in the cleanup of the Santa Susana Field Lab. DOE may want to make use of the ASTM International *Standard Guide for Greener Cleanups*, released in November 2013, which outlines a voluntary process for evaluating and implementing activities to reduce the environmental footprint of a cleanup.
AL-36	*Commenter: Organization* The best alternative (best for the flora, the fauna, and the future of the area) is to demolish and clean up the most contaminated buildings, pads, and sump ponds, to use various proven scientific and safe remediation methods for removal and/or remediating contamination by heavy metals, industrial chemicals/solvents, minor radiological elements in the short term. Then to use biological remediation of the soil over the long term to achieve a healthy natural resource suitable for recreational use by humans and as a vital wildlife linkage between the Santa Monica Mountains and Los Padres National Forest. Over an even longer term, the natural ecological systems will come into balance once again.
AL-37	*Commenters: Organization and individual* Will the timetable of the project include the follow-up native plant habitat remediation to make the site stable enough to prevent frequent dust storms carrying allergens and Valley fever from blowing down on residential communities, or severe erosion and floods due to heavy winter rains or changes in groundwater levels and drainages that will negatively affect downstream water sources, native plant habitat, and residential areas?

Code [a]	Commenter and Comment Summary
AL-38	*Commenters: Organizations and individuals* Where will the contaminated soil go? If the soil is so contaminated that it is defined as hazardous (the only reason to remove it from the site), then where are the hazardous waste sites with enough remaining space to accommodate these millions of cubic yards (DOE, NASA, etc.)? Buttonwillow, Chiquita Canyon, Lancaster Landfill, or Sunshine Canyon are not appropriate for this. The Port of Los Angeles does not have space or permission to store that enormous amount of hazardous waste while waiting for ships permitted to load such materials.
AL-39	*Commenter: Organization* To support what native habitat remains, the fill soil must, at least, have similar pH and an agricultural profile similar to the soils native to the site. Where will that come from? Will it be "clean" or contain further contaminants, either chemical or biological?
AL-40	*Commenters: Organizations and individuals* Since Area IV was heavily involved in research of radiological materials, all remaining structures that show evidence of contamination should be removed, and the soil within the building footprint, including an approximately 30-meter buffer, at least horizontally, shall be cleaned up to background levels, as specified in the 2010 AOC. Areas outside of the radiologically contaminated buildings can be cleaned up to either background levels or suburban residential levels, depending on their location and level of radiological contamination.
AL-41	*Commenters: Organizations and Mitchell Englander (Councilman 12th District)* The EIS should examine a range of alternatives that could reduce those truck and other impacts while still assuring cleanup to background. These alternatives would be in two broad categories: (1) ways to reduce the volume of soil that needs to be removed from the site and disposed of, while still meeting the background cleanup goal; and (2) alternatives that could reduce, or even eliminate, the impacts from trucking that soil which does need to be removed (compaction of soil in trucks, refining estimate of how much soil needs to be cleaned up, better delineation of contamination, look at using multiple routes to minimize impacts to one group of people, look at using fire roads, use alternate energy vehicles (electric or natural-gas-powered), seal trucks so contaminants aren't released, look at truck to rail transport, and consider conveyor system to the rail line).
AL-42	*Commenters: Multiple individuals and organizations* Will the EIS explore the option of there may well be numerous other possible routes? Spreading the trucks over multiple routes would reduce the impacts to people near any one route. Will the option of improving existing fire roads leading off SSFL or create a new one be explored?
AL-43	*Commenter: Individual* If DOE is unable to find suitable soil, incorporate all five alternative uses, and include a rigorous and comprehensive risk-based analysis, then the EIS must modify its preferred selected alternative to match that which can be achieved. The community and Elected Official preferred alternative of Open Space would dictate the least destructive, disruptive, and expensive of the remediations proposed. My sense of what my community's opinion is that the highest and best use of this site is as open space, and or as a Chumash sacred space. Whether this property eventually belongs to the Federal, state, county governments, or to the only locally recognized American Indian tribe/Santa Ynez Band of Chumash; none of these entities want to industrialize, develop, or farm this site.
AL-44	*Commenter: Individual* Only highly contaminated areas of DOE-SSFL that exceed EPA and DTSC health risk standards (i.e., are sufficiently contaminated to be a true health risk for an open space user) and cannot be "cleaned" with any other method and refilled with appropriate soil, should be allowed to be treated in a separate manner. These "highly contaminated areas" could be subject to scoop, haul, and replacement soil using whatever can be found, even the less desirable remediations of gravel and sand.
AL-45	*Commenter: Individual* If cleanup can be accomplished through phytoremediation, and other *in situ* techniques which are slower, but effective, they should not be discounted because of the artificially selected time lines. From the most recent analysis presented at local community meetings by responsible parties' staff, it seems that these alternative methods are often as effective and much less damaging to the DOE-SSFL site and to the surrounding communities; their major drawback is that they just take more time to work.

Code [a]	***Commenter and Comment Summary***
AL-46	*Commenter: Organization* The following suggestions are offered as to some of the characteristics replacement soil should have: (1) capable of supporting native plants characteristic of the areas to be mined throughout all phases of their life cycle, including germination, establishment, growth, persistence, reproduction and dispersal; (2) capable of supporting microflora characteristic of the various native plant associations typically found in the area, including aeromonas, rhizobia, mycchorhizae, etc.; (3) replacement soil should be capable of supporting the numerous species of burrowing animals found at SSFL, such as insects (especially pollinators), California legless lizard, and a number of other reptiles, amphibians, mammals, insects, and others; (4) replacement soil should not contain any substances or organisms that will inhibit the germination, growth, persistence, or development of reproductive or dispersal structures of native plants; (5) replacement soil should not contain any substances or organisms that inhibit pollinators, seed dispersers, mutualistic microorganisms, or other organisms critical in the life cycles of native plants; (6) soil texture, chemical composition, and type should be mimicked as much as possible to increase the probability over time for the re-establishment of native plant communities and their associated fauna; and (7) replacement soil should be free of pathogenic fungi, bacteria, insect pests, weed seeds, and other harmful organisms or chemicals.
AL-47	*Commenter: Organization* DOE can reduce the impacts somewhat by excavating relatively small areas at a time and immediately backfilling those areas with suitable replacement soil and restoring the native vegetative cover (in some cases replacing invasive weeds with native plants).
AL-48	*Commenter: Individual* The number of calculated truckloads does not include return trips of empty trucks to the site. Therefore, the actual number of truck trips needed for transport of excavated material would be roughly double that estimate. The figure also does not include an undetermined number of truck trips required to transport materials originating from demolished structures, whether to a landfill or to a recycler. The EIS should include hard numbers on both the amount of this material and the number of truck trips required to transport it. Likewise, the calculated number of truck trips does not include the number required to transport construction, demolition, excavation, drilling, or other equipment to and from the site. Finally, these figures, plus the number of commuting trips involving workers needed to accomplish the goals of the cleanup, need to be added in to formulate the final figure for the number of vehicle trips to and from the site during the cleanup.
AL-49	*Commenter: Individual* DOE should provide rationale and evaluations for each alternative, including those that are rejected from consideration.
AL-50	*Commenter: Individual* DOE should consider that the negative environmental impacts of the cleanup impact only a few adjacent communities and those on truck traffic routes and disposal site communities, while the claims for more-severe cleanup come from more-distant communities which are not likely at risk from the current levels of contamination at SSFL or from the necessary truck traffic required to implement the more severe cleanup alternatives.
AL-51	*Commenters: Multiple Individuals* DOE should avoid weaknesses of the NASA EIS, as identified by EPA in its September 30, 2013, letter. The major EPA comment relative to the scoping of the DOE EIS was that the 500,000 cubic yards of soil to be dug and hauled by NASA's 2010 AOC cleanup was excessive and would have negative health impacts, while placing a burden on available disposal facilities. Since the current DOE soil estimates range from 1.1 to 1.7 million cubic yards and they would add to both the NASA and Boeing soil removal and hauling amounts, the EPA suggestion of evaluating a health-risk-based alterative, such as Suburban Residential, with a greatly reduced soil removal, should be followed.
AL-52	*Commenters: Organizations and Mitchell Englander (Councilman 12th District)* In the EIS, DOE committed to looking at alternative ways of accomplishing the cleanup to background required by the 2010 AOC. What DOE committed not to do was, with the exception of the required No Action alternative, prepare an EIS on whether it should violate the requirements of the 2010 AOC and use a far less protective cleanup standard that would leave much of the contamination on site, not cleaned up. The EIS alternatives were to be alternative ways to clean up to background as required by the 2010 AOC, not whether to comply with the 2010 AOC
AL-53	*Commenters: Organizations and Mitchell Englander (Councilman 12th District)* There is no serious consideration in the amended NOI of alternative ways of reducing or even avoiding truck impacts. Although there are some who are exaggerating the truck impacts as a way to try to block the cleanup, nonetheless, there are legitimate desires to reduce such impacts if possible. An EIS that takes a hard look at ways to reduce those impacts, while still fully complying with the requirement to clean up to background, would be useful.

Code [a]	***Commenter and Comment Summary***
AL-54	*Commenters: Organizations and Mitchell Englander (Councilman 12th District)* The EIS should examine a range of alternatives that could reduce those truck and other impacts while still assuring cleanup to background. These alternatives would be in two broad categories: (1) ways to reduce the volume of soil that needs to be removed from the site and disposed of, while still meeting the background cleanup goal, and (2) alternatives that could reduce, or even eliminate, the impacts from trucking that soil which does need to be removed.
AL-55	*Commenters: Organization and Mitchell Englander (Councilman 12th District)* Soil volumes targeted for either treatment or offsite disposal could be markedly reduced were efforts employed to more carefully characterize the boundaries of the contamination, and we recommend that this alternative be carefully evaluated as well. DOE has, as indicated above, released a draft order-of-magnitude estimate of soil volumes prepared by Boeing's prime contractor at the site. The Southern California Federation of Scientists has produced a detailed critique of the estimates, identifying a number of assumptions that in its view markedly inflate the figures, concerns which we share. (*Statement of the Southern California Federation of Scientists at DOE Scoping Hearing for the Draft Environmental Impact Statement for the Santa Susana Field Laboratory*, March 1, 2014.) A clear alternative that should be examined in detail in the EIS to reduce volumes of soil that need removal and transport would involve better delineation of the extent of the contamination and careful work to assure that one is removing contaminated soil and not large amounts of soil that is not above background would be a very important alternative. It would reduce both onsite impacts of the cleanup and offsite impacts associated with transport through neighborhoods and subsequent disposal.
AL-56	*Commenters: Organization and individual* Request that the EIS consider showing alternative cleanup scenarios based upon risk so that the decision-makers can compare the soil volume, the trucks, and other likely and potential impacts on our community. These alternative standards should include cleanup to the (1) 2010 AOC level; (2) cleanup to a suburban residential standard; (3) cleanup to an industrial/commercial standard; (4) cleanup to a parkland standard.
AL-57	*Commenters: Individual and organization* Remediation at most EPA Superfund sites is based upon future use and risk to those who will be using the property when remediation is complete, although we do acknowledge that Santa Susana is not a Superfund site. DTSC is the lead agency for this project. According to the PowerPoint on the Agreements in Principle, DTSC has entered into an agreement with DOE and NASA under their State Superfund authority. This authority requires the use of the Nine Balancing Criteria which are: (1) overall protection of human health and the environment; (2) compliance with applicable, relevant and appropriate requirements; (3) long-term effectiveness and permanence; (4) reduction of toxicity, mobility, or volume; (5) short-term effectiveness; (6) ability to implement; (7) cost; (8) state acceptance; and (9) community acceptance.
AL-58	*Commenter: Organization* In the draft document prepared by MWH for the DOE, there is a map that shows the clearly contaminated chemical areas which must be removed. We would like to see the soil volume for this map, and the DOE should explain just what chemicals are found in these areas and why these areas must be removed. Please provide maps that show the soil volumes for these [in] all of Area IV and the NBZ, based on alternative cleanup standards.
AL-59	*Commenters: Organization and individual* NASA's Office of Inspector General stated that NASA should consider a cleanup based upon risk. A risk-based cleanup would decrease the soil volume by half, or possibly as much as two thirds, depending upon the cleanup scenario. Is this the case for the area that DOE is responsible for remediating as well? In the EIS, please explain risk and the associated exposure pathways and explain the EPA methods of determining how EPA determines toxicity and risk based upon future use.
AL-60	*Commenter: Organization* The EPA recommended that NASA clean up all radionuclides to background levels. However, they indicated to NASA that DTSC and EPA clean up chemicals based upon risk. DOE must show all alternative cleanup scenarios and their associated costs in order for the decision-makers, including Congress, to make the appropriate appropriations for the cleanup.
AL-61	*Commenter: Organization* Supports *in situ* treatment when possible as long as the treatments are deemed safe. These proposed treatments must be spelled out in the EIS. Also support *in situ* treatment using the naturally occurring onsite bacteria and with site-specific native plants.

Code [a]	**Commenter and Comment Summary**
AL-62	*Commenters: Organization and individual* Recommend that Area IV be divided into the sub-areas that are currently drawn, and that each sub-area be addressed separately based upon the contaminants that are present, risk, what archaeological sites are in the area, the locations of protected endangered species and protected trees, and the locations of wildlife habitats. Each must be prioritized based upon risk, while considering all Federal, state, and local laws and the balancing criteria.
AL-63	*Commenters: Individual and organization* There is not even enough soil to be used as backfill which complies with "background levels"—even for the totally inadequate amount that NASA is proposing. We strongly believe that the entire SSFL should be cleaned up to suburban residential levels, except with regard to areas where radiological materials were directly used, which is a stricter level than EPA allows for parkland usage (the Boeing land will become open space parkland once the cleanup is completed to suburban residential levels).
AL-64	*Commenters: Individuals* Consider an alternative route for truck trips to and from SSFL that routes all vehicles directly past the residences of the 2010 AOC advocates and supporters, including agency officials. As part of this alternative, please also consider an alternative of contributing to the development of new landfills to receive SSFL soil waste in the communities of Santa Cruz, Oak Park, and Simi Valley, where many of the 2010 AOC supporters and advocates live or have their base of operations.
AL-65	*Commenter: Individual* Consider alternatives that create more local jobs so that those communities that have been damaged by the SSFL at least get some benefit of having local jobs created.
AL-66	*Commenters: Individuals* Where will the funding for the project come from? Will it be fully funded or will you get 3 years into the remediation and just run out of money? The EIS should address how the effort will be funded and if it will be funded for the entire life span of the project.
AL-67	*Commenter: Individual* DOE is pretending in their analysis that green cleanup and risk-based cleanup and suburban cleanup are contradictory, but this is not the case. If the cleanup is done to schedule and to background, it should be clean, and it will permit the wildlife to return to the clean and secure space and open it to public use.
AL-68	*Commenter: Organization* Chemical contamination (and to leave it *in situ*) is not within DOE's discretion. Not only is there a 2010 AOC, but under RCRA, it's the state and regulator who decide how much contamination is to be cleaned up, and they have spoken. You don't have the discretion to do an EIR/EIS to walk away from chemical contamination.
AL-69	*Commenter: Individual* Will the EIS employ or discuss the radiological trigger levels? It appears that many of the radiological trigger levels are multiples over background.
AL-70	*Commenters: Multiple individuals and organizations* The best approach for the EIS would be a risk-based assessment, with the final intended use of the SSFL as the ultimate goal.
AL-71	*Commenter: Individual* Figure 2 from the public meetings (Area IV 2010 AOC Radiological Soil Areas) does not show an area near Runkle Canyon that is significantly above background (strontium-90) and another area where Area IV meets Runkle Canyon, Ahmanson Ranch, and the Southern Buffer Zone. Will the EIS address why such areas are not listed in the proposed cleanup?
AL-72	*Commenter: Individual* Will the Southern Buffer Zone be included in analysis/considered for cleanup activities and/or addressed in the EIS?
AL-73	*Commenter: Individual* Are all radionuclides bad? How will DOE remove the site-related radionuclides without stirring up the naturally occurring radionuclides? Are all radionuclides worse than the chemicals on site?

Code [a]	***Commenter and Comment Summary***
AL-74	*Commenter: Individual* There is no way to sum the contaminants of concern at the SSFL site and to clean up the site based on risk. I don't believe that we have the ability to establish the combined risk from all of the chemicals and radionuclides. For example, polyaromatic hydrocarbons and the dioxins at the SSFL site are contaminants of concern, and some of the hardest to detect, and some of the most toxic at very low levels. Yet these contaminants are widespread throughout the SSFL site due the 2005 fire, as well as from site activities. How do we determine if all of these dioxins on the SSFL site should be removed when the dioxins on the adjacent properties of Sage Ranch, Ahmanson Ranch, Brandeis Bardin, Dayton Canyon, and Runkle Canyon have probably not been sampled for these contaminants of concern—yet they are most likely there due to the same fire history as the SSFL?
AL-75	*Commenter: Individual* Radionuclides should be listed with their columns for Look-Up Table Values compared to the EPA screening levels for the various scenarios—agricultural, suburban residential, industrial/commercial, and parkland/open space.
AL-76	*Commenter: Individual* There should be a discussion based upon the EPA recommendations to NASA of cleaning up Area IV to "background" for the radionuclides, and to a risk based level for chemicals.
AL-77	*Commenter: Organization* DOE can reduce the impacts somewhat by excavating relatively small areas at a time and immediately backfilling those areas with suitable replacement soil, and restoring the native vegetative cover (in some cases replacing invasive weeds with native plants).
AL-78	*Commenter: Individual* It appears that based upon Judge Cochran's comments in the current litigation against DTSC *et al.*, that the most environmentally friendly cleanup standard under the 2010 AOC would be the No Further Action.
AL-79	*Commenter: Individual* A Cost Table should be presented for each separate SSFL area and for all areas combined. The costs of cleanup for all six levels need to be done; emphasis should be on a comparison between recreational level, suburban residential level, and cleanup to background/Look-Up Table (cleanup to background) level.
AL-80	*Commenter: Individual* One major theme for analysis should be based on an ultimate use of the property as a park/open space/ recreational area. Most of the local communities surrounding SSFL do not want SSFL turned into an industrial park or millionaire mansions; the consensus of the local community is to transfer the land to Federal, state, county, or local cities as a park/open space/recreational area.
AL-81	*Commenter: Individual* Explain why SSFL requires a higher level of cleanup than other, more-hazardous sites in California? Please list all California sites that were cleaned up to recreational, industrial, suburban residential, rural residential, or agricultural levels. Has some or all of California agricultural land ever been tested to determine its contamination level?
AL-82	*Commenter: Individual* The cleanup needs to be health-risk-based. The CA DTSC must create a new Look-Up Table based on scientific, health-risk research, with a priority ranking of chemical and radiological contaminants.
AL-83	*Commenter: Individual* There should be no remediation or cleanup measures that cannot be easily reversed until after all legal and planning/work plan activities are finalized.
AL-84	*Commenter: Individual* There needs to be a net health benefit of the cleanup. More-moderate cleanup levels (suburban residential, recreational) should be applied to SSFL instead of the proposed CUB level. Research is beginning to show that the health, environmental, cultural, environmental justice, and psychological costs of the 2010 AOC proposed cleanup at SSFL are greater than the supposed health risks of the current SSFL, especially if used as open space. Will cleanup to background actually result in any meaningful reduction of health risks?

Code [a]	***Commenter and Comment Summary***
AL-85	*Commenter: Individual* Can the NBZ be left undisturbed? It was once used as a ranch, grazing, and rural residential. Can this area be exempted from soil remediation and immediately be reclassified as recreation/parkland?

AOC = *Administrative Order on Consent for Remedial Action*; Boeing = The Boeing Company; CA = California; CEQA = California Environmental Quality Act; CFR = *Code of Federal Regulations*; CUB = cleanup to background; DTSC = California Department of Toxic Substances Control; EIR = environmental impact report; EIS = environmental impact statement; EPA = U.S. Environmental Protection Agency; MWH = MWH Americas, Inc.; NASA = National Aeronautics and Space Administration; NBZ = Northern Buffer Zone; NEPA = National Environmental Policy Act; NOI = Notice of Intent; RCRA = Resource Conservation and Recovery Act.

[a] The code corresponds to the entries in a database containing all of the comments received during the 2014 scoping period.

Appendix D
Detailed Project Information

APPENDIX D
DETAILED PROJECT INFORMATION

This appendix provides detailed information on selected topics referenced in other sections of this *Draft Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory* (*Draft SSFL Area IV EIS*). The topics addressed are as follows:

- Area IV Structures – Descriptions and photographs of the U.S. Department of Energy (DOE)-owned structures in Santa Susana Field Laboratory (SSFL) Area IV that are addressed in this environmental impact statement (EIS).
- Chemical and Radiological Look-Up Tables (LUTs) – Tables listing the chemical LUT values and the provisional radiological LUT values. The chemical LUT values were established by the California Department of Toxic Substances Control (DTSC) in accordance with the 2010 *Administrative Order on Consent for Remedial Action* (2010 AOC) (DTSC 2010a); that is, the AOC LUT values that would apply under the Cleanup to AOC LUT Values Alternative and the revised LUT values that would apply under the Cleanup to Revised LUT Values Alternative.
- Comparison to Other Cleanup Projects in California – Tables comparing the cleanup levels established for chemicals at two other cleanup projects in California with the AOC LUT values.
- Disposal Facility Selection for Analysis – A discussion of the process and rationale for selecting the disposal facilities that form the basis for the waste management and transportation analyses and associated analyses related to socioeconomics, environmental justice, and sensitive-aged populations.
- Cumulative Impacts Candidates – A description of the other projects in the vicinity of SSFL that were considered in the development of the cumulative impacts analysis presented in Chapter 5.
- Principal Analysis Assumptions – A summary of the principal assumptions the formed the basis for the analyses in this EIS.

D.1 Area IV Structures

At one time, there were over 200 numbered structures within Area IV. As studies or experiments were completed, the buildings were decommissioned, demolished, and removed. Today, only 22 structures remain in Area IV; 18 are owned by DOE (shown in **Figures D–1** and **D–2**), and the remainder by The Boeing Company (Boeing). The remaining DOE buildings consist of (1) prefabricated metal upper structures constructed on either grade-level concrete platforms or formed concrete basements or (2) cinder block/concrete walls and metal roofs. Of the 18 buildings, 15 were not impacted by site radiological operations, have previously been "free released,"[1] or have been decontaminated, but have not undergone a formal release process. The remaining 3 structures are contaminated with radioactive materials. **Table D–1** provides additional information and photographs of each remaining DOE building. Note that, in Table D–1, buildings that have been free released or have been decontaminated, but have not undergone the free release process, are designated as "not considered a radioactively contaminated structure," while buildings that were not impacted by site radiological operations are designated as "not contaminated with radioactive material."

[1] For a building to be free released, it must meet the conditions of DOE Order 458.1, *Radiation Protection of the Public and the Environment,* which limits doses to the public from DOE activities to either 25 millirem per year (or as low as reasonably achievable) or requires the surface contamination levels to meet the default limits expressed in DOE Order 5400.5 (same title as DOE Order 458.1 and superseded by that Order) and U.S. Nuclear Commission Regulatory Guide 1.86, *Termination of Operating Licenses for Nuclear Reactors.*

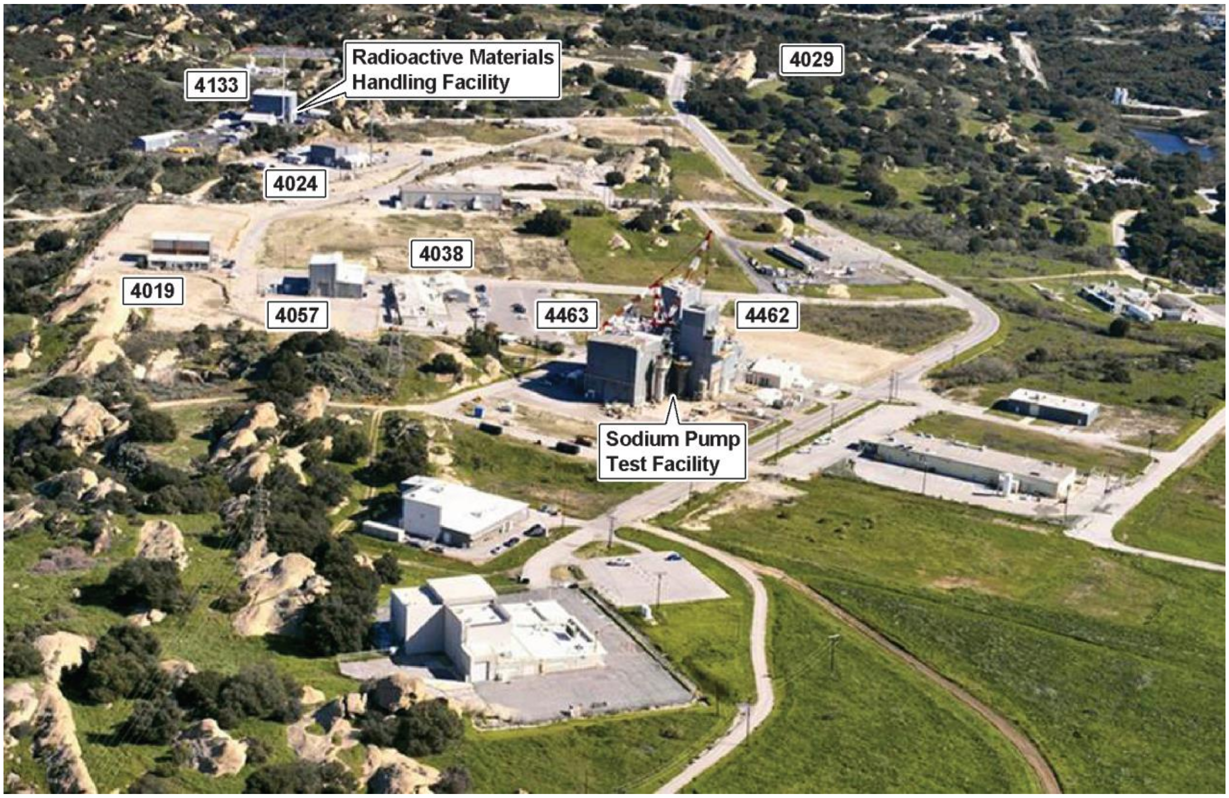


Figure D–1 Remaining Structures in Area IV

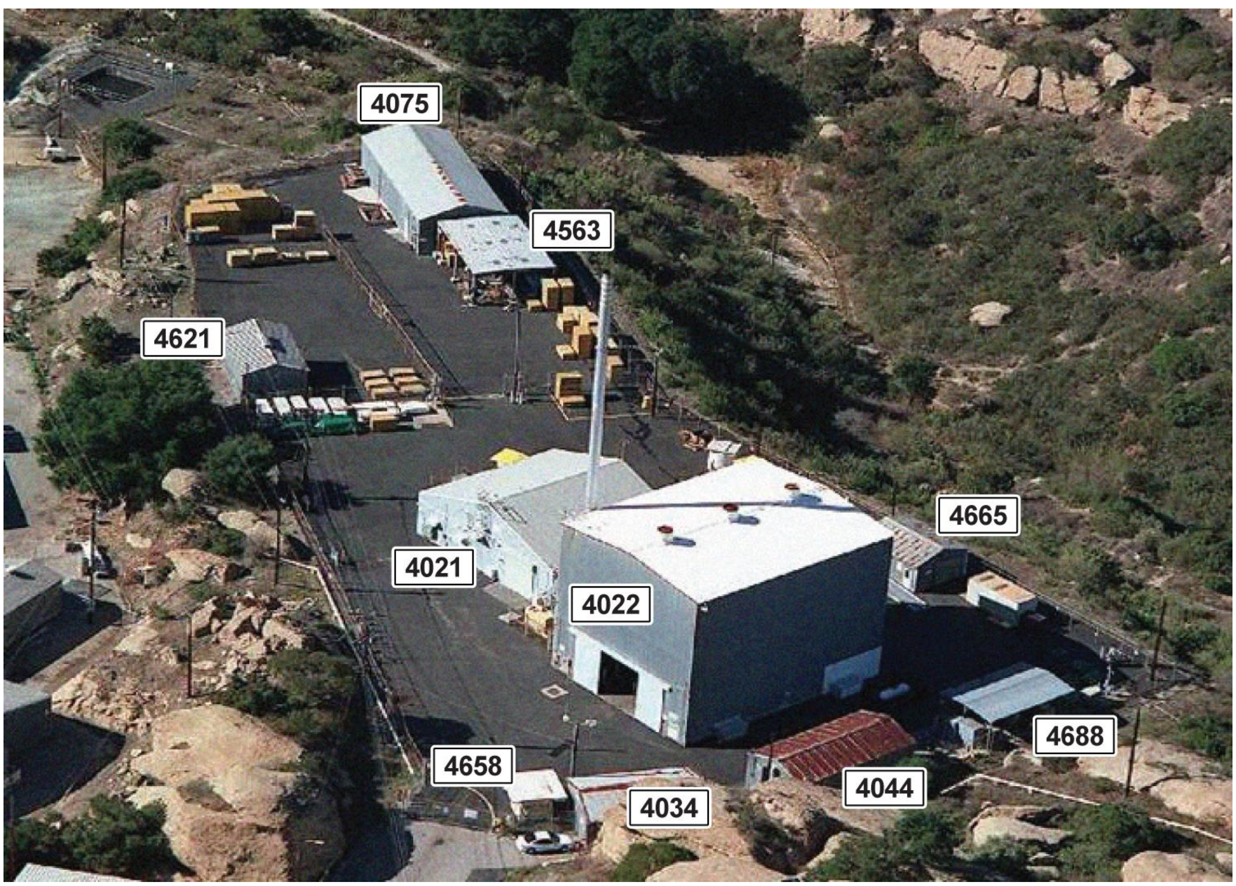
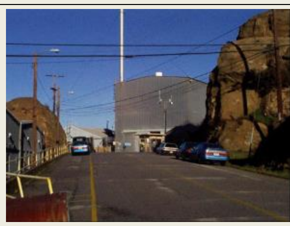
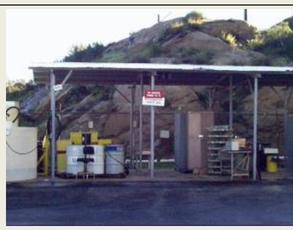
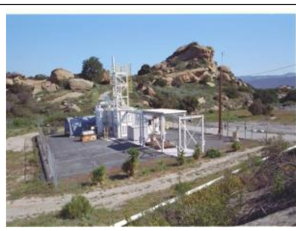


Figure D–2 Radioactive Materials Handling Facility Overview

Table D–1 DOE Buildings in Santa Susana Field Laboratory Area IV to be Removed

Building Number	***Building Description***
Radioactive Materials Handling Facility (RMHF)	
 **4021**	Constructed in 1959, the Decontamination and Packaging Facility (Building 4021) was primarily used to process waste materials (mixed fission products and fuels) from the Sodium Reactor Experiment (SRE), Southwest Experimental Fast Oxide Reactor, Experimental Breeder Reactor, Fermi Reactor, Systems for Nuclear Auxiliary Power (SNAP), and other onsite programs. Waste processing conducted in the facility included radioactive component cleaning, size reduction, liquid waste processing, decontamination services, and waste packaging activities. Due to project activities or accidental release, Building 4021 is contaminated with radioactive material.
 **4022**	Constructed in 1959, the Radioactive Storage Building (Building 4022) was used for storage of SRE fuel, Southwest Experimental Fast Oxide Reactor fuel, Experimental Breeder Reactor-II blanket assemblies, SRE decommissioned waste, plutonium, Fermi Reactor fuel, high-level radioactive waste, and other waste from onsite decommissioning activities in seven underground vaults. Due to project activities or accidental release, Building 4022 is contaminated with radioactive material.
 **4034**	Constructed in 1961, Building 4034 was an office building that served as the main office and point of entry for RMHF. It is not considered a radioactively contaminated structure.
 **4044**	Constructed in the mid-1960s, Building 4044 served various purposes, including a clean shop, health physics offices, and a break room. It is not considered a radioactively contaminated structure.
 **4075**	Constructed in 1971, Building 4075 served as a storage area for radioactive waste prior to shipment to disposal sites. It is not considered a radioactively contaminated structure.
 **4563**	Constructed in 1958, Building 4563 was a paved storage yard at RMHF used for storing radioactive waste pending shipment to a disposal facility. It is not considered a radioactively contaminated structure.

Building Number	Building Description
 **4621**	Constructed in the mid-1960s, Building 4621 was used for interim storage of contaminated equipment and source materials (primarily mixed fission products) for RMHF. It is not considered a radioactively contaminated structure.
 **4658**	Constructed in the early 1980s, Building 4658 served as a guard shack and main entrance point for RMHF until the late 1980s, when it was deemed no longer necessary. It is not considered a radioactively contaminated structure.
 **4665**	Constructed in the mid-1960s, Building 4665 was used as an oxidation facility for RMHF. It is not considered a radioactively contaminated structure.
 **4688**	Building 4688 was constructed in the early 1960s. It was assumed that the building started out supporting sodium cleaning activities at Building 4723 due to its location; however, no documentation exists to support this assumption. In the mid-1960s, the building was moved to the RMHF complex, where it was used as a storage area for RMHF. It is not considered a radioactively contaminated structure.
Hazardous Waste Management Facility (HWMF)	
 **4029**	Constructed in 1959 as the Radiation Measurements Facility (Old Calibration Facility), Building 4029 was used for storage and use of radioactive source materials in three below-grade concrete structures from 1959 to 1974. From 1978 to 1997, Building 4029 became the Hazardous Waste Storage Facility (part of HWMF) and provided storage for reactive metal waste and contaminated equipment prior to shipment off site. In 1983, HWMF was permitted under the Resource Conservation and Recovery Act (RCRA) to treat and store nonradiological chemical wastes. In 1988, the below-grade structures that housed the radioactive materials in Building 4029 were excavated and disposed of. All operations at Building 4029 ceased in 1997. Building 4029 is not contaminated with radioactive material.
 **4133**	Originally labeled Building 4724 (the Contaminated Sodium Facility), this building supported SRE until establishment of HWMF in 1977, when it was moved to its present location, was renamed Building 4133, and became part of HWMF. Building 4133 was used to treat reactive metals until 1997, when all operations ceased. Building 4133 is not contaminated with radioactive material.

Building Number	***Building Description***
Sodium Pump Test Facility (SPTF)	
 **4462 and 4463**	Constructed in 1974, Building 4462 was the main SPTF building where sodium pumps were tested. Building 4462 is not contaminated with radioactive material. Constructed in 1974, Building 4463 was used to assemble, disassemble, and clean pumps and other parts of SPTF. Building 4463 is not contaminated with radioactive material.
Systems for Nuclear Auxiliary Power (SNAP)	
 **4019**	Constructed in 1962, Building 4019 was constructed to perform criticality acceptance tests of SNAP reactors before they were delivered for launch. The building contained the SNAP Flight System Critical Facility, Acceptance Test Facility, and Energy Technology Engineering Center (ETEC) Construction Staging and Computer Facility. Building 4019 was previously surveyed and free released in accordance with the applicable standard at the time. As a conservative measure, the debris from this building has been included in the low-level radioactive waste volume estimate.
 **4024**	Constructed in 1960, Building 4024 was used for testing SNAP reactors in a simulated operational environment. The building contained the Development Test Laboratory, SNAP Environmental Test Facility, Building 4928 (cooling tower), and Building 4725 (substation). Due to project activities or accidental release, Building 4024 is contaminated with radioactive material.
Energy Technology Engineering Center (ETEC)	
 **4038**	Constructed in 1962, Building 4038 was an office building providing office space for SNAP, DOE/ETEC, and/or the Liquid Metals Engineering Center. Building 4038 is not contaminated with radioactive material.
Miscellaneous Buildings	
 **4057**	Constructed in 1961, the Building 4057 Warehouse was used to house two sodium test rigs. It was decommissioned for laboratory use in 1998 and is currently being used as a records room. The Building 4057 Warehouse is not contaminated with radioactive material.

Source: Sapere 2005.

D.2 Chemical and Radiological Look-Up Tables

In 2010, DTSC entered into the 2010 AOC (DTSC 2010a) with DOE. The 2010 AOC stipulates that the end state after soil cleanup shall be consistent with background. The 2010 AOC further explains that the soils cleanup standard would be based on LUT values, which are: (1) for chemicals, local background concentrations or method detection limits[2] for those chemicals whose method detection limits exceed local background concentrations and (2) for radionuclides, local background concentrations or minimum detection limits for radionuclides whose detection limits exceed local background concentrations. The 2010 AOC defines the minimum detection limit for a radionuclide as the smallest amount of activity that can be quantified for comparison with regulatory limits.[3]

In November 2012, the U.S. Environmental Protection Agency (EPA) provided DTSC a copy of the *Final Technical Memorandum Look-Up Table Recommendations Santa Susana Field Laboratory, Area IV Radiological Study* (HGL 2012a). The document provided guidance and recommendations for developing a radionuclide LUT. Following the EPA recommendations and guidance, in January 2013, DTSC published a draft provisional LUT for radionuclides in soils. As implied in the *Draft Provision Radiological Look-Up Table Values* (DTSC 2013a), two laboratories, identified as EPA Lab A and EPA Lab B, were used by EPA in performing radiological characterization. Radiological LUT values based on minimum detectible concentrations were determined for the two laboratories. The resulting values vary from as little as a few percent to as much as an order of magnitude, depending on the radionuclide. DTSC indicated that it will apply the values for EPA Lab B for the draft provisional LUT values. Therefore, DOE used these values in determining the areas of Area IV and the Northern Buffer Zone (NBZ) that exceed the AOC LUT values. **Table D–2** presents the provisional radiological LUT values for soil remediation (based on the EPA Lab B results). Use of the lower values is conservative in that it would overestimate the areas requiring remediation compared to the EPA Lab A–derived values. The radionuclide LUT is provisional because EPA recommended not selecting final LUT values until a single laboratory is selected to conduct the radionuclide analysis and the selected laboratory can demonstrate its ability to meet EPA's defined measurement quality objectives for the cleanup confirmation sampling. The radiological LUT values would be used under the Cleanup to AOC LUT Values and the Cleanup to Revised LUT Values Alternatives.

---

[2] Per the 2010 AOC (DTSC 2010a), "detection limit" means the method reporting limit, which is the lowest concentration at which an analyte can be confidently detected in a sample and its concentration can be reported with a reasonable degree of accuracy and precision.

[3] In its *Final Technical Memorandum, Look-Up Table Recommendations, Santa Susana Field Laboratory Area IV Radiological Study* (HGL 2012b), the EPA stated: "In exercising independent technical judgment, as identified in Section 5.2 of the AOC (DTSC 2010a), EPA recommends an adjustment to the BTVs [background threshold values] and minimum detectable concentrations [limits] (MDC) to include appropriate consideration for [method uncertainty] to ensure an acceptably low decision error rate of approximately 5 percent. This adjustment is not believed by EPA to be contrary to the 2010 AOC requirement that LUT values incorporate BTVs and laboratory MDCs." The memorandum also stated: "For purposes of this technical memorandum, and for the appropriate use of BTVs, it is important to note that the MDC is not used as a detection decision criterion. Rather, the MDC is understood to represent a level of activity at which the associated uncertainty becomes predictably constrained to a level that is useful for defining a substitute cleanup value when the BTV is not practically or technologically supported by the laboratory data. The use of the MDC in this case, defined as "the smallest amount of activity that can be quantified for comparison with regulatory limits," is consistent with the 2010 AOC requirements and definitions."

Table D–2 Provisional Radiological Look-Up Table Values

Radionuclide	Symbol	Provisional Look-Up Table Basis	Provisional Look-Up Table Value (picocuries per gram) [a,b]
Americium-241	Am-241	MDC	0.039
Cesium-137	Cs-137	BTV	0.225
Cobalt-60	Co-60	MDC	0.0363
Europium-152	Eu-152	MDC	0.0739
Europium-154	Eu-154	MDC	0.198
Europium-155	Eu-155	MDC	0.231
Nickel-59	Ni-59	MDC	0.875
Plutonium-238	Pu-238	MDC	0.0254
Plutonium-239/240	Pu-239/240	MDC	0.023
Strontium-90	Sr-90	MDC	0.117
Thorium-228	Th-228	BTV	4.27
Thorium-230	Th-230	BTV	2.38
Thorium-232	Th-232	BTV	3.44
Uranium-233/234	U-233/234	BTV	2.18
Uranium-235	U-235	MDC	0.152
Uranium-238	U-238	BTV	1.96

BTV = background threshold value; MDC = minimum detection concentration.
[a] Provisional Look-Up Table Values are the higher of the BTV (HGL 2012a) or the radiological reference concentration (HGL 2012b), calculated in accordance with the recommendation in HGL 2012a.
[b] Provisional values derived from minimum detection concentration were based on the lower of the minimum detection concentrations identified by the two laboratories that performed soil sample analyses (DTSC 2013a, HGL 2012b).
Source: DTSC 2013a.

DTSC developed the chemical AOC LUT for 116 chemicals in June 2013 (DTSC 2013b). The chemical AOC LUT includes chemicals that were assessed during DTSC's chemical background study, as well as those chemicals most frequently identified as contaminants at SSFL and the NBZ or of interest to DTSC. The chemical AOC LUT values are not provisional because they provide analytical standards for multiple laboratories to report and use when establishing data quality objectives. **Table D–3** presents the chemical AOC LUT values for soil remediation; these are the values that would be used under the Cleanup to AOC LUT Values Alternative.

Table D–3 also presents chemical risk-based screening level (RBSL) values. The chemical RBSL values are based on an assessment of the concentrations of chemicals in the soil that would result in generally acceptable health risks; the values are derived from the analysis in the *Final Standardized Risk Assessment Methodology Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California* (MWH 2014c). The RBSL values, determined on an individual chemical basis, are concentrations that correspond to a lifetime cancer risk of 1×10^{-6} (1 chance in 1 million) or a toxicity hazard quotient[4] of 1 for direct exposure pathways for a suburban resident scenario. The direct pathways include inhalation, ingestion, and dermal contact.

[4] A hazard quotient is a unitless value determined by dividing the exposure concentration by the reference concentration reported in the EPA Integrated Risk Information System for direct exposure pathways. The reference concentration is an estimate of a continuous exposure concentration to the human population (including sensitive sub-groups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

Table D–3 Chemical AOC Look-Up Table Values and Risk-Based Screening Level Values

Chemical Constituent	Units	AOC LUT Values [a]		RBSL Values [c]
		Basis [b]	Value	
Alcohols – EPA Method 8015B				
Ethanol	mg/kg	BG MRL	0.7	note 1
Methanol	mg/kg	BG MRL	0.7	note 1
Anions – EPA Methods 300.0/9056A				
Fluoride	mg/kg	BTV	10.2	3,040
Nitrate	mg/kg	BTV	22.3	note 1
Cyanide – EPA Method 9012A				
Cyanide	mg/kg	BG MRL	0.6	45.6
Dioxin-Furans – EPA Method 1613B				
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	note 2	note 3
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	--	note 2	note 3
1,2,3,4,7,8,9-HpCDF	pg/g	--	note 2	note 3
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	note 2	note 3
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	note 2	note 3
1,2,3,6,7,8-HxCDD	pg/g	--	note 2	note 3
1,2,3,6,7,8-HxCDF	pg/g	--	note 2	note 3
1,2,3,7,8,9-HxCDD	pg/g	--	note 2	note 3
1,2,3,7,8,9-HxCDF	pg/g	--	note 2	note 3
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	note 2	note 3
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	note 2	note 3
2,3,4,6,7,8-HxCDF	pg/g	--	note 2	note 3
2,3,4,7,8-PeCDF	pg/g	--	note 2	note 3
2,3,7,8-Tetrachlorodibenzodioxin (TCDD)	pg/g	--	note 2	note 3
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	--	note 2	note 3
Octachlorodibenzodioxin (OCDD)	pg/g	--	note 2	note 3
Octachlorodibenzofuran (OCDF)	pg/g	--	note 2	note 3
2,3,7,8-Tetrachlorodibenzodioxin (TCDD) toxicity equivalence (TEQ)				
2,3,7,8-TCDD TEQ	pg/g	BTV-TEQ	0.912 note 2	4,800 note 3
Energetics – EPA Method 8330				
1,3,5-Trinitroperhydro-1,3,5-triazine (RDX)	μg/kg	M-L MRL	300	5,940
Formaldehyde – EPA Method 8315A				
Formaldehyde	μg/kg	BG MRL	1,870	12,200,000
Herbicides – EPA Method 8151A				
2,4,5-Trichlorophenoxyacetic acid (T)	μg/kg	BTV	1.2	686,000
2,4,5-Trichlorophenoxyace acid (TP)	μg/kg	BTV	0.63	549,000
2,4-Dichlorophenoxyacetic acid (D)	μg/kg	BTV	5.8	686,000
4-(2,4-dichlorophenoxy)butyric acid (2,4-DB)	μg/kg	BG MRL	2.4	549,000
2,4-Dichloroprop (DP)	μg/kg	BTV	2.4	686,000
Dalapon (2,2-dichloropropionic acid)	μg/kg	BG MRL	12.5	2,060,000
Dicamba	μg/kg	BTV	1.3	2,060,000
Dinoseb (Dinitrobutyl phenol)	μg/kg	BG MRL	3.3	68,600
2-methyl-4-chlorophenoxyacetic acid (MCPA)	μg/kg	BTV	761	34,300
Methylchlorophenoxypropionic acid (MCPP)	μg/kg	BTV	377	68,600
Pentachlorophenol	μg/kg	M-L MRL	170	21,200
Metals – EPA Methods 6010B/6020A				
Aluminum	mg/kg	BTV	58,600	75,300
Antimony	mg/kg	BTV	0.86	26
Arsenic	mg/kg	BTV	46	0.0658

Chemical Constituent	Units	AOC LUT Values [a]		RBSL Values [c]
		Basis [b]	Value	
Barium	mg/kg	BTV	371	11,000
Beryllium	mg/kg	BTV	2.2	31
Boron	mg/kg	BTV	34	15,200
Cadmium	mg/kg	BTV	0.7	4.6
Chromium	mg/kg	BTV	94	37,200
Cobalt	mg/kg	BTV	44	22.8
Copper	mg/kg	BTV	119	3,040
Lead	mg/kg	BTV	49	80
Lithium	mg/kg	BTV	91	152
Manganese	mg/kg	BTV	1,120	6,130
Molybdenum	mg/kg	BTV	3.2	380
Nickel	mg/kg	BTV	132	908
Potassium	mg/kg	BTV	14,400	NC
Selenium	mg/kg	BTV	1	380
Silver	mg/kg	BTV	0.2	230
Sodium	mg/kg	BTV	1,780	note 1
Strontium	mg/kg	BTV	163	45,600
Thallium	mg/kg	BTV	1.2	0.76
Vanadium	mg/kg	BTV	175	188
Zinc	mg/kg	BTV	215	22,800
Zirconium	mg/kg	BTV	19	6.09
Hexavalent Chromium – EPA Methods 7199/7196A				
Hexavalent Chromium	mg/kg	BTV	2	1.29
Mercury – EPA Methods 7471A/7470A				
Mercury	mg/kg	BG MRL	0.13	16.8
Methyl Mercury – EPA Method 1630 (Mod)				
Methyl Mercury	μg/kg	M-L MRL	0.05	7.61
PCBs/PCTs – EPA Method 8082				
Aroclor 1016	μg/kg	M-L MRL	17	3,860
Aroclor 1221	μg/kg	M-L MRL	33	ND
Aroclor 1232	μg/kg	M-L MRL	17	ND
Aroclor 1262	μg/kg	M-L MRL	33	ND
Aroclor 1254	μg/kg	M-L MRL	17	232
Aroclor 1260	μg/kg	M-L MRL	17	232
Aroclor 1268	μg/kg	M-L MRL	33	ND
Aroclor 1242	μg/kg	M-L MRL	17	232
Aroclor 1248	μg/kg	M-L MRL	17	232
Aroclor 5432	μg/kg	M-L MRL	50	ND
Aroclor 5442	μg/kg	M-L MRL	50	ND
Aroclor 5460	μg/kg	M-L MRL	50	232
Perchlorate – EPA Methods 6850/6860				
Perchlorate	μg/kg	BTV	1.63	53,300
Pesticides – EPA Method 8081A				
Aldrin	μg/kg	BG MRL	0.24	34.8
Alpha-Hexachlorocyclohexane (BHC)	μg/kg	BG MRL	0.24	219
Beta-BHC	μg/kg	BTV	0.23	394
Chlordane	μg/kg	BTV	7	1,690
Delta-BHC	μg/kg	BTV	0.22	328
Dieldrin	μg/kg	BG MRL	0.48	36.9
Endosulfan I	μg/kg	BG MRL	0.24	412,000

Chemical Constituent	Units	AOC LUT Values [a]		RBSL Values [c]
		Basis [b]	Value	
Endosulfan II	µg/kg	BG MRL	0.48	412,000
Endosulfan Sulfate	µg/kg	BG MRL	0.48	412,000
Endrin	µg/kg	BG MRL	0.48	20,600
Endrin Aldehyde	µg/kg	BTV	0.7	20,600
Endrin Ketone	µg/kg	BTV	0.7	20,600
Gamma-BHC – Lindane	µg/kg	BG MRL	0.24	537
Heptachlor	µg/kg	BG MRL	0.24	144
Heptachlor Epoxide	µg/kg	BG MRL	0.24	107
Methoxychlor	µg/kg	BG MRL	2.4	343,000
Mirex	µg/kg	BTV	0.5	32.8
p,p-Dichlorodiphenyldichloroethane (DDD)	µg/kg	BG MRL	0.48	2,460
p,p-Dichlorodiphenyldichloroethylene (DDE)	µg/kg	BTV	8.6	1,740
p,p-Dichlorodiphenyltrichloroethane (DDT)	µg/kg	BTV	13	1,740
Toxaphene	µg/kg	BG MRL	8.8	493
Semi-Volatiles (SVOCs)/PAHs – EPA Method 8270C(SIM)				
Acenaphthylene	µg/kg	BG MRL	2.5	2,980,000
Anthracene	µg/kg	BG MRL	2.5	16,400,000
Benzo(a)anthracene	µg/kg	–	note 4	387
Benzo(a)pyrene	µg/kg	–	note 4	38.7
Benzo(b)fluoranthene	µg/kg	–	note 4	387
Benzo(g,h,i)perylene	µg/kg	BG MRL	2.5	1,650,000
Benzo(k)fluoranthene	µg/kg	–	note 4	387
Bis(2-Ethylhexyl)phthalate	µg/kg	BTV	61	173,000
Butylbenzylphthalate	µg/kg	BTV	100	274,000
Chrysene	µg/kg	–	note 4	3,870
Dibenzo(a,h)anthracene	µg/kg	–	note 4	113
Diethyl phthalate	µg/kg	BG MRL	27	48,900,000
Dimethyl phthalate	µg/kg	BG MRL	27	48,900,000
Di-n-butylphthalate	µg/kg	BG MRL	27	6,110,000
Di-n-octylphthalate	µg/kg	BG MRL	27	611,000
Fluoranthene	µg/kg	BTV	5.2	2,200,000
Fluorene	µg/kg	BTV	3.8	2,180,000
Indeno(1,2,3-cd)pyrene	µg/kg	–	note 4	387
Naphthalene	µg/kg	BTV	3.6	14,600
Phenanthrene	µg/kg	BTV	3.9	16,400,000
Pyrene	µg/kg	BTV	5.6	1,650,000
1-Methyl naphthalene	µg/kg	BG MRL	2.5	7,290
2-Methylnaphthalene	µg/kg	BG MRL	2.5	162,000
Acenaphthene	µg/kg	BG MRL	2.5	3,230,000
Benzo(a)pyrene Equivalent				
Benzo(a)pyrene TEQ	µg/kg	BTV-TEQ	4.47 note 4	38.7
Other SVOCs				
Benzoic Acid - EPA 8270	µg/kg	M-L MRL	660	244,000,000
N-Nitrosodimethylamine – 8270C(SIM)	µg/kg	M-L MRL	10	32.5
Phenol – EPA 8270	µg/kg	M-L MRL	170	18,300,000
TPH – EPA Method 8015				
TPH EFH (C15-C20)	mg/kg	M-L MRL	5 note 5	5 note 5

Chemical Constituent	Units	AOC LUT Values [a]		RBSL Values [c]
		Basis [b]	Value	
Terphenyls – EPA Method 8015				
o-Terphenyl	mg/kg	M-L MRL	7	65
VOCs – EPA Method 8260				
1,1-Dichloroethene	µg/kg	M-L MRL	5	55,800
1,4-Dioxane – EPA 8260 (SIM)	µg/kg	M-L MRL	10	19,300
2-Hexanone	µg/kg	M-L MRL	10	170,000
Acetone	µg/kg	M-L MRL	20	60,100,000
Benzene	µg/kg	M-L MRL	5	115
cis-1,2-Dichloroethene	µg/kg	M-L MRL	5	9,220
Ethylbenzene	µg/kg	M-L MRL	5	2,310
Hexachlorobutadiene	µg/kg	M-L MRL	5	6,670
Methylene chloride	µg/kg	M-L MRL	10	2,970
Tetrachloroethene	µg/kg	M-L MRL	5	416
Toluene	µg/kg	M-L MRL	5	3,740,000
Trichloroethene	µg/kg	M-L MRL	5	797
Vinyl chloride	µg/kg	M-L MRL	5	20.4

µg/kg = micrograms per kilogram (parts per billion); AOC = *Administrative Order on Consent for Remedial Action;* BTV = background threshold value; BG MRL = background method reporting limit; EPA = U.S. Environmental Protection Agency; mg/kg = milligrams per kilogram (parts per million); LUT = Look-Up Table; M-L MRL = multi-lab method reporting limit; ND = not detected; PAH = polycyclic aromatic hydrocarbon; PCB = polychlorinated biphenyl; PCT = polychlorinated terphenyl; pg/g = picograms per gram (parts per trillion); RBSL = risk-based screening level; RDX = research department explosive; SIM = selective ion monitoring; SVOC = semi-volatile organic compound; TEQ = toxicity equivalent; TPH = total petroleum hydrocarbons; TPH EFH = total petroleum hydrocarbon-extractable fuel hydrocarbon; VOC = volatile organic compound.

[a] The AOC LUT values and their bases are from the *Chemical Look-Up Table Technical Memorandum, Santa Susana Field Laboratory, Ventura County, California* (DTSC 2013b).

[b] The Basis refers to the source of the data used to develop the AOC LUT value, as described in *Chemical Look-Up Table Technical Memorandum, Santa Susana Field Laboratory, Ventura County, California* (DTSC 2013b).

[c] The RBSL values are derived from the *Final Standardized Risk Assessment Methodology Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California* (MWH 2014c) for the suburban resident exposure scenario direct pathways (inhalation, incidental ingestion, and dermal exposure). They are based on a risk level of 1×10^{-6} for chemical carcinogens or a hazard quotient of 1 for noncarcinogenic chemicals.

Notes:

1. Excluded because it is a naturally occurring, low-toxicity chemical.
2. The California Department of Toxic Substances Control applied the World Health Organization's 2,3,7,8-TCDD toxicity equivalence approach for dioxin-furans. To evaluate 2,3,7,8-TCDD equivalence, dioxin-furans need to meet respective background study MRLs.
3. The 2,3,7,8-TCDD toxicity equivalence approach would be used to evaluate dioxin-furans.
4. Benzo(a)pyrene equivalence developed based on sum of carcinogenic PAHs. In order to evaluate benzo(a)pyrene equivalence, carcinogenic PAHs need to meet respective background study MRLs.
5. For locations where TPH is the sole constituent, a cleanup strategy will be considered based on the findings of a soil treatability study, and the soil will be cleaned to the 5 milligrams per kilogram LUT value.

Based on the RBSLs, DOE has proposed revised LUT values. Revised LUT values were established for any chemical constituent that exceeded its AOC LUT value in more than 2.5 percent[5] of the soil samples collected by DOE in Area IV and the NBZ and exceeded its RBSL value in at least one of those samples. Although they did not exceed the threshold of occurring in more than 2.5 percent of the soil samples, chromium VI, cobalt, lead, and Aroclor 1248 were also included because they were detected in multiple samples in small, concentrated areas, or "hotspots." Selenium was added, even though no samples exceeded the selenium human health RBSL, because it exceeded its AOC LUT

[5] If one were to analyze a soil sample 100 times, the accepted false positive error rate is 5 percent meaning 5 samples are expected to provide a false result. The 2.5 percent criterion was used to be conservative.

value in more than 2.5 percent of the soil samples and also exceeded the risk-based ecological screening level that, for selenium, is lower than the human health RBSL. These chemicals, as well as their corresponding revised LUT values, are presented in **Table D–4** and would be used under the Cleanup to Revised LUT Values Alternative.

Table D–4 Chemical Revised Look-Up Table Values

Chemical Constituent	Units	Revised LUT Values [a]
2,3,7,8-Tetrachlorodibenzodioxin (TCDD) toxicity equivalence (TEQ)		
2,3,7,8-TCDD TEQ	pg/g	4,800 note 1
Metals – EPA Methods 6010B/6020A		
Antimony	mg/kg	26
Cadmium	mg/kg	4.6
Chromium VI [b, c]	mg/kg	2
Cobalt [b, c]	mg/kg	44
Lead [b]	mg/kg	80
Selenium [d]	mg/kg	380
Silver	mg/kg	230
Mercury – EPA Methods 7471A/7470A		
Mercury	mg/kg	16.8
PCBs/PCTs – EPA Method 8082		
Aroclor 1254	μg/kg	232
Aroclor 1260	μg/kg	232
Aroclor 1242 [e]	μg/kg	232
Aroclor 1248 [b]	μg/kg	232
Aroclor 5460	μg/kg	232
Pesticides – EPA Method 8081A		
Dieldrin	μg/kg	36.9
Semi-Volatiles (SVOCs)/PAHs – EPA Method 8270C(SIM)		
Naphthalene [e]	μg/kg	14,600
1-Methyl naphthalene [e]	μg/kg	7,290
Benzo(a)pyrene Equivalent		
Benzo(a)pyrene TEQ	μg/kg	38.7

μg/kg = micrograms per kilogram (parts per billion); EPA = U.S. Environmental Protection Agency; mg/kg = milligrams per kilogram (parts per million); LUT = Look-Up Table; PAH = polycyclic aromatic hydrocarbon; PCB = polychlorinated biphenyl; PCT = polychlorinated terphenyl; pg/g = picograms per gram (parts per trillion); SIM = selective ion monitoring; SVOC = semi-volatile organic compound; TEQ = toxicity equivalent.

[a] The revised LUT values are derived from RBSLs in the *Final Standardized Risk Assessment Methodology Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California* (MWH 2014c) for the suburban resident exposure scenario direct pathways (inhalation, incidental ingestion, and dermal exposure). They are based on a risk level of 1×10^{-6} for chemical carcinogens or a hazard quotient of 1 for noncarcinogenic chemicals. If an RBSL value were less than the AOC LUT value, the AOC LUT value would be used.

[b] These constituents did not exceed the revised LUT values in more than 2.5 percent of the soil samples, but are included here due to their presence in hotspots.

[c] The RBSL value for this constituent is lower than the AOC LUT value. Because the AOC LUT value is based on background levels or laboratory capabilities, the AOC LUT value is used in this revised LUT.

[d] Selenium exceeded the LUT value in more than 2.5 percent of the soil samples and also exceeded the risk-based ecological screening level that, for selenium, is lower than the human health RBSL.

[e] Only one sample exceeded the RBSL.

Note:

1. The 2,3,7,8-TCDD toxicity equivalence approach would be used to evaluate dioxin-furans.

D.3 Comparison to Other Cleanup Projects in California

When requested by the community to provide examples of California cleanup projects for facilities similar to SSFL, DTSC identified cleanup of Hunter's Point Naval Shipyard (San Francisco) and McClellan Air Force Base (Sacramento) as comparable projects. The soil values in **Table D–5** provide a comparison of the SSFL Area IV AOC LUT values to the residential scenario cleanup values used for the Hunter's Point Naval Shipyard and McClellan Air Force Base projects.

Table D–5 Comparison of SSFL Area IV Soil Cleanup Levels with Hunter's Point Naval Shipyard and McClellan Air Force Base Residential Scenario Cleanup Values

Chemical of Concern	*Santa Susana Field Laboratory*		*Hunter's Point* [d]	*McClellan AFB* [e]
	Area IV LUT Value [a]	*SSFL RBSL* [b, c]		
	Values in milligrams per kilogram (parts per million)			
Antimony	0.86	26.4	10	20
PCB Aroclor 1254	0.017	0.232	0.093	0.063
PCB Aroclor 1260	0.017	0.232	0.21	0.063
Arsenic	46	0.0658	11.1	12
Benzo(a)anthracene [f]	0.00447	0.387	0.37	0.088
Benzo(a)pyrene [f]	0.00447	0.0387	.33	0.018
Benzo(b)fluoranthene [f]	0.00447	0.387	0.34	0.11
Benzo(k)fluoranthene [f]	0.00447	0.387	0.34	0.11
Beta-Hexachlorocyclohexane (BHC)	0.00023	0.394	0.0066	NA
Bis(2-ethylhexyl)phthalate	0.061	173	1.1	NA
Cadmium	0.7	4.6	3.5	4.1
Copper	119	3,040	159	130
Dibenzo(a,h)anthracene	0.0047	0.113	0.33	0.038
Dieldrin	0.00048	0.0369	0.0034	0.0045
Dioxins	0.000000912	0.00000481	NA	0.0000042
Heptachlor epoxide	0.00024	0.107	0.0017	NA
Indeno(1,2,3-cd)pyrene	0.0047	0.387	0.35	0.12
Iron	NA	NA	58,000	NA
Lead	49	80	155	140
Manganese	1,120	6,130	1431	830
Mercury	0.13	16.8	2.3	1.6
Naphthalene	0.0036	14.6	1.7	2.4
Tetrachloroethene	0.005	0.416	0.48	NA
Trichloroethene	0.005	0.797	2.9	NA
Vanadium	175	188	117	NA
Zinc	215	22,800	373	1700
Total Petroleum Hydrocarbons – Diesel	5	NA	NA	3,200
Total Petroleum Hydrocarbons – Gasoline	5	NA	NA	160

AFB = Air Force Base; LUT = Look-Up Table; NA = not available; PCB = polychlorinated biphenyl; RBSL = risk-based screening level.

[a] DTSC 2013b.

[b] MWH 2014c.

[c] The RBSLs are based on a suburban residential scenario established for SSFL (MWH 2014c), in which it was assumed that a receptor would be present on the remediated site 24 hours per day, 350 days per year, for 30 years.

[d] Jonas & Associates 2008.

[e] EPA 2015.

[f] These values are based on the benzo(a)pyrene toxicity equivalent (see Table D-3).

D.4 Disposal Facility Selection for Analysis

Remediation of Area IV and the NBZ could generate large quantities of nonhazardous soil, as well as smaller quantities of other wastes, including nonhazardous demolition debris, hazardous soil and demolition debris, and soil and demolition debris classified as low-level radioactive waste (LLW) or mixed low-level radioactive waste (MLLW). In addition, small quantities of recyclable material from building demolition would be generated. All waste and recyclable material would be shipped to offsite facilities for disposal or recycle.

Identification and Selection of Disposal and Recycle Facilities

Because of the multiplicity of facilities that are potentially suitable for disposal of waste from DOE remediation activities, analyzing the impacts of shipping waste to each facility would be inefficient and detract from comparing the impacts among the alternatives. For purposes of analysis, multiple candidate facilities with favorable attributes were identified for each waste type, then a limited number of representative facilities were selected for analysis. **Table D–6** provides the list of candidate facilities; information about each facility, such as location and available waste services, is provided in Chapter 3, Section 3.10.

Of the disposal facilities operating for disposal of LLW or MLLW, four were identified as candidates for disposal of waste from SSFL, as listed in Table D–6.[6] Of these facilities, the Nevada National Security Site (NNSS) was selected as representative for detailed analysis because it is one of two DOE facilities selected in the third Record of Decision (ROD) (August 5, 1998; 63 *Federal Register* [FR] 41810) for the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997) for regional disposal of DOE LLW and MLLW. The Hanford Site (Hanford) was also selected in DOE's 1998 ROD; however, in DOE's December 13, 2013, ROD (78 FR 75913) for the *Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington* (DOE 2013b), DOE deferred a decision on importing wastes from other sites (with limited exceptions) for disposal at Hanford, at least until the Waste Treatment Plant at Hanford is operational. In addition, Energy*Solutions* in Utah was selected as a representative facility because MLLW from DOE activities at SSFL may require treatment before disposal. A wider range of treatment services is available at the Energy*Solutions* facility than at NNSS, and Energy*Solutions* in Utah is closer to SSFL than Waste Control Specialists in Texas.

Compared to those used for disposal of LLW and MLLW, a larger number of facilities are in operation for treatment or disposal of hazardous waste. Candidate sites with favorable attributes included those within a few days drive by truck from SSFL, those capable of direct rail access, and those providing a variety of treatment services for hazardous waste. Attributes considered favorable included proximity to SSFL because shipment to closer facilities would have smaller impacts than shipment to more-distant facilities; direct rail access because of the potential environmental and economic advantages of shipping waste by rail rather than by truck; and a variety of treatment services because the hazardous waste generated from SSFL remediation could require treatment before disposal, pursuant to EPA regulations.

[6] This excludes facilities that only accept commercially generated LLW pursuant to State Compacts created under provisions of the Low-Level Radioactive Waste Policy Act, as amended, or to facilities licensed to accept only exempt waste under U.S. Nuclear Regulatory Commission or Agreement State regulations.

Table D–6 Candidate Facilities[a]

Facility	Location	Distance (road miles)	Remarks
Radioactive Waste Facilities			
EnergySolutions	Clive, UT	780	LLW and MLLW disposal; MLLW treatment; can accept waste by direct rail shipment
Hanford Site	Richland, WA	1,100	Disposal of DOE LLW and MLLW [b]
Nevada National Security Site	Nye County, NV	330	Disposal of DOE LLW and MLLW; limited MLLW treatment capability projected
Waste Control Specialists	Andrews, TX	1,100	LLW and MLLW disposal; MLLW treatment; can accept waste by direct rail shipment
Hazardous Waste Facilities			
Aragonite Incineration Facility	Aragonite, UT	710	Hazardous waste incineration facility; can accept waste by direct rail shipment
Beatty Landfill	Beatty, NV	290	Hazardous waste treatment and disposal
Buttonwillow Landfill	Buttonwillow, CA	120	CA Class I facility: hazardous waste treatment and disposal
Deer Trail Landfill	Deer Trail, CO	1,100	Hazardous waste treatment and disposal
Grassy Mountain Landfill	Grantsville, UT	710	Hazardous waste treatment and disposal; can accept waste by direct rail shipment
Kettleman Hills Landfill	Kettleman City, CA	170	CA Class I facility: hazardous waste treatment and disposal [c]
US Ecology	Grand View, ID	1,020	Hazardous waste treatment and disposal; can accept waste by direct rail shipment
Waste Control Specialists	Andrews, TX	1,100	Hazardous waste treatment and disposal; can accept waste by direct rail shipment
Westmorland Landfill	Westmorland, CA	230	CA Class I facility: hazardous waste treatment and disposal
Nonhazardous Waste Facilities			
Altamont Landfill	Livermore, CA	330	CA Class II landfill
Antelope Valley Landfill	Palmdale, CA	59	CA Class III landfill
Azusa Land Reclamation	Azusa, CA	37	CA unclassified (inert waste) landfill
Chiquita Canyon Sanitary Landfill	Castaic, CA	37	CA Class III landfill
El Sobrante Landfill	Corona, CA	97	CA Class III landfill
Hay Road Landfill	Vacaville, CA	380	CA Class II landfill
Lancaster Landfill and Recycling Center	Lancaster, CA	64	CA Class III landfill
Mesquite Regional Landfill [d]	El Centro, CA	270	CA Class III landfill; can accept waste by direct rail shipment
McKittrick Waste Treatment Site	McKittrick, CA	140	CA Class II landfill
NuWay Arrow Landfill	Irwindale, CA	55	CA Class III landfill
Ostrom Road Landfill	Wheatland, CA	420	CA Class II landfill
Recycle Facilities			
Kramer Metals	Los Angeles, CA	46	Recycle facility
P.W. Gillibrand, Inc.	Simi Valley, CA	18	Recycle facility
Standard Industries	Ventura, CA	41	Recycle facility

CA = California; CO = Colorado; ID = Idaho; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; NV = Nevada; TX = Texas; UT = Utah; WA = Washington.

[a] Representative facilities selected for detailed analyses are shown in bold and italics type.

[b] In DOE's December 13, 2013, *Record of Decision for the Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington* (78 FR 75913), DOE deferred a decision on importing wastes from other DOE sites (with limited exceptions) for disposal at the Hanford Site, at least until the Hanford Waste Treatment Plant is operational.

[c] Kettleman Hills is currently unable to accept waste from SSFL, but may be able to do so in the future.

[d] The Mesquite Regional Landfill is designed and intended to accept nonhazardous waste from the Los Angeles area by rail shipment. The landfill is not currently in operation due to reduced need for disposal capacity in recent years.

Of the nine hazardous waste facilities identified as candidates, one standalone facility provides thermal destruction and other treatment services (Aragonite Incinerator in Utah), and the remaining eight facilities provide a variety of treatment services, as well as disposal capacity. Three facilities are located in California, five in other states, and all are within a few days drive by truck from SSFL.

Three hazardous waste facilities were selected as representative for detailed analysis: the Buttonwillow and Westmorland Class I facilities in California[7] and US Ecology in Idaho. The Buttonwillow and Westmorland facilities were selected because of their proximity to SSFL and because, in addition to hazardous waste for treatment and disposal, they may accept nonhazardous waste for disposal. This attribute was considered advantageous because of uncertainties about the application of California Executive Order D-62-02 to nonhazardous waste generated from Area IV remediation (see text box). A third facility located in California, the Kettleman Hills Landfill, was not selected for detailed analysis because it is currently unable to receive waste from SSFL.

> **California Executive Order D-62-02**
>
> California Executive Order D-62-02 was issued in September 2002 and imposed a moratorium on the disposal in California of Class III or unclassified waste management units of decommissioned material meeting Federal and state cleanup standards, stemming from concerns about the hypothetical presence of radioactive materials in hazardous and nonhazardous waste from SSFL remediation. After September 2002, decommissioned material from Area IV that is not classified as low-level radioactive waste or mixed low-level radioactive waste was sent to California Class I facilities, which are permitted for disposal of hazardous waste.

Of the six candidate hazardous waste facilities located outside the State of California, US Ecology in Idaho was selected as a representative facility because it is capable of receiving waste directly by rail and because of uncertainties regarding the extent and variety of treatment services that may be required. Based on discussions with representatives from the candidate disposal facilities, it is not expected that the hazardous waste generated from SSFL remediation would present unusual treatment challenges. However, in consideration of uncertainties, US Ecology in Idaho was selected as representative because the impacts from shipment to US Ecology would bound the impacts from shipment of waste to three other, somewhat closer facilities (the Aragonite Incinerator[8] and Grassy Mountain Landfill in Utah and the Beatty facility in Nevada), in the event that shipments to one or more of these facilities were necessary for some portion of the hazardous waste. US Ecology in Idaho also may receive waste by direct rail shipment, while the closer Beatty facility can receive waste only by truck. The Aragonite Incinerator and Grassy Mountain Landfill are also capable of receiving waste by direct rail shipment and are closer to SSFL than US Ecology in Idaho. Both the Deer Trail Landfill in Colorado and Waste Control Specialists in Texas are farther from SSFL than US Ecology in Idaho and were not considered preferable for analysis as representative facilities.

For disposal of SSFL nonhazardous waste, 11 California Class II, Class III, and unclassified (inert waste) landfills were identified as candidate facilities from lists issued by the California State Water Resources Control Board (SWRCB) (SWRCB 2014). Considering the large quantity of nonhazardous waste that could result from Area IV remediation, eight landfills were initially identified that: (1) are in reasonable proximity to SSFL (within a few hundred miles), (2) accept a range of materials, and (3) use composite-lined disposal units. (Many landfills on the SWRCB list

---

[7] The California landfill classification system is explained in Chapter 3, Section 3.10.1, of this EIS. Essentially, a Class I facility is permitted to dispose of hazardous waste. Class II, Class III, and unclassified (inert waste) landfills are permitted to dispose of nonhazardous waste. Class II facilities have the least restrictions on the range of nonhazardous wastes that may be accepted, and unclassified landfills have the most restrictions.

[8] Residue from waste treated at the Aragonite Incinerator would be disposed of at the Grassy Mountain Landfill, which is located only about 20 road miles from the incinerator.

were not considered favorable because they only accept waste from specific counties or communities in California; were closed; had restrictions on the types of wastes accepted; or were much further from SSFL than other candidate sites.) These eight landfills included two Class II facilities, five Class III facilities, and one unclassified (inert waste) facility. Three additional facilities were identified, consisting of the Hay Road and Ostrom Road Landfills and the Mesquite Regional Landfill. The Hay Road and Ostrom Road Landfills were identified, even though they are both approximately 400 miles from SSFL, because they are both Class II landfills and thus can accept a wider range of nonhazardous wastes than Class III and unclassified landfills. The Mesquite Regional Landfill was identified because it is designed to accept waste directly by rail delivery.

For nonhazardous waste from building demolition, three facilities were selected as representative, assuming waste shipment occurred by truck: the Antelope Valley and Chiquita Canyon Landfills and the McKittrick Waste Treatment Site. The Antelope Valley and Chiquita Canyon Class III Landfills are both located at reasonable distances from SSFL (59 miles and 37 miles, respectively), and were considered preferable to the El Sobrante and Lancaster Class III Landfills because the latter two facilities are at slightly greater distances from SSFL. Both the NuWay Arrow Landfill and the Azusa Land Reclamation Project are closer to SSFL than the Antelope Valley and Chiquita Canyon Landfills, but were considered less preferable because of the more restrictive range of nonhazardous wastes that may be accepted at these facilities. The McKittrick Waste Treatment Site was selected because of uncertainties about the application of California Executive Order D-62-02 to DOE waste from SSFL and, being a Class II landfill, it can accept a wider range of nonhazardous wastes than can Class III and unclassified landfills, as discussed above. The facility was considered preferable to the other candidate Class II landfills because of its closer proximity to SSFL.

For nonhazardous soil, the same three nonhazardous waste facilities, the Antelope Valley and Chiquita Canyon Landfills and the McKittrick Waste Treatment Site, were selected as representative, assuming waste shipment occurred by truck. In addition, because of the large volume of nonhazardous soil that may be generated, two Class I facilities were selected for evaluation: the Buttonwillow and Westmorland Landfills. These facilities were also selected because of uncertainties about the application of California Executive Order D-62-02 to DOE waste; because they both accept a wider variety of wastes than do the other identified unclassified and Class III landfills (the Azusa, El Sobrante, Lancaster, and NuWay Arrow Landfills); and because they are closer to SSFL than the Hay Road and Ostrom Road Class II Landfills.

In addition, for nonhazardous waste generated from both soil remediation and building demolition, the Mesquite Regional Landfill was evaluated for shipment of waste by rail. The Mesquite Regional Landfill is designed to dispose of nonhazardous waste shipped from the Los Angeles area by rail and is the only waste facility (hazardous or nonhazardous) in California with direct-rail shipment capability. The facility was selected for detailed analysis because of the possible large volume of nonhazardous waste from Area IV remediation and the potential for reduced impacts from bulk shipment of waste by rail rather than by truck. The facility is not currently accepting waste for disposal, however, because of a reduced need in California in recent years for nonhazardous waste disposal capacity.

Numerous recycle facilities are available in the vicinity of SSFL, including standalone facilities and facilities that are collocated with nonhazardous waste landfills. Compared to the projected quantities of LLW/MLLW, hazardous waste, and nonhazardous waste from SSFL remediation, only small quantities of recycle material are projected. Therefore, three candidate recycle facilities were identified and selected as representative facilities for analysis. All are located within 50 miles of SSFL.

Shipment of Waste by Rail

Because of the large volume of LLW or MLLW, hazardous waste, and nonhazardous waste that may be generated from remediation of Area IV, analyses of waste shipment by rail were included in this EIS. Rail shipment may offer economic and environmental advantages (e.g., fewer emissions of pollutants), depending on the quantities of wastes to be shipped and the distances. Generally speaking, rail shipment becomes more economically and environmentally attractive as waste quantities and shipment distances increase. As noted above, the capability of a treatment or disposal facility to receive waste by rail was considered an important attribute when identifying candidate facilities and selecting representative facilities for further analysis. Rail shipment was not considered for recycle material because of the small quantities to be generated, the number of possible recycle facilities in the SSFL vicinity, and the proximity of the three representative facilities to SSFL, as discussed above.

Because SSFL lacks a direct rail shipment capability, waste must be transported by truck from SSFL to a location somewhere in the SSFL vicinity where the waste can be transferred to railcars for transport to the offsite facilities. To minimize the potential for dispersion of shipped material during truck and train transport and truck-to-rail transfer operations, the waste would not be shipped in bulk form for transfer to rail gondolas, but instead would be shipped within overpacks such as International Organization for Standards containers (also known as sea-land or intermodal containers).

A favorable attribute for an intermodal location for truck-to-rail transfer was considered to be an existing rail siding within a reasonable truck distance from SSFL that has sufficient space to stage waste delivery trucks, load individual railcars using cranes, and stage loaded railcars, pending their assembly into a trainload for shipment (more than 1 working day could be required to load and stage sufficient railcars for a trainload). Based on review of the rail network in the SSFL vicinity and on discussions with Los Angeles County waste management representatives (Revilla 2015a, 2015b), it was decided to analyze use of the Puente Hills Intermodal Facility under construction in City of Industry, California. This does not mean that other locations for intermodal transfer would not be considered, but that the Puente Hills facility had sufficient favorable attributes to make it a representative facility for analysis. These attributes include the following:

- *A reasonable distance from SSFL* – At about 60 road miles distance, Puente Hills is about a 3-hour round trip from SSFL, meaning it would be reasonable to expect that a single driver delivering waste to the facility could make at least two and perhaps three shipments in a day.
- *Existing infrastructure* – Puente Hills is designed and is being constructed to ship waste from the Los Angeles area to disposal facilities outside the area. Infrastructure is being developed, such as access roads, rail sidings, cranes, etc., which are intended to facilitate efficient delivery of waste by truck, transfer of containers to railcars, and assembly of trains for offsite shipment.
- *Scheduling* – Completion of Puente Hills construction, including road and rail modifications, is expected by the time remediation of Area IV and the NBZ would resume after issuance of the *Final SSFL Area IV EIS* and its ROD.
- *Existing environmental assessments* – The environmental impacts from construction and operation of the Puente Hills Intermodal Facility were analyzed in the *Puente Hills Intermodal Facility Final Environmental Impact Report* (City of Industry 2008) and the *Addendum to the Puente Hills Intermodal Facility Environmental Impact Report* (City of Industry 2009).

There are other operating intermodal facilities in the Los Angeles area, such as those located near the ports of Los Angeles and Long Beach. These facilities, however, are located at greater distances from SSFL than the Puente Hills Intermodal Facility and are oriented toward intermodal transfers from cargo ships.

Waste shipment by a combination of truck and rail was analyzed for three evaluated disposal facilities that were capable of direct-rail shipment from SSFL. These facilities are:

- Energy*Solutions* at Clive, Utah, for LLW and MLLW;
- US Ecology at Grand View, Idaho, for hazardous waste; and
- Mesquite Regional Landfill near El Centro, California, for nonhazardous waste.[9]

In addition, NNSS was evaluated for shipment of LLW and MLLW by a combination of truck and rail shipment. Although, at 330 road miles distance, it is closer to SSFL than Energy*Solutions* in Utah (780 miles), it is nonetheless distant from SSFL. Considering its distance and the quantity of LLW and MLLW that may be generated (up to 91,000 cubic yards; see Chapter 4, Section 4.10, of this EIS), there could be economic and environmental advantages from shipping waste to the site using a truck and rail combination. Furthermore, evaluation of a truck and rail combination for shipment of waste from SSFL to NNSS would be consistent with the analyses for waste delivery to NNSS in the *Final Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada* (*NNSS SWEIS*) (DOE 2013a). NNSS, however, does not have the capability of receiving waste by direct-rail shipment. For this reason, waste shipped by rail and intended for NNSS disposal would require transfer of waste containers from railcars to trucks at a second intermodal location near NNSS. For purposes of analysis, the rail yard at Barstow, California, was assumed for this second intermodal location for NNSS deliveries. The Barstow rail yard was evaluated in the *NNSS SWEIS* as an intermodal location for transfer of waste delivered by rail and truck combination to NNSS.

D.5 Cumulative Impacts Candidates

Chapter 5 of this EIS presents the potential cumulative impacts of DOE's remediation activities at SSFL and the NBZ along with other past, present, and reasonably foreseeable future activities in the vicinity. The analysis in Chapter 5 focuses on those activities that, after screening, were determined to have potentially cumulative impacts with DOE's activities. This section shows the range of present and reasonably foreseeable future activities that were considered in the cumulative impacts analysis.

The region of influence (ROI) for cumulative impacts is a 10-mile radius from the SSFL boundary. Activities in the ROI that could contribute to cumulative impacts include new residential development, new industrial and commercial ventures, resource investigation and development, new utility and infrastructure development, new waste treatment and disposal facilities, and contaminated site remediation. A large portion of the information on these other activities was gathered for the preparation of the DTSC program environmental impact report for the entire SSFL (ESA 2015). **Figure D–3** shows the locations of the other reasonably foreseeable actions in the ROI. **Table D–7** presents key information for each of these actions (numbers in the first column of Table D–7 correspond to locations on Figure D–3).

[9] The Mesquite Regional Landfill was not evaluated for delivery of nonhazardous waste by truck because of its distance (270 road miles) from SSFL. All of the other candidate and representative facilities are much closer to SSFL and, thus, more reasonable to consider for delivery by truck.

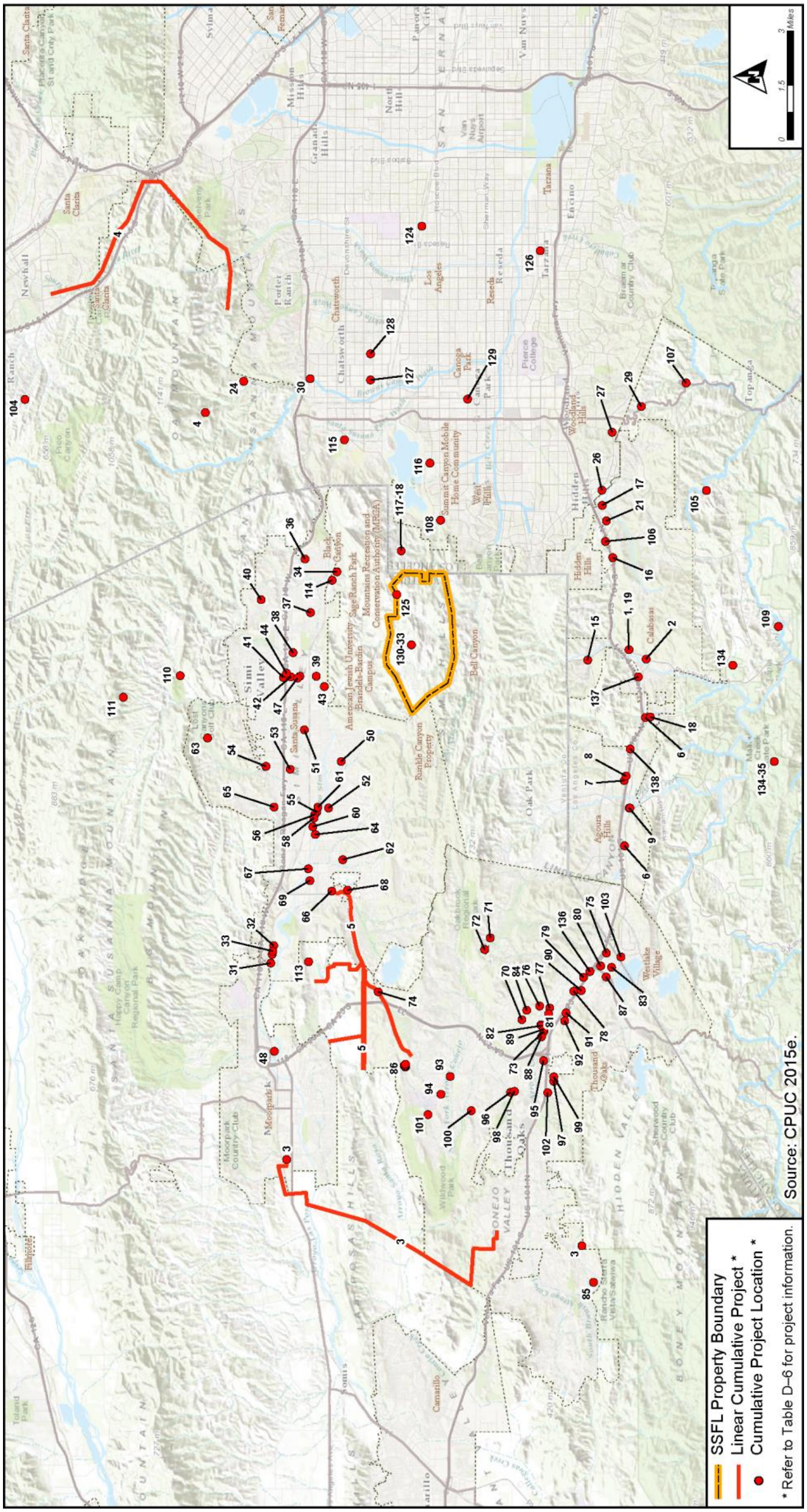


Figure D–3 Locations of Other Actions in the Santa Susana Field Laboratory Region of Influence

Table D–7 Key Information for Other Actions in the Santa Susana Field Laboratory Region of Influence

Figure D–3 Map No.	Type of Project	Lead Agency	Project Name	Description of Project	Residential Units	Square Footage	Area (acres)	Approximate Distance from SSFL (miles)	Implementation Status	Address	Included in the Cumulative Impacts Analysis
1	Hotel	City of Calabasas	Canyon Oaks - Hotel	New hotel – 120 rooms		10,700	3	4.5 miles south	Draft EIR under review	4790 Las Virgenes Road	
2	Residential	City of Calabasas	Paxton Townhome Project	Multi-family townhomes – 78 units	78		5	6 miles south	Under review with City	4240 Las Virgenes Road	
3	T-Line	California Public Utilities Commission	Moorpark-Newbury	The subtransmission line would extend between SCE's Moorpark Substation and Newbury Substation within a portion of SCE's existing Moorpark-Ormond Beach 220-kV transmission Line right-of-way and within a portion of SCE's existing Moorpark-Newbury-Pharmacy 66 kV Subtransmission Line Right-of-Way. Requirements include 9 miles of new 66-kV subtransmission line; new tubular steel poles to carry the line; new lightweight steel poles; associated infrastructure within Moorpark and Newbury substations to facilitate new line.				8 miles west	Draft EIR under review	Ventura County, generally between State Route 118 (Los Angeles Avenue) to the north, U.S. Highway 101 to the south, and west of State Route 23, in the cities of Moorpark and Thousand Oaks and portions of unincorporated Ventura County between the two cities.	Yes
4	Energy	California Public Utilities Commission	Southern California Gas Company Aliso Canyon Turbine Replacement Project	The Aliso Canyon Project, as proposed by Southern California Gas Company (SoCalGas), includes removal from service of the existing gas turbine driven compressor station located at the Aliso Canyon natural gas storage field (storage field) in unincorporated Los Angeles County and the City of Los Angeles, California. The turbine driven compressor station will be replaced with three variable frequency compression trains installed in a new compressor station (Central Compressor Station). Other onsite and offsite associated facilities will be upgraded as part of the project. Under Section 851 of the Public Utilities Code, an existing SCE electrical easement on SoCalGas property will also be enlarged. Project components pass through unincorporated Los Angeles, the City of Los Angeles, the City of Santa Clarita (in Los Angeles County), the City of Mission Hills (in Los Angeles County), and unincorporated Ventura County.			3,600	9 miles northeast	Under construction	Aliso Canyon natural gas storage field in unincorporated Los Angeles County and the City of Los Angeles, California.	Yes

Figure D–3 Map No.	*Type of Project*	*Lead Agency*	*Project Name*	*Description of Project*	*Residential Units*	*Square Footage*	*Area (acres)*	*Approximate Distance from SSFL (miles)*	*Implementa-tion Status*	*Address*	*Included in the Cumulative Impacts Analysis*
5	T-Line	CPUC - Southern California Edison	Presidential Substation Project	The substation site would be located in the City of Thousand Oaks, and the subtransmission source lines would be located in both unincorporated Ventura County and the City of Thousand Oaks.				3 miles northwest	Approved for construction	Substation located in the City of Thousand Oaks, and the subtransmission lines would be located in unincorporated Ventura County and the City of Thousand Oaks	Yes
6	Commercial	City of Agoura Hills	APB Properties, LLC	Five empty lots and one developed lot for a site total of approximately 4.18 acres		30,000	4	5.5 miles south	Approved by City	27489 Agoura Hills, Agoura Hills, CA	
7	Commercial	City of Agoura Hills	Shirvanian Family Investment	Industrial park with 7 buildings		103,000	10	5.5 miles southwest	Approved by City	Lots between 28700 and 28811 Canwood Street, Agoura Hills, CA	
8	Commercial	City of Agoura Hills	Ware Malcomb for Agoura Business Center West	A General Plan Amendment application to change project site from Business Manufacturing to Commercial Retail and a CUP application to construct three retail buildings.		21,782	2	5.5 miles southwest	Approved by City	Northwest corner of Canwood Street and Derry Avenue, Agoura Hills, CA	
9	Mixed Use	City of Agoura Hills	E.F Moore & Co	Agoura Village mixed-use development	95	48,500	18	5.75 miles southwest	Under review by City	SEC of Agoura and Kanan Road, Agoura Hills, CA	
11	Commercial	City of Agoura Hills	Healthcote for Buckley	Commercial/medical building		14,075	3	6 miles southwest	Under review by City	South of Agoura Road near western city limits, Agoura Hills, CA	
12	Residential	City of Agoura Hills	Symphony Development	Subdivide into eight lots			35	6 miles southwest	Approved by City	4995 Kanan Road, Agoura Hills, CA	
13	Mixed Use	City of Agoura Hills	Utopia Hills by Alon Zakoot	Mixed use and live/work project		44,668	1	6 miles southwest	Under review by City	Agoura Road, Agoura Hills, CA	
14	Mixed Use	City of Agoura Hills	Cornerstone	Mixed-use development		42,847	6	6.5 miles southwest	Under review by City	SEC Agoura Road, Agoura Hills, CA	
15	Commercial	City of Calabasas	Vidovich Commercial Center	Commercial retail and office		45,040		3.6 miles south	Construction permit obtained	5741 Las Virgenes Road, Calabasas, CA	
16	Commercial	City of Calabasas	Malamut Vintage Auto	Retail (auto sales)		20, 983		4.6 miles southeast	Under construction	24439 Calabasas Road, Calabasas, CA	
17	Mixed Use	City of Calabasas	Village at Calabasas Condominiums and Mixed Use	Multi-family. Condo with street retail – 80 units	80	10,700		4.7 miles southeast	Under construction	23500 Park Sorrento, Calabasas, CA	
18	Hotel	City of Calabasas	Rondell Oasis Hotel Project	Hotel – 127 rooms		72,954	4	4.7 miles southeast	Application filed with the City	26300 Rondell Road, Calabasas, CA	
19	Residential	City of Calabasas	Canyon Oaks Residential	Single-family – 71 units	71		13	4.8 miles south	Draft EIR under review	4790 Las Virgenes Road, Calabasas, CA	

Figure D–3 Map No.	*Type of Project*	*Lead Agency*	*Project Name*	*Description of Project*	*Residential Units*	*Square Footage*	*Area (acres)*	*Approximate Distance from SSFL (miles)*	*Implementa-tion Status*	*Address*	*Included in the Cumulative Impacts Analysis*
20	Hotel	City of Calabasas	Hilton Garden Inn Expansion	Construct hotel expansion – 51 rooms.		28,787		4.8 miles southeast	Application filed with the City	24150 Park Sorrento, Calabasas, CA	
21	Park	City of Calabasas	Calabasas Senior Center	Construct community Center		9,500		4.8 miles southeast	Under construction	100/200 Civic Center Way, Calabasas, CA	
22	Commercial	City of Calabasas	Cheesecake Factory Corporate Center Expansion	Construct commercial Office		18,628		5.3 miles southeast	Under review by City	26901 Malibu Hills Road, Calabasas, CA	
23	Mixed Use	City of Los Angeles	MGA Mixed-Use Campus Project	MGA is relocating its corporate headquarters, which will include 700 rental-housing units, ancillary office space, a running track, and an amphitheater; 256,000 square feet for office space will be derived from current office space on site.	700	256,000	24	5 miles east	Final EIR completed; under review	Chatsworth-Porter Ranch community of the City of Los Angeles, CA	Yes
24	Residential	City of Los Angeles	Hidden Creeks Estates	Construct 188 single-family dwelling units with an equestrian boarding facility	188		259	5 miles north	Under review by City	12100 Browns Canyon Road, Los Angeles, CA	Yes
26	Mixed Use	City of Los Angeles	Motion Picture and Television Fund Retirement Home Supplemental EIR	Conditional Use and Zone Variance to allow construction of 191,500 square feet of new medical use, with number of licensed beds increasing to 290 from existing 256. Construction of 285,070 square feet of residential retirement facilities with a net increase of 269 new units. Construction of 60,500 square feet of new services/administrative buildings and 21,000 square feet of new activity/recreational facilities.	269	558,070	9	5.5 miles southeast	Final EIR completed	23450 Calabasas Road, Los Angeles, CA	
27	Residential	City of Los Angeles	Vesting Tentative Tract	Develop 37 detached single-family homes.	37		6	5.75 miles southeast	Final EIR completed; under review	22255 Mulholland Drive, Woodland Hills, Los Angeles, CA	
29	Mixed Use	City of Los Angeles	The Village at Westfield Topanga Project	Phased development of about 444,744 square feet of shopping center uses, including about 165,759 square feet for an anchor retailer, which would support an ancillary member-only fueling station, and about 278,985 square feet of shopping center retail space. Also includes a 275-room hotel with ground floor dining and retail and restaurant uses, a grocery store, and office and community/cultural center uses as well.		444,744	30	6.75 miles northeast	Under construction	6360 North Topanga Canyon Boulevard, Los Angeles, CA	Yes

Figure D–3 Map No.	Type of Project	Lead Agency	Project Name	Description of Project	Residential Units	Square Footage	Area (acres)	Approximate Distance from SSFL (miles)	Implementa-tion Status	Address	Included in the Cumulative Impacts Analysis
30	Church/ School	City of Los Angeles	Sierra Canyon Secondary School	Construct a three-story, 75,000-square-foot building property in the A1-1K zone as an expansion of, and adjacent to, an existing 60,000-square-foot church and private school (grades K-12) on a separate parcel east of Shoshone Avenue.		75,000	6	9.25 miles northeast	Final EIR completed; under review	11047 North De Soto Avenue, Chatsworth, Los Angeles, CA	
31	Commercial	City of Simi Valley	Larry Ready Construction	Construct a contractor storage yard and recreational vehicle storage yard.				10.0 miles northwest	Under construction	890 and 900 West Los Angeles Avenue, Simi Valley, CA	
32	Commercial	City of Simi Valley	West Simi Business Center	Construct a 167,417-square-foot, multi-tenant industrial park.		167,417		10.0 miles northwest	Approved by the City, unbuilt	903 Quimisa Drive, Simi Valley, CA	
33	Commercial	City of Simi Valley	Donley RV Storage	Construct a recreational vehicle storage lot, including recreational vehicle retail part sales, rental, and repair service uses.				10.0 miles northwest	Approved by the City, unbuilt	North side of Los Angeles Avenue, approximately 1,300 feet east of Quimisa Avenue, Simi Valley, CA	
34	Residential	City of Simi Valley	Katherine Road South	Construct a 31-unit apartment complex, including five single-story buildings, a single-story manager's unit, and a common building.	31			2 miles north	In plan check stage	1384 Katherine Road South, Simi Valley, CA	
35	Residential	City of Simi Valley	Kuehner Apartments	Construct a six-unit apartment complex.	6			2.5 miles north	Under construction	Katherine Road South, Simi Valley, CA	
36	Residential	City of Simi Valley	Savannah	Construct 66 condominiums.	66			2.5 miles north	Under construction	Northwest corner of Kuehner Drive and 118 Freeway, Simi Valley, CA	
37	Residential	City of Simi Valley	Humkar	Construct 16 townhomes.	16			2.75 miles northwest	Approved by the City, unbuilt	5496 East Los Angeles Avenue, Simi Valley, CA	
38	Residential	City of Simi Valley	Mountain View Apartments	Construct a 50-unit senior apartment complex with an Affordable Housing Agreement.	50			3.5 miles northwest	In plan check stage	4862 East Cochran Street, Simi Valley, CA	
39	Residential	City of Simi Valley	Landmark at Tapo/Ish	Construct a single-family residence on each of three existing lots.	3			3.75 miles northwest	Approved by the City, unbuilt	Southwest corner of Tapo Street and Ish Drive, Simi Valley, CA	
40	Perk	City of Simi Valley	Chumash Park	Construct a new community park.				4 miles north	In plan check stage	East side of Flanagan Drive at north end of road	
41	Hospital/ Assisted Living	City of Simi Valley	Clinicas del Camino Real	Construct an 11,052-square-foot, one-story medical facility.		11,052		4 miles northwest	Under construction	4370 Eve Road, Simi Valley, CA	

Figure D–3 Map No.	*Type of Project*	*Lead Agency*	*Project Name*	*Description of Project*	*Residential Units*	*Square Footage*	*Area (acres)*	*Approximate Distance from SSFL (miles)*	*Implementa-tion Status*	*Address*	*Included in the Cumulative Impacts Analysis*
42	Commercial	City of Simi Valley	Express Car Wash	Construct a two-lot subdivision and a 2,035-square-foot, self-service car wash.		2,035		4 miles northwest	Planning commission denied, appealed to the City	2401 Tapo Street, Simi Valley, CA	
43	Commercial	City of Simi Valley	Guardian Street Office Building	Construct a 54,311-square-foot, three-story office building and a parking lot.		54,311		4 miles northwest	Application complete	4180 Guardian Street, Simi Valley, CA	
44	Residential	City of Simi Valley	Apricot Apartments	Construct a 10-unit affordable apartment complex.	10		1	4 miles northwest	In plan check stage	4453 Apricot Road, Simi Valley, CA	
45	Residential	City of Simi Valley	Apricot Development	Construct seven townhomes.	7			4 miles northwest	Approved by the City, unbuilt	4453 Apricot Road, Simi Valley, CA	
46	Residential	City of Simi Valley	Apricot Road - JMA	Construct a three-unit apartment complex.	3			4 miles northwest	Under construction	4424 Apricot Road, Simi Valley, CA	
47	Mixed Use	City of Simi Valley	The Market Place	Construct 72 townhomes, 36 senior condominiums, and a commercial building.	108			4 miles northwest	Under construction	2225 and 2245 Tapo Street, Simi Valley, CA	Yes
48	Park	City of Simi Valley	Arroyo Simi Greenway	Construct a recreational trail and associated improvements along the Arroyo Simi.				4-10 miles northwest	Application complete	Along the Arroyo Simi, from the west end of the City to the east end, Simi Valley, CA	
49	Mixed Use	City of Simi Valley	Hummingbird Nest Ranch	Convert existing equestrian and residential facilities and construct new facilities. Planned uses include a 105 room hotel, equestrian center, conference center, pool, etc.			125	5 miles north	Permitting is complete; Construction will begin in 2016	Northern terminus of Kuehner Drive, Simi Valley, CA	Yes
50	Church/ School	City of Simi Valley	Archangel Michael Coptic Orthodox Church	Construct a 500-seat sanctuary, multipurpose room, day care center, and guesthouse and convert existing church to a senior center.				5 miles northwest	Approved by the City, unbuilt	1122 Appleton Road, Simi Valley, CA	
51	Residential	City of Simi Valley	Runkle Canyon Residential Project	Construct 298 single-family homes, 25 custom homes, and 138 senior condominiums.	461		1,595	5 miles west	Under construction	Southern terminus of Sequoia Avenue, Simi Valley, CA	Yes
52	Commercial	City of Simi Valley	7-Eleven Market	Demolish an existing gas station and construct a foodmart with gas station.			1	6 miles northwest	Under construction	1369 Erringer Road, Simi Valley, CA	
53	Hotel	City of Simi Valley	Hampton Inn	Construct a three-story, 103-room hotel.				6 miles northwest	Approved by the City, unbuilt	2585 East Cochran Street, Simi Valley, CA	
54	Hospital/ Assisted Living	City of Simi Valley	Simi Valley Hospital ER Expansion	Construct a 17,100-square-foot addition to the hospital.		17,100		6 miles northwest	Under construction	2975 Sycamore Drive, Simi Valley, CA	
55	Residential	City of Simi Valley	River Run	Construct 40 townhomes.	40		2	6 miles northwest	Approved by the City, unbuilt	1748 Heywood Street, Simi Valley, CA	
56	Residential	City of Simi Valley	Information Unavailable	Construct four townhomes.	4			6.25 miles northwest	Approved by the City, unbuilt	1762 Patricia Avenue, Simi Valley, CA	

Figure D–3 Map No.	*Type of Project*	*Lead Agency*	*Project Name*	*Description of Project*	*Residential Units*	*Square Footage*	*Area (acres)*	*Approximate Distance from SSFL (miles)*	*Implementation Status*	*Address*	*Included in the Cumulative Impacts Analysis*
57	Residential	City of Simi Valley	Information Unavailable	Construct a six-unit apartment complex.	6			6.25 miles northwest	Approved by the City, unbuilt	1762 Patricia Avenue, Simi Valley, CA	
58	Residential	City of Simi Valley	Azad Group	Construct three townhomes.	3			6.5 miles northwest	Approved by the City, unbuilt	Northeast corner of Patricia Avenue and Galt Street, Simi Valley, CA	
59	Residential	City of Simi Valley	Azad Group	Construct three townhomes.	3			6.5 miles northwest	Approved by the City, unbuilt	Northeast corner of Patricia Avenue and Galt Street, Simi Valley, CA	
60	Residential	City of Simi Valley	Jarel Enterprises Inc.	Construct 12-unit condominium complex.	12			6.5 miles northwest	In plan check stage	1525 Patricia Avenue, Simi Valley, CA	
61	Residential	City of Simi Valley	City Ventures	Construct 62 townhome condominiums.	62		5	7 miles northwest	Approved by the City, unbuilt	Southwest corner of Erringer Road and Heywood Street, Simi Valley, CA	
62	Residential	City of Simi Valley	Huppert	Construct five single-family residences.	5			7 miles northwest	Approved by the City, unbuilt	1055 Fourth Street, City of Simi Valley	
63	Residential	City of Simi Valley	Lost Canyons	Master planned development to grade for 364 single-family lots, infrastructure, streets, common area improvements, etc.	364		1,770	7 miles northwest	Approved by the City, unbuilt	3301 Lost Canyons Drive, Simi Valley, CA	Yes
64	Residential	City of Simi Valley	Sage View Apartments	Construct an eight-unit apartment complex.	8			7 miles northwest	Under construction	1378 Patricia Avenue, Simi Valley, CA	
65	Residential	City of Simi Valley	Simi Homes	Construct four homes on existing lots.	4			7 miles northwest	In plan check stage	Big Sky Place and Erringer Road, Simi Valley, CA	
66	Commercial	City of Simi Valley	Centre Court	Convert a soccer field in an existing retail center to a one-story, 10,600-square-foot retail building.		10,600		8 miles northwest	Approved by the City, unbuilt	1308 Madera Road, Simi Valley, CA	
67	Commercial	City of Simi Valley	Medical Office Building	Construct an approximately 25,000-square-foot, three-story medical office building.		25,000		8 miles northwest	Approved by the City, unbuilt	525 East Los Angeles Avenue, Simi Valley, CA	
68	Park	City of Simi Valley	Sinaloa Park	Create a community park facility with miniature golf and associated uses.				8 miles northwest	Approved by the City, unbuilt	980 Madera Road, Simi Valley, CA	
69	Residential	City of Simi Valley	Simi-37	Construct 37 multi-family townhomes.	37		3	8 miles northwest	Approved by the City, unbuilt	Southeast corner of Los Angeles Avenue and Simi Village Drive, Simi Valley, CA	
70	Church/ School	City of Thousand Oaks	Information Unavailable	Construct 20,000-square-foot sanctuary, youth church, office, and classroom buildings; encroach into the protected zone of five oak trees.		20,000		10.0 miles southwest	Approved by the City	750 Erbes Road, Thousand Oaks, CA	

Figure D–3 Map No.	Type of Project	Lead Agency	Project Name	Description of Project	Residential Units	Square Footage	Area (acres)	Approximate Distance from SSFL (miles)	Implementation Status	Address	Included in the Cumulative Impacts Analysis
71	Residential	City of Thousand Oaks	Information Unavailable	Construct five single-family homes; encroach within the protected zones of four oak trees.	5			5.5 miles southwest	Approved by the City	Northwest corner of Kanan Road and Rayburn Street, Thousand Oaks, CA	
72	Residential	City of Thousand Oaks	Information Unavailable	Construct 13 single-family dwellings; remove six oaks; encroach into the protected zone of five oaks and one landmark tree; prune five oaks and two landmark trees.	13			6 miles southwest	Approved by the City	2000 Upper Ranch Road, Thousand Oaks, CA	
73	Residential	City of Thousand Oaks	Information Unavailable	Allow one lot subdivision of 0.74 acres; construct eight townhome units.	8		1	7 miles west	Approved by the City	East side Erbes Road, 750 feet north of Thousand Oaks Boulevard, Thousand Oaks, CA	
74	Residential	City of Thousand Oaks	Information Unavailable	Divide 42.8 acres into eight lots; construct six single-family detached dwellings.	6		43	7 miles west	Approved by the City	Olsen Road East of the 23 Freeway, Thousand Oaks, CA	
75	Mixed Use	City of Thousand Oaks	Information Unavailable	Construct 482,000-square-foot, phased commercial complex consisting of seven office buildings, restaurant, parking structure, senior assisted living and skilled nursing facility; transplant one oak; encroach within the protected zone of seven oaks; and prune two oaks for the construction of new solar carports.		482,000		7.75 miles southwest	Under construction	3059 Townsgate Road, Thousand Oaks, CA	
76	Residential	City of Thousand Oaks	Information Unavailable	Divide 12.42 acres into 10 lots; construct eight single-family dwellings.	8		12	7.75 miles southwest	Under construction	Northeast corner of Hillcrest Drive and Conejo School Road, Thousand Oaks, CA	
77	Residential	City of Thousand Oaks	Information Unavailable	Construct a three-unit apartment complex.	3			7.75 miles southwest	Approved by the City	2423 Chiquita Lane, Thousand Oaks, CA	
78	Residential	City of Thousand Oaks	Information Unavailable	Construct four detached townhouse units; divide 0.5 acre into condominium lot.	4		1	7.75 miles southwest	Approved by the City	134 Sunset Drive, Thousand Oaks, CA	
79	Commercial	City of Thousand Oaks	Information Unavailable	Demolish dealership and construct a Lexus dealership; make site improvements.				7.75 miles southwest	Under construction	3735 Auto Mall Drive, Thousand Oaks, CA	
80	Hotel	City of Thousand Oaks	Information Unavailable	Construct a five-story wing and three-story parking structure at the Hyatt Westlake; remove one oak tree and encroach into the protected zone of five oak trees.				7.75 miles southwest	Approved by the City	880 South Westlake Boulevard, Thousand Oaks, CA	

Figure D–3 Map No.	*Type of Project*	*Lead Agency*	*Project Name*	*Description of Project*	*Residential Units*	*Square Footage*	*Area (acres)*	*Approximate Distance from SSFL (miles)*	*Implementa-tion Status*	*Address*	*Included in the Cumulative Impacts Analysis*
81	Residential	City of Thousand Oaks	Information Unavailable	Divide 0.98 acres; construct 13 townhomes.	13		1	8 miles southwest	Approved by the City	Northeast corner Conejo School Road and Chiquita Lane, Thousand Oaks, CA	
82	Residential	City of Thousand Oaks	Information Unavailable	Construct a 45-unit apartment complex, remove one oak tree; encroach into the protected zone of one oak tree; allow a lot manager.	45			8 miles southwest	Approved by the City	1815 and 1825 Los Feliz Drive, Thousand Oaks, CA	
83	Commercial	City of Thousand Oaks	Information Unavailable	Renovate exterior; construct building addition and two new buildings; and change parking and landscaping at shopping center. There will be tree removal as well.				8 miles southwest	Under construction	2725-2785 Agoura Road and 924-1024 South Westlake Boulevard, Thousand Oaks, CA	
84	Residential	City of Thousand Oaks	Information Unavailable	Subdivide 12.52 acres into six lots of record, consisting of five residential lots and one open space lot.	5		13	8 miles southwest	Pre-application stage	600 Lone Oak Drive, Thousand Oaks, CA	
85	Park	City of Thousand Oaks	Information Unavailable	Develop a Community Park on approximately 145 acres, consisting of 17 acres of amenities, open space, and interconnecting multi-use trails.			145	8 miles southwest	Pending	Banyan Park on Meadowcrest Street, Thousand Oaks, CA	
86	Residential	City of Thousand Oaks	Information Unavailable	Reconfigure five recorded lots into four; construct four single-family detached dwellings.	4			8 miles west	Under construction	730, 742, 766, 778 and 786 Calle Contento, Thousand Oaks, CA	
87	Commercial	City of Thousand Oaks	Information Unavailable	Construct a 6,000-square-foot retail/restaurant addition; subdivide one lot; remove 2 landmark trees; and encroach into the protected zone of 11 landmark trees.		6,000		8.25 miles southwest	Approved by the City	971 and 973 South Westlake Boulevard, Thousand Oaks, CA	
88	Residential	City of Thousand Oaks	Information Unavailable	Construct a three-story, 36-unit apartment; remove three oak trees and one landmark tree; encroach into the protected zone of five oak trees; and prune four oak trees.	36			8.5 miles southwest	Approved by the City	1475 East Thousand Oaks Boulevard, Thousand Oaks, CA	
89	Residential	City of Thousand Oaks	Information Unavailable	Divide 0.5 acres; construct seven townhomes.	7		1	8.5 miles southwest	Approved by the City	1735 Los Feliz Drive, Thousand Oaks, CA	
90	Commercial	City of Thousand Oaks	Information Unavailable	Construct 98,200 square-foot office and self-storage facility; encroach into the protected zone of six oak trees.		98,200		8.5 miles southwest	Under construction	3500 Willow Lane, Thousand Oaks, CA	
91	Commercial	City of Thousand Oaks	Information Unavailable	Construct industrial building; remove one and transplant four oak trees.				8.5 miles southwest	Pending	2650 Willow Lane, Thousand Oaks, CA	

Figure D–3 Map No.	Type of Project	Lead Agency	Project Name	Description of Project	Residential Units	Square Footage	Area (acres)	Approximate Distance from SSFL (miles)	Implementa-tion Status	Address	Included in the Cumulative Impacts Analysis
92	Commercial	City of Thousand Oaks	Information Unavailable	Construct an 8,000-square-foot industrial building; remove three oak trees and one toyon tree.		8,000		8.5 miles southwest	Pending	SE of Willow Lane on Conejo Ridge Road, Thousand Oaks, CA	
93	Residential	City of Thousand Oaks	Information Unavailable	Construct four new homes; remove one oak tree; encroach into the protected zone of 2 landmark trees.	4			8.75 miles southwest	Under construction	390 Arcturus Street, Thousand Oaks, CA	
94	Church/ School	City of Thousand Oaks	Information Unavailable	Construct a 15,800-square-foot fellowship hall with classrooms at Holy Trinity Lutheran Church.		15,800		9 miles southwest	Approved by the City	One West Avenida de Los Arboles, Thousand Oaks, CA	
95	Residential	City of Thousand Oaks	Information Unavailable	Construct a 4-unit apartment building; encroach into the protected zone of two oak trees.	4			9 miles southwest	Under construction	Northeast corner of Pierce and Jensen Courts, Thousand Oaks, CA	
96	Residential	City of Thousand Oaks	Information Unavailable	Divide 25.14 acres into 29 lots; construct 20 single-family dwellings and encroach into protected zones of four oak trees; additional export of 16,000 cubic yards.	20		25	9.4 miles southwest	Under construction	Southwest corner of Mayflower Street and Warwick Avenue, Thousand Oaks, CA	
97	Residential	City of Thousand Oaks	Information Unavailable	Construct 14 units at 248-unit Los Robles Apartment complex; encroach into the protected zone of eight oak trees.	14			9.5 miles southwest	Approved by the City	300 East Rolling Oaks Drive, Thousand Oaks, CA	
98	Residential	City of Thousand Oaks	Information Unavailable	Divide 2.01 acres into one lot; construct 23 townhomes.	23		2	9.5 miles southwest	Approved by the City	950 Warwick Avenue, Thousand Oaks, CA	
99	Hospital/ Assisted Living	City of Thousand Oaks	Information Unavailable	Construct 89-bed assisted living facility (Oakmont Senior Living).				9.5 miles southwest	Pending	400 Rolling Oaks Drive, Thousand Oaks, CA	
100	Commercial	City of Thousand Oaks	Information Unavailable	Construct a new 189,499-square-foot, four-story building wing; construct new multi-level parking structure; remove two oak trees and encroach into the protected zone of three oak trees.		189,499		9.5 miles southwest	Approved by the City	215 West Janss Road, Thousand Oaks, CA	
101	Residential	City of Thousand Oaks	Information Unavailable	Construct seven single-family detached homes.	7			9.5 miles west	Under construction	Southwest corner of Olsen Road and Morningstar Avenue, Thousand Oaks, CA	
102	Commercial	City of Thousand Oaks	Information Unavailable	Demolish existing restaurant and construct a new two-story medical office building.				9.75 miles southwest	Under construction	55 East Rolling Oaks Drive, Thousand Oaks, CA	
103	Residential	City of Westlake Village	One Eighty (Leisure Care) Project	Construct a 136-unit senior living community to be located at a former hospital site.	136		2	10.5 miles southeast	Approved by the City	4415 Lakeview Canyon Road, Westlake Village, CA	
104	Church/ School	County of Los Angeles	Information Unavailable	Construct three two-story dormitories; total square footage 22,157.		22,157		8.1 miles southeast	Approved by the County	26412 Thackery Lane, Stevenson Ranch	

Figure D–3 Map No.	***Type of Project***	***Lead Agency***	***Project Name***	***Description of Project***	***Residential Units***	***Square Footage***	***Area (acres)***	***Approximate Distance from SSFL (miles)***	***Implementation Status***	***Address***	***Included in the Cumulative Impacts Analysis***
105	Church/ School	County of Los Angeles	Information Unavailable	Authorize demolition of a two-story building and construction of a two-story learning center in the same location and installation of a fire access road serving the learning center; installation of two modular classrooms and toilet structures, all in accordance with CUP 96-184-(3).				7.50 miles southeast	Approved by the County	1717 Old Topanga Canyon Road, Topanga, CA	
106	Hospital/ Assisted Living	County of Los Angeles	Information Unavailable	Construct new assisted living facility with 140 units and 160 beds.				4.5 miles southeast	Under review by the County	24141 Ventura Boulevard, Calabasas, CA	
107	Hotel	County of Los Angeles	Information Unavailable	CUP for new residence to be used as a bed and breakfast in the Santa Monica Mountains North Area Community Standards District and variance for the ridgeline encroachment. 919.5 cubic yards cut and 654.9 cubic yards fill with 264.9 cubic yards export.				8.46 miles southeast	EIR under review	1832 N Topanga Canyon Boulevard, Topanga, CA	
108	Residential	County of Los Angeles	Sterling Properties	Dayton Canyon is the site of a proposed Centex Homes housing development called Sterling Properties. It is located west of the intersection of Roscoe Boulevard and Valley Circle Boulevard in West Hills and is less than a mile from the eastern property boundary of SSFL. 150 single-family homes are planned on 64.2 acres out of the development's 359.4 total acreage.	150		64	1 mile east	Under construction	West of the intersection of Roscoe Boulevard and Valley Circle Boulevard in West Hills, CA	Yes
109	Residential	County of Los Angeles	Information Unavailable	Malibu Local Coastal Plan: six (Residential I) (11 dwelling units per acre) Zone: R-1-20,000 (single-family residence) (minimum lot size 20,000 square feet); Other: Malibu Coastal Zone single-family residences are considered a conforming use with reference to the above-mentioned regulations.	6			8.9 miles south	Application received	25734 Punto De Vista Drive, Calabasas, CA	
110	Park	County of Ventura	Information Unavailable	Construct a 3-acre archery range with associated 165-space gravel parking lot.			3	8 miles north	Application in process	4651 Tapo Canyon Road, Simi Valley, CA	
111	Energy	County of Ventura	Information Unavailable	Drill 12 oil and gas exploratory wells; add three oil stock tanks, a flow treater, a water tank, a transfer pump, and a containment berm around the water tank.			7	8 miles north	Application in process	No address	
112	Remediation	County of Ventura	Fishback Waste Cleanup	Remediation project. Remove an estimated 100,000 cubic yards of construction debris and other materials from the property.				1 miles north	Remediation plan requested by County	South of the City of Simi Valley	

Figure D–3 Map No.	Type of Project	Lead Agency	Project Name	Description of Project	Residential Units	Square Footage	Area (acres)	Approximate Distance from SSFL (miles)	Implementa-tion Status	Address	Included in the Cumulative Impacts Analysis
113	Residential	Ventura County Planning Division	Butler Ranch Zone Change and Tentative Tract Map Project	The proposed project consists of a request for approval of a: (1) change in the zoning designation of the portion of the project site that consists of APNs 500-0-360-185 and 513-0-050-065, from AE-40 ac (Agricultural Exclusive, 40 acres minimum lot size) to OS-20 ac (Open Space, 20 acres minimum lot size); and (2) Vesting Tentative Tract Map to: (a) subdivide APNs 500-0-360-185 and 513-0-050-065 into 24 lots for residential development; and (b) designate APN 500-0-370-275 as a remainder parcel. The 24 lots for residential development will range from 20.04 acres to 24.85 acres in size, and the remainder parcel will be 63.87 acres in size.	24	1,106,206	556	6 miles northwest	EIR is being prepared. The proposed project does not include build-out of the proposed lots at this time	1313 Tierra Rejada Road, Simi Valley, CA 93065	
114	Residential	Ventura County Planning Division	Colton Lee Manufactured Housing Community	The Planning Division is currently processing an application for a General Plan Amendment and Zone Change to allow up to 60 dwelling units on the subject property. The project site is located within the unincorporated area of Ventura County, within the existing Santa Susana Knolls Community, located south/southeast of the City of Simi Valley. The project site is located adjacent to Katherine Road, across the street from Knoll's Park.	60			1 mile northeast	Final EIR completed	Corner of Katherine Road and Peppertree Lane West, Simi Valley, CA	Yes
115	Remediation	Department of Recreation and Parks/ Department of Toxic Substances Control	Chatsworth Park South	Remediation Project. Permanently cap soil with lead and polycyclic aromatic hydrocarbons resulting from former firing range.			81	4 miles northeast	Active	22360 Devonshire Street, Chatsworth, CA	
116	Remediation	Department of Toxic Substances Control	Raytheon Systems Company	Remediation Project. Site houses a hazardous waste storage area and a 4,000-gallon waste oil tank.			86	2 miles southeast	Active	8433 Fallbrook Ave Canoga Park, CA	
117	Remediation	Department of Toxic Substances Control	The Boeing Company, Canoga Park	Remediation Project. Aerospace manufacturing and testing resulted in groundwater and soil contamination. Three groundwater treatment systems have been installed.			791	On site	Active	Woolsey Canyon Road, Simi Valley, CA	Yes

Figure D–3 Map No.	*Type of Project*	*Lead Agency*	*Project Name*	*Description of Project*	*Residential Units*	*Square Footage*	*Area (acres)*	*Approximate Distance from SSFL (miles)*	*Implementa-tion Status*	*Address*	*Included in the Cumulative Impacts Analysis*
118	Remediation	Department of Toxic Substances Control	The Boeing Company, Canoga Park	Remediation Project. Aerospace manufacturing and testing, as well as storage of alkali metal, resulted in aquifer and soil contamination.			465	On site	Active	Woolsey Canyon Road, Simi Valley, CA	Yes
124	Remediation	Department of Toxic Substances Control	MJ Plating Industrial Building	Remediation Project. Cleanup of PCE in soil, as well as trichloroethylene and PCE in soil gas samples. Drilling, sampling, and installation of soil borings and vapor probes will be required.			<1	7.75 miles east	Active	18141 Napa Street, Northridge, CA	
125	Remediation	Department of Toxic Substances Control	NASA Area II	Previous firing range. Soil and soil vapor under investigation for explosives.			100	On site	Active	Chatsworth, CA Los Angeles County	Yes
126	Remediation	Department of Toxic Substances Control	Former Bodycote Facility	Cleanup on parcel with chlorinated solvents and benzene from metal manufacturing that occurred previously on the site. Groundwater has been impacted.			1	8 miles southeast	Active	18600 Oxnard Street, Tarzana, CA	
127	Remediation	Department of Toxic Substances Control	New Hampshire Ball Bearing	Soil and groundwater VOC contamination is present.			8	9 miles east	Active	9730 Independence Avenue, Chatsworth, CA	
128	Remediation	Department of Toxic Substances Control	Proodos Properties, Inc.	Soil and soil vapor under investigation. Possible contamination from dry cleaning business.			8	9 miles east	Active	9737 Mason Avenue, Chatsworth, CA	
129	Remediation	Department of Toxic Substances Control	The Marquardt Company	Previously, aerospace manufacturing and testing occurred, resulting in lead and arsenic contaminants. Soil and soil vapor extraction implemented. Groundwater is also contaminated.			56	9.5 miles east	Active	16555 Saticoy Street, Van Nuys, CA	
130	Remediation	Department of Toxic Substances Control	Boeing Demolition at SSFL	Demolish various structures at SSFL.				On site	Undergoing demolition	Santa Susana Field Laboratory, Canoga Park, CA	Yes
131	Remediation	Department of Toxic Substances Control	NASA Demolition at SSFL	Demolish various structures at SSFL.				On site	Undergoing demolition	Santa Susana Field Laboratory, Canoga Park, CA	Yes
133	Remediation	Department of Toxic Substances Control	NASA/SSFL	Remediation Project. Dioxin, metals, TPH motor oil, etc., are contaminants of concern, Groundwater affected; sediments, soil, and soil vapor under investigation.			452	On site	Active	Santa Susana Field Laboratory, Simi Valley, CA	Yes

Figure D–3 Map No.	Type of Project	Lead Agency	Project Name	Description of Project	Residential Units	Square Footage	Area (acres)	Approximate Distance from SSFL (miles)	Implementation Status	Address	Included in the Cumulative Impacts Analysis
134	Park	National Park Service	Santa Monica Mountains National Recreation Area, Visitor Center at King Gillette Ranch	The National Park Service, California State Parks, Santa Monica Mountains Conservancy, and Mountains Recreation and Conservation Authority are preparing a Design Concept Plan (DCP) for King Gillette Ranch in the Santa Monica Mountains. The DCP would guide future management and operations at King Gillette Ranch and address management of visitor-serving uses at the ranch, including establishment of an interagency visitor center for the SMMNRA, public trail access, and environmental education. The plan would also guide natural and cultural resource preservation and restoration.				8 miles south	FONSI issued	Santa Monica Mountains National Recreation Area	
135	Park	National Park Service	Santa Monica Mountains National Recreation Area Interagency Trail Management Plan	Trail Management Plan (TMP). The TMP will establish the overall vision for future development and management of the nearly 500-mile SMMNRA trail network. Based on identified desired conditions for park natural, cultural, and recreational resources, the TMP will prescribe a comprehensive plan for circulation, access, and allowable trail uses for trails throughout the national recreation area. The TMP EIS/EIR will consider alternative visions for the trail network and provide a detailed analysis of the potential environmental impacts of each vision.				8 miles south	Draft EIR being prepared	Santa Monica Mountains National Recreation Area	
136	Transportation	Caltrans	U.S. Highway 101/ State Route 23 Interchange Improvement Project	Add a lane to the southbound State Route 23/northbound U.S. Highway 101 connector. Construct sound walls along U.S. Highway 101 at various locations. Add a lane to the northbound and southbound U.S. Highway 101 freeway at various locations. Widen three bridges (northbound side only) – Hampshire Road, Moorpark Road, and Conejo School Road. Realign Moorpark Road northbound on-ramp and add a lane to the Moorpark Road northbound off-ramp. Realign Hampshire Road northbound on- and off-ramps.				8 miles southwest	Under construction	U.S. Highway 101/ State Route 23 Interchange	Yes

Figure D–3 Map No.	*Type of Project*	*Lead Agency*	*Project Name*	*Description of Project*	*Residential Units*	*Square Footage*	*Area (acres)*	*Approximate Distance from SSFL (miles)*	*Implementa-tion Status*	*Address*	*Included in the Cumulative Impacts Analysis*
137	Transporta-tion	Caltrans	Lost Hills Road/U.S. Highway 101 Lost Hills Road Overcrossing Replacement and Interchange Modification Project	Caltrans and the City of Calabasas propose to widen and replace the existing Lost Hills Road Bridge and modify the interchange. The proposed project area includes the bridge and the on- and off-ramps located at the U.S. Highway 101/ Lost Hills Road interchange.				5 miles south	Expect construction completion in 2016	Lost Hills Road/ U.S. Highway 101 Lost Hills Road Bridge	Yes
138	Transporta-tion	Caltrans	U.S. Highway 101/ Palo Comado Canyon Road Interchange Improvement Project	Caltrans proposes to improve the existing U.S. Highway 101/Palo Comado Canyon Road interchange in the City of Agoura Hills, Los Angeles County. The proposed project would include widening the Palo Comado Canyon Road and Palo Comado Canyon Bridge across U.S. Highway 101 and modifying the interchange ramps to improve traffic circulation, safety, and bicycle/pedestrian access.				5 miles south	Under construction	U.S. Highway 101/ Palo Comado Canyon Road	Yes
Total					**3,432**	**4,070,372**	**10,464**				

>= greater than; CA = California; Caltrans = California Department of Transportation; CPUC = California Public Utilities Commission; CUP = conditional use permit; EIR = environmental impact report; EIS = environmental impact statement; FONSI = Finding of No Significant Impact; kV = kilovolt; NASA = National Aeronautics and Space Administration; PCE = perchloroethylene; SCE = Southern California Edison; SMMNRA = Santa Monica Mountains National Recreation Area; TPH = total petroleum hydrocarbons; VOC = volatile organic compound.

Source: Caltrans 2015a, 2015b, 2015c; CEC 2015; City of Agoura Hills 2015; City of Calabasas 2015; City of Los Angeles 2015; City of Simi Valley 2015; City of Thousand Oaks 2015a, 2015b; County of Ventura 2015a, 2015b, 2015c 2015d; CPUC 2015a, 2015b, 2015c, 2015d; DTSC 2015; LCMTA 2015; NPS 2015a, 2015b, 2015c, 2015d, 2015e; ESA 2015.

D.6 Principal Analysis Assumptions

This subsection summarizes the principal assumptions that form the basis for the analyses in this EIS.

D.6.1 Soil Volumes Exceeding AOC LUT Values Requiring Removal under the 2010 AOC

This subsection describes the development of the soil volume exceeding AOC LUT values that would be subject to removal under the 2010 AOC (DTSC 2010a). This subsection first addresses the development of preliminary estimates of the volume of soil containing chemicals in concentrations exceeding AOC LUT values, as well as the volume of soil containing radionuclides in concentrations exceeding provisional LUT values. Next, the subsection addresses the total preliminary soil volume for combined chemical and radioactive constituents, taking into account a small overlap between the areas with chemical or radioactive contamination. Next, the subsection addresses projected reductions in the soil volume requiring removal under the AOC, because some of the preliminary soil volume exceeding AOC LUT values is in areas that are to be protected from extensive remediation through the 2010 AOC exemption process or that contain total petroleum hydrocarbons (TPH) suitable for remediation by natural attenuation. Last, the subsection summarizes the total volume of soil exceeding AOC LUT values that would be subject to removal under the 2010 AOC.

Preliminary Volumes of Soil Exceeding AOC LUT Values for Chemicals. The 2010 AOC signed by DOE and DTSC requires a soil cleanup decision for any location with any chemical that exceeds the soil LUT value for that chemical. DTSC published its list of AOC LUT values for chemicals in June 2013.[10] The LUT provides "not-to-exceed" concentrations for 116 chemicals observed throughout SSFL, not just in Area IV. Of the 116 chemicals listed, 64 of the chemicals were reported in at least one soil sample. However, 56 of those chemicals have either a natural or an external source for their presence in Area IV. DOE tasked MWH Americas, Inc., (MWH) to plot the footprints of all locations within Area IV and the NBZ that exhibit a soil chemical concentration exceeding an LUT value. MWH compared the soil results for the entirety of the soil chemistry database involving approximately 8,000 soil samples. MWH used the Area IV geographic information system (GIS) to illustrate and plot locations exceeding any LUT value. MWH then drew polygons around the locations to produce a map illustrating preliminary remediation areas (areas exceeding LUT values) (**Figure D–4**).

Using the GIS database, MWH used color-coded dots to represent each sample location. Dots for locations where any chemical exceeded an LUT value were colored differently from locations where all chemical concentrations were below the LUT values. MWH then grouped and mapped the locations (as polygons), based on exceedances of the LUT values (Figure D–4). Lateral extent beyond an exceedance point was estimated based on the degree of exceedance, bedrock, historic site operation, release mechanism, and topography, including drainages.

---

[10] *Chemical Look-Up Table Technical Memorandum, Santa Susana Field Laboratory, Ventura County, California.* June 11, 2013 (DTSC 2013b). DTSC published "not to exceed" concentrations for 125 chemicals.

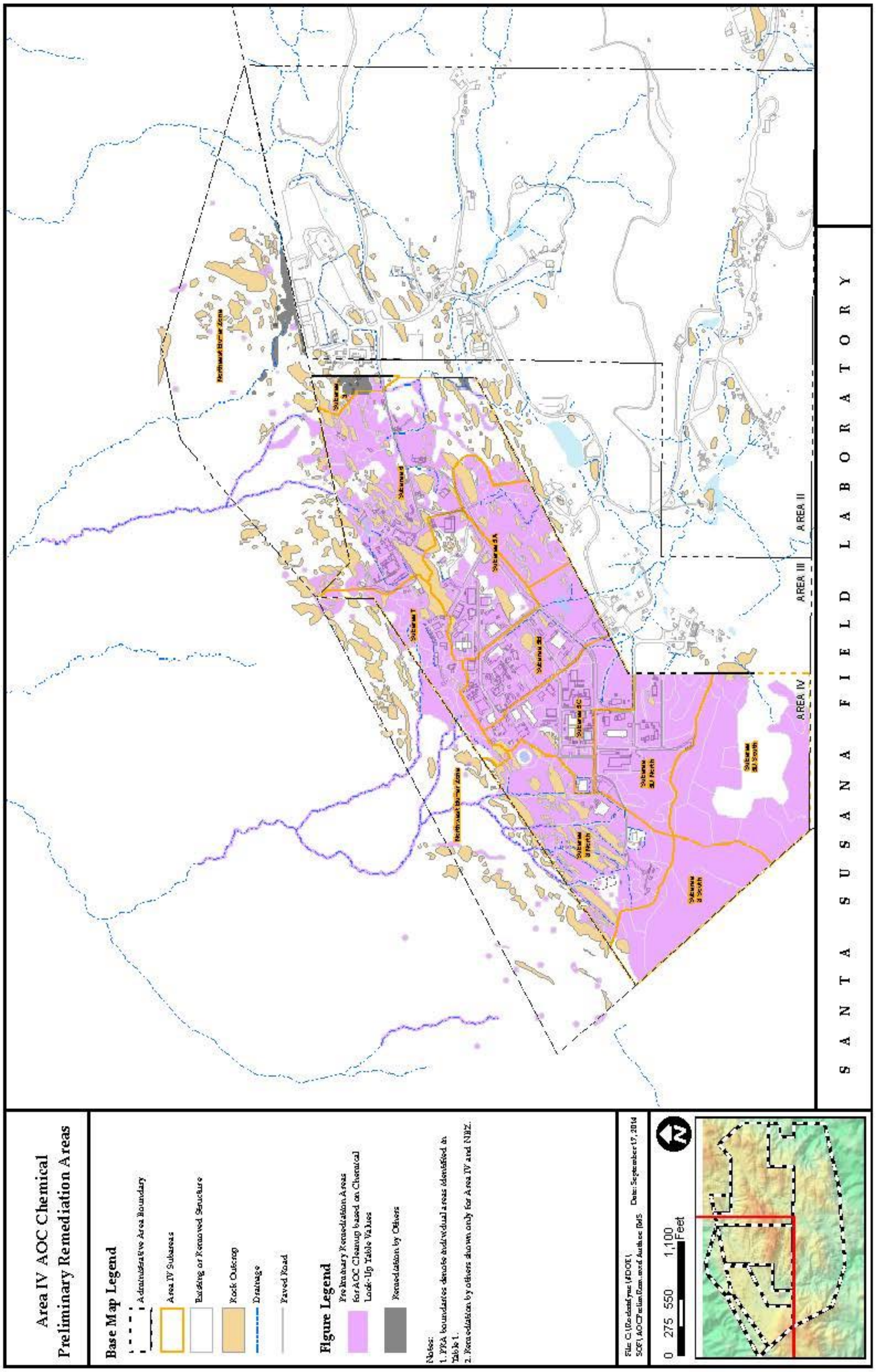


Figure D–4 Area IV 2010 AOC Chemical Preliminary Remediation Areas

MWH mapped 393 locations with at least one chemical exceeding an LUT value and termed the locations "preliminary remediation areas" (PRAs). For each of the 393 locations, MWH determined their areal extent and then estimated the depth of contamination. Depth was either the bedrock interface or deepest sample exceeding an LUT value. MWH then calculated volumes for each location, summed the volumes for the 393 locations, and applied a 30 percent expansion factor to the total volume.

MWH determined that the 393 locations together comprise approximately 1,800,000 cubic yards of soil (with an expansion factor of 30 percent). Considering analysis assumptions and uncertainties, MWH stated that the range of soil with any chemical above its LUT value was between 1,300,000 to 2,800,000 cubic yards (with the expansion factor) (MWH 2014a).

After MWH completed the chemically impacted soil volume estimate, the three SSFL responsible parties (DOE, the National Aeronautics and Space Administration [NASA], and Boeing) agreed to present soil volumes as *in situ* calculations, convert volumes to tonnage, and base transportation requirements for soil on soil tonnage rather than volume (see Section D.6.6). Hence, the *in situ* volume of soil (i.e., with no expansion factor) within Area IV and the NBZ was estimated to be 1,410,000 cubic yards (including calculation rounding assumptions).

MWH analysts noted (MWH 2014a) that, in conducting their data review, they did not consider the natural origins for many of the constituents (metals, TPH, polycyclic aromatic hydrocarbons [PAHs], dioxins) because the 2010 AOC (DTSC 2010a) requires a point-by-point, chemical-by-chemical comparison of each constituent with its respective LUT value.

Preliminary Volumes of Soil Exceeding Provisional LUT Values for Radionuclides. The 2010 AOC signed by DOE and DTSC requires a soil cleanup decision by DOE for any location containing any radionuclide that exceeds its LUT value. The intention was to have EPA establish the radionuclide LUT values. However, in completing its radiological characterization study, EPA did not identify specific radionuclide LUT values, but instead offered a process for developing radionuclide LUT values (HGL 2012a).

EPA used three commercial radiological laboratories to analyze samples for the presence of radionuclides. Because the first laboratory used for the background study did not have the capacity to handle the soil volume for the onsite characterization work, EPA contracted two additional laboratories, identified as EPA Lab A and EPA Lab B. These two laboratories produced significantly different minimal detectable concentrations (MDCs) for the samples they analyzed (order of magnitude differences).

EPA's suggested method for calculating radionuclide LUT values included examples based on soil results reported by the two laboratories. However, EPA recommended that neither the EPA Lab A nor EPA Lab B MDC values should be used for the radionuclide LUT values, but instead that the LUT values should be based on the MDCs that would be demonstrated by a future laboratory (to be used for soil remediation LUT value confirmation). However, because this new laboratory would be procured as part of soil remediation operations, these MDCs are not currently available. In publishing the provisional radionuclide LUT values in January 2013,[11] DTSC chose the lower of the two laboratories' MDCs, the EPA Lab B MDCs. Immediately following publication of the radionuclide provisional LUT values by DTSC, DOE surveyed commercial laboratories throughout the United States to determine their capabilities for achieving the MDCs. The laboratories'

[11] As published on DTSC's web site on January 30, 2013.

responses were that they could meet the EPA Lab A MDCs, but would have difficulty in achieving the EPA Lab B MDCs.

DOE tasked MWH to prepare a soil volume estimate based on EPA's site characterization study using the soil data reported by EPA's contractor (HydroGeoLogic, Inc.) for soil samples collected in 2010, 2011, and 2012. Because the radionuclides MDCs to be used during soil remediation operations had not been identified, to provide an upper limit for volume estimates for EIS impact analysis, MWH used the Lab B MDCs as the basis for this estimate. Similar to the volume estimate process that MWH used for the chemical soil data (described in the previous subsection), MWH identified any soil sample location that exceeded any EPA Lab B provisional radionuclide LUT value. The GIS system produced color dots where those exceedances occurred; the dots were then grouped and the areas and volumes exceeding the provisional LUT values were calculated. This exercise resulted in the identification of 215 locations exceeding any EPA Lab B radionuclide MDC. MWH's rough order of magnitude estimate for this soil ranged from 80,000 to 180,000 cubic yards, with a midpoint at 120,000 cubic yards, including an *ex situ* expansion factor of 30 percent. Without the expansion factor, the *in situ* volume of radiological impacted soil was estimated at about 91,000 cubic yards (including value-rounding assumptions) (**Figure D–5**) (MWH 2014b).

Because the preliminary LUT for cesium-237 is the background threshold value developed by EPA, not an MDC, and cesium-237 is the most prevalent radionuclide observed by EPA in its study, the volume difference between the use of MDCs for either EPA Lab A or EPA Lab B is minimal. A difference could occur, however, where strontium-90 is the only constituent of concern based on the MDC for EPA Lab A.

MWH included the presence of uranium and thorium species (naturally occurring radioactive materials) in its volume calculations. The areas with site-related naturally occurring radionuclides requiring remediation will be determined during soil remedial action planning, based on EPA's guidance for evaluating naturally occurring radioactive materials.

Preliminary Soil Considering the Overlap Between Chemically and Radiologically Impacted Soil. As discussed above, MWH estimated the volume of soil exceeding chemical LUT values to be about 1,410,000 cubic yards (MWH 2014a), and the soil volume exceeding provisional radionuclide LUT values to be about 91,000 cubic yards (MWH 2014b). To determine the degree of overlap between areas that have chemical or radioactive constituents, MWH developed GIS-based polygon maps showing the extent of chemical and radionuclide exceedances in separate colors. The area of chemical LUT exceedances was much greater than that of radionuclides. A visual review of the extent of both constituent types indicated that there was a significant overlap of the distribution of radiologically impacted soil with chemically impacted soil. Using their knowledge of site conditions and GIS data presentation (**Figure D–6**), MWH analysts estimated that there was a 97 percent overlap of radionuclides with chemically impacted soil. That is, 97 percent of areas with radionuclides above the provisional LUT values overlapped with chemically impacted soil. Only 3 percent of the radionuclide contamination is located in areas where the soil meets chemical AOC LUT values. This leaves an estimated 3,000 cubic yards of radiologically impacted soil without chemicals exceeding LUT values. Therefore, the total estimated quantity of chemically and/or radiologically impacted soil exceeding AOC LUT values is about 1,413,000 cubic yards.

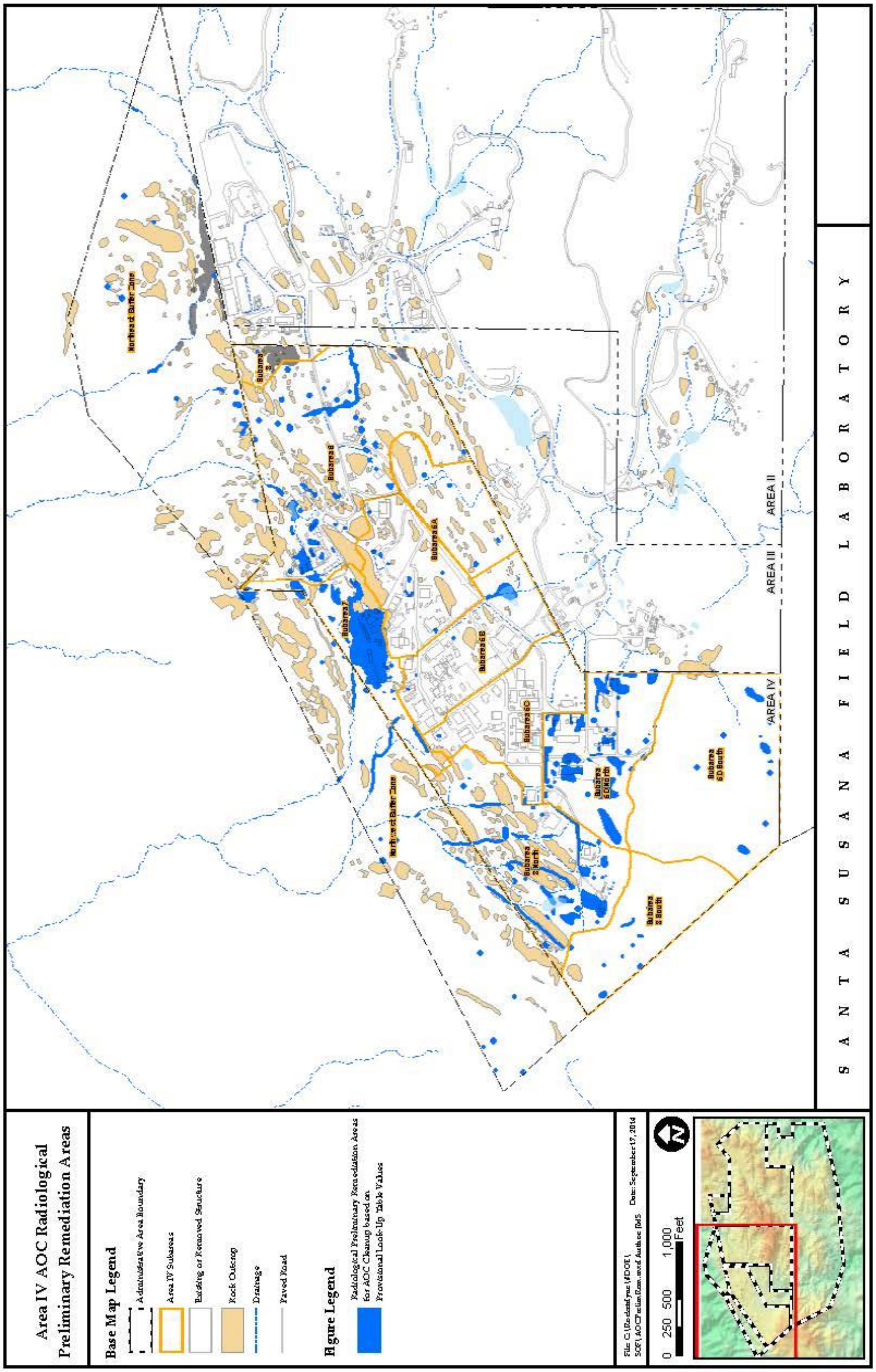


Figure D–5 Area IV 2010 AOC Radiological Preliminary Remediation Areas

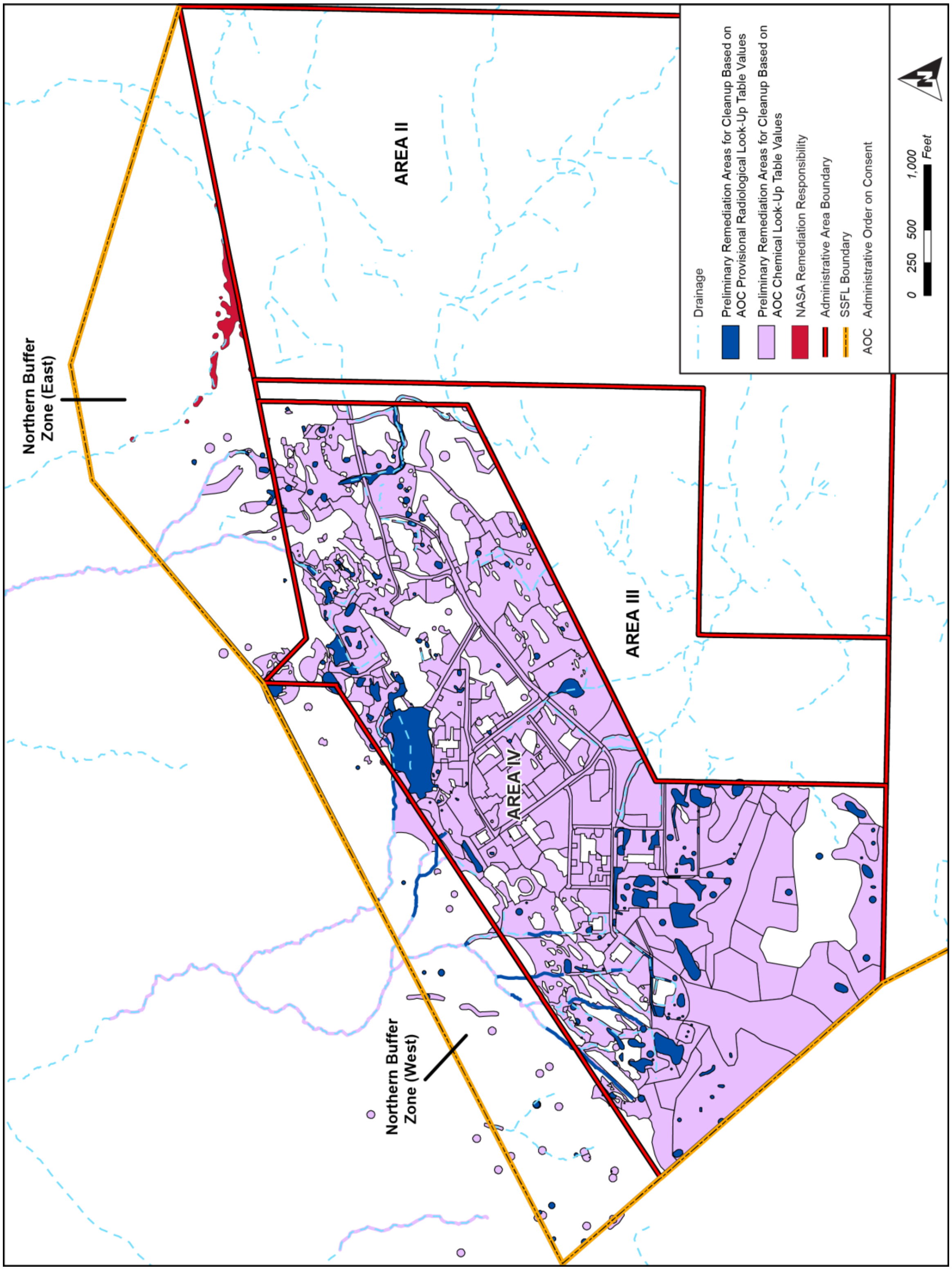


Figure D–6 Extent of Radiological and Chemical Constituents Above AOC Look-Up Table Values

Reductions in Soil Volume Considering Proposed Exemption Areas and Areas Containing TPH. The 2010 AOC (DTSC 2010a) signed by DOE and DTSC allows for exemptions from cleanup to protect biological and cultural resources, among other considerations. Because the application of exemptions will be determined through consultation with the U.S. Fish and Wildlife Service and the State Historic Preservation Officer, a process that is still ongoing, MWH did not apply exemptions when estimating soil volumes.

Proposed exemption areas were developed by DOE contractor biologists and cultural resource specialists. Using GIS, the proposed exemption areas were mapped over the preliminary remediation areas (**Figure D–7**). Soil depth for most of the proposed exemption areas is shallower than in the main part of Area IV, and soil results show that contamination is primarily near the surface in the proposed exemption areas. Considering the expected soil and contamination depth, MWH scientists estimated that up to 330,000 cubic yards of soil with at least one chemical exceeding an LUT value may be subject to application of the 2010 AOC exemption process.

In addition, soil treatability studies demonstrated that two chemical groups (TPH and PAHs) decompose naturally in soils. Using GIS mapping, MWH analysts evaluating the site data determined the locations where TPH and PAHs were the only constituents s; the impacted soil volume found in those areas was approximately 150,000 cubic yards. Per the 2010 AOC, this volume is being considered for natural attenuation of these constituents.

Total Soil Volume Exceeding AOC LUT Values and Subject to Removal. Assuming 330,000 cubic yards of soil would be subject to the 2010 AOC exemption process and 150,000 cubic yards would be allowed to naturally attenuate, the minimum quantity of soil to be excavated and removed from Area IV/NBZ would be 933,000 cubic yards (1,413,000 cubic yards minus 330,000 cubic yards for proposed exemptions and 150,000 cubic yards for natural attenuation).

D.6.2 Alternative Development

This subsection summarizes four analyses performed to support the development of the alternatives evaluated in this EIS. The first two analyses support DOE's decisions in Chapter 2, Section 2.2.3, regarding certain alternatives considered but dismissed from detailed study in this EIS. These two analyses address (1) the implications in terms of truck traffic in the SSFL ROI of completing SSFL cleanup by the end of calendar year 2017 and (2) the implications in terms of project duration and water use for treatment of contaminated soil by soil washing processes. The third and fourth analyses address certain technical aspects that increase the difficulty of implementing the "cleanup to background" approach described in the 2010 AOC: (1) addressing the 2010 AOC requirements for remediation of total petroleum hydrocarbons and (2) locating sources of backfill that meet the AOC LUT values prescribed by DTSC.

Truck Traffic in the SSFL ROI due to Cleanup of Area IV and the NBZ by the end of 2017. For DOE to demolish all of the buildings and remove all of the soil exceeding the AOC LUT values by the end of calendar year 2017 (assuming work started in January 2017), approximately 200 truck round trips per day, 365 days a year, would be required. To deliver clean backfill, another 125 daily truck round trips would be needed, making a total of 325 daily truck round trips. Working 250 days per year (50 weeks per year, 5 days per week), soil remediation would require up to 470 truck round trips per day (including building removal, soil removal, and backfill). Working 12 hours per day at the above rates (325 or 470 truck round trips per day) would result in a truck leaving the site every 1.5 to 2 minutes.

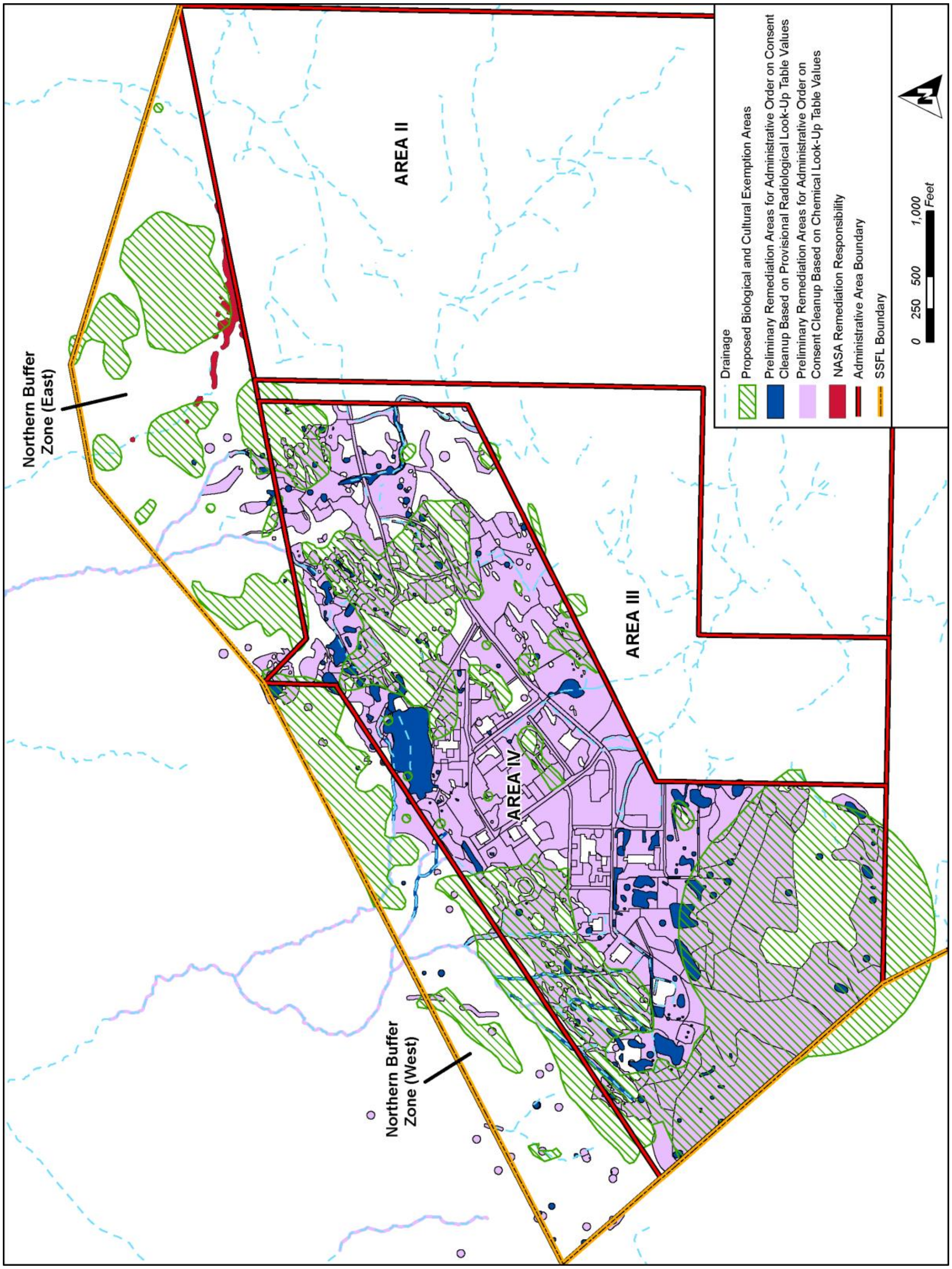


Figure D–7 Area IV Radiological/Chemical Look-Up Table Areas and Proposed Exemption Areas

Soil Washing Technology Duration and Water Use. Soil washing is the process of using a solvent, detergent, acid, or other reactant to remove contaminants from soil. Because soil contaminants in Area IV (metals, PCBs, PAHs, dioxins) have differing chemical properties, the manner for removing each chemical type (washing them from soil) would differ. Soil washing is applied in a batch process, typically in 20-ton units involving 1 hour of agitating and flushing the soil with treatment solutions (each batch would involve approximately 13 cubic yards of soil). Multiple washing steps would be required for each type of contaminant, meaning it would take at least 3 hours per batch to treat the soil. Assuming three treatment systems, each working for 8 hours for each working day and 3 hours to treat each batch, an average of about 104 cubic yards of soil would be treated each working day. Assuming 933,000 cubic yards (approximately 1,430,000 tons) of soil to be treated and 250 working days per year, it would take approximately 8,970 working days (about 36 years) to treat the soil.

Soil washing requires large volumes of water to treat soil and then rinse it. Typical soil washing exercises require between 10,000 and 20,000 gallons of water per batch (ITRCWG 1997). Assuming 20,000 gallons for each batch of soil (about 13 cubic yards) and an average of 104 cubic yards of soil treated per day, an average of about 80,000 to 160,000 gallons per day would be needed over 36 years, for a total water use, assuming 250 working days per year, of 720 million to 1.44 billion gallons. This water would need either to be treated on site for reuse or disposed of off site and be replaced by new clean water.

Soil washing is normally performed as a volume reduction process to reduce the amount of material being disposed of as hazardous waste. Soil washing is not performed to remove 100 percent of soil contaminants to background levels. The LUT values are set so low that it is highly unlikely that, at the end of the soil washing process, the LUT values could be achieved in the treated soil (i.e., it may not be possible to remove all contaminants from the soil).

Concerns about Compliance with the AOC LUT Value for TPH. DTSC did not sample the location of its background study for the presence of TPH. DTSC instead selected 5 parts per million as the LUT value for TPH. In several locations of Area IV and the NBZ, TPH is the only chemical exceeding an LUT value (**Figure D–8**). MWH estimated that up to 150,000 cubic yards of soil within 10 acres of Area IV/NBZ may exhibit TPH contamination only (MWH 2014a). Sampling results from the soil treatability study concluded that a portion of the chemicals observed in soil samples reflect naturally occurring organic matter. The university studying this issue also concluded that, due to interferences of natural occurring organic matter, "Reliable TPH measurements near background TPH levels or near the 5 milligrams per kilogram look-up table value for Area IV would be nearly impossible," (Nelson et al. 2015). In addition, a review of the soil TPH data indicates that as much as 300 milligrams per kilogram of the results could be contributed by naturally occurring sources (Burgesser 2015). DTSC noted in a footnote to its June 2013 chemical LUT technical memorandum (DTSC 2013b) that, "For locations where TPH is the sole constituent, a cleanup strategy will be considered based on the findings of the soil treatability." DTSC has not yet discussed this strategy with DOE based on the findings of the soil treatability study.

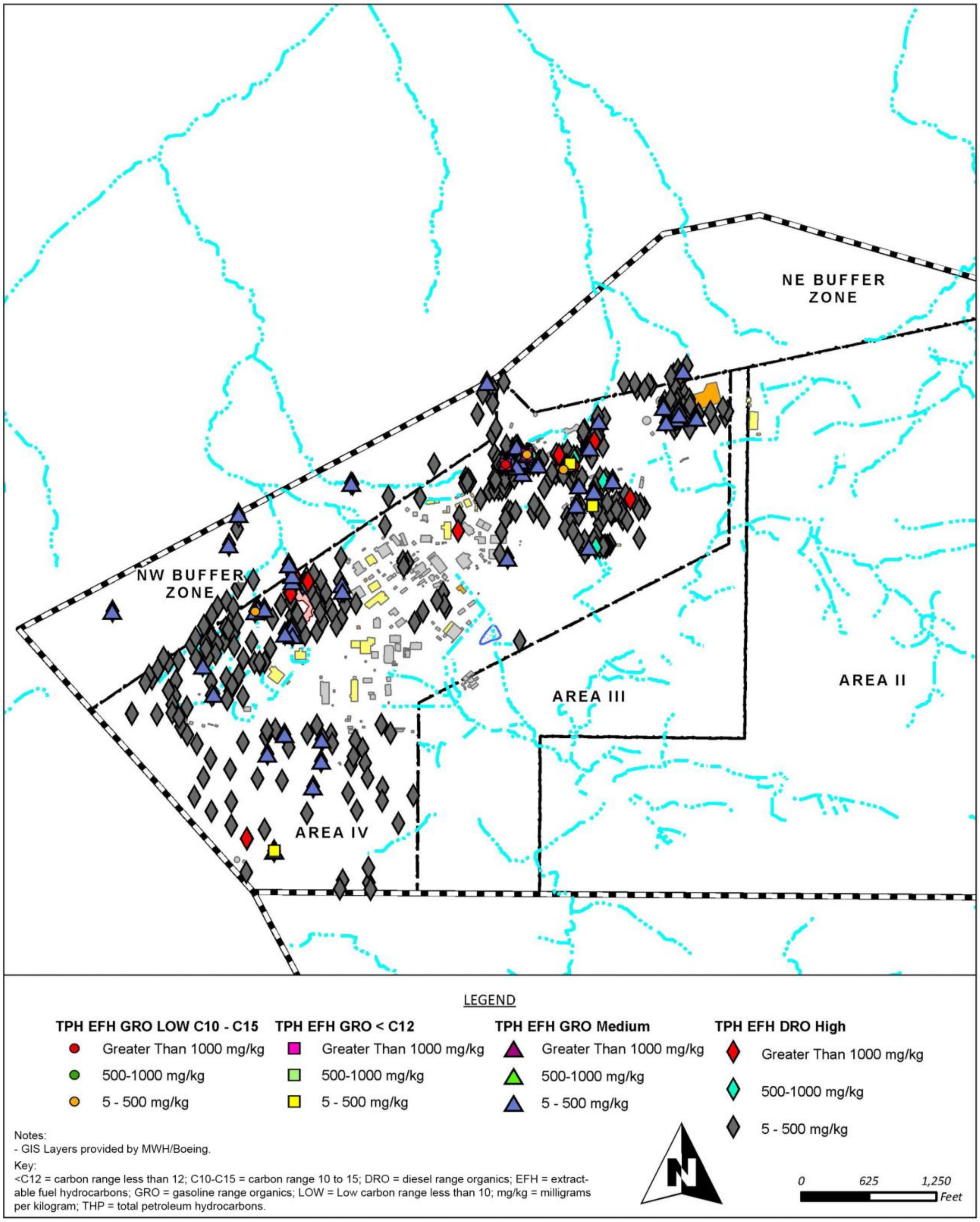


Figure D–8 Area IV Total Petroleum Hydrocarbons Results

Concerns about Locating Backfill Material Meeting AOC LUT Values. The 2010 AOC (DTSC 2010a) states that any backfill replacing soil removed as part of a remedial action must meet the chemical concentrations listed in the AOC LUT. This means that the concentration of any of the 116 chemicals listed in the chemical LUT and present in a backfill material must be either equal to or less than the value presented in the LUT. If DOE cannot locate soil meeting the 2010 AOC definition, then DTSC would address the backfill requirements.

To make an initial assessment about whether a source of soil borrow material (earthen material used by construction contractors to fill excavations and grade land for development purposes) exists that would meet the 2010 AOC (DTSC 2010a) stipulation, DOE evaluated three potential borrow sources. These include data from two commercial borrow soil sources and data provided by Malibou Lake Mountain Club for soil material dredged from Malibou Lake. Because restoration of excavated areas will require use of a soil amendment to facilitate revegetation of disturbed areas, DOE also evaluated commercial soil products for compliance with the LUT values. The results of DOE's initial soil borrow investigations are summarized below:

- *Gillbrand*. A soil sample was collected from Gillbrand in Simi Valley on February 22, 2015. The results of the sample are provided in **Table D–8**. The sample of fill soil exceeds the LUT values for antimony, anthracene, and phenanthrene. None of these results is at a level that would pose a risk to human health or the environment.
- *Tapo Fill*. A soil sample was collected from Tapo Fill in Simi Valley on May 14, 2015. The results of the sample are provided in **Table D–9**. The sample of fill soil exceeds LUT values for pyrene, benzo(g,h,i)perylene, p,p-Dichlorodiphenyldichloroethylene, p,p-Dichlorodiphenyldichloroethane, dieldrin, chlordane, Arochlor 1254, and petroleum hydrocarbons. None of these results is at a level that would pose a risk to human health or the environment.
- *Malibou Lake Sediment*. Malibou Lake is a privately owned recreational facility located in Agora, California. The lake fills in with sediment, reducing its depth and water quality and requiring occasional dredging to increase its depth. The dredged material is a potential backfill source for Area IV. The chemical characteristics of the lake sediment have been evaluated by the park operators (Malibou Lake Mountain Club, Ltd, 2007). **Table D–10** provides a summary of their data for metals. LUT values are exceeded for antimony, cadmium, manganese, molybdenum, and selenium. **Table D–11** provides data for PAHs. LUT values are exceeded for benzo[g,h,i]perylene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene. None of these chemicals is at a concentration that poses a risk to human health or the environment. No PCBs were detected, and pesticide results were below LUT values.
- *Soil Amendment Products*. Because restoration of areas disturbed during remediation may require soil amendments to facilitate revegetation, DOE analyzed samples of commercially available soil amendments commonly used by residential gardeners. **Table D–12** provides the results and, as shown, the commercial products exhibit chemical concentrations exceeding LUT values for many chemicals.

Table D–8 Results of a Soil Sample from Gillibrand in Simi Valley, California

Analyte Group	Analyte Name	Unit	LUT Value	Result		MDL
Alcohols	Ethanol	ug/kg	700	1,000	U	200
Alcohols	Methanol	ug/kg	700	1,000	U	200
Alcohols	Isopropanol	ug/kg		1,000	U	200
Anion	Nitrate	mg/kg	22.3	0.99	U	0.79
Cyanide	Cyanide	mg/kg	0.6	0.5	U	0.18
SVOCs	Phenol	ug/kg	170	33	U	16
SVOCs	Pyrene	ug/kg	5.6	5	J	3
SVOCs	N-Nitrosodimethylamine	ug/kg	10	160	U	66
SVOCs	Dimethylphthalate	ug/kg	27	160	U	66
SVOCs	Diethylphthalate	ug/kg	27	160	U	66
SVOCs	Phenanthrene	ug/kg	3.9	**4**	J	3
SVOCs	Anthracene	ug/kg	2.5	**5**	J	3
SVOCs	Di-n-butylphthalate	ug/kg	27	160	U	66
SVOCs	Fluoranthene	ug/kg	5.2	5	J	3
SVOCs	Butylbenzylphthalate	ug/kg	100	160	U	66
SVOCs	Benzo(a)anthracene	ug/kg		5	J	3
SVOCs	Chrysene	ug/kg		6	J	3
SVOCs	Di-n-octylphthalate	ug/kg	27	160	U	66
SVOCs	2-Methylnaphthalene	ug/kg	2.5	17	U	3
SVOCs	Benzoic acid	ug/kg	660	490	U	160
SVOCs	Naphthalene	ug/kg	3.6	1.6	U	0.66
SVOCs	2-Methylnaphthalene	ug/kg	2.5	0.97	J	0.66
SVOCs	1-Methylnaphthalene	ug/kg	2.5	1.6	U	0.66
SVOCs	Acenaphthylene	ug/kg	2.5	1.6	U	0.33
SVOCs	Acenaphthene	ug/kg		1.6	U	0.66
SVOCs	Fluorene	ug/kg	3.8	1.6	U	0.66
SVOCs	Phenanthrene	ug/kg	3.9	1.6	U	0.66
SVOCs	Anthracene	ug/kg	2.5	1.6	U	0.33
SVOCs	Fluoranthene	ug/kg	5.2	1.6	U	0.66
SVOCs	Pyrene	ug/kg	5.6	1.6	U	0.33
SVOCs	Benzo(a)anthracene	ug/kg		1.6	U	0.66
SVOCs	Benzo(b)fluoranthene	ug/kg		1.6	U	0.66
SVOCs	Benzo(k)fluoranthene	ug/kg		1.6	U	0.66
SVOCs	Benzo(a)pyrene	ug/kg		1.6	U	0.66
SVOCs	Indeno(1,2,3-cd)pyrene	ug/kg		1.6	U	0.66
SVOCs	Dibenzo(a,h)anthracene	ug/kg		1.6	U	0.66
SVOCs	Benzo(g,h,i)perylene	ug/kg		1.6	U	0.66
SVOCs	N-Nitrosodimethylamine	ug/kg	10	1.6	U	0.66
SVOCs	Dimethylphthalate	ug/kg	27	18	U	5.9
SVOCs	Diethylphthalate	ug/kg	27	18	U	5.9
SVOCs	Di-n-butylphthalate	ug/kg	27	18	U	5.9
SVOCs	bis(2-Ethylhexyl)phthalate	ug/kg	61	18	U	5.9
SVOCs	Di-n-octylphthalate	ug/kg	27	18	U	5.9
SVOCs	Benzo(e)pyrene	ug/kg		17	U	3.3
Herbicides	2,4-Dichlorophenoxyacetic acid (D)	ug/kg	5.8	36	U	12
Herbicides	Dinoseb	ug/kg	3.3	24	U	9
Herbicides	2,4,5-Trichlorophenoxyace acid (TP)	ug/kg	0.63	1.7	U	0.75
Herbicides	2,4,5-Trichlorophenoxyacetic acid (T)	ug/kg	1.2	1.7	U	0.82
Herbicides	Dalapon	ug/kg	12.5	90	U	44
Herbicides	Dicamba	ug/kg	1.3	12	U	4
Herbicides	Methylchlorophenoxypropionic acid (MCPP)	ug/kg	377	2,500	U	750
Herbicides	2-methyl-4-chlorophenoxyacetic acid (MCPA)	ug/kg	761	2,500	U	760

Analyte Group	Analyte Name	Unit	LUT Value	Result		MDL
Herbicides	2,4-DP (Dichlorprop)	ug/kg	2.4	17	U	9
Herbicides	4-(2,4-dichlorophenoxy)butyric acid (2,4-DB)	ug/kg	2.4	17	U	6.2
Pesticides	Endrin Aldehyde	ug/kg	0.7	1.7	U	0.33
Pesticides	Endrin Ketone	ug/kg	0.7	1.8	U	0.6
Pesticides	Alpha-Hexachlorocyclohexane (BHC)	ug/kg	0.24	0.83	U	0.17
Pesticides	Beta-BHC	ug/kg	0.23	1	U	0.3
Pesticides	Gamma-BHC (Lindane)	ug/kg	0.24	0.83	U	0.17
Pesticides	Delta-BHC	ug/kg	0.22	0.9	U	0.45
Pesticides	Heptachlor	ug/kg	0.24	0.83	U	0.17
Pesticides	Aldrin	ug/kg	0.24	0.83	U	0.17
Pesticides	Heptachlor Epoxide	ug/kg	0.24	0.83	U	0.17
Pesticides	p,p-Dichlorodiphenyldichloroethylene (DDE)	ug/kg	8.6	1.7	U	0.33
Pesticides	p,p-Dichlorodiphenyldichloroethane (DDD)p	ug/kg	0.48	1.7	U	0.33
Pesticides	p,p-Dichlorodiphenyltrichloroethane (DDT)	ug/kg	13	1.7	U	0.35
Pesticides	Mirex	ug/kg	0.5	1.7	U	0.35
Pesticides	Methoxychlor	ug/kg	2.4	6.7	U	1.7
Pesticides	Dieldrin	ug/kg	0.48	1.7	U	0.33
Pesticides	Endrin	ug/kg	0.48	1.7	U	0.33
Pesticides	Chlordane	ug/kg	7	17	U	4
Pesticides	Toxaphene	ug/kg	8.8	33	U	14
Pesticides	Endosulfan I	ug/kg	0.24	0.83	U	0.22
Pesticides	Endosulfan II	ug/kg	0.48	1.7	U	0.33
Pesticides	Endosulfan Sulfate	ug/kg	0.48	1.7	U	0.33
Terphenyls	m-Terphenyl	mg/kg		0.17	U	0.067
Terphenyls	o-Terphenyl	mg/kg	7	0.17	U	0.067
Terphenyls	p-Terphenyl	mg/kg		0.17	U	0.067
PCB/PCTs	Aroclor 1016	ug/kg	17	17	U	3.3
PCB/PCTs	Aroclor 1221	ug/kg	33	17	U	5
PCB/PCTs	Aroclor 1232	ug/kg	17	17	U	4
PCB/PCTs	Aroclor 1242	ug/kg	17	17	U	4
PCB/PCTs	Aroclor 1248	ug/kg	17	17	U	3.3
PCB/PCTs	Aroclor 1254	ug/kg	17	17	U	4.3
PCB/PCTs	Aroclor 1260	ug/kg	17	17	U	3.8
PCB/PCTs	Aroclor 1262	ug/kg	33	17	U	3.3
PCB/PCTs	Aroclor 1268	ug/kg	33	17	U	3.3
PCB/PCTs	Aroclor 5432	ug/kg	50	33	U	9.9
PCB/PCTs	Aroclor 5442	ug/kg	50	33	U	9.9
PCB/PCTs	Aroclor 5460	ug/kg	50	33	U	9.9
EFH	Extractable fuel hydrocarbon (EFH) (carbon range 8 to 11 [C8-C11])	mg/kg	5	4.9	U	2
EFH	EFH (C12-C14)	mg/kg	5	4.9	U	2
EFH	EFH (C15-C20)	mg/kg	5	4.9	U	2
EFH	EFH (C21-C30)	mg/kg	5	4.9	U	2
EFH	EFH (C30-C40)	mg/kg	5	9.9	U	3.9
Hex Chromium	Hexavalent Chromium	mg/kg	2	0.23	J	0.14
Mercury	Mercury	mg/kg	0.13	0.0155	U	0.0093
Metals	Aluminum	mg/kg	58,600	3,240		4.41
Metals	Calcium	mg/kg		69,900		7.36
Metals	Iron	mg/kg		4,560		3.24
Metals	Lithium	mg/kg	91	2	J	0.62
Metals	Magnesium	mg/kg		1220		1.62
Metals	Potassium	mg/kg	14,400	498		12.6
Metals	Sodium	mg/kg	1,780	330		16.2
Metals	Arsenic	mg/kg	46	3.77	J	0.621

Analyte Group	Analyte Name	Unit	LUT Value	Result		MDL
Metals	Antimony	mg/kg	0.86	**1.09**	J	0.32
Metals	Barium	mg/kg	371	16.1		0.032
Metals	Beryllium	mg/kg	2.2	0.117	J	0.065
Metals	Cadmium	mg/kg	0.7	0.149	J	0.032
Metals	Chromium	mg/kg	94	15.5		0.107
Metals	Cobalt	mg/kg	44	1.68		0.0932
Metals	Copper	mg/kg	119	0.674	J	0.32
Metals	Lead	mg/kg	49	2.91	U	0.485
Metals	Manganese	mg/kg	1,120	108		0.0806
Metals	Molybdenum	mg/kg	3.2	2.79		0.165
Metals	Nickel	mg/kg	132	6.61		0.146
Metals	Tin	mg/kg		1.84	J	0.417
Metals	Titanium	mg/kg		201		0.165
Metals	Vanadium	mg/kg	175	14.3		0.0883
Metals	Zinc	mg/kg	215	9.46		0.252
Metals	Boron	mg/kg	34	2.99	J	0.816
Metals	Phosphorus	mg/kg		396		0.311
Metals	Zirconium	mg/kg	19	2.27	J	0.786
Metals	Selenium	mg/kg	1	0.388	U	0.0971
Metals	Silver	mg/kg	0.2	0.194	U	0.0194
Metals	Strontium	mg/kg	163	94.2		0.0555
Metals	Thallium	mg/kg	1.2	0.0654	J	0.0291
Perchlorate	Perchlorate	ug/kg	1.63	5	U	2.1
Glycols	Ethylene glycol	mg/kg		9.9	U	5
Glycols	Propylene glycol	mg/kg		9.9	U	5
Glycols	Diethylene glycol	mg/kg		9.9	U	5
Glycols	Triethylene glycol	mg/kg		9.9	U	5
Dioxins	2,3,7,8-Tetrachlorodibenzo-p-dioxin	ng/kg		0.988	U	0.0258
Dioxins	2,3,7,8-Tetrachlorodibenzofuran	ng/kg		0.988	U	0.0178
Dioxins	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	ng/kg		4.94	U	0.0205
Dioxins	1,2,3,7,8-Pentachlorodibenzofuran	ng/kg		0.0554	JQ	0.0129
Dioxins	2,3,4,7,8-Pentachlorodibenzofuran	ng/kg		0.0466	JBQ	0.0119
Dioxins	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	ng/kg		0.0111	JBQ	0.0109
Dioxins	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	ng/kg		0.02	JBQ	0.012
Dioxins	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	ng/kg		0.0136	JBQ	0.0123
Dioxins	1,2,3,4,7,8-Hexachlorodibenzofuran	ng/kg		0.0458	JBQ	0.00925
Dioxins	1,2,3,6,7,8-Hexachlorodibenzofuran	ng/kg		0.029	JB	0.00916
Dioxins	1,2,3,7,8,9-Hexachlorodibenzofuran	ng/kg		4.94	U	0.0123
Dioxins	2,3,4,6,7,8-Hexachlorodibenzofuran	ng/kg		0.0364	JBQ	0.00882
Dioxins	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	ng/kg		0.0847	JBQ	0.015
Dioxins	1,2,3,4,6,7,8-Heptachlorodibenzofuran	ng/kg		0.0736	JBQ	0.00572
Dioxins	1,2,3,4,7,8,9-Heptachlorodibenzofuran	ng/kg		0.0229	JBQ	0.0102
Dioxins	Octachlorodibenzodioxin (OCDD)	ng/kg		0.456	JBQ	0.0306
Dioxins	Octachlorodibenzofuran (OCDF)	ng/kg		0.121	JB	0.0216
Dioxins	TEQ [a]	ng/kg	0.912	0.00294		

B = the analyte was also found in a blank sample; J = the value is an estimate; LUT = Look-Up Table; MDL = method detection limit; mg/kg = milligram per kilogram; ng/kg = nanogram per kilogram; PCB = polychlorinated biphenyl; PCT = polychlorinated terphenyl; Q = matrix spike results outside of quality assurance limits; SVOC = semi-volatile organic compound; TEQ = toxicity equivalent; U = non-detect; ug/kg = microgram per kilogram.

[a] Using the World Health Organization's 2,3,7,8-TCDD toxicity equivalence approach for dioxin-furans (2005).

Note: Values that exceed LUT values are in bold text and shaded cells.

Table D–9 Results of a Soil Sample from Tapo Fill in Simi Valley, California

Analyte Group	Analyte	Unit	LUT Value	Result	
SVOC	Phenol	ug/kg	170	33	U
SVOC	2-Chlorophenol	ug/kg		33	U
SVOC	1,4-Dichlorobenzene	ug/kg		33	U
SVOC	N-Nitrosodi-n-propylamine	ug/kg		33	U
SVOC	1,2,4-Trichlorobenzene	ug/kg		33	U
SVOC	4-Chloro-3-methylphenol	ug/kg		33	U
SVOC	4-Nitrophenol	ug/kg		490	U
SVOC	Pentachlorophenol	ug/kg		170	U
SVOC	4-Methylphenol	ug/kg		33	U
SVOC	2-Nitrophenol	ug/kg		33	U
SVOC	2,4-Dimethylphenol	ug/kg		33	U
SVOC	2,4-Dichlorophenol	ug/kg		33	U
SVOC	2,4,6-Trichlorophenol	ug/kg		33	U
SVOC	2,4-Dinitrophenol	ug/kg		650	U
SVOC	4,6-Dinitro-2-methylphenol	ug/kg		490	U
SVOC	Dimethylphthalate	ug/kg	27	160	U
SVOC	Diethylphthalate	ug/kg	27	160	U
SVOC	Di-n-butylphthalate	ug/kg	27	160	U
SVOC	Butylbenzylphthalate	ug/kg	100	160	U
SVOC	Benzo(a)anthracene	ug/kg		4	J
SVOC	bis(2-Ethylhexyl)phthalate	ug/kg	61	170	U
SVOC	Di-n-octylphthalate	ug/kg	27	160	U
SVOC	Naphthalene	ug/kg	3.6	1.6	U
SVOC	2-Methylnaphthalene	ug/kg	2.5	1.6	U
SVOC	1-Methylnaphthalene	ug/kg	2.5	1.6	U
SVOC	Acenaphthylene	ug/kg	2.5	1.6	U
SVOC	Acenaphthene	ug/kg	2.5	1.6	U
SVOC	Fluorene	ug/kg	3.7	1.6	U
SVOC	Phenanthrene	ug/kg	3.9	1.9	
SVOC	Anthracene	ug/kg	2.5	0.63	J
SVOC	Fluoranthene	ug/kg	5.2	4.3	
SVOC	Pyrene	ug/kg	5.6	**6.5**	
SVOC	Chrysene	ug/kg		5.4	
SVOC	Benzo(b)fluoranthene	ug/kg		6.8	
SVOC	Benzo(k)fluoranthene	ug/kg		1.9	
SVOC	Benzo(a)pyrene	ug/kg	4.47	3.9	
SVOC	Indeno(1,2,3-cd)pyrene	ug/kg		1.9	
SVOC	Dibenzo(a,h)anthracene	ug/kg		0.69	J
SVOC	Benzo(g,h,i)perylene	ug/kg		2.4	
SVOC	N-Nitrosodimethylamine	ug/kg	10	1.6	U
SVOC	Dimethylphthalate	ug/kg	27	18	U
SVOC	Diethylphthalate	ug/kg	27	18	U
SVOC	Di-n-butylphthalate	ug/kg	27	18	U
SVOC	Butylbenzylphthalate	ug/kg	100	18	U

Analyte Group	Analyte	Unit	LUT Value	Result	
SVOC	bis(2-Ethylhexyl)phthalate	ug/kg	61	8.7	J
SVOC	Di-n-octylphthalate	ug/kg	27	18	U
SVOC	Benzo(e)pyrene	ug/kg		3.5	J
SVOC	Formaldehyde	ug/kg	1870	2000	U
Pesticide/Herbicide	2,4-Dichlorophenoxyacetic acid (D)	ug/kg	5.8	36	U
Pesticide/Herbicide	Dinoseb	ug/kg	3.3	24	U
Pesticide/Herbicide	2,4,5-Trichlorophenoxyace acid (TP)	ug/kg	0.63	1.7	U
Pesticide/Herbicide	2,4,5-Trichlorophenoxyacetic acid (T)	ug/kg	1.2	1.7	U
Pesticide/Herbicide	Dalapon	ug/kg	12.5	89	U
Pesticide/Herbicide	Dicamba	ug/kg	1.3	12	U
Pesticide/Herbicide	Methylchlorophenoxypropionic acid (MCPP)	ug/kg	377	2,500	U
Pesticide/Herbicide	2-methyl-4-chlorophenoxyacetic acid (MCPA)	ug/kg	761	2,500	U
Pesticide/Herbicide	2,4-DP (Dichlorprop)	ug/kg	2.4	17	U
Pesticide/Herbicide	4-(2,4-dichlorophenoxy)butyric acid (2,4-DB)	ug/kg	2.4	17	U
Pesticide/Herbicide	Endrin Aldehyde	ug/kg	0.7	1.7	U
Pesticide/Herbicide	Endrin Ketone	ug/kg	0.7	1.8	U
Pesticide/Herbicide	Alpha-Hexachlorocyclohexane (BHC)	ug/kg	0.24	0.83	U
Pesticide/Herbicide	Beta-BHC	ug/kg	0.23	1	U
Pesticide/Herbicide	Gamma-BHC (Lindane)	ug/kg	0.24	0.83	U
Pesticide/Herbicide	Delta-BHC	ug/kg	0.22	0.9	U
Pesticide/Herbicide	Heptachlor	ug/kg	0.24	0.83	U
Pesticide/Herbicide	Aldrin	ug/kg	0.24	0.83	U
Pesticide/Herbicide	Heptachlor Epoxide	ug/kg	0.24	**0.75**	J
Pesticide/Herbicide	p,p-Dichlorodiphenyldichloroethylene (DDE)	ug/kg	8.6	**9.9**	
Pesticide/Herbicide	p,p-Dichlorodiphenyldichloroethane (DDD)	ug/kg	0.48	**5.5**	J
Pesticide/Herbicide	p,p-Dichlorodiphenyltrichloroethane (DDT)	ug/kg	13	4.5	
Pesticide/Herbicide	Mirex	ug/kg	0.5	1.7	U
Pesticide/Herbicide	Methoxychlor	ug/kg	2.4	6.7	U
Pesticide/Herbicide	Dieldrin	ug/kg	0.48	**1**	J
Pesticide/Herbicide	Endrin	ug/kg	0.48	1.7	U
Pesticide/Herbicide	Chlordane	ug/kg	7	**29**	P
Pesticide/Herbicide	Toxaphene	ug/kg	8.8	33	U
Pesticide/Herbicide	Endosulfan I	ug/kg	0.24	0.83	U
Pesticide/Herbicide	Endosulfan II	ug/kg	0.48	1.7	U
Pesticide/Herbicide	Endosulfan Sulfate	ug/kg	0.48	1.7	U
PCB	Aroclor 1016	ug/kg	17	17	U
PCB	Aroclor 1221	ug/kg	33	17	U
PCB	Aroclor 1232	ug/kg	17	17	U
PCB	Aroclor 1242	ug/kg	17	17	U
PCB	Aroclor 1248	ug/kg	17	17	U
PCB	Aroclor 1254	ug/kg	17	**23**	
PCB	Aroclor 1260	ug/kg	17	17	U
PCB	Aroclor 1262	ug/kg	33	17	U
PCB	Aroclor 1268	ug/kg	33	17	U
PCB	Aroclor 5432	ug/kg	50	32	U

Analyte Group	Analyte	Unit	LUT Value	Result	
PCB	Aroclor 5442	ug/kg	50	32	U
PCB	Aroclor 5460	ug/kg	50	32	U
TPH	Extractable fuel hydrocarbon (EFH) (carbon range 8 to 11 [C8-C11])	mg/kg	5	5	U
TPH	EFH (C12-C14)	mg/kg	5	5	U
TPH	EFH (C15-C20)	mg/kg	5	5	U
TPH	EFH (C21-C30)	mg/kg	5	**15**	
TPH	EFH (C30-C40)	mg/kg	5	**39**	
Inorganic	Nitrate	mg/kg	22.3	4.7	
Metals	Aluminum	mg/kg	58,600	8,610	
Metals	Calcium	mg/kg		8,020	
Metals	Iron	mg/kg		13,300	
Metals	Lithium	mg/kg	91	8.5	
Metals	Magnesium	mg/kg		3,480	
Metals	Potassium	mg/kg	14,400	1,760	
Metals	Sodium	mg/kg	1780	239	
Metals	Arsenic	mg/kg	46	5.73	
Metals	Antimony	mg/kg	0.86	3.92	U
Metals	Barium	mg/kg	371	80.3	
Metals	Beryllium	mg/kg	2.2	0.307	J
Metals	Cadmium	mg/kg	0.7	0.569	J
Metals	Chromium	mg/kg	94	17	
Metals	Cobalt	mg/kg	44	4.58	
Metals	Copper	mg/kg	119	11.8	
Metals	Lead	mg/kg	49	4.81	
Metals	Manganese	mg/kg	1,120	187	
Metals	Molybdenum	mg/kg	3.2	1.26	J
Metals	Nickel	mg/kg	132	11.1	
Metals	Tin	mg/kg		2.45	J
Metals	Titanium	mg/kg		525	
Metals	Vanadium	mg/kg	175	36	
Metals	Zinc	mg/kg	215	37.8	
Metals	Boron	mg/kg	34	3.14	J
Metals	Phosphorus	mg/kg		1100	
Metals	Zirconium	mg/kg	19	1.88	J
Metals	Selenium	mg/kg	1	0.25	J
Metals	Silver	mg/kg	0.2	0.0541	J
Metals	Strontium	mg/kg	163	39.3	
Metals	Thallium	mg/kg	1.2	0.116	J
Inorganic	Perchlorate	ug/kg	1.63	5	U
Metals	Hexavalent Chromium	mg/kg	2	0.59	
Metals	Mercury	mg/kg	0.13	0.0139	J
SVOC	m-Terphenyl	mg/kg		0.17	U
SVOC	o-Terphenyl	mg/kg	7	0.17	U
SVOC	p-Terphenyl	mg/kg		0.17	U

Analyte Group	Analyte	Unit	LUT Value	Result	
VOC	Ethanol	ug/kg	0.7	500	U
VOC	Methanol	ug/kg	0.7	500	U
VOC	Isopropanol	ug/kg		500	U
VOC	Ethylene glycol	mg/kg		9.9	U
VOC	Propylene glycol	mg/kg		9.9	U
VOC	Diethylene glycol	mg/kg		9.9	U
VOC	Triethylene glycol	mg/kg		9.9	U
Dioxins	2,3,7,8-Tetrachlorodibenzo-p-dioxin	ng/kg		0.958	U
Dioxins	2,3,7,8-Tetrachlorodibenzofuran	ng/kg		0.958	U
Dioxins	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	ng/kg		0.0463	JBQ
Dioxins	1,2,3,7,8-Pentachlorodibenzofuran	ng/kg		0.183	JB
Dioxins	2,3,4,7,8-Pentachlorodibenzofuran	ng/kg		0.306	JBQ
Dioxins	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	ng/kg		0.0866	J
Dioxins	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	ng/kg		0.304	JB
Dioxins	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	ng/kg		0.155	JBQ
Dioxins	1,2,3,4,7,8-Hexachlorodibenzofuran	ng/kg		0.0671	JBQ
Dioxins	1,2,3,6,7,8-Hexachlorodibenzofuran	ng/kg		0.123	JBQ
Dioxins	1,2,3,7,8,9-Hexachlorodibenzofuran	ng/kg		0.0754	JBQ
Dioxins	2,3,4,6,7,8-Hexachlorodibenzofuran	ng/kg		0.153	JB
Dioxins	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	ng/kg		8.31	B
Dioxins	1,2,3,4,6,7,8-Heptachlorodibenzofuran	ng/kg		1.14	JB
Dioxins	1,2,3,4,7,8,9-Heptachlorodibenzofuran	ng/kg		0.106	JB
Dioxins	Octachlorodibenzodioxin (OCDD)	ng/kg		98.1	B
Dioxins	Octachlorodibenzofuran (OCDF)	ng/kg		3.39	JB
Dioxins	TEQ [a]	ng/kg	3.9	0.186	

B = the analyte was also found in a blank sample; J = the value is an estimate; LUT = Look-Up Table; mg/kg = milligram per kilogram; ng/kg = nanogram per kilogram; PCB = polychlorinated biphenyl; Q = matrix spike results outside of quality assurance limits; SVOC = semi-volatile organic compound; TEQ = toxicity equivalent; TPH = total petroleum hydrocarbons; U = non-detect; ug/kg = microgram per kilogram; VOC = volatile organic compound.

[a] Using the World Health Organization's 2,3,7,8-TCDD toxicity equivalence approach for dioxin-furans (2005).

Note: Values that exceed LUT values are in bold text and shaded cells.

Table D–10 Results of Samples of Malibou Lake Sediments in Agora, California (Trace Metals)

		Sample Designator			
Analyte	***LUT Value***	***East Sediment 11/02/06***	***MCS-1 11/02/06***	***West Sediment R1 11/02/06***	***West Sediment R2 11/02/06***
Aluminum	58,600	15,630	671.6	12,300	12,740
Antimony	0.86	**0.949**	0.421	0.356	0.423
Arsenic	46	5.581	2.236	2.34	2.583
Barium	371	118	77.16	81.64	78.49
Beryillium	2.2	0.477	0.208	0.269	0.28
Cadmium	0.7	**3.822**	**3.409**	0.512	0.6
Chromium	94	51.345	21.535	62.765	63.765
Cobalt	44	13.3	5.957	14.54	15.21
Copper	119	40.946	12.366	40.436	41.256
Iron		27,840	12790	27,100	28,320
Lead)	49	13.485	3.683	4.637	4.378
Manganese	91	**456.399**	**229.299**	**316.699**	**315.599**
Mercury	0.13	<0.01	<.01	0.033	0.0408
Molybdenum	3.2	**5.189**	2.695	1.037	1.067
Nickel	132	44.55	19.98	49.06	49.75
Selenium	1	**2.322**	**1.21**	0.868	0.893
Silver	0.2	0.11	<.025	0.066	0.06
Strontium	163	72.46	64.69	37.99	35.66
Thallium	1.2	0.26	0.129	.047 J	0.049
Tin		2.387	0.893	1.711	1.693
Titanium		686.795	344.695	836.795	828.095
Vanadium	175	76.991	41.871	63.661	67.601
Zinc	215	80.874	37.764	49.864	51.264

< = less than; LUT = Look-Up Table.
Note: Values that exceed LUT values are in bold text and shaded cells.

Table D–11 Results of Samples of Malibou Lake Sediments in Agora, California (Polycyclic Aromatic Hydrocarbons)

		Sample Designator			
Analyte	***LUT Value***	***East Sediment 11/02/06***	***MCS-1 11/02/06***	***West Sediment R1 11/02/06***	***West Sediment R2 11/02/06***
1-Methylnaphthalene	2.5	**4.4** J	1.8 J	**5.1**	1.3 J
1- Methylphenanthrene		<1	<1	<1	<1
2,3,5- Trimethylnaphthalene		4.6 J	1.8 J	2.4 J	<1
2,6-Dimethylnaphthalene		5	2.4J	6.2	1.7 J
2-Methylnaphthalene		8.3	3.9 J	13.6	3.1 J
Acenaphthene		2 J	1J	1.5 J	<1
Acenaphthylene	2.5	<1	<1	<1	<1
Anthracene	2.5	1.6 J	<1	1.7	<1
Benz[a]anthracene		7.1	3.3 J	4.2 J	2.2 J
Benzo[a]pyrene	4.47	4.2 J	1.5 J	<1	2.5 J
Benzo[b]fluoranthene		11.7	5.4	6.6	3.3 J
Benzo[e]pyrene		9.9	5.1	6.1	3.1 J
Benzo[g,h,i]perylene	2.5	**12.5**	**6.3**	**6.3**	**3.2** J
Benzo[k]fluoranthene		11.6	6	5.7	3.3 J
Biphenyl		6.4	2J	2.5J	<1
Chrysene		13.7	6.9	8.1	4.1 J
Dibenz[a,h]anthracene		1.5 J	<1	<1	<1
Dibenzothiophene		<1	<1	<1	1.4 J
Fluoranthene	5.2	**19.3**	**12.7**	**10.9**	4.4 J
Fluorene	3.8	**7.6**	2.4	3.5 J	1.1 J
Indeno[1,2,3-c,d]pyrene		9.2	3.7	3.7	2.1 J
Naphthalene	3.6	**6.6**	2.4	**4.5** J	<1
Perylene		39.4	9.8	28	<119.8
Phenanthrene	3.9	**13.9**	**6.9**	**9.2**	3.6 J
Pyrene	5.6	**14.9**	**9.5**	**8.8**	3.7 J

< = less than; LUT = Look-Up Table; J = the value is an estimate.
Note: Values that exceed LUT values are in bold text and shaded cells.

Table D–12 Results of Samples of Commercial Available Soil Amendment Products

Chemical Name	*Units*	*LUT Values*	*Product 1*			*Product 2*			*Product 3*			*Product 4*			*Product 3 – Duplicate*		
			Result		*MRL*	*Result*		*MRL*	*Result*		*MRL*	*Result*		*MRL*	*Result*		*MRL*
Acenaphthene	ug/kg	2.5	84	U	84	**320**		57	75	U	75	83	U	83	72	U	72
Acenaphthylene	ug/kg	2.5	84	U	84	57	U	57	75	U	75	83	U	83	72	U	72
Anthracene	ug/kg	2.5	**30**	J	84	**260**		57	**20**	J	75	**31**	J	83	**31**	J	72
Benzo(a)anthracene	ug/kg	BaP TEQ	84	U	84	310		57	75	U	75	49	J	83	29	J	72
Benzo(a)pyrene	ug/kg	4.47	84	U	84	**120**		57	75	U	75	83	U	83	72	U	72
Benzo(b)fluoranthene	ug/kg	BaP TEQ	84	U	84	270		57	75	U	75	44	J	83	72	U	72
Benzo(e)pyrene	ug/kg	NE	860	U	860	580	U	580	760	U	760	840	U	840	730	U	730
Benzo(g,h,i)perylene	ug/kg	2.5	84	U	84	**53**	J	57	75	U	75	83	U	83	72	U	72
Benzo(k)fluoranthene	ug/kg	BaP TEQ	84	U	84	81		57	75	U	75	83	U	83	72	U	72
Butylbenzylphthalate	ug/kg	100	910	U	910	620	U	620	810	U	810	890	U	890	770	U	770
Di-n-butylphthalate	ug/kg	27	910	U	910	620	U	620	810	U	810	890	U	890	770	U	770
Chrysene	ug/kg	BaP TEQ	84	U	84	380		57	29	J	75	160		83	17	J	72
Dibenz(a,h)anthracene	ug/kg	BaP TEQ	84	U	84	57	U	57	75	U	75	83	U	83	72	U	72
Diethylphthalate	ug/kg	27	910	U	910	620	U	620	810	U	810	890	U	890	770	U	770
Dimethylphthalate	ug/kg	27	910	U	910	620	U	620	810	U	810	890	U	890	770	U	770
Bis(2-Ethylhexyl)phthalate	ug/kg	61	910	U	910	620	U	620	810	U	810	**370**	J	890	770	U	770
Fluoranthene	ug/kg	5.2	84	U	84	**2,100**		57	75	U	75	**160**		83	**42**	J	72
Fluorene	ug/kg	3.8	84	U	84	**210**		57	75	U	75	83	U	83	72	U	72
Indeno(1,2,3-cd)pyrene	ug/kg	BaP TEQ	84	U	84	50	J	57	75	U	75	83	U	83	72	U	72
1-Methylnaphthalene	ug/kg	2.5	84	U	84	**86**		57	75	U	75	83	U	83	72	U	72
2-Methylnaphthalene	ug/kg	2.5	84	U	84	**38**	J	57	75	U	75	83	U	83	72	U	72
Naphthalene	ug/kg	3.6	**69**	J	84	**35**	J	57	75	U	75	83	U	83	72	U	72
N-Nitrosodimethylamine	ug/kg	10	84	U	84	57	U	57	75	U	75	83	U	83	72	U	72
Di-n-octylphthalate	ug/kg	27	910	U	910	620	U	620	810	U	810	890	U	890	770	U	770
Phenanthrene	ug/kg	3.9	84	U	84	**2,400**		57	**38**	J	75	**110**		83	**63**	J	72
Pyrene	ug/kg	5.6	**35**	J	84	**1,100**		57	75	U	75	**87**		83	**50**	J	72
2,4-Dichlorophenoxyacetic acid (D)	ug/kg	5.8	91	U	91	62	U	62	81	U	81	89	U	89	77	U	77
Dalapon	ug/kg	NE	230	U	230	150	U	150	200	U	200	220	U	220	190	U	190
4-(2,4-dichlorophenoxy)butyric acid (2,4-DB)	ug/kg	2.4	43	U	43	29	U	29	**21**	J	38	42	U	42	**29**	J	37
Dicamba	ug/kg	1.3	30	U	30	21	U	21	27	U	27	30	U	30	26	U	26
Dinoseb	ug/kg	NE	60	U	60	41	U	41	54	U	54	60	U	60	52	U	52
2,4-DP (Dichlorprop)	ug/kg	2.4	43	U	43	29	U	29	38	U	38	42	U	42	37	U	37

Chemical Name	Units	LUT Values	Product 1			Product 2			Product 3			Product 4			Product 3 – Duplicate		
			Result		MRL	Result		MRL	Result		MRL	Result		MRL	Result		MRL
2-methyl-4-chlorophenoxyacetic acid (MCPA)	ug/kg	761	6,300	U	6,300	**1,600**	J	4,300	**2,800**	J	5,600	6,200	U	6,200	**2,300**	J	5,400
Methylchlorophenoxy-propionic acid (MCPP) (Mecoprop)	ug/kg	377	6,300	U	6,300	4,300	U	4,300	**3,200**	J	5,600	**6,600**		6,200	**4,500**	J	5,400
2,4,5-Trichlorophenoxyacetic acid (T)	ug/kg	0.63	4.3	U	4.3	**5.1**		2.9	3.8	U	3.8	**4.5**		4.2	3.7	U	3.7
2,4,5-Trichlorophenoxyace acid (TP)	ug/kg	1.2	**2.6**	J	4.3	**2**	J	2.9	3.8	U	3.8	4.2	U	4.2	**3**	J	3.7
Aldrin	ug/kg	0.24	4.2	U	4.2	2.8	U	2.8	3.7	U	3.7	4.1	U	4.1	3.6	U	3.6
Alpha-Hexachlorocyclohexane (BHC)	ug/kg	0.24	4.2	U	4.2	2.8	U	2.8	22	U	22	7.7	U	7.7	20	U	20
Beta-BHC	ug/kg	0.24	9.6	U	9.6	6.5	U	6.5	8.5	U	8.5	9.4	U	9.4	8.2	U	8.2
Gamma-BHC - Lindane	ug/kg	0.24	4.2	U	4.2	2.8	U	2.8	3.7	U	3.7	4.1	U	4.1	3.6	U	3.6
Chlordane	ug/kg	7	86	U	86	58	U	58	76	U	76	84	U	84	73	U	73
p,p-Dichlorodiphenyldichloro-ethane (DDD)	ug/kg	0.5	8.6	U	8.6	9.8	U	9.8	7.6	U	7.6	**1.9**	J	8.4	7.3	U	7.3
p,p-Dichlorodiphenyldichloro-ethylene (DDE)	ug/kg	8.6	8.6	U	8.6	14	U	14	7.6	U	7.6	8.4	U	8.4	7.3	U	7.3
p,p-Dichlorodiphenyltrichloro-ethane (DDT)	ug/kg	13	3.4	J	8.6	5.8	U	5.8	7.6	U	7.6	5.4	J	8.4	7.3	U	7.3
Delta-BHC	ug/kg	0.22	4.2	U	4.2	2.8	U	2.8	**4.2**		3.7	4.1	U	4.1	**2.4**	J	3.6
Dieldrin	ug/kg	0.48	**4.7**	J	8.6	5.8	U	5.8	7.6	U	7.6	8.4	U	8.4	7.3	U	7.3
Endosulfan I	ug/kg	0.24	**3.4**	J	4.2	2.8	U	2.8	3.7	U	3.7	4.1	U	4.1	3.6	U	3.6
Endosulfan II	ug/kg	0.48	12	U	12	5.8	U	5.8	7.6	U	7.6	**6.7**	J	8.4	**10**		7.3
Endosulfan Sulfate	ug/kg	0.48	**2.8**	J	8.6	**8.6**		5.8	8.1	U	8.1	**29**		8.4	7.3	U	7.3
Endrin	ug/kg	0.48	8.6	U	8.6	**2.7**	J	5.8	**2.7**	J	7.6	8.4	U	8.4	7.3	U	7.3
Endrin Aldehyde	ug/kg	0.7	8.6	U	8.6	29	U	29	7.6	U	7.6	8.4	U	8.4	7.3	U	7.3
Endrin Ketone	ug/kg	0.7	9.1	U	9.1	**3.9**	J	6.2	**7.6**	J	8.1	14	U	14	**16**		7.7
Heptachlor	ug/kg	0.24	4.2	U	4.2	2.8	U	2.8	**1.8**	J	3.7	4.1	U	4.1	3.6	U	3.6
Heptachlor Epoxide	ug/kg	0.24	4.2	U	4.2	2.8	U	2.8	**1.3**	J	3.7	4.1	U	4.1	3.6	U	3.6
Methoxychlor	ug/kg	2.4	34	U	34	23	U	23	30	U	30	33	U	33	29	U	29
Mirex	ug/kg	0.5	8.6	U	8.6	**7**		5.8	7.6	U	7.6	**13**		8.4	7.3	U	7.3
Toxaphene	ug/kg	8.8	170	U	170	110	U	110	150	U	150	160	U	160	710	U	710
Aroclor 5432	ug/kg	50	170	U	170	110	U	110	150	U	150	160	U	160	140	U	140
Aroclor 5442	ug/kg	50	170	U	170	110	U	110	150	U	150	160	U	160	140	U	140
Aroclor 5460	ug/kg	50	170	U	170	110	U	110	150	U	150	160	U	160	140	U	140

Chemical Name	Units	LUT Values	Product 1			Product 2			Product 3			Product 4			Product 3 – Duplicate		
			Result		MRL	Result		MRL	Result		MRL	Result		MRL	Result		MRL
PCB-1016	ug/kg	17	86	U	86	58	U	58	76	U	76	84	U	84	73	U	73
PCB-1221	ug/kg	33	86	U	86	58	U	58	76	U	76	84	U	84	73	U	73
PCB-1232	ug/kg	17	86	U	86	58	U	58	76	U	76	84	U	84	73	U	73
PCB-1242	ug/kg	17	86	U	86	58	U	58	76	U	76	84	U	84	73	U	73
PCB-1248	ug/kg	17	86	U	86	58	U	58	76	U	76	84	U	84	73	U	73
PCB-1254	ug/kg	17	86	U	86	58	U	58	76	U	76	84	U	84	73	U	73
PCB-1260	ug/kg	17	86	U	86	58	U	58	76	U	76	84	U	84	73	U	73
PCB-1262	ug/kg	33	86	U	86	58	U	58	76	U	76	84	U	84	73	U	73
PCB-1268	ug/kg	33	86	U	86	58	U	58	76	U	76	84	U	84	73	U	73
Extractable fuel hydrocarbon (EFH) (carbon range 12 to 14 [C12-C14])	mg/kg	5	190	U	190	130	U	130	**69**	J	170	190	U	190	320	U	320
EFH (C15-C20)	mg/kg	5	**240**		190	**380**		130	**480**		170	**450**		190	**660**		320
EFH (C21-C30)	mg/kg	5	**1,700**		190	**1,000**		130	**2,400**		170	**1,500**		190	**2,900**		320
EFH (C30-C40)	mg/kg	5	**2,200**		380	**2,500**		260	**3,000**		340	**2,200**		370	**3,600**		650
EFH (C8-C11)	mg/kg	5	190	U	190	130	U	130	**85**	J	170	190	U	190	320	U	320
Aluminum	mg/kg	58,600	4,730		101	8,180		68	2,790		90	4,730		99	3,240		83.5
Antimony	mg/kg	0.86	10.1	U	10.1	6.79	U	6.79	8.99	U	8.99	9.93	U	9.93	8.35	U	8.35
Arsenic	mg/kg	46	2.36	J	10.1	4.57	J	6.79	1.24	J	8.99	2.06	J	9.93	8.35	U	8.35
Barium	mg/kg	371	75.6		2.52	91.6		1.7	50.4		2.25	57.9		2.48	53.6		2.09
Beryllium	mg/kg	2.2	2.52	U	2.52	0.141	J	1.7	2.25	U	2.25	2.48	U	2.48	2.09	U	2.09
Boron	mg/kg	34	16	J	25.2	**45.7**		17	10.2	J	22.5	15.5	J	24.8	11	J	20.9
Cadmium	mg/kg	0.7	0.519	J	2.52	**0.774**	J	1.7	0.373	J	2.25	0.553	J	2.48	0.407	J	2.09
Calcium	mg/kg	NE	10,900		50.4	19,700		34	5,630		45	12,400		50	7,040		41.8
Chromium	mg/kg	94	7.12	J	7.56	12.6		5.09	4.56	J	6.74	8.05		7.44	4.92	J	6.26
Cobalt	mg/kg	44	1.84	J	2.52	3.98		1.7	1.37	J	2.25	2.56		2.48	1.73	J	2.09
Copper	mg/kg	119	12.9		5.04	19.5		3.4	4.54		4.49	7.23		4.96	4.37		4.18
Iron	mg/kg	NE	5,130		101	11,300		67.9	4,440		89.9	6,860		99.3	4,880		83.5
Lead	mg/kg	49	10.1		7.56	11.1		5.09	4.94	J	6.74	7.33	J	7.44	4.79	J	6.26
Lithium	mg/kg	91	3.3	J	10.1	7.9		6.8	9	U	9	3.8	J	9.9	2.5	J	8.4
Magnesium	mg/kg	1,120	**2,160**		25.2	**5,320**		17	**1,530**		22.5	**4,160**		24.8	**1,790**		20.9
Manganese	mg/kg	1,120	271		2.52	282		1.7	132		2.25	156		2.48	146		2.09
Molybdenum	mg/kg	3.2	1.29	J	5.04	2.3	J	3.4	0.436	J	4.49	0.457	J	4.96	4.18	U	4.18
Nickel	mg/kg	132	4.24	J	5.04	7.52		3.4	2.86	J	4.49	5.41		4.96	3.48	J	4.18
Phosphorus	mg/kg	NA	1510		25.2	2,410		17	918		22.5	1,360		24.8	1,030		20.9

Chemical Name	Units	LUT Values	Product 1			Product 2			Product 3			Product 4			Product 3 – Duplicate		
			Result		MRL	Result		MRL	Result		MRL	Result		MRL	Result		MRL
Potassium	mg/kg	14,400	5,690		252	9,040		170	4,020		225	5,080		248	3,990		209
Sodium	mg/kg	1,780	626		252	1,540		170	354		225	533		248	348		209
Tin	mg/kg	NE	8.51	J	25.2	3.82	J	17	4.49	J	22.5	4.63	J	24.8	3.62	J	20.9
Titanium	mg/kg	NE	270		2.52	653		1.7	231		2.25	427		2.48	281		2.09
Vanadium	mg/kg	175	11		2.52	26		1.7	8.76		2.25	14		2.48	10.2		2.09
Zinc	mg/kg	215	57.1		10.1	97.8		6.79	31.3		8.99	46.7		9.93	33.6		8.35
Zirconium	mg/kg	19	2.58	J	12.6	8.49	U	8.49	11.2	U	11.2	12.4	U	12.4	10.4	U	10.4
Selenium	mg/kg	1	1.01	U	1.01	0.484	J	0.679	0.899	U	0.899	0.993	U	0.993	0.835	U	0.835
Silver	mg/kg	0.2	0.0551	J	0.504	0.138	J	0.34	0.449	U	0.449	0.0523	J	0.496	0.418	U	0.418
Strontium	mg/kg	163	115		1.01	114		0.679	51.9		0.899	81.5		0.993	58.7		0.835
Thallium	mg/kg	1.2	0.504	U	0.504	0.11	J	0.34	0.449	U	0.449	0.496	U	0.496	0.418	U	0.418
Mercury	mg/kg	0.13	0.0316	J	0.0411	0.0395		0.028	0.032	J	0.037	0.0361	J	0.041	0.031	J	0.036
Chloride	mg/kg	NE	447		126	2810	J	4,280	782		562	1,220		620	561		537
Fluoride	mg/kg	NE	6.7		1.3	0.86	U	0.86	5.5		1.1	1.8		1.2	11.6		1.1
Nitrate	mg/kg	22.3	1.9	U	1.9	1.3	U	1.3	9.4		1.7	7.8		1.9	**54.8**		43
Orthophosphate	mg/kg	NE	102		12.6	41.5		8.6	151		11.2	68.3		12.4	225		215
Ammonia	mg/kg	NE	375		12.6	284		8.6	1,380		22.5	246		12.4	1450		21.5
2,3,7,8-Tetrachlorodibenzodioxin (TCDD)	ng/kg	TEQ	1.74	JB	2.49	1.71	U	1.71	0.145	JBQ	2.24	2.47	U	2.47	0.083	JBQ	2.14
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	ng/kg	TEQ	5.8	JB	12.4	0.411	JB	8.53	0.492	JB	11.2	1.14	JBQ	12.4	0.29	JB	10.7
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	ng/kg	TEQ	6.02	JB	12.4	0.731	JB	8.53	0.478	JB	11.2	2.18	JB	12.4	0.362	JB	10.7
1,2,3,6,7,8-HxCDD	ng/kg	TEQ	13.3	B	12.4	3.27	JB	8.53	1.49	JB	11.2	7.28	JB	12.4	1.34	JB	10.7
1,2,3,7,8,9-HxCDD	ng/kg	TEQ	8.12	JB	12.4	1.44	JB	8.53	0.779	JB	11.2	3.44	JB	12.4	0.531	JB	10.7
1,2,3,4,6,7,8-HpCDD	ng/kg	TEQ	89.6	B	12.4	110	B	8.53	28	B	11.2	189	B	12.4	25	B	10.7
Octachlorodibenzodioxin (OCDD)	ng/kg	TEQ	384	B	24.9	991	B	17.1	250	B	22.4	1320	B	24.7	233	B	21.4
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	ng/kg	TEQ	10.2	C	2.49	0.423	J	1.71	0.408	J	2.24	0.407	JQ	2.47	0.319	J	2.14
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	ng/kg	TEQ	6.22	JB	12.4	0.706	JB	8.53	0.791	JB	11.2	0.956	JB	12.4	0.451	JB	10.7
2,3,4,7,8-PeCDF	ng/kg	TEQ	10.1	JB	12.4	0.576	JBQ	8.53	0.821	JB	11.2	0.832	JBQ	12.4	0.609	JB	10.7

Chemical Name	Units	LUT Values	Product 1			Product 2			Product 3			Product 4			Product 3 – Duplicate		
			Result		MRL	Result		MRL	Result		MRL	Result		MRL	Result		MRL
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	ng/kg	TEQ	4.66	JB	12.4	1.11	JB	8.53	0.51	JBQ	11.2	1.24	JB	12.4	0.443	JBQ	10.7
1,2,3,6,7,8-HxCDF	ng/kg	TEQ	5.58	JB	12.4	0.846	JB	8.53	0.636	JB	11.2	0.988	JB	12.4	0.484	JB	10.7
1,2,3,7,8,9-HxCDF	ng/kg	TEQ	2.19	JB	12.4	0.127	JB	8.53	0.351	JB	11.2	0.309	JB	12.4	0.126	JB	10.7
2,3,4,6,7,8-HxCDF	ng/kg	TEQ	8.11	JB	12.4	1.07	JB	8.53	0.614	JB	11.2	1.15	JB	12.4	0.43	JB	10.7
1,2,3,4,6,7,8-HpCDF	ng/kg	TEQ	29	B	12.4	16.6	B	8.53	5.35	JB	11.2	12.7	B	12.4	5.41	JB	10.7
1,2,3,4,7,8,9-HpCDF	ng/kg	TEQ	2.87	JB	12.4	1.21	JB	8.53	0.458	JBQ	11.2	0.784	JB	12.4	0.448	JBQ	10.7
Octachlorodibenzofuran (OCDF)	ng/kg	TEQ	26.5	B	24.9	59.4	B	17.1	13.3	JB	22.4	26.7	B	24.7	13.7	JB	21.4
TEQ [a]	ng/kg	0.912	**17.9**			**2.93**			**1.65**			**4.11**			**1.22**		

B = the analyte was also found in a blank sample; BaP TEQ = 4.7; J = the value is an estimate; mg/kg = milligram per kilogram; LUT = Look-Up Table; MRL = method reporting limit; NE = not evaluated; ng/kg = nanogram per kilogram; Q = matrix spike results outside of quality assurance limits; TEQ = toxicity equivalent; U = non-detect; ug/kg = microgram per kilogram.

[a] Using the World Health Organization's 2,3,7,8-TCDD toxicity equivalence approach for dioxin-furans (2005).

Note: Values that exceed LUT values are in bold text and shaded cells

D.6.3 Assumptions for Backfill Volumes

Remediation of Area IV and the NBZ will create onsite excavations requiring backfilling. The following summarizes the assumptions used to estimate the backfill required due to the soil remediation action alternatives, Building Removal Alternative, and Groundwater Treatment Alternative.

Backfill for Soil Remediation. Although it may be possible to re-grade some locations to maintain proper drainage, this will not be possible for most excavations. This is because the site investigation data show contamination at depth, sometimes up to 10 feet below ground surface, with much of the contamination extending to shallow bedrock. In addition, a minimum of 2 feet of backfill would be required in most locations to re-establish vegetation. Considering the data, DOE estimated that the volumes of backfill required under each of the three soil remediation action alternatives would amount to approximately 75 percent of the volumes of the soil removed under the alternatives.

Backfill for Building Removal. Three of the buildings to be removed under the Building Removal Alternative (Buildings 4022, 4019, and 4024) have extensive below-grade construction; after their removal, large excavations would be left that would require backfilling. DOE considered two volume estimates in determining the volume of soil needed to backfill the excavations of buildings with basements. The smaller estimate of 8,140 cubic yards was provided by North Wind, DOE's building demolition contractor (North Wind 2014), and accounts for the potential to partially backfill the excavations with onsite soil. A second estimate developed for this EIS includes assumptions about the volume of void space that would be left after the walls and floors of the affected buildings were removed, assuming that all backfill for the excavations would be delivered from offsite sources. The larger volume estimate (13,500 cubic yards) was used for purposes of estimating the number of backfill trucks.

Backfill for Groundwater Treatment. Assuming bedrock containing strontium-90 is removed under the Groundwater Treatment Alternative, a small excavation would be left that would require a very small volume of backfill. Similar to the assumptions about backfill requirements for soil remediation, it was assumed that the volume of backfill after excavation of the bedrock would represent about 75 percent of the volume of the waste.

D.6.4 Assumptions for Water Use

Remediation of Area IV and the NBZ at SSFL will require use of water for activities such as dust suppression. Due to the low pumping rate of groundwater at Area IV, it was assumed that all water used for remediation would be obtained from the Calleguas Municipal Water District. The largest water use would be in support the soil remediation action alternatives, the Building Removal Alternative, and the Groundwater Treatment Alternative, assuming removal of bedrock at the Remote Materials Handling Facility (RMHF) leach field that contains strontium-90. A very small quantity of water from the Calleguas Municipal Water District would also be required to support installation of wells under the Groundwater Monitored Natural Attenuation Alternative (see Section D.6.5).

Water Use under the Soil Remediation Action Alternatives. Water use for all soil remediation action alternatives was estimated to be 16,000 gallons per day, consistent with Boeing's experience during its remediation and soil removal efforts at SSFL (Leidos 2015). Assuming 250 working days per year, about 4 million gallons of water would be annually required.

Water Use under the Building Removal Alternative. Building removal was estimated to require about 3,000 gallons per working day (France 2016a). It was assumed that building removal would require 2 years, and that removal would occur over 5 working months during each year, assuming 250 working days per year. After rounding, 5 months of work at 250 working days per year would total about 105 days in 1 year. Three thousand gallons per day times 105 days equals 315,000 gallons per year. Over 2 years, about 630,000 gallons would be required from the Calleguas Municipal Water District.

Water Use under the Groundwater Treatment Alternative. This alternative would use water primarily for dust suppression, assuming bedrock was removed at the strontium-90 source. Water would be used for suppressing dust along haul roads, at the working face of the bedrock excavation, and near truck loading. The total water requirement would be about 8,000 gallons per day (France 2016c) for 20 days, or about 160,000 gallons.

D.6.5 Assumptions for Groundwater Remediation Alternatives

Remediation of Area IV and the NBZ will include remediation of a number of plumes within groundwater at Area IV that contain hazardous or radioactive constituents. The suite of groundwater treatment technologies to be implemented at Area IV will be determined independently from this EIS by means of a Resource Conservation and Recovery Act Corrective Measures Study (see Chapter 2, Section 2.6). Because the results of this Corrective Measures Study are yet to be determined, this EIS considers two groundwater remediation action alternatives to envelope the potential impacts that could occur during groundwater remediation activities, assuming the implementation of those technologies planned for inclusion in the Corrective Measure Study that would result in conservatively high impacts. Implementing the Groundwater Monitored Natural Attenuation Alternative was assumed for analysis to result in generation of waste from the assumed installation of five additional wells, as well as purge water from sampling the network of monitoring wells in Area IV. Implementing the Groundwater Treatment Alternative was assumed for analysis to require removal of bedrock at the RMHF leach field, as well as construction and operation of groundwater treatment systems. Of concern regarding the Groundwater Treatment Alternative is the assumed quantity of waste that could result from bedrock excavation, the quantity of waste that could result from operation of groundwater treatment systems, and the required operational periods of the assumed pump and treat systems.

Waste Generation from Installation of Additional Monitoring Wells. Wastes from installation of five additional monitoring wells under the Groundwater Monitored Natural Attenuation Alternative would primarily consist of drill "cuttings" and well development water.

The following assumptions were made to determine the volume of the cuttings produced during the drilling of five additional wells at Area IV:

- All wells will be 150 feet in depth.
- The upper 20 feet will be an 8-inch boring drilled through alluvium that produces 0.26 cubic yards of soil material.
- The lower 130 feet will a 6-inch bedrock core that produces 1 cubic yard of waste.
- Each well will produce 1.26 cubic yards of cuttings, or about 6 cubic yards of cuttings for 5 wells.
- An expansion factor of about 1.7 was assumed for the highly coarse material, resulting in an estimated volume of waste of approximately 10 cubic yards (6 cubic yards times the expansion factor of 1.7).

Well installation will require the use of water for activities such as cooling drill bits, removing drill cuttings, developing wells, mixing grout and cement for installation of drill casing, and decontaminating equipment before and after drilling a well. As projected from NASA's experience in installing five wells at SSFL (NASA 2015a), it was assumed that installation of each well would require about 1,000 gallons of water, or about 5,000 gallons of water for all five wells. The source for this installation water was assumed to be the Calleguas Municipal Water District.

Well Sampling Purge Water Volume. Well water monitoring activities will result in generation of purge water as part of ensuring quality control of the samples of water obtained for offsite analysis. Low flow methods are used to sample monitoring wells at SSFL. Typically, between 5 and 7 gallons of purge water are produced for each well during sampling that requires handling and disposal. For purposes of this EIS, it was assumed that 40 wells would be annually sampled, resulting in an annual production of about 200 to 280 gallons of purge water. A volume of 250 gallons within this range was used for EIS purposes.

RMHF Leach Field Bedrock Excavation. Site investigation data for the RMHF leach field site show bedrock contamination to about 35 feet below ground surface (CDM Smith 2015). The predicted excavation depth to remove impacted bedrock would be 40 feet. The area of the former leach field is 20 feet wide by 40 feet deep. The volume of impacted bedrock at the leach field site was estimated to be 415 cubic yards. To access the site, a 100-foot long trench would be excavated from the leach field's western edge. The volume of material needing to be trenched to access the impacted bedrock from the west was estimated to be about 635 cubic yards. Combined, an estimated 1,050 cubic yards would be excavated. Due to the coarse nature of the extracted bedrock, the disposal volume after placement into containers (that is, the envelope volume of the disposal containers) was estimated to be about 1,700 cubic yards. For planning purposes, all of the excavated material was assumed to be transported to a regulated disposal facility. It was estimated that it would require 20 working days to reach and remove the impacted bedrock.

Waste from Operation of Groundwater Pump and Treat Systems. As discussed above, bedrock removal was assumed to be the primary groundwater treatment technology used at the RMHF leach field. For other plumes of groundwater contamination, a variety of active (e.g., pump and treat, enhanced groundwater [chemical or biological] treatment, or soil vapor extraction) or passive (i.e., monitored natural attenuation) treatment technologies could be used. The largest quantity of waste and number of required truck shipments to or from SSFL were determined to result from use of pump and treat systems with chemical or biological enhancements. Considering the characteristics of the plumes at Area IV, four such systems were assumed, each containing treatment media such as filter media, granular activated carbon, or ion-exchange resins. Because the treatment media could contain hazardous constituents, it was assumed that the media, or waste from a regeneration process, would be managed as hazardous waste. About 1,000 pounds of treatment media would be processed annually from each pump and treat system (France 2016b), so that remediation of four plumes would annually generate about 4,000 pounds of hazardous waste.

Operational Period of Groundwater Pump and Treat Systems. For purposes of analysis, a 5-year period of operation of active pump and treat systems was assumed. This assumption is based on experience with pump and treat actions at Area IV.

The purpose of groundwater pump and treat actions is to reduce significant contaminant mass. It is usually not possible for the actions to meet final cleanup standards due to some residual contaminants being adsorbed to soil and bedrock materials. For example, RMHF well RD-63 was pumped for 10 years, from 1994 to 2005. The starting concentration in the well was 20 parts per billion for trichloroethylene (TCE). In 1999, the concentration was reduced to 8 parts per billion.

When pumping ceased, there was no rebound (increase) in groundwater concentrations, as would be expected if a significant source of TCE remained. Today, the concentration is at about 6 parts per billion (cleanup level of 5 parts per billion), reflecting residual contamination desorbing from bedrock. TCE concentrations in well RD-34A, downgradient of well RD-63, decreased from 82 parts per billion prior to pumping in 1994 to 5 parts per billion in 1998. This well also did not exhibit a rebound, and the concentration is less than 5 parts per billion today.

Well RD-21 at the Former Sodium Disposal Facility was pumped for 5 years, from 1997 to 2002. TCE concentrations dropped from nearly 2,500 parts per billion to less than 500 parts per billion in that time frame. Based on the rate of decline of TCE during this pumping period, it was assumed that pumping over an additional 5 years would reduce TCE concentrations to a level where pump and treat would not be effective (i.e., no significant mass would be left to be removed). There was no rebound in TCE concentration in well RD-21, and today the TCE concentration is 140 parts per billion. Based on the experience with well RD-34A, it was assumed that 5 years of pumping would remove the remaining contaminant mass.

D.6.6 Assumptions for Transportation of Waste and Materials

This subsection addresses DOE assumptions used in part to determine potential impacts resulting from transportation of waste, backfill, and other materials. Salient assumptions address (1) analyzing shipment of soil in terms of tonnage rather than volume, (2) average shipment tonnages and soil density, (3) daily limits on truck round trips to and from SSFL, and (4) cumulative deliveries to waste disposal and recycle facilities by DOE, NASA, and Boeing.

Shipment of soil in terms of tonnage rather than volume. Early in the development of this EIS, it was determined that, in estimating soil removal volumes and truck requirements, DOE, NASA, and Boeing were assuming different expansion factors for soil after removal from the ground. That is, DOE's analyses were being performed assuming a 30 percent expansion factor; Boeing was assuming a 25 percent expansion factor; and NASA was not assuming an expansion factor. To preclude the confusion that could result from these different assumptions, the three parties agreed to present soil volumes using the *in situ* quantities and not to apply an expansion factor. In addition, it was agreed to determine truck requirements in terms of an average tonnage payload per truck. Based on Boeing's experience in completing interim soil removal actions (ISRAs), Boeing recommended an average payload per truck of 23 tons. This recommendation noted that nonhazardous soil (which would be the majority of the waste shipped off site) could be shipped in end-dump trucks, and the average payload of the end-dump trucks used for the ISRA shipments was 23 tons. This recommendation also noted that roll-off bins were used for ISRA shipments of hazardous soil with payloads of 15.7 tons. Because the average density of the shipped ISRA soil (based on transport history) was about 1.55 tons per cubic yard, Boeing recommended an average soil density of about 1.6 tons per cubic yard (Boeing 2014). DOE's assumptions differed from this recommendation, as discussed below.

DOE Assumptions of Average Truck Payload and Soil Density for the *SSFL Area IV EIS*. For purposes of analysis, DOE assumed an average payload of 20 tons for shipment of soil under the soil remediation action alternatives; an average payload of 23 tons for delivery of backfill to SSFL under all action alternatives requiring backfill shipment; and an average soil density of 1.5 tons per cubic yard.

20-ton Payload for Soil Shipment. Although it is possible that end-dump trucks could be used to ship soil waste from Area IV and the NBZ, an average 20-ton payload was conservatively assumed in consideration of the potential for use of containers (e.g., cargo containers, "burrito wraps," drums, boxes, or lift liners) for a portion or all of the soil to be removed. These considerations, for example, argued for the following assumptions:

1. *Contamination control.* The public expressed concerns about contaminated dust being released from waste trucks carrying shipments on roads in the vicinity of SSFL. Although steps would be taken to minimize dust generation from end-dump trucks, one would expect a smaller potential for dust generation from containerized waste than from end-dumps. End dump trucks would be covered with tarps, or the waste within the end-dumps could be placed within wraps or bags, which would minimize if not eliminate dust generation; but the waste within containers would be essentially sealed. Lift liners shipped within cargo containers or wraps within intermodals, for example, would have two independent barriers to dust generation. The ability for containers such as lift liners, B-25 boxes, or wraps to be sealed against dust generation is demonstrated by the acceptance of these types of containers at radioactive waste disposal facilities. Although all disposal facility operators are concerned about contamination control, the emphasis on contamination control is particularly strong at LLW and MLLW facilities. Transport vehicles are typically surveyed for contamination both on arrival and on leaving a disposal facility.
2. *Use of trucks to transport soil as well as use of a combination of truck and rail transport.* Remediation of Area IV and the NBZ will result in generation of large quantities of soil waste, particularly nonhazardous soil, which may need to be transported for long distances for disposal. It thus may be cost-effective to ship some or all of the soil using a truck/rail combination rather than totally by truck. Because there is no rail access at SSFL, soil under the truck/rail option would be trucked to an intermodal facility located within a reasonable distance to SSFL, and then loaded onto trains for delivery to the disposal facilities. It is not expected that any intermodal facility that may be located near SSFL would have the capability for transfer of bulk quantities of soil to train cars (gondolas). For this reason, and because of the need for contamination control at the intermodal facility, the only feasible way to implement the truck/rail option would be to truck the waste within containers (e.g., cargo containers) that can be transferred easily to railcars with no dusting.
3. *Flexibility in use of different types of trucks and waste containers.* Although excavated soil from contaminated areas at Area IV and the NBZ could probably be directly loaded into end-dump trucks, this transport mode may not be applicable for waste generated by focused remedial actions in the exemption areas proposed under the 2010 AOC (DTSC 2010a). Focused removal actions within the proposed exemption areas would include measures intended to minimize disturbance of vegetation and soils, such as removal of only as much contaminated soil as necessary using hand tools and portable mechanized equipment. For operational efficiency and minimization of impacts within the proposed exemption areas, waste from focused removal actions would be likely placed within containers rather than within end-dump trucks. There may also be other removal activities outside of the proposed exemption areas where it would be more efficient to place removed soil within containers. If the potential for shipment of soil within containers was not considered, then one could underestimate the number of truck shipments from Area IV and the NBZ.

Therefore, it was conservatively assumed for both the truck and the truck/rail options that all soil waste would be shipped within containers with a payload of 20 tons per truck. This assumption does not preclude the use of end-dump trucks or other transport configurations for soil, particularly nonhazardous soil, but bounds the transportation and traffic impacts that could occur from shipment of the waste from SSFL to the evaluated facilities. It also eliminates the analytical complexity that would result if one average payload were assumed for the truck option and another average payload for the truck/rail option.

23-ton Payload for Backfill Shipment. Consistent with Boeing's recommendation (Boeing 2014), it was assumed that shipment of backfill would be delivered to Area IV and the NBZ using vehicles such as covered end-dump trucks with an average payload of 23 tons. All backfill to be delivered would be determined to meet the required values for chemical and radionuclide content, as determined by DTSC. In addition, there would no need either to place the backfill into smaller containers for delivery or to consider delivery via a truck/rail option. Therefore, an assumption of 23 tons was determined to be reasonable.

Average Soil Density of 1.5 Tons per Cubic Yard. A range of reasonable soil densities could apply to the soil excavated at SSFL. As noted above, based on analysis of soil removed during an earlier SSFL project and using topographic surveys of the affected area (pre- and post-soil removal) and shipment weights recorded on shipment manifests, Boeing calculated an average density of soil of 1.55 tons per cubic yard and recommended rounding up to an average density of 1.6 tons per cubic yard (Boeing 2014). At the time of that recommendation, however, a number of analyses being performed for this EIS had been using 1.5 tons per cubic yard, based on prior engineering judgment. It was decided to continue using a soil density of 1.5 tons per cubic yard to avoid the need to redo the analyses.

Using the lower density (1.5 tons per cubic yard), about 7 percent fewer trucks would be required for soil removal than if the suggested density (1.6 tons per cubic yard) were assumed. Yet, as noted above, DOE assumed an average soil shipment payload of 20 tons per soil shipment rather than the 23 tons per soil shipment suggested by Boeing (Boeing 2014). This assumption of 20-ton payloads results in approximately 13 percent more shipments of nonhazardous soil than if 23-ton payloads were assumed. Overall, therefore, DOE has determined that the assumption of 1.5 tons per cubic yard is reasonable.

Truck Round Trips to and from SSFL. It was assumed for analysis that the number of heavy-duty truck round trips to and from SSFL on any working day would be capped at 96, considering truck deliveries or shipments by DOE, NASA, and Boeing, and that each heavy-duty truck that entered SSFL on a working day would leave SSFL on the same working day. The assumed maximum number of heavy-duty truck round trips was developed from a Transportation Agreement among DOE, NASA, and Boeing (Boeing 2015a). This agreement states the anticipation that trucks[12] would be dispatched from the site at 10-minute intervals on week days, but not less than 5-minute intervals, and that truck traffic would be staggered to allow a "maximum of 96 truckloads departing the Site per day" (Boeing 2015a). [13] The 96-truck capacity is to be shared (coordinated) among the three parties. The agreement does not apply to light- and medium-duty trucks that may be used for tasks such as delivery of supplies to the site or transport of well water samples to offsite laboratories. In addition, the agreement is silent on any limit on the daily number of heavy-duty trucks delivering backfill or equipment to the site.

---

[12] Per the Transportation Agreement, trucks were defined as semi-tractor trailers of a combination of straight truck and trailer or any Class 7 (gross vehicle weight rating [GVWR] from 26,201 to 330,00 pounds) or Class 8 vehicle (GVWR above 33,000 pounds) (Boeing 2015a). Class 7 and 8 trucks are termed heavy-duty trucks in this EIS.

[13] A "truckload" is not defined in the Transportation Agreement; "loaded trucks," however, are defined as "trucks hauling fill material to the Site and trucks hauling remediation or demolition debris from the Site." The term, "loaded truck," is used in the Transportation Agreement in the context of the three agreement parties' need to keep track of the weights of the trucks in order to determine cost-sharing for road repairs and maintenance resulting from pavement damage (Boeing 2015a).

Considering the Transportation Agreement, it was assumed for analysis that the daily number of heavy-duty truck round trips to and from SSFL would be capped at 96, and that this limit would be applied to all heavy-duty truck shipments of waste (including shipments of well installation and monitoring water), equipment (including well drill rigs), or backfill to or from the site. This limit was assumed because it was recognized that traffic impacts (increases in traffic densities, the potential for pavement damage) would depend on the number of truck round trips rather than just the number of trucks leaving SSFL. That is, traffic impacts would depend on the number of loaded trucks arriving or leaving SSFL, as well as the number of unloaded trucks arriving or leaving. This is in keeping with the recognition in the Transportation Agreement that the potential for loaded trucks to result in pavement damage was not limited to trucks hauling waste from the site.

Cumulative Deliveries at the Recycle and Disposal Facilities. For purposes of analysis, estimates were made of the cumulative daily truck trips from SSFL resulting from DOE, NASA, and Boeing shipments to recycle and waste disposal facilities. Estimates of total waste volumes and truck shipments are summarized in **Table D–13** for radioactive waste (LLW and MLLW), hazardous waste, nonhazardous waste, recycle material, and backfill.[14]

Table D–13 Total Waste, Recycle Material, and Backfill Volumes and Shipments[a]

Generators	*LLW and MLLW*	*Hazardous Waste*	*Nonhazardous Waste*	*Recycle Material*	*Backfill*	*Total*
Volume (cubic yards)						
DOE	57,600 to 103,000	49,100	53,200 to 794,000	3,540	125,000 to 715,000	288,000 to 1,660,000
NASA	87,000	436,000 to 699,000	116,000	34,300 [b]	202,000 to 290,000	875,000 to 1,230,000
Boeing	None expected	53,700	282,000	Not reported	113,000	449,000
Total	145,000 to 190,000	539,000 to 802,000	451,000 to 1,190,000	37,840	440,000 to 1,120,000	1,610,000 to 3,340,000
Number of Shipments						
DOE	4,550 to 7,980	3,690 to 3,930	4,020 to 59,600	340	8,150 to 46,600	20,700 to 118,000
NASA	5,700	28,800 to 45,800	7,420	2,060	13,000 to 19,000	57,000 to 80,000
Boeing	None expected	3,500	18,400	Not reported	7,370	29,300
Total	10,300 to 13,700	36,000 to 53,200	29,900 to 85,400	2,400	28,500 to 73,000	107,000 to 228,000

Boeing = The Boeing Company; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste, NASA = National Aeronautics and Space Administration.

[a] All values have been rounded.

[b] Includes recycle material, material for resale, and material for export from the United States.

Estimates of DOE waste volumes and shipments are from Chapter 4, Table 4–73, of this EIS, based on the waste volumes and shipments that would result from implementing the six evaluated combinations of action alternatives. Waste volumes for NASA and Boeing were obtained from NASA 2014, NASA 2015b, and Boeing 2015b and are summarized in this EIS in Chapter 5, Table 5–9, in accordance with the analysis in Section 5.10. Total NASA and Boeing shipments were determined assuming an average truckload of waste and recycle material of about 23 tons per truck and an average waste density of 1.5 tons per cubic yard. Shipments were assumed to occur over 250 working days in a year.

[14] In addition, over 12 years under the Groundwater Monitored Natural Attenuation Alternative, there would be about 17 DOE shipments of water from well installation and monitoring (see Chapter 2, Table 2-5).

Estimates of DOE backfill volumes are from Chapter 5, Table 5—1, of this EIS, based on the backfill volumes that would result from implementing the six evaluated combinations of action alternatives. The number of DOE backfill shipments was determined assuming a backfill volume of 1.5 tons per cubic yard and an average truckload of 23 tons. Estimates of NASA and Boeing backfill volumes were obtained from NASA 2015b and Boeing 2015b. Estimates of the number of Boeing backfill shipments were made using the same assumptions as those for DOE backfill shipments; the number of NASA backfill shipments was obtained from NASA 2015b.

It was assumed for analysis that: (1) DOE, NASA, and Boeing remediation operations would all start in the first year of combined site remediation; (2) NASA building removal would be performed concurrently with NASA soil removal; (3) all backfill would be delivered to SSFL from offsite sources; and (4) previously assumed schedules for DOE soil and building debris transport from Area IV would be maintained (32 daily building debris shipments during the first 2 years and 48 daily soil shipments thereafter). In accordance with the Transportation Agreement among DOE, NASA, and Boeing (Boeing 2015a), it was assumed that the maximum number of daily heavy-duty truck round trips from SSFL from all three parties would be 96 round trips. During the first 2 years of combined site remediation, assuming truck trips were allotted equally during these 2 years among DOE, NASA, and Boeing, each party could make 32 daily truck round trips—that is, a theoretical 8,000 round trips per year (32 times 250 days per year equals 8000). However, during these 2 years, daily truck round trips from DOE activities would average less than the daily 32 allotted to it (see below). After these 2 years, when building demolition is complete, it was assumed that DOE could ship up to 48 daily truck round trips. (The increase in DOE truck round trips from an average maximum of 32 per day to 48 per day is based on the assumption that Boeing would be largely finished with remediation activities after the end of the second year.

For purposes of analysis, it was assumed that NASA and Boeing would ship each type of waste (radioactive, hazardous, and nonhazardous) and recycle material to the evaluated recycle and waste disposal facilities in the same proportions as they are projected to be generated. It was further assumed that the waste would be shipped in accordance with the above assumptions, i.e., after the first 2 years, the combined NASA and Boeing shipments would make 12,000 annual truck round trips until there is no more waste and backfill to be shipped, while DOE would make up to 12,000 annual truck round trips (48 times 250 days per year equals 12,000).

The analysis was performed assuming three possible scenarios:

1. DOE, NASA, and Boeing are limited to 32 truck round trips each during the first 2 years of combined site remediation.
2. Boeing uses DOE's unused truck round trip capacity during these first 2 years.
3. NASA also uses DOE's unused truck round trip capacity during these first 2 years.

For each scenario, it was assumed for analysis that all of each type of waste (e.g., LLW or MLLW, hazardous waste, etc.) generated by DOE, NASA, and Boeing would be sent to a single facility authorized for that type of waste.

Under these assumptions, the maximum numbers of average daily deliveries to the evaluated recycle and disposal facilities were determined. For a given type of waste or recycle material, the year when peak deliveries from DOE occur may be different from the year when peak deliveries from NASA or Boeing may occur. The estimated maximum daily deliveries reflect the year when the maximum deliveries would occur considering all three parties:

- *Seventeen daily deliveries to an assumed single LLW/MLLW facility.* DOE shipments would result in the largest number of daily deliveries of LLW and MLLW. The largest number of daily deliveries of DOE LLW and MLLW to any single assumed facility is about 14 (rounded from about 14.2; see Chapter 4, Section 4.10, of this EIS). Boeing is not projected to ship LLW or MLLW. NASA is expected to ship about 87,000 cubic yards of LLW[15] in about 5,700 shipments out of about 57,000 to 80,000 total NASA shipments (waste and recycle material). Assuming 6,000 NASA shipments per year, there would be 428 to 600 shipments of LLW from NASA per year (5,700/80,000 × 6,000 = 428; 5,700/57,000 × 6,000 = 600), or up to 2.4 shipments per day (600/250 = 2.4). Considering both DOE and NASA, there would be a maximum of about 17 daily deliveries, as rounded, to an assumed single LLW/MLLW facility.

- *Thirty-nine daily deliveries to an assumed single hazardous waste facility*. The largest daily shipment of hazardous waste to a single assumed hazardous waste facility from all three parties would occur if NASA were to use DOE's unused delivery capacity during the first 2 years of combined site remediation (scenario 3). The maximum daily shipments would occur in the first year, when DOE would make approximately 833 shipments[16] and NASA would make 15,167 shipments.[17] During this year, the average daily number of DOE shipments would be negligible compared to those from NASA and Boeing.[18] From Table D–13, NASA is projected to ship 436,000 to 699,000 cubic yards of hazardous waste (28,800 to 45,800 shipments), out of 57,000 to 80,000 total shipments (waste, recycle material, and backfill). Assuming 15,167 NASA shipments in a year, there would be about 7,660 to 8,770 annual shipments of hazardous waste (28,800/57,000 × 15,167 = 7,660; 45,800/80,000 × 15,167 = 8,770), or up to 35.1 shipments per day (8,770/250 = 35.1). Boeing is projected to ship about 53,700 cubic yards of hazardous waste in about 3,500 truckloads, out of about 29,300 total shipments (waste and backfill). Assuming 8,000 Boeing shipments in a year, which would be the case during the first 2 years while DOE performs building demolition, there would be about 956 annual shipments of hazardous waste (3,500/29,300 × 8,000 = 956), or about 3.8 shipments per day (956/250 = 3.8 shipments). The result is a total of about 39 shipments per day (35.1 + 3.8).
- *Forty-three daily deliveries to an assumed single nonhazardous waste facility.* The largest total number of daily deliveries from all three parties would occur after DOE completes shipment of waste from building demolition (i.e., after 2018), and NASA and Boeing are each assumed to make 6,000 shipments in a year. DOE would make the largest number of daily deliveries of nonhazardous waste, about 25 daily deliveries, as rounded from 24.7 (see Chapter 4, Section 4.10, of this EIS). From Table D–13 for hazardous waste, and assuming Boeing would make 6,000 shipments in a year, Boeing would make about 3,770 annual shipments of nonhazardous waste (18,400/29,300 × 6,000 = 3,770) , or 15 deliveries per day (3,770 shipments/250 days per year = 15.1). Assuming NASA would make 6,000 shipments in a year and the maximum total number of waste, recycle material, and backfill shipments would be 80,000, NASA would make about 557 shipments (7,420/80,000 ×6,000 = 557), or

[15] NASA did not conduct radiological operations in its areas of SSFL; estimated quantities of radioactive waste from NASA remediation are due to naturally occurring isotopes and the LUT values established in accordance with the 2010 NASA *Administrative Order on Consent for Remedial Action* (DTSC 2010b).

[16] Assuming that, during the first year, there would be 750 DOE shipments of waste and recycle material, 63 shipments of backfill, 1 shipment of well purge water in a tanker (these three values are from Chapter 2, Table 2-5, of this EIS), and 19 shipments of equipment and supplies.

[17] The total number of annual shipments would be 24,000 shipments. DOE and NASA would share 16,000 shipments, while Boeing would make 8,000 shipments.

[18] The largest number of shipments of hazardous waste from DOE alone is about 8 daily shipments, which would occur after DOE completes building demolition.

about 2 per day (557 shipments/250 days per year = 2.2). However, if NASA makes the minimal assumed shipments of total waste and backfill (57,000), a slightly higher fraction of the waste that would be annually shipped would be comprised of nonhazardous waste.[19] Assuming 6,000 NASA shipments in a year, this case would result in shipment of about 781 annual shipments of nonhazardous waste (7,420/57,000 × 6,000 = 781), or 3 per day (781 shipments/250 days per year = 3.1). Taking the more conservative case, the sum total of daily deliveries from all three parties would be about 43 (25 from DOE + 15 from Boeing + 3 from NASA = 43).[20]

- *Four daily deliveries to an assumed single recycle facility.* DOE deliveries of recycle material would occur during building removal (during the first 2 years of combined site remediation), resulting in about 2 daily deliveries (calculated value of about 1.6). Boeing is not projected to ship recycle material. NASA is projected to ship about 34,300 cubic yards of recycle material, including export and reuse material (see Chapter 5, Section 5.10) in about 2,060 shipments. These shipments would represent about 2.58 percent (2,060/80,000) to 3.61 percent (2,060/57,000) of the total number of NASA shipments. The largest number of NASA shipments would occur in the first year, assuming NASA used the excess DOE truck capacity during that year (scenario 3). In this case, NASA would make 15,167 shipments to DOE's 883. Considering the above percentages, NASA would make up to 583 shipments of recycle material in a year (0.0361 × 15,167 = 583), or 2 deliveries per day (583/250 days per year = 2.3).[21] Adding the contribution of DOE and NASA results in about 4 daily deliveries of recycle material (1.6 from DOE + 2.3 from NASA = 3.9).

Occasionally, daily shipments could be larger than these averages if the three parties simultaneously gave priority to generation and shipment of a given type of waste. For example, if the three parties each shipped nothing but nonhazardous waste on a given day, the number of deliveries on that day to a single assumed nonhazardous waste facility could be larger than 43. However, this is considered to be an unusual scenario, given that each party would have different schedules for waste generation and different quantities of each type of waste (e.g., NASA waste is mostly hazardous soil, while DOE waste is mostly nonhazardous soil). In addition, there would be shipments of backfill to consider when assessing the total number of daily round trips. If the three parties each shipped nothing but nonhazardous waste on a given day and did not receive backfill during that day, there could theoretically be up to 96 deliveries to a single assumed nonhazardous waste facility. This scenario is considered to be unlikely, however, both for the above reasons and because of other issues that would likely limit the daily number of shipments (e.g., funding, planning, and the need for regulatory analysis and approval of the content of soil after removal).

---

[19] The difference in waste shipments between the low and high values for NASA is due to differences in the assumed quantities of hazardous waste shipped. This also results in differences in the amounts of backfill shipped.

[20] The largest number of nonhazardous waste shipments, considering only NASA and Boeing, is 42 daily shipments; these shipments would occur in 2017 under scenario 2, when DOE is generating only small quantities of nonhazardous waste from building demolition.

[21] This is conservative because recycle, reuse, and resale material would probably not be shipped to any single facility, but instead to multiple facilities; it does, however, account for the possibility that all material might actually be recycled.

D.7 References

Boeing (The Boeing Company), 2014, personal communication (email) from A Lenox, to D. Dassler, Boeing, S. Jennings and J. Jones, U.S. Department of Energy; A. Elliot and P. Zorba, National Aeronautics and Space Administration, "Common Assumptions for Soil Volume/Transportation Estimates: Based on ISRA Soil Excavation/Transportation actuals," October 12.

Boeing (The Boeing Company), 2015a, *Transportation Agreement for the Santa Susana Field Laboratory Ventura County, California Between the Boeing Company (Boeing) and the U.S. Government As Represented by the National Aeronautics and Space Administration (NASA) and the Department of Energy (DOE)*.

Boeing (The Boeing Company), 2015b, personal communication (email), D. W. Dassler to J. Wondolleck, CDM Smith, "Re: DOE EIS questions," June 11.

Burgesser, T., 2015, Memorandum to K. Roberts and J. Wondolleck, *An evaluation of Chemicals of Natural Origin on Reported Total Petroleum Hydrocarbon Concentrations at the Santa Susana Field Laboratory*, October 8.

Caltrans (California Department of Transportation), 2015a, *District 7 Projects* (accessed on September 24, 2015, http://www.dot.ca.gov/dist07/travel/projects/projects.php).

Caltrans (California Department of Transportation), 2015b, *District 7 Projects US-101/SR-23 Interchange Improvement Project* (accessed on October 10, 2015, http://www.dot.ca.gov/dist07/travel/projects/details.php?id=39).

Caltrans (California Department of Transportation), 2015c, *District 7 Environmental Documents* (accessed September 24, 2015, http://www.dot.ca.gov/dist07/resources/envdocs).

CDM Smith, 2015, *Final RCRA Facility Investigation (RFI) Groundwater Work Plan, Portions of Area IV under DOE Responsibility, Santa Susana Field Laboratory, Ventura, California*, November 9.

CEC (California Energy Commission), 2015, *Status of All Projects* (accessed on March 10, 2015, http://www.energy.ca.gov/sitingcases/all_projects.html), February 23.

City of Agoura Hills, 2015, *City of Agoura Hills Development Summar*y, Commercial and Residential Projects, June 2015 Quarterly Report, Planning Department, Agoura Hills, California, June.

City of Calabasas, 2015, *Projects, Plans & Reports in the City of Calabasas* (accessed on October 9, 2015, http://www.cityofcalabasas.com/projects.html), Public Works Department, City of Calabasas, California.

City of Industry, 2008, *Final Puente Hills Intermodal Facility Final Environmental Impact Report*, Vol. 1, State Clearinghouse Number 20006021097 (available at http://lacsd.org/solidwaste/wbr/phimf/default.asp), May.

City of Industry, 2009, *Addendum to the Puente Hills Intermodal Facility Environmental Impact Report*, State Clearinghouse No. 2006021097 (available at http://lacsd.org/solidwaste/wbr/ phimf/default.asp), February.

City of Los Angeles, 2015, *Major Projects*, Department of City Planning (accessed on October 21, 2015, https://ladcp.maps.arcgis.com/apps/MapJournal/index.html?appid=b06f97ccf94741fdaad27443013eead1), October.

City of Simi Valley, 2015, *Quarterly Development Summary Second Quarter 2015*, Department of Environmental Services, Simi Valley, California, June 30.

City of Thousand Oaks, 2015a, *Development Activity Report*, Community Development Department, Thousand Oaks, California, October.

City of Thousand Oaks, 2015b, *Construction Info & Road Closures,* "toaks.org.10123," (accessed on October 10, 2015, http://www.toaks.org/government/depts/public_works/construction_projects/current_projects/route_101_23_interchange_improvement_project/construction_info_n_road_closures.asp), Community Development Department, Thousand Oaks, California, October.

County of Ventura, 2015a, *Environmental Impact Reports (EIR)*, Ventura County Planning Division (accessed on March 12, 2015, http://www.ventura.org/rma/planning/ceqa/eir-archive.html).

County of Ventura, 2015b, *Planning*, "Environmental Impact Reports (EIR)," Ventura County Planning Division (accessed on October 9, 2015, http://www.ventura.org/rma/planning/ceqa/eir.html).

County of Ventura, 2015c, *Planning*, "Notices of Preparation for Environmental Impact Reports," Ventura County Planning Division (accessed on March 12 and October 9, 2015, http://www.ventura.org/rma/planning/ceqa/ nop.html).

County of Ventura, 2015d, *Planning*, "Recently Approved & Pending Projects," Ventura County Planning Division (accessed on October 9, 2015, http://www.ventura.org/rma/planning/permits/pending-projects. html).

CPUC (California Public Utilities Commission), 2015a, *Current Projects* (accessed on March 10, 2015, http://www.cpuc.ca.gov/PUC/energy/Environmental/Current+Projects/index.htm), February 17.

CPUC (California Public Utilities Commission), 2015b, *Southern California Edison's Presidential Substation Projec*t (accessed on October 9, 2015, http://www.cpuc.ca.gov/Environmental/info/esa/presidentialsubstation/index.html).

CPUC (California Public Utilities Commission), 2015c, *Southern California Edison – Moorpark-Newbury 66 kV Subtransmission Line Project* (accessed on October 9, 2015, http://www.cpuc.ca.gov/Environmental/info/esa/moorpark_newbury/index.html), June 11.

CPUC (California Public Utilities Commission), 2015d, *Southern California Gas Company Aliso Canyon Turbine Replacement Project* (accessed on October 9, 2015, http://www.cpuc.ca.gov/Environmental/info/ene/aliso_canyon/aliso_canyon_home.html), September 17.

DOE (U.S. Department of Energy), 1997, *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*, Vol. 1, DOE/EIS-0200F, May.

DOE (U.S. Department of Energy), 2013a, *Final Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada*, Vol. 1, Book 1, DOE/EIS-0426, Las Vegas, Nevada, February.

DOE (U.S. Department of Energy), 2013b, *Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*, DOE/EIS-0391, Richland, Washington, November.

DTSC (State of California Department of Toxic Substances Control), 2010a, *The State of California Environmental Protection Agency, Department of Toxic Substances Control and the United States Department of Energy, In the Matter of: Santa Susana Field Laboratory, Simi Hills, Ventura County, California, Administrative Order on Consent for Remedial Action*, Docket No. HSA-CO 10/11-037, Health and Safety Code Sections 25355.5(a)(1)(B), 58009 and 58010, December 6.

DTSC (State of California Department of Toxic Substances Control), 2010b, *The State of California Environmental Protection Agency, Department of Toxic Substances Control and the United States National Aeronautics and Space Administration, In the Matter of: Santa Susana Field Laboratory, Simi Hills, Ventura County, California, Administrative Order on Consent for Remedial Action*, Docket No. HSA-CO 10/11-038, Health and Safety Code Sections 25355.5(a)(1)(B), 58009 and 58010, September 3.

DTSC (Department of Toxic Substances Control), 2013a, *Draft Provisional Radiological Look-Up Table Values* (available at http://www.dtsc-ssfl.com/files/lib_look-uptables/radiological/66513_65861_ Draft_Provisional_Radiological_Look-Up_Table_Values_1-30-13.pdf), January.

DTSC (Department of Toxic Substances Control), 2013b, *Chemical Look-Up Table Technical Memorandum, Santa Susana Field Laboratory, Ventura County*, California, June 11.

DTSC (Department of Toxic Substances Control), 2015, *EnviroStor Cleanup Sites* (available at http://www.envirostor.dtsc.ca.gov/public/mapfull.asp?global_id=&x=-119&y=37&zl=18&ms= 640,480&mt=m&findaddress=True&city=calabasas&zip=&county=&state_response=true&voluntary_cleanup=true&school_cleanup=true&ca_site=true&tiered_permit=true&evaluation=true&military_evaluation=true&school_investigation=true), May 15.

EPA (U.S. Environmental Protection Agency), 2015, *Record of Decision for FOSET #2 – Action Sites, Former McClellan Air Force Base, McClellan, California*, Final, EPA Region 9, San Francisco, California, March.

ESA (U.S. Environmental Science Associates), 2015, Personal communication (email) from J. Ricks to S. Enyeart, Leidos, Re: SSFL Cumulative MAP, May 12.

France, L., 2016a, CDM Smith, Personal communication (email) to G. Roles, Leidos, "RE: SSFL EIS: Water Use for Building and Sr-90 Bedrock Removal," January 11.

France, L., 2016b, CDM Smith, Personal communication (email) to G. Roles, Leidos, "FW: GAC and filter media," January 11.

France, L., 2016c, CDM Smith, Personal communication (email) to G. Roles, Leidos, "water estimate for bedrock excavation," January 14.

HGL (HydroGeoLogic, Inc.), 2012a, Memorandum from L. S. Vaughn, Project Manager, to A. Bain, U.S. Environmental Protection Agency, Region 9, "Re: Final Technical Memorandum, Look-Up Table Recommendations, Santa Susana Field Laboratory Area IV Radiological Study," November 27.

HGL (HydroGeoLogic, Inc.), 2012b, *Final Radiological Characterization of Soils, Area IV and the Northern Buffer Zone, Area IV Radiological Study, Santa Susana Field Laboratory, Ventura County*, California, prepared for the U.S. Environmental Protection Agency, Region 9, December 21.

ITRCWG (Interstate Technology and Regulatory Cooperation Work Group), 1997, *Technical and Regulatory Guidelines for Soil Washing, Final*, December.

Jonas & Associates (Jonas and Associates Inc.), 2008, *Final Second Five-Year Review of Remedial Actions, Hunters Point Shipyard, San Francisco, California*, Martinez, California, November 11.

LCMTA (Los Angeles County Metropolitan Transportation Authority), 2015, *Measure R Highway Subregional Program (MRHSP),* "Action: Approve Updated Project List," Planning and Program Committee, Los Angeles, California, April 15.

Leidos (Leidos, Inc.), 2015, Personal communication (email) from S. Enyeart to Dassler, David W., DOE, et al., "FW: Boeing meeting notes and data request," September 4.

Malibou Lake Mountain Club, Ltd., 2007, *Sediment Sampling Report Malibou Lake Agoura Hills, Los Angeles County, California*, prepared by Donald S. Eley, LFR-Levine Fricke, January 24.

MWH (MWH Americas, Inc.), 2014a, Personal communication from D. Hambrick, M. Sherwin, and D. Collins to J. Jones and S. Jennings, U.S. Department of Energy, "RE: Rough Order-of-Magnitude Estimates for AOC Chemical Preliminary Remediation Volumes in Area IV and the Northern Buffer Zone, and Associated Truck Transport Estimates, based on DTSC Look-Up Table Values, Draft" September 29.

MWH (MWH Americas, Inc.), 2014b, *Rough Order-of-Magnitude Estimates for AOC Radiological Preliminary Remediation Volumes in Area IV and the Northern Buffer Zone, and Associated Truck Transport Estimates, based on DTSC Provisional Look-Up Table Volumes*, September 29.

MWH (MWH Americas, Inc.), 2014c, *Final Standardized Risk Assessment Methodology Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California*, Pasadena, California, August.

NASA (National Aeronautics and Space Administration), 2014, *Final Environmental Impact Statement for Proposed Demolition and Environmental Cleanup Activities at Santa Susana Field Laboratory, Ventura County, California*, George C. Marshall Space Flight Center, Huntsville, Alabama, March.

NASA (National Aeronautics and Space Administration), 2015a, *Results from Bravo Bedrock Vapor Extraction Treatability Study Technical Memorandum*, November 11.

NASA (National Aeronautics and Space Administration), 2015b, Personal communication (email) from A. Elliott to S. Jennings, U.S. Department of Energy, "Re: Cumulative Analysis for our EIS," September 24.

Nelson, Y. M., S. Cronin, K. Cochran, and A. Varni, 2015, *Chemical Characterization of Residual Fuel Hydrocarbons in Soils at the Santa Susana Field Laboratory, Final Report*, California Polytechnic State University, San Luis Obispo, California, July 31.

North Wind, 2014, Personal communication (email) from B. Frazee to S. Jennings, U.S. Department of Energy, "ETEC D&D Waste Quantity Estimates," November 10.

NPS (National Park Service), 2015a, *Santa Monica Mountains National Recreation Area*, "Current Projects," (accessed on March 10, 2015, http://parkplanning.nps.gov/parkHome.cfm?parkID=341).

NPS (National Park Service), 2015b, *Redwood National Park/Santa Monica Mountains National Recreation Area Invasive Plant Management Plan Environmental Assessment* (accessed on March 11, 2015, http://parkplanning.nps.gov/projectHome.cfm?projectID=44351).

NPS (National Park Service), 2015c, *Visitor Center at King Gillette Ranch* (accessed on October 10, 2015, http://parkplanning.nps.gov/projectHome.cfm?projectID=23534).

NPS (National Park Service), 2015d, *SMMNRA Interagency Trail Management Plan* (accessed on October 10, 2015, http://parkplanning.nps.gov/projectHome.cfm?projectID=13510).

NPS (National Park Service), 2015e, *Plan Process,* "Santa Monica Mountains National Recreation Area SMMNRA Interagency Trail Management Plan," (accessed on October 10, 2015, http://parkplanning.nps.gov/PlanProcess.cfm?projectID=13510).

Revilla, M., 2015a, Sanitation Districts of Los Angeles County, Personal communication (email) to J. Trombly, Leidos, Inc., "FW: Rail Facility," January 28.

Revilla, M., 2015b, Sanitation Districts of Los Angeles County, Personal communication (email) to J. Trombly, Leidos, Inc., "FW: Rail Facility," September 4.

Sapere (Sapere Consulting, Inc.), 2005, *Historical Site Assessment of Area IV, Santa Susana Field Laboratory, Ventura County, California*, May.

SWRCB (State Water Resources Control Board), 2014, *Wastes Allowed for Discharge at Disposal Facilities* (accessed on November 14, 2014, http://www.waterboards.ca.gov/water_issues/programs/land_disposal/walist.shtml).

Appendix E
Consultations

APPENDIX E
CONSULTATIONS

The U.S. Department of Energy (DOE) began consultation efforts with the appropriate agencies, tribes, and members of the public prior to publication of the 2008 Notice of Intent in the *Federal Register* (FR) (73 FR 28437) and has continued consultations since. Such consultations are performed in accordance with the intent and spirit of the National Environmental Policy Act (NEPA) and with applicable Federal and state laws and Executive Orders, as described in the following sections. Additional information on applicable regulatory requirements is found in Chapter 8 of this *Draft Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory (Draft SSFL Area IV EIS)*.

E.1 Cultural Resources

E.1.1 Regulatory Environment

The National Historic Preservation Act (NHPA) provides for preservation of cultural resources and promotes a policy of cooperation between Federal agencies, states, tribes, and local governments. The NHPA created the Advisory Council on Historic Preservation to serve as an independent counsel on historic preservation issues to the President, Congress, and Federal and state agencies. This Act also requires agencies to consult with Native American tribes if a proposed Federal action may affect historic properties to which they attach religious and cultural significance. Supplementary guidance for Native American consultation under Section 106 is also available in *Consultation with Native American Tribes in the Section 106 Review Process: A Handbook* (ACHP 2008). The American Indian Religious Freedom Act sets the policy of the United States to "protect and preserve for American Indians their inherent right of freedom to believe, express, and exercise the traditional religions of the American Indian…including but not limited to access to sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites." Executive Order 13007, *Indian Sacred Sites*, requires that, in managing Federal lands, agencies must accommodate access and ceremonial use of sacred sites, which may or may not be protected by other laws or regulations, and must avoid adversely affecting the physical integrity of these sites. The Presidential *Memorandum on Government-to-Government Relations with Native American Tribal Governments* specifies a commitment to developing more-effective day-to-day working relationships with tribal governments. Executive Order 13175, *Consultation and Coordination with Indian Tribal Governments*, reaffirms the U.S. Government's responsibility for continued collaboration and consultation with tribal governments in the development of Federal policies that have tribal implications. This Executive Order also seeks to strengthen U.S. Government-to-Government relationships with Native American tribes and reduce the imposition of unfunded mandates upon those tribes.

E.1.2 Federal, State, Local Agency, and Public Consultation

DOE identified relevant Federal and local agencies that might have cultural resources concerns. **Table E–1** lists the primary contacts made and DOE interactions in support of compliance with Section 106 of the NHPA (Title 36, *Code of Federal Regulations*, Section 800.2(c) [36 CFR 800.2(c)]). Correspondence with the California State Historic Preservation Officer (SHPO) initiated formal consultation for the proposed undertaking in 2009; the consultation relationship was renewed in 2014. DOE and SHPO continue to consult regarding the proposed undertaking and the associated Section 106 Programmatic Agreement. DOE is also consulting with concerned members of the public and tribes (see Tables E–2 and E–3) regarding the Section 106 Programmatic Agreement.

Table E–1 SHPO and Other Section 106 Consultation-Related Contacts

Recipient	*From*	*Date*	*Subject/Notes*
M. W. Donaldson, California SHPO	Stephanie Jennings, DOE	April 20, 2009	Request from DOE to initiate Section 106 and NEPA consultation with the California SHPO.
Stephanie Jennings, DOE NEPA Manager	Cheryl Foster-Curley, SHPO	June 3, 2009	E-mail regarding identification status of buildings. Ms. Foster-Curley notes they will need to be evaluated, and Ms. Jennings replies that they have been and were found to be not eligible.
Federal, state, and local agencies and members of interested public – California State University Northridge – California Department of Fish and Game, Region 5 – California Department of Parks and Recreation – California Native Plant Society Los Angeles/Santa Monica Mountains Chapter – California State Assembly – Cleanuprocketdyne.org and Aerospace Cancer Museum of Education – Members of the local professional cultural resources community – California OHP/SHPO – Renewable Resources Group – Santa Barbara Museum of Natural History – Santa Monica Mountains Conservancy – Santa Susana Mountain Park Association – U.S. Fish and Wildlife Service, Ventura Fish and Wildlife Office – West Hills Neighborhood Council – Boeing – EPA – GSA – NASA	Stephanie Jennings, DOE	November 2009	Invitation to participate in a tour and workshop focused on cultural and natural resources found within Area IV and the NBZ at SSFL.
Site tour attendees – California SHPO – California Department of Parks and Recreation – California Native Plant Society – Cleanuprocketdyne.org and Aerospace Cancer Museum of Education – Members of the local professional cultural resources community – Renewable Resources Group – Santa Susana Mountain Park Association Board of Directors – Santa Susana Mountain Park Association – U.S. Fish & Wildlife Service – West Hills Neighborhood Council – EPA – GSA – NASA	DOE	December 2, 2009	Tour and workshop focused on cultural and natural resources found within Area IV and the NBZ at SSFL.

Recipient	*From*	*Date*	*Subject/Notes*
M. W. Donaldson, SHPO	Craig Cooper, EPA	June 3, 2010	Radiological characterization of Area IV. Although this letter is from EPA, not DOE, it regards Area IV, is phrased as Section 106 consultation, and is the result of an interagency cooperation agreement between DOE and EPA.
Craig Cooper, EPA	Susan Stratton for M. W. Donaldson, SHPO	July 15, 2010	SHPO concurs with EPA's finding of no adverse effect on historic properties. SHPO also concurs that the buildings are not eligible and "with your finding of not eligible for the 263 historic structures listed in Table 1 of the report: Historic Structures/Sites Report for Area IV of the Santa Susana Field Laboratory by Post/Hazeltine Associates."
M. W. Donaldson, SHPO	Craig Cooper, EPA	October 15, 2010	Radiological characterization of the NBZ. Although this letter is from EPA, not DOE, it regards Area IV, is phrased as Section 106 consultation, and is the result of an interagency cooperation agreement.
M. W. Donaldson, SHPO	Stephanie Jennings, DOE	September 28, 2011	Package of information regarding consultation with tribes.
M. W. Donaldson, SHPO	Stephanie Jennings, DOE	October 24, 2011	Package of information regarding location of geological trenching and archaeological sites.
Carol Roland-Nawi, SHPO	Stephanie Jennings, DOE	February 11, 2013	Requests initiation of Section 106 and NEPA consultation.
Stephanie Jennings, DOE	Susan K. Stratton for Carol Roland-Nawi, SHPO	February 15, 2013	Requests clarification of whether DOE intends to substitute NEPA for Section 106.
Carol Roland-Nawi, SHPO	Stephanie Jennings, DOE	May 2013	Clarifies that DOE does not intend to use "substitution" to comply with Section 106.
Stephanie Jennings, DOE	Kathleen Martyn Goforth, Environmental Review Section, EPA	April 2, 2014	Reiterates Section 106 and tribal consultation concerns per Executive Order 13007, *Indian Sacred Sites*.
Carol Roland-Nawi, SHPO, represented on the tour by Susan K. Stratton and Ed Carroll, OHP	DOE, plus NASA, Boeing, and DTSC	April 24, 2014	SHPO tour. Includes representatives of DOE, NASA, Boeing, and DTSC cultural resources.
Carol Roland-Nawi, SHPO; Ed Carroll, Timothy Grant, and Brendon Greenaway, OHP	John Jones and Stephanie Jennings, DOE; John Wondolleck, CDM Smith; Sandy Enyeart and Stephen Bryne, Leidos	December 16, 2014	Presentation on the DOE undertaking at SSFL. Report on architectural history and archaeological studies to date. Discussion of next steps in the Section 106 process (definition of the APE and results of identification).
John Jones, DOE, ETEC Director	Carol Roland-Nawi, SHPO	February 25, 2015	Acknowledges initiation of Section 106 consultation and consultation regarding the APE; agrees that DOE's determination of the APE is consistent with definition in 36 CFR 800.16(d) and encloses map of APE with approval signature.
Ed Carroll, Brendon Greenaway, OHP	Stephanie Jennings, DOE; Sandy Enyeart, Lorraine Gross, Stephen Bryne, Leidos	April 10, 2015	Discussion of Section 106 steps. Consultation on APE (APE map signed by Dr. Carol Roland-Nawi on February 24, 2015). Discussion of the potential of an archaeological district for all of SSFL. SHPO input on Extended Phase I Work Plan.

Recipient	From	Date	Subject/Notes
Ed Carroll, Timothy Grant, Brendon Greenaway, and Annmarie Medin, OHP	John Jones and Stephanie Jennings, DOE; John Wondolleck, CDM Smith; Stephen Bryne, Leidos	November 5, 2015	Discussion of Section 106 status and presentation of results of the Extended Phase I study. Delivered letter from DOE requesting SHPO concurrence on the eligibility of 10 archaeological sites in Area IV.
Advisory Council on Historic Preservation	Stephanie Jennings, DOE	May 5, 2016	Invitation to participate in Section 106 consultation to develop a Programmatic Agreement to resolve adverse effects to historic properties.
Teena Takata, Santa Susana Mountain Park Association; Kathleen Martyn Goforth, EPA Region IX; Sharon Dabek, Mark B. Osokow, San Fernando Valley Audubon Society; Scott Silverstein, Woodland Hills-Warner Center Neighborhood Council; Karen DiBiase, West Hills Neighborhood Council; Dan Larson and Gwen Romani, Compass Rose Archaeological, Inc.; Christine Rowe, David Szymanski, Santa Monica Mountains National Recreation Area, National Park Service; Abraham Weitzberg, SSFL Community Advisory Group; John Luker, Santa Susana Mountain Park Association; Anthony Zepeda; Sam Cohen, Santa Ynez Band of Chumash Indians; Barbara Tejada; Christina Walsh	John Jones, DOE	May 5, 2016	Invitation to demonstrate legal or economic relation to the undertaking or to properties potentially affect the proposed project, and to participate in Section 106 consultation to develop a Programmatic Agreement to resolve adverse effects to historic properties.
Stephanie Jennings, DOE	Christina Walsh	May 10, 2016	Accepting invitation to participate in Section 106 Programmatic Agreement development
Stephanie Jennings, DOE	Gary Brown	May 10, 2016	Accepting invitation to participate in Section 106 Programmatic Agreement development
Stephanie Jennings, DOE	Christine Rowe	May 12, 2016	Accepting invitation to participate in Section 106 Programmatic Agreement development
Stephanie Jennings, DOE	Colin Cloud Hampson	May 18, 2016	Accepting invitation to participate in Section 106 Programmatic Agreement development
Stephanie Jennings, DOE	Abe Weitzberg	May 19, 2016	Accepting invitation to participate in Section 106 Programmatic Agreement development
Stephanie Jennings, DOE	Albert Knight	May 20, 2016	Accepting invitation to participate in Section 106 Programmatic Agreement development
Stephanie Jennings, DOE	Advisory Council on Historic Preservation	May 26, 2016	In response to letter of May 6, 2016, declining to participate in Section 106 consultation to develop a Programmatic Agreement to resolve adverse effects to historic properties.
John Jones, DOE	Karen DiBiase	May 31, 2016	Accepting invitation to participate in Section 106 Programmatic Agreement development

Recipient	From	Date	Subject/Notes
Stephanie Jennings, John Jones, and Debbie Kramer, DOE; Wendy Lowe, P2 Solutions	Edward Carroll, State Historic Preservation Office; Brendan Greenaway and Annmarie Medin, California Department of Parks	June 15, 2016	Meeting with SHPO to discuss Section 106 consultation process and Programmatic Agreement
Nicole Doner, Ventura County Cultural Heritage Board; Simi Valley Historical Society; Clark Stevens, Resource Conservation District of the Santa Monica Mountains; Ventura County Archaeological Society	John Jones, DOE	July 14, 2016	Invitation to demonstrate legal or economic relation to the undertaking or to properties potentially affected by the proposed project, and to participate in Section 106 consultation to develop a Programmatic Agreement to resolve adverse effects to historic properties.
Gary M. Brown, Santa Monica Mountains National Recreation Area; Pat Havens, Simi Valley Historical Society; Albert Knight, Santa Barbara Museum of Natural History Anthropology Department; John Luker, Santa Susana Mountain Park Association; Mark Osokow, San Fernando Valley Audubon Society; Bruce Rowe, Christine Rowe, Clark Stevens, Resource Conservation District of the Santa Monica Mountains; Brian Sujata, Barbara Tejada, California State Parks; Alec Uzemeck, SSFL Citizens Advisory Committee; Christina Walsh, SSFL National Monument Project; Ronald Ziman, SSFL Citizens Advisory Committee	John Jones and Stephanie Jennings, DOE	August 17, 2016	Programmatic Agreement Development Meeting

APE = area of potential effect; Boeing = The Boeing Company; DTSC = Department of Toxic Substances Control; EPA = U.S. Environmental Protection Agency; GSA = General Services Administration; NASA = National Aeronautics and Space Administration; NBZ = Northern Buffer Zone; NEPA = National Environmental Policy Act; OHP = Office of Historic Preservation; SHPO = State Historic Preservation Officer.

Concerns expressed by agencies and the public included the following:

- Unnecessary disturbance of sites or collection of artifacts by unauthorized personnel, especially during radiological and chemical characterization and sampling activities
- Cooperation and coordination with the other land managers at Santa Susana Field Laboratory (SSFL) (the National Aeronautics and Space Administration [NASA] and The Boeing Company [Boeing])
- Fire danger
- Archaeological site protection
- Definition of terms included in the 2010 *Administrative Order on Consent for Remedial Action* (2010 AOC) (DTSC 2010) and associated documents, including the term, "Native American artifacts that are formally recognized as Cultural Resources."

In compliance with Section 106 of the NHPA, consultation is ongoing and will continue until the process is complete.

E.1.3 Native American Consultation

Although informal consultation has been ongoing with tribes and other members of the interested public, the Santa Ynez Band of Chumash Indians is the only federally recognized tribe. DOE initiated Government-to-Government consultation with the Santa Ynez Band of Chumash Indians in January 2014, in compliance with the NHPA, NEPA, Executive Orders 13007 and 13175, and the Presidential *Memorandum on Government-to-Government Relations with Native American Tribal Governments* (see Chapter 8, Section 8.1.8, of this EIS). At the time, DOE also formally issued an invitation to the Santa Ynez Band of Chumash Indians to be a cooperating agency for this environmental impact statement (EIS), and the invitation was accepted (letter dated February 9, 2014). DOE also consulted with tribes that are not federally recognized throughout the NEPA and Section 106 process.

Assembled tribes (people affiliated with the Santa Ynez Band of Chumash Indians, the Santa Ynez Band Tribal Elders Council, the Fernandeño Tataviam Band of Mission Indians, Chumash/Tataviam/Fernandeño heritage, and the Barbareño/Ventureño Band of Mission Indians) expressed the following sentiments and general areas of concern regarding the proposed action and cultural resources at SSFL during the 2014 scoping period (DOE 2014):

- DOE should work with the California Department of Toxic Substances Control (DTSC) and the collective tribes to broadly define and apply the Native American artifacts exemption (also referred to as an exception) contained in the 2010 AOC, Attachment B, "Final Agreement in Principle."
- If an archeological site exists in a contaminated area, DOE should first request an exemption in accordance with the 2010 AOC. If an exemption is not permitted by DTSC, DOE should implement all necessary data recovery efforts and decontaminate whatever is recovered, with the ultimate disposition, either museum placement or reburial, in accordance with the decision of the collective tribes.

- Area IV should be considered a traditional cultural property, eligible for protection via the *National Register of Historic Places* and applicable provisions from National Register Bulletin No. 38, *Guidelines for Evaluating and Documenting Traditional Cultural Properties under the NHPA* (NPS 1998), and linked to Burro Flats [the Burro Flats Painted Cave site in Area II is listed on the *National Register of Historic Places* (Number 76000539, March 10, 1975)].

- The tribes would like access to cultural resources studies at SSFL and maps of site locations and overall chemical or radiological contamination areas.

- The tribes requested assurance that Native American monitors would be required where there is any excavation of dirt or removal of structures, and that the monitors would receive training and appropriate gear if they are to be present in areas where there is radiological and chemical contamination. Training should include hazard materials training, and all training and personal protective equipment should be provided by DOE.

- The tribes requested additional research at and subsurface review of all areas scheduled for excavation, as well as additional studies in areas where there are known sites, using the least intrusive measures possible (e.g., samples should be dug by hand).

- The agreement not to excavate any dirt, per the SHPO, needs to be revisited.[1]

- The *Memorandum of Understanding Among the U.S. Department of Defense, U.S. Department of the Interior, U.S. Department of Agriculture, U.S. Department of Energy, and the Advisory Council on Historic Preservation Regarding Interagency Coordination and Collaboration for the Protection of Indian Sacred Sites* (DOD et al. 2012) and the *Action Plan to Implement the Memorandum of Understanding Regarding Interagency Coordination and Collaboration for the Protection of Indian Sacred Sites* (DOD et al. 2013) should be applied to the SSFL site.

- The EIS should address Cultural Resources as directed by the applicable laws and regulations, including how DOE will avoid adversely affecting the physical integrity, accessibility, or use of sacred sites.

- DOE should develop a Cultural Resources Management Plan. The tribes should be included, in consultation with SHPO, if new archaeological sites are discovered. The agency archaeologist should meet professional qualification standards.

- All environmental factors should be considered when assessing the overall cultural sensitivity of the SSFL; significant, negative, and unmitigated impacts to sacred sites and cultural resources would result from soil cleanup to background.

Tables E–2 and **E–3** summarize tribal consultation efforts.

[1] This may refer to Public Resources Code 21084.3(a): "Public agencies shall, when feasible, avoid damaging effects to any tribal cultural resource," as well as to common professional practices.

Table E–2 Summary of Native American Meetings at the Santa Susana Field Laboratory

Native American Meetings at SSFL		
Date	***Event***	***Invited and Attendee Affiliation in addition to DOE*** [a]
December 3, 2009	Tour and workshop focused on cultural and natural resources found within Area IV and the NBZ at SSFL	*Invited affiliations:* – Chumash – Chumash, Fernandeño, Tataviam, Kitanemuk – Chumash, Fernandeño, Tataviam, Shoshone Paiute, Yaqui – Chumash, Tataviam, Fernandeño – Coastal Band of the Chumash Nation – Fernandeño Tataviam Band of Mission Indians – Los Angeles City/County Native American Indian Commission – San Luis Obispo County Chumash Council, Chumash – Santa Ynez Band of Mission Indians, Chumash – Santa Ynez Tribal Elders Council, Chumash – Santa Ynez Band of Chumash Indians Elders Council, Chumash – Tongva Ancestral Territorial Tribal Nation – Wishtoyo Foundation *Attendee affiliations:* – Chumash – Chumash/Fernandeño/Tataviam/Kitanemuk – Chumash/Fernandeño/Tataviam/Shoshone/Paiute/Yaqui – Chumash/Tataviam/Fernandeño – Fernandeño Tataviam Band of Mission Indians – Santa Ynez Band of Chumash Indians Elders Council – Wishtoyo Foundation
April 2010	Visit Area II's Burro Flats Painted Cave site and Area IV	Fernandeño/Tataviam
September 12, 2011	Meeting/Site Tour	All interested Native American groups
March 3, 2014	NEPA Scoping Meeting for Native Americans	– Santa Ynez Band of Chumash Indians – Santa Ynez Band Tribal Elders Council – Fernandeño Tataviam Band of Mission Indians – Chumash/Tataviam/Fernandeño – Barbareño/Ventureño Band of Mission Indians – DOE Headquarters (via conference call) – California Department of Toxic Substances Control
July 18-19, 2014	Native American Sacred Sites Summit Meeting	*Invited affiliations:* – Los Angeles City/County Native American Indian Commission – Barbareño/Ventureño Band of Mission Indians – Gabrielino Tongva Indians of California – Fernandeño Tataviam Band of Mission Indians – Santa Ynez Band of Chumash Indians – Coastal Band of the Chumash Nation – Chumash/Tataviam/Fernandeño – Chumash – Ketanemuk and Towlumne Tejon Indians – Kizh Gabrieleno Band of Mission Indians – Kern Valley Indian Council – Chumash/Fernandeño/Tataviam/Shoshone/Paiute/Yaqui – Tongva Ancestral Territorial Tribal Nation – San Gabriel Band of Mission Indians – Owl Clan – San Fernando Band of Mission Indians – San Luis Obispo County Chumash Council – Wishtoyo Foundation – San Manuel Band of Mission Indians – DOE

Native American Meetings at SSFL		
Date	***Event***	***Invited and Attendee Affiliation in addition to DOE*** [a]
		– Boeing – National Aeronautics and Space Administration – California Department of Toxic Substances Control – National Park Service – California State Historic Preservation Officer – Native American Heritage Commission – Bureau of Indian Affairs – California Environmental Protection Agency – California State Parks – Thomas King (Author and consultant) – Leidos – CH2M Hill – John Minch & Associates – Environmental Science Associates *Attendee affiliations:* – Los Angeles City/County Native American Indian Commission – Barbareño/Ventureño Band of Mission Indians – Gabrielino Tongva Indians of California – Fernandeño Tataviam Band of Mission Indians – Santa Ynez Band of Chumash Indians – Chumash/Tataviam/Fernandeño – Chumash – Kizh Gabrieleno Band of Mission Indians – Chumash/Fernandeño/Tataviam/Shoshone/Paiute/Yaqui – Wishtoyo Foundation – DOE – Boeing – National Aeronautics and Space Administration – California Department of Toxic Substances Control – National Park Service – California State Historic Preservation Officer – Native American Heritage Commission – Bureau of Indian Affairs – California Environmental Protection Agency – California State Parks – Thomas King (Author and consultant) – Leidos – CH2M Hill – John Minch & Associates
September 4, 2014	Santa Susana Field Laboratory Sacred Sites Council Meeting with DOE	– Santa Ynez Band of Chumash Indians – Fernandeño Tataviam Band of Mission Indians – Chumash/Tataviam/Fernandeño – Barbareño/Ventureño Band of Mission Indians – Wishtoyo Foundation – Chumash Tataviam Native American Monitoring Group – Tataviam – Gabrielino Tongva – MWH Americas, Inc. – California Department of Toxic Substances Control – Leidos

Native American Meetings at SSFL		
Date	***Event***	***Invited and Attendee Affiliation in addition to DOE*** [a]
October 9, 2014	Santa Susana Field Laboratory Sacred Sites Council Site Tour/Meeting with DOE	– Santa Ynez Band of Chumash Indians – Fernandeño Tataviam Band of Mission Indians – Chumash/Tataviam/Fernandeño – Barbareño/Ventureño Band of Mission Indians – MWH Americas, Inc. – California Department of Toxic Substances Control – Leidos
November 21, 2014	Site tour	– Fernandeño Tataviam Band of Mission Indians – Leidos
January 30, 2015	Meet with DOE to discuss proposed Extended Phase 1 archaeological study and tribes input for draft EIS	– Santa Ynez Band of Chumash Indians – Santa Ynez Band of Mission Indians – Ventureño Chumash/Tataviam – Chumash/Tataviam – Ventureño Chumash – Tataviam Band of Mission Indians – Coastal Band of Chumash Nation – Gabrielino Tongva – Leidos
March 16, 2015	Native American Contributions to this *Draft SSFL Area IV EIS*	– Santa Ynez Band of Chumash Indians – Fernandeño Tataviam Band of Mission Indians – Chumash/Tataviam/Fernandeño – Barbareño/Ventureño Band of Mission Indians – Kizh Gabrieleno Band of Mission Indians – Leidos – CDM Smith
April 7, 2015	Santa Susana Field Laboratory Sacred Sites Council Meeting with DOE	– Santa Ynez Band of Chumash Indians – Fernandeño Tataviam Band of Mission Indians – Chumash/Tataviam/Fernandeño – Barbareño/Ventureño Band of Mission Indians – MWH Americas, Inc. – California Department of Toxic Substances Control – Kizh Gabrieleno Band of Mission Indians – Tataviam – Chumash/Tataviam – Gabrielino Tongva Indians of California – Chumash/Gabrielino – Leidos – P2 Solutions
January 21, 2016	Santa Susana Field Laboratory Sacred Sites Council Meeting with DOE	– Fernandeño/Tataviam – Fernandeño/Tataviam/Chumash – Santa Ynez Band of Chumash Indians – Santa Ynez Chumash – Chumash – Gabrieleno and Kizh – Kizh Nation – Native American Monitoring Group – National Aeronautics and Space Administration, Marshal Space Flight Center – National Aeronautics and Space Administration, Headquarters – National Aeronautics and Space Administration, SSFL – JMA – CH2M – P2 Solutions – Leidos

Native American Meetings at SSFL		
Date	***Event***	***Invited and Attendee Affiliation in addition to DOE*** [a]
		By phone: – California Department of Toxic Substances Control – National Aeronautics and Space Administration – Environmental Science Associates
July 7, 2016	Programmatic Agreement Development Meeting	– Santa Ynez Band of Chumash Indians – Gabrielino Tongva Indians of California – Chumash, Fernandeño Tataviam – Gabrielino/Tongva Nation – Kizh Gabrieleno Band of Mission Indians – Chumash, Fernandeño Tataviam, Shoshone Paiute, Yaqui – Fernandeño Tataviam Band of Mission Indians – Kizh Gabrieleno Band of Mission Indians – Santa Ynez Band Tribal Elders Council – Tongva Ancestral Territorial Tribal Nation – Chumash, Fernandeño Tataviam – Coastal Band of the Chumash Nation – Barbareño/Ventureño Band of Mission Indians – P2 Solutions – Leidos
August 16, 2016	Programmatic Agreement Development Meeting	– Gabrielino Tongva/Chumash – Government Affairs and Legal Officer for the Santa Ynez Band of Chumash Indians – Public Affairs Director for the Fernandeño Tataviam Band of Mission Indians – Chumash, Fernandeño Tataviam – Tribal Historic and Cultural Preservation Director for the Fernandeño Tataviam Band of Mission Indians – Santa Ynez Band of Chumash Indians – Barbareño/Ventureño Band of Mission Indians – Cultural Preservation Consultant for the Santa Ynez Band Tribal Elders Council – Fernandeño Tataviam/Ventureño Chumash – P2 Solutions – Leidos
October 4, 2016	Programmatic Agreement Development Meeting	– Gabrielino Tongva/Chumash – Government Affairs and Legal Officer for the Santa Ynez Band of Chumash Indians – Public Affairs Director for the Fernandeño Tataviam Band of Mission Indians – Chumash, Fernandeño Tataviam – Santa Ynez Band of Chumash Indians – Fernandeño Tataviam Band of Mission Indians – Barbareño/Ventureño Band of Mission Indians – Cultural Preservation Consultant for the Santa Ynez Band Tribal Elders Council – Fernandeño Tataviam/Ventureño Chumash – P2 Solutions (facilitator) – Leidos (monitor)

Boeing = The Boeing Company; NBZ = Northern Buffer Zone; NEPA = National Environmental Policy Act.

[a] Affiliations provided by attendees.

Table E–3 Summary of Native American and Related Formal Contacts

Section 106, Government-to-Government, NEPA			
Recipient	***From***	***Date***	***Subject***
Larry Myers, NAHC	Stephanie Jennings, DOE	April 20, 2009	Request for Tribal Consultation List and information on sacred lands.
Stephanie Jennings, DOE	Katy Sanchez, NAHC	November 3, 2009	Response to April 20, 2009, letter from DOE. Includes Native American Tribal Consultation List.
Stephanie Jennings, DOE	Fernandeño Tataviam Band of Mission Indians, William Gonzalez, Chairman	May 10, 2010	Thanks for tour of April 2010.
Milford Wayne Donaldson, California SHPO	Fernandeño Tataviam Band of Mission Indians William Gonzalez, Chairman	June 12, 2010	Regarding concerns about EPA's characterization program and cultural resources protocols.
Cynthia Gomez, Executive Director, NAHC	Stephanie Jennings, DOE	February 11, 2013	1) Resubmitting the "Local Government Tribal Consultation List Request" 2) "Information on sacred lands and Native American contacts, both federally recognized and other Native American groups who might have interests in the area."
Stephanie Jennings, DOE	Dave Singleton, NAHC	February 15, 2013	Reply to request for sacred lands search and Native American Contacts.
Wendy Green Lowe, P2 Solutions	Dave Singleton, NAHC	November 27, 2013	Reply to request for Sacred Lands search and Native American contacts.
Stephanie Jennings, DOE	Vincent Armenta, Tribal Chairman, Santa Ynez Band of Chumash Indians	January 20, 2014	Requesting Section 106 consultation from DOE.
Stephanie Jennings, DOE	Vincent Armenta, Tribal Chairman, Santa Ynez Band of Chumash Indians	January 20, 2014	Designates the DOE portion of SSFL as an Indian sacred site pursuant to Executive Order 13007, *Indian Sacred Sites*.
Vincent Armenta, Santa Ynez Band of Chumash Indians	David Huizenga, Senior Advisor for Environmental Management, DOE	February 5, 2014	Invitation to be cooperating agency for the EIS for Area IV and NBZ.
Stephanie Jennings, DOE	Vincent Armenta, Tribal Chairman, Santa Ynez Band of Chumash Indians	February 9, 2014	Santa Ynez Band of Chumash Indians accepts invitation to be cooperating agency for the EIS for Area IV and NBZ, with Santa Ynez Band of Chumash Indians POC Sam Cohen, Government and Legal Specialist for the Santa Ynez Band of Chumash Indians.

Section 106, Government-to-Government, NEPA			
Recipient	**From**	**Date**	**Subject**
Vincent Armenta, Santa Ynez Band of Chumash Indians, and Sam Cohen Tribal Counsel	Stephanie Jennings, DOE	February 20, 2014	Invitation to share plans for EIS and seek input from Tribe on the scope of the EIS. Also invitation to attend a special scoping meeting for Native Americans.
Stephanie Jennings, DOE	Sam Cohen, Santa Ynez Band of Chumash Indians	March 30, 2014	Santa Ynez Band of Chumash Indians provides additional scoping comments on the EIS.
Stephanie Jennings, DOE	Sam Cohen, Santa Ynez Band of Chumash Indians	December 3, 2014	Via e-mail, "RE: Santa Susana Field Laboratory (SSFL), Area IV and Northern Buffer Zone EIS and other issues for Secretary."
Joe Calderone, Chumash, Tongva, Mexican; Colin Cloud Hampson, Fernandeño Tataviam Band of Mission Indians; Sam Cohen, Santa Ynez Band of Chumash Indians; Christina Conley-Haddock, Gabrielino Tongva Tribe; Kimia Fatehi, Tataviam; Beverly Salazar Folkes, Chumash, Tataviam, Fernandeño; Sandonne Goad, Gabrielino/Tongva Nation; Martha Gonzalez, Kizh Gabrieleno Band of Mission Indians; Caitlin Gulley, Fernandeño Tataviam Band of Mission Indians; Randy Guzman-Folkes, Chumash, Fernandeño, Tataviam, Shoshone Paiute, Yaqui; Brian Holguin, Santa Ynez Band of Chumash Indians; Adam Loya, Gabrielino/Tongva Nation; Frances Ortega, Fernandeno Tataviam Band of Mission Indians; Rudy Ortega, Fernandeno Tataviam Band of Mission Indians; Steve Ortega, Fernandeno Tataviam Band of Mission Indians; Kathy Pappo, Barbareño/Ventureño Band of Mission Indians; Tim Poyorena-Miguel, Kizh Gabrieleno Band of Mission Indians; Freddie Romero, Santa Ynez Band Tribal Elders Council; John Tommy Rosas, Tongva Ancestral Territorial Tribal Nation; Andrew Salas, Kizh Gabrieleno Band of Mission Indians; Alan Salazar, Chumash, Tataviam, Fernandeno; Gary Stickel, Kizh Gabrieleno Band of Mission Indians; Maura Sullivan, Coastal Band of the Chumash Nation; Christina Swindall, Tribal Secretary, Kizh Gabrieleno Band of Mission Indians; Patrick Tumamait, Barbareño/Ventureño Band of Mission Indians; Julie Lynn Tumamait-Stennslie, Barbareño/Ventureño Band of Mission Indians	John Jones, DOE	May 5, 2016	Invitation to participate in development of the Section 106 Programmatic Agreement

Section 106, Government-to-Government, NEPA			
Recipient	***From***	***Date***	***Subject***
Stephanie Jennings, DOE	John Tommy Rosas	May 6, 2016	Accepting invitation to participate in Section 106 Programmatic Agreement development
Stephanie Jennings, DOE	Alan Salazar	May 9, 2016	Accepting invitation to participate in Section 106 Programmatic Agreement development
Stephanie Jennings, DOE	Freddie Romero	May 9, 2016	Accepting invitation to participate in Section 106 Programmatic Agreement development
Stephanie Jennings, DOE	Patrick Tumamait	May 10, 2016	Accepting invitation to participate in Section 106 Programmatic Agreement development
Stephanie Jennings, DOE	Sam Cohen	May 10, 2016	Accepting invitation to participate in Section 106 Programmatic Agreement development
Stephanie Jennings, DOE	Kathleen Pappo	May 14, 2016	Accepting invitation to participate in Section 106 Programmatic Agreement development
Stephanie Jennings, DOE	Brian Holguin	May 17, 2016	Accepting invitation to participate in Section 106 Programmatic Agreement development
Stephanie Jennings, DOE	Caitlin Gulley	May 17, 2016	Accepting invitation to participate in Section 106 Programmatic Agreement development
Stephanie Jennings, DOE	Beverly Folkes	May 18, 2016	Accepting invitation to participate in Section 106 Programmatic Agreement development
Stephanie Jennings, DOE	Joe Calderon	May 24, 2016	Accepting invitation to participate in Section 106 Programmatic Agreement development
Stephanie Jennings, DOE	Andy Salas	May 25, 2016	Accepting invitation to participate in Section 106 Programmatic Agreement development
Stephanie Jennings, DOE	Kenneth Kahn, Santa Ynez Band of Chumash Indians Tribal Chairman	August 24, 2016	Letter requesting Section 106 consultations for the SSFL and proposed undertaking by DOE
Kenneth Kahn, Santa Ynez Band of Chumash Indians Tribal Chairman	John Jones	August 26, 2016	Reaffirming DOE's commitment to enter into formal consultation, as stated in previous letters of February 20, 2016 and May 5, 2016.

EIS = environmental impact statement; EPA = U.S. Environmental Protection Agency; NAHC = Native American Heritage Commission; NEPA = National Environmental Policy Act; NBZ = Northern Buffer Zone; POC = Point of Contact; SHPO = State Historic Preservation Officer.

E.2 Biological Resources

E.2.1 Regulatory Environment

The Endangered Species Act (ESA) requires Federal agencies with reason to believe that a prospective action may affect an endangered or threatened species or its habitat to consult with the U.S. Fish and Wildlife Service (USFWS) and/or National Marine Fisheries Service, depending on the species involved, to ensure that the action does not jeopardize the continued existence of the species or destroy or adversely modify its critical habitat (50 CFR Part 17). Because remediation of SSFL Area IV and the Northern Buffer Zone has the potential to affect federally listed threated or endangered species, DOE will consult with USFWS in compliance with Section 7 of the ESA. Informal consultation has been ongoing with USFWS and the California Department of Fish and Wildlife (CDFW, formerly called the California Department of Fish and Game) since 2009, as described below in **Table E–4**.

Table E–4 Biological Resources Meetings and Teleconferences

Date	Event	Participants
September 16, 2009	Biological Survey Meeting: SSFL Area IV and the Northern Undeveloped Land (i.e., the Northern Buffer Zone) (included office meeting and site visit) Discussion of Study Plan for Fall Biological Surveys	– USFWS: Jenny Marek, Mark Elvin – CDFG (now CDFW):[a] Mary Meyer – California Native Plant Society: Betsey Landis, Snowdy Dodson – EPA: Craig Cooper, Gregg Dempsey – DOE: Stephanie Jennings, Lance Martin, Thomas Johnson – The Boeing Company (Boeing): Ravnesh Amar, Paul Costa, Randy Ueshiro – CDM Smith: John Wondolleck – SAIC (now Leidos): Tom Mulroy, Debra Barringer – HydroGeoLogic, Inc.: Eric Evans
November 4, 2009	SSFL Biological Survey Meeting at USFWS Offices in Ventura, California. Discussion of Fall Biological Survey Results	– USFWS: Jenny Marek, Mark Elvin, Chris Delith – CDFG: Mary Meyer – EPA: Craig Cooper, Mary Aycock – DOE: Stephanie Jennings – CDM Smith: John Wondolleck – HydroGeoLogic, Inc.: Eric Evans – SAIC (now Leidos): Tom Mulroy
June 26, 2013	Biological resource meeting and field trip at DOE Simi Valley and SSFL Area IV	– USFWS: Jenny Marek, Mark Elvin – CDFW (formerly CDFG): Mary Meyer – San Fernando Valley Audubon: Mark Osokow – CNPS: Mark Osokow – Southwestern Herpetological Society: Mark Osokow – Santa Susana Mountain Park Association: John Luker, (Vice-President) – DTSC: Brian Faulkner (Ecological Risk Assessor), Laura Rainey (Project Manager) – DOE: Stephanie Jennings, John Jones, Jazmin Bell – CDM Smith: John Wondolleck – Leidos: Tom Mulroy, Tara Schoenwetter
March 3, 2014	Biological scoping meeting held at DOE Simi Valley and via teleconference	– USFWS: Jenny Marek, Mark Elvin – CDFW: Mary Meyer – MWH Americas, Inc.: David Collins, Dixie Hambrick – DOE: Stephanie Jennings, John Jones – CDM Smith: John Wondolleck – Leidos: Tom Mulroy, Tara Schoenwetter

Date	Event	Participants
November 6, 2014	Meeting with USFWS, CDFW, and USACE, at USFWS office, Ventura, California Topics: Exclusion zones, including California Rare Plant Rank Species, and Coast live oak areas Mapping of vegetation and wetlands/waters of the U.S.	– USFWS: Jenny Marek, Mark Elvin – CDFW: Mary Meyer, Christian Van Jackson – USACE: Antal Szijj, Jeff Phillips – MWH Americas, Inc.: David Collins, Dixie Hambrick – DTSC: Brian Faulkner, Laura Rainey – DOE: Stephanie Jennings, John Jones – CDM Smith: John Wondolleck – Leidos: Tom Mulroy, Tara Schoenwetter
November 4, 2015	Meeting with USFWS, CDFW, and USACE, at USFWS office, Ventura, California Topics: SSFL site-wide biological assessment, provide updates, ask questions and determine next steps; proposed 2010 AOC exemption areas in Area IV; annotated outline and action area; site-wide habitat map status update; species to be covered; schedule for next meeting	– USFWS: Jenny Marek – CDFW: Mary Meyer – DOE: Stephanie Jennings, John Jones, Steve Tetreault – CDM Smith: John Wondolleck – USACE: Antal Szijj, – DTSC: Matt Wetter, Brian Faulkner, Laura Rainey, Roger Paulson, – Leidos: Tom Mulroy, Tara Schoenwetter, Lauren Brown – NASA: Allen Elliott – CH2M Hill (for NASA): Steven Long, Gary Santolo – Padre (for Boeing): Chris Dunn
December 9, 2015	Meeting with USFWS, CDFW, DTSC, DOE, NASA, Boeing, at DOE office Simi Valley, California. Topics: Discuss the SSFL site-wide Biological Assessment and chemicals of concern. To provide a preliminary overview of chemicals in relation to the AOC exemption areas. Review of contaminants of concern, perform a GIS exercise, address questions; identify next steps	– USFWS: Jenny Marek – DOE: John Jones, Stephanie Jennings – CDM Smith: John Wondolleck, Rebecca Farmer, Catherine Love – DTSC: Matt Wetter, Laura Rainey, Brian Faulkner, Roger Paulson – CDFW: Jeff Humble, Christine Found-Jackson – ESA: May Lau, Deanna Hansen – NASA: Allen Elliott – CH2M: Randy Dean – DTSC: Kim Hudson – Boeing: Paul Costa – Leidos: Tom Mulroy, Tara Schoenwetter
June 16, 2016	Meeting with USFWS, DOE, DTSC, Boeing, NASA at USFWS office, Ventura, California Topics: Discuss the SSFL site-wide Biological Assessment, AOC and application of exemptions, format of the Biological Opinion, identification of species and their habitats, cleanup criteria being evaluated, identification of chemicals of concern and cleanup criteria for DOE Area IV, evaluation of locations possibly requiring a cleanup action, Soils Remedial Action Implementation Plan status and discussion	– USFWS: Jenny Marek – DOE: John Jones, Stephanie Jennings – CDM Smith: John Wondolleck – DTSC: Mark Malinowski Matt Wetter, Brian Faulkner, Kim Hudson – NASA: Peter Zorba – MWHA: Dixie Hambrick – ESA: Jason Ricks, May Lau – CH2M: Steve Long – Boeing: Paul Costa – Leidos: Tom Mulroy, Tara Schoenwetter, Mike Barta

Date	Event	Participants
July 6, 2016	Meeting with CDFW, DOE, teleconference Topics include: Discuss the Biological Assessment, discuss DOE interpretation of AOC intent for application of exemptions, species and habitats being evaluated for protection under the AOC exemptions, identification and mapping of species and their habitats, exercise of comparing strict AOC cleanup with cleanup based on exemption criteria, protection of oaks, result of exemptions evaluation process as presented in the Soils Remedial Action Implementation Plan, how the exemption protocols will be implemented in the DOE Biological Assessment, next steps for the DOE Biological Assessment	– CDFW: Mary Meyer, Jeff Humble – DOE: John Jones, Stephanie Jennings – CDM Smith: John Wondolleck, Wardah Azhar – NASA: Peter Zorba – Boeing: Paul Costa, Mark Zeller – DTSC: Matt Wetter, Brian Faulkner, Mark Malinowski – ESA: Jason Ricks, Greg Ainsworth – CH2M: Beth Vaughn, Steve Long, Gary Santolo, Mike Bedan, Kelly Teplitsky – Leidos: Tom Mulroy, Tara Schoenwetter, Lauren Brown, Mike Barta

AOC = *Administrative Order on Consent for Remedial Action*; Boeing = The Boeing Company; CDFG = California Department of Fish and Game; CDFW = California Department of Fish and Wildlife; CNPS = California Native Plant Society; DTSC = Department of Toxic Substances Control; EPA = U.S. Environmental Protection Agency; ESA = Environmental Science Associates; GIS = geographic information system; NASA = National Aeronautics and Space Administration; SAIC = Science Applications International Corporation; USACE = U.S. Army Corps of Engineers; USFWS = U.S. Fish and Wildlife Service.

[a] Effective January 1, 2013, the California Department of Fish and Game changed its name to California Department of Fish and Wildlife.

The California Endangered Species Act (CESA) provides protection and preservation of native species and their habitats threatened with extinction and those experiencing a significant decline, which, if not halted, would lead to a threatened or endangered designation. CDFW works to protect and preserve such sensitive resources and their habitats. The CESA allows for take incidental to otherwise lawful activity, but emphasizes early consultation to avoid potential impacts to rare, endangered, and threatened species and to develop appropriate mitigation planning to offset project-caused losses of listed species.

For more regulatory information on Biological Resources, refer to Chapter 8 of this *Draft SSFL Area IV EIS*.

E.2.2 Endangered Species Consultation and Coordination

Formal consultation for the proposed undertaking with USFWS (Ventura, California, Office) has not yet been initiated. DOE is preparing a biological assessment as part of ESA compliance and plans to submit it to USFWS. Depending on the findings of the assessment, DOE will request initiation of formal consultation with USFWS after the biological assessment is submitted.

Informal consultation has been ongoing among DOE, USFWS, and CDFW through periodic meetings and teleconferences since 2009. Table E–4 summarizes informal biological consultation meetings and teleconferences held since June 2013.

In addition to coordination with USFWS and CDFW, DOE has actively sought input from agencies and groups regarding biological resources. Representatives of U.S. Army Corps of Engineers and various groups, including the California Native Plant Society, Audubon Society, Southwest Herpetological Society, and Santa Susana Mountain Park Association, have participated in meetings and onsite reviews of proposed project actions and onsite biological resources.

Concerns expressed by agencies included the following:

- Methods for vegetation mapping, assessment and classification
- Wildlife assessment and protection measures
- Methods and timing for vegetation trimming and protection of listed species during assessment activities
- Evaluation criteria for analyzing environmental effects
- Cleanup methods and technologies
- Current surveys for special status species, including federally and state-listed species, as well as other special status species, including California Rare Plant Rank plants, CDFW California Species of Special Concern, migratory birds, bats, and any local species of concern
- Avoidance, minimization of impacts, and mitigation for federally and state-listed rare, threatened, and endangered species or their habitats, including federally designated critical habitat
- Best management practices to prevent or minimize displacement and death to wildlife during construction
- Revegetation methods, including using only native plant species currently present on the site and locally collected plant materials (i.e., seed, cuttings) for propagation
- Development of restoration performance standards
- Best management practices to prevent or minimize erosion
- Issues associated with spread and control of invasive plant species
- Concerns associated with the protection of oak trees and oak woodlands
- Sustaining wildlife movement corridors and habitat connectivity (on site and within offsite movement corridors)
- Alternatives analysis

E.3 References

ACHP (Advisory Council on Historic Preservation), 2008, *Consultation with Indian Tribes in the Section 106 Review Process: A Handbook*, Washington, DC (available at http://www.achp.gov/regs-tribes2008.pdf), November.

DOE (U.S. Department of Energy), 2014, *Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory Final Scoping Summary Report*, Simi Valley, California (available at http://www.etec.energy.gov/Library/Cleanup_and_Characterization/EIS/Final%20Scoping%20 Summary%20Report%20SSFL%20EIS.pdf), August 6.

DTSC (State of California Department of Toxic Substances Control), 2010, *The State of California Environmental Protection Agency, Department of Toxic Substances Control and the United States Department of Energy, In the Matter of: Santa Susana Field Laboratory, Simi Hills, Ventura County, California, Administrative Order on Consent for Remedial Action*, Docket No. HSA-CO 10/11-037, Health and Safety Code Sections 25355.5(a)(1)(B), 58009 and 58010, December 6.

NPS (National Park Service), 1998, *Guidelines for Evaluating and Documenting Traditional Cultural Properties*, National Register Bulletin No. 38 (available at http://www.nps.gov/nr/publications/bulletins/pdfs/nrb38.pdf).

U.S. Department of Defense, U.S. Department of the Interior, U.S. Department of Agriculture, U.S. Department of Energy, and Advisory Council on Historic Preservation, 2012, *Memorandum of Understanding among the U.S. Department of Defense, U.S. Department of the Interior, U.S. Department of Agriculture, U.S. Department of Energy, and the Advisory Council on Historic Preservation Regarding Interagency Coordination and Collaboration for the Protection of Indian Sacred Sites*, December 4.

U.S. Department of Defense, U.S. Department of the Interior, U.S. Department of Agriculture, U.S. Department of Energy, Advisory Council on Historic Preservation, 2013, *Action Plan to Implement the Memorandum of Understanding Regarding Interagency Coordination and Collaboration for the Protection of Indian Sacred Sites*, March 5.

Appendix F
Cultural Resources

APPENDIX F
CULTURAL RESOURCES

F.1 Culture History/Historic Setting

F.1.1 Pre-Contact Era

Human prehistory (defined as that time before written records) in the Simi Valley area extends back some 10,000 to 13,000 years (Johnson 1997). The following summary of the project area's history prior to contact with Euro-Americans is adapted from Glassow et al. 2007 and King 1990, unless otherwise cited.

F.1.1.1 Paleo-Coastal Period (11000 to 7000 calibrated B.C.E.)

The Paleo-Coastal use or occupation of the project area is unknown, but this period is thought to be coeval with Paleo-Indian manifestations elsewhere in North America. The earliest evidence for human occupation in North America is found on California's Channel Islands. Radiocarbon dates derived from human bones, as well as rodent bones at the Arlington Springs site (CA-SRI-173)[1] on Santa Rosa Island, have yielded dates of approximately 11000 calibrated (cal.) before the common era (B.C.E.). On the coastal mainland opposite Santa Rosa Island, a basal corner of a Clovis-type projectile point was found at an archaeological site, possibly indicating a mainland occupation of comparable age. At Daisy Cave (CA-SMI-261) on San Miguel Island, the earliest deposits appear to date to as early as 9500 cal. B.C.E. The Surf site (CA-SBA-931), located near the mouth of the Santa Ynez River on the mainland, was occupied from circa (ca.) 8000 to 7500 B.C.E. The data indicate that the inhabitants of this site collected shellfish 10,000 years ago and utilized flaked stone tools manufactured from local chert. The Malaga Cave site (CA-LAN-138) near Palos Verdes on the southern edge of the Los Angeles basin was occupied very early, possibly as early as 8000 cal. B.C.E.

F.1.1.2 Millingstone Horizon (7000 to 5000 cal. B.C.E.)

The Millingstone Horizon is the earliest well-established cultural manifestation in the general area. Sometime between 7000 and 6500 cal. B.C.E., the population of the whole Southern California region began expanding. Most sites of this age are at or near the coast. However, the apparent lack of inland sites dating to this period may be due to their decreased visibility and the lack of easily recoverable organic remains from which radiocarbon dates can be obtained.

Sites of this age typically contain abundant grinding stones (manos and metates). In addition to ground-stone artifacts, hammerstones that may have originally been cores or core tools are common. In the Santa Monica Mountains, flaked stone tools include abundant fist-sized plano-convex cores and core tools (scraper planes), as well as flake tools of quartzite, basalt, and other volcanic rock. Few or no projectile points are typically found at Millingstone Horizon sites. Little faunal data are available from interior sites prior to 5000 B.C.E., but rabbits and deer are assumed to have been important food resources. The production of olive shell (*Olivella biplicata*) beads began during this period, and the widespread trade of these beads may signify the start of a regional exchange network. Millingstone Horizon sites often contain substantial deposits and hundreds of artifacts, indicating regular use of the sites and long periods of residence. Social organization may have consisted of up to 50 people occupying a residential base; these individuals may have been members of an extended family.

[1] An alphanumerical site number is assigned by the State of California to archaeological sites.

F.1.1.3 Early Period (5000 to 500 cal. B.C.E.)

The Early period in Southern California is defined by a sequence of changes in shell beads and ornaments (King 1990). In central and southern California and the Great Basin, rectangular beads of *Olivella biplicata*, *Haliotis* spp., *Mytilus californianus*, and double-perforated *Haliotis* spp. (abalone) ornaments have been found in Early period mortuary and midden contexts (King 1990). In the Santa Barbara Channel region, Early period collections are also characterized by the presence of clam shell circular (disc) beads, stone disc and cylinder beads, and whole *Olivella biplicata* shells with both their spires and bases ground or chipped (King 1990).

F.1.1.4 Middle Period (500 cal. B.C.E. to ca. 1100 C.E.)

During the Middle period, the use of mortars and pestles became prevalent. These artifacts may have been used to process acorns or, alternatively, to process tuberous roots of plants found in marshland settings (Johnson 1997). Side-notched projectile points appear at this time, suggesting that the hunting of large game, including deer, was important (Glenn 1991). Digging stick weights also occur at this time, suggesting the importance of corms, bulbs, and tubers in the diet. Residential bases in inland valleys, as well as coastal campsites, were occupied. In inland valleys, populations appear to have occupied the large residential bases while making seasonal rounds. Trade with coastal areas may have included toolstone, basketry, bone tools, and pine nuts.

The beginning of the Middle period in both central and southern California is characterized by a change from rectangular *Olivella biplicata* and abalone beads to disc beads and from two-holed abalone pendants to one-holed pendants (King 1990). During the Middle period, more types of ornaments were used than during the Early period (King 1990). In the Santa Barbara Channel region, keyhole limpet ornaments made from or including the enamel area around the shellfish's orifice were first used at the beginning of the Middle period and were made in large numbers throughout the Middle period (King 1990). Punched beads of *Trivia californiana* and other small cowries were especially common during the first four phases of the Middle period (King 1990). Small- to medium-sized *Olivella biplicata* shells with ground spires, many of which were diagonally ground, are common in contexts dated from the early phases of the Middle period.

F.1.1.5 Late Period (ca. 1100 to 1840 C.E.)

The Late period in southern California is marked by the occurrence of *Olivella biplicata* callus beads and clam disc and cylinder beads (King 1990). Also during the Late period, abalone ornament types were adapted to be strung together with beads into necklaces. Late period ornaments tend to have most of their perforations near their margins (King 1990). Asphaltum "skirt weights" were possibly used only during the Late period (King 1990). The Late period includes the colonization of the Central Chumash Indians beginning in 1782. The last part of the Late period corresponds to Spanish colonization (King 1990), and is marked by the presence of glass beads, iron tools, and other goods acquired from the Spanish, as well as changes in beads and ornaments of Chumash manufacture.

During the transition from the Middle period to the Late period, the plank canoe (tomol) began to be used for fishing and for transportation between the mainland and the Channel Islands (Johnson 1997). A regional exchange network, based on shell bead money produced on the Northern Channel Islands, also was established during this time (Johnson 1997). About 1,500 years before the present, the bow and arrow appear in the archaeological record. Arrow points included leaf-shaped (convex base) and square-stemmed types, which were attached to arrow shafts with asphaltum.

Beginning ca. 1500 in the common era (C.E.), populations peaked and settlements were integrated into regional sociopolitical organizations based on hereditary ranking, specialization, and exchange

(Glassow et al. 2007). At the time of Spanish contact, the Chumash and their neighbors had the most complex political and economic organization in California.

F.1.2 Ethnographic Era

The ethnographic era in this part of California is generally considered to begin in 1769, when the Spanish first established missions. This marks the beginning of the time when specific cultures were systematically studied and information was recorded by Euro-Americans regarding perceptions of culture and territory. The Santa Susana Field Laboratory (SSFL) is located near the boundary of the Chumash, Fernandeño Tataviam, and Gabrielino Tongva Native American ethnographic groups (see the blue dot in **Figure F–1**), possibly within the Chumash territory near the borders of the Fernandeño Tataviam and Gabrielino Tongva territories (Kroeber 1925). This map, based on the Native American Heritage Commission map, shows conceptual boundaries and should not be construed literally. Some tribes dispute these historic territorial divisions. The Chumash, Fernandeño Tataviam and Gabrielino Tongva ethnographic groups are discussed individually in this section. In addition, Chapter 9 of this *Draft Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory (Draft SSFL Area IV EIS)* was written by the Chumash, Fernandeño Tataviam, and Gabrielino Tongva Tribes and provides the Native American perspective.

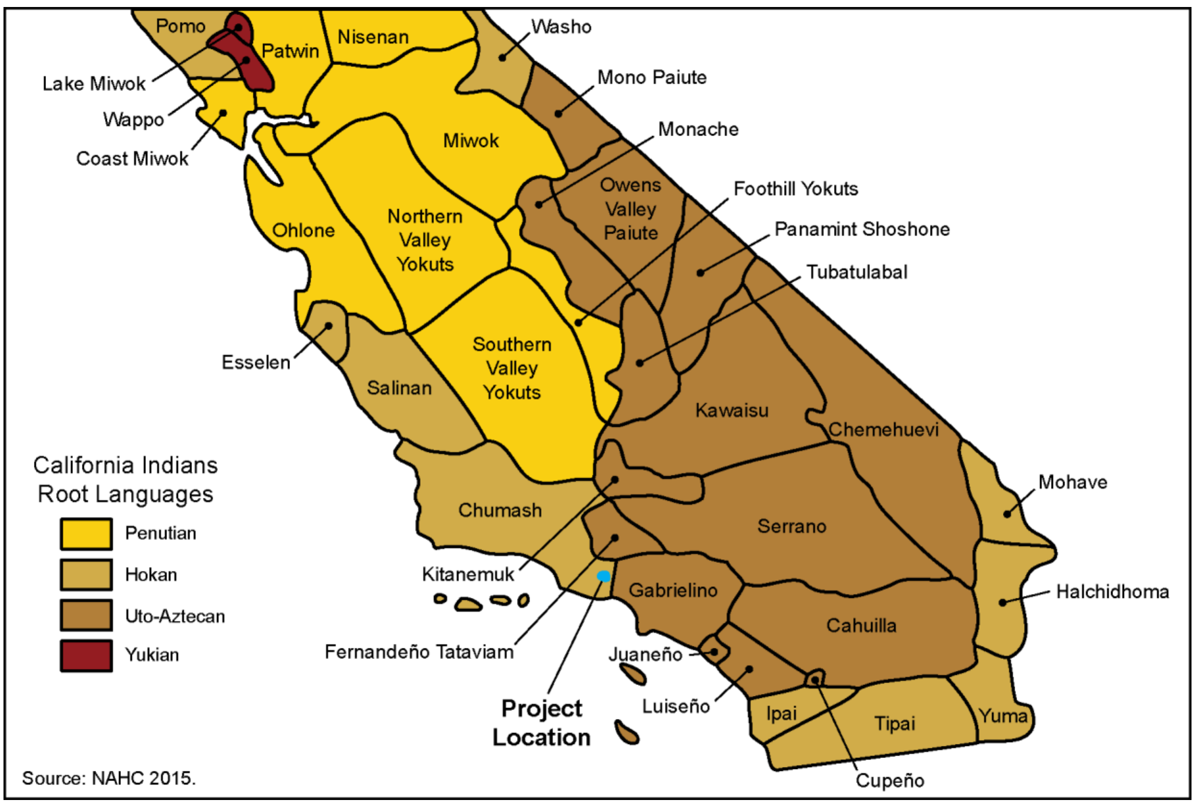


Figure F–1 Historic Tribal Boundaries in Relation to the Santa Susana Field Laboratory

F.1.2.1 Chumash

Chumash refers to a group of people who share a language belonging to the Hokan linguistic family (Landberg 1965). There were at least six Chumash languages, including Purismeño, Obispeño, the Island language, as well as Ventureño, Barbareño, Ynezeño, which were spoken by three linguistic/geographic entities with a shared common culture (Grant 1978a, 1978b). The Ventureño group is also referred to as the Eastern Coastal Chumash (Grant 1978b). The SSFL area is most closely associated with the Ventureño, or Eastern Coastal Chumash, cultural group.

The Chumash settlement pattern consisted of a main settlement or village (called *rancherías* by the Spanish), with one or more outlying seasonally occupied camps (Landberg 1965). A typical village consisted of several houses, a semi-subterranean sweathouse (*temescal*), store houses, a ceremonial enclosure, a gaming area, and a cemetery (Grant 1978b; Landberg 1965). Chumash dwellings consisted of hemispherical houses, which were made by driving strong, pliable poles into the ground and then arching them into the center, where they were tied (Grant 1978b). Houses were thatched with interwoven grasses. Reed matting was used for mattresses and flooring, as well as to create room divisions and doors (Grant 1978b).

Chumash material culture includes steatite (soapstone) pots and griddles, beads, medicine tubes, smoking pipes, fish hooks, whale effigies, and charmstones (Grant 1978b, Landberg 1965). Large bowls, mortars, and pestles were manufactured from sandstone (Grant 1978b). Sandstone "doughnut" stones (perforated sandstone discs) may have had multiple uses, including as weights on digging sticks (Grant 1978b). Natural asphaltum was used for attaching shell inlays to stone, caulking canoes, sealing water baskets, and fastening projectile points to arrow and spear shafts (Grant 1978b).

Projectile points were manufactured from chert, obsidian, and fused shale, as well as bone and wood (Landberg 1965). Chipped stone tools included knives, scraper planes, and choppers (Landberg 1965). Wooden plates and bowls are known from the ethnographic literature. Chumash basketry included water bottles, seed beaters, large burden baskets, flat trays, cradles, hoppers, bait baskets, and large twined tule mats (Grant 1978b).

Chumash subsistence was based on hunting and gathering. Chumash people made extensive use of plants (Timbrook 2007), including acorns, walnuts, pine nuts, buckeye nuts, laurel berries, wild strawberries, yucca, prickly pears, wild onion, chia seeds, soap plant, wild cherry, berries, mushrooms, and water cress (Grant 1978b; Landberg 1965). Animal foods included California mule deer, coyote, bobcat, fox, rabbits, ground squirrel, pocket gopher, and woodrat (Grant 1978b; Landberg 1965). Birds hunted and eaten included eagle, hawk, dove, quail, duck, geese, crane, and mudhen (Landberg 1965). Reptiles, amphibians, and insects were collected and eaten (Landberg 1965). Shellfish, fish, and marine mammals were important food items, particularly along the coast. Fish were obtained with spears, nets, fishhooks, poison, and traps (Landberg 1965).

Simi takes its name from the Chumash village of Shimiyi (Applegate 1974; Kroeber 1925). This village, named for the presence of thread-like clouds that sometimes may be seen in the Simi Valley (Johnson 1997), was a more populous and important town, where festivals, feasts, and perhaps councils were held (King and Parsons 1999). The village of Shimiyi contributed recruits to both the Ventura and San Fernando Missions (King and Parsons 1999) and may be represented by archaeological sites CA-VEN-95, -96, and -340 (King and Parsons 1999).

At least two other Chumash villages, Ta'apu and Kimishax, were also located in Simi Valley (Johnson 1997). Chumash descendants are numerous in the area today and have been involved in cultural revitalization throughout the 20th century (Glassow et al. 2007). Chapter 9 of this environmental impact statement (EIS) includes the Chumash perspective.

F.1.2.1.1 Chumash Style Rock Art

Chumash–style rock art has been described as some of the most interesting and spectacular rock art in the United States (Grant 1965, 1978b); because of its presence at SSFL (primarily in Area II), it is important to briefly discuss it here. The location of many sites with Chumash-style rock art suggests that they are shrines or sacred sites (Grant 1978b), and the figures may represent the supernatural world (Santa Barbara Museum of Natural History Education Center 1988). Individual images may be semi-abstract representations of supernatural beings or things seen in dreams, while others may represent concepts or ideas (Santa Barbara Museum of Natural History Education Center 1988).

Ventureño Chumash–style rock art sites generally occur in eroded sandstone shelters away from permanent settlements (Grant 1978b). Ventureño Chumash–style rock art typically contains anthropomorphic or zoomorphic creatures, often on a small scale (Grant 1978b). Settlements associated with Ventureño Chumash–style rock art sites include seasonal seed-gathering and hunting camps (Grant 1978b).

The vast majority of the pictograph sites in both the Santa Monica and Santa Susana Mountains are red monochrome, although sometimes more than one shade of red is present (Knight 2001); three polychrome panels have been recorded, all in the northwest San Fernando Valley (Knight 2001). The most common motifs in the region include anthropomorphs, aviforms, the aquatic motif, reptiles, and amphibians (Knight 2001).

The Burro Flats Painted Cave Site (CA-VEN-1072/56-001072)

The Burro Flats Painted Cave site in SSFL Area II is considered "one of the most elaborate, and probably the best preserved painted petroglyph [sic] in California" (Fenenga 1973) and "the most spectacular pictograph site in the Santa Susana Mountains" (Knight 2001). Although this site is outside the area of potential effects (APE)[2] for this U.S. Department of Energy (DOE) undertaking, it is within the region of influence (ROI), and an understanding of the resource is useful in evaluating the overall context of cultural resources at SSFL. The Burro Flats Painted Cave site, inclusive of CA-VEN-151 through CA-VEN-161 and covering an area of 25 acres, is listed on the *National Register of Historic Places* (NRHP) (Number 76000539, March 10, 1975).

Rock art at the Burro Flats Painted Cave site has been described in detail (La Monk 1953, Grant 1965; Knight 2001) and photographed extensively (Landberg 1965). The main pictograph cave is located within a series of the truncated sandstone deposits that form a small canyon running south several hundred yards down from Burro Flats (Rozaire 1959). A number of features have been separately recorded as sites (CA-VEN-151 through CA-VEN-161), although they may all be part of landscape modifications by a single community (Fenenga 1973). The site includes a large area of midden, fire-cracked rocks, two boulders with linear pecked and engraved cupules, five locations of bedrock milling or mortars, and a network of paths worn into the soft sandstone by generations of people using the site (Fenenga 1973). Field excavation classes were held at the site complex in the 1960s. Unfortunately, no comprehensive report on this excavation has yet been published (Knight 2001).

Although possibly first visited in the modern era in the 1940s (Knight 2001), the site wasn't recorded until the 1950s. The art was reported to have at least five paint colors, including "black and white, red oxide, pink and blue" (La Monk 1953); other colors reported added orange, pink, and blue, with red and white (Rozaire 1959). There may have been at least three separate painting

[2] The APE of an undertaking is "the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if any such properties exist" (Title 36, *Code of Federal Regulations*, Section 800.16(d)). The APE for DOE's undertaking consists of Area IV and the Northern Buffer Zone at SSFL.

episodes or periods of occupation, based on the superposition (or overpainting) of some elements and the covering of some elements by soot or fire-blackening (La Monk 1953; Rozaire 1959). The site contains at least eight pictograph panels and 14 distinct petroglyph concentrations that include true petroglyphs, cupules, incised rocks, and bedrock mortars (Knight 2001). Today, the individual rock art components at the Burro Flats Painted Cave site include polychrome pictographs, red-only pictographs, black-only pictographs, white-only pictographs, orange-only pictographs, blue-only pictographs, four petroglyphs, cupules, and multiple crude grooves (Knight 2001).

The site also contains three "little mortars" that are in a natural position to hold paint or pigment for the painter's work (La Monk 1953). Also present are bedrock mortars and petroglyphs consisting of a series of pecked dots forming lines at the bottom of the back wall.

The pictographs at Burro Flats Painted Cave site are described as characteristic of other pictographs in the west-central coast ranges of Santa Barbara, Kern, Los Angeles, and Ventura Counties, including motifs such as circles, segmented worms or centipedes, and stick-like anthropomorphic and zoomorphic figures (Rozaire 1959).

As a result of archaeoastronomical observations performed at the Burro Flats Painted Cave site (Romani 1981; Romani et al. 1985b), researchers concluded that the site played a significant role in the annual winter solstice ceremony, perhaps functioning as a private location for the performance of rituals commemorating Kakunupmawa, the Sun (Romani 1981:191). Other researchers have noted an astronomical element in the pictographs at the Burro Flats Painted Cave site: during the winter solstice, the sun shines through a natural cut in the overhang at the western end of the rock art panel, and sunlight strikes the second ring of five concentric rings, which are painted in white (Krupp 1994). This observation may be corroborated by ethnographic data (Mills and Brickfield 1986; Johnson 2006).

F.1.2.2 Fernandeño Tataviam

The Fernandeño Tataviam, possibly Takic language speakers, lived on the upper reaches of the Santa Clara River east of Piru Creek. As described ethnographically, their territory extended over the Sawmill Mountains to the north and included the southwestern portion of the Antelope Valley (King and Blackburn 1978). To the west, the Tataviam territory bordered Chumash territory. To the south, in the vicinity of the Santa Susana Mountains, Tataviam territory bordered various Gabrielino-speaking groups (King and Blackburn 1978). As indicated in Chapter 9 of this EIS, the Fernandeño Tataviam dispute some of these boundary descriptions.

Tataviam settlements ranged from small villages with populations of 10 to 15 people to large centers with more than 200 people (King and Blackburn 1978). Subsistence was based on hunting and gathering. The primary vegetable foods included buds of chaparral yucca (*Yucca whipplei*), acorns, sage seeds, juniper berries, and berries of the islay (*Prunus ilicifolia*). Animal foods included small mammals, deer, and perhaps antelope (King and Blackburn 1978). By 1810, all or nearly all of the Tataviam had been baptized at the San Fernando mission (King and Blackburn 1978), and the name Fernandeño was associated with the Tataviam (Bean and Smith 1978).

The village of Momonga is situated on the eastern slope of the Simi Hills in the vicinity of Santa Susana Pass, near a major trail that crossed over the original Santa Susana Pass into Simi Valley (Johnson 2006). Momonga was also known as the Rancheria de las Piedras (Village of the Stones) due to the striking rock formations that occur in the area (Johnson 2006). Residents of Momonga were recruited to the San Fernando mission (Roderick 2001). Several locations have been suggested for Momonga: near a major trail that crosses over the original Santa Susana Pass into the Simi Valley that may be represented by the Chatsworth site complex, which includes CA-LAN-357, a residential site with pictographs in adjacent rockshelters; CA-LAN-901, located nearby;

CA-LAN-21, interpreted as a mourning ritual site; CA-LAN-89, which surrounds Stoney Point; or a complex of sites consisting of CA-LAN-448, -449, and -1126 that is located within the Santa Susana Pass State Historic Park (Johnson 2006).

F.1.2.3 Gabrielino Tongva

The Gabrielino Tongva were Cupan language speakers; the name Gabrielino refers to the Spanish mission established in their territory: Mission San Gabriel (Bean and Smith 1978).

The Gabrielino Tongva occupied land that included much of present-day Los Angeles and Orange Counties (McCawley 1996) and was bordered to the northwest by the Chumash and to the north by the Tataviam. In addition to their mainland territory, the Gabrielino Tongva occupied three of the Channel Islands lying off the coast of southern California: Santa Catalina, San Clemente, and San Nicolas; they also made excursions to Santa Barbara Island (McCawley 1996). As indicated in Chapter 9 of this EIS, the Gabrielino Tongva dispute aspects of this boundary description.

The Gabrielino Tongva established large, permanent villages along rivers and streams; these were connected to smaller satellite villages through economic, religious, and social ties (Bean and Smith 1978). The distribution of known Gabrielino Tongva communities suggests considerable regional variation in the density of settlement; in some regions, such as the San Fernando Valley or the San Bernardino Valley, communities appear to have been rather widely distributed; other regions, such as the San Gabriel Valley or the Palos Verdes Peninsula, may have been more densely populated (McCawley 1996).

Gabrielino Tongva houses were domed, circular, thatched structures. Large structures could hold up to 50 people. The center of each community was occupied by an unroofed sacred enclosure known as the *yovaar* (Bean and Smith 1978; McCawley 1996). Small, semicircular, semi-subterranean sweathouses with earthen roofs and larger, earth-covered ceremonial sweathouses were used by the Gabrielino Tongva (McCawley 1996). Other structures included menstrual huts and ceremonial enclosures (Bean and Smith 1978). The Gabrielino Tongva population at the time of European contact was estimated to reside in 50 to 100 villages, each with 50 to 100 inhabitants (Bean and Smith 1978).

Gabrielino Tongva material culture included steatite pipes, ritual objects, ornaments, cooking utensils, bedrock and portable mortars, metates, mullers, mealing brushes, wooden stirrers, paddles, shell spoons, bark platters, wooden bowls, and ceramic vessels (Bean and Smith 1978). Tools included saws manufactured from deer scapulae, bone and shell needles, fishhooks and awls, scrapers, bone and shell flakers, wedges, flint and cane knives, and flint drills (Bean and Smith 1978). Basketry included mortar hoppers, plates, trays, winnowers, carrying and serving baskets, and storage baskets.

The nearest neighbor to Momonga to the south was the village of El Escorpión. Chumash, Fernandeño Tataviam, and Gabrielino Tongva congregated at El Escorpión, also known as Huwam or Jucjauynga, located near the mouth of Bell Creek in Bell Canyon (Johnson 2006; Roderick 2001). The Fernandeño Tataviam, Serrano, and Gabrielino Tongva refer to this village as Jucjauynga. During the mission period, this was one of the larger villages in the San Fernando Valley, and a total of 76 people were baptized from El Escorpión (King and Parsons 1999). Many of the people recruited from this village had Chumash names (King and Parsons 1999); however, this village may have held a mixed linguistic population of Chumash and Fernandeño speakers (Johnson 2006). Archaeological site CA-LAN-413 was apparently the remains of the village of El Escorpión. Most, or all, of this village has been destroyed by modern development.

Castle Peak, located in the nearby Simi Hills, was an important landmark in the region. Castle Peak was known as Kas'élewun, a name translated as "lengua," or "tongue" in Ventureño Chumash

(Johnson 2006; McCawley 1996). A bead shrine was reportedly located atop the peak (Romani et al. 1985b; McCawley 1996). Three important caves are located near Castle Peak: the Cave of Munits; the Cueva de los Chuchos ("Cave of the Dogs"); and the Cueva del las Pulgas ("Cave of the Fleas") (McCawley 1996). This area later became the 1,110-acre Mexican land grant known as Rancho El Escorpión (Beck and Haase 1974).

F.1.3 Post-Contact Era

F.1.3.1 Early Exploration and Settlement

The first known contact by Euro-Americans in this area occurred when the Gaspar de Portolá expedition passed through the area in 1769. Portolá, along with 65 soldiers and two Franciscan friars, marched north from San Diego; although Portolá did not pass through Simi, scouts from his expedition reportedly crossed "the Hogback" (the Santa Susana Mountains) between Camulos and Tapo and camped near present-day Simi (Cameron 1963).

The Pueblo of Los Angeles was founded in 1781 (Havens 1997); to the north, Rancho Simi was the first land grant in present-day Ventura County (Hoover et al. 1966). Rancho Simi, encompassing 113,009 acres, was granted in 1795 and 1821 to Miguel Patricio and Francisco Javier Pico. One of the largest land grants in California, Rancho Simi extended from the Santa Susana Mountains to the present-day town of Moorpark (Hoover et al. 1966; Havens 1997). An early structure on the rancho, called Casa Viejo, was established near the confluence of Tapo Creek and Arroyo Simi (Havens 1997). As with other Spanish ranchos, cattle and sheep were raised on Rancho Simi (Havens 1997). Olives and grapes were also cultivated (Havens 1997). In 1842, Rancho Simi was acquired by Jose de la Guerra y Noriega (Cameron 1963), who built an adobe house on the property (Hoover et al. 1966).

The mission of San Buenaventura in Ventura, established March 31, 1782, was the first Spanish mission in the area, but was included in the District of Santa Barbara because of the location of a presidio there (Hoover et al. 1966; Ventura County Historical Society 1972). The mission at San Buenaventura was situated near the Chumash village of Shisholop, one of the largest villages in the area. Ventura County was organized as a county in 1873, and Ventura was named the county seat (Hoover et al. 1966; Ventura County Historical Society 1972).

F.1.3.2 Euro-American Settlement

In the early 1800s, farming and ranching were the area's primary economic mainstays. By the early 1830s, there were 19 ranches in Ventura County covering nearly half a million acres. Cattle, sheep, horses, and mules were raised. After 1848, ranching declined and the production of wheat, barley, corn, and other dry-farmed crops expanded. The first commercial citrus grove in the county was planted near Santa Paula in 1874 (Edwards et al. 1970).

During the 1860s, a few Euro-American settlers moved into Simi Valley. A precarious passage was cut through the rocks of Santa Susana Pass in 1860, and this route became the new coast stage route (Roderick 2001). Known as "Devil's Slide," this route was challenging for horses and stagecoach drivers (Roderick 2001:31). A branch of the Butterfield Line ran over the old Fremont Grade (now Santa Susana Pass) daily from Santa Barbara to a connection with the main Butterfield Line near present-day Pacoima (Cameron 1963). The Pacific Coast Stage Line began running over the Santa Susana Pass into Simi Valley in 1861 on its route between Los Angeles and San Francisco, and the Overland Mail Company stage began using the new pass in September of the same year (Havens 1997; Roderick 2001). In 1865, the Philadelphia and California Petroleum Company purchased Ranchos Simi, Las Posas, and San Francisco for possible oil exploration (Havens 1997).

Also around this time, the Santa Susana Pass was a favorite hideout of several gangs of bandits (Cameron 1963). Tiburcio Vazquez, one of the most feared outlaws during the 1870s and 1880s (Havens 1997), was known to steal horses, hold up stagecoaches, and rob stores and banks. The stagecoach road remained the only way in and out of Simi Valley until the late 1890s (Havens 1997).

Farming remained the main occupation in Simi Valley until the 1950s (Havens 1997). After 1877, this consisted almost exclusively of dry-land grain farming, which relied on natural rainwater instead of irrigation (Cameron 1963). Raising sheep, cattle, and horses and keeping bees were other occupations that began early in Simi Valley and continued through the years (Havens 1997).

Although Ventura County was considered rural and distant from the large population centers, there was a flurry of subdivision with some emphasis on Simi Valley in the late 1800s and early 20th century (Cameron 1963). The Simi Land and Water Company divided Rancho Simi into individual farms and ranches and advertised its lands in the Midwestern and New England states (Havens 1997). The towns of Simi and Santa Susana both resulted from the real estate boom of the late 19th and early 20th centuries (Hoover et al. 1966). Santa Susana was named for Saint Susana, the Roman virgin and martyr of the third century C.E. (Ricard 1972). These communities are now considered part of the Greater Los Angeles metropolitan area.

Santa Susana Pass and the Burro Flats area of SSFL were popular filming locations in the first half of the 20th century (Mealey and Brodie 2005; Reid 2006; Roderick 2001), and more than 2,000 movies were shot in the rocky terrain (Roderick 2001). In the 1920s and 1930s, Hollywood film studios shot a number of westerns on the property (Post/Hazeltine Associates 2009). In the 1970s, SSFL was used for numerous TV shows. SSFL was also the scene of science fiction movies (most notably *Star Wars*, which filmed some of its computer-bank scenes in a test stand blockhouse).

Santa Susana Pass State Historic Park contains numerous pre-contact-era sites and sandstone quarries (Mealey and Brodie 2005). The Devil's Slide stagecoach road was used through the 1860s and 1870s (Mealey and Brodie 2005) until completion of a railroad tunnel in 1905 and construction of the Santa Susana Pass road in 1895 led to its abandonment (Mealey and Brodie 2005). The stage route, stage station, and various features related to historic uses, as well as portions of pre-contact-era sites, are listed on the NRHP (listed January 10, 1974). The stage route was commemorated by a plaque along the route placed by the Native Daughters of the Golden West in 1939 and was declared a Los Angeles City Historical Cultural Monument (Number 92, designated January 5, 1972) and Ventura County Historical Landmark (Number 104, designated October 21, 1986) (Mealey and Brodie 2005). More recent uses of this park have included ranching and filming locations, off-road activities, and recreation (Mealey and Brodie 2005). Spahn Ranch (P-19-003502), an old movie location near Santa Susana Pass, became known because Charles Manson and his followers squatted there for about a year prior to the 1969 Manson killings (Roderick 2001). The ranch was destroyed by fire in 1970 (Mealey and Brodie 2005; Roderick 2001). The land encompassing SSFL was also ranch land and by the early 20th century had been acquired by the Dundas and Silvernale families, who used the land for cattle grazing (Post/Hazeltine Associates 2009). In the 1920s and 1930s, Hollywood film studios shot a number of westerns on what is now the SSFL property (Post/Hazeltine Associates 2009).

F.1.3.3 Santa Susana Field Laboratory

SSFL is primarily an outcome of the post-World War II space race. SSFL was developed as a remote site to test rocket engines to support the growing aerospace industry of southern California. Established in 1947 by North American Aviation (which later became the Rocketdyne Division of Rockwell International and subsequently, was acquired by The Boeing Company [Boeing]), SSFL first was used to test rocket engines for the U.S. Department of Defense and then later for the

National Aeronautics and Space Administration (NASA). SSFL is noted for the testing of rocket engines for the Atlas, Thor, Jupiter, Apollo, and Saturn missions and the Space Shuttle program.

In the early 1950s, Rockwell International acquired ownership of the land that became the western portion of SSFL and created Atomics International to conduct nuclear research in what would become Area IV of SSFL. Starting in the mid-1950s, the Atomic Energy Commission, a predecessor agency of DOE, leased a 90-acre portion of Area IV from Rocketdyne and funded nuclear energy research that primarily involved testing of small pilot-scale reactors. From 1955 to 1980, DOE funded operation of 10 reactors. Nuclear research was also performed in Area IV by commercial entities. In the early 1960s, the Atomic Energy Commission created the Energy Technology Engineering Center (ETEC) as a "center of excellence" for liquid metals research. This work involved testing the properties of liquid sodium and potassium in a variety of non-nuclear programs. Other operations at ETEC focused on applied engineering and development of emerging energy technologies, including solar and fossil energy, as well as development of an energy conservation methodology.

By 1980, all reactor operations had ceased, and nuclear research within Area IV was terminated in 1988. At the height of research activities in the late 1960s, there were over 200 numbered structures in Area IV. When the mission of each experimental activity ended, DOE began decontamination, decommissioning, and demolition of the structures. At present, only 22 structures remain; 18 owned by DOE and 4 by Boeing. In 1996, Rockwell International sold its aerospace and defense business, including Areas I, III, and IV of SSFL, to Boeing, the current land owner.

F.2 Background Research

The APE for this EIS is defined as Area IV and the Northern Buffer Zone (NBZ) within SSFL. In a letter dated February 25, 2015, the California State Historic Preservation Officer (SHPO) agreed with this definition of the APE. The ROI for this EIS is defined as the area within a 1-mile radius of SSFL, including all of SSFL (inclusive of the APE).

F.2.1 Records Search and Summary of Results

A cultural resources records search was conducted for the ROI. The purpose of the records search was to identify cultural resources surveys, historic properties (i.e., NRHP-listed and -eligible cultural resources), and other previously recorded sites within the ROI. The *Draft SSFL Area IV EIS* record search, first conducted in December 2009, was updated in June 2014. The records search included a literature and archive review, as well as a search of all recorded archaeological studies and sites in the ROI. The following six record repositories were examined in 2009 and again in 2014:

- South Central Coastal Information Center of the California Historical Resources Information System
- California Points of Historical Interest
- California Historical Landmarks
- *California Register of Historical Resources* (California Register)
- California State Historic Resources Inventory
- NRHP

Historical maps may show elements of the built environment or historic place names that may be useful in identifying and understanding the features located through archaeological survey. In addition to the repositories listed above, historical maps were examined for potential historic-era sites in the APE. These included the U.S. Geological Survey maps of the Calabasas Quadrangle (1903) and Santa Susana Quadrangle (1903 and 1941).

Results of the records search are described in Sections F.2.2 and F.2.3.

F.2.2 Previous Studies within the Region of Influence

The records search identified 34 cultural resources studies conducted within the ROI (consisting of the area within a 1-mile radius of SSFL) (see **Table F–1**). Descriptions for the 10 studies covering portions of the APE are included in this table.

Table F–1 Previous Studies within the Region of Influence

Author(s)/Entity	*Year*	*Title and Pertinent Information*
Studies outside the APE but within SSFL and/or within 1 mile of the APE		
Knight, Albert	No date	Recent Investigations at Burro Flats, Ventura County, California
Redtfeldt, Gordon	No date	*Prehistoric Indian Rock Art of California*
La Monk, Charles	1953	*Pictograph Cave at Burro Flats*
Rozaire, Charles E.	1959	"Pictographs at Burro Flats"
Fenenga, Franklin	1973	*An Archaeological Survey of the Area of Air Force Plant 57, Coca Test Area, Santa Susana Field Laboratory, Ventura County, California*
Lopez, Robert	1975	*An Archaeological Survey of the Southern Pacific Milling Company's Runkle Canyon Gravel Quarry Lease, Simi Valley, Ventura County, California*
Pence, R.L.	1978	*Archaeological Assessment of TT 3045, Simi Valley, California*
City of Simi Valley	1980	RE: Response Letter of April 21, 1980.
Van Horn, David M.	1980	*Archaeological Survey Report: The Ventura County Portion of the Las Virgenes Ranch*
Edberg, Bob	1985	"Shamans and chiefs: visions of the future"
Pence Archaeological Consulting	1987a	*Archaeological Reconnaissance of the Proposed Cerwin Ranch Development for Conditional Use Permit Number CUP-4440*
Pence Archaeological Consulting	1987b	*Archaeological Reconnaissance and Test of TT 3045, Simi Valley*
Romani et al.	1985b	"Astronomical investigations at Burro Flats: aspects of ceremonialism at a Chumash/Gabrielino rock art and habitation site"
Romani et al.	1985a	"Astronomy, myth, and ritual in the west San Fernando Valley"
Bissell, Ronald M.	1989	*Cultural Resources Summary of the Ahmanson Ranch Property, 5500 Acres in Ventura County, California*
W&S Consultants	1990	*Phase I Archaeological Survey and Resource Assessment of the Rancho Pacifica Property, Runkle Ranch, City of Simi Valley, Ventura County, California*
W&S Consultants	1991	*Phase II Archaeological Test Excavations at CA-VEN-1017 and CA-VEN-1018, Simi Valley, Ventura County, California*
W&S Consultants	1992	*Phase I Archaeological Survey and Assessment of Two Areas of Unauthorized Grading on the Czerwinski Portion of the Runkle Ranch Specific Plan Area, Simi Valley, Ventura County, California*
King, Chester, and Jeff Parsons	1999	*Archaeological Records of Settlement and Activity in the Simi Hills*
King, Chester	2006	*Archaeological Assessment of Areas Burned by the Topanga Fire, Ventura and Los Angeles Counties, California*
Craft, Andrea and Soraya Mustain	2007a	*Archaeological Survey Report for Southern California Edison Company Big Rock 16kV Reconductor O&M Project, Ventura County, California*
Emmick, Jamelon and James C. Bard	2008	*Final Cultural Resources Inventory of Santa Susana Field Laboratory NASA Areas I and II, Ventura County, California*
Holland, Donna	2010	*Cultural Resources Management Plan for Santa Susana Field Laboratory, Ventura County, California* An Integrated Cultural Resources Management Plan (ICRMP) for the NASA portion of SSFL was completed in 2009. The ICRMP was designed to assist NASA in identifying procedures required to comply with appropriate Federal laws and implementing regulations. This is a management document; no archaeological survey was conducted for its preparation.

Author(s)/Entity	*Year*	*Title and Pertinent Information*
Corbett, Ray and Richard Guttenberg	2014	*Phase I Archaeological Survey Santa Susana Field Laboratory Area I, Area III, and Southern Undeveloped Land (SUL), Ventura County, California*
Studies inside Area IV and NBZ (the APE)		
C.W. Clewlow, Jr. and Michael R. Walsh	1999	*Cultural Resource Assessment and Report on Archival Research, Surface Reconnaissance, and Limited Subsurface Evaluation at Rocketdyne Santa Susana Field Laboratory, Ventura County, California* An archaeological survey of a portion of SSFL, consisting of a proposed 5.5-acre soil borrow area, did not identify any cultural resources.
W&S Consultants	2001	*Class III Inventory/Phase I Archaeological Survey of the Santa Susana Field Laboratory Area 4, Ventura County, California* An archaeological survey of Area IV in 2001 was the first systematic archaeological survey conducted at SSFL. This study consisted of an on-foot, intensive survey of the 290-acre Area IV. The study identified four previously unknown archaeological sites (CA-VEN-1772, -1773, -1774, and -1775). These four sites were recommended as ineligible for listing in the *National Register of Historic Places*. However, because formal concurrence of ineligibility has not been sought from nor been given by the State Historic Preservation Officer at the California Office of Historic Preservation, in accordance with Title 36, *Code of Federal Regulations*, Part 800, the four sites are treated as eligible for inclusion in the NRHP until determined otherwise.
Craft, Andrea and Soraya Mustain	2007b	*Archaeological Survey Report for Southern California Edison Company Energy Circuit 16kV O/O Chatsworth Sub DSP Project, Ventura County, California* An archaeological survey for Southern California Edison of the Energy Circuit 16kV O/O Chatsworth Distribution Substation Plan identified one isolated, pre-contact-era artifact, but no archaeological sites in the approximately 30.1-acre region of influence.
Orfila, Rebecca S.	2009	*Archaeological Survey for the Southern California Edison Company: Replacement of Two Deteriorated Power Poles on the Saugus-Haskell-Solemint 66kV Line, Newhall, Los Angeles County, One Deteriorated Pole on the Burro Flats-Chatsworth-Thrust 66kV Line* An archaeological survey for Southern California Edison Company of a deteriorated power pole on the Burro Flats-Chatsworth-Thrust 66-kilovolt transmission line did not identify any cultural resources within 30 meters of the pole.
Post/Hazeltine Associates	2009	*Historic Structures/Sites Report for Area IV of the Santa Susana Field Laboratory* A historic structures/sites report for Area IV concluded that Area IV was not eligible for listing in the NRHP or the *California Register of Historical Resources* (California Register) as a historic district. Area IV was considered to lack sufficient integrity to convey its historic appearance or association with the history of nuclear power research and development in the United States and the post–World War II transformation of California. Moreover, none of the buildings, structures, or features within Area IV was considered to be individually eligible for listing in the NRHP or the California Register.
Romani, Gwen	2009	*Archaeological Survey Report: Southern California Edison Proposed Fiber Optic Moorpark East Copper Cable Replacement Project, Los Angeles and Ventura Counties, California* An archaeological survey of Southern California Edison Company's proposed fiber optic Moorpark East copper cable replacement project in Los Angeles and Ventura Counties identified CA-VEN-1302, a lithic scatter in Areas III and IV of SSFL.
Hogan, Michael and Bai "Tom" Tang	2010	*Cultural Resources Identification Survey: NBZ at the Santa Susana Field Laboratory Site, Simi Hills Area, Ventura County, California* An archaeological survey of the Northern Undeveloped Land (now referred to as the Northern Buffer Zone [NBZ]) was completed. This study of approximately 182 acres identified three previously unknown archaeological sites. These sites included two lithic scatters (CA-VEN-1803 and -1804) and a natural water cistern with an associated lithic scatter (CA-VEN-1805). Hogan and Tang concluded that the historical significance of the three sites could not be determined without further archaeological investigations. Five locations of isolated artifacts (P-56-100471, -100472, -100473, -100474, and -100475) were also identified in this study.

Author(s)/Entity	Year	Title and Pertinent Information
Guttenberg, Richard and Ray Corbett (for JMA)	2010	*Project Description and Cultural Resources Assessment, Santa Susana Field Laboratory, NBZ Radiological Study, Ventura County, California* A project description and cultural resources assessment of the SSFL NBZ's radiological region of influence was completed for John Minch and Associates, Inc. (JMA), in 2010 by Guttenberg and Corbett. This study was undertaken to provide a description of known and potential cultural resources for the EPA's then-proposed (and now completed) Radiological Characterization Survey of the NBZ. For this study, previous archaeological investigations conducted on the property and records at the South Central Coastal Information Center of the California Historical Resources Information System at California State University, Fullerton, were reviewed.
Corbett, Ray, Richard B. Guttenberg, and Albert Knight (for JMA)	2012	*Final Report Cultural Resource Compliance and Monitoring Results for USEPA's Radiological Study of the Santa Susana Field Laboratory Area IV and Northern Buffer Zone, Ventura County, California* From July 2010 through August 2012, JMA provided cultural resources compliance and monitoring for EPA's radiological study of Area IV and the NBZ. A total of 19 new archaeological sites and 54 new isolated artifacts in Area IV and the NBZ were recorded during this time.
Bryne, Stephen (for Leidos)	2014	*Archaeological Survey, Site Verification, and Monitoring Performed During the Phase 3 Soil Chemical Sampling in Area IV, the Northern Buffer Zone (NBZ), and Adjacent Lands Santa Susana Field Laboratory Ventura County, California* From 2011 through 2014, Leidos surveyed for and monitored completion of Phase 3 soil chemical sampling on Area IV and the NBZ; this included surface and subsurface sampling and excavation of geological test pits and trenches. Fieldwork included verifying the location of previously recorded sites, updating records and site boundaries, and documenting two previously unrecorded isolates.

APE = area of potential effects; EPA = U.S. Environmental Protection Agency; JMA = John Minch and Associates, Inc.; NASA = National Aeronautics and Space Administration; NBZ = Northern Buffer Zone; NRHP = *National Register of Historic Places*.

Source: SCCIC 2009, 2014. Information Center of the California Historical Resources Information System records searches, December 22, 2009 (SCCIC, #10100.6981), and June 10, 2014, (SCCIC, #14058.219); *SSFL Area IV EIS* administrative record.

F.2.3 Archaeological Resources within the Region of Influence

The 2009 and 2014 records searches identified 94 archaeological sites and 86 isolates within the ROI. Fifteen of these sites are now included within the boundaries of site CA-VEN-1072/56-001072, also known as the Burro Flats Painted Cave site. This site (or group of sites), which is outside the APE on the NASA-owned portion of SSFL, is listed on the NRHP and California Register. No historic-era locations were identified in Area IV or the NBZ as a result of the records search.

All of Area IV and the NBZ have been surveyed for archaeological resources (W&S Consultants 2001; Hogan and Tang 2010). Sixteen previously recorded sites are either in Area IV or are located in both Area III and Area IV. Ten previously recorded sites are located in the NBZ. Fifteen previously recorded isolated artifacts are located in Area IV; another 38 isolated artifacts are in the NBZ.

Archaeological sites in Area IV include bedrock mortars, a scatter of marine shell, open-air lithic scatters, and rockshelters with single lithic artifacts, multiple lithic artifacts, and midden soils, (i.e., habitation sites). One site contains pre-contact-era pictographs and one site contains a historic pictograph. The NBZ has a similar complement of open-air lithic scatters and rockshelters with artifacts; the abundance of rockshelters in the NBZ reflects the more rugged nature of this portion of the APE. Isolated artifacts found throughout Area IV and the NBZ indicate the widespread use of the area.

DOE developed and implemented an extended phase 1 testing program to evaluate the NRHP eligibility of selected archaeological sites in the APE that are located where chemical or radioactive remediation could be required. This program was developed in consultation with SHPO, EIS cooperating agencies, including the Santa Ynez Band of Chumash Indians, and the Santa Susana Field Laboratory Sacred Sites Council (SSFL Sacred Sites Council). DOE is consulting with the SHPO under Section 106 of the National Historic Preservation Act and seeking concurrence on the determination of eligibility and finding of effect resulting from the testing program. **Tables F–2** and **F–3** list the previously recorded archaeological sites and isolated finds, respectively, within a 1-mile radius of the SSFL, which includes the APE of Area IV and the NBZ.

Table F–2 Previously Recorded Archaeological Sites within the Region of Influence

Primary Number	*Trinomial Site Number* [a]	*Site Description*	*NRHP and California Register Eligibility*
Outside SSFL but within 1 mile of SSFL			
56-000712	VEN-712	Lithic scatter	Unevaluated
56-000730	VEN-730	Rockshelter with midden	Unevaluated
56-000731	VEN-731	Rockshelter with associated artifacts	Unevaluated
56-000732	VEN-732	Rockshelter with associated artifacts	Unevaluated
56-000733	VEN-733	Rockshelter with quartzite flakes	Unevaluated
56-000763	VEN-763	Rockshelter with associated artifacts	Unevaluated
56-000764	VEN-764	Rockshelter with midden	Unevaluated
56-001017	VEN-1017	Lithic quarry/workshop	Unevaluated
56-001050	VEN-1050	Rockshelter with steatite or schist pendant and lithic scatter	Unevaluated
56-001119	VEN-1119	Bedrock milling station with two mortars and one cupule	Unevaluated
56-001346	VEN-1346	Rockshelter	Unevaluated
56-001347	VEN-1347	Rockshelter	Unevaluated
56-001348	VEN-1348	Rockshelter	Unevaluated
56-001358	VEN-1358	Rockshelter and bowl mortar fragment	Unevaluated
56-001424	VEN-1424	Rockshelter with an associated lithic scatter	Unevaluated
56-001433	VEN-1433	Lithic scatter	Unevaluated
56-001434	VEN-1434	Rockshelter with an associated lithic scatter	Unevaluated
56-001435	VEN-1435	Rockshelter; lithic scatter; pictographs	Unevaluated
56-001436	VEN-1436	Rockshelter; groundstone arrowshaft straightener	Unevaluated
56-001437	VEN-1437	Lithic scatter	Unevaluated
56-001439	VEN-1439	Lithic scatter	Unevaluated
56-001440	VEN-1440	Rockshelter; historic canteen; stacked rock feature	Unevaluated
56-001441	VEN-1441	Rockshelter; faunal remains	Unevaluated
56-001442	VEN-1442	Lithic scatter	Unevaluated
56-001464	VEN-1464	Rockshelter; two ground-stone comal fragments	Unevaluated
56-001469	VEN-1469	Lithic scatter	Unevaluated
56-001470	VEN-1470	Lithic scatter	Unevaluated
56-001471	VEN-1471	Rockshelter, lithic scatter, one ground-stone sandstone mano fragment	Unevaluated
56-001472	VEN-1472	Rockshelter; lithic scatter; faunal remains; Monterey chert biface; pictographs	Unevaluated
56-001474	VEN-1474	Lithic scatter	Unevaluated
56-001475	VEN-1475	Rockshelter; lithic scatter	Unevaluated
56-001476	VEN-1476	Rockshelter; lithic scatter	Unevaluated
56-001477	VEN-1477	Rockshelter; lithic scatter; faunal remains; pictographs	Unevaluated
56-001478	VEN-1478	Rockshelter with one associated lithic artifact	Unevaluated
56-001479	VEN-1479/H	Rockshelter; lithic scatter; pictographs; historic bottle	Unevaluated
56-001480	VEN-1480	Lithic scatter	Unevaluated
56-001482	VEN-1482	Rockshelter; pictographs	Unevaluated

Primary Number	Trinomial Site Number [a]	Site Description	NRHP and California Register Eligibility
56-001485	VEN-1485	Rockshelter; lithic scatter	Unevaluated
56-001486	VEN-1486	Rockshelter; lithic scatter	Unevaluated
56-001487	VEN-1487/H	Inscribed boulders with one associated lithic artifact	Unevaluated
56-001488	VEN-1488/H	Inscribed sandstone outcrop	Unevaluated
56-001489	VEN-1489	Rockshelter with associated lithic scatter, midden, fire hearth, and pictographs	Unevaluated
56-001490	VEN-1490	Rockshelter with one associated lithic artifact	Unevaluated
56-001491	VEN-1491H	Sandstone boulder with historic inscriptions	Unevaluated
56-001492	VEN-1492	Rockshelter; lithic scatter	Unevaluated
56-001493	VEN-1493	Rockshelter; asphaltum fragments; faunal remains	Unevaluated
56-001495	VEN-1495	Lithic scatter	Unevaluated
56-001497	VEN-1497	Rockshelter; lithic scatter	Unevaluated
56-001568	VEN-1568	Sandstone boulder with artifact cache	Unevaluated
56-001569	VEN-1569	Cave with basket fragment	Unevaluated
Within SSFL but outside Area IV and NBZ			
SSFL, Area II			
56-000151 [b]	VEN-151	Midden deposit	Listed on the NRHP and California Register
56-000152 [b]	VEN-152	Midden, pictographs	Listed on the NRHP and California Register
56-000153 [b]	VEN-153	Midden, pictographs	Listed on the NRHP and California Register
56-000154 [b]	VEN-154	Midden, bedrock mortars, petroglyphs	Listed on the NRHP and California Register
56-000155 [b]	VEN-155	Petroglyphs	Listed on the NRHP and California Register
56-000156 [b]	VEN-156	Pictograph, rockshelter	Listed on the NRHP and California Register
56-000157 [b]	VEN-157	Pictograph, rockshelter	Listed on the NRHP and California Register
56-000158 [b]	VEN-158	Pictograph, rockshelter	Listed on the NRHP and California Register
56-000159 [b]	VEN-159	Pictograph, rockshelter	Listed on the NRHP and California Register
56-000160 [b]	VEN-160	Pictograph, rockshelter	Listed on the NRHP and California Register
56-000161 [b]	VEN-161	Pictograph, rockshelter	Listed on the NRHP and California Register
56-001065 [b]	VEN-1065	Two rockshelters with midden and associated artifacts	Listed on the NRHP and California Register
56-001066 [b]	VEN-1066	Rockshelter with pictograph	Listed on the NRHP and California Register
56-001067 [b]	VEN-1067	Pre-contact trail	Listed on the NRHP and California Register
56-001068 [b]	VEN-1068	Rockshelter with three bedrock milling stations	Listed on the NRHP and California Register
56-001072 [c]	VEN-1072	Burro Flats Painted Cave site	Listed on the NRHP and California Register
56-001800	VEN-1800	Rockshelter with associated artifacts	Unevaluated
SSFL, Area III			
56-001303	VEN-1303H	Building foundations, structure pads	Unevaluated

Primary Number	***Trinomial Site Number*** [a]	***Site Description***	***NRHP and California Register Eligibility***
Partially Within Area IV			
SSFL, in both Area III and Area IV			
56-001302	VEN-1302	Lithic scatter	Unevaluated
56-001411	VEN-1411	Large rockshelter/shallow cave with associated midden and dense lithic scatter	Unevaluated
56-001413	VEN-1413	Rockshelter with midden, bedrock mortar, and pictographs	Unevaluated
56-001417	VEN-1417	Rockshelter with associated lithic scatter	Unevaluated
Within Area IV and NBZ			
SSFL, Area IV			
56-001355	VEN-1355	Low-density marine shell scatter	Unevaluated
56-001412	VEN-1412	Rockshelter with associated lithic scatter	Unevaluated
56-001414	VEN-1414	Bedrock mortar with associated lithic scatter	Unevaluated
56-001415	VEN-1415	Lithic scatter	Unevaluated
56-001416	VEN-1416	Rockshelter with associated lithic scatter	Unevaluated
56-001418	VEN-1418	Rockshelter with one associated lithic artifact	Unevaluated
56-001420	VEN-1420	Lithic scatter	Unevaluated
56-001428	VEN-1428	Lithic scatter	Unevaluated
56-001772	VEN-1772	Cave with historic pictograph	Unevaluated
56-001773	VEN-1773	Rockshelter with associated artifacts	Unevaluated
56-001774	VEN-1774	Single bedrock mortar	Unevaluated
56-001775	VEN-1775	Rockshelter with midden and associated artifacts	Unevaluated
SSFL, NBZ			
56-001419	VEN-1419	Lithic scatter	Unevaluated
56-001421	VEN-1421	Rockshelter with associated lithic scatter	Unevaluated
56-001422	VEN-1422	Rockshelter with an associated lithic scatter	Unevaluated
56-001423	VEN-1423	Rockshelter/cave with associated rock feature	Unevaluated
56-001425	VEN-1425	Rockshelter/cave with an associated lithic scatter	Unevaluated
56-001426	VEN-1426	Rockshelter with one associated lithic artifact	Unevaluated
56-001427	VEN-1427	Rockshelter with an associated lithic scatter and faunal remains	Unevaluated
56-001803	VEN-1803	Lithic scatter	Unevaluated
56-001804	VEN-1804	Lithic scatter	Unevaluated
56-001805	VEN-1805	Lithic scatter with natural water cistern	Unevaluated

APE = Area of Potential Effects, consisting of Area IV and NBZ; California Register = *California Register of Historical Resources*; NBZ = Northern Buffer Zone; NRHP = *National Register of Historic Places*.

[a] All site numbers in the second column are preceded by "CA-."

[b] These sites are included within the boundaries of 56-001072/CA-VEN-1072 (the Burro Flats Painted Cave site).

[c] Site 56-001072/CA-VEN-1072 (the Burro Flats Painted Cave site) includes sites 56-000151/CA-VEN-151 through 56-000161/CA-VEN-161 and 56-001065/CA-VEN-1065 through 56-001068/CA-VEN-1068.

Note:

The APE comprises Area IV and the NBZ; the region of influence consists of SSFL and land within a 1-mile radius of SSFL (which includes the APE).

Table F–3 Previously Recorded Isolated Finds within the Region of Influence

Primary Number[a]	Location	Isolate Description	NRHP Eligibility
Outside SSFL but within 1 mile of SSFL			
56-100135	1-mile radius	Isolate—quartzite scraper plane	Unevaluated
56-100140	1-mile radius	Isolate—chert core	Unevaluated
56-100189	1-mile radius	Isolate—quartzite flake	Unevaluated
56-100256	1-mile radius	Isolate—quartzite flake	Unevaluated
56-100259	1-mile radius	Isolate—quartzite hammerstone	Unevaluated
Within SSFL but outside Area IV and NBZ			
56-100379	Area I	Isolate—fused shale flake	Unevaluated
56-100380	Area I	Isolate—quartzite core	Unevaluated
56-100381	Area I	Isolate—quartzite core	Unevaluated
56-100382	Area I	Isolate—quartzite flake	Unevaluated
56-100375	Area III	Isolate—quartzite flake	Unevaluated
56-100376	Area III	Isolate—quartzite flake	Unevaluated
56-100377	Area III	Isolate—quartzite flake	Unevaluated
56-100378	Area III	Isolate—quartzite shatter	Unevaluated
56-100385	Area III	Isolate—quartzite core	Unevaluated
56-100386	Area III	Isolate—quartzite core fragment	Unevaluated
56-100388	Area III	Isolate—quartzite core	Unevaluated
56-100329	SBZ	Isolate—quartzite core	Unevaluated
56-100330	SBZ	Isolate—quartzite core	Unevaluated
56-100331	SBZ	Isolate—chert flake	Unevaluated
56-100332	SBZ	Isolate—quartzite core fragment	Unevaluated
56-100333	SBZ	Isolate—quartzite flake	Unevaluated
56-100334	SBZ	Isolate—quartzite core fragment	Unevaluated
56-100336	SBZ	Isolate—chalcedony flake	Unevaluated
56-100337	SBZ	Isolate—quartzite core fragment	Unevaluated
56-100338	SBZ	Isolate—quartzite core	Unevaluated
56-100339	SBZ	Isolate—quartzite flake	Unevaluated
56-100370	SBZ	Isolate—quartzite cobble	Unevaluated
56-100371	SBZ	Isolate—quartzite flake	Unevaluated
56-100372	SBZ	Isolate—quartzite flake	Unevaluated
56-100374	SBZ	Isolate—quartzite core	Unevaluated
56-100383	SBZ	Isolate—quartzite core fragment	Unevaluated
56-100384	SBZ	Isolate—quartzite flake	Unevaluated
56-100202	Area III	Isolate--chalcedony flake	Unevaluated
Within Area IV and NBZ			
56-100198	Area IV	Isolate—steatite bowl rim fragment	Unevaluated
56-100258	Area IV	Isolate—quartzite hammerstone	Unevaluated
56-100282	Area IV	Isolate—quartzite core	Unevaluated
56-100283	Area IV	Isolate—quartzite core	Unevaluated
56-100284	Area IV	Isolate—quartzite core	Unevaluated
56-100286	Area IV	Isolate—quartzite flake	Unevaluated
56-100287	Area IV	Isolate—quartzite flake	Unevaluated
56-100288	Area IV	Isolate—quartzite flake	Unevaluated
56-100289	Area IV	Isolate—steatite arrowshaft straightener	Unevaluated
56-100290	Area IV	Isolate—fused shale debitage	Unevaluated
56-100291	Area IV	Isolate—quartzite flake	Unevaluated
56-100292	Area IV	Isolate—quartzite scraper/plane	Unevaluated
56-100294	Area IV	Isolate—quartzite core fragment	Unevaluated
56-100310	Area IV	Isolate—chert flake	Unevaluated

Primary Number [a]	*Location*	*Isolate Description*	*NRHP Eligibility*
56-100321	Area IV	Isolate—quartzite core	Unevaluated
56-100285	NBZ	Isolate—metavolcanic core	Unevaluated
56-100293	NBZ	Isolate—quartzite core	Unevaluated
56-100295	NBZ	Isolate—five quartzite core fragments and flakes	Unevaluated
56-100296	NBZ	Isolate—Monterey chert discoidal scraper	Unevaluated
56-100297	NBZ	Isolate—quartzite flake	Unevaluated
56-100298	NBZ	Isolate—quartzite flake	Unevaluated
56-100299	NBZ	Isolate—Pismo clam fragment	Unevaluated
56-100300	NBZ	Isolate—quartzite flake	Unevaluated
56-100301	NBZ	Isolate—quartzite core	Unevaluated
56-100302	NBZ	Isolate—quartzite flake	Unevaluated
56-100303	NBZ	Isolate—quartzite core	Unevaluated
56-100304	NBZ	Isolate—quartzite flake	Unevaluated
56-100305	NBZ	Isolate—quartzite flake	Unevaluated
56-100306	NBZ	Isolate—quartzite or basalt flake	Unevaluated
56-100307	NBZ	Isolate—quartzite core	Unevaluated
56-100308	NBZ	Isolate—quartzite core	Unevaluated
56-100309	NBZ	Isolate—quartzite flake	Unevaluated
56-100311	NBZ	Isolate—quartzite core	Unevaluated
56-100312	NBZ	Isolate—quartzite core	Unevaluated
56-100313	NBZ	Isolate—quartzite core	Unevaluated
56-100314	NBZ	Isolate—quartzite core	Unevaluated
56-100315	NBZ	Isolate—quartzite core	Unevaluated
56-100316	NBZ	Isolate—quartzite core fragment	Unevaluated
56-100318	NBZ	Isolate—bifacial granite mano	Unevaluated
56-100319	NBZ	Isolate—quartzite flake	Unevaluated
56-100320	NBZ	Isolate—quartzite scraper/plane	Unevaluated
56-100322	NBZ	Isolate—quartzite scraper/plane/chopper	Unevaluated
56-100323	NBZ	Isolate—quartzite flake	Unevaluated
56-100324	NBZ	Isolate—fused shale projectile point	Unevaluated
56-100325	NBZ	Isolate—fused shale utilized flake	Unevaluated
56-100326	NBZ	Isolate—quartzite core	Unevaluated
56-100327	NBZ	Isolate—fused shale chunk	Unevaluated
56-100328	NBZ	Isolate—quartzite core	Unevaluated
56-100471	NBZ	Isolate—quartzite shatter	Unevaluated
56-100472	NBZ	Isolate—quartzite flake	Unevaluated
56-100473	NBZ	Isolate—quartzite core	Unevaluated
56-100474	NBZ	Isolate—quartzite flake	Unevaluated
56-100475	NBZ	Isolate—ground-stone mano	Unevaluated

APE = Area of Potential Effects, consisting of Area IV and NBZ; NBZ = Northern Buffer Zone; NRHP = *National Register of Historic Places*; SBZ = Southern Buffer Zone.

[a] California does not assign trinomials to isolated finds.

Note:

The APE comprises Area IV and the NBZ; the region of influence consists of SSFL and land within a 1-mile radius of SSFL (which include the APE).

F.2.4 Architectural Resources within the Area of Potential Effects

All standing structures at SSFL Area IV and the NBZ have been inventoried and evaluated for NRHP eligibility. The most recent inventory produced a historic structures/sites report prepared for DOE in 2009, following Federal guidelines for historic cultural resource studies (Post/Hazeltine Associates 2009). The historic structures/sites report includes:

- documentation of the historic context and physical appearance of the resources within the project site, including individual buildings, structures, and features on these parcels;
- evaluation of the integrity of Area IV of SSFL and its individual components;
- identification of potential historic, architectural, and cultural resources within the project site;
- evaluation of the potential eligibility of historic resources for listing at the Federal level; and
- evaluation of the potential eligibility of historic resources for listing at the state level.

The 2009 study indicates that the decommissioning and demolition process (ongoing since the mid-1970s) has significantly impacted the setting of Area IV by removing buildings, structures, and features (Post/Hazeltine Associates 2009). At the time of the 2009 study, more than 75 percent of the buildings, structures, and features associated with Area IV during its period of significance had been demolished (Post/Hazeltine Associates 2009).

The 2009 study concluded that Area IV of SSFL is not eligible for listing in the NRHP or the California Register as a historic district, primarily because it lacks sufficient integrity to convey its historic appearance or association with the history of nuclear power research and development in the United States and the post–World War II transformation of California (Post/Hazeltine Associates 2009). None of the buildings, structures, or architectural features within Area IV is individually eligible for listing in the NRHP or the California Register (Post/Hazeltine Associates 2009). The SHPO concurred with the finding that none of the inventoried buildings were eligible for listing on the NRHP (OHP 2010), and also that Area IV of SSFL is not eligible as a historic district based on architectural elements.

Under NRHP criterion A (association with significant events), the buildings have a direct association with two important historic episodes: (1) the United States' and California's nuclear power research and development in the post–World War II period and (2) the post–World War II economic and population development of Southern California. However, the buildings lack integrity, particularly of setting and feeling, and cannot convey the association (Post/Hazeltine Associates 2009). Under NRHP criterion B (association with significant persons), although Area IV of SSFL has a direct association with various nuclear research and development programs from the late 1940s until the mid-1980s, none of the many scientists and technicians who worked at SSFL during this period appears to have made individual contributions of such note that Area IV, or any of its individual components, meets this criterion (Post/Hazeltine Associates 2009). Under NRHP criterion C (embodying distinctive architectural characteristics), the remaining buildings, structures, and features in Area IV, while functional in design, were constructed with concrete and/or prefabricated metal and do not meet this criterion (Post/Hazeltine Associates 2009). The evaluation of architectural resources in SSFL Area IV under NRHP criterion D (likely to yield information important in prehistory or history) was not considered in the 2009 Post/Hazeltine Associates report.

F.2.5 Traditional Cultural Properties

No traditional cultural properties have been formally identified in Area IV or the NBZ by the South Central Coastal Information Center, of the California Historical Resources Information System, the California Register, or the NRHP. Outside of Area IV and the NBZ, one archaeological site located in Area II (on land owned by the U.S. Government and managed by NASA), CA-VEN-1072/56-001072 (the Burro Flats Painted Cave site) may be considered a traditional cultural property.

The Santa Ynez Band of Chumash Indians, a federally recognized tribe, submitted a nomination form (NAHC 2014) to the Native American Heritage Commission. The application states, in part:

> All of those who have had the opportunity to visit agree that the Burro Flats Painted Cave and the surrounding Santa Susana Field Laboratory (where numerous Native American sites are now known to exist) are part of a large and important Traditional Cultural Landscape. Today, many indigenous people consider the Burro Flats Painted Cave to be a very important shrine site, and feel strongly that it and the surrounding area are important to their culture. It is for this reason that the Elder's Council of the Santa Ynez Band of Chumash Indians has requested that the entire former Santa Susana Field Lab be described as <u>the Santa Susana Sacred Sites and Traditional Cultural Property</u> by the State of California.

Currently, DOE, the Santa Ynez Band of Chumash Indians, and the California Office of Historic Preservation are in consultation as to how this nomination affects management of cultural resources on SSFL.

DOE's cultural resources consultations for proposed cleanup activities at SSFL date to 2009. DOE formally initiated Government-to-Government consultation in January 2014 with the Santa Ynez Band of Chumash Indians, the federally recognized tribe involved with SSFL. At the time, DOE also formally issued an invitation to the Santa Ynez Band of Chumash Indians to be a cooperating agency for DOE's *SSFL Area IV EIS*, and the invitation was accepted (Santa Ynez Band of Chumash Indians 2014). Formal consultation is in compliance with National Historic Preservation Act, National Environmental Policy Act (NEPA), Executive Orders 13007 and 13175, and the Presidential *Memorandum on Government-to-Government Relations with Native American Tribal Governments*. Consultation is further guided by the principles described by the Advisory Council on Historic Preservation (ACHP 2008, 2012), and DOE follows DOE Order 144.1, *Department of Energy American Indian Tribal Government Interactions and Policy*. Other authorities that could be invoked include the Native American Graves Protection and Repatriation Act and the American Indian Religious Freedom Act.

DOE has also consulted with tribes that are not federally recognized throughout its SSFL NEPA and Section 106 processes. In July 2014, DOE hosted a Native American Sacred Sites Summit Meeting, which resulted in formation of the Santa Susana Field Laboratory Sacred Sites Council (SSFL Sacred Sites Council). The SSFL Sacred Sites Council includes representatives from the federally recognized Santa Ynez Band of Chumash Indians, as well as other interested tribes that are not federally recognized, including the Fernandeño Tataviam, Ventureño, and Gabrielino Tongva. The SSFL Sacred Sites Council meets regularly to consider topics regarding relevant issues and concerns, including properties at SSFL that are of traditional or religious cultural importance to the tribes. They have contributed to this EIS, including preparing their tribal histories and perspectives (see Chapter 9, "Native American Histories and Perspectives").

F.3 References

ACHP (Advisory Council on Historic Preservation), 2008, *Consultation with Native American Tribes in the Section 106 Review Process: A Handbook*, Washington, DC (available at http://www.achp.gov/regs-tribes2008.pdf), November.

ACHP (Advisory Council on Historic Preservation), 2012, *Traditional Cultural Landscapes in the Section 106 Review Process*, Washington, DC (available at http://www.achp.gov/na_culturallandscapes.html), March.

Applegate, R. B., 1974, "Chumash Placenames," *The Journal of California Anthropology*, Vol. 1, No. 2, University of California Merced Library (available at http://escholarship.org/uc/item/3s34f5ss).

Bean, L. J. and C. R. Smith, 1978, "Gabrielino," *Handbook of the North American Indians*, Vol. 8, *California,* R. F. Heizer, Ed., Smithsonian Institution, Washington, DC, pp. 538-549.

Beck, W. A. and Y. D. Haase, 1974, *Historical Atlas of California*, University of Oklahoma Press, Norman, Oklahoma.

Bissell, R. M., 1989, *Cultural Resources Summary of the Ahmanson Ranch Property, 5500 Acres in Ventura County, California*, RMW Paleo Associates, Mission Viejo, California, on file under V-1174, South Central Coastal Information Center of the California Historical Resources Information System, California State University, Fullerton, Fullerton, California, November 29.

Bryne, S., 2014, *Archaeological Survey, Site Verification, and Monitoring Performed During the Phase 3 Soil Chemical Sampling in Area IV, the Northern Buffer Zone, and Adjacent Lands Santa Susana Field Laboratory Ventura County, California*, Leidos, Inc., November.

Cameron, J. S., 1963, *Simi Grows Up The Story of Simi, Ventura County, California*, Anderson, Ritchie & Simon, Simi, California.

City of Simi Valley, 1980, Letter from M. W. Kuhn, Environmental Planner, Department of Community Development, City of Simi Valley, to M. Rosen, Archaeological Survey, "RE: Response Letter of April 21, 1980," on file under V-280, South Central Coastal Information Center of the California Historical Resources Information System, California State University, Fullerton, Fullerton, California, April 23.

Clewlow, C. W., Jr. and M. R. Walsh, 1999, *Cultural Resource Assessment and Report on Archival Research, Surface Reconnaissance, and Limited Subsurface Evaluation at Rocketdyne Santa Susana Field Laboratory, Ventura County, California*, on file under VN-1818, South Central Coastal Information Center of the California Historical Resources Information System, California State University, Fullerton, Fullerton, California, July 16.

Corbett, R. and R. B. Guttenberg, 2014, *Phase I Archaeological Survey Santa Susana Field Laboratory Area I, Area III, and Southern Undeveloped Land, Ventura County, California*, John Minch and Associates, Inc., Mission Viejo, California, on file under VN-03154, South Central Coastal Information Center of the California Historical Resources Information System, California State University, Fullerton, Fullerton, California, February.

Corbett, R., R. B. Guttenberg, and A. Knight, 2012, *Final Report: Cultural Resource Compliance and Monitoring Results for USEPA's Radiological Study of the Santa Susana Field Laboratory Area IV and Northern Buffer Zone*, Mission Viejo, California.

Craft, A. M. and S. L. Mustain, 2007a, *Archaeological Survey Report for Southern California Edison Company Big Rock 16kV Reconductor O&M Project, Ventura County, California*, John & Stokes, San Diego, California, on file under VN-2607, South Central Coastal Information Center of the California Historical Resources Information System, California State University, Fullerton, Fullerton, California, October.

Craft, A. M., and S. L. Mustain, 2007b, *Archaeological Survey Report for Southern California Edison Company Energy Circuit 16kV o/o Chatsworth Sub DSP Project, Ventura County, California*, John & Stokes, San Diego, California, on file under VN-2611, South Central Coastal Information Center of the California Historical Resources Information System, California State University, Fullerton, Fullerton, California, October.

Edberg, B., 1985, "Shamans and Chiefs: Visions of the Future," *Earth and Sky*, A. Benson and T. Hoskinson, Ed., Slo'w Press, Thousand Oaks, California, pp. 65-92.

Edwards, R. D., D. F. Rabey, and R. W. Kover, 1970, *Soil Survey Ventura Area, California*, U.S. Department of Agriculture, Soil Conservation Service, April.

Emmick, J. and J. C. Bard, 2008, *Final Cultural Resources Inventory of Santa Susana Field Laboratory NASA Areas I and II, Ventura County, California*, EPA ID No. 1800013863, on file under VN-2711, South Central Coastal Information Center of the California Historical Resources Information System, California State University, Fullerton, Fullerton, California, April.

Fenenga, F., 1973, *An Archaeological Survey of the Area of Air Force Plant 57, Coca Test Area, Santa Susana Field Laboratory, Ventura County, California*, on file under V-211, South Central Coastal Information Center of the California Historical Resources Information System, October.

Glassow, M. A., L. H. Gamble, J. E. Perry, and G. S. Russell, 2007, "Prehistory of the Northern California Bight and the Adjacent Transverse Ranges," *California Prehistory Colonization, Culture, and Complexity*, T. L. Jones and K. A. Klar, Ed., Altamira Press, Lanham, Maryland, pp. 191-213.

Glenn, B., 1991, *Typological Analysis of Projectile Points Recovered from Excavations on Vandenberg Air Force Base, Santa Barbara County, California*, M.A. thesis, University of California Los Angeles, Archaeology Program, Los Angeles, California.

Grant, C., 1965, *The Rock Paintings of the Chumash A Study of a California Indian Culture*, University of California Press, Berkeley and Los Angeles, California.

Grant, C., 1978a, "Chumash: Introduction," *Handbook of the North American Indians*, Vol. 8, *California,* R. F. Heizer, Ed., Smithsonian Institution, Washington, DC, pp. 505-508.

Grant, C., 1978b, "Eastern Coastal Chumash," *Handbook of the North American Indians*, Vol. 8, *California,* R. F. Heizer, Ed., Smithsonian Institution, Washington, DC, pp. 509-519.

Guttenberg, R. and R. Corbett, 2010, *Project Description and Cultural Resources Assessment, Santa Susana Field Laboratory, Northern Undeveloped Lands Radiological Study, Ventura County, California*, John Minch and Associates, Inc., Mission Viejo, California, October.

Havens, P., 1997, *Simi Valley: A Journey Through Time*, Simi Valley Historical Society and Museum, Simi Valley, California.

Hogan, M. and B. Tang, 2010, *Cultural Resources Identification Survey Northern Undeveloped Land at the Santa Susana Field Laboratory Site Simi Hills Area, Ventura County, California,* CRM Tech, Colton, California, June 10.

Holland, D., 2010, *Integrated Cultural Resources Management Plan for Santa Susana Field Laboratory, Ventura County, California*, *January 2009-2013*, National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Alabama, on file under VN-02994, South Central Coastal Information Center of the California Historical Resources Information System, California State University, Fullerton.

Hoover, M. B., H. E. Rensch, and E. G. Rensch, 1966, *Historic Spots in California*, Third edition, Stanford University Press, Stanford, California.

Johnson, J. R., 1997, "Chumash Indians in Simi Valley," Chapter 1, *Simi Valley: A Journey Through Time*, P. Havens, Simi Valley Historical Society, Simi Valley, California, pp. 5-21.

Johnson, J. R., 2006, *Ethnohistoric Overview for the Santa Susana Pass State Historic Park Cultural Resources Inventory Project*, Santa Barbara Museum of Natural History, Santa Barbara, California, June.

King, C. D., 1990, *Evolution of Chumash Society: A Comparative Study of Artifacts Used for Social System Maintenance in the Santa Barbara Channel Region Before A.D. 1804*, Garland Publishing, New York.

King, C., 2006, *Archaeological Assessment of Areas Burned by the Topanga Fire, Ventura and Los Angeles Counties, California*, Topanga Anthropological Consultants, Topanga, California, on file under VN-03152, South Central Coastal Information Center of the California Historical Resources Information System, California State University, Fullerton, October.

King, C. and J. Parsons, 1999, *Malu'liwini Archaeological Records of Settlement and Activity in the Simi Hills*, Topanga Anthropological Consultants, Topanga, California, on file under VN-2239, South Central Coastal Information Center of the California Historical Resources Information System, California State University, Fullerton, Fullerton, California, July 7.

King, C. and T. C. Blackburn, 1978, "Tataviam," *Handbook of North American Indians*, Vol. 8, *California*, R. F. Heizer, Ed., Smithsonian Institution, Washington, DC, pp. 535-537.

Knight, A., 2001, Rock Art of the Santa Monica and Santa Susana Mountains, Santa Barbara Museum of Natural History, Santa Barbara, California, unpublished manuscript on file at Leidos, Carpinteria, California, July.

Knight, A., n.d., "Recent Investigations at Burro Flats (CA-VEN-102), Ventura County, California," *Society for California Archaeology Newsletter*, Vol. 29, No. 5, Santa Susana Mountain Parks Association, Chatsworth, California.

Kroeber, A. L., 1925, "The Chumash," Chapter 37, *Handbook of the Indians of California*, 1976 edition by Dover Publications, Inc., New York, New York.

Krupp, E. C., 1994, *Echoes of the Ancient Skies The Astronomy of Lost Civilizations*, 2003 edition by Dover Publications, Inc., Mineola, New York.

La Monk, C. S., 1953, *Pictograph Cave Burro Flats*, on file under V-1089, South Central Coastal Information Center of the California Historical Resources Information System, California State University, Fullerton, Fullerton, California.

Landberg, L. C. W., 1965, *The Chumash Indians of Southern California*, Southwest Museum Papers No. 19, Southwest Museum, Los Angeles, California.

Lopez, R., 1975, *An Archaeological Survey of the Southern Pacific Milling Company's Runkle Canyon Gravel Quarry Lease, Simi Valley, Ventura County, California*, on file under VN-845, South Central Coastal Information Center of the California Historical Resources Information System, California State University, Fullerton, Fullerton, California, December.

McCawley, W., 1996, *The First Angelinos The Gabrielino Indians of Los Angeles*, Malki Museum Press, Banning, California, and Ballena Press, Novato, California.

Mealey, M. and N. Brodie, 2005, *Santa Susana Pass State Historic Park Cultural Resources Inventory Archaeology,* California State Parks, Southern Service Center, October.

Mills and Brickfield, 1986, *The Papers of John Peabody Harrington in the Smithsonian Institution 1907-1957,* E. L. Mills and A. J. Brickfield, Ed., Vol. 3, *A Guide to the Field Notes: Native American History, Language and Culture of Southern California/Basin,* prepared in the National Anthropological Archives, Department of Anthropology, National Museum of Natural History, Washington, DC, Kraus International Publications, White Plains, New York.

NAHC (Native American Heritage Commission), 2014, *Native American Heritage Commission Sacred Lands Inventory, Santa Susana Sacred Sites and Traditional Cultural Landscape*.

NAHC (Native American Heritage Commission), 2015, *California Indians Language Groups*, based on Hinton, Leanne, *Flutes of Fire: Essays on California Indian Languages*, Berkeley, California, (accessed on June 3, 2015, http://www.parks.ca.gov/?page_id=23548).

OHP (Office of Historic Preservation, California Department of Parks and Recreation), 2010, Personal communication (email) from M. W. Donaldson, State Historic Preservation Officer, to C. Cooper, U.S. Environmental Protection Agency, July 15.

Orfila, R. S., 2009, Personal communication (email) to A. Williams, Southern California Edison, "RE: *Archaeological Survey for the Southern California Edison Company: Replacement of Two Deteriorated Power Poles on the Saugus-Haskell-Solemint 66kV Line, Newhall, Los Angeles County (WO 4605-2208), One Deteriorated Power Pole on the Burro Flats-Chatsworth-Thrust 66kV Line, Chatsworth, Ventura County (WO 4605-2352), One Deteriorated Power Pole on the Seacliff 16KV Line, Rincon Point, Ventura County (WO 6059-4800 E-4803), One Deteriorated Power Pole on the Crabtree 16KV Line, Saugus, Los Angeles County (WO 6059-4800-94881), One Deteriorated Power Pole on the Clarinet 16 KV Line, Martins, Los Angeles County (WO 6059-4800-94883),* and *One Deteriorated Power Pole on the Guitar 16 KV Line, Wayside Honor Rancho, Los Angeles County (WO 6059-4800-94885)*," RSO Consulting, Bakersfield, California, on file under VN-02879, South Central Coastal Information Center of the California Historical Resources Information System, California State University, Fullerton, November 8.

Pence Archaeological Consulting, 1987a, *Archaeological Reconnaissance of the Proposed Cerwin Ranch Development for Conditional Use Permit Number CUP-4440*, Simi Valley, California, on file under V-571, South Central Coastal Information Center of the California Historical Resources Information System, California State University, Fullerton, Fullerton, California.

Pence Archaeological Consulting, 1987b, *Archaeological Reconnaissance and Test of TT 3045, Simi Valley*, Simi Valley, California, on file under V-696, South Central Coastal Information Center of the California Historical Resources Information System, California State University, Fullerton, Fullerton, California, October 2.

Pence, R. L., 1978, *Archaeological Assessment of TT 3045, Simi Valley, California*, on file under V-389, South Central Coastal Information Center of the California Historical Resources Information System, California State University, Fullerton, Fullerton, California, February 28.

Post/Hazeltine Associates, 2009, *Historic Structures/Sites Report for Area IV of the Santa Susana Field Laboratory*, Santa Barbara, California, on file under VN-02996, South Central Coastal Information Center of the California Historical Resources Information System, California State University, Fullerton, April 9.

Redtfeldt, G., n.d, *Prehistoric Indian Rock Art of California*, Lemon Cove, California, on file under V-1058, South Central Coastal Information Center of the California Historical Resources Information System, California State University, Fullerton, Fullerton, California.

Reid, J. H., 2006, *Great Hollywood Westerns: Classic Pictures, Must-see Movies & "B" Films.*

Ricard, H. F., 1972, "Place Names of Ventura County," *Ventura County Historical Society Quarterly*, Vol. 17, No. 2, Winter.

Roderick, K., 2001, *The San Fernando Valley: America's Suburb*, Los Angeles Times Books, Los Angeles, California.

Romani, G., 2009, *Archaeological Survey Report: Southern California Edison Proposed Fiber Optic Moorpark East Copper Cable Replacement Project, Los Angeles and Ventura Counties, California*, Compass Rose Archaeological, Inc., Van Nuys, California, on file under VN-02797, South Central Coastal Information Center of the California Historical Resources Information System, California State University, Fullerton, September 7.

Romani, J., 1981, *Astronomy and Social Integration: An Examination of Astronomy in a Hunter and Gatherer Society*, M.A. thesis, California State University, Northridge, California, June.

Romani, J., D. Larson, G. Romani, and A. Benson, 1985a, "Astronomy, Myth, and Ritual in the West San Fernando Valley," *Visions of the Sky: Archaeological and Ethnological Studies of California Indian Astronomy*, G. S. Breschini, T. Haversat, Ed., Coyote Press, Salinas, California, pp. 109-134.

Romani, J., G. Romani, and D. Larson, 1985b, "Astronomical Investigations at Burro Flats: Aspects of Ceremonialism at a Chumash/Gabrielino Rock Art and Habitation Site," *Earth and Sky*, A. Benson and T. Hoskinson, Ed., Slo'w Press, Thousand Oaks, California, pp. 93-108.

Rozaire, C. E., 1959, "Pictographs at Burro Flats," *Ventura County Historical Society Quarterly*, Vol. 4, No. 2, February.

Santa Barbara Museum of Natural History Education Center, 1988, *California's Chumash Indians*, EZ Nature Books, San Luis Obispo, California.

Santa Ynez Band of Chumash Indians, 2014, Letter from V. P. Armenta, Tribal Chairman, to S. Jennings, NEPA Document Manager, U.S. Department of Energy, "Re: Santa Susana Field Laboratory (SSFL), Area IV and Northern Buffer Zone EIS, Acceptance of invitation to be Cooperating Agency," Santa Ynez, California, February 9.

SCCIC (South Central Coastal Information Center), 2009, Letter from M. Galaz to S. Bryne, SAIC, "RE: Records Search for the Santa Susana Field Laboratory" (SCCIC #10100.6981), December 22.

SCCIC (South Central Coastal Information Center), 2014, Letter from L. Noyes to S. Bryne, Leidos, Inc., "RE: Santa Susana Field Laboratory" (SCCIC #14058.219), June 10.

Timbrook, J., 2007, *Chumash Ethnobotany Plant Knowledge Among the Chumash People of Southern California*, Santa Barbara Museum of Natural History, Santa Barbara, California, and Heyday Books, Berkeley, California.

Van Horn, D. M., 1980, Archaeological Survey Report: The Ventura County Portion of the Las Virgenes Ranch (Draft), Archaeological Resources, Ltd., Costa Mesa, California, on file under V-714, South Central Coastal Information Center of the California Historical Resources Information System, California State University, Fullerton, Fullerton, California, April 17.

Ventura County Historical Society, 1972, *Ventura County Historical Society Quarterly*, Vol. 17, No. 2, Winter.

W&S Consultants, 1990, *Phase I Archaeological Survey and Resource Assessment of the Rancho Pacifica Property, Runkle Ranch, City of Simi Valley, Ventura County, California*, Canoga Park, California, on file under V-924, South Central Coastal Information Center of the California Historical Resources Information System, California State University, Fullerton, Fullerton, California. April 18.

W&S Consultants, 1991, *Phase II Archaeological Test Excavations at CA-VEN-1017 and CA-VEN-1018, Simi Valley, Ventura County, California*, Canoga Park, California, on file under V-968, South Central Coastal Information Center of the California Historical Resources Information System, California State University, Fullerton, Fullerton, California, January 14.

W&S Consultants, 1992, *Phase I Archaeological Survey and Assessment of Two Areas of Unauthorized Grading on the Czerwinski Portion of the Runkle Ranch Specific Plan Area, Simi Valley, Ventura County, California*, Canoga Park, California, on file under V-1178, SCCIC, California State University, Fullerton, California, October 30.

W&S Consultants, 2001, Class III Inventory/Phase I Archaeological Survey of the Santa Susana Field Laboratory Area 4, Ventura County, California, Sun Valley, California, on file under VN-2480, South Central Coastal Information Center of the California Historical Resources Information System, California State University, Fullerton, Fullerton, California, September 24.

Appendix G
Human Health

APPENDIX G
HUMAN HEALTH

G.1 Introduction

This appendix to the *Draft Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory* presents the methods used to estimate human health effects from exposure to the Santa Susana Field Laboratory (SSFL) Area IV and Northern Boundary Zone (NBZ) sources. The potential for adverse health impacts was based on a screening level evaluation that incorporates numerous assumptions and uncertainties. The assessment was conducted to generate reasonably conservative results that are unlikely to be exceeded.

The primary components of the impact assessment are:

- site characterization,
- exposure assessment,
- toxicity evaluation (in terms of risk-based screening levels (RBSLs), and
- estimation of health effects (i.e., impact characterization).

The site characterization (as discussed in Chapter 3) provided media concentrations of chemical and radioactive constituents (CDM Smith 2017; HGL 2012),[1] which were compared with RBSLs (cancer risk for carcinogens or hazard index for noncarcinogens) to provide an estimate of potential impacts on receptors. Additionally, building survey measurements were used in the evaluation of potential worker exposure during building removal.

The screening levels were specific to each receptor and incorporate the exposure assessment and toxicity evaluation components of the impact assessment. The potential health effects were then calculated from the ratio of the site media concentrations to the screening levels. Each component of the human health impact assessment is discussed in the following sections.

G.2 Site Characterization

The site characterization for the impact assessment considered the physical location of the site source areas and laboratory measurements from media sampling of constituent concentrations in the Area IV and NBZ source areas and offsite background locations. For this evaluation, the data were limited to analytical results of soil sampling (see Section G.3.3). Groundwater was not included in the assessment because groundwater wells at Area IV have pumping rates of about 0.5 to 1 gallon per hour (CDM Smith 2015), which is insufficient for residential use. Additionally, building surface radiological survey measurements were used in the decontamination and decommissioning (D&D) worker evaluation, which is presented in Section G.8.

The geographical locations of Area IV and the NBZ and additional physical descriptions of the soil source areas are presented in Chapter 3 and are summarized in this section. Area IV and the NBZ are located within a secured perimeter fence that limits access to the soil sources. The area surrounding SSFL includes recreational areas and residential developments, primarily to the south and northeast. There are nine sub-areas of interest for the public human health impacts assessment;

[1] HydroGeoLogic, Inc., was the U.S. Environmental Protection Agency contractor that performed radiological soil characterization of Area IV and the NBZ. CDM Smith was the U.S. Department of Energy contractor that performed chemical soil characterization.

they include eight sub-areas in Area IV (Sub-areas 3, 5A, 5B, 5C, 5D, 6, 7, and 8) and the NBZ (see **Figure G–1**). The soils in the sub-areas are generally characterized as sandy loam, and exposed bedrock is prevalent.

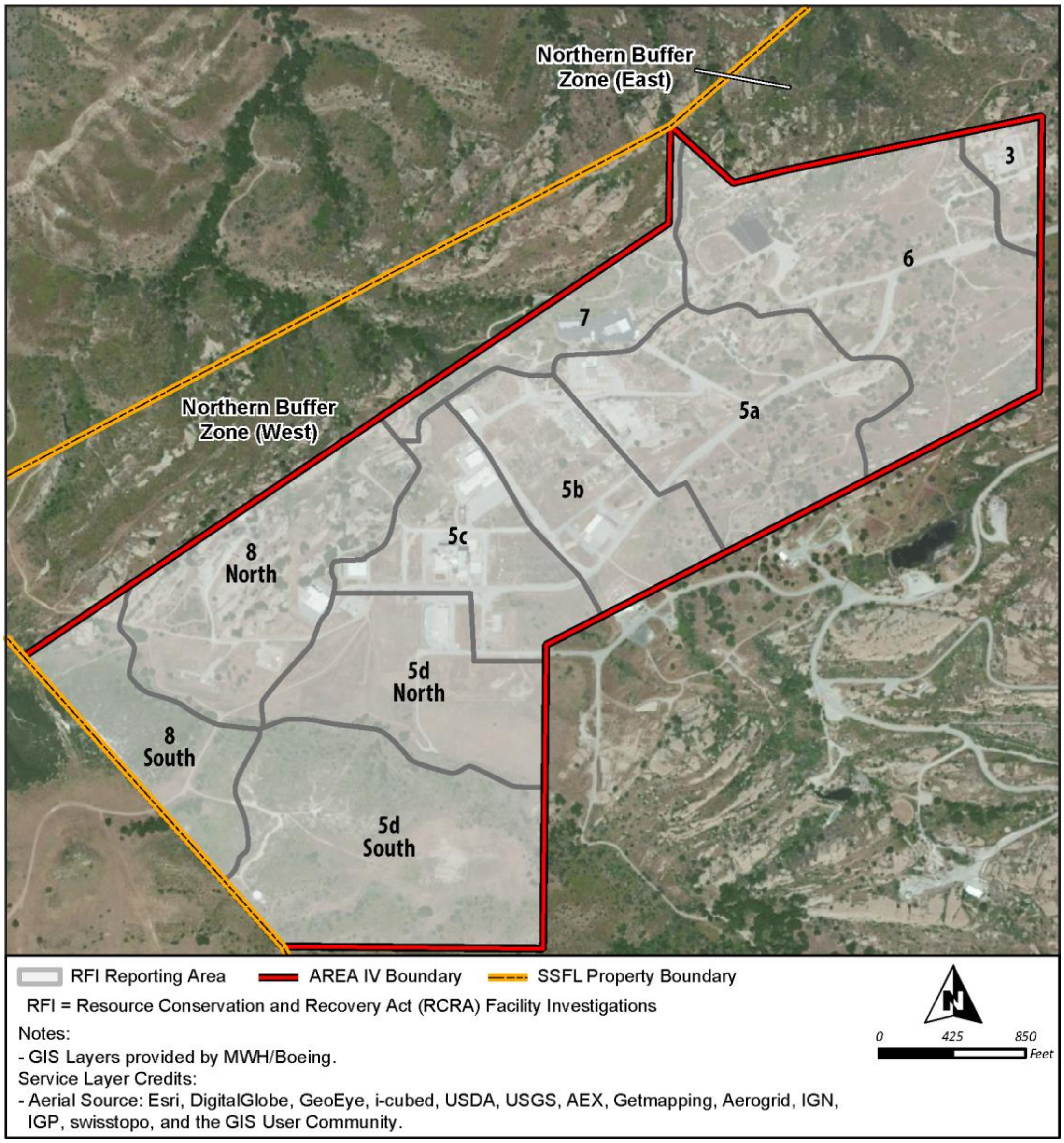


Figure G–1 Santa Susana Field Laboratory Area IV Soil Characterization Sub-areas

G.2.1 Laboratory Analytical Results

The analytical laboratory results from soil sampling of the chemical and radiological source areas at Area IV and the NBZ were the basis for the impact assessment.

The U.S. Environmental Protection Agency (EPA) collected 3,487 soil samples and 55 sediment samples for radiological characterization. Results of the radiological characterization effort are presented in the *Final Radiological Characterization of Soils, Area IV and the Northern Buffer Zone, Area IV Radiological Study, Santa Susana Field Laboratory, Ventura County, California* (HGL 2012). Soil samples were analyzed for up to 55 radionuclides, depending on the operational history of the area being sampled; not all samples were analyzed for all radionuclides. EPA also conducted an extensive background study for the presence of radionuclides in the region of SSFL (HGL 2011)[2] that demonstrated the variability in the levels of activity of naturally occurring radionuclides. Therefore, EPA noted that the activity levels of some radionuclides could exceed background levels without being attributed to site operations (HGL 2012).

The U.S. Department of Energy (DOE) conducted soil sampling for chemical analysis in three phases. In Phase 1, EPA collected two soil samples at its sampling locations and provided one from each location to DOE for chemical analysis. This phase included sampling the drainages leading into the NBZ and the drainages in Area III. In Phase 2, DOE conducted random soil sampling with EPA in the NBZ. Phase 3 soil sampling was based on a data gap analysis using the information collected for Area IV to determine where additional soil sampling was needed. DOE's Phase 3 sampling only involved analysis of samples for chemicals because EPA conducted its own independent Phase 3 radiological soil sampling. During the chemical constituent sampling and analysis conducted per the 2010 *Administrative Order on Consent for Remedial Action* (DTSC 2010), 5,854 soil samples were collected. Results of the chemical characterization effort are presented in the *Chemical Data Summary Report*, *Santa Susana Field Laboratory, Ventura County, California* (CDM Smith 2017).

Statistical evaluations of the analytical data were used to generate soil concentrations of chemicals and radionuclides that are representative of the central tendency in the Area IV and NBZ and background data sets, as described in the following sections. The term "central tendency" describes values that are most typically found in the overall distribution of values (it may be represented by an average such as a median or mean), as opposed to upper-boundary values that might reflect the extremes of the distribution. For purposes of analysis in this environmental impact statement (EIS), central tendency is represented by the median or mean (arithmetic). Statistical parameters used in the evaluation are presented in Section G.2.2.2, and the sources of the soil characterization data are described in Chapter 3, Section 3.9.3.2.

G.2.2 Data Evaluation

The available Area IV and NBZ soil data were compiled into a database for subsequent evaluation and use in the impact assessment. The soil concentration data for radiological and chemical constituents included results from both Area IV and the NBZ, as well as from offsite background locations. The data evaluation incorporated the following:

- development of constituent lists that represent potential receptor exposures;
- compilation of representative summary statistics for constituents in Area IV and the NBZ and offsite background media; and
- incorporation of specific data considerations, such as adjustments to radiological and chemical database values to reflect analytical laboratory issues or a summation of data for a particular chemical group.

Each of these steps is described in the following sections. These data were used to calculate representative Area IV, NBZ, and offsite background concentrations of constituents in soil for use in the impact assessment.

---

[2] HydroGeoLogic, Inc., was the EPA contractor that performed chemical characterization of off-SSFL reference areas. The characterization data provide background soil concentrations to which samples collected at SSFL can be compared.

G.2.2.1 Constituent Lists

The laboratory analysis of soil samples produced concentrations of constituents that may be above or below the detection limits of the analytical instruments. Chemical constituents that were reported as detected (CDM Smith 2017) and radioactive constituents found above the EPA field action levels (FALs) (HGL 2012) were included in the impact assessment analysis.

For the radiological assessment, additional constituents were added to the data set to reflect the ingrowth of decay progeny isotopes and account for their contributions to dose and risk (e.g., polonium-210). These daughter isotopes are associated with and assumed to be in activity equilibrium with the parent isotopes that have been detected in soil in order to address their contribution to dose and risk.

The background constituent list included the natural uranium and thorium decay chain radionuclides, with these isotopes contributing a major portion of the overall radiological impacts from background. EPA determined in its site survey that analytical results associated with uranium and thorium decay chain radionuclides that were greater than its FALs or radiological trigger levels[3] were from natural background sources in most cases (HGL 2012).[4] However, the data show that the variability in the natural background from location to location is significant (as evidenced by negative incremental differences from background when including the uranium and thorium decay chain radionuclides) and may mask the incremental impacts from other site-related radionuclides (from processes versus background) when viewing the total radiological impacts. Therefore, DOE calculated the incremental radiological impacts with and without the uranium and thorium decay chain radionuclides to avoid introducing a negative bias based on the background variability.

For this evaluation, the hypothetical suburban residential and recreational receptors were selected for analysis as the most likely exposures, as presented in Section G.3. Because the analytes detected in soil vary for each sub-area, the constituent list is specific to the receptor (that is, a resident or recreational user) and location (that is, background or Area IV and the NBZ) under evaluation. The development of the location-specific constituent lists is detailed below and reflected in the constituents presented in the tables in this appendix.

G.2.2.2 Summary Statistics

The soil data presented in this section represent statistical summaries of the raw analytical data collected from the site and offsite background locations where samples were collected (HGL 2011; URS 2012).[5] The statistical values selected as representative differ based on available data and interpretations regarding the nature of the sampling (e.g., biased sampling based on known sources or random sampling of potential source areas). The available statistics were used to represent the data as follows:

- Site radiological data – The median of detected results above the EPA FALs was used to generate the values presented in **Table G–1** for each sub-area in Area IV and the NBZ.

---

[3] The radiological trigger levels were based on the background threshold level (BTV) or the highest laboratory-associated minimum detectable concentration (MDC), whichever was higher, plus a method uncertainty factor that was not included in the FALs. A laboratory result that exceeded the radiological trigger level indicated that the sample concentration was likely to have exceeded either the BTV or MDC.

[4] EPA identified a few instances for which they suggested additional evaluation to determine if uranium and thorium decay chain radionuclide concentrations were site-related (contributions from site processes versus from background).

[5] URS Corporation was the State of California Department of Toxic Substances Control contractor for the chemical characterization of off-SSFL reference areas. The characterization data provide background soil concentrations to which samples collected at SSFL can be compared.

Daughter products of long-lived parent isotopes are included in the evaluation (see the discussion below).

- Site chemical data – The arithmetic mean of the detected results in the analytical sampling data set was used to generate the values presented in **Table G–2** for each sub-area in Area IV and the NBZ. The values represent the arithmetic average of detected results in the analytical sampling data set.
- Background radiological data – Results of radiological soil sampling at background locations (HGL 2011) were used to generate the values presented in **Table G–3**. The soil concentrations represent the 95 percent upper confidence level on the arithmetic mean (UCL95), based on the available analytical sampling data.
- Background chemical data – Results of chemical soil sampling at background locations (URS 2012) were used to generate the values presented in **Table G–4.** The soil concentrations represent the UCL95 of the analytical sampling data results.

All tables are presented sequentially at the end of this appendix.

DOE used these statistical data summaries in the risk calculations to determine potential adverse health impacts associated with Area IV and the NBZ, as well as for background soil. The median was used for the site radiological data because the sampling was conducted in a biased, rather than random, manner, and the median makes no assumptions about the population distribution. It should be noted that, because of the number of sampling results included in each data set, there was very little difference between the median and arithmetic mean and between the arithmetic mean and the UCL95. The use of only the detected results above the detection limits for chemicals or the detected results above the EPA FALs for radionuclides, biased the calculated means and median highs, resulting in an overestimation of potential impacts. However, applying these results to the impact calculations for potential remediation areas within a sub-area was considered a fair representation of those areas by DOE and also provided a conservative basis for assessing the impacts from the entirety of each sub-area.

G.2.2.3 Data Considerations

The sampling results from site sources and offsite background locations formed the basis of the analytical data set used in the impact assessment. Because of limitations in the analytical methods and the need to facilitate the impact assessment, several adjustments were made to both the radiological and chemical data, as presented in this section.

Radiological Data Adjustments

Radiological data were adjusted using surrogate values from equilibrium of radioactive decay progeny with their parents. These adjustments were made to account for issues associated with analytical interferences (e.g., gamma spectroscopy interference in radium-226 analysis due to the presence of uranium-235) and measurement uncertainties for some decay products of long-lived, naturally occurring radionuclides that were detected in site and background soils. Isotopes were identified by the energy spectra detected in media samples. In some cases, the signature radioactive energies were similar for several isotopes, and laboratory interpretation was required. In other cases, the uncertainty of the measurement of a decay product was much higher than that of its parent.

To avoid these interference and uncertainty issues, the concept of using surrogate values from the secular equilibriums of radioactive decay progeny radionuclides with long-lived parents was employed. Where a parent isotope was detected, daughter isotopic concentrations were set equal to that measured for the parent, assuming secular equilibrium. The parent and daughter isotopes included in the adjustment are presented in **Table G–5**.

For example, the daughter isotope adjustment included setting the concentration of radium-226 equal to the concentration of the parent radionuclide thorium-230 because there is gamma spectral interference from uranium-235 with the radium-226 peak. In addition to radium-226, the isotopes lead-210, bismuth-210, and polonium-210 were also set equal to the thorium-230 parent concentration because they were not reported from the sample analyses and their impact contribution also needed to be included in the assessment.

Chemical Data Adjustments

Chemical data were adjusted by combining constituents based on the availability of screening level data for individual constituents, which facilitated the impact assessment calculations. For example, the carcinogenic polychlorinated dibenzo-p-dioxins (PCDDs) were evaluated as the sum of their toxicity equivalents (TEQs), relative to 2,3,7,8 tetrachlorodibenzo-p-dioxin (TCDD), because screening levels for the individual PCDDs are not available. The TCDD TEQs for the included constituents are presented in **Table G–6**.

Although TEQs are also available for polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs), the impact assessment utilized the screening values for the individual constituents instead of calculating TEQs for these analytes to provide a more specific analysis for these constituents where possible.

G.3 Exposure Assessment

The exposure assessment explored the possibility of impacts to humans and determined the receptors with a potential for exposure to Area IV or NBZ sources. Likely exposure scenarios were identified based on consideration of exposures that might occur under the No Action Alternative, as well as under the remediation alternatives. Because impacts associated with the No Action Alternative may persist for an extended period of time, both current and future exposures were considered, as described further in this section.

The exposure assessment consisted of the following components:

- selecting exposure scenarios,
- identifying potential receptors,
- defining exposure pathways,
- determining the exposure parameters, and
- quantifying the exposure to the source areas.

Details of the exposure assessment are presented in the following sections.

G.3.1 Receptor Exposure Scenarios

Potential exposure scenarios were determined using assumptions regarding plausible receptors associated with the Area IV and NBZ source areas. Because significant uncertainty accompanies any projection of future site uses, the exposure assessment was based on assumptions that were likely to overestimate impacts to receptors in order to be protective of human health.

Under current conditions, access to Area IV and the NBZ is controlled, which precludes certain exposures (e.g., to an onsite resident). Although the landowner, Boeing, has stated its intent to maintain its portion of SSFL (including Area IV and the NBZ) as undeveloped open space

(Boeing 2016), in order to be protective of unanticipated exposures, it was assumed that there is a lapse in active management control of the site over time. Due to this lapse, a person was assumed to build a house on site in an area where the soil contains chemical and radioactive constituents (i.e., exposure of a hypothetical future onsite resident); however, the point in the future when active management of the site might be lost is uncertain. For this reason, and to provide a basis for comparison with exposure to a future resident, the potential for a hypothetical resident to occupy the site under current conditions was included in the evaluation.

In the future, source area exposures would be affected by radioactive decay of source materials. Current conditions were evaluated using the measured radiological source area concentrations, while future conditions were evaluated assuming 100 years of institutional control, during which the radioactive constituents in the source areas would decay. The two soil exposure scenarios are therefore: current conditions (baseline exposure without radioactive decay) and future conditions (loss of institutional controls and 100 years of radioactive decay).

The exposure scenarios under current conditions are associated with all soil remediation alternatives, including the No Action Alternative (under which source areas would be left undisturbed) and were evaluated quantitatively. Under future conditions, the No Action Alternative was evaluated quantitatively; however, the action alternatives were evaluated qualitatively because the source areas (soil with concentrations above the action levels) would largely be removed.

The following section describes identification of the specific receptors associated with the selected exposure scenarios.

G.3.2 Receptor Identification

Potential receptors were identified by considering a range of individuals engaged in public or occupational activities. The receptors included in the impact assessment were assumed to be located within the Area IV or NBZ sub-areas.

The receptor scenarios analyzed were as follows:

- No Action Alternative
  - Current Conditions (baseline without radioactive decay)
    - Onsite suburban resident
    - Onsite recreational user
    - Onsite monitoring and maintenance worker
  - Future Conditions (after assumed loss of institutional controls and radioactive decay)
    - Onsite suburban resident
    - Onsite recreational user
- Remediation Alternatives (during remedial actions)
  - Onsite soil remediation worker
  - Onsite building D&D worker
  - Onsite bedrock remediation worker
- Remediation Alternatives (post-remedial action implementation)
  - Onsite suburban resident
  - Onsite recreational user

The potential receptors listed above represent a range of possible exposures that were further evaluated to focus on the exposures considered most likely under the remediation alternatives considered.

G.3.2.1 No Action Alternative Exposures

Under the Soil No Action Alternative, members of the public would be restricted from accessing the site through fencing, signage, and routine patrols of site security personnel. Although DOE's intent would be to prevent public access to the site, two scenarios involving site access were analyzed: a hypothetical future onsite suburban resident and a hypothetical recreational user. As indicated previously, the hypothetical onsite suburban resident exposure was based on an assumed lapse in active management control of the site, resulting in a person building a house on the site in an area where the soil contains chemical and radioactive constituents.

As it is not possible to predict when such a lapse would occur, two analyses were conducted: (1) an evaluation assuming current conditions as a baseline and (2) an evaluation of future conditions after a 100-year period. Evaluation of impacts on the hypothetical future onsite suburban resident did not account for natural processes (such as wind erosion or soil accretion) that might change the availability of the chemical and radioactive constituents or for chemical degradation, but did include 100 years of decay of radioactive constituents.

Onsite Suburban Resident

The onsite suburban resident is a hypothetical person who establishes a residence in Area IV or the NBZ in an area with soil containing chemical or radioactive constituents. The onsite suburban resident was assumed to be exposed 24 hours a day, 350 days per year, for 30 years, as defined in the *Final Standardized Risk Assessment Methodology Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California* (SRAM) (MWH 2014). Direct exposure pathways for a suburban resident as identified in the SRAM include dermal absorption of chemicals, direct radiation exposure, and inhalation and incidental ingestion of chemical and radioactive constituents (MWH 2014). The direct exposure pathways impacts are discussed in this evaluation.

The onsite suburban resident scenario assumed that an individual is exposed as a child for 6 years and as an adult for 24 years, for 350 days each year. Specific soil ingestion rates, skin surface area, and other direct pathway exposure parameter values were used, as presented in the SRAM.

The SRAM (MWH 2014) also includes an indirect exposure pathway for the suburban resident. The indirect exposure pathway assumes the hypothetical future suburban resident ingests fruits and vegetables raised in an onsite garden in an area with soil containing chemical or radioactive constituents. The potential impacts of the indirect exposure pathway on the onsite suburban resident are not addressed in this EIS because the models for making exposure point concentration calculations in plants are associated with significant uncertainty, as discussed in the SRAM, and future use of the property as residential development is expected to be restricted by the landowner (Boeing 2016).

As previously indicated, the potential for a current onsite resident was included to provide a conservative assessment of exposures due to the uncertainty associated with the loss of site access controls. A scenario involving a hypothetical suburban resident currently living on the site was analyzed as a baseline, representing exposure to current conditions.

Onsite Recreational User

The onsite recreational user is a hypothetical member of the public who engages in outdoor recreational activities, such as hiking, in Area IV and the NBZ. This scenario also provides a conservatively high estimate of potential impacts to a site visitor because a site visitor's exposure time would likely be much less than that assumed for the recreational user. The recreational user was assumed to be exposed 8 hours a day, 75 days per year, for 30 years. Exposure pathways include dermal absorption of chemicals, direct radiation exposure, and inhalation and incidental ingestion of chemical and radioactive constituents. (The air pathway is the dominant pathway.) The recreational user was considered under both the Soil No Action Alternative and the soil remediation action alternatives. Under the Soil No Action Alternative, site access was assumed in spite of institutional controls that would make the recreational user a trespasser.

The exposure parameters for the recreational user under the No Action Alternative reflect an active individual, resulting in significant soil exposures. The basic assumptions were that the recreational user was exposed for 8 hours per day, 75 days each year, for 6 years as a child and 24 years as an adult.

Monitoring and Maintenance Workers

The monitoring and maintenance worker is a worker who performs routine work in Area IV and the NBZ that does not involve demolishing buildings or removing soil, as part of the No Action Alternative. Activities could include checking the security of site fences and buildings, collecting groundwater or other samples, and changing filter media. Exposure pathways include dermal absorption of chemicals, direct radiation exposure, and inhalation and incidental ingestion of chemical and radioactive constituents.

The impacts on workers performing ongoing monitoring and maintenance of Area IV and the NBZ were judged to be the same as or less than the impacts on Area IV workers under the Building No Action Alternative (see Chapter 4, Section 4.9.2.1) because less activity would be required for maintenance of soil areas than for maintenance of structures. Workers would be protected from chemical and radiation exposure through the implementation of DOE regulations (e.g., Title 10, *Code of Federal Regulations,* Parts 835 and 851 [10 CFR Parts 835 and 851]) and DOE Orders developed to ensure protection of worker health and safety. As exposures were assumed to be similar to current exposures associated with managing the site, they were not quantified in this assessment.

G.3.2.2 Soil Remediation Action Alternative Exposures

Remedial action alternatives include soil, bedrock, and building removal and may result in exposures to workers (during remediation) and members of the public (after remediation). Workers would be exposed in varying degrees (depending on job assignments and other factors, including duration of exposure) to inhalation of chemicals and radionuclides that become airborne from remediation activities, incidental ingestion of chemicals and radionuclides, dermal absorption of chemicals, and direct radiation from radioactive materials. Workers would be protected in accordance with DOE regulations (e.g., 10 CFR Parts 835 and 851) and DOE Orders, and radiation protection practices would be employed so that worker doses are as low as reasonably achievable.[6] Personal protective equipment, such as coveralls and respirators, would be used as dictated by the level of chemical and radiological impacts associated with each area. Breathing protection equipment may be used by workers when necessary to reduce the impacts from exposure to toxic chemicals to below DOE occupational exposure limits and the thresholds for toxic effects.

---

[6] "As low as is reasonably achievable" (ALARA) is the approach to radiation protection to manage and control exposures (both individual and collective) to the work force and to the general public to as low as is reasonable, taking into account social, technical, economic, practical, and public policy considerations. ALARA is not a dose limit, but a process which has the objective of attaining doses as far below the applicable limits as is reasonably achievable (10 CFR Part 835).

Physical controls, including use of tools that allow workers to perform their jobs at some distance from contaminated or activated materials and use of surfactants or water sprays to control the generation of dust, would be applied as appropriate. Additionally, administrative controls, such as limiting time of exposure, would be employed to ensure workers do not exceed DOE annual dose limits.

Soil Remediation Worker

Considering the relatively low risks from exposure to chemicals and radionuclides in soil that are projected for an onsite suburban resident (see Section G.5.1), it is expected that the risks to workers involved in soil remediation would be very small and were not estimated (see Section 4.9.2.2).

Decontamination and Decommissioning Workers

The D&D worker is an individual involved in the removal of Area IV buildings. D&D worker exposure pathways include direct radiation exposure and inhalation and incidental ingestion of radioactive materials on building surfaces. The exposure parameters for the D&D worker are specific to each building, as presented in Section G.8.

Bedrock Remediation Workers

The bedrock remediation worker is an individual involved in the removal of strontium-contaminated bedrock (under the Groundwater Treatment Alternative). Exposure pathways are associated with the bedrock material removed from an excavation, which may result in ingestion, inhalation, and external exposures during an assumed 20-day remediation period (see Section G.9).

Onsite Suburban Resident

The exposure scenario for a hypothetical onsite suburban resident following remediation would be the same as that for a hypothetical suburban resident under the No Action Alternative, except that the concentrations of chemicals and radionuclides in the soil would be lower. As shown in Section G.5, Impact Characterization, risks to an onsite suburban resident under the No Action Alternative are only slightly different from those from exposure to background soil. Because the risks are only slightly different from background under the No Action Alternative and the concentrations of chemicals and radionuclides in Area IV and the NBZ would be reduced under the soil remediation alternatives, the impacts were evaluated qualitatively (see Section 4.9.2.2).

Onsite Recreational User

The exposure scenario for a hypothetical recreational user following remediation would be the same as that for a hypothetical recreational user under the No Action Alternative, except that the concentrations of chemicals and radionuclides in the soil would be lower. For the same reasons discussed above for the onsite suburban resident, onsite recreational user exposure associated with the soil remediation alternatives was evaluated qualitatively (see Section 4.9.2.2).

G.3.2.3 Receptor Summary

The selection of representative receptors considered a range of potential current and future exposure scenarios for each of the remediation alternatives. Section G.3.3 presents the methods used to calculate the exposures for each of the receptors included in the risk evaluations: the hypothetical onsite suburban resident, hypothetical onsite recreational user, D&D worker, and bedrock remediation worker.

G.3.3 Quantification of Soil Exposures

The quantification of exposures combined the measured site soil concentrations with the exposure parameters to estimate the exposure of each receptor to each soil constituent. For this assessment, the RBSLs incorporated the exposure parameters and were compared with the site media concentrations. This section presents the development of the soil concentrations of constituents, and subsequent sections present the RBSLs (see Section G.4) used to assess the potential for site-related health impacts. Discussion of the D&D worker exposure is presented in Section G.8, and the remediation worker exposure from excavation of strontium-contaminated bedrock is presented in Section G.9.

Exposure-Specific Constituent Lists

Constituent lists were developed for the onsite suburban resident and onsite recreational user. The onsite suburban resident was assumed to remain in a single location throughout the duration of the exposure. Therefore, risk calculations were developed for each sub-area, and the location producing the maximum overall risk was selected as representative for the onsite residential exposure associated with Area IV or the NBZ. The list of constituents for the onsite suburban resident was therefore based on the constituents in the particular sub-area that would produce the maximum risk.

For the onsite recreational user, exposure was assumed to occur over the entire site; therefore, the constituent list represents a compilation of the detected radiological and chemical constituents from each sub-area.

As described in Section G.2.2.3, uranium and thorium decay chain radionuclide concentrations were adjusted for daughter isotopes where the data did not indicate secular equilibrium with the parent isotope.

The background constituent list includes the natural uranium and thorium decay chain radionuclides, as previously discussed (see Section G.2.2.1). Therefore, incremental radiological impacts were calculated with and without including the uranium and thorium decay chain radionuclides, as reflected in both the site and background constituent lists.

G.4 Risk-Based Screening Levels in Soil

The risk assessment is based on a comparison of measured soil concentrations with RBSLs from the SRAM (MWH 2014) to determine the potential for adverse health effects to exposed individuals. For the Area IV and NBZ impact assessment, health impacts were evaluated for an increase in cancer incidence rates and/or the potential for toxic effects. Cancer-inducing chemicals and radionuclides were evaluated for the rate of cancer occurrence, and toxic chemicals were assessed for noncarcinogenic health effects.

RBSLs are acceptable concentrations in environmental media that are considered unlikely to result in adverse health effects and serve as a benchmark to compare with potential impacts associated with the Area IV and NBZ sources. The screening levels used to assess cancer incidence risk were established based on a risk level of 1 additional cancer incidence per million exposures, or 1×10^{-6}, for carcinogenic chemicals and radionuclides in soil. The assessment of chemical toxicity was based on screening levels established for a hazard index of 1. The chemical RBSLs for soil used in this risk assessment were obtained from the SRAM (MWH 2014), and radiological RBSLs were obtained from the EPA online source for *Preliminary Remediation Goals for Radionuclides* (Preliminary Remediation Goals [PRGs]) (EPA 2015b).

RBSLs were calculated by combining the exposure parameters for each receptor with the toxicity data specific to each constituent. The result was a soil concentration for a particular constituent that is unlikely to cause adverse health effects to an exposed individual. RBSLs were set at a conservatively low level of acceptable health effects for each individual constituent (e.g., an incremental cancer incidence risk of 1×10^{-6}, a hazard index of 1), so that exposure to numerous constituents would result in a cumulative exposure that would be unlikely to cause adverse health effects.

The suburban resident and recreational RBSLs were based on a standard set of exposure pathways for soil that included ingestion, inhalation, and dermal and external exposure. Screening levels were particular to each constituent, which included a large number of species that may be found further discussed in environmental literature. For example, there are several forms of individual constituents, particularly metals that have a wide range of screening levels (e.g., mercuric chloride, methyl mercury). Available site data does not provide information regarding the speciation of chemical constituents found in Area IV and NBZ sources; however, conservative assumptions were made to include the potential forms of constituents that result in reasonable estimates of adverse health effects (e.g., metals present in elemental form). While radiological speciation (e.g., uranium oxides versus uranium chlorides) is a factor in assessing adverse health effects, screening levels were only available for elemental radioactive isotopes.

In addition to radiological RBSLs based on cancer incidence risk, mortality and dose estimates were obtained by calculating mortality and dose RBSLs for each radionuclide using ratios of conversion factors from EPA Federal Guidance Reports (FGRs) and International Commission on Radiation Protection (ICRP) reports, as discussed in Section G.4.3.

The screening levels were calculated for a particular media and receptor based on the particular exposure pathways under consideration. For each exposure pathway and individual receptor, the exposure parameters were used to calculate screening levels for each constituent.

Tables G–7 through **G–18**, located at the end of this appendix, present the RBSLs used in the impact assessment, as discussed in Sections G.4.1 through G.4.3.

G.4.1 Chemical Morbidity Risk-Based Screening Levels – Values from SRAM

For SSFL, a number of chemical RBSLs were already established in the SRAM (MWH 2014), including those for a suburban resident and recreational receptor. The SRAM RBSLs for individual pathways for a suburban resident or recreational user exposed to chemicals in soil include the following:

- Incidental soil ingestion
- Inhalation of suspended soil
- Dermal contact with soil

The calculation used to estimate risks from the RBSLs was based on an overall value for all pathways combined.

Soil Exposure – Residential and Recreational User

The following equation was used to develop composite RBSLs for the suburban resident and recreational user soil exposure to chemical constituents:

$$\text{RBSL soil} = 1/[(1/\text{RBSL}_{ing}) + (1/\text{RBSL}_{inh}) + (1/\text{RBSL}_{derm})]$$

Where:

$RBSL_{ing}$ = RBSL from soil ingestion

$RBSL_{inh}$ = RBSL from inhalation of suspended soil

$RBSL_{derm}$ = RBSL from dermal contact with soil

Chemical RBSLs were developed separately for carcinogenic and toxic effects.

G.4.2 Radiological Morbidity Risk-Based Screening Levels

Because no RBSLs were available in the SRAM (MWH 2014) for radioactive constituents, an online screening level calculation tool from the EPA was used to generate air and soil RBSLs (EPA 2015b). Exposure parameters were entered for the resident and recreational user, consistent with the SRAM exposure scenarios. Radiological air RBSLs were based on the inhalation pathway only and did not include external exposure due to submergence in airborne radioactive material.

The external exposure pathway for radionuclides in soil was evaluated using default RESRAD [RESidual RADioactive] (see Section G.7) parameters because this pathway was not addressed in the SRAM.

RESRAD is a family of computer model codes that were designed to estimate radiation doses and risks from residual radioactive materials and is sponsored by the DOE Office of Health, Safety and Security and the Office of Environmental Management, with support from the U.S. Nuclear Regulatory Commission (NRC). RESRAD was developed by Argonne National Laboratory, and code and version control is currently maintained by DOE through Argonne National Laboratory. The RESRAD computer codes are important tools that are widely used by DOE, other Federal agencies (e.g., NRC, EPA), and the commercial nuclear industry, as well as by international organizations and businesses engaged in the remediation of areas contaminated with radioactive materials. RESRAD provides a model for assessing radiation dose and risk from soil containing residual radioactive material. RESRAD version 6.5, which was used for this purpose, includes 72 age-dependent dose conversion factors from ICRP that make it compatible with the risk factors obtained from FGR 13 (EPA 1999), which were used for the No Action Alternative sub-area calculations of dose and risk (see Section G.7).

G.4.3 Cancer Mortality and Radiological Dose Conversion Factors

In addition to potential cancer incidence from radiation exposure, the impact assessment estimated potential radiological cancer mortality and radiological dose. For chemical constituents, cancer mortality data are not readily available; therefore, cancer fatality risks were not calculated. However, for radionuclides, estimates of cancer fatality and dose rates were developed from mortality and dose factors available in the literature, as described below.

In order to develop radiological cancer mortality and dose RBSLs, conversion factors were calculated and applied to the morbidity (cancer incidence) RBSLs. The general method used to calculate the mortality and dose RBSL conversion factors was to compile published morbidity, mortality, and dose factors and then generate ratios between morbidity/mortality and morbidity/dose. The ratios were then applied to the morbidity-based screening levels, resulting in RBSLs for mortality risk and radiological doses.

Three documents were used in the development of the mortality and dose conversion factors for radionuclides: two EPA FGRs and one ICRP report:

- *External Exposure To Radionuclides In Air, Water, And Soil*, Federal Guidance Report No. 12 (FGR 12) (EPA 1993) – Presents dose factors for soil external exposure to members of the public.
- *Cancer Risk Coefficients for Environmental Exposure to Radionuclides*, Federal Guidance Report No. 13 (FGR 13) (EPA 1999) – Presents morbidity and mortality factors for ingestion, inhalation, and external exposure to soil.
- *Compendium of Dose Coefficients Based on ICRP Publication 60*, ICRP Publication 119 (ICRP 2012) – Presents dose factors for ingestion and inhalation for exposure to members of the public.

The morbidity, mortality, and dose factors were compiled for the radionuclides evaluated at Area IV and the NBZ. Application of these data to the risk estimates is described further below.

The values presented in FGR 13 (EPA 1999) served as the basis for the morbidity-to-mortality conversion factors. For each isotope, the mortality factor was divided by the morbidity factor for each exposure pathway (ingestion, inhalation, external exposure). Similarly, the dose factors and morbidity-to-dose ratios for ingestion, inhalation, and external exposure pathways were generated for each individual radionuclide. The morbidity screening levels included multiple exposure pathways; therefore, the conversion to a mortality screening level included ratios within each pathway. The following equation presents the approach:

$$RBSL_{morb} = 1 / [(1/RBSL_{morb\text{-}ing})+(1/RBSL_{morb\text{-}inh})+(1/RBSL_{morb\text{-}ext})]$$

$RBSL_{morb\text{-}ing}$ is the RBSL for morbidity via the ingestion exposure pathway. Similarly, $RBSL_{morb\text{-}inh}$ and $RBSL_{morb\text{-}ext}$ are values for the inhalation and external exposure pathways, respectively. The mortality RBSLs were calculated by substituting mortality-based factors for each pathway, which were calculated as follows:

$$RBSL_{mort\text{-}ing} = RBSL_{morb\text{-}ing} \times CF_{mort\text{-}morb\text{-}ing}$$

$$RBSL_{mort\text{-}inh} = RBSL_{morb\text{-}inh} \times CF_{mort\text{-}morb\text{-}inh}$$

$$RBSL_{mort\text{-}ext} = RBSL_{morb\text{-}ext} \times CF_{mort\text{-}morb\text{-}ext}$$

$CF_{mort\text{-}morb\text{-}ing}$, $CF_{mort\text{-}morb\text{-}inh}$, and $CF_{mort\text{-}morb\text{-}ext}$ are the ratios of mortality to morbidity for each exposure pathway. A similar calculation was used to generate the RBSLs for dose, based on the morbidity-to-dose conversion factors.

In a final step, ratios of the RBSLs were calculated to allow a direct conversion of the morbidity risk results to mortality risk and dose. The conversion factors for morbidity to mortality and morbidity to dose are specific to each radionuclide and receptor evaluated in the impact assessment.

The equation for the RBSL conversion factors for mortality is:

$$CF_{rbsl\text{-}mort} = RBSL_{mort}/RBSL_{morb}$$

The $CF_{rbsl\text{-}mort}$ is in units of cancer fatalities per cancer incidence and is always less than 1 because not every cancer incidence results in a fatality.

For conversion of morbidity to dose, the following equation was used:

$$CF_{rbsl\text{-}dose} = RBSL_{dose}/RBSL_{morb}$$

The $CF_{rbsl\text{-}dose}$ is in units of millirem (one-thousandth of a roentgen equivalent man [rem]) and represents the dose that would correspond to an incidence rate of cancer (in this case 1×10^{-6} or a 1 chance in 1 million incidence rate) for a particular isotope and receptor.

Calculation of Mortality Risk and Radiological Dose

Using the conversion factors generated in the previous section, the morbidity risks were converted to mortality risks as follows:

$$\text{Mortality Risk} = \text{Morbidity Risk} \times CF_{rbsl\text{-}mort}$$

Where:

$$CF_{rbsl\text{-}mort} = RBSL_{mort}/RBSL_{morb}$$

For the radiological dose, the equation is:

$$\text{Dose (millirem)} = \text{Morbidity Risk} \times CF_{rbsl\text{-}dose}$$

Where:

$$CF_{rbsl\text{-}dose} = RBSL_{dose}/RBSL_{morb} \qquad \text{(millirem per incidence)}$$

The results and conversion factors in the above equations are all isotope- and receptor-specific.

G.4.4 Conservation of Natural Resources Alternative Screening Levels

In addition, for the Conservation of Natural Resources Alternative, RESRAD modeling software was used to calculate concentrations in soil that would equate to the DOE dose constraint of 25 millirem per year (DOE 2011). The resulting RESRAD-based soil concentrations were used to determine remediation areas and cleanup volumes for radionuclides. The development of these dose-based cleanup levels is discussed in Section G.7.

G.5 Impact Characterization

Impact characterization is the process of estimating potential adverse health effects from site exposures to Area IV or NBZ source materials. In this impact assessment, the screening levels for individual constituents were compared with media concentrations to obtain estimates of impacts associated with receptor exposures. The equations used to estimate risks and hazards are presented below.

The potential for increased cancer incidence due to exposure to source materials was estimated for both chemical and radioactive constituents as follows:

$$ILCR = (C_m / SL) \times SLRB$$

Where:

ILCR = constituent incremental lifetime cancer incidence risk (unitless)

C_m = exposure concentration of a constituent in media (picocuries per gram, milligrams per kilogram, picocuries per cubic meter, or micrograms per cubic meter)

SL = screening level for a constituent in media (picocuries per gram, milligrams per kilogram, picocuries per cubic meter, or micrograms per cubic meter)

SLRB = screening level risk basis, typically 1 additional cancer incidence per million exposures, or 1×10^{-6} (unitless)

For example, a hypothetical radioactive constituent with a site soil concentration of 2 picocuries per gram, using a screening level of 1 picocurie per gram based on a screening level risk basis of 1×10^{-6}, results in an estimated cancer incidence risk of 2×10^{-6}. Where the site concentration is twice the screening level, the site risk is twice the screening level risk basis.

Similarly, the potential for toxic effects due to exposure to chemicals was estimated using the following equation:

$$HQ = (C_m / SL) \times SLHQ$$

Where:

HQ = constituent hazard quotient (unitless)

C_m = exposure concentration of a constituent in media (milligrams per kilogram or micrograms per cubic meter)

SL = screening level for a constituent in media (milligrams per kilogram or micrograms per cubic meter)

SLHQ = screening level hazard quotient, typically 0.1 (unitless)

The following sections present the risks and hazards resulting from using the screening levels to calculate the exposure concentrations in environmental media.

Tables located at the end of this appendix present the results of the analyses. **Tables G–19** through **G–26** present radiological cancer morbidity risks to an onsite suburban resident from direct exposure pathways for Area IV and NBZ soil and background soil. **Tables G–27** through **G–30** present the chemical morbidity risks and chemical hazard quotients of individual constituents to an onsite resident for Area IV and NBZ soil and background soil from direct exposure pathways. **Tables G–31** through **G–38** present the radiological and chemical morbidity risks and chemical hazard quotients to a recreational user for Area IV and NBZ soil and background soil.

Tables G–39 and **G–40** present summaries of the impact estimates for the onsite resident and recreational user from direct soil exposure and the cumulative cancer incidence from both chemical and radioactive constituents.

Risk results were summed for constituents in sub-areas, based on the potential for adverse health effects (e.g., radiological cancer incidence, chemical toxicity). Radiological cancer risks are based on effects associated with exposure to ionizing radiation; therefore, results for radionuclides were summed for each sub-area. Similarly, chemical cancer risks are associated with similar mechanisms within the human body, and impacts are considered to be additive among constituents. For chemical toxicity, individual constituents may have significantly different impacts resulting from exposure (e.g., kidney effects, anemia, and respiratory effects). However, to provide a conservative estimate of toxic effects from chemical exposure, results for all chemical constituents were summed for each sub-area.

Results for individual sub-areas were used to determine the overall potential for adverse health effects, based on the activity pattern for each particular receptor, as follows:

- Onsite suburban resident – Impacts from the sub-area that produced the maximum overall risks were considered representative of an individual remaining in a single location throughout the exposure.
- Onsite recreational user – Impacts were evaluated from the average concentrations of all constituents in all sub-areas in order to represent an individual moving throughout Area IV and the NBZ during the exposure.

The sub-area that would produce the maximum impact to the resident may vary, based on the scenario under evaluation. The selection of the maximum sub-area was based on analysis that excluded the uranium and thorium decay chain radionuclides to reflect the site risks without including the background impacts of these radionuclides. To be conservative in the assessment of overall impacts, the maximum chemical and radiological impacts were summed, regardless of whether they would occur from the same sub-area.

The following were identified as the maximum sub-areas:

- Onsite suburban resident direct pathways
  - Radiological cancer incidence under current conditions that represent a baseline exposure and lack of radioactive decay (5B)
  - Radiological cancer incidence under future conditions that represent an assumed loss of institutional controls after 100 years of radioactive decay (5D)
  - Chemical cancer incidence (5D)
  - Chemical hazard index (NBZ)

The characterization of impacts included a comparison of cancer risk estimates and hazard indices with acceptable values. Acceptable cancer incidence risks are considered to be in the ranges of 10^{-4} to 10^{-6}, or a rate of 1 additional cancer incidence per 10,000 or 1,000,000 exposures to source material, respectively. Acceptable hazard indices are those less than 1; an increased likelihood of adverse health effects is associated with hazard indices above 1. The results of the risk evaluation were compared with the acceptable standards to estimate the potential for human health impacts from Area IV and NBZ soil exposures and from background soil exposures.

Unlike other constituents, the analysis of adverse health effects due to lead exposure is based on comparison of estimated blood lead levels with levels that are protective of health effects. The mechanisms by which lead is stored and transported throughout the human body are represented in detailed lead models, which are the basis for developing soil screening levels. Based on lead modeling, the SRAM (MWH 2014) presents lead screening levels for the onsite residential and recreational exposures, as follows:

- Onsite child suburban resident – 80 milligram per kilogram
- Onsite child recreational user – 360 milligram per kilogram

The screening levels are based on an acceptable 90th percentile blood lead concentration of 1 microgram per deciliter in the blood of exposed individuals (SRAM). The development of lead screening levels neglected additional sources of potential lead exposure (e.g., food products, ambient air) in the analysis. The acceptable lead levels were based on California Department of Toxic Substances Control guidance for protection against incidence of developmental effects in exposed individuals.

Comparing these screening levels with the average lead concentrations in SSFL site soils (see Table G.4) results in the following assessment:

- No sub-areas exceeded the screening level for the onsite child recreational user exposure scenario.
- Only Sub-area 7, with a concentration of 182 milligrams per kilogram, exceeded the screening level for the onsite child suburban resident exposure.

From this information, the following conclusions are drawn relative to the acceptable lead screening levels:

- In the NBZ, the location of maximum toxic effects for the onsite suburban resident scenario (see Section G.5.1.2), the lead median concentration of 11 milligrams per kilogram is well below the screening level of 80 milligrams per kilogram, indicating that the blood lead level in an exposed individual would remain acceptable.
- The onsite child suburban resident exposure to lead from Sub-area 7 soils indicates the potential for blood lead levels exceeding the acceptable level; none of the other sub-areas .
- The onsite child recreational user exposure is unlikely to result in blood lead levels above the acceptable level.

Based on a comparison of site soil concentrations with acceptable soil screening levels, DOE concluded that the incremental impacts associated with lead exposure to site soil are unlikely to result in blood lead levels in children that would cause adverse health effects, with the exception of Sub-area 7 exposures to an onsite child suburban resident (a scenario that is not expected to occur based on the landowner's intent to maintain its portion of SSFL (including Area IV and the NBZ) as undeveloped open space [Boeing 2016]).

G.5.1 Onsite Suburban Resident

The following section summarizes the impact assessment for the potential onsite suburban resident exposures to chemical and radioactive constituents for evaluation of both current conditions (baseline without radioactive decay) and future conditions (after assumed loss of institutional controls and radioactive decay). The sub-areas that would produce the maximum impacts to the hypothetical onsite suburban resident were selected as the basis for evaluation. For radiological impact analyses, sub-area selection was based on impacts without the uranium and thorium decay chain radionuclides. Sub-area 5B was selected for evaluation of radiological impacts under current conditions. Sub-area 5D was selected for evaluation of radiological impacts under future conditions, as well as evaluation of chemical cancer risk. The NBZ was selected for evaluation of noncarcinogenic impacts, as measured by a hazard index.

G.5.1.1 Onsite Suburban Resident Radiological Results

The onsite suburban resident radiological exposure results for the site and background are presented in Tables G–19 through G–26 and are discussed below.

Site Soil Radiological Results

Under current conditions, including the uranium and thorium decay chain radionuclides, the Sub-area 5B results presented in Table G–19 indicate a radiological cancer incidence risk of 1.3×10^{-4}. The radiological results for Sub-area 5B were used for the point of comparison for the onsite suburban resident exposures to soil, as described in Section G.5. The maximum sub-area cancer incidence risk would be primarily due to radium-226. Under current conditions, excluding the uranium and thorium decay chain radionuclides, the cancer incidence risk from Sub-area 5B would be 4.2×10^{-5} (see Table G–21). The risk under future conditions would be mainly due to tritium, but this result was based on a single detection above the EPA FAL (CDM Smith 2014), which resulted in an overestimation of impacts that was not considered representative of the average for the sub-area. (The one detected result was used for the exposure point concentration for the sub-area, and the non-detected results were not weighted in, resulting in an overestimation of the average impacts.)

Under future conditions, including the uranium and thorium decay chain radionuclides, the maximum cancer incidence risk from Sub-area 5D would be 9.1×10^{-5} (see Table G–20). Excluding the uranium and thorium decay chain radionuclides, the decayed cancer incidence risk from Sub-area 5D would be 2.2×10^{-6} (see Table G–22).

Under both current and future conditions, with the uranium and thorium decay chain radionuclides included, the primary contributor to risk would be radium-226 from the uranium-238 naturally occurring decay chain. Excluding the uranium and thorium decay chain radionuclides, under both current and future conditions, the risks would be due almost exclusively to cesium-137 (excluding tritium for the reasons discussed above).

The background soil data include the natural uranium and thorium decay chain radionuclides that would contribute a major portion of the radiological impacts (see Section G.2.2), as presented below.

Background Soil Radiological Results

The cancer incidence risks for the onsite suburban resident exposed to background concentrations under current conditions, including the uranium and thorium decay chain radionuclides, would be 1.5×10^{-4}. Under future conditions, the risks would be 1.3×10^{-4} (see Tables G–23 and G–24). Radium-226 from the uranium-238 naturally occurring decay chain would contribute significantly to risks under both current and future scenarios.

Removing the risk contributions from the uranium and thorium decay chain radionuclides resulted in cancer incidence risks of 1.9×10^{-5} under current conditions (primarily due to tritium) and 2.0×10^{-7} under future conditions (primarily due to cesium-137), as presented in Tables G–25 and G–26.

Onsite Resident Radiological Results Summary

The onsite resident radiological soil evaluation can be summarized as follows:

- Results with uranium and thorium decay chain radionuclides (current/future conditions)
  - Cancer incidence
    - Site: 1.3×10^{-4} / 9.1×10^{-5}
    - Background: 1.5×10^{-4} / 1.3×10^{-4}
  - Cancer fatality
    - Site: 1.0×10^{-4}/ 6.6×10^{-5}
    - Background: 1.1×10^{-4} / 9.4×10^{-5}
  - Annual radiological dose (millirem)
    - Site: 5.3 / 4.0
    - Background: 6.3 / 5.7
- Results without uranium and thorium decay chain radionuclides (current/future conditions)
  - Cancer incidence
    - Site: 4.2×10^{-5} / 2.2×10^{-6}
    - Background: 1.9×10^{-5} / 2.0×10^{-7}
  - Cancer fatality
    - Site: 3.3×10^{-5} / 1.5×10^{-6}
    - Background: 1.6×10^{-5} / 1.5×10^{-7}

- Annual radiological dose (millirem)
  - Site: 1.3 / 0.09
  - Background: 0.6 / 0.01

Interpretation of these radiological results is provided in the following discussion.

Onsite Suburban Resident Incremental Radiological Results

The incremental radiological impacts were based on a comparison of the results from background sources with those from the site. Incremental results both with and without the uranium and thorium decay chain radionuclides are presented in Table G–39 and are discussed below.

The incremental radiological results for the onsite suburban residential soil exposure, including the uranium and thorium decay chain radionuclides, would be as follows (current/future conditions):

- Cancer incidence risk: below background/below background
- Cancer fatality risk: below background/below background
- Annual radiological dose (millirem): below background/below background

The incremental radiological results, without the uranium and thorium decay chain radionuclides, would be as follows (current/future conditions):

- Cancer incidence risk: 2.3×10^{-5} / 2.0×10^{-6}
- Cancer fatality risk: 1.7×10^{-5} / 1.4×10^{-6}
- Annual radiological dose (millirem): 0.67 / 0.08

The radiological impact results show cancer incidence risks within the acceptable range (see Section G.5), indicating a low likelihood of adverse health effects due to the onsite suburban residential exposures.

G.5.1.2 Onsite Suburban Resident Chemical Results

Chemical impacts to the onsite suburban resident (presented in Tables G–27 through G–30) were evaluated for site and background exposures to soil, as discussed in the following sections.

Site Soil Chemical Results

Results for onsite suburban resident exposure to chemical constituents in soil source areas are presented in this section. Cancer incidence risks indicated that Sub-area 5D would have the maximum total of 1.3×10^{-4}, almost entirely due to arsenic, as presented in Table G–27. The chemical carcinogenic results for Sub-area 5D are used for the point of comparison for the onsite suburban resident exposures to soil, as described in Section G.5.

The noncarcinogenic exposures to soil resulted in a hazard index for the NBZ of 3.6, with Aroclor 1248 (a PCB), zirconium, and other metals as the primary contributors (see Table G–28). The chemical noncarcinogenic results for the NBZ are used for the point of comparison for the onsite suburban resident exposures to soil, as described in Section G.5.

The results of the chemical soil exposure assessment indicate a low likelihood of adverse health effects, particularly when considering the conservative exposure assumptions used to assess the hypothetical onsite suburban resident.

Background Soil Chemical Results

The onsite suburban residential cancer incidence risk from background soil exposures was 1.6×10^{-4}, due almost entirely to arsenic (see Table G–29). The hazard index was 3.5, due to metals such as zirconium, cobalt, and arsenic, as presented in Table G–30.

Onsite Suburban Resident Chemical Results Summary

The onsite suburban resident chemical evaluation can be summarized as follows:

- Cancer incidence risk
  - Site: 1.3×10^{-4}
  - Background: 1.6×10^{-4}
- Hazard index
  - Site: 3.6
  - Background: 3.5

Onsite Suburban Resident Incremental Chemical Results

The incremental chemical risk and hazard index would be as follows:

- Cancer incidence risk: below background
- Chemical hazard index: 0.1

The chemical results above and the radiological calculations presented previously are summarized in the following section.

G.5.1.3 Summary of Onsite Suburban Resident Results

The following summarizes the impact assessment results for the incremental onsite suburban resident exposure under current/future conditions (see Table G–39).

With uranium and thorium decay chain radionuclides:

- Radiological cancer incidence risk: below background / below background
- Radiological cancer fatality risk: below background / below background
- Annual radiological dose (millirem): below background / below background

Without uranium and thorium decay chain radionuclides:

- Radiological cancer incidence risk: 2.3×10^{-5} / 2.0×10^{-6}
- Radiological cancer fatality risk: 1.7×10^{-5} / 1.4×10^{-6}
- Annual radiological dose (millirem): 0.67 / 0.08

Chemical results:

- Chemical cancer incidence risk: below background
- Chemical hazard index: 0.1

These results indicate a low likelihood of adverse health effects associated with onsite suburban resident exposures within Area IV and NBZ.

The cumulative cancer incidence risks are presented in Table G–40 and combine the chemical and radiological results. The resulting incremental cumulative cancer incidence risks are negative. These negative results are due to the variability in the background concentrations of chemicals and radionuclides and the low average concentrations in Area IV and NBZ soils that are attributable to site activities.

G.5.2 Onsite Recreational User

The risk evaluation for the potential onsite recreational user included an evaluation of site and background concentrations for radiological and chemical constituents, as described below.

G.5.2.1 Onsite Recreational User Radiological Soil Results

Two sets of calculations were developed for the recreational user radiological exposure, which included an evaluation of isotopic soil concentrations with and without the uranium and thorium decay chain radionuclides. Tables G–31 through G–34 present the results, which are discussed below.

Site Soil Radiological Results

The site results for the onsite recreational user were based on the overall maximum average concentrations in any sub-area in order to represent exposure across all of Area IV and the NBZ. The radiological cancer incidence risks were 2.9×10^{-5}, primarily due to the uranium and thorium decay chain radionuclides (see Table G–31). Excluding the uranium and thorium decay chain radionuclides, the radiological cancer incidence risk is 8.6×10^{-6} due to cesium-137 (see Table G–32).

Background Soil Radiological Results

The background soil radiological cancer incidence risk was 2.9×10^{-5}, with a primary risk contribution from the uranium and thorium decay chain radionuclides (see Table G–33). Excluding the uranium and thorium decay chain radionuclides, the cancer incidence risk was 1.6×10^{-6}, due primarily to tritium and cesium-137 (see Table G–34).

Onsite Recreational User Radiological Summary

The onsite recreational user radiological risks can be summarized as follows:

- Results with uranium and thorium decay chain radionuclides
  - Cancer incidence
    - Site: 2.9×10^{-5}
    - Background: 2.9×10^{-5}
  - Cancer fatality
    - Site: 2.1×10^{-5}
    - Background: 2.1×10^{-5}
  - Annual radiological dose (millirem)
    - Site: 1.2
    - Background: 1.2
- Results without uranium and thorium decay chain radionuclides
  - Cancer incidence
    - Site: 8.6×10^{-6}
    - Background: 1.6×10^{-6}

- Cancer fatality
  - Site: 6.3×10^{-6}
  - Background: 1.3×10^{-6}
- Annual radiological dose (millirem)
  - Site: 0.37
  - Background: 0.05

The estimated incremental radiological impacts are discussed in the following section.

Onsite Recreational User Incremental Radiological Results

The incremental radiological impacts were based on a comparison of the results from background sources with those from the site. Incremental results both with and without the uranium and thorium decay chain radionuclides are presented in Table G–39 and are discussed below.

Including the uranium and thorium decay chain radionuclides, the incremental radiological risks would be as follows:

- Cancer incidence risk: at background level
- Cancer fatality risk: at background level
- Annual radiological dose (millirem): at background level

Excluding the uranium and thorium decay chain radionuclides, the incremental radiological risks would be as follows:

- Cancer incidence risk: 7.0×10^{-6}
- Cancer fatality risk: 5.0×10^{-6}
- Annual radiological dose (millirem): 0.31

The onsite recreational user results indicate a low likelihood of adverse health effects due to radiological impacts associated with Area IV and NBZ sources.

G.5.2.2 Onsite Recreational User Chemical Results

Impacts associated with the onsite recreational exposure to chemical constituents are presented in Tables G–35 through G–38 and are described in the following section.

Site Soil Chemical Results

The average results representing the recreational user exposure indicated a potential cancer incidence risk of 4.1×10^{-5}, primarily due to arsenic (see Table G–35). The overall hazard index was 1.2, primarily due to Aroclor 1248, along with zirconium and other metals (see Table G–36).

Background Soil Chemical Results

The background risk results for chemical constituents indicated a cancer incidence risk of 4.4×10^{-5}, entirely due to arsenic (see Table G–37). The overall hazard index would be 0.78, due primarily to metals such as zirconium (see Table G–38).

Onsite Recreational User Chemical Summary

The onsite recreational user chemical risks can be summarized as follows:

- Cancer incidence risk
  - Site: 4.1×10^{-5}
  - Background: 4.4×10^{-5}
- Hazard index
  - Site: 1.2
  - Background: 0.78

These results are further discussed below.

Onsite Recreational User Incremental Chemical Results

The incremental impacts were based on a comparison of the results from background concentrations with the maximum of the average concentrations from all of the sub-areas (see Table G–39).

The incremental chemical results are as follows:

- Cancer incidence risk: below background
- Hazard index: 0.42

The onsite recreational user results indicate a low likelihood of adverse health effects due to chemical impacts associated with Area IV and NBZ sources.

G.5.2.3 Onsite Recreational User Summary

The following summarizes the impact assessment results for the incremental onsite recreational user exposure (see Table G–39).

Including the uranium and thorium decay chain radionuclides, the incremental radiological risks would be as follows:

- Cancer incidence risk: at background level
- Cancer fatality risk: at background level
- Annual radiological dose (millirem): at background level

Excluding the uranium and thorium decay chain radionuclides, the incremental radiological risks would be as follows:

- Cancer incidence risk: 7.0×10^{-6}
- Cancer fatality risk: 5.0×10^{-6}
- Annual radiological dose (millirem): 0.31

The incremental chemical results are as follows:

- Cancer incidence risk: at background level
- Hazard index of: 0.42

These results indicate a low likelihood of adverse health effects associated with onsite recreational user exposures within Area IV and the NBZ.

The cumulative cancer incidence risks are presented in Table G–40 and combine the chemical and radiological results, which indicate that the incremental cumulative cancer incidence risks are below background when the uranium and thorium decay chain radionuclides are considered, but the cumulative incremental total cancer risk was 4.0×10^{-6}, primarily due to radionuclides.

G.6 Summary of the No Action Alternative Soil Evaluation

The incremental impact assessment calculations for the hypothetical onsite suburban resident and recreational user exposures indicate the following:

- Onsite suburban resident direct pathways
  - There is a low probability of adverse health effects associated with potential onsite exposure to Area IV and NBZ process-related sources.
- Onsite recreational user
  - There is a low probability of adverse health effects associated with potential onsite exposure to Area IV and NBZ process-related sources.

These conclusions were based on the available data and assumptions regarding anticipated future exposures. The impact assessment calculations used to draw conclusions regarding Area IV and the NBZ were based on numerous uncertainties and assumptions and, therefore, should be considered estimates of potential human health effects.

G.7 RESRAD Analysis for the Conservation of Natural Resources Alternative

For the Conservation of Natural Resources Alternative, RESRAD modeling software was used to calculate concentrations in soil that would equate to the DOE dose constraint of 25 millirem per year (per DOE Order 458.1) to determine remediation areas and cleanup volumes for radionuclides. In determining required remediation areas and cleanup volumes for the Conservation of Natural Resources Alternative, a sum-of-fraction approach was applied to the single radionuclide values when more than one radionuclide was present in the soils to ensure that the total overall impacts remained at the target limit of 25 millirem per year.

G.7.1 RESRAD Exposure Parameters

The RESRAD evaluation focused on the residential exposure scenario. Exposure parameters used in the RESRAD calculations were consistent with those presented in the SRAM (MWH 2014) for the residential exposure scenario and are presented in **Table G–41**. Where specific radiological exposure parameters were needed that were not provided in the SRAM, assumptions were made to reflect a conservative scenario. For example, RESRAD uses a dust-loading factor that is based on conversion of the SRAM particulate emission factor. Exposure pathways included in the calculations were soil ingestion, inhalation of dust, and external exposure to radiation.

G.7.2 RESRAD Output

Table G–42 provides the soil radionuclide concentrations for single radionuclides that equate to either a dose of 25 millirem (column SRAM/RESRAD) and to a 10^{-6} cancer incidence risk (SRAM/RESRAD RBSL), based on the RESRAD model calculation.

The RESRAD output provides acceptable soil concentrations relative to dose/risk, similar to the RBSL that was used to calculate cancer incidence risk, as presented in the preceding sections. However, RESRAD calculates dose by direct conversion of soil exposures to dose using radiological dose factors. Unlike RESRAD, the methods of calculating dose from cancer incidence screening levels involve indirect comparison of soil concentrations with dose factors, using ratios of cancer risk to dose, which is less precise. The following section provides a comparison of the soil screening values generated by RESRAD and the RBSLs developed for radioactive constituents.

G.7.3 Comparison of RESRAD and Risk-Based Screening Level Approaches

Table G–42 compares the RESRAD-calculated concentrations with the concentrations determined by using the radiological RBSLs presented earlier (see Section G.4). It should be noted that the values for the uranium and thorium decay chain radionuclides are significantly different because RESRAD and the RBSLs make different assumptions about decay chain radionuclides that are assumed to be in equilibrium. The difference in assumptions has to be taken into account when applying these values and summing the impacts for the radionuclides in the decay chain that are assumed to be in equilibrium when it is determined that these radionuclides are site-related and above background levels. Otherwise, the table shows good agreement between the radiological RBSLs (EPA PRG-based) and the RESRAD-calculated RBSLs.

G.8 Building Remediation Exposures

The remedial action alternatives include building D&D activities. Potential D&D worker exposures were characterized using the methods described in the following sections. The building exposure assessment was based on:

- radiological measurements of building interiors,
- assumed isotopic distributions from historical site measurements,
- estimated release rates of radionuclides into building air,
- calculated indoor isotopic air concentrations, and
- comparison of calculated air concentrations with screening level air concentrations to estimate worker dose and risk.

The following sections provide further details on the elements listed above.

G.8.1 Building Characterization Data

The characterization data for the building structures, including fixed and removable surface contamination for both gross alpha and gross beta emissions, external dose rates, and building dimensions, were obtained from various building survey reports (shown in **Table G–43**) and are summarized in **Table G–44**.

To obtain data for individual isotopes, the gross alpha and gross beta fixed and removable surface area concentrations were partitioned among 15 beta-emitting radionuclides and 9 alpha-emitting radionuclides, as shown in **Table G–45**. The radionuclide partitioning was based on the ratios of the volume-weighted sums of the individual alpha and beta emitters to the total alpha and beta sums, including ingrowth progeny, from historical characterization records of 2,355 shipments of waste from D&D activities at the Radioactive Materials Handling Facility (RMHF). The vast majority of the shipments occurred between 1990 and 2011. These waste characterization records were used as the basis for radionuclide partitioning because the available characterization data for the structures were insufficient to determine the radionuclide partitioning ratios.

The structure dimensions were used to estimate the total contaminated surface area of each building (assuming interior floors walls and ceilings only for buildings; exterior surfaces of buildings were generally assumed to be insignificantly contaminated [potential contamination on the roofs of 4075, 4621, 4665, and 4688, based on past surveys, was accounted for]) and the total interior volume of air (see Table G–44). Most of the building survey reports did not have randomly collected data that would provide a statistical basis for calculating averages. Therefore, a representative concentration was obtained by using the median concentration (which is statistically more robust and does not depend on the shape of the distribution of results) for both gross alpha and gross beta emissions when enough data were available. For a few structures that are without available individual sampling data, the maximum surface contamination values for both gross alpha and gross beta emissions were used.

G.8.2 Source Term of Suspended Materials

The amount of material that may become suspended in air during D&D actions was estimated from the measurements of building surfaces, the physical dimension of the buildings, and assumptions regarding the release fraction of contaminated material during building demolition. The isotopic concentrations per unit area were multiplied by the building surface areas to obtain the total building source term of fixed and removable contamination. That is, the total radionuclide-partitioned surface area concentrations were multiplied by the total estimated surface area of each structure to obtain the total source term for each structure. Likewise, the removable radionuclide-partitioned surface area concentrations were multiplied by the total estimated surface area of each structure to obtain the removable source term for each structure.

The building source terms were multiplied by the assumed release fractions for fixed and removable contamination to determine the source terms of released material. Independent release fractions were assumed for fixed and removable contamination, with an assumed 0.1 percent of the total contamination and 0.5 percent of the removable contamination suspended in air during remedial activities. Additionally, it was assumed that 50 percent of the removable material is not respirable; therefore, the removable respirable release is 0.25 percent of the measured value on building surfaces. The air release fractions and respirable fractions are based on bounding values from DOE-HDBK-3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities* (DOE 1994) for loose powders and hard unyielding surfaces for removable and total contamination, respectively. The calculated airborne source term of respirable material is the basis for calculating the air concentration in building air.

During remedial actions associated with building demolitions, mitigation measures were assumed to reduce the amount of material suspended in air. Water spraying was assumed to reduce the airborne particulate concentration by 50 percent in all buildings (EPA 1996). For Buildings 4021 and 4022 sub-grade vaults, it was assumed that workers would wear respiratory protection that would provide 99 percent efficiency in particulate removal.

G.8.3 Building Air Concentrations

Building air concentrations were calculated by dividing the estimated airborne source term by the building interior volume. It was assumed that the released material would remain within the building and would completely mix into the indoor air. These air concentrations incorporate the reduction of airborne source materials due to mitigation measures (e.g., water spray, respirators).

G.8.4 Screening Level Air Concentrations

Estimated risks and doses were calculated by comparing the building indoor air concentrations to screening level air concentrations corresponding to a specific cancer incidence risk or dose rate. The screening level air concentrations are isotope-specific and are available for individual exposure pathways (e.g., ingestion, inhalation, external), as well as for particular cancer incidence frequency (e.g., 10^{-4}, 10^{-6}) and dose rates (e.g., 15 millirem per year, 25 millirem per year).

The screening levels used were the EPA Indoor Worker Building Preliminary Remediation Goals (BPRGs) from the *Preliminary Remediation Goals for Radionuclides in Buildings* (EPA 2015a), as shown in **Table G–46**, which were downloaded from the EPA online calculator (https://epa-bprg.ornl.gov/) using default exposure parameters. The cancer fatality risk was calculated from the cancer incidence risk based on the ratio of risk values for each pathway and each radionuclide from FGR 13 (EPA 1999). The annual committed effective dose was calculated from the cancer incidence risk based on the ratio of risk and dose values for each pathway and each radionuclide from FGR 13 and ICRP Publication 119 (ICRP 2012). The following paragraphs provide additional detail regarding the cancer incidence risk calculation for each pathway and receptor.

G.8.5 Building Preliminary Remediation Goal Exposure Adjustments

The BPRGs were calculated assuming a default set of exposure parameters that do not reflect the assumed exposure for the building remedial worker. Therefore, the BPRGs were adjusted to provide a more accurate estimate of the potential risks and doses associated with the remedial actions for each individual building. These adjustments are necessary because the BPRGs are based on an exposure frequency of 250 days per year for a duration of 25 years (a total of 6,250 days), and the removal actions for each building are estimated to be significantly shorter in duration. The final BPRGs were multiplied by 6,250 days and divided by the remedial action duration for each building (see Table G–46).

The default BPRGs are associated with cancer incidence risk. BPRGs associated with cancer mortality and dose were developed by using the ratio of cancer incidence risk to cancer mortality risk (see **Table G–47**) and the ratio of cancer incidence risk to radiological dose (see **Table G–48**) for each radionuclide. These ratios were developed using the methods presented in Section G.4.3.

G.8.6 Decontamination and Decommissioning Worker Exposure Estimates

The D&D worker exposures were calculated for each individual pathway and summed to determine the overall cancer incidence and fatality risk, as well as the radiological dose. It was assumed that a single D&D worker would be exposed in all buildings and that the risks and doses are cumulative over the duration of building D&D activities.

Table G–49 presents the cancer incidence risks and indicates a total risk of 1.1×10^{-4}, due almost entirely to the inhalation pathway. The building representing the largest cancer incidence risk is Building 4019, Systems for Nuclear Auxiliary Power (SNAP), with a cancer incidence risk of 2.4×10^{-5}. The primary contributors to risk would be plutonium-239, plutonium-240, strontium-90, and americium-241. The cancer incidence risks are at the upper end of the acceptable risk range, which is 1 additional cancer incidence in 10,000 exposed individuals or 1×10^{-4}, and indicate the potential for an adverse health effect to the D&D worker.

Cancer mortality risks total approximately 1×10^{-4} (see **Table G–50**), and the estimated dose to the D&D worker would be a total of 480 millirem over the entire period of building remedial activities, which would be 127 days (see **Table G–51**). As planned, building demolition would be conducted over a 2-year period; therefore, on an annualized basis, the committed effective dose equivalent rate to the D&D worker would be approximately 240 millirem each year.

Example Calculation: Inhalation of Plutonium-239 Associated with the Building 4019 SNAP Facility

This section presents a sample calculation for the D&D worker exposure to plutonium-239 in the Building 4019 SNAP facility via the inhalation pathway, given the following:

- Total alpha (disintegrations per minute per 100 square centimeters): 13
- Removable alpha (disintegrations per minute per 100 square centimeters): 6
- Fraction of alpha as plutonium-239: 0.484

The above information, plus a conversion of 2.22 disintegrations per minute per picocurie and a surface area of 8,540 square meters, gives:

- an overall plutonium-239 inventory of 2.4×10^6 picocuries in total surface contamination and
- an overall plutonium-239 inventory of 9.6×10^5 picocuries in removable surface contamination.

Respirable release fractions of 0.001 for total contamination and 0.0025 for removable contamination (which includes a release fraction of 0.005 and a respirable fraction of 0.5) give the following:

- an overall plutonium-239 inventory release to air of 2.4×10^3 picocuries from total contamination;
- an overall plutonium-239 inventory release to air of 2.3×10^3 picocuries from removable contamination; and
- a cumulative plutonium-239 inventory released to air of 4.7×10^3 picocuries.

A building volume of 4.8×10^3 cubic meters gives a building air concentration of respirable plutonium-239 of 0.99 picocuries per cubic meter.

Assuming 50 percent removal of respirable particles due to water spray and no respirator use for the Building 4019 SNAP facility gives an exposure air concentration of plutonium-239 for the D&D worker of 0.49 picocuries per cubic meter.

The BPRG (established for a cancer incidence rate of 1×10^{-6}) used to evaluate the cancer incidence risk is as follows:

- a default cancer incidence BPRG for inhalation of plutonium-239 of 1.4×10^{-4} picocuries per cubic meter for 6,250 days of exposure and
- an adjusted cancer incidence BPRG for inhalation of plutonium-239 of 4.1×10^{-2} picocuries per cubic meter for a 22-day D&D of the Building 4019 SNAP facility.

The cancer incidence risk is calculated as the exposure air concentration divided by the adjusted BPRG times the BPRG risk level of 1×10^{-6}, which gives a D&D worker inhalation cancer incidence risk of plutonium-239 in the Building 4019 SNAP facility of 1.2×10^{-5}.

The calculation of cancer mortality risk was based on the cancer incidence BPRG and the ratio of incidence to mortality of 1.1 for plutonium-239 via the inhalation pathway. The BPRG (established for a cancer incidence rate of 1×10^{-6}) used to evaluate the cancer mortality risk is as follows:

- an adjusted cancer mortality BPRG for inhalation of plutonium-239 of 4.5×10^{-2} picocuries per cubic meter for a 22-day D&D of the Building 4019 SNAP facility and
- a D&D worker inhalation cancer mortality risk of plutonium-239 in the Building 4019 SNAP facility of 1.1×10^{-5}.

The results indicate a low likelihood of adverse health impacts due to the D&D worker exposures.

G.9 Remediation Worker Exposure During Bedrock Removal

As part of the remediation of groundwater under the Groundwater Treatment Alternative, the potential removal of contaminated bedrock may result in remediation worker exposures. The bedrock has been identified as a potential source of elevated levels of strontium-90 in Area IV groundwater because the groundwater concentrations increase when the water table rises to the level of the bedrock following rains.

Worker exposure is based on the following pathways:

- inadvertent ingestion of material during bedrock handling;
- inhalation of suspended bedrock material; and
- external exposure due to radioactive constituents in bedrock.

The following sections present the information used to evaluate potential impacts to a remediation worker during Groundwater Treatment Alternative implementation.

G.9.1 Characterization of Bedrock

The best characterization of the bedrock was performed in 1978 following RMHF leach field remediation, as described in the *RMDF Leach Field Decontamination Final Report* (Carroll, Marzec, and Stelle 1982) and reconsidered in the *SSFL Area IV RCRA Facility Investigation Groundwater Work Plan* (CDM Smith 2015). The following is extracted from the *RMDF Leach Field Decontamination Final Report*:

> "A crack filled with porous material was found along the north wall of the excavation. Samples taken from the crack measured up to 2,500 picocuries per gram. This crack was excavated approximately 10 feet below the rock surface and was found to split and wander under the leach field excavation. This network of cracks was sampled for contamination. The tests indicated 500 to 900 picocuries per gram above the target activity level of 100 picocuries per gram. Two smaller cracks…also exhibited small soil areas with activity above 100 picocuries per gram. It is estimated that no more than 0.6 millicurie remain in all three cracks. The radioactivity is identified as primarily Sr-90 + Y-90 [strontium-90 and yttrium-90]."

and:

> "The environmental report on the removal of the leach field states that after excavation, on average 300 picocuries per gram of strontium-90 and traces of cesium-137 remained in bedrock cracks. Following removal of what bedrock material could be excavated, the bedrock was sealed with a bituminous asphalt mastic material and the site backfilled with 10 feet of soil.
>
> The environmental report on the removal action states that three bedrock cracks exhibiting radioactive contamination were mapped prior to sealing. The cracks averaged 1.5 inches wide and were 7, 12, and 19 feet in length (Rockwell 1982). They were estimated to be 10 feet deep, which was the depth that hydraulic hammering of bedrock was stopped.
>
> Several cracks or fractures were identified during remediation as containing strontium-90 contamination that extended to greater depths. The total strontium-90 activity remaining below the excavated zone was estimated to be about 0.05 curies, although there is significant uncertainty in this calculated estimate (Tuttle 1978). Elevated strontium-90 activity was observed in the cracks and the adjoining rock, with estimated specific activity of 200 to 1,000 picocuries per gram. The vadose zone below the RMHF former leach field is the principal remaining source of strontium-90 at this location, with contamination existing in the fracture

zones and the sandstone matrix of the Upper Burro Flats Member. Strontium-90 is released to groundwater by recharge from downward percolating infiltration or by direct contact with contaminated rock when the water table rises by as much as 25 feet."

The available information indicates the following:

- There is a network of cracks, three of which had measured concentrations of strontium-90 above 100 picocuries per gram.
- Other cracks containing less than 100 picocuries per gram were not mapped or included in the average calculated concentrations.
- The total strontium-90 in the three cracks was estimated to be 0.6 millicurie. However, the total strontium-90 remaining below the excavation zone was estimated to be 50 millicuries, and the strontium-90 activity was observed to be in both the cracks and the adjoining bedrock. The indication is that the cracks do not account for the majority of the strontium-90 activity, and no average concentration was reported for the bedrock as a whole. Therefore, the maximum concentration reported of 2,500 picocuries per gram total activity from the *RMDF Leach Field Decontamination Final Report* (Carroll, Marzec, and Stelle 1982) was used as the basis for estimating the risk and dose to the D&D workers. However, the concentration of 2,500 picocuries per gram in this report is identified as mostly strontium-90 plus yttrium-90. Because the yttrium-90 is in equilibrium with strontium-90, the strontium-90 concentrations in 1982 were at most about 1,250 picocuries per gram. This is in close agreement with the concentration of 1,000 picocuries per gram of strontium-90 listed as the top end of the range of concentrations in *RMDF Leach Field Decontamination Final Report*. Strontium-90 has a half-life of about 29 years. Decay of strontium-90 for the 37 years since 1978 would result in a current concentration of about 516 picocuries per gram. Therefore, a concentration of 516 picocuries per gram of strontium-90 was used as the source term for the bedrock to be excavated.

The bedrock characterization data were combined with assumptions regarding the excavation and handling of bedrock (see **Table G–52**) to determine the potential for adverse health effects to the remediation worker.

G.9.2 Bedrock Remediation Worker Exposure Concentrations

The remediation worker exposure to bedrock was based on the following assumptions:

- The remediation worker is present in a 140,000-cubic-foot excavation hole extending to the bottom of the excavated bedrock.
- Bedrock is removed in approximately 1-cubic-foot sections that contain strontium-90 contamination (516 picocuries per gram). The total volume of bedrock removed is 1,050 cubic yards (volume in the ground).
- The outermost 1/8-inch (0.01-foot) layer on all sides of each cubic foot is available for removal during excavation. This corresponds to available contamination on a surface area of 6 square feet with a depth of 0.01 foot per cubic foot of bedrock removed, or 0.06 cubic feet of contamination per cubic foot of bedrock removed. The total volume of removal material in the excavated bedrock is therefore 1,772 cubic feet.

Exposure to radioactive material on bedrock surfaces is considered analogous to exposure from radioactive contamination on hard surfaces such as walls or floors.

Bedrock remediation worker exposure pathways include external exposure, ingestion of removable material, and inhalation of removable material suspended in air. The estimated exposure concentrations for each pathway are presented in **Table G–53** and discussed below.

External Exposure Concentration

External exposure is conservatively evaluated based on contamination assumed to be present in the outer 1/8-inch of each cubic foot of excavated bedrock, expressed as a surface concentration (picocuries per square centimeter), which is calculated as:

- Source term in outer layer of bedrock of 6.2×10^{10} picocuries from:
  - Bedrock concentration of 416 picocuries per gram
  - Bedrock density of 150 pounds per cubic foot
  - Volume of removable outer layer of excavated bedrock of 1,772 cubic feet
- Area of outer layer of excavated bedrock of 170,100 square feet from:
  - Excavated volume of 1,050 cubic yards
  - Surface area of 6 square feet for each cubic foot excavated
- Area concentration for external exposure of 3.66×10^{5} picocuries per square foot, or 394 picocuries per square centimeter

Ingestion Exposure Concentration

Ingestion exposures were based on the surface concentration of strontium-90 in the removable outer layer of the excavated bedrock, expressed as a surface concentration (picocuries per square centimeter), just as for external exposure. It was assumed for the ingestion evaluation that a removable concentration would be created from the 1/8-inch surface layer on each cubic foot of the bedrock, to be multiplied by a release fraction to estimate the surface area concentration available for removal as settled dust, with the following subsequent exposure due to ingestion:

- an area concentration of 394 picocuries per square centimeter;
- a release fraction of 0.001 (DOE 1994); and
- an available area concentration of 0.4 picocuries per square centimeter for ingestion exposure.

Inhalation Exposure Concentration

Inhalation exposures were based on an air concentration, which was calculated from the source term of removable material assumed to be released from the surface of excavated material, mitigation measures for suppression of suspended material, and an assumed air volume for the worker, as follows:

- Source term in outer layer of bedrock of 6.2×10^{7} picocuries
- Release fraction of 0.001 from bedrock
- Suspended material suppression factor of 0.5
- Air volume of 140,000 cubic feet (air volume in excavation pit)
- Resulting air concentration of 7.9×10^{3} picocuries per cubic meter
- Respirator removal factor of 0.01
- Exposure air concentration of 79 picocuries per cubic meter

In the following section, the exposure concentrations are compared with screening level concentrations to estimate bedrock remediation worker risk and dose.

G.9.3 Bedrock Remediation Worker Risk Estimates

The exposure concentrations were compared with screening levels to estimate the potential for impacts associated with workers during bedrock remedial actions. Default BPRGs (EPA 2015a) were used as the basis for the screening level used for comparison and were generated for a cancer incidence risk of 1×10^{-6}. The default BPRGs were adjusted from a standard 6,250-day exposure duration (25 years, 250 days per year) to an exposure of 20 days, representing the bedrock remedial duration. Results for each of the remediation worker exposure pathways are presented in **Table G–54** and are summarized below.

External exposure was quantified based on the following:

- Representative surface concentration of 79 picocuries per square centimeter
- Adjusted BPRG for external exposure of 1.8×10^{3} picocuries per square centimeter
- Cancer incidence risk of 2.2×10^{-7}
- Cancer fatality risk of 1.8×10^{-7}
- Radiological dose of 1.9 millirem

Ingestion exposure was estimated based on the following:

- Surface concentration of 0.39 picocuries per square centimeter
- BPRG for ingestion of 6.4 picocuries per square centimeter
- Cancer incidence risk of 6.1×10^{-8}
- Cancer fatality risk of 1.1×10^{-7}
- Radiological dose of 0.93 millirem

Inhalation exposure was calculated based on the following:

- Air concentration of 79 picocuries per cubic meter
- BPRG for inhalation of 7.7 picocuries per cubic meter
- Cancer incidence risk of 1.0×10^{-5}
- Cancer fatality risk of 9.5×10^{-6}
- Radiological dose of 130 millirem

These results indicate a low likelihood of adverse health effects for the bedrock remediation worker.

G.10 Risk Assessment Tables

The following tables present the site and background soil data, exposure factors, and risk assessment calculations for the Soil No Action Alternative under both current and future conditions. Additionally, the tables present the risks and doses associated with remediation actions under the Building Removal Alternative and bedrock excavation under the Groundwater Treatment Alternative.

Key to Radionuclide Abbreviations

Ac-227	actinium-227	Ni-59	nickel-59	Ra-226	radium-226
Am-241	americium-241	Ni-63	nickel-63	Ra-228	radium-228
Bi-210	bismuth-210	Pa-231	protactinium-231	Sr-90	strontium-90
Bi-211	bismuth-211	Pb-210	lead-210	Th-227	thorium-227
Bi-212	bismuth-212	Pb-211	lead-211	Th-228	thorium-228
Cm-243	curium-243	Pb-212	lead-212	Th-230	thorium-230
Co-60	cobalt-60	Po-210	polonium-210	Th-232	thorium-232
Cs-134	cesium-134	Pu-238	plutonium-238	Th-234	thorium-234
Cs-137	cesium 137	Pu-239	plutonium-239	Tl-207	thallium-207
Eu-152	europium-152	Pu-240	plutonium-240	Tl-208	thallium-208
Eu-154	europium-154	Pu-241	plutonium-241	U-234	uranium-234
Fe-55	iron-55	Pu-242	plutonium-242	U-235	uranium-235
H-3	tritium	Ra-223	radium-223	U-238	uranium-238
Na-22	sodium-22	Ra-224	radium-224	+D	plus daughters

Table G–1 Site Soil Concentrations of Radionuclides – Area IV and the Northern Buffer Zone

	Site Soil Concentration of Radionuclides (picocuries per gram) in Sub-areas									
Constituent	**3**	**5A**	**5B**	**5C**	**5D**	**6**	**7**	**8**	**NBZ**	**Maximum Value**
Ac-227	4.8×10^{-2}	4.0×10^{-2}	3.9×10^{-2}	4.0×10^{-2}	4.8×10^{-2}	5.2×10^{-2}	5.3×10^{-2}	4.4×10^{-2}	4.5×10^{-2}	5.3×10^{-2}
Am-241	--	--	--	--	5.9×10^{-2}	--	--	5.0×10^{-2}	--	5.9×10^{-2}
Bi-210	8.8×10^{-1}	9.7×10^{-1}	9.0×10^{-1}	9.2×10^{-1}	8.6×10^{-1}	9.0×10^{-1}	8.4×10^{-1}	8.5×10^{-1}	8.5×10^{-1}	9.7×10^{-1}
Bi-211	4.8×10^{-2}	4.0×10^{-2}	3.9×10^{-2}	4.0×10^{-2}	4.8×10^{-2}	5.2×10^{-2}	5.3×10^{-2}	4.4×10^{-2}	4.5×10^{-2}	5.3×10^{-2}
Bi-212	1.1	1.3	1.2	1.3	1.2	1.2	1.1	1.2	1.1	1.3
Co-60	--	--	2.3×10^{-2}	2.5×10^{-2}	--	4.8×10^{-2}	2.6×10^{-2}	--	--	4.8×10^{-2}
Cs-137	--	6.6×10^{-1}	3.2×10^{-1}	5.7×10^{-1}	1.2	5.1×10^{-1}	6.6×10^{-1}	2.1×10^{-1}	2.4×10^{-1}	1.2
Eu-152	--	1.2×10^{-1}	5.4×10^{-2}	--	--	--	--	--	--	1.2×10^{-1}
Eu-154	--	--	--	--	1.4×10^{-1}	--	--	--	--	1.4×10^{-1}
H-3	--	--	7.4	--	--	--	--	--	--	7.4
Ni-59	--	2.4×10^{1}	--	--	--	--	--	--	--	2.4×10^{1}
Pa-231	4.8×10^{-2}	4.0×10^{-2}	3.9×10^{-2}	4.0×10^{-2}	4.8×10^{-2}	5.2×10^{-2}	5.3×10^{-2}	4.4×10^{-2}	4.5×10^{-2}	5.3×10^{-2}
Pb-210	8.8×10^{-1}	9.7×10^{-1}	9.0×10^{-1}	9.2×10^{-1}	8.6×10^{-1}	9.0×10^{-1}	8.4×10^{-1}	8.5×10^{-1}	8.5×10^{-1}	9.7×10^{-1}
Pb-211	4.8×10^{-2}	4.0×10^{-2}	3.9×10^{-2}	4.0×10^{-2}	4.8×10^{-2}	5.2×10^{-2}	5.3×10^{-2}	4.4×10^{-2}	4.5×10^{-2}	5.3×10^{-2}
Pb-212	1.1	1.3	1.2	1.3	1.2	1.2	1.1	1.2	1.1	1.3
Po-210	8.8×10^{-1}	9.7×10^{-1}	9.0×10^{-1}	9.2×10^{-1}	8.6×10^{-1}	9.0×10^{-1}	8.4×10^{-1}	8.5×10^{-1}	8.5×10^{-1}	9.7×10^{-1}
Pu-238	--	1.4×10^{-2}	--	--	4.9×10^{-2}	--	--	--	--	4.9×10^{-2}
Ra-223	4.8×10^{-2}	4.0×10^{-2}	3.9×10^{-2}	4.0×10^{-2}	4.8×10^{-2}	5.2×10^{-2}	5.3×10^{-2}	4.4×10^{-2}	4.5×10^{-2}	5.3×10^{-2}
Ra-224	1.1	1.3	1.2	1.3	1.2	1.2	1.1	1.2	1.1	1.3
Ra-226	8.8×10^{-1}	9.7×10^{-1}	9.0×10^{-1}	9.2×10^{-1}	8.6×10^{-1}	9.0×10^{-1}	8.4×10^{-1}	8.5×10^{-1}	8.5×10^{-1}	9.7×10^{-1}
Ra-228	1.1	1.3	1.2	1.3	1.2	1.2	1.1	1.2	1.1	1.3
Sr-90	4.4×10^{-1}	5.8×10^{-1}	1.2×10^{-1}	9.8×10^{-2}	6.0×10^{-1}	6.2×10^{-1}	8.1×10^{-1}	1.0	5.9×10^{-1}	1.0
Th-227	4.8×10^{-2}	4.0×10^{-2}	3.9×10^{-2}	4.0×10^{-2}	4.8×10^{-2}	5.2×10^{-2}	5.3×10^{-2}	4.4×10^{-2}	4.5×10^{-2}	5.3×10^{-2}
Th-228	1.1	1.3	1.2	1.3	1.2	1.2	1.1	1.2	1.1	1.3
Th-230	8.8×10^{-1}	9.7×10^{-1}	9.0×10^{-1}	9.2×10^{-1}	8.6×10^{-1}	9.0×10^{-1}	8.4×10^{-1}	8.5×10^{-1}	8.5×10^{-1}	9.7×10^{-1}
Th-232	1.1	1.3	1.2	1.3	1.2	1.2	1.1	1.2	1.1	1.3
Tl-207	4.8×10^{-2}	4.0×10^{-2}	3.9×10^{-2}	4.0×10^{-2}	4.8×10^{-2}	5.2×10^{-2}	5.3×10^{-2}	4.4×10^{-2}	4.5×10^{-2}	5.3×10^{-2}
Tl-208	3.7×10^{-1}	4.2×10^{-1}	3.9×10^{-1}	4.2×10^{-1}	3.9×10^{-1}	3.8×10^{-1}	3.8×10^{-1}	3.9×10^{-1}	3.7×10^{-1}	4.2×10^{-1}
U-234	7.9×10^{-1}	8.0×10^{-1}	7.6×10^{-1}	7.7×10^{-1}	7.4×10^{-1}	8.9×10^{-1}	9.0×10^{-1}	7.4×10^{-1}	8.2×10^{-1}	9.0×10^{-1}
U-235	4.8×10^{-2}	4.0×10^{-2}	3.9×10^{-2}	4.0×10^{-2}	4.8×10^{-2}	5.2×10^{-2}	5.3×10^{-2}	4.4×10^{-2}	4.5×10^{-2}	5.3×10^{-2}
U-238	8.5×10^{-1}	8.0×10^{-1}	7.8×10^{-1}	7.7×10^{-1}	7.9×10^{-1}	9.2×10^{-1}	9.0×10^{-1}	7.8×10^{-1}	8.6×10^{-1}	9.2×10^{-1}

NBZ = Northern Buffer Zone.

Notes:

– Values presented above are the median concentrations of radioactive constituents above EPA field action levels for the onsite soil source areas.

– The maximum of the averages for all sub-areas is the constituent concentration used to evaluate the recreational exposure for an individual assumed to be moving throughout Area IV during exposure.

– "--" indicates that the radionuclide is not included in the soil data set for that sub-area.

Table G–2 Site Soil Concentrations of Chemicals – Area IV and the Northern Buffer Zone

Constituent	Site Soil Concentration of Chemicals (milligrams per kilogram) in Sub-areas								
	3	5A	5B	5C	5D	6	7	8	NBZ
Aluminum	1.3×10^{4}	1.7×10^{4}	1.6×10^{4}	1.7×10^{4}	2.4×10^{4}	1.5×10^{4}	1.4×10^{4}	2.2×10^{4}	1.2×10^{4}
Antimony	1.6×10^{-1}	2.6×10^{-1}	1.5×10^{-1}	3.2×10^{-1}	4.6×10^{-1}	2.0×10^{-1}	8.6	7.8×10^{-1}	3.1×10^{-1}
Arsenic	4.7	5.8	5.6	5.7	7.9	5.9	7.4	5.9	6.1
Barium	8.9×10^{1}	1.1×10^{2}	1.1×10^{2}	1.1×10^{2}	1.3×10^{2}	1.0×10^{2}	9.6×10^{1}	1.1×10^{2}	8.3×10^{1}
Beryllium	5.6×10^{-1}	7.1×10^{-1}	6.4×10^{-1}	6.9×10^{-1}	8.6×10^{-1}	6.5×10^{-1}	6.0×10^{-1}	7.5×10^{-1}	5.2×10^{-1}
Boron	4.6	4.3	4.9	6.3	1.0×10^{1}	4.8	5.9	9.3	5.6
Cadmium	3.8×10^{-1}	3.8×10^{-1}	2.6×10^{-1}	2.8×10^{-1}	3.6×10^{-1}	3.8×10^{-1}	2.9×10^{-1}	3.3×10^{-1}	2.4×10^{-1}
Chromium	1.8×10^{1}	2.5×10^{1}	2.3×10^{1}	2.3×10^{1}	3.4×10^{1}	2.2×10^{1}	2.2×10^{1}	2.8×10^{1}	1.6×10^{1}
Chromium, hexavalent	--	6.1×10^{-1}	5.3×10^{-1}	7.1×10^{-1}	6.7×10^{-1}	6.6×10^{-1}	7.6×10^{-1}	5.5×10^{-1}	8.4×10^{-1}
Cobalt	5.5	6.7	6.6	7.0	1.0×10^{1}	7.0	6.3	8.5	5.4
Copper	7.1×10^{1}	1.4×10^{1}	1.2×10^{1}	1.2×10^{1}	1.7×10^{1}	1.3×10^{1}	1.3×10^{1}	1.6×10^{1}	1.5×10^{1}
Cyanide	--	--	--	1.2	2.2×10^{-1}	--	5.7×10^{-1}	2.7×10^{-1}	8.1×10^{-1}
Lead	1.5×10^{1}	1.7×10^{1}	9.7	1.2×10^{1}	1.2×10^{1}	2.0×10^{1}	1.8×10^{2}	3.3×10^{1}	1.1×10^{1}
Lithium	2.1×10^{1}	2.4×10^{1}	2.4×10^{1}	2.2×10^{1}	2.6×10^{1}	2.4×10^{1}	2.4×10^{1}	2.4×10^{1}	2.5×10^{1}
Manganese	2.5×10^{2}	3.0×10^{2}	2.9×10^{2}	2.8×10^{2}	3.8×10^{2}	2.8×10^{2}	2.8×10^{2}	3.6×10^{2}	2.9×10^{2}
Mercury	4.0×10^{-2}	6.2×10^{-2}	7.1×10^{-2}	8.7×10^{-2}	4.2×10^{-1}	1.9×10^{-1}	3.6×10^{-2}	5.5×10^{-2}	8.3×10^{-1}
Molybdenum	5.5×10^{-1}	8.5×10^{-1}	6.7×10^{-1}	6.3×10^{-1}	6.3×10^{-1}	7.4×10^{-1}	7.3×10^{-1}	6.2×10^{-1}	5.6×10^{-1}
Nickel	1.1×10^{1}	1.5×10^{1}	1.4×10^{1}	1.4×10^{1}	2.3×10^{1}	1.5×10^{1}	1.3×10^{1}	1.7×10^{1}	1.0×10^{1}
Selenium	3.2×10^{-1}	1.6×10^{-1}	4.9×10^{-1}	1.6×10^{-1}	1.8×10^{-1}	3.0×10^{-1}	1.6×10^{-1}	2.1×10^{-1}	3.4×10^{-1}
Silver	3.8×10^{-1}	3.4×10^{-1}	4.2×10^{-1}	1.7×10^{-1}	8.1×10^{-2}	4.6×10^{-1}	8.0×10^{-2}	5.2×10^{-2}	1.6×10^{-1}
Strontium	1.8×10^{1}	2.3×10^{1}	2.7×10^{1}	3.1×10^{1}	3.9×10^{1}		1.8×10^{1}	5.8×10^{1}	1.9×10^{1}
Thallium	2.6×10^{-1}	3.0×10^{-1}	2.8×10^{-1}	2.8×10^{-1}	3.6×10^{-1}	2.8×10^{-1}	2.8×10^{-1}	3.1×10^{-1}	2.5×10^{-1}
Tin	--	9.4	2.1	3.1	1.6×10^{1}	2.7	1.0×10^{1}	--	7.1
Vanadium	3.6×10^{1}	4.2×10^{1}	4.0×10^{1}	4.2×10^{1}	6.2×10^{1}	3.9×10^{1}	4.0×10^{1}	5.2×10^{1}	3.2×10^{1}
Zinc	7.7×10^{1}	8.1×10^{1}	7.5×10^{1}	7.9×10^{1}	8.0×10^{1}	8.2×10^{1}	1.0×10^{2}	7.1×10^{1}	6.2×10^{1}
Zirconium	1.8	2.7	2.5	3.8	4.6	2.4	2.6	3.9	3.5
1-Methylnaphthalene	2.7×10^{-3}	7.1×10^{-1}	1.4×10^{-2}	6.8×10^{-3}	2.7×10^{-3}	2.4×10^{-3}	4.1×10^{-2}	1.8×10^{-3}	2.2×10^{-3}
2-Methylnaphthalene	6.5×10^{-3}	6.7×10^{-1}	1.3×10^{-2}	7.4×10^{-3}	2.4×10^{-3}	3.0×10^{-3}	3.3×10^{-2}	2.7×10^{-3}	2.4×10^{-3}
Acenaphthene	9.3×10^{-4}	1.1×10^{-1}	1.0×10^{-2}	1.9×10^{-2}	2.6×10^{-2}	9.6×10^{-3}	1.8×10^{-1}	4.2×10^{-3}	4.1×10^{-3}
Acenaphthylene	1.3×10^{-3}	4.7×10^{-3}	5.3×10^{-3}	2.0×10^{-3}	4.3×10^{-3}	2.5×10^{-3}	9.5×10^{-3}	1.3×10^{-3}	1.3×10^{-3}
Anthracene	3.1×10^{-3}	1.9×10^{-2}	1.6×10^{-2}	1.5×10^{-2}	3.8×10^{-2}	1.5×10^{-2}	1.3×10^{-1}	2.8×10^{-3}	1.1×10^{-2}
Benzo(a)pyrene TEQ	1.0×10^{-2}	--	--	--	--	2.8×10^{-2}	--	--	--
Benzo(a)anthracene	2.3×10^{-2}	4.1×10^{-2}	7.8×10^{-2}	3.5×10^{-2}	7.6×10^{-2}	3.6×10^{-2}	2.9×10^{-1}	1.8×10^{-2}	1.4×10^{-2}
Benzo(a)pyrene	1.1×10^{-2}	2.8×10^{-2}	1.2×10^{-1}	2.9×10^{-2}	5.9×10^{-2}	3.4×10^{-2}	2.2×10^{-1}	1.4×10^{-2}	1.3×10^{-2}
Benzo(b)fluoranthene	2.0×10^{-2}	4.0×10^{-2}	1.2×10^{-1}	3.8×10^{-2}	6.4×10^{-2}	4.7×10^{-2}	2.6×10^{-1}	1.4×10^{-2}	1.2×10^{-2}
Benzo(e)pyrene	8.2×10^{-2}	2.4×10^{-2}	3.7×10^{-2}	1.8×10^{-2}	4.4×10^{-2}	1.8×10^{-2}	1.7×10^{-2}	5.2×10^{-2}	--
Benzo(g,h,i)perylene	1.6×10^{-2}	1.2×10^{-2}	2.0×10^{-1}	1.6×10^{-2}	3.5×10^{-2}	1.7×10^{-2}	3.5×10^{-2}	5.0×10^{-3}	6.7×10^{-3}
Benzo(k)fluoranthene	1.6×10^{-2}	2.0×10^{-2}	4.4×10^{-2}	2.3×10^{-2}	5.5×10^{-2}	2.4×10^{-2}	1.6×10^{-1}	9.8×10^{-3}	9.6×10^{-3}
Bis(2-ethylhexyl)phthalate	1.8×10^{-2}	9.5×10^{-2}	1.3×10^{-1}	5.4×10^{-2}	3.0×10^{-2}	5.3×10^{-2}	9.7×10^{-2}	1.9×10^{-2}	2.8×10^{-2}
Butylbenzylphthalate	7.3×10^{-3}	2.2×10^{-2}	1.8×10^{-2}	1.4×10^{-2}	2.0×10^{-2}	2.1×10^{-2}	2.2×10^{-2}	5.9×10^{-2}	2.7×10^{-2}
Chrysene	9.9×10^{-3}	3.2×10^{-2}	1.0×10^{-1}	3.6×10^{-2}	5.3×10^{-2}	3.4×10^{-2}	2.2×10^{-1}	1.1×10^{-2}	9.7×10^{-3}
Dibenzo(a,h)anthracene	3.3×10^{-3}	1.0×10^{-2}	3.9×10^{-2}	1.1×10^{-2}	2.7×10^{-2}	9.4×10^{-3}	2.5×10^{-2}	6.1×10^{-3}	7.7×10^{-3}
Diethylphthalate	--	8.3×10^{-3}	1.4×10^{-2}	1.1×10^{-2}	9.7×10^{-3}	1.4×10^{-2}	--	8.9×10^{-3}	--
Dimethylphthalate	--	3.6×10^{-2}	1.2×10^{-1}	--	1.0×10^{-2}	9.7×10^{-3}	--	--	5.0×10^{-2}
Di-n-butylphthalate	8.2×10^{-3}	2.1×10^{-1}	1.1×10^{-2}	1.5	1.4×10^{-2}	9.2×10^{-2}	7.0×10^{-2}	1.4×10^{-2}	3.1×10^{-2}
Di-n-octylphthalate	--	5.0×10^{-2}	2.4×10^{-2}	1.8×10^{-2}	1.3×10^{-2}	2.6×10^{-2}	2.9×10^{-1}	2.0×10^{-2}	4.0×10^{-2}
Fluoranthene	1.4×10^{-2}	5.7×10^{-2}	7.2×10^{-2}	8.4×10^{-2}	9.3×10^{-2}	7.7×10^{-2}	6.4×10^{-1}	1.3×10^{-2}	1.6×10^{-2}
Fluorene	3.4×10^{-3}	4.6×10^{-3}	9.9×10^{-3}	1.0×10^{-2}	1.1×10^{-2}	6.3×10^{-3}	9.4×10^{-2}	2.8×10^{-3}	3.8×10^{-3}
Indeno(1,2,3-cd)pyrene	6.3×10^{-3}	1.3×10^{-2}	2.6×10^{-1}	2.0×10^{-2}	4.5×10^{-2}	1.9×10^{-2}	4.4×10^{-2}	5.6×10^{-3}	8.4×10^{-3}
Morpholine	--	--	6.9×10^{-2}	--	--	--	--	--	--
Naphthalene	8.4×10^{-3}	7.6×10^{-2}	1.6×10^{-2}	4.6×10^{-3}	2.3×10^{-3}	3.1×10^{-3}	3.8×10^{-2}	3.0×10^{-3}	4.9×10^{-3}

Constituent	Site Soil Concentration of Chemicals (milligrams per kilogram) in Sub-areas								
	3	5A	5B	5C	5D	6	7	8	NBZ
N-Nitrosodimethylamine	--	7.4×10^{-4}	4.4×10^{-3}	7.9×10^{-3}	2.1×10^{-3}	5.8×10^{-2}	2.9×10^{-2}	--	3.5×10^{-3}
Phenanthrene	8.6×10^{-3}	5.5×10^{-2}	4.6×10^{-2}	4.5×10^{-2}	3.4×10^{-2}	4.7×10^{-2}	4.9×10^{-1}	7.1×10^{-3}	1.0×10^{-2}
Pyrene	1.2×10^{-2}	5.0×10^{-2}	9.8×10^{-2}	7.5×10^{-2}	8.6×10^{-2}	6.8×10^{-2}	5.2×10^{-1}	1.3×10^{-2}	1.3×10^{-2}
Total TCDD TEQ	3.5×10^{-6}	7.1×10^{-6}	6.3×10^{-6}	6.7×10^{-6}	4.4×10^{-6}	1.5×10^{-5}	6.5×10^{-6}	1.8×10^{-6}	3.0×10^{-6}
Aroclor 1242	--	--	7.0×10^{-2}	--	7.9×10^{-4}	1.5×10^{-3}	2.4×10^{-3}	--	--
Aroclor 1248	--	5.2×10^{-3}	3.7×10^{-1}	3.7×10^{-3}	6.1×10^{-2}	2.6×10^{-1}	2.0×10^{-3}	3.1×10^{-1}	1.3
Aroclor 1254	3.7×10^{-2}	1.2×10^{-2}	4.7×10^{-2}	3.1×10^{-2}	4.0×10^{-2}	1.5×10^{-1}	2.9×10^{-2}	4.3×10^{-2}	8.3×10^{-2}
Aroclor 1260	3.9×10^{-2}	3.0×10^{-2}	3.6×10^{-2}	2.5×10^{-2}	8.8×10^{-3}	4.8×10^{-2}	2.4×10^{-2}	8.1×10^{-3}	1.4×10^{-1}
Aroclor 1262	--	--	2.4×10^{-2}	--	4.4×10^{-3}	--	--	--	--
Aroclor 1268	--	1.3×10^{-2}	1.7×10^{-2}	--	--	--	--	7.5×10^{-3}	--
Aroclor 5442	--	2.0×10^{-3}	--	--	1.5×10^{-2}	--	--	--	--
Aroclor 5460	5.6×10^{-2}	1.6×10^{-2}	2.0×10^{-2}	1.8×10^{-2}	6.0×10^{-3}	1.7×10^{-1}	3.4×10^{-2}	7.9×10^{-2}	3.6×10^{-2}
1,1,2-Trichloro-1,2,2-trifluoroethane	--	--	--	--	1.9×10^{-4}	--	--	--	--
1,2,3-Trichlorobenzene	--	8.5×10^{-2}	--	--	--	--	--	--	--
1,2,4-Trimethylbenzene	--	3.2×10^{-2}	--	--	--	--	--	5.7×10^{-4}	--
1,2-Dibromoethane	--	--	4.2×10^{-4}	--	--	--	--	--	--
1,2-Dichloroethane	--	2.3×10^{-3}	2.8×10^{-4}	--	--	2.5×10^{-3}	--	--	--
1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	3.6×10^{-4}	--
1,4-Dichlorobenzene	--	--	--	--	--	3.3×10^{-4}	--	--	--
2-Butanone (Methyl ethyl ketone)	--	6.2×10^{-3}	7.8×10^{-3}	6.0×10^{-3}	3.6×10^{-3}	9.1×10^{-3}	2.9×10^{-3}	2.5×10^{-3}	--
2-Phenylbutane	--	2.7×10^{-1}	8.0×10^{-5}	--	--	--	--	--	--
4-Methyl-2-pentanone (Methyl isobutyl ketone)	--	--	9.6×10^{-3}	5.1×10^{-3}	--	--	--	8.8×10^{-4}	--
Acetone	--	2.4×10^{-2}	3.6×10^{-2}	1.9×10^{-2}	1.4×10^{-2}	1.0×10^{-2}	1.1×10^{-2}	9.3×10^{-3}	--
Benzene	--	2.4×10^{-3}	1.4×10^{-4}	1.1×10^{-4}	1.8×10^{-4}	--	--	1.1×10^{-4}	--
Bromodichloromethane	--	5.0×10^{-2}	--	--	--	--	--	--	--
Chloroform	--	--	1.4×10^{-4}	2.4×10^{-4}	1.6×10^{-4}	1.5×10^{-4}	--	3.3×10^{-4}	--
Cymene	--	1.3×10^{-1}	1.8×10^{-4}	--	--	--	--	--	--
Ethylbenzene	--	2.9×10^{-2}	1.8×10^{-4}	7.0×10^{-5}	--	7.0×10^{-5}	8.0×10^{-5}	4.6×10^{-4}	--
Hexachloro-1,3-butadiene	--	1.0×10^{-1}	--	--	--	--	--	--	--
Isopropylbenzene	--	1.4×10^{-1}	9.0×10^{-5}	--	--	2.9×10^{-4}	--	--	--
m,p-Xylene	--	1.0×10^{-3}	6.1×10^{-4}	1.9×10^{-4}	--	2.1×10^{-4}	3.2×10^{-4}	1.6×10^{-3}	--
Methylene Chloride	--	4.1×10^{-3}	1.4×10^{-3}	4.7×10^{-3}	2.9×10^{-2}	7.4×10^{-2}	--	1.5×10^{-2}	4.2×10^{-3}
n-Butylbenzene	--	2.1×10^{-1}	--	--	--	--	--	--	--
n-Propylbenzene	--	3.4×10^{-1}	9.0×10^{-5}	--	--	--	--	--	--
o-Xylene	--	5.8×10^{-3}	2.0×10^{-4}	--	--	--	--	4.9×10^{-4}	--
Styrene	--	--	5.7×10^{-3}	--	--	--	--	--	--
tert-Butylbenzene	--	4.7×10^{-2}	--	--	--	--	--	--	--
Tetrachloroethene	--	--	--	--	--	--	--	5.2×10^{-4}	--
Toluene	--	2.3×10^{-4}	--	1.8×10^{-4}	1.5×10^{-4}	1.8×10^{-4}	2.8×10^{-4}	2.3×10^{-4}	--
Trichloroethene	--	1.6×10^{-4}	8.3×10^{-4}	5.3×10^{-4}	--	--	--	6.8×10^{-3}	--
Vinyl Chloride	--	--	--	--	--	--	--	2.7×10^{-4}	--

NBZ = Northern Buffer Zone; TCDD = 2,3,7,8-tetrachlorodibenzo-p-dioxin; TEQ = toxicity equivalent.

Notes:

– Results were based on the arithmetic mean concentration of chemical constituents in onsite soil source areas.

– The maximum of the averages for all sub-areas is the concentration used to evaluate the recreational exposure for an individual assumed to be moving throughout Area IV and NBZ during exposure.

– "--" indicates that the radionuclide is not included in the soil data set for that sub-area.

Table G–3 Background Soil Concentrations of Radionuclides

Constituent	*Data Source*	*UCL95 (picocuries per gram)*
Am-241	Background Data	0.0118
Cs-134	Background Data	0.0147
Cs-137+D	Background Data	0.0734
Co-60	Background Data	-
Cm-243	Background Data	-
Eu-152	Background Data	0.0036
Eu-154	Background Data	0.0167
Pb-210	Th-230 Parent	1.267
Pu-238	Background Data	0.00174
Pu-239+D	Background Data	0.00459
Po-210	Th-230 Parent	1.267
Ra-226+D	Th-230 Parent	1.267
Sr-90+D	Background Data	0.0289
Th-230	Background Data	1.267
Th-232	Background Data	1.665
H-3	Background Data	3.765
U-234	Background Data	1.159
U-235+D	Background Data	0.0661
U-238+D	Background Data	1.168
Bi-210	Th-230 Parent	1.267
Pa-231	U-235 Parent	0.0661
Ac-227	U-235 Parent	0.0661
Th-227	U-235 Parent	0.0661
Ra-223+D	U-235 Parent	0.0661
Pb-211	U-235 Parent	0.0661
Bi-211	U-235 Parent	0.0661
Tl-207	U-235 Parent	0.0661
Ra-228+D	Th-232 Parent	1.665
Th-228	Th-232 Parent	1.665
Ra-224+D	Th-232 Parent	1.665
Pb-212	Th-232 Parent	1.665
Bi-212+D	Th-232 Parent	1.665
Tl-208	Th-232 Parent (0.333 decay fraction)	0.554

UCL95 = 95 percent upper confidence level on the arithmetic mean.

Notes:

– Constituent names are those generally appearing in the sources of the screening values. The "+D" indicates that long-lived daughter products are included in the evaluation of the parent isotope.

– Results are the UCL95s for the SSFL background data set (MWH 2015).

– No results were given for Co-60 because it was detected in 1 of 141 samples.

– Th-234 (1.512 picocuries per gram) was eliminated from the final background data set because U-238 evaluated as U-238+D includes contributions from Th-234.

– Measured background concentrations for Pb-211 (1.206 picocuries per gram), Po-210 (1.274), and Ra-226 (1.404) were replaced with the Th-230 parent concentration (1.267).

– Additional daughter Bi-210 was not included in the measured background data, but is assigned the concentration of the Th-230 parent concentration (1.267).

– Additional U-235 daughter isotopes (Pa-231, Ac-227, Th-227, Ra-223, Pb-211, Bi-211, and Tl-207) were assigned the U-235 concentration (0.0661 picocuries per gram).

– Additional Th-232 daughter isotopes (Ra-228, Th-228, Ra-224, Pb-212, Bi-212, and Tl-208) were assigned the Th-232 concentration (1.665 picocuries per gram).

– Added Sr-90 and Cm-243 to match constituents found in sub-area soils.

Table G–4 Background Soil Concentrations of Chemicals

Analyte Type	*Constituent*	*UCL95 (milligrams per kilogram)*
Metals		
	Aluminum	2.20×10^{4}
	Antimony	2.56×10^{-1}
	Arsenic	1.08×10^{1}
	Barium	1.31×10^{2}
	Beryllium	9.11×10^{-1}
	Boron	8.40
	Cadmium	2.66×10^{-1}
	Chromium	3.94×10^{1}
	Cobalt	1.33×10^{1}
	Copper	1.93×10^{1}
	Cyanides	1.88×10^{-1}
	Fluoride	1.96
	Hexavalent chromium	5.53×10^{-1}
	Lead	1.59×10^{1}
	Lithium	3.41×10^{1}
	Manganese	4.37×10^{2}
	Mercury	1.47×10^{-2}
	Molybdenum	9.34×10^{-1}
	Nickel	2.78×10^{1}
	Selenium	3.04×10^{-1}
	Silver	5.20×10^{-2}
	Strontium	3.51×10^{1}
	Thallium	3.83×10^{-1}
	Tin	6.89×10^{-1}
	Titanium	1.13×10^{3}
	Vanadium	7.30×10^{1}
	Zinc	9.27×10^{1}
	Zirconium	5.18
Energetic	Perchlorate	3.87×10^{-4}
Semi-volatile organic compounds		
	bis(2-Ethylhexyl) phthalate	
	Butyl benzyl phthalate	1.46×10^{-2}
	Diethyl phthalate	-
	Dimethyl phthalate	6.40×10^{-3}
	Di-n-butyl phthalate	6.16×10^{-3}
	Di-n-octyl phthalate	6.04×10^{-3}
	Formaldehyde	6.00×10^{-1}
Polycyclic aromatic hydrocarbons		
	1-Methyl naphthalene	6.82×10^{-4}
	2-Methylnaphthalene	6.93×10^{-4}
	Acenaphthene	
	Acenaphthylene	4.04×10^{-4}
	Anthracene	3.72×10^{-4}
	Benzo(a)anthracene	7.61×10^{-4}
	Benzo(a)pyrene	8.47×10^{-4}

Analyte Type	*Constituent*	*UCL95 (milligrams per kilogram)*
	Benzo(b)fluoranthene	1.43×10^{-3}
	Benzo(ghi)perylene	7.54×10^{-4}
	Benzo(k)fluoranthene	1.40×10^{-3}
	Chrysene	1.17×10^{-3}
	Dibenzo(a,h)anthracene	7.16×10^{-4}
	Fluoranthene	1.30×10^{-3}
	Fluorene	8.83×10^{-4}
	Indeno(1,2,3-cd)pyrene	6.85×10^{-4}
	Naphthalene	8.61×10^{-4}
	Phenanthrene	9.44×10^{-4}
	Pyrene	1.21×10^{-3}
Pesticides		
	4,4'-DDD	9.35×10^{-5}
	4,4'-DDE	1.79×10^{-3}
	4,4'-DDT	2.48×10^{-3}
	Aldrin	6.69×10^{-5}
	alpha-BHC	3.54×10^{-5}
	beta-BHC	7.20×10^{-5}
	Chlordane (Technical)	1.96×10^{-3}
	delta-BHC	5.55×10^{-5}
	Dieldrin	8.08×10^{-5}
	Endosulfan I	5.17×10^{-5}
	Endosulfan II	1.04×10^{-4}
	Endosulfan sulfate	8.77×10^{-5}
	Endrin	8.72×10^{-5}
	Endrin aldehyde	1.58×10^{-4}
	Endrin ketone	1.21×10^{-4}
	gamma-BHC	3.72×10^{-5}
	Heptachlor	6.86×10^{-5}
	Heptachlor epoxide	5.51×10^{-5}
	Mirex	1.36×10^{-4}
	p,p'-Methoxychlor	4.02×10^{-4}
	Toxaphene	2.69×10^{-3}
Herbicides		
	2,4,5-T	1.99×10^{-4}
	2,4,5-TP (Silvex)	1.35×10^{-4}
	2,4-Dichlorophenoxyacetic Acid (2,4-D)	1.65×10^{-3}
	2,4-Dichlorophenoxybutyric acid	1.92×10^{-3}
	2,4-DP (Dichlorprop)	9.17×10^{-4}
	Dalapon	
	Dicamba	4.95×10^{-4}
	Dinoseb	
	MCPA	1.42×10^{-1}
	MCPP	9.76×10^{-2}

Analyte Type	*Constituent*	*UCL95 (milligrams per kilogram)*
Polychlorinated dibenzo-p-dioxins/polychlorinated dioxins/furans		
	1,2,3,4,6,7,8-Heptachlorodibenzofuran	4.01×10^{-7}
	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	1.49×10^{-6}
	1,2,3,4,7,8,9-Heptachlorodibenzofuran	3.76×10^{-8}
	1,2,3,4,7,8-Hexachlorodibenzofuran	7.01×10^{-8}
	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	4.51×10^{-8}
	1,2,3,6,7,8-Hexachlorodibenzofuran	9.30×10^{-8}
	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	3.37×10^{-7}
	1,2,3,7,8,9-Hexachlorodibenzofuran	4.64×10^{-7}
	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	4.29×10^{-7}
	1,2,3,7,8-Pentachlorodibenzofuran	9.64×10^{-8}
	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	5.53×10^{-8}
	2,3,4,6,7,8-Hexachlorodibenzofuran	1.05×10^{-7}
	2,3,4,7,8-Pentachlorodibenzofuran	1.15×10^{-7}
	2,3,7,8-TCDD	8.92×10^{-9}
	2,3,7,8-TCDD TEQ	2.78×10^{-7}
	2,3,7,8-TCDD_TEQ_Bird	4.81×10^{-7}
	2,3,7,8-TCDD_TEQ_Mammal	2.78×10^{-7}
	2,3,7,8-Tetrachlorodibenzofuran	1.44×10^{-7}
	Octachlorodibenzofuran	6.83×10^{-7}
	Octachlorodibenzo-p-dioxin	9.73×10^{-6}
Other		
	Nitrate	4.44
	Orthophosphate – PO4	5.59×10^{2}

TCDD = 2,3,7,8-tetrachlorodibenzo-p-dioxin; TEQ = toxicity equivalent; UCL95 = 95 percent upper confidence level on the arithmetic mean.

Notes:

– Results are the UCL95s of the background data set (MWH 2015).

– No results were provided for acenapthene, dalapon, and dinoseb because they were not detected.

Table G–5 Soil Concentration Surrogates for Uranium and Thorium Decay Chain Radioisotopes

U-238 Decay Chain		*U-235 Decay Chain*		*Th-232 Decay Chain*	
Isotopic Name	*Data*	*Isotopic Name*	*Data*	*Isotopic Name*	*Data*
U-238+D	U-238	U-235+D	U-235	Th-232	Th-232
U-234	U-234	Pa-231	U-235	Ra-228+D	Th-232
Th-230	Th-230	Ac-227	U-235	Th-228	Th-232
Ra-226+D	Th-230	Th-227	U-235	Ra-224+D	Th-232
Pb-210	Th-230	Ra-223+D	U-235	Pb-212	Th-232
Bi-210	Th-230	Pb-211	U-235	Bi-212+D	Th-232
Po-210	Th-230	Bi-211	U-235	Tl-208	Th-232
		Tl-207	U-235		

Notes:

– Isotopic names are those presented for the screening levels used in the risk assessment. The "+D" indicates that daughter isotopes are included for that particular screening value.

– The Data column indicates which parent isotopic concentration was used as a surrogate for the daughter isotope.

– A decay fraction of 0.333 is applied for Tl-208 because it is formed in only one of three decays of the parent isotope.

Table G–6 Calculation of TCDD TEQ for Area IV Site Soil Data

Chemical	*TCDD TEF*	*Sub-area*	*Average of Detects (ng/kg)*	*TEQ Average (ng/kg)*	*TEQ Average Concentration Converted (mg/kg)*
1,2,3,4,6,7,8-Heptachlorodibenzo-p-Dioxin	0.01	5A	131	1.31	1.31×10^{-6}
1,2,3,4,7,8-Hexachlorodibenzo-p-Dioxin	0.10	5A	1.85	0.185	1.85×10^{-7}
1,2,3,6,7,8-Hexachlorodibenzo-p-Dioxin	0.10	5A	4.63	0.463	4.63×10^{-7}
1,2,3,7,8,9-Hexachlorodibenzo-p-Dioxin	0.10	5A	3.4	0.34	3.40×10^{-7}
1,2,3,7,8-Pentachlorodibenzo-p-Dioxin	1.00	5A	1.38	1.38	1.38×10^{-6}
2,3,7,8-TCDD	1.00	5A	0.246	0.246	2.46×10^{-7}
Octachlorodibenzodioxin	0.0003	5A	1750	0.525	5.25×10^{-7}
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	5A	21.4	0.214	2.14×10^{-7}
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	5A	3.36	0.0336	3.36×10^{-8}
1,2,3,4,7,8-Hexachlorodibenzofuran	0.10	5A	3.66	0.366	3.66×10^{-7}
1,2,3,6,7,8-Hexachlorodibenzofuran	0.10	5A	2.88	0.288	2.88×10^{-7}
1,2,3,7,8,9-Hexachlorodibenzofuran	0.10	5A	1.23	0.123	1.23×10^{-7}
1,2,3,7,8-Pentachlorodibenzofuran	0.03	5A	1.41	0.0423	4.23×10^{-8}
2,3,4,6,7,8-Hexachlorodibenzofuran	0.10	5A	4.37	0.437	4.37×10^{-7}
2,3,4,7,8-Pentachlorodibenzofuran	0.30	5A	3.42	1.026	1.03×10^{-6}
2,3,7,8-Tetrachlorodibenzofuran	0.10	5A	0.971	0.0971	9.71×10^{-8}
Octachlorodibenzofuran	0.0003	5A	51.4	0.01542	1.54×10^{-8}
Total TCDD TEQ	**--**	**5A**	**--**	**7.09142**	$\mathbf{7.09\times10^{-6}}$
1,2,3,4,6,7,8-Heptachlorodibenzo-p-Dioxin	0.01	5B	135	1.35	1.35×10^{-6}
1,2,3,4,7,8-Hexachlorodibenzo-p-Dioxin	0.10	5B	2.22	0.222	2.22×10^{-7}
1,2,3,6,7,8-Hexachlorodibenzo-p-Dioxin	0.10	5B	5.4	0.54	5.40×10^{-7}
1,2,3,7,8,9-Hexachlorodibenzo-p-Dioxin	0.10	5B	3.37	0.337	3.37×10^{-7}
1,2,3,7,8-Pentachlorodibenzo-p-Dioxin	1.00	5B	1.2	1.2	1.20×10^{-6}
2,3,7,8-TCDD	1.00	5B	0.245	0.245	2.45×10^{-7}
Octachlorodibenzodioxin	0.0003	5B	1610	0.483	4.83×10^{-7}
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	5B	22.8	0.228	2.28×10^{-7}
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	5B	3.54	0.0354	3.54×10^{-8}
1,2,3,4,7,8-Hexachlorodibenzofuran	0.10	5B	2.58	0.258	2.58×10^{-7}
1,2,3,6,7,8-Hexachlorodibenzofuran	0.10	5B	2.14	0.214	2.14×10^{-7}
1,2,3,7,8,9-Hexachlorodibenzofuran	0.10	5B	0.894	0.0894	8.94×10^{-8}
1,2,3,7,8-Pentachlorodibenzofuran	0.03	5B	1.1	0.033	3.30×10^{-8}
2,3,4,6,7,8-Hexachlorodibenzofuran	0.10	5B	2.55	0.255	2.55×10^{-7}
2,3,4,7,8-Pentachlorodibenzofuran	0.30	5B	2.51	0.753	7.53×10^{-7}
2,3,7,8-Tetrachlorodibenzofuran	0.10	5B	0.504	0.0504	5.04×10^{-8}
Octachlorodibenzofuran	0.0003	5B	61.5	0.01845	1.85×10^{-8}
Total TCDD TEQ	**--**	**5B**	**--**	**6.31165**	$\mathbf{6.31\times10^{-6}}$
1,2,3,4,6,7,8-Heptachlorodibenzo-p-Dioxin	0.01	5C	227	2.27	2.27×10^{-6}
1,2,3,4,7,8-Hexachlorodibenzo-p-Dioxin	0.10	5C	2.03	0.203	2.03×10^{-7}
1,2,3,6,7,8-Hexachlorodibenzo-p-Dioxin	0.10	5C	8.33	0.833	8.33×10^{-7}
1,2,3,7,8,9-Hexachlorodibenzo-p-Dioxin	0.10	5C	4.17	0.417	4.17×10^{-7}
1,2,3,7,8-Pentachlorodibenzo-p-Dioxin	1.00	5C	1.07	1.07	1.07×10^{-6}
2,3,7,8-TCDD	1.00	5C	0.222	0.222	2.22×10^{-7}
Octachlorodibenzodioxin	0.0003	5C	1680	0.504	5.04×10^{-7}
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	5C	20	0.2	2.00×10^{-7}
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	5C	2.77	0.0277	2.77×10^{-8}
1,2,3,4,7,8-Hexachlorodibenzofuran	0.10	5C	1.66	0.166	1.66×10^{-7}
1,2,3,6,7,8-Hexachlorodibenzofuran	0.10	5C	1.08	0.108	1.08×10^{-7}
1,2,3,7,8,9-Hexachlorodibenzofuran	0.10	5C	0.626	0.0626	6.26×10^{-8}
1,2,3,7,8-Pentachlorodibenzofuran	0.03	5C	1.16	0.0348	3.48×10^{-8}
2,3,4,6,7,8-Hexachlorodibenzofuran	0.10	5C	1.96	0.196	1.96×10^{-7}

Chemical	TCDD TEF	Sub-area	Average of Detects (ng/kg)	TEQ Average (ng/kg)	TEQ Average Concentration Converted (mg/kg)
2,3,4,7,8-Pentachlorodibenzofuran	0.30	5C	1.15	0.345	3.45×10^{-7}
2,3,7,8-Tetrachlorodibenzofuran	0.10	5C	0.265	0.0265	2.65×10^{-8}
Octachlorodibenzofuran	0.0003	5C	41.1	0.01233	1.23×10^{-8}
Total TCDD TEQ	**--**	**5C**	**--**	**6.69793**	**6.70×10^{-6}**
1,2,3,4,6,7,8-Heptachlorodibenzo-p-Dioxin	0.01	5D	128	1.28	1.28×10^{-6}
1,2,3,4,7,8-Hexachlorodibenzo-p-Dioxin	0.10	5D	1.14	0.114	1.14×10^{-7}
1,2,3,6,7,8-Hexachlorodibenzo-p-Dioxin	0.10	5D	3.73	0.373	3.73×10^{-7}
1,2,3,7,8,9-Hexachlorodibenzo-p-Dioxin	0.10	5D	2.54	0.254	2.54×10^{-7}
1,2,3,7,8-Pentachlorodibenzo-p-Dioxin	1.00	5D	0.738	0.738	7.38×10^{-7}
2,3,7,8-TCDD	1.00	5D	0.157	0.157	1.57×10^{-7}
Octachlorodibenzodioxin	0.0003	5D	1610	0.483	4.83×10^{-7}
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	5D	11.3	0.113	1.13×10^{-7}
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	5D	2.15	0.0215	2.15×10^{-8}
1,2,3,4,7,8-Hexachlorodibenzofuran	0.10	5D	1.35	0.135	1.35×10^{-7}
1,2,3,6,7,8-Hexachlorodibenzofuran	0.10	5D	0.768	0.0768	7.68×10^{-8}
1,2,3,7,8,9-Hexachlorodibenzofuran	0.10	5D	0.716	0.0716	7.16×10^{-8}
1,2,3,7,8-Pentachlorodibenzofuran	0.03	5D	1.18	0.0354	3.54×10^{-8}
2,3,4,6,7,8-Hexachlorodibenzofuran	0.10	5D	0.93	0.093	9.30×10^{-8}
2,3,4,7,8-Pentachlorodibenzofuran	0.30	5D	1.25	0.375	3.75×10^{-7}
2,3,7,8-Tetrachlorodibenzofuran	0.10	5D	0.342	0.0342	3.42×10^{-8}
Octachlorodibenzofuran	0.0003	5D	38	0.0114	1.14×10^{-8}
Total TCDD TEQ	**--**	**5D**	**--**	**4.3659**	**4.37×10^{-6}**
1,2,3,4,6,7,8-Heptachlorodibenzo-p-Dioxin	0.01	NBZ	21.7	0.217	2.17×10^{-7}
1,2,3,4,7,8-Hexachlorodibenzo-p-Dioxin	0.10	NBZ	0.346	0.0346	3.46×10^{-8}
1,2,3,6,7,8-Hexachlorodibenzo-p-Dioxin	0.10	NBZ	1.87	0.187	1.87×10^{-7}
1,2,3,7,8,9-Hexachlorodibenzo-p-Dioxin	0.10	NBZ	0.919	0.0919	9.19×10^{-8}
1,2,3,7,8-Pentachlorodibenzo-p-Dioxin	1.00	NBZ	0.297	0.297	2.97×10^{-7}
2,3,7,8-TCDD	1.00	NBZ	0.122	0.122	1.22×10^{-7}
Octachlorodibenzodioxin	0.0003	NBZ	170	0.051	5.10×10^{-8}
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	NBZ	7.61	0.0761	7.61×10^{-8}
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	NBZ	2.19	0.0219	2.19×10^{-8}
1,2,3,4,7,8-Hexachlorodibenzofuran	0.10	NBZ	2.41	0.241	2.41×10^{-7}
1,2,3,6,7,8-Hexachlorodibenzofuran	0.10	NBZ	1.4	0.14	1.40×10^{-7}
1,2,3,7,8,9-Hexachlorodibenzofuran	0.10	NBZ	0.266	0.0266	2.66×10^{-8}
1,2,3,7,8-Pentachlorodibenzofuran	0.03	NBZ	2.33	0.0699	6.99×10^{-8}
2,3,4,6,7,8-Hexachlorodibenzofuran	0.10	NBZ	1.23	0.123	1.23×10^{-7}
2,3,4,7,8-Pentachlorodibenzofuran	0.30	NBZ	4.01	1.203	1.20×10^{-6}
2,3,7,8-Tetrachlorodibenzofuran	0.10	NBZ	0.764	0.0764	7.64×10^{-8}
Octachlorodibenzofuran	0.0003	NBZ	14	0.0042	4.20×10^{-9}
Total TCDD TEQ	**--**	**NBZ**	**--**	**2.9826**	**2.98×10^{-6}**
1,2,3,4,6,7,8-Heptachlorodibenzo-p-Dioxin	0.01	3	74.2	0.742	7.42×10^{-7}
1,2,3,4,7,8-Hexachlorodibenzo-p-Dioxin	0.10	3	0.855	0.0855	8.55×10^{-8}
1,2,3,6,7,8-Hexachlorodibenzo-p-Dioxin	0.10	3	2.32	0.232	2.32×10^{-7}
1,2,3,7,8,9-Hexachlorodibenzo-p-Dioxin	0.10	3	2.35	0.235	2.35×10^{-7}
1,2,3,7,8-Pentachlorodibenzo-p-Dioxin	1.00	3	0.653	0.653	6.53×10^{-7}
2,3,7,8-TCDD	1.00	3	0.156	0.156	1.56×10^{-7}
Octachlorodibenzodioxin	0.0003	3	712	0.2136	2.14×10^{-7}
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	3	16	0.16	1.60×10^{-7}
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	3	1.67	0.0167	1.67×10^{-8}
1,2,3,4,7,8-Hexachlorodibenzofuran	0.10	3	1.56	0.156	1.56×10^{-7}
1,2,3,6,7,8-Hexachlorodibenzofuran	0.10	3	1.37	0.137	1.37×10^{-7}

Chemical	TCDD TEF	Sub-area	Average of Detects (ng/kg)	TEQ Average (ng/kg)	TEQ Average Concentration Converted (mg/kg)
1,2,3,7,8,9-Hexachlorodibenzofuran	0.10	3	0.286	0.0286	2.86×10^{-8}
1,2,3,7,8-Pentachlorodibenzofuran	0.03	3	1.11	0.0333	3.33×10^{-8}
2,3,4,6,7,8-Hexachlorodibenzofuran	0.10	3	1.46	0.146	1.46×10^{-7}
2,3,4,7,8-Pentachlorodibenzofuran	0.30	3	1.49	0.447	4.47×10^{-7}
2,3,7,8-Tetrachlorodibenzofuran	0.10	3	0.722	0.0722	7.22×10^{-8}
Octachlorodibenzofuran	0.0003	3	43.7	0.01311	1.31×10^{-8}
Total TCDD TEQ	**--**	**3**	**--**	**3.52701**	**3.53×10^{-6}**
1,2,3,4,6,7,8-Heptachlorodibenzo-p-Dioxin	0.01	6	318	3.18	3.18×10^{-6}
1,2,3,4,7,8-Hexachlorodibenzo-p-Dioxin	0.10	6	17.6	1.76	1.76×10^{-6}
1,2,3,6,7,8-Hexachlorodibenzo-p-Dioxin	0.10	6	12	1.2	1.20×10^{-6}
1,2,3,7,8,9-Hexachlorodibenzo-p-Dioxin	0.10	6	7.15	0.715	7.15×10^{-7}
1,2,3,7,8-Pentachlorodibenzo-p-Dioxin	1.00	6	3.76	3.76	3.76×10^{-6}
2,3,7,8-TCDD	1.00	6	0.877	0.877	8.77×10^{-7}
Octachlorodibenzodioxin	0.0003	6	3930	1.179	1.18×10^{-6}
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	6	49.1	0.491	4.91×10^{-7}
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	6	7.45	0.0745	7.45×10^{-8}
1,2,3,4,7,8-Hexachlorodibenzofuran	0.10	6	3.81	0.381	3.81×10^{-7}
1,2,3,6,7,8-Hexachlorodibenzofuran	0.10	6	3.22	0.322	3.22×10^{-7}
1,2,3,7,8,9-Hexachlorodibenzofuran	0.10	6	0.926	0.0926	9.26×10^{-8}
1,2,3,7,8-Pentachlorodibenzofuran	0.03	6	2.07	0.0621	6.21×10^{-8}
2,3,4,6,7,8-Hexachlorodibenzofuran	0.10	6	4.28	0.428	4.28×10^{-7}
2,3,4,7,8-Pentachlorodibenzofuran	0.30	6	2.18	0.654	6.54×10^{-7}
2,3,7,8-Tetrachlorodibenzofuran	0.10	6	1.21	0.121	1.21×10^{-7}
Octachlorodibenzofuran	0.0003	6	127	0.0381	3.81×10^{-8}
Total TCDD TEQ	**--**	**6**	**--**	**15.3353**	**1.53×10^{-5}**
1,2,3,4,6,7,8-Heptachlorodibenzo-p-Dioxin	0.01	7	136	1.36	1.36×10^{-6}
1,2,3,4,7,8-Hexachlorodibenzo-p-Dioxin	0.10	7	16.3	1.63	1.63×10^{-6}
1,2,3,6,7,8-Hexachlorodibenzo-p-Dioxin	0.10	7	4.68	0.468	4.68×10^{-7}
1,2,3,7,8,9-Hexachlorodibenzo-p-Dioxin	0.10	7	2.79	0.279	2.79×10^{-7}
1,2,3,7,8-Pentachlorodibenzo-p-Dioxin	1.00	7	0.963	0.963	9.63×10^{-7}
2,3,7,8-TCDD	1.00	7	0.208	0.208	2.08×10^{-7}
Octachlorodibenzodioxin	0.0003	7	1440	0.432	4.32×10^{-7}
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	7	19.5	0.195	1.95×10^{-7}
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	7	2.04	0.0204	2.04×10^{-8}
1,2,3,4,7,8-Hexachlorodibenzofuran	0.10	7	1.94	0.194	1.94×10^{-7}
1,2,3,6,7,8-Hexachlorodibenzofuran	0.10	7	1.11	0.111	1.11×10^{-7}
1,2,3,7,8,9-Hexachlorodibenzofuran	0.10	7	0.665	0.0665	6.65×10^{-8}
1,2,3,7,8-Pentachlorodibenzofuran	0.03	7	1.13	0.0339	3.39×10^{-8}
2,3,4,6,7,8-Hexachlorodibenzofuran	0.10	7	1.54	0.154	1.54×10^{-7}
2,3,4,7,8-Pentachlorodibenzofuran	0.30	7	1.27	0.381	3.81×10^{-7}
2,3,7,8-Tetrachlorodibenzofuran	0.10	7	0.415	0.0415	4.15×10^{-8}
Octachlorodibenzofuran	0.0003	7	40.8	0.01224	1.22×10^{-8}
Total TCDD TEQ	**--**	**7**	**--**	**6.54954**	**6.55×10^{-6}**
1,2,3,4,6,7,8-Heptachlorodibenzo-p-Dioxin	0.01	8	25.7	0.257	2.57×10^{-7}
1,2,3,4,7,8-Hexachlorodibenzo-p-Dioxin	0.10	8	0.547	0.0547	5.47×10^{-8}
1,2,3,6,7,8-Hexachlorodibenzo-p-Dioxin	0.10	8	1.33	0.133	1.33×10^{-7}
1,2,3,7,8,9-Hexachlorodibenzo-p-Dioxin	0.10	8	0.901	0.0901	9.01×10^{-8}
1,2,3,7,8-Pentachlorodibenzo-p-Dioxin	1.00	8	0.383	0.383	3.83×10^{-7}
2,3,7,8-TCDD	1.00	8	0.107	0.107	1.07×10^{-7}
Octachlorodibenzodioxin	0.0003	8	200	0.06	6.00×10^{-8}
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	8	3.41	0.0341	3.41×10^{-8}

Chemical	TCDD TEF	Sub-area	Average of Detects (ng/kg)	TEQ Average (ng/kg)	TEQ Average Concentration Converted (mg/kg)
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	8	0.571	0.00571	5.71×10^{-9}
1,2,3,4,7,8-Hexachlorodibenzofuran	0.10	8	0.919	0.0919	9.19×10^{-8}
1,2,3,6,7,8-Hexachlorodibenzofuran	0.10	8	0.548	0.0548	5.48×10^{-8}
1,2,3,7,8,9-Hexachlorodibenzofuran	0.10	8	0.449	0.0449	4.49×10^{-8}
1,2,3,7,8-Pentachlorodibenzofuran	0.03	8	1.47	0.0441	4.41×10^{-8}
2,3,4,6,7,8-Hexachlorodibenzofuran	0.10	8	0.727	0.0727	7.27×10^{-8}
2,3,4,7,8-Pentachlorodibenzofuran	0.30	8	0.933	0.2799	2.80×10^{-7}
2,3,7,8-Tetrachlorodibenzofuran	0.10	8	0.641	0.0641	6.41×10^{-8}
Octachlorodibenzofuran	0.0003	8	7.08	0.002124	2.12×10^{-9}
Total TCDD TEQ	**--**	**8**	**--**	**1.779134**	**1.78×10^{-6}**

kg = kilogram; mg = milligram; NBZ = Northern Buffer Zone; ng = nanogram; TCDD = 2,3,7,8-tetrachlorodibenzo-p-dioxin; TEF = toxicity equivalence factor; TEQ = toxicity equivalent.

Notes:

– TEF from Van den Berg et al. 2006.
– Average of detects is the arithmetic mean for samples with detectable levels for each constituent.
– TEQ is calculated as the average of detects times the TEF. Values are converted to soil concentrations in units of mg/kg in the adjacent column.
– TCDD TEQ is the sum of all values for a given sub-area.

Table G–7 Onsite Suburban Resident[a] Risk-Based Screening Levels for Radionuclides in Soil

Constituent	Onsite Resident RBSL for Radionuclides in Soil (picocuries per gram)	Constituent	Onsite Resident RBSL for Radionuclides in Soil (picocuries per gram)
Ac-227	4.0	Po-210	1.3×10^{1}
Am-241	2.0	Pu-238	3.9
Bi-210	2.6×10^{4}	Pu-239	3.4
Bi-211	2.7×10^{6}	Ra-223	8.7×10^{1}
Bi-212	3.6×10^{4}	Ra-224+D	2.2×10^{3}
Cm-243	3.2×10^{-1}	Ra-226+D	1.2×10^{-2}
Co-60	3.3×10^{-2}	Ra-228+D	8.7×10^{-2}
Cs-134	1.4×10^{-1}	Sr-90+D	3.8
Cs-137+D	5.5×10^{-2}	Th-227	8.8×10^{1}
Eu-152	3.6×10^{-2}	Th-228	2.9×10^{1}
Eu-154	4.5×10^{-2}	Th-230	4.5
H-3	2.2×10^{-1}	Th-232+D	4.1
Ni-59	6.5×10^{2}	Tl-207	1.5×10^{7}
Pa-231	6.0×10^{-1}	Tl-208	2.1×10^{4}
Pb-210	7.1×10^{-1}	U-234	5.2
Pb-211	1.0×10^{5}	U-235+D	1.7×10^{-1}
Pb-212	3.4×10^{3}	U-238+D	6.9×10^{-1}

RBSL = risk-based screening level.

[a] The onsite suburban resident exposure is based on the following direct pathways: ingestion, inhalation, and external.

Notes:

– Radiological RBSLs are from EPA sources (epa-prgs.ornl.gov/radionuclides/) and were calculated using the *Final Standardized Risk Assessment Methodology Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California* (MWH 2014) parameters for onsite suburban resident exposure.
– Cancer-based values were calculated for a risk level of 1×10^{-6}.
– Constituents listed with "+D" indicate that long-lived daughter products were included in the screening value.

Table G–8 Onsite Suburban Resident[a] Risk-Based Screening Levels for Chemicals in Soil

Constituent	*Onsite resident RBSL for Chemicals in Soil (mg/kg)*		*Constituent*	*Onsite resident RBSL for Chemicals in Soil (mg/kg)*	
	Cancer	*Noncancer*		*Cancer*	*Noncancer*
Aluminum		7.5×10^{3}	Fluoranthene		2.2×10^{2}
Antimony		2.6	Fluorene		2.2×10^{2}
Arsenic	6.6×10^{-2}	2.1	Indeno(1,2,3-cd)pyrene	3.9×10^{-1}	
Barium		1.1×10^{3}	Morpholine	NA	NA
Beryllium	1.5×10^{3}	3.1	Naphthalene	1.5×10^{1}	6.9×10^{1}
Boron		1.6×10^{3}	N-Nitrosodimethylamine	3.3×10^{-2}	4.9×10^{-2}
Cadmium	8.4×10^{2}	4.6×10^{-1}	Phenanthrene		1.6×10^{3}
Chromium		3.7×10^{3}	Pyrene		1.6×10^{2}
Chromium VI	1.3	2.3×10^{1}	2,3,7,8-TCDD	4.8×10^{-6}	5.1×10^{-6}
Cobalt	3.9×10^{2}	2.2	Aroclor 1242	2.3×10^{-1}	1.1×10^{-1}
Copper		3.0×10^{2}	Aroclor 1248	2.3×10^{-1}	1.1×10^{-1}
Cyanides		4.6	Aroclor 1254	2.3×10^{-1}	1.1×10^{-1}
Lead		8.0	Aroclor 1260	2.3×10^{-1}	1.1×10^{-1}
Lithium		1.6×10^{1}	Aroclor 1262	NA	NA
Manganese		6.2×10^{2}	Aroclor 1268	NA	NA
Mercury		1.7	Aroclor 5442	NA	NA
Molybdenum		3.8×10^{1}	Aroclor 5460	2.3×10^{-1}	1.1×10^{-1}
Nickel	1.4×10^{4}	9.1×10^{1}	1,1,2-Trichloro-1,2,2-trifluoroethane		2.9×10^{3}
Selenium		3.8×10^{1}	1,2,3-Trichlorobenzene	6.1×10^{1}	3.9
Silver		2.3×10^{1}	1,2,4-Trimethylbenzene		4.0
Strontium		4.6×10^{3}	1,2-Dibromoethane	1.0×10^{-1}	5.4
Thallium		7.6×10^{-2}	1,2-Dichloroethane	2.7×10^{-1}	1.5
Tin		4.6×10^{3}	1,3,5-Trimethylbenzene		1.8×10^{1}
Vanadium		1.9×10^{1}	1,4-Dichlorobenzene	1.3	2.5×10^{2}
Zinc		2.2×10^{3}	Methyl ethyl ketone		2.3×10^{3}
Zirconium		6.1×10^{-1}	2-Phenylbutane	NA	NA
1-Methylnaphthalene	7.2	2.9×10^{2}	Methyl isobutyl ketone		5.0×10^{2}
2-Methylnaphthalene		1.6×10^{1}	Acetone		6.0×10^{3}
Acenaphthene		3.2×10^{2}	Benzene	1.2×10^{-1}	3.6
Acenaphthylene		3.0×10^{2}	Bromodichloromethane	1.9×10^{-1}	1.9×10^{1}
Anthracene		1.6×10^{3}	Chloroform	7.3×10^{-1}	3.0×10^{1}
Benzo(a)pyrene	3.9×10^{-2}		Cymene	NA	NA
Benzo(a)anthracene	3.9×10^{-1}		Ethylbenzene	2.3	3.0×10^{2}
Benzo(a)pyrene	3.9×10^{-2}		Hexachloro-1,3-butadiene	NA	NA
Benzo(b)fluoranthene	3.9×10^{-1}		Cumene		1.5×10^{2}
Benzo(e)pyrene		1.6×10^{2}	m,p-Xylene		4.3×10^{1}
Benzo(ghi)perylene		1.6×10^{2}	Methylene Chloride	3.0	2.9×10^{1}
Benzo(k)fluoranthene	3.9×10^{-1}		n-Butylbenzene		8.6×10^{1}
bis(2-Ethylhexyl) phthalate	1.7×10^{2}	1.2×10^{2}	n-Propylbenzene		3.2×10^{2}
Butyl benzyl phthalate	2.7×10^{2}	1.2×10^{3}	o-Xylene		2.8×10^{1}
Chrysene	3.9		Styrene		1.2×10^{3}
Dibenzo(a,h)anthracene	1.1×10^{-1}		tert-Butylbenzene		1.7×10^{2}
Diethyl phthalate		4.9×10^{3}	Tetrachloroethene	4.2×10^{-1}	5.2

Constituent	Onsite resident RBSL for Chemicals in Soil (mg/kg)		Constituent	Onsite resident RBSL for Chemicals in Soil (mg/kg)	
	Cancer	Noncancer		Cancer	Noncancer
Dimethyl phthalate		4.9×10^{3}	Toluene		3.8×10^{2}
Di-n-butyl phthalate		6.1×10^{2}	Trichloroethene	8.0×10^{-1}	3.0×10^{-1}
Di-n-octyl phthalate		6.1×10^{1}	Vinyl Chloride	2.1×10^{-2}	5.0

kg = kilogram; mg = milligram; NA = not available; RBSL = risk-based screening level; TCDD = 2,3,7,8-tetrachlorodibenzo-p-dioxin.

[a] The onsite suburban resident exposure is based on the following direct pathways: ingestion, inhalation, and dermal.

Notes:

– RBSLs were developed from the *Final Standardized Risk Assessment Methodology Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California* (SRAM) (MWH 2014) values for onsite suburban resident exposure.
– Cancer-based values were calculated for a risk level of 1×10^{-6}, and noncancer values were calculated for a hazard index of 0.1.
– Blanks indicate that no RBSL is available for the constituent.
– Not available [NA] indicates that the constituent is not present in the RBSL source tables from the SRAM.

Table G–9 Onsite Recreational User Risk-Based Screening Levels for Radionuclides in Soil

Constituent	Recreational RBSL for Radionuclides in Soil (picocuries per gram)	Constituent	Recreational RBSL for Radionuclides in Soil (picocuries per gram)
Ac-227	1.94×10^{1}	Po-210	6.20×10^{1}
Am-241	9.57	Pu-238	1.83×10^{1}
Bi-210	1.24×10^{5}	Pu-239	1.60×10^{1}
Bi-211	1.31×10^{7}	Ra-223	4.20×10^{2}
Bi-212	1.77×10^{5}	Ra-224+D	1.03×10^{4}
Cm-243	1.53	Ra-226+D	5.79×10^{-2}
Co-60	1.58×10^{-1}	Ra-228+D	4.20×10^{-1}
Cs-134	6.9×10^{-1}	Sr-90+D	1.83×10^{1}
Cs-137+D	2.65×10^{-1}	Th-227	4.28×10^{2}
Eu-152	1.76×10^{-1}	Th-228	1.38×10^{2}
Eu-154	2.21×10^{-1}	Th-230	2.13×10^{1}
H-3	3.08	Th-232+D	1.97×10^{1}
Ni-59	3.11×10^{3}	Tl-207	7.02×10^{7}
Pa-231	2.92	Tl-208	9.95×10^{4}
Pb-210	3.30	U-234	2.45×10^{1}
Pb-211	5.06×10^{5}	U-235+D	8.17×10^{-1}
Pb-212	1.65×10^{4}	U-238+D	3.35

RBSL = risk-based screening level.

Notes:

– Radiological RBSLs are from EPA sources (epa-prgs.ornl.gov/radionuclides/) and were calculated using the *Final Standardized Risk Assessment Methodology Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California* (MWH 2014) parameters for recreational exposure.
– Cancer-based values were calculated for a risk level of 1×10^{-6}.
– Recreational pathways for radiological exposures to soil include ingestion, inhalation, and external exposure.
– Constituents listed with "+D" indicate that long-lived daughter products were included in the screening value.

Table G–10 Onsite Recreational User Risk-Based Screening Levels for Chemicals in Soil

Constituent	Recreational RBSL for Chemicals in Soil (mg/kg)		Constituent	Recreational RBSL for Chemicals in Soil (mg/kg)	
	Cancer	Noncancer		Cancer	Noncancer
Aluminum		3.6×10^{4}	Fluoranthene		1.0×10^{3}
Antimony		1.3×10^{1}	Fluorene		1.0×10^{3}
Arsenic	2.5×10^{-1}	1.0×10^{1}	Indeno(1,2,3-cd)pyrene	9.6×10^{-1}	
Barium		5.2×10^{3}	Morpholine	NA	NA
Beryllium	2.1×10^{4}	1.4×10^{1}	Naphthalene	2.0×10^{2}	4.2×10^{2}
Boron		7.1×10^{3}	N-Nitrosodimethylamine	8.9×10^{-2}	2.2×10^{-1}
Cadmium	1.2×10^{4}	9.1×10^{-1}	Phenanthrene		7.7×10^{3}
Chromium		1.7×10^{4}	Pyrene		7.7×10^{2}
Chromium VI	6.3	1.1×10^{2}	2,3,7,8-TCDD	1.8×10^{-5}	2.4×10^{-5}
Cobalt	5.5×10^{3}	1.1×10^{1}	Aroclor 1242	5.6×10^{-1}	5.1×10^{-1}
Copper		1.5×10^{3}	Aroclor 1248	5.6×10^{-1}	5.1×10^{-1}
Cyanides		2.1×10^{1}	Aroclor 1254	5.6×10^{-1}	5.1×10^{-1}
Lead		3.6×10^{1}	Aroclor 1260	5.6×10^{-1}	5.1×10^{-1}
Lithium		7.1×10^{1}	Aroclor 1262	NA	NA
Manganese		3.0×10^{3}	Aroclor 1268	NA	NA
Mercury		7.8	Aroclor 5442	NA	NA
Molybdenum		1.8×10^{2}	Aroclor 5460	5.6×10^{-1}	5.1×10^{-1}
Nickel	1.9×10^{5}	4.2×10^{2}	1,1,2-Trichloro-1,2,2-trifluoroethane	3.3	3.7×10^{2}
Selenium		1.8×10^{2}	1,2,3-Trichlorobenzene		3.7
Silver		1.1×10^{2}	1,2,4-Trimethylbenzene	3.3×10^{2}	3.8×10^{1}
Strontium		2.1×10^{4}	1,2-Dibromoethane	4.6×10^{-1}	7.3
Thallium		3.6×10^{-1}	1,2-Dichloroethane		1.6×10^{3}
Tin		2.1×10^{4}	1,3,5-Trimethylbenzene	5.9	1.0×10^{1}
Vanadium		8.7×10^{1}	1,4-Dichlorobenzene		7.2×10^{2}
Zinc		1.1×10^{4}	Methyl ethyl ketone	3.0×10^{1}	2.4×10^{3}
Zirconium		2.8	2-Phenylbutane	NA	NA
1-Methylnaphthalene	3.2×10^{1}	1.6×10^{3}	Methyl isobutyl ketone		1.6×10^{4}
2-Methylnaphthalene		9.4×10^{1}	Acetone		1.3×10^{2}
Acenaphthene		1.5×10^{3}	Benzene		3.1×10^{4}
Acenaphthylene		1.5×10^{3}	Bromodichloromethane		1.9×10^{2}
Anthracene		7.7×10^{3}	Chloroform		1.6×10^{2}
Benzo(a)pyrene	9.6×10^{-2}		Cymene	NA	NA
Benzo(a)anthracene	9.6×10^{-1}		Ethylbenzene		9.2×10^{1}
Benzo(a)pyrene	9.6×10^{-2}		Hexachloro-1,3-butadiene	NA	NA
Benzo(b)fluoranthene	9.6×10^{-1}		Cumene		1.2×10^{1}
Benzo(e)pyrene		7.7×10^{2}	m,p-Xylene		5.7×10^{2}
Benzo(ghi)perylene		7.7×10^{2}	Methylene Chloride		2.7×10^{3}
Benzo(k)fluoranthene	9.6×10^{-1}		n-Butylbenzene		8.2×10^{2}
bis(2-Ethylhexyl) phthalate	4.9×10^{2}	5.7×10^{2}	n-Propylbenzene		2.5×10^{3}
Butyl benzyl phthalate	7.7×10^{2}	5.7×10^{3}	o-Xylene		3.9×10^{2}
Chrysene	9.6		Styrene		6.5×10^{3}
Dibenzo(a,h)anthracene	2.7×10^{-1}		tert-Butylbenzene		1.7×10^{3}
Diethyl phthalate		2.2×10^{4}	Tetrachloroethene	3.5	6.0×10^{1}

Constituent	Recreational RBSL for Chemicals in Soil (mg/kg)		Constituent	Recreational RBSL for Chemicals in Soil (mg/kg)	
	Cancer	**Noncancer**		**Cancer**	**Noncancer**
Dimethyl phthalate		2.2×10^4	Toluene		2.4×10^3
Di-n-butyl phthalate		2.9×10^3	Trichloroethene	1.0×10^1	3.6
Di-n-octyl phthalate		2.9×10^2	Vinyl Chloride	2.8×10^{-1}	5.0×10^1

kg = kilogram; mg = milligram; NA = not available; RBSL = risk-based screening level; TCDD = 2,3,7,8-tetrachlorodibenzo-p-dioxin.

Notes:

– RBSLs were developed from the Final Standardized Risk Assessment Methodology Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California (MWH 2014) values for the recreational exposure scenario.
– Cancer-based values were calculated for a risk level of 1×10^{-6}, and hazard-based values were calculated for a hazard index equal to 0.1.
– Recreational pathways for chemical exposures to soil include ingestion, inhalation, and dermal contact.
– Blanks indicate that no RBSL is available for the constituent.
– Not available [NA] indicates that the constituent is not present in the RBSL source tables.

Table G–11 Sources for Morbidity, Mortality, and Dose Coefficients for Human Health Assessments

Pathway	*Receptors*	*Document*	*Source*	*Description*
Mortality and Morbidity				
Inhalation	Worker and Non-worker	FGR 13	Table 2.1	Inhalation values
Ingestion of Food and Tap Water	Worker and Non-worker	FGR 13	Table 2.2a	Used for ingestion of soil and building sources
External – Plane surface, Air, Soil	Worker and Non-worker	FGR 13	Table 2.3	Submergence used for air, plane surface used for building, and soil values used for source areas.
Dose				
Ingestion and Inhalation	Worker	ICRP 119	Table A.1	Inhalation values
Ingestion	Resident	ICRP 119	Table F.1	Ingestion effective dose coefficients from infant to adult
Inhalation	Resident	ICRP 119	Table G.1	Inhalation effective dose coefficients from infant to adult
External – Air Submersion	Worker and Non-worker	FGR 12	Table III.1	Effective Dose used for independent evaluation of inhalation pathway during remediation
External – Plane Surface	Worker and Non-worker	FGR 12	Table III.3	Effective Dose
External – Soil	Worker and Non-worker	FGR 12	Table III.7	Effective Dose for infinite depth source

FGR = Federal Guidance Report; ICRP = International Council on Radiation Protection.
Source: EPA 1993, 1999; ICRP 2012.

Table G–12 Ratios Used to Convert Cancer Morbidity Risks to Mortality Risk and Dose

	Ingestion		*Inhalation*		*External – Soil*	
Nuclide	*Cancer Mortality to Morbidity Risk Ratio*	*Radiological Dose to Cancer Morbidity Risk Ratio*	*Cancer Mortality to Morbidity Risk Ratio*	*Radiological Dose to Cancer Morbidity Risk Ratio*	*Cancer Mortality to Morbidity Risk Ratio*	*Radiological Dose to Cancer Morbidity Risk Ratio*
Units	*(fatality/ incidence)*	*(Sv/incidence)*	*(fatality/ incidence)*	*(Sv/incidence)*	*(fatality/ incidence)*	*(Sv/incidence)*
H-3	0.68	10.23	0.85	8.36	1.00	1.00
Na-22	0.69	9.38	0.69	12.38	0.68	13.66
Fe-55	0.76	10.51	0.84	17.59	1.00	1.00
Ni-59	0.60	6.00	0.77	10.32	1.00	1.00
Ni-63	0.60	5.84	0.83	10.84	1.00	1.00
Co-60	0.64	5.64	0.83	10.33	0.68	13.51
Sr-90	0.87	15.05	0.93	12.68	0.68	15.06
Cs-134	0.69	13.67	0.69	14.83	0.68	13.76
Cs-137	0.68	12.87	0.68	14.33	0.69	14.55
Eu-152	0.57	5.96	0.82	17.07	0.68	13.63
Eu-154	0.57	4.96	0.85	16.99	0.68	13.59
Eu-155	0.56	4.28	0.90	17.21	0.68	15.18
Tl-207	NA	NA	NA	NA	0.69	13.45
Tl-208	NA	NA	NA	NA	0.68	13.44
Bi-210	0.55	3.69	0.95	10.86	0.70	13.49
Pb-210	0.73	21.70	0.87	14.71	0.67	17.86
Po-210	0.72	91.60	0.94	11.26	0.68	13.67
Bi-211	NA	NA	NA	NA	0.68	14.04
Pb-211	0.75	11.46	0.95	11.00	0.68	13.81
Bi-212	0.70	9.63	0.95	14.76	0.68	13.61
Pb-212	0.62	6.26	0.95	10.90	0.68	14.27
Ra-223	0.62	10.93	0.95	0.11	0.68	14.33
Ra-224	0.60	10.12	0.95	11.11	0.68	14.17
Ra-226	0.69	20.14	0.95	11.29	0.68	14.31
Ac-227	0.81	165.91	0.89	101.85	0.68	14.67
Th-227	0.56	4.71	0.95	10.55	0.68	14.21
Ra-228	0.71	17.88	0.90	18.57	1.00	1.00
Th-228	0.62	18.05	0.95	11.17	0.68	14.64
Th-230	0.67	65.22	0.94	18.18	0.68	15.23
Pa-231	0.70	116.20	0.80	127.27	0.68	14.14
Th-232	0.68	63.89	0.94	21.37	0.67	15.71
Th-234	0.55	3.70	0.86	9.27	0.68	15.20
U-234	0.64	18.99	0.94	11.36	0.67	16.42
U-235	0.64	18.43	0.94	11.36	0.68	14.34
U-238	0.65	19.23	0.94	11.51	0.63	21.33
Pu-238	0.76	50.22	0.89	50.72	0.63	21.63
Pu-239	0.77	53.19	0.88	55.62	0.67	15.25
Pu-240	0.77	53.08	0.88	55.56	0.63	21.66
Pu-241	0.82	77.80	0.85	99.78	0.68	14.81

Nuclide	Ingestion		Inhalation		External – Soil	
	Cancer Mortality to Morbidity Risk Ratio	Radiological Dose to Cancer Morbidity Risk Ratio	Cancer Mortality to Morbidity Risk Ratio	Radiological Dose to Cancer Morbidity Risk Ratio	Cancer Mortality to Morbidity Risk Ratio	Radiological Dose to Cancer Morbidity Risk Ratio
Units	(fatality/ incidence)	(Sv/incidence)	(fatality/ incidence)	(Sv/incidence)	(fatality/ incidence)	(Sv/incidence)
Pu-242	0.77	53.69	0.88	56.74	0.63	21.13
Am-241	0.71	55.10	0.87	55.26	0.67	16.36
Cm-243	0.69	45.05	0.88	42.64	0.68	14.34

NA = not available; Sv = sievert.

Notes:

– Morbidity, mortality, and dose factors were taken from FGR 12, FGR 13, and ICRP 119.

– Ingestion-related cancer risk factors were based on dietary intakes. Dose factors were based on 50-year committed effective dose equivalents.

– Inhalation factors assumed lung clearance classes for individual radionuclides, typically the default recommendation.

– External exposure factors are for a three-dimensional slab exposure.

– Ratios were applied to estimates of radiological cancer morbidity risks to obtain cancer mortality and dose estimates.

– Fatality and incidence represent the rate in an exposed individual, and the ratio indicates the fraction of cancers that results in death.

– Doses in units of sieverts (1 Sv = 100 rem) and represent the dose from a cancer incidence rate of 1, or a dose that is considered certain to cause cancer.

– Incidence represents the rate of cancer incidence in exposed individuals.

– Dividing the above values by 1×10^{-6} would therefore represent the dose associated with a cancer incidence rate of 1 cancer per 1,000,000 exposed individuals.

Table G–13 Risk-Based Screening Levels for Onsite Suburban Resident[a] Exposures to Radionuclides in Soil – Cancer Mortality

	Cancer Morbidity RBSL (picocuries per gram per 1×10^{-6} incidence)				*Mortality to Morbidity Conversion Factors (fatality/incidence)*			*Cancer Mortality RBSL (picocuries per gram per 1×10^{-6} fatality)*			
Constituent	*Ingestion of Soil*	*Inhalation*	*External – Soil*	*Overall*	*Ingestion*	*Inhalation*	*External – Soil*	*Ingestion of Soil*	*Inhalation*	*External – Soil*	*Overall*
H-3	--	2.2×10^{-1}	--	2.2×10^{-1}	0.68	0.85	1.00	--	2.6×10^{-1}	--	2.6×10^{-1}
Na-22	3.3×10^{2}	5.9×10^{5}	7.8×10^{-2}	7.8×10^{-2}	0.69	0.69	0.68	4.9×10^{2}	8.6×10^{5}	1.1×10^{-1}	1.1×10^{-1}
Fe-55	3.2×10^{3}	3.7×10^{7}	1.6×10^{9}	3.2×10^{3}	0.76	0.84	1.00	4.2×10^{3}	4.4×10^{7}	1.6×10^{9}	4.2×10^{3}
Ni-59	1.2×10^{3}	3.0×10^{6}	1.5×10^{3}	6.5×10^{2}	0.60	0.77	1.00	2.0×10^{3}	3.9×10^{6}	1.5×10^{3}	8.4×10^{2}
Ni-63	5.2×10^{2}	1.4×10^{6}	--	5.1×10^{2}	0.60	0.83	1.00	8.7×10^{2}	1.6×10^{6}	--	8.6×10^{2}
Co-60	8.4×10^{1}	2.9×10^{5}	3.3×10^{-2}	3.3×10^{-2}	0.64	0.83	0.68	1.3×10^{2}	3.5×10^{5}	4.8×10^{-2}	4.8×10^{-2}
Sr-90+D	8.2	2.3×10^{4}	7.2	3.8	0.87	0.93	0.68	9.4	2.5×10^{4}	1.1×10^{1}	5.0
Cs-134	1.4×10^{2}	1.0×10^{6}	1.4×10^{-1}	1.4×10^{-1}	0.69	0.69	0.68	2.0×10^{2}	1.5×10^{6}	2.1×10^{-1}	2.1×10^{-1}
Cs-137+D	2.6×10^{1}	8.9×10^{4}	5.5×10^{-2}	5.5×10^{-2}	0.68	0.68	0.69	3.8×10^{1}	1.3×10^{5}	8.0×10^{-2}	7.9×10^{-2}
Eu-152	1.1×10^{2}	7.4×10^{4}	3.6×10^{-2}	3.6×10^{-2}	0.57	0.82	0.68	1.9×10^{2}	9.0×10^{4}	5.3×10^{-2}	5.3×10^{-2}
Eu-154	8.3×10^{1}	9.3×10^{4}	4.6×10^{-2}	4.5×10^{-2}	0.57	0.85	0.68	1.5×10^{2}	1.1×10^{5}	6.7×10^{-2}	6.7×10^{-2}
Eu-155	6.8×10^{2}	1.7×10^{6}	3.6	3.5	0.56	0.90	0.68	1.2×10^{3}	1.9×10^{6}	5.2	5.2
Tl-207	--	--	1.5×10^{7}	1.5×10^{7}	NA	NA	0.69	--	--	2.1×10^{7}	2.1×10^{7}
Tl-208	--	--	2.1×10^{4}	2.1×10^{4}	NA	NA	0.68	--	--	3.0×10^{4}	3.0×10^{4}
Bi-210	5.0×10^{4}	2.4×10^{7}	5.5×10^{4}	2.6×10^{4}	0.55	0.95	0.70	9.0×10^{4}	2.5×10^{7}	7.8×10^{4}	4.2×10^{4}
Pb-210	7.1×10^{-1}	7.0×10^{2}	1.0×10^{2}	7.1×10^{-1}	0.73	0.87	0.67	9.8×10^{-1}	8.1×10^{2}	1.6×10^{2}	9.7×10^{-1}
Po-210	1.3×10^{1}	2.7×10^{4}	1.2×10^{5}	1.3×10^{1}	0.72	0.94	0.68	1.9×10^{1}	2.9×10^{4}	1.8×10^{5}	1.9×10^{1}
Bi-211	--	--	2.7×10^{6}	2.7×10^{6}	NA	NA	0.68	--	--	3.9×10^{6}	3.9×10^{6}
Pb-211	2.5×10^{8}	5.4×10^{10}	1.0×10^{5}	1.0×10^{5}	0.75	0.95	0.68	3.4×10^{8}	5.7×10^{10}	1.5×10^{5}	1.5×10^{5}
Bi-212	8.5×10^{7}	1.5×10^{10}	3.7×10^{4}	3.6×10^{4}	0.70	0.95	0.68	1.2×10^{8}	1.6×10^{10}	5.4×10^{4}	5.4×10^{4}
Pb-212	2.2×10^{5}	1.9×10^{8}	3.5×10^{3}	3.4×10^{3}	0.62	0.95	0.68	3.5×10^{5}	2.0×10^{8}	5.1×10^{3}	5.0×10^{3}
Ra-223	8.8×10^{2}	1.6×10^{5}	1.5×10^{2}	1.3×10^{2}	0.62	0.95	0.68	1.4×10^{3}	1.7×10^{5}	2.1×10^{2}	1.9×10^{2}
Ra-224+D	3.9×10^{3}	1.3×10^{6}	5.0×10^{3}	2.2×10^{3}	0.60	0.95	0.68	6.4×10^{3}	1.4×10^{6}	7.3×10^{3}	3.4×10^{3}
Ra-226+D	1.2	2.6×10^{2}	1.2×10^{-2}	1.2×10^{-2}	0.69	0.95	0.68	1.7	2.7×10^{2}	1.8×10^{-2}	1.8×10^{-2}
Ac-227	4.3	7.5×10^{1}	7.8×10^{2}	4.0	0.81	0.89	0.68	5.3	8.4×10^{1}	1.2×10^{3}	4.9
Th-227	2.5×10^{3}	8.4×10^{4}	9.2×10^{1}	8.8×10^{1}	0.56	0.95	0.68	4.5×10^{3}	8.8×10^{4}	1.3×10^{2}	1.3×10^{2}
Ra-228+D	1.5	6.1×10^{2}	9.2×10^{-2}	8.7×10^{-2}	0.71	0.90	1.00	2.1	6.8×10^{2}	9.2×10^{-2}	8.8×10^{-2}
Th-228	3.6×10^{1}	5.9×10^{2}	1.9×10^{2}	2.9×10^{1}	0.62	0.95	0.68	5.8×10^{1}	6.2×10^{2}	2.8×10^{2}	4.4×10^{1}
Th-230	4.8	2.1×10^{2}	1.2×10^{2}	4.5	0.67	0.94	0.68	7.1	2.2×10^{2}	1.8×10^{2}	6.6

Constituent	Cancer Morbidity RBSL (picocuries per gram per 1×10^-6^ incidence)				Mortality to Morbidity Conversion Factors (fatality/incidence)			Cancer Mortality RBSL (picocuries per gram per 1×10^-6^ fatality)			
	Ingestion of Soil	*Inhalation*	*External – Soil*	*Overall*	*Ingestion*	*Inhalation*	*External – Soil*	*Ingestion of Soil*	*Inhalation*	*External – Soil*	*Overall*
Pa-231	2.7	9.4×10^{1}	7.9×10^{-1}	6.0×10^{-1}	0.70	0.80	0.68	3.8	1.2×10^{2}	1.2	8.8×10^{-1}
Th-232+D	3.7×10^{-1}	8.3×10^{1}	2.5×10^{-2}	2.3×10^{-2}	0.68	0.94	0.67	5.4×10^{-1}	8.8×10^{1}	3.7×10^{-2}	3.5×10^{-2}
Th-234	4.0×10^{3}	7.4×10^{7}	1.8×10^{3}	1.2×10^{3}	0.55	0.86	0.68	7.2×10^{3}	8.6×10^{7}	2.6×10^{3}	1.9×10^{3}
U-234	5.4	2.6×10^{2}	4.0×10^{2}	5.2	0.64	0.94	0.67	8.3	2.8×10^{2}	5.9×10^{2}	8.0
U-235+D	5.2	2.9×10^{2}	1.7×10^{-1}	1.7×10^{-1}	0.64	0.94	0.68	8.1	3.1×10^{2}	2.6×10^{-1}	2.5×10^{-1}
U-238+D	4.0	3.0×10^{2}	8.4×10^{-1}	6.9×10^{-1}	0.65	0.94	0.63	6.2	3.2×10^{2}	1.3	1.1
Pu-238	4.0	1.6×10^{2}	1.6×10^{3}	3.9	0.76	0.89	0.63	5.2	1.7×10^{2}	2.6×10^{3}	5.0
Pu-239+D	3.5	1.3×10^{2}	4.8×10^{2}	3.4	0.77	0.88	0.67	4.5	1.5×10^{2}	7.1×10^{2}	4.3
Pu-240	3.5	1.3×10^{2}	1.4×10^{3}	3.4	0.77	0.88	0.63	4.5	1.5×10^{2}	2.2×10^{3}	4.4
Pu-241	5.5×10^{2}	1.6×10^{4}	4.7×10^{4}	5.3×10^{2}	0.82	0.85	0.68	6.7×10^{2}	1.8×10^{4}	6.9×10^{4}	6.4×10^{2}
Pu-242	3.7	1.4×10^{2}	2.3×10^{2}	3.5	0.77	0.88	0.63	4.7	1.6×10^{2}	3.6×10^{2}	4.5
Am-241	4.4	2.0×10^{2}	3.7	2.0	0.71	0.87	0.67	6.3	2.2×10^{2}	5.5	2.9
Cm-243	6.3	2.7×10^{2}	3.3×10^{-1}	3.2×10^{-1}	0.69	0.88	0.68	9.1	3.1×10^{2}	4.9×10^{-1}	4.7×10^{-1}

NA = not available; RBSL = risk-based screening level.

[a] The onsite suburban resident exposure is based on the following direct pathways: ingestion, inhalation, and external.

Notes:

– Constituents evaluated were those identified from sampling of soil source areas.
– Mortality to morbidity conversion factors are the ratio of the morbidity risk values divided by the mortality risk values, as presented in Table G–14.
– Overall Cancer Mortality RBSLs were calculated from individual pathway values as follows: Overall = 1/((1/ingestion) + (1/produce) + (1/inhalation) + (1/external exposure)).
– Values are in units of picocuries per gram for a cancer incidence risk of 1×10^{-6}.
– Radiological RBSLs are from EPA sources (epa-prgs.ornl.gov/radionuclides/) and were calculated using the *Final Standardized Risk Assessment Methodology Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California* (MWH 2014) parameters for onsite suburban resident exposure.
– Constituents listed with "+D" indicate that long-lived daughter products were included in the screening value.
– "--" indicates that the radionuclide does not have available values for a particular pathway.

Table G–14 Risk-Based Screening Levels for Onsite Recreational Exposure to Radionuclides in Soil – Cancer Mortality

	Cancer Morbidity RBSL (picocuries per gram per 1×10^{-6} incidence)				*Mortality to Morbidity Conversion Factors (fatality/incidence)*			*Cancer Mortality RBSL (picocuries per gram per 1×10^{-6} fatality)*			
Constituent	***Ingestion of Soil***	***Inhalation***	***External – Soil***	***Overall***	***Ingestion***	***Inhalation***	***External – Soil***	***Ingestion of Soil***	***Inhalation***	***External – Soil***	***Overall***
H-3	8.5×10^{4}	3.1	-	3.1	0.68	0.85	1.00	1.3×10^{5}	3.6	--	3.6
Na-22	1.6×10^{3}	8.3×10^{6}	3.8×10^{-1}	3.8×10^{-1}	0.69	0.69	0.68	2.3×10^{3}	1.2×10^{7}	5.5×10^{-1}	5.5×10^{-1}
Fe-55	1.5×10^{4}	5.2×10^{8}	7.7×10^{9}	1.5×10^{4}	0.76	0.84	1.00	2.0×10^{4}	6.2×10^{8}	7.7×10^{9}	2.0×10^{4}
Ni-59	5.5×10^{3}	4.2×10^{7}	7.2×10^{3}	3.1×10^{3}	0.60	0.77	1.00	9.2×10^{3}	5.5×10^{7}	7.2×10^{3}	4.0×10^{3}
Ni-63	2.4×10^{3}	1.9×10^{7}	-	2.4×10^{3}	0.60	0.83	1.00	4.0×10^{3}	2.3×10^{7}	--	4.0×10^{3}
Co-60	3.9×10^{2}	4.0×10^{6}	1.6×10^{-1}	1.6×10^{-1}	0.64	0.83	0.68	6.1×10^{2}	4.9×10^{6}	2.3×10^{-1}	2.3×10^{-1}
Sr-90+D	3.8×10^{1}	3.3×10^{5}	3.5×10^{1}	1.8×10^{1}	0.87	0.93	0.68	4.4×10^{1}	3.5×10^{5}	5.2×10^{1}	2.4×10^{1}
Cs-134	6.5×10^{2}	1.5×10^{7}	6.9×10^{-1}	6.9×10^{-1}	0.69	0.69	0.68	9.4×10^{2}	2.1×10^{7}	1.0	1.0
Cs-137+D	1.2×10^{2}	1.2×10^{6}	276×10^{-1}	2.7×10^{-1}	0.68	0.68	0.69	1.8×10^{2}	1.8×10^{6}	3.9×10^{-1}	3.9×10^{-1}
Eu-152	5.0×10^{2}	1.0×10^{6}	1.8×10^{-1}	1.8×10^{-1}	0.57	0.82	0.68	8.7×10^{2}	1.3×10^{6}	2.6×10^{-1}	2.6×10^{-1}
Eu-154	3.9×10^{2}	1.3×10^{6}	2.2×10^{-1}	2.2×10^{-1}	0.57	0.85	0.68	6.8×10^{2}	1.5×10^{6}	3.2×10^{-1}	3.2×10^{-1}
Eu-155	3.2×10^{3}	2.3×10^{7}	1.7×10^{1}	1.7×10^{1}	0.56	0.90	0.68	5.6×10^{3}	2.6×10^{7}	2.5×10^{1}	2.5×10^{1}
Tl-207	--	--	7.0×10^{7}	7.0×10^{7}	NA	NA	0.69	--	--	1.0×10^{8}	1.0×10^{8}
Tl-208	--	--	1.0×10^{6}	1.0×10^{5}	NA	NA	0.68	--	--	1.5×10^{5}	1.5×10^{5}
Bi-210	2.3×10^{5}	3.4×10^{8}	2.7×10^{5}	1.2×10^{5}	0.55	0.95	0.70	4.2×10^{5}	3.5×10^{8}	3.8×10^{5}	2.0×10^{5}
Pb-210	3.3	9.8×10^{3}	5.1×10^{2}	3.3	0.73	0.87	0.67	4.6	1.1×10^{4}	7.6×10^{2}	4.5
Po-210	6.2×10^{1}	3.8×10^{5}	5.9×10^{5}	6.2×10^{1}	0.72	0.94	0.68	8.7×10^{1}	4.0×10^{5}	8.7×10^{5}	8.7×10^{1}
Bi-211	--	--	1.3×10^{7}	1.3×10^{7}	NA	NA	0.68	--	--	1.9×10^{7}	1.9×10^{7}
Pb-211	1.2×10^{9}	7.6×10^{11}	5.1×10^{5}	5.1×10^{5}	0.75	0.95	0.68	1.6×10^{9}	7.9×10^{11}	7.4×10^{5}	7.4×10^{5}
Bi-212	4.0×10^{8}	2.2×10^{11}	1.8×10^{5}	1.8×10^{5}	0.70	0.95	0.68	5.7×10^{8}	2.3×10^{11}	2.6×10^{5}	2.6×10^{5}
Pb-212	1.0×10^{6}	2.7×10^{9}	1.7×10^{4}	1.7×10^{4}	0.62	0.95	0.68	1.6×10^{6}	2.8×10^{9}	2.5×10^{4}	2.4×10^{4}
Ra-223	4.1×10^{3}	2.3×10^{6}	7.1×10^{2}	6.1×10^{2}	0.62	0.95	0.68	6.7×10^{3}	2.4×10^{6}	1.0×10^{3}	9.0×10^{2}
Ra-224+D	1.8×10^{4}	1.8×10^{7}	2.4×10^{4}	1.0×10^{4}	0.60	0.95	0.68	3.0×10^{4}	1.9×10^{7}	3.5×10^{4}	1.6×10^{4}
Ra-226+D	5.5	3.6×10^{3}	5.9×10^{-2}	5.8×10^{-2}	0.69	0.95	0.68	8.0	3.8×10^{3}	8.6×10^{-2}	8.5×10^{-2}
Ac-227	2.0×10^{1}	1.1×10^{3}	3.8×10^{3}	1.9×10^{1}	0.81	0.89	0.68	2.5×10^{1}	1.2×10^{3}	5.6×10^{3}	2.4×10^{1}
Th-227	1.2×10^{4}	1.2×10^{6}	4.4×10^{2}	4.3×10^{2}	0.56	0.95	0.68	2.1×10^{4}	1.2×10^{6}	6.5×10^{2}	6.3×10^{2}
Ra-228+D	6.9	8.6×10^{3}	4.5×10^{-1}	4.2×10^{-1}	0.71	0.90	1.00	9.8	9.5×10^{3}	4.5×10^{-1}	4.3×10^{-1}
Th-228	1.7×10^{2}	8.3×10^{3}	9.4×10^{2}	1.4×10^{2}	0.62	0.95	0.68	2.7×10^{2}	8.7×10^{3}	1.4×10^{3}	2.2×10^{2}
Th-230	2.2×10^{1}	3.0×10^{3}	5.8×10^{2}	2.1×10^{1}	0.67	0.94	0.68	3.3×10^{1}	3.2×10^{3}	8.5×10^{2}	3.2×10^{1}
Pa-231	1.2×10^{1}	1.3×10^{3}	3.8	2.9	0.70	0.80	0.68	1.8×10^{1}	1.6×10^{3}	5.6	4.3
Th-232+D	1.7	1.2×10^{3}	1.2×10^{-1}	1.1×10^{-1}	0.68	0.94	0.67	2.5	1.2×10^{3}	1.8×10^{-1}	1.7×10^{-1}
Th-234	1.9×10^{4}	1.0×10^{9}	8.6×10^{3}	5.9×10^{3}	0.55	0.86	0.68	3.4×10^{4}	1.2×10^{9}	1.3×10^{4}	9.2×10^{3}

Constituent	Cancer Morbidity RBSL (picocuries per gram per 1×10^{-6} incidence)				Mortality to Morbidity Conversion Factors (fatality/incidence)			Cancer Mortality RBSL (picocuries per gram per 1×10^{-6} fatality)			
	Ingestion of Soil	***Inhalation***	***External – Soil***	***Overall***	***Ingestion***	***Inhalation***	***External – Soil***	***Ingestion of Soil***	***Inhalation***	***External – Soil***	***Overall***
U-234	2.5×10^{1}	3.6×10^{3}	1.9×10^{3}	2.5×10^{1}	0.64	0.94	0.67	3.9×10^{1}	3.8×10^{3}	2.9×10^{3}	3.8×10^{1}
U-235+D	2.4×10^{1}	4.0×10^{3}	8.5×10^{-1}	8.2×10^{-1}	0.64	0.94	0.68	3.8×10^{1}	4.3×10^{3}	1.2	1.2
U-238+D	1.9×10^{1}	4.3×10^{3}	4.1	3.4	0.65	0.94	0.63	2.9×10^{1}	4.5×10^{3}	6.5	5.3
Pu-238	1.9×10^{1}	2.2×10^{3}	7.9×10^{3}	1.8×10^{1}	0.76	0.89	0.63	2.4×10^{1}	2.4×10^{3}	1.3×10^{4}	2.4×10^{1}
Pu-239+D	1.6×10^{1}	1.8×10^{3}	2.3×10^{3}	1.6×10^{1}	0.77	0.88	0.67	2.1×10^{1}	2.1×10^{3}	3.5×10^{3}	2.1×10^{1}
Pu-240	1.6×10^{1}	1.8×10^{3}	6.8×10^{3}	1.6×10^{1}	0.77	0.88	0.63	2.1×10^{1}	2.1×10^{3}	1.1×10^{4}	2.1×10^{1}
Pu-241	2.6×10^{3}	2.2×10^{5}	2.3×10^{5}	2.5×10^{3}	0.82	0.85	0.68	3.1×10^{3}	2.6×10^{5}	3.3×10^{5}	3.1×10^{3}
Pu-242	1.7×10^{1}	1.9×10^{3}	1.1×10^{3}	1.7×10^{1}	0.77	0.88	0.63	2.2×10^{1}	2.2×10^{3}	1.8×10^{3}	2.2×10^{1}
Am-241	2.1×10^{1}	2.7×10^{3}	1.8×10^{1}	9.6	0.71	0.87	0.67	2.9×10^{1}	3.1×10^{3}	2.7×10^{1}	1.4×10^{1}
Cm-243	2.9×10^{1}	3.8×10^{3}	1.6	1.5	0.69	0.88	0.68	4.2×10^{1}	4.3×10^{3}	2.4	2.3

NA = not available; RBSL = risk-based screening level.

Notes:

– Constituents evaluated were those identified from sampling of soil source areas.
– Mortality to morbidity conversion factors are the ratio of the morbidity risk values divided by the mortality risk values, as presented in Table G–14.
– Overall Cancer Mortality RBSLs were calculated from individual pathway values as follows: Overall = 1/((1/ingestion) + (1/inhalation) + (1/external exposure)).
– Values are in units of picocuries per gram for a cancer incidence risk of 1×10^{-6}.
– Radiological RBSLs are from EPA sources (epa-prgs.ornl.gov/radionuclides/) and were calculated using the *Final Standardized Risk Assessment Methodology Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California* (MWH 2014) parameters for recreational exposure.
– Constituents listed with "+D" indicate that long-lived daughter products were included in the screening value.
– "--" indicates that the radionuclide does not have available values for a particular pathway.

Table G–15 Risk-Based Screening Levels for Onsite Suburban Resident[a] Exposure to Radionuclides in Soil – Radiological Dose

Constituent	*Cancer Morbidity RBSL (picocuries per gram per 1×10^{-6} incidence)*				*Dose to Morbidity Conversion Factor (sieverts/incidence)*			*Radiological Dose RBSL (picocuries per gram per sievert)*			
	Ingestion of Soil	***Inhalation***	***External – Soil***	***Overall***	***Ingestion***	***Inhalation***	***External – Soil***	***Ingestion of Soil***	***Inhalation***	***External – Soil***	***Overall***
H-3	--	2.2×10^{-1}	-	2.2×10^{-1}	10.23	8.36	1.00	--	2.6×10^{4}	--	2.6×10^{4}
Na-22	3.3×10^{2}	5.9×10^{5}	7.8×10^{-2}	7.8×10^{-2}	9.38	12.38	13.66	3.6×10^{7}	4.8×10^{10}	5.7×10^{3}	5.7×10^{3}
Fe-55	3.2×10^{3}	3.7×10^{7}	1.6×10^{9}	3.2×10^{3}	10.51	17.59	1.00	3.0×10^{8}	2.1×10^{12}	1.6×10^{15}	3.0×10^{8}
Ni-59	1.2×10^{3}	3.0×10^{6}	1.5×10^{3}	6.5×10^{2}	6.00	10.32	1.00	2.0×10^{8}	2.9×10^{11}	1.5×10^{9}	1.7×10^{8}
Ni-63	5.2×10^{2}	1.4×10^{6}	-	5.1×10^{2}	5.84	10.84	1.00	8.8×10^{7}	1.2×10^{11}	--	8.8×10^{7}
Co-60	8.4×10^{1}	2.9×10^{5}	3.3×10^{-2}	3.3×10^{-2}	5.64	10.33	13.51	1.5×10^{7}	2.8×10^{10}	2.4×10^{3}	2.4×10^{3}
Sr-90+D	8.2	2.3×10^{4}	7.2	3.8	15.05	12.68	15.06	5.5×10^{5}	1.8×10^{9}	4.8×10^{5}	2.6×10^{5}
Cs-134	1.4×10^{2}	1.0×10^{6}	1.4×10^{-1}	1.4×10^{-1}	13.67	14.83	13.76	1.0×10^{7}	7.0×10^{10}	1.0×10^{4}	1.0×10^{4}
Cs-137+D	2.6×10^{1}	8.9×10^{4}	5.5×10^{-2}	5.5×10^{-2}	12.87	14.33	14.55	2.0×10^{6}	6.2×10^{9}	3.8×10^{3}	3.8×10^{3}
Eu-152	1.1×10^{2}	7.4×10^{4}	3.6×10^{-2}	3.6×10^{-2}	5.96	17.07	13.63	1.8×10^{7}	4.3×10^{9}	2.7×10^{3}	2.7×10^{3}
Eu-154	8.3×10^{1}	9.3×10^{4}	4.6×10^{-2}	4.5×10^{-2}	4.96	16.99	13.59	1.7×10^{7}	5.5×10^{9}	3.3×10^{3}	3.3×10^{3}
Eu-155	6.8×10^{2}	1.7×10^{6}	3.6	3.5	4.28	17.21	15.18	1.6×10^{8}	9.6×10^{10}	2.3×10^{5}	2.3×10^{5}
Tl-207	--	-	1.5×10^{7}	1.5×10^{7}	NA	NA	13.45	--	--	1.1×10^{12}	1.1×10^{12}
Tl-208	--	-	2.1×10^{4}	2.1×10^{4}	NA	NA	13.44	--	--	1.5×10^{9}	1.5×10^{9}
Bi-210	5.0×10^{4}	2.4×10^{7}	5.5×10^{4}	2.6×10^{4}	3.69	10.86	13.49	1.4×10^{10}	2.2×10^{12}	4.1×10^{9}	3.1×10^{9}
Pb-210	7.1×10^{-1}	7.0×10^{2}	1.0×10^{2}	7.1×10^{-1}	21.70	14.71	17.86	3.3×10^{4}	4.7×10^{7}	5.8×10^{6}	3.3×10^{4}
Po-210	1.3×10^{1}	2.7×10^{4}	1.2×10^{5}	1.3×10^{1}	91.60	11.26	13.67	1.5×10^{5}	2.4×10^{9}	8.9×10^{9}	1.5×10^{5}
Bi-211	--	--	2.7×10^{6}	2.7×10^{6}	NA	NA	14.04	--	--	1.9×10^{11}	1.9×10^{11}
Pb-211	2.5×10^{8}	5.4×10^{10}	1.0×10^{5}	1.0×10^{5}	11.46	11.00	13.81	2.2×10^{13}	4.9×10^{15}	7.5×10^{9}	7.5×10^{9}
Bi-212	8.5×10^{7}	1.5×10^{10}	3.7×10^{4}	3.6×10^{4}	9.63	14.76	13.61	8.9×10^{12}	1.0×10^{15}	2.7×10^{9}	2.7×10^{9}
Pb-212	2.2×10^{5}	1.9×10^{8}	3.5×10^{3}	3.4×10^{3}	6.26	10.90	14.27	3.4×10^{10}	1.8×10^{13}	2.4×10^{8}	2.4×10^{8}
Ra-223	8.8×10^{2}	1.6×10^{5}	1.5×10^{2}	1.3×10^{2}	10.93	0.11	14.33	8.0×10^{7}	1.5×10^{12}	1.0×10^{7}	9.0×10^{6}
Ra-224+D	3.9×10^{3}	1.3×10^{6}	5.0×10^{3}	2.2×10^{3}	10.12	11.11	14.17	3.8×10^{8}	1.2×10^{11}	3.5×10^{8}	1.8×10^{8}
Ra-226+D	1.2	2.6×10^{2}	1.2×10^{-2}	1.2×10^{-2}	20.14	11.29	14.31	5.9×10^{4}	2.3×10^{7}	8.5×10^{2}	8.3×10^{2}
Ac-227	4.3	7.5×10^{1}	7.8×10^{2}	4.0	165.91	101.85	14.67	2.6×10^{4}	7.3×10^{5}	5.3×10^{7}	2.5×10^{4}
Th-227	2.5×10^{3}	8.4×10^{4}	9.2×10^{1}	8.8×10^{1}	4.71	10.55	14.21	5.3×10^{8}	7.9×10^{9}	6.4×10^{6}	6.4×10^{6}
Ra-228+D	1.5	6.1×10^{2}	9.2×10^{-2}	8.7×10^{-2}	17.88	18.57	1.00	8.3×10^{4}	3.3×10^{7}	9.2×10^{4}	4.4×10^{4}
Th-228	3.6×10^{1}	5.9×10^{2}	1.9×10^{2}	2.9×10^{1}	18.05	11.17	14.64	2.0×10^{6}	5.3×10^{7}	1.3×10^{7}	1.7×10^{6}
Th-230	4.8	2.1×10^{2}	1.2×10^{2}	4.5	65.22	18.18	15.23	7.3×10^{4}	1.2×10^{7}	7.8×10^{6}	7.2×10^{4}
Pa-231	2.7	9.4×10^{1}	7.9×10^{-1}	6.0×10^{-1}	116.20	127.27	14.14	2.3×10^{4}	7.4×10^{5}	5.6×10^{4}	1.6×10^{4}
Th-232+D	3.7×10^{-1}	8.3×10^{1}	2.5×10^{-2}	2.3×10^{-2}	63.89	21.37	15.71	5.7×10^{3}	3.9×10^{6}	1.6×10^{3}	1.2×10^{3}
Th-234	4.0×10^{3}	7.4×10^{7}	1.8×10^{3}	1.2×10^{3}	3.70	9.27	15.20	1.1×10^{9}	7.9×10^{12}	1.2×10^{8}	1.1×10^{8}

Constituent	Cancer Morbidity RBSL (picocuries per gram per 1×10^{-6} incidence)				Dose to Morbidity Conversion Factor (sieverts/incidence)			Radiological Dose RBSL (picocuries per gram per sievert)			
	Ingestion of Soil	Inhalation	External – Soil	Overall	Ingestion	Inhalation	External – Soil	Ingestion of Soil	Inhalation	External – Soil	Overall
U-234	5.4	2.6×10^{2}	4.0×10^{2}	5.2	18.99	11.36	16.42	2.8×10^{5}	2.3×10^{7}	2.4×10^{7}	2.8×10^{5}
U-235+D	5.2	2.9×10^{2}	1.7×10^{-1}	1.7×10^{-1}	18.43	11.36	14.34	2.8×10^{5}	2.5×10^{7}	1.2×10^{4}	1.2×10^{4}
U-238+D	4.0	3.0×10^{2}	8.4×10^{-1}	6.9×10^{-1}	19.23	11.51	21.33	2.1×10^{5}	2.6×10^{7}	3.9×10^{4}	3.3×10^{4}
Pu-238	4.0	1.6×10^{2}	1.6×10^{3}	3.9	50.22	50.72	21.63	7.9×10^{4}	3.1×10^{6}	7.5×10^{7}	7.7×10^{4}
Pu-239+D	3.5	1.3×10^{2}	4.8×10^{2}	3.4	53.19	55.62	15.25	6.5×10^{4}	2.3×10^{6}	3.1×10^{7}	6.4×10^{4}
Pu-240	3.5	1.3×10^{2}	1.4×10^{3}	3.4	53.08	55.56	21.66	6.6×10^{4}	2.3×10^{6}	6.5×10^{7}	6.4×10^{4}
Pu-241	5.5×10^{2}	1.6×10^{4}	4.7×10^{4}	5.3×10^{2}	77.80	99.78	14.81	7.1×10^{6}	1.6×10^{8}	3.2×10^{9}	6.8×10^{6}
Pu-242	3.7	1.4×10^{2}	2.3×10^{2}	3.5	53.69	56.74	21.13	6.8×10^{4}	2.4×10^{6}	1.1×10^{7}	6.6×10^{4}
Am-241	4.4	2.0×10^{2}	3.7	2.0	55.10	55.26	16.36	8.0×10^{4}	3.5×10^{6}	2.3×10^{5}	5.8×10^{4}
Cm-243	6.3	2.7×10^{2}	3.3×10^{-1}	3.2×10^{-1}	45.05	42.64	14.34	1.4×10^{5}	6.4×10^{6}	2.3×10^{4}	2.0×10^{4}

NA = not available; RBSL = risk-based screening level.

[a] The onsite suburban resident exposure is based on the following direct pathways: ingestion, inhalation, and external.

Notes:

– Constituents evaluated were those identified from sampling of soil source areas.
– Dose to morbidity conversion factors are the ratio of the dose factors divided by the morbidity risk values, as presented in Table G–14.
– Overall Cancer Mortality Preliminary Remediation Goals were calculated from individual pathway values as follows: Overall = 1/((1/ingestion) + (1/inhalation) + (1/external exposure)).
– Values are in units of picocuries per gram for a cancer incidence risk of 1×10^{-6}.
– Radiological RBSLs are from EPA sources (epa-prgs.ornl.gov/radionuclides/) and were calculated using the *Final Standardized Risk Assessment Methodology Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California* (MWH 2014) parameters for onsite suburban resident exposure.
– Dose in units of sieverts, where 1 sievert = 100 rem.
– Constituent with "+D" indicates that long-lived daughter products were included in the screening value.
– "--" indicates that the radionuclide dose not have available values for a particular pathway.

Table G–16 Risk-Based Screening Levels for Recreational Exposure to Radionuclides in Soil – Radiological Dose

Constituent	*Cancer Morbidity RBSL (picocuries per gram per 1×10⁻⁶ incidence)*				*Dose to Morbidity Conversion Factor (sieverts/incidence)*			*Radiological Dose RBSL (picocuries per gram per sievert)*			
	Ingestion of Soil	***Inhalation***	***External – Soil***	***Overall***	***Ingestion***	***Inhalation***	***External – Soil***	***Ingestion of Soil***	***Inhalation***	***External – Soil***	***Overall***
H-3	8.53×10^{4}	3.08	--	3.08	10.23	8.36	1.00	8.3×10^{9}	3.7×10^{5}	--	3.7×10^{5}
Na-22	1.56×10^{3}	8.27×10^{6}	3.77×10^{-1}	3.77×10^{-1}	9.38	12.38	13.66	1.7×10^{8}	6.7×10^{11}	2.8×10^{4}	2.8×10^{4}
Fe-55	1.49×10^{4}	5.17×10^{8}	7.73×10^{9}	1.49×10^{4}	10.51	17.59	1.00	1.4×10^{9}	2.9×10^{13}	7.7×10^{15}	1.4×10^{9}
Ni-59	5.47×10^{3}	4.22×10^{7}	7.19×10^{3}	3.11×10^{3}	6.00	10.32	1.00	9.1×10^{8}	4.1×10^{12}	7.2×10^{9}	8.1×10^{8}
Ni-63	2.40×10^{3}	1.90×10^{7}	--	2.40×10^{3}	5.84	10.84	1.00	4.1×10^{8}	1.8×10^{12}	--	4.1×10^{8}
Co-60	3.91×10^{2}	4.02×10^{6}	1.58×10^{-1}	1.58×10^{-1}	5.64	10.33	13.51	6.9×10^{7}	3.9×10^{11}	1.2×10^{4}	1.2×10^{4}
Sr-90+D	3.84×10^{1}	3.27×10^{5}	3.50×10^{1}	1.83×10^{1}	15.05	12.68	15.06	2.6×10^{6}	2.6×10^{10}	2.3×10^{6}	1.2×10^{6}
Cs-134	6.50×10^{2}	1.45×10^{7}	6.90×10^{-1}	6.90×10^{-1}	13.67	14.83	13.76	4.8×10^{7}	9.8×10^{11}	5.0×10^{4}	5.0×10^{4}
Cs-137+D	1.20×10^{2}	1.24×10^{6}	2.66×10^{-1}	2.65×10^{-1}	12.87	14.33	14.55	9.3×10^{6}	8.7×10^{10}	1.8×10^{4}	1.8×10^{4}
Eu-152	4.97×10^{2}	1.03×10^{6}	1.76×10^{-1}	1.76×10^{-1}	5.96	17.07	13.63	8.3×10^{7}	6.0×10^{10}	1.3×10^{4}	1.3×10^{4}
Eu-154	3.88×10^{2}	1.30×10^{6}	2.21×10^{-1}	2.21×10^{-1}	4.96	16.99	13.59	7.8×10^{7}	7.7×10^{10}	1.6×10^{4}	1.6×10^{4}
Eu-155	3.16×10^{3}	2.32×10^{7}	1.72×10^{1}	1.71×10^{1}	4.28	17.21	15.18	7.4×10^{8}	1.3×10^{12}	1.1×10^{6}	1.1×10^{6}
Tl-207	--	--	7.02×10^{7}	7.02×10^{7}	NA	NA	13.45	--	--	5.2×10^{12}	5.2×10^{12}
Tl-208	--	--	9.95×10^{4}	9.95×10^{4}	NA	NA	13.44	--	--	7.4×10^{9}	7.4×10^{9}
Bi-210	2.33×10^{5}	3.35×10^{8}	2.66×10^{5}	1.24×10^{5}	3.69	10.86	13.49	6.3×10^{10}	3.1×10^{13}	2.0×10^{10}	1.5×10^{10}
Pb-210	3.32	9.77×10^{3}	5.06×10^{2}	3.30	21.70	14.71	17.86	1.5×10^{5}	6.6×10^{8}	2.8×10^{7}	1.5×10^{5}
Po-210	6.20×10^{1}	3.81×10^{5}	5.92×10^{5}	6.20×10^{1}	91.60	11.26	13.67	6.8×10^{5}	3.4×10^{10}	4.3×10^{10}	6.8×10^{5}
Bi-211	--	--	1.31×10^{7}	1.31×10^{7}	NA	NA	14.04	--	--	9.3×10^{11}	9.3×10^{11}
Pb-211	1.17×10^{9}	7.56×10^{11}	5.07×10^{5}	5.06×10^{5}	11.46	11.00	13.81	1.0×10^{14}	6.9×10^{16}	3.7×10^{10}	3.7×10^{10}
Bi-212	3.98×10^{8}	2.15×10^{11}	1.77×10^{5}	1.77×10^{5}	9.63	14.76	13.61	4.1×10^{13}	1.5×10^{16}	1.3×10^{10}	1.3×10^{10}
Pb-212	1.00×10^{6}	2.69×10^{9}	1.68×10^{4}	1.65×10^{4}	6.26	10.90	14.27	1.6×10^{11}	2.5×10^{14}	1.2×10^{9}	1.2×10^{9}
Ra-223	4.10×10^{3}	2.29×10^{6}	7.10×10^{2}	6.05×10^{2}	10.93	0.11	14.33	3.8×10^{8}	2.1×10^{13}	5.0×10^{7}	4.4×10^{7}
Ra-224+D	1.80×10^{4}	1.84×10^{7}	2.41×10^{4}	1.03×10^{4}	10.12	11.11	14.17	1.8×10^{9}	1.7×10^{12}	1.7×10^{9}	8.7×10^{8}
Ra-226+D	5.51	3.59×10^{3}	5.85×10^{-2}	5.79×10^{-2}	20.14	11.29	14.31	2.7×10^{5}	3.2×10^{8}	4.1×10^{3}	4.0×10^{3}
Ac-227	1.98×10^{1}	1.05×10^{3}	3.81×10^{3}	1.94×10^{1}	165.91	101.85	14.67	1.2×10^{5}	1.0×10^{7}	2.6×10^{8}	1.2×10^{5}
Th-227	1.17×10^{4}	1.17×10^{6}	4.44×10^{2}	4.28×10^{2}	4.71	10.55	14.21	2.5×10^{9}	1.1×10^{11}	3.1×10^{7}	3.1×10^{7}
Ra-228+D	6.94	8.57×10^{3}	4.48×10^{-1}	4.20×10^{-1}	17.88	18.57	1.00	3.9×10^{5}	4.6×10^{8}	4.5×10^{5}	2.1×10^{5}
Th-228	1.66×10^{2}	8.27×10^{3}	9.39×10^{2}	1.38×10^{2}	18.05	11.17	14.64	9.2×10^{6}	7.4×10^{8}	6.4×10^{7}	8.0×10^{6}
Th-230	2.23×10^{1}	2.96×10^{3}	5.76×10^{2}	2.13×10^{1}	65.22	18.18	15.23	3.4×10^{5}	1.6×10^{8}	3.8×10^{7}	3.4×10^{5}
Pa-231	1.24×10^{1}	1.32×10^{3}	3.83	2.92	116.20	127.27	14.14	1.1×10^{5}	1.0×10^{7}	2.7×10^{5}	7.6×10^{4}
Th-232+D	1.71	1.16×10^{3}	1.20×10^{-1}	1.13×10^{-1}	63.89	21.37	15.71	2.7×10^{4}	5.4×10^{7}	7.6×10^{3}	5.9×10^{3}

Constituent	Cancer Morbidity RBSL (picocuries per gram per 1×10^{-6} incidence)				Dose to Morbidity Conversion Factor (sieverts/incidence)			Radiological Dose RBSL (picocuries per gram per sievert)			
	Ingestion of Soil	***Inhalation***	***External – Soil***	***Overall***	***Ingestion***	***Inhalation***	***External – Soil***	***Ingestion of Soil***	***Inhalation***	***External – Soil***	***Overall***
Th-234	1.86×10^{4}	1.03×10^{9}	8.63×10^{3}	5.90×10^{3}	3.70	9.27	15.20	5.0×10^{9}	1.1×10^{14}	5.7×10^{8}	5.1×10^{8}
U-234	2.50×10^{1}	3.62×10^{3}	1.92×10^{3}	2.45×10^{1}	18.99	11.36	16.42	1.3×10^{6}	3.2×10^{8}	1.2×10^{8}	1.3×10^{6}
U-235+D	2.41×10^{1}	4.03×10^{3}	8.45×10^{-1}	8.17×10^{-1}	18.43	11.36	14.34	1.3×10^{6}	3.5×10^{8}	5.9×10^{4}	5.6×10^{4}
U-238+D	1.88×10^{1}	4.25×10^{3}	4.09	3.35	19.23	11.51	21.33	9.8×10^{5}	3.7×10^{8}	1.9×10^{5}	1.6×10^{5}
Pu-238	1.85×10^{1}	2.17×10^{3}	7.91×10^{3}	1.83×10^{1}	50.22	50.72	21.63	3.7×10^{5}	4.3×10^{7}	3.7×10^{8}	3.6×10^{5}
Pu-239+D	1.63×10^{1}	1.82×10^{3}	2.33×10^{3}	1.60×10^{1}	53.19	55.62	15.25	3.1×10^{5}	3.3×10^{7}	1.5×10^{8}	3.0×10^{5}
Pu-240	1.62×10^{1}	1.82×10^{3}	6.84×10^{3}	1.61×10^{1}	53.08	55.56	21.66	3.1×10^{5}	3.3×10^{7}	3.2×10^{8}	3.0×10^{5}
Pu-241	2.58×10^{3}	2.20×10^{5}	2.27×10^{5}	2.52×10^{3}	77.80	99.78	14.81	3.3×10^{7}	2.2×10^{9}	1.5×10^{10}	3.3×10^{7}
Pu-242	1.71×10^{1}	1.92×10^{3}	1.12×10^{3}	1.67×10^{1}	53.69	56.74	21.13	3.2×10^{5}	3.4×10^{7}	5.3×10^{7}	3.1×10^{5}
Am-241	2.06×10^{1}	2.73×10^{3}	1.80×10^{1}	9.57	55.10	55.26	16.36	3.7×10^{5}	4.9×10^{7}	1.1×10^{6}	2.8×10^{5}
Cm-243	2.93×10^{1}	3.83×10^{3}	1.62	1.53	45.05	42.64	14.34	6.5×10^{5}	9.0×10^{7}	1.1×10^{5}	9.6×10^{4}

RBSL = risk-based screening level.

Notes:

– Constituents evaluated were those identified from sampling of soil source areas.
– Dose to morbidity conversion factors are the ratio of the dose factors divided by the morbidity risk values, as presented in Table G–14.
– Overall Cancer Mortality RBSLs were calculated from individual pathway values as follows: Overall = 1/((1/ingestion) + (1/inhalation) + (1/external exposure)).
– Values are in units of picocuries per gram for a cancer incidence risk of 1×10^{-6}.
– Radiological RBSLs are from EPA sources (epa-prgs.ornl.gov/radionuclides/) and were calculated using the *Final Standardized Risk Assessment Methodology Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California* (MWH 2014) parameters for recreational exposure.
– Dose in units of sieverts, where 1 sievert = 100 rem.
– Constituent listed with "+D" indicate that long-lived daughter products were included in the screening value.
– "--" indicates that the radionuclide dose not have available values for a particular pathway.

Table G–17 Morbidity, Mortality, and Dose Conversion Factors for Onsite Suburban Resident[a] Exposure to Radionuclides in Soil

Constituent	*Morbidity RBSL (picocuries per gram per 1×10^{-6} incidence)*	*Mortality RBSL (picocuries per gram per 1×10^{-6} fatality)*	*Mortality per Morbidity Conversion Factor (fatality/incidence)*	*Dose Factor (picocuries per gram per sievert)*	*Dose per Morbidity Conversion Factor*		
					(sieverts per 1×10^{-6} incidence)	*(sieverts per incidence)*	*(millirem per incidence)*
H-3	2.2×10^{-1}	2.6×10^{-1}	**8.5×10^{-1}**	2.6×10^{4}	8.4×10^{-6}	8.4	**8.4×10^{5}**
Na-22	7.8×10^{-2}	1.1×10^{-1}	**6.8×10^{-1}**	5.7×10^{3}	1.4×10^{-5}	1.4×10^{1}	**1.4×10^{6}**
Fe-55	3.2×10^{3}	4.2×10^{3}	**7.6×10^{-1}**	3.0×10^{8}	1.1×10^{-5}	1.1×10^{1}	**1.1×10^{6}**
Ni-59	6.5×10^{2}	8.4×10^{2}	**7.7×10^{-1}**	1.7×10^{8}	3.8×10^{-6}	3.8	**3.8×10^{5}**
Ni-63	5.1×10^{2}	8.6×10^{2}	**6.0×10^{-1}**	8.8×10^{7}	5.8×10^{-6}	5.8	**5.8×10^{5}**
Co-60	3.3×10^{-2}	4.8×10^{-2}	**6.8×10^{-1}**	2.4×10^{3}	1.4×10^{-5}	1.4×10^{1}	**1.4×10^{6}**
Sr-90+D	3.8	5.0	**7.7×10^{-1}**	2.6×10^{5}	1.5×10^{-5}	1.5×10^{1}	**1.5×10^{6}**
Cs-134	1.4×10^{-1}	2.1×10^{-1}	**6.8×10^{-1}**	1.0×10^{4}	1.4×10^{-5}	1.4×10^{1}	**1.4×10^{6}**
Cs-137+D	5.5×10^{-2}	7.9×10^{-2}	**6.9×10^{-1}**	3.8×10^{3}	1.5×10^{-5}	1.5×10^{1}	**1.5×10^{6}**
Eu-152	3.6×10^{-2}	5.3×10^{-2}	**6.8×10^{-1}**	2.7×10^{3}	1.4×10^{-5}	1.4×10^{1}	**1.4×10^{6}**
Eu-154	4.5×10^{-2}	6.7×10^{-2}	**6.8×10^{-1}**	3.3×10^{3}	1.4×10^{-5}	1.4×10^{1}	**1.4×10^{6}**
Eu-155	3.5	5.2	**6.8×10^{-1}**	2.3×10^{5}	1.5×10^{-5}	1.5×10^{1}	**1.5×10^{6}**
Tl-207	1.5×10^{7}	2.1×10^{7}	**6.9×10^{-1}**	1.1×10^{12}	1.4×10^{-5}	1.4×10^{1}	**1.4×10^{6}**
Tl-208	2.1×10^{4}	3.0×10^{4}	**6.8×10^{-1}**	1.5×10^{9}	1.3×10^{-5}	1.3×10^{1}	**1.3×10^{6}**
Bi-210	2.6×10^{4}	4.2×10^{4}	**6.3×10^{-1}**	3.1×10^{9}	8.4×10^{-6}	8.4	**8.4×10^{5}**
Pb-210	7.1×10^{-1}	9.7×10^{-1}	**7.3×10^{-1}**	3.3×10^{4}	2.2×10^{-5}	2.2×10^{1}	**2.2×10^{6}**
Po-210	1.3×10^{1}	1.9×10^{1}	**7.2×10^{-1}**	1.5×10^{5}	9.2×10^{-5}	9.2×10^{1}	**9.2×10^{6}**
Bi-211	2.7×10^{6}	3.9×10^{6}	**6.8×10^{-1}**	1.9×10^{11}	1.4×10^{-5}	1.4×10^{1}	**1.4×10^{6}**
Pb-211	1.0×10^{5}	1.5×10^{5}	**6.8×10^{-1}**	7.5×10^{9}	1.4×10^{-5}	1.4×10^{1}	**1.4×10^{6}**
Bi-212	3.6×10^{4}	5.4×10^{4}	**6.8×10^{-1}**	2.7×10^{9}	1.4×10^{-5}	1.4×10^{1}	**1.4×10^{6}**
Pb-212	3.4×10^{3}	5.0×10^{3}	**6.8×10^{-1}**	2.4×10^{8}	1.4×10^{-5}	1.4×10^{1}	**1.4×10^{6}**
Ra-223	1.3×10^{2}	1.9×10^{2}	**6.7×10^{-1}**	9.0×10^{6}	1.4×10^{-5}	1.4×10^{1}	**1.4×10^{6}**
Ra-224+D	2.2×10^{3}	3.4×10^{3}	**6.4×10^{-1}**	1.8×10^{8}	1.2×10^{-5}	1.2×10^{1}	**1.2×10^{6}**
Ra-226+D	1.2×10^{-2}	1.8×10^{-2}	**6.8×10^{-1}**	8.3×10^{2}	1.4×10^{-5}	1.4×10^{1}	**1.4×10^{6}**
Ac-227	4.0	4.9	**8.1×10^{-1}**	2.5×10^{4}	1.6×10^{-4}	1.6×10^{2}	**1.6×10^{7}**
Th-227	8.8×10^{1}	1.3×10^{2}	**6.7×10^{-1}**	6.4×10^{6}	1.4×10^{-5}	1.4×10^{1}	**1.4×10^{6}**
Ra-228+D	8.7×10^{-2}	8.8×10^{-2}	**9.8×10^{-1}**	4.4×10^{4}	2.0×10^{-6}	2.0	**2.0×10^{5}**
Th-228	2.9×10^{1}	4.4×10^{1}	**6.4×10^{-1}**	1.7×10^{6}	1.7×10^{-5}	1.7×10^{1}	**1.7×10^{6}**
Th-230	4.5	6.6	**6.8×10^{-1}**	7.2×10^{4}	6.2×10^{-5}	6.2×10^{1}	**6.2×10^{6}**
Pa-231	6.0×10^{-1}	8.8×10^{-1}	**6.9×10^{-1}**	1.6×10^{4}	3.8×10^{-5}	3.8×10^{1}	**3.8×10^{6}**
Th-232+D	2.3×10^{-2}	3.5×10^{-2}	**6.7×10^{-1}**	1.2×10^{3}	1.9×10^{-5}	1.9×10^{1}	**1.9×10^{6}**
Th-234	1.2×10^{3}	1.9×10^{3}	**6.4×10^{-1}**	1.1×10^{8}	1.2×10^{-5}	1.3×10^{1}	**1.2×10^{6}**
U-234	5.2	8.0	**6.5×10^{-1}**	2.8×10^{5}	1.9×10^{-5}	1.9×10^{1}	**1.9×10^{6}**

Constituent	Morbidity RBSL (picocuries per gram per 1×10^{-6} incidence)	Mortality RBSL (picocuries per gram per 1×10^{-6} fatality)	Mortality per Morbidity Conversion Factor (fatality/incidence)	Dose Factor (picocuries per gram per sievert)	Dose per Morbidity Conversion Factor		
					(sieverts per 1×10^{-6} incidence)	(sieverts per incidence)	(millirem per incidence)
U-235+D	1.7×10^{-1}	2.5×10^{-1}	**6.8×10^{-1}**	1.2×10^{4}	1.5×10^{-5}	1.5×10^{1}	**1.5×10^{6}**
U-238+D	6.9×10^{-1}	1.1	**6.4×10^{-1}**	3.3×10^{4}	2.1×10^{-5}	2.1×10^{1}	**2.1×10^{6}**
Pu-238	3.9	5.0	**7.7×10^{-1}**	7.7×10^{4}	5.0×10^{-5}	5.0×10^{1}	**5.0×10^{6}**
Pu-239+D	3.4	4.3	**7.7×10^{-1}**	6.4×10^{4}	5.3×10^{-5}	5.3×10^{1}	**5.3×10^{6}**
Pu-240	3.4	4.4	**7.7×10^{-1}**	6.4×10^{4}	5.3×10^{-5}	5.3×10^{1}	**5.3×10^{6}**
Pu-241	5.3×10^{2}	6.4×10^{2}	**8.2×10^{-1}**	6.8×10^{6}	7.8×10^{-5}	7.8×10^{1}	**7.8×10^{6}**
Pu-242	3.5	4.5	**7.7×10^{-1}**	6.6×10^{4}	5.3×10^{-5}	5.3×10^{1}	**5.3×10^{6}**
Am-241	2.0	2.9	**6.9×10^{-1}**	5.8×10^{4}	3.4×10^{-5}	3.4×10^{1}	**3.4×10^{6}**
Cm-243	3.2×10^{-1}	4.7×10^{-1}	**6.8×10^{-1}**	2.0×10^{4}	1.6×10^{-5}	1.6×10^{1}	**1.6×10^{6}**

RBSL = risk-based screening level.

[a] The onsite suburban resident exposure is based on the following direct pathways: ingestion, inhalation, and external.

Notes:

– Constituents evaluated were those identified from sampling of soil source areas.
– Radiological RBSLs are from EPA sources (epa-prgs.ornl.gov/radionuclides/) and were calculated using the *Final Standardized Risk Assessment Methodology Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California* (MWH 2014) parameters for onsite suburban resident exposure.
– Incidence and fatality refer to the rates of cancer incidence and fatalities in exposed individuals.
– Morbidity RBSLs are in units of picocuries per gram for a cancer incidence risk of 1×10^{-6}.
– Mortality RBSLs were calculated by adjusting the Morbidity RBSLs, based on the ratio of mortality to morbidity for each individual pathway, and represent the fractions of incidences resulting in a fatality.
– The dose to morbidity conversion factor is expressed as (1) ratio represents a dose that would result in 1 cancer incidence per 1,000,000 exposed individuals, a dose that would result in a cancer incidence rate of 1, or a dose that is considered certain to cause cancer; and (2) sieverts were converted to millirem based on 1 sievert = 100,000 millirem.
– The dose to morbidity conversion factor was multiplied by the estimated cancer incidence rate to obtain the associated radiological dose.
– Constituents listed with "+D" indicate that long-lived daughter products were included in the screening value.

Table G–18 Morbidity, Mortality, and Dose Conversion Factors for the Onsite Recreational User Exposure to Radionuclides in Soil

Constituent	*Morbidity RBSL (picocuries per gram per 1×10^{-6} incidence)*	*Mortality RBSL (picocuries per gram per 1×10^{-6} fatality)*	*Mortality per Morbidity Conversion Factor (fatality/incidence)*	*Dose Factor (picocuries per gram per sievert)*	*Dose per Morbidity Conversion Factor*		
					(sieverts per 1×10^{-6} incidence)	*(sieverts per incidence)*	*(millirem per incidence)*
H-3	3.1	3.6	**8.5×10^{-1}**	3.7×10^{5}	8.4×10^{-6}	8.4	**8.4×10^{5}**
Na-22	3.8×10^{-1}	5.5×10^{-1}	**6.8×10^{-1}**	2.8×10^{4}	1.4×10^{-5}	1.4×10^{1}	**1.4×10^{6}**
Fe-55	1.5×10^{4}	2.0×10^{4}	**7.6×10^{-1}**	1.4×10^{9}	1.1×10^{-5}	1.1×10^{1}	**1.1×10^{6}**
Ni-59	3.1×10^{3}	4.0×10^{3}	**7.7×10^{-1}**	8.1×10^{8}	3.8×10^{-6}	3.8	**3.8×10^{5}**
Ni-63	2.4×10^{3}	4.0×10^{3}	**6.0×10^{-1}**	4.1×10^{8}	5.8×10^{-6}	5.8	**5.8×10^{5}**
Co-60	1.6×10^{-1}	2.3×10^{-1}	**6.8×10^{-1}**	1.2×10^{4}	1.4×10^{-5}	1.4×10^{1}	**1.4×10^{6}**
Sr-90+D	1.8×10^{1}	2.4×10^{1}	**7.7×10^{-1}**	1.2×10^{6}	1.5×10^{-5}	1.5×10^{1}	**1.5×10^{6}**
Cs-134	6.9×10^{-1}	1.0	**6.8×10^{-1}**	5.0×10^{4}	1.4×10^{-5}	1.4×10^{1}	**1.4×10^{6}**
Cs-137+D	2.7×10^{-1}	3.9×10^{-1}	**6.9×10^{-1}**	1.8×10^{4}	1.5×10^{-5}	1.5×10^{1}	**1.5×10^{6}**
Eu-152	1.8×10^{-1}	2.6×10^{-1}	**6.8×10^{-1}**	1.3×10^{4}	1.4×10^{-5}	1.4×10^{1}	**1.4×10^{6}**
Eu-154	2.2×10^{-1}	3.2×10^{-1}	**6.8×10^{-1}**	1.6×10^{4}	1.4×10^{-5}	1.4×10^{1}	**1.4×10^{6}**
Eu-155	1.7×10^{1}	2.5×10^{1}	**6.8×10^{-1}**	1.1×10^{6}	1.5×10^{-5}	1.5×10^{1}	**1.5×10^{6}**
Tl-207	7.0×10^{7}	1.0×10^{8}	**6.9×10^{-1}**	5.2×10^{12}	1.4×10^{-5}	1.4×10^{1}	**1.4×10^{6}**
Tl-208	1.0×10^{5}	1.5×10^{5}	**6.8×10^{-1}**	7.4×10^{9}	1.3×10^{-5}	1.3×10^{1}	**1.3×10^{6}**
Bi-210	1.2×10^{5}	2.0×10^{5}	**6.2×10^{-1}**	1.5×10^{10}	8.3×10^{-6}	8.3	**8.3×10^{5}**
Pb-210	3.3	4.5	**7.3×10^{-1}**	1.5×10^{5}	2.2×10^{-5}	2.2×10^{1}	**2.2×10^{6}**
Po-210	6.2×10^{1}	8.7×10^{1}	**7.2×10^{-1}**	6.8×10^{5}	9.2×10^{-5}	9.2×10^{1}	**9.2×10^{6}**
Bi-211	1.3×10^{7}	1.9×10^{7}	**6.9×10^{-1}**	9.3×10^{11}	1.4×10^{-5}	1.4×10^{1}	**1.4×10^{6}**
Pb-211	5.1×10^{5}	7.4×10^{5}	**6.8×10^{-1}**	3.7×10^{10}	1.4×10^{-5}	1.4×10^{1}	**1.4×10^{6}**
Bi-212	1.8×10^{5}	2.6×10^{5}	**6.8×10^{-1}**	1.3×10^{10}	1.4×10^{-5}	1.4×10^{1}	**1.4×10^{6}**
Pb-212	1.7×10^{4}	2.4×10^{4}	**6.8×10^{-1}**	1.2×10^{9}	1.4×10^{-5}	1.4×10^{1}	**1.4×10^{6}**
Ra-223	6.1×10^{2}	9.0×10^{2}	**6.7×10^{-1}**	4.4×10^{7}	1.4×10^{-5}	1.4×10^{1}	**1.4×10^{6}**
Ra-224+D	1.0×10^{4}	1.6×10^{4}	**6.4×10^{-1}**	8.7×10^{8}	1.2×10^{-5}	1.2×10^{1}	**1.2×10^{6}**
Ra-226+D	5.8×10^{-2}	8.5×10^{-2}	**6.8×10^{-1}**	4.0×10^{3}	1.4×10^{-5}	1.4×10^{1}	**1.4×10^{6}**
Ac-227	1.9×10^{1}	2.4×10^{1}	**8.1×10^{-1}**	1.2×10^{5}	1.7×10^{-4}	1.7×10^{2}	**1.7×10^{7}**
Th-227	4.3×10^{2}	6.3×10^{2}	**6.8×10^{-1}**	3.1×10^{7}	1.4×10^{-5}	1.4×10^{1}	**1.4×10^{6}**
Ra-228+D	4.2×10^{-1}	4.3×10^{-1}	**9.8×10^{-1}**	2.1×10^{5}	2.0×10^{-6}	2.0	**2.0×10^{5}**
Th-228	1.4×10^{2}	2.2×10^{2}	**6.3×10^{-1}**	8.0×10^{6}	1.7×10^{-5}	1.7×10^{1}	**1.7×10^{6}**
Th-230	2.1×10^{1}	3.2×10^{1}	**6.7×10^{-1}**	3.4×10^{5}	6.3×10^{-5}	6.3×10^{1}	**6.3×10^{6}**
Pa-231	2.9	4.3	**6.9×10^{-1}**	7.6×10^{4}	3.8×10^{-5}	3.8×10^{1}	**3.8×10^{6}**
Th-232+D	1.1×10^{-1}	1.7×10^{-1}	**6.8×10^{-1}**	5.9×10^{3}	1.9×10^{-5}	1.9×10^{1}	**1.9×10^{6}**
Th-234	5.9×10^{3}	9.2×10^{3}	**6.4×10^{-1}**	5.1×10^{8}	1.2×10^{-5}	1.2×10^{1}	**1.2×10^{6}**
U-234	2.5×10^{1}	3.8×10^{1}	**6.4×10^{-1}**	1.3×10^{6}	1.9×10^{-5}	1.9×10^{1}	**1.9×10^{6}**

Constituent	Morbidity RBSL (picocuries per gram per 1×10^{-6} incidence)	Mortality RBSL (picocuries per gram per 1×10^{-6} fatality)	Mortality per Morbidity Conversion Factor (fatality/incidence)	Dose Factor (picocuries per gram per sievert)	Dose per Morbidity Conversion Factor		
					(sieverts per 1×10^{-6} incidence)	(sieverts per incidence)	(millirem per incidence)
U-235+D	8.2×10^{-1}	1.2	**6.8×10^{-1}**	5.6×10^{4}	1.5×10^{-5}	1.5×10^{1}	**1.5×10^{6}**
U-238+D	3.4	5.3	**6.3×10^{-1}**	1.6×10^{5}	2.1×10^{-5}	2.1×10^{1}	**2.1×10^{6}**
Pu-238	1.8×10^{1}	2.4×10^{1}	**7.7×10^{-1}**	3.6×10^{5}	5.0×10^{-5}	5.0×10^{1}	**5.0×10^{6}**
Pu-239+D	1.6×10^{1}	2.1×10^{1}	**7.7×10^{-1}**	3.0×10^{5}	5.3×10^{-5}	5.3×10^{1}	**5.3×10^{6}**
Pu-240	1.6×10^{1}	2.1×10^{1}	**7.7×10^{-1}**	3.0×10^{5}	5.3×10^{-5}	5.3×10^{1}	**5.3×10^{6}**
Pu-241	2.5×10^{3}	3.1×10^{3}	**8.2×10^{-1}**	3.3×10^{7}	7.7×10^{-5}	7.7×10^{1}	**7.7×10^{6}**
Pu-242	1.7×10^{1}	2.2×10^{1}	**7.7×10^{-1}**	3.1×10^{5}	5.3×10^{-5}	5.3×10^{1}	**5.3×10^{6}**
Am-241	9.6	1.4×10^{1}	**6.9×10^{-1}**	2.8×10^{5}	3.5×10^{-5}	3.5×10^{1}	**3.5×10^{6}**
Cm-243	1.5	2.3	**6.8×10^{-1}**	9.6×10^{4}	1.6×10^{-5}	1.6×10^{1}	**1.6×10^{6}**

RBSL = risk-based screening level.

Notes:

– Constituents evaluated were those identified from sampling of soil source areas.

– Radiological RBSLs are from EPA sources (epa-prgs.ornl.gov/radionuclides/) and were calculated using the *Final Standardized Risk Assessment Methodology Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California* (MWH 2014) parameters for recreational exposure.

– Incidence and fatality refer to the rates of cancer incidence and fatalities in exposed individuals.

– Morbidity RBSLs are in units of picocuries per gram for a cancer incidence risk of 1×10^{-6}.

– Mortality RBSLs were based on adjusting the Morbidity RBSL (based on the ratio of mortality to morbidity for each individual pathway) and represent the fraction of incidence resulting in a fatality.

– The dose to morbidity conversion factor is expressed as (1) ratio represents a dose that would result in 1 cancer incidence per 1,000,000 exposed individuals, a dose that would result in a cancer incidence rate of 1, or a dose that is considered certain to cause cancer; and (2) sieverts were converted to millirem, based on 1 sievert = 100,000 millirem.

– The dose to morbidity conversion factor was multiplied by the estimated cancer incidence rate to obtain the associated radiological dose.

– Constituents listed with "+D" indicate that long-lived daughter products were included in the screening value.

Table G–19 Site Soil Cancer Incidence Risk from Radionuclides for the Onsite Suburban Resident[a] Exposure Scenario – No Action Alternative – Current Conditions – With Uranium and Thorium Decay Chain Radionuclides

Constituent	*Site Soil Radiological Cancer Morbidity Risk in Sub-areas*								
	3	*5A*	*5B*	*5C*	*5D*	*6*	*7*	*8*	*NBZ*
Ac-227	1.2×10^{-8}	9.9×10^{-9}	9.8×10^{-9}	9.9×10^{-9}	1.2×10^{-8}	1.3×10^{-8}	1.3×10^{-8}	1.1×10^{-8}	1.1×10^{-8}
Am-241	--	--	--	--	3.0×10^{-8}	--	--	2.5×10^{-8}	--
Bi-210	3.3×10^{-11}	3.7×10^{-11}	3.5×10^{-11}	3.5×10^{-11}	3.3×10^{-11}	3.4×10^{-11}	3.2×10^{-11}	3.2×10^{-11}	3.3×10^{-11}
Bi-211	1.8×10^{-14}	1.5×10^{-14}	1.5×10^{-14}	1.5×10^{-14}	1.8×10^{-14}	1.9×10^{-14}	2.0×10^{-14}	1.6×10^{-14}	1.7×10^{-14}
Bi-212	3.1×10^{-11}	3.4×10^{-11}	3.2×10^{-11}	3.4×10^{-11}	3.2×10^{-11}	3.2×10^{-11}	3.1×10^{-11}	3.2×10^{-11}	3.0×10^{-11}
Cm-243	--	--	5.6×10^{-8}	--	--	--	--	--	2.0×10^{-7}
Co-60	--	--	7.0×10^{-7}	7.6×10^{-7}	--	1.5×10^{-6}	8.1×10^{-7}	--	--
Cs-137	--	1.2×10^{-5}	5.8×10^{-6}	1.0×10^{-5}	2.2×10^{-5}	9.4×10^{-6}	1.2×10^{-5}	3.8×10^{-6}	4.3×10^{-6}
Eu-152	--	3.3×10^{-6}	1.5×10^{-6}	--	--	--	--	--	--
Eu-154	--	--	--	--	3.0×10^{-6}	--	--	--	--
H-3	--	--	3.4×10^{-5}	--	--	--	--	--	--
Ni-59	--	3.7×10^{-8}	--	--	--	--	--	--	--
Pa-231	7.9×10^{-8}	6.5×10^{-8}	6.5×10^{-8}	6.6×10^{-8}	7.9×10^{-8}	8.5×10^{-8}	8.7×10^{-8}	7.3×10^{-8}	7.5×10^{-8}
Pb-210	1.2×10^{-6}	1.4×10^{-6}	1.3×10^{-6}	1.3×10^{-6}	1.2×10^{-6}	1.3×10^{-6}	1.2×10^{-6}	1.2×10^{-6}	1.2×10^{-6}
Pb-211	4.6×10^{-13}	3.8×10^{-13}	3.8×10^{-13}	3.8×10^{-13}	4.6×10^{-13}	5.0×10^{-13}	5.1×10^{-13}	4.2×10^{-13}	4.4×10^{-13}
Pb-212	3.3×10^{-10}	3.7×10^{-10}	3.5×10^{-10}	3.7×10^{-10}	3.4×10^{-10}	3.4×10^{-10}	3.3×10^{-10}	3.4×10^{-10}	3.2×10^{-10}
Po-210	6.6×10^{-8}	7.3×10^{-8}	6.8×10^{-8}	6.9×10^{-8}	6.4×10^{-8}	6.8×10^{-8}	6.3×10^{-8}	6.4×10^{-8}	6.4×10^{-8}
Pu-238	--	3.5×10^{-9}	--	--	1.3×10^{-8}	--	--	--	--
Pu-239	--	--	--	1.1×10^{-8}	1.6×10^{-8}	1.1×10^{-8}	1.7×10^{-8}	2.4×10^{-8}	1.1×10^{-8}
Ra-223	5.5×10^{-10}	4.6×10^{-10}	4.5×10^{-10}	4.6×10^{-10}	5.5×10^{-10}	6.0×10^{-10}	6.1×10^{-10}	5.1×10^{-10}	5.2×10^{-10}
Ra-224	5.1×10^{-10}	5.8×10^{-10}	5.4×10^{-10}	5.8×10^{-10}	5.4×10^{-10}	5.3×10^{-10}	5.2×10^{-10}	5.3×10^{-10}	5.1×10^{-10}
Ra-226	7.3×10^{-5}	8.1×10^{-5}	**7.5×10^{-5}**	7.7×10^{-5}	7.1×10^{-5}	7.5×10^{-5}	7.0×10^{-5}	7.1×10^{-5}	7.1×10^{-5}
Ra-228	1.3×10^{-5}	1.4×10^{-5}	1.4×10^{-5}	1.4×10^{-5}	1.3×10^{-5}	1.3×10^{-5}	1.3×10^{-5}	1.3×10^{-5}	1.3×10^{-5}
Sr-90	1.2×10^{-7}	1.5×10^{-7}	3.0×10^{-8}	2.5×10^{-8}	1.6×10^{-7}	1.6×10^{-7}	2.1×10^{-7}	2.6×10^{-7}	1.5×10^{-7}
Th-227	5.4×10^{-10}	4.5×10^{-10}	4.4×10^{-10}	4.5×10^{-10}	5.4×10^{-10}	5.9×10^{-10}	6.0×10^{-10}	5.0×10^{-10}	5.1×10^{-10}
Th-228	3.9×10^{-8}	4.4×10^{-8}	4.1×10^{-8}	4.4×10^{-8}	4.1×10^{-8}	4.0×10^{-8}	4.0×10^{-8}	4.1×10^{-8}	3.9×10^{-8}
Th-230	1.9×10^{-7}	2.1×10^{-7}	2.0×10^{-7}	2.1×10^{-7}	1.9×10^{-7}	2.0×10^{-7}	1.9×10^{-7}	1.9×10^{-7}	1.9×10^{-7}
Th-232	2.7×10^{-7}	3.0×10^{-7}	2.8×10^{-7}	3.0×10^{-7}	2.8×10^{-7}	2.8×10^{-7}	2.7×10^{-7}	2.8×10^{-7}	2.7×10^{-7}
Tl-207	3.3×10^{-15}	2.7×10^{-15}	2.7×10^{-15}	2.7×10^{-15}	3.3×10^{-15}	3.6×10^{-15}	3.6×10^{-15}	3.0×10^{-15}	3.1×10^{-15}
Tl-208	1.8×10^{-11}	2.0×10^{-11}	1.9×10^{-11}	2.0×10^{-11}	1.9×10^{-11}	1.9×10^{-11}	1.8×10^{-11}	1.9×10^{-11}	1.8×10^{-11}

Constituent	Site Soil Radiological Cancer Morbidity Risk in Sub-areas								
	3	**5A**	**5B**	**5C**	**5D**	**6**	**7**	**8**	**NBZ**
U-234	1.5×10^{-7}	1.5×10^{-7}	1.5×10^{-7}	1.5×10^{-7}	1.4×10^{-7}	1.7×10^{-7}	1.7×10^{-7}	1.4×10^{-7}	1.6×10^{-7}
U-235	2.8×10^{-7}	2.4×10^{-7}	2.3×10^{-7}	2.4×10^{-7}	2.8×10^{-7}	3.1×10^{-7}	3.1×10^{-7}	2.6×10^{-7}	2.7×10^{-7}
U-238	1.2×10^{-6}	1.2×10^{-6}	1.1×10^{-6}	1.1×10^{-6}	1.1×10^{-6}	1.3×10^{-6}	1.3×10^{-6}	1.1×10^{-6}	1.2×10^{-6}
Sub-area Total Cancer Incidence Risk	**9.0×10^{-5}**	**1.1×10^{-4}**	**1.3×10^{-4}**	**1.1×10^{-4}**	**1.1×10^{-4}**	**1.0×10^{-4}**	**1.0×10^{-4}**	**9.1×10^{-5}**	**9.2×10^{-5}**

NBZ = Northern Buffer Zone.

[a] The onsite suburban resident exposure is based on the following direct pathways: ingestion, inhalation, and external.

Notes:

– Results were based on the median concentrations of radioactive constituents in onsite soil source areas.
– Cancer risk represents increased cancer incidence in exposed individuals.
– "--" indicates that no data are available for the constituent in the sub-area.
– Shaded cells with bold text indicate the primary contributor(s) to maximum sub-area total cancer incidence risk.
– Sub-area totals combine results for all radionuclides, assuming similar carcinogenic mechanisms.
– Cancer risks below 1 chance in 1,000,000 (1×10^{-6}) are not considered significant, while risks approaching 1 chance in 10,000 ($\times10^{-4}$) are a level of concern.

Table G–20 Site Soil Cancer Incidence Risk from Radionuclides for the Onsite Suburban Resident[a] Exposure Scenario – No Action Alternative –Future Conditions – With Uranium and Thorium Decay Chain Radionuclides

Constituent	*Site Soil Radiological Cancer Morbidity Risk in Sub-areas*								
	3	*5A*	*5B*	*5C*	*5D*	*6*	*7*	*8*	*NBZ*
Ac-227	1.2×10^{-8}	9.9×10^{-9}	9.8×10^{-9}	9.9×10^{-9}	1.2×10^{-8}	1.3×10^{-8}	1.3×10^{-8}	1.1×10^{-8}	1.1×10^{-8}
Am-241	--	--	--	--	2.5×10^{-8}	--	--	2.1×10^{-8}	--
Bi-210	3.3×10^{-11}	3.7×10^{-11}	3.4×10^{-11}	3.5×10^{-11}	3.3×10^{-11}	3.4×10^{-11}	3.2×10^{-11}	3.2×10^{-11}	3.3×10^{-11}
Bi-211	1.8×10^{-14}	1.5×10^{-14}	1.5×10^{-14}	1.5×10^{-14}	1.8×10^{-14}	1.9×10^{-14}	2.0×10^{-14}	1.6×10^{-14}	1.7×10^{-14}
Bi-212	3.1×10^{-11}	3.4×10^{-11}	3.2×10^{-11}	3.4×10^{-11}	3.2×10^{-11}	3.2×10^{-11}	3.1×10^{-11}	3.2×10^{-11}	3.0×10^{-11}
Cm-243	--	--	5.2×10^{-9}	--	--	--	--	--	1.9×10^{-8}
Co-60	--	--	1.4×10^{-12}	1.6×10^{-12}	--	3.0×10^{-12}	1.7×10^{-12}	--	--
Cs-137	--	1.2×10^{-6}	5.8×10^{-7}	1.0×10^{-6}	2.2×10^{-6}	9.4×10^{-7}	1.2×10^{-6}	3.8×10^{-7}	4.3×10^{-7}
Eu-152	--	2.0×10^{-8}	9.0×10^{-9}	--	--	--	--	--	--
Eu-154	--	--	--	--	9.4×10^{-10}	--	--	--	--
H-3	--	--	1.2×10^{-7}	--	--	--	--	--	--
Ni-59	--	3.7×10^{-8}	--	--	--	--	--	--	--
Pa-231	7.9×10^{-8}	6.5×10^{-8}	6.5×10^{-8}	6.6×10^{-8}	7.9×10^{-8}	8.5×10^{-8}	8.7×10^{-8}	7.3×10^{-8}	7.5×10^{-8}
Pb-210	1.2×10^{-6}	1.4×10^{-6}	1.3×10^{-6}	1.3×10^{-6}	1.2×10^{-6}	1.3×10^{-6}	1.2×10^{-6}	1.2×10^{-6}	1.2×10^{-6}
Pb-211	4.6×10^{-13}	3.8×10^{-13}	3.8×10^{-13}	3.8×10^{-13}	4.6×10^{-13}	5.0×10^{-13}	5.1×10^{-13}	4.2×10^{-13}	4.4×10^{-13}
Pb-212	3.3×10^{-10}	3.7×10^{-10}	3.5×10^{-10}	3.7×10^{-10}	3.4×10^{-10}	3.4×10^{-10}	3.3×10^{-10}	3.4×10^{-10}	3.2×10^{-10}
Po-210	6.6×10^{-8}	7.3×10^{-8}	6.8×10^{-8}	6.9×10^{-8}	6.4×10^{-8}	6.8×10^{-8}	6.3×10^{-8}	6.4×10^{-8}	6.4×10^{-8}
Pu-238	--	1.6×10^{-9}	--	--	5.8×10^{-9}	--	--	--	--
Pu-239	--	--	--	1.1×10^{-8}	1.6×10^{-8}	1.1×10^{-8}	1.7×10^{-8}	2.3×10^{-8}	1.1×10^{-8}
Ra-223	5.5×10^{-10}	4.6×10^{-10}	4.5×10^{-10}	4.6×10^{-10}	5.5×10^{-10}	6.0×10^{-10}	6.1×10^{-10}	5.1×10^{-10}	5.2×10^{-10}
Ra-224	5.1×10^{-10}	5.8×10^{-10}	5.4×10^{-10}	5.8×10^{-10}	5.4×10^{-10}	5.3×10^{-10}	5.2×10^{-10}	5.3×10^{-10}	5.1×10^{-10}
Ra-226	7.3×10^{-5}	8.1×10^{-5}	7.5×10^{-5}	7.7×10^{-5}	**7.1×10^{-5}**	7.5×10^{-5}	7.0×10^{-5}	7.1×10^{-5}	7.1×10^{-5}
Ra-228	1.3×10^{-5}	1.4×10^{-5}	1.4×10^{-5}	1.4×10^{-5}	1.3×10^{-5}	1.3×10^{-5}	1.3×10^{-5}	1.3×10^{-5}	1.3×10^{-5}
Sr-90	1.0×10^{-8}	1.4×10^{-8}	2.7×10^{-9}	2.3×10^{-9}	1.4×10^{-8}	1.4×10^{-8}	1.9×10^{-8}	2.3×10^{-8}	1.4×10^{-8}
Th-227	5.4×10^{-10}	4.5×10^{-10}	4.4×10^{-10}	4.5×10^{-10}	5.4×10^{-10}	5.9×10^{-10}	6.0×10^{-10}	5.0×10^{-10}	5.1×10^{-10}
Th-228	3.9×10^{-8}	4.4×10^{-8}	4.1×10^{-8}	4.4×10^{-8}	4.1×10^{-8}	4.0×10^{-8}	4.0×10^{-8}	4.1×10^{-8}	3.9×10^{-8}
Th-230	1.9×10^{-7}	2.1×10^{-7}	2.0×10^{-7}	2.0×10^{-7}	1.9×10^{-7}	2.0×10^{-7}	1.9×10^{-7}	1.9×10^{-7}	1.9×10^{-7}
Th-232	2.7×10^{-7}	3.0×10^{-7}	2.8×10^{-7}	3.0×10^{-7}	2.8×10^{-7}	2.8×10^{-7}	2.7×10^{-7}	2.8×10^{-7}	2.7×10^{-7}
Tl-207	3.3×10^{-15}	2.7×10^{-15}	2.7×10^{-15}	2.7×10^{-15}	3.3×10^{-15}	3.6×10^{-15}	3.6×10^{-15}	3.0×10^{-15}	3.1×10^{-15}
Tl-208	1.8×10^{-11}	2.0×10^{-11}	1.9×10^{-11}	2.0×10^{-11}	1.9×10^{-11}	1.9×10^{-11}	1.8×10^{-11}	1.9×10^{-11}	1.8×10^{-11}

Constituent	*Site Soil Radiological Cancer Morbidity Risk in Sub-areas*								
	3	*5A*	*5B*	*5C*	*5D*	*6*	*7*	*8*	*NBZ*
U-234	1.5×10^{-7}	1.5×10^{-7}	1.5×10^{-7}	1.5×10^{-7}	1.4×10^{-7}	1.7×10^{-7}	1.7×10^{-7}	1.4×10^{-7}	1.6×10^{-7}
U-235	2.8×10^{-7}	2.4×10^{-7}	2.3×10^{-7}	2.4×10^{-7}	2.8×10^{-7}	3.1×10^{-7}	3.1×10^{-7}	2.6×10^{-7}	2.7×10^{-7}
U-238	1.2×10^{-6}	1.2×10^{-6}	1.1×10^{-6}	1.1×10^{-6}	1.1×10^{-6}	1.3×10^{-6}	1.3×10^{-6}	1.1×10^{-6}	1.2×10^{-6}
Sub-area Total Cancer Incidence Risk	**8.9×10^{-5}**	**1.0×10^{-4}**	**9.3×10^{-5}**	**9.6×10^{-5}**	**9.1×10^{-5}**	**9.3×10^{-5}**	**8.8×10^{-5}**	**8.8×10^{-5}**	**8.8×10^{-5}**

NBZ = Northern Buffer Zone.

[a] The onsite suburban resident exposure is based on the following direct pathways: ingestion, inhalation, and external.

Notes:

– Results were based on the median concentrations of radioactive constituents in onsite soil source areas and a 100-year decay period prior to exposure.
– Cancer risk represents increased cancer incidence in exposed individuals.
– Sr-90, Cs-137, and Pu-239/240 results include exposure due to significant daughter products.
– "--" indicates that no data are available for the constituent in the sub-area.
– Shaded cells with bold text indicate the primary contributor(s) to maximum sub-area total cancer incidence risk.
– Sub-area totals combine results for all radionuclides, assuming similar carcinogenic mechanisms.
– Cancer risks below 1 chance in 1,000,000 (1×10^{-6}) are not considered significant, while risks approaching 1 chance in 10,000 (1×10^{-4}) are a level of concern.

Table G–21 Site Soil Cancer Incidence Risk from Radionuclides for the Onsite Suburban Resident[a] Exposure Scenario – No Action Alternative – Current Conditions – Without Uranium and Thorium Decay Chain Radionuclides

Constituent	*Site Soil Radiological Cancer Morbidity Risk in Sub-areas*								
	3	*5A*	*5B*	*5C*	*5D*	*6*	*7*	*8*	*NBZ*
Am-241	--	--	--	--	3.0×10^{-8}	--	--	2.5×10^{-8}	--
Cm-243/244	--	--	5.6×10^{-8}	--	--	--	--	--	2.0×10^{-7}
Co-60	--	--	7.0×10^{-7}	7.6×10^{-7}	--	1.5×10^{-6}	8.1×10^{-7}	--	--
Cs-137	--	1.2×10^{-5}	5.8×10^{-6}	1.0×10^{-5}	2.2×10^{-5}	9.4×10^{-6}	1.2×10^{-5}	3.8×10^{-6}	4.3×10^{-6}
Eu-152	--	3.3×10^{-6}	1.5×10^{-6}	--	--	--	--	--	--
Eu-154	--	--	--	--	3.0×10^{-6}	--	--	--	--
H-3	--	--	**3.4×10^{-5}**	--	--	--	--	--	--
Ni-59	--	3.7×10^{-8}	--	--	--	--	--	--	--
Pu-238	--	3.5×10^{-9}	--	--	1.3×10^{-8}	--	--	--	--
Pu-239/240	--	--	--	1.1×10^{-8}	1.6×10^{-8}	1.1×10^{-8}	1.7×10^{-8}	2.4×10^{-8}	1.1×10^{-8}
Sr-90	1.2×10^{-7}	1.5×10^{-7}	3.0×10^{-8}	2.5×10^{-8}	1.6×10^{-7}	1.6×10^{-7}	2.1×10^{-7}	2.6×10^{-7}	1.5×10^{-7}
Sub-area Total Cancer Incidence Risk	**1.2×10^{-7}**	**1.6×10^{-5}**	**4.2×10^{-5}**	**1.1×10^{-5}**	**2.5×10^{-5}**	**1.1×10^{-5}**	**1.3×10^{-5}**	**4.1×10^{-6}**	**4.7×10^{-6}**

NBZ = Northern Buffer Zone.

[a] The onsite suburban resident exposure is based on the following direct pathways: ingestion, inhalation, and external.

Notes:

– Results were based on the median concentrations of radioactive constituents in onsite soil source areas.
– Cancer risk represents increased cancer incidence in exposed individuals.
– "--" indicates that no data are available for the constituent in the sub-area.
– Shaded cells with bold text indicate the primary contributor(s) to maximum sub-area total cancer incidence risk. The primary contributor, H-3 (tritium), was found in only one sample in this sub-area and, therefore, the value shown likely overestimates its prevalence and importance to the overall risk.
– Sub-area totals combine results for all radionuclides, assuming similar carcinogenic mechanisms.
– Cancer risks below 1 chance in 1,000,000 (1×10^{-6}) are not considered significant, while risks approaching 1 chance in 10,000 (1×10^{-4}) are a level of concern.

Table G–22 Site Soil Cancer Incidence Risk from Radionuclides for the Onsite Suburban Resident[a] Exposure Scenario – No Action Alternative – Future Conditions – Without Uranium and Thorium Decay Chain Radionuclides

Constituent	*Site Soil Radiological Cancer Morbidity Risk in Sub-areas*								
	3	***5A***	***5B***	***5C***	***5D***	***6***	***7***	***8***	***NBZ***
Am-241	--	--	--	--	2.5×10^{-8}	--	--	2.1×10^{-8}	--
Cm-243/244	--	--	5.2×10^{-9}	--	--	--	--	--	1.9×10^{-8}
Co-60	--	--	1.4×10^{-12}	1.6×10^{-12}	--	3.0×10^{-12}	1.7×10^{-12}	--	--
Cs-137	--	1.2×10^{-6}	5.8×10^{-7}	1.0×10^{-6}	$\mathbf{2.2\times10^{-6}}$	9.4×10^{-7}	1.2×10^{-6}	3.8×10^{-7}	4.2×10^{-7}
Eu-152	--	2.0×10^{-8}	9.0×10^{-9}	--	--	--	--	--	--
Eu-154	--	--	--	--	9.4×10^{-10}	--	--	--	--
H-3	--	--	1.2×10^{-7}	--	--	--	--	--	--
Ni-59	--	3.7×10^{-8}	--	--	--	--	--	--	--
Pu-238	--	1.6×10^{-9}	--	--	5.8×10^{-9}	--	--	--	--
Pu-239/240	--	--	--	1.1×10^{-8}	1.6×10^{-8}	1.1×10^{-8}	1.7×10^{-8}	2.3×10^{-8}	1.1×10^{-8}
Sr-90	1.0×10^{-8}	1.4×10^{-8}	2.7×10^{-9}	2.3×10^{-9}	1.4×10^{-8}	1.4×10^{-8}	1.9×10^{-8}	2.3×10^{-8}	1.3×10^{-8}
Sub-area Total Cancer Incidence Risk	$\mathbf{1.0\times10^{-8}}$	$\mathbf{1.3\times10^{-6}}$	$\mathbf{7.2\times10^{-7}}$	$\mathbf{1.1\times10^{-6}}$	$\mathbf{2.2\times10^{-6}}$	$\mathbf{9.6\times10^{-7}}$	$\mathbf{1.2\times10^{-6}}$	$\mathbf{4.5\times10^{-7}}$	$\mathbf{4.7\times10^{-7}}$

NBZ = Northern Buffer Zone.

[a] The onsite suburban resident exposure is based on the following direct pathways: ingestion, inhalation, and external.

Notes:

– Results were based on the median concentrations of radioactive constituents in onsite soil source areas and a 100-year decay period prior to exposure.
– Cancer risk represents increased cancer incidence in exposed individuals.
– "--" indicates that no data are available for the constituent in the sub-area.
– Shaded cells with bold text indicate the primary contributor(s) to maximum sub-area total cancer incidence risk.
– Sub-area totals combine results for all radionuclides, assuming similar carcinogenic mechanisms.
– Cancer risks below 1 chance in 1,000,000 (1×10^{-6}) are not considered significant, while risks approaching 1 chance in 10,000 (1×10^{-4}) are a level of concern.

Table G–23 Background Soil Cancer Incidence Risk from Radionuclides for the Onsite Suburban Resident[a] Exposure Scenario – Current Conditions – With Uranium and Thorium Decay Chain Radionuclides

Constituent	Background Soil Radiological Cancer Morbidity Risk	Constituent	Background Soil Radiological Cancer Morbidity Risk	Constituent	Background Soil Radiological Cancer Morbidity Risk
Ac-227	1.7×10^{-8}	Pb-210	1.8×10^{-6}	Sr-90	2.3×10^{-9}
Am-241	5.9×10^{-9}	Pb-211	6.4×10^{-13}	Th-227	7.5×10^{-10}
Bi-210	4.8×10^{-11}	Pb-212	4.9×10^{-10}	Th-228	5.8×10^{-8}
Bi-211	2.5×10^{-14}	Po-210	9.5×10^{-8}	Th-230	2.8×10^{-7}
Bi-212	4.6×10^{-11}	Pu-238	4.5×10^{-10}	Th-232	4.0×10^{-7}
Cs-134	1.0×10^{-7}	Pu-239	1.4×10^{-9}	Tl-207	4.6×10^{-15}
Cs-137	1.3×10^{-6}	Ra-223	7.6×10^{-10}	Tl-208	2.7×10^{-11}
Eu-152	1.0×10^{-7}	Ra-224	7.7×10^{-10}	U-234	2.2×10^{-7}
Eu-154	3.7×10^{-7}	Ra-226	1.1×10^{-4}	U-235	3.9×10^{-7}
H-3	1.7×10^{-5}	Ra-228	1.9×10^{-5}	U-238	1.7×10^{-6}
Pa-231	1.1×10^{-7}				
				Overall Total Cancer Incidence Risk	**1.5×10^{-4}**

[a] The onsite suburban resident exposure is based on the following direct pathways: ingestion, inhalation, and external.

Notes:

- Results were based on the 95 percent upper confidence levels on the arithmetic mean concentrations of the radioactive constituents in background soil and a 100-year decay period prior to exposure.
- Cancer risk represents increased cancer incidence in exposed individuals.
- Shaded cells with bold text indicate the primary contributor(s) to overall total cancer incidence risk.
- Sub-area totals combine results for all radionuclides, assuming similar carcinogenic mechanisms.
- Cancer risks below 1 chance in 1,000,000 (1×10^{-6}) are not considered significant, while risks approaching 1 chance in 10,000 (1×10^{-4}) are a level of concern.

Table G–24 Background Soil Cancer Incidence Risk from Radionuclides for the Onsite Suburban Resident[a] Exposure Scenario – Future Conditions – With Uranium and Thorium Decay Chain Radionuclides

Constituent	Background Soil Radiological Cancer Morbidity Risk	Constituent	Background Soil Radiological Cancer Morbidity Risk	Constituent	Background Soil Radiological Cancer Morbidity Risk
Ac-227	1.7×10^{-8}	Pb-210	1.8×10^{-6}	Sr-90	2.0×10^{-10}
Am-241	5.0×10^{-9}	Pb-211	6.4×10^{-13}	Th-227	7.5×10^{-10}
Bi-210	4.8×10^{-11}	Pb-212	4.9×10^{-10}	Th-228	5.8×10^{-8}
Bi-211	2.5×10^{-14}	Po-210	9.5×10^{-8}	Th-230	2.8×10^{-7}
Bi-212	4.6×10^{-11}	Pu-238	2.0×10^{-10}	Th-232	4.0×10^{-7}
Cs-134	2.6×10^{-22}	Pu-239	1.4×10^{-9}	Tl-207	4.6×10^{-15}
Cs-137	1.3×10^{-7}	Ra-223	7.6×10^{-10}	Tl-208	2.7×10^{-11}
Eu-152	6.0×10^{-10}	Ra-224	7.7×10^{-10}	U-234	2.2×10^{-7}
Eu-154	1.2×10^{-10}	Ra-226	1.1×10^{-4}	U-235	3.9×10^{-7}
H-3	6.1×10^{-8}	Ra-228	1.9×10^{-5}	U-238	1.7×10^{-6}
Pa-231	1.1×10^{-7}				
				Overall Total Cancer Incidence Risk	**1.3×10^{-4}**

[a] The onsite suburban resident exposure is based on the following direct pathways: ingestion, inhalation, and external.

Notes:

- Results were based on the 95 percent upper confidence levels on the arithmetic mean concentrations of radioactive constituents in background soil and a 100-year decay period prior to exposure.
- Cancer risk represents increased cancer incidence in exposed individuals.
- Shaded cells with bold text indicate the primary contributor(s) to overall total cancer incidence risk.
- Sub-area totals combine results for all radionuclides, assuming similar carcinogenic mechanisms.
- Cancer risks below 1 chance in 1,000,000 (1×10^{-6}) are not considered significant, while risks approaching 1 chance in 10,000
- (1×10^{-4}) are a level of concern.

Table G–25 Background Soil Cancer Incidence Risk from Radionuclides for the Onsite Suburban Resident[a] Exposure Scenario – Current Conditions – Without Uranium and Thorium Decay Chain Radionuclides

Constituent	*Background Soil Radiological Cancer Morbidity Risk*	*Constituent*	*Background Soil Radiological Cancer Morbidity Risk*
Americium-241	5.9×10^{-9}	Plutonium-238	4.5×10^{-10}
Cesium-134	1.0×10^{-7}	Plutonium-239/240	1.4×10^{-9}
Cesium-137	1.3×10^{-6}	Strontium-90	2.3×10^{-9}
Europium-152	1.0×10^{-7}	Tritium	1.7×10^{-5}
Europium-154	3.7×10^{-7}		
		Overall Total Cancer Incidence Risk	**1.9×10^{-5}**

[a] The onsite suburban resident exposure is based on the following direct pathways: ingestion, inhalation, and external.

Notes:

- Results were based on the 95 percent upper confidence levels on the arithmetic mean concentrations of radioactive constituents in background soil.
- Cancer risk represents increased cancer incidence in exposed individuals.
- Shaded cells with bold text indicate the primary contributor(s) to overall total cancer incidence risk.
- Sub-area totals combine results for all radionuclides, assuming similar carcinogenic mechanisms.
- Cancer risks below 1 chance in 1,000,000 (1×10^{-6}) are not considered significant, while risks approaching 1 chance in 10,000 (1×10^{-4}) are a level of concern.

Table G–26 Background Soil Cancer Incidence Risk from Radionuclides for the Onsite Suburban Resident[a] Exposure Scenario – Future Conditions – Without Uranium and Thorium Decay Chain Radionuclides

Constituent	*Background Soil Radiological Cancer Morbidity Risk*	*Constituent*	*Background Soil Radiological Cancer Morbidity Risk*
Americium-241	5.0×10^{-9}	Plutonium-238	2.0×10^{-10}
Cesium-134	2.6×10^{-22}	Plutonium-239/240	1.4×10^{-9}
Cesium-137	1.3×10^{-7}	Strontium-90	2.0×10^{-10}
Europium-152	6.0×10^{-10}	Tritium	6.1×10^{-8}
Europium-154	1.2×10^{-10}		
		Overall Total Cancer Incidence Risk	**2.0×10^{-7}**

[a] The onsite suburban resident exposure is based on the following direct pathways: ingestion, inhalation, and external.

Notes:

- Results were based on the 95 percent upper confidence levels on the arithmetic mean concentrations of radioactive constituents in background soil and a 100-year decay period prior to exposure.
- Cancer risk represents increased cancer incidence in exposed individuals.
- Shaded cells with bold text indicate the primary contributor(s) to overall total cancer incidence risk.
- Sub-area totals combine results for all radionuclides, assuming similar carcinogenic mechanisms.
- Cancer risks below 1 chance in 1,000,000 (1×10^{-6}) are not considered significant, while risks approaching 1 chance in 10,000 (1×10^{-4}) are a level of concern.

Table G–27 Site Soil Cancer Incidence Risk from Chemicals for the Onsite Suburban Resident[a] Exposure Scenario – No Action Alternative

Constituent	*Site Soil Chemical Cancer Morbidity Risk in Sub-areas*								
	3	*5A*	*5B*	*5C*	*5D*	*6*	*7*	*8*	*NBZ*
Aluminum	--	--	--	--	--	--	--	--	--
Antimony	--	--	--	--	--	--	--	--	--
Arsenic	7.2×10^{-5}	8.8×10^{-5}	8.5×10^{-5}	8.6×10^{-5}	**1.2×10^{-4}**	9.0×10^{-5}	1.1×10^{-4}	8.9×10^{-5}	9.2×10^{-5}
Barium	--	--	--	--	--	--	--	--	--
Beryllium	3.7×10^{-10}	4.7×10^{-10}	4.3×10^{-10}	4.6×10^{-10}	5.7×10^{-10}	4.3×10^{-10}	4.0×10^{-10}	5.0×10^{-10}	3.4×10^{-10}
Boron	--	--	--	--	--	--	--	--	--
Cadmium	4.5×10^{-10}	4.6×10^{-10}	3.0×10^{-10}	3.3×10^{-10}	4.3×10^{-10}	4.5×10^{-10}	3.5×10^{-10}	3.9×10^{-10}	2.8×10^{-10}
Chromium	--	--	--	--	--	--	--	--	--
Chromium, hexavalent	--	4.6×10^{-7}	4.0×10^{-7}	5.4×10^{-7}	5.1×10^{-7}	5.0×10^{-7}	5.7×10^{-7}	4.2×10^{-7}	6.4×10^{-7}
Cobalt	1.4×10^{-8}	1.7×10^{-8}	1.7×10^{-8}	1.8×10^{-8}	2.7×10^{-8}	1.8×10^{-8}	1.6×10^{-8}	2.2×10^{-8}	1.4×10^{-8}
Copper	--	--	--	--	--	--	--	--	--
Cyanide	--	--	--	--	--	--	--	--	--
Lithium	--	--	--	--	--	--	--	--	--
Manganese	--	--	--	--	--	--	--	--	--
Mercury	--	--	--	--	--	--	--	--	--
Molybdenum	--	--	--	--	--	--	--	--	--
Nickel	8.1×10^{-10}	1.1×10^{-9}	1.0×10^{-9}	9.8×10^{-10}	1.6×10^{-9}	1.1×10^{-9}	9.6×10^{-10}	1.2×10^{-9}	7.4×10^{-10}
Selenium	--	--	--	--	--	--	--	--	--
Silver	--	--	--	--	--	--	--	--	--
Strontium	--	--	--	--	--	--	--	--	--
Thallium	--	--	--	--	--	--	--	--	--
Tin	--	--	--	--	--	--	--	--	--
Vanadium	--	--	--	--	--	--	--	--	--
Zinc	--	--	--	--	--	--	--	--	--
Zirconium	--	--	--	--	--	--	--	--	--
1-Methylnaphthalene	3.7×10^{-10}	9.8×10^{-8}	1.9×10^{-9}	9.4×10^{-10}	3.7×10^{-10}	3.3×10^{-10}	5.7×10^{-9}	2.5×10^{-10}	3.0×10^{-10}
2-Methylnaphthalene	--	--	--	--	--	--	--	--	--
Acenaphthene	--	--	--	--	--	--	--	--	--
Acenaphthylene	--	--	--	--	--	--	--	--	--
Anthracene	--	--	--	--	--	--	--	--	--
Benzo(a)pyrene TEQ	2.6×10^{-7}	--	--	--	--	7.2×10^{-7}	--	--	--
Benzo(a)anthracene	6.0×10^{-8}	1.1×10^{-7}	2.0×10^{-7}	9.1×10^{-8}	2.0×10^{-7}	9.3×10^{-8}	7.5×10^{-7}	4.7×10^{-8}	3.6×10^{-8}
Benzo(a)pyrene	2.8×10^{-7}	7.2×10^{-7}	3.1×10^{-6}	7.5×10^{-7}	1.5×10^{-6}	8.8×10^{-7}	5.7×10^{-6}	3.6×10^{-7}	3.4×10^{-7}
Benzo(b)fluoranthene	5.2×10^{-8}	1.0×10^{-7}	3.1×10^{-7}	9.8×10^{-8}	1.7×10^{-7}	1.2×10^{-7}	6.7×10^{-7}	3.6×10^{-8}	3.1×10^{-8}

Constituent	Site Soil Chemical Cancer Morbidity Risk in Sub-areas								
	3	**5A**	**5B**	**5C**	**5D**	**6**	**7**	**8**	**NBZ**
Benzo(e)pyrene	--	--	--	--	--	--	--	--	--
Benzo(g,h,i)perylene	--	--	--	--	--	--	--	--	--
Benzo(k)fluoranthene	4.1×10^{-8}	5.2×10^{-8}	1.1×10^{-7}	6.0×10^{-8}	1.4×10^{-7}	6.2×10^{-8}	4.1×10^{-7}	2.5×10^{-8}	2.5×10^{-8}
Bis(2-ethylhexyl)phthalate	1.0×10^{-10}	5.5×10^{-10}	7.5×10^{-10}	3.1×10^{-10}	1.7×10^{-10}	3.0×10^{-10}	5.6×10^{-10}	1.1×10^{-10}	1.6×10^{-10}
Butylbenzylphthalate	2.7×10^{-11}	8.1×10^{-11}	6.6×10^{-11}	5.2×10^{-11}	7.4×10^{-11}	7.7×10^{-11}	8.1×10^{-11}	2.2×10^{-10}	1.0×10^{-10}
Chrysene	2.6×10^{-9}	8.3×10^{-9}	2.6×10^{-8}	9.3×10^{-9}	1.4×10^{-8}	8.8×10^{-9}	5.7×10^{-8}	2.8×10^{-9}	2.5×10^{-9}
Dibenzo(a,h)anthracene	2.9×10^{-8}	8.7×10^{-8}	3.4×10^{-7}	9.6×10^{-8}	2.4×10^{-7}	8.2×10^{-8}	2.2×10^{-7}	5.3×10^{-8}	6.7×10^{-8}
Diethylphthalate	--	--	--	--	--	--	--	--	--
Dimethylphthalate	--	--	--	--	--	--	--	--	--
Di-n-butylphthalate	--	--	--	--	--	--	--	--	--
Di-n-octylphthalate	--	--	--	--	--	--	--	--	--
Fluoranthene	--	--	--	--	--	--	--	--	--
Fluorene	--	--	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	1.6×10^{-8}	3.4×10^{-8}	6.7×10^{-7}	5.2×10^{-8}	1.2×10^{-7}	4.9×10^{-8}	1.1×10^{-7}	1.4×10^{-8}	2.2×10^{-8}
Morpholine	--	--		--	--	--	--	--	--
Naphthalene	5.6×10^{-10}	5.1×10^{-9}	1.1×10^{-9}	3.1×10^{-10}	1.5×10^{-10}	2.1×10^{-10}	2.5×10^{-9}	2.0×10^{-10}	3.3×10^{-10}
N-Nitrosodimethylamine	--	2.2×10^{-8}	1.3×10^{-7}	2.4×10^{-7}	6.4×10^{-8}	1.8×10^{-6}	8.8×10^{-7}	--	1.1×10^{-7}
Phenanthrene	--	--	--	--	--	--	--	--	--
Pyrene	--	--	--	--	--	--	--	--	--
Total TCDD TEQ	7.3×10^{-7}	1.5×10^{-6}	1.3×10^{-6}	1.4×10^{-6}	9.0×10^{-7}	3.2×10^{-6}	1.4×10^{-6}	3.7×10^{-7}	6.2×10^{-7}
Aroclor 1242	--	--	3.0×10^{-7}	--	3.4×10^{-9}	6.5×10^{-9}	1.0×10^{-8}	--	--
Aroclor 1248	--	2.3×10^{-8}	1.6×10^{-6}	1.6×10^{-8}	2.6×10^{-7}	1.1×10^{-6}	8.7×10^{-9}	1.3×10^{-6}	5.6×10^{-6}
Aroclor 1254	1.6×10^{-7}	5.2×10^{-8}	2.0×10^{-7}	1.3×10^{-7}	1.7×10^{-7}	6.5×10^{-7}	1.3×10^{-7}	1.9×10^{-7}	3.6×10^{-7}
Aroclor 1260	1.7×10^{-7}	1.3×10^{-7}	1.6×10^{-7}	1.1×10^{-7}	3.8×10^{-8}	2.1×10^{-7}	1.0×10^{-7}	3.5×10^{-8}	6.1×10^{-7}
Aroclor 1262	--	--	--	--	--	--	--	--	--
Aroclor 1268	--	--	--	--	--	--	--	--	--
Aroclor 5442	--	--	--	--	--	--	--	--	--
Aroclor 5460	2.4×10^{-7}	6.9×10^{-8}	8.7×10^{-8}	7.8×10^{-8}	2.6×10^{-8}	7.4×10^{-7}	1.5×10^{-7}	3.4×10^{-7}	1.6×10^{-7}
1,1,2-Trichloro-1,2,2-trifluoroethane	--	--	--	--		--	--	--	--
1,2,3-Trichlorobenzene	--	1.4×10^{-9}	--	--	--	--	--	--	--
1,2,4-Trimethylbenzene	--		--	--	--	--	--		--
1,2-Dibromoethane	--	--	4.0×10^{-9}	--	--	--	--	--	--
1,2-Dichloroethane	--	8.7×10^{-9}	1.1×10^{-9}	--	--	9.4×10^{-9}	--	--	--
1,3,5-Trimethylbenzene	--	--	--	--	--	--	--		--
1,4-Dichlorobenzene	--	--	--	--	--	2.6×10^{-10}	--	--	--
2-Butanone (Methyl ethyl ketone)	--	--	--	--	--	--	--	--	--
2-Phenylbutane	--	--	--	--	--	--	--	--	--

Constituent	Site Soil Chemical Cancer Morbidity Risk in Sub-areas								
	3	***5A***	***5B***	***5C***	***5D***	***6***	***7***	***8***	***NBZ***
4-Methyl-2-pentanone (Methyl isobutyl ketone)	--	--	--	--	--	--	--	--	--
Acetone	--	--	--	--	--	--	--	--	--
Benzene	--	2.0×10^{-8}	1.2×10^{-9}	9.3×10^{-10}	1.5×10^{-9}	--	--	9.3×10^{-10}	--
Bromodichloromethane	--	2.6×10^{-7}	--	--	--	--	--	--	--
Chloroform	--	--	1.9×10^{-10}	3.3×10^{-10}	2.2×10^{-10}	2.0×10^{-10}	--	4.5×10^{-10}	--
Cymene	--	--	--	--	--	--	--	--	--
Ethylbenzene	--	1.3×10^{-8}	7.8×10^{-11}	3.0×10^{-11}	--	3.0×10^{-11}	3.5×10^{-11}	2.0×10^{-10}	--
Hexachloro-1,3-butadiene	--	--	--	--	--	--	--	--	--
Isopropylbenzene	--	--	--	--	--	--	--	--	--
m,p-Xylene	--	--	--	--	--	--	--	--	--
Methylene Chloride	--	1.4×10^{-9}	4.7×10^{-10}	1.6×10^{-9}	9.7×10^{-9}	2.5×10^{-8}	--	5.0×10^{-9}	1.4×10^{-9}
n-Butylbenzene	--	--	--	--	--	--	--	--	--
n-Propylbenzene	--	--	--	--	--	--	--	--	--
o-Xylene	--	--	--	--	--	--	--	--	--
Styrene	--	--		--	--	--	--	--	--
tert-Butylbenzene	--	--	--	--	--	--	--	--	--
Tetrachloroethene	--	--	--	--	--	--	--	1.2×10^{-9}	--
Toluene	--	--	--	--	--	--	--	--	--
Trichloroethene	--	2.0×10^{-10}	1.0×10^{-9}	6.7×10^{-10}	--	--	--	8.5×10^{-9}	--
Vinyl Chloride	--	--	--	--	--	--	--	1.3×10^{-8}	--
Sub-area Total Cancer Incidence Risk	**7.4×10^{-5}**	**9.2×10^{-5}**	**9.4×10^{-5}**	**9.0×10^{-5}**	**1.3×10^{-4}**	**1.0×10^{-4}**	**1.2×10^{-4}**	**9.3×10^{-5}**	**1.0×10^{-4}**

NBZ = Northern Buffer Zone; TCDD = 2,3,7,8-tetrachlorodibenzo-p-dioxin; TEQ = toxicity equivalent.

[a] The onsite suburban resident exposure is based on the following direct pathways: ingestion, inhalation, and dermal.

Notes:

– Results were based on the arithmetic mean concentrations of chemical constituents in onsite soil source areas.
– Cancer risk represents increased cancer incidence in exposed individuals.
– "--" indicates that no data/carcinogenic screening levels are available for the constituent in the sub-area.
– Shaded cells with bold text indicate the primary contributor(s) to maximum sub-area total cancer incidence risk.
– Sub-area totals combine results for all chemicals, assuming similar carcinogenic mechanisms.
– Cancer risks below 1 chance in 1,000,000 or (1×10^{-6}) are not considered significant, while risks approaching 1 chance in 10,000 (1×10^{-4}) are a level of concern.

Table G–28 Site Soil Hazard Indices from Chemicals for the Onsite Suburban Resident[a] Exposure Scenario – No Action Alternative

Constituent	*Site Soil Chemical Hazard Index in Sub-areas*								
	3	***5A***	***5B***	***5C***	***5D***	***6***	***7***	***8***	***NBZ***
Aluminum	1.7×10^{-1}	2.3×10^{-1}	2.1×10^{-1}	2.3×10^{-1}	3.2×10^{-1}	2.0×10^{-1}	1.9×10^{-1}	3.0×10^{-1}	1.6×10^{-1}
Antimony	6.1×10^{-3}	9.7×10^{-3}	5.7×10^{-3}	1.2×10^{-2}	1.8×10^{-2}	7.7×10^{-3}	3.3×10^{-1}	3.0×10^{-2}	1.2×10^{-2}
Arsenic	2.2×10^{-1}	2.7×10^{-1}	2.6×10^{-1}	2.7×10^{-1}	3.7×10^{-1}	2.8×10^{-1}	3.5×10^{-1}	2.8×10^{-1}	2.8×10^{-1}
Barium	8.0×10^{-3}	9.6×10^{-3}	9.5×10^{-3}	1.0×10^{-2}	1.2×10^{-2}	9.1×10^{-3}	8.6×10^{-3}	9.9×10^{-3}	7.5×10^{-3}
Beryllium	1.8×10^{-2}	2.3×10^{-2}	2.1×10^{-2}	2.2×10^{-2}	2.8×10^{-2}	2.1×10^{-2}	1.9×10^{-2}	2.4×10^{-2}	1.6×10^{-2}
Boron	2.9×10^{-4}	2.8×10^{-4}	3.2×10^{-4}	4.1×10^{-4}	6.6×10^{-4}	3.1×10^{-4}	3.8×10^{-4}	5.9×10^{-4}	3.6×10^{-4}
Cadmium	8.2×10^{-2}	8.3×10^{-2}	5.6×10^{-2}	6.0×10^{-2}	7.8×10^{-2}	8.3×10^{-2}	6.3×10^{-2}	7.1×10^{-2}	5.1×10^{-2}
Chromium	4.7×10^{-4}	6.6×10^{-4}	6.1×10^{-4}	6.2×10^{-4}	9.1×10^{-4}	5.8×10^{-4}	5.9×10^{-4}	7.5×10^{-4}	4.3×10^{-4}
Chromium, hexavalent	--	2.7×10^{-3}	2.3×10^{-3}	3.1×10^{-3}	2.9×10^{-3}	2.9×10^{-3}	3.3×10^{-3}	2.4×10^{-3}	3.7×10^{-3}
Cobalt	2.5×10^{-1}	3.0×10^{-1}	2.9×10^{-1}	3.1×10^{-1}	4.7×10^{-1}	3.2×10^{-1}	2.8×10^{-1}	3.8×10^{-1}	2.4×10^{-1}
Copper	2.4×10^{-2}	4.6×10^{-3}	4.0×10^{-3}	4.0×10^{-3}	5.7×10^{-3}	4.3×10^{-3}	4.2×10^{-3}	5.2×10^{-3}	5.0×10^{-3}
Cyanide	--	--	--	2.6×10^{-2}	4.8×10^{-3}	--	1.2×10^{-2}	5.9×10^{-3}	1.8×10^{-2}
Lithium	1.4×10^{-1}	1.6×10^{-1}	1.5×10^{-1}	1.4×10^{-1}	1.7×10^{-1}	1.5×10^{-1}	1.5×10^{-1}	1.5×10^{-1}	1.6×10^{-1}
Manganese	4.0×10^{-2}	4.8×10^{-2}	4.6×10^{-2}	4.6×10^{-2}	6.1×10^{-2}	4.6×10^{-2}	4.5×10^{-2}	5.8×10^{-2}	4.6×10^{-2}
Mercury	2.4×10^{-3}	3.7×10^{-3}	4.3×10^{-3}	5.2×10^{-3}	2.6×10^{-2}	1.1×10^{-2}	2.2×10^{-3}	3.3×10^{-3}	5.0×10^{-2}
Molybdenum	1.4×10^{-3}	2.2×10^{-3}	1.8×10^{-3}	1.7×10^{-3}	1.7×10^{-3}	2.0×10^{-3}	1.9×10^{-3}	1.6×10^{-3}	1.5×10^{-3}
Nickel	1.2×10^{-2}	1.7×10^{-2}	1.5×10^{-2}	1.5×10^{-2}	2.5×10^{-2}	1.6×10^{-2}	1.5×10^{-2}	1.9×10^{-2}	1.1×10^{-2}
Selenium	8.4×10^{-4}	4.1×10^{-4}	1.3×10^{-3}	4.2×10^{-4}	4.6×10^{-4}	7.9×10^{-4}	4.2×10^{-4}	5.6×10^{-4}	8.9×10^{-4}
Silver	1.7×10^{-3}	1.5×10^{-3}	1.8×10^{-3}	7.4×10^{-4}	3.5×10^{-4}	2.0×10^{-3}	3.5×10^{-4}	2.3×10^{-4}	7.1×10^{-4}
Strontium	3.9×10^{-4}	5.0×10^{-4}	5.9×10^{-4}	6.7×10^{-4}	8.5×10^{-4}	4.8×10^{-4}	3.8×10^{-4}	1.3×10^{-3}	4.2×10^{-4}
Thallium	3.4×10^{-1}	3.9×10^{-1}	3.6×10^{-1}	3.7×10^{-1}	4.7×10^{-1}	3.7×10^{-1}	3.7×10^{-1}	4.1×10^{-1}	3.3×10^{-1}
Tin	--	2.1×10^{-4}	4.6×10^{-5}	6.7×10^{-5}	3.6×10^{-4}	5.9×10^{-5}	2.3×10^{-4}	--	1.6×10^{-4}
Vanadium	1.9×10^{-1}	2.2×10^{-1}	2.1×10^{-1}	2.3×10^{-1}	3.3×10^{-1}	2.1×10^{-1}	2.1×10^{-1}	2.8×10^{-1}	1.7×10^{-1}
Zinc	3.4×10^{-3}	3.6×10^{-3}	3.3×10^{-3}	3.5×10^{-3}	3.6×10^{-3}	3.7×10^{-3}	4.5×10^{-3}	3.2×10^{-3}	2.8×10^{-3}
Zirconium	3.0×10^{-1}	4.5×10^{-1}	4.0×10^{-1}	6.1×10^{-1}	7.5×10^{-1}	3.9×10^{-1}	4.2×10^{-1}	6.4×10^{-1}	**5.7×10^{-1}**
1-Methylnaphthalene	9.4×10^{-7}	2.5×10^{-4}	4.9×10^{-6}	2.4×10^{-6}	9.4×10^{-7}	8.4×10^{-7}	1.4×10^{-5}	6.3×10^{-7}	7.7×10^{-7}
2-Methylnaphthalene	4.0×10^{-5}	4.2×10^{-3}	8.1×10^{-5}	4.6×10^{-5}	1.5×10^{-5}	1.9×10^{-5}	2.1×10^{-4}	1.7×10^{-5}	1.5×10^{-5}
Acenaphthene	2.9×10^{-7}	3.4×10^{-5}	3.1×10^{-6}	5.9×10^{-6}	8.1×10^{-6}	3.0×10^{-6}	5.6×10^{-5}	1.3×10^{-6}	1.3×10^{-6}
Acenaphthylene	4.4×10^{-7}	1.6×10^{-6}	1.8×10^{-6}	6.7×10^{-7}	1.4×10^{-6}	8.4×10^{-7}	3.2×10^{-6}	4.4×10^{-7}	4.4×10^{-7}
Anthracene	1.9×10^{-7}	1.2×10^{-6}	9.9×10^{-7}	9.3×10^{-7}	2.3×10^{-6}	9.3×10^{-7}	8.0×10^{-6}	1.7×10^{-7}	6.8×10^{-7}
Benzo(a)pyrene TEQ	--	--	--	--	--	--	--	--	--
Benzo(a)anthracene	--	--	--	--	--	--	--	--	--
Benzo(a)pyrene	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	--	--	--	--	--	--	--	--	--

Constituent	*Site Soil Chemical Hazard Index in Sub-areas*								
	3	*5A*	*5B*	*5C*	*5D*	*6*	*7*	*8*	*NBZ*
Benzo(e)pyrene	5.0×10^{-5}	1.5×10^{-5}	2.3×10^{-5}	1.1×10^{-5}	2.7×10^{-5}	1.1×10^{-5}	1.0×10^{-5}	3.2×10^{-5}	--
Benzo(g,h,i)perylene	9.8×10^{-6}	7.4×10^{-6}	1.2×10^{-4}	9.8×10^{-6}	2.1×10^{-5}	1.0×10^{-5}	2.1×10^{-5}	3.1×10^{-6}	4.1×10^{-6}
Benzo(k)fluoranthene	--	--	--	--	--	--	--	--	--
Bis(2-ethylhexyl)phthalate	1.4×10^{-5}	7.6×10^{-5}	1.0×10^{-4}	4.3×10^{-5}	2.4×10^{-5}	4.3×10^{-5}	7.8×10^{-5}	1.5×10^{-5}	2.3×10^{-5}
Butylbenzylphthalate	5.9×10^{-7}	1.8×10^{-6}	1.4×10^{-6}	1.1×10^{-6}	1.6×10^{-6}	1.7×10^{-6}	1.8×10^{-6}	4.7×10^{-6}	2.2×10^{-6}
Chrysene	--	--	--	--	--	--	--	--	--
Dibenzo(a,h)anthracene	--	--	--	--	--	--	--	--	--
Diethylphthalate	--	1.7×10^{-7}	2.9×10^{-7}	2.2×10^{-7}	2.0×10^{-7}	2.9×10^{-7}	--	1.8×10^{-7}	--
Dimethylphthalate	--	7.4×10^{-7}	2.5×10^{-6}	--	2.0×10^{-7}	2.0×10^{-7}	--	--	1.0×10^{-6}
Di-n-butylphthalate	1.3×10^{-6}	3.4×10^{-5}	1.8×10^{-6}	2.5×10^{-4}	2.3×10^{-6}	1.5×10^{-5}	1.1×10^{-5}	2.3×10^{-6}	5.1×10^{-6}
Di-n-octylphthalate	--	8.2×10^{-5}	3.9×10^{-5}	3.0×10^{-5}	2.1×10^{-5}	4.3×10^{-5}	4.8×10^{-4}	3.3×10^{-5}	6.6×10^{-5}
Fluoranthene	6.4×10^{-6}	2.6×10^{-5}	3.3×10^{-5}	3.8×10^{-5}	4.3×10^{-5}	3.5×10^{-5}	2.9×10^{-4}	6.0×10^{-6}	7.3×10^{-6}
Fluorene	1.6×10^{-6}	2.1×10^{-6}	4.6×10^{-6}	4.6×10^{-6}	5.1×10^{-6}	2.9×10^{-6}	4.4×10^{-5}	1.3×10^{-6}	1.8×10^{-6}
Indeno(1,2,3-cd)pyrene	--	--	--	--	--	--	--	--	--
Morpholine	--	--		--	--	--	--	--	--
Naphthalene	1.2×10^{-5}	1.1×10^{-4}	2.3×10^{-5}	6.7×10^{-6}	3.3×10^{-6}	4.5×10^{-6}	5.5×10^{-5}	4.4×10^{-6}	7.1×10^{-6}
N-Nitrosodimethylamine	--	1.5×10^{-3}	9.0×10^{-3}	1.6×10^{-2}	4.3×10^{-3}	1.2×10^{-1}	5.9×10^{-2}	--	7.1×10^{-3}
Phenanthrene	5.3×10^{-7}	3.4×10^{-6}	2.8×10^{-6}	2.8×10^{-6}	2.1×10^{-6}	2.9×10^{-6}	3.0×10^{-5}	4.4×10^{-7}	6.2×10^{-7}
Pyrene	7.4×10^{-6}	3.1×10^{-5}	6.0×10^{-5}	4.6×10^{-5}	5.3×10^{-5}	4.2×10^{-5}	3.2×10^{-4}	8.0×10^{-6}	8.0×10^{-6}
Total TCDD TEQ	7.0×10^{-2}	1.4×10^{-1}	1.2×10^{-1}	1.3×10^{-1}	8.6×10^{-2}	3.0×10^{-1}	1.3×10^{-1}	3.5×10^{-2}	5.9×10^{-2}
Aroclor 1242	--	--	6.3×10^{-2}	--	7.1×10^{-4}	1.3×10^{-3}	2.1×10^{-3}	--	--
Aroclor 1248	--	4.7×10^{-3}	3.3×10^{-1}	3.3×10^{-3}	5.5×10^{-2}	2.3×10^{-1}	1.8×10^{-3}	2.8×10^{-1}	**1.2**
Aroclor 1254	3.3×10^{-2}	1.1×10^{-2}	4.2×10^{-2}	2.8×10^{-2}	3.6×10^{-2}	1.3×10^{-1}	2.6×10^{-2}	3.8×10^{-2}	7.4×10^{-2}
Aroclor 1260	3.5×10^{-2}	2.7×10^{-2}	3.2×10^{-2}	2.2×10^{-2}	7.9×10^{-3}	4.3×10^{-2}	2.1×10^{-2}	7.3×10^{-3}	1.3×10^{-1}
Aroclor 1262	--	--	--	--	--	--	--	--	--
Aroclor 1268	--	--	--	--	--	--	--	--	--
Aroclor 5442	--	--	--	--	--	--	--	--	--
Aroclor 5460	5.0×10^{-2}	1.4×10^{-2}	1.8×10^{-2}	1.6×10^{-2}	5.4×10^{-3}	1.5×10^{-1}	3.0×10^{-2}	7.1×10^{-2}	3.2×10^{-2}
1,1,2-Trichloro-1,2,2-trifluoroethane	--	--	--	--	6.6×10^{-9}	--	--	--	--
1,2,3-Trichlorobenzene	--	2.2×10^{-3}	--	--	--	--	--	--	--
1,2,4-Trimethylbenzene	--	8.0×10^{-4}	--	--	--	--	--	1.4×10^{-5}	--
1,2-Dibromoethane	--	--	7.7×10^{-6}	--	--	--	--	--	--
1,2-Dichloroethane	--	1.5×10^{-4}	1.8×10^{-5}	--	--	1.6×10^{-4}	--	--	--
1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	2.0×10^{-6}	--
1,4-Dichlorobenzene	--	--	--	--	--	1.3×10^{-7}	--	--	--
2-Butanone (Methyl ethyl ketone)	--	2.7×10^{-7}	3.4×10^{-7}	2.6×10^{-7}	1.5×10^{-7}	3.9×10^{-7}	1.2×10^{-7}	1.1×10^{-7}	--

Constituent	***Site Soil Chemical Hazard Index in Sub-areas***								
	3	***5A***	***5B***	***5C***	***5D***	***6***	***7***	***8***	***NBZ***
2-Phenylbutane	--	--	--	--	--	--	--	--	--
4-Methyl-2-pentanone (Methyl isobutyl ketone)	--	--	1.9×10^{-6}	1.0×10^{-6}	--	--	--	1.8×10^{-7}	--
Acetone	--	4.0×10^{-7}	6.0×10^{-7}	3.2×10^{-7}	2.3×10^{-7}	1.7×10^{-7}	1.8×10^{-7}	1.6×10^{-7}	--
Benzene	--	6.6×10^{-5}	3.9×10^{-6}	3.0×10^{-6}	5.0×10^{-6}	--	--	3.0×10^{-6}	--
Bromodichloromethane	--	2.7×10^{-4}	--	--	--	--	--	--	--
Chloroform	--	--	4.7×10^{-7}	8.1×10^{-7}	5.4×10^{-7}	5.0×10^{-7}	--	1.1×10^{-6}	--
Cymene	--	--	--	--	--	--	--	--	--
Ethylbenzene	--	9.8×10^{-6}	6.1×10^{-8}	2.4×10^{-8}	--	2.4×10^{-8}	2.7×10^{-8}	1.5×10^{-7}	--
Hexachloro-1,3-butadiene	--	--	--	--	--	--	--	--	--
Isopropylbenzene	--	9.2×10^{-5}	5.9×10^{-8}	--	--	1.9×10^{-7}	--	--	--
m,p-Xylene	--	2.3×10^{-6}	1.4×10^{-6}	4.4×10^{-7}	--	4.9×10^{-7}	7.5×10^{-7}	3.7×10^{-6}	--
Methylene Chloride	--	1.4×10^{-5}	4.8×10^{-6}	1.6×10^{-5}	1.0×10^{-4}	2.5×10^{-4}	--	5.2×10^{-5}	1.4×10^{-5}
n-Butylbenzene	--	2.4×10^{-4}	--	--	--	--	--	--	--
n-Propylbenzene	--	1.1×10^{-4}	2.9×10^{-8}	--	--	--	--	--	--
o-Xylene	--	2.0×10^{-5}	7.0×10^{-7}	--	--	--	--	1.7×10^{-6}	--
Styrene	--	--	4.9×10^{-7}	--	--	--	--	--	--
tert-Butylbenzene	--	2.7×10^{-5}	--	--	--	--	--	--	--
Tetrachloroethene	--	--	--	--	--	--	--	1.0×10^{-5}	--
Toluene	--	6.1×10^{-8}	--	4.8×10^{-8}	4.0×10^{-8}	4.8×10^{-8}	7.5×10^{-8}	6.1×10^{-8}	--
Trichloroethene	--	5.4×10^{-5}	2.8×10^{-4}	1.8×10^{-4}	--	--	--	2.3×10^{-3}	--
Vinyl Chloride	--	--	--	--	--	--	--	5.4×10^{-6}	--
Sub-area Total Hazard Index	**2.0**	**2.4**	**2.7**	**2.6**	**3.3**	**3.1**	**2.8**	**3.1**	**3.6**

NBZ = Northern Buffer Zone; TCDD = 2,3,7,8-tetrachlorodibenzo-p-dioxin; TEQ = toxicity equivalent.

[a] The onsite suburban resident exposure is based on the following direct pathways: ingestion, inhalation, and dermal.

Notes:

– Results were based on the arithmetic mean concentrations of chemical constituents in onsite soil source areas.
– The chemical hazard index represents the potential for toxic effects in exposed individuals due to cumulative exposure from the exposure pathways.
– "--" indicates that no data/noncarcinogenic screening levels are available for the constituent in the sub-area.
– Shaded cells with bold text indicate the primary contributor(s) to maximum sub-area total hazard index.
– The hazard index represents the ratio of exposure from a particular constituent to an acceptable level, where levels below 1 are not considered significant and results greater than 1 indicate an increasing likelihood of toxic effects.
– The total hazard index is a sum of the hazard indices for each pathway and constituent by sub-area and was conservatively applied to all constituents without consideration of target organs.

Table G–29 Background Soil Cancer Incidence Risk from Chemicals for the Onsite Suburban Resident[a] Exposure Scenario

Constituent	*Background Soil Chemical Cancer Morbidity Risk*	*Constituent*	*Background Soil Chemical Cancer Morbidity Risk*
Aluminum	--	Fluoranthene	--
Antimony	--	Fluorene	--
Arsenic	**1.6×10^{-4}**	Indeno(1,2,3-cd)pyrene	1.8×10^{-9}
Barium	--	Morpholine	--
Beryllium	6.1×10^{-10}	Naphthalene	5.7×10^{-11}
Boron	--	N-Nitrosodimethylamine	--
Cadmium	3.2×10^{-10}	Phenanthrene	--
Chromium	--	Pyrene	--
Chromium, hexavalent	--	Total TCDD TEQ	--
Cobalt	3.4×10^{-8}	Aroclor 1242	--
Copper	--	Aroclor 1248	--
Cyanide	--	Aroclor 1254	--
Lead	--	Aroclor 1260	--
Lithium	--	Aroclor 1262	--
Manganese	--	Aroclor 1268	--
Mercury	--	Aroclor 5442	--
Molybdenum	--	Aroclor 5460	--
Nickel	2.0×10^{-9}	1,1,2-Trichloro-1,2,2-trifluoroethane	--
Selenium	--	1,2,3-Trichlorobenzene	--
Silver	--	1,2,4-Trimethylbenzene	--
Strontium	--	1,2-Dibromoethane	--
Thallium	--	1,2-Dichloroethane	--
Tin	--	1,3,5-Trimethylbenzene	--
Vanadium	--	1,4-Dichlorobenzene	--
Zinc	--	2-Butanone (Methyl ethyl ketone)	--
Zirconium		2-Phenylbutane	--
1-Methylnaphthalene	--	4-Methyl-2-pentanone (Methyl isobutyl ketone)	--
2-Methylnaphthalene	--	Acetone	--
Acenaphthene	--	Benzene	--
Acenaphthylene	--	Bromodichloromethane	--
Anthracene	--	Chloroform	--
Benzo(a)pyrene TEQ	--	Cymene	--
Benzo(a)anthracene	2.0×10^{-9}	Ethylbenzene	--
Benzo(a)pyrene	2.2×10^{-8}	Hexachloro-1,3-butadiene	--
Benzo(b)fluoranthene	3.7×10^{-9}	Isopropylbenzene	--
Benzo(e)pyrene	--	m,p-Xylene	--
Benzo(g,h,i)perylene	--	Methylene chloride	--
Benzo(k)fluoranthene	3.6×10^{-9}	n-Butylbenzene	--
Bis(2-ethylhexyl)phthalate	--	n-Propylbenzene	--
Butylbenzylphthalate	--	o-Xylene	--
Chrysene	3.0×10^{-10}	Styrene	--
Dibenzo(a,h)anthracene	6.3×10^{-9}	tert-Butylbenzene	--
Diethylphthalate	--	Tetrachloroethene	--
Dimethylphthalate	--	Toluene	--
Di-n-butylphthalate	--	Trichloroethene	--
Di-n-octylphthalate	--	Vinyl Chloride	--
		Overall Total Cancer Incidence Risk	**1.6×10^{-4}**

Constituent	Background Soil Chemical Cancer Morbidity Risk	Constituent	Background Soil Chemical Cancer Morbidity Risk

TCDD = 2,3,7,8-tetrachlorodibenzo-p-dioxin; TEQ = toxicity equivalent.

[a] The onsite suburban resident exposure is based on the following direct pathways: ingestion, inhalation, and dermal.

Notes:

– Results were based on the arithmetic mean concentrations of chemical constituents in background soil.
– Cancer risk represents increased cancer incidence in exposed individuals.
– "--" indicates" that no data/carcinogenic screening levels are available for the constituent in background.
– Shaded cells with bold text indicate the primary contributor(s) to overall total cancer incidence risk.
– The overall total combines results for all chemicals, assuming similar carcinogenic mechanisms.
– Cancer risks below 1 chance in 1,000,000 (1×10^{-6}) are not considered significant, while risks approaching 1 chance in 10,000 (1×10^{-4}) are a level of concern.

Table G–30 Background Soil Hazard Indices from Chemicals for the Onsite Suburban Resident[a] Exposure Scenario

Constituent	Background Soil Chemical Hazard Index	Constituent	Background Soil Chemical Hazard Index	Constituent	Background Soil Chemical Hazard Index
Aluminum	2.9×10^{-1}	Benzo(a)pyrene TEQ	--	Aroclor 5460	--
Antimony	9.8×10^{-3}	Benzo(a)anthracene	--	1,1,2-Trichloro-1,2,2-trifluoroethane	--
Arsenic	**5.1×10^{-1}**	Benzo(a)pyrene	--	1,2,3-Trichlorobenzene	--
Barium	1.2×10^{-2}	Benzo(b)fluoranthene	--	1,2,4-Trimethylbenzene	--
Beryllium	2.9×10^{-2}	Benzo(e)pyrene	--	1,2-Dibromoethane	--
Boron	5.4×10^{-4}	Benzo(g,h,i)perylene	--	1,2-Dichloroethane	--
Cadmium	5.8×10^{-2}	Benzo(k)fluoranthene	--	1,3,5-Trimethylbenzene	--
Chromium	1.1×10^{-3}	Bis(2-ethylhexyl)phthalate	--	1,4-Dichlorobenzene	--
Chromium, hexavalent	--	Butylbenzylphthalate	--	2-Butanone (Methyl ethyl ketone)	--
Cobalt	**6.0×10^{-1}**	Chrysene	--	2-Phenylbutane	--
Copper	6.4×10^{-3}	Dibenzo(a,h)anthracene	--	4-Methyl-2-pentanone (Methyl isobutyl ketone)	--
Cyanide	--	Diethylphthalate	--	Acetone	--
Lead	--	Dimethylphthalate	--	Benzene	--
Lithium	2.2×10^{-1}	Di-n-butylphthalate	--	Bromodichloromethane	--
Manganese	7.0×10^{-2}	Di-n-octylphthalate	--	Chloroform	--
Mercury	8.9×10^{-4}	Fluoranthene	6.0×10^{-7}	Cymene	--
Molybdenum	2.5×10^{-3}	Fluorene	4.1×10^{-7}	Ethylbenzene	--
Nickel	3.0×10^{-2}	Indeno(1,2,3-cd)pyrene		Hexachloro-1,3-butadiene	--
Selenium	8.0×10^{-4}	Morpholine	--	Isopropylbenzene	--
Silver	2.3×10^{-4}	Naphthalene	1.2×10^{-6}	m,p-Xylene	--
Strontium	7.7×10^{-4}	N-Nitrosodimethylamine	--	Methylene Chloride	--
Thallium	5.0×10^{-1}	Phenanthrene	5.8×10^{-8}	n-Butylbenzene	--
Tin	1.5×10^{-5}	Pyrene	7.4×10^{-7}	n-Propylbenzene	--
Vanadium	3.9×10^{-1}	Total TCDD TEQ	--	o-Xylene	--
Zinc	4.1×10^{-3}	Aroclor 1242	--	Styrene	--
Zirconium	**8.5×10^{-1}**	Aroclor 1248	--	tert-Butylbenzene	--
1-Methylnaphthalene	--	Aroclor 1254	--	Tetrachloroethene	--
2-Methylnaphthalene	4.3×10^{-6}	Aroclor 1260	--	Toluene	--
Acenaphthene	--	Aroclor 1262	--	Trichloroethene	--
Acenaphthylene	1.4×10^{-7}	Aroclor 1268	--	Vinyl Chloride	--
Anthracene	2.3×10^{-8}	Aroclor 5442	--		
				Overall Total Hazard Index	**3.5**

Constituent	Background Soil Chemical Hazard Index	Constituent	Background Soil Chemical Hazard Index	Constituent	Background Soil Chemical Hazard Index

TCDD = 2,3,7,8-tetrachlorodibenzo-p-dioxin; TEQ = toxicity equivalent.

[a] The onsite suburban resident exposure is based on the following direct pathways: ingestion, inhalation, and dermal.

Notes:

– Results were based on the arithmetic mean concentrations of chemical constituents in background soil.
– The chemical hazard index represents the potential for toxic effects in exposed individuals due to cumulative exposure from the exposure pathways.
– "--"indicates that no data/noncarcinogenic screening levels are available for the constituent in background soil.
– Shaded cells with bold text indicate the primary contributor(s) to overall total hazard index.
– The hazard index represents the ratio of exposure from a particular constituent to an acceptable level, where levels below 1 are not considered significant and results greater than 1 indicate an increasing likelihood of toxic effects.
– The total hazard index is a sum of the hazard indices for each pathway and constituent and was conservatively applied to all constituents without consideration of the target organ.

Table G–31 Site Soil Cancer Incidence Risk from Radionuclides for the Onsite Recreational Exposure Scenario – No Action Alternative – With Uranium and Thorium Decay Chain Radionuclides

Constituent	Site Soil Radiological Cancer Morbidity Risk	Constituent	Site Soil Radiological Cancer Morbidity Risk	Constituent	Site Soil Radiological Cancer Morbidity Risk
Ac-227	2.7×10^{-9}	Pa-231	1.8×10^{-8}	Sr-90	5.5×10^{-8}
Am-241	6.2×10^{-9}	Pb-210	2.9×10^{-7}	Th-227	1.2×10^{-10}
Bi-210	7.8×10^{-12}	Pb-211	1.0×10^{-13}	Th-228	9.1×10^{-9}
Bi-211	4.0×10^{-15}	Pb-212	7.6×10^{-11}	Th-230	4.5×10^{-8}
Bi-212	7.1×10^{-12}	Po-210	1.6×10^{-8}	Th-232	6.3×10^{-8}
Cm-243/244	3.0×10^{-7}	Pu-238	2.7×10^{-9}	Tl-207	7.5×10^{-16}
Co-60	4.2×10^{-8}	Pu-239	5.0×10^{-9}	Tl-208	4.2×10^{-12}
Cs-137	4.5×10^{-6}	Ra-223	1.3×10^{-10}	U-234	3.7×10^{-8}
Eu-152	6.8×10^{-7}	Ra-224	1.2×10^{-10}	U-235	6.5×10^{-8}
Eu-154	6.2×10^{-7}	**Ra-226**	**1.7×10^{-5}**	U-238	2.7×10^{-7}
H-3	2.4×10^{-6}	Ra-228	3.0×10^{-6}		
Ni-59	7.7×10^{-9}				
Overall Total Cancer Incidence Risk					**2.9×10^{-5}**

Notes:

– Results were based on the median concentrations of radioactive constituents in onsite soil source areas.
– Cancer risk represents increased cancer incidence in exposed individuals.
– Sr-90, Cs-137, and Pu-239/240 results include exposure due to significant daughter products.
– Shaded cells with bold text indicate the primary contributor(s) to overall total cancer incidence risk.
– The overall total combines results for all radionuclides, assuming similar carcinogenic mechanisms.
– Cancer risks below 1 chance in 1,000,000 (1×10^{-6}) are not considered significant, while risks approaching 1 chance in 10,000 (1×10^{-4}) are a level of concern.

Table G–32 Site Soil Cancer Incidence Risk from Radionuclides for the Onsite Recreational Exposure Scenario – No Action Alternative – Without Uranium and Thorium Decay Chain Radionuclides

Constituent	Site Soil Radiological Cancer Morbidity Risk	Constituent	Site Soil Radiological Cancer Morbidity Risk	Constituent	Site Soil Radiological Cancer Morbidity Risk
Am-241	6.2×10^{-9}	Eu-152	6.8×10^{-7}	Pu-238	2.7×10^{-9}
Cm-243/244	3.0×10^{-7}	Eu-154	6.2×10^{-7}	Pu-239/240	5.0×10^{-9}
Co-60	4.2×10^{-8}	H-3	2.4×10^{-6}	Sr-90	5.5×10^{-8}
Cs-137	**4.5×10^{-6}**	Ni-59	7.7×10^{-9}		
				Overall Total Cancer Incidence Risk	**8.6×10^{-6}**

Notes:
– Results were based on the median concentrations of radioactive constituents in onsite soil source areas.
– Cancer risk represents increased cancer incidence in exposed individuals.
– Shaded cells with bold text indicate the primary contributor(s) to overall total cancer incidence risk.
– Sr-90, Cs-137, and Pu-239/240 results include exposure due to significant daughter products.
– The overall total combines results for all radionuclides, assuming similar carcinogenic mechanisms.
– Cancer risks below 1 chance in 1,000,000 (1×10^{-6}) are not considered significant, while risks approaching 1 chance in 10,000 (1×10^{-4}) are a level of concern.

Table G–33 Background Soil Cancer Incidence Risk from Radionuclides for the Onsite Recreational Exposure Scenario – With Uranium and Thorium Decay Chain Radionuclides

Constituent	Background Soil Radiological Cancer Morbidity Risk	Constituent	Background Soil Radiological Cancer Morbidity Risk	Constituent	Background Soil Radiological Cancer Morbidity Risk
Ac-227	3.4×10^{-9}	Pb-210	3.8×10^{-7}	Sr-90	1.6×10^{-9}
Am-241	1.2×10^{-9}	Pb-211	1.3×10^{-13}	Th-227	1.5×10^{-10}
Bi-210	1.0×10^{-11}	Pb-212	1.0×10^{-10}	Th-228	1.2×10^{-8}
Bi-211	5.0×10^{-15}	Po-210	2.0×10^{-8}	Th-230	5.9×10^{-8}
Bi-212	9.4×10^{-12}	Pu-238	9.5×10^{-11}	Th-232	8.5×10^{-8}
Cs-134	2.1×10^{-8}	Pu-239	2.9×10^{-10}	Tl-207	9.4×10^{-16}
Cs-137	2.8×10^{-7}	Ra-223	1.6×10^{-10}	Tl-208	5.6×10^{-12}
Eu-152	2.1×10^{-8}	Ra-224	1.6×10^{-10}	U-234	4.7×10^{-8}
Eu-154	7.6×10^{-8}	**Ra-226**	**2.2×10^{-5}**	U-235	8.1×10^{-8}
H-3	1.2×10^{-6}	Ra-228	4.0×10^{-6}	U-238	3.5×10^{-7}
Pa-231	2.3×10^{-8}				
				Overall Total Cancer Incidence Risk	**2.9×10^{-5}**

Notes:
– Results were based on the 95 percent upper confidence levels on the arithmetic mean concentrations of radioactive constituents in background soil and a 100-year decay period prior to exposure.
– Shaded cells with bold text indicate the primary contributor(s) to overall total cancer incidence risk.
– Cancer risk represents increased cancer incidence in exposed individuals.
– The overall total combines results for all radionuclides, assuming similar carcinogenic mechanisms.
– Cancer risks below 1 chance in 1,000,000 (1×10^{-6}) are not considered significant, while risks approaching 1 chance in 10,000 (1×10^{-4}) are a level of concern.

Table G–34 Background Soil Cancer Incidence Risk from Radionuclides for the Onsite Recreational Exposure Scenario – Without Uranium and Thorium Decay Chain Radionuclides

Constituent	*Background Soil Radiological Cancer Morbidity Risk*	*Constituent*	*Background Soil Radiological Cancer Morbidity Risk*
Americium-241	1.2×10^{-9}	Plutonium-238	9.5×10^{-11}
Cesium-134	2.1×10^{-8}	Plutonium-239/240	2.9×10^{-10}
Cesium-137	**2.8×10^{-7}**	Strontium-90	1.6×10^{-9}
Europium-152	2.1×10^{-8}	**Tritium**	**1.2×10^{-6}**
Europium-154	7.6×10^{-8}		
		Overall Total Cancer Incidence Risk	**1.6×10^{-6}**

Notes:
- Results were based on the 95 percent upper confidence levels on the arithmetic mean concentrations of radioactive constituents in background soil.
- Shaded cells with bold text indicate the primary contributor(s) to overall total cancer incidence risk.
- Cancer risk represents increased cancer incidence in exposed individuals.
- The overall total combines results for all radionuclides, assuming similar carcinogenic mechanisms.
- Cancer risks below 1 chance in 1,000,000 (1×10^{-6}) are not considered significant, while risks approaching 1 chance in 10,000 (1×10^{-4}) are a level of concern.

Table G–35 Site Soil Cancer Incidence Risk from Chemicals for the Onsite Recreational Exposure Scenario – No Action Alternative

Constituent	*Site Soil Chemical Cancer Morbidity Risk*	*Constituent*	*Site Soil Chemical Cancer Morbidity Risk*
Aluminum	--	Fluoranthene	--
Antimony	--	Fluorene	--
Arsenic	**3.2×10^{-5}**	Indeno(1,2,3-cd)pyrene	2.7×10^{-7}
Barium	--	Morpholine	--
Beryllium	4.1×10^{-11}	Naphthalene	3.8×10^{-10}
Boron	--	N-Nitrosodimethylamine	6.5×10^{-7}
Cadmium	3.2×10^{-11}	Phenanthrene	--
Chromium	--	Pyrene	--
Chromium, hexavalent	1.3×10^{-7}	Total TCDD TEQ	8.4×10^{-7}
Cobalt	1.9×10^{-9}	Aroclor 1242	1.2×10^{-7}
Copper	--	Aroclor 1248	2.3×10^{-6}
Cyanide	--	Aroclor 1254	2.7×10^{-7}
Lead	--	Aroclor 1260	2.5×10^{-7}
Lithium	--	Aroclor 1262	--
Manganese	--	Aroclor 1268	--
Mercury	--	Aroclor 5442	--
Molybdenum	--	Aroclor 5460	3.0×10^{-7}
Nickel	1.2×10^{-10}	1,1,2-Trichloro-1,2,2-trifluoroethane	5.7×10^{-11}
Selenium	--	1,2,3-Trichlorobenzene	
Silver	--	1,2,4-Trimethylbenzene	9.7×10^{-11}
Strontium	--	1,2-Dibromoethane	9.1×10^{-10}
Thallium	--	1,2-Dichloroethane	
Tin	--	1,3,5-Trimethylbenzene	6.1×10^{-11}
Vanadium	--	1,4-Dichlorobenzene	--
Zinc	--	2-Butanone (Methyl ethyl ketone)	3.0×10^{-10}
Zirconium	--	2-Phenylbutane	--
1-Methylnaphthalene	2.2×10^{-8}	4-Methyl-2-pentanone (Methyl isobutyl ketone)	--
2-Methylnaphthalene	--	Acetone	--
Acenaphthene	--	Benzene	--
Acenaphthylene	--	Bromodichloromethane	--
Anthracene	--	Chloroform	--

Constituent	*Site Soil Chemical Cancer Morbidity Risk*	*Constituent*	*Site Soil Chemical Cancer Morbidity Risk*
Benzo(a)pyrene TEQ	2.9×10^{-7}	Cymene	--
Benzo(a)anthracene	3.0×10^{-7}	Ethylbenzene	--
Benzo(a)pyrene	2.3×10^{-6}	Hexachloro-1,3-butadiene	--
Benzo(b)fluoranthene	2.7×10^{-7}	Isopropylbenzene	--
Benzo(e)pyrene	--	m,p-Xylene	--
Benzo(g,h,i)perylene	--	Methylene Chloride	--
Benzo(k)fluoranthene	1.7×10^{-7}	n-Butylbenzene	--
Bis(2-ethylhexyl)phthalate	2.7×10^{-10}	n-Propylbenzene	--
Butylbenzylphthalate	7.7×10^{-11}	o-Xylene	--
Chrysene	2.3×10^{-8}	Styrene	--
Dibenzo(a,h)anthracene	1.4×10^{-7}	tert-Butylbenzene	--
Diethylphthalate	--	Tetrachloroethene	1.5×10^{-10}
Dimethylphthalate	--	Toluene	--
Di-n-butylphthalate	--	Trichloroethene	6.7×10^{-10}
Di-n-octylphthalate	--	Vinyl Chloride	9.5×10^{-10}
		Overall Total Cancer Incidence Risk	**4.1×10^{-5}**

TCDD = 2,3,7,8-tetrachlorodibenzo-p-dioxin; TEQ = toxicity equivalent.
Notes:
– Results were based on the arithmetic mean concentrations of chemical constituents in onsite soil source areas.
– Shaded cells with bold text indicate the primary contributor(s) to overall total cancer incidence risk.
– Cancer risk represents increased cancer incidence in exposed individuals.
– "--" indicates that no data/carcinogenic screening levels are available for the constituent.
– The overall total combines results for all chemicals, assuming similar carcinogenic mechanisms.
– Cancer risks below 1 chance in 1,000,000 (1×10^{-6}) are not considered significant, while risks approaching 1 chance in 10,000 (1×10^{-4}) are a level of concern.

Table G–36 Site Soil Hazard Indices from Chemicals for the Onsite Recreational Exposure Scenario – No Action Alternative

Constituent	*Site Soil Chemical Hazard Index*	*Constituent*	*Site Soil Chemical Hazard Index*
Aluminum	6.8×10^{-2}	Fluoranthene	6.1×10^{-5}
Antimony	6.9×10^{-2}	Fluorene	9.0×10^{-6}
Arsenic	7.8×10^{-2}	Indeno(1,2,3-cd)pyrene	--
Barium	2.6×10^{-3}	Morpholine	--
Beryllium	6.0×10^{-3}	Naphthalene	1.8×10^{-5}
Boron	1.4×10^{-4}	N-Nitrosodimethylamine	2.6×10^{-2}
Cadmium	4.2×10^{-2}	Phenanthrene	6.4×10^{-6}
Chromium	2.0×10^{-4}	Pyrene	6.7×10^{-5}
Chromium, hexavalent	7.6×10^{-4}	Total TCDD TEQ	6.4×10^{-2}
Cobalt	9.7×10^{-2}	Aroclor 1242	1.4×10^{-2}
Copper	4.9×10^{-3}	**Aroclor 1248**	**2.5×10^{-1}**
Cyanide	5.6×10^{-3}	Aroclor 1254	2.9×10^{-2}
Lead	--	Aroclor 1260	2.7×10^{-2}
Lithium	3.7×10^{-2}	Aroclor 1262	--
Manganese	1.3×10^{-2}	Aroclor 1268	--
Mercury	1.1×10^{-2}	Aroclor 5442	--
Molybdenum	4.9×10^{-4}	Aroclor 5460	3.3×10^{-2}
Nickel	5.4×10^{-3}	1,1,2-Trichloro-1,2,2-trifluoroethane	5.2×10^{-8}
Selenium	2.8×10^{-4}	1,2,3-Trichlorobenzene	2.3×10^{-3}
Silver	4.4×10^{-4}	1,2,4-Trimethylbenzene	8.5×10^{-5}
Strontium	2.7×10^{-4}	1,2-Dibromoethane	5.8×10^{-6}
Thallium	9.9×10^{-2}	1,2-Dichloroethane	1.6×10^{-7}
Tin	7.7×10^{-5}	1,3,5-Trimethylbenzene	3.6×10^{-6}

Constituent	Site Soil Chemical Hazard Index	Constituent	Site Soil Chemical Hazard Index
Vanadium	7.1×10^{-2}	1,4-Dichlorobenzene	4.6×10^{-8}
Zinc	9.4×10^{-4}	2-Butanone (Methyl ethyl ketone)	3.8×10^{-7}
Zirconium	**1.6×10^{-1}**	2-Phenylbutane	--
1-Methylnaphthalene	4.4×10^{-5}	4-Methyl-2-pentanone (Methyl isobutyl ketone)	5.8×10^{-8}
2-Methylnaphthalene	7.2×10^{-4}	Acetone	2.9×10^{-5}
Acenaphthene	1.2×10^{-5}	Benzene	7.7×10^{-9}
Acenaphthylene	6.4×10^{-7}	Bromodichloromethane	2.7×10^{-5}
Anthracene	1.7×10^{-6}	Chloroform	2.0×10^{-7}
Benzo(a)pyrene TEQ	--	Cymene	
Benzo(a)anthracene	--	Ethylbenzene	3.2×10^{-5}
Benzo(a)pyrene	--	Hexachloro-1,3-butadiene	--
Benzo(b)fluoranthene	--	Isopropylbenzene	1.2×10^{-3}
Benzo(e)pyrene	1.1×10^{-5}	m,p-Xylene	2.8×10^{-7}
Benzo(g,h,i)perylene	2.6×10^{-5}	Methylene Chloride	2.8×10^{-6}
Benzo(k)fluoranthene	--	n-Butylbenzene	2.6×10^{-5}
Bis(2-ethylhexyl)phthalate	2.3×10^{-5}	n-Propylbenzene	1.4×10^{-5}
Butylbenzylphthalate	1.0×10^{-6}	o-Xylene	1.5×10^{-6}
Chrysene	--	Styrene	8.8×10^{-8}
Dibenzo(a,h)anthracene	--	tert-Butylbenzene	2.8×10^{-6}
Diethylphthalate	6.2×10^{-8}	Tetrachloroethene	8.7×10^{-7}
Dimethylphthalate	5.3×10^{-7}	Toluene	1.2×10^{-8}
Di-n-butylphthalate	5.2×10^{-5}	Trichloroethene	1.9×10^{-4}
Di-n-octylphthalate	1.0×10^{-4}	Vinyl Chloride	5.5×10^{-7}
		Overall Total Hazard Index	**1.2**

TCDD = 2,3,7,8-tetrachlorodibenzo-p-dioxin; TEQ = toxicity equivalent.

Notes:

– Results were based on the arithmetic mean concentrations of chemical constituents in onsite soil source areas.
– The chemical hazard index represents the potential for toxic effects in exposed individuals due to cumulative exposure from the exposure pathways.
– "--" indicates that no data/noncarcinogenic screening levels are available for the constituent.
– Shaded cells with bold text indicate the primary contributor(s) to overall total hazard index.
– The hazard index represents the ratio of exposure from a particular constituent to an acceptable level, where levels below 1 are not considered significant and results greater than 1 indicate an increasing likelihood of toxic effects. The total hazard index is a sum of the hazard indices for each pathway and constituent and was conservatively applied to all constituents without consideration of target organs.

Table G–37 Background Soil Cancer Incidence Risk from Chemicals for the Onsite Recreational Exposure Scenario

Constituent	Background Soil Chemical Cancer Morbidity Risk	Constituent	Background Soil Chemical Cancer Morbidity Risk
Aluminum	--	Fluoranthene	--
Antimony	--	Fluorene	--
Arsenic	**4.4×10^{-5}**	Indeno(1,2,3-cd)pyrene	7.1×10^{-10}
Barium	--	Morpholine	--
Beryllium	4.3×10^{-11}	Naphthalene	4.3×10^{-12}
Boron	--	N-Nitrosodimethylamine	--
Cadmium	2.2×10^{-11}	Phenanthrene	--
Chromium	--	Pyrene	--
Chromium, hexavalent	--	Total TCDD TEQ	--
Cobalt	2.4×10^{-9}	Aroclor 1242	--
Copper	--	Aroclor 1248	--
Cyanide	--	Aroclor 1254	--
Lead	--	Aroclor 1260	--
Lithium	--	Aroclor 1262	--
Manganese	--	Aroclor 1268	--
Mercury	--	Aroclor 5442	--
Molybdenum	--	Aroclor 5460	--
Nickel	1.5×10^{-10}	1,1,2-Trichloro-1,2,2-trifluoroethane	--
Selenium	--	1,2,3-Trichlorobenzene	--
Silver	--	1,2,4-Trimethylbenzene	--
Strontium	--	1,2-Dibromoethane	--
Thallium	--	1,2-Dichloroethane	--
Tin	--	1,3,5-Trimethylbenzene	--
Vanadium	--	1,4-Dichlorobenzene	--
Zinc	--	2-Butanone (Methyl ethyl ketone)	--
Zirconium	--	2-Phenylbutane	--
1-Methylnaphthalene	--	4-Methyl-2-pentanone (Methyl isobutyl ketone)	--
2-Methylnaphthalene	--	Acetone	--
Acenaphthene	--	Benzene	--
Acenaphthylene	--	Bromodichloromethane	--
Anthracene	--	Chloroform	--
Benzo(a)pyrene TEQ	--	Cymene	--
Benzo(a)anthracene	7.9×10^{-10}	Ethylbenzene	--
Benzo(a)pyrene	8.8×10^{-9}	Hexachloro-1,3-butadiene	--
Benzo(b)fluoranthene	1.5×10^{-9}	Isopropylbenzene	--
Benzo(e)pyrene	--	m,p-Xylene	--
Benzo(g,h,i)perylene	--	Methylene Chloride	--
Benzo(k)fluoranthene	1.5×10^{-9}	n-Butylbenzene	--
Bis(2-ethylhexyl)phthalate	--	n-Propylbenzene	--
Butylbenzylphthalate	--	o-Xylene	--
Chrysene	1.2×10^{-10}	Styrene	--
Dibenzo(a,h)anthracene	2.6×10^{-9}	tert-Butylbenzene	--
Diethylphthalate	--	Tetrachloroethene	--
Dimethylphthalate	--	Toluene	--
Di-n-butylphthalate	--	Trichloroethene	--
Di-n-octylphthalate	--	Vinyl Chloride	--
		Overall Total Cancer Incidence Risk	**4.4×10^{-5}**

Constituent	Background Soil Chemical Cancer Morbidity Risk	Constituent	Background Soil Chemical Cancer Morbidity Risk

TCDD = 2,3,7,8-tetrachlorodibenzo-p-dioxin; TEQ = toxicity equivalent.

Notes:

– Results were based on the arithmetic mean concentrations of chemical constituents in background soil.
– Cancer risk represents increased cancer incidence in exposed individuals.
– "--" indicates that no data/carcinogenic screening levels are available for the constituent in background.
– Shaded cells with bold text indicate the primary contributor(s) to overall total cancer incidence risk.
– The overall total combines results for all chemicals, assuming similar carcinogenic mechanisms.
– Cancer risks below 1 chance in 1,000,000 (1×10^{-6}) are not considered significant, while risks approaching 1 chance in 10,000 (1×10^{-4}) are a level of concern.

Table G–38 Background Soil Hazard Indices from Chemicals for the Onsite Recreational Exposure Scenario

Constituent	Background Soil Chemical Hazard Index	Constituent	Background Soil Chemical Hazard Index
Aluminum	6.1×10^{-2}	Fluoranthene	1.2×10^{-7}
Antimony	2.0×10^{-3}	Fluorene	8.4×10^{-8}
Arsenic	1.1×10^{-1}	Indeno(1,2,3-cd)pyrene	--
Barium	2.5×10^{-3}	Morpholine	--
Beryllium	6.3×10^{-3}	Naphthalene	2.0×10^{-7}
Boron	1.2×10^{-4}	N-Nitrosodimethylamine	--
Cadmium	2.9×10^{-2}	Phenanthrene	1.2×10^{-8}
Chromium	2.3×10^{-4}	Pyrene	1.6×10^{-7}
Chromium, hexavalent	--	Total TCDD TEQ	--
Cobalt	1.2×10^{-1}	Aroclor 1242	--
Copper	1.3×10^{-3}	Aroclor 1248	--
Cyanide	--	Aroclor 1254	--
Lead	--	Aroclor 1260	--
Lithium	4.8×10^{-2}	Aroclor 1262	--
Manganese	1.5×10^{-2}	Aroclor 1268	--
Mercury	1.9×10^{-4}	Aroclor 5442	--
Molybdenum	5.3×10^{-4}	Aroclor 5460	--
Nickel	6.6×10^{-3}	1,1,2-Trichloro-1,2,2-trifluoroethane	--
Selenium	1.7×10^{-4}	1,2,3-Trichlorobenzene	--
Silver	4.9×10^{-5}	1,2,4-Trimethylbenzene	--
Strontium	1.6×10^{-4}	1,2-Dibromoethane	--
Thallium	1.1×10^{-1}	1,2-Dichloroethane	--
Tin	3.2×10^{-6}	1,3,5-Trimethylbenzene	--
Vanadium	8.4×10^{-2}	1,4-Dichlorobenzene	--
Zinc	8.7×10^{-4}	2-Butanone (Methyl ethyl ketone)	--
Zirconium	$\mathbf{1.8\times10^{-1}}$	2-Phenylbutane	--
1-Methylnaphthalene	--	4-Methyl-2-pentanone (Methyl isobutyl ketone)	--
2-Methylnaphthalene	7.4×10^{-7}	Acetone	--
Acenaphthene	--	Benzene	--
Acenaphthylene	2.7×10^{-8}	Bromodichloromethane	--
Anthracene	4.8×10^{-9}	Chloroform	--
Benzo(a)pyrene TEQ	--	Cymene	--
Benzo(a)anthracene	--	Ethylbenzene	--
Benzo(a)pyrene	--	Hexachloro-1,3-butadiene	--
Benzo(b)fluoranthene	--	Isopropylbenzene	--
Benzo(e)pyrene	--	m,p-Xylene	--
Benzo(g,h,i)perylene	--	Methylene Chloride	--

Constituent	***Background Soil Chemical Hazard Index***	***Constituent***	***Background Soil Chemical Hazard Index***
Benzo(k)fluoranthene	--	n-Butylbenzene	--
Bis(2-ethylhexyl)phthalate	--	n-Propylbenzene	--
Butylbenzylphthalate	--	o-Xylene	--
Chrysene	--	Styrene	--
Dibenzo(a,h)anthracene	--	tert-Butylbenzene	--
Diethylphthalate	--	Tetrachloroethene	--
Dimethylphthalate	--	Toluene	--
Di-n-butylphthalate	--	Trichloroethene	--
Di-n-octylphthalate	--	Vinyl Chloride	--
		Overall Total Hazard Index	**7.8×10^{-1}**

TCDD = 2,3,7,8-tetrachlorodibenzo-p-dioxin; TEQ = toxicity equivalent.

Notes:

– Results were based on the arithmetic mean concentrations of chemical constituents in background soil.
– Chemical hazard quotients represent the potential for toxic effects in exposed individuals due to exposure to individual constituents.
– "--" indicates that no data/noncarcinogenic screening levels are available for the constituent in background.
– Shaded cells with bold text indicate the primary contributor(s) to overall total hazard index.
– The hazard index represents the ratio of exposure from a particular constituent to an acceptable level, where levels below 1 are not considered significant and results greater than 1 indicate an increasing likelihood of toxic effects.
– The total hazard index is a sum of the hazard indices for each pathway and constituent and was conservatively applied to all constituents without consideration of target organs.

Table G–39 Summary of SSFL Area IV and Northern Buffer Zone Impact Assessment[a]

Scenario	Annual Radiological Impact (millirem)	Excess Lifetime Cancer Risk [b]			Hazard Index
		Radiological		Chemical	
		Incidence	Fatality	Incidence	
With Uranium and Thorium Decay Chain Radionuclides					
Impacts from Average Background					
Onsite suburban resident [c] – Current	6.3	1.5×10^{-4}	1.1×10^{-4}	1.6×10^{-4}	3.5
Onsite suburban resident [c] – Future	5.7	1.3×10^{-4}	9.4×10^{-5}	1.6×10^{-4}	3.5
Recreational user	1.2	2.9×10^{-5}	2.1×10^{-5}	4.4×10^{-5}	0.78
Total Impacts from SSFL Soil					
Onsite suburban resident [c] – Current	5.3	1.3×10^{-4}	1.0×10^{-4}	1.3×10^{-4}	3.6
Onsite suburban resident [c] – Future	4.0	9.1×10^{-5}	6.6×10^{-5}	1.3×10^{-4}	3.6
Recreational user	1.2	2.9×10^{-5}	2.1×10^{-5}	4.1×10^{-5}	1.2
Without Uranium and Thorium Decay Chain Radionuclides					
Impacts from Average Background					
Onsite suburban resident [c] – Current	0.60	1.9×10^{-5}	1.6×10^{-5}	1.6×10^{-4}	3.5
Onsite suburban resident [c] – Future	0.01	2.0×10^{-7}	1.5×10^{-7}	1.6×10^{-4}	3.5
Recreational user	0.05	1.6×10^{-6}	1.3×10^{-6}	4.4×10^{-5}	0.78
Total Impacts from SSFL Soil					
Onsite suburban resident [c] – Current	1.3	4.2×10^{-5}	3.3×10^{-5}	1.3×10^{-4}	3.6
Onsite suburban resident [c] – Future	0.09	2.2×10^{-6}	1.5×10^{-6}	1.3×10^{-4}	3.6
Recreational user	0.37	8.6×10^{-6}	6.3×10^{-6}	4.1×10^{-5}	1.2
Summary of Results					
Incremental Impacts from No Action Alternative (total minus background) with Uranium and Thorium Decay Chain Radionuclides					
Onsite suburban resident [c] – Current	-1	-2.0×10^{-5}	-1.0×10^{-5}	-3.0×10^{-5}	0.10
Onsite suburban resident [c] – Future	-1.7	-3.9×10^{-5}	-2.8×10^{-5}	-3.0×10^{-5}	0.10
Recreational user	0.0	0.0	0.0	-3.0×10^{-6}	0.42
Incremental Impacts from No Action Alternative (total minus background) without Uranium and Thorium Decay Chain Radionuclides [d]					
Onsite suburban resident [c] – Current	0.67	2.3×10^{-5}	1.7×10^{-5}	-3.0×10^{-5}	0.1
Onsite suburban resident [c] – Future	0.08	2.0×10^{-6}	1.4×10^{-6}	-3.0×10^{-5}	0.1
Recreational user	0.31	7.0×10^{-6}	5.0×10^{-6}	-3.0×10^{-6}	0.42

[a] All impacts for soil constituents were based on the mean concentrations for all constituents that had 1 or more exceedances of the Look-Up Table (LUT) values. For the onsite resident, the mean concentrations were only from the sub-areas that gave the highest impacts. For the recreational user, the mean concentrations were averaged for all sub-areas. Direct pathways include external radiation exposure, dermal contact, inhalation, and incidental ingestion.

[b] Total cancer risk per receptor can be estimated by combining the chemical and radiological risks. However, combining the risks should be done with the recognition that the underlying risk slope factors were developed differently. The slope factors used to determine chemical risks generally represent an upper bound or 95 percent upper confidence level (on the arithmetic mean) value developed from studies on laboratory animals. Radionuclide slope factors are best estimates or average values developed from epidemiology studies.

[c] The onsite suburban resident exposure was based on the direct pathways: ingestion, inhalation, dermal and external.

[d] The background includes the natural uranium and thorium decay chain radionuclides that contribute a major portion of the radiological impacts. The EPA determined in its site survey that analytical results associated with uranium and thorium decay chain radionuclides that were greater than its field action levels or radiological trigger levels were from natural background sources in most cases (HGL 2012). However, the variability in the natural background from location to location is significant and may mask the incremental impacts from site-related radionuclides when viewing the total radiological impacts. Therefore, incremental radiological impacts are shown with and without the uranium and thorium decay chain radionuclides included.

Notes:

– Highlighted cells indicate site impacts less than those estimated for background exposures.

– The onsite suburban resident evaluations were based on the sub-areas with the maximum total cancer incidence risk for radionuclides without decay (5B), with decay (5D), as well as chemical cancer risk (5D) and hazards (the Northern Buffer Zone).

– For the onsite suburban resident exposures, current results were based on baseline conditions without radioactive decay, and future results were based on an assumed loss of institutional controls after 100 years of radioactive decay.

– Values are rounded to 2 significant figures, and the results of subtraction presented in the table may differ from those calculated from table entries due to rounding.

Table G–40 Summary of SSFL Area IV and Northern Buffer Zone Total Cancer Incidence Risk[a]

Scenario	Excess Lifetime Cancer Incidence Risk [b]		Total Cancer Incidence Risk
	Radiological	Chemical	
With Uranium and Thorium Decay Chain Radionuclides			
Impacts from Average Background			
Onsite suburban resident [c] – Current	1.5×10^{-4}	1.6×10^{-4}	3.1×10^{-4}
Onsite suburban resident [c] – Future	1.3×10^{-4}	1.6×10^{-4}	2.9×10^{-4}
Recreational user	2.9×10^{-5}	4.4×10^{-5}	7.3×10^{-5}
Total Impacts from SSFL Soil			
Onsite suburban resident [c] – Current	1.3×10^{-4}	1.3×10^{-4}	2.6×10^{-4}
Onsite suburban resident [c] – Future	9.1×10^{-5}	1.3×10^{-4}	2.2×10^{-4}
Recreational user	2.9×10^{-5}	4.1×10^{-5}	7.0×10^{-5}
Without Uranium and Thorium Decay Chain Radionuclides			
Impacts from Average Background			
Onsite suburban resident [c] – Current	1.9×10^{-5}	1.6×10^{-4}	1.8×10^{-4}
Onsite suburban resident [c] – Future	2.0×10^{-7}	1.6×10^{-4}	1.6×10^{-4}
Recreational user	1.6×10^{-6}	4.4×10^{-5}	4.6×10^{-5}
Total Impacts from SSFL Soil			
Onsite suburban resident [c] – Current	4.2×10^{-5}	1.3×10^{-4}	1.7×10^{-4}
Onsite suburban resident [c] – Future	2.2×10^{-6}	1.3×10^{-4}	1.3×10^{-4}
Recreational user	8.6×10^{-6}	4.1×10^{-5}	5.0×10^{-5}
Summary of Results			
Incremental Impacts from No Action Alternative (Total minus Background) with Uranium and Thorium Decay Chain Radionuclides			
Onsite suburban resident [c] – Current	-2.0×10^{-5}	-3.0×10^{-5}	-5.0×10^{-5}
Onsite suburban resident [c] – Future	-3.9×10^{-5}	-3.0×10^{-5}	-6.9×10^{-5}
Recreational user	0	-3.0×10^{-6}	-3.0×10^{-6}
Incremental Impacts from No Action Alternative (Total minus Background) without Uranium and Thorium Decay Chain Radionuclides [d]			
Onsite suburban resident [c] – Current	2.3×10^{-5}	-3.0×10^{-5}	-7.0×10^{-6}
Onsite suburban resident [c] – Future	2.0×10^{-6}	-3.0×10^{-5}	-2.8×10^{-5}
Recreational user	7.0×10^{-6}	-3.0×10^{-6}	4.0×10^{-6}

[a] All impacts for soil constituents are based on the mean concentration for all constituents that had 1 or more exceedances of the LUT values. For the onsite resident, the mean concentrations were only from the sub-area that gave the highest impacts. For the recreational user the mean concentrations were averaged for all sub-areas. Direct pathways include external radiation exposure, dermal contact, inhalation, and incidental ingestion. The indirect exposure pathway impacts for the suburban resident are presented and discussed addressed in Appendix G.

[b] The total cancer risk per receptor is estimated by combining the chemical and radiological risks. However, combining the risks should be done with the recognition that the underlying risk slope factors were developed differently. The slope factors used to determine chemical risks generally represent an upper bound or 95 percent upper confidence level (on the arithmetic mean) value developed from studies on laboratory animals. Radionuclide slope factors are best estimates or average values developed from epidemiology studies.

[c] The onsite suburban resident exposure was based on the direct pathways: ingestion, inhalation, dermal and external.

[d] The background includes the natural uranium and thorium decay chain radionuclides, which contribute a major portion of the radiological impacts. EPA determined in its site survey that analytical results associated with uranium and thorium decay chain radionuclides that were greater than its field action levels or radiological trigger levels were from natural background sources in most cases (HGL 2012). However, the variability in the natural background from location to location is significant and may mask the incremental impacts from site-related radionuclides when viewing the total radiological impacts. Therefore, incremental radiological impacts are shown with and without the uranium and thorium decay chain radionuclides included.

Notes:

- Shaded cells indicate site impacts less than those estimated for background exposures.
- The onsite suburban resident evaluations were based on the sub-areas with the maximum total cancer incidence risk for radionuclides without decay (5A), with decay (5B), as well as chemical cancer risk (5D).
- For the onsite suburban resident exposures, current results were based on baseline conditions without radioactive decay, and future results were based on an assumed loss of institutional controls after 100 years of radioactive decay.
- Values are rounded to 2 significant figures.

Table G–41 Parameters for Radionuclide Preliminary Remediation Goal Calculation for Santa Susana Field Laboratory

Parameter	*Units*	*RESRAD Default Value*	*SRAM Value*	*RESRAD Site-Specific Values Used*	*Rationale*
Contaminated Zone					
Area of contaminated zone	m^2	100,000	Dependent on assumed exposure area	10,000	Area assumed to conservatively represent residential conditions.
Thickness of contaminated zone	m	2	Considered all depths	0.5	Typical contamination depth based on sampling data.
Fraction of contamination that is submerged	unitless	0	NA	0	RESRAD Default
Length parallel to aquifer flow	m	100	NA	NA	Not applicable to pathways used.
Basic radiation dose limit	mrem/yr	25	NA	25	DOE Maximum Guideline level
Time since placement of material	yr	0	NA	0	No decay was assumed. Ingrowth of natural decay daughters will have to be handled separately.
Times for calculation	yr	0, 1, 30, 100, 300, 1,000	NA	0	The zero time was used to represent current conditions. Ingrowth daughters will have to be calculated separately. Hundred-year loss of institutional control will also have to be calculated separately.
Cover and Contaminated Zone Hydrological Data					
Initial principal radionuclide	pCi/g	area-specific	area-specific	area-specific	All radionuclides exceeding EPA field action levels by sub-area.
Concentration in groundwater	pCi/L	not- used	not used	NA	Not applicable to pathways used.
Cover depth	m	0	NA	0	No cover was assumed for site conditions.
Density of cover material	g/cm^3	1.5	1.5	NA	Not applicable; no cover assumed.
Cover erosion rate	m/yr	0.001	NA	NA	Not applicable; no cover assumed.
Density of contaminated zone	g/cm^3	1.5	1.5	1.5	RESRAD default
Contaminated zone erosion rate	m/yr	0.001	0	0.001	Not applicable to 0 time
Contaminated zone total porosity	unitless	0.4	0.43	NA	Not applicable to pathways used and 0 time.
Contaminated zone field capacity	unitless	0.2	NA	NA	Not applicable to pathways used and 0 time.
Contaminated zone hydraulic conductivity	m/yr	10	NA	NA	Not applicable to pathways used and 0 time.
Contaminated zone b parameter	unitless	5.3	NA	NA	Not applicable to pathways used and 0 time.
Average annual wind speed	m/sec	2	4.69 (EPA 2001 Soil Screening Guidance default for default PEF)	NA	Not applicable; no cover assumed. PEF used for mass loading.
Humidity in air (g/m^3)	g/m^3	8	NA	8	RESRAD default
Evapotranspiration coefficient	unitless	0.5	NA	NA	Not applicable to pathways used.
Precipitation	m/yr	1	NA	NA	Not applicable to pathways used.
Irrigation rate	m/yr	0.2	NA	NA	Not applicable to pathways used.
Irrigation mode	unitless	overhead	NA	NA	Not applicable to pathways used.

Parameter	*Units*	*RESRAD Default Value*	*SRAM Value*	*RESRAD Site-Specific Values Used*	*Rationale*
Runoff coefficient	unitless	0.2	NA	NA	Not applicable to pathways used.
Watershed area for nearby stream or pond	m^2	1.0×10^6	NA	NA	Not applicable to pathways used.
Accuracy for water/soil computations	unitless	1.0×10^{-3}	NA	NA	Not applicable to pathways used.
Exposure Assumptions					
Exposure duration	yrs	30	30 (24 adult, 6 child)	30 (24 adult, 6 child)	Time-weighted child/adult
Fraction of time spent indoors	unitless	0.5	NA	0.639	SRAM assumption of total 24 hours/day, 350 days per year, with RESRAD default indoor/outdoor ratio applied.
Fraction of time spent outdoors	unitless	0.25	NA	0.32	SRAM assumption of total 24 hours per day 350 days per year, with RESRAD default indoor/outdoor ratio applied.
Exposure time	hr/day	18	24 (350 day/yr)	Adjusted	Fraction of time above corrected for SRAM 24 hours/day, 350 days per year.
Shielding factor, external gamma	unitless	0.7	NA	0.7	RESRAD default
Shape factor flag, external gamma	unitless	1	NA	1	RESRAD default
Inhalation					
Inhalation rate	m^3/yr	8400	0.35/0.55 m^3 per hour	4468	SRAM time-weighted child/adult
Mass loading for inhalation	g/m^3	0.0001	1.36×10^9 mg^3/kg	7.35×10^{-7}	Based on SRAM PEF
Shielding factor, inhalation	unitless	0.4	NA	0.4	RESRAD default
Soil Ingestion					
Soil ingestion rate	g/yr	36.5		NA	Adult
Soil ingestion rate – adult	mg/day	NA	100	NA	Adult
Soil ingestion rate – child	mg/day	NA	200	NA	Child
Soil ingestion rate – time weighted average	g/yr	NA	43.8	43.8	SRAM time-weighted child/adult
Fruit and Vegetable Ingestion					
Fruits, vegetables and grain consumption	kg/yr	160	Not grouped the same	NA	Not applicable to pathways used.
Leafy vegetable consumption	kg/yr	14	Not grouped the same	NA	Not applicable to pathways used.
Fruit ingestion rate	kg/day	NA	0.3773(adult), 0.08145(child)	NA	Not applicable to pathways used.
Fruit ingestion rate, time weighted average	kg-yr/ kg-day	NA	0.1619	NA	Not applicable to pathways used.
Vegetable ingestion rate	kg/day	NA	0.3248(adult), 0.0849(child)	NA	Not applicable to pathways used.
Vegetable ingestion rate, time weighted average	kg-yr/ kg-day	NA	0.1453	NA	Not applicable to pathways used.
Contamination fraction of plant food	unitless	0.5	1	NA	Not applicable to pathways used.
Mass loading for foliar deposition	g/m^3	0.0001	0.26	NA	Not applicable to pathways used.
Depth of soil mixing layer	m	0.15	NA	NA	Not applicable to pathways used.
Depth of roots	m	0.9	NA	NA	Not applicable to pathways used.

Parameter	Units	RESRAD Default Value	SRAM Value	RESRAD Site-Specific Values Used	Rationale
Irrigation fraction from groundwater	unitless	1	NA	NA	Not applicable to pathways used.
				NA	Not applicable to pathways used.
Summary of Pathway Selections					
External gamma		active	complete	active	
Inhalation (without radon)		active	complete	active	
Plant ingestion		active	complete	suppressed	Not applicable to pathways used.
Meat ingestion		active	incomplete for residential	suppressed	Not applicable to pathways used.
Milk ingestion		active	incomplete for residential	suppressed	Not applicable to pathways used.
Aquatic foods		active	incomplete for residential	suppressed	Not applicable to pathways used.
Drinking water		active	incomplete for residential	suppressed	Not applicable to pathways used.
Soil ingestion		active	complete	active	
Radon		suppressed	NA	suppressed	Not applicable to pathways used.

cm^3 = cubic centimeter; EPA = U.S. Environmental Protection Agency; g = gram; hr = hour; kg = kilogram; m = meter; m^2 = square meter; m^3 = cubic meter; mg = milligram; mrem = millirem; NA = not applicable or not available; pCi/g =picocuries per gram; pCi/L = picocuries per liter; PEF = SRAM particulate emission factor; RESRAD = RESidual RADioactive modeling software; sec = second; SRAM = *Final Standardized Risk Assessment Methodology Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California* (MWH 2014); yr(s) = year(s).

Table G–42 Onsite Suburban Resident Risk-Based/Dose-Based Screening Levels for Radionuclides in Soil

Constituent	*Residential RBSL for Radionuclides in Soil (RME) (pCi/g)*	*SRAM/RESRAD RBSL (RME) (pCi/g)*	*SRAM/RESRAD 25 mrem (RME) pCi/g)*
Ac-227	4.0	6.9×10^{-2}	1.7×10^{1}
Am-241	2.0	2.0	4.0×10^{2}
Bi-210	2.6×10^{4}	5.8×10^{2}	8.7×10^{3}
Bi-211	2.7×10^{6}	--	--
Bi-212	3.6×10^{4}	--	--
Cm-243	3.2×10^{-1}	1.5×10^{-1}	5.6×10^{1}
Co-60	3.3×10^{-2}	1.5×10^{-2}	2.3
Cs-137	5.5×10^{-2}	2.5×10^{-2}	1.0×10^{1}
Eu-152	3.6×10^{-2}	1.7×10^{-2}	5.1
Eu-154	4.5×10^{-2}	2.1×10^{-2}	4.7
H-3	2.2×10^{-1}	1.2×10^{3}	2.8×10^{4}
Ni-59	6.5×10^{2}	2.1×10^{3}	2.6×10^{6}
Pa-231	6.0×10^{-1}	9.5×10^{-2}	9.3×10^{1}
Pb-210	7.1×10^{-1}	4.0×10^{-1}	1.3×10^{2}
Pb-211	1.0×10^{5}	--	--
Pb-212	3.4×10^{3}	--	--
Po-210	1.3×10^{1}	2.0×10^{1}	3.0×10^{2}
Pu-238	3.9	5.2	7.0×10^{2}
Pu-239	3.4	4.5	6.4×10^{2}
Ra-223	8.7×10^{1}	2.4×10^{1}	5.0×10^{2}
Ra-224	2.2×10^{3}	4.6	1.6×10^{2}
Ra-226	1.2×10^{-2}	6.5×10^{-3}	3.3
Ra-228	8.7×10^{-2}	1.5×10^{-2}	4.8
Sr-90	3.8	3.4	1.2×10^{3}
Th-227	8.8×10^{1}	1.4×10^{1}	2.3×10^{2}
Th-228	2.9×10^{1}	6.5×10^{-2}	4.1
Th-230	4.5	8.3×10^{-1}	7.1×10^{2}
Th-232	4.1	5.8×10^{-3}	7.4×10^{1}
Tl-207	1.5×10^{7}	--	--
Tl-208	2.1×10^{4}	--	--
U-234	5.2	9.6	3.2×10^{3}
U-235	1.7×10^{-1}	1.0×10^{-1}	4.5×10^{1}
U-238	6.9×10^{-1}	4.6×10^{-1}	2.4×10^{2}

mrem = millirem; pCi/g =picocuries per gram; RBSL = risk-based screening level; RESRAD = RESidual RADioactive modeling software; RME = Reasonable Maximum Exposure; SRAM = *Final Standardized Risk Assessment Methodology Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California* (MWH 2014).

Notes:

– Radiological RBSLs are from EPA sources (epa-prgs.ornl.gov/radionuclides/) and were calculated using the *Final Standardized Risk Assessment Methodology Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California* (MWH 2014) parameters for suburban residential garden pathway exposure.

– "--" indicates that the radionuclide is included in the dose/risk factor for its parent.

– Cancer-based values were calculated for a risk level of 1×10^{-6}.

– Residential pathways for radiological exposures to soil include ingestion, inhalation, and external exposure.

Table G–43 Summary of Building Survey Sources

Building	Reference
4019 (System Nuclear Qualification Test Facility [SNAP])	*Draft Technical Memorandum Subarea HSA-5B Historical Site Assessment Santa Susana Field Laboratory Site Area IV Radiological Study Ventura County, California*, EPA, October 2010, from Boeing Report, RS-00009, *Building 4019, Final Status Survey Report*, The Boeing Company, Santa Susana Field Laboratory, June 10, 1999.
4021 (Radioactive Materials Handling Facility [RMHF]); Decon Facility	*Radioactive Materials Handling Facility Current Radiological Status*, The Boeing Company, Santa Susana Field Laboratory, March 16, 2007.
4022 (RMHF)	*Final Combined Summary Report: Radioactive Materials Handling Facility Building Surveys*, The Boeing Company, Santa Susana Field Laboratory, October 2007.
4022 (RMHF) Sub-grade Vaults	*Radioactive Materials Handling Facility Current Radiological Status*, The Boeing Company, Santa Susana Field Laboratory, March 16 2007; RMHF_B4022_vault 7 block D pre-fixative_732-A_2012-02-07.xlsx; RMHF_B4022_vault 7 Shield Blocks_732-A_2011-10-19.xlsx.
4024 Including Test Cells and Core Bores (SNAP)	*Report of Radiological Characterization and Confirmatory Survey Results for the SNAP Environmental Test Facility – Building 4024*, prepared by Areva NP, Inc., for The Boeing Company, Santa Susana Field Laboratory, January 2008.
4024 Paved Yard and Concrete Slabs (SNAP)	*Report of Radiological Characterization and Confirmatory Survey Results for the SNAP Environmental Test Facility – Building 4024*, prepared by Areva NP, Inc., for The Boeing Company, Santa Susana Field Laboratory, January 2008.
4075 (RMHF); Radioactive Waste Storage	*Final Combined Summary Report: Radioactive Materials Handling Facility Building Surveys*, The Boeing Company, Santa Susana Field Laboratory, October 2007.
4563 (RMHF); Open-walled Storage Area	*Final Combined Summary Report: Radioactive Materials Handling Facility Building Surveys*, The Boeing Company, Santa Susana Field Laboratory, October 2007.
4621 (RMHF); Contaminated Equipment Storage	*Final Combined Summary Report: Radioactive Materials Handling Facility Building Surveys*, The Boeing Company, Santa Susana Field Laboratory, October 2007.
4665 (RMHF); Oxidation Facility and Nonradioactive Waste Storage	*Final Combined Summary Report: Radioactive Materials Handling Facility Building Surveys*, The Boeing Company, Santa Susana Field Laboratory, October 2007 (Total) and *Radioactive Materials Handling Facility Current Radiological Status*, The Boeing Company, Santa Susana Field Laboratory, March 16, 2007 (Removable).
4688 (RMHF); Open-walled Cleaning Station and Radioactive Materials Storage	*Final Combined Summary Report: Radioactive Materials Handling Facility Building Surveys*, The Boeing Company, Santa Susana Field Laboratory, October 2007.

Table G–44 Building Survey Results and Physical Dimensions

Parameter	*Buildings*											
	4019 (SNAP) System Nuclear Qualification Test Facility	***4021 (RMHF); Decon Facility***	***4022 (RMHF)***	***4022 (RMHF) Subgrade Vaults***	***4024 Including Test Cells and core bores***	***4024 Paved Yard and Concrete Slabs***	***4075 (RMHF); Radioactive Waste Storage***	***4563 (RMHF); Open-walled Storage Area***	***4621 (RMHF); Contami-nated Equipment Storage***	***4658 (RMHF); Former Guard Shack***	***4665 (RMHF); Oxidation Facility and Non-radioactive Waste Storage***	***4688 (RMHF); Open-walled Cleaning Station and Radioactive Materials Storage***
Total Alpha (dpm/100 cm^2)	1.30×10^{1}	4.00×10^{2}	1.53×10^{2}	7.40×10^{1}	0.00	4.09×10^{1}	1.68×10^{1}	4.00×10^{1}	6.88×10^{1}	0.00	6.17×10^{1}	2.88×10^{2}
Total Beta (dpm/100 cm^2)	9.61×10^{2}	4.20×10^{5}	6.93×10^{3}	9.58×10^{4}	3.29×10^{3}	8.44×10^{2}	0.00	1.63×10^{2}	3.84×10^{2}	0.00	1.35×10^{3}	5.00×10^{2}
Removable Alpha (dpm/100 cm^2)	5.00	2.00×10^{1}	2.00×10^{1}	2.00×10^{1}	0.00	0.00	5.00	1.05	2.20×10^{-1}	0.00	2.00×10^{1}	1.44×10^{1}
Removable Beta (dpm/100 cm^2)	2.50×10^{1}	6.85×10^{2}	1.00×10^{2}	1.50×10^{3}	0.00	0.00	6.00×10^{1}	0.00	0.00	0.00	1.00×10^{2}	2.50×10^{1}
Surface Area Represented (m^2)	8.54×10^{3}	1.95×10^{3}	1.81×10^{3}	1.37×10^{3}	3.12×10^{3}	2.68×10^{3}	1.20×10^{3}	8.48×10^{2}	3.57×10^{2}	1.00×10^{2}	2.68×10^{2}	1.17×10^{2}
Interior Air Volume (m^3)	4.82×10^{3}	9.91×10^{2}	5.52×10^{3}	6.13×10^{2}	7.18×10^{3}	1.63×10^{4}	6.12×10^{2}	2.58×10^{3}	1.81×10^{2}	5.10×10^{1}	1.36×10^{2}	3.57×10^{2}
Building Demolition Duration (days)	2.20×10^{1}	1.40×10^{1}	1.40×10^{1}	1.40×10^{1}	3.90×10^{1}	4.00	4.00	4.00	4.00	4.00	4.00	4.00

dpm = disintegrations per minute; cm^2 = square centimeters; m^2 = square meters; m^3 = cubic meters; RMHF = Radioactive Materials Handling Facility; SNAP = Systems for Nuclear Auxiliary Power.

Notes:

– Values for total and removable alpha/beta contamination represent the maximum of the calculated median values for each building survey in units of dpm per 100 cm^2.

– Demolition duration is based on the planned Building Removal Alternative.

Table G–45 Fraction of Building Surface Activity Associated with Individual Radionuclides

Radionuclide	Decay Type	Volume weighted percent of surface activity		
		Total	Alpha	Beta
H-3	beta	7.57×10^{-2}	--	7.57×10^{-2}
Na-22	beta	3.48×10^{-13}	--	3.48×10^{-13}
Fe-55	beta	1.16×10^{-4}	--	1.16×10^{-4}
Ni-63	beta	2.58	--	2.58
Co-60	beta	3.65×10^{-1}	--	3.65×10^{-1}
Sr-90	beta	4.80×10^{1}	--	4.80×10^{1}
Cs-134	beta	1.59×10^{-5}	--	1.59×10^{-5}
Cs-137	beta	1.12	--	1.12
Eu-152	beta	3.54×10^{-3}	--	3.54×10^{-3}
Eu-154	beta	3.78×10^{-4}	--	3.78×10^{-4}
Eu-155	beta	2.52×10^{-5}	--	2.52×10^{-5}
Th-232	alpha	1.62×10^{-1}	1.62×10^{-1}	--
U-234	alpha	1.12	1.12	--
U-235	alpha	1.03×10^{-1}	1.03×10^{-1}	--
U-238	alpha	1.29	1.29	--
Pu-238	alpha	1.90	1.90	--
Pu-239	alpha	4.84×10^{1}	4.84×10^{1}	--
Pu-240	alpha	1.80×10^{1}	1.80×10^{1}	--
Pu-241	beta	2.38×10^{-2}	--	2.38×10^{-2}
Pu-242	alpha	1.22×10^{-1}	1.22×10^{-1}	--
Am-241	alpha	2.07×10^{1}	2.07×10^{1}	--

Notes:
– Isotopic fractions were developed from historical characterization records of 2,355 shipments of waste from D&D activities and shipped from the RMHF area (Boeing 2014).
– "--" indicates that the decay type is not applicable for that radionuclide.

Table G–46 Building Preliminary Remediation Goals for Decontamination and Decommissioning Worker Exposure

Radionuclide	Dust BPRG (pCi/cm^2)	Ambient Air BPRG (pCi/m^3)	3-D External Ground Plane BPRG (pCi/cm^2)
H-3	3.8×10^{1}	1.8×10^{1}	--
Na-22	8.1×10^{-1}	5.5×10^{-1}	4.8×10^{-1}
Fe-55	1.1×10^{1}	3.4×10^{1}	--
Ni-63	2.8	1.5	--
Co-60	4.2×10^{-1}	2.7×10^{-1}	2.3×10^{-1}
Sr-90	2.1×10^{-2}	2.5×10^{-2}	5.8
Cs-134	1.7×10^{-1}	9.6×10^{-1}	8.5×10^{-1}
Cs-137	3.8×10^{-2}	9.3×10^{-2}	3.6×10^{-1}
Eu-152	5.6×10^{-1}	7.4×10^{-2}	2.3×10^{-1}
Eu-154	4.7×10^{-1}	9.0×10^{-2}	2.8×10^{-1}
Eu-155	4.1	1.6	1.0×10^{1}
Th-232	1.2×10^{-3}	9.2×10^{-5}	8.8×10^{-2}
U-234	1.8×10^{-2}	2.9×10^{-4}	1.9×10^{2}
U-235	1.8×10^{-2}	3.2×10^{-4}	1.1
U-238	1.6×10^{-2}	3.4×10^{-4}	2.5
Pu-238	8.6×10^{-3}	1.7×10^{-4}	2.3×10^{2}
Pu-239	7.5×10^{-3}	1.4×10^{-4}	3.7×10^{2}
Pu-240	7.5×10^{-3}	1.4×10^{-4}	2.2×10^{2}
Pu-241	9.0×10^{-1}	1.6×10^{-2}	1.3×10^{5}
Pu-242	7.9×10^{-3}	1.5×10^{-4}	2.1×10^{2}
Am-241	1.0×10^{-2}	2.2×10^{-4}	6.3

BPRG = Building Preliminary Remediation Goal; D&D = decontamination and decommissioning; pCi/cm^2 = picocuries per square centimeter; pCi/m^3 = picocuries per cubic meter.
Note:
– BPRGs are from the EPA online calculator using default exposure assumptions (https://epa-bprg.ornl.gov/).
– "--" indicates that the decay type is not applicable for that radionuclide.

Table G–47 Ratio of Morbidity to Mortality for Decontamination and Decommissioning Worker Exposure Pathways

Radionuclide	Ingestion	Inhalation	External
H-3	1.5	1.2	1.0
Na-22	1.5	1.5	1.5
Fe-55	1.3	1.2	1.0
Ni-63	1.7	1.2	1.0
Co-60	1.6	1.2	1.5
Sr-90	1.1	1.1	1.2
Cs-134	1.5	1.2	1.5
Cs-137	1.5	1.5	1.2
Eu-152	1.7	1.2	1.5
Eu-154	1.8	1.2	1.5
Eu-155	1.8	1.1	1.5
Th-232	1.5	1.1	1.6
U-234	1.6	1.1	1.6
U-235	1.6	1.1	1.5
U-238	1.5	1.1	1.7
Pu-238	1.3	1.1	1.7
Pu-239	1.3	1.1	1.6
Pu-240	1.3	1.1	1.7
Pu-241	1.2	1.2	1.5
Pu-242	1.3	1.1	1.7
Am-241	1.4	1.2	1.5

Note: Ratios were developed from Federal Guidance Reports, as described in Section G.4.3.

Table G–48 Ratio of Morbidity to Dose for Decontamination and Decommissioning Worker Exposure Pathways

Radionuclide	Ingestion	Inhalation	External
H-3	0.10	0.12	1.00
Na-22	0.11	0.08	0.08
Fe-55	0.10	0.06	1.00
Ni-63	0.17	0.10	1.00
Co-60	0.18	0.10	0.08
Sr-90	0.07	0.08	0.11
Cs-134	0.07	0.07	0.08
Cs-137	0.08	0.07	0.16
Eu-152	0.17	0.06	0.08
Eu-154	0.20	0.06	0.08
Eu-155	0.23	0.06	0.07
Th-232	0.02	0.05	0.05
U-234	0.06	0.10	0.04
U-235	0.05	0.10	0.08
U-238	0.05	0.10	0.04
Pu-238	0.02	0.02	0.04
Pu-239	0.02	0.02	0.04
Pu-240	0.02	0.02	0.04
Pu-241	0.01	0.01	0.66
Pu-242	0.02	0.02	0.04
Am-241	0.02	0.02	0.06

Note: Ratios were developed from Federal Guidance Reports, as described in Section G.4.3.

Table G–49 Cancer Incidence Risk for Decontamination and Decommissioning Worker Exposures

	Buildings											
Exposure Pathway	***4019 (SNAP) System Nuclear Qualification Test Facility***	***4021 (RMHF); Decon Facility***	***4022 (RMHF)***	***4022 (RMHF) Sub-grade Vaults***	***4024 Including Test Cells and core bores***	***4024 Paved Yard and Concrete Slabs***	***4075 (RMHF); radioactive waste storage***	***4563 (RMHF); Open-walled Storage Area***	***4621 (RMHF); Contaminated Equipment Storage***	***4665 (RMHF); Oxidation Facility and Non-radioactive Waste Storage***	***4688 (RMHF); Open-walled Cleaning Station and Radioactive Materials Storage***	***Total Building D&D Project***
Ingestion	8.3×10^{-15}	2.9×10^{-7}	4.9×10^{-8}	4.0×10^{-7}	2.2×10^{-9}	7.1×10^{-11}	5.7×10^{-9}	3.7×10^{-10}	1.2×10^{-10}	1.3×10^{-8}	6.6×10^{-9}	7.7×10^{-7}
Inhalation	2.4×10^{-5}	1.1×10^{-5}	2.2×10^{-5}	3.0×10^{-6}	4.0×10^{-6}	6.0×10^{-7}	4.9×10^{-6}	1.2×10^{-6}	1.2×10^{-5}	1.9×10^{-5}	8.9×10^{-6}	1.1×10^{-4}
External Exposure	2.0×10^{-9}	5.5×10^{-7}	9.2×10^{-9}	1.3×10^{-7}	1.2×10^{-8}	3.2×10^{-10}	2.9×10^{-12}	6.8×10^{-11}	1.6×10^{-10}	5.2×10^{-10}	2.4×10^{-10}	7.0×10^{-7}
Total	$\mathbf{2.4\times10^{-5}}$	$\mathbf{1.2\times10^{-5}}$	$\mathbf{2.2\times10^{-5}}$	$\mathbf{3.6\times10^{-6}}$	$\mathbf{4.0\times10^{-6}}$	$\mathbf{6.0\times10^{-7}}$	$\mathbf{4.9\times10^{-6}}$	$\mathbf{1.2\times10^{-6}}$	$\mathbf{1.2\times10^{-5}}$	$\mathbf{1.9\times10^{-5}}$	$\mathbf{8.9\times10^{-6}}$	$\mathbf{1.1\times10^{-4}}$

D&D = decontamination and decommissioning; RMHF = Radioactive Materials Handling Facility; SNAP = Systems for Nuclear Auxiliary Power.
Note: Cancer incidence risk represents the frequency of additional cancers occurring in an exposed individual and is compared with the acceptable range of 1 cancer per 10,000 to 1 cancer per 1,000,000 exposures.

Table G–50 Cancer Mortality Risk for Decontamination and Decommissioning Worker Exposures

	Buildings											
Exposure Pathway	***4019 (SNAP) System Nuclear Qualification Test Facility***	***4021 (RMHF); Decon Facility***	***4022 (RMHF)***	***4022 (RMHF) Sub-grade Vaults***	***4024 Including Test Cells and core bores***	***4024 Paved Yard and Concrete Slabs***	***4075 (RMHF); radioactive waste storage***	***4563 (RMHF); Open-walled Storage Area***	***4621 (RMHF); Contaminated Equipment Storage***	***4665 (RMHF); Oxidation Facility and Non-radioactive Waste Storage***	***4688 (RMHF); Open-walled Cleaning Station and Radioactive Materials Storage***	***Total Building D&D Project***
Ingestion	1.5×10^{-8}	2.5×10^{-7}	4.0×10^{-8}	3.5×10^{-7}	1.9×10^{-9}	6.0×10^{-11}	4.8×10^{-9}	2.8×10^{-10}	9.4×10^{-11}	1.1×10^{-8}	5.2×10^{-9}	6.7×10^{-7}
Inhalation	2.1×10^{-5}	1.0×10^{-5}	1.9×10^{-5}	2.6×10^{-6}	3.7×10^{-6}	5.3×10^{-7}	4.3×10^{-6}	1.0×10^{-6}	1.0×10^{-5}	1.7×10^{-5}	7.9×10^{-6}	9.8×10^{-5}
External Exposure	1.6×10^{-9}	4.5×10^{-7}	7.4×10^{-9}	1.0×10^{-7}	9.7×10^{-9}	2.6×10^{-10}	1.9×10^{-12}	5.4×10^{-11}	1.2×10^{-10}	4.2×10^{-10}	1.8×10^{-10}	5.7×10^{-7}
Total	$\mathbf{2.1\times10^{-5}}$	$\mathbf{1.1\times10^{-5}}$	$\mathbf{1.9\times10^{-5}}$	$\mathbf{3.2\times10^{-6}}$	$\mathbf{3.7\times10^{-6}}$	$\mathbf{5.3\times10^{-7}}$	$\mathbf{4.3\times10^{-6}}$	$\mathbf{1.0\times10^{-6}}$	$\mathbf{1.0\times10^{-5}}$	$\mathbf{1.7\times10^{-5}}$	$\mathbf{7.9\times10^{-6}}$	$\mathbf{9.9\times10^{-5}}$

D&D = decontamination and decommissioning; RMHF = Radioactive Materials Handling Facility; SNAP = Systems for Nuclear Auxiliary Power.
Note: Cancer mortality risk represents the frequency of additional cancer fatalities occurring in an exposed individual.

Table G–51 Radiological Dose for Decontamination and Decommissioning Worker Exposures

Exposure Pathway	*Buildings*											*Total Building D&D Project*
	4019 (SNAP) System Nuclear Qualification Test Facility	*4021 (RMHF); Decon Facility*	*4022 (RMHF)*	*4022 (RMHF) Sub-grade Vaults*	*4024 Including Test Cells and core bores*	*4024 Paved Yard and Concrete Slabs*	*4075 (RMHF); radioactive waste storage*	*4563 (RMHF); Open-walled Storage Area*	*4621 (RMHF); Contaminated Equipment Storage*	*4665 (RMHF); Oxidation Facility and Non-radioactive Waste Storage*	*4688 (RMHF); Open-walled Cleaning Station and Radioactive Materials Storage*	
Ingestion	8.3×10^{-15}	5.2×10^{-1}	1.6×10^{-1}	6.9×10^{-1}	3.3×10^{-3}	1.6×10^{-4}	1.5×10^{-2}	1.9×10^{-3}	5.4×10^{-4}	4.5×10^{-2}	2.8×10^{-2}	1.5
Inhalation	1.1×10^{2}	2.4×10^{1}	1.0×10^{2}	7.0	5.0	2.9	2.5×10^{1}	6.0	5.9×10^{1}	9.5×10^{1}	4.6×10^{1}	4.8×10^{2}
External Exposure	1.7×10^{-3}	4.8×10^{-1}	8.1×10^{-3}	1.1×10^{-1}	1.0×10^{-2}	2.9×10^{-4}	5.3×10^{-6}	6.6×10^{-5}	1.5×10^{-4}	4.6×10^{-4}	2.5×10^{-4}	6.1×10^{-1}
Total	**1.1×10^{2}**	**2.5×10^{1}**	**1.0×10^{2}**	**7.8**	**5.1**	**2.9**	**2.5×10^{1}**	**6.0**	**5.9×10^{1}**	**9.5×10^{1}**	**4.6×10^{1}**	**4.8×10^{2}**

D&D = decontamination and decommissioning; RMHF = Radioactive Materials Handling Facility; SNAP = Systems for Nuclear Auxiliary Power.
Note: All results are in millirem over the duration of the exposures.

Table G–52 Bedrock Parameters for Excavation Remedial Action

Parameter	*Value*	*Units*	*Description*
Bedrock strontium-90 mass concentration	516	picocuries per gram	Measured
Density of bedrock	150	pounds per cubic foot	Estimated
Excavation area	2,400	square feet	Assumed 30- × 80-foot area
Excavation soil volume	140,000	cubic feet	Assumed 3-foot depth
Excavation soil volume - converted	3,964	cubic meters	Converted volume
Bedrock excavation volume	1,050	cubic yards	From remedial design plans for excavated material (see Chapter 2)
Bedrock excavation volume	28,350	cubic feet	Converted volume
Excavated bedrock surface area	170,100	square feet	Estimated from remedial action description
Excavated bedrock release depth	0.01	feet	Assumed to be 1/8th inch thick
Volume of potential bedrock release material	1,772	cubic feet	Surface area of each cubic foot of bedrock removed (6 square feet) times depth of material that is available for exposure (1/8 inch) on each surface of each bedrock block.
Volume of potential release material – converted	18	cubic meters	Converted volume

Notes:
– Bedrock concentration of strontium-90 based on available measurements (see Section G.9).
– The density of bedrock is assumed to be 150 pounds per cubic foot.
– The excavation area and bedrock excavation volume were estimated for the Groundwater Treatment Alternative.
– The depth of available contamination is assumed to be 1/8 inch.

Table G–53 Bedrock Excavation Exposure Concentrations for Remediation Worker

Parameter	*Value*	*Units*	*Description*
Source material in excavated bedrock surface area	6.2×10^{10}	picocuries	Volume of potential release material times mass concentration, density, and mass conversion
Area concentration on surface of excavated bedrock	3.7×10^{5}	picocuries per square foot	Source material in excavated surface area divided by excavated bedrock surface area
Area concentration for external exposures	390	picocuries per square centimeter	Converted area concentration
Bedrock source material release fraction	1.0×10^{-3}	unitless	Assumed portion of surface area source material that is available for release
Area concentration for ingestion exposures	0.39	picocuries per square centimeter	Area concentration for external exposures times release fraction
Bedrock material release source term	6.2×10^{7}	picocuries	Source material in excavated bedrock rubble surface area times release fraction
Mitigation measure release reduction factor	0.50	unitless	Assumed 50 percent removal by water spray
Air Concentration of released source term	7,900	picocuries per cubic meter	Material release source term times reduction factor divided by excavation volume
Respirator exposure reduction factor	0.01	unitless	Assumed 99 percent efficiency of respirator
Exposure air concentration	79	picocuries per cubic meter	Air concentration times reduction factor

Assumptions:

– Bedrock density of 150 pounds per cubic feet.
– Bedrock concentration of strontium-90 of 516 picocuries per gram.
– Total volume of excavated bedrock of 1050 cubic yards.
– Surface area of contaminated material equals 170,100 square feet in source term for external and ingestion exposure.
– Volume of contaminated material equals 1,772 cubic feet in source term for inhalation exposure.
– Volume of air in excavation area for inhalation exposures of 140,000 cubic feet.

Table G–54 Bedrock Excavation Impact Assessment for Remediation Worker

Pathway Parameters	*Ingestion*	*Inhalation*	*External*	*Total*
Exposure Concentration Units	pCi/cm^2	pCi/m^3	pCi/cm^2	
Exposure Concentration	0.39	79	390	
Default BPRG	0.021	0.025	5.8	
Adjusted BPRG	6.4	7.7	1,800	
Cancer Incidence to Fatality Ratio	1.15	1.07	1.23	
Cancer Incidence to Dose Ratio (millirem/risk)	0.07	0.08	0.11	
Cancer Incidence Risk	6.1×10^{-8}	1.0×10^{-5}	2.2×10^{-7}	**1.0×10^{-5}**
Cancer Fatality Risk	5.3×10^{-8}	9.5×10^{-6}	1.8×10^{-7}	**9.8×10^{-6}**
Radiological Dose (millirem)	0.93	130	1.9	**130**

BPRG = Building Preliminary Remediation Goals; pCi/cm^2 = picocuries per square centimeter; pCi/cm^3 = picocuries per cubic meter.

Notes:

– BPRGs are for a cancer incidence rate of 1×10^{-6} and were adjusted from a default exposure duration of 6,250 days to a 20-day duration of bedrock removal.
– Strontium-90 BPRG ratios for fatality and dose were calculated based on comparison of literature values (see Section G.9.1).
– Cancer incidence to dose ratio is based on dose per each 1×10^{-6} cancer incidence risk.

G.11 References

Boeing (The Boeing Company), 2014, Personal communication (email) from Philip Rutherford to Gary Roles, Leidos, "Re: D&D of SSFL," May 29.

Boeing (The Boeing Company), 2016, Letter from S. L. Shestag to S. Kuehl, Third District County of Los Angeles, M. Englander, Los Angeles City Council, and F. Pavley, Senator, 27th District, "Re: Letter of December 14, 2015 from Supervisor Kuehl, Councilman Englander, and Senator Pavley to Barbara Lee, Director California Department of Toxic Substances Control," February 22.

Carroll, J. W., J. M. Marzec, and A. M. Stelle, 1982, *RMDF Leach Field Decontamination Final Report,* Rockwell International, Atomics International Division, September 15.

CDM Smith, 2014, personal communication (email) from J. Wondolleck to T. Rucker, Leidos, transmitting MWH SSFL Area IV and NBZ soil data sets, December 18.

CDM Smith, 2015, *Final RCRA Facility Investigation (RFI) Groundwater Work Plan, Portions of Area IV under DOE Responsibility, Santa Susana Field Laboratory, Ventura County, California*, November 9.

CDM Smith, 2017, *Chemical Data Summary Report*, *Santa Susana Field Laboratory, Ventura County, California*, Denver, Colorado, May.

DOE (U.S. Department of Energy), 1994, *DOE Handbook, Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities,* Vols. I and II, (Reaffirmed in 2013), DOE-HDBK-3010-94, Washington, DC, December.

DOE (U.S. Department of Energy), 2011, *Administrative Change to DOE O 458.1, Radiation Protection of the Public and the Environment*, Change 3 (January 15, 2013), Office of Health, Safety and Security, Washington, DC.

DTSC (State of California Department of Toxic Substances Control), 2010, *The State of California Environmental Protection Agency, Department of Toxic Substances Control and the United States Department of Energy in the Matter of Santa Susana Field Laboratory, Simi Hills, Ventura County, California, Administrative Order on Consent for Remedial Action*, Docket No. HSA-CO 10/11-037, Health and Safety Code Sections *25355.5(a)(1)(B), 58009 and 58010* (available at http://www.etec.energy.gov/ Regulation/RegDocs/ SSFL_DOE_AOC_Final.pdf), December 6.

EPA (U.S. Environmental Protection Agency), 1993, *External Exposure to Radionuclides in Air, Water, and Soil*, Federal Guidance Report No. 12, EPA 402-R-93-81, Office of Radiation and Indoor Air, Washington, DC, September.

EPA (U.S. Environmental Protection Agency), 1996, *EPA Environmental Engineering Sourcebook*, J. R. Boulding, Ed., Ann Arbor Press, Chelsea, Michigan.

EPA (U.S. Environmental Protection Agency), 1999, *Cancer Risk Coefficients for Environmental Exposure to Radionuclides*, Federal Guidance Report No. 13, EPA 402-R-99-001, Office of Radiation and Indoor Air, Washington, DC, September.

EPA (U.S. Environmental Protection Agency), 2001, *Risk Assessment Guidance for Superfund*, *Volume I, Human Health Evaluation Manual, (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments)*, Final, Office of Emergency and Remedial Response, December.

EPA (U.S. Environmental Protection Agency), 2015a, *Preliminary Remediation Goals for Radionuclides in Buildings (BPRG)* (available at https://epa-bprg.ornl.gov/), March 29.

EPA (U.S. Environmental Protection Agency), 2015b, *Preliminary Remediation Goals for Radionuclides (PRG)* (available at http://epa-prgs.ornl.gov/radionuclides/), August 29.

HGL (HydroGeoLogic, Inc.), 2011, *Final Radiological Background Study Report*, *Santa Susana Field Laboratory, Ventura County, California*, prepared for the U.S. Environmental Protection Agency, Region 9, October.

HGL (HydroGeoLogic, Inc.), 2012, *Final Radiological Characterization of Soils, Area IV and the Northern Buffer Zone, Area IV Radiological Study, Santa Susana Field Laboratory, Ventura County, California*, prepared for the U.S. Environmental Protection Agency, Region 9, December 21.

ICRP (International Commission on Radiological Protection), 2012, *Compendium of Dose Coefficients based on ICRP Publication 60*, ICRP Publication 119, October.

MWH (MWH Americas, Inc.), 2014, *Final Standardized Risk Assessment Methodology Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California*, Pasadena, California, August.

MWH (MWH Americas, Inc.), 2015, Personal communication (email) from D. Hambrick to S. Jennings and J. Jones, U.S. Department of Energy, and A. Lenox and D. Dassler, Boeing "RE: Background calculations for chemicals and radionuclides," July 27.

URS (URS Corporation), 2012, *Final Chemical Soil Background Study Report, Santa Susana Field Laboratory, Ventura County, California*, Los Angeles, California, prepared for the California Environmental Protection Agency, Department of Toxic Substances Control, December.

Van den Berg, M., L. S. Birnbaum, M. Denison, M. De Vito, W. Farland, M. Feeley, H. Fiedler, H. Hakansson, A. Hanberg, L. Haws, M. Rose, S. Safe, D. Schrenk, C. Tohyama, A. Tritscher, J. Tuomisto, M. Tysklind, N. Walker, and R. E. Peterson, 2006, "The 2005 World Health Organization Reevaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-like Compounds," *Toxicological Sciences*, Vol. 93, Issue 2, pp. 223–241, July.

Appendix H
Evaluation of Transportation and Traffic Impacts

APPENDIX H
EVALUATION OF TRANSPORTATION AND TRAFFIC IMPACTS

H.1 Introduction

Transportation of any commodity involves a risk to transport crew members and members of the public. This risk results directly from transportation-related accidents and indirectly from increased levels of air pollution from vehicle emissions, regardless of the cargo. Transport of certain materials, such as hazardous or radioactive waste, can pose an additional risk due to the unique nature of the material itself. To permit a complete appraisal of the environmental impacts of the alternatives, this appendix to the *Draft Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory (Draft SSFL Area IV EIS)* assesses the human health risks associated with the transportation of radioactive waste, hazardous waste, nonhazardous waste, and nonradioactive materials on public highways.

This appendix provides an overview of the approach used to assess the human health risks that could result from transportation. The topics in this appendix include the scope of the assessment, packaging, determination of potential transportation routes, analytical methods used for the risk assessment (for example, computer models), and important assessment assumptions. In addition, to aid in understanding and interpreting the results, specific areas of uncertainty are described with an emphasis on how those uncertainties may affect comparisons of the alternatives.

The risk assessment results are presented in this appendix in terms of "per-shipment" risk factors, as well as the total risks for a given alternative. Per-shipment risk factors provide an estimate of the risk from a single shipment. The total risks for a given alternative are estimated by multiplying the expected number of shipments by the appropriate per-shipment risk factors.

H.2 Scope of Assessment

The scope of the transportation risk assessment, including transportation activities; potential radiological, chemical, and nonradiological impacts; transportation modes; and receptors, is described in this section. This evaluation focuses on using offsite public highways, but onsite impacts are also considered. Additional details of the assessment are provided in the remaining sections of this appendix.

H.2.1 Transportation-Related Activities

The transportation risk assessment estimates the human health risks related to transportation for each alternative. This includes incident-free risks from being in the vicinity of a shipment during transport or at stops, as well as accident risks; this appendix also addresses traffic impacts in Section H.13.

H.2.2 Radiological Impacts

For each alternative, radiological risks (that is, those risks that result from the radioactive nature of the materials) were assessed for incident-free (normal) transportation conditions and accidents. The radiological risk associated with incident-free transportation conditions would result from the potential exposure of people to external radiation in the vicinity of a shipment. The radiological risk from transportation accidents would come from the potential release and dispersal of radioactive material into the environment during an accident and the subsequent exposure of people.

Radiological impacts are calculated in terms of radiation dose and associated health effects in the exposed populations. The radiation dose calculated is the total effective dose equivalent (see Title 10, *Code of Federal Regulations*, Part 20 [10 CFR Part 20]), which is the sum of the effective dose equivalent from external radiation exposure and the 50-year committed effective dose equivalent from internal radiation exposure. Radiation doses are presented in units of roentgen equivalent man (rem) or millirem (one-thousandth of a rem) for individuals and person-rem for populations. The impacts are further expressed as health risks in terms of latent cancer fatalities (LCFs) in exposed individuals and populations using dose-to-risk conversion factors recommended by the Interagency Steering Committee on Radiation Standards (DOE 2003a). A health risk conversion factor of 0.0006 LCFs per rem or person-rem of exposure is used for both the public and workers (DOE 2003a).

H.2.3 Nonradiological Impacts

In addition to radiological risks posed by transportation activities, vehicle-related risks are assessed from nonradiological causes (that is, causes related to the transport vehicles, not the radioactive cargo). Nonradiological transportation risks, which would be incurred for shipments of any commodity, are assessed for accidents involving transportation of radioactive and nonradioactive wastes and deliveries of backfill soil, equipment, and supplies. Nonradiological accident risk refers to the potential occurrence of transportation accidents that result in fatalities unrelated to the characteristics (for example, radioactive nature) of the cargo. For this analysis, state-specific fatality rate data along the routes for truck and rail transports were used to determine the nonradiological risks (i.e., traffic fatalities) associated with transportation.

Nonradiological risks during incident-free transportation conditions could also be caused by potential exposure to increased vehicle exhaust emissions. As explained in Section H.6.2, these emission impacts, in terms of excess latent mortalities, were not considered.

H.2.4 Transportation Modes

Two options were evaluated for delivery of waste or recyclable material to offsite facilities: truck and truck/rail. The following waste facilities were evaluated under the truck option:

- the Nevada National Security Site (NNSS) in Nevada and Energy*Solutions* in Utah for low-level radioactive waste (LLW) and mixed low-level radioactive waste (MLLW);
- Buttonwillow and Westmorland in California and US Ecology in Idaho for hazardous wastes;
- Chiquita Canyon, Antelope Valley, and McKittrick in California for nonhazardous waste from building removal (these facilities, as well as Buttonwillow and Westmorland in California, were evaluated for nonhazardous waste from soil remediation); and
- Kramer Metals; Standard Industries, and P. W. Gillibrand in California for building recycle materials.[1]

---

[1] Building recycle materials would only be generated under the Building Removal Alternative and would only be transported via truck because the recycle facilities do not have rail connections and are in close proximity to the Santa Susana Field Laboratory.

For the truck/rail option, some types of wastes could be sent by truck to an intermodal facility (assumed to be the Puente Hills Intermodal Facility, which is under construction in City of Industry, California) about 60 miles from Santa Susana Field Laboratory (SSFL), where the waste would be placed on railcars for delivery to appropriate disposal facilities. The evaluated facilities and wastes are:

- NNSS for LLW and MLLW;
- Energy*Solutions* at Clive, Utah, for LLW and MLLW; and
- US Ecology at Grand View, Idaho, for hazardous and nonhazardous wastes.

For truck/rail shipment to NNSS, waste would be transferred to trucks from the railcars at a second intermodal facility (in addition to the Puente Hills facility), which was assumed to be located at the Barstow, California, rail yard, and then delivered to NNSS. See Appendix D, Section D.4, for additional information on how the disposal facilities for the truck and truck/rail options were selected.

H.2.5 Receptors

Radiation-related transportation risks were calculated and are presented separately for workers and members of the general public. The workers considered are truck crew members involved in transportation and inspection of the packages. The general public includes all persons who could be exposed to a shipment while it is moving or stopped during transit. For incident-free operation, the affected population includes individuals living within 0.5 miles of each side of the road. Several scenarios were also evaluated for impacts to hypothetical maximally exposed individuals (MEIs). For example, an MEI could be a resident living near the highway who is exposed to all shipments transported on the road. Refer to Section H.6.3 for a description of the MEI scenarios that were analyzed. For accident conditions, the affected population includes individuals residing within 50 miles of the accident, and the MEI would be an individual located 330 feet directly downwind from the accident (NRC 1977). The risk to the affected population is a measure of the radiological risk posed to society as a whole by the alternative being considered. As such, the impact on the affected population was used as the primary means of comparing impacts among the alternatives.

H.3 Packaging and Transportation Regulations

This section provides a high-level summary of radioactive materials packaging and transportation regulations. Regulations pertaining to the transportation of radioactive materials are primarily published by the U.S. Department of Transportation (DOT) (49 CFR Parts 106, 107, and 171–178) and U.S. Nuclear Regulatory Commission (NRC) (10 CFR Parts 20, 61, and 71). Interested readers are encouraged to visit the cited resources for current specifics or to review DOT's *Radioactive Material Regulations Review* (RAMREG-12-2008) (DOT 2008) for a comprehensive discussion on radioactive material regulations.

H.3.1 Radiological Packaging Regulations

The primary regulatory approach to promote safety from radiological exposure is the specification of standards for the packaging of radioactive materials. Packaging represents the primary barrier between the radioactive material being transported and radiation exposure to the public, workers, and the environment. Transportation packaging for radioactive materials must be designed, constructed, and maintained to contain and shield its contents during normal transport conditions. For highly radioactive material, such as high-level radioactive waste or spent nuclear fuel, packaging must contain and shield the contents in the event of severe accident conditions. The type of packaging used is determined by the total radioactive hazard presented by the material within the packaging. For analyses of waste transports in this environmental impact statement (EIS), three basic types of packaging were used: Excepted, Industrial, and Type A. Specific requirements for these packages are detailed in 49 CFR Part 173, Subpart I. All packages are designed to protect and retain their content under normal operations.

Excepted packaging is limited to transporting materials that meet the requirements outlined in 49 CFR 173.421. Industrial packaging is used to transport materials that, because of their low concentration of radioactive materials, present a limited hazard to the public and the environment. Both are a subset of Type A packaging. Type A packaging is designed to protect and retain its contents under normal transport conditions; because it is used to transport materials with higher radioactive content, it must maintain sufficient shielding to limit radiation exposure to handling personnel. Type A packaging, typically a 55-gallon drum or standard waste box, is commonly used to transport radioactive materials with higher concentrations or amounts of radioactivity than materials transported in Excepted or Industrial packages. Packaging requirements are an important consideration for transportation risk assessment.

Radioactive materials shipped in Type A containers, or packagings, are subject to specific radioactivity limits identified as A1 and A2 values in 49 CFR 173.435. In addition, external radiation limits, as prescribed in 49 CFR 173.441, must be met. If the material qualifies as low specific activity, as defined in 10 CFR Part 71 and 49 CFR Part 173, it may be shipped in a shipping container such as Industrial or Type A Packaging (49 CFR 173.427); see also RAMREG-12-2008 (DOT 2008).

Type A packaging is designed to retain its radioactive contents in normal transport. Under normal conditions, a Type A package must withstand the following:

- operating temperatures ranging from -40 to 158 degrees Fahrenheit;
- external pressures ranging from 3.5 to 20 pounds per square inch;
- normal vibration experienced during transportation;
- simulated rainfall of 2 inches per hour for 1 hour;
- free fall from 1 to 4 feet, depending on the package weight;
- water immersion tests;
- impact of a 13-pound steel cylinder with rounded ends dropped from 3.3 feet onto the most vulnerable surface; and
- a compressive load of five times the mass of the gross weight of the package for 24 hours, or the equivalent of 1.9 pounds per square inch, multiplied by the vertically projected area of the package for 24 hours.

H.3.2 Transportation Regulations

The regulatory standards for packaging and transporting radioactive materials are designed to achieve the following four primary objectives:

- Protect persons and property from radiation emitted from packages during transportation by specific limitations on the allowable radiation levels;
- Contain radioactive material in the package (achieved by packaging design requirements based on performance-oriented packaging integrity tests and environmental criteria);
- Prevent nuclear criticality (an unplanned nuclear chain reaction that could occur as a result of concentrating too much fissile material in one place); and
- Provide physical protection against theft and sabotage during transit.

DOT regulates the transportation of hazardous materials in interstate commerce by land, air, and water. DOT specifically regulates the carriers of radioactive materials and the conditions of transport such as routing, handling and storage, and vehicle and driver requirements. DOT also regulates the labeling, classification, and marking of radioactive material packagings.

NRC regulates the packaging and transportation of radioactive material for its licensees, including commercial shippers of radioactive materials. In addition, under an agreement with DOT, NRC sets the standards for packages containing fissile materials and Type B packagings.

The U.S. Department of Energy (DOE), through its Orders, management directives, and contractual agreements, ensures the protection of public health and safety by imposing standards on its transportation activities equivalent to those of DOT and NRC. According to 49 CFR 173.7(d), packagings made by or under the direction of DOE may be used for transporting Class 7 materials (radioactive materials) when the packages are evaluated, approved, and certified by DOE against packaging standards equivalent to those specified in 10 CFR Part 71.

DOT also has requirements that help reduce transportation impacts. Some requirements affect drivers, packaging, labeling, marking, and placarding. Others specifying the maximum dose rate from radioactive material shipments help reduce incident-free transportation doses.

H.4 Emergency Response

The U.S. Department of Homeland Security (DHS) is responsible for establishing policies for, and coordinating civil emergency management, planning, and interaction with, Federal Executive agencies that have emergency response functions in the event of a transportation incident. In the event a transportation incident involving nuclear material occurs, guidelines for response actions are outlined in the *National Response Framework* (DHS 2013).

The Federal Emergency Management Agency (FEMA), an organization within DHS, coordinates Federal and state participation in developing emergency response plans and is responsible for the development and the maintenance of the *Nuclear/Radiological Incident Annex* (DHS 2008) to the *National Response Framework* (DHS 2013). The *Nuclear/Radiological Incident Annex* to the *National Response Framework* describes the policies, situations, concepts of operations, and responsibilities of the Federal departments and agencies governing the immediate response and short-term recovery activities for incidents involving release of radioactive materials to address the consequences of the event.

DHS has the authority to activate Nuclear Incident Response Teams, which include DOE Radiological Assistance Program teams that can be dispatched from regional DOE Offices in response to a radiological incident. These teams provide first-responder radiological assistance to protect the health and safety of the general public, responders, and the environment and to assist in the detection, identification and analysis, and response to events involving radiological or nuclear material. Deployed teams provide traditional field monitoring and assessment support, as well as a search capability.

DOE uses DOE Order 151.1C, *Comprehensive Emergency Management System* (DOE 2005), as a basis to establish a comprehensive emergency management program that provides detailed, hazard-specific planning and preparedness measures to minimize the health impacts of accidents involving loss of control over radioactive material or toxic chemicals. DOE provides technical assistance to other Federal agencies and to state and local governments. Contractors are responsible for maintaining emergency plans and response procedures for all facilities, operations, and activities under their jurisdiction and for implementing those plans and procedures during emergencies. Contractor and state and local government plans are fully coordinated and integrated. In addition, DOE established the Transportation Emergency Preparedness Program to ensure its operating contractors and state, tribal, and local emergency responders are prepared to respond promptly, efficiently, and effectively to accidents involving DOE shipments of radioactive material. This program is a component of the overall emergency management system established by DOE Order 151.1C.

In the event of a radiological release from a shipment along a route, local emergency response personnel would be the first to arrive at the accident scene. It is expected that response actions would be taken in the context of the *Nuclear/Radiological Incident Annex* (DHS 2008). Based on their initial assessment at the scene, training, and available equipment, first responders would involve state and Federal resources as necessary. First responders and/or state and Federal responders would initiate actions in accordance with the DOT *Emergency Response Guidebook* (DOT 2012a) to isolate the incident and perform actions necessary to protect human health and the environment (such as evacuations or other means to reduce or prevent impacts to the public). Cleanup actions are the responsibility of the carrier. DOE would partner with the carrier, shipper, and applicable state and local jurisdictions to ensure cleanup actions meet regulatory requirements.

To mitigate the possibility of an accident, DOE issued DOE Manual 460.2-1A, *Radioactive Material Transportation Practices Manual for Use with DOE Order 460.2A* (DOE 2008a). As specified in this manual, carriers are expected to exercise due caution and care in dispatching shipments. According to the manual, the carrier determines the acceptability of weather and road conditions, whether a shipment should be held before departure, and when actions should be taken while *en route*. The manual emphasizes that shipments should not be dispatched if severe weather or bad road conditions make travel hazardous. Current weather conditions, the weather forecast, and road conditions at the point of origin and along the entire route would be considered before dispatching a shipment.

H.5 Methodology

The transportation risk assessment is based on the alternatives described in Chapter 2 of this EIS. **Figure H–1** summarizes the transportation risk assessment methodology. After the EIS alternatives were identified and the requirements of the shipping campaign were understood, data were collected on material characteristics and accident parameters.

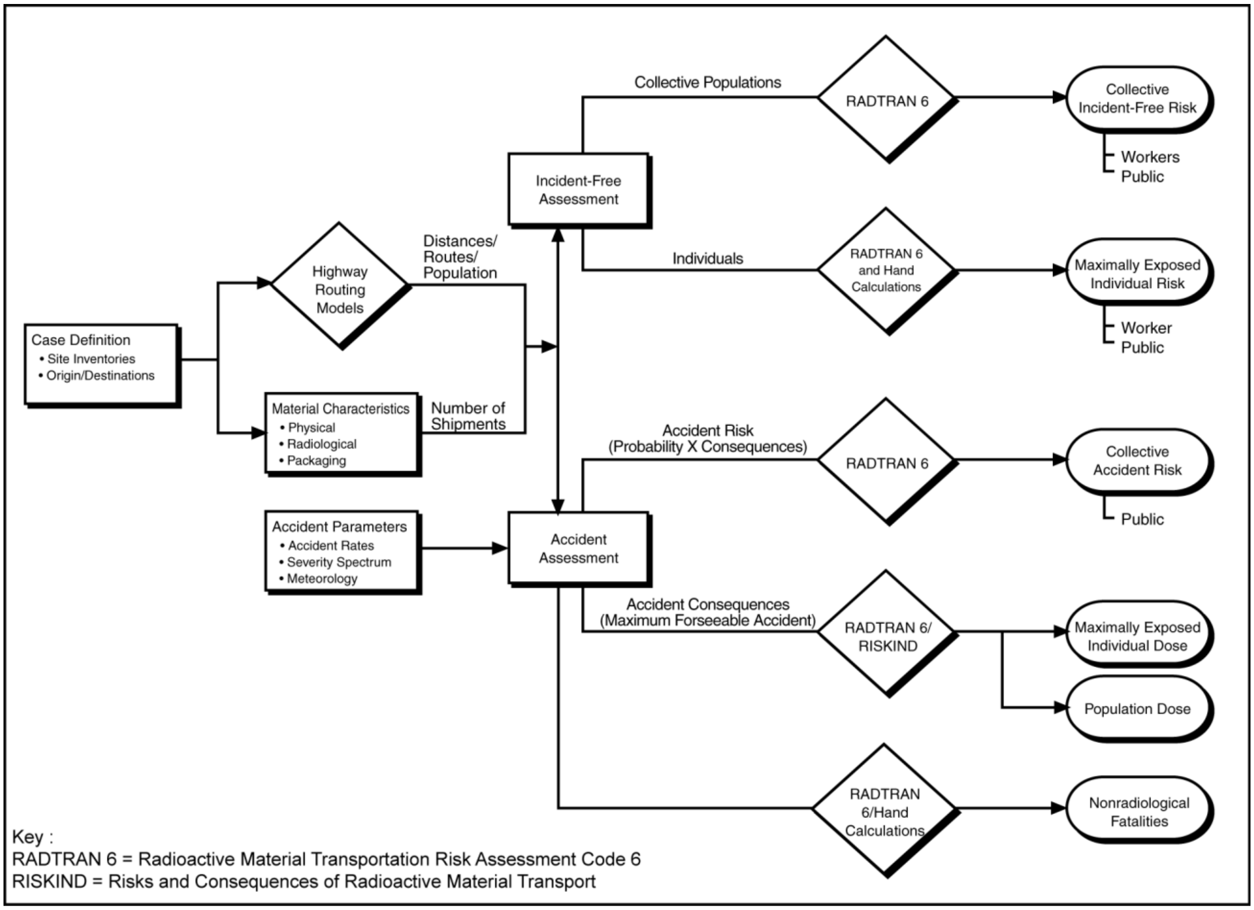


Figure H–1 Transportation Risk Assessment

Potential transportation impacts calculated for this EIS are presented in two parts: impacts from incident-free or routine transportation and impacts from transportation accidents. Impacts from transportation accidents are further divided into nonradiological and radiological impacts. Nonradiological impacts could result from transportation accidents in terms of traffic fatalities. Radiological impacts of incident-free transportation include impacts on members of the public and crew from radiation emanating from materials in the shipment. Radiological impacts from accident conditions consider all foreseeable scenarios that could damage transportation packages, leading to releases of radioactive materials to the environment.

Impacts from transportation accidents are expressed in terms of probabilistic risk, which is the probability of an accident multiplied by the consequences of that accident and summed over all reasonably conceivable accident conditions. Hypothetical transportation accident conditions ranging from low-speed "fender-bender" collisions to high-speed collisions with or without fires were analyzed. Accident frequencies and consequences were evaluated using a method developed by NRC and originally published in the *Final Environmental Impact Statement on the Transportation of*

Radioactive Materials by Air and Other Modes, NUREG-0170 (*Radioactive Material Transportation Study*) (NRC 1977); *Shipping Container Response to Severe Highway and Railway Accident Conditions*, NUREG/CR-4829 (*Modal Study*) (NRC 1987); and *Reexamination of Spent Fuel Shipping Risk Estimates*, NUREG/CR-6672 (*Reexamination Study*) (NRC 2000). Radiological accident risk is expressed in terms of additional LCFs, and nonradiological accident risk is expressed in terms of additional traffic fatalities. Incident-free risk is also expressed in terms of additional LCFs.

Transportation-related risks were calculated and are presented separately for workers and members of the general public. The workers considered were the truck crew members transporting the radioactive materials. The general public included all persons who could be exposed to a shipment while it is moving or stopped during transit.

The first step in the ground transportation analysis was to determine the distances and populations along the routes. The Transportation Routing Analysis Geographic Information System (TRAGIS) computer program (Johnson and Michelhaugh 2003) was used to identify routes and the associated distances and populations for purposes of analysis. The TRAGIS computer program is a geographic information system-based transportation analysis computer program used to identify the highway, rail, and waterway routes for transporting radioactive materials within the United States that were used in the analysis. Both the road and rail network are 1:100,000-scale databases, which were developed from the U.S. Geological Survey digital line graphs and the U.S. Bureau of the Census Topological Integrated Geographic Encoding and Referencing System. The population densities along each route were derived from 2000 Census Bureau data (Johnson and Michelhaugh 2003). The features in TRAGIS allow users to determine routes for shipment of radioactive materials that conform to DOT regulations, as specified in 49 CFR Part 397. State-level U.S. Census data for 2010 (Census 2010) was used in relation to the 2000 census data to project the population densities to 2020 levels

The information from TRAGIS, along with the properties of the material being shipped and route-specific accident frequencies, was entered into the Radioactive Material Transportation Risk Assessment (RADTRAN) 6.02 computer code (SNL 2013) to calculate incident-free transport and accident risks on a per-shipment basis. The risks under each alternative were determined by summing the products of per-shipment risks for each waste type by the corresponding number of shipments.

The RADTRAN 6.02 computer code (SNL 2013) was used for incident-free and accident risk assessments to estimate the impacts on populations, as well as for incident-free assessments associated with MEIs. RADTRAN 6.02 was developed by Sandia National Laboratories to calculate radiological risks associated with the transportation of radioactive materials by a variety of modes, including truck, rail, air, ship, and barge.

The RADTRAN 6.02 (SNL 2013) population risk calculations included both the consequences and probabilities of potential exposure events. For incident-free transportation, the probability of exposure is assumed to be 1 and the exposure pathway is direct radiation emanating from the transportation packages. The RADTRAN 6.02 code accident consequence analyses included the following exposure pathways: cloud shine, ground shine, direct radiation (from loss of shielding), inhalation (from dispersed materials), and resuspension (inhalation of resuspended materials) (SNL 2013). The collective population risk is a measure of the total radiological risk posed to society as a whole by the alternative being considered. As such, the collective population risk was used as the primary means of comparing the various alternatives.

The Risks and Consequences of Radioactive Material Transport (RISKIND) computer code (Yuan et al. 1995) was used to estimate the doses to MEIs and populations for the worst-case maximum reasonably foreseeable transportation accident. The RISKIND computer code was developed for DOE's Office of Civilian Radioactive Waste Management to estimate potential radiological consequences and health risks to individuals and the collective population from exposures associated with the transportation of spent nuclear fuel; however, this code is also applicable to transportation of other types of cargo, as the code can model complex atmospheric dispersion and estimate radiation doses to MEIs near the accident. Use of the RISKIND computer code as implemented in this EIS is consistent with direction provided in *A Resource Handbook on DOE Transportation Risk Assessment* (DOE 2002b).

The RISKIND calculations were conducted to supplement the collective risk results calculated using RADTRAN 6.02 (SNL 2013). Whereas the collective risk results provide a measure of the overall risks of each alternative, the RISKIND calculations are meant to address areas of specific concern to individuals and population subgroups. Essentially, the RISKIND analyses are meant to address "what if" questions, such as "what if I live next to a site access road?" or "what if an accident happens near my town?"

H.5.1 Transportation Routes

To assess incident-free and transportation accident radiological impacts, route characteristics were determined for the following offsite shipments that would occur as part of routine operations:

- LLW from SSFL to NNSS, Nevada, and Energy*Solutions*, Clive, Utah, and
- MLLW from SSFL to NNSS, Nevada, and Energy*Solutions*, Clive, Utah.

These sites would constitute the locations where the majority of shipments would be transported.

H.5.1.1 Offsite Route Characteristics

Route characteristics that are important to the radiological risk assessment include the total shipment distance and population distribution along the route. The specific route selected determines both the total potentially exposed population and the expected frequency of transportation-related accidents. Route characteristics for routes analyzed in this EIS are summarized in **Table H–1**. Rural, suburban, and urban areas were characterized according to the following breakdown (Johnson and Michelhaugh 2003):

- rural population densities range from 0 to 140 persons per square mile;
- suburban population densities range from 140 to 3,326 persons per square mile; and
- urban population densities include all population densities greater than 3,326 persons per square mile.

The affected population for route characterization and incident-free dose calculation includes all persons living within 0.5 miles of each side of the transportation route.

Table H–1 Offsite Transport Truck/Rail Route Characteristics

Origin	Destination	Nominal Distance (miles)	Distance Traveled in Zones (miles)			Population Density in Zone [a] (number per square mile)			Number of Affected Persons [b]
			Rural	Suburban	Urban	Rural	Suburban	Urban	
Truck (Site vicinity, Los Angeles city-wide, and intermodal truck segments)									
SSFL	Topanga Canyon Boulevard (site vicinity)	5	3	1	2	115	864	10,356	18,158
Topanga Canyon Boulevard	Connection to I-15 (city-wide) [c]	68	0	0	68	0	0	10,357	702,910
Topanga Canyon Boulevard	Intermodal location (Puente Hills Intermodal Facility, CA) [d]	43	0	0	43	0	0	16,463	700,316
Barstow, CA	NNSS, NV [e]	166	156	10	0	12	803	0	9,968
Truck (total)									
SSFL	Energy*Solutions*, UT	775	466	189	119	43	1,552	10,093	1,518,885
	NNSS, NV	304	201	34	69	32	1,412	10,357	774,540
Rail									
SSFL [f]	Energy*Solutions*, UT	794	645	88	61	7	1,264	15,967	1,086,353
	NNSS, NV [e]	260	163	53	44	9	1,300	11,895	591,237

CA = California; NNSS = Nevada National Security Site; NV = Nevada; UT = Utah.

[a] Population densities were projected to 2020 using state-level data from the 2010 census (Census 2010) and assuming state population growth rates from 2000 to 2010 continue to 2020.

[b] For offsite shipments, the estimated number of persons residing within 0.5 miles along the transportation route, projected to 2020.

[c] Route used for truck shipments.

[d] Route used for rail shipments.

[e] Because NNSS does not have a rail yard, truck transport from a nearby rail yard would be required.

[f] There are no rail connections to SSFL. For purposes of analysis, it was assumed that transfer to rail would occur at the Puente Hills Intermodal Facility in City of Industry, California.

Note: Rounded to nearest mile.

In developing the truck route characteristics, the route was divided into three sections: site vicinity, citywide, and remainder of the route. This was done to develop more-detailed risk characteristics for the routes as the shipment occurs from the SSFL site through the immediate neighborhood, through the city, and outside of the city. The site vicinity refers to the route section that connects the SSFL site to Topanga Canyon Boulevard through Woolsey Canyon Road, Lake Manor Drive, and Plummer Street. Because TRAGIS did not include any nodes on this section, the route characteristics were developed by mapping the route from SSFL to Topanga Canyon Boulevard; by breaking the route into rural, suburban, and urban areas; and by assuming the same population densities as for the citywide route. The citywide portion refers to the transport route through the city using U.S. Highway 101 to Interstate 210 to the interchange onto Interstate 15. The TRAGIS model provided the necessary route characteristics for this section.

In developing the rail route characteristics, the route was divided into three sections: site vicinity, citywide, and remainder of the route. Because SSFL does not have a direct rail connection, truck transport of radioactive material to a nearby rail yard would be required. For purposes of analysis, the Puente Hills Intermodal Facility, which is under construction in City of Industry, California, was assumed as the transfer point for truck to rail (see Appendix D, Section D.4). As described above, the site vicinity refers to the route section that connects the SSFL site to Topanga Canyon Boulevard through Woolsey Canyon Road, Lake Manor Drive, and Plummer Street. The citywide portion refers to the transport route through the city using U.S. Highway 101 to U.S. Highway 60 and on to the Puente Hills Intermodal Facility.

Analyzed truck and rail routes for offsite shipments of radioactive waste from SSFL are shown in **Figures H–2** and **H–3**.

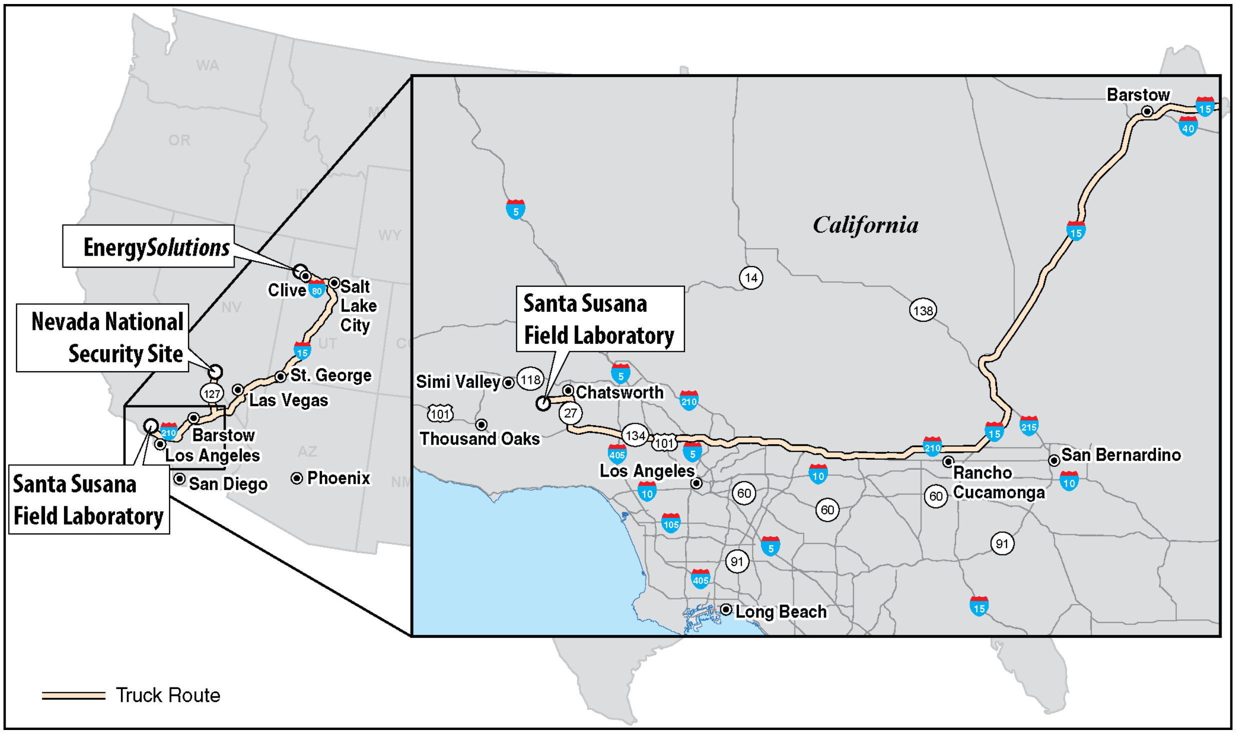


Figure H–2 Analyzed National and Regional Truck Routes from the Santa Susana Field Laboratory

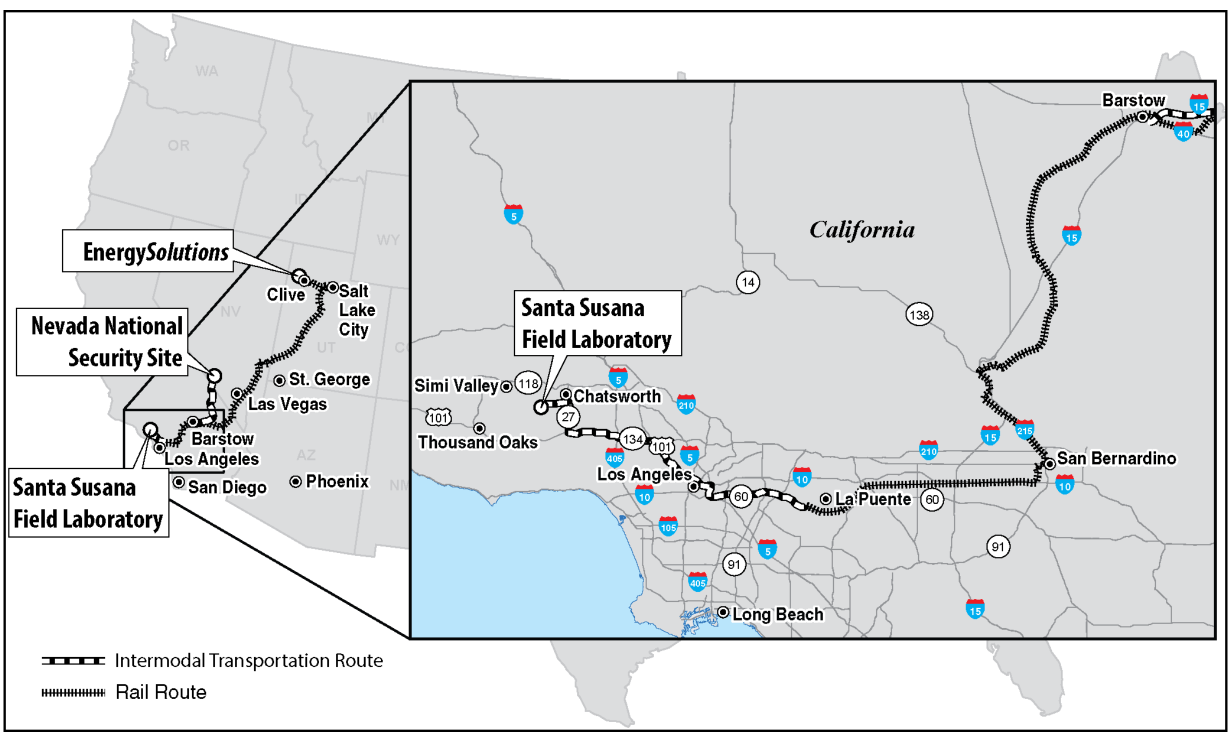


Figure H–3 Analyzed National and Regional Rail Routes from the Santa Susana Field Laboratory

H.5.2 Radioactive and Hazardous Waste Shipments

Transportation of all radioactive and hazardous wastes was assumed to occur in certified or certified-equivalent packaging on exclusive-use vehicles. Use of legal-weight, heavy combination trucks was assumed for highway transportation. Type A packages (including excepted and industrial packaging) would be transported on common flatbed or covered trailers.

For transportation by truck, the maximum payload weight was considered to be about 48,000 pounds, based on the Federal gross vehicle weight limit of 80,000 pounds (23 CFR 658.17). While there are large numbers of multi-trailer combinations (known as longer combination vehicles) with gross weights in excess of the Federal limit in operation on rural roads and turnpikes in some states (DOT 2000), for evaluation purposes, the load limit for the legal truck was based on the Federal gross vehicle weight. The width restriction is about 102 inches (23 CFR 658.15). Length restrictions vary by state, but were assumed for purposes of analysis to be no more than 48 feet.

The various wastes that would be transported under the alternatives in this EIS include LLW, MLLW, hazardous wastes, and nonhazardous wastes.[2] Several types of containers would be used to transport radioactive waste and hazardous waste. **Table H–2** lists the types of containers assumed for the analysis, along with their volumes and the number of containers in a shipment. A shipment is defined as the amount of waste transported on a single truck.

Table H–2 Waste Type and Associated Container Characteristics[a]

Waste Type	*Container*	*Container Volume (cubic feet)* [b]	*Container Mass (pounds)* [c]	*Shipment Description*
LLW and MLLW	B-25	90	10,000	5 per truck; 10 per railcar
LLW and MLLW	Soft-liner [d]	260	24,000	2 per truck; 4 per railcar
LLW and MLLW	Intermodal container	690	60,000	1 per truck; 2 per railcar
Hazardous waste	Soft-liner [d]	260	24,000	2 per truck; 4 per railcar
Hazardous waste	B-25	90	10,000	5 per truck; 10 per railcar

LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste.

a Containers and transport packages identified in this table were used to determine the transportation impacts for purposes of analysis.

b Container exterior volume.

c Filled container maximum mass. Container mass includes the mass of the container shell, its internal packaging, and the materials within.

d The soft-liners would be shipped within 20-foot International Organization for Standardization containers.

Source: DOE 1997; MHF 2015.

In general, the number of shipping containers per shipment was estimated on the basis of the dimensions and weight of the shipping containers, the Transport Index,[3] and the transport vehicle dimensions and weight limits. The various wastes were assumed to be transported on standard truck semi-trailers in a single stack.

It was assumed that all radioactive waste transported to a radioactive waste disposal facility (for example, NNSS) would meet the facility's waste acceptance criteria. For purposes of analysis, it was

---

2 Nonhazardous wastes do not require special packaging and can be transported in any truck. They were considered, but do not require special discussion. See Chapter 4, Section 4.10, of this EIS for additional information on nonhazardous waste disposal.

3 The Transport Index is a dimensionless number (rounded up to the next tenth) that is placed on the label of a package to designate the degree of control to be exercised by the carrier. Its value is equivalent to the maximum radiation level in millirem per hour at 1 meter from the package (10 CFR 71.4 and 49 CFR 173.403).

assumed that LLW and MLLW generated at SSFL would be transported in Type A packages to NNSS in Nevada and Energy*Solutions* in Clive, Utah, for disposal.

H.5.3 Radionuclide Inventories

Radionuclide inventories are used to determine accident risks associated with a hypothetical release of a portion of the radioactive cargo. To simplify the analysis and provide conservatism, the compositions of the LLW and MLLW were assumed to be the maximum concentrations of each radionuclide per radioisotope across all waste streams. For soils, the concentrations were based on the maximum measured concentration values in soil samples; for the building debris, the concentrations were based on the maximum total building surface contaminations, adjusted for the considerations of the waste streams that were processed in each building. **Table H–3** shows the radionuclide concentrations in curies per cubic yard for soil and building debris. For removal of contaminated bedrock in the vicinity of the Radioactive Materials Handling Facility, the radionuclide concentrations assumed for analysis included the cesium-137 and strontium-90 soil concentrations listed in Table H–3.

Table H–3 Low-Level and Mixed Low-level Radioactive Waste Radionuclide Concentrations

Radionuclides	*Curies per Cubic Yard*	*Radionuclides*	*Curies per Cubic Yard*
Soil			
Americium-241	8.02×10^{-8}	Europium-152	2.25×10^{-7}
Cesium-137	2.67×10^{-4}	Plutonium-238	6.70×10^{-8}
Cobalt-60	6.53×10^{-8}	Plutonium-239/240	2.54×10^{-7}
Curium 243/244	8.80×10^{-8}	Strontium-90	2.90×10^{-5}
Building Debris			
Americium-241	3.01×10^{-9}	Plutonium-240	2.62×10^{-9}
Cesium-134	2.42×10^{-12}	Plutonium-241	3.63×10^{-9}
Cesium-137	1.72×10^{-7}	Plutonium-242	1.77×10^{-11}
Cobalt-60	5.56×10^{-8}	Sodium-22	5.31×10^{-20}
Europium-152	5.41×10^{-10}	Strontium-90	7.32×10^{-6}
Europium-154	5.76×10^{-11}	Thorium-232	2.35×10^{-11}
Europium-155	3.84×10^{-12}	Tritium-3	1.15×10^{-8}
Iron-55	1.76×10^{-11}	Uranium-234	1.63×10^{-10}
Nickel-63	3.93×10^{-7}	Uranium-235	1.49×10^{-11}
Plutonium-238	2.77×10^{-10}	Uranium-238	1.88×10^{-10}
Plutonium-239	7.03×10^{-9}		

H.6 Incident-free Transportation Risks

H.6.1 Radiological Risk

During incident-free transportation of radioactive materials, a radiological dose results from exposure to the external radiation field that surrounds the shipping containers. The population dose is a function of the number of people exposed, their proximity to the containers, their length of time of exposure, and the intensity of the radiation field surrounding the containers.

Radiological impacts were determined for crew members and the general population during incident-free transportation. For truck shipments, the crew members were the drivers of the shipment vehicles. The general population analyzed included persons residing within 0.50 miles of the truck route (off-link), persons sharing the road (on-link), and persons at stops. Exposures to workers loading and unloading shipments at SSFL were not included in this analysis, but were subsumed within occupational exposures for site workers (see Chapter 4, Section 4.9, of this EIS). Exposures to inspectors were evaluated and are presented separately in Section H.6.3.

Collective doses for the crew and general population were calculated using the RADTRAN 6.02 computer code (SNL 2013). The radioactive material shipments were assigned an external dose rate based on their radiological characteristics. The waste container dose rate at 1 meter from its surface, or its Transport Index, depends on the distribution and quantities of the radionuclides, the waste density, the shielding provided by the packaging, and the self-shielding provided by the waste mixture. If a waste container had a high external dose rate that could exceed a Transportation Index of 10, it would be categorized as an exclusive-use shipment and would have further transport and dose rate limitations. Such exclusive-use shipments must meet a regulatory limit of 10 millirem per hour at 6.6 feet from the outer lateral surface of the transport vehicle (10 CFR 71.47 and 49 CFR 173.441).

Based on the radionuclide concentrations shown in Table H–3, a dose rate of 0.01 millirem per hour at 1 meter was assigned to packages containing LLW and MLLW. In all cases, the maximum external dose rate would be less than or equal to the regulatory limit of 10 millirem per hour at 6.6 feet from the outer lateral surface of the vehicle.

To calculate the collective dose, a unit risk factor was developed to estimate the impact of transporting a single shipment of radioactive material over a unit distance of travel in a given population density zone. The unit risk factors were combined with routing information, such as shipment distances in various population density zones, to determine the risk for a single shipment (a shipment risk factor) between a given origin and destination. Unit risk factors were developed on the basis of travel on interstate highways and freeways, as required by 49 CFR Parts 171 to 178, for highway-route-controlled quantities of radioactive material within rural, suburban, and urban population zones by using RADTRAN 6.02 (SNL 2013) and its default data. In addition, it was assumed that, for 10 percent of the time, travel through suburban and urban zones would encounter rush-hour conditions, leading to lower average speed and higher traffic volume.

The radiological risks from transporting the waste were estimated in terms of the numbers of LCFs among the crew and the exposed population. A health risk conversion factor of 0.0006 LCFs per rem or person-rem of exposure was used for both the public and workers (DOE 2003a).

H.6.2 Nonradiological Risk

Nonradiological risk (vehicle-related health risk) resulting from incident-free transport of radioactive materials may be associated with the generation of air pollutants by the transport vehicles used during shipment and was analyzed separately from the risks of the radioactive materials to be shipped. The vehicle-related health risk under incident-free transport conditions is the excess latent mortality resulting from inhalation of vehicle emissions. Unit risk factors for pollutant inhalation in terms of mortality have been developed, as described in *A Resource Handbook on DOE Transportation Risk Assessment* (DOE 2002b). These unit risk factors account for potential fatalities from emissions of particulates and sulfur dioxide, but they are applicable only to the urban population zone, which is a small fraction of the total transport distance. The emergence of considerable data regarding minimum threshold values for health risks from chemical constituents of vehicle exhaust has made linear extrapolation to estimate the risks from lower exposure levels to vehicle emissions untenable. Calculated risks should be compared with standard or other comparable risks to put the risks in perspective, but this is not possible with emission risks. This calculation was deleted from

RADTRAN 5 (Neuhauser, Kanipe, and Weiner 2000) and its recent revisions; therefore, no risk factors were assigned to the vehicle emissions analyzed in this EIS. The estimated amounts of vehicle emissions for each alternative are presented in Chapter 4, Section 4.6, of this EIS.

H.6.3 Maximally Exposed Individual Exposure Scenarios

Maximum individual doses for routine offsite transportation were estimated for transportation workers, as well as for members of the general population.

For truck shipments, four hypothetical scenarios were evaluated to determine the MEI in the general population. These scenarios are as follows (DOE 2002a):

- a resident living 98 feet from the highway used to transport the shipping containers;
- a person caught in traffic and located 4 feet from the surface of the shipping containers for 60 minutes;
- a person at a rest stop or gas station 66 feet from the shipping containers for 60 minutes; and
- a service station worker at a distance of 52 feet from the shipping container for 50 minutes.

Hypothetical MEI doses were accumulated over a single year for all transportation shipments. However, for the scenario involving an individual caught in traffic next to a shipping container, the radiological exposures were calculated on a per event basis. Because a potentially large number of trucks would leave the site over a year's time and travel through nearby neighborhoods, it is possible that an individual could be exposed to multiple shipments. The MEI dose for an individual stuck in traffic next to a shipping container would equal the single event exposure dose (shown in Table H–7) multiplied by the number of exposure events. For example, if an individual were stuck in traffic next to a shipping container for 1 hour 10 times (total exposure duration of 10 hours), the MEI dose would be 0.3 millirem.

The transportation worker would be a truck crew member who could be a DOE employee or a driver for a commercial carrier. In addition to complying with DOT requirements, a DOE employee would also need to comply with 10 CFR Part 835, which limits worker radiation doses to 5 rem per year; however, DOE's goal is to maintain radiological exposure as low as reasonably achievable. DOE has therefore established an Administrative Control Level of 2 rem per year (DOE 2009). A commercial truck driver who has been trained as a radiation worker is subject to Occupational Safety and Health Administration regulations, which limit the whole body dose to 5 rem per year (29 CFR 1910.1096(b)), and the DOT requirement of 2 millirem per hour in the truck cab (49 CFR 173.411). Commercial truck drivers who have been trained as radiation workers would have the same administrative dose limit as DOE employees; therefore, for purposes of analysis, a maximally exposed driver would not be expected to exceed the DOE Administrative Control Level of 2 rem per year (DOE 2009). For a truck driver who is not trained as a radiation worker, the maximum annual dose is limited to 100 millirem (10 CFR 20.1301).

Other workers would include inspectors who would inspect the truck and its cargo along the route. An inspector was assumed to be at a distance of 1 meter from the cargo for a duration of 1 hour per event.

The following three hypothetical scenarios were also evaluated for railcar shipments (DOE 2002a):

- a rail yard worker working at a distance of 33 feet from the shipping container for 2 hours;
- a resident living 98 feet from the rail line on which the shipping container is being transported; and
- a resident living 656 feet from a rail stop during classification and inspection for 20 hours.

The maximally exposed transportation worker (excluding drivers) for both truck and rail shipments would be an individual inspecting the cargo at a distance of 1 meter from the shipping container for 1 hour.

H.7 Transportation Accident Risks

H.7.1 Methodology

The offsite transportation accident analysis considered the impacts of accidents during the transportation of materials. Under accident conditions, impacts on human health and the environment could result from the release and dispersal of radioactive material. Transportation accident impacts were assessed using an accident analysis methodology developed by NRC. This section provides an overview of the methodologies; detailed descriptions of various methodologies are found in the *Radioactive Material Transportation Study,* NUREG-0170 (NRC 1977); *Modal Study*, NUREG/CR-4829 (NRC 1987); and *Reexamination Study,* NUREG/CR-6672 (NRC 2000), as applicable. Accidents that could potentially breach the shipping container were represented by a spectrum of accident severities and radioactive release conditions. Historically, most transportation accidents involving radioactive materials have resulted in little or no release of radioactive material from the shipping container. Consequently, the analysis of accident risks evaluated accidents ranging from high-probability accidents of low severity to hypothetical high-severity accidents that have a correspondingly low probability of occurrence. The accident analysis calculated the probabilities and consequences from this spectrum of accidents.

To provide DOE and the public with a reasonable assessment of radioactive waste transportation accident impacts, two types of analysis were performed. First, an accident risk assessment was performed that takes into account the probabilities and consequences of a spectrum of potential accident severities using a methodology developed by NRC (NRC 1977, 1987, 2000). For the spectrum of accidents considered in the analysis, the RADTRAN 6.02 code (SNL 2013) sums the product of consequences and probability over all accident severity categories to obtain a probability-weighted risk value referred to in this appendix as "dose risk," to the population within 50 miles, which is expressed in units of person-rem. Second, to represent the maximum reasonably foreseeable impacts to individuals and populations should an accident occur, maximum radiological consequences were calculated in an urban or suburban population zone for an accidental release with a likelihood of occurrence greater than 1 chance in 10 million per year using the RISKIND computer program (Yuan et al. 1995).

For accidents in which a waste container remains undamaged, population and individual radiation exposures from the waste package were evaluated for the time needed to recover the container and resume shipment. The collective dose over all segments of the transportation routes was evaluated for an affected population to a distance of 0.5 miles from the accident location. This approach is consistent with that used in incident-free transport public dose calculations, where those individuals within a distance of 0.5 miles from the route are considered (NRC 1977). When the package remains undamaged, people would receive a dose only from external radiation from the package. In general, the external dose to individuals in this population would be inversely proportional to the square of the distance of the affected individuals from the accident. Any additional dose to those residing beyond 0.5 miles from the accident would be negligible. The dose to an individual (first responder) was calculated assuming that the individual would be located at 6.6 to 33 feet from the package.

H.7.2 Accident Rates

Whenever material is shipped, the possibility exists that a traffic accident could result in vehicular damage, injury, or a fatality. An accident fatality is the death of a person who is killed instantly or dies within 30 days due to injuries sustained in the accident. Even when drivers are trained in defensive driving and take great care, there is a risk of a traffic accident.

To calculate accident risks, vehicle accident and fatality rates were taken from data provided in *State-Level Accident Rates for Surface Freight Transportation: A Reexamination*, ANL/ESD/TM-150 (Saricks and Tompkins 1999) and updated, as discussed below. Accident rates are generically defined as the number of accident involvements (or fatalities) in a given year per unit of travel in that same year. Therefore, the rate is a fractional value, with the accident involvement representing the numerator of the fraction and vehicular activity (total travel distance in truck kilometers, converted to miles for presentation in this EIS) its denominator. Accident rates were generally determined for a multi-year period. For assessment purposes, the total number of expected accidents or fatalities was calculated by multiplying the total shipment distance for a specific case by the appropriate accident or fatality rate. No reduction in accident or fatality rates was assumed, even though radioactive material carrier drivers are better trained and have better-maintained equipment.

A review of truck accidents and fatalities by the Federal Carrier Safety Administration indicated that state-level accidents and fatalities were underreported (UMTRI 2003). For the years 1994 through 1996, which formed the bases for the analysis in the Saricks and Tompkins report, the review identified that accidents were underreported by about 39 percent and fatalities were underreported by about 36 percent. Therefore, the state-level truck accident and fatality rates in the Saricks and Tompkins report were increased by factors of 1.64 and 1.57, respectively, to account for the underreporting in the analyses for this EIS.

For truck transportation, the calculated accident rates were specifically for heavy combination trucks involved in interstate commerce. Heavy combination trucks typically used for radioactive material shipments are rigs composed of a separable tractor unit containing the engine and one to three freight trailers connected to each other. Truck accident rates were computed for each state based on statistics compiled by the Federal Highway Administration, Office of Motor Carriers, from 1994 to 1996 (Saricks and Tompkins 1999; adjusted for underreporting using UMTRI 2003).

For offsite transport of radioactive waste, separate accident rates and accident fatality risks were used for rural, suburban, and urban population zones. The values selected were the state-level accident and fatality rates provided in the Saricks and Tompkins report (Saricks and Tompkins 1999); adjusted for underreporting using UMTRI 2003. The rates in the Saricks and Tompkins report are cited in terms of accident and fatality per car-kilometer and railcar-kilometer traveled (rather than miles). For transport by rail, the accident and fatality rate was based on an average of 8 railcars per train, as well as 16 truck shipments of materials (both LLW/MLLW and hazardous wastes) from SSFL to the intermodal site for each rail transport to the evaluated disposal facility. For transport to NNSS in Nevada, there would be another 16 truck shipments from a second intermodal facility, because there is no direct rail access to NNSS. For purposes of analysis the second intermodal facility was assumed to be the rail yard at Barstow, California. The selected accident and fatality rates used in this EIS are limited to the rates in those states where trucks and rails would travel while transporting wastes from SSFL to the evaluated disposal facilities. For trucks, the selected state-level rates are those associated with accidents and fatalities on interstate highways.

For local and regional transport, California State accident and fatality rates were used. The data provided in the Saricks and Tompkins report (Saricks and Tompkins 1999) were adjusted for underreporting (UMTRI 2003). The adjusted fatality rate was used to determine the nonradiological risks associated with transport of nonradioactive material and waste (for example, construction material and hazardous waste).

H.7.3 Accident Severity Categories and Conditional Probabilities

Accident severity categories for potential radioactive waste transportation accidents are described in the *Radioactive Material Transportation Study* (NRC 1977) for radioactive waste in general, the *Modal Study* (NRC 1987), and the *Reexamination Study* (NRC 2000) for spent nuclear fuel. The methods described in the *Modal Study* and the *Reexamination Study* are applicable to transportation of radioactive materials in a Type B spent fuel cask. The accident severity categories presented in the *Radioactive Material Transportation Study* would be applicable to all other waste transported off site.

The *Radioactive Material Transportation Study* (NRC 1977) originally was used to estimate conditional probabilities associated with accidents involving transportation of radioactive materials. The *Modal Study* (NRC 1987) and the *Reexamination Study* (NRC 2000) are initiatives taken by NRC to refine more precisely the analysis presented in the *Radioactive Material Transportation Study* for spent nuclear fuel shipment casks.

Whereas the *Radioactive Material Transportation Study* (NRC 1977) analysis was primarily performed using best engineering judgments and presumptions concerning cask response, the later studies (NRC 1987, 2000) relied on sophisticated structural and thermal engineering analysis and a probabilistic assessment of the conditions that could be experienced in severe transportation accidents. Their results were based on analyses of representative spent nuclear fuel casks that were assumed to have been designed, manufactured, operated, and maintained according to national codes and standards. The design parameters of the representative casks were chosen to meet the minimum test criteria specified in 10 CFR Part 71. These studies are believed to provide realistic, yet conservative, results regarding radiological releases under transport accident conditions.

In the *Modal Study* (NRC 1987) and the *Reexamination Study* (NRC 2000), potential accident damage to a cask was categorized according to the magnitude of the mechanical forces (impact) and thermal forces (fire) to which a cask may be subjected during an accident. Because all accidents can be described in these terms, severity is independent of the specific accident sequence. In other words, any sequence of events that results in an accident in which a cask is subjected to forces within a certain range of values is assigned to the accident severity region associated with that range. The accident severity scheme is designed to take into account all potential foreseeable transportation accidents, including accidents with low probabilities, but high consequences, and those with high probabilities, but low consequences.

As discussed earlier, the accident consequence assessment considered the potential impacts of severe transportation accidents. In terms of risk, the severity of an accident must be viewed in terms of potential radiological consequences, which are directly proportional to the fraction of the radioactive material within a cask that is released to the environment during the accident. Although accident severity regions span the entire range of mechanical and thermal accident loads, they are grouped into accident categories that can be characterized by a single set of release fractions and, therefore, can be considered together in the accident consequence assessment. The accident category severity fraction is the sum of all conditional probabilities in that accident category.

For the accident risk assessment, the RADTRAN 6.02 computer code (SNL 2013) sums the product of the consequences and probabilities over all accident categories to obtain a probability-weighted risk value referred to in this appendix as "dose risk," which is expressed in units of person-rem.

H.7.4 Atmospheric Conditions

Because it is impossible to predict the specific location of an offsite transportation accident, generic atmospheric conditions were selected for the risk and consequence assessments. On the basis of observations from National Weather Service surface meteorological stations at over 177 locations in the United States, on an annual average, neutral conditions (Pasquill Stability Classes C and D) occur 58.5 percent of the time, and stable (Pasquill Stability Classes E, F, and G) and unstable (Pasquill Stability Classes A and B) conditions occur 33.5 percent and 8 percent of the time, respectively (DOE 2002a). The neutral weather conditions predominate in each season, but most frequently in the winter (nearly 60 percent of the observations).

Neutral weather conditions (Pasquill Stability Class D) compose the most frequently occurring atmospheric stability condition in the United States and are thus most likely to be present in the event of an accident involving a radioactive waste shipment. Neutral weather conditions are typified by moderate wind speeds, vertical mixing within the atmosphere, and good dispersion of atmospheric contaminants. Stable weather conditions are typified by low wind speeds, very little vertical mixing within the atmosphere, and poor dispersion of atmospheric contaminants. The atmospheric condition used in RADTRAN 6.02 (SNL 2013) is an average weather condition that corresponds to a combination of Pasquill Stability Classes D and E.

The accident consequences for the maximum reasonably foreseeable accident (an accident with a likelihood of occurrence greater than 1 in 10 million per year) were assessed for both stable (Class F with a wind speed of 3.3 feet per second) and neutral (Class D with a wind speed of 13 feet per second) atmospheric conditions. The population dose was evaluated under neutral atmospheric conditions, and the MEI dose under stable atmospheric conditions. The MEI dose would represent an accident under weather conditions that result in a conservative dose (that is, a stable weather condition with minimum diffusion and dilution). The population dose would represent an average weather condition.

H.7.5 Acts of Sabotage or Terrorism

In response to the events of September 11, 2001, DOE continually assesses its measures in place to minimize the risk or potential consequences of radiological sabotage. While it is not possible to determine terrorists' motives and targets with certainty, DOE considers the threat of terrorist attack to be real and makes all efforts to reduce any vulnerability to this threat.

The impacts of intentional destructive acts (IDAs) are presented here to provide perspective on the risks that the transportation of the SSFL contaminated soil and building debris could pose should such an act occur. The consequences of an IDA involving radioactive and hazardous material depend on the material's packaging, chemical composition, radioactive and physical properties, accessibility, quantity, and ease of dispersion, as well as on the surrounding environment, including the number of people who are close to the event. An IDA could occur during loading of the haul trucks and transportation activities under any of the alternatives.

The low-grade nature of the contaminated soils and building debris considered in this EIS poses little risk, in general, to human health and the environment, even under accident conditions, as discussed in Tables H–4 through H–8 of this appendix. Because of the low-grade nature of the contaminated soils and building debris, a spill of the entire truck shipment (20 tons) would not constitute a reportable quantity as defined in 49 CFR 172.101. The impacts of an IDA could be represented by the impacts of any of the reasonably foreseeable accidents presented in Table H–8. These accidents represent the situations that would result in the highest amount of released materials without considering the accidents' probability. All accident cases (in both urban and suburban areas) indicate a very small consequence and risk to the public and individuals—the highest dose would be 0.0064 person-rem to the population in the urban area (with a risk of 4×10^{-6} LCF) and an MEI dose of 0.0042 millirem (with a risk of 2×10^{-9}).

H.8 Risk Analysis Results

Per-shipment risk factors have been calculated for the collective populations of exposed persons and for the transport crew for all anticipated routes and shipment configurations. Radiological risks are presented in per-shipment doses for each unique route, material, and container combination. Per-shipment radiological risk factors for incident-free transportation and accident conditions are presented in **Table H–4**. These factors have been adjusted to reflect the projected population in 2020. For incident-free transportation, both dose and LCF risk factors are provided for the crew and exposed population. The radiological risks would result from potential exposure of people to external radiation emanating from the packaged waste. The exposed population includes the off-link public (people living along the route), on-link public (pedestrian and car occupants along the route), and public at rest and fuel stops. LCF risk factors were calculated by multiplying the accident dose risks by a health risk conversion factor of 0.0006 cancer fatalities per person-rem of exposure (DOE 2003a).

For transportation accidents, the risk factors are given for radiological impacts in terms of potential LCFs in the exposed population; for nonradiological impacts, the risk factors are given in terms of number of traffic fatalities. LCFs represent the number of additional latent fatal cancers expected among the exposed population in the event of an accident. Under accident conditions, the population would be exposed to radiation from released radioactivity if the package were damaged and would receive an external radiation dose if the package were unbreached. For accidents with no release, the analysis conservatively assumed that it would take about 12 hours to remove the package and/or vehicle from the accident area (DOE 2002a). The nonradiological risk factors are non-occupational traffic fatalities resulting from transportation accidents.

As stated in Section H.7.3, the accident dose is called the "dose risk" because the values incorporate the spectrum of accident severity probabilities and associated consequences (for example, dose). The accident dose risks would be very low because the accident severity probabilities (that is, the likelihood of accidents leading to confinement breach of a package or shipping cask and release of its contents) would be small, and the content and form of the wastes (that is, solids) are such that a breach would lead to a nondispersible and mostly noncombustible release. Although persons reside within a 50-mile radius along the transportation route, they are generally quite far from the route. Because RADTRAN 6.02 (SNL 2013) assumes a homogeneous population, it greatly overestimates the actual doses because this assumption theoretically places people directly adjacent to the route, where the highest doses would be present.

As indicated in Table H–4, all per-shipment risk factors would be less than one. This means that no LCFs or traffic fatalities are expected to occur during each transport. For example, the risk factors to truck crews and populations from transporting one shipment of LLW/MLLW from SSFL to NNSS in B-25 boxes by truck are given as 3×10^{-8} and 1×10^{-8} LCFs, respectively. These risk factors can also be interpreted to mean that during a single shipment of waste, there is a chance of approximately 1 in 33 million that an additional latent fatal cancer could be experienced among the exposed workers from exposure to radiation, and a chance of 1 in 100 million that an additional latent fatal cancer could be experienced among the exposed population residing along the transport route. These chances are essentially equivalent to zero risk. It should be noted that the maximum allowable dose rate in the truck cab is less than or equal to 2 millirem per hour.

Table H–5 shows the maximum risks of transporting radioactive waste to each disposal facility under each alternative using truck and intermodal transport methods. The risks were calculated by multiplying the previously given per-shipment factors by the number of shipments over the duration of the project and, for radiological doses, by the health risk conversion factors. Where different transportation containers would be sent to the same disposal facility, the container with the highest potential risks was included for analysis. The risks are for the total offsite transport of the radioactive materials over the duration of the project. Table H–5 indicates that the Cleanup to AOC [*Administrative Order on Consent for Remedial Action* (DTSC 2010)] LUT [Look-Up Table] Values Alternative and the Cleanup to Revised LUT Values Alternative would have a higher radiological risk to the population during incident-free transportation than the other alternatives because these Alternatives would require the largest number of shipments.

Nonradiological accident risks (the potential for fatalities as a direct result of traffic accidents) present the greatest risks, with an estimate of up to 0.3 fatalities for the duration of the analysis. Considering the transportation activities analyzed in this EIS would occur over a 12-year period and the average number of traffic fatalities in the United States is about 33,000 per year (DOT 2011), the traffic fatality risk under all alternatives would be very small. See Section H.10 for further discussion of accident fatality rates.

Table H–4 Risk Factors per Shipment of Radioactive Waste[a]

Destination	Container	Transportation Method	One-way Miles Traveled	Incident-Free				Accident	
				Crew		Population			
				Dose (person-rem)	LCFs[b]	Dose (person-rem)	LCFs[b]	Radiological Risk[b,c]	Nonradiological Risk (traffic fatalities)[b]
Truck									
Energy*Solutions*	B-25 box	Truck	780	1.3×10^{-4}	8×10^{-8}	4.9×10^{-5}	3×10^{-8}	6×10^{-13}	4×10^{-5}
	Lift liner	Truck	780	1.5×10^{-4}	9×10^{-8}	4.0×10^{-5}	2×10^{-8}	5×10^{-13}	4×10^{-5}
	Intermodal container	Truck	780	1.9×10^{-4}	1×10^{-7}	4.9×10^{-5}	3×10^{-8}	6×10^{-13}	4×10^{-5}
NNSS	B-25 box	Truck	300	5.0×10^{-5}	3×10^{-8}	2.0×10^{-5}	1×10^{-8}	5×10^{-14}	6×10^{-6}
	Lift liner	Truck	300	6.0×10^{-5}	4×10^{-8}	1.6×10^{-5}	1×10^{-8}	4×10^{-14}	6×10^{-6}
	Intermodal container	Truck	300	7.3×10^{-5}	4×10^{-8}	2.0×10^{-5}	1×10^{-8}	5×10^{-14}	6×10^{-6}
Rail/Truck									
Energy*Solutions*	B-25 box	Truck	50	1.3×10^{-4}	8×10^{-8}	4.2×10^{-5}	3×10^{-8}	2×10^{-13}	1×10^{-5}
		Rail	790	2.7×10^{-4}	2×10^{-7}	4.8×10^{-4}	3×10^{-7}	4×10^{-13}	5×10^{-4}
		TOTAL	**840**	**4.1×10^{-4}**	**2×10^{-7}**	**5.2×10^{-4}**	**3×10^{-7}**	**6×10^{-13}**	**5×10^{-4}**
	Lift liner	Truck	50	1.6×10^{-4}	9×10^{-8}	3.5×10^{-5}	2×10^{-8}	2×10^{-13}	1×10^{-5}
		Rail	790	2.2×10^{-4}	1×10^{-7}	4.1×10^{-4}	2×10^{-7}	3×10^{-13}	5×10^{-4}
		TOTAL	**840**	**3.7×10^{-4}**	**2×10^{-7}**	**4.4×10^{-4}**	**3×10^{-7}**	**5×10^{-13}**	**5×10^{-4}**
	Intermodal container	Truck	50	1.9×10^{-4}	1×10^{-7}	4.2×10^{-5}	3×10^{-8}	2×10^{-13}	1×10^{-5}
		Rail	790	2.7×10^{-4}	2×10^{-7}	4.8×10^{-4}	3×10^{-7}	4×10^{-13}	5×10^{-4}
		TOTAL	**840**	**4.7×10^{-4}**	**3×10^{-7}**	**5.2×10^{-4}**	**3×10^{-7}**	**6×10^{-13}**	**5×10^{-4}**
NNSS[e]	B-25 box	Truck	200	5.5×10^{-4}	3×10^{-7}	6.4×10^{-5}	4×10^{-8}	3×10^{-13}	7×10^{-5}
		Rail	260	1.1×10^{-4}	6×10^{-8}	3.4×10^{-4}	2×10^{-7}	3×10^{-13}	4×10^{-4}
		TOTAL	**470**	**6.6×10^{-4}**	**4×10^{-7}**	**4.0×10^{-4}**	**2×10^{-7}**	**6×10^{-13}**	**5×10^{-4}**
	Lift liner	Truck	200	6.6×10^{-4}	4×10^{-7}	5.3×10^{-5}	3×10^{-8}	3×10^{-13}	7×10^{-5}
		Rail	260	8.3×10^{-5}	5×10^{-8}	2.9×10^{-4}	2×10^{-7}	3×10^{-13}	4×10^{-4}
		TOTAL	**470**	**7.5×10^{-4}**	**4×10^{-7}**	**3.4×10^{-4}**	**2×10^{-7}**	**5×10^{-13}**	**5×10^{-4}**
	Intermodal container	Truck	200	8.1×10^{-4}	5×10^{-7}	6.4×10^{-5}	4×10^{-8}	3×10^{-13}	7×10^{-5}
		Rail	260	1.0×10^{-4}	6×10^{-8}	3.3×10^{-4}	2×10^{-7}	3×10^{-13}	4×10^{-4}
		TOTAL	**470**	**9.2×10^{-4}**	**6×10^{-7}**	**4.0×10^{-4}**	**2×10^{-7}**	**6×10^{-13}**	**5×10^{-4}**

				Incident-Free				Accident	
				Crew		Population			
Destination	Container	Transportation Method	One-way Miles Traveled	Dose (person-rem)	LCFs [b]	Dose (person-rem)	LCFs [b]	Radiological Risk [b,c]	Nonradiological Risk (traffic fatalities) [b]

LCF = latent cancer fatality; NNSS = Nevada National Security Site; rem = roentgen equivalent man.

[a] All shipments would contain LLW/MLLW.

[b] Risk is expressed in terms of LCFs, except for the nonradiological risk, where it refers to the number of traffic accident fatalities. Radiological risk is calculated for one-way travel, while nonradiological risk is calculated for two-way travel. Accident dose-risk can be calculated by dividing the risk values by 0.0006 (DOE 2003a). The values were rounded to one non-zero digit.

[c] Radiological risk is the same regardless of whether the material being transported is soil, building materials, or bedrock. Because the radioactive content in soil, building materials, and groundwater bedrock debris is very small, the accident risk is dominated by doses from external radiation from packages during the 12-hour recovery time after an accident with no release.

[d] For purposes of analysis, it was assumed that, for every rail shipment of 8 railcars, 16 truck shipments would be required to transfer the waste from SSFL to the Puente Hills Intermodal Facility, which is under construction in City of Industry, California, and to transport waste from Barstow, California, to NNSS.

[e] Because NNSS does not have a rail yard, the waste would be transported from a nearby rail yard (Barstow, CA) to NNSS via truck.

Table H–5 Risks to Crew Members and Populations from Transporting Radioactive Material and Waste under Each Alternative

			Incident-Free				*Accident*	
			Crew		*Population*			
Destination	*Number of Shipments* [a]	*One-way Miles Traveled*	*Dose (person-rem)*	*LCFs* [b]	*Dose (person-rem)*	*LCFs* [b]	*Radiological Risk* [b,c]	*Nonradiological Risk* [b]
Cleanup to AOC LUT Values Alternatives [e]								
Truck								
Energy*Solutions*	6,830	5,290,000	1.3	8×10^{-4}	0.33	2×10^{-4}	4×10^{-9}	3×10^{-1}
NNSS	6,830	2,080,000	0.50	3×10^{-4}	0.13	8×10^{-5}	4×10^{-10}	4×10^{-2}
Rail/Truck [d]								
Energy*Solutions*	430	665,000	0.20	1×10^{-4}	0.22	1×10^{-4}	3×10^{-10}	2×10^{-1}
NNSS	430	1,570,000	0.39	2×10^{-4}	0.17	1×10^{-4}	3×10^{-10}	2×10^{-1}
Cleanup to Revised LUT Values Alternatives [e]								
Truck								
Energy*Solutions*	6,830	5,290,000	1.3	8×10^{-4}	0.33	2×10^{-4}	4×10^{-9}	3×10^{-1}
NNSS	6,830	2,080,000	0.50	3×10^{-4}	0.13	8×10^{-5}	4×10^{-10}	4×10^{-2}
Rail/Truck [d]								
Energy*Solutions*	430	665,000	0.20	1×10^{-4}	0.22	1×10^{-4}	3×10^{-10}	2×10^{-1}
NNSS	430	1,570,000	0.39	2×10^{-4}	0.17	1×10^{-4}	3×10^{-10}	2×10^{-1}
Conservation of Natural Resources Alternative								
Truck								
Energy*Solutions*	3,530	2,730,000	0.66	4×10^{-4}	0.17	1×10^{-4}	2×10^{-9}	1×10^{-1}
NNSS	3,530	1,070,000	0.26	2×10^{-4}	0.069	4×10^{-5}	2×10^{-10}	2×10^{-2}
Rail/Truck [d]								
Energy*Solutions*	220	344,000	0.10	6×10^{-5}	0.12	7×10^{-5}	1×10^{-10}	1×10^{-1}
NNSS	220	810,000	0.20	1×10^{-4}	0.089	5×10^{-5}	1×10^{-10}	1×10^{-1}
Building Removal Alternative								
Truck								
Energy*Solutions*	1,030	808,000	0.19	1×10^{-4}	0.050	3×10^{-5}	6×10^{-10}	5×10^{-3}
NNSS	1,030	311,000	0.075	5×10^{-5}	0.020	1×10^{-5}	5×10^{-11}	6×10^{-3}
Rail/Truck [d]								
Energy*Solutions*	65	101,000	0.030	2×10^{-5}	0.034	2×10^{-5}	4×10^{-11}	3×10^{-2}
NNSS	65	239,000	0.060	4×10^{-5}	0.026	2×10^{-5}	4×10^{-11}	3×10^{-2}

Destination	Number of Shipments [a]	One-way Miles Traveled	Incident-Free				Accident	
			Crew		Population			
			Dose (person-rem)	LCFs [b]	Dose (person-rem)	LCFs [b]	Radiological Risk [b,c]	Nonradiological Risk [b]
Groundwater Treatment Alternative [f]								
Truck								
Energy*Solutions*	130	99,200	0.024	1×10^{-5}	6.2×10^{-3}	4×10^{-6}	8×10^{-11}	4×10^{-5}
NNSS	130	38,900	9.3×10^{-3}	6×10^{-6}	2.5×10^{-3}	2×10^{-6}	7×10^{-12}	8×10^{-4}
Rail/Truck [d]								
Energy*Solutions*	10	12,500	3.7×10^{-3}	2×10^{-6}	4.2×10^{-3}	3×10^{-6}	5×10^{-12}	4×10^{-3}
NNSS	10	29,400	5.3×10^{-3}	3×10^{-6}	3.2×10^{-3}	2×10^{-6}	5×10^{-12}	4×10^{-3}

AOC = *Administrative Order on Consent for Remedial Action*; LCF = latent cancer fatality; LUT = Look-Up Table; NNSS = Nevada National Security Site; rem = roentgen equivalent man.

[a] The number of shipments were rounded to the nearest ten when greater than 100, and to the nearest 5 when less than 100. Under the Truck Option, the number of shipments would be those sent directly to the disposal facilities. Under the Truck/Rail Option, the same number of truck shipments would leave SSFL, but the trucks would transport the waste to an intermodal facility, and the listed Truck/Rail shipments would be the number of rail shipments that would result. (Essentially, every 16 truck shipments are equal to 1 rail shipment.) Also see table note "d".

[b] Risk is expressed in terms of LCFs, except for nonradiological risk, where it refers to the number of traffic accident fatalities. Radiological risk is calculated for one-way travel, while nonradiological risk is calculated for two-way travel. Accident dose-risk can be calculated by dividing the risk values by 0.0006 (DOE 2003a). The values were rounded to one non-zero digit.

[c] Because the radioactive content in soil, building materials, and groundwater bedrock debris is very small, the accident risk is dominated by doses from external radiation from packages during the 12-hour recovery time after an accident with no release.

[d] For purposes of analysis, it was assumed that, for every rail shipment of 8 railcars, there would be 16 truck shipments to transfer the waste from SSFL to the Puente Hills Intermodal Facility, which is under construction in City of Industry, California. Because NNSS does not have a rail connection, rail shipments would be shipped by rail from Puente Hills to a second intermodal facility (which was assumed for analysis to be at Barstow, California) and then transported by truck to NNSS; impacts from these additional shipments were included in the tabulated results in this table.

[e] Impacts from transport of radioactive waste would be the same under either the Cleanup to AOC LUT Values Alternative or the Cleanup to Revised LUT Values Alternative.

[f] Very small quantities of well installation cuttings and water and purge waste from environmental sampling would be generated under the Groundwater Monitored Natural Attenuation Alternative that are not expected to be classified as low-level radioactive of mixed low-level radioactive waste. If determined otherwise when generated, the wastes would be safely transported to appropriate authorized facilities for disposition.

Table H–6 shows the range of risks of transporting radioactive wastes and materials to each disposal facility using truck and truck/rail transport methods, assuming a combination of alternatives involving shipment of radioactive wastes was implemented. The total impacts were calculated by summing the doses from the each of the action alternatives in Table H–5 and multiplying by the health risk conversion factors. The disposal location with the maximum risk factors to truck crews and populations for all truck shipments would be Energy*Solutions*, with risk factors of 9×10^{-4} and 2×10^{-4}, respectively. The disposal locations with the maximum risk factors to truck/rail crews and populations for all truck/rail shipments would be NNSS, with a risk factor of 3×10^{-4} for the crews, and Energy*Solutions*, with a risk factor of 2×10^{-4} for populations. These risk factors are essentially equivalent to zero risk.

Table H–6 Total Doses and Risks from Transporting Radioactive Waste under Combined Action Alternatives

Destination	Number of Shipments [a]	One-way Miles Traveled	Incident-Free: Crew Dose (person-rem)	Incident-Free: Crew LCFs [b]	Incident-Free: Population Dose (person-rem)	Incident-Free: Population LCFs [b]	Accident: Radiological Risk [b, c]	Accident: Non-radiological Risk [b]
High Impact Combination [d]								
Truck								
Energy*Solutions*	7,980	6,197,000	1.5	9×10^{-4}	0.39	2×10^{-4}	5×10^{-9}	3×10^{-1}
NNSS	7,980	2,430,000	0.58	3×10^{-4}	0.16	9×10^{-5}	4×10^{-10}	5×10^{-2}
Rail/Truck [e]								
Energy*Solutions*	500	779,000	0.23	1×10^{-4}	0.26	2×10^{-4}	3×10^{-10}	3×10^{-1}
NNSS	500	1,840,000	0.46	3×10^{-4}	0.20	1×10^{-4}	3×10^{-10}	2×10^{-1}
Low Impact Combination [f]								
Truck								
Energy*Solutions*	4,680	3,637,000	0.88	5×10^{-4}	0.23	1×10^{-4}	3×10^{-9}	2×10^{-1}
NNSS	4,680	1,420,000	0.34	2×10^{-4}	0.092	6×10^{-5}	2×10^{-10}	3×10^{-2}
Rail/Truck [e]								
Energy*Solutions*	290	458,000	0.14	8×10^{-5}	0.15	9×10^{-5}	2×10^{-10}	1×10^{-1}
NNSS	290	1,078,000	0.27	2×10^{-4}	0.12	7×10^{-5}	2×10^{-10}	1×10^{-1}

LCF = latent cancer fatality; NNSS = Nevada National Security Site; rem = roentgen equivalent man.

[a] The number of shipments was rounded to the nearest ten. The cited values for truck/rail transport reflect the rail shipment numbers (see footnote e for additional details).

[b] Risk is expressed in terms of LCFs, except for nonradiological risk, where it refers to the number of traffic accident fatalities. Radiological risk is calculated for one-way travel, while nonradiological risk is calculated for two-way travel. Accident dose-risk can be calculated by dividing the risk values by 0.0006 (DOE 2003a). The values were rounded to one non-zero digit.

[c] Because the radiological accident risks for soil, building material, and bedrock presented in Table H–4 are dominated by the doses associated with the 12-hour recovery after an accident, only one value is shown.

[d] Impacts if DOE implemented the Cleanup to AOC LUT Values or Cleanup to Revised LUT Values Alternative, Building Removal Alternative, and Groundwater Treatment Alternative.

[e] For purposes of analysis, it was assumed that, for every rail shipment of 8 railcars, there would be 16 truck shipments to transfer the waste from SSFL to the Puente Hills Intermodal Facility, which is under construction in City of Industry, California. Shipments to NNSS also include truck transports from Barstow, California, to NNSS.

[f] Impacts if DOE implemented the Conservation of Natural Resources, Building Removal, and Groundwater Monitored Natural Attenuation Alternatives.

The risks to various exposed individuals under incident-free transportation conditions were estimated for the hypothetical exposure scenarios identified in Section H.6.3. The maximum estimated doses to workers and the public MEIs are presented in **Table H–7**, considering all shipment types. Doses are presented on a per-event basis (rem per event, per exposure, or per shipment), because it is generally unlikely that the same person would be exposed to all shipments. For those individuals that could have multiple exposures, the cumulative dose was calculated.

Table H–7 Estimated Dose to Maximally Exposed Individuals under Incident-Free Transportation Conditions

Receptor	*Dose to Maximally Exposed Individual*
Workers	
Crew member (truck/rail driver)	2 rem per year [a]
Inspector	3.6×10^{-5} rem per event per hour of inspection
Rail yard worker	1.0×10^{-5} rem per event
Public	
Resident (along the truck route)	4.9×10^{-10} rem per event
Resident (along the rail route)	9.8×10^{-10} rem per event
Person in traffic congestion	3.0×10^{-5} rem per event per one hour stop
Resident near rail yard during classification	1.3×10^{-7} rem per event
Person at a rest stop/gas station	3.2×10^{-7} rem per event per hour of stop
Gas station attendant	4.2×10^{-7} rem per event

rem = roentgen equivalent man.

[a] In addition to complying with DOT requirements, a DOE employee would also need to comply with 10 CFR Part 835, which limits worker radiation doses to 5 rem per year; however, DOE's goal is to maintain radiological exposure as low as reasonably achievable. DOE has therefore established the Administrative Control Level of 2 rem per year (DOE 2009). Based on the number of commercial shipments and the total crew dose per shipment to two drivers in Table H–4, a commercial driver dose would not exceed this administrative control limit. Therefore, the administrative control limit reflected in this table (Table H–7) is for the maximally exposed truck crew member.

The maximum dose to a crew member, as shown in Table H–7, was based on the assumption that the same individual would be responsible for driving multiple shipments until the administrative limit is reached. Note that the potential exists for larger individual exposures under one-time events of a longer duration. For example, the maximum dose to a person stuck in traffic next to a shipment of LLW/MLLW waste for 1 hour was calculated to be 3.0×10^{-5} rem (0.030 millirem). This was generally considered a one-time event for that individual, although this individual may encounter another exposure of a similar or longer duration in his or her lifetime. An inspector inspecting the conveyance and its cargo would be exposed to a maximum dose rate of 3.6×10^{-5} rem (or 0.036 millirem) per hour if the inspector stood within 1 meter of the cargo for the duration of the inspection.

A member of the public residing along the route would likely receive multiple exposures from passing shipments. The cumulative dose to this resident was calculated by assuming all shipments pass his or her home. The cumulative dose also was calculated assuming that the resident was present for every shipment and was unshielded at a distance of about 98 feet from the route. Therefore, the cumulative dose depends on the number of shipments passing a particular point and is independent of the actual route being considered. Assuming the maximum resident dose provided in Table H–7 for all radioactive shipments, the maximum dose to this resident on a truck route, if all the materials were shipped via this route, would be, about 3.3×10^{-3} millirem for the Cleanup to AOC LUT Values Alternative or Cleanup to Revised LUT Values Alternative, about

1.7×10^{-3} for the Conservation of Natural Resources Alternative, about 5.0×10^{-4} millirem for the Building Removal Alternative, and about 6.3×10^{-5} millirem for the Groundwater Treatment Alternative. A resident living along a rail route, if exposed to all rail shipments, would receive a dose of about 4.2×10^{-4} millirem for the Cleanup to AOC LUT Values Alternative or Cleanup to Revised LUT Values Alternative, 2.2×10^{-4} for the Conservation of Natural Resources Alternative, 6.4×10^{-5} millirem for the Building Removal Alternative, and 7.9×10^{-6} millirem for the Groundwater Treatment Alternative.

The accident risk assessment and the impacts shown in Table H–5 take into account the entire spectrum of potential accidents, from minor accidents (i.e., fender-benders) to extremely severe accidents (i.e., high-speed collisions). To provide additional insight into the severity of accidents in terms of the potential dose to an MEI and the public, an accident consequence assessment was performed for a maximum reasonably foreseeable hypothetical transportation accident with a likelihood of occurrence greater than 1 chance in 10 million per year.

The following assumptions were used to estimate the consequences of maximum reasonably foreseeable offsite transportation accidents:

- The accident is the most severe with the highest release fraction (high-impact and high-temperature fire accident [highest severity category]).
- The individual is 330 feet downwind from a ground release accident.
- The individual is exposed to airborne contamination for 2 hours and ground contamination for 24 hours, with no interdiction or cleanup. A stable weather condition (Pasquill Stability Class F) with a wind speed of 2.2 miles per hour was assumed.
- The population was assumed to have a uniform density to a radius of 50 miles and be exposed to the entire plume passage and 7 days of ground exposure, without interdiction and cleanup. A neutral weather condition (Pasquill Stability Class D) with a wind speed of 8.8 miles per hour also was assumed. Because the consequence would be proportional to the population density, the accident was assumed to occur in an urban[4] area with the highest density (see Table H–1).

Table H–8 provides the estimated dose and risk to an individual and population from a maximum foreseeable truck transportation accident with the highest consequences under each alternative. Only those accidents with a probability greater than 1×10^{-7} (1 chance in 10 million) per year were analyzed. The accident was assumed to be a severe impact in conjunction with a long fire. The highest consequences for the maximum foreseeable accident, based on population dose, would be from accidents occurring in an urban area involving the transport of LLW/MLLW (soil) via truck under all rail routes, as part of the transport to disposal facilities. The highest consequences for the maximum foreseeable accident, based on population dose, in the Los Angeles metropolitan area would be from accidents involving the transport of LLW/MLLW (soil) via truck under all rail routes, as part of the transport to an intermodal facility.

[4] If the likelihood of an accident in an urban area is less than 1 chance in 10 million per year, then the accident was evaluated for a suburban area.

Table H–8 Estimated Dose to the Population and to Maximally Exposed Individuals under the Maximum Reasonably Foreseeable Accident

Transport Mode	Material or Waste in the Accident With the Highest Consequences	Applicable Alternatives	Maximum Likelihood of the Accident (per year)	Population Zone	Population [a]		MEI [b]	
					Dose (person-rem)	LCFs	Dose (rem)	Increased Probability of a Fatal Cancer
Truck transport to disposal facility [c]	LLW/MLLW (soil)	All [d]	2.0×10^{-6}	Urban	2.6×10^{-4}	2×10^{-7}	2.6×10^{-7}	2×10^{-10}
Rail transport to disposal facility [c]	LLW/MLLW (soil)	All [d]	4.7×10^{-7}	Urban	6.4×10^{-3}	4×10^{-6}	4.2×10^{-6}	2×10^{-9}
Truck transport to disposal facility [c]	LLW/MLLW (building debris)	All	3.0×10^{-7}	Urban	4.1×10^{-4}	2×10^{-7}	1.7×10^{-7}	1×10^{-10}
Rail transport to disposal facility [e]	LLW/MLLW (building debris)	All	1.5×10^{-7}	Suburban	8.2×10^{-4}	5×10^{-7}	2.7×10^{-6}	2×10^{-9}
Truck transport through LA metropolitan area (disposal via truck)	LLW/MLLW (soil)	All [f]	6.2×10^{-7}	Urban	2.6×10^{-4}	2×10^{-7}	2.6×10^{-7}	2×10^{-10}
Truck transport through LA metropolitan area (disposal via truck/rail)	LLW/MLLW (soil)	All [f]	4.0×10^{-7}	Urban	4.1×10^{-4}	2×10^{-7}	2.6×10^{-7}	2×10^{-10}

LA = Los Angeles; LCF = latent cancer fatality; LLW = low-level radioactive waste; MEI = maximally exposed individual; MLLW = mixed low-level waste.

[a] The population extends at a uniform density to a radius of 50 miles. The weather condition was assumed to be Pasquill Stability Class D, with a wind speed of 8.8 miles per hour.

[b] The MEI was assumed to be at a distance downwind from the accident that would maximize exposure and to be exposed to the entire plume of the radioactive release. The weather condition was assumed to be Pasquill Stability Class F, with a wind speed of 2.2 miles per hour.

[c] The maximum dose and frequency would occur for transports to Energy*Solutions* in Utah because of the longer travel distance.

[d] Assuming that all radioactive soil is transported within 2 years. This condition is true for the Cleanup to Revised LUT Values and Conservation of Natural Resources Alternatives. The maximum likelihood of a maximum reasonably foreseeable accident for the Cleanup to AOC LUT Values Alternative for the truck and truck/rail options are 4.2×10^{-7} and about 1.0×10^{-7} per year, respectively.

[e] The maximum dose and frequency would occur for transports to NNSS in Nevada because of the additional truck trips needed to transport waste from the Barstow intermodal facility to NNSS.

[f] Assuming that all radioactive soil is transported within 2 years. This condition is true for the Cleanup to Revised LUT Values and Conservation of Natural Resources Alternatives. The maximum likelihood of a maximum reasonably foreseeable accident for the Cleanup to AOC LUT Values Alternative for the truck and truck/rail options are about 1.3×10^{-7} and about 1.0×10^{-7} per year, respectively.

H.8.1 Radioactive Release Characteristics

Radiological consequences were calculated by assigning radionuclide release fractions on the basis of the type of waste, the type of shipping container, and the accident severity category. The release fraction is defined as the fraction of the radioactive material in the container that could be released to the atmosphere in a given severity of accident. Release fractions vary according to the waste type and the physical or chemical properties of the radioisotopes. Most solid radionuclides are nonvolatile and are, therefore, relatively nondispersible.

Representative release fractions were developed for each waste and container type on the basis of DOE and NRC reports (DOE 1994, 2002b, 2003b; NRC 1977, 2000). The severity categories and corresponding release fractions provided in these documents cover a range of accidents from no impact (zero speed) to impacts with a speed in excess of 120 miles per hour onto an unyielding surface. Traffic accidents that could occur at the facility would be of minor impact due to lower local speed, with no release potential.

All radioactive waste was assumed to be transported from SSFL in Type A containers, including industrial packages (IP-1 or IP-2), B-25 boxes, soft-liners, and International Organization for Standardization (ISO) containers. For this waste, the fractions of radioactive material assumed to be released from a shipping container during a severe accident were based on recommended values from the *Radioactive Material Transportation Study* (NRC 1977) and *DOE Handbook – Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facility* (DOE 1994). The release fractions for concrete, asphalt, or rebar were assumed to be a factor of 10 less than those for soil. For groundwater source removal, the release fractions for contaminated bedrocks were assumed to be a factor 100 less than those for soil because the contamination is entrapped within solid rocks that would be removed for offsite disposal.

For those accidents where the waste container was undamaged and no radioactive material was released, it was assumed that it would take 12 hours to recover from the accident and resume shipment. During this period, no individual would remain close to the cask. A first responder was assumed to stay at a location 6.6 to 33 feet from the package for 1 hour (DOE 2002b).

H.9 Long-term Impacts of Radioactive Material Transportation

The *Final Environmental Impact Statement for a Geological Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE 2002a) and *Final Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE 2008b) analyzed the cumulative impacts of the transportation of radioactive material, consisting of impacts of historical shipments of radioactive waste and spent nuclear fuel, reasonably foreseeable actions that include transportation of radioactive material, and general radioactive material transportation that was not related to a particular action. The collective dose to the general population and workers was the measure used to quantify cumulative transportation impacts. This measure of impact was chosen because it may be directly related to the LCFs using a cancer risk coefficient. **Table H–9** provides an updated summary of the total worker and general population collective doses from various transportation activities involving the shipment of radioactive materials. The table shows that the potential impacts of transportation related to this EIS would be small compared with the overall transportation impacts.

The total collective worker dose from all types of shipments that are not associated with this EIS (historical, reasonably foreseeable actions; and general transportation) was estimated to be about 421,000 person-rem (potentially resulting in 252 LCFs) for the period from 1943 through 2073 (131 years) (DOE 2015a). Note the potential doses from transport of radioactive materials associated with the alternatives evaluated in this EIS would be very small and would be insignificant compared to the dose from other nuclear material shipments. The total general population collective dose was estimated to be about 436,000 person-rem (potentially resulting in 262 LCFs). The majority of the collective dose for workers and the general population would be due to the general transportation of radioactive material (see Table H–9). Examples of these activities are shipments of radiopharmaceuticals to nuclear medicine laboratories and shipments of commercial LLW to commercial disposal facilities.

Table H–9 Cumulative Transportation-Related Radiological Collective Doses and Latent Cancer Fatalities (1943 to 2073)

Category	*Collective Worker Dose (person-rem)*	*Collective General Population Dose (person-rem)*
Transportation Impacts in this EIS [a]	0.34 to 1.5 [b] 0.14 to 0.46 [c]	0.092 to 0.39 [b] 0.12 to 0.26 [c]
Transportation impacts from NASA actions [d]	0.50	0.19
Transportation impacts from Boeing actions [e]	NA	NA
Subtotal	**0.64 to 2**	**0.28 to 0.58**
Other Nuclear Material Shipments		
Past, Present, and Reasonably Foreseeable DOE Actions [f]	31,400	36,900
Past, Present, and Reasonably Foreseeable non-DOE Actions [f]	5,380	61,300
General Radioactive Material Transport (1943 to 2073) [f]	384,000	338,000
Total Collective Dose (up to 2073) [g]	**421,000**	**436,000**
Total Latent Cancer Fatalities [h]	**252**	**262**

Boeing = The Boeing Company; EIS = environmental impact statement; NA = not applicable; NASA = National Aeronautics and Space Administration.

[a] Range of values from Table H–6.
[b] Transport by truck.
[c] Transport by truck/rail.
[d] Due to the similarities between DOE and NASA LLW/MLLW shipment characteristics (soil, shipping methods, and disposal location [Energy*Solutions*, Utah]) the collective worker dose and collective population dose were estimated using the estimated number of NASA LLW/MLLW shipments and the per shipment risk factors for shipments to Energy*Solutions* used in Table H–4. These numbers are not found in the NASA final EIS (NASA 2014); however, they were estimated and are presented here for purposes of analysis of cumulative impacts.
[e] Boeing is not disposing of any LLW/MLLW.
[f] From the *Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement* (DOE 2015a); this reference provides the details of all contributing actions. Most of these activities are unrelated to activities at SSFL.
[g] Total includes the maximum values from the EIS alternatives. Total may not equal the sum of the contributions due to rounding.
[h] Total LCFs were calculated assuming 0.0006 LCFs per rem of exposure (DOE 2003a).

The total number of potential LCFs (among the workers and the general population) estimated to result from radioactive material transportation over the period between 1943 and 2073 would be about 514 (262 from workers and 252 from the general population) (DOE 2015a). These potential LCFs averaged over 131 years would lead to about 4 LCFs per year. Over this same period (131 years), about 74 million people would die from cancer, based on the average annual number of cancer deaths in the United States of about 566,000, with no more than a 1 percent fluctuation in the number of cancer fatalities in any given year (CDC 2008, 2011, 2012a, 2012b, 2013). The transportation-related LCFs would be 0.0007 percent of the total number of cancer deaths; therefore, this number is indistinguishable from the natural fluctuation in the total annual death rate from cancer.

H.10 Impacts from Transporting Hazardous Waste, Nonhazardous Waste, and Backfill

This section evaluates the impacts of transporting hazardous waste, nonhazardous waste, and backfill. For truck shipments, hazardous wastes were assumed to be transported to US Ecology in Idaho (about 950 miles); nonhazardous wastes were assumed to be transported to Westmorland (about 230 miles) in California. These sites represent the farthest truck distances to the disposal facilities herein evaluated for the two different types of waste. Equipment and supplies were assumed to be transported to SSFL from locations within 50 miles of SSFL, while backfill was assumed to be transported to SSFL from locations within 100 miles of SSFL. For truck/rail shipments, hazardous and nonhazardous wastes were assumed to be transported to US Ecology in Idaho.

Transport of backfill, equipment, and supplies would only be done via truck. For hazardous waste transport by truck, the accident and fatality rates were taken from Saricks and Tompkins (Saricks and Tompkins 1999), adjusted for underreporting using UMTRI 2003, similar to those used for transporting LLW or MLLW, with values of 4.3 accidents per 10 million truck-kilometers and 1.9 fatalities per 100 million truck-kilometers. For nonhazardous waste, recycle material, and backfill transport, the accident rates are those listed for the State of California in Saricks and Tompkins (adjusted for underreporting using UMTRI 2003), with values of 1.4 accidents per 10 million truck-kilometers and 0.57 fatalities per 100 million truck-kilometers. For hazardous waste transport by rail, accident and fatality rates were taken from Saricks and Tompkins, similar to those used for transporting LLW or MLLW, with values of 4.8 accidents per 100 million rail-kilometers and 2.2 fatalities per 100 million rail-kilometers. Rail accident and fatality rates were assumed to be 4.98 accidents per 100 million rail-kilometers and 3.52 fatalities per 100 million rail-kilometers for nonhazardous material (Saricks and Tompkins 1999; UMTRI 2003). **Table H–10** summarizes the impacts in terms of total numbers of truck and rail shipments, miles, accidents, and fatalities for the action alternatives. The results indicate that the Cleanup to AOC LUT Values Alternative would have the greatest risks for both truck and rail transport.

Table H–10 Risks from Transporting Nonradioactive Waste and Miscellaneous Materials under Each Action Alternative

Alternative	*Number of Truck Shipments* [a]	*Number of Rail Shipments* [a]	*Two-way Miles Traveled*	*Number of Accidents*	*Number of Traffic Fatalities*
Truck					
Cleanup to AOC LUT Values	**110,000**	**NA**	**39,000,000**	**12**	**0.52**
Hazardous	3,680	NA	7,500,000	5.2	0.23
Nonhazardous	59,500	NA	27,350,0000	6.0	0.25
Backfill/Equipment/Supplies	45,700	NA	4,540,000	1.0	0.041
Cleanup to Revised LUT Values	**17,000**	**NA**	**10,200,000**	**5.8**	**0.25**
Hazardous	3,680	NA	7,500,000	5.2	0.23
Nonhazardous	3,900	NA	1,793,000	0.39	0.016
Backfill/Equipment/Supplies	9,440	NA	936,300	0.21	8.5×10^{-3}
Conservation of Natural Resources	**14,900**	**NA**	**10,000,000**	**5.7**	**0.25**
Hazardous	3,680	NA	7,500,000	5.2	0.23
Nonhazardous	3,900	NA	1,793,000	0.39	0.016
Backfill/Equipment/Supplies	7,290	NA	722,000	0.16	6.6×10^{-3}
Building Removal	**1,400**	**NA**	**201,000**	$\mathbf{5.5 \times 10^{-2}}$	$\mathbf{2.3 \times 10^{-3}}$
Hazardous	10	NA	23,000	1.6×10^{-2}	7.1×10^{-4}
Nonhazardous	120	NA	54,000	1.2×10^{-2}	4.9×10^{-4}
Building Recycle Material	340	NA	34,000	7.5×10^{-3}	3.1×10^{-4}
Backfill/Equipment/Supplies	920	NA	89,000	2.0×10^{-2}	8.1×10^{-4}
Groundwater Monitored Natural Attenuation [b]	**280**	**NA**	**17,000**	$\mathbf{3.7 \times 10^{-3}}$	$\mathbf{1.5 \times 10^{-4}}$
Hazardous	0	NA	0	0	0
Nonhazardous	20	NA	4,000	8.7×10^{-4}	3.6×10^{-5}
Equipment/Supplies	260 [c]	NA	13,000	2.8×10^{-3}	1.2×10^{-4}
Groundwater Treatment	**420**	**NA**	**503,000**	**0.34**	$\mathbf{1.5 \times 10^{-2}}$
Hazardous [d]	240	NA	490,000	0.34	1.5×10^{-2}
Nonhazardous	0	NA	0	0	0
Backfill/Equipment/Supplies	180	NA	13,000	2.9×10^{-3}	1.2×10^{-4}

Alternative	Number of Truck Shipments [a]	Number of Rail Shipments [a]	Two-way Miles Traveled	Number of Accidents	Number of Traffic Fatalities
Truck/Rail					
Cleanup to AOC LUT Values	**110,000**	**3,900**	**19,590,000**	**7.9**	**2.6**
Hazardous	3,680	230	880,000	0.40	0.15
Nonhazardous	59,500	3,700	14,180,000	6.5	2.4
Backfill/Equipment/Supplies [e]	45,700	NA	4,540,000	1.0	0.041
Cleanup to Revised LUT Values	**17,000**	**470**	**2,743,000**	**1.0**	**0.32**
Hazardous	3,680	230	880,000	0.40	0.15
Nonhazardous	3,900	240	930,000	0.43	0.16
Backfill/Equipment/Supplies [e]	9,440	NA	936,300	0.21	8.5×10^{-3}
Conservation of Natural Resources	**14,900**	**470**	**2,529,000**	**1.0**	**0.31**
Hazardous	3,680	230	880,000	0.40	0.15
Nonhazardous	3,900	240	930,000	0.43	0.16
Backfill/Equipment/Supplies [e]	7,290	NA	722,000	0.16	6.6×10^{-3}
Building Removal	**1,400**	**10**	**156,000**	$\mathbf{4.2 \times 10^{-2}}$	$\mathbf{7.0 \times 10^{-3}}$
Hazardous	10	1	3,400	1.7×10^{-3}	6.5×10^{-4}
Nonhazardous	120	10	29,600	1.4×10^{-2}	5.2×10^{-3}
Building Recycle Material [e]	340	NA	34,000	7.5×10^{-3}	3.1×10^{-4}
Backfill/Equipment/Supplies [e]	920	NA	89,000	2.0×10^{-2}	8.1×10^{-4}
Groundwater Monitored Natural Attenuation	b	b	b	b	b
Groundwater Treatment	d	d	d	d	d

AOC = *Administrative Order on Consent for Remedial Action*; LUT = Look-Up Table; NA = not applicable.
[a] The number of truck and rail shipments were rounded to the nearest 10.
[b] Wastes generated under the Groundwater Monitored Natural Attenuation Alternative were assumed to consist of nonhazardous well installation cuttings and water from well development and sampling that would be shipped by truck only. If during generation these wastes were determined to be low-level radioactive or mixed low-level radioactive wastes, they would be safely transported to appropriate authorized facilities for disposition.
[c] Includes 240 shipments of well water samples that would be delivered to offsite laboratories in light-duty trucks or cars.
[d] Groundwater treatment systems were assumed to include pump and treat or other systems requiring periodic exchange of treatment media by a vendor. The media were assumed to contain hazardous constituents and be either disposed of as hazardous waste or as hazardous waste generated as part of processing the treatment media. Only truck shipment was assumed for this material.
[e] These shipments would be performed using truck only.
Note: Values have been rounded.

Table H–11 shows the range of risks (high and low) of transporting nonradioactive waste and material using truck and truck/rail transport methods, considering all potential combinations of action alternatives. For the High Impact Combination, it was assumed that DOE would implement the Cleanup to AOC LUT Values Alternative, the Building Removal Alternative, and the Groundwater Treatment Alternative. For the Low Impact Combination, it was assumed that DOE would implement the Conservation of Natural Resources Alternative,[5] the Building Removal Alternative, and Groundwater Monitored Natural Attenuation Alternative. The numbers of accidents that could result from transporting nonradioactive waste and material by truck range from 5.8 to 13, while the number of fatalities range from 0 (calculated value: 0.25) to 1 (calculated value: 0.54). The numbers of accidents that could result from transporting nonradioactive waste and material by truck/rail range from 1.0 to 8.0, while the number of fatalities range from 0 (calculated value: 0.32) to 3 (calculated value: 2.6).

[5] Note that, for transporting nonradioactive wastes, both the Conservation of Natural Resources Alternative and the Cleanup to Revised LUT Values Alternative would have the same impacts. However, the Conservation of Natural Resources Alternative would have a smaller radioactive transportation impact.

Table H–11 Total Risks from Transporting Nonradioactive Waste and Material

Transport Method	Number of Truck Shipments	Number of Rail Shipments	Total Distance Traveled (miles; two-way)	Number of Accidents	Number of Fatalities
High Impact Combination [a]					
Truck	111,000	NA	40,000,000	13	0.54
Truck/Rail [b]	111,000	3,960	19,800,000	8.0	2.6
Low Impact Combination [c]					
Truck	16,600	NA	10,200,000	5.8	0.25
Truck/Rail [b]	16,600	490	2,700,000	1.0	0.32

NA = not applicable.
[a] Impacts if DOE implemented the Cleanup to AOC LUT Values, Building Removal, and Groundwater Treatment Alternatives.
[b] Truck shipments include shipments of hazardous and nonhazardous waste from SSFL to an intermodal rail yard and shipments of backfill soil to SSFL. Backfill would be transported using truck only.
[c] Impacts if DOE implemented the Conservation of Natural Resources, Building Removal, and Groundwater Monitored Natural Attenuation Alternatives.

H.11 Conclusions

Based on the results presented in the previous sections, the following conclusions have been reached (see Tables H–4 to H–11):

- For all alternatives, it is unlikely that transportation of radioactive waste would cause an additional fatality as a result of radiation exposure, either from incident-free transport or postulated transportation accidents.
- The highest risk to the public due to incident-free transportation would occur under either the Cleanup to AOC LUT Values Alternative or Cleanup to Revised LUT Values Alternative, where 6,830 truck shipments of radioactive waste from SSFL would occur (see Table H–5).
- The nonradiological accident risks (the potential for fatalities as a direct result of traffic accidents) present greater risks than the radiological accident risks. For comparison, in the United States in 2012, there were over 4,100 fatalities due to crashes involving large trucks (DOT 2014) and over 32,000 traffic fatalities due to all vehicular crashes (DOT 2012b). The incremental increase in risk to the general population from shipments associated with SSFL would therefore be very small and would not substantially contribute to cumulative impacts.

H.12 Uncertainty and Conservatism in Estimated Impacts

The sequence of analyses performed to generate the estimates of radiological risk for transportation includes: (1) determination of the inventory and characteristics, (2) estimation of shipment requirements, (3) determination of route characteristics, (4) calculation of radiation doses to exposed individuals (including estimating of environmental transport and uptake of radionuclides), and (5) estimation of health effects. Uncertainties are associated with each of these steps. Uncertainties exist in the way that the physical systems being analyzed are represented by the computational models; in the data required to exercise the models (due to measurement errors, sampling errors, natural variability, or unknowns caused simply by the future nature of the actions being analyzed); and in the calculations themselves (for example, approximate algorithms used within the computer codes).

In principle, one can estimate the uncertainty associated with each input or computational source and predict the resultant uncertainty in each set of calculations. Thus, one can propagate the uncertainties from one set of calculations to the next and estimate the uncertainty in the final, or absolute, result; however, conducting such a full-scale quantitative uncertainty analysis is often impractical and sometimes impossible, especially for actions to be initiated at an unspecified time in the future. Instead, the risk analysis is designed to ensure, through uniform and judicious selection of scenarios, models, and input parameters, that relative comparisons of risk among the various alternatives are meaningful. In the transportation risk assessment, this design is accomplished by uniformly applying common input parameters and assumptions to each alternative. Therefore, although considerable uncertainty is inherent in the absolute magnitude of the transportation risk for each alternative, much less uncertainty is associated with the relative differences among the alternatives in a given measure of risk.

In the following sections, areas of uncertainty are discussed for the assessment steps enumerated above. Special emphasis is placed on identifying whether the uncertainties affect relative or absolute measures of risk. The reality and conservatism of the assumptions are addressed. Where practical, the parameters that most significantly affect the risk assessment results are identified.

H.12.1 Uncertainties in Material Inventory and Characterization

The inventories and the physical and radiological characteristics are important input parameters to the transportation risk assessment. The potential numbers of shipments under all alternatives were primarily based on the projected dimensions of package contents, the strength of the radiation field, and assumptions concerning shipment capacities. The physical and radiological characteristics are important in determining the material released during accidents and the subsequent doses to exposed individuals through multiple environmental exposure pathways.

Uncertainties in the inventory and characterization are reflected in the transportation risk results. If the inventory is overestimated (or underestimated), the resulting transportation risk estimates also will be overestimated (or underestimated) by roughly the same factor. However, the same inventory estimates were used to analyze the transportation impacts of each of the alternatives. Therefore, for comparative purposes, the observed differences in transportation risks among the alternatives, as given in Table H–5, are believed to represent unbiased, reasonably accurate estimates from current information in terms of relative risk comparisons.

H.12.2 Uncertainties in Containers, Shipment Capacities, and Number of Shipments

The transportation requirement for each alternative was based in part on assumptions concerning the packaging characteristics and shipment capacities for commercial trucks. Representative shipment capacities were defined for assessment purposes based on probable future shipment capacities. In reality, the actual shipment capacities may differ from the predicted capacities, such that the projected number of shipments and, consequently, the total transportation risk, would change. However, although the predicted transportation risks may increase or decrease accordingly, the relative differences in risks among alternatives would remain about the same.

H.12.3 Uncertainties in Route Determination

Analyzed routes were determined between SSFL and the sites evaluated in this EIS. The routes were determined to be consistent with current guidelines, regulations, and practices, but may not be the actual routes that would be used in the future. In reality, the actual routes could differ from the ones that are analyzed with regard to distances and total populations along the routes. Moreover, because materials could be transported over an extended time starting in the future, the highway infrastructure and the demographics along the routes could change. These effects were not accounted for in the transportation assessment; however, such changes are not expected to significantly affect the relative comparisons of risk among the alternatives considered in this EIS.

H.12.4 Uncertainties in the Calculation of Radiation Doses

The models used to calculate radiation doses from transportation activities introduce a further uncertainty. Estimating the accuracy or absolute uncertainty of the risk assessment results is generally difficult. The accuracy of the calculated results is closely related to the limitations of the computational models and to the uncertainties in each of the input parameters that the model requires. The single greatest limitation facing users of RADTRAN 6.02 (SNL 2013), or any computer code of this type, is the availability of data for certain input parameters. Populations (off-link and on-link) along the transportation routes, shipment surface dose rates, and the locations of individuals residing near the routes are among the most uncertain data in dose calculations. In preparing these data, one makes assumptions that the off-link population is uniformly distributed; the on-link population is proportional to the traffic density, with an assumed occupancy of two persons per car; the shipment surface dose rate is the maximum allowed dose rate; and a potential exists for an individual to be residing at the edge of the highway. Clearly, not all assumptions are accurate. For example, the off-link population is mostly heterogeneous, and the on-link traffic density varies widely within a geographic zone (urban, suburban, or rural). Finally, added to this complexity are the assumptions regarding the expected distance between the public and the shipment at a traffic stop, rest stop, or traffic jam, and the afforded shielding.

Uncertainties associated with the computational models were reduced by using state-of-the-art computer codes that have undergone extensive review. Because many uncertainties are recognized, but difficult to quantify, assumptions were made at each step of the risk assessment process that were intended to produce conservative results (that is, to overestimate the calculated dose and radiological risk). Because parameters and assumptions were applied consistently to all alternatives, this model bias is not expected to affect the meaningfulness of relative comparisons of risk; however, the results may not represent risks in an absolute sense.

H.12.5 Uncertainties in Traffic Fatality Rates

Vehicle accident and fatality rates were taken from Saricks and Tompkins 1999, as updated using UMTRI 2003. Truck and rail accident rates were computed for each state based on statistics compiled by the Federal Highway Administration, Office of Motor Carriers, and the Federal Railroad Administration from 1994 to 1996. The statistics are provided in terms of unit car-kilometers for each state, as well as national average and mean values. In this analysis, route-specific (origin-destination) rates were used.

Finally, it should be emphasized that the analysis was based on accident data for the years 1994 through 1996. While these data are considered to be the best available data, future accident and fatality rates may change due to vehicle and highway improvements. More-recent DOT national accident and fatality statistics for large trucks and buses indicate lower accident and fatality rates for recent years (DOT 2009) compared to those of 1994 through 1996 and earlier statistical data.

H.13 Traffic

H.13.1 Region of Influence

This subsection primarily addresses potential impacts of the alternatives on the capacity and traffic flow of surface transportation systems serving SSFL. The region of influence for transportation includes roads and rail lines that could be used to transport LLW, MLLW, hazardous waste, and nonhazardous materials and waste to offsite facilities and for delivery of equipment and materials to SSFL. It also includes local roads used by personnel and contractors travelling to and from SSFL in passenger vehicles and light trucks (such as step vans and pickup trucks), medium-duty trucks, and heavy-duty trucks. Finally, it addresses traffic on roads in the vicinities of the representative recycle, disposal, and intermodal facilities.

H.13.2 Description of Impact Drivers

The following components and activities of the proposed action can cause potential impacts.

The proposed action involves truck and worker commuter trips to or from SSFL, coming from and going to destinations within the local area and wider region. These trips represent additional traffic volumes over baseline levels that could affect the quality of traffic flow (expressed as a level of service [LOS] rating for each road), particularly at certain times of day, and based on road, traffic, environmental, and control conditions. In addition, increased traffic on local roads can degrade the pavement surface and condition of the road. This can affect other users and their vehicles and increase publicly funded road maintenance requirements.

Three primary types of trucks having the characteristics summarized in **Table H–12** would be used to transport waste, equipment, and materials. These include light-duty trucks with gross vehicle weight ratings (GVWRs) up to 14,000 pounds; medium-duty trucks with GVWRs from 14,001 pounds to 26,000 pounds; and heavy-duty trucks with GVWRs equal to or exceeding 26,001 pounds.[6]

Table H–12 Truck Classification System

General Designation	*Class*	*Gross Vehicle Weight Rating*	*Example*
Light-duty	1	0 – 6,000 pounds	Pickup truck
	2	6,001 – 10,000 pounds	
	3	10,001 – 14,000 pounds	
Medium-duty	4	14,001 – 16,000 pounds	Flatbed truck
	5	16,001 – 19,500 pounds	
	6	19,501 – 26,000 pounds	
Heavy-duty	7	26,001 – 33,000 pounds	Dump truck; tractor-trailer
	8	>33,000 pounds	

> = greater than.
Source: DOE 2015b.

[6] GVWRs of heavy-duty trucks can exceed 80,000 pounds in some states and situations. A limit of 80,000 pounds was assumed, however, for purposes of analysis in this EIS.

It was assumed that waste from soil remediation, building removal, and groundwater remediation would be transported off site for disposal using heavy-duty trucks with 20 tons of waste per truck,[7] while backfill would be transported to SSFL using heavy-duty trucks with 23 tons of backfill per truck. To minimize dust and contain the contents of each truck while in transit, trucks would be covered and, as appropriate, waste would be placed into containers before departing SSFL.

Waste would be transported directly to a treatment or disposal facility or to a location close to SSFL which, for purposes of analysis, was assumed to be the Puente Hills Intermodal Facility, which is under construction in City of Industry, California (see Appendix D, Section D.4). There, the cargo would be loaded onto railcars for transport to a facility that can receive waste by rail. This option will require sufficient railcar capacity to ship materials, as well as adequate storage and lifting capacity at road-to-rail transfer locations to marshal and load shipments onto freight cars. Equipment and supplies would be transported to SSFL to implement the action alternatives. It was assumed that heavy equipment for soil remediation, building removal, or groundwater remediation would be primarily delivered using heavy-duty trucks, while most supplies would be delivered using medium-duty trucks. Light-duty trucks and other vehicles, such as cars, would be used for activities such as delivery of well monitoring samples to offsite laboratories for analysis. It was also assumed that cars or light-duty trucks would be used by site workers commuting to SSFL. One worker per vehicle was assumed; however, less worker traffic would occur if workers shared rides during the commute.

H.13.3 Impact Assessment Protocol

H.13.3.1 Affected Environment

SSFL Vicinity

Chapter 3, Section 3.8, includes data summarizing daily road traffic volumes in the SSFL vicinity, as well as traffic peak hours and directional distributions gathered from traffic records compiled by the City of Los Angeles. Road geometric characteristics were obtained from field inspection. Information about potential road-to-rail transfer locations was obtained by communicating with freight rail operators in the region. Current road pavement condition data were obtained from field surveys conducted on local roads.

Impacts were analyzed for roads on the four most-direct routes from SSFL to the inter-regional highway network:

- Woolsey Canyon Road to Valley Circle Boulevard; south on Valley Circle Boulevard to Roscoe Boulevard; east on Roscoe Boulevard to Topanga Canyon Boulevard; then north on Topanga Canyon Boulevard to Ronald Reagan Freeway (State Route 118).
- Woolsey Canyon Road to Valley Circle Boulevard; north to northeast on Valley Circle Boulevard (a section of this road is called Lake Manor Drive) to Plummer Street; east on Plummer Street to Topanga Canyon Boulevard; then north on Topanga Canyon Boulevard to Ronald Reagan Freeway (State Route 118).

[7] Shipment of soil waste could also occur using trucks such as semi-trailer dump trucks that can transport larger quantities than 20 tons per load (i.e., up to 23 tons). In this case, there would be fewer shipments of soil waste from SSFL and smaller traffic impacts than those evaluated in this appendix.

- Woolsey Canyon Road to Valley Circle Boulevard; south on Valley Circle Boulevard to the Ventura Freeway (U.S. Highway 101).
- Woolsey Canyon Road to Valley Circle Boulevard; south on Valley Circle Boulevard to Roscoe Boulevard; east on Roscoe Boulevard to Topanga Canyon Boulevard; then south on Topanga Canyon Boulevard to the Ventura Freeway (U.S. Highway 101).

The routes and road segments evaluated are summarized in **Table H–13** and illustrated in **Figure H–4**.

Table H–13 Routes and Road Segments Analyzed

Route 1					
Road	Woolsey Canyon Road	Valley Circle Blvd [a]	Plummer Street	Topanga Canyon Blvd	SR 118 (Ronald Reagan Freeway)
Segment	SSFL entrance to Valley Circle Blvd	Woolsey Canyon to Plummer Street	Valley Circle Blvd to Topanga Canyon Blvd	Plummer Street to SR 118 (Ronald Reagan Freeway)	Junction with Topanga Canyon Blvd
Route 2					
Road	Woolsey Canyon Road	Valley Circle Blvd [a]	Roscoe Blvd	Topanga Canyon Blvd	SR 118 (Ronald Reagan Freeway)
Segment	SSFL entrance to Valley Circle Blvd	Woolsey Canyon to Roscoe Blvd	Valley Circle Blvd to Topanga Canyon Blvd	Roscoe Blvd to SR 118 (Ronald Reagan Freeway)	Junction with Topanga Canyon Blvd
Route 3					
Road	Woolsey Canyon Road	Valley Circle Blvd [a]	Valley Circle Blvd	Valley Circle Blvd	U.S. Highway 101 (Ventura Freeway)
Segment	SSFL entrance to Valley Circle Blvd	Woolsey Canyon to Roscoe Blvd	Roscoe Blvd to Victory Blvd	Victory Blvd to U.S. Highway 101	Junction with Topanga Canyon Blvd
Route 4					
Road	Woolsey Canyon Road	Valley Circle Blvd [a]	Roscoe Blvd	Topanga Canyon Blvd	U.S. Highway 101 (Ventura Freeway)
Segment	SSFL entrance to Valley Circle Blvd	Woolsey Canyon to Roscoe Blvd	Valley Circle Blvd to Topanga Canyon Blvd	Roscoe Blvd to U.S. Highway 101 (Ventura Freeway)	Junction with Topanga Canyon Blvd

Blvd = Boulevard; SR = State Route.
[a] A section of Valley Circle Boulevard is called Lake Manor Drive.

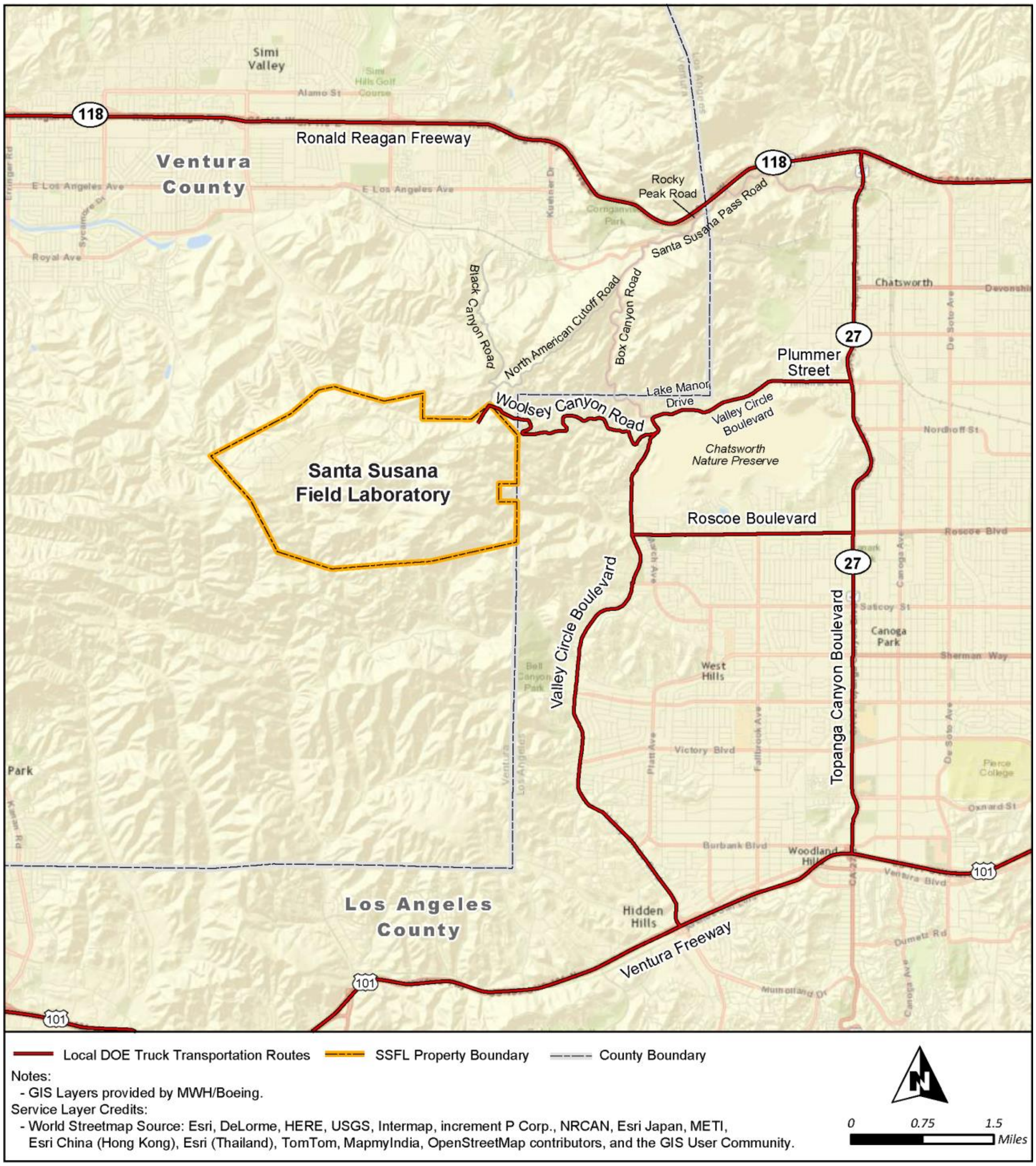


Figure H–4 Local Transportation Routes for Waste Transportation Vehicles

Disposal and Recycle Facility Vicinities

The affected environments for the evaluated disposal and recycle facilities and intermodal facilities in this EIS were assumed to consist of roads near the facilities that could be used to transport waste and recycle materials to the facilities. Current daily traffic volumes and LOS ratings for selected vicinity roads were obtained from various sources and are summarized in **Table H–14**.

Table H–14 Traffic Volumes and Level of Service Ratings for Roads in the Vicinities of Evaluated Disposal and Recycle Facilities and Intermodal Facilities

Facility (State)	*Road Segment*	*Average Daily Traffic*	*Capacity*	*Level of Service* [a]
Disposal and Recycle Facilities				
Antelope Valley (CA)	SR 14 at Avenue S	69,000	87,100	C
Chiquita Canyon (CA)	SR 126 at Commerce Center Drive	22,300	31,300	C
Mesquite (CA)	SR 78 east of junction with SR 115	3,450	16,400	A
Buttonwillow (CA)	SR 33 at Lokern Road	1,900	16,400	A
	SR 58 at Lokern Road	2,550	16,400	A
Westmorland (CA)	SR 78 junction with SR 86	670	16,400	A
McKittrick (CA)	SR 58 at junction of SR 33	350	16,400	A
US Ecology (ID)	SR 78 northwest of Grandview Road	483	16,400	A
Energy*Solutions* (UT)	Interstate 80 north of Clive, Utah	7,245	16,400	C
NNSS (NV)	U.S. Highway 95, 4 miles north of the Mercury interchange	3,200	16,400	B
Kramer Metals (CA)	Alameda Street at Slauson Avenue	24,000	34,000	C
Standard Industries (CA)	SR 232 junction with SR 118	14,600	16,400	D
P. W. Gillibrand (CA)	Tapo Canyon Road north of Presidio Drive	2,500	20,000	A
Intermodal Facilities				
Puente Hills (CA)	Pellissier Place west of Workman Mill Road	19,471	28,000	B
	Crossroads Parkway South just south of SR 60 Eastbound On/Off Ramps	18,744	32,000	A
	Workman Mill Road at SR 60 Overcrossing	17,992	28,000	B
	Workman Mill Road north of Crossroads Parkway South	8,623	28,000	A
	Workman Mill Road south of Crossroads Parkway South	16,750	28,000	A
Barstow (CA)	Interstate 15 at L Street	71,000	87,100	C

CA = California; ID = Idaho; NNSS = Nevada National Security Site; NV = Nevada; SR = State Route; UT = Utah.
[a] See Section H.13.4 and Table H–19 for an explanation of Levels of Service.
Source: Caltrans 2015; City of Industry 2008; ITD 2015; LA 2015, NDOT 2015; SV 2007; UDOT 2015.

Intermodal Facility Vicinities

The SSFL region is served by two commercial rail lines: Union-Pacific and Burlington-Northern Santa-Fe. Both freight lines operate intermodal transfer facilities that could be used for road-to-rail shipment of materials. Based on review of the rail network in the SSFL vicinity and on discussions with Los Angeles County waste management representatives (Revilla 2015a, 2015b), it was decided to analyze use of the Puente Hills Intermodal Facility. This does not mean that other locations for intermodal transfer would not be considered, but that the Puente Hills facility had sufficient favorable attributes to make it a representative facility for analysis. For further discussion see Appendix D, Section D.4.2. The Puente Hills Intermodal Facility, including road and rail modifications, is under construction in City of Industry, California, for operation by the Los Angeles County Sanitation District.

Impacts from operation of the Puente Hills Intermodal Facility were evaluated in the *Puente Hills Intermodal Facility Environmental Impact Report* (*PHIF EIR*) (City of Industry 2008) and the *Addendum* *to the Puente Hills Intermodal Facility Environmental Impact Report* (*PHIF EIR Addendum*) (City of Industry 2009). Traffic impacts were evaluated in the *PHIF EIR*, assuming that the facility would have the capacity to handle two trains per day, or approximately 8,000 tons per day of municipal solid waste received in trucks from various materials recovery facilities and transfer stations in the Los Angeles area. Initial discussions with Los Angeles County waste management representatives indicated openness to receipt of waste from SSFL (Revilla 2015a). The *PHIF EIR* and *PHIF EIR Addendum* determined that the construction or operation of the Puente Hills Intermodal Facility would not result in any significant impacts to local traffic, assuming that mitigation measures were implemented. Any shipments from SSFL to the Puente Hills Intermodal Facility would be within the total daily or annual number of trucks evaluated and authorized for the facility. Therefore, no traffic impacts would be expected from shipment of waste from SSFL to the Puente Hills Intermodal Facility in addition to those already evaluated in the *PHIF EIR* and *PHIF EIR Addendum* (City of Industry 2008, 2009). To provide additional support for this expectation, however, this appendix estimates the projected increases in traffic volumes in the vicinity of the Puente Hills Intermodal Facility that could occur from implementing the action alternatives evaluated in this EIS. Current daily traffic volumes and LOS ratings for roads in the vicinity of the Puente Hills Intermodal Facility are summarized in Table H–14.

Because NNSS lacks direct rail access, shipments of LLW or MLLW under the truck/rail option to NNSS would require offloading waste at a second intermodal facility nearer to NNSS, with subsequent truck shipment to the site. For the reasons summarized in Appendix D, Section D.4, of this EIS, the rail yard at Barstow, California, was assumed for purposes of analysis of traffic impacts as this second intermodal facility. Current daily traffic volumes and LOS ratings for a selected road in the vicinity of the Barstow, California, rail yard are summarized in Table H–14.

H.13.3.2 Methods Used to Analyze and Quantify Impacts

Traffic Flow Analysis

The impact of additional truck traffic on the road network was assessed by comparing the increased traffic forecasted for a segment against the carrying capacity of that segment as determined by procedures contained in the *2010 Highway Capacity Manual* (TRB 2010) published by the Transportation Research Board. **Table H–15** summarizes the total number of round trips for heavy-duty, medium-duty, and light-duty trucks (including trucks and cars used by workers) by year and action alternative. These summaries include heavy-duty trucks used for shipment of waste; heavy- and medium-duty trucks used for delivery of equipment, supplies, and backfill; and light-duty trucks (e.g., pickups) and cars used by workers to commute to and from SSFL.

Table H–16 summarizes the average daily number of truck round trips for shipment of waste and equipment, the average daily truck round trips for shipment of backfill, and the annual number of worker round trips for each action alternative. The Cleanup to AOC LUT Values Alternative has the largest increase in daily vehicle round trips. This is primarily due to the large volume of soil that would be disposed of under these alternatives.

The *2010 Highway Capacity Manual* (TRB 2010) procedures combine traffic volume characteristics, including the vehicle types composing the traffic stream, with road geometric, terrain, and traffic control features to quantify the traffic carrying capacity of the highway segment, as well as the quality of flow as measured by LOS.

Table H–15 Vehicle Round Trips by Year

Vehicle	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*	*Year 6*	*Year 7*	*Year 8*	*Year 9*	*Year 10*	*Year 11*	*Year 12*	*Total*
Cleanup to AOC LUT Values Alternative													
Heavy	0	26	11,778	11,999	11,999	11,999	11,999	11,999	11,999	11,999	11,999	7,867	116,000
Light	0	0	6,250	6,250	6,250	6,250	6,250	6,250	6,250	6,250	6,250	6,250	62,500
Total	0	26	18,000	18,200	18,200	18,200	18,200	18,200	18,200	18,200	18,200	14,100	178,000
Cleanup to Revised LUT Values Alternative													
Heavy	0	26	11,778	11,999	40	0	0	0	0	0	0	0	23,800
Light	0	0	6,250	6,250	521	0	0	0	0	0	0	0	13,000
Total	0	26	18,000	18,200	561	0	0	0	0	0	0	0	36,900
Conservation of Natural Resources Alternative													
Heavy	0	26	11,778	6,587	0	0	0	0	0	0	0	0	18,400
Light	0	0	6,250	6,250	0	0	0	0	0	0	0	0	12,500
Total	0	26	18,000	12,800	0	0	0	0	0	0	0	0	30,900
Building Removal Alternative													
Heavy	832	1,584	0	0	0	0	0	0	0	0	0	0	2,420
Light	2,708	2,708	0	0	0	0	0	0	0	0	0	0	5,420
Total	3,540	4,290	0	0	0	0	0	0	0	0	0	0	7,830
Groundwater Monitored Natural Attenuation Alternative													
Heavy	1	1	11	1	1	1	1	1	1	1	1	1	22
Medium	0	0	20	0	0	0	0	0	0	0	0	0	20
Light	228	228	378	228	228	228	228	228	228	228	228	228	2,890
Total	230	230	410	230	230	230	230	230	229	230	230	230	2,930
Groundwater Treatment Alternative													
Heavy	0	15	211	0	0	0	0	0	0	0	0	0	226
Medium	0	4	48	48	48	48	48	0	0	0	0	0	244
Light	0	0	641	16	16	16	16	0	0	0	0	0	705
Total	0	19	900	64	64	64	64	0	0	0	0	0	1,180

AOC = *Administrative Order on Consent for Remedial Action*; LUT = Look-Up Table.
Note: Totals have been rounded.

Table H–16 Forecasted Round Trips for Santa Susana Field Laboratory Action Alternatives

Action Alternative	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*	*Year 6*	*Year 7*	*Year 8*	*Year 9*	*Year 10*	*Year 11*	*Year 12*
Average Daily Truck Round Trips for Waste, Equipment, and Supplies												
Soil Remediation Alternatives												
Cleanup to AOC LUT Values	0	< 1[a]	29	29	29	29	29	29	29	29	29	19
Cleanup to Revised LUT Values	0	< 1[a]	29	29	< 1	0	0	0	0	0	0	0
Conservation of Natural Resources	0	< 1[a]	29	16	0	0	0	0	0	0	0	0
Building Demolition Alternatives												
Building Removal	7 [b]	7 [b]	0	0	0	0	0	0	0	0	0	0
Groundwater Remediation Alternatives												
Groundwater Monitoring Natural Attenuation	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Groundwater Treatment Alternative	0	< 1	< 1	< 1	< 1	< 1	< 1	0	0	0	0	0
Average Daily Backfill Round Trips												
Soil Remediation Alternatives												
Cleanup to AOC LUT Values	0	0	19	19	19	19	19	19	19	19	19	12
Cleanup to Revised LUT Values	0	0	19	19	< 1	0	0	0	0	0	0	0
Conservation of Natural Resources	0	0	19	10	0	0	0	0	0	0	0	0
Building Demolition Alternatives												
Building Removal	1 [c]	20 [c]	0	0	0	0	0	0	0	0	0	0
Groundwater Remediation Alternatives												
Groundwater Monitoring Natural Attenuation	0	0	0	0	0	0	0	0	0	0	0	0
Groundwater Treatment Alternative	0	0	< 1	0	0	0	0	0	0	0	0	0
Annual Worker Round Trips												
Soil Remediation Alternatives												
Cleanup to AOC LUT Values	0	0	6,250	6,250	6,250	6,250	6,250	6,250	6,250	6,250	6,250	6,250
Cleanup to Revised LUT Values	0	0	6,250	6,250	521	0	0	0	0	0	0	0
Conservation of Natural Resources	0	0	6,250	6,250	0	0	0	0	0	0	0	0
Building Demolition Alternatives												
Building Removal	2,708	2,708	0	0	0	0	0	0	0	0	0	0
Groundwater Remediation Alternatives												
Groundwater Monitoring Natural Attenuation	208	208	358	208	208	208	208	208	208	208	208	208
Groundwater Treatment Alternative	0	0	625	0	0	0	0	0	0	0	0	0

AOC = *Administrative Order on Consent for Remedial Action*; LUT = Look-Up Table.

[a] During the second year of the project activities there would be approximately 26 shipments of equipment by heavy-duty truck.

[b] The values were averaged over 5 months of building removal work during each year.

[c] The values were averaged over 3 months in the first year of project activities and 2 months in the second year of project activities.

Heavy-duty trucks have different operating characteristics than automobiles and other light-duty vehicles. A single truck can have the equivalent impact of several automobiles because heavy-duty trucks accelerate more slowly than passenger cars. Methods contained in the *2010 Highway Capacity Manual* (TRB 2010) account for these differences by converting heavy-duty truck volumes into passenger car equivalents. **Table H–17** presents LOS average daily traffic service volume threshold values for six-lane and eight-lane urban freeway facilities located on level and rolling terrain.[8] **Table H–18** presents LOS average daily traffic service volume threshold values for urban street facilities with posted speed limits of 30 mph and 45 mph. Analysis of LOS for a facility was accomplished by comparing daily traffic volumes against the service volume thresholds presented in this table. As shown in Table H–17, for example, a six-lane urban freeway with an average daily traffic of 85,000, a peak hour factor of 0.08 (i.e., 8 percent of the traffic occurs during the peak hour), and a directional distribution of 0.50 (i.e., the directional distribution of traffic is 50 percent in each direction) is operating at LOS C (it exceeds the LOS B threshold of 81,300).

Pavement Deterioration

Pavement deterioration is determined by procedures outlined in the *1993 AASHTO Guide for Design of Pavement Structures* (AASHTO 1993), published by the American Association of Highway Transportation Officials (AASHTO). Additional truck traffic was converted into Equivalent Single Axle Loads (ESALs) and compared against current or baseline loadings.

The impact of trucks on pavement is measured by the number of ESALs. One ESAL is defined as the damage to pavement caused by the passage of a single 18,000-pound vehicle axle. Therefore, an ESAL can be thought of as a unit of pavement damage. The larger the number of ESALs over a road segment, the higher the pavement damage associated with traffic flow.

ESAL values are a function of pavement type (concrete or flexible) and truck axle configurations. To calculate ESALs for any truck, AASHTO developed axle load equivalency factors for different pavement types, axle configurations, and weights. For example, the axle weight distribution for a typical five-axle semi-trailer with a legal limit of 80,000 pounds might be 12,000 pounds on the steering axle, 34,000 pounds on the tandem drive axle, and 34,000 pounds on the tandem trailer axle. The axle load equivalency factors for the steering, drive, and trailer axles are: 0.189, 1.09, and 1.09, respectively.[9] The total ESAL value of the truck is 4.07. A 4,000-pound passenger car with two 2,000-pound axles has an ESAL equivalent of 0.0004, which means that one semi-trailer truck as defined above does pavement damage similar to more than 10,000 passenger vehicles. A two-axle, 18,000-pound, medium-duty delivery truck with 4,000 pounds on the front axle and 14,000 pounds on the rear axle has an ESAL equivalent of 0.362, which means that one semi-trailer truck does pavement damage similar to approximately 11 medium-duty trucks.

---

[8] LOS estimated by Highway Capacity Manual 2010 Exhibit 16-14 or Exhibit 15-30.

[9] Based on flexible pavements; Structural Number (N) = 5, Pavement terminal serviceability rating (p) = 2.5.

Table H–17 Generalized Daily Service Volumes for Urban Freeway Facilities

		Six-Lane Freeway				*Eight-Lane Freeway*			
K-Factor	***D-Factor***	***LOS B***	***LOS C***	***LOS D***	***LOS E***	***LOS B***	***LOS C***	***LOS D***	***LOS E***
Level Terrain									
0.08	0.50	81,300	113,300	141,100	163,400	108,400	151,100	188,100	217,800
	0.55	73,900	103,000	128,300	148,500	98,600	137,300	171,000	198,000
	0.60	67,800	94,400	117,600	136,100	90,400	125,900	156,800	181,500
	0.65	62,600	87,200	108,500	157,700	83,400	116,200	144,700	167,500
0.09	0.50	72,300	100,700	125,400	145,200	96,400	134,300	167,200	193,600
	0.55	65,700	91,600	114,000	132,000	87,600	122,100	152,000	176,000
	0.60	60,200	83,900	104,500	121,000	80,300	111,900	139,400	161,300
	0.65	55,600	77,500	96,500	111,700	74,100	103,300	128,600	148,900
0.10	0.50	65,100	90,600	112,900	130,700	86,800	120,900	150,500	174,200
	0.55	59,100	82,400	102,600	118,800	78,900	109,900	136,800	158,400
	0.60	54,200	75,500	94,100	108,900	72,300	100,700	125,400	145,200
	0.65	50,000	69,700	86,800	100,500	66,700	93,000	115,800	134,000
0.11	0.50	59,100	82,400	102,600	118,800	78,900	109,900	136,800	158,400
	0.55	53,800	74,900	93,300	108,000	71,700	99,900	124,400	144,000
	0.60	49,300	67,700	85,500	99,000	65,700	91,600	114,000	132,000
	0.65	45,500	63,400	78,900	91,400	60,700	84,500	105,300	121,800
Rolling Terrain									
0.08	0.50	77,500	108,000	134,500	155,800	103,400	144,000	179,400	207,700
	0.55	70,500	98,200	122,300	141,600	94,000	131,000	163,100	188,800
	0.60	64,600	90,000	112,100	129,800	86,200	120,000	149,500	173,100
	0.65	59,700	83,100	103,500	119,000	79,500	110,800	138,000	159,700
0.09	0.50	68,900	96,000	119,600	138,400	91,900	128,000	159,500	184,600
	0.55	62,700	87,300	108,700	125,900	83,600	116,400	145,000	167,800
	0.60	57,400	80,000	99,700	115,400	76,600	106,700	132,900	153,800
	0.65	53,000	73,900	92,000	106,500	70,700	98,500	122,700	142,000
0.10	0.50	62,000	86,400	107,600	124,600	82,700	115,200	143,500	166,100
	0.55	56,400	78,600	97,900	113,300	75,200	104,800	130,500	151,000
	0.60	51,700	72,000	89,700	103,800	68,900	96,000	119,600	138,400
	0.65	47,700	66,500	32,800	95,800	63,600	88,600	110,400	127,800
0.11	0.50	56,400	78,600	97,900	113,300	75,200	107,800	130,500	151,000
	0.55	51,300	71,400	89,000	103,000	68,400	95,200	118,600	137,300
	0.60	47,000	65,500	81,500	94,400	62,700	87,300	108,700	125,900
	0.65	43,400	60,400	75,300	87,100	57,800	80,600	100,400	116,200

D-Factor = directional distribution of traffic; K-Factor = traffic in peak hour; LOS = level of service.
Source: *2010 Highway Capacity Manual,* Exhibit 10-8 (TRB 2010).

Table H–18 Generalized Daily Service Volumes for Urban Street Facilities

		Two-Lane Streets				*Four-Lane Streets*				*Six-Lane Streets*			
K-Factor	***D-Factor***	***LOS B***	***LOS C***	***LOS D***	***LOS E***	***LOS B***	***LOS C***	***LOS D***	***LOS E***	***LOS B***	***LOS C***	***LOS D***	***LOS E***
Posted Speed = 30 mph													
0.09	0.55	NA	5,900	15,400	19,900	NA	11,300	31,400	37,900	NA	16,300	46,400	54,300
	0.60	NA	5,400	14,100	18,300	NA	10,300	28,800	34,800	NA	15,000	42,500	49,800
0.10	0.55	NA	5,300	13,800	17,900	NA	10,100	28,200	34,100	NA	14,700	41,800	48,900
	0.60	NA	4,800	12,700	16,400	NA	9,300	25,900	31,300	NA	13,500	38,300	44,800
0.11	0.55	NA	4,800	12,600	16,300	NA	9,200	25,700	31,000	NA	13,400	38,000	44,500
	0.60	NA	4,400	11,500	14,900	NA	8,400	23,500	28,400	NA	12,200	34,800	40,800
Posted Speed = 45 mph													
0.09	0.55	NA	10,300	18,600	19,900	NA	21,400	37,200	37,900	NA	31,900	54,000	54,300
	0.60	NA	9,400	17,100	18,300	NA	19,600	34,100	34,800	NA	29,200	49,500	49,800
0.10	0.55	NA	9,300	16,800	17,900	NA	19,300	33,500	34,100	NA	28,700	48,600	48,900
	0.60	NA	8,500	15,400	16,400	NA	17,700	30,700	31,300	NA	26,300	44,500	44,800
0.11	0.55	NA	8,400	15,300	16,300	NA	17,500	30,500	31,000	NA	26,100	44,200	44,400
	0.60	NA	7,700	14,000	14,900	NA	16,100	27,900	28,400	NA	23,900	40,500	40,700

D-Factor = directional distribution of traffic; K-Factor = traffic in peak hour; LOS = level of service; NA = not applicable.
Source: *2010 Highway Capacity Manual,* Exhibit 16-14 (TRB 2010).

Analysis of pavement deterioration was based on estimating the number of additional trucks, and therefore ESALs, associated with material shipments over the road network. Baseline ESAL loadings were developed for each road. ESAL increases associated with truck traffic were developed for each road and alternative considering the number of years that heavy-duty trucks would traverse the roads and compared to baseline loadings. Although beyond the scope of this EIS, the impacts of increased axle loadings can be used in engineering studies of the remaining service life of analyzed road segments. Most flexible pavements are designed for a 20-year service life, after which the pavement structure is projected to require reconstruction to repair accumulated damage. In designing pavement structures, engineers consider an estimate of axle loadings based on the anticipated traffic. If traffic exceeds the forecasted loading, the pavement structure will experience heavier than planned loadings, resulting in acceleration in the use of the remaining pavement service life and a sooner-than-anticipated requirement for renewal of the pavement structure.

Road-to-Rail

Road-to-rail impacts were assessed by analyzing the impact of added truck traffic on the quality of flow on roads serving potential intermodal facilities.

Recycle and Disposal Facilities

The analysis of impacts on roads in the vicinities of the recycle and disposal facilities was based on a review of current road service volume, road capacity, and current LOS. These roads are outside those evaluated in the SSFL vicinity and summarized in Table H–14. The impact analysis estimated the number of additional truck trips as a percent increase over current traffic on roads in the facility vicinities to provide a relative context for the potential impact of additional trips.

H.13.4 Evaluation of Impacts

Traffic Quality of Flow

The quality of flow, as characterized by factors such as travel speed and delay, freedom to maneuver, reliability, and comfort, is determined by transportation system elements called service measures. The *2010 Highway Capacity Manual* (TRB 2010) defines six LOS ratings, ranging from A to F, for each service measure (or for multiple service measures for various types of roads) (see **Table H–19**). Facilities operating at LOS E are considered to be operating at capacity. Once LOS E service volumes are exceeded, traffic operating conditions have broken down and traffic delays are extremely high. The impact evaluation identifies when this condition may occur.

Pavement Deterioration

Pavement deterioration is accelerated by increased ESALs; therefore, the more ESALs traversing a pavement, the higher the rate of damage. No quantitative threshold value was assumed to determine deterioration impacts. Rather, a relative comparison was made among the EIS alternatives of the ESALs that would result from the projected additional truck traffic. The evaluation of impacts describes any estimated change in conditions.

Table H–19 Level of Service Definitions

Level of Service	*Operating Conditions*	*Delay*
A	Highest quality of service; free traffic flow; low volumes and densities; little or no restriction on maneuverability or speed.	None
B	Stable traffic flow; speed becoming slightly restricted; low restriction on maneuverability.	None
C	Stable traffic flow, but less freedom to select speed, change lanes, or pass; density increasing. LOS A though C meets the Ventura County LOS threshold of acceptability.	Minimal
D	Approaching unstable flow; speeds tolerable, but subject to sudden and considerable variation; less maneuverability and driver comfort. LOS A through D meets Caltrans LOS threshold of acceptability.	Minimal
E	Unstable traffic flow with rapidly fluctuating speeds and flow rates; short headways; low maneuverability; and lower driver comfort. LOS A through E meets Los Angeles City and County threshold of acceptability.	Significant
F	Forced traffic flow; speed and flow may drop to zero with high densities.	Considerable

Caltrans = California Department of Transportation; LOS = level of service.
Source: TRB 2010.

Road-to-Rail

Impacts were evaluated based on change in LOS ratings on roads in the vicinity of rail facilities, similar to the criteria described above for Traffic Quality of Flow.

H.13.5 Impact Analysis Results

SSFL Vicinity

The increased vehicle trips summarized in Table H–15 were used to determine the percent increase in average daily traffic for each route under each alternative and option, as shown in **Table H–20**. Under all alternatives, the largest increase in average daily traffic would be on Woolsey Canyon Road. The largest increase on this road would be about 7.2 to 7.3 percent from the third year through the eleventh year of project activities under the Cleanup to AOC LUT Values Alternative.

Table H–21 shows the range of impacts to average daily traffic that would result if DOE implemented combinations of action alternatives. The largest impacts would occur under the combination of the Cleanup to AOC LUT Values, Building Removal, and Groundwater Treatment Alternatives (High Impact Combination), which would increase the average daily traffic on Woolsey Canyon Road by a maximum of 7.6 percent in the third year of project activities. This increased traffic would occur at those or comparable levels for 9 years. Under the combination of the Conservation of Natural Resources, Building Removal, and Groundwater Monitored Natural Attenuation Alternatives (Low Impact Combination), the average daily traffic on Woolsey Canyon Road would increase by 7.4 percent in the third year of project activities with noticeably smaller increases in other evaluated years. Note that the percent increase in average daily traffic was determined for the first two years of project activities assuming that waste and backfill would be shipped under the Building Removal Alternative over 2 to 5 months in each of two working years. If the waste and backfill was instead shipped over the duration of each working year, the average daily traffic during the first two years of project activities would increase by no more than 1 percent for any evaluated road.

As discussed in Section H.13.3.2, the impact that vehicles have on pavement is measured using ESALs. Baseline ESAL values for each alternative were calculated by multiplying current annual

ESAL values for each route by the estimated duration of heavy-duty truck transport for each alternative (see **Table H–22**). To determine the additional ESALs that would occur under each alternative, the vehicle trips obtained from Tables H–15 and H–16 were converted into ESALs using the conversion factors defined in Section H.13.3.2 (see **Table H–23**). The Cleanup to AOC LUT Values Alternative would have the largest number of additional ESALs (about 200,000) because the alternative would result in the largest number of additional vehicle trips. All action alternatives, except the Groundwater Monitored Natural Attenuation and Groundwater Treatment Alternatives, could cause damage to the surrounding roads that may need to be repaired sooner than currently anticipated.

ESALs would increase by about 210,000 if DOE implemented the Cleanup to AOC LUT Values, Building Removal, and Groundwater Treatment Alternatives. If DOE implemented both groundwater action alternatives, there would be no noticeable further increase in ESALs. If DOE implemented the Conservation of Natural Resources, Building Removal, and Groundwater Monitored Natural Attenuation Alternatives, ESAL values would increase by about 45,000. Either of these combinations could further damage roads in the SSFL vicinity that may need to be repaired sooner than currently anticipated.

Disposal and Recycle Facilities

Assuming all waste was delivered to the disposal and recycle facilities by truck, **Table H–24** summarizes the maximum percent increase in average daily traffic for roads in the vicinity of each facility by action alternative; also shown is the percent of current road capacity. Current average daily traffic and capacities for the roads evaluated for each facility are summarized in Table H–14. For purposes of analysis, it was assumed that each evaluated facility for each action alternative receives all of each type of waste or all recycle material, consistent with the type of waste that facility is authorized to receive. For example, if all LLW or MLLW under the Cleanup to AOC LUT Values Alternative was shipped to Energy*Solution*s in Utah, the average daily traffic for the evaluated road would increase by a maximum of 0.078 percent and the projected traffic would represent a maximum of about 0.035 percent of the evaluated road capacity.

As shown in Table H–24, for nearly all evaluated disposal and recycle facilities, roads near these facilities would likely experience no noticeable increase in average daily traffic above background levels and, therefore, no change to current LOS ratings as a result of any of the alternatives analyzed in this EIS. The largest increase would be for the McKittrick Water Treatment Site if it received all nonhazardous waste from Area IV (up to a 14 percent increase under the Cleanup to AOC LUT Values Alternative), while the second largest would be for the Westmorland Facility if it received all nonhazardous waste from Area IV (up to 7.4 percent increase). One reason that the increases would be larger for these facilities is that the current average daily traffic levels on the evaluated roads near these facilities are low and far less than the road capacities. Both evaluated roads have current LOS ratings of A, and as shown in Table H–24, the projected increased traffic under any action alternative would represent less than 1 percent of their current capacities.

Table H–20 Percent Increase in Average Daily Traffic in the SSFL Vicinity under Each Action Alternative

Road	*Segment*	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*	*Year 6*	*Year 7*	*Year 8*	*Year 9*	*Year 10*	*Year 11*	*Year 12*
Cleanup to AOC LUT Values Alternatives													
Woolsey Canyon Road	SSFL entrance to Valley Circle Blvd	-	0.010	7.2	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	5.6
Valley Circle Blvd	Woolsey Canyon to Plummer Street	-	0.003	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	1.8
	Woolsey Canyon to Roscoe Blvd	-	0.002	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.3
	Roscoe Blvd to Victory Blvd	-	0.001	0.71	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.56
	Victory Blvd to U.S. Highway 101	-	*	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31
Roscoe Blvd	Valley Circle Blvd to Topanga Canyon Blvd	-	0.0026	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.4
Plummer Street	Valley Circle Blvd to Topanga Canyon Blvd	-	0.004	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.1
Topanga Canyon Blvd	Plummer Street to SR 118 (Ronald Reagan Freeway)	-	*	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.27
	Roscoe Blvd to SR 118 (Ronald Reagan Freeway)	-	*	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.27
	Roscoe Blvd to U.S. Highway 101	-	*	0.31	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.25
SR 118	Junction with Topanga Canyon Blvd	-	*	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.087
U.S. Highway 101	Junction with Topanga Canyon Blvd	-	*	0.060	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.047
Cleanup to Revised LUT Values Alternative													
Woolsey Canyon Road	SSFL entrance to Valley Circle Blvd	-	0.010	7.2	7.3	0.23	-	-	-	-	-	-	-
Valley Circle Blvd	Woolsey Canyon to Plummer Street	-	0.003	2.3	2.3	0.072	-	-	-	-	-	-	-
	Woolsey Canyon to Roscoe Blvd	-	0.002	1.6	1.6	0.050	-	-	-	-	-	-	-
	Roscoe Blvd to Victory Blvd	-	0.001	0.71	0.72	0.022	-	-	-	-	-	-	-
	Victory Blvd to U.S. Highway 101	-	*	0.40	0.40	0.012	-	-	-	-	-	-	-
Roscoe Blvd	Valley Circle Blvd to Topanga Canyon Blvd	-	0.003	1.8	1.8	0.057	-	-	-	-	-	-	-
Plummer Street	Valley Circle Blvd to Topanga Canyon Blvd	-	0.004	2.7	2.7	0.083	-	-	-	-	-	-	-
Topanga Canyon Blvd	Plummer Street to SR 118 (Ronald Reagan Freeway)	-	*	0.34	0.34	0.011	-	-	-	-	-	-	-
	Roscoe Blvd to SR 118 (Ronald Reagan Freeway)	-	*	0.34	0.34	0.011	-	-	-	-	-	-	-
	Roscoe Blvd to U.S. Highway 101	-	*	0.31	0.32	0.010							
SR 118	Junction with Topanga Canyon Blvd	-	*	0.11	0.11	0.003	-	-	-	-	-	-	-
U.S. Highway 101	Junction with Topanga Canyon Blvd	-	*	0.060	0.061	0.002	-	-	-	-	-	-	-
Conservation of Natural Resources Alternative													
Woolsey Canyon Road	SSFL entrance to Valley Circle Blvd	-	0.010	7.2	5.1	-	-	-	-	-	-	-	-
Valley Circle Blvd	Woolsey Canyon to Plummer Street	-	0.003	2.3	1.6	-	-	-	-	-	-	-	-
	Woolsey Canyon to Roscoe Blvd	-	0.002	1.6	1.1	-	-	-	-	-	-	-	-
	Roscoe Blvd to Victory Blvd	-	0.001	0.71	0.51	-	-	-	-	-	-	-	-
	Victory Blvd to U.S. Highway 101	-	*	0.40	0.28	-	-	-	-	-	-	-	-

Road	***Segment***	***Year 1***	***Year 2***	***Year 3***	***Year 4***	***Year 5***	***Year 6***	***Year 7***	***Year 8***	***Year 9***	***Year 10***	***Year 11***	***Year 12***
Roscoe Blvd	Valley Circle Blvd to Topanga Canyon Blvd	-	0.003	1.8	1.3	-	-	-	-	-	-	-	-
Plummer Street	Valley Circle Blvd to Topanga Canyon Blvd	-	0.004	2.7	1.9	-	-	-	-	-	-	-	-
Topanga Canyon Blvd	Plummer Street to SR 118 (Ronald Reagan Freeway)	-	*	0.34	0.24	-	-	-	-	-	-	-	-
	Roscoe Blvd to SR 118 (Ronald Reagan Freeway)	-	*	0.34	0.24	-	-	-	-	-	-	-	-
	Roscoe Blvd to U.S. Highway 101	-	*	0.31	0.22								
SR 118	Junction with Topanga Canyon Blvd	-	*	0.11	0.079	-	-	-	-	-	-	-	-
U.S. Highway 101	Junction with Topanga Canyon Blvd	-	*	0.060	0.043	-	-	-	-	-	-	-	-
Building Removal Alternative[a]													
Woolsey Canyon Road	SSFL entrance to Valley Circle Blvd	3.4	5.3	-	-	-	-	-	-	-	-	-	-
Valley Circle Blvd	Woolsey Canyon to Plummer Street	1.1	1.7	-	-	-	-	-	-	-	-	-	-
	Woolsey Canyon to Roscoe Blvd	0.76	1.2	-	-	-	-	-	-	-	-	-	-
	Roscoe Blvd to Victory Blvd	0.33	0.52	-	-	-	-	-	-	-	-	-	-
	Victory Blvd to U.S. Highway 101	0.19	0.29	-	-	-	-	-	-	-	-	-	-
Roscoe Blvd	Valley Circle Blvd to Topanga Canyon Blvd	0.85	1.3	-	-	-	-	-	-	-	-	-	-
Plummer Street	Valley Circle Blvd to Topanga Canyon Blvd	1.3	1.9	-	-	-	-	-	-	-	-	-	-
Topanga Canyon Blvd	Plummer Street to SR 118 (Ronald Reagan Freeway)	0.16	0.25	-	-	-	-	-	-	-	-	-	-
	Roscoe Blvd to SR 118 (Ronald Reagan Freeway)	0.16	0.25	-	-	-	-	-	-	-	-	-	-
	Roscoe Blvd to U.S. Highway 101	0.15	0.23										
SR 118	Junction with Topanga Canyon Blvd	0.052	0.082	-	-	-	-	-	-	-	-	-	-
U.S. Highway 101	Junction with Topanga Canyon Blvd	0.028	0.044	-	-	-	-	-	-	-	-	-	-
Groundwater Monitored Natural Attenuation Alternative													
Woolsey Canyon Road	SSFL entrance to Valley Circle Blvd	0.092	0.092	0.16	0.092	0.092	0.092	0.092	0.092	0.092	0.092	0.092	0.092
Valley Circle Blvd	Woolsey Canyon to Plummer Street	0.029	0.029	0.052	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029
	Woolsey Canyon to Roscoe Blvd	0.020	0.020	0.036	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
	Roscoe Blvd to Victory Blvd	0.009	0.009	0.016	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
	Victory Blvd to U.S. Highway 101	0.005	0.005	0.009	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Roscoe Blvd	Valley Circle Blvd to Topanga Canyon Blvd	0.023	0.023	0.041	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023
Plummer Street	Valley Circle Blvd to Topanga Canyon Blvd	0.034	0.034	0.060	0.034	0.034	0.034	0.034	0.034	0.034	0.034	0.034	0.034
Topanga Canyon Blvd	Plummer Street to SR 118 (Ronald Reagan Freeway)	0.004	0.004	0.008	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
	Roscoe Blvd to SR 118 (Ronald Reagan Freeway)	0.004	0.004	0.008	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
	Roscoe Blvd to U.S. Highway 101	0.004	0.004	0.007	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
SR 118	Junction with Topanga Canyon Blvd	0.001	0.001	0.003	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
U.S. Highway 101	Junction with Topanga Canyon Blvd	*	*	0.001	*	*	*	*	*	*	*	*	*

Road	Segment	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
Groundwater Treatment Alternative													
Woolsey Canyon Road	SSFL entrance to Valley Circle Blvd	-	0.008	0.36	0.026	0.026	0.026	0.026	-	-	-	-	-
Valley Circle Blvd	Woolsey Canyon to Plummer Street	-	0.002	0.11	0.008	0.008	0.008	0.008	-	-	-	-	-
	Woolsey Canyon to Roscoe Blvd	-	0.002	0.080	0.006	0.006	0.006	0.006	-	-	-	-	-
	Roscoe Blvd to Victory Blvd	-	*	0.035	0.003	0.003	0.003	0.003	-	-	-	-	-
	Victory Blvd to U.S. Highway 101	-	*	0.020	0.001	0.001	0.001	0.001	-	-	-	-	-
Roscoe Blvd	Valley Circle Blvd to Topanga Canyon Blvd	-	0.002	0.090	0.006	0.006	0.006	0.006	-	-	-	-	-
Plummer Street	Valley Circle Blvd to Topanga Canyon Blvd	-	0.003	0.13	0.009	0.009	0.009	0.009	-	-	-	-	-
Topanga Canyon Blvd	Plummer Street to SR 118 (Ronald Reagan Freeway)	-	*	0.017	0.001	0.001	0.001	0.001	-	-	-	-	-
	Roscoe Blvd to SR 118 (Ronald Reagan Freeway)	-	*	0.017	0.001	0.001	0.001	0.001	-	-	-	-	-
	Roscoe Blvd to U.S. Highway 101	-	*	0.016	0.001	0.001	0.001	0.001					
SR 118	Junction with Topanga Canyon Blvd	-	*	0.006	*	*	*	*	-	-	-	-	-
U.S. Highway 101	Junction with Topanga Canyon Blvd	-	*	0.003	*	*	*	*	-	-	-	-	-

* = Percent increase in daily vehicle trips is less than 0.001 percent; - = No additional vehicle trips would occur during this year; AOC = *Administrative Order on Consent for Remedial Action*; Blvd = Boulevard; LUT = Look-Up Table; SR = State Route.

[a] The percent increase in average daily traffic was determined for the Building Removal Alternative assuming that waste and backfill would be shipped over 2 to 5 months in each of two working years. If the waste and backfill was instead shipped over the duration of each working year, the average daily traffic would increase by no more than 1 percent for any evaluated road.

Table H–21 Percent Increase in Daily Vehicle Trips Assuming DOE Implements all Action Alternatives

Road	*Segment*	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*	*Year 6*	*Year 7*	*Year 8*	*Year 9*	*Year 10*	*Year 11*	*Year 12*
High Impact Combination [a]													
Woolsey Canyon Road	SSFL entrance to Valley Circle Blvd	3.4	5.3	7.6	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	5.6
Valley Circle Blvd	Woolsey Canyon to Plummer Street	1.1	1.7	2.4	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	1.8
	Woolsey Canyon to Roscoe Blvd	0.76	1.2	1.7	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.3
	Roscoe Blvd to Victory Blvd	0.33	0.52	0.74	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.56
	Victory Blvd to U.S. Highway 101	0.19	0. 29	0.42	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31
Roscoe Blvd	Valley Circle Blvd to Topanga Canyon Blvd	0.85	1.3	1.9	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.4
Plummer Street	Valley Circle Blvd to Topanga Canyon Blvd	1.3	2.0	2.8	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.1
Topanga Canyon Blvd	Plummer Street to SR 118 (Ronald Reagan Freeway)	0.16	0.25	0.36	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.27
	Roscoe Blvd to SR 118 (Ronald Reagan Freeway)	0.16	0.25	0.36	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.27
	Roscoe Blvd to U.S. Highway 101	0.15	0.23	0.33	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.25
SR 118	Junction with Topanga Canyon Blvd	0.052	0.082	0.12	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.087
U.S. Highway 101	Junction with Topanga Canyon Blvd	0.028	0.044	0.063	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.047
Low Impact Combination [b]													
Woolsey Canyon Road	SSFL entrance to Valley Circle Blvd	3.5	5.4	7.4	5.2	0.092	0.092	0.092	0.092	0.092	0.092	0.092	0.092
Valley Circle Blvd	Woolsey Canyon to Plummer Street	1.1	1.7	2.3	1.7	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029
	Woolsey Canyon to Roscoe Blvd	0.78	1.2	1.6	1.2	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
	Roscoe Blvd to Victory Blvd	0.34	0.53	0.72	0.51	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
	Victory Blvd to U.S. Highway 101	0.19	0.30	0.41	0.29	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Roscoe Blvd	Valley Circle Blvd to Topanga Canyon Blvd	0.87	1.4	1.8	1.3	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023
Plummer Street	Valley Circle Blvd to Topanga Canyon Blvd	1.3	2.0	2.7	1.9	0.034	0.034	0.034	0.034	0.034	0.034	0.034	0.034
Topanga Canyon Blvd	Plummer Street to SR 118 (Ronald Reagan Freeway)	0.16	0.25	0.35	0.25	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
	Roscoe Blvd to SR 118 (Ronald Reagan Freeway)	0.16	0.25	0.35	0.25	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
	Roscoe Blvd to U.S. Highway 101	0.15	0.23	0.32	0.23	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
SR 118	Junction with Topanga Canyon Blvd	0.054	0.083	0.11	0.080	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
U.S. Highway 101	Junction with Topanga Canyon Blvd	0.029	0.045	0.061	0.044	*	*	*	*	*	*	*	*

* = Percent increase in daily vehicle trips is less than 0.001; SR = State Route.

[a] Impacts if DOE implemented the Cleanup to AOC LUT Values, Building Removal, and Groundwater Treatment Alternatives.

[b] Impacts if DOE implemented the Conservation of Natural Resources, Building Removal, and Groundwater Monitored Natural Attenuation Alternatives.

Table H–22 Baseline ESAL Values

Alternative	Years [a]	Route 1	Route 2	Route 3	Route 4
Soil Remediation Alternatives					
Cleanup to AOC LUT Values	11	35,000	67,000	43,000	41,000
Cleanup to Revised LUT Values	4	13,000	25,000	16,000	15,000
Conservation of Natural Resources	3	9,500	18,000	12,000	11,000
Building Demolition Alternatives					
Building Removal	2	6,300	12,000	7,900	7,500
Groundwater Remediation Alternatives					
Groundwater Monitored Natural Attenuation	12	38,000	74,000	47,000	45,000
Groundwater Treatment	6	19,000	37,000	24,000	22,000
Combination of Alternatives					
Low [b]	12	38,000	74,000	47,000	45,000
High [c]	12	38,000	74,000	47,000	45,000

AOC = *Administrative Order on Consent for Remedial Action*; ESAL = Equivalent Single Axle Load; LUT = Look-Up Table.
[a] Number of years considered for evaluation of baseline ESAL values.
[b] Additional ESALs that would occur if the Conservation of Natural Resources, Building Removal, and Groundwater Monitored Natural Attenuation Alternatives were implemented.
[c] Additional ESALs that would occur if the Cleanup to AOC LUT Values, Building Removal, and Groundwater Treatment Alternatives were implemented.
Note: Calculated ESAL values have been rounded.

Table H–23 Additional ESALs under Each Action Alternative

Alternative	Years [a]	Route 1	Route 2	Route 3	Route 4
Soil Remediation Alternatives					
Cleanup to AOC LUT Values	11	200,000	200,000	200,000	200,000
Cleanup to Revised LUT Values	4	51,000	51,000	51,000	51,000
Conservation of Natural Resources	3	40,000	40,000	40,000	40,000
Building Demolition Alternatives					
Building Removal	2	5,200	5,200	5,200	5,200
Groundwater Remediation Alternatives					
Groundwater Monitored Natural Attenuation	12	85	85	85	85
Groundwater Treatment	6	990	990	990	990
Combination of Alternatives					
Low [b]	12	45,000	45,000	45,000	45,000
High [c]	12	210,000	210,000	210,000	210,000

AOC = *Administrative Order on Consent for Remedial Action*; ESAL = Equivalent Single Axle Load; LUT = Look-Up Table.
[a] Number of years considered for evaluation of additional ESAL values.
[b] Additional ESALs that would occur if the Conservation of Natural Resources, Building Removal, and Groundwater Monitored Natural Attenuation Alternatives were implemented.
[c] Additional ESALs that would occur if the Cleanup to AOC LUT Values, Building Removal, and Groundwater Treatment Alternatives were implemented.
Note: Calculated ESAL values have been rounded.

Table H–24 Maximum Percent Increase in Average Daily Traffic and Road Capacity Along Evaluated Roads for Each Recycle and Disposal Facility and Action Alternative

Action Alternative	*Waste*	*Facility (State)*	*Percent Increase in Average Daily Traffic*	*Percent of Current Road Capacity*
Cleanup to AOC LUT Values	LLW/MLLW	Energy*Solutions* (UT)	0.078	0.035
		NNSS (NV)	0.18	0.035
	Hazardous waste	Buttonwillow (CA)	0.16	0.019
		Westmorland (CA)	0.46	0.019
		US Ecology (ID)	0.63	0.019
	Nonhazardous waste	Chiquita Canyon (CA)	0.22	0.16
		Antelope Valley (CA)	0.072	0.057
		McKittrick (CA)	14	0.30
		Buttonwillow (CA)	2.6	0.30
		Westmorland (CA)	7.4	0.30
Cleanup to Revised LUT Values	LLW/MLLW	Energy*Solutions* (UT)	0.38	0.17
		NNSS (NV)	0.85	0.17
	Hazardous waste	Buttonwillow (CA)	0.77	0.090
		Westmorland (CA)	2.2	0.090
		US Ecology (ID)	3.0	0.090
	Nonhazardous waste	Chiquita Canyon (CA)	0.072	0.051
		Antelope Valley (CA)	0.023	0.018
		McKittrick (CA)	4.6	0.098
		Buttonwillow (CA)	0.85	0.098
		Westmorland (CA)	2.4	0.098
Conservation of Natural Resources	LLW/MLLW	Energy*Solutions* (UT)	0.38	0.17
		NNSS (NV)	0.85	0.17
	Hazardous waste	Buttonwillow (CA)	0.77	0.090
		Westmorland (CA)	2.2	0.090
		US Ecology (ID)	3.0	0.090
	Nonhazardous waste	Chiquita Canyon (CA)	0.073	0.052
		Antelope Valley (CA)	0.023	0.019
		McKittrick (CA)	4.6	0.099
		Buttonwillow (CA)	0.85	0.099
		Westmorland (CA)	2.4	0.099
Building Removal	LLW/MLLW	Energy*Solutions* (UT)	0.14	0.0060
		NNSS (NV)	0.31	0.0060
	Hazardous waste	Buttonwillow (CA)	0.0058	0.00067
		Westmorland (CA)	0.016	0.00067
		US Ecology (ID)	0.023	0.00067
	Nonhazardous waste	Chiquita Canyon (CA)	0.0051	0.0036
		Antelope Valley (CA)	0.0016	0.0013
		McKittrick (CA)	0.32	0.0069
	Recycle	P. W. Gillibrand (CA)	0.13	0.016
		Kramer Metals (CA)	0.014	0.010
		Standard Industries (CA)	0.023	0.020

Action Alternative	Waste	Facility (State)	Percent Increase in Average Daily Traffic	Percent of Current Road Capacity
Groundwater Monitored Natural Attenuation	Nonhazardous waste	Chiquita Canyon (CA)	0.00018	0.00013
		Antelope Valley (CA)	0.000058	0.000046
		McKittrick (CA)	0.011	0.00024
Groundwater Treatment	LLW/MLLW	Energy*Solutions* (UT)	0.014	0.0062
		NNSS (NV)	0.032	0.0062
	Hazardous waste	Buttonwillow (CA)	0.020	0.0023
		Westmorland (CA)	0.057	0.0023
		US Ecology (ID)	0.080	0.0023

AOC = *Administrative Order on Consent for Remedial Action*; CA = California; ID = Idaho; LLW = low-level radioactive waste; LUT = Look-Up Table; MLLW = mixed low-level radioactive waste; NNSS = Nevada National Security Site; NV = Nevada; UT = Utah.

Intermodal Facilities

As discussed in Section H.2.4, intermodal facilities would be used to transfer waste containers from truck to rail and from rail to truck. Transfer of waste containers involves both industrial accident risks (LLW/MLLW and nonradiological waste containers) and radiological risks (LLW/MLLW containers). The two intermodal facilities assumed to be used in this EIS (Puente Hills and Barstow) would have safety measures in place to reduce the risk of industrial accidents, so no additional accidents would be expected to result from transferring waste containers related to SSFL activities. The radiological risks to the workers are expected to be minimal due to the low concentration of radioactive material in each waste container, the shielding provided by both the waste container and the intermodal container it will be transported in, and the use of remote equipment (i.e., cranes). Risks to the public are expected to be minimal due to the low concentration of radioactive material in each waste container, the shielding provided by both the waste container and the intermodal container it will be transported in, and the distance between the public and the transfer activities.

Table H–25 summarizes the calculated maximum percent increase in average daily traffic for roads in the vicinities of the Puente Hills Intermodal Facility and the rail yard at Barstow, California, by action alternative. The roads analyzed for each facility are summarized in Table H–14. As shown in Table H–25, roads near the assumed intermodal facilities would likely experience no noticeable increase in average daily traffic above background levels and, therefore, no change to current LOS ratings as a result of any of the alternatives analyzed in this EIS.

Table H–25 Maximum Percent Increase in Average Daily Traffic at Each Intermodal Facility under Each Action Alternative [a]

Action Alternative	*Waste*	*Site*	*Percent Increase*
Cleanup to AOC LUT Values	LLW/MLLW	Puente Hills	0.066
		Barstow	0.0080
	Hazardous waste	Puente Hills	0.035
	Nonhazardous waste	Puente Hills	0.57
Cleanup to Revised LUT Values	LLW/MLLW	Puente Hills	0.32
		Barstow	0.038
	Hazardous waste	Puente Hills	0.17
	Nonhazardous waste	Puente Hills	0.19
Conservation of Natural Resources	LLW/MLLW	Puente Hills	0.32
		Barstow	0.038
	Hazardous waste	Puente Hills	0.17
	Nonhazardous waste	Puente Hills	0.19
Building Removal	LLW/MLLW	Puente Hills	0.11
		Barstow	0.014
	Hazardous waste	Puente Hills	0.0013
	Nonhazardous	Puente Hills	0.013
Groundwater Treatment	LLW/MLLW	Puente Hills	0.012
		Barstow	0.0014

AOC = *Administrative Order on Consent for Remedial Action*; LLW = low-level radioactive waste; LUT = Look-Up Table; MLLW = mixed low-level radioactive waste.

[a] The truck/rail option is not considered for the Groundwater Monitored Natural Attenuation Alternative and thus there would be no shipment of waste under this alternative to an intermodal facility.

H.14 References

AASHTO (American Association of State Highway and Transportation Officials), 1993, *AASHTO Guide for Design of Pavement Structures*, ISBN 1-56051-055-2, American Association of State Highway and Transportation Officials, Washington, DC.

Caltrans (California Department of Transportation), 2015, *Annual Average Daily Traffic [AADT]) for all Vehicles on California State Highways for 2013* (available at http://traffic-counts.dot.ca.gov).

CDC (U.S. Centers for Disease Control and Prevention), 2008, "Deaths: Preliminary Data for 2006," M. P. Heron, D. L. Hoyert, J. Xu, C. Scott, B. Tejada-Vera, *National Vital Statistics Reports*, Vol. 56, No. 16, Atlanta, Georgia (available at http://www.cdc.gov/nchs/data/nvsr/nvsr56/nvsr56_16.pdf), June 11.

CDC (U.S. Centers for Disease Control and Prevention), 2011, "Deaths: Leading Causes for 2007," M. P. Heron, *National Vital Statistics Reports*, Vol. 59, No. 8, Atlanta, Georgia (available at http://www.cdc.gov/nchs/data/nvsr/nvsr59/nvsr59_08.pdf), August 26.

CDC (U.S. Centers for Disease Control and Prevention), 2012a, "Deaths: Leading Causes for 2008," M. P. Heron, *National Vital Statistics Reports*, Vol. 60, No. 6, Atlanta, Georgia (available at http://www.cdc.gov/nchs/data/nvsr/nvsr60/nvsr60_06.pdf), June 6.

CDC (U.S. Centers for Disease Control and Prevention), 2012b, "Deaths: Leading Causes for 2009," M. P. Heron, *National Vital Statistics Reports*, Vol. 61, No. 7, Atlanta, Georgia (available at http://www.cdc.gov/nchs/data/nvsr/nvsr61/nvsr61_07.pdf), October 26.

CDC (U.S. Centers for Disease Control and Prevention), 2013, "Deaths: Final Data for 2010," S. Murphy, J. Xu, K. Kochanek, *National Vital Statistics Reports*, Vol. 61, No. 4, Atlanta, Georgia (available at http://www.cdc.gov/nchs/data/nvsr/nvsr61/nvsr61_04.pdf), May 8.

Census (U.S. Census Bureau), 2010, *Resident Population Data*, "Population Change" (accessed on December 21, 2010, http://www.census.gov/2010census/data/apportionment-pop-text.php).

City of Industry, 2008, *Final Puente Hills Intermodal Facility Final Environmental Impact Report*, Vol. 1, State Clearinghouse No. 20006021097 (available at http://www.lacsd.org/info/waste_by_rail/phimf/phimf_feir.asp), May.

City of Industry, 2009, *Addendum to the Puente Hills Intermodal Facility Environmental Impact Report*, State Clearinghouse No. 2006021097 (available at http://www.lacsd.org/civicax/filebank/blobdload.aspx?blobid=4332), February.

DHS (U.S. Department of Homeland Security), 2008, *Nuclear/Radiological Incident Annex*, Federal Emergency Management Agency, Washington, DC, June.

DHS (U.S. Department of Homeland Security), 2013, *National Response Framework*, Second Edition, Federal Emergency Management Agency, Washington, DC, May.

DOE (U.S. Department of Energy), 1994, *DOE Handbook, Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*, Vols. I and II, (Reaffirmed in 2013), DOE-HDBK-3010-94, Washington, DC, December.

DOE (U.S. Department of Energy), 1997, *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement*, Vol. 1, DOE/EIS-0026-S-2, Carlsbad Area Office, Carlsbad, New Mexico, September.

DOE (U.S. Department of Energy), 2002a, *Final Environmental Impact Statement for a Geological Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*, Appendices J, "Transportation," and M, "Supplemental Transportation Information," DOE/EIS-0250, Office of Civilian Radioactive Waste Management, Washington, DC, February.

DOE (U.S. Department of Energy), 2002b, *A Resource Handbook on DOE Transportation Risk Assessment*, DOE/EM/NTP/HB-01, Office of Environmental Management, Albuquerque, New Mexico (accessed at http://www.ntp.doe.gov/ readnews21.shtml), July.

DOE (U.S. Department of Energy), 2003a, *Estimating Radiation Risk from Total Effective Dose Equivalent (TEDE)*, ISCORS Technical Report No. 1, Rev. 1, DOE/EH-412/0015/0802, Office of Environmental Policy and Guidance, Washington, DC, January.

DOE (U.S. Department of Energy), 2003b, *Final West Valley Demonstration Project Waste Management Environmental Impact Statement*, Appendix D, "Transportation," DOE/EIS-0337F (available at http://energy.gov/nepa/downloads/eis-0337-draft-environmental-impact-statement),West Valley Area Office, West Valley, New York, December.

DOE (U.S. Department of Energy), 2005, DOE Order 151.1C, *Comprehensive Emergency Management System*, Office of Emergency Operations, Washington, DC, November 2.

DOE (U.S. Department of Energy), 2008a, *Radioactive Material Transportation Practices Manual for Use with DOE Order 460.2A*, DOE M 460.2-1A, Office of Environmental Management, Washington, DC, June 4.

DOE (U.S. Department of Energy), 2008b, *Final Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*, DOE/EIS-0250F-S2, and *Final Environmental Impact Statement for a Rail Alignment for the Construction and Operation of a Railroad in Nevada to a Geologic Repository at Yucca Mountain, Nye County, Nevada*, DOE/EIS-0369, Office of Civilian Radioactive Waste Management, Las Vegas, Nevada, June.

DOE (U.S. Department of Energy), 2009, *DOE Standard Radiological Control*, DOE-STD-1098-2008, Change Notice 1, Washington, DC, May.

DOE (U.S. Department of Energy), 2015a, *Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement*, Volume 1, Chapter 4, Table 4-48, DOE/EIS-0283-S2, Washington, DC, April.

DOE (U.S. Department of Energy), 2015b, *Vehicle Weight Classes and Categories,* Alternative Fuels Data Center: Maps and Data (accessed on May 7, 2015, http://www.afdc.energy.gov/data/10380).

DOT (U.S. Department of Transportation), 2000, *Comprehensive Truck Size and Weight Study*, Volume I, Summary Report, FHWA-PL-00-029, August.

DOT (U.S. Department of Transportation), 2008, *Radioactive Material Regulations Review*, RAMREG-12-2008, Pipeline and Hazardous Materials Safety Administration, December 8.

DOT (U.S. Department of Transportation), 2009, *Large Truck and Bus Crash Facts 2007*, FMCSA-RRA-09-029, Federal Motor Carrier Safety Administration, January.

DOT (U.S. Department of Transportation), 2011, *Welcome to the FHWA Safety Program*, "Reducing Highway Fatalities," Federal Highway Administration (available at http://safety.fhwa.dot.gov/), July 13.

DOT (U.S. Department of Transportation), 2012a, *2012 Emergency Response Guidebook*, RAMREG-12-2008, Pipeline and Hazardous Materials Safety Administration, Washington, DC.

DOT (U.S. Department of Transportation), 2012b, *Traffic Safety Facts 2010*, DOT HS 811 659, National Highway Traffic Safety Administration, Washington, DC, June.

DOT (U.S. Department of Transportation), 2014, *Motor Carrier Safety Progress Report*, DOT HS 809 919, Federal Motor Carrier Safety Administration, Washington, DC (available at http://www.fmcsa.dot.gov/sites/fmcsa.dot.gov/files/docs/MCSPR-09-30-14_508(2).pdf), September 30.

DTSC (State of California Department of Toxic Substances Control), 2010, *The State of California Environmental Protection Agency, Department of Toxic Substances Control and the United States Department of Energy, In the Matter of: Santa Susana Field Laboratory, Simi Hills, Ventura County, California, Administrative Order on Consent for Remedial Action*, Docket No. HSA-CO 10/11-037, Health and Safety Code Sections 25355.5(a)(1)(B), 58009 and 58010, December 6.

ITD (Idaho Transportation Department), 2015, *State of Idaho Traffic Survey and Analysis Continuous Monitoring Stations* (available at http://itd.idaho.gov/highways/roadwaydata/?Maps/ ATR_WIMmap_map.html).

Johnson, P. E., and R. D. Michelhaugh, 2003, *Transportation Routing Analysis Geographic Information System (TRAGIS) User's Manual*, ORNL/NTRC-006, Rev. 0, U.S. Department of Energy, Oak Ridge National Laboratory, Oak Ridge, Tennessee (available at http://apps.ntp.doe.gov/tragis/ tragis.htm), June.

LA (City of Los Angeles Department of Transportation), 2015, *City of Los Angeles Department of Transportation Traffic Counts* (available at http://ladot.lacity.org/WhatWeDO/TrafficVolumeCounts? CurrentCountData.index.htm).

MHF (MHF Packaging Solutions), 2015, *MHF Packaging Solutions* (company brochure), Cranberry Township, Pennsylvania.

NASA (National Aeronautics and Space Administration), 2014, *Final Environmental Impact Statement for Proposed Demolition and Environmental Cleanup Activities at Santa Susana Field Laboratory ,* Ventura County, California, George C. Marshall Space Flight Center, Huntsville, Alabama , March.

NDOT (Nevada Department of Transportation), 2015, *Annual Average Daily Traffic Count Stations, County Name: Nye*, Traffic Records Information Access (TRINA) (available at http://aps.nevadot.com/trina).

Neuhauser, K. S., F. L. Kanipe, and R. F. Weiner, 2000, *RADTRAN 5 Technical Manual*, SAND2000-1256, Sandia National Laboratories, Albuquerque, New Mexico, May.

NRC (U.S. Nuclear Regulatory Commission), 1977, *Final Environmental Impact Statement on the Transportation of Radioactive Materials by Air and Other Modes*, Appendix H, "Method for Derating Accident Severity Categories," NUREG-0170, Office of Standards Development, Washington, DC, December.

NRC (U.S. Nuclear Regulatory Commission), 1987, *Shipping Container Response to Severe Highway and Railway Accident Conditions*, Vol. 1, NUREG/CR-4829 (UCID-20733), Washington, DC (available at http://ttd.sandia.gov/nrc/docs.htm), February.

NRC (U.S. Nuclear Regulatory Commission), 2000, *Reexamination of Spent Fuel Shipping Risk Estimates*, Vol. 1, Main Report, NUREG/CR-6672 (SAND2000-0234), Office of Nuclear Material Safeguards and Analysis, Washington, DC (available at http://ttd.sandia.gov/nrc/ docs.htm), March.

Revilla, M., 2015a, Sanitation Districts of Los Angeles County, Personal communication (email) to J. Trombly, Leidos, Inc., "FW: Rail Facility," January 28.

Revilla, M., 2015b, Sanitation Districts of Los Angeles County, Personal communication (email) to J. Trombly, Leidos, Inc., "FW: Rail Facility," September 4.

Saricks, C., and M. M. Tompkins, 1999, *State-Level Accident Rates for Surface Freight Transportation: A Reexamination*, ANL/ESD/TM-150, Center for Transportation Research, Argonne National Laboratory, U.S. Department of Energy, Argonne, Illinois, April.

SNL (Sandia National Laboratories), 2013, *RADTRAN6/RadCat 6 User Guide*, SAND2013-8095, Albuquerque, New Mexico, and Livermore, California, September.

SV (Simi Valley Department of Environmental Services), 2007, *Simi Valley General Plan Update Technical Background Report*, Chapter 5, "Circulation," October.

TRB (Transportation Research Board), 2010, *HCM 2010 Highway Capacity Manual*, Fifth Edition, National Academies of Science, Washington, DC, December.

UDOT (Utah Department of Transportation), 2015, *Traffic Maps – AADT* (available at http://www.dot.utah.gov/main/f?p=100:pg:0:V,T:528).

UMTRI (University of Michigan Transportation Research Institute), 2003, *Evaluation of the Motor Carrier Management Information System Crash File, Phase One*, UMTRI-2003-6, Center for National Truck Statistics, Ann Arbor, Michigan, March.

Yuan, Y. C., S. Y. Chen, B. M. Biwer, and D. J. LePoire, 1995, *RISKIND—A Computer Program for Calculating Radiological Consequences and Health Risks from Transportation of Spent Nuclear Fuel*, ANL/EAD-1, Argonne National Laboratory, Argonne, Illinois, November.

Appendix I
Wetlands Assessment

APPENDIX I
WETLANDS ASSESSMENT

I.1 Introduction

This appendix of this *Draft Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory (Draft SSFL Area IV EIS)* presents the results of wetland surveys and an assessment of wetland resources to evaluate potential effects on wetland resources associated with cleanup alternatives for Santa Susana Field Laboratory (SSFL) Area IV and the Northern Buffer Zone (NBZ).

In May 2014, a series of jurisdictional determination (JD) surveys were conducted in Area IV and the NBZ by scientists from Leidos, Inc., in support of this environmental impact statement (EIS) to determine areas that may be subject to the regulatory jurisdiction of the United Army Corps of Engineers (USACE) under Section 404 of the Clean Water Act (Title 33, *Code of Federal Regulations*, Parts 320-330 [33 CFR Parts 320-330]) or the Los Angeles Regional Water Quality Control Board (LARWQCB) under Section 401 (Water Quality Certification) of the Clean Water Act (40 CFR Part 131). The survey results presented in this appendix are subject to verification by the Los Angeles District Office of USACE. The assessment of wetland resources was prepared in accordance with the U.S. Department of Energy (DOE) floodplain/wetland environmental review requirements (10 CFR Part 1022). Due to the location of SSFL at the summit of the Santa Susana Mountains and the semiarid environment, water is scarce, the development of natural wetlands is limited, and there are no floodplains. Because no floodplains are present in the project area, the assessment only addresses wetland resources, including wetlands, other waters of the U.S., and aquatic habits and biota (as functions of wetland resources).

This appendix is organized as follows: Section I.1 provides an introduction, the location of the survey areas, a brief description of the proposed project and alternatives, and a description of the existing environment in the project area (including vegetation, soils, climate, and hydrology). Section I.2 provides an overview of the regulatory requirements, guidelines, and definitions pertaining to USACE JDs. Section I.3 describes the survey methods that were used, including a pre-assessment data search and field surveys. The results of the JD surveys are provided in Section I.4; Section I.5 presents the impacts to wetland resources associated with the proposed project and alternatives; a summary is included in Section I.6; and references are provided in Section I.7. Plant names follow *The Jepson Manual: Vascular Plants of California* (Baldwin et al. 2012) and Wetland Indicator Status provided by *The National Wetland Plant List: 2014 Update of Wetland Ratings* (Lichvar et al. 2014). Attachment I1 includes a summary of field observations. Copies of Wetland Determination Data Forms are included in Attachment I2. Attachment I3 provides representative photos taken during the JD surveys.

I.1.1 Project Location

SSFL was developed as a remote site to test rocket engines and conduct nuclear research. It is located in Ventura County, California, on 2,850 acres in the hills between Chatsworth and Simi Valley. The property is divided into four administrative areas and two contiguous buffer zones that are north and south of the administrative areas (see **Figure I–1**). **Figure I–2** shows SSFL and the surrounding communities, as well as the layout of SSFL, including Areas I, II, III, and IV and the adjacent buffer zones. The survey areas included Area IV (about 290 acres) and the NBZ (about 182 acres).

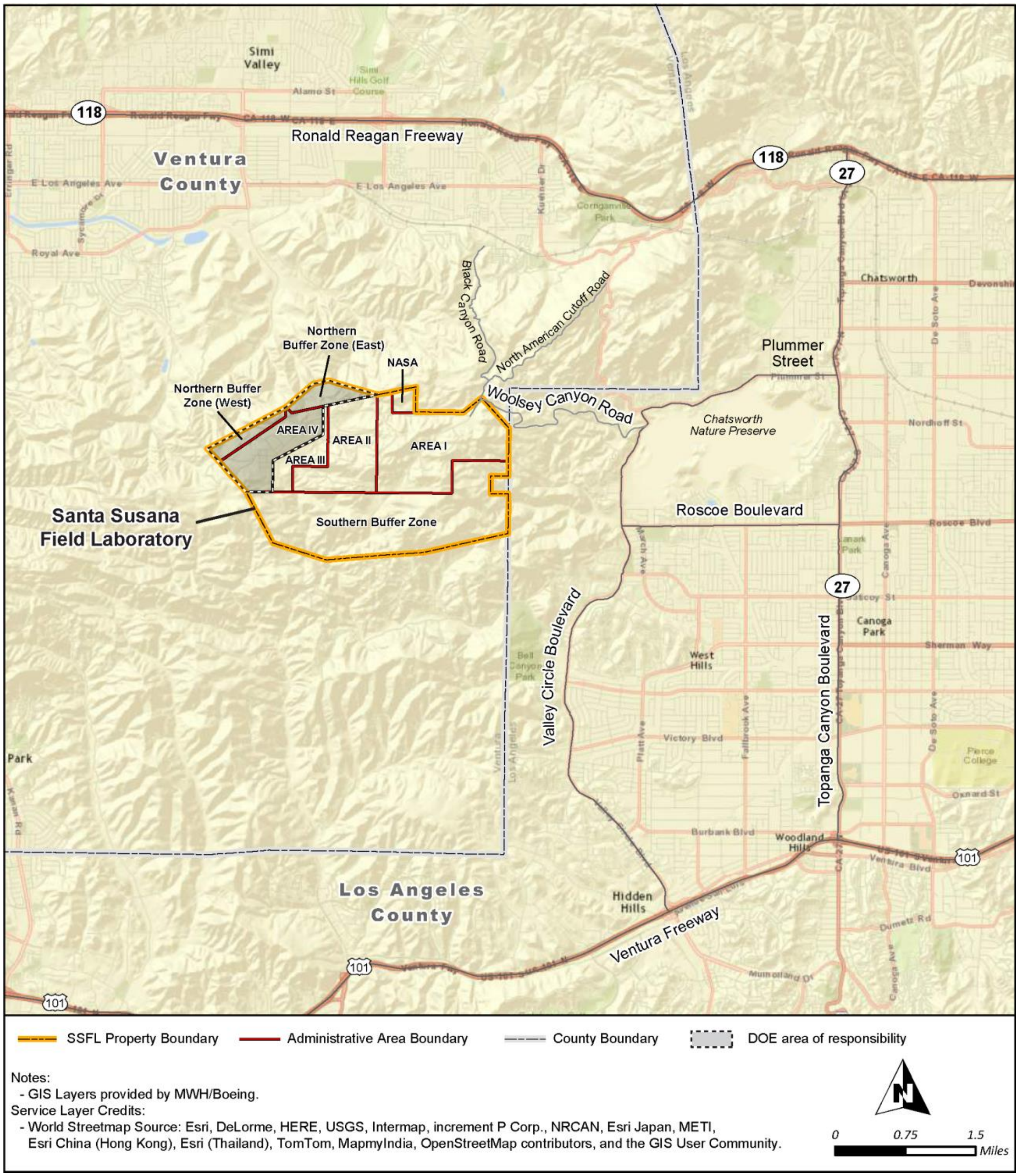


Figure I–1 Project Location, Santa Susana Field Laboratory

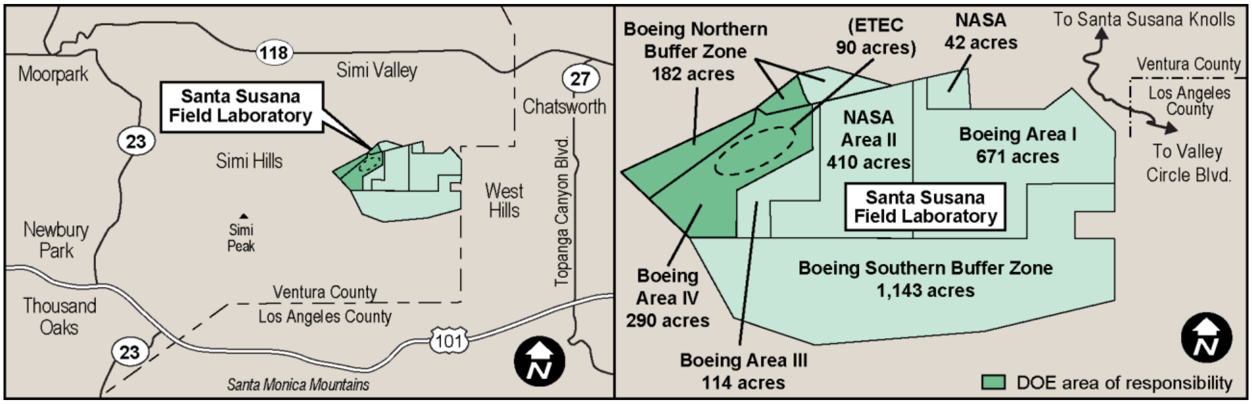


Figure I–2 Santa Susana Field Laboratory and Surrounding Communities

I.1.2 Project Description

DOE proposes to complete remediation of SSFL Area IV and the NBZ to comply with applicable requirements for radiological and hazardous contaminants. These requirements include regulations, orders, and agreements, including the 2007 *Consent Order for Corrective Action* (2007 CO) (DTSC 2007), as applicable, and the 2010 *Administrative Order on Consent for Remedial Action* (2010 AOC) (DTSC 2010). These two orders stipulate the cleanup standards for SSFL Area IV soil and groundwater, but do not dictate how DOE must conduct the cleanup. DOE proposes to remove existing facilities and support buildings, remediate radiologically and chemically impacted soil and groundwater, dispose of resulting waste, and restore the affected environment in accordance with applicable laws, orders, regulations, and agreements with the State of California.

DOE is evaluating separate alternatives for the three components that make up its remediation project: soil remediation, building demolition, and groundwater remediation. For purposes of comparison, the soil remediation action alternatives address remediation of the soil in Area IV and the NBZ to AOC Look-Up Table (LUT) values for chemicals and radionuclides, revised LUT values for chemicals, or risk-based values for chemicals and radionuclides (expressed as a radiation dose for radionuclides). The building demolition action alternative (the Building Removal Alternative) addresses removal of the remaining DOE-owned buildings in Area IV and disposal of the debris off site. The groundwater remediation action alternatives address implementation of management practices to clean up groundwater in accordance with the requirements of the 2007 CO (DTSC 2007). Additional details on each of the alternatives are included in this EIS in Chapter 2, "Alternatives."

I.1.3 Existing Setting

Geology and Soils

SSFL is located in the Simi Hills, a northeast/southwest-trending sub-range of the Santa Monica Mountains of California. The topography of Area IV and the NBZ ranges from 1,300 feet above mean sea level within the lower extent of the NBZ, to 1,810 feet above mean sea level within the central portion of Area IV, to 2,150 feet above mean sea level along the southwestern boundary of Area IV. Along the northwestern boundary of Area IV, the land slopes steeply toward Simi Valley. The central portion of Area IV, where the majority of development occurred, is relatively flat (Burro Flats).

The geology of the area is characterized by steep outcrops of the Chatsworth Formation, a thick sequence of steeply dipping sandstone beds interbedded with siltstone. Between the resistant sandstone outcrops, which are conspicuous features of the site, are more or less level or flat areas that overlie more-erodible portions of the formation. Most of the development in Area IV took place on Burro Flats, the largest of these areas of relatively flat topography. The NBZ adjacent to Area IV is characterized by steep, nearly barren sandstone outcrops that parallel the northern border of Area IV to the west, giving way to relatively dense chaparral on less rocky slopes toward the eastern boundary of Area IV. The bedding plane of these outcrops lies nearly parallel to the slope in some areas, which results in steep slabs of bedrock covered with a thin veneer of soil alternating with bare patches of sandstone, where the veneer of soil and vegetation has slipped from the surface. Bedrock is exposed at the ground surface over about 40 percent of Area IV and the NBZ, and there is minimal to no soil in these areas.

Shallow soils (typically less than 5 feet thick) cover much of the rest of Area IV, although soil depth in the Burro Flats area can be 5 to 10 feet and sometimes up to 20 feet thick. There are three predominant soil types in Area IV: sedimentary rock land, a sandy loam of the Saugus series, and a loam of the Zamora series. The sedimentary rock land, found mostly in the mountainous area of the NBZ, consists of residuum of weathered bedrock and unweathered bedrock, with slopes of 30 to 75 percent. Bedrock is found at the surface or in the top 20 inches of this soil type. The Saugus series soils are predominantly found in the northeast part of Area IV and consist of somewhat deep, well-drained soils that usually form on dissected terraces (such as Burro Flats) and foothills. The sandy loam of the Saugus series is moderately permeable and usually has slopes of 5 to 30 percent. The Zamora series soils are typically well-drained loam formed on a nearly level grade or on strongly sloping fans and terraces. The Zamora series has slopes that range from 2 to 15 percent and are generally found in the southern part of Area IV. A fourth soil type, Gaviota, is also found in the southern part of Area IV and the southwestern corner of the NBZ and consists of rocky, sandy loam with 15 to 50 percent slopes (NRCS 2014).

Vegetation

Natural communities on SSFL include unique habitats associated with the sandstone outcrops that are restricted to the local vicinity, more-widespread plant communities that are characteristic of the region, including chaparral, grasslands, oak and walnut woodlands, and areas that are disturbed/developed. Natural and man-made disturbances, including the 2005 Topanga fire and vegetation cutting or clearing for fire prevention (and, more recently, for soil testing and site characterization), have resulted in plant communities at a variety of different successional stages. Prior to cutting, upland vegetation in Area IV was primarily grassland dominated by non-native annual grasses and herbaceous species, chaparral communities dominated by native species, and oak woodland or savanna in locations that have favorable exposures and soil conditions. Disturbed areas exhibit a vegetative cover dominated by both non-native and native species that are easily able to disperse to and establish in open habitats. The non-native species include both invasive species, which are species rapidly expanding their range and dominance in the area, and naturalized species, which are species already widespread and dominant in disturbed habitats in the area. Northern mixed chaparral is the most abundant vegetation type on site, generally occurs on moderately to steeply sloping hillsides, and is particularly well developed in the NBZ and on two hills in the western portion of Area IV.

The flatter areas of the site are mostly previously developed and are in some stage of vegetation recovery following removal of structures and remediation of the individual building sites at various times over the years. The vegetative cover of these areas varies across the site and is related to a variety of factors, including the year and seasonal timing of remediation, type of restoration activities, and characteristics of adjacent locations. Some former facility sites support a high abundance of invasive non-native plant species, while other sites support a prevalence of native species (SAIC 2009).

Climate and Surface Water

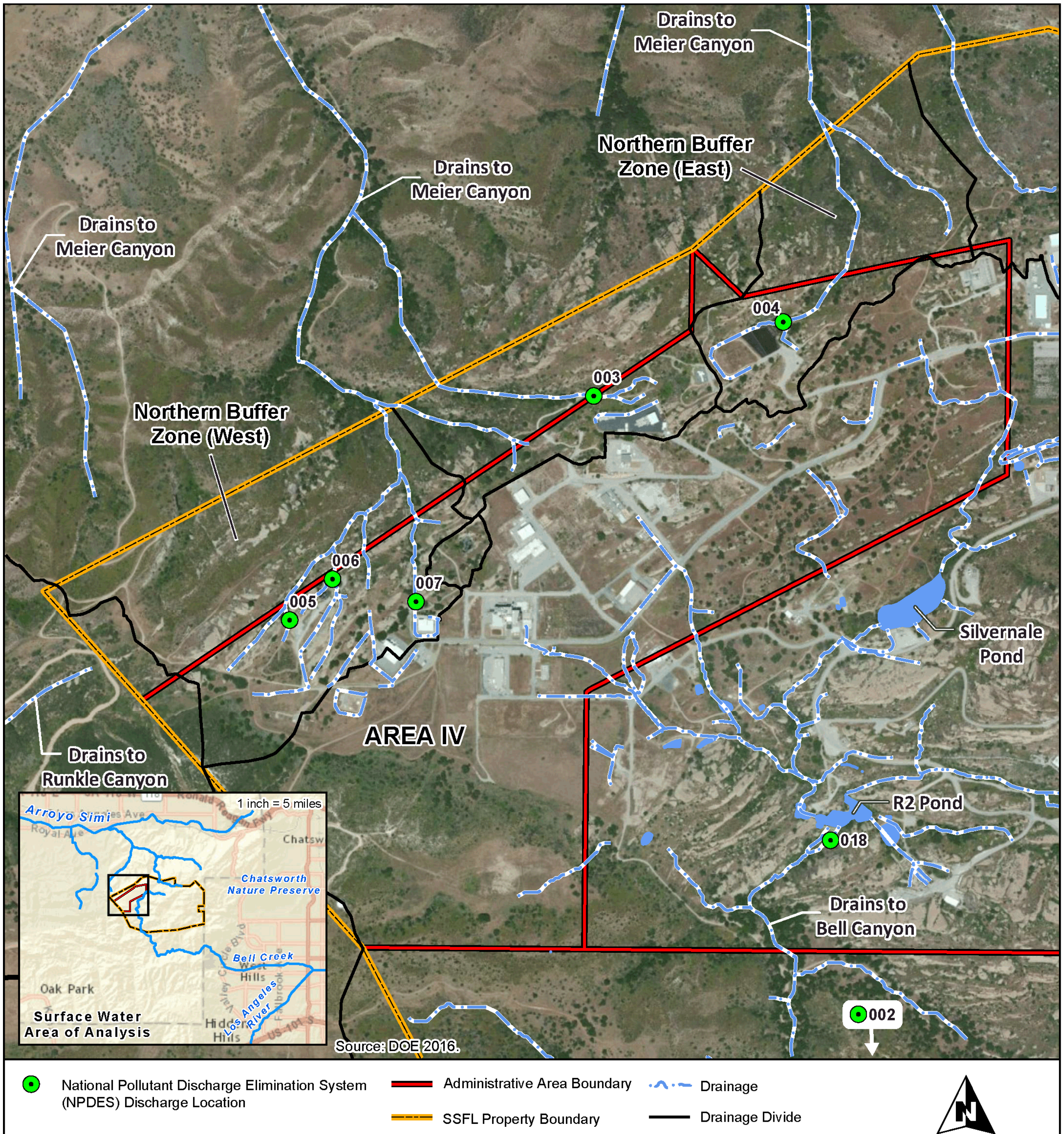
SSFL lies in a semiarid Mediterranean-climate region, with precipitation falling mostly during the cooler months (November through March). The summer months are typically dry. Temperatures are moderated by the relatively cool waters of the nearby Pacific Ocean, as well as a marine layer of overcast and fog that frequently reaches the site and both moderates temperatures and elevates humidity, especially from May through July. Because of SSFL's location at and near the summit of a low mountain range in a semiarid environment, water is scarce and very seasonal. There are no perennial streams (i.e., streams containing running water year-round) or naturally occurring permanent water bodies within Area IV or the NBZ (EPA 2009).

Surface water in Area IV and the NBZ is associated with seasonal precipitation and generally consists of natural and man-made intermittent or ephemeral drainages. Several ephemeral drainages lead north from Area IV into the NBZ and southeast into Areas II and III (see **Figure I–3**). Drainage from the northern portion of Area IV and the NBZ flows north into Meier Canyon, which connects to Arroyo Simi, which flows westward to connect with Calleguas Creek, which empties into the Pacific Ocean at Mugu Lagoon about 30 miles downstream of the SSFL. Drainage from the southern portion flows to the southeast through SSFL Areas III and II, then into the Bell Creek drainage system. Bell Creek, downstream of SSFL, meets Arroyo Calabasas and becomes the Los Angeles River. The Los Angeles River extends 51 miles downstream of its confluence with Bell Creek, flowing east and southward to the Pacific Ocean. The regional watersheds for Arroyo Simi and the Los Angeles River are depicted in **Figure I–4**.

Engineered stormwater collection and treatment systems, developed to address National Pollution Discharge Elimination System (NPDES) discharge requirements, control stormwater flows from SSFL. These systems receive runoff primarily during the winter rainy season (November through March). Stormwater runoff collected at the stormwater collection and treatment outfalls (the NPDES discharge locations shown in Figure I–3) is routed to Silvernale pond in Area III for treatment before being released into the Bell Canyon watershed (see Figure I–4). In some years, the runoff completely evaporates in Silvernale pond, with no release to the Bell Canyon watershed.

During a site visit conducted in early October 2009, no locations in Area IV held water (SAIC 2010). However, Silvernale Pond (SSFL Area III) and one of the ponds associated with Outfall 18 (SSFL Area II), both located off site, held water at that time.

Arroyo Simi, Calleguas Creek, Bell Creek, and the Los Angeles River are listed on the LARWQCB 2010 303(d) list of water-quality-impaired segments (SWRCB 2010). SSFL operates under an NPDES permit issued to The Boeing Company (Boeing) by LARWQCB. This permit allows the discharge of stormwater runoff and treated groundwater into the Bell Creek watershed to the south, as well as the discharge of stormwater runoff from the northwest slope into Calleguas Creek (Boeing 2011).



Notes:
- Outfall 002 is located off the map in the SSFL Souther Buffer Zone.
- GIS Layers provided by MWH/Boeing.

Service Layer Credits:
- Aerial Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community.
- World Streetmap Source: Esri, DeLorme, HERE, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, OpenStreetMap contributors, and the GIS User Community.
- Hydrography Source: National Hydrography Dataset Plus - NHDPlus, v2.10, USEPA and the USGS (2012).

Figure I–3 Area IV Surface Water

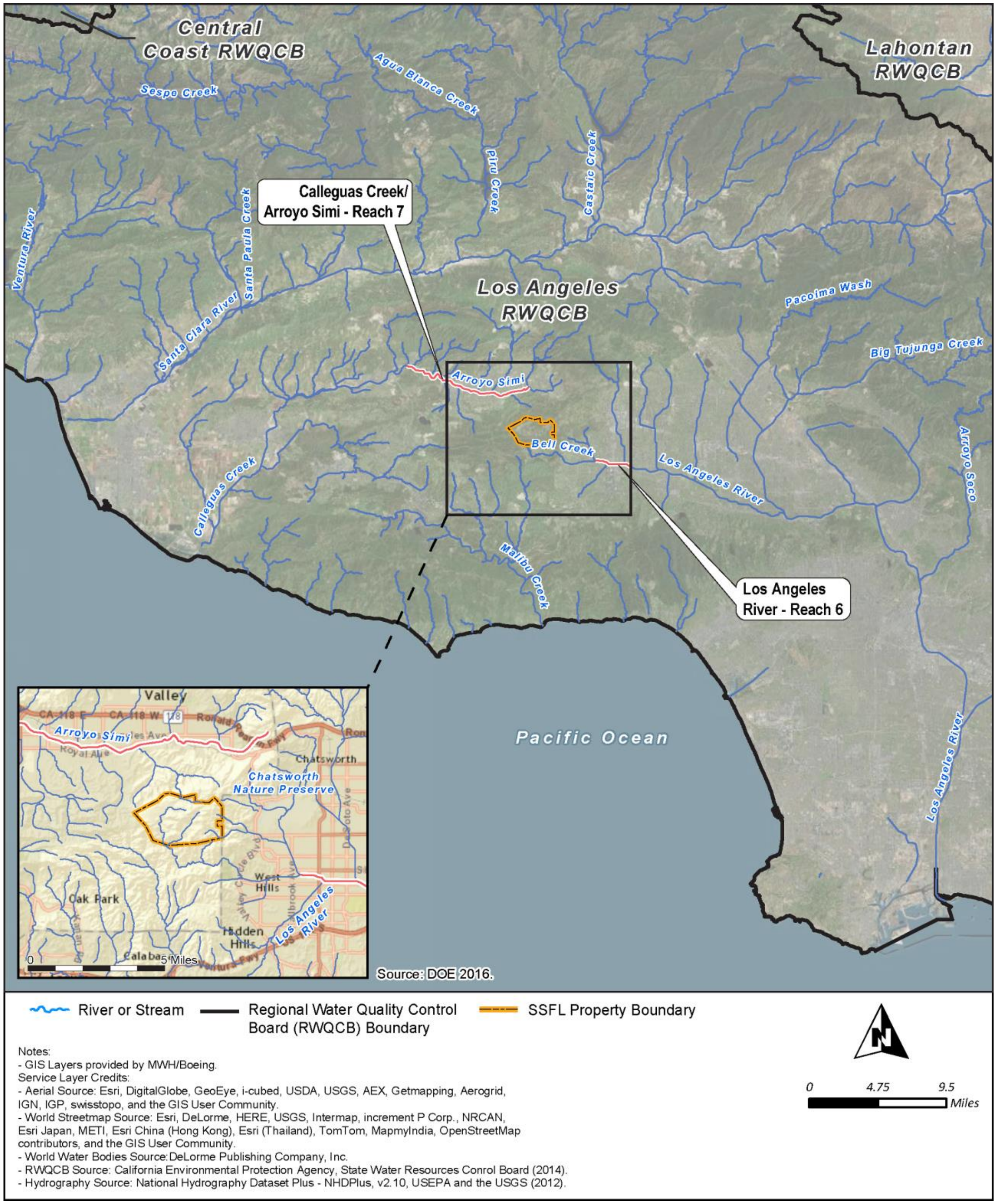


Figure I–4 Regional Drainage Basins

I.2 Regulatory Requirements, Guidelines, and Definitions

Federal wetlands and other waters of the U.S. have legal protection in accordance with Sections 401 and 404 of the Clean Water Act. USACE regulates the discharge of dredged or fill material into waters of the U.S. pursuant to Section 404 of the Clean Water Act and generally requires the issuance of an individual permit, or coverage under an existing Nationwide Permit, for all actions that have the potential to degrade or modify these features (Title 33, *United States Code*, Section 1344 [33 U.S.C. 1344], *Permits for Dredged or Fill Material*).

LARWQCB regulates activities pursuant to Section 401 of the Clean Water Act (33 U.S.C. 1341, *Certification*). Section 401 requires all applicants that apply for a Federal license or permit to conduct an activity that may result in a discharge of a pollutant into waters of the U.S. to obtain a 401 Water Quality Certification from LARWQCB, which plays a role in reviewing water quality and wetland issues, including avoidance and minimization of impacts. Section 401 certification is required prior to issuance of a Section 404 permit.

In addition to Clean Water Act requirements, DOE must comply with 10 CFR Part 1022 ("Compliance with Floodplain and Wetland Environmental Review Requirements"). This regulation establishes policy and procedures for DOE responsibilities under Executive Order 11988, *Floodplain Management*, and Executive Order 11990, *Protection of Wetlands*. Both Executive Orders direct Federal agencies to provide leadership and take action to minimize the destruction, loss, or degradation of wetlands and floodplains, as well as to preserve and enhance the beneficial values of wetlands and floodplains. Potential impacts on floodplains and wetlands from implementation of the proposed alternatives are analyzed in Chapter 4, Section 4.5, of this EIS and summarized in Section I.5 in this Appendix.

Jurisdictional Determination

Jurisdictional wetlands and waters of the U.S., as defined by USACE, are determined with consideration of guidance from the U.S. Environmental Protection Agency (EPA) and USACE on implementing the Supreme Court's decision in the consolidated cases, *Rapanos v. United States* and *Carabell v. United States*. Under that decision, USACE asserts jurisdiction over traditional navigable waters (TNWs); wetlands adjacent to TNWs; non-navigable relatively permanent waters (RPWs) that are tributaries to TNWs (i.e., RPWs that flow at least seasonally); and wetlands that abut such tributaries to TNWs. USACE may also assert jurisdiction over tributaries to features that do not have seasonal flow if there is a specific nexus for doing so, such as if the flow characteristics and functions of the tributary significantly affect the chemical, physical, and biological integrity of downstream navigable waters, or if adjacent wetlands are present. USACE will not assert jurisdiction over swales and erosional features (EPA and Army 2007).

However, EPA and USACE published a final rule (effective in California August 28, 2015) that defines the scope of waters protected under the Clean Water Act and is consistent with the Clean Water Act, science, the agencies' technical expertise and experience, and Supreme Court decisions. The final rule revises the existing definition of "waters of the United States" and establishes categories of waters that are jurisdictional, other categories that are excluded, and categories of waters and wetlands that require a case-specific significant nexus evaluation to determine whether they are waters of the U.S. and covered by the Clean Water Act. EPA and USACE define waters of the U.S. for all sections of the Clean Water Act to include TNWs, interstate waters, territorial seas, impoundments of jurisdictional waters, covered tributaries, and covered adjacent waters. Adjacent and neighboring waters include waters/wetlands within 1,500 feet (305 meters) of an Ordinary High Water Mark. Waters in these categories are jurisdictional waters of the U.S. by rule; no additional analysis is required (USACE and EPA 2015).

In addition, the new Clean Water Rule identifies certain waters that can be waters of the U.S. only where a case-specific determination has found a significant nexus with jurisdictional waters of the U.S. The rule specifies five types of waters, including western vernal pools in California that may be found to have a significant nexus on a case-specific basis. Based on the new rule, western vernal pools in California with a significant nexus within 4,000 feet of jurisdictional waters may be under USACE jurisdiction. Vernal pools in western states are reservoirs of biodiversity and can be connected genetically to other locations and aquatic habitats through wind- and animal-mediated dispersal. Because animals and other organisms can move between western vernal pool complexes and streams, insects and zooplankton can be flushed from vernal pools into streams and other waters during periods of overflow, carried by animal vectors (including humans) or dispersed by wind. USACE and EPA concluded that western vernal pools in California can be genetically connected to (i.e., have a significant nexus to) other jurisdictional waters and, therefore, may be under USACE jurisdiction (USACE and EPA 2015).

It is USACE's responsibility to determine whether a water feature falls under its jurisdiction, as defined by the Clean Water Act. There are two types of USACE JDs: a Preliminary JD and an Approved JD. A Preliminary JD is a nonbinding document that is advisory in nature and presumes USACE jurisdiction over features within a survey area that meet the USACE definition of wetlands or other waters of the U.S. An Approved JD is an official determination by USACE that jurisdictional wetlands or other waters of the U.S. are present or absent within a survey area and identifies the limits of those features subject to Clean Water Act jurisdiction. An Approved JD is a legal, binding document that indicates the findings of a JD are correct and are valid for 5 years from date of issuance. If no waters regulated under the Clean Water Act are present on the site, an Approved JD is a legally defensible statement to that effect. An applicant can elect to request to obtain an Approved JD to support a request for a permit authorization, or it can elect to use a Preliminary JD (and in some instances no JD) to voluntary waive or set aside questions regarding Clean Water Act jurisdiction over a site and, instead, obtain individual or general permit authorization. The recipient of a Preliminary JD can later request and obtain an Approved JD if it becomes necessary or appropriate during a permit or appeal process (USACE 2008a). USACE determines which form of JD is appropriate for any particular circumstance based on all of the relevant factors, including an applicant's preference, the kind of permit authorization being used (individual permit versus general permit), and the nature of the proposed activity.

Definitions

As defined under Section 404 of the Clean Water Act, wetlands are areas that are "inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Wetlands generally include swamps, marshes, bogs, and similar areas (EPA, 40 CFR 230.3, and USACE, 33 CFR 328.3). Wetlands are recognized as a special aquatic site under the Clean Water Act Section 404(b)(1) guidelines, and a "no net loss" policy continues to guide Federal regulatory actions affecting wetlands under Section 404. Jurisdictional wetland areas are identified and delineated according to USACE's *Wetlands Delineation Manual* (USACE 1987) and regional supplements, which for the project area is the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (Version 2.0)* (*Arid West Regional Supplement*) (USACE 2008b), per the requirements of the Los Angeles District Office of USACE.

Jurisdictional wetlands are a subset of waters of the U.S., which include, in addition to wetlands as defined above, areas subject to the ebb and flow of the tide and areas that are within the limits of ordinary high water. Waters are currently described as any areas that might be considered waterways, for either commerce or recreation, even on a limited scale. Frequently, the term "wetlands and other waters of the U.S." is used when describing areas under USACE jurisdiction.

Jurisdictional boundaries of waters of the U.S. are determined with consideration of recent guidance from EPA and USACE on implementing the Supreme Court's decision in the consolidated cases *Rapanos v. United States* and *Carabell v. United States* (EPA and Army 2007). Under that decision, the USACE asserts jurisdiction over the following features:

Traditional Navigable Waters. TNWs are all waters subject to the ebb and flow of the tides and waters that are presently used, have been used in the past, or may be susceptible for use to transport interstate or foreign commerce (33 CFR 328.3(a)(1)). *There are no TNWs in SSFL Area IV or the NBZ.*

Wetlands adjacent to TNWs. These are wetlands defined as cited above. The term "adjacent" means bordering, contiguous, or neighboring, i.e., meeting one of the following criteria: (1) there is an unbroken surface or shallow sub-surface connection to the TNW; (2) the wetland is physically separated from the TNW artificially by a man-made dike or by natural barrier such as a berm or dune; or (3) the wetland is reasonably close to the TNW, such that direct ecological interconnections are present. *There are no wetlands adjacent to TNWs in SSFL Area IV or the NBZ.*

Non-navigable, but Relatively Permanent Waters that are tributaries to TNWs. These RPWs are waters that typically flow year-round or continuously for at least 3 months. The boundaries of such waters are determined by the limits of ordinary high water (33 CFR 328.3). *Bell Creek and Arroyo Simi may be considered RPWs that are tributary to TNWs.*

Wetlands adjacent to RPWs. The guidance stipulates that a continuous surface connection must be present between the wetland and RPW. If such a connection is not present, additional criteria must be satisfied. *There are no wetlands adjacent to RPWs in SSFL Area IV or the NBZ.*

Non-RPWs and adjacent wetlands with a significant nexus to TNWs. To establish a significant nexus requires an assessment of the flow characteristics and functions of the tributary and any adjacent wetland to determine whether they significantly affect the chemical, physical, and biological integrity of downstream navigable waters. There are numerous natural ephemeral streams on SSFL that may be considered non-RPWs with significant nexus to TNWs (including Bell Creek or Arroyo Simi). *The wetlands and vernal pools identified during the JD surveys (see Section I.4), may be considered wetlands with significant nexus to TNWs.*

Cowardin Classification System

Streams and wetlands were classified using the Cowardin Classification System (Cowardin et al. 1979), which is also used by the U.S. Fish and Wildlife Service's *National Wetland Inventory* (USFWS 2014). The *National Wetland Inventory* provides information on the extent and status of the Nation's wetlands through a series of topical maps depicting wetlands (typically vegetated) and deepwater habitats (typically unvegetated). The *National Wetland Inventory* uses high-altitude imagery and identifies wetlands based on the visible signatures of wetland vegetation or hydrology. The *National Wetland Inventory* is not intended to define the limits of jurisdiction for any Federal, state, or local agency (USFWS 2014), but is used as a tool to contribute to the existing information available for the survey areas. The *National Wetland Inventory* and USACE use Cowardin Classification Codes to describe types of wetlands. Riverine (streams and rivers) and Palustrine (wetlands adjacent to streams or rivers and depressional wetlands) systems are present in the project area. Other types of wetland systems that include Marine (ocean and beaches), Estuarine (wetlands with tidal inundation), and Lacustine (lakes and shores) systems are not present in the survey areas. The Cowardin Classification Codes applicable to wetlands and other waters of the U.S. within the survey areas are defined below as a hierarchy by system, subsystem, class, and subclass (as applicable according to the Cowardin Code); only those terms applicable to the SSFL site are included below).

Systems:

R = Riverine System – This classification includes all wetlands and deepwater habitats that are contained in natural or artificial channels periodically or continuously containing flowing water or that form a connecting link between two bodies of standing water. Upland islands or Palustrine wetlands may occur in the channel, but are part of the Riverine system.

Subsystem:

4 = Intermittent (present in project area) – The channel contains flowing water only part of the year. When water is not flowing, it may remain in isolated pools or surface water may be absent.

SB = Streambed Class – This class is limited to intermittent streams and contains all channels that are periodically flooded or exposed. (Note: there is no Cowardin classification for ephemeral, so intermittent is used in the Cowardin Classification Code for ephemeral streams).

P = Palustrine System – This classification includes non-tidal wetlands dominated by trees, shrubs, emergents, mosses or lichens. There are no subsystems for the Palustrine system. Classes include those identified for Riverine systems as well as the following (more than one class may apply):

Class:

EM = Emergent (present in project area) – This class is characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens, that are present for most of the growing season in most years.

Subclass 1 – Persistent—typically dominated by low growing perennial plants.

Subclass 2 – Non-persistent—typically dominated by annual species (i.e., vernal pools).

SS = Scrub-Shrub (present in project area) – This class is characterized by woody vegetation less than 20 feet tall, including true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions.

Subclass 1 – Broad-leaved deciduous—These are shrubs that are predominantly deciduous and broad-leaved, such as willows (*Salix* spp.),

Subclass 3 – Broad-leaved evergreen—These are shrubs that are predominantly evergreen and broad-leaved; for the project area, one area dominated by mulefat was identified and investigated (Pit 1); this area did not meet the criteria for USACE jurisdictional wetland determination.

Modifiers:

In order to more accurately describe the wetland and deepwater habitats, one or more modifiers (such as water regime, water chemistry, soil, disturbance/development-related, etc.) or special modifiers (associated with unusual circumstances) may be applied at the class or lower level in the hierarchy. The following modifiers and special modifiers were used for the SSFL site:

Water regime (Non-tidal):

A = Temporarily Flooded – Surface water is present for brief periods during the growing season, but the water table usually lies well below the soil surface most of the year. Plants that grow in both uplands and wetlands are characteristic of this water regime. (Note: This applies to all of the drainages within the survey areas. Drainages in the survey areas are ephemeral, flowing only during and shortly after rain events. This modifier also applies to vernal pools.)

Special Modifiers:

h = Diked or impounded – Wetlands have been created or modified by a man-made barrier or dam that obstructs the inflow or outflow of water.

r = Artificial – This modifier applies to specific substrate types that have been placed by man using natural or synthetic materials. Although asphalt and concrete channels are not specifically called out in the definition, this modifier is used to identify asphalt and concrete-lined drainages within the survey areas.

x = Excavated – This applies to wetlands within basins or channels that have been dug, gouged, blasted, or suctioned by man using artificial means.

As stated above, the *National Wetland Inventory* (USFWS 2014) is used as a supplementary resource to identify the potential for wetlands to occur within the Area IV or the NBZ. Because the *National Wetland Inventory* mapping is based on high-altitude imagery, wetland boundaries and wetland types identified by the *National Wetland Inventory* may not be the same as those identified as a result of field surveys. In addition, wetlands or streams assigned a Cowardin Classification Code may or may not meet the USACE JD criteria. For example, many sites that support riparian forest and scrub identified in the Cowardin Classification System do not have the hydric (wetland) soils and wetland hydrology necessary to meet USACE jurisdictional criteria for wetlands.

I.3 Methods

This section describes the methods used to delineate the wetlands and other waters of the U.S. in the project area. Prior to conducting the field surveys, the following literature and materials were reviewed:

- Aerial photography of the project site to determine the potential locations of USACE jurisdictional wetlands or other waters of the U.S.;
- *Wetland and Waters of the United States, Delineation for the NASA-Administered Portions of the Santa Susana Field Laboratory, Ventura County California* (NASA 2012), a recent study conducted on lands adjacent to the survey area;
- the U.S. Fish and Wildlife Service's *National Wetland Inventory* (USFWS 2014) to identify areas mapped as wetland features;
- the U.S. Department of Agriculture Natural Resources Conservation Service soil mapping data (NRCS 2014);
- U.S. Geologic Survey topographic quadrangles; and
- Geographic Information System data for the survey areas (provided by DOE).

Field surveys were conducted from May 6 to 8, 2014, in Area IV (290 acres) and the NBZ (182 acres), by scientists from Leidos, Inc. Based on previous reports and observations, it was expected that the extent of wetlands would be limited and potential other waters of the U.S. would be the primary focus of the surveys. Methodology in the USACE *A Field Guide to the Identification of the Ordinary High Water Mark in the Arid West Region of the United States – A Delineation Manual* (Lichvar and McColley 2008) was referenced in determining the boundaries of the non-wetland waters of the U.S. The field team walked all drainage features within the survey areas, periodically stopping to collect cross-section data from representative points within the drainage channel (see **Figure I–5** in Section I.4). Because rainfall was below average and there had been an extended dry period prior to the surveys, special consideration was given to surface topography with channels or low spots, which were investigated for evidence that surface or flowing water may be present at some time during the year. Cross-sections perpendicular to channels were selected to represent overall site characteristics. Additional field notes and photographs were taken at each survey location.

Assessments of potential wetlands, seasonally ponded features, and vernal pools were conducted using the wetland delineation method described in the USACE *Wetlands Delineation Manual* (USACE 1987) and the *Arid West Regional Supplement* (USACE 2008b) to the manual. For each potential wetland site, the Wetland Determination Data Form included in the *Arid West Region Supplement* (USACE 2008b) was completed to document indicators of wetland conditions in each of the three parameters: hydrophytic vegetation, hydric soils, and wetland hydrology. Where delineation was performed, vegetation cover was assessed, and a narrow pit up to 24 inches in depth was dug to assess soil and groundwater conditions (a pit was not dug in areas of known contaminated soils or vernal pools with a potential to support listed endangered species). Survey points were mapped electronically using a Trimble Geo XT2005 sub-meter differential Global Positioning System unit and/or plotted in the field on ortho-rectified aerial photographs. Plant names follow The *Jepson Manual: Vascular Plants of California* (Baldwin et al. 2012). Representative photographs were also taken at each of the sites.

I.4 Results

Wetlands and other Waters of the U.S.

The results presented in this section are subject to verification by USACE. Because of climate conditions and the topography of Area IV and the NBZ, water is limited and development of riparian and wetland vegetation is likewise limited. All of the drainages within Area IV and the NBZ are ephemeral (i.e., flow is present briefly during and immediately following local rain events). There are numerous natural ephemeral streams at SSFL that may be considered non-RPWs that have significant nexus to RPWs that are tributary to TNWs (including Bell Creek or Arroyo Simi). In addition, there are several man-made concrete and asphalt-lined or dirt drainage ditches that flow into non-RPWs. Mapped wetlands within Area IV consisted of a small man-made impoundment, vernal pools, and a deep pit containing water and wetland vegetation that was originally excavated in bedrock and intended for a building (Building 4056) that was not constructed.

Figure I–5 at the end of this section depicts the results of the surveys with labels indicating survey points where survey data were collected. Survey data were collected using a drainage number and letter to indicate points where Ordinary High Water Mark data were collected using the Ordinary High Water Mark data sheet as a guide. Attachment I1, Table I1–1, is a list of observation points within the drainage features (i.e., other waters of the U.S.) that were investigated in Area IV and includes information on whether the surveyors determined the feature to be within the jurisdictional waters of the U.S. (yes/no); the receiving water when known; a description of the feature; the Cowardin Class; the width and depth of the feature (in feet); and additional notes. Drainage features that were not considered to be other waters of the U.S. included constructed stormwater drainages or swales (including asphalt or concrete drainages and excavated drainages and swales) that were clearly excavated from uplands and associated with developed areas (including removed building pads); culverts at road crossings that were not associated with defined drainage channels; discontinuous erosional channels; and weakly expressed upland swales on hill slopes (consistent with the findings in NASA 2012).

A total of 13,100 linear feet covering 0.62 acres of riverine waters of the U.S. were mapped in Area IV and the NBZ. All of the drainages within Area IV and the NBZ were ephemeral and assigned a Cowardin Classification Code of Riverine (R), Intermittent (4), Streambed (SB), Temporarily Flooded (A) (i.e., R4SBA) with special modifiers, as needed, to indicate whether the stream was artificial (r) or excavated (x) (Cowardin et al. 1979). Artificial or excavated drainages included concrete and asphalt-lined ditches around building pads or roadsides that were in upland areas with no upstream connection to a natural drainage (these were identified as non-waters of the U.S.). The natural and unlined excavated channels on the site were generally all considered potential waters of the U.S. and ranged from shallow swales with multiple small flow channels at the base or narrow channels with defined bed and banks to channels up to 2 feet wide and 3 feet deep in the more remote canyons. Nearly all of the channels had sandy beds or beds that were cut out of sandstone, and none supported wetland vegetation. In general, the active channels were either unvegetated or vegetated with the same upland herbaceous species as the adjacent uplands. In the steeper canyons in the NBZ, coast live oak (*Quercus agrifolia*) trees were denser along the channels, creating a coast live oak riparian woodland community associated with the drainage. There were also occasional willows) and small sycamores (*Platanus racemosa*) along some of the ephemeral drainages.

Potential jurisdictional wetlands within SSFL Area IV included a small area dominated by mulefat (*Baccharis salicifolia*), a man-made impoundment (the Sodium Reactor Experiment [SRE] pond), a deep excavated pit (the Building 4056 Excavation), and vernal pools (see Figure I–5). These areas are described below, and **Table I–1** presents the results of wetland investigations within the survey areas, including whether Area IV met the USACE criteria for jurisdictional wetlands (wetland vegetation, hydric soils, and wetland hydrology); the Cowardin Classification Code; size of the feature; and notes. Copies of wetland delineation forms are included in Attachment I2.

The wetland soil pit (Pit 1, [see Figure I–5, Table I–1, and the Pit 1 form in Attachment I2]) was located within an area dominated by mulefat that was adjacent to an asphalt-lined channel. This area was included in the *National Wetland Inventory* map as Palustrine Shrub/Scrub (USFWS 2014). Mulefat, a native shrub species, has a facultative Wetland Indicator Status, meaning it is equally likely to occur in wetlands or non-wetlands, and was the only plant species present that produced a positive indicator for wetland vegetation. There were indications that surface water flowed over the area as sheet flow, but there were no defined bed and banks. The surface water eventually reached an asphalt-lined drainage that feeds into Drainage 1A (see Attachment I1, Table I1–1). The soils appeared to be compacted fill material, consisted of silty sand and sandy loam with a thin surface of loamy clay, and had cracks in the surface, which is a positive indicator for wetland hydrology. There were no positive indicators for hydric soils; therefore, this area did not meet the three criteria for a USACE jurisdictional wetland.

The small impoundment below Outfall 4 is known as the SRE pond and is a man-made feature (Pit 2 [see Figure I–5]). No digging was done in the SRE pond because of the potential to encounter contaminated soils. During previous surveys conducted by the authors of the current report, the pond was observed to be dominated by cattails (*Typha* sp.) and bulrush (*Schoenoplectus* sp.), perennial wetland plant species with an obligate Wetland Indicator Status (meaning they nearly always occur in wetlands and are positive indicators for wetland vegetation), but these species were not present at the time of the May 2014 surveys. In May 2014, rabbitsfoot grass (*Polypogon monspeliensis*), a non-native annual with a facultative Wetland Indicator Status (nearly always occurring in wetlands in the region) was the dominant plant species. There was no surface water in the pond at the time of the May 2014 surveys, but soils were saturated near the surface, a positive indicator of wetland hydrology. Even though a soil pit was not dug, the pond has been present for many years, and the soils were expected to have developed positive indicators for wetland soils. The SRE Pond, although man-made, may be considered a jurisdictional wetland, having met all three criteria for determination of wetlands, and is situated within an ephemeral drainage, although diked, that is a tributary of a non-RPW.

The Building 4056 excavation is also a man-made feature and is identified as a pond on the *National Wetland Inventory* map (USFWS 2014). The excavation has nearly vertical walls that lead to a pond about 50 feet below ground level. The area is fenced, and no access is allowed, so a wetland determination form was not used on this feature. Perennial wetland vegetation was dominant on the perimeter of the pond, including cattails and willows (*Salix* spp.). The pond is known to contain water year round. Although it could not be determined whether this feature would meet the criteria for a USACE jurisdictional wetland, it appears to be isolated, with no nexus to any of the drainages in Area IV and, therefore, non-jurisdictional (see Table I–1).

Two isolated vernal pools covering 0.025 acres were identified in Area IV (near the Building 4056 excavation), and three vernal rock pools were identified in the NBZ (see Figure I–5). Vernal pools are seasonal wetlands that begin to fill in late fall or early winter during rain events. Year-to-year variation in the time and duration of precipitation affects the depth and extent of standing water. In dry years, many pools do not fill (USACE 2008a). Vernal pools can provide habitat for several federally listed fairy shrimp species. The vernal pools in Area IV were investigated (see Table I–1 below, as well as the forms for VP-1 and VP-2 in Attachment I1). The pools occurred in a flat area that was previously disturbed and had compacted soils, which appeared to be the result of frequent access by heavy equipment. At the time of the May 2014 surveys, the pools were dry and supported upland annual plant species. During previous surveys conducted by the authors of the current report, the pools had supported annual vernal pool plant species such as woolly marbles (*Psilocarphus* sp.) and, during 2012 surveys, unidentified fairy shrimp were observed. Soil pits were not dug in these areas to avoid any potential impacts to sensitive fairy shrimp species, should they be present. The surface soils were cracked and consisted of fine sediments.

The three vernal rock pools identified in the NBZ were depressions within the sandstone that contained water for a long-enough period to support fairy shrimp, but were unvegetated. The versatile fairy shrimp (*Branchinecta lindahli*), an unlisted species, was identified in these pools in March 2010 (Padre 2013). In general, the vernal pools in Area IV and vernal rock pools in the NBZ do not appear to meet all three criteria for USACE jurisdictional wetlands, but the determination is inconclusive without additional data, and it is unknown whether USACE will assert jurisdiction over these features.

Aquatic Habitats and Biota

Wetlands provide important watershed functions by trapping floodwaters; recharging groundwater; removing pollution; and providing fish, wildlife, and plant habitat. Due to the location of SSFL at the summit of the Santa Susana Mountains and the semiarid environment, water is scarce, the development of natural wetlands is limited, and there are no floodplains. The watershed functions of the wetlands and ephemeral streams in Area IV and the NBZ are minimal due to the small size of wetlands and the temporary nature of the flows of the natural ephemeral streams. There are no perennial streams (streams containing running water year-round) or naturally occurring permanent water bodies within the Area IV and the NBZ. NPDES outfalls designed to control the release of stormwater off site are present in the project area and would be maintained throughout the project. The SRE pond, the Building 4056 Excavation, and vernal pools do support aquatic habitats and biota, including wetland vegetation and seasonal surface water capable of periodically (seasonally to semiannually) supporting aquatic organisms. Vernal pools can provide habitat for federally listed fairy shrimp species, as discussed in Chapter 3, Section 3.5, of this EIS. Vernal pools are seasonal wetlands that begin to fill in late fall or early winter during rain events. Year-to-year variation in the time and duration of precipitation affects the depth and extent of standing water. In dry years, many pools do not fill or do not hold water for sufficient time to support vernal pool biota.

Table I–1 Results of USACE Jurisdictional Determination Surveys–Wetlands

Pit or Feature ID code	*Wetland Survey Results* [a]				*Cowardin Class* [b]	*Acres*	*Notes*
	Veg	*Hydro*	*Soils*	*Wetland (Yes/No)*			
Pit 1 – Mulefat patch	Yes	Yes	No	No	PSS3	NA	No positive indicators for hydric soils.
Pit 2 – SRE Pond	Yes	Yes	No data	Yes	PEM1rh	0.02	Created pond, artificial hydrology. Man-made feature; pit not dug in area because of contaminated soils; positive indicators for wetland vegetation and hydrology.
VP-1 – Vernal Pool	No in 2014	Yes	Yes	Unknown	PEM2	<0.01	Pit not dug in vernal pool that is known to contain fairy shrimp species; vegetation did not meet criteria in 2014, but may meet criteria in wetter years, depending on dominant plant species.
VP-2 – Vernal Pool	No in 2014	Yes	Yes	Unknown	PEM2	<0.01	Pit not dug in vernal pool that is known to contain fairy shrimp species; vegetation did not meet criteria in 2014, but may meet criteria in wetter years, depending on dominant plant species.
Building 4056 Excavation	Yes	Yes	No data	Yes	PSS3/EM1rx	0.02	Deep excavation in bedrock with vertical walls, no access, pit not dug in area; perennial ponded water (presumably from groundwater seepage), wetland vegetation dominant around the edges of the excavation. Identified on the National Wetland Inventory map (USFWS 2014). Isolated, no nexus to drainage in Area IV.
Rock vernal pools	No	Yes	Yes	Unknown	NA	<0.01	Seasonal water in small depressions in sandstone in the NBZ that are known to contain fairy shrimp species. No vegetation present.

SRE = Sodium Reactor Experiment.

Notes:

[a] Copies of USACE delineation field forms for Pits 1 and 2 and Vernal Pool 1 and 2 are provided in Attachment I1.

[b] Cowardin Class (Cowardin et al. 1979) =

PSS3 = Palustrine (P), Scrub-Shrub Broad-leaved Evergreen (SS3)
PEM1 = Palustrine (P), Emergent Persistent (EM1)
PEM2 = Palustrine (P) Emergent Non-persistent (EM2);
PSS3/EM1rx = Palustrine (P), Scrub-Shrub Broad-leaved Deciduous (SS1)/Emergent Persistent (EM1)/
Special Modifiers – r = artificial, h = diked, x = excavated.
NA = not applicable.

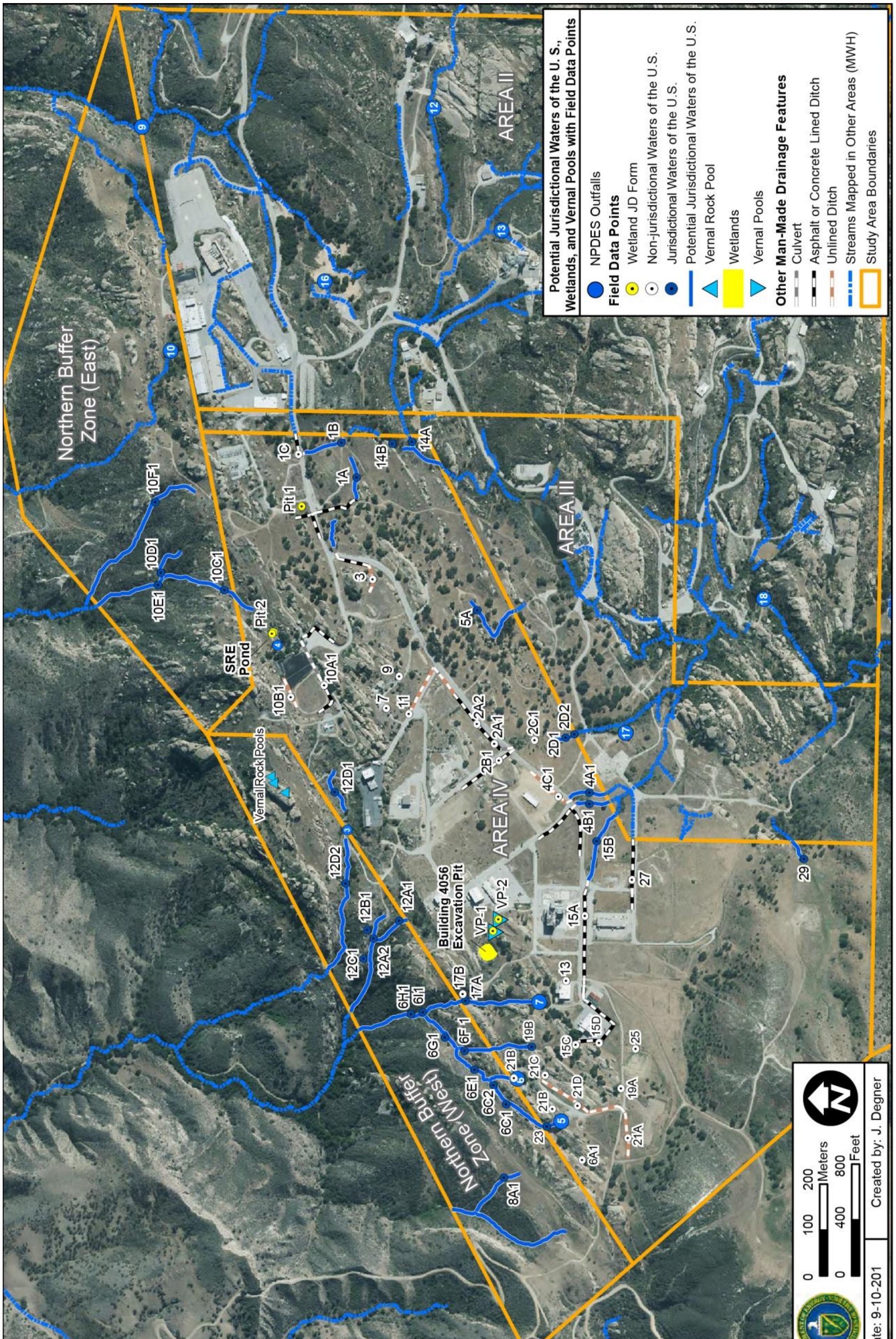


Figure I–5 Wetlands, Vernal Pools, and Jurisdictional Waters of the U.S.

I.5 Assessment of Impacts and Mitigation Measures

I.5.1 Impact Assessment

As stated in Section I.1.2, Project Description, DOE is evaluating separate alternatives for the three components that make up its remediation project: soil remediation, building demolition, and groundwater remediation. The remediation of radiologically and chemically impacted soil, removal of existing facilities and support buildings, and groundwater remediation within SSFL Area IV and the NBZ have the potential to directly and indirectly impact wetlands resources, including wetlands, other waters of the U.S. (i.e., ephemeral streams), and aquatic habitats and biota. Potential direct impacts include disturbance or direct removal of individual plants or habitat; indirect impacts could result from dust, noise, or human activity. The project has incorporated proposed AOC exemption areas that support sensitive resources (biological, cultural), including vernal pools that would be remediated via focused removal actions. Details on methods for implementing each of the project components, including remediation within the proposed exemption areas, are presented in Chapter 2 of this EIS.

The discussion below presents a comparison of impacts on wetlands resources for each of the alternatives, including the No Action Alternative, for (1) soil remediation, (2) building removal, and (3) groundwater remediation, followed by a description of potential impacts and measures incorporated into the project to avoid or minimize impacts.

I.5.1.1 Soil Remediation

Soil No Action Alternative	***Cleanup to AOC LUT Values Alternative***	***Cleanup to Revised LUT Values Alternative***	***Conservation of Natural Resources Alternative***
No adverse impacts on wetlands, waters of the U.S., or aquatic habitats and biota.	Direct impacts on: – 0.02 acres of wetlands – 0.4 acres of ephemeral streams – 0.26 acres of man-made drainages	Direct impacts on: – 0.02 acres wetlands – 0.22 acres ephemeral streams – 0.14 acres man-made drainages	Direct impacts on: – 0.02 acres wetlands – 0.19 acres ephemeral streams – 0.14 acres man-made drainages

AOC = *Administrative Order on Consent for Remedial Action*; LUT = Look-Up Table.

I.5.1.1.1 Cleanup to AOC LUT Values Alternative

Figure I–6 illustrates areas projected for remediation under the Cleanup to AOC LUT Values Alternative, as well as the locations of aquatic features, including wetlands, potential jurisdictional waters of the U.S., and other drainage features. Soil removal would directly impact the following wetland habitats and aquatic features outside of the proposed exemption areas:

- Wetlands – 0.02 acres (the SRE wetland). The Building 4056 excavation and the adjacent vernal pools are within a proposed exemption area.
- Waters of the U.S.
  - 0.4 acres, 8,336 linear feet (natural ephemeral streams in Area IV and parts of the NBZ adjacent to Area IV)
  - 0.26 acres, 6,272 linear feet (man-made asphalt and concrete lined and unlined drainage ditches in Area IV)

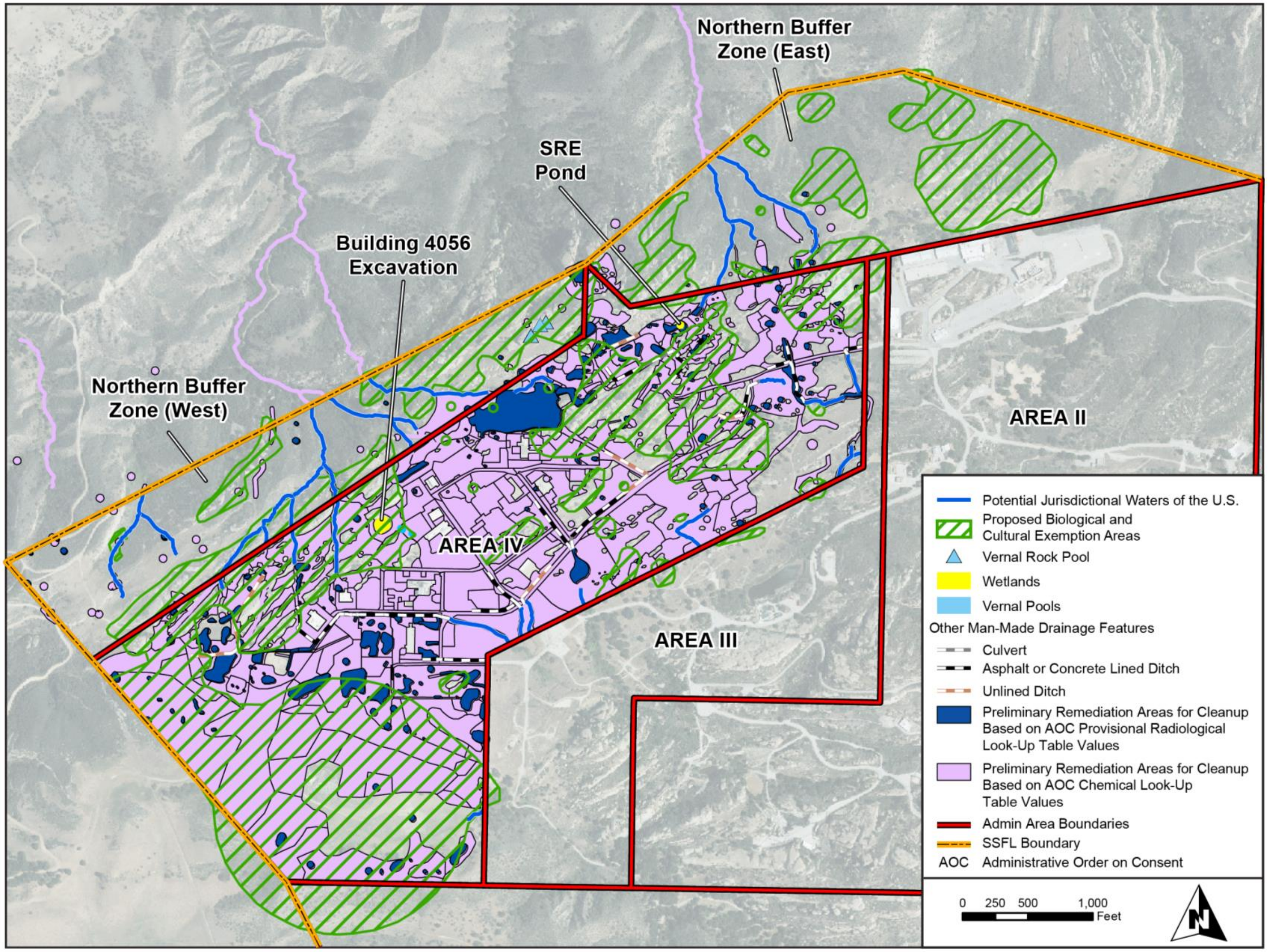


Figure I–6 Impacts to Wetlands and Waters of the U.S. under the Cleanup to AOC LUT Values Alternative

The removal actions for the proposed exemption areas would avoid direct impacts on aquatic and wetland habitats and biota to the extent feasible, including the Building 4056 excavation and adjacent vernal pools. The rock vernal pools are on top of a large sandstone outcrop and are outside any proposed remediation area. Limited indirect impacts could occur from soil disturbance caused by personnel and equipment access and wind and water erosion. These localized impacts would be temporary and would be reduced by measures including pre-remediation surveys, identification of access routes, biological monitors, and soil stabilization and restoration techniques. The waters of the U.S. (i.e., natural ephemeral streams and man-made drainage features) that cannot be avoided would be directly impacted. Following cleanup, onsite drainages would be restored by revegetation of exposed soil surfaces to the extent feasible. At a minimum, a 1:1 replacement is expected for any ephemeral stream impacted from the proposed activities. USACE would have the final determination of compensation as part of the permitting process under Section 404 of the Clean Water Act.

Indirect impacts to wetland resources could occur from erosion and movement of sediment or soil. In addition, migration of sediment or pollutants during cleanup could impact wetlands and vernal pool habitats and biota. As described in Chapter 4, Section 4.3, of this EIS, stormwater pollution prevention plans (SWPPPs) and best management practices (BMPs) implemented to protect surface water resources during soil removal and until restoration, or other means of stabilizing soils, would protect wetland resources from runoff and erosion. Therefore, no substantial indirect impacts to wetlands, waters of the U.S., or aquatic habitats and biota are expected.

I.5.1.1.2 Cleanup to Revised LUT Values Alternative

Figure I–7 illustrates areas projected for remediation under the Cleanup to Revised LUT Values Alternative, as well as locations of aquatic features, including wetlands, potential jurisdictional waters of the U.S., and other drainage features. Soil removal would directly impact the following wetland habitats and aquatic features outside of the proposed exemption areas:

- Wetlands 0.02 acres (the SRE wetland near Outfall 4)
- Waters of the U.S.
    - 0.22 acres, 4,275 linear feet (natural ephemeral streams)
    - 0.14 acres, 3,421 linear feet (man-made asphalt-lined, concrete-lined, and unlined drainage ditches)

There would be generally similar impacts to those described under the Cleanup to AOC LUT Values Alternative, but the area of drainages affected would be less due to the reduced area undergoing remediation. Direct impacts to the Building 4056 wetland and vernal pools within the proposed exemption areas would be avoided to the extent feasible. As under the previous action alternative, implementation of mitigation measures and BMPs, including those that would protect surface water resources, would avoid or reduce potential indirect impacts.

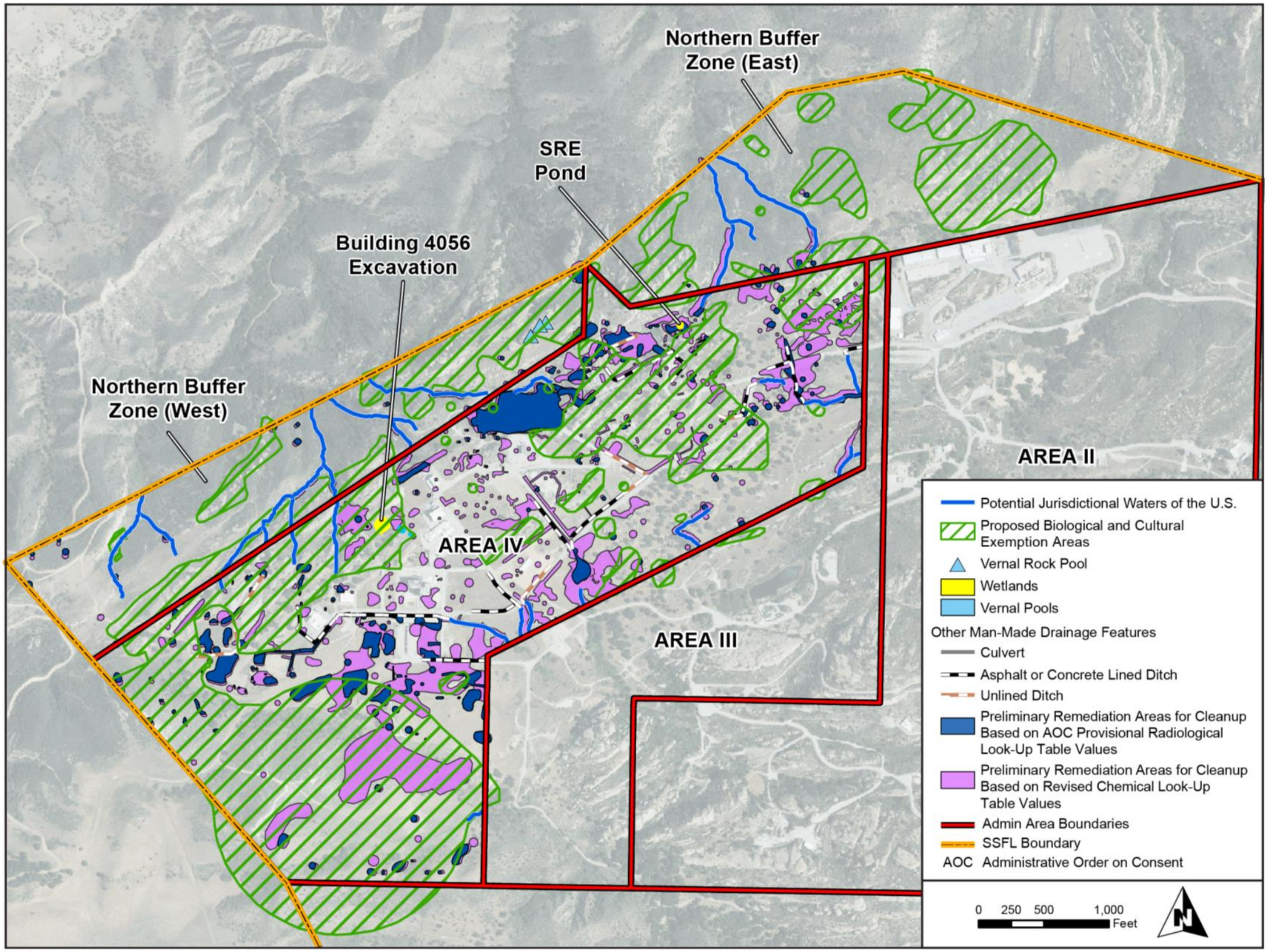


Figure I–7 Impacts to Wetlands and Waters of the U.S. under the Cleanup to Revised LUT Values Alternative

I.5.1.1.3 Conservation of Natural Resources Alternative

Areas projected for remediation of chemically impacted soil under the Conservation of Natural Resources Alternative are the same as those for the Cleanup to Revised LUT Values Alternative. A smaller area of radiologically impacted soils would be remediated under the Conservation of Natural Resources Alternative than under the Cleanup to Revised LUT Values Alternative, resulting in a slight reduction in the area of natural ephemeral streams that would be impacted. Soil removal would directly impact the following wetland habitats and aquatic features outside of the proposed exemption areas:

- Wetlands 0.02 acres (the SRE wetland near Outfall 4)
- Waters of the U.S.
  - 0.19 acres, 3,544 linear feet (natural ephemeral streams)
  - 0.14 acres, 3,421 linear feet (man-made asphalt-lined, concrete-lined, and unlined drainage ditches)

As under the previous two action alternatives, implementation of mitigation measures and BMPs, including those that would protect surface water resources, would avoid or reduce potential indirect impacts.

I.5.1.2 Building Removal

Building No Action Alternative	*Building Removal Alternative*
No adverse impacts on aquatic and wetland habitats and biota;	Wetlands or jurisdictional waters of the U.S. would not be directly impacted. Existing drainage structures and impervious surfaces may be removed, but would be replaced by more-natural drainage patterns. Indirect impacts from runoff would be minimized by use of BMPs.

BMPs = best management practices.

Demolition and regrading would not directly impact wetlands, natural ephemeral streams, or vernal pools. Impacts would be restricted to removal of man-made drainage ditches, culverts, and impervious areas such as paved lots. In most areas, the ditches surrounding the buildings were installed to direct runoff from buildings and pads. Because the ditches are in upland habitat, USACE may or may not assert jurisdiction over these features (concurrence from USACE is required). Removal of the ditches and subsequent regrading and restoration to natural conditions would have minimal impacts on natural drainage in Area IV and NBZ. If re-graded contours were such that erosion was a concern, then drainage features that mimic the natural drainages in Area IV may be incorporated. Because there would be no direct impacts on wetlands, natural ephemeral streams, or aquatic habitats or biota, no mitigation would be needed (confirmation from USACE and LARWQCB is required).

The alternative could indirectly impact wetlands and aquatic habitat and biota due to movement of sediment or potential contaminants into surface waters. In addition, the inadvertent release of sediment or pollutants into vernal pool habitats could affect these habitats and aquatic biota. For example, relatively small amounts of sediment could alter the natural topography of the vernal pool features and affect the hydrologic regime. Sediment and pollutants could also cause mortality to fairy shrimp cysts and adults. However, implementing SWPPPs and BMPs to protect surface water would reduce the potential for indirect impacts from runoff, sedimentation, and erosion. In addition, use of existing disturbed areas to the extent feasible to support building removal, designated biologist-approved access routes, and other possible measures would further reduce impacts. Therefore, no substantial impacts on wetlands, aquatic habitats, and biota are expected.

I.5.1.3 Groundwater Remediation

Groundwater No Action Alternative	*Groundwater Monitored Natural Attenuation Alternative*	*Groundwater Treatment Alternative*
No adverse impacts on aquatic and wetland habitats and biota	No adverse impacts on wetlands, waters of the U.S., or aquatic habitats and biota are expected.	No adverse impacts on wetlands, waters of the U.S., or aquatic habitats and biota are expected.

I.5.1.3.1 Groundwater Monitored Natural Attenuation Alternative

No adverse impacts to wetlands, waters of the U.S., or aquatic habitats and biota are expected under the Groundwater Monitoring Natural Attenuation Alternative, including installation of new monitoring wells. This is due to the scarcity of wetland and aquatic habitat on site, the infrequent, low-intensity nature of the activity, use of existing wells and access routes, and the likely placement of possible new wells in accessible, previously disturbed habitat, as well as the implementation of BMPs and mitigation measures that would enable avoidance of impacts on wetland and aquatic habitat.

I.5.1.3.2 Groundwater Treatment Alternative

Groundwater treatment for most plumes would include localized ground disturbance, mostly in previously disturbed areas, so that impacts to wetlands, waters of the U.S., or aquatic habitats and biota would be avoided or minimized.

Remedial measures for the Radioactive Materials Handling Facility strontium-90 source may include groundwater-level manipulation by active pumping to lower the water table. Direct impacts on aquatic and wetland resources may be avoided by measures such as conducting pre-activity surveys, designating access routes and work areas to minimize indirect impacts on intermittent drainages, and restricting equipment and personnel to designated work areas. Groundwater manipulation that lowers the water table is not expected to affect wetlands whose hydrology depends on a high water table because the manipulation would be temporary and not in close proximity to either of the potential jurisdictional wetlands in Area IV and the NBZ (i.e., the SRE wetland near Outfall 4 and the Building 4056 excavation). Vernal pools depend on surface water and would be unaffected by groundwater manipulation. Therefore, no adverse impacts on wetlands, waters of the U.S., or aquatic habitats and biota are expected.

I.5.2 Mitigation Measures

Following soil remediation and building removal, wetland resources impacted by project activities would be restored by recontouring and revegetation of exposed soil surfaces to the extent feasible. At a minimum, a 1:1 replacement is expected for any wetland or ephemeral stream impacted from the proposed activities. Implementing SWPPPs and BMPs to protect surface water would reduce the potential for indirect impacts from runoff, sedimentation, and erosion. In accordance with the USACE requirements, mitigation measures include a sequence of (1) seeking to avoid impacts, (2) minimizing impacts in space and/or time, and (3) providing compensation for impacts that are unavoidable. USACE would have the final determination of any compensation as part of the permitting process under Section 404 of the Clean Water Act.

I.6 Summary

In summary, a total of 13,100 linear feet covering 0.62 acres of riverine waters of the U.S. were mapped in Area IV and the NBZ (see Figure I–5). All of the drainages within Area IV and the NBZ were ephemeral and assigned a Cowardin Classification Code of R4SBA (see Attachment I1, Table I1–1). Approximately 0.05 acres of potentially jurisdictional wetlands were mapped in Area IV and the NBZ, including a man-made impoundment (the SRE pond) and vernal pools (Figure I–5). In addition, three vernal rock pools were identified in the NBZ that contained water for a long-enough time to support the common versatile fairy shrimp, but were unvegetated. Soil remediation activities have the potential to directly impact less than 1 acre of wetland resources. The Cleanup to AOC LUT Values Alternative would impact up to 0.68 acres, whereas the Cleanup to Revised LUT Values and Conservations of Resources Alternatives would impact up to 0.38 and 0.35 acres, respectively. For all soil remediation alternatives, impacts would be localized and temporary and would be avoided or reduced by measures including pre-remediation surveys, identification of access routes, presence biological monitors, and soil stabilization and restoration techniques. For impacts that cannot be avoided, areas would be restored by revegetation of exposed soil surfaces to the extent feasible. No direct impacts to wetlands, waters of the U.S., or aquatic habitats and biota are expected to occur from the Building Removal Alternative and groundwater remediation alternatives. Indirect impacts that could occur as a result of erosion or migration of sediment or pollutants during any of the project activities would be avoided or reduced by incorporating SWPPPs and BMPs during soil removal and maintaining them until restoration, or other means of stabilizing soils, has been completed. This would protect wetland resources. Therefore, no substantial indirect impacts to wetlands, waters of the U.S., or aquatic habitats and biota are expected. A 1:1 replacement is expected for any wetland, ephemeral stream, or aquatic habitat impacted by the proposed activities. USACE would have the final determination of any compensation that may be required as part of the permitting process under Section 404 of the Clean Water Act.

The results of the wetland delineation surveys are subject to verification by USACE. Any project-related activities with the potential to result in placement of fill, excavation, or other impacts to areas determined to be jurisdictional by USACE's Los Angeles District Office will require regulatory coverage, as prescribed by Sections 401 and 404 of the Clean Water Act. If it is determined that project activities will directly or indirectly affect features determined to be jurisdictional, it will require submittal of a 404 permit application to USACE and a 401 Water Quality Certification from LARWQCB. If the direct or indirect effects of the project action would result in a "minimal amount" of potential fill into jurisdictional wetlands or waters of the U.S., and potential loss of jurisdictional features is minimized, coverage under an existing USACE Nationwide Permit may be possible in place of the 404 permit application, although the 401 Water Quality Certification may still be required. If mitigation for permanent or temporary loss of jurisdictional features were required, USACE would make the final determination as part of the permitting process under Section 404 of the Clean Water Act.

I.7 References

Baldwin, B. G., D. H. Goldman, D. J. Keil, R. Patterson, T. J. Rosatti, and D. H. Wilken, 2012, *The Jepson Manual: Vascular Plants of California*, Second Edition, University of California Press, Berkeley, California.

Boeing (The Boeing Company), 2011, *2010 Annual NPDES Discharge Monitoring Report* , Santa Susana Field Laboratory, Canoga Park, California (accessed on July 14, 2014, http://www.boeing.com/boeing/aboutus/environment/santa_susana/ents/monitoring_reports.page), February 28.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRue, 1979, *Classification of Wetlands and Deepwater habitats of the United States*, U.S. Department of the Interior, Fish and Wildlife Services, Washington, DC, December.

DTSC (State of California Department of Toxic Substances Control), 2007, *The State of California Environmental Protection Agency, Department of Toxic Substances Control, The Boeing Company, the National Aeronautics and Space Administration, and the United States Department of Energy, In the Matter of: Santa Susana Field Laboratory, Simi Hills, Ventura County, California, Consent Order for Corrective Action*, Docket No. P3-07/08-003, Health and Safety Code Section 25187, August 16.

DTSC (State of California Department of Toxic Substances Control), 2010, *The State of California Environmental Protection Agency, Department of Toxic Substances Control and the United States Department of Energy, In the Matter of: Santa Susana Field Laboratory, Simi Hills, Ventura County, California, Administrative Order on Consent for Remedial Action*, Docket No. HSA-CO 10/11-037, Health and Safety Code Sections 25355.5(a)(1)(B), 58009 and 58010, December 6.

EPA (U.S. Environmental Protection Agency), 2009, *Fact sheet: Total Maximum Daily Loads*, Office of Water (accessed on November 12, 2014, http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/upload/2009_09_09_tmdl_results_22tmdl_progress_factsht.pdf), May 5.

EPA and Army (U.S. Environmental Protection Agency and the U.S. Army), 2007, *Clean Water Act Jurisdiction Following the U.S. Supreme Court's Decision in Rapanos v. United States and Carabell v. United States,* Guidance Memorandum, June 5.

Lichvar, R. W., M. Butterwick, N. C. Melvin, and W. N. Kirchner, 2014, *The National Wetland Plant List: 2014 Update of Wetland Ratings,* U.S. Army Corps of Engineers, *Phytoneuron* 2014-41, pp. 1-42, April.

Lichvar, R. W., and S. M. McColley, 2008, *A Field Guide to the Identification of the Ordinary High Water Mark (OHWM) in the Arid West Region of the United States, A Delineation Manual,* ERDC/CRREL TR-08-12 (available at http://www.spk.usace.army.mil/Portals/12/documents/regulatory/pdf/Ordinary_High_Watermark_Manual_Aug_2008.pdf), August.

NASA (National Aeronautics and Space Administration), 2012, *Wetlands and Waters of the United States, Delineation for the NASA-Administered Portions of the Santa Susana Field Laboratory, Ventura County California*, Huntsville, Alabama, March.

NRCS (Natural Resources Conservation Service), 2014, *Custom Soil Resource Report for Ventura Area, California*, U.S. Department of Agriculture, May 5.

Padre (Padre Associates, Inc.), 2013, *Draft Biological Resources Study for the Boeing Company Santa Susana Field Laboratory Soils and Groundwater Remediation Project*, Ventura, California, December.

SAIC (Science Applications International Corporation), 2009, *Fall Biological Survey Report for Santa Susana Field Laboratory Area IV and Northern Undeveloped Areas*, Carpinteria, California, November 13.

SAIC (Science Applications International Corporation), 2010, *California Red-legged Frog Habitat Site Assessment at Santa Susana Field Laboratory Area IV and Vicinity*, Carpinteria, California, March 25.

SWRCB (State Water Resources Control Board), 2010, California 2010 303(d) Combined California 2010 303(d) List (accessed on July 14, 2014, http://maps.waterboards.ca.gov/webmap/303d/files/2010_USEPA_approv_303d_List_Final_122311wsrcs.xls).

USACE (U.S. Army Corps of Engineers), 1987, *Corps of Engineers Wetlands Delineation Manual,* Wetlands Research Program Technical Report Y-87-1, Waterways Experiment Station, Vicksburg, Mississippi.

USACE (U.S. Army Corps of Engineers), 2008a, Regulatory Guidance Letter, Subject: "Jurisdictional Determinations," No. 08-02, June 28.

USACE (U.S. Army Corps of Engineers), 2008b, *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (Version 2.0)*, Wetlands Regulatory Assistance Program, Vicksburg, Mississippi (available at http://www.usace.army.mil/Portals/2/docs/civilworks/regulatory/reg_supp/trel08-28.pdf), September.

USACE and EPA (U.S. Army Corps of Engineers and U.S. Environmental Protection Agency), 2015, "Clean Water Rule: Definition of 'Waters of the United States,'" *Federal Register,* Vol. 80, No. 124: 37054 to 37127, June 29.

USFWS (U.S. Fish and Wildlife Service), 2014, Map, SSFL NWI-2, *National Wetlands Inventory* (accessed on May 5, 2014, http://www.fws.gov/wetlands/NWI/index.html).

Attachment I1
OBSERVATIONS AT U.S. ARMY CORPS OF ENGINEERS JURISDICTIONAL DETERMINATION SURVEY POINTS AT SSFL AREA IV AND NBZ – WATERS OF THE U.S.

This page intentionally left blank.

Table I1–1 Observations at USACE Jurisdictional Determination Survey Points at SSFL Area IV and NBZ – Waters of the U.S.

Drainage Inspection Field Code	*Waters of the U.S. (Yes/No)*	*Receiving Water*	*Description*	*Cowardin Class[2]*	*Width of WUS (feet)*	*Depth of WUS (feet)*	*Notes*
1A	Yes	Bell Creek	Drainage Channel	R4SBA	2	0.5	Channel determined by bed and bank; receives water from two asphalt-lined stormwater drainages. No vegetation in channel. Non-native grasses dominant outside channel banks.
1B	Yes	Bell Creek	Drainage Channel	R4SBA	2	0.5	Channel determined by bed and bank; receives water from two asphalt-lined stormwater drainages. No vegetation in channel. Non-native grasses dominant outside channel banks.
1C	No	Bell Creek	Asphalt Lined Drainage	R4SBAr	NA	NA	Asphalt-line channel receives water from disturbed upland and roadsides No vegetation in channel
2A1	No	Bell Creek	Asphalt Lined Drainage	R4SBAr	NA	NA	Asphalt-line channel receives water from disturbed upland and roadsides. No vegetation in channel, ruderal weeds along roadside.
2A2	No	Bell Creek	Asphalt Lined Drainage	R4SBAr	NA	NA	Asphalt-line channel receives water from disturbed upland and roadsides. No vegetation in channel, ruderal weeds along roadside.
2B1	No	Bell Creek	Asphalt Lined Drainage	R4SBAr	NA	NA	Asphalt ditch with ruderal weeds along roadside.
2C1	No	NA	NA	NA	NA	NA	This area has been heavily disturbed by earth moving equipment, with no clear or continuous channel. Former dam site of the 17th Street Pond.
2D1	Yes	Bell Creek	Drainage Channel	R4SBA	3.5	0.5	Channel determined by bed and bank. Minimal evidence of recent flow with non-native grasses in channel. Upstream of Outfall 17.
2D2	Yes	Bell Creek	Drainage Channel	R4SBA	3.5	0.5	Silt fence adjacent to channel. No evidence of recent flow. Willows along bank. Upstream of Outfall 17.
3A	No	Bell Creek	Concrete and Asphalt Lined Drainages	R4SBAr	NA	NA	Concrete-lined stormwater channel from former building location and asphalt-lined roadside drainage receive water from disturbed upland areas only.
3B	Yes	Bell Canyon	Drainage Channel	R4SBA	2	4	Culvert empties into erosional channel with defined bed and banks. There is a break in the channel that has no evidence of bed and bank to connect the flow to Drainage 1.
4A1	Yes	Bell Creek	Drainage Channel	R4SBA	2	1	Non-native grasses growing in channel. Gully erosion occurring. Mulefat, willows, and oaks along banks. Flow is toward Outfall 18.
4B1	Yes	Bell Creek	Drainage Channel	R4SBA	3	0.5	Non-native grasses growing in channel. Parallels 4A channel. Flow is toward Outfall 18
4C1	Yes	Bell Creek	Unlined Ditch or Swale	R4SBAx	2	0.2	Drainage occurs along road that appears to have been excavated and recently hydroseeded with straw waddles across ditch to prevent erosion. Flow is toward Outfall 18.
5A	Yes	Bell Creek	Drainage Channel	R4SBA	2	0.5	Drainage swale dominated by non-native grasses. Section of channel flows on a dirt road.

Drainage Inspection Field Code	*Waters of the U.S. (Yes/No)*	*Receiving Water*	*Description*	*Cowardin Class[2]*	*Width of WUS (feet)*	*Depth of WUS (feet)*	*Notes*
6A1	No	NA	NA	NA	NA	NA	Area is between sandstone outcrops with dense grass; no evidence of flow and downstream berm, which would prevent surface flow from connecting.
6C1	Yes	Arroyo Simi	Drainage Channel	R4SBA	1.5	0.5	Natural drainage in sandstone bedrock; downstream of Outfall 5.
6C2	Yes	Arroyo Simi	Drainage Channel	R4SBA	2	0.5	Natural drainage with sandy bottom; downstream of Outfall 6.
6D1	Yes	Arroyo Simi	Drainage Channel	R4SBA	1.3	0.25	Natural drainage in sandstone bedrock; downstream of Outfall 6.
6E1	Yes	Arroyo Simi	Drainage Channel	R4SBA	1.5	0.25	Natural drainage with sand bottom; downstream of Outfall 6.
6F1	Yes	Arroyo Simi	Drainage Channel	R4SBA	1	0.25	Drainage side channel; downstream of Outfall 6.
6G1	Yes	Arroyo Simi	Drainage Channel	R4SBA	1.5	0.25	Natural drainage with sandy bottom; downstream of Outfall 6.
6H1	Yes	Arroyo Simi	Drainage Channel	R4SBA	2.5	0.25	Natural drainage in sandstone bedrock; downstream of Outfall 7.
6I1	Yes	Arroyo Simi	Drainage Channel	R4SBA	1.3	0.25	Side channel; downstream of Outfall 7.
7	No	NA	NA	NA	NA	NA	No evidence of drainage channel. Recent grading, hydroseeding and erosion control in the area.
8A1	Yes	Arroyo Simi	Drainage channel	R4SBA	1	0.25	Natural drainage with sandy bottom
9	No	NA	NA	NA	NA	NA	No evidence of drainage channel. Recent grading, hydroseeding, and erosion control in the area.
10A1	No	Arroyo Simi	Asphalt Lined Drainage	R4SBAr	NA	NA	Asphalt-lined channel receives water from disturbed upland and roadsides. No vegetation in channel. Channel flows into a box culvert then into treatment facility.
10B1	Yes	Arroyo Simi	Unlined Drainage	R4SBAx	1.5	0.25	Channel near sandstone cliff; flows toward Outfall 4.
10C1	Yes	Arroyo Simi	Drainage Channel	R4SBA	1.5	0.25	Natural drainage channel with sandy bottom; downstream of Outfall 4.
10D1	Yes	Arroyo Simi	Drainage Channel	R4SBA	0.75	0.1	Natural drainage channel with bedrock/ sandy bottom; connects to 10E1.
10E1	Yes	Arroyo Simi	Drainage Channel	R4SBA	1.5	0.25	Natural drainage channel with bedrock/ sand bottom; downstream of Outfall 4.
10F1	Yes	Arroyo Simi	Drainage Channel	R4SBA	2	0.25	Natural drainage channel with sandy bottom.
11	No	Bell Creek	Unlined Swale	R4SBAx	NA	NA	Roadside drainage swale, receives runoff from road and adjacent uplands. No change in vegetation; channel based on topography. Flows into asphalt-lined drainage 2A.
12A1	Yes	Arroyo Simi	Drainage Channel	R4SBA	1.75	0.25	Channel filled with woody debris; no recent evidence of flow. Waters of the United States based on the bed and banks.
12A2	Yes	Arroyo Simi	Drainage Channel	R4SBA	3.5	0.25	Area has been disturbed by previous grading and sediment deposits.
12B1	Yes	Arroyo Simi	Drainage Channel	R4SBA	1	0.5	Heavily disturbed; appears to have been cut by a bulldozer blade.
12C1	Yes	Arroyo Simi	Drainage Channel	R4SBA	2	0.25	Thick oak leaf litter in channel.
12D1	Yes	Arroyo Simi	Drainage Channel	R4SBA	2	0.25	Upstream from stormwater treatment facility in channel; flows toward Outfall 3.

Drainage Inspection Field Code	***Waters of the U.S. (Yes/No)***	***Receiving Water***	***Description***	***Cowardin Class[2]***	***Width of WUS (feet)***	***Depth of WUS (feet)***	***Notes***
12D2	Yes	Arroyo Simi	Drainage Channel	R4SBA	1.5	0.25	Flow is treated and diverted upstream. Thick leaf litter in channel indicates infrequent flows.
13	No	NA	NA	NA	NA	NA	Drainage around building 100 building pad; all drainage goes into a pond and does not connect to channel 15.
14A	Yes	Bell Creek	Drainage Channel	R4SBA	3	0.75	Channel has defined bed and bank and no vegetation in channel bed.
14B	Yes	Bell Creek	Drainage Channel	R4SBA	3	0.75	Debris deposited in channel. Channel has defined bed and bank; no vegetation in channel bed.
15A	No	Bell Creek	Asphalt Lined Drainage	R4SBAr/x	NA	NA	Indications of recent high flows include sediment deposits in channel and on adjacent roadside. Baker tanks are upstream of this point and run-off is likely associated with release from tanks. Shallow roadside drainage, with upland vegetation growing in portions of the channel bed that are unlined or have sufficient sediment to support annual species. Flows into erosion channel.
15B	Yes	Bell Creek	Drainage Channel	R4SBA	4	3	Indications of recent flow include drift/debris deposits and bent vegetation.
15C	No	Bell Creek	Asphalt Lined Drainage	R4SBAr	NA	NA	Drainage collects runoff from adjacent grassland area and directs it around the building pad.
15D	No	Bell Creek	Asphalt Lined Drainage	R4SBAr	NA	NA	Drainage at perimeter of building pad.
17A	Yes	Arroyo Simi	Drainage Swale	R4SBA	3	0.5	Natural swale dominated by non-native grassland under oaks; portions have defined bed and banks, which become more defined downstream (down slope); downstream of Outfall 7.
17B	No	NA	NA	NA	NA	NA	No evidence of drainage previously mapped in this location. Silt fence on slope to prevent erosion where channel had been mapped.
19A	No	NA	NA	NA	NA	NA	No evidence of drainage previously mapped in this location.
19B	Yes	Arroyo Simi	Drainage Channel	R4SBA	1.5	0.5	Bed and banks not well defined, but present in parts of the drainage.
21A	No	Arroyo Simi	Drainage Swale	R4SBAx	NA	NA	Swale in upland non-native grassland, associated with former building pad.
21B	No	Arroyo Simi	NA	NA	NA	NA	Area has been altered significantly. No bed and banks.
21C	No	Arroyo Simi	NA	NA	NA	NA	No flow apparent in previously mapped side channel.
21D	NA	Arroyo Simi	Drainage Swale	R4SBAx	NA	NA	Drainage follows roadside; no defined bed and banks; no change in vegetation; drainage based on topography. Water from upland and disturbed areas only, including former building pads and roads.
23	Yes	Arroyo Simi	Drainage Channel	R4SBA	2	1	Vegetation in channel is sparse; most of the surrounding vegetation is oak woodland. Downstream of Outfall 5 and upstream of Field Point 6C1.
25	No	NA	NA	NA	NA	NA	Channel was previously mapped in this location, but no evidence of a channel in 2015.

Drainage Inspection Field Code	*Waters of the U.S. (Yes/No)*	*Receiving Water*	*Description*	*Cowardin Class*[2]	*Width of WUS (feet)*	*Depth of WUS (feet)*	*Notes*
27	No	Bell Creek	Asphalt Lined Drainage	R4SBAr	NA	NA	Road side drainage starts at building pad and follows road. Drains building pad, road, and other upland areas.
29	Yes	Bell Creek	Drainage Channel	R4SBA	2	1	Starts in grassland and drops approximately 25 feet down cliff.

NA = not applicable; WUS = Waters of the U.S.

Notes:

Cowardin Class (Cowardin et al. 1979) = Riverine (R), Intermittent (4), Streambed (SB), Temporarily Flooded (A); special modifiers- artificial (r), diked (h) or excavated (x).

Attachment I2
WETLAND DETERMINATION DATA FORMS

This page intentionally left blank.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Santa Susana Field Lab. (SSFL) City/County: Ventura Co Sampling Date: 5-6-2014
Applicant/Owner: Dept of Energy (DOE) State: CA Sampling Point: Pit 1
Investigator(s): L. Brown, T. Schmoutter, J. Dagner, T. Mulroy Section, Township, Range: ______
Landform (hillslope, terrace, etc.): terrace Local relief (concave, convex, none): flat Slope (%): 0
Subregion (LRR): LRR C Lat: ______ Long: ______ Datum: ______
Soil Map Unit Name: Saugus Sandy Loam NWI classification: PSS
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ___ (If no, explain in Remarks.)
Are Vegetation N, Soil Y, or Hydrology Y significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No ___
Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓ No ___	Is the Sampled Area within a Wetland? Yes ___ No ✓
Hydric Soil Present?	Yes ___ No ✓	
Wetland Hydrology Present?	Yes ✓ No ___	

Remarks: Difficult to dig. Water mainly comes from runoff via the road. When conditions are suitable area ponds/standing water up in concrete drainage ditch. Area was previously developed & there is evidence of altered soils and fill.

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: ______)			
1.			
2.			
3.			
4.			
= Total Cover			
Sapling/Shrub Stratum (Plot size: 3m²)			
1. Baccharis salicifolia	90	Y	FAC
2.			
3.			
4.			
5.			
= Total Cover			
Herb Stratum (Plot size: ______)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
= Total Cover			
Woody Vine Stratum (Plot size: ______)			
1.			
2.			
= Total Cover	90		

% Bare Ground in Herb Stratum 100 % Cover of Biotic Crust 0

Dominance Test worksheet:
Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)
Total Number of Dominant Species Across All Strata: 1 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 100% (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species ______	x 1 = ______
FACW species ______	x 2 = ______
FAC species ______	x 3 = ______
FACU species ______	x 4 = ______
UPL species ______	x 5 = ______
Column Totals: ______ (A)	______ (B)

Prevalence Index = B/A = ______

Hydrophytic Vegetation Indicators:
✓ Dominance Test is >50%
__ Prevalence Index is ≤3.0[1]
__ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
__ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No ___

Remarks: No understory at pit location (w/i 1m²); nearby is Stipa sp., Bromus madritensis ssp. rubens!

US Army Corps of Engineers Arid West – Version 2.0

Sampling Point: Pit 1

SOIL

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-0.5	10YR 4/2	100					loamy clay	
0.5-4	2.5Y 4/3	100					silty sand	sand is very course
4-12	10YR 3/3	100					sandy loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ___ No ✓

Remarks: Soil appears layered, poss. deposits from sheet flow.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ✓ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ✓ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No ✓ Depth (inches): ______

Water Table Present? Yes ___ No ✓ Depth (inches): ______

Saturation Present? (includes capillary fringe) Yes ___ No ✓ Depth (inches): ______

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Alpha, Alpha dipyridyl test negative, hydrology appears to be eph. sheet flow.

US Army Corps of Engineers

Arid West – Version 2.0

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: SSFL City/County: Ventura Sampling Date: 6-May-14
Applicant/Owner: DOE State: CA Sampling Point: PIT 2 (SRE POND)
Investigator(s): LB, TS, TM, JD Section, Township, Range: ____
Landform (hillslope, terrace, etc.): ____ Local relief (concave, convex, none): Concave Slope (%): <1
Subregion (LRR): LRRC Lat: ____ Long: ____ Datum: ____
Soil Map Unit Name: Sedimentary Rock Land NWI classification: N/A
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No ____ (If no, explain in Remarks.)
Are Vegetation ____, Soil ✓, or Hydrology ✓ significantly disturbed? Yes Are "Normal Circumstances" present? Yes ✓ No ____
Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓ No ____	Is the Sampled Area within a Wetland? Yes ✓ No ____
Hydric Soil Present?	Yes ✓ No ____	
Wetland Hydrology Present?	Yes ✓ No ____	

Remarks: Pond is manmade, contamination present (no pit dug). Western toad observed. Dam & spillway present. Flow to Arroyo Simi.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: Ø)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
= Total Cover			
Sapling/Shrub Stratum (Plot size: Ø)			
1.			
2.			
3.			
4.			
5.			
= Total Cover			
Herb Stratum (Plot size: ____)			
1. Polypogon monspeliensis	95%	Y	FACW
2.			
3.			
4.			
5.			
6.			
7.			
8.			
= Total Cover			
Woody Vine Stratum (Plot size: Ø)			
1.			
2.			
= Total Cover			

% Bare Ground in Herb Stratum ____ % Cover of Biotic Crust ____

Dominance Test worksheet:
Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)
Total Number of Dominant Species Across All Strata: 1 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 100% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	____	x 1 = ____
FACW species	____	x 2 = ____
FAC species	____	x 3 = ____
FACU species	____	x 4 = ____
UPL species	____	x 5 = ____
Column Totals:	____ (A)	____ (B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:
__ Dominance Test is >50%
__ Prevalence Index is ≤3.0[1]
__ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
__ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No ____

Remarks: Formerly full of cattails and bulrush, some old mulefat on outer rim.

US Army Corps of Engineers Arid West – Version 2.0

Sampling Point: Pit 2

SOIL

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

__ Histosol (A1)
__ Histic Epipedon (A2)
__ Black Histic (A3)
__ Hydrogen Sulfide (A4)
__ Stratified Layers (A5) (LRR C) - likely
__ 1 cm Muck (A9) (LRR D)
__ Depleted Below Dark Surface (A11)
__ Thick Dark Surface (A12)
__ Sandy Mucky Mineral (S1)
__ Sandy Gleyed Matrix (S4)
__ Sandy Redox (S5)
__ Stripped Matrix (S6)
__ Loamy Mucky Mineral (F1)
__ Loamy Gleyed Matrix (F2)
__ Depleted Matrix (F3)
__ Redox Dark Surface (F6)
__ Depleted Dark Surface (F7)
__ Redox Depressions (F8)
__ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

__ 1 cm Muck (A9) (LRR C)
__ 2 cm Muck (A10) (LRR B)
__ Reduced Vertic (F18)
__ Red Parent Material (TF2)
✓ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):
Type: _____
Depth (inches): _____

(not confirmed)
Hydric Soil Present? Yes ✓ No ___

Remarks: No pit due to contamination - Man-made, soils wet, pond has been present for numerous years - Soil likely deposited in layers with organic matter & standing water / very spongy texture when walked on.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

__ Surface Water (A1)
__ High Water Table (A2)
✓ Saturation (A3)
__ Water Marks (B1) (Nonriverine)
__ Sediment Deposits (B2) (Nonriverine)
__ Drift Deposits (B3) (Nonriverine)
✓ Surface Soil Cracks (B6)
✓ Inundation Visible on Aerial Imagery (B7)
__ Water-Stained Leaves (B9)
__ Salt Crust (B11)
✓ Biotic Crust (B12)
__ Aquatic Invertebrates (B13)
__ Hydrogen Sulfide Odor (C1)
__ Oxidized Rhizospheres along Living Roots (C3)
__ Presence of Reduced Iron (C4)
__ Recent Iron Reduction in Tilled Soils (C6)
__ Thin Muck Surface (C7)
__ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

__ Water Marks (B1) (Riverine)
__ Sediment Deposits (B2) (Riverine)
__ Drift Deposits (B3) (Riverine)
__ Drainage Patterns (B10)
__ Dry-Season Water Table (C2)
__ Crayfish Burrows (C8)
__ Saturation Visible on Aerial Imagery (C9)
__ Shallow Aquitard (D3)
__ FAC-Neutral Test (D5)

Field Observations:

	Yes	No	Depth (inches)
Surface Water Present?		X	
Water Table Present?	X		N/A
Saturation Present? (includes capillary fringe)	X		0

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Saturated to surface based on walking over area & feeling spongy soils - Inundation visible at some times, dry at present

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: SSFL City/County: Ventura Co Sampling Date: 6-May-14

Applicant/Owner: DOE State: CA Sampling Point: VP-1

Investigator(s): Leidos - LB, TS, JD, TM Section, Township, Range: slightly concave

Landform (hillslope, terrace, etc.): terrace Local relief (concave, convex, none): ______ Slope (%): 0

Subregion (LRR): LRR C Lat: ______ Long: ______ Datum: ______

Soil Map Unit Name: Zamora loam NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ____ (If no, explain in Remarks.)

Are Vegetation ✓, Soil ✓, or Hydrology ✓ significantly disturbed? Yes Are "Normal Circumstances" present? Yes ✓ No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? No (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____ No ✓	Is the Sampled Area within a Wetland? Yes ____ No ✓
Hydric Soil Present?	Yes ✓ No ____	
Wetland Hydrology Present?	Yes ✓ No ____	

Remarks: near bldgs, compacted and cleared

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 0)			
1.			
2.			
3.			
4.			
= Total Cover			
Sapling/Shrub Stratum (Plot size: 0)			
1.			
2.			
3.			
4.			
5.			
= Total Cover			
Herb Stratum (Plot size: 10 m²)			
1. Trichostema lanceolatum	15	Y	FACU
2. Erodium botrys	2	N	FACU
3. Lotus purshianus	1	N	—
4.			
5.			
6.			
7.			
8.			
= Total Cover	17		
Woody Vine Stratum (Plot size: 0)			
1.			
2.			
= Total Cover			

% Bare Ground in Herb Stratum 85 % Cover of Biotic Crust 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	______	x 1 = ______
FACW species	______	x 2 = ______
FAC species	______	x 3 = ______
FACU species	______	x 4 = ______
UPL species	______	x 5 = ______
Column Totals:	______ (A)	______ (B)

Prevalence Index = B/A = ______

Hydrophytic Vegetation Indicators:

- __ Dominance Test is >50% NO
- __ Prevalence Index is ≤3.0[1]
- __ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- __ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ____ No ✓

Remarks: also present Bromus, Asclepias, Heterotheca, Hypochaeris [illegible], Bromus madritensis
Area has scattered [illegible] and Acmispon glaber

US Army Corps of Engineers Arid West – Version 2.0

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: SSFL City/County: Ventura Sampling Date: 7-May-14

Applicant/Owner: DOE State: CA Sampling Point: VP-02

Investigator(s): LB, TS Section, Township, Range: ____

Landform (hillslope, terrace, etc.): terrace Local relief (concave, convex, none): slightly concave Slope (%): 6

Subregion (LRR): LRR-C Lat: ____ Long: ____ Datum: ____

Soil Map Unit Name: Zamora loam NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ✓, or Hydrology ✓ significantly disturbed? yes Are "Normal Circumstances" present? Yes ✓ No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? No (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____ No ✓	Is the Sampled Area within a Wetland? Yes ____ No ✓
Hydric Soil Present?	Yes ✓ No ____	
Wetland Hydrology Present?	Yes ✓ No ____	

Remarks: Area has been graded and compacted. Adjacent to building pad.

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 0)			
1.			
2.			
3.			
4.			
= Total Cover	0		
Sapling/Shrub Stratum (Plot size: 0)			
1.			
2.			
3.			
4.			
5.			
= Total Cover	0		
Herb Stratum (Plot size: ____)			
1. Erodium botrys	30	Y	FACU
2. Melilotus indicus	2	N	FACU
3. Bromus madritensis	4	Y	UPL
4. Hypochaeris (sp?)	1	N	FACU(?)
5. Lotus purshianus	2	N	—
6. Tricostemma lanceolatum	1	N	FACU
7.			
8.			
= Total Cover	40		
Woody Vine Stratum (Plot size: 0)			
1.			
2.			
= Total Cover	0		

% Bare Ground in Herb Stratum 60% % Cover of Biotic Crust 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	____	x 1 = ____
FACW species	____	x 2 = ____
FAC species	____	x 3 = ____
FACU species	____	x 4 = ____
UPL species	____	x 5 = ____
Column Totals:	____ (A)	____ (B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:

- ___ Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ____ No ✓

Remarks: Stipa in pool & on edge, Acmispon glaber (small) present

US Army Corps of Engineers Arid West – Version 2.0

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: SSFL City/County: Ventura Sampling Date: 7-May-14

Applicant/Owner: DOE State: CA Sampling Point: VP-02

Investigator(s): LB, TS Section, Township, Range: ______

Landform (hillslope, terrace, etc.): terrace Local relief (concave, convex, none): slight concave Slope (%): 6

Subregion (LRR): LRR C Lat: ______ Long: ______ Datum: ______

Soil Map Unit Name: Zamora loam NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ______ (If no, explain in Remarks.)

Are Vegetation ______, Soil ✓, or Hydrology ✓ significantly disturbed? yes Are "Normal Circumstances" present? Yes ✓ No ______

Are Vegetation ______, Soil ______, or Hydrology ______ naturally problematic? No (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ______ No ✓		Is the Sampled Area within a Wetland? Yes ______ No ✓
Hydric Soil Present? Yes ✓ No ______		
Wetland Hydrology Present? Yes ✓ No ______		

Remarks: Area has been graded and compacted. Adjacent to building pad.

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 0)			
1.			
2.			
3.			
4.			
	0 = Total Cover		
Sapling/Shrub Stratum (Plot size: 0)			
1.			
2.			
3.			
4.			
5.			
	0 = Total Cover		
Herb Stratum (Plot size: ______)			
1. Erodium botrys	30	Y	FACU
2. Melilotus indicus	2	N	FACU
3. Bromus madritensis	4	Y	UPL
4. Hypochaeris (sp?)	1	N	FACU(?)
5. Lotus purshianus	2	N	—
6. Tricostemma lanceolatum	1	N	FACU
7.			
8.			
	40 = Total Cover		
Woody Vine Stratum (Plot size: 0)			
1.			
2.			
	0 = Total Cover		

% Bare Ground in Herb Stratum 60% % Cover of Biotic Crust 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0% (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species ______	x 1 = ______
FACW species ______	x 2 = ______
FAC species ______	x 3 = ______
FACU species ______	x 4 = ______
UPL species ______	x 5 = ______
Column Totals: ______ (A)	______ (B)

Prevalence Index = B/A = ______

Hydrophytic Vegetation Indicators:

- __ Dominance Test is >50%
- __ Prevalence Index is ≤3.0[1]
- __ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- __ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ______ No ✓

Remarks: Stipa in pool & on edge, Acmispon glaber (small) present

US Army Corps of Engineers Arid West – Version 2.0

Sampling Point: UP-2

SOIL

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ✓ Vernal Pools (F9) (not confirmed)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ✓ No ___

Remarks: soil surface is very rocky, area has been altered by grading and compaction

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ✓ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No ✓ Depth (inches): ______

Water Table Present? Yes ___ No ✓ Depth (inches): ______

Saturation Present? (includes capillary fringe) Yes ___ No ✓ Depth (inches): ______

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: small areas with the surface soil cracks, Not wet in 2014, wet in previous years (wet in 2012, not in 2013).

US Army Corps of Engineers

Arid West – Version 2.0

Attachment I3
PHOTOGRAPHS

This page intentionally left blank.

Photo 1 (May 7, 2014) above was taken in the southern part of Area IV and depicts an ephemeral drainage that has a defined bed and banks (5A on Section 4, Figure I–5). Photo 2 (May 6, 2014) below shows a swale-like drainage feature with a shallow flow channel present at the base of the swale, indicating water does flow through the swale (1B on Figure I–5). Both these features were identified as waters of the U.S.

Photo 3 (May 7, 2014) above depicts a roadside drainage (15A on Figure I–5) created to drain runoff from developed upland areas, such as building pads; this drainage was identified in the survey as "non-waters of the U.S." Photo 4 (May 7, 2014) below shows downstream, where this ephemeral drainage had left the roadside and clearly exhibited developed bed and banks; this drainage was identified as "waters of the U.S." (15B in Figure I–5).

Photo 5 (May 7, 2014) above shows part of the Northern Buffer Zone (NBZ) in the foreground. Dominant vegetation in this part of the NBZ is chaparral, with oak trees growing along the ephemeral drainage. Simi Valley is visible in the background. Photo 6 (May 8, 2014) below depicts drainage #12, which is located in the NBZ, with rocky slopes and dense vegetation along the banks (see Figure I–5).

Photo 7 (May 8, 2014) above is an example of a drainage along the base of a sandstone outcrop. Photo 8 (May 7, 2014) below is an example of field notes (with drainage cross sections) taken during the surveys.

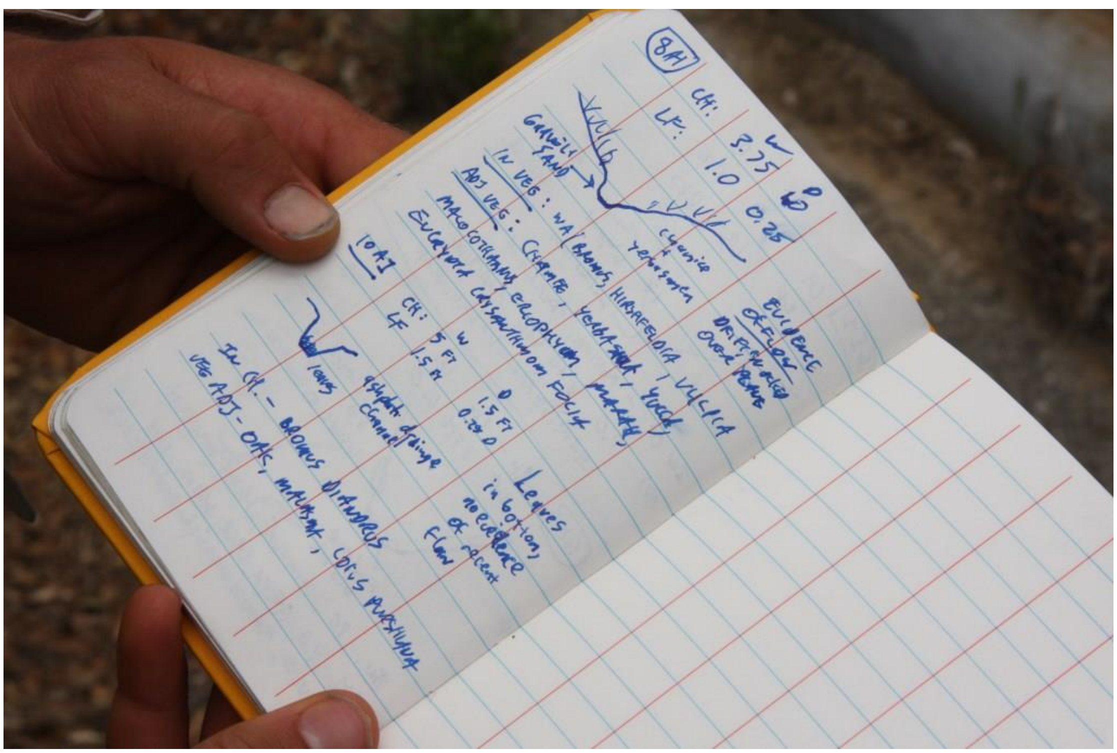


Photo 9 (May 6, 2014) above is the location of soil Pit 1, in an area of mulefat scrub that was investigated for wetland determination. Soil Pit 1 is also shown in Photo 10 (May 6, 2014) below; the soils did not have any positive indicators for hydric soils, and the site did not meet the three criteria for determination of wetlands.

Photo 11 above was taken during March 2014 and shows the Sodium Reactor Experiment (SRE) Pond with surface water present. Cattails and bulrush were present in this pond in previous years. Photo 12 (May 2014) below shows the SRE Pond with no surface water. The bright green grasses include rabbitsfoot grass, an annual, non-native facultative wetland plant species.

Photo 13 above (taken in March 2014, looking southward) is one of the vernal pools in Area IV with surface water present taken in March 2014. Photo 14 below is the same vernal pool in May 2014 when dry (looking northward).

Photos 15 and 16 (March 7, 2014) depict two of the rock vernal pools in the NBZ.

APPENDIX J
COST-BENEFIT ANALYSIS REPORT

Cost-Benefit Analysis Report
Area IV Santa Susana Field Laboratory
Ventura County, California

Prepared for:

Department of Energy
Energy Technology and Engineering Center
4100 Guardian Street
Simi Valley, California 93063

Prepared by:

CDM Federal Programs Corporation (CDM Smith)
555 17th Street, Suite 1100
Denver, Colorado 80202

Prepared under:

US Department of Energy
EM Consolidated Business Center
Contract DE-EM0001128
CDM Smith Task Order DE-DT0003515

August 29, 2016
Version 3

Cost-Benefit Analysis Report
Area IV Santa Susana Field Laboratory
Ventura County, California

Contract DE-EM0001128

CDM Smith Task Order DE-DT0003515

Prepared by: ____________________ August 29, 2016
Ian Lo, PE Date
CDM Smith Environmental Engineer

Approved by: ____________________ August 29, 2016
Pawan Sharma, PE Date
CDM Smith Engineer

Approved by: ____________________ August 29, 2016
John Wondolleck Date
CDM Smith Project Manager

Other Main Contributors:

Todd Bragdon, Melissa Harclerode, Gary Hazen, Teddy Marcum, Ahbay Sonawane, Gina Veronese, and Lynn Woodbury

Table of Contents

List of Figures

List of Tables

Attachments

This page intentionally left blank.

Acronyms

17th Street	17th Street Pond
AFB	McClellan Air Force Base
AOC	Administrative Order on Consent
B4064/NCY	Building 4064/New Conservation Yard
BG MRL	Background Method Reporting Limit
BMP	Best Management Practice
BOE	Basis of Estimate
BTV	Background Threshold Value
CBA	Cost-Benefit Analysis
CDM Smith	CDM Smith Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulation
COPC	Contaminant of Potential Concern
CV	Coefficient of Variation
DOE	Department of Energy
DTSC	Department of Toxic Substances Control
ECES	Environmental Cost Element Structure
EC^2	Environmental Cost Engineering Committee
EIS	Environmental Impact Statement
EPC	Exposure Point Concentration
FDA	U.S. Food and Drug Administration
GHG	Greenhouse Gas
GIS	Geographic Information System
GOF	Goodness of Fit
GSR	Green and Sustainable Remediation
HI	Hazard Index
HPAL	Hunter's Point Ambient Level
HPNS	Hunter's Point Naval Shipyard
HQ	Hazard Quotient
HSC	California Health and Safety Code
LCC	Life-Cycle Cost
LCCA	Life-Cycle Cost Analysis
LLW	Low Level Radioactive Waste
LUT	Look-Up Table
MCACES	Micro Computer Aided Cost Engineering System
M-L MRL	Multi Laboratory Method Reporting Limit
MLLW	Mixed Low Level Radioactive Waste
MM	Millions
MRL	Method Reporting Limit
NAVFAC	Naval Facilities Engineering Command
NBZ	Northern Buffer Zone
NCP	National Oil and Hazardous Substances Pollution Contingency Plan

NEPA	National Environmental Policy Act
NRDL	Naval Radiological Defense Laboratory
OMB	Office of Management and Budget
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated Biphenyl
PQL	Practical Quantification Limit
PRG	Preliminary Remediation Goal
PW	Present Worth
RAL	Remediation Action Level
RBC	Risk Based Concentration
RBSL	Risk Based Screening Level
RCRA	Resource Conservation and Recovery Act
RME	Reasonable Maximum Exposure
RMHF	Radioactive Material Handling Facility
ROD	Record of Decision
SLTM	Surveillance and Long-Term Maintenance
SRAM	Standardized Risk Assessment Methodology
SRE	Sodium Reactor Experiment
SSFL	Santa Susana Field Laboratory
SVOC	Semi-volatile Organic Compound
TPH	Total Petroleum Hydrocarbon
UCL	Upper Confidence Limit
UM	Analytical Measurement Uncertainty
UPB	Unit Price Book
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
WBS	Work Breakdown Structure

Executive Summary

ES.1 Purpose and Scope

This Cost-Benefit Analysis (CBA) compares the costs and benefits of the remedial action alternatives presented in the *Draft Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory* (EIS) for addressing soil contamination in Area IV and the Northern Buffer Zone (NBZ) of the Santa Susana Field Laboratory (SSFL). The U.S. Department of Energy (DOE) will conduct the remedial action.

This CBA was developed in accordance to 40 Code of Regulation (CFR) § 1502.23 to support the EIS in evaluating the remedial action alternatives for soil contamination at SSFL Area IV/NBZ. Chapter 2 of the SSFL Area IV/NBZ EIS includes a detailed description of the remedial action alternatives.

The scope of this CBA includes identifying and estimating benefits and costs of the remedial action alternatives. This CBA quantifies the benefits of reduced risk to human receptor by assessing cancer risks and non-cancer hazards resulting from implementation of each alternative. This CBA presents the estimated capital construction costs, surveillance and long-term maintenance costs, and total life-cycle costs of each alternatives. These costs are compared to the risk reduction benefits. This CBA also evaluates uncertainty in cleanup decisions to consider errors that may leave human and ecological receptors exposed to unacceptable levels of contamination or result in unnecessary expenditure of resources. This CBA evaluates the environmental, economic, and social impacts (i.e., “triple bottom line”) associated with each soil remedial alternative. Lastly, best management practices (BMPs) associated with GSR were selected and evaluated for DOE’s consideration during its preparation of the soil remediation design for Area IV/NBZ.

ES.2 Risk Management

Chapter 6.8 of Division 20 of the California Health and Safety Code (HSC), including Section 25359.20, requires that any response action at SSFL be based upon the provisions of Section 25356.1.5 of the HSC. Section 2536.1.5 of the HSC requires that any health or ecological risk assessment prepared in conjunction with a response action be based upon Subpart E of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR 300.400 et seq.) and the policies, guidelines, and practices of USEPA. Accordingly, this CBA describes the use of risk assessment at SSFL consistent with NCP and USEPA requirements to support risk management evaluations at SSFL.

USEPA uses the general risk range of 1×10^{-4} (1 cancer in an exposed population of ten thousand) to 1×10^{-6} (1 cancer in an exposed population of one million) as a “target range” to evaluate the need for remediation or mitigation at a site. Decisions on whether to remediate or mitigate risks that fall in this range are made on a site-specific basis. For sites where the cumulative carcinogenic risk is within the target risk range, remedial actions are generally not warranted unless a chemical specific standard is violated, there are significant non-carcinogenic risks, or an adverse environmental impact has been identified that warrants action (USEPA 1991a). In general, USEPA considers excess cancer risks that are below about 1 x 10^{-6} to be so small as to be negligible, and risks above 1 x 10^{-4} to be sufficiently large that remediation is desirable. However, no "bright line" has been established at the upper end of the risk range and risk management decisions are made on a site-by-site basis. Site-specific considerations, including types of exposure, uncertainties in estimating exposures, size of the affected population, and limitations of remedial activities, may determine the cancer risk level acceptable for a site.

The cleanup standards and risk management approach under each of the remedial action alternatives being considered in the EIS are described in the following paragraphs. The No Action Alternative, under which DOE would not treat any soil to reduce constituent concentrations and would leave the soil in place, forms the basis for comparison of risk reduction between the remedial action alternatives. The No Action Alternative would involve only the continued implementation of currently existing monitoring programs. The remedial action alternatives are presented below.

Cleanup to AOC LUT Values Alternative

Under this alternative, risk assessment is not employed. Cleanup decisions are based on a point-by-point and analyte-by-analyte comparisons with respective to AOC Look-Up Table (LUT) values established from background soil data for chemicals (established by DTSC) and radionuclides (established by USEPA). A statistical approach calculating the upper simultaneous limit at 95% confidence was used in derivation of the background values (USL95) (DTSC 2013).

Cleanup to Revised LUT Values Alternative

Under this alternative, soil risk-based screening level (RBSL) values are used as a substitute for the background AOC LUT values to determine chemical constituent cleanup standard; the cleanup standard for radioactive constituents remain the same as under the Cleanup to AOC LUT Values Alternative. The RBSLs were calculated for a suburban residential exposure scenario established for the SSFL (see *Final Standardized Risk Assessment Methodology [SRAM],* MWH 2014). This scenario assumes that suburban residents are directly exposed to soil 24 hours per day, 350 days per year (i.e., this value assumes that 15 vacation days per year are spent away from home), for 30 years. These assumptions are standard default USEPA exposure factors for residents (USEPA 1991b). The revised LUT values for chemical constituents are concentrations that correspond to a 1 x 10^{-6} risk of developing cancer and/or a non-cancer hazard index (HI) of 1.

Conservation of Natural Resources Alternative

Under the Conservation of Natural Resources Alternative, a risk assessment based on NCP and USEPA guidance is performed, as described in the SRAM (MWH 2014). Cancer risks and non-cancer hazards are calculated for suburban residents exposed to surface soil within defined exposure areas; the same exposure duration assumptions were used for RBSLs. The resulting risks are compared with a cancer risk between 1 x 10^{-6} and 1 x 10^{-4} and non-cancer hazard [HI] of 1) to determine if risk reduction is warranted. If risks are greater than a 1 x 10^{-4} risk, or HI of 1, soil associated with soil samples containing risk drivers are removed in an iterative process until the resulting risk and hazards fall within the risk range.

Other Risk Management Approaches for California

DOE compared the risk management approaches of the remedial action alternatives being considered in the EIS for Area IV/NBZ to two other cleanup efforts in California, Hunters Point Naval Shipyard and McClellan Air Force Base. These two sites were previously identified by DTSC as having similar risk management approaches to the Cleanup to AOC LUT Values Alternative. However, the risk management approach at these sites established cleanup goals that involved incorporating risk-based cleanup elements (e.g. cleanup goals were risk-based), establishing a set of contaminants of potential concern (COPCs) to be targeted for cleanup activities, and/or using a tiered approach to identify areas for soil removal. From a risk management perspective, these sites utilize approaches that are more similar to the Cleanup to Revised LUT Values Alternative or the Conservation of Natural Resources Alternative than to the Cleanup to AOC LUT Values Alternative.

ES.3 Cost/Risk Analysis

ES.3.1 Cost Estimate Approach

The cost presented in the cost/risk analysis are the present worth of the life cycle cost of the alternatives. The cost estimate for each alternative includes estimated costs for general condition requirements; mobilization/demobilization of construction equipment; implementation of best management practices; excavation, hauling, and disposal of contaminated soils; site restoration; and post-construction monitoring. See the Basis of Estimate (CDM Smith 2016a) for the development and assumptions made for the cost estimate of each alternative.

ES.3.2 Risk Analysis Approach

The primary benefit of the remedial action would be the reduction in risk to human receptor. As such, the CBA quantifies risk levels under a No Action Alternative and risk reduction under the three remedial action alternatives. For each remedial action alternative, the risk analysis evaluates risks to human receptor associated with exposure to COPCs in surface soil from a subset of Area IV comprising of four exposure areas. These exposure areas are: the Radioactive Material Handling Facility (RMHF), the Sodium Reactor Experiment (SRE) area, Building 4064/New Conservation Yard (B4064/NCY) area, and the 17th Street Pond area (17th Street). These areas were selected as they have been identified by USEPA as having radionuclide contamination, had been subject to prior cleanup actions, and provided a range of chemical constituents characteristic of Area IV operations. The range of risk in these four exposure areas is expected to represent the upper boundary across Area IV/NBZ for cancer risk and for non-cancer hazard.

The steps conducted for this risk analysis include: 1) identification of representative exposure areas, 2) selection of COPCs, 3) estimation of exposure point concentrations, 4) estimation of cancer risks and non-cancer hazards, and 5) determination of cleanup volumes.

The cost/risk analysis then compares the reduction in cancer risk and non-cancer hazard for the four exposure areas to remedial action costs for the entire Area IV/NBZ under each remedial action alternative. These comparisons indicate the cost versus benefit of each remedial action alternatives in terms of risk reduction.

ES.3.3 Cost/Risk Analysis Results

Cancer Risk and Remedial Action Cost

Cancer risk for all remedial action alternatives would fall within the USEPA target cancer risk range of 1×10^{-4} to 1×10^{-6}. The estimated present-worth of the life cycle costs for the remedial action alternatives are $468 million dollars (MM) for the Cleanup to AOC LUT Values Alternative; $168 MM for the Cleanup to Revised LUT Values Alternative, and $124 MM for the Conservation of Natural Resources Alternative (See **Figure ES-1** and **Table ES-1**) (CDM Smith 2016a). The incremental increase in cost to reduce cancer risk from between 1×10^{-4} (1 in 10,000 additional cancers) and 1×10^{-5} (1 in 100,000 additional cancers) (Conservation of Natural Resources Alternative) to between 1×10^{-5} and 1×10^{-6} (1 in 1,000,000 additional cancers) (Cleanup to Revised LUT Values Alternative) is approximately $44MM. The remaining cancer risks in the Cleanup to Revised LUT Values Alternative (3.7×10^{-6} to 9.8×10^{-6}) and in the Cleanup to AOC LUT Values Alternative (3.2×10^{-6} to 9.6×10^{-6}) are similar (difference of less than 0.5×10^{-6}), but the cost of the Cleanup to AOC LUT Values Alternative is $300MM greater, an increase of 178% over the Cleanup to Revised LUT Values Alternative cost. The remaining cancer risk under the Cleanup to AOC LUT Values Alternative is above the NCP point of departure of 1×10^{-6}.

Under the Conservation of Natural Resources Alternative, approximately 90% or more of the cancer risk reduction compared to the Cleanup to AOC LUT Values Alternative (risk reduction under the Cleanup to AOC LUT Values Alternative is 100% by definition) is achieved for three of the four exposure areas. At the fourth exposure area, the RMHF, the cancer risk percent reduction under the Conservation of Natural Resources Alternative is 78.7%, despite the current cancer risk (e.g. cancer risk under No Action Alternative) already being within the USEPA target cancer risk range of 1×10^{-4} to 1×10^{-6}. The cost for the above range of cancer risk reduction benefit (e.g., cost of Conservation of Natural Resources Alternative for the entire Area IV/NBZ) is estimated to be $124MM.

Under the Cleanup to Revised LUT Values Alternative, approximately 99.4% to 99.9% of the cancer risk reduction relative to the Cleanup to AOC LUT Values Alternative (100% reduction by definition) is achieved. Relative to the Conservation of Natural Resources Alternative, the increase in percent risk reduction ranges from 1.8% to 21%. The cost for the Cleanup to Revised LUT Values Alternative is $168MM, which is an additional $44MM over the cost of the Conservation of Natural Resources Alternative.

Under the Cleanup to AOC LUT Values Alternative (100% risk reduction by definition), the percent risk reduction is almost identical to the Cleanup to Revised LUT Values Alternative (a percent risk reduction difference of 0.6% or less). The cost for the Cleanup to AOC LUT Values Alternative is $468MM, which is an additional $300MM over the cost of the Cleanup to Revised LUT Values Alternative.

Non-Cancer Hazard and Remedial Action Cost

All remedial action alternatives would meet the non-cancer hazard threshold with an HI of 1 or below; the No Action Alternative would not meet the threshold. As presented previously, the estimated present-worth of the life cycle costs for the remedial action alternatives range from $124MM to $468MM (See **Figure ES-2** and **Table ES-1**) (CDM Smith 2016a). Since cleanup to HI of 1 is commonly considered acceptable, and is a commonly used cleanup metric for non-cancer hazard, any further reduction of HI below 1 is only added benefit, but not a cleanup driver. As such, cleanup for non-cancer hazard under the Conservation of Natural Resources Alternative would be considered sufficient, and that any additional cleanup effort, if required, would be driven by cancer risk.

The Conservation of Natural Resources Alternative would achieve HI reduction ranging from 62.5% to 97.6% compared to the Cleanup to AOC LUT Values Alternative in three of the four exposure areas. At the fourth exposure area, the B4064/NCY area, the HI percent reduction under the Conservation of Natural Resources Alternative is 0%. This is because the current non-cancer hazard at the B4064/NCY area is already considered acceptable (HI of 0.8, which is less than the acceptable HI of 1), and therefore require no further cleanup with respect to non-cancer hazard under the Conservation of Natural Resources Alternative. The cost for the Conservation of Natural Resources Alternative for the entire Area IV/NBZ is estimated to be $124MM.

Under the Cleanup to Revised LUT Values Alternative, HI reductions of 92.6% to 99.7% in the four exposure areas are achieved. Relative to the Conservation of Natural Resources Alternative, the increase in percent HI reduction for the Cleanup to Revised LUT Values Alternative ranges from 2% (RMHF) to 97.4% (B4064/NCY area). The cost for the Cleanup to Revised LUT Values Alternative is $168MM, which is an additional $44MM over the cost of the Conservation of Natural Resources Alternative.

Under the Cleanup to AOC LUT Values Alternative, the percent HI reduction is only 0.3 to 7.4% greater than the Cleanup to Revised LUT Values Alternative. The cost for the Cleanup to AOC LUT Values Alternative is $468MM, an additional $300MM over the Cleanup to Revised LUT Values Alternative.

ES.4 Uncertainty in Cleanup Decisions

ES.4.1 Rationale for Evaluating Uncertainty in Cleanup Decisions

In order to make cleanup decisions that involve remediation of only contaminated soils that exceed cleanup standards (e.g., no unnecessary remediation of clean soil), the remediation manager would require having high confidence in the conclusion that contaminants are present at concentrations that exceed the cleanup standards. In making cleanup decisions, two types of decision errors are possible:

- A *false negative decision error* would occur if a remediation manager decides exposures are not of health concern, when in fact they are of concern.
- A *false positive decision error* would occur if a remediation manager decides exposures are above a level of concern, when in fact they are not.

Remediation managers are most concerned about guarding against the occurrence of false negative decision errors, since an error of this type may leave human and ecological receptors exposed to unacceptable levels of contamination. However, remediation managers are also concerned with the probability of making false positive decision errors. Although this type of decision error does not result in unacceptable exposures, it may result in unnecessary expenditure of resources (i.e., remediation of soils that are not actually contaminated). DTSC stated in the Chemical Look-Up Table Technical Memorandum (DTSC 2013) that the goal for SSFL Area IV/NBZ is to limit the false positive decision error rate to 5% or less.

In order to determine the false positive error rates for the remedial action alternatives being considered in the EIS (except for the No Action Alternative), several statistical simulations using Monte Carlo methods were performed to assess the potential false positive decision error rates for each remedial action alternative.

ES.4.2 Results of Uncertainty Analysis

The statistical simulations demonstrated the false positive error rate can be well above 5% for the Cleanup to AOC LUT Values Alternative, even when the underlying dataset is equivalent to the DTSC background soil levels.

For the Cleanup to Revised LUT Values Alternative, the false positive error rate tends to be much lower than the Cleanup to AOC LUT Values Alternative, and will tend to limit the false positive decision error rate. However, the false positive error rate for this alternative will depend upon the proximity of the mean concentration of soil in Area IV/NBZ to the RBSL and the underlying concentration variability. As the concentration approaches the RBSL and as the variability increases, the likelihood of a false positive decision error increases.

Both the Cleanup to AOC LUT Values Alternative and the Cleanup to Revised LUT Values Alternative employ a point-by-point evaluation in determining the extents of soil remediation. Under the Conservation of Natural Resources Alternative, soil remediation determinations are made in terms of the exposure area, such that the mean concentration that remains in the exposure area after cleanup will be within the specified limit of acceptability. To minimize chances of underestimating the true amount of exposure and risk, risk calculations are based on the 95% upper confidence limit[1] (95UCL) of the mean, which limits the probability of a false negative decision error to no more than 5%. The likelihood of a false positive decision error will depend on how close the exposure area mean is to the limit of acceptability and the underlying variability in the exposure area dataset. The false positive decision error can be decreased through the collection of additional samples. This is because, in general, as the number of available sample data points increases, the closer its 95UCL will be to the true mean concentration of the exposure area; and as the 95UCL approaches the true mean concentration, the false positive error rate in cleanup decision will decrease. However, if the underlying variability of the exposure area dataset is high, or if the true mean concentration is close to the limit of acceptability, the beneficial impact of more data towards false positive error rate may be minimal.

ES.5 Green and Sustainable Remediation

ES.5.1 Green and Sustainable Remediation Evaluation Approach

Green and sustainable remediation (GSR) is the "*site-specific employment of products, processes, technologies, and procedures that mitigate contaminant risk to receptors while making decisions*

[1] The 95% upper confidence limit is a number one can be 95% confident that the true mean (average) concentration of the population is below that value. A slightly simpler definition is that it is a level that risk manager can be confident is health protective when it is used to calculate risks and hazards.

that are cognizant of balancing community goals, economic impacts, and environmental effects" (ITRC 2011). A GSR assessment was conducted to evaluate the environmental, economic, and social impacts (i.e., "triple bottom line") associated with each remedial action alternative considered. The GSR assessment in this CBA is comprised of an evaluation of the environmental footprint, a social-economic impact assessment, and a community impact assessment for each remedial action alternative.

ES.5.2 Green and Sustainable Remediation Evaluation Results

Results of Environmental Footprint Analysis

The environmental footprint of each soil remedial alternative was assessed using Naval Facilities Engineering Command (NAVFAC) SiteWise™ tool. The results of the environmental footprint analysis of the remedial action alternatives considered in the EIS indicate that the Cleanup to AOC LUT Values Alternative emits the most greenhouse gas (GHG, which consist of carbon dioxide [CO_2], methane [CH_4], and nitrous oxide [N_2O]) and criteria pollutants (nitrogen oxide [NO_x], sulfur oxide [SO_x], and particulate matter [PM_{10}, defined as matter particles with a diameter of 10 micrometers or less]) emissions and consumes the largest amount of energy, water resources, and landfill space. In comparison, the Conservation of Natural Resources Alternative emits the lowest emissions and utilizes the lowest amount of energy, water resources, and landfill space. The overall environmental footprint is therefore the largest with the Cleanup to AOC LUT Values Alternative and the smallest with the Conservation of Natural Resources Alternative.

Results of Social-Economic Analysis

The social-economic impacts were evaluated using an enhanced cost analysis evaluating the social cost of various environmental metrics among the proposed remedial alternatives. The Conservation of Natural Resources Alternative contributes the least to long-term global impacts and their associated social costs (an estimated $9MM), while the Cleanup to AOC LUT Values Alternative contributes the most (an estimated $36MM). A comparison of the social cost among the proposed alternatives results in an approximately 75% reduction in monetized global impacts by implementing the Conservation of Natural Resources Alternative in lieu of the Cleanup to AOC LUT Values Alternative, and approximately 63% reduction in monetized global impacts by implementing Cleanup to Revised LUT Values Alternative in lieu of the Cleanup to AOC LUT Values Alternative.

Results from Other Qualitative Evaluations

Other qualitative GSR evaluations include an assessment on the potential short-term and long-term detrimental impacts of the implementation of the remedial action alternatives to the surrounding community, and an evaluation on resources lost based on water, clean top soil, and landfill space consumption.

Potential short-term detrimental impacts the surrounding community may endure from dig and haul activities include traffic congestion during hauling of excavated material and backfill to/from the site, generation of noise and dust during dig and hauling activities, and incidental impacts to local businesses due to increased truck traffic. Based on total hauling truck count and project duration for each alternative, the Cleanup to AOC LUT Values Alternative would have the greatest short-term detrimental impact on the neighboring community due to its highest amount of truck hauling and longest duration, while the Conservation of Natural Resources Alternative would have the least impact due to least amount of truck hauling and shortest duration.

The Boeing Company, the landowner of Area IV, had publicly stated that future land use will be open space (Boeing 2016). In the long-term, remediation of contaminated soil, especially surface soils, would be consistent with that intent. Facilitating future use, via remedial activities, can indirectly benefit the community's quality of life, including beneficial impacts related to increased property value, aesthetic value, and potential access to more greenspace. The Cleanup to AOC LUT Values Alternative, given its longest duration (10 years), would provide this potential benefit within the longest timeframe. The Cleanup to Revised LUT Values Alternative and the Conservation of Natural Resources Alternative would both achieve this potential benefit within the shortest timeframe of 2 years.

In terms of resources lost under each remedial action alternative, the Cleanup to AOC LUT Values Alternative would use the highest amount of water, clean top soil, and landfill space; and would therefore represent a significantly higher amount of resources lost compared to the other remedial action alternatives.

ES.5.3 GSR Best Management Practices

DOE decided to elevate use of GSR to incorporate GSR elements in all of the remedial action alternatives being considered in the EIS (except for the No Action Alternative by definition). This approach provides for independent analysis and selection of GSR elements suitable for the remedial action prior to development and evaluation of the remedial action alternatives through the NCP process.

The fundamental core of incorporating GSR elements into a remedy is the selection and employment of BMPs for green cleanup (GSR BMPs). The GSR BMPs were selected specifically to achieve cleanup while staying green and sustainable. GSR BMPs were selected and screened for applicability, and only non-regulation/requirement driven and applicable BMPs were categorized as GSR BMPs. Examples of the selected GSR BMPs include resource conservation measures, environment protection measures, waste recycling/reduction measures, and work optimization measures. The GSR BMPs were selected and evaluated for DOE's consideration during its preparation of the soil remediation design for Area IV/NBZ.

ES.6 Summary of Cost Benefit Analysis

The results from each of the components of the cost benefit analysis are summarized in **Table ES-1**.

Table ES-1 - Summary of Cost Benefit Analysis
SSFL Area IV and NBZ

Cost Benefit Analysis Component			Remedial Action Alternative[1]				See Section[2]
			No Action Alternative	Conservation of Natural Resources Alternative	Cleanup to Revised LUT Values Alternative	Cleanup to AOC LUT Values Alternative	
Risk Management Approach	Risk Management Approach		No risk management approach is utilized.	Cancer risks and non-cancer hazards are calculated for suburban residents exposed to surface soil within defined exposure areas. The resulting risks are compared with the cleanup standards (cancer risk between 1×10^{-6} and 1×10^{-4}, and non cancer hazard [HI] of 1) to determine if risk reduction is warranted. If risks are above acceptable levels, soil associated with soil samples containing risk drivers are removed in an iterative process until the resulting risk and hazards fall within acceptable levels.	The AOC LUT values for chemicals are replaced with risk-based screening levels (RBSLs) calculated for a suburban residential exposure scenario established for the SSFL (MWH 2014). The LUT values for radioactive constituents remain the same as under the Cleanup to AOC LUT Values Alternative. The suburban residential exposure scenario assumes that suburban residents are directly exposed to soil 24 hours per day, 350 days per year, for 30 years. These revised LUT values for chemical constituents are concentrations that correspond to a 1×10^{-6} risk of developing cancer and/or a non-cancer hazard index (HI) of 1.	Risk assessment is not employed, but instead involves point-by-point and analyte-by-analyte comparisons for determining remediation areas based on AOC Look-Up Table (LUT) Values established from background soil data and a statistical approach calculating the upper simultaneous limit at 95% confidence (USL95).	2
Cost	Present Worth of Life Cycle Cost for Remedial Action at Area IV/NBZ (million dollars)		$3MM	$124MM	$168MM	$468MM	3
Human Receptor Risk	Remaining Cancer Risk in the four exposure areas evaluated	Minimum	6.3E-05	1.1E-05	3.7E-06	3.2E-06	4
		Maximum	3.5E-04	4.0E-05	9.8E-06	9.6E-06	
		Average	2.1E-04	2.2E-05	6.0E-06	5.6E-06	
	Remaining Non-Cancer Hazard Index (HI) in the four exposure areas evaluated[3]	Minimum	0.8	0.6	0.04	0.02	4
		Maximum	30	1	0.5	0.4	
		Average	9	0.8	0.4	0.3	
Uncertainty	Potential for Cleanup Decision Error		Not Applicable (no cleanup)	False positive decision error rate depends upon proximity to decision threshold and underlying constituent concentration variability. When site concentrations are similar to background, the relative false positive decision error rate is as follows:			5
				Lowest	Moderate	Highest; > 5%	
Green and Sustainability	Environmental Footprint (largest, moderate, smallest)		Not Applicable (no cleanup)	Smallest	Moderate	Largest	6
	Estimated Social Cost (million dollars)		Not Applicable (no cleanup)	$9MM	$13MM	$36MM	6
	Community Impact (highest, moderate, lowest)		Not Applicable (no cleanup)	Lowest	Moderate	Highest	6
	Resources Lost (greatest, moderate, least)		Not Applicable (no cleanup)	Least	Moderate	Greatest	6

Note:

1. The remedial action alternative are ordered from left to right based on remaining public health risks (highest to lowest).
2. Refer to the indicated section of the CBA for greater detail of each CBA component.
3. For the purposes of presentation in the CBA, the HI's as presented in Table 4-1 of the Risk Estimate Development (CDM Smith 2016b) have been rounded to the nearest one significant figure.

AOC - Administrative Order on Consent for remedial action
CBA - cost benefit analysis
HI - hazard index
LUT - Look-up Table
MM - million dollars
NBZ - Northern Buffer Zone
RBSLs - risk-based screening levels
SSFL - Santa Susana Field Laboratory
USL - upper simultaneous limit

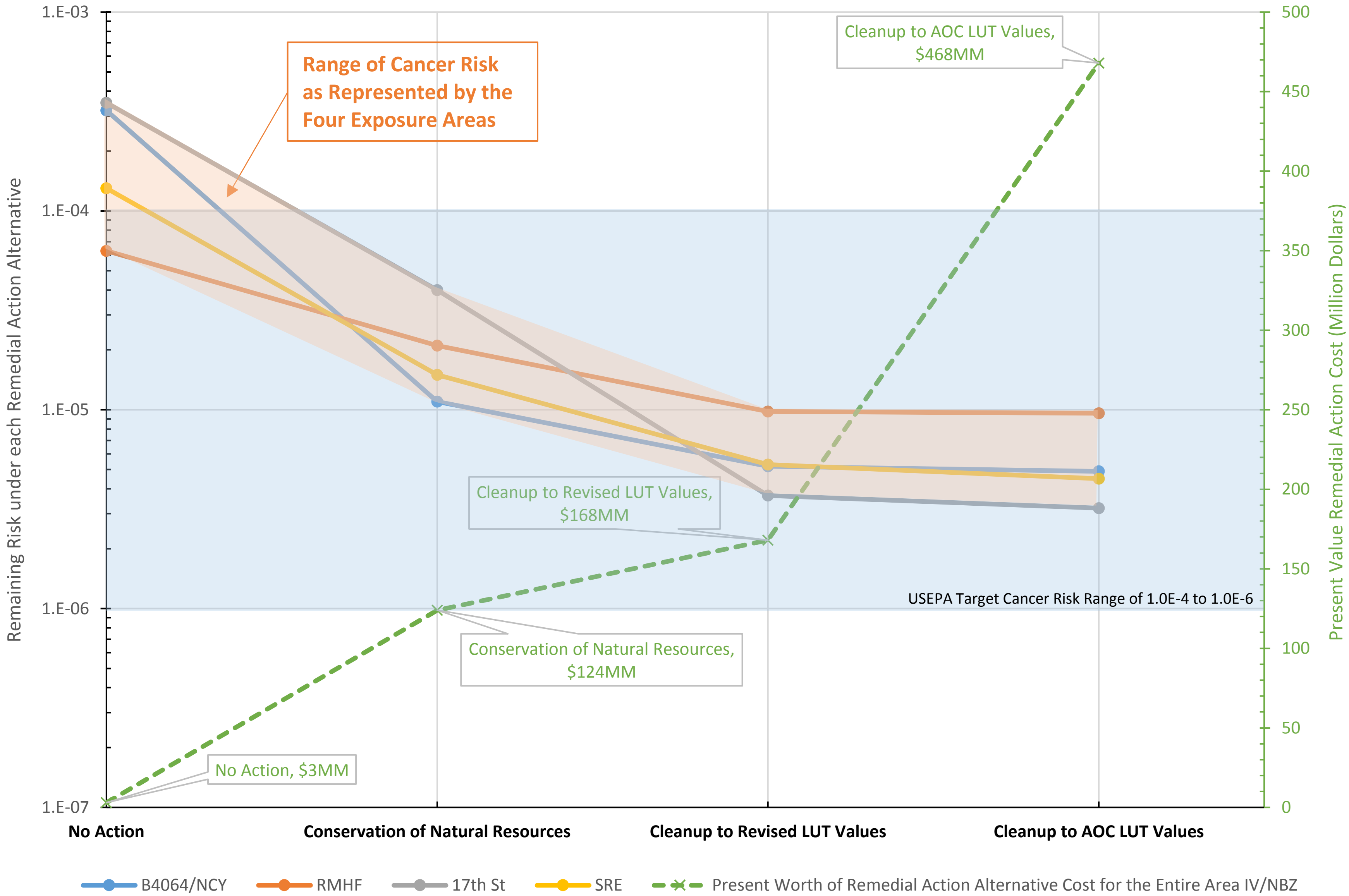


Figure ES-1 Remaining Cancer Risk and Remedial Action Cost among Remedial Alternatives

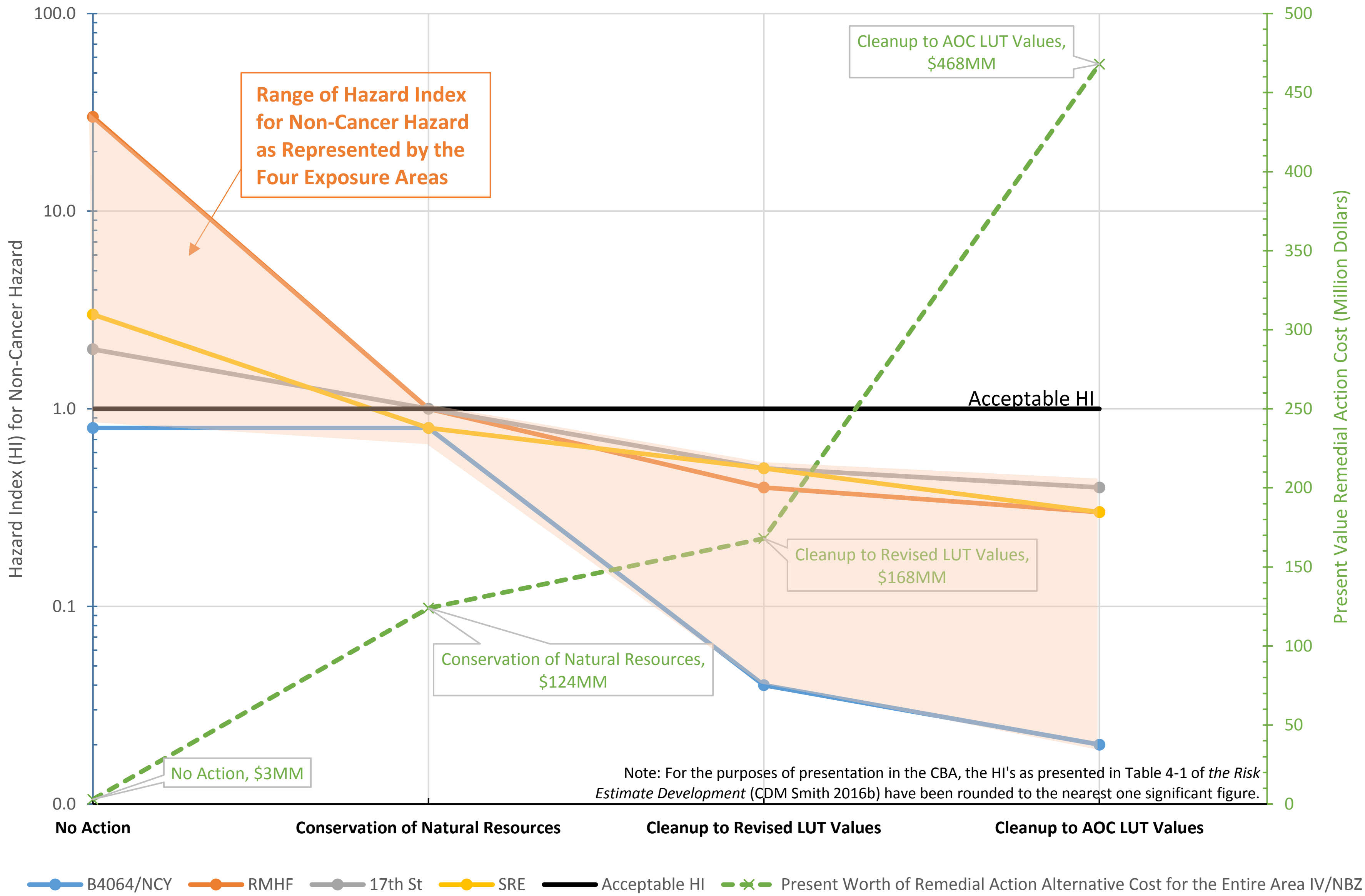


Figure ES-2 Remaining Non-Cancer Hazard and Remedial Action Cost among Remedial Alternatives

Section 1

Introduction

1.1 Purpose

This Cost-Benefit Analysis (CBA) documents the cost-benefit analysis of the remedial action alternatives to address soil contamination in Area IV and the Northern Buffer Zone (NBZ) of the Santa Susana Field Laboratory (SSFL). **Figure 1-1** shows Area IV and the NBZ along with key Area IV features discussed in this document. This CBA was prepared by CDM Federal Programs Corporation (CDM Smith) under the direction of and contract with the U.S. Department of Energy (DOE).

The remedial action alternatives for contaminated soils are identified in Chapter 2, Sections 2.3, 2.4, and 2.5 of the *Draft Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory* (EIS). The remedial action will be conducted in accordance with the 2010 Administrative Order on Consent for Remedial Action (AOC) between California Department of Toxic Substances Control (DTSC) and DOE (DTSC 2010). DOE will conduct the remedial action.

As part of the evaluation of environmental impacts, the EIS addresses three remedial action alternatives to address soil contamination at SSFL Area IV/NBZ. This CBA was developed to support decision makers in evaluating the remedial action alternatives for soil contamination at SSFL Area IV/NBZ. This CBA will also include the evaluation of a No Action Alternative where appropriate to serve as a baseline comparison. The National Environmental Policy Act (NEPA) regulations in 40 CFR § 1502.23 states that:

> *If a cost-benefit analysis relevant to the choice among environmentally different alternatives is being considered for the proposed action, it shall be incorporated by reference or appended to the statement as an aid in evaluating the environmental consequences. To assess the adequacy of compliance with section 102(2)(B) of the Act the statement shall, when a cost-benefit analysis is prepared, discuss the relationship between that analysis and any analyses of unquantified environmental impacts, values, and amenities. For purposes of complying with the Act, the weighing of the merits and drawbacks of the various alternatives need not be displayed in a monetary cost-benefit analysis and should not be when there are important qualitative considerations. In any event, an environmental impact statement should at least indicate those considerations, including factors not related to environmental quality, which are likely to be relevant and important to a decision.*

Accordingly, this CBA is included in the EIS as Appendix J.

1.2 Scope

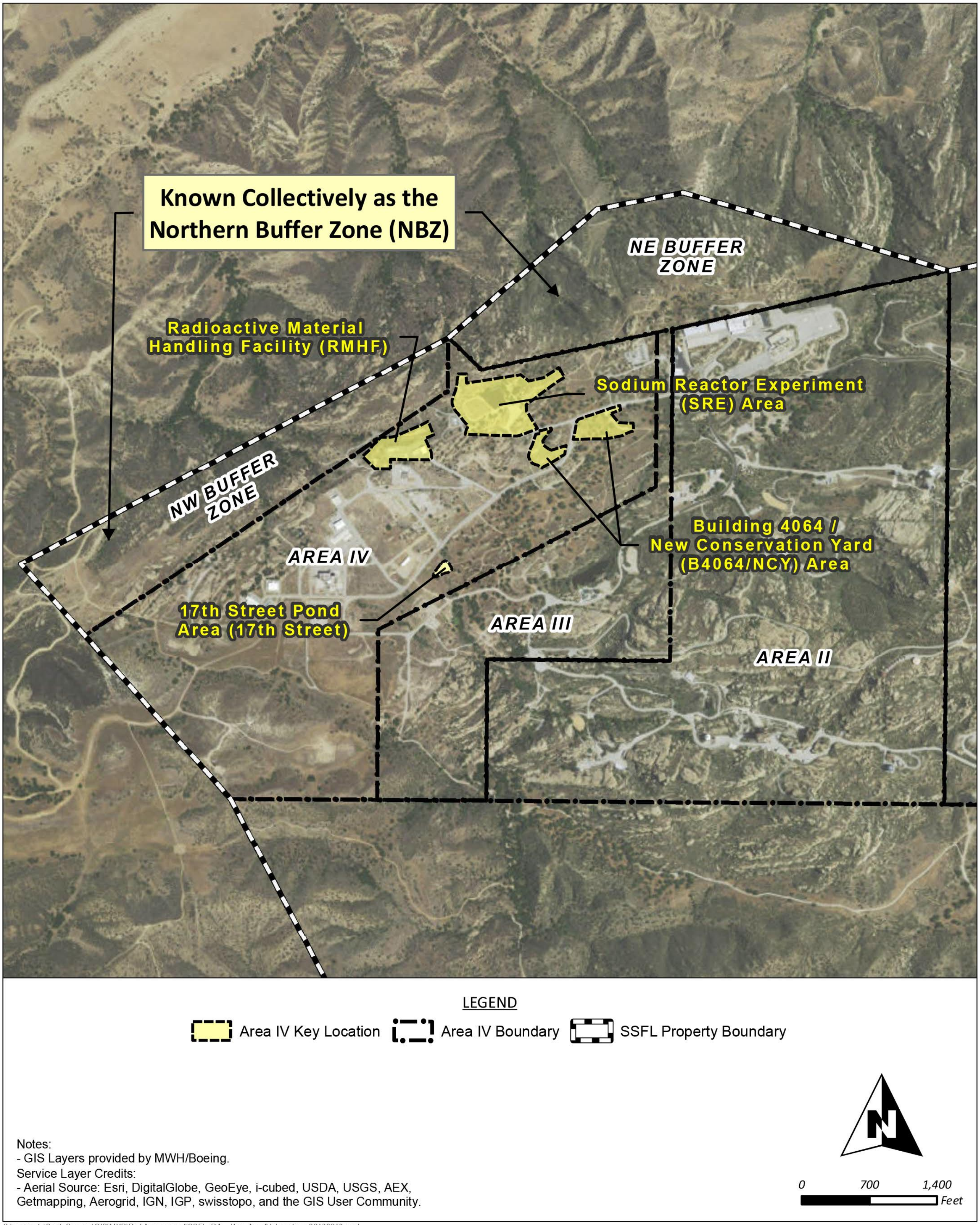
The scope of this CBA includes identifying and estimating benefits and costs of the remedial action alternatives. This CBA quantifies the benefits of reduced risk to human receptor by assessing cancer risks and non-cancer hazards resulting from implementation of each alternative.

This CBA presents the estimated capital construction costs, surveillance and long-term maintenance costs, and total life-cycle costs of each alternatives. These costs are compared to the risk reduction benefits. This CBA also evaluates uncertainty in cleanup decisions to consider errors that may leave human and ecological receptors exposed to unacceptable levels of contamination or result in unnecessary expenditure of resources. This CBA also evaluates the environmental, economic, and social impacts (i.e., "triple bottom line") associated with each soil remedial alternative. Lastly, green and sustainable best management practices (BMPs) were selected and evaluated for DOE's consideration during its preparation of the soil remediation design for Area IV/NBZ.

1.3 CBA Structure

The subsequent sections present the methodology and results of this CBA:

- Section 1: Introduction – this section presents the purpose and scope of this CBA.
- Section 2: Risk Management – this section explains the development and rationale of the cleanup standard behind each remedial action alternative, which is the basis of all subsequent cost-benefit evaluations.
- Section 3: Cost Estimate – this section presents the development and results of the cost estimates associated with each remedial action alternative for soil at Area IV/NBZ, which are the basis of the cost/risk evaluation in Section 4.
- Section 4: Cost / Risk Analysis – this section presents the cost and risk associated with each remedial action alternative and provides a cost/risk comparison between the alternatives.
- Section 5: Uncertainty in Cleanup Decisions – this section highlights the uncertainty in cleanup decisions associated with each remedial action alternative.
- Section 6: Green and Sustainability Remediation (GSR) Evaluation – this section evaluates the green and sustainability aspect of the remedial action alternatives, and considers the environmental footprint, social-economics impacts, and impacts to the community from each remedial action alternative. In addition, green and sustainable BMPs were selected and evaluated for DOE's consideration during its preparation of the soil remediation design for Area IV/NBZ.



C:_projects\SantaSusana\GIS\MXD\RiskAssessment\SSFL_RA__Key_AreaIV_Location_20160310.mxd

FIGURE 1-1
Key Area IV Locations

Section 2

Risk Management

Chapter 2 of the EIS presents the following four alternatives for soil at Area IV/NBZ, including three alternatives that involve remedial actions (remedial action alternatives):

- No Action Alternative
- Cleanup to AOC Look-Up Table (LUT) Values Alternative
- Cleanup to Revised LUT Values Alternative
- Conservation of Natural Resources Alternative

Each of the three soil remedial action alternative utilizes a different risk management approach to address remediation of the soil in Area IV/NBZ. Risk management is the process of deciding what actions should be taken to protect human and ecological receptors; risk management decisions are informed by a variety of factors including the following (USEPA 2000):

- Scientific Factors: Risk assessment including information drawn from toxicology, chemistry, epidemiology, ecology, and mathematics.
- Economic Factors: Cost of risks and the benefits of reducing them, the cost of risk mitigation or remediation options and the distributional effects.
- Laws and Legal Decisions: Factors define the basis for risk assessment, management decisions, and, in some instances, the schedule, level or methods for risk reduction.
- Social Factors: Factors including income level, ethnic background, community values, land use, zoning, availability of health care, life style, and psychological condition of the affected populations, may affect the susceptibility of an individual or a definable group to risks from a particular stressor.
- Technological Factors: Factors include the feasibility, impacts, and range of risk management options.
- Political Factors: Factors are based on the interactions among branches of the Federal government, with other Federal, state, and local government entities, and even with foreign governments; these may range from practices defined by Agency policy and political administrations through inquiries from member of Congress, special interest groups, or concerned citizens.
- Public Values: Factors reflect the broad attitudes of society about environmental risks and risk management.

The purpose of any risk management approach is to provide benefits related to reduction of risk to human receptor. This section discusses the use of risk assessment to support risk management; summarizes the cleanup standards and risk management approach for each of the soil remedial action alternative identified in Chapter 2 of the EIS; and presents other risk management approaches utilized by DTSC at other sites.

2.1 Use of Risk Assessment to Support Risk Management

Chapter 6.8 of Division 20 of the California Health and Safety Code (HSC), including Section 25359.20, requires that any remedial action at SSFL be based upon the provisions of Section 25356.1.5 of the HSC. Section 25356.1.5 of the HSC requires that any health or ecological risk assessment prepared in conjunction with a response action be based upon Subpart E of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR 300.400 et seq.), promulgated by the USEPA, and the policies, guidelines, and practices of USEPA. Accordingly, this section describes the use of risk assessment to support risk management at SSFL based on NCP requirements.

The NCP requires a site-specific baseline risk assessment to be conducted as part of the remedial process at CERCLA sites (40 CFR 300.430[d][1]). The primary purpose of the baseline risk assessment is to provide remediation managers with an understanding of the actual and potential risks to human receptor and the environment posed by the site and any uncertainties associated with the assessment. The baseline risk assessment identifies contaminants of concern, exposure pathways and evaluates whether the site poses a current or potential risk to human receptor and the environment in the absence of any remedial action. It provides the basis for determining whether or not remedial action is necessary and a technical basis for performing remedial actions. Generally, where the baseline risk assessment indicates that a cumulative site risk to an individual using reasonable maximum exposure (“RME”) assumptions for either current or future land use exceeds the 1×10^{-4} lifetime excess cancer risk, or a non-cancer Hazard Index (HI) of 1, a cleanup action under CERCLA is generally warranted at the site.

In general, USEPA considers excess cancer risks that are below about 1 chance in 1,000,000 (1×10^{-6}) to be so small as to be negligible, and risks above 1×10^{-4} to be sufficiently large that remediation is desirable. USEPA uses the general 1×10^{-4} to 1×10^{-6} risk range as a “target range” within which it strives to manage risks as part of the Superfund program. Remedial action is generally not warranted if cancer risk for current and future land use is less than 1×10^{-4}, unless it violates a chemical specific standard that defines acceptable risk, or there are non-carcinogenic effects, or there are adverse environmental impacts that warrant action (USEPA 1991a). Furthermore, the upper boundary of the risk range is not a discrete line at 1×10^{-4}, although USEPA generally used 1×10^{-4} in making risk management decisions. A specific risk estimate around 1×10^{-4} may be considered acceptable if justified based on site-specific conditions, including any remaining uncertainties on the nature and extent of contamination and associated risks. Therefore, in certain cases USEPA may consider risk estimates slightly greater than 1×10^{-4} or an HI >1 to be protective (USEPA 1991a).

The target cancer risk of 1×10^{-6} or HI <1 is the NCP’s point of departure for analysis of remedial action alternatives. The use of the cancer-risk point-of-departure for analysis of remedial options reflects USEPA’s preference for managing risks at the more protective end of the risk range. It should be used as a starting point for discussion of an acceptable target risk at a site, not the ultimate remediation goal. As USEPA maintains, the preference does not reflect a presumption that the final remedial action should attain such goals. The basis for 1 x 10^{-6} target risk dates back to the mid-1970s, when USEPA and the U.S. Food and Drug Administration (FDA) issued guidance for estimating risk associated with low-level exposures to potentially carcinogenic chemicals. Their guidance made upper-bound estimated risks of one extra cancer over the lifetime of 1 million people (1 x 10^{-6}) action levels for regulatory attention. Estimated risks below those levels are considered negligible because they individually add so little to the background rate of about 240,000 cancer deaths per 1 million total deaths in the United States (CRARM 1997).

Note: Final cleanup decisions for Area IV and the NBZ may also factor in risk reduction for ecological receptors. This CBA only addresses risk reduction for human receptors.

2.2 Cleanup Standards Scenarios

The cleanup standards for each soil remedial action alternative are described below. The basis of the risk management approach under each of these cleanup standards scenarios is analyzed.

Evaluation of a No Action Alternative, under which DOE would not treat any soil to reduce constituent concentrations and would leave the soil in place, is required under the National Environmental Policy Act (NEPA). The No Action Alternative would involve only the continued implementation of currently existing monitoring programs. The No Action Alternative establishes the baseline against which the potential environmental impacts of the remedial action alternatives can be compared. The No Action Alternative does not utilize a risk management approach and is not further discussed below.

2.2.1 Cleanup to AOC Look-Up Table Values Alternative

As described in the EIS, the 2010 AOC (DTSC 2010) stipulates that soils be cleaned up to the local background concentrations, or minimum detection limits for chemical contaminants for which the minimum detection limits exceed background concentrations, and background for radionuclides, or minimum detectable activity for radionuclides that do not have a background concentration. These background cleanup goals for chemicals were established by DTSC as the AOC LUT values (DTSC 2012), which are presented in **Attachment A**. The AOC LUT approach uses do-not-exceed values, based on background, as the decision points. The AOC cleanup evaluation process does not involve risk assessment, but instead involves point-by-point and analyte-by-analyte comparisons for determining remediation areas. To limit removing soil that is not contaminated (i.e., reduce the number of false-positive results), the AOC LUT values were established using background soil data and calculating the upper simultaneous limit at 95% confidence (USL95). The USL95 is the statistic such that all potential observations from the background population will be less than or equal to USL95 with 95% confidence. The background soil data and the details of the USL95 calculation are presented in the Chemical Soil Background Report (URS 2012).

2.2.2 Cleanup to Revised LUT Values Alternative

As described in the EIS, under this alternative, soil risk-based screening level (RBSL) values established (and presented in **Attachment A**) for a suburban residential exposure scenario at

SSFL (MWH 2014[1]) are used as a substitute for the background AOC LUT values to determine chemical constituent cleanup; the cleanup standard for radioactive constituents remain the same as under the Cleanup to AOC LUT Values Alternative. Per the SRAM, the Suburban Resident scenario assumes that suburban residents are directly exposed to soil 24 hours per day, 350 days per year (i.e., this value assumes that 15 vacation days per year are spent away from home), for 30 years. These assumptions are standard default USEPA exposure factors for residents (USEPA 1991b). The revised LUT values for chemical constituents are concentrations that correspond to a 1×10^{-6} risk of developing cancer and/or a non-cancer hazard index (HI) of 1.

2.2.3 Conservation of Natural Resources Alternative

Under the Conservation of Natural Resources Alternative, cancer risks and non-cancer hazards are calculated for suburban residents exposed to surface soil within 10,000 square meter (2.5 acre) exposure areas[2] (DOE 2011). The resulting risks are evaluated versus the 'target range' for risk management of (see Section 2.1) to determine if risk reduction is warranted. If risks are above acceptable levels, soil associated soil samples containing risk drivers are removed in an iterative process until the resulting risk and hazards fall within acceptable levels.

This evaluation is consistent with the risk assessment process outlined in the SRAM (MWH Americas, Inc. [MWH] 2014) for chemically impacted soil which in turn is based on guidelines developed by USEPA for Superfund sites. The SRAM established the methodology to be used to determine human receptor risks due to exposure to chemicals present in various media at the SSFL. Exposure to radionuclides is assessed in the same basic manner. The assumptions and methodologies used to evaluate this alternative are described in **Section 4.1.2** and in the document *Risk Estimate Development for Selected Areas of Santa Susana Field Laboratory Area IV* (*Risk Estimate Development*) (CDM Smith 2016b).

The target cancer risk range used to evaluate this alternative is 1×10^{-6} and 1×10^{-4}. The rationale for this risk range is described in **Section 2.1**. As outlined in the OSWER directive (USEPA 1991a), when cancer risks are below 1×10^{-4} (1 in 10,000), remediation and/or mitigation are generally not warranted; however, no "bright line" has been established at the upper end of the risk range and risk management decisions are made on a site-by-site basis. Decisions for remedial action taken at sites with cancer risks within the 1×10^{-4} to 1×10^{-6} range must explain why remedial action is warranted. The point of departure for the development of remedial goals is 1×10^{-6} (1 in 1,000,000) pursuant to the NCP. Site-specific considerations, including types of exposure, uncertainties in estimating exposures, size of the affected population, and limitations of remedial activities, may determine the cancer risk level acceptable for a site.

The acceptable target non-cancer hazard used to evaluate this alternative is an HI of 1; however, no bright line is established at an HI of 1. An HI of 1 or less for exposure via all chemicals and routes indicates that the receptor's exposure is equal to or less than an "allowable" exposure level and adverse health effects are considered unlikely to occur. HI's greater than 1 are further refined by summing only chemicals that effect the same target organ or system (USEPA 1989). HIs for chemicals affecting the same target organ or system that are greater than 1 indicate a possibility

[1] Site Risk Assessment Methodology (SRAM)
[2] 10,000 square meters is the suggested exposure area in the RESRAD risk computer model.

for adverse health effects. However, the HI should not be interpreted as a probability; generally, the greater the HI is above unity, the greater the level of concern.

2.3 Risk Management Approaches Applied to Similar California Sites

In this section, the risk management approaches described for the EIS remedial action alternatives are compared to the risk management approach employed in other federal facility cleanup efforts in California. These sites are:

- Hunters Point Naval Shipyard located in San Francisco, CA
- McClellan Air Force Base located in Sacramento, CA

As discussed in the EIS, the California Department of Toxic Substances Control (DTSC) referenced these two sites as having a similar approach to address contaminated soil as is provided by the Area IV/NBZ Cleanup to AOC LUT Values Alternative. Both of these sites are in California requiring cleanup due to contamination in soil, and both are managed by a federal agency. A discussion of the risk management approaches utilized for these two sites is presented below and each of the site risk management approaches is compared to those provided in the Area IV/NBZ soil remedial action alternatives.

2.3.1 Hunters Point Naval Shipyard Risk Management Approach

Hunters Point Naval Shipyard (HPNS) is located in southeastern San Francisco on a peninsula that extends east into San Francisco Bay. HPNS consists of 866 acres: 420 acres on land and 446 acres under water in San Francisco Bay. In 1940, the Navy obtained ownership of HPNS for shipbuilding, repair, and maintenance activities. After World War II, activities at HPNS shifted to submarine maintenance and repair. HPNS was also the site of the Naval Radiological Defense Laboratory (NRDL). Parcel E is one of six parcels (Parcels A through F) originally designated for environmental restoration. The Record of Decision (ROD) issued by the Navy for Parcel E (NAVFAC 2013) addresses soils contaminated with metals, pesticides, polychlorinated biphenyls (PCBs), dioxins/furans, semivolatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH), and volatile organic compounds (VOCs).

The soil remedial action and risk management approach utilizes risk-based concentrations (RBCs) established for a target cancer risk of 1 x 10^{-6} and a target HI of 1. For metals, if the background soil concentration, referred to as the Hunter's Point ambient level (HPAL), was higher than the RBC, the HPAL was selected. For organics, if the RBC was below the lab practical quantification limit (PQL), the PQL was selected. These selected values are identified as the soil "remediation goals" for the site, and are similar in approach to the derivation of the AOC LUT values.

The background soil concentrations (HPALs) were derived by calculating the 95 percent upper confidence limit (UCL) on the 95th percentile of a data set that included metals results for soil samples collected at Parcels B, C, D, and E in uncontaminated areas. In addition, metals with maximum concentrations detected below the HPALs were excluded as contaminants of potential concern (COPCs) in the risk evaluations. HPALs are site-specific ambient concentrations for metals, representing a concentration that about 5 percent of all ambient results would exceed. In addition, the remedial approach utilizes a two-tiered approach to identify areas of soil contamination requiring removal: Tier 1 action levels are 10x the remediation goal and Tier 2 action levels are 5x the remediation goal. This soil remediation approach that utilized a tiered approach to determine remediation areas is different than the uniform, point by point comparison utilized under the Cleanup to AOC LUT Values Alternative.

In general, it appears that the remedial approach at HPNS for chemical contamination is not similar to the Cleanup to AOC LUT Values Alternative as previously indicated by DTSC. However, the remedial approach at HPNS is similar to the Cleanup to Revised LUT Values Alternative in that a risk-based remediation approach is utilized and site specific cleanup goals do not default to background concentrations or laboratory method detection limits (MDLs). The HPNS remedial approach is also similar to the Conservation of Natural Resources Alternative in that a tiered approach was utilized to identify areas for soil removal.

Regarding the HPNS remedial and risk management approach to address radiological contaminants in soil, the cleanup objectives were selected such that a "residual radiological risk at the final ground surface (based on residential exposure) would be within the risk management range specified in the NCP (1×10^{-6} to 1×10^{-4})." Accordingly, the HPNS remedial approach is generally consistent with the Conservation of Natural Resources Alternative, such that both site approaches utilize a risk management approach directing cleanup to achieve the risk management range specified in the NCP (1×10^{-6} to 1×10^{-4}).

2.3.2 Former McClellan Air Force Base Risk Management Approach

The former McClellan Air Force Base (AFB) Superfund Site Record of Decision (ROD) (USEPA 2009) addresses contaminated soil on the 62-acre portion of land referred to as Parcel C-6, located in the southwestern section of the site. The former McClellan AFB is located approximately 7 miles northeast of Sacramento, California, and consists of approximately 3,450 acres. Parcel C-6 was the first portion of the former McClellan AFB selected for early transfer with privatized cleanup ("privatization").

Regarding the selected remedy and risk management approach at this site, the ROD states that because "the reasonably anticipated use of the property is industrial, the selected remedy is intended to actively remediate all contamination that exceeds industrial risk based levels and to maintain residential use restrictions on the balance of the Property where residential risk based levels are exceeded." The risk-based levels were calculated based on a target cancer risk of 1×10^{-6} and a non-cancer HI of 1, similar to the Cleanup to Revised LUT Values Alternative approach. In addition, the ROD indicates that in cases "where the McClellan soil background level exceeded the…risk-based screening levels, the soil background value was used as the screening level." This is also consistent with the Cleanup to Revised LUT Values Alternative approach where risk-based values are used in preference to background where risk-based values are protective of the receptor group(s) of concern. Unlike the Cleanup to AOC LUT Values Alternative approach, this site's soil remedial action objectives are primarily based on risk-based screening levels and are not based on laboratory detection limits. In addition, this site's approach only utilizes background soil concentrations for cleanup goals where background exceeds the risk-based screening levels, which is similar to the Cleanup to Revised LUT Values Alternative approach. In summary, it appears that the risk management approach at the former McClellan AFB for chemical contamination is not similar to the Cleanup to AOC LUT Values Alternative.

This page intentionally left blank.

Section 3

Cost Estimate

3.1 Basis of Estimate

The remedial action alternative cost estimates presented in this CBA are based primarily on the methodology described in the following cost guidance document:

- Cost Estimating Guide for Program and Project Management, *DOE G 430.1-1X*, April 2004

The methodology shown in the above DOE cost estimating guidance was supplemented with the following cost estimating guides for specific information:

- Cost Estimating Guide, *DOE G 430.1-1*, 03-28-97
- Cost Estimating Guide, *DOE G 413.3-21*, 5-9-2011

The unit costs developed for the remedial action alternative cost estimates were prepared using the U.S. Army Corps of Engineers (USACE) Micro Computer Aided Cost Engineering System (MCACES) Second Generation (MII) software (MII 4.2, Build 3) for various work activities, as presented in Section 2.3 of the Basis of Estimate (BOE) *Basis of Estimate. Draft Detailed Remedial Action Alternative Cost Estimates* (CDM Smith 2016a). The USACE cost guidance was used primarily for developing the structure and methodology used in the MII estimate.

Some of the unit costs within the work breakdown structure (WBS) of the draft detailed remedial action alternative cost estimates were developed using three cost estimate techniques. They include 1) detailed, unit-cost, or activity-based; 2) parametric; and 3) specific analogy cost estimate techniques. Detailed, unit-cost, or activity-based cost estimates are the most definitive of the estimate techniques and use information down to the lowest level of detail available. Parametric estimating produces higher-level estimates when little information, other than basic parameters, is known about a project. Specific analogies use the known cost or schedule of an item as an estimate for a similar item in a new system.

It should be noted that the overall work activity organization indicated within the WBS of the remedial action alternative cost estimates was developed by CDM Smith to capture the technical scope of all remedial action alternatives as presented in the EIS.

3.2 Approach

The detailed cost estimates are prepared to support this CBA in evaluating the remedial action alternatives to address contaminated soils in Area IV/NBZ. For further detail on the approach for the cost estimate, refer to the BOE (CDM Smith 2016a).

The detailed remedial action cost estimates are prepared to support the CBA in evaluating the implementation of the four remedial action alternatives to address contaminated soils in Area IV/NBZ. The cost estimates do not include costs for design, regulatory, and procurement activities that will be conducted prior to implementation. The cost estimates have been prepared with the current understanding of the alternatives as presented in the EIS and in this CBA. It is understood that future design, regulatory, and/or procurement activities may alter one or all of the alternatives, and cost estimates will be refined, as appropriate.

The cost estimates are organized using the Environmental Cost Element Structure (ECES) codes as developed by the Environmental Cost Engineering Committee (EC^2), August 2003. The following project life-cycle phases were assumed in determining the ECES codes:

- Phase 4: Construction
- Phase 6: Surveillance and Long-Term Maintenance (SLTM)
- Phase 8: Program Management, Support, and Infrastructure

The BOE (CDM Smith 2016a) contains further detail on work activities along with the corresponding ECES identified.

3.3 Assumptions

Key technical approach regarding soil remedial action implementation that has significant impact on the cost includes the assumptions below. Assumptions made for the cost estimate are consistent with the assumptions made for the EIS. Refer to the BOE (CDM Smith 2016a) for further information on the complete set of assumptions made.

Contaminated Soil Areas and Volumes

Contaminated soil areas and volumes for cleanup used in this CBA are those presented in the EIS and are presented in **Table 3-1**. Contaminated soils were categorized and volumes were calculated based on the review of chemical concentrations relative to hazardous waste regulatory criteria, RBSLs, and LUT values and radionuclide concentrations relative to LUT values. For purposes of this evaluation, while volumes are reported in bank (in place) cubic yards they are referred to generically as "cubic yards." It is noted that each of the remedial action alternatives have different volumes because some of the remedial action alternatives do not involve excavation and disposal of all soil categories (e.g., no excavation/disposal of Category 1 soil under the Cleanup to Revised LUT Values Alternative and no excavation/disposal of Categories 1 and 4 soil under the Conservation of Natural Resources Alternative).

- Soil Categories 1 and 2 – This soil does not meet the definition of either chemical hazardous waste[1] or radioactive waste and is assumed to be transported to a permitted Resource Conservation and Recovery Act (RCRA) Class 2 or Class 3 disposal facility. The calculated volume for Soil Category 1 and 2 is 741,000 cubic yards and 52,000 cubic yards, respectively.

---

[1] For definition of chemical hazardous wastes, see 22 California Code of Regulation (CCR) Section 66261 and Title 40 CFR Part 261.

- Soil Category 3 – This soil exceeds the hazardous waste criteria and is assumed to be transported to a permitted RCRA Class 1 disposal facility. The calculated volume for Soil Category 3 is 49,000 cubic yards.

- Soil Category 4 and 6 – These soil categories are classified as low-level radioactive waste (LLW), which is assumed to be transported for disposal outside of California. The calculated volume for Soil Category 4 and 6 is 44,000 cubic yards and 3,000 cubic yards, respectively.

- Soil Category 5 – This soil category is classified as mixed low-level radioactive waste (MLLW) and is assumed to be transported for disposal outside of California. The calculated volume for Soil Category 5 is 44,000 cubic yards.

Excavation

It is assumed that the excavation would be completed using an excavator with a 3 cubic yard bucket (CAT 345B or equal). Excavated soil would be direct-loaded in the trucks for offsite disposal. It is also assumed that the average depth of excavation is 5 feet.

Hauling

Excavated contaminated soils are assumed to be loaded in bulk in covered, 20-ton capacity, rear dump trucks suitable for hauling on highways. Hazardous, LLW, and MLLW soils would be transported in a way that satisfies the DOE's requirements for a "sealed" container.

Wastes Disposition

The following disposal facilities were assumed:

- Soil Category 1 and 2 – The excavated volume of these soil categories is assumed to be disposed within the state of California. It is assumed that Chiquita Canyon Landfill, CA or Westmorland Landfill, CA will be used for disposal. Thus, an average one-way travel distance of 135 miles is assumed for disposal by road.

- Soil Category 3 – The excavated volume of this soil category can be disposed at multiple disposal facilities within or outside the state of California. For cost estimating purposes; the Nevada National Security Site (NNSS) is assumed to be the most representative disposal facility in-terms of mileage. Thus, an average one-way travel distance of 300 miles is assumed for disposal by road.

- Soil Category 4, 5, and 6 – The excavated volume of these soil categories is assumed to be disposed at the EnergySolutions' disposal facility in Clive, Utah. The one-way travel distance by road for disposal is 780 miles.

Backfill Soil Volumes

It is assumed that approximately 75 percent of the soil volume removed for each alternative would be replaced with backfill to accomplish slope stabilization. In addition, 10 percent of those backfill soil volumes would be generated on site by crushing onsite sandstones from locations as approved by all the stakeholders. The rest of the backfill soil volume for each alternative is assumed to be procured from an offsite commercial location(s) outside of the SSFL. The assumed one-way travel distance by road for of the offsite borrow source is 50 miles.

General Conditions
General conditions include cost for various work plans and submittals, home office and job site personnel, and onsite temporary construction facilities. These are based on assumed duration for each alternative.

Best Management Practices
It is assumed that the existing stormwater controls measure will be in-place for use during the implementation of the remedial action, and only temporary erosion and sediment control measures would be required. Assumed temporary erosion and sediment control measures include silt fence, wattles, sediment traps, rock filter dams, track-out prevention, and temporary seeding.

Restoration
It is assumed that all disturbed areas will be seeded using native grass and wildflower seed mix.

Post-Construction Monitoring
Post-construction monitoring includes cost for monitoring of total petroleum hydrocarbon (TPH)/polycyclic aromatic hydrocarbons (PAHs) impacted soils and areas where residual contamination is above the established LUT values (biological and cultural sensitive areas). It includes monitoring, sampling, analysis, and reporting.

Period of Analysis
The period of analysis for the cost estimate is assumed to be 30 years after construction and Area IV soil removal and disposal for periodic SLTM of TPH/PAHs-impacted soils and areas where residual contamination is above the established LUT values (biological and cultural sensitive areas).

Present Worth (PW) Calculations
Present worth (PW) calculations are included in the remedial action alternative cost estimates to perform the life-cycle cost analysis (LCCA) as described in Appendix H of *Cost Estimating Guide for Program and Project Management*, DOE G 430.1-1X. As described in Appendix H of DOE G430.1-1X, a nominal discount rate of 3.5 percent (30-Year) was used for calculating PW cost. Nominal discount rates are based on the Appendix C (Revised November 2015 for Calendar Year 2016) of the Office of Management and Budget (OMB) Circular A-94.

Additional assumptions for the cost estimate preparation are listed in the BOE (CDM Smith 2016a).

3.4 Cost Estimate Summary

The cost estimate task is at a planning stage for this CBA and will be refined as additional information is collected, reviewed, and the project designed. These detailed remedial action alternative cost estimates are prepared to support CD-1 stage of the project/program life-cycle; thus, they are classified as Class 3 (Preliminary) estimates based on cost estimate classification as presented in Table 2-2 of the *Cost Estimating Guide for Program and Project Management* (DOE 2004). The accuracy range of the Class 3 (Preliminary) cost estimate is based on *AACE International Recommended Practice No. 17R-97* (Figure 1 – Generic Cost Estimate Classification Matrix) as included in Appendix J (Cost Estimate Classification) of the *Cost Estimating Guide for*

Program and Project Management (DOE 2004), where the Class 3 (Preliminary) estimates has an Expected Accuracy Range of plus 20 percent and minus 10 percent (+20%/-10%) to +60%/-30% of the final cost. For this cost estimate the accuracy range is projected to be +40%/-20% of the final cost.

Table 3-2 (Remedial Action Alternatives Cost Summary) summarizes the capital construction costs, surveillance and long-term maintenance costs, and total life-cycle costs in current (CY 2016) dollars and future dollars. It also presents the summary of the LCCA, which is the present worth of the estimated total life cycle costs of the alternatives. **Figure 3-1** graphically demonstrates the present worth of the total life-cycle costs and their projected accuracy ranges (+40%/-20%) for the alternatives.

Capital construction costs include costs for activities required for Area IV/NBZ soil remediation. These activities include general condition requirements; mobilization/demobilization of construction equipment; implementation of best management practices; excavation, hauling, and disposal of contaminated soils; and site restoration. Surveillance and long-term maintenance costs includes costs for implementing post-construction monitoring.

This page intentionally left blank.

Table 3-1 Remediation Soil Quantities by Alternative
SSFL Area IV / NBZ

	Cleanup to AOC LUT Values Alternative	*Cleanup to Revised LUT Values Alternative*	*Conservation of Natural Resources Alternative*
Soil Category 1 Chemicals above AOC LUT values, but below risk-based levels and hazardous waste standards. Radionuclides at or below AOC LUT values.	741,000 cubic yards 1,112,000 tons 55,600 truckloads		
Soil Category 2 Chemicals above risk-based levels, but below hazardous standards. Radionuclides at or below AOC LUT values.	52,000 cubic yards 78,000 tons 3,900 truckloads	52,000 cubic yards 78,000 tons 3,900 truckloads	52,000 cubic yards 78,000 tons 3,900 truckloads
Soil Category 3 Chemicals above hazardous waste standards. Radionuclides at or below AOC LUT values.	49,000 cubic yards 73,500 tons 3,700 truckloads	49,000 cubic yards 73,500 tons 3,700 truckloads	49,000 cubic yards 73,500 tons 3,700 truckloads
Soil Category 4 Chemicals above AOC LUT values, but below risk-based levels and hazardous waste standards. Radionuclides above AOC LUT values, but below risk-based levels.	44,000 cubic yards 66,000 tons 3,300 truckloads	44,000 cubic yards 66,000 tons 3,300 truckloads	
Soil Category 5 Chemicals above risk-based levels and may be a hazardous waste. Radionuclides above AOC LUT values.	44,000 cubic yards 66,000 tons 3,300 truckloads	44,000 cubic yards 66,000 tons 3,300 truckloads	44,000 cubic yards 66,000 tons 3,300 truckloads
Soil Category 6 Chemicals at or below AOC LUT values. Radionuclides above risk-based levels.	3,000 cubic yards 4,500 tons 230 truckloads	3,000 cubic yards 4,500 tons 230 truckloads	3,000 cubic yards 4,500 tons 230 truckloads
Total Volume	933,000 cubic yards	192,000 cubic yards	148,000 cubic yards
Total Weight	1,399,500 tons	288,000 tons	222,000 tons
Total Truck Round Trips [a]	70,000 truckloads	14,400 truckloads	11,100 truckloads

AOC = *Administrative Order on Consent for Remedial Action*; LUT = Look-Up Table.

[a] Truck round trips were conservatively estimated based on transporting 20 tons of containerized waste per truck. If 23-ton trucks were used for nonradioactive waste, truck trips would be reduced by 11 percent under the Cleanup to AOC LUT Values Alternative and the Cleanup to Revised LUT Values Alternative, and 9 percent under the Conservation of Resources Alternative.

Notes:

Sums and products may not equal those calculated from table entries due to rounding.

Cubic yards are converted to tons using a conversion factor of 1.5 tons per cubic yards (see Appendix D of the EIS).

Soils with radionuclides above LUT values and chemically impacted soils categorized as exceeding risk-assessment-based levels would be removed under all alternatives (Soil Categories 2, 3, 4, 5, and 6). The number of truckloads for these soils is based on 20 tons per truckload for containerized soil.

For Soil Category 1, the number of truckloads is based on 20 tons per truck.

TABLE 3-2
REMEDIAL ACTION ALTERNATIVES COST SUMMARY

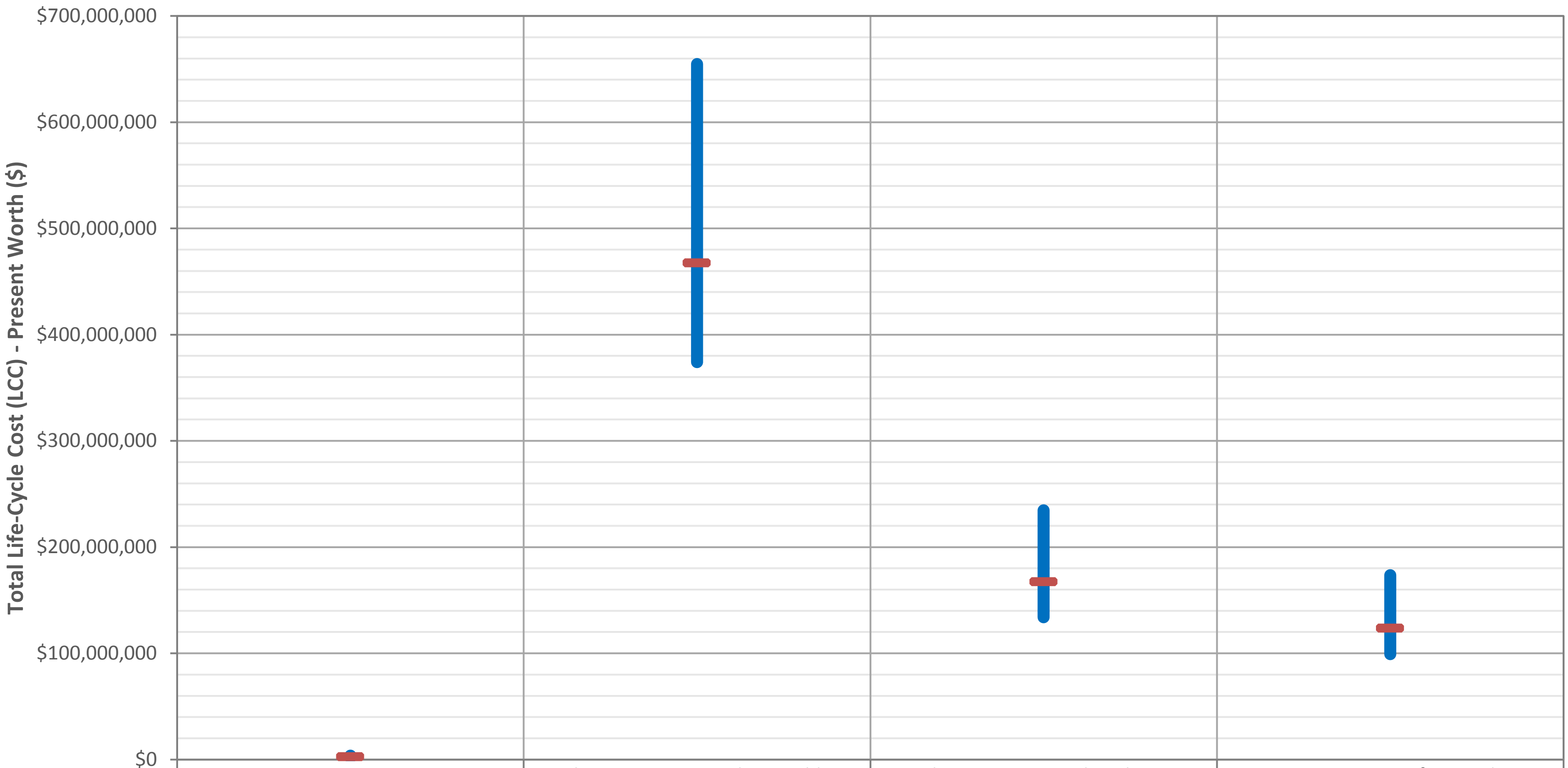
Site:	SSFL Area IV/NBZ
Location:	Ventura County, California
Document:	Basis of Estimate, Detailed Remedial Action Alternative Cost Estimates
Project/Program Life-Cycle Stage:	Critical Decision (CD)-1 [Approve Alternative Selection and Cost Range]
Cost Estimate Classification:	Class 3, Preliminary (Level of Definition: 10% to 40%)
Base Year:	2016
Date of Estimate:	April 2016

ALTERNATIVE	CAPITAL CONSTRUCTION COST (AREA IV SOIL REMEDIATION)	
	CURRENT (CY 2016) COST	FUTURE COST
	Total Project Cost	Total Project Cost
No Action Alternative	$0	$0
Cleanup to AOC Look-Up Table Values Alternative	$482,542,000	$604,398,000
Cleanup to Revised Look-Up Table Values Alternative	$168,032,000	$186,367,000
Conservation of Natural Resources Alternative	$123,637,000	$137,126,000

ALTERNATIVE	SURVEILLANCE AND LONG-TERM MAINTENANCE (SLTM) COST	
	CURRENT (CY 2016) COST	FUTURE COST
	Total Project Cost	Total Project Cost
No Action Alternative	$2,856,000	$4,631,000
Cleanup to AOC Look-Up Table Values Alternative	$2,526,000	$5,535,000
Cleanup to Revised Look-Up Table Values Alternative	$2,105,000	$4,374,000
Conservation of Natural Resources Alternative	$2,526,000	$4,374,000

ALTERNATIVE	TOTAL LIFE-CYCLE COST (LCC)		LIFE-CYCLE COST ANALYSES (LCCA)[2]
	CURRENT (CY 2016) COST	FUTURE COST	PRESENT WORTH (PW)
	Total Project Cost	Total Project Cost	Total Project Cost
No Action Alternative	$2,856,000	$4,631,000	$2,661,000
Cleanup to AOC Look-Up Table Values Alternative	$485,068,000	$609,933,000	$467,658,000
Cleanup to Revised Look-Up Table Values Alternative	$170,137,000	$190,741,000	$167,546,000
Conservation of Natural Resources Alternative	$126,163,000	$141,500,000	$123,898,000

Notes:
1 - Current costs, life-cycle costs, and estimated remedial timeframes for each remedial action alternative are presented on tables CS-1 through CS-4.
2 - Per the *DOE Cost Estimating Guide, DOE G 430.1-1X, Appendix H,* "The lowest PW is the preferred alternative from an economic perspective."



	No Action Alternative	Cleanup to AOC Look-Up Table Values Alternative	Cleanup to Revised Look-Up Table Values Alternative	Conservation of Natural Resources Alternative
Total LCC (+40%)	$3,726,000	$654,722,000	$234,565,000	$173,458,000
Total LCC	$2,661,000	$467,658,000	$167,546,000	$123,898,000
Total LCC (-20%)	$2,129,000	$374,127,000	$134,037,000	$99,119,000

Remedial Action Alternative

Figure 3-1
Estimated Present Worth and Accuracy Ranges of Total Life-Cycle Costs for Remedial Action Alternatives

Section 4

Cost/Risk Analysis

4.1 Cost/Risk Analysis Methodology

4.1.1 Cost Estimates for Area IV/NBZ

The cost estimates for the remedial action alternatives described in **Section 3** were utilized in this cost/risk analysis. See **Section 3** for the development and assumptions made for the cost estimate of each alternative. It is noted that the excavation volumes under each remedial action alternative as presented in Chapter 2 of the EIS are assumed during preparation of the cost estimate. Cost estimates for remediation of individual exposure areas (as defined in **Section 4.1.2**) are not part of the scope of this CBA.

4.1.2 Risk Estimates for Select Exposure Areas

The primary benefit of a soil remedial action would be the reduction in risk to human receptor. As such, the benefits analysis determines potential risk estimates under a No Action Alternative and risk reduction with implementation of the remedial action alternatives within four exposure areas within Area IV. These four exposure areas were selected as most representative of past operations across the entire Area IV/NBZ. Risk reductions determined from these four exposure areas would be compared to the site-wide cost estimates prepared for Area IV/NBZ. Four exposure areas were chosen as balance between adequate representation to the site-wide risks, and time-constraints to complete this cost/risk analysis for the EIS.

This section describes how risk estimates were calculated for the four exposure areas. For each remedial action alternative, the risk estimates to human receptor associated with exposure to COPCs in soil were determined for the four exposure areas.

Overall, this analysis is intended to provide a range of possibilities that the remediation manager can use to address risks and hazards at the Area IV/NBZ. This range allows the remediation manager to select targets for remediation that reflect both quantitative and qualitative (uncertainty) aspects of the assessment. As in any risk assessment, the estimates of potential health threats (cancer risks and non-cancer health effects) have numerous associated uncertainties. Uncertainties are inherent in the risk assessment process because of the numerous assumptions that are made in estimating exposure, toxicity, and potential risk. As a result of the uncertainties, this assessment should not be construed as presenting absolute risks or hazards. Rather, it is a conservative analysis intended to indicate the potential for adverse impacts to occur for the scenario evaluated. The scenario considered in this analysis assumed residential land use. Potential cancer risks and non-cancer hazards were estimated for suburban residents exposed to contaminants in soil assuming reasonable maximum exposure. In general, assumptions made throughout this analysis are conservative in that they tend to overestimate exposure and resultant risk rather than underestimate it. The probable future land use of Area IV/NBZ, which Boeing had publicly stated will be open space (Boeing 2016), must be considered in the interpretation and application of this analysis. The overall risk to human receptor attributable to Area IV/NBZ is an upper-bound probability of adverse health effects based on residential land use; true health effects may be lower. The risk assessments conducted for each alternative allow for the comparative analysis of risk reduction, with respect to the Cleanup to AOC LUT Values Alternative, which by definition provides 100% risk reduction (see **Section 4.3.2**).

The steps conducted for this risk analysis include: 1) identification of representative exposure areas, 2) selection of COPCs, 3) estimation of exposure point concentrations, 4) estimation of cancer risks and non-cancer hazards, and 5) determination of excavation volumes. These steps are summarized below and described in detail in the document *Risk Estimate Development for Selected Areas of Santa Susana Field Laboratory Area IV* (*Risk Estimate Development*) (CDM Smith 2016b).

Step 1: Exposure Areas

To establish the basis for the 10,000 square meter (2.5 acre) exposure areas, Area IV and the NBZ were subdivided to create the risk assessment exposure areas (see **Figure 4-1**). Four historical operation areas within Area IV were selected for this cost/risk analysis. These locations were selected as risk assessment exposure areas to be evaluated in this CBA because they were identified by USEPA as four of the five locations that exhibited 70% of radionuclide contamination within Area IV (HGL 2012). The four of five locations were chosen because they are similar to the rest of Area IV in terms of site conditions. They are: the Radioactive Material Handling Facility (RMHF), the Sodium Reactor Experiment (SRE) area, Building 4064/New Conservation Yard (B4064/NCY) area, and the 17th Street Pond area (17th Street). The exposure areas analyzed in this CBA do not encompass the entirety of the facility, but only 2.5-acre portions of the site as further explained in the next paragraph. **Figure 1-1** shows the relative locations of these exposure areas within Area IV. A screening criterion for selection of an exposure area was that the available database is representative of the exposure area's current condition and that the number of samples for chemicals and radionuclides is adequate for statistical evaluation (i.e., a minimum of 20 samples each). With the remaining possible exposure areas within Area IV, these four areas were selected as they have been identified with radionuclide contamination, had been subject to prior cleanup actions, and provided a range of chemical constituents characteristic of Area IV operations. The range of current risks in these four exposure areas is considered to represent the upper boundary across Area IV/NBZ for cancer risk and for non-cancer hazard. The four areas selected also meet other factors influencing their selection and included: the spatial distribution of soil samples containing concentrations exceeding AOC LUTs, analysis of historical uses of areas, and consideration of site features (e.g., drainages). Based on the evaluation of available data, site-related soil contamination in Area IV is unevenly distributed and generally exists as hot spots.

The size of SRE, RMHF, and 17th Street exposure areas evaluated are each 10,000 m^2 or about 2.5 acres. This is the default exposure area used in the RESRAD (RESidual RADioactivity) on-site model, developed by DOE, to evaluate residential exposures to radionuclides, and was considered appropriate to assess chemical and radionuclide exposures for suburban residents. The B4064/NCY area encompasses four 2.5-acre exposure areas. Because the radionuclide impacted area for B4064/NCY area was at the boundary of these four 2.5-acre exposure areas, the risk assessment for B4064/NCY area incorporated the area of radiological impact across these four exposure areas. See **Figure 4-1** for the breakdown of these risk assessment exposure areas in Area IV/NBZ and the locations of the four selected exposure areas evaluated in this CBA.

Step 2: Selection of COPCs

After identifying exposure areas, COPCs were selected for each exposure area using the criteria described in the report "*Risk Estimate Development for Selected Areas of Santa Susana Field Laboratory Area IV*" (CDM Smith 2016b). The same set of COPCs selected for each exposure area were evaluated for all remedial action alternatives. COPCs in soils for the SSFL site are site-related chemicals or radionuclides that exist at concentrations above either the naturally occurring or risk-determined levels above which a chemical or radionuclide poses a threat to human receptor. A chemical is considered a COPC if it was detected at concentrations exceeding LUTs and/or RBSLs in more than 2.5% of the samples collected within the identified exposure area. Chemicals selected as COPCs for the four exposure areas are: PAHs, dioxins, PCBs, antimony, hexavalent chromium, lead, and mercury. COPCs also include the nine process-related radionuclides identified by USEPA as part of its soils investigation (HGL 2012) exceeding field action levels (FALs). These radionuclides identified include: Cesium-137, Strontium-90, Plutonium-239/240, Cobalt-60, Europium-152, Plutonium-238, Americium-241, Curium-243/244, and Nickel-59. Of these radionuclides the majority of the detections (meaning 99% of detections) were from Cesium-137, Strontium-90, and Plutonium-239/240. Identification of a chemical or radionuclide as a COPC does not indicate that it poses a health risk; instead, its identification as a COPC indicates that a quantitative risk assessment may be warranted to determine if unacceptable risk may exist.

Additional evaluation is also performed for those chemicals not selected as COPCs. The final assessment considers the history of use at the site, the location of these samples in relation to any other site-related chemicals, and an evaluation of the distribution of that chemical to determine if it is indicative of natural variability (e.g., geological origin, biological origin, fire origin) or potential hot spots. If all of these criteria considerations are negative, the chemical is not considered to be a COPC. If this evaluation indicates that the chemical may be site-related, the chemical is considered a COPC.

Step 3: Estimation of Exposure Point Concentrations

Exposure point concentrations (EPCs) represent concentrations of COPCs to which receptors may be exposed based on the assumption of random exposure within an exposure area. EPCs were estimated for each COPC selected for each exposure area. Typically, EPCs are estimated as the upper one-sided 95 percent confidence limit of the arithmetic mean (95 percent UCL) to help reduce the chance that the actual average concentration is not underestimated. For this assessment for most COPCs EPCs were the 95th UCL as calculated by the USEPA software program ProUCL version 5.0 (USEPA 2013). EPCs were calculated for each of the alternatives as described below:

- No Action Alternative: EPCs under this alternative were estimated for surface soil datasets for each exposure area including detects and non-detects at the detection limit in ProUCL.
- Cleanup to AOC LUT Values Alternative: EPCs under this alternative were estimated by removing all soil samples within an exposure area with COPC concentrations above their respective AOC LUT values and replacing those values with background values. An EPC was then estimated for the resulting dataset for each COPC.

- Cleanup to Revised LUT Values Alternative: EPCs under this alternative were estimated by removing all chemical soil samples with COPC concentrations above their respective RBSL and replacing those values with background values. An EPC was then estimated for the resulting dataset for each COPC. The EPC for radionuclides was the same as that estimated for the Cleanup to AOC LUT Values Alternative (i.e., cleanup of radionuclides to their background concentrations).
- Conservation of Natural Resources Alternative: EPCs under this alternative were estimated by first determining risk drivers and then removing soil samples for risk drivers in an iterative process until the resulting risk and hazards (HI of 1 or less) were within acceptable levels. For this analysis the acceptable cancer risk level upper bound threshold was assumed to be 1×10^{-4} and the non-cancer threshold was assumed to be 1. COPC concentrations that were removed from the dataset were replaced with the background value for that COPC. For cancer risks that approached the upper bound limit of the cancer target risk range (i.e., 1×10^{-4}) additional soil samples were removed to provide a more protective or conservative risk reduction.

Step 4: Estimation of Cancer Risks and Non-Cancer Hazards

The total cumulative risk value for each exposure area was calculated by first calculating the risk for each COPC, and then summing the risk for each COPC. Cumulative risk and hazards for each exposure area are then compared with the assumed acceptable cancer risk ranges and the non-cancer target threshold as specified in **Section 2** to provide input into risk management decisions. Results of the risk analysis are presented in the following sections. For further information on risk assessment methodology, refer to *Risk Estimate Development* (CDM Smith 2016b).

Cancer risk and non-cancer hazards were determined for each alternative for comparison. Cancer risks and non-cancer hazards are back calculated for each exposure area using RBSLs for suburban residents and estimated EPCs. In this approach because risk is proportional to concentration, the EPC for each COPC is divided by its RBSL and multiplied by the cancer risk or non-cancer hazard value used to develop the RBSL as appropriate as demonstrated below. The chemical RBSLs used in this analysis were developed in the *Final Standardized Risk Assessment Methodology (SRAM) Rev.2. Addendum* (MWH 2014) and are based on a cancer risk of 1×10^{-6} or a non-cancer hazard of 1 for each individual chemical for suburban residents.

$$Cancer\ Risk\ for\ Chemical\ COPC = \frac{EPC\ for\ Chemical\ COPC}{RBSL\ for\ Chemical\ COPC} \times (1 \times 10^{-6})$$

$$Non - Cancer\ Hazard\ for\ Chemical\ COPC = \frac{EPC\ for\ Chemical\ COPC}{RBSL\ for\ Chemical\ COPC}\ x\ 1$$

To estimate cancer risk associated with exposure to radionuclides preliminary remediation goals (PRGs) were estimated for process-related radionuclides using the RESRAD (RESidual RADioactivity) on-site model applied to the risk analysis in this CBA and in the *Draft Evaluation of Radionuclide Risk in Selected Areas of the Santa Susana Field Laboratory Memorandum* (CDM Smith 2015). Input parameters to the RESRAD model were adjusted to be consistent with the assumptions developed for the suburban resident scenario presented in the *Final Standardized*

Risk Assessment Methodology (SRAM) Rev.2. Addendum (MWH 2014) in conjunction with the unrevised portions of the *SRAM Rev.2* (MWH 2005). The PRG for each radionuclide represents a soil concentration that would result in a maximum dose of 25 millirem per year (mrem/year). Both DOE and the Nuclear Regulatory Commission (NRC) use the 25 mrem/year dose threshold as the general limit or constraint for soil cleanup or site decontamination. The 25 mrem/year dose corresponds to approximately a 1×10^{-4} cancer risk. The EPC for each radionuclide COPC is divided by its respective PRG and multiplied by 1×10^{-4} to estimate cancer risk as demonstrated below.

$$Cancer\ Risk\ for\ Radionuclides\ COPC = \frac{EPC\ for\ Radionuclide\ COPC}{PRG\ for\ Radionuclide\ COPC} \times (1 \times 10^{-4})$$

Step 5: Determination of Excavation Volumes

Excavation volumes were determined for risk reduction associated with exposure to chemical COPCs, exposure to radionuclide COPCs, and for exposure to both chemicals and radionuclide COPCs for each of the four exposure area under each remedial action alternative.

For the Cleanup to AOC LUT Values and the Cleanup to Revised LUT Values Alternatives, maps identifying sample locations with chemical exceedances of LUT values and/or RBSLs were prepared for each 2.5-acre exposure area. For the Conservation of Natural Resources Alternative, maps identifying sample locations that were required to be removed in order to reduce cancer risk and non-cancer hazards to acceptable levels were prepared for each 2.5-acre exposure area. Areas that need to be excavated in order to remove these sample locations that exceeded the respective criteria for each alternative were delineated on the maps. The excavation footprint in square meters for each exposure area under each remedial action alternative was obtained using GIS. Volumes were estimated considering the depth of contamination. Multiple sample depths are available at most locations; for this analysis samples collected at depths up to 5 feet below ground surface were considered, which is consistent with findings from the Chemical Data Summary Report (CDM Smith 2017). Areas with at least one location having contamination depth greater than 2 feet were multiplied by the 5-foot depth to obtain the excavation volume, whereas areas with contamination depth not exceeding 2 feet were multiplied by the 2-foot depth to obtain excavation volumes.

A similar process was conducted for radionuclides except that maps identifying exceedances of LUTs for Cesium-137 and Strontium-90 were displayed to demarcate areas requiring excavation to meet cleanup-criteria. For the Conservation of Natural Resources Alternative, areas that were required to reduce cancer risk to acceptable levels were identified for each exposure area. The area in square meters for each scenario was obtained using GIS. The resulting areas were multiplied with the shallower depth of 2 feet to obtain excavation volumes for radiological risk.

The methodology used to estimate excavation volumes is described in greater detail in the *Risk Estimate Development* (CDM Smith 2016b).

4.2 Cost/Risk Analysis for Remedial Alternatives

This section evaluates the risk associated with remedial action alternatives and compares risks to the remedial action costs. **Table 4-1** presents the results from the risk assessment of the four exposure areas (the RMHF, the SRE area, B4064/NCY area, and 17th Street). These results include:

- the excavation volumes in each exposure area to meet cleanup requirement under each remedial alternative;
- the estimated remaining cancer risk and non-cancer hazard (based on HI[1]) in each exposure area after implementation of the remedial action alternatives; and
- the estimated present-worth of the remedial action cost under each remedial action alternative for the entire Area IV/NBZ.

The estimated remaining cancer risk and non-cancer hazards (HI) for each exposure area under each remedial action alternative are plotted onto graphs as shown in **Figure 4-2** and **Figure 4-3**, respectively. The x-axis in these graphs have been arranged such that the remedial action alternatives are shown in order of remaining risk from highest (e.g., No Action Alternative) to the lowest (e.g., Cleanup to AOC LUT). The range of risk in these four exposure areas is expected to represent the upper boundary across Area IV/NBZ for cancer risk and for non-cancer hazard.

Figures showing the locations in each exposure area identified for excavation based on chemical contamination, radionuclide contamination, and combined chemical and radionuclide contamination are presented in the *Risk Estimate Development* (CDM Smith 2016b).

4.2.1 No Action Alternative

Cost Estimate

The present worth of the life cycle cost to implement remedial action under this alternative is approximately $3MM (see **Section 3.4**). There are no capital costs associated with this alternative. The costs associated with this alternative are related to ongoing surveillance and long-term monitoring and maintenance.

Risk Reduction

Under this alternative, the Area IV/NBZ would be left as-is and no volume of contaminated soil would be removed; therefore, no risk reduction would be achieved. The risk remaining at Area IV/NBA would be the risk posed by the chemicals and radionuclide currently present in the soil.

For the four exposure areas evaluated for risk, the cancer risk under this alternative range from 6.3×10^{-5} (at the RMHF) to 3.5×10^{-4} (17th Street), and the hazard index for non-cancer hazard range from 0.8 (B4064/NCY area) to 30 (RMHF).

---

[1] For purposes of presentation in the CBA, all HI's as presented in Table 4-1 of *Risk Estimate Development* (CDM Smith 2016b) were rounded to the nearest one significant figure.

At the RMHF, the current cancer risk (6.3 x 10^{-5}) is within the USEPA target range of 1 x 10^{-6} and 1 x 10^{-4}. The other three areas only present a current cancer risk of slightly above the USEPA target range of 1 x 10^{-6} to 1 x 10^{-4}.

Under the No Action Alternative, the current non-cancer hazard, presented as HI, at the RMHF is highest among the four areas with an HI of 30. This HI is significantly higher than the other three areas, where HI ranges from 0.8 to 3. This is due to the presence of lead in soil at the RMHF; lead is not a COPC at the other three locations evaluated. At the B4064/NCY area, the HI is already within the acceptable value of 1.0.

4.2.2 Cleanup to AOC LUT Values Alternative

Cost Estimate

The total present worth of the life cycle cost to implement remedial action under this alternative is $468 MM (see **Section 3.4**). The present-value capital costs associated with this alternative is approximately $466MM, and the present-value periodic surveillance and long-term maintenance is approximately $2MM. The majority of the capital costs are associated with soil excavation and disposal costs.

Risk Reduction

Based on results from the risk assessment for the four exposure areas, the volumes that would be removed under this alternative in each of the exposure areas would range from 6,500 (RMHF exposure area[2]) to 24,000 cubic yards (B4064/NCY Area). The remaining cancer risk in the four exposure areas after the implementation of this alternative would range from 3.2 x 10^{-6} (17th Street) to 9.6 x 10^{-6} (RMHF), and the HI for non-cancer hazard would range from 0.02 (B4064/NCY area) to 0.4 (17th Street). The cancer risk results for the Cleanup to AOC LUT Values Alternative suggest that the inherent cancer risk of background concentrations at the Site (e.g., the cancer risk if COPC concentrations are at AOC LUT Values) is greater than 1 x 10^{-6} in all four exposure areas. The main risk driver for background cancer risk for all four exposure areas is Cesium-137.

The risk reduction benefit under this alternative is associated with the removal of soils containing COPC concentrations above the AOC LUT values. The cancer risk reduction from these exposure areas, which is the difference between the current cancer risk and the remaining cancer risk in each of the exposure areas under this alternative, would range from 5.3 x 10^{-5} (RMHF) to 3.4 x 10^{-4} (17th Street). The reduction in non-cancer hazard (HI) from these exposure areas would range from 0.8 (B4064/NCY area) to above 20 (RMHF).

4.2.3 Cleanup to Revised LUT Values Alternative

Cost Estimate

The total present worth of the life cycle cost to implement the remedial action under this alternative is $168MM (see **Section 3.4**). The present-value capital costs associated with this alternative is approximately $166MM, and the present-value periodic surveillance and long-term

---

[2] The RMHF encompasses approximately seven 2.5-acre exposure areas so actual volume of impacted soil at the RMHF is expected to be much greater; SRE encompasses nine exposure areas; 17th Street one exposure area; B4064/NCY area potentially four exposure areas.

maintenance is approximately $2MM. The majority of the capital costs are associated with soil excavation and disposal costs.

Risk Reduction

Based on results from the risk assessment for the four exposure areas, the volumes that would be removed under this alternative in each of the exposure areas would range from 2,500 (RMHF) to 9,600 cubic yards (17th Street). The remaining cancer risk in the four exposure areas after the implementation of this alternative would range from 3.7×10^{-6} (17th Street) to 9.8×10^{-6} (RMHF), and the hazard index for non-cancer hazard would range from 0.04 (B4064/NCY area) to 0.5 (17th Street and the SRE area).

The risk reduction benefit under this alternative is associated with the removal of soils containing COPC concentrations above the revised LUT values (RBSLs). The cancer risk reduction from these exposure areas, which is the difference between the current cancer risk and the remaining cancer risk in each of the exposure areas under this alternative, would range from 5.3×10^{-5} (RMHF) to 3.4×10^{-4} (17th Street). The reduction in non-cancer hazard (HI) from these exposure areas would range from 0.8 (B4064/NCY area) to above 20 (RMHF).

4.2.4 Conservation of Natural Resources Alternative

Cost Estimate

The present worth of the life cycle cost to implement remedial action under this alternative is $124MM (see **Section 3.4**). The present-value capital costs associated with this Alternative is approximately $122MM, and the present-value periodic surveillance and long-term maintenance is approximately $2MM. The majority of the capital costs are associated with soil excavation and disposal costs.

Risk Reduction

Based on results from the risk assessment for the four exposure areas, the volumes that would be removed under this alternative in each of the exposure areas would range from 13 (B4064/NCY area) to 290 cubic yards (17th Street). The remaining cancer risk in the four exposure areas after the implementation of this alternative would range from 1.1×10^{-5} (B4064/NCY area) to 4.0×10^{-5} (17th Street), and the hazard index for non-cancer hazard would range from 0.6 (RMHF) to 1 (17th Street) (see footnote[3]).

The risk reduction benefit under this alternative is associated with the removal of soil containing COPCs that drive the total risk within an exposure area to above the acceptable cancer risk level threshold of 1×10^{-4} and/or the non-cancer HI threshold of 1. The cancer risk reduction from these exposure areas, which is the difference between the current cancer risk and the remaining cancer risk in each of the exposure areas under this alternative, would range from 4.2×10^{-5} (RMHF) to 3.1×10^{-4} (17th Street). The reduction in non-cancer hazard (HI) from these exposure areas would range from 0 (B4064/NCY area) to above 20 (RMHF).

---

[3] For 17th Street, the total HI under the Conservation of Natural Resources Alternative is 1.3 before rounding according to Table 3-4 of the *Risk Estimate Development* (CDM Smith 2016b). However, the HI for individual target organs is less than 1, which is considered acceptable. HI is rounded to 1 significant figure for the purpose of presentation in this CBA.

4.3 Comparative Cost Benefit Analysis

This section compares the cancer risk and non-cancer health hazard (evaluated by HI) associated with the four exposure areas to the cost for implementation of each of the remedial action alternative in two ways:

1. Compare the remaining risks and the associated remedial action cost among the remedial action alternatives.
2. Compare the reduction in risk and the associated remedial action cost among the remedial action alternatives.

As stated in **Section 4.1.2**, the range of current risks in the four exposure areas is considered to represent the upper boundary across Area IV/NBZ for cancer risk and for non-cancer hazard. As such, this comparative cost benefit analysis between the cancer risk and non-cancer hazard for the four exposure areas and the site-wide remedial action alternative cost estimates is considered conservative, and appropriate for risk management decisions.

4.3.1 Remaining Cancer Risk, Remaining Non-Cancer Hazard, and Remedial Action Cost Comparison

This comparison demonstrates the costs associated with the alternatives relative to its ability to meet the target cancer risk range ($1x10^{-4}$ to $1x10^{-6}$ per USEPA) and the non-cancer hazard threshold (HI of 1.0).

Figure 4-4 presents the estimated remaining cancer risk for each exposure area under each remedial action alternative on one y-axis as well as the associated present worth of the remedial action costs for the remedial alternatives for the entire Area IV/NBZ on the other y-axis. This figure contains the same cancer risk-related information as **Figure 4-2**, except the remaining cancer risks from all of the exposure areas are plotted on the same graph instead of separately. The range of estimated cancer risk from the four exposure areas is expected to represent the upper boundary of cancer risk to be found elsewhere within Area IV/NBZ. This range of cancer risk is highlighted in **Figure 4-4** in light orange.

Figure 4-4 shows that all alternatives except the No Action Alternative would meet the USEPA target cancer risk range of $1x10^{-4}$ to $1x10^{-6}$, and that the estimated present-worth of the life cycle costs for these remedial action alternatives range from $124MM to $468MM. The figure shows that the cost to reduce risk from between $1x10^{-4}$ and $1x10^{-5}$ (Conservation of Natural Resources Alternative) to between $1x10^{-5}$ and $1x10^{-6}$ (Cleanup to Revised LUT Values Alternative) is roughly $44MM. It also shows that the estimated remaining risk in the Cleanup to Revised LUT Values Alternative and in the Cleanup to AOC LUT Values Alternative is similar, but the increase in cost between the two alternatives is roughly $300MM, an increase of 178% over the Cleanup to Revised LUT Values Alternative cost.

None of the alternatives meet the NCP's point of departure target risk of 1×10^{-6}. This is due to the inherent risk associated with the background concentrations of chemical and radionuclide constituents in the natural soil at the Site, which is greater than $1x10^{-6}$. The inherent risk of the background soil therefore limits the risk reduction to below $1x10^{-6}$ unless cleanup to less than background is performed.

Figure 4-5 presents the remaining non-cancer hazard for the four exposure areas under each remedial action alternative as well as the associated present worth of the remedial action cost for the remedial alternatives. It contains the same HI-related information as **Figure 4-3**, except the estimated remaining HI from all of the exposure areas are plotted on the same graph instead of separately. The figure shows that all alternatives except the No Action Alternative would meet the acceptable non-cancer hazard threshold with an HI of 1 or below, and that the present-worth of the remedial action costs for these alternatives range from $124MM to $468MM.

Since cleanup to HI of 1 is commonly considered acceptable, and is a commonly used cleanup metric for non-cancer hazard, any further reduction of HI below 1 is only added benefit, but not a cleanup driver. As such, this figure demonstrates that cleanup for non-cancer hazard under the Conservation of Natural Resources Alternative would be considered sufficient, and that any additional cleanup effort, if required, would be driven by cancer risk.

4.3.2 Reduction of Cancer Risk, Reduction of Non-Cancer Hazard, and Cost Comparison

This comparison among the alternatives demonstrates the relative benefit in terms of estimated percent reduction in cancer risk, the estimated percent reduction in HI, and its associated cost estimate among the remedial action alternatives. Estimated percent cancer risk and percent HI reductions were determined using the risk reduction under the Cleanup to AOC LUT Values Alternative as basis. The estimated percent reductions in both cancer risk and in HI under the Cleanup to AOC LUT Values Alternative are the greatest among the four remedial action alternatives evaluated, and is therefore used as a basis of comparison for other alternatives when evaluating risk-reduction benefit.

Reduction of Cancer Risk and Cost Comparison

Figure 4-6 presents the estimated percent reduction in cancer risk of each remedial action alternative relative to the Cleanup to AOC LUT Values Alternative. Percent reduction was calculated by taking the reduction of remaining cancer risk between the alternative being evaluated and the No-Action Alternative, and divide that by the reduction of remaining risk between the No Action Alternative and the Cleanup to AOC LUT Values Alternative, as demonstrated below:

$$Percent\ Reduction\ in\ Cancer\ Risk =$$

$$\frac{(Cancer\ Risk\ under\ No\ Action - Cancer\ Risk\ under\ Alternative\ of\ Interest)}{(Cancer\ Risk\ under\ No\ Action - Cancer\ Risk\ Under\ Cleanup\ to\ AOC\ LUT)}\ x\ 100\%$$

Therefore, the percent reduction in cancer risk is always 0% under the No Action Alternative (e.g., no risk reduction) and always 100% under the Cleanup to AOC LUT Values Alternative. Percent reduction in cancer risk is also presented in **Table 4-1**.

The results show that for three of the four exposure areas evaluated, the Conservation of Natural Resources Alternative would achieve approximately 90% or more of the cancer risk reduction compared to the Cleanup to AOC LUT Values Alternative. At the RMHF, the cancer risk percent reduction under the Conservation of Natural Resources Alternative is 78.7% despite the current cancer risk range (e.g., cancer risk under No Action Alternative) is already within the USEPA target cancer risk range. The cost for the above range of cancer risk reduction benefit (e.g., cost of Conservation of Natural Resources Alternative for the entire Area IV/NBZ) is estimated to be $124MM.

Under the Cleanup to Revised LUT Values Alternative, approximately 99.4% to 99.9% of the cancer risk reduction relative to the Cleanup to AOC LUT Values Alternative is achieved. Relative to the Conservation of Natural Resources Alternative, the increase in percent risk reduction ranges from 1.8% to 21%. The cost for the Cleanup to Revised LUT Values Alternative is $168MM, which is an additional $44MM over the cost of the Conservation of Natural Resources Alternative.

Under the Cleanup to AOC LUT Values Alternative (100% risk reduction by definition), the percent risk reduction is almost identical to the Cleanup to Revised LUT Values Alternative (99.4% to 99.9%). The cost for the Cleanup to AOC LUT Values Alternative is $468MM, which is an additional $300MM over the cost of the Cleanup to Revised LUT Values Alternative.

Reduction of Non-Cancer Hazard and Cost Comparison

Figure 4-7 presents the estimated percent reduction in HI of each remedial action alternative relative to the Cleanup to AOC LUT Values Alternative. Percent reduction was calculated by taking the reduction of remaining HI between the alternative being evaluated and the No-Action Alternative, and divide that by the reduction of remaining HI between the No Action Alternative and the Cleanup to AOC LUT Values Alternative, as demonstrated below:

$$Percent\ Reduction\ in\ HI =$$

$$\frac{(HI\ under\ No\ Action - HI\ under\ Alternative\ of\ Interest)}{(HI\ under\ No\ Action - HI\ Under\ Cleanup\ to\ AOC\ LUT)}\ x\ 100\%$$

Therefore, the percent reduction in HI is always 0% under the No Action Alternative (e.g., no HI reduction) and always 100% under the Cleanup to AOC LUT Values Alternative. Percent reduction in HI is also presented in **Table 4-1**.

The results show that for three of the four exposure areas evaluated, the Conservation of Natural Resources Alternative would achieve HI reduction ranging from 62.5% to 97.6%. At the B4064/NCY area, the HI percent reduction under the Conservation of Natural Resources Alternative is 0%. This is because the current non-cancer hazard at B4064/NCY area is already considered acceptable (HI of 0.8, which is less than the acceptable HI of 1), and therefore require no further cleanup with respect to non-cancer hazard under the Conservation of Natural Resources Alternative. The cost for the Conservation of Natural Resources Alternative for the entire Area IV/NBZ is estimated to be $124MM.

Under the Cleanup to Revised LUT Values Alternative, HI reductions of 92.6% to 99.7% in the four exposure areas are achieved. Relative to the Conservation of Natural Resources Alternative, the increase in percent HI reduction for the Cleanup to Revised LUT Values Alternative ranges from 2% (RMHF) to 97.4% (B4064/NCY area). The cost for the Cleanup to Revised LUT Values

Alternative is $168MM, which is an additional $44MM over the cost of the Conservation of Natural Resources Alternative.

Under the Cleanup to AOC LUT Values Alternative, the percent HI reduction is only 0.3% to 7.4% greater than the Cleanup to Revised LUT Values Alternative. The cost for the Cleanup to AOC LUT Values Alternative is $468MM, an additional $300MM over the Cleanup to Revised LUT Values Alternative.

Table 4-1 - Exposure Areas Risk Assessment Results
SSFL Area IV / NBZ

			No Action Alternative	Conservation of Natural Resources Alternative	Cleanup to Revised LUT Values Alternative	Cleanup to AOC LUT Values Alternative
Volume	Volume to be Removed (Cubic Yard)	B4064/NCY	0	13	9,400	24,000
		RMHF	0	169	2,500	6,500
		17th St	0	290	9,600	18,000
		SRE	0	281	7,000	18,000
		Minmum	0	13	2,500	6,500
		Maximum	0	290	9,600	24,000
		Average	0	188	7,125	16,625
Cancer Risk	Cancer Risk	B4064/NCY	3.2E-04	1.1E-05	5.2E-06	4.9E-06
		RMHF	6.3E-05	2.1E-05	9.8E-06	9.6E-06
		17th St	3.5E-04	4.0E-05	3.7E-06	3.2E-06
		SRE	1.3E-04	1.5E-05	5.3E-06	4.5E-06
		Minmum	6.3E-05	1.1E-05	3.7E-06	3.2E-06
		Maximum	3.5E-04	4.0E-05	9.8E-06	9.6E-06
		Average	2.2E-04	2.2E-05	6.0E-06	5.6E-06
	Percent Reduction in Cancer Risk Relative to Percent Reduction of Cleanup to AOC LUT Values Alternative	B4064/NCY	0%	98.1%	99.9%	100%
		RMHF	0%	78.7%	99.6%	100%
		17th St	0%	89.4%	99.9%	100%
		SRE	0%	91.6%	99.4%	100%
		Minmum	0%	78.7%	99.4%	100%
		Maximum	0%	98.1%	99.9%	100%
		Average	0%	89.4%	99.7%	100%
Non-Cancer Hazard	Non-Cancer Hazard (as Hazard Index, or HI)[2]	B4064/NCY	0.8	0.8	0.04	0.02
		RMHF	30	1.0	0.4	0.3
		17th St	2	1	0.5	0.4
		SRE	3	0.8	0.5	0.3
		Minmum	0.8	0.8	0.04	0.02
		Maximum	30	1	0.5	0.4
		Average	9	0.9	0.4	0.3
	Percent Reduction in Non-Cancer Hazard (as HI) Relative to Percent Reduction of Cleanup to AOC LUT Values Alternative	B4064/NCY	0%	0.0%	97.4%	100%
		RMHF	0%	97.6%	99.7%	100%
		17th St	0%	62.5%	93.8%	100%
		SRE	0%	81.5%	92.6%	100%
		Minmum	0%	0.0%	92.6%	100%
		Maximum	0%	97.6%	99.7%	100%
		Average	0%	60.4%	95.9%	100%
Cost	Present Worth of Remedial Action Cost for the Entire Area IV / NBZ (Million U.S. Dollars)		$3MM	$124MM	$168MM	$468MM

Notes:

1. The remedial action alternatives are presented in the order (from left to right) of excavation volume (from least to most) and therefore of remaining risk (from highest risk to lowest risk).

2. For the purposes of presentation in the CBA, the HI's as presented in Table 4-1 of the Risk Estimate Development (CDM Smith 2016b) have been rounded to the nearest one significant figure.

B4064/NCY - Building 4064 / New Conservation Yard area

RHMF - Radioactive Material Handling Facility

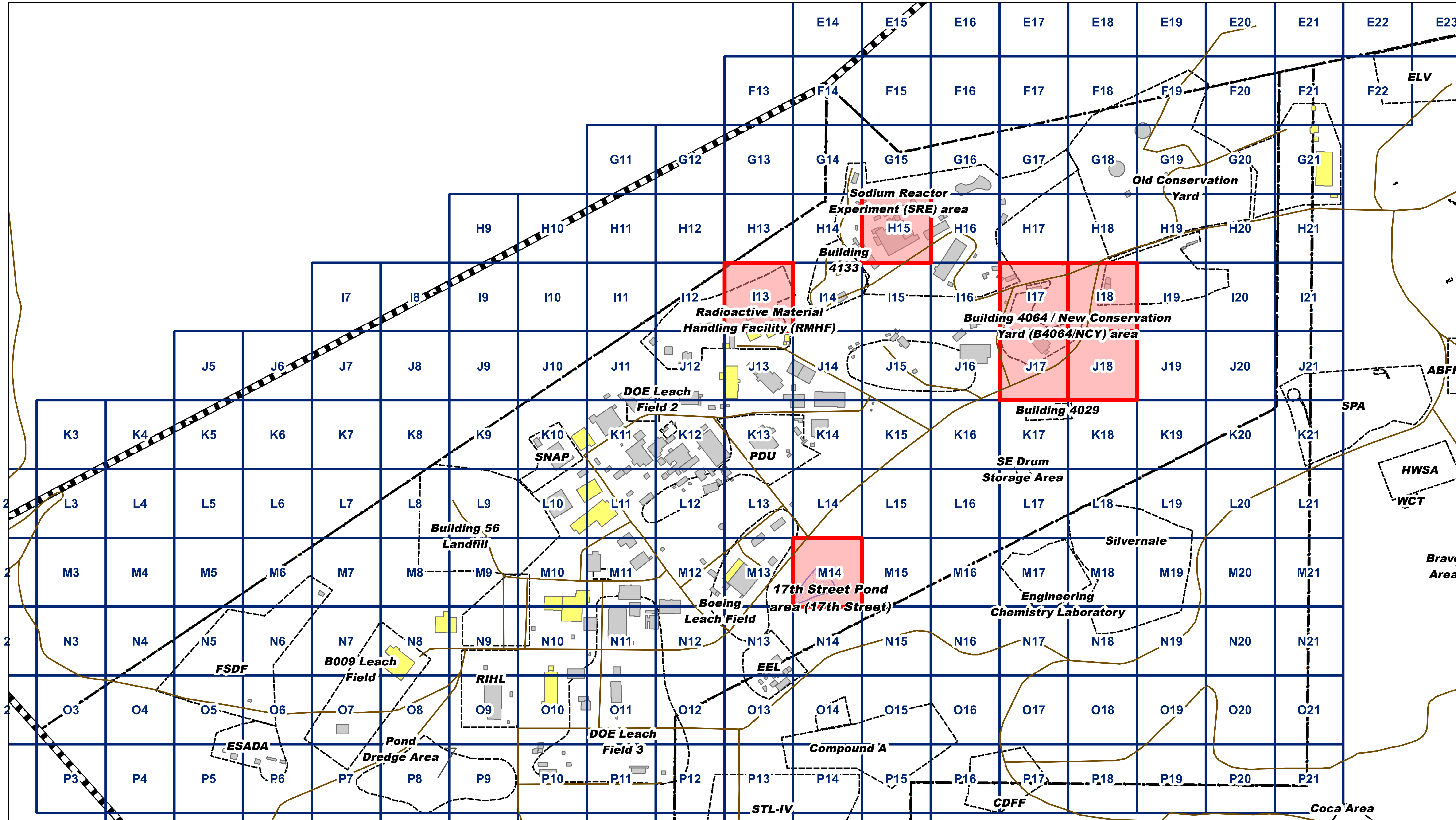
17th St - 17th Street Pond

SRE - Sodium Reactor Experiment Area

HI - hazard index

AOC - Administrative Order on Consent for Remedial Action

LUT - Look-up Table



Legend

- Road Centerline
- Former Pond
- Demolished Structure
- Existing Structure
- Exposure Areas
- Grid (100m x 100m)
- RI Site Boundary
- Area Boundary
- SSFL Property Boundary

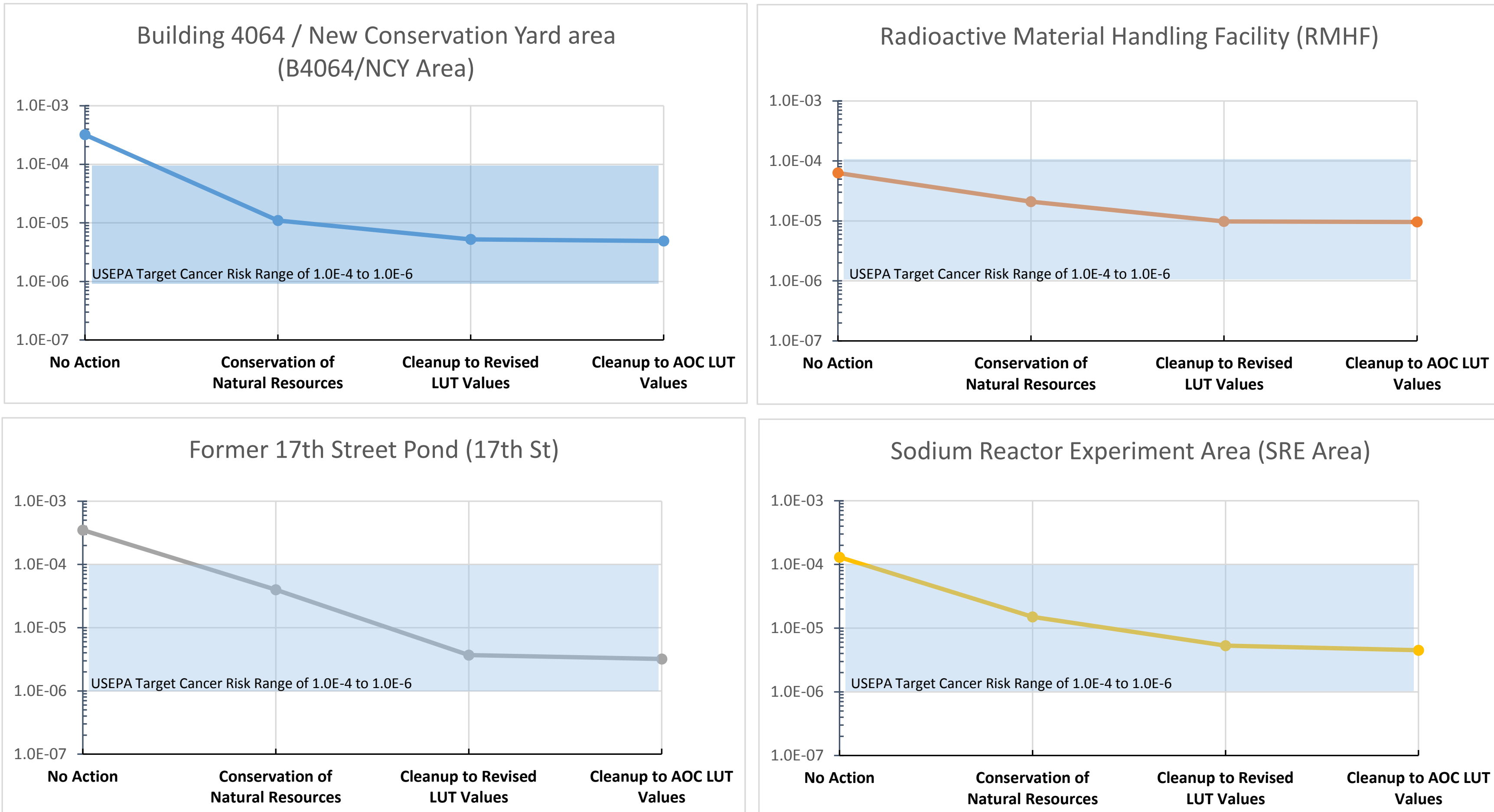
Risk Assessment Exposure Areas

Santa Susana Field Laboratory
Ventura County, California
Figure 4-1

N

0 65 130 260 390 Meters

P:\Santa Susanna\GIS\MXD\RiskAssessment\SSFL_RA_ExposureAreas_20160302.mxd 3/10/2016

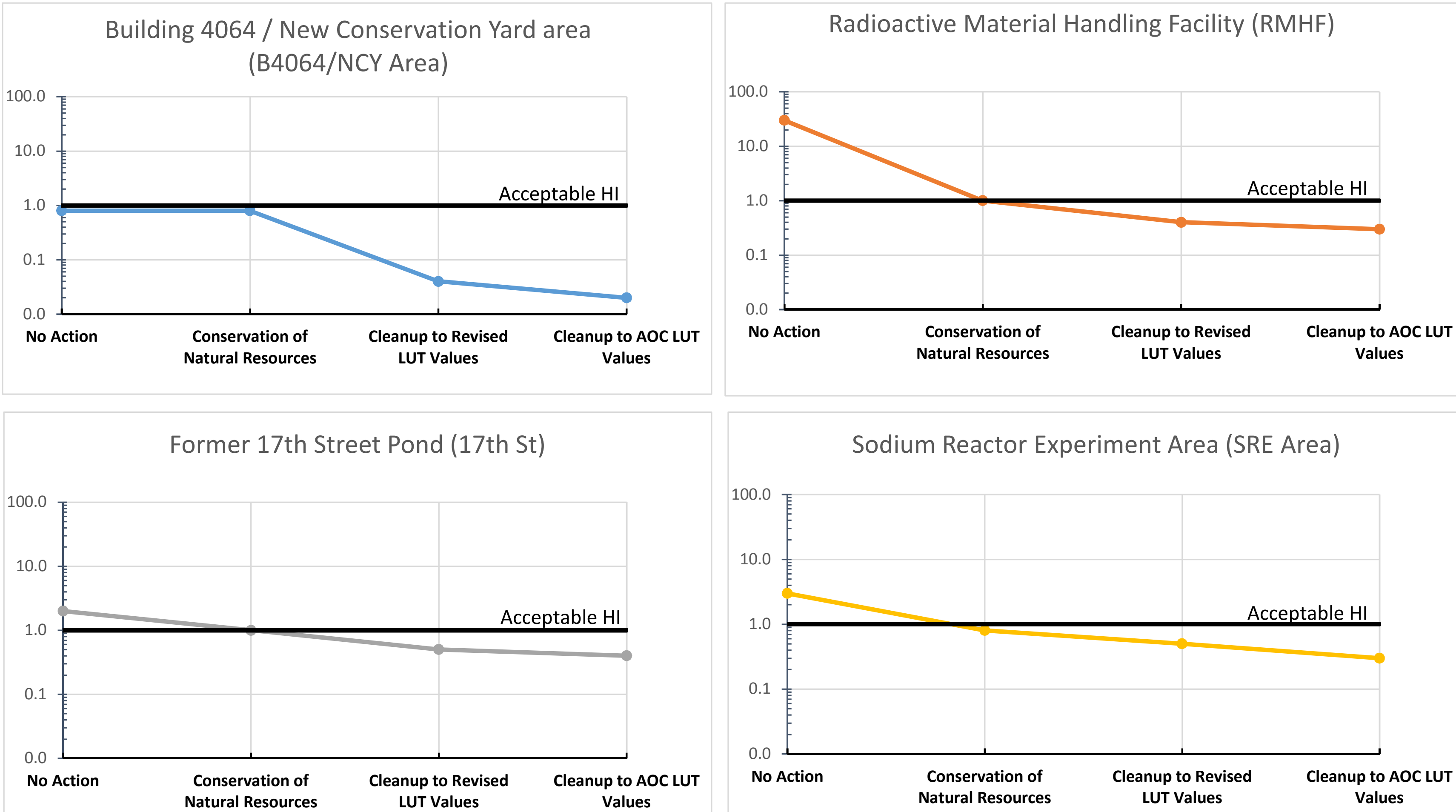


Notes:

AOC - Administrative Order of Consent

LUT - Lookup Table

Figure 4-2 Remaining Cancer Risk at Each Exposure Area



Notes:

HI - hazard index

AOC - Administrative Order of Consent

LUT - Lookup Table

Note: For the purposes of presentation in the CBA, the HI's as presented in Table 4-1 of the *Risk Estimate Development* (CDM Smith 2016b) have been rounded to the nearest one significant figure.

Figure 4-3 Hazard Index for Remaining Non-Cancer Hazard at Each Exposure Area

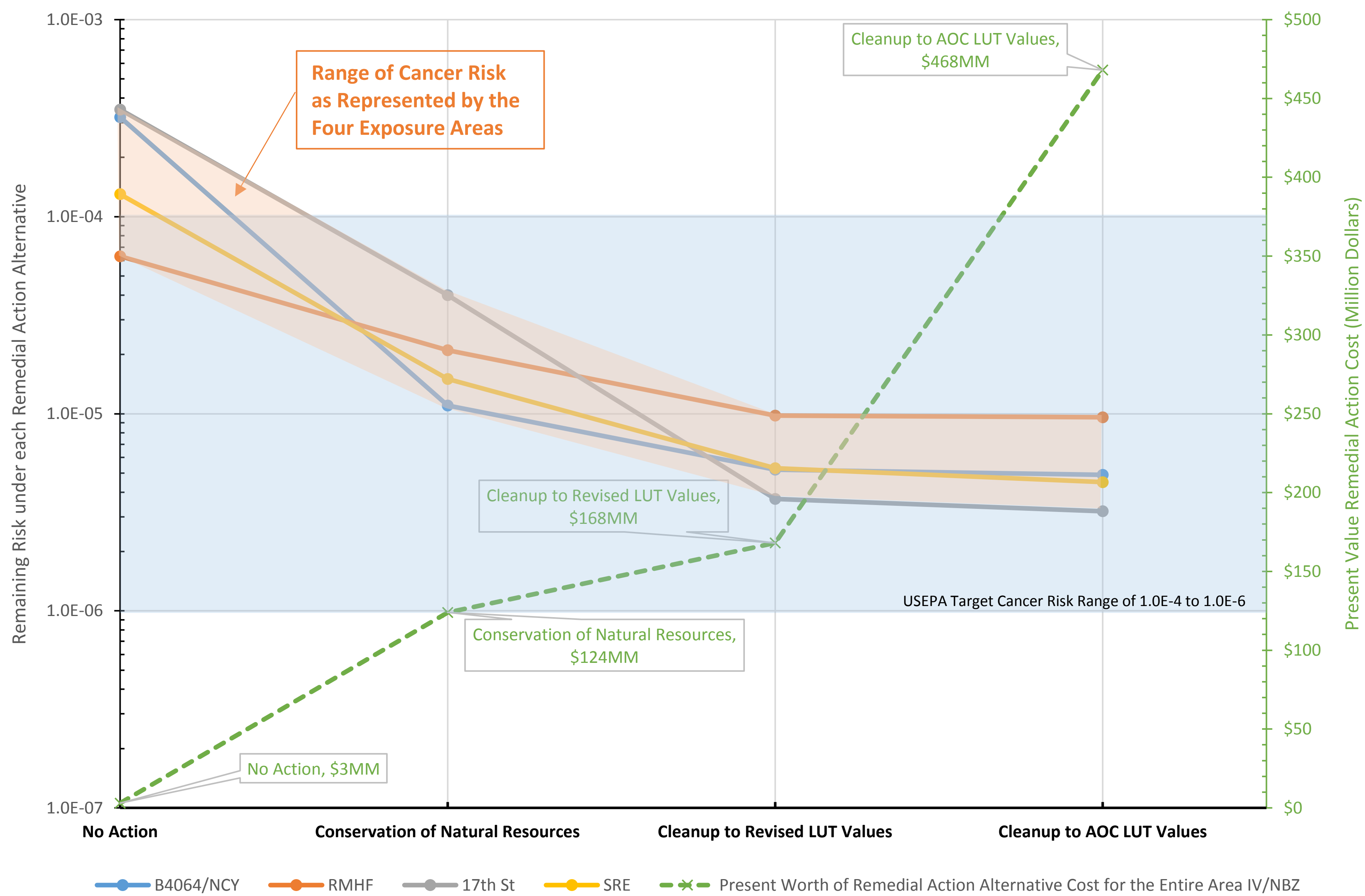


Figure 4-4 Remaining Cancer Risk and Remedial Action Cost among Remedial Alternatives

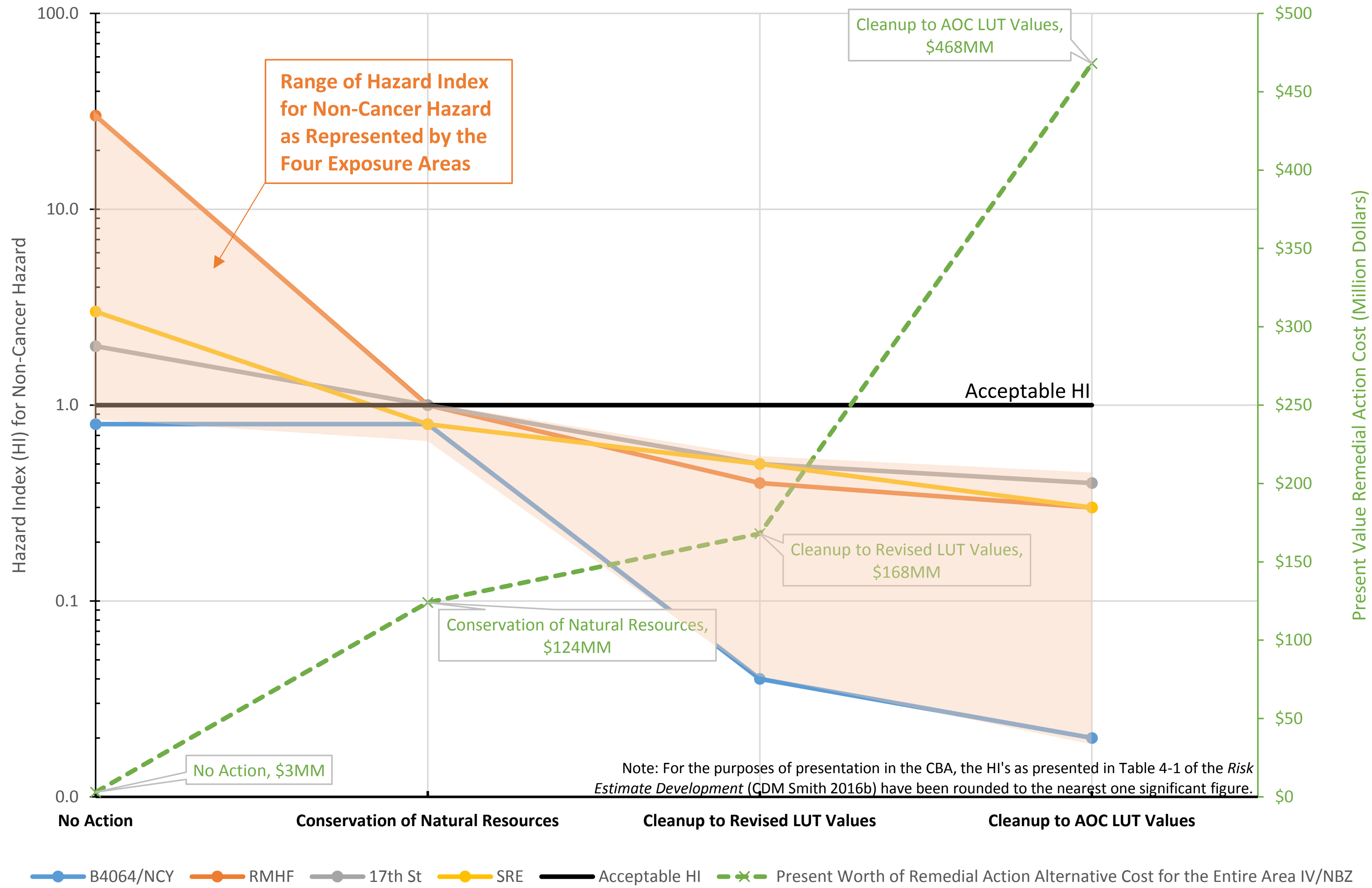


Figure 4-5 Remaining Non-Cancer Hazard and Remedial Action Cost among Remedial Alternatives

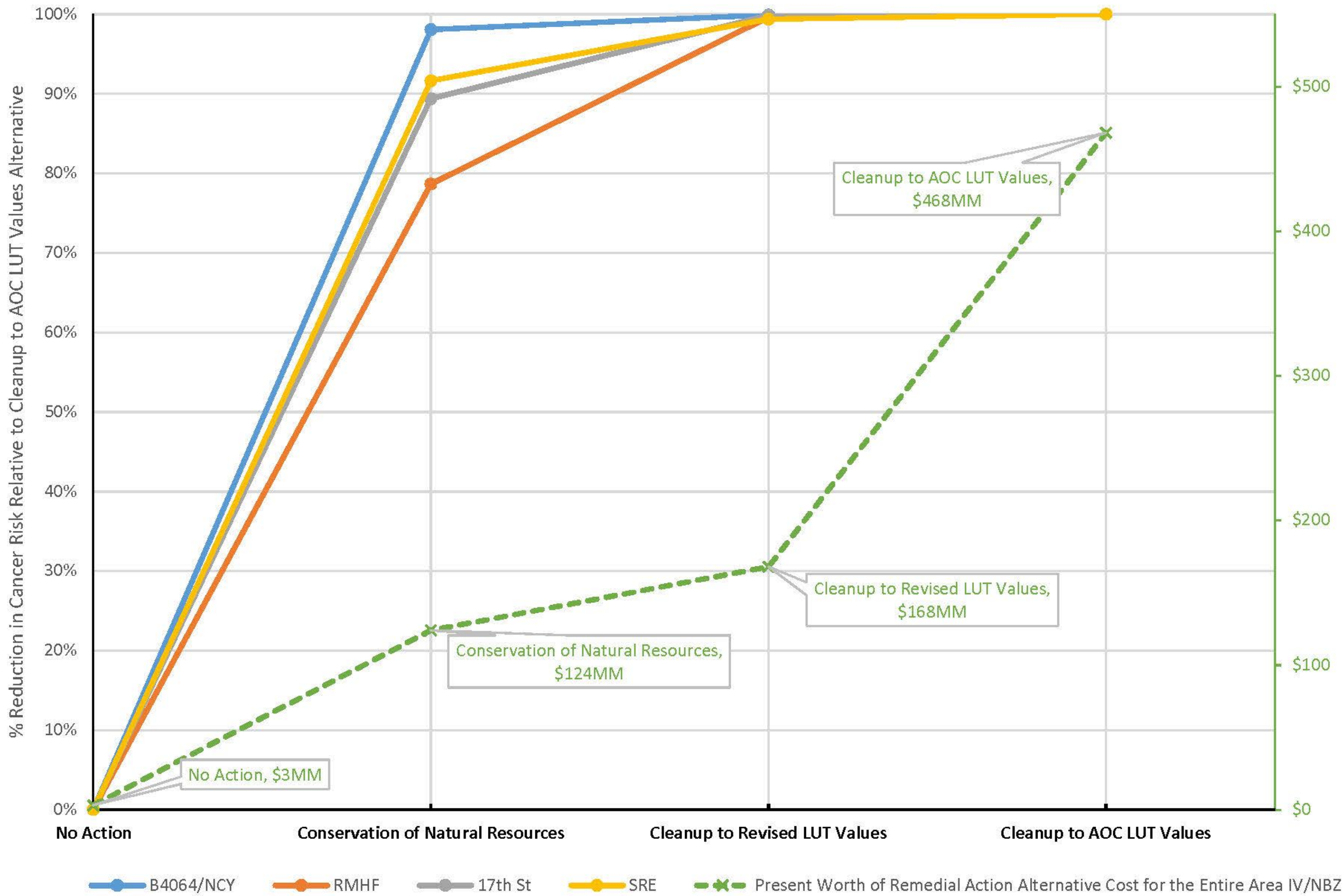


Figure 4-6 Percent Reduction in Cancer Risk among the Remedial Alternatives

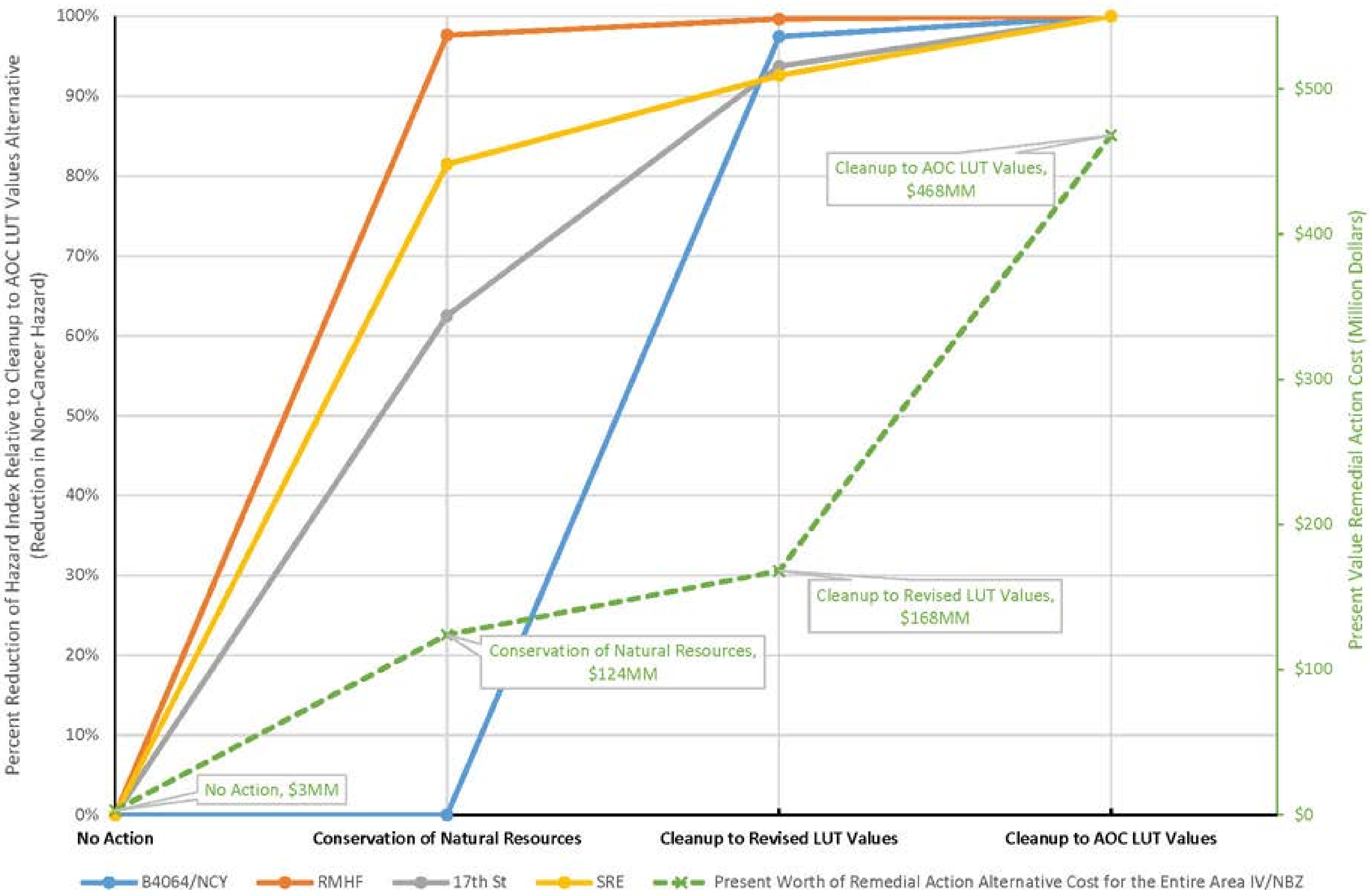


Figure 4-7 Percent Reduction in Non-Cancer Hazard among the Remedial Alternatives

Section 5

Uncertainty in Cleanup Decisions

In this section, the uncertainties in cleanup decisions associated with the EIS remedial action alternatives are evaluated. In general, uncertainty in cleanup decisions is higher when concentrations of COPCs are similar (e.g., in the same order of magnitude as) to the cleanup standards because of the difficulty to differentiate between contaminated soil that requires cleanup and clean soil that does not require remediation. In order to make cleanup decisions that involve remediation of only contaminated soils that exceed cleanup standards (e.g., no unnecessary remediation of clean soil), the remediation manager would require having high confidence in the conclusion that contaminants are present at concentrations that exceed the cleanup standard. In making cleanup decisions, two types of decision errors are possible:

- A *false negative decision error* would occur if a remediation manager decides site exposures are not of health concern, when in fact they are of concern.
- A *false positive decision error* would occur if a remediation manager decides site exposures are above a level of concern, when in fact they are not.

Remediation managers are most concerned about guarding against the occurrence of false negative decision errors, since an error of this type may leave human and ecological receptors exposed to unacceptable levels of contamination. However, remediation managers are also concerned with the probability of making false positive decision errors. Although this type of decision error does not result in unacceptable exposures, it may result in unnecessary expenditure of resources (i.e., remediation of soils that are not actually contaminated). For the purposes of the Area IV/NBZ, the goal is to limit the false positive decision error rate to 5% or less (DTSC 2013).

5.1 Cleanup to AOC LUT Values Alternative

As described in **Section 2**, the AOC LUT values are either derived from the background threshold value (BTV) or the laboratory method reporting limit (MRL). BTVs were calculated from the *established*[1] background soil dataset as the upper simultaneous limit at 95 percent confidence (USL95) (DTSC 2012). MRLs were based on either the laboratory MRL from the background study (referred to as the "BG MRL") or as determined based on multi-laboratory evaluation of MRLs for several different laboratories in earlier site investigations (referred to as the "M-L MRL").

The AOC LUT value derivation procedure (DTSC 2013) incorporated an adjustment to specify a false positive decision error rate of 5% for analytical measurement uncertainty as follows:

$$\text{LUT value} = \text{Cleanup Level} + 1.645 \cdot U_M$$

[1] The *established* background dataset excludes outliers (as identified in DTSC, 2012).

where:

Cleanup Level = the greater of the background BTV or the method reporting limit (MRL)

U_M = the analytical measurement uncertainty (see Table 1 in DTSC, 2013)

1.645 = the normal distribution quantile consistent with 5% false positive decision error

5.1.1 Compounding Decision Error

Although the AOC LUT derivation procedure was intended to limit the false positive error rate to 5% (i.e., there would only be a 5% chance that a soil that is not contaminated would be deemed to be above the LUT), this procedure did not take into consideration there is the potential for compounding decision error due to the fact that each soil sample is analyzed for multiple chemicals and radionuclides. For any given sample, the reported results must meet the LUT values for more than 120 different chemicals and radionuclides in order to be deemed "clean soil" (i.e., no remediation required). If each chemical or radionuclide has an independent 5% chance of failure, then compounding the cleanup decision based on 116 different chemicals and 16 radionuclides means there is a greater chance that DOE would be remediating clean soil, not contaminated soil (i.e., the false positive decision error is greater than 5%).

In order to further evaluate the issue of compounding decision error, statistical simulations using the Monte Carlo method were performed. Monte Carlo simulation is a computer-based method for iteratively analyzing how variability and uncertainty affects the reliability of the system that is being modeled (USEPA 1997). In the simulation, inputs are randomly generated from probability distributions to simulate the process of sampling from an actual population.

Table 5-1 illustrates the issue of compounding false positive decision error. This table presents the output of a Monte Carlo simulation (Simulation 1A) in which the "true" soil concentration represents clean soil (i.e., equivalent to the DTSC established background dataset). For each analyte, the sample concentration is specified as a lognormal distribution with the mean and standard deviation set equal to the calculated statistics based on the DTSC established background dataset. Analytical uncertainty was incorporated into the simulation by specifying the analyte result as a normal distribution with the mean set equal to the simulated sample concentration and the standard deviation based on the U_M specified in Table 1 of DTSC (2013). In this simulation, a false positive error occurred when the simulated analyte result, which is equivalent to background, exceeded its respective AOC LUT value. The false positive error rate was tracked for each analyte and across all analytes in a simulation of 10,000 iterations. It was not necessary to track the false negative decision error rate because the true concentration is specified as background; thus, the simulated concentration, by definition, is equal to background (i.e., there is no such thing as a false negative, only true negatives). For the purposes of illustration, the simulation was restricted to 84 chemicals with an AOC LUT value. However, the concept of compounding decision error would also apply to radionuclides and would be exacerbated further for samples where more than 84 chemicals have been analyzed.

As illustrated in **Table 5-1**, although there are no individual analytes for which the false positive error rate is greater than 5% under Simulation 1A, the false positive error rate across all analytes is about 10%, meaning that in about 1,000 of 10,000 simulations the simulated sample was ranked as “contaminated soil” for one or more analytes when the sample was actually representative of background conditions. This simulation demonstrates the AOC LUT values will not limit the false positive decision error to 5% or less. The false positive error rate from the simulation is likely biased low because it defines clean soil in terms of the established background dataset (i.e., where potential outliers have been excluded).

Therefore, a second simulation (Simulation 1B) was performed in which the true soil concentration was equivalent to the DTSC distinct background dataset (i.e., where potential outliers in the background dataset had not been excluded). As illustrated in **Table 5-1**, in Simulation 1B, the false positive error rate was less than 5% for the majority of analytes (70 of 84 analytes; 83%). However, there were several individual analytes where the false positive error rate was above 5%; typically, this occurred most frequently for analytes where the concentration coefficient of variation (CV) was higher than 0.5. In addition, the false positive error rate across all analytes was greater than 90%, significantly higher than the target decision error limit of 5%.

This simulation assumes that contamination is independent for each analyte. Independence means the presence of one analyte is unrelated (i.e., not correlated or not derived from the same source or mechanism) with the presence of another analyte. If specific analytes are dependent (i.e., are correlated and expected to be co-located), the impact of compounding decision error is likely to be decreased. Thus, although this is likely to represent a “worst case” simulation example, it clearly demonstrates the concept of compounding decision error.

5.1.2 Comparison of DTSC Background Locations to AOC LUT Values

The results of these simulations are supported by a comparison of the DTSC background soil results to the AOC LUT values. A comparison of the DTSC distinct background soil dataset results with the AOC LUT values shows 61 of the 268 collected background soil samples had one or more analytes that exceeded its respective AOC LUT value, which corresponds to a false positive error rate of 23%. This comparison demonstrates the application of the AOC LUT values to the background study locations, which are “clean soil” by definition, would have resulted in unnecessary soil remediation at nearly one quarter of all the background sampling locations.

It is recognized some of these 61 background soil samples above the AOC LUT values were likely deemed to be outliers as part of the BTV derivation process. While the exclusion of outliers is appropriate for the purposes of deriving BTVs, it is not possible to distinguish which samples within the Area IV/NBZ dataset may actually be representative of these authentic background outliers. Thus, when evaluating the Area IV/NBZ soil dataset relative to the AOC LUT values, inevitably it is likely some samples within the dataset would be consistent with the background outliers but incorrectly identified as “contaminated soil” in need of remediation.

It is also possible that some of these 61 background soil samples are above the AOC LUT values because they contain infrequently detected chemicals for which the AOC LUT was based on the MRL. For example, toxaphene was detected in 3 of the 148 (2%) background soil samples analyzed for organic chemicals. Due to the low detection frequency, the AOC LUT value was based on the MRL, despite the fact the background dataset supports the conclusion that infrequent detections of toxaphene are present in background locations. Therefore, if toxaphene is detected in Area IV/NBZ soil, its presence may not necessarily be indicative the soil is contaminated.

5.1.3 Derivation of BTVs

As described above, BTVs were calculated from the established background soil dataset (meaning identified outliers were excluded prior to the calculation). Although the exclusion of outliers is consistent with BTV derivation guidance (USEPA 2013), the approach for identifying statistical outliers in the background datasets used the Rosner method, which is based on the assumption that the data are normally distributed (DTSC 2013). However, in many cases, after identified outliers were removed, the data were determined to be gamma-distributed. Therefore, it is possible the use of the Rosner method identified more samples as outliers than necessary, which would tend to lower the resulting USL95 (i.e., the BTV would be biased low). If the BTV were too low, this would tend to increase the false positive decision error rate.

An alternate outlier identification approach, which may limit the number of potential outliers, would be to perform iterative goodness of fit (GOF) tests, sequentially removing the maximum concentration until the GOF test passes. If fewer outliers were removed, the calculated USL95 would tend to be higher, which would lower the false positive decision error rate when making comparisons to the AOC LUT values.

Another alternate approach to try to limit the issue of compounding false positive decision error would be to change the underlying USL statistic (e.g., from a 95% to a 99% coverage) when deriving the BTV. For example, for 5 independent analytes, the individual analyte confidence levels would be: 1 – 0.05/5 = 0.99 (USL99), and for 80 independent analytes: 1 – 0.05/80 = 0.999 (USL99.9) (Bonferroni correction). However, due to the high number of COPCs that need to be evaluated, it is unlikely that the necessary coverage will be possible.

5.2 Cleanup to Revised LUT Values Alternative

As discussed above, use of the AOC LUT values to identify soil samples requiring remediation is likely to result in a false positive decision error rate above 5%. Thus, an alternate cleanup scenario has been evaluated to try to limit the false positive error rate, but still ensure soils that have the potential to result in unacceptable risks are identified for remediation.

For the Cleanup to Revised LUT Values Alternative, the application of the LUT values is similar to the Cleanup to AOC LUT Values Alternative, meaning the Area IV/NBZ results are compared on a point-by-point basis to the action level, but revised LUT values are proposed. These revised LUT values are based on risk-based screening levels (RBSLs), which are derived based on a target cancer risk of 1×10^{-6} and non-cancer hazard quotient (HQ) of 1 and assuming a default suburban residential exposure scenario (i.e., 24 hours per day, 350 days per year, 30 years).

To evaluate the potential false positive error rate for the RBSL-based approach, another Monte Carlo simulation was performed (Simulation 2). This simulation was similar to what was described above for Simulation 1B; the "true" soil concentration represents clean soil (i.e., equivalent to the DTSC *distinct* background dataset) and the sampling variability and analytical uncertainty distributions were specified in the same manner as described for Simulation 1B.

However, in Simulation 2, a false positive error occurred when the simulated analyte result, which is equivalent to background, exceeded its respective RBSL value[2].

As illustrated in **Table 5-1**, under Simulation 2, there are no individual analytes for which the false positive error rate is greater than 5% and the false positive error rate across all analytes is also below 5%. By way of comparison, the same underlying distribution assumptions yielded a false positive error rate higher than 90% for Simulation 1B under the Cleanup to AOC LUT Values Alternative (see **Table 5-1**).

However, under Cleanup to Revised LUT Values Alternative, the false positive error rate will depend upon the proximity of the true mean concentration to the RBSL and the underlying concentration variability. As the true concentration approaches the RBSL and as the variability increases, the likelihood of a false positive decision error increases. **Figure 5-1** illustrates this concept. As shown, when the true mean is far from the RBSL (e.g., 20 times lower than the RBSL), the likelihood of a false positive decision error is low, even when there is a high variability in the underlying concentration data (e.g., CV is 1.5). The false positive decision error rate increases as the true mean approaches the RBSL; for example, for a CV of 1.0, the false positive decision error rate is about 7% when the true mean is 10 times lower than the RBSL and increases to almost 60% when the true mean is 5 times lower than the RBSL.

5.3 Conservation of Natural Resources Alternative

As described above, the Cleanup to Revised LUT Values Alternative will tend to limit the frequency of potential false positive decision errors more effectively than the Cleanup to AOC LUT Values Alternative. However, both the Cleanup to AOC LUT Values Alternative and the Cleanup to Revised LUT Values Alternative employ a point-by-point evaluation; meaning decisions regarding the need for soil remediation are determined on a sample-by-sample basis. In essence, this type of evaluation sets the receptor exposure area equal to a single sampling location, effectively assuming the entire exposure duration (i.e., 24 hours per day, 365 days per year, 30 years) is spent at that single location. Clearly, such an assumption is unrealistic. The more likely exposure scenario is that a given receptor will be exposed in a larger area and the long-term exposure will be represented based on multiple sampling locations within that area.

According to risk assessment guidance (USEPA 1989), it is assumed a receptor will be randomly exposed across the entire exposure area; hence, the exposure concentration metric is based on the mean concentration within the exposure area. If there are subareas within the exposure area that have different concentrations, their contribution to the calculated mean will be in relative proportion to their spatial extent within the area (i.e., a small area of high concentration will have only a small contribution to the exposure area mean, but a large area of high concentration will greatly influence the exposure area mean). To minimize chances of underestimating the true amount of exposure and risk, risk calculations are based on the 95% upper confidence limit (95UCL) of the sample mean (USEPA 1992). Use of the 95UCL in risk calculations limits the probability of a false negative decision error to no more than 5%.

Under this alternative, soil remediation determinations are made in terms of the exposure area, such that the *mean* concentration that remains in the exposure area after cleanup will be within

[2] If the RBSL was lower than the AOC LUT (e.g., arsenic), the AOC LUT was selected as the RBSL.

the specified limits of acceptability. Thus, if an exposure area has a 95UCL concentration above the risk-based limit (e.g., RBSL), some level of remediation is required. However, it is not necessary that all concentrations above the risk-based limit within the exposure area are remediated. Rather, all that is required is to remediate enough of the exposure area such that the mean concentration is reduced below the risk-based limit. The concentration value that is to be removed to achieve the risk-based limit is often referred to as a Remedial Action Level (RAL). The concept of and difference between risk-based limits and RALs is discussed in Schultz and Griffin (2001)[3].

The appropriate RAL will depend upon the nature and extent of contamination in any given exposure area. As part of the Conservation of Natural Resources Alternative, the RAL concept has been applied to four different exposure areas at the Site. In applying this approach, specific soil sampling locations were "statistically removed" from the calculated 95UCL until the resulting risk estimates derived from the 95UCL resulted in a cumulative cancer risk below 1×10^{-4} and a non-cancer HI less than 1. These "statistically removed" samples effectively represent those locations within the exposure area where remedial actions would be taken.

The false positive decision error rate under this alternative will depend upon 1) the variability in the underlying exposure area dataset and 2) the proximity of the exposure area mean to the RAL. If there is high variability in the reported sample concentrations for a given exposure area, the likelihood of a false positive error will increase; this is because the difference between the mean concentration and the calculated 95UCL concentration (which is the statistic used as the basis of the remedial decision) will be large. As the exposure area mean concentration approaches the RAL, the likelihood of a false positive decision error will also tend to increase. The false positive decision error can be decreased through the collection of additional samples (e.g., as part of a soil confirmation study to guide remedial actions). USEPA's *Guidance on Systematic Planning Using the Data Quality Objectives Process* (USEPA 2006) provides detailed information on how to specify a sampling design such that it achieves a target false positive decision error rate. In general, when the study objectives are to characterize the mean concentration and limit variability, sampling designs in which multi-point composite samples are collected using a systematic approach are preferred.

---

[3] See also http://www2.epa.gov/region8/calculating-preliminary-remediation-goals-prgs

Table 5-1. Monte Carlo Simulation Results of False Positive Error Rates

	Simulation:	1A	1B	2
	Alternative:	Cleanup to AOC LUT Values		Cleanup to Revised LUT Values
	Basis of True Conc.: Cleanup Level:	Established Bkg* AOC LUT	Distinct Bkg** AOC LUT	Distinct Bkg** RBSL
Analysis Method	**Analyte**	**False Positive Error Rate (%)**		
6010B/6020A	Aluminum	0.01%	0.18%	0.01%
	Antimony	0.55%	**7.09%**	0.01%
	Arsenic	0.23%	1.97%	1.91%
	Barium	0.00%	0.01%	0.00%
	Beryllium	0.32%	0.24%	0.00%
	Boron	0.06%	0.60%	0.00%
	Cadmium	0.66%	0.29%	0.00%
	Calcium Metal	ncl	ncl	ncl
	Chromium	0.29%	0.21%	0.00%
	Cobalt	0.03%	0.05%	0.05%
	Copper	0.00%	0.03%	0.00%
	Iron	ncl	ncl	ncl
	Lead	0.12%	0.20%	0.00%
	Lithium	0.00%	0.25%	0.00%
	Magnesium	ncl	ncl	ncl
	Manganese	0.07%	0.06%	0.00%
	Molybdenum	0.03%	0.14%	0.00%
	Nickel	0.10%	0.06%	0.00%
	Phosphorus	ncl	ncl	ncl
	Potassium	0.00%	0.03%	ncl
	Selenium	0.02%	0.28%	0.00%
	Silver	0.16%	0.12%	0.00%
	Sodium	0.21%	0.88%	ncl
	Strontium	0.00%	0.04%	0.00%
	Thallium	0.01%	0.02%	0.01%
	Tin	ncl	ncl	0.00%
	Titanium Metal Powder	ncl	ncl	ncl
	Vanadium	0.00%	0.16%	0.08%
	Zinc	0.13%	0.10%	0.00%
	Zirconium	0.01%	0.75%	0.77%
6850	Perchlorate	0.09%	0.46%	0.00%
7199/7196A	Chromium (Hexavalent Compounds)	0.29%	0.39%	0.42%
7471A	Mercury	0.00%	0.20%	0.00%
8015B	Ethanol	---[a]	0.00%	ncl
	Methanol	0.05%	0.00%	ncl
8081A	4,4'-DDD	0.05%	2.05%	0.00%
	4,4'-DDE	0.14%	1.29%	0.00%
	4,4'-DDT	0.08%	0.75%	0.00%
	Aldrin	---[a]	3.57%	0.00%
	Alpha-BHC	---[a]	0.19%	0.00%
	Beta-BHC	0.17%	2.03%	0.00%
	Chlordane	0.31%	0.44%	0.41%
	Delta-BHC	0.47%	**14.18%**	0.00%
	Dieldrin	0.00%	0.74%	0.00%
	Endosulfan I	0.00%	1.69%	0.00%

Table 5-1. Monte Carlo Simulation Results of False Positive Error Rates

	Simulation:	1A	1B	2
	Alternative:	Cleanup to AOC LUT Values		Cleanup to Revised LUT Values
	Basis of True Conc.: Cleanup Level:	Established Bkg* AOC LUT	Distinct Bkg** AOC LUT	Distinct Bkg** RBSL
Analysis Method	**Analyte**	**False Positive Error Rate (%)**		
	Endosulfan II	0.14%	1.22%	0.00%
	Endosulfan Sulfate	0.04%	**5.20%**	0.00%
	Endrin	0.00%	0.42%	0.00%
	Endrin Aldehyde	0.71%	1.56%	0.00%
	Endrin Ketone	0.57%	1.27%	0.00%
	Gamma-Bhc (Lindane)	0.00%	0.13%	0.00%
	Heptachlor	0.00%	0.37%	0.00%
	Heptachlor Epoxide	0.16%	0.27%	0.00%
	Methoxychlor	0.00%	0.32%	0.00%
	Mirex	0.57%	3.97%	0.00%
	Technical Toxaphene	---[a]	**5.25%**	0.00%
8151A	2,2-Dichlor-Propionic Acid	---	**25.33%**	0.00%
	2,4,5-T	0.55%	1.65%	0.00%
	2,4-D	0.17%	0.13%	0.00%
	2,4-DB	---[a]	**51.86%**	0.00%
	Dicamba	0.15%	0.28%	0.00%
	Dichlorprop	0.07%	**5.12%**	0.00%
	Dinitrobutyl Phenol	---	**14.64%**	0.00%
	MCPA	0.53%	1.83%	0.00%
	MCPP	0.37%	**11.51%**	0.00%
	Silvex (2,4,5-TP)	0.51%	1.08%	0.00%
8270C/8270C-SIM	1-Methylnaphthalene	---[a]	0.00%	0.00%
	2-Methylnaphthalene	---[a]	0.00%	0.00%
	Acenaphthene	---[a]	0.00%	0.00%
	Acenaphthylene	0.02%	0.00%	0.00%
	Anthracene	0.00%	0.00%	0.00%
	Benzo(a)anthracene	---	---[b]	0.00%
	Benzo(a)pyrene	0.08%	**5.55%**	0.14%
	Benzo(b)fluoranthene	---	---[b]	0.00%
	Benzo(g,h,i)perylene	0.00%	**10.01%**	0.00%
	Benzo(k)fluoranthene	---	---[b]	0.00%
	Bis(2-ethylhexyl)phthalate	0.51%	**5.98%**	0.00%
	Butylbenzylphthalate	0.58%	0.64%	0.00%
	Chrysene	---	---[b]	0.00%
	Dibenzo(a,h)anthracene	---	---[b]	0.00%
	Diethylphthalate	---[a]	0.00%	0.00%
	Dimethylphthalate	---[a]	**7.94%**	0.00%
	Di-n-butylphthalate	0.00%	0.00%	---
	Di-n-octylphthalate	0.00%	0.00%	0.00%
	Fluoranthene	0.00%	1.87%	0.00%
	Fluorene	0.08%	0.16%	0.00%
	Indeno(1,2,3-cd)pyrene	---	---[b]	0.00%
	Naphthalene	0.32%	1.56%	0.00%
	Phenanthrene	0.00%	0.22%	0.00%
	Pyrene	0.00%	3.53%	0.00%

Table 5-1. Monte Carlo Simulation Results of False Positive Error Rates

	Simulation:	1A	1B	2
	Alternative:	Cleanup to AOC LUT Values		Cleanup to Revised LUT Values
	Basis of True Conc.: Cleanup Level:	Established Bkg* AOC LUT	Distinct Bkg** AOC LUT	Distinct Bkg** RBSL
Analysis Method	**Analyte**	**False Positive Error Rate (%)**		
	Total TEQ_BAP	---[c]	3.67%	0.17%
1613B	Total TEQ_Dioxin	---[c]	0.50%	0.00%
300.0/9056A	Fluoride	0.00%	1.36%	0.00%
353.2MOD/300.0	Nitrate	1.29%	1.27%	---
8315/D6303	Formaldehyde	---	0.00%	0.00%
9012B	Cyanide	0.02%	**9.35%**	0.00%
ASTM D1498	Oxidation-Reduction Potential	---	---	---
SW-846 9045C	Ph	---	---	---
	Across All Analytes	**11.47%**	**92.50%**	3.90%

Notes:

AOC LUT = look-up table values per the AOC

Bkg = background

ncl = no clean-up level

RBSL = risk-based screening level

TEQ = toxic equivalent

*Established background dataset, mean and standard deviation values as reported in Table 5 of the Soil Background Report.

**Distinct background dataset, as determined from the raw background results in the project database.

[a] Mean and standard deviation not presented in Table 5 of Soil Background Report (DTSC 2012) due to infrequent detection.

[b] Carcinogenic PAHs were evaluated in terms of BaP TEQ.

[c] Table 5 of Soil Background Report (DTSC 2012) does not provide results in terms of TEQ.

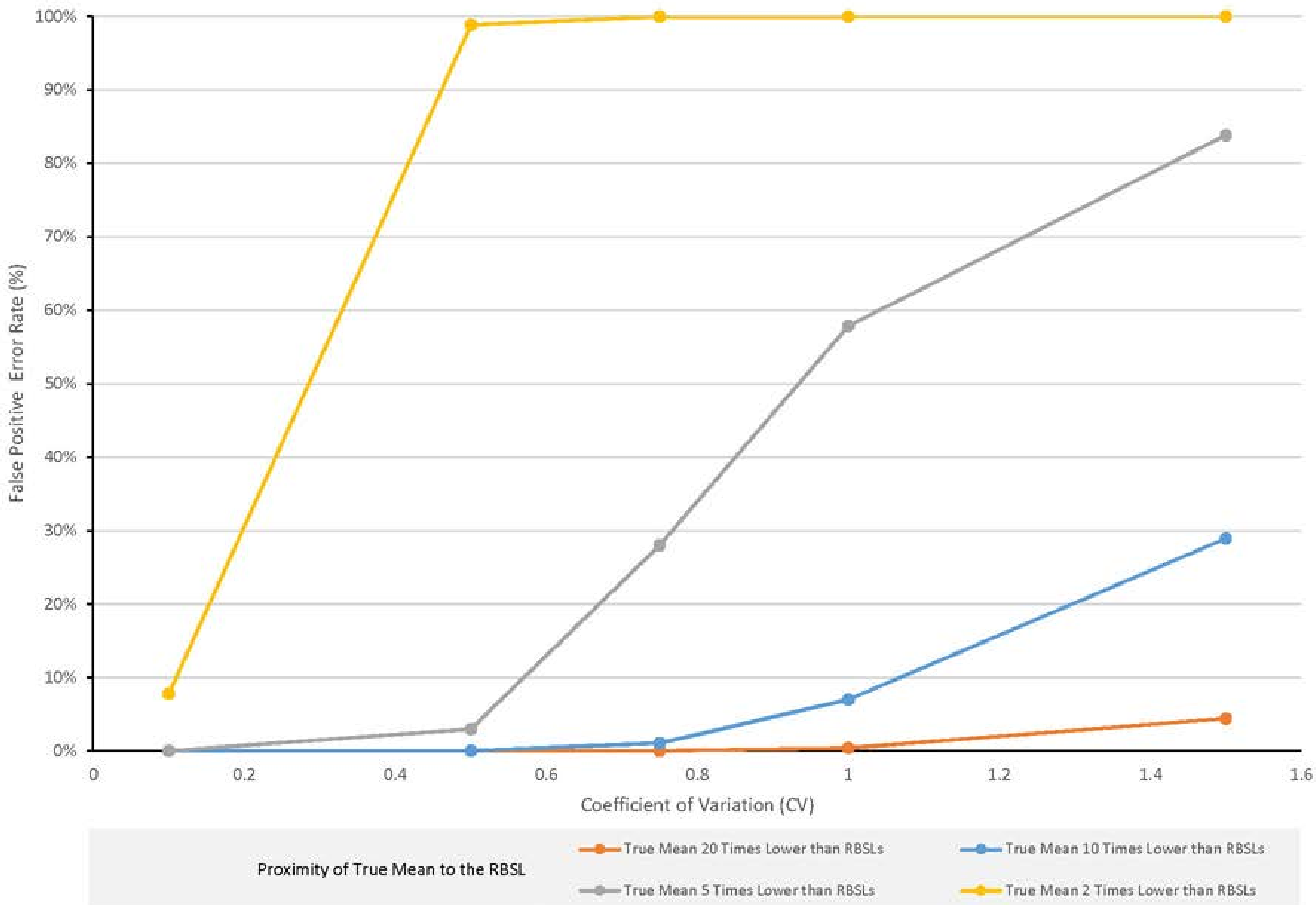


Figure 5-1 Probability of False Positive Decision Error as a Function of Proximity to the RBSL

Section 6

Green and Sustainable Remediation

Green and sustainable remediation (GSR) is the "*site-specific employment of products, processes, technologies, and procedures that mitigate contaminant risk to receptors while making decisions that are cognizant of balancing community goals, economic impacts, and environmental effects*" (ITRC 2011). Incorporation of GSR in this CBA is in alignment with USEPA's green remediation strategy and the DOE's *2011 Strategic Sustainability Performance Plan.*

This section presents two approaches that DOE is considering during the planning and implementation of soil remediation at Area IV/NBZ. The first approach pertains to the evaluation of the remedial action alternatives being considered in the EIS from a GSR perspective. DOE will consider the results from the GSR evaluation presented in **Section 6.1** during its decision making process for selecting the final remedial action alternative for soil remediation at Area IV/NBZ.

The second approach involves the incorporation of various GSR elements into the final remedial action alternative to be selected for soil remediation at Area IV/NBZ. These GSR elements would be incorporated into the final remedial action alternative for soil remediation at Area IV/NBZ in the form of best management practices (BMPs). **Section 6.2** describes the evaluation process of these BMPs.

6.1 Green and Sustainable Remediation Evaluation

6.1.1 Approach and Methodology

A GSR assessment was conducted to evaluate the environmental, economic, and social impacts (i.e., "triple bottom line") associated with each remedial action alternative considered in the EIS for soil in Area IV/NBZ.

This GSR assessment is comprised of the following impacts and corresponding evaluation methodologies:

- Environmental footprint: Naval Facilities Engineering Command (NAVFAC) SiteWise™ footprint evaluation tool;
- Social-Economic impacts: enhanced cost analysis of social cost of environmental metrics; and
- Community impacts: qualitative evaluation of potential detrimental and beneficial impacts.

The GSR assessment was conducted in accordance with ASTM International (2013) *E2893-13 Standard Guide for Greener Cleanups*, USEPA's (2012) *Methodology for Understanding and Reducing a Project's Environmental Footprint*, and Interstate Technology & Regulatory Council (ITRC) (2011) *Technical and Regulatory Guidance: Green and Sustainable Remediation: A Practical Framework, GSR-2*.

Environmental Footprint Analysis

Environmental footprint of each remedial action alternative was assessed using NAVFAC's SiteWise™ tool. SiteWise™ is a stand-alone tool developed jointly by the U.S. Navy, the U.S. Army, the U.S. Army Corps of Engineers (USACE), and Battelle that assesses the remedy footprint of a remedial alternative/technology in terms of a consistent set of metrics, including: (1) greenhouse gas (GHG) emissions; (2) energy use (total energy use and electricity from renewable and non-renewable sources); (3) air emissions of criteria pollutants (total emissions and onsite emissions) including nitrogen oxide (NO_x), sulfur oxide (SO_x), and particulate matter (PM_{10}, defined as matter particles with a diameter of 10 micrometers or less); (4) water consumption; (5) resource consumption (e.g., landfill space and top soil consumption); and, (6) worker safety (risk of fatality, injury and lost hours) (NAVFAC 2013).

The scope and boundary of the GSR assessment included the following components of each alternative evaluated:

- Fuel usage to transport project personnel, equipment, and machinery to and from the Area IV/NBZ.
- Fuel usage to operate earthwork and supporting equipment/machinery to conduct excavation, backfilling, and transportation and disposal activities.
- Water consumption for dust control.
- Volume of excavated soil and waste transported for offsite disposal.
- Volume of backfill transported onsite.
- Landfill space.
- Labor hours associated with onsite activities.

Details on input parameters and assumptions are provided in **Attachment B**. These assumptions are in alignment with the EIS as well as the cost estimate, which is presented in **Section 3**.

Enhanced Cost Analysis

Enhanced cost analysis evaluates the monetized global impacts among the proposed remedial alternatives. Monetized global impacts were quantified by integrating the social cost of environmental metrics (i.e., emissions and energy consumption) into the footprint analysis. The following social cost metrics were used for the analysis:

- greenhouse gas, which is comprised of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O);
- criteria pollutants including NO_x, SO_x, and PM_{10}; and
- energy consumption

The social cost of environmental metrics represent the monetary value that can be assigned for societal disamenities associated with an incremental increase in emissions and resource consumption. These societal disamenities and their associated unit social costs are listed in **Table 6-1**. The unit social cost of environmental metrics used for this analysis were obtained from literature, as presented below and in **Table 6-1**.

USEPA quantified the social cost for CO_2, CH_4, and N_2O for the years 2015 and 2020 (in 2007 US$) at discount rates of 2.5, 3, and 5 percent. A lower discount rate means society places higher value on future impacts (e.g., climate change and chronic risk to human receptors). While a higher discount rate means society places higher value on present impacts (e.g., daily traffic congestion and general inconvenience due to onsite activities taking place). The social costs with a discount rate of 2.5 percent were used in the enhanced cost analysis since the environmental footprint metrics (e.g., GHG emissions) used in this GSR assessment are associated with long-term and intergenerational societal impacts (Harclerode et al., 2015). Muller and Mendelsohn (2010) quantified the social cost of NOx, SOx, and PM_{10} (2002 US$) in quantiles ($1^{st}$, 25^{th}, 50^{th}, 75^{th}, 99^{th}, and 99.9^{th}) based on the environmental setting of the project and geographic distribution of existing nearby point sources. The 50^{th} percentile social cost values were used since Area IV/NBZ is located in the vicinity of a suburban area, outside of Los Angeles. The social cost of energy is a set cost value quantified in 2000 US$ by Greenstone and Looney (2011). All social cost values were adjusted for inflation over time using the United States Government Consumer Price Index.

Other Qualitative Evaluations

The main remedial components of each alternative considered consists of removal / transportation / disposal of excavated soil, transportation/placement of backfill, and consumption of water for dust suppression. The potential detrimental impacts of these remedial components to the surrounding community and resources lost were qualitatively evaluated. Community impacts were assessed based on short-term and long-term impacts of remedy implementation. The resources lost metric was evaluated based on the amount of topsoil consumed for backfill, landfill space to be occupied, and the amount of water consumed for dust suppression.

6.1.2 Results from Environmental Footprint Analysis

Table 6-2 presents the results of the environmental footprint analysis. Figures comparing the quantified environmental metrics for each alternative are shown in **Figure 6-1**. Normalized impacts of select environmental metrics are shown in **Figure 6-2**.

The results indicate that the Cleanup to AOC LUT Values Alternative emits the most GHG (CO_2, CH_4, and N_2O) and criteria pollutants (NO_x, SO_x, and PM_{10}) emissions and consumes the largest amount of energy, water resources, and landfill space. In comparison, the Conservation of Natural Resources Alternative emits the lowest emissions and utilizes the lowest amount of energy, water resources, and landfill space.

When compared with the Cleanup to AOC LUT Values Alternative, the Cleanup to Revised LUT Values Alternative would result in approximately 63% less in GHG emission and energy usage, while the Conservation of Natural Resources Alternative would result in approximately 75% less in GHG emission and energy usage. In terms of water consumption and total emissions of criteria pollutant, both the Cleanup to Revised LUT Values Alternative and the Conservation of Natural

Resources Alternative would result in a reduction of approximately 80% or more when compared to the Cleanup to AOC LUT Values Alternative.

Residual handling (e.g., transportation and disposal of excavated soil) and to a lesser degree, earthwork equipment use (e.g., for excavation and backfilling) are the primary contributors to all three alternatives' environmental footprints. The contribution of these two activities to each alternative's environmental footprint is directly related to the soil excavation/disposal volumes and total truck count (e.g., larger soil excavation volume equates to the higher disposal volume, which would require more trucks to transport soil to disposal facilities). As such, according to the EIS, the Cleanup to AOC LUT Values Alternative has the highest excavation/disposal volumes and total truck count, thus has the largest environmental footprint.

In conclusion, the overall environmental footprint is the largest with the Cleanup to AOC LUT Values Alternative and the smallest with the Conservation of Natural Resources Alternative.

6.1.3 Results from Enhanced Cost Analysis

The results of the enhanced cost analysis are presented in **Table 6-3**.

The Conservation of Natural Resources Alternative contributes the least to long-term global impacts and their associated social costs (an estimated $9 MM (million)), while the Cleanup to AOC LUT Values Alternative contributes the most (an estimated $36 MM).

A comparison of the social cost among the proposed alternatives results in an approximately 75% reduction in monetized global impacts by implementing the Conservation of Natural Resources Alternative in lieu of the Cleanup to AOC LUT Values Alternative, and approximately 63% reduction in monetized global impacts by implementing Cleanup to Revised LUT Values Alternative in lieu of the Cleanup to AOC LUT Values Alternative.

Under all remedial action alternatives, GHG emissions and energy consumption contribute the most towards long-term global impacts (i.e., societal disamenities). GHG emissions and energy consumption are both directly related to residual handling and earthwork equipment use, as both activities generate GHG emissions and consumes energy significantly higher than any other activities associated with any of the alternatives. Since the Cleanup to AOC LUT Values Alternative has the most residual handling (e.g., highest soil disposal volume per the EIS) and earthwork equipment use (e.g., highest excavation volume and longest duration per the EIS) compared to other alternatives, its GHG emissions and energy consumption are therefore also highest. On the other hand, since the Conservation of Natural Resources Alternative has the least amount of residual handling and earthwork equipment use per the EIS, its GHG emissions and energy consumptions are the lowest.

6.1.4 Results from Other Qualitative Evaluations

Impacts to the Surrounding Community

Potential short-term detrimental impacts the surrounding community may endure from dig and haul activities include:

- Traffic congestion during hauling of excavated material and backfill to/from Area IV/NBZ.

- Generation of noise and dust during dig and hauling activities.
- Incidental impacts to local businesses due to increased truck traffic.

Based on total hauling truck count and project duration for each alternative, the Cleanup to AOC LUT Values Alternative would have the greatest short-term detrimental impact on the neighboring community due to its highest amount of truck hauling and longest duration, while the Conservation of Natural Resources Alternative would have the least impact due to least amount of truck hauling and shortest duration.

Boeing has publicly stated that the future land use of Area IV and the NBZ will be open space (Boeing 2016). Remediation of contaminated soil, especially surface soils, would facilitate future use, via remedial activities, can indirectly benefit the community's quality of life, including beneficial impacts related to increased property value, aesthetic value, and potential access to more greenspace. The Cleanup to AOC LUT Values Alternative, given its longest duration (10 years), would provide this potential benefit within the longest timeframe. The Cleanup to Revised LUT Values Alternative and the Conservation of Natural Resources Alternative would both achieve this potential benefit within the shortest timeframe of 2 years.

Resources Lost

Water, clean top soil, and landfill space are the three major resources required for each of the remedial action alternatives. Water is used for dust control during excavation activities, while clean top soil is used for backfilling. Excavated soil would be disposed at hazardous and non-hazardous landfills, depending on the contaminants in the soil. Volumes of these resources to be consumed under each of the remedial action alternative are shown on **Figure 6-1**. **Table 6-2** and **Figure 6-2** presents the relative amount of resources lost under the remedial alternatives.

The volume of water to be consumed during excavation activities is dependent on the size of the excavation area as well as the duration of excavation activities. Both of these factors would be highest under the Cleanup to AOC LUT Values Alternative and significantly lower for both the Cleanup to Revised LUT Values Alternative and the Conservation of Natural Resources Alternative. As such, the Cleanup to AOC LUT Values Alternative would have the highest water consumption.

The volume of clean top soil is directly proportional to the excavation and backfilling volume under each remedial action alternative. Since the excavation volume is highest under the Cleanup to AOC LUT Values Alternative, its consumption of clean top soil for backfilling is also the highest. The Cleanup to Revised LUT Values Alternative and the Conservation of Natural Resources Alternative both have significantly lower excavation and backfilling volume, and therefore have significantly lower clean top soil consumption.

The Cleanup to AOC LUT Values Alternative consumes the highest amount of non-hazardous landfill space, greater than 15 times compared to the other alternatives. The Conservation of Natural Resources Alternative consumes the least amount of hazardous landfill space while the Cleanup to AOC LUT Values Alternative and Cleanup to Revised LUT Values Alternative consume the highest amount of hazardous landfill space.

In conclusion, the Cleanup to AOC LUT Values Alternative would use the highest amount of water, clean top soil, and landfill space; and would therefore represent a significantly higher amount of resources lost compared to the other alternatives.

6.2 Incorporation of Green and Sustainable Remediation Elements

During all four of the 2012 Community Alternatives Development Workshops for the Site, participants stressed that DOE should take efforts to minimize damage to the natural environment during cleanup. DOE has made a commitment to minimizing such impacts by using the principles of "green cleanup." These petitions are consistent with DOE's Office of Environmental Management's goal to consider, to the extent practical, green, sustainable and innovative technology practices in all phases of remediation when they reduce costs, expedite project schedules, minimize risk, and/or maximize effectiveness.

Given its internal goal and external petitions, DOE decided to elevate use of GSR to incorporate GSR elements in all of the remedial action alternatives being considered in the EIS (except for the No Action Alternative by definition). This approach provides for independent analysis and selection of GSR elements suitable for the remedial action prior to development and evaluation of the remedial action alternatives through the NCP process.

For this project, green cleanup decisions for the action alternatives would be guided to the extent possible by the following two guidance documents:

- USEPA's Principles for Greener Cleanups (http://www.epa.gov/oswer/greenercleanups/) (Principles), and
- The American Society for Testing and Materials' (ASTM) E2893, Standard Guide for Greener Cleanups (http://www.astm.org/Standards/E2893.htm) (the Standard).

These Principles and the Standard were developed in processes comparable to the U.S. Green Council's Leadership in Energy and Environmental Design (LEED) Certification System. The purpose of both EPA's Principles and ASTM's Standard is to improve the decision-making process involved with site cleanup, while assuring the protection of human receptor and the environment by minimizing the environmental "footprint" of cleanup activities. The fundamental core of both the Principles and the Standard is the selection and employment of BMPs for green cleanup. EPA's Principles provides a framework for evaluating and selecting BMPs by way of five recommended core elements: (1) minimizing total energy and maximizing use of renewable energy; (2) minimizing air pollutants and greenhouse gas emissions; (3) minimizing water use and impacts to water resources; (4) reducing, reusing, and recycling material and waste; and (5) protecting land and ecosystems. The ASTM's Standard contains an extensive list of BMPs that are categorized consistent with the recommended core elements from the EPA's Principles.

Selection of Best Management Practices

Two sources of potentially applicable GSR BMPs for the remedy were evaluated as described below.

One source of BMPs is the ASTM Standard, which contains an extensive list of potentially applicable BMPs under various categories including buildings, materials, power and fuel, project planning and management, residual solid and liquid wastes, sampling and analysis, land restoration, surface/storm water, vehicles and equipment, and wastewater. Each of these BMPs addresses one or more of the five core elements (energy, air, water, materials and wastes, and land and ecosystem) recommended in the EPA Principles.

The second source of BMPs were BMPs that were developed as part of the EIS impact analyses, where reduction and prevention of impacts from the remedial action alternatives were evaluated (EIS Chapter 4). These BMPs cover various EIS categories including land resources, geology and soils, surface water, groundwater, biological resources, air quality and greenhouse gas, noise, transportation and traffic, human health and safety, waste management, and cultural resources.

The BMP sources identified above were compiled, assessed, and categorized into two types of BMPs:

1. project-related/regulation-driven BMPs (required BMPs), and
2. GSR-related BMPs (GSR BMPs).

The required BMPs are presented in Chapter 6 of the EIS. They were developed to reduce or eliminate project impacts and to address regulatory requirements or stakeholders input. Many of these required BMPs have been implemented during remedial actions at the neighboring Boeing site. Examples of the required BMPs include dust control measures, stormwater control measures, truck idling prevention measures, traffic control, erosion control, health and safety measures, noise reduction measures, and biological/cultural resources protection measures.

The GSR BMPs are presented in **Table 6-4**. The GSR BMPs were selected specifically to achieve cleanup while staying green and sustainable, which is in alignment with USEPA's green remediation strategy and the DOE's *2011 Strategic Sustainability Performance Plan*. Most of the GSR BMPs are from the ASTM Standards. These GSR BMPs were screened for applicability, and only non-regulation/requirement driven and applicable BMPs were categorized as GSR BMPs. Examples of these GSR BMPs include resource conservation measures, environment protection measures, waste recycling/reduction measures, and work optimization measures.

The GSR BMPs were further evaluated for adequate coverage of all facets of GSR. During this evaluation, each of the GSR BMPs were further categorized into one or more of 12 GSR focused elements as listed below. **Table 6-4** demonstrates that the GSR BMPs being considered to be incorporated into soil remedial action alternatives at Area IV of SSFL provide adequate coverage across all 12 GSR focused elements.

- Energy Conservation
- Use of On-Site Materials
- Water Conservation
- Use of Natural Resources

- Air Quality
- Carbon Footprint
- Protection of Resources
- Project Footprint Reduction
- Recycling / Reuse
- Waste Reduction
- Keeping Materials Out of Landfill
- Optimizing Project Work

DOE will evaluate the GSR BMPs listed in **Table 6-4**, and make the final decision on the list of BMPs to be implemented during soil remediation at Area IV/NBZ.

Table 6-1 - Societal Disamenities and Unit Social Costs for Environmental Metrics
SSFL Area IV and NBZ

Environmental Metric		Societal Disamenities	Unit Social Costs[1,2]
Greenhouse Gas	Carbon Dioxide (CO_2)	Long-term global impacts of climate change, including changes in net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services (USG, 2013).	$183 per metric ton
	Methane (CH_4) and Nitrous Oxide (N_2O)	Long-term global impacts of climate change, including changes in agriculture, energy production, water availability, human health, coastal communities, and biodiversity (Marten and Newbold, 2012).	
Criteria Pollutants	Total Nitrogen Oxides (NO_x)	Long-term societal impacts, including health effects, reduced crop and timber yields, materials depreciation, lost recreation services, and reduced visibility (Muller and Mendelsohn, 2010).	$329 per metric ton
	Sulfur Oxides (SOx)		$1,278 per metric ton
	Particulate Matter (PM_{10})		$224 per metric ton
Energy Consumption (non-carbon social cost)		Long-term societal impacts, including health costs, shortened life spans, environmental mitigation, and broad impacts of climate change (Greenstone et al., 2011).	$14 per MMBTU

Notes:

MMBTU - million British Thermal Unit

[1]Social cost of environmental metrics are based on:

- CO_2 (2007 US$, 2.5% discount rate): United States Government, Interagency Working Group on Social Cost of Carbon. (2013). Technical support document: - Technical update of the social cost of carbon for regulatory impact analysis – Under Executive Order 12866. Revised July 2015.
- CH_4 and N_2O (2020 US$, 2.5% discount rate): Marten, A. L., Kopits, E. A., Griffiths, C. W., Newbold, S. C., & Wolverton, A. (2015). Incremental CH_4 and N_2O mitigation benefits consistent with the US Government's SC-CO_2 estimates. Climate Policy, 15(2), 272-298.
- Energy (2000 US$): Greenstone, M. & Looney, A. (2011). A strategy for america's energy future: Illuminating energy's full costs. The Hamilton Project Strategy Paper. Washington, DC: Brookings. Value was adjusted for inflation over time using the United States Government Consumer Price Index.
- Total Nitrogen Oxides (NO_x), sulfur oxides (SO_x), and Particulate Matter (PM_{10}) (2002 US$, 50th Quantile, based on site location in residential area oustide of Los Angeles): Muller, N. Z., & Mendelsohn, R. (2010). Weighing the value of a ton of pollution. Regulation, 33(2), 20-24. Values were adjusted for inflation over time using the United States Government Consumer Price Index.

[2]Methodology used to quantify social cost of environmental impacts metrics based on:

- Harclerode, M. A., P. Lal, & M. E. Miller. 2015. Quantifying Global Impacts to Society from the Consumption of Natural Resources during Environmental Remediation Activities. Journal of Industrial Ecology, Special Issue: Linking Local Consumption to Global Impacts.
- Harclerode M, Lal P, & Miller M. 2013. Estimating Social Impacts of a Remediation Project Life Cycle With Environmental Footprint Evaluation Tools. Remediation Journal. Volume 24, Issue 1.

Table 6-2 Footprint Analysis - Sustainability Metric Results and Relative Impact
SSFL Area IV and NBZ

Remedial Alternatives	GHG Emissions	Onsite NO_x Emissions	Onsite SO_x Emissions	Onsite PM_{10} Emissions	Total NO_x Emissions	Total SO_x Emissions	Total PM_{10} Emissions	Total energy Used	Water Consumption	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Topsoil Consumption	Community Impacts	Resources Lost
	metric ton	metric ton	metric ton	metric ton	metric ton	metric ton	metric ton	MMBTU	gallons	tons	tons	cubic yards		
Quantitative Sustainability Metrics Results[1,2]:														
Cleanup to AOC LUT Values	96,000	85	2.5	7.7	220	66	270	1,300,000	40,000,000	1,200,000	210,000	700,000	Qualitative	Qualitative
Cleanup to Revised LUT Values Alternative	35,000	17	0.5	1.5	50	14	60	480,000	8,000,000	78,000	210,000	140,000	Qualitative	Qualitative
Conservation of Natural Resources Alternative	24,000	15	0.44	1.3	38	10	45	320,000	8,000,000	78,000	140,000	110,000	Qualitative	Qualitative
Relative Impact:														
Cleanup to AOC LUT Values Alternative	High	High	High	High	High	High	High	High	High	High	High	High	High	High
Cleanup to Revised LUT Values Alternative	Medium	Low	Low	Low	Low	Low	Low	Medium	Low	Low	High	Low	Low	Low
Conservation of Natural Resources Alternative	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Medium	Low	Low	Low

Notes:

[1]Based on results from footprint analysis using Sitewise™.

[2]All results rounded to 2 significant figures.

AOC - Administrative Order on Consent for remedial action

GHG - greenhouse gas

LUT - lookup table

MMBTU - million British Thermal Unit

PM_{10} - matter particles with a diameter of 10 micrometers or less

NOx - nitrogen oxide

SOx - sulfur oxide

Table 6-3 - Enhanced Cost Analysis - Social Cost
SSFL Area IV and NBZ

Remedial Alternatives	GHG Emissions[2]	Total NO_x Emissions	Total SO_x Emissions	Total PM_{10} Emissions	Total energy Used	
	metric ton	metric ton	metric ton	metric ton	MMBTU	
Environmental Impact Metrics under Each Alternative[1]						
Cleanup to AOC LUT Values Alternative	96,000	220	66	270	1,300,000	
Cleanup to Revised LUT Values Alternative	35,000	50	14	60	480,000	
Conservation of Natural Resources Alternative	24,000	38	10	45	320,000	
Unit Social Cost for Environmental Impact Metrics[3]						
Social Cost in 2016 US$	$ 183	$ 329	$ 1,278	$ 224	$ 14	
Social Cost of Environmental Impact Metrics for Each Alternative 2016 US$						**Total Social Cost[4]**
Cleanup to AOC LUT Values Alternative	$ 17,568,000	$ 72,380	$ 84,348	$ 60,480	$ 18,200,000	**$ 35,985,000**
Cleanup to Revised LUT Values Alternative	$ 6,405,000	$ 16,450	$ 17,892	$ 13,440	$ 6,720,000	**$ 13,173,000**
Conservation of Natural Resources Alternative	$ 4,392,000	$ 12,502	$ 12,780	$ 10,080	$ 4,480,000	**$ 8,907,000**

Notes:

[1]Based on results from footprint analysis using Sitewise™.

[2]Greenhouse gas emissions (GHG) are generally comprised of 99% carbon dioxide (CO_2), 0.5% methane (CH_4), and 0.5% nitrous oxide (N_2O).

[3]See Table 6-1 for the basis of unit social costs.

[4]Rounded to the nearest thousand dollars.

AOC - Administrative Order on Consent of remedial action
GHG - greenhouse gas
LUT - lookup table
MMBTU - million British Thermal Unit
NOx - nitrogen oxide
PM_{10} - matter particles with a diameter of 10 micrometers or less
SOx - sulfur oxide

Table 6-4 Green and Sustainable Remediation Best Management Practices
SSFL Area IV/NBZ

Green and Sustainable Remediation Best Management Practice	Resource Conservation				Protection of Environment				Waste Management			Optimizing Project Work	Applicability to Area IV Cleanup Actions
	Energy Conservation	Use of On-Site Materials	Water Conservation	Use of Natural Resources	Air Quality	Carbon Foot Print	Protection of Resources	Project Footprint Reduction	Recycling / Reuse	Waste Reduction	Keeping Materials Out of Landfills	Optimizing Project Work	
Steam-clean or use phosphate-free detergents or biodegradable cleaning products instead of organic solvents or acids to decontaminate sampling equipment			X										Use of solvents or acids is most likely not being considered for equipment decontamination
For constructed wetlands, maximize use of gravity flow for conveyance of water	X												Use of wetlands for water conveyance or treatment is most likely not being considered for Area IV cleanup actions
Use treated slurry and/or process water for other cleanup activities or non-remedial applications such as irrigation or wetlands enhancement Use uncontaminated wastewater or treated water for tasks such as wash water, irrigation, dust control, constructed wetlands, or other uses Remediation technologies and dust suppression could supplement water sources with treated water that is re-injected into the local aquifers.			X										Treated extracted groundwater could be used a source for dust control water, but only for about 700 gallons per day of makeup water. Use of the water would require state of California approval.
Employ closed-loop graywater washing system for decontamination of trucks			X										DOE will consider graywater systems in the building D&D and soil removal contractors' scopes of work

Table 6-4 Green and Sustainable Remediation Best Management Practices
SSFL Area IV/NBZ

	Resource Conservation				Protection of Environment				Waste Management			Optimizing Project Work	
Green and Sustainable Remediation Best Management Practice	Energy Conservation	Use of On-Site Materials	Water Conservation	Use of Natural Resources	Air Quality	Carbon Foot Print	Protection of Resources	Project Footprint Reduction	Recycling / Reuse	Waste Reduction	Keeping Materials Out of Landfills	Optimizing Project Work	Applicability to Area IV Cleanup Actions
Use captured rainwater for tasks such as wash water, irrigation, dust control, constructed wetlands, or other uses			X										Use of captured stormwater runoff is a consideration but would need to be worked out with landowner (Boeing) and included in remediation contractors scopes of work
Consider discharging wastewater to a POTW or other regional water treatment plant rather than building and operating an on-site treatment plant, when feasible and environmentally beneficial based on additional analysis	X							X				X	DOE will use portable toilets and is not considering a site treatment system for domestic wastes; on-site treatment of contaminated groundwater in specialized treatment unit.

Table 6-4 Green and Sustainable Remediation Best Management Practices
SSFL Area IV/NBZ

Green and Sustainable Remediation Best Management Practice	Resource Conservation				Protection of Environment				Waste Management			Optimizing Project Work	Applicability to Area IV Cleanup Actions
	Energy Conservation	Use of On-Site Materials	Water Conservation	Use of Natural Resources	Air Quality	Carbon Foot Print	Protection of Resources	Project Footprint Reduction	Recycling / Reuse	Waste Reduction	Keeping Materials Out of Landfills	Optimizing Project Work	
Select plant species (including those used for constructed wetlands) that should be compatible with local and regional ecosystems and require minimal water and amendments Use plants/amendment/input that require minimal management and water - Use local plant stock to minimize transportation and increase acclimation survivability (that is, decrease probability of replanting) Maximize use of native, non-invasive and/or drought resistant vegetative cover across the site during restoration using a suitable mix of shrubs, grasses, and forbs to preserve biodiversity and related ecosystem services Revegetate excavated areas and/or areas disrupted by equipment or vehicles as quickly as possible using native vegetation, if possible, and restore as close as possible to original conditions	X		X	X	X	X	X						DOE is considering all of these vegetation actions should be part of the project description
Plant at the optimum time of the season (for example, late winter/early spring) to minimize irrigation requirements and increase acclimation survivability Design systems to allow natural volunteer growth/spreading to fill in entire target area over time (minimize initial planting; fill in over time), if time permits Use pre-existing, native and non-invasive vegetation for phytoremediation and restoration activities	X		X	X			X					X	DO will consider where practical, seasonal planting of native vegetation Use of natural revegetation processes will be considered where practical
Minimize clearing of trees throughout investigation and cleanup	X						X						DOE will protect trees as necessary during cleanup.

Table 6-4 Green and Sustainable Remediation Best Management Practices
SSFL Area IV/NBZ

Green and Sustainable Remediation Best Management Practice	Resource Conservation				Protection of Environment				Waste Management			Optimizing Project Work	Applicability to Area IV Cleanup Actions
	Energy Conservation	Use of On-Site Materials	Water Conservation	Use of Natural Resources	Air Quality	Carbon Foot Print	Protection of Resources	Project Footprint Reduction	Recycling / Reuse	Waste Reduction	Keeping Materials Out of Landfills	Optimizing Project Work	
The proposed project will use BMPs that incorporate native landscaping and efficient irrigation.			X				X						Site revegetation will use native species
Backfilling would proceed in completed excavated areas in a relatively short period of time so that areas of newly exposed soil are not open any longer than necessary. However, backfilling will proceed within two weeks of DTSC and EPA approval that cleanup meets LUT values.												X	DOE will revegetate disturbed land as quickly as possible following cleanup confirmation approvals from DTSC and EPA
Use on-site generated renewable energy (including but not limited to solar photovoltaic, wind turbines, landfill gas, geothermal, biomass combustion, etc.) to fully or partially provide power otherwise achieved through onsite fuel consumption or use of grid electricity Use solar power pack system for low-power system demands (for example, security lighting, system telemetry)	X			X	X	X							DOE will look for opportunities for onsite renewable energy; DOE to consider in contractor scope.
Select facilities with green policies for worker accommodations and periodic meetings Contract a laboratory that uses green practices and/or chemicals	X		X		X	X							Facility selection is not part of remediation scope. DOE will consider green practices in analytical laboratory scope, but labs must first meet project analytical and State certification requirements

Table 6-4 Green and Sustainable Remediation Best Management Practices
SSFL Area IV/NBZ

	Resource Conservation				Protection of Environment				Waste Management			Optimizing Project Work	
Green and Sustainable Remediation Best Management Practice	Energy Conservation	Use of On-Site Materials	Water Conservation	Use of Natural Resources	Air Quality	Carbon Foot Print	Protection of Resources	Project Footprint Reduction	Recycling / Reuse	Waste Reduction	Keeping Materials Out of Landfills	Optimizing Project Work	Applicability to Area IV Cleanup Actions
Use local staff (including subcontractors) when possible to minimize resource consumption Use local laboratory to minimize impacts from transportation	X				X	X							Preference for local on-site worker will be in DOE contractor scope. Use of local laboratory must be balanced with California certification and cleanup level considerations throughput and data quality meeting AOC limits
Use onsite or nearby sources of backfill material for excavated areas, if shown to be free of contaminants	X	X		X	X								Use of nearby clean sources of backfill will be considered Sources must meet LUT values
Use on-site/local materials, when possible (for example, wood waste for compost, rocks for drainage control)	X	X			X								DOE will consider use of existing excavated bedrock rubble, such as on the B4133 saddle, beneath the RMHF, and B56 landfill as onsite fill material

Table 6-4 Green and Sustainable Remediation Best Management Practices
SSFL Area IV/NBZ

Green and Sustainable Remediation Best Management Practice	Resource Conservation				Protection of Environment				Waste Management			Optimizing Project Work	Applicability to Area IV Cleanup Actions
	Energy Conservation	Use of On-Site Materials	Water Conservation	Use of Natural Resources	Air Quality	Carbon Foot Print	Protection of Resources	Project Footprint Reduction	Recycling / Reuse	Waste Reduction	Keeping Materials Out of Landfills	Optimizing Project Work	
Survey on-site infrastructure to determine material types and approximate quantities that could be reused or recycled and evaluate opportunities for on-site or local re-use and/or recycling Reclaim and stockpile uncontaminated soil for use as fill or other purposes such as frost prevention and erosion control layers in landfill covers Salvage uncontaminated and pest- or disease-free organic debris, including trees downed during site clearing, for use as fill, mulch, compost, or habitat creation Salvage uncontaminated objects/infrastructure with potential recycle, resale, donation, or reuse		X							X	X	X		Uncontaminated soil will be used for regrading where possible Mulch that can be shown to be free of weed species can be used for compost and habitat creation
Use recycled content (for example, steel made from recycled metals, concrete and/or asphalt from recycled crushed concrete and/or asphalt, respectively, and plastic made from recycled plastic; tarps made with recycled or biobased contents instead of virgin petroleum-based contents) Choose geotextile fabric or drainage tubing composed of 100% recycled materials, rather than virgin materials, for lining, erosion control, and drainage on landfill covers Purchase materials in bulk quantities and packed in reusable/recyclable containers and drums to reduce packaging waste									X	X	X		DOE will consider use of recycled materials in contractor scopes of work DOE to consider use of recycled materials in contractor scopes of work DOE to consider use of purchase bulk material in contractors scope of work

Table 6-4 Green and Sustainable Remediation Best Management Practices
SSFL Area IV/NBZ

Green and Sustainable Remediation Best Management Practice	Resource Conservation				Protection of Environment				Waste Management			Optimizing Project Work	Applicability to Area IV Cleanup Actions
	Energy Conservation	Use of On-Site Materials	Water Conservation	Use of Natural Resources	Air Quality	Carbon Foot Print	Protection of Resources	Project Footprint Reduction	Recycling / Reuse	Waste Reduction	Keeping Materials Out of Landfills	Optimizing Project Work	
Use products, packing material, and equipment that can be reused or recycled Recycle as much non-usable/spent equipment/materials as possible following completion of project To the maximum practical extent, recyclable materials, including non-hazardous remediation and demolition debris, will be reused or recycled, where feasible Salvage uncontaminated objects/infrastructure with potential recycle, resale, donation, or reuse Reuse or recycle recovered product and materials (for example, cardboard, plastics, asphalt, concrete, etc.) Use filters that can be backwashed to avoid frequent disposal of filters									X	X	X		DOE to consider recycling as part of contractor scopes of work
Use SmartWay transportation retrofits (for example skirts, air tabs) on tractor-trailers whenever possible Replace conventional vehicles with electric, hybrid, ethanol, or compressed natural gas vehicles	X				X	X							DOE will consider SmartWay retrofits in contractor scopes of work DOE will consider alternative vehicles in contractor scopes scope of work

Table 6-4 Green and Sustainable Remediation Best Management Practices
SSFL Area IV/NBZ

Green and Sustainable Remediation Best Management Practice	Resource Conservation				Protection of Environment				Waste Management			Optimizing Project Work	Applicability to Area IV Cleanup Actions
	Energy Conservation	Use of On-Site Materials	Water Conservation	Use of Natural Resources	Air Quality	Carbon Foot Print	Protection of Resources	Project Footprint Reduction	Recycling / Reuse	Waste Reduction	Keeping Materials Out of Landfills	Optimizing Project Work	
Use biodiesel produced from waste or cellulose-based products, preferring local sources wherever readily available to reduce transportation impacts Minimize diesel emissions through the use of retrofitted engines, ultra-low or low sulfur diesel or alternative fuels, or filter/treatment devices to achieve BACT or MACT					X	X	X						DOE will consider biodiesel in construction contractors scope of work DOE will consider retrofitted engines in construction contractors scope of work
Use biodegradable hydraulic fluids on hydraulic equipment such as drill rigs							X						DOE will consider biodegradable fluids in soil removal contractors scopes of work
Buy carbon offset credits (for example, for airline flights) when in person meetings are required					X	X							DOE will consider in construction contractor scopes of work
Enhance existing natural resources, manage surface drainage, prevent soil/sediment runoff and promote carbon sequestration by incorporating wetlands, bioswales, and other types of vegetation into overall remedial approach					X		X						Wetlands and bioswales are not part of the proposed project
Restore and maintain surface water banks in ways that mirror natural conditions							X						Drainage channel restoration is part of the proposed project
Mix amendments into soil in-situ whenever possible to minimize dust generation and emissions					X								Use of soil amendments is not part of proposed project

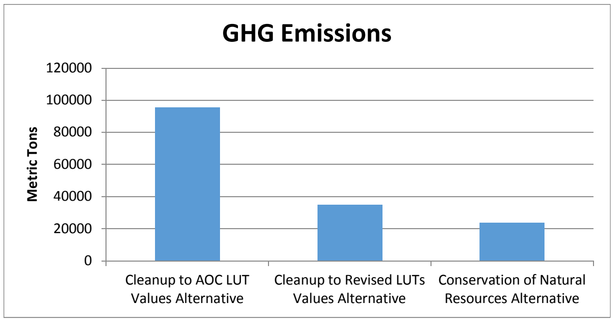
Table 6-4 Green and Sustainable Remediation Best Management Practices
SSFL Area IV/NBZ

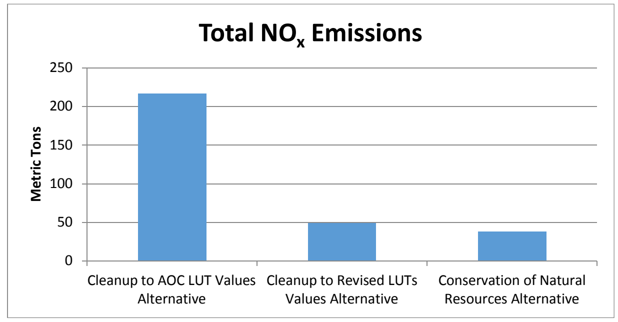
Green and Sustainable Remediation Best Management Practice	Resource Conservation				Protection of Environment				Waste Management			Optimizing Project Work	Applicability to Area IV Cleanup Actions
	Energy Conservation	Use of On-Site Materials	Water Conservation	Use of Natural Resources	Air Quality	Carbon Foot Print	Protection of Resources	Project Footprint Reduction	Recycling / Reuse	Waste Reduction	Keeping Materials Out of Landfills	Optimizing Project Work	
To maintain the SSFL property in an undeveloped, natural condition, previously disturbed areas will be used for stockpiling and equipment storage and operations to minimize the potential impacts of erosion, landslides, or disturbance of habitat, to the extent possible. Minimize soil compaction and land disturbance during site activities by restricting traffic to confined corridors and protecting ground surfaces with biodegradable covers, where applicable							X	X					Use of previously disturbed areas for staging is part of the proposed project An on-site traffic plan (already part of proposed project) to confine movements to established roads will be developed by DOE contractor
Use excavated areas to serve as retention basins in final storm water control plans							X	X					DOE will look for opportunities for retention basins; placement will need to be addressed with land owner
Soundproof all aboveground equipment housing to prevent noise disturbance to surrounding environment								X					All "above ground' equipment will use appropriate mufflers.
Cover filled excavations with biodegradable fabric to control erosion and serve as a substrate for ecosystems Use biobased products (for example, erosion control fabrics containing agricultural byproducts) Use biodegradable seed matting constructed of recycled materials (for example, paper, saw dust, hay)						X	X	X	X				DOE will consider for soil contractors scope of work DOE will consider for soil contractors scope of work DOE will consider for soil contractors scope of work

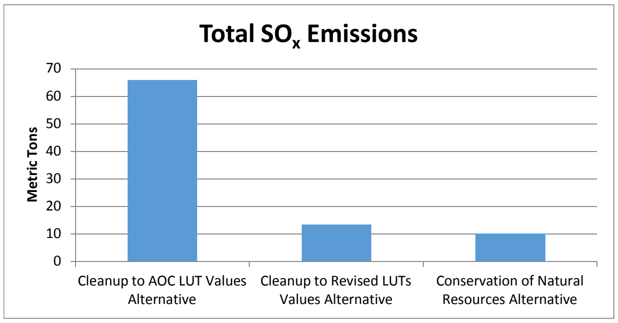
Table 6-4 Green and Sustainable Remediation Best Management Practices
SSFL Area IV/NBZ

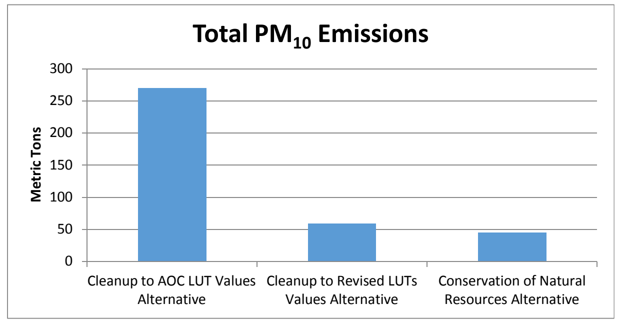
Green and Sustainable Remediation Best Management Practice	Resource Conservation				Protection of Environment				Waste Management			Optimizing Project Work	Applicability to Area IV Cleanup Actions
	Energy Conservation	Use of On-Site Materials	Water Conservation	Use of Natural Resources	Air Quality	Carbon Foot Print	Protection of Resources	Project Footprint Reduction	Recycling / Reuse	Waste Reduction	Keeping Materials Out of Landfills	Optimizing Project Work	
In anticipation of the potential for roadway damage, DOE will survey the existing conditions of the roads planned for use prior to the commencement of work and will repair damage caused by its D&D and cleanup activities. DOE will seek to enter into an agreement to share this work.								X				X	As a 'green' measure, DOE will consider roadway damage/repair should consider the life of transport truck tires
Use dedicated materials (that is, reuse of sampling equipment and nonuse of disposable materials/equipment) when performing multiple rounds of sampling										X	X		Use of dedicated materials will continue to be part of current groundwater sampling scope
Prepare, store, and distribute documents electronically using an environmental information management system										X			Electronic storage of documents will be part of DOE contractors scopes of work
Establish green requirements (for example, SMPs and BMPs) as evaluation criteria in the selection of contractors and include language in RFPs, RFQs, subcontracts, contracts, etc.												X	DOE will continue use of Green BMPs
During remedial activities, DOE will continue to coordinate with various conservation groups interested in preserving the natural resources at the SSFL property, including those in areas not affected by remediation activities, and in utilizing the site for educational, recreational and research purposes.												X	DOE will continue coordination with conservation groups

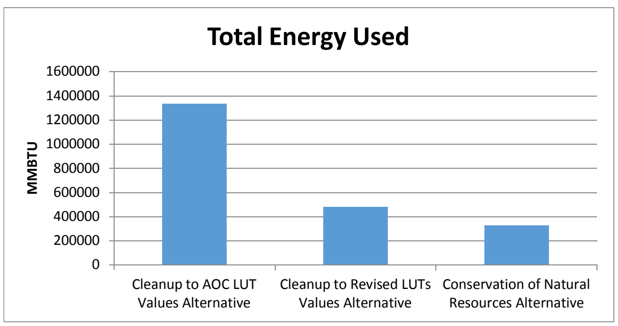
AOC = Administrative Order on Consent; BACT = best available control technology; BMP = best management practice; D&D = decontamination and decommissioning; DOE = Department of Energy; DTSC = Department of Toxic Substances Control; EPA = U.S. Environmental Protection Agency; FFS = Focused Feasibility Study; GSR = Green and Sustainable Remediation; LUT = look-up table; MACT = maximum achievable control technology; NBZ = Northern Buffer Zone; POTW = publicly owned treatment works; RFP = request for proposal; RFQ = request for quotation; SMP = site management plan; SSFL = Santa Susana Field Laboratory.

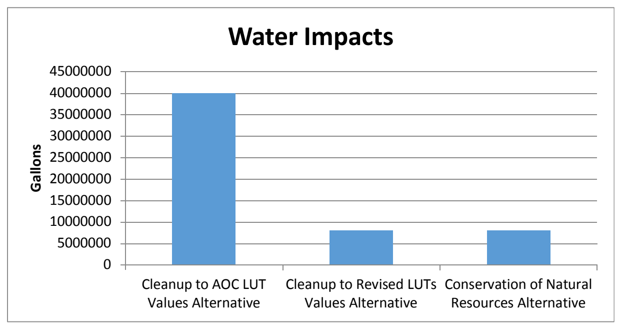


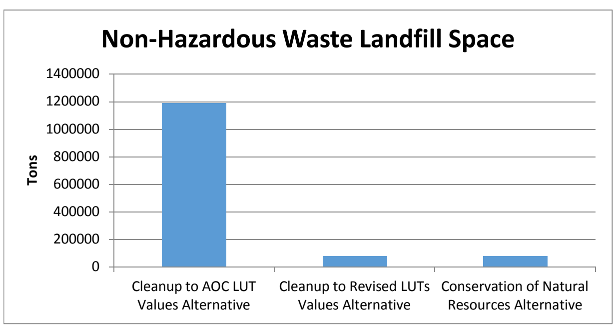


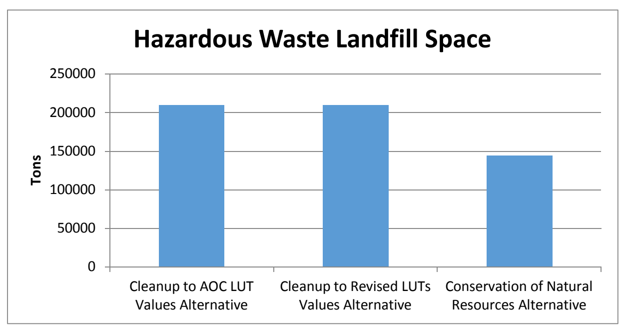


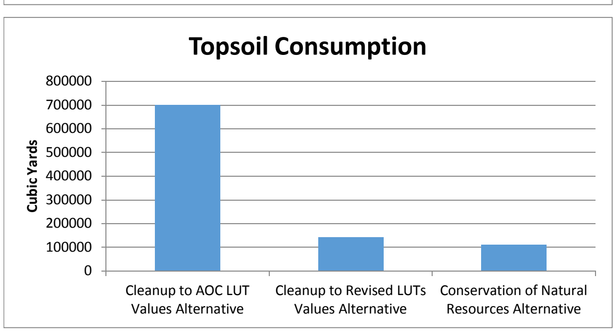






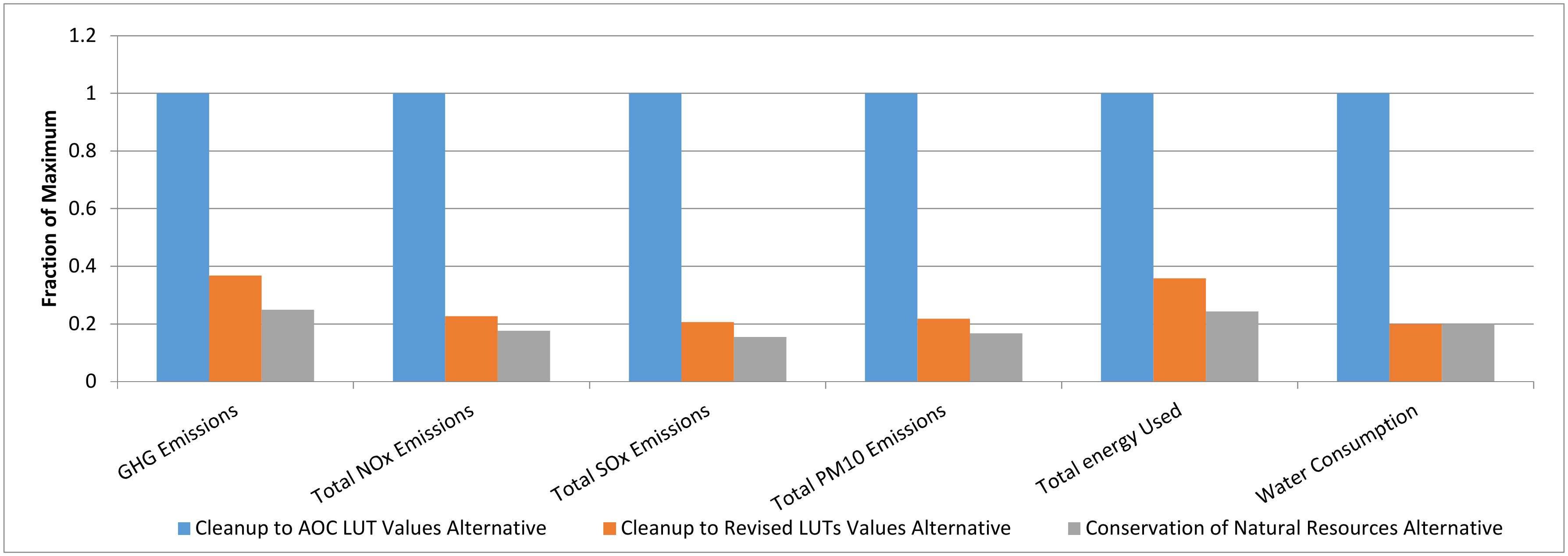






Notes:
GHG - greenhouse gas
MMBTU - million British Thermal Unit
NOx - nitrogen oxide
PM_{10} - matter particles with a diameter of 10 micrometers or less
SOx - sulfur oxide

Figure 6-1 - Footprint Analysis Results - Environmental Metrics
SSFL Area IV and NBZ



Notes:

GHG - greenhouse gas

NOx - nitrogen oxide

PM_{10} - matter particles with a diameter of 10 micrometers or less

SOx - sulfur oxide

Figure 6-2 - Footprint Analysis Results - Normalized Environmental Metrics

SSFL Area IV and NBZ

Section 7

References

ASTM International. 2013. *Standard Guide for Greener Cleanups* (E2893-13). November.

Boeing 2016. Letter from Steven Shestag to Sheila Kuehl, Mitchel Englander, and Fran Pavely. Future Land use will be Undeveloped Open Space. February 22.

CDM Smith. 2015. Memorandum. *Draft Evaluation of Radionuclide Risk in Selected Areas of the Santa Susana Field Laboratory (SSFL)*. September 25.

CDM Smith. 2016a. *Basis of Estimate. Draft Detailed Remedial Action Alternative Cost Estimates. Area IV and Northern Buffer Zone. Santa Susana Field Laboratory. Ventura County, California.* March.

CDM Smith. 2016b. *Risk Estimate Development for Selected Areas of Santa Susana Field Laboratory Area IV. Ventura County, California*. March.

CDM Smith. 2017. *Chemical Data Summary Report*. Santa Susana Field Laboratory. Ventura County, California.

Commission on Risk Assessment and Risk Management (CRARM). 1997. Framework for Environmental Health Risk Management, Final Report. Volume 1.

Department of Energy (DOE). 1997. *Cost Estimating Guide*, DOE G 430.1-1, 03-28-97. March.

DOE. 2001. *User's Manual for RESRAD Version 6*. ANL/EAD-4. July.

DOE. 2004. *Cost Estimating Guide for Program and Project Management*, DOE G 430.1-1X, April 2004

DOE. 2011. *2011 Strategic Sustainability Performance Plan*.

DOE. 2011. *Cost Estimating Guide*, DOE G 413.3-21, 5-9-2011. May

California Department of Toxic Substances Control (DTSC). 2010. *Administrative Order on Consent for Remedial Action.* Santa Susana Field Laboratory. Simi Hills. Ventura County, California. December 6.

DTSC. 2012. *Final Results Report, Chemical Soil Background Study*, for the Santa Susana Field laboratory (SSFL). December 28.

DTSC. 2013. *Chemical Look-Up Table Technical Memorandum*, Santa Susana Field Laboratory, Ventura County, California. June 11, 2013.

Greenstone, M. and Looney, A. 2011. *A strategy for America's energy future: Illuminating energy's full costs*. The Hamilton Project Strategy Paper. Washington, DC: Brookings. May.

Harclerode, M. A., Pankaj, L., and Miller, M. E. 2015. *Quantifying Global Impacts to Society from the Consumption of Natural Resources during Environmental Remediation Activities.* Journal of Industrial Ecology. Volume 20, Issue 3, Page 410-422. December.

HydroGeoLogic Inc., (HGL). 2012. *Final Radiological Characterization of Soils*, Area IV and the Northern Buffer Zone, Area IV Radiological Study, Santa Susana Field Laboratory, Ventura County, California, Prepared for EPA Region 9 by HydroGeoLogic, Inc. December 21, 2012

ITRC. 2011. *Green and Sustainable Remediation: A Practical Framework*. Washington D.C.: ITRC, Green and Sustainable Remediation Team. November.

Marten, A. L. and Newbold, S. 2012. *Estimating the Social Cost of Non-CO2 GHG Emissions: Methane and Nitrous Oxide*. Washington D.C.: USEPA National Center for Environmental Economics, Work Paper Series #11-01.

Marten, A. L., Kopits, E. A., Griffiths, C. W., Newbold, S. C., & Wolverton, A. (2015). *Incremental CH4 and N2O mitigation benefits consistent with the US Government's SC-CO2 estimates*. Climate Policy, 15(2), 272-298.

Muller N. Z. and Mendelsohn, R. 2010. *Weighing the value of a ton of pollution*. Regulation, 33(2): 20-24

MWH Americas, Inc. (MWH), 2005. Standardized Risk Assessment Methodology (SRAM) Work Plan, Santa Susana Field Laboratory, Ventura County, California. Revision 2 – Final. September. HDMSE00198.

MWH, 2014, *Final Standardized Risk Assessment Methodology Revision 2 Addendum*, Santa Susana Field Laboratory, Ventura County, California, August.

Schulz, T. W., and S. Griffin. 2001. *Practical methods for meeting remediation goals at hazardous waste sites*. Risk Analysis 21(1):43-52.

URS. 2012. *Chemical Soil Background Report*, Santa Susana Field Laboratory, Ventura County, California. Prepared by URS for California Environmental Protection Agency, Department of Toxic Substances Control. Final - December 2012.

U.S. Environmental Protection Agency (USEPA). 1989. *Risk Assessment Guidance for Superfund: Human Health Evaluation Manual,* Part A, EPA/540/1-89/002. EPA Office of Emergency and Remedial Response, Washington, D.C., OSWER Directive 9285.701A. NTIS PB90-155581.

USEPA. 1991a. *Role of Baseline Risk Assessment in Superfund Remedy Selection Decisions*. OSWER Directive 9355.0-30. April 22.

USEPA. 1991b. *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors*. Interim Final. OSWER Directive: 9285.6-03. March 25.

USEPA. 1992. *Supplemental Guidance to RAGS: Calculating the Concentration Term*. Publication 9285.7-08I. May.

USEPA. 1997. *Guiding Principles for Monte Carlo Analysis.* Risk Assessment Forum, U.S. Environmental Protection Agency. EPA/630/R-97/001. March 1997.

USEPA. 2000. *Science Policy Council Handbook, Risk Characterization*. EPA 100-B-00-002. December.

USEPA. 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4. EPA/240/B-06/001. February 2006.

USEPA. 2009. *Record of Decision*, Parcel C-6, Former McClellan Air Force Base, McClellan, California. May.

USEPA. 2012. *Methodology for Understanding and Reducing a Project's Environmental Footprint*. Office of Solid Waste and Emergency Response and Office of Superfund Remediation and Technology Innovation. September 16.

USEPA. 2013. *ProUCL 5.0.00 Technical User's Guide*. EPA/600/R-07/041. September.

U.S. Navy Facility Engineering Command (NAVFAC). 2013. *Record of Decision for Parcel E*, Hunters Point Naval Shipyard, San Francisco, California. December.

United States Government (USG). 2013. *Technical Support Document - Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis*- Under Executive Order 12866. USG: Interagency Working Group on Social Cost of Carbon. May.

This page intentionally left blank.

Attachment A

AOC LUT Values and RBSLs

This page intentionally left blank.

Summary of AOC Lookup Table (LUT) Values
Area IV/NBZ
Santa Susana Field Laboratory

Chemical Name	Unit	AOC Lookup Table Value[1]
Inorganic Compounds		
Aluminum	mg/kg	58,600
Antimony	mg/kg	0.86
Arsenic	mg/kg	46
Barium	mg/kg	371
Beryllium	mg/kg	2.2
Boron	mg/kg	34
Cadmium	mg/kg	0.7
Chromium	mg/kg	94
Cobalt	mg/kg	44
Copper	mg/kg	119
Hexavalent chromium	mg/kg	2
Lead	mg/kg	49
Lithium	mg/kg	91
Manganese	mg/kg	1,120
Mercury	mg/kg	0.13
Methyl Mercury	ug/kg	0.05
Molybdenum	mg/kg	3.2
Nickel	mg/kg	132
Selenium	mg/kg	1
Silver	mg/kg	0.2
Strontium	mg/kg	163
Thallium	mg/kg	1.2
Vanadium	mg/kg	175
Zinc	mg/kg	215
Zirconium	mg/kg	19
Perchlorate		
Perchlorate	ug/kg	1.63
Energetic Constituents		
RDX	ug/kg	300
Volatile Organic Compounds		
Cis-1,2-Dichloroethene	ug/kg	5
Ethylbenzene	ug/kg	5

Summary of AOC Lookup Table (LUT) Values
Area IV/NBZ
Santa Susana Field Laboratory

Chemical Name	Unit	AOC Lookup Table Value[1]
Methylene Chloride	ug/kg	10
Tetrachloroethene	ug/kg	5
Toluene	ug/kg	5
Trichloroethene	ug/kg	5
Vinyl Chloride	ug/kg	5
1,1-Dichloroethene	ug/kg	5
2-Hexanone	ug/kg	10
Benzene	ug/kg	5
1,4-Dioxane	ug/kg	10
Acetone	ug/kg	20
Hexachloro-1,3-Butadiene	ug/kg	5
Alcohols		
Ethanol	mg/kg	0.7
Methanol	mg/kg	0.7
Formaldehyde		
Formaldehyde	ug/kg	1,870
Semi-Volatile Organic Compounds		
bis(2-Ethylhexyl) phthalate	ug/kg	61
Butylbenzylphthalate	ug/kg	100
Diethyl phthalate	ug/kg	27
Dimethyl phthalate	ug/kg	27
Di-n-butylphthalate	ug/kg	27
Di-n-octylphthalate	ug/kg	27
N-Nitrosodimethylamine (NDMA)	ug/kg	10
Benzoic acid	ug/kg	660
Phenol	ug/kg	170
Polycyclic Aromatic Hydrocarbons		
1-Methylnaphthalene	ug/kg	2.5
2-Methylnaphthalene	ug/kg	2.5
Acenaphthene	ug/kg	2.5
Acenaphthylene	ug/kg	2.5
Anthracene	ug/kg	2.5
Benzo(g,h,i)perylene	ug/kg	2.5

Summary of AOC Lookup Table (LUT) Values
Area IV/NBZ
Santa Susana Field Laboratory

Chemical Name	**Unit**	**AOC Lookup Table Value[1]**
Fluoranthene	ug/kg	5.2
Fluorene	ug/kg	3.8
Naphthalene	ug/kg	3.6
Phenanthrene	ug/kg	3.9
Pyrene	ug/kg	5.6
Total TEQ_BAP	ug/kg	4.47
Pesticides		
p,p-DDD	ug/kg	0.48
p,p-DDE	ug/kg	8.6
p,p-DDT	ug/kg	13
Aldrin	ug/kg	0.24
alpha-BHC	ug/kg	0.24
beta-BHC	ug/kg	0.23
Chlordane	ug/kg	7
delta-BHC	ug/kg	0.22
Dieldrin	ug/kg	0.48
Endosulfan I	ug/kg	0.24
Endosulfan II	ug/kg	0.48
Endosulfan sulfate	ug/kg	0.48
Endrin	ug/kg	0.48
Endrin aldehyde	ug/kg	0.7
Endrin ketone	ug/kg	0.7
gamma-BHC (Lindane)	ug/kg	0.24
Heptachlor	ug/kg	0.24
Heptachlor epoxide	ug/kg	0.24
Methoxychlor	ug/kg	2.4
Mirex	ug/kg	0.5
Toxaphene	ug/kg	8.8
Herbicides		
2,4,5-T	ug/kg	1.2
2,4,5-TP (Silvex)	ug/kg	0.63
2,4-Dichlorophenoxyacetic Acid (2,4-D)	ug/kg	5.8
2,4-Dichlorophenoxybutyric acid (2,4-DB)	ug/kg	2.4
2,4-DP (Dichlorprop)	ug/kg	2.4
Dalapon	ug/kg	12.5

Summary of AOC Lookup Table (LUT) Values
Area IV/NBZ
Santa Susana Field Laboratory

Chemical Name	Unit	AOC Lookup Table Value[1]
Dicamba	ug/kg	1.3
Dinoseb	ug/kg	3.3
MCPA (2-Methyl-4-Chlorophenoxyacetic Acid)	ug/kg	761
MCPP	ug/kg	377
Pentachlorophenol	ug/kg	170
PCDD/PCDFs		
2,3,7,8-TCDD TEQ	ng/kg	0.912
Polychlorinated Biphenyls (PCBs)		
Aroclor 1016	ug/kg	17
Aroclor 1221	ug/kg	33
Aroclor 1232	ug/kg	17
Aroclor 1262	ug/kg	33
Aroclor 1254	ug/kg	17
Aroclor 1260	ug/kg	17
Aroclor 1268	ug/kg	33
Aroclor 1242	ug/kg	17
Aroclor 1248	ug/kg	17
Aroclor 5432	ug/kg	50
Aroclor 5442	ug/kg	50
Aroclor 5460	ug/kg	50
Extractable Fuel Hydrocarbon (EFH)		
TPH EFH (C15-C20)	mg/kg	5
Anions		
Fluoride	mg/kg	10.2
Nitrate	mg/kg	22.3
Cyanide		
Cyanide	mg/kg	0.6
Terphenyls		
o-Terphenyl	mg/kg	7

Summary of AOC Lookup Table (LUT) Values
Area IV/NBZ
Santa Susana Field Laboratory

Chemical Name	Unit	AOC Lookup Table Value[1]

[1]AOC Lookup table (LUT) values were developed based on determined background concentrations at Area IV/NBZ of the SSFL. If background concentration is not available, the corresponding method detection limit was used as LUT values.
AOC = 2010 Administrative Order on Consent for Remedial Action
BAP = Benzo(a)pyrene
EFH = Extractable Fuel Hydrocarbon
LUT = Look-up Table
PCDD/PCDF - polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans
SSFL = Santa Susana Field Laboratory
TCDD - 2,3,7,8-Tetrachlorodibenzo-p-dioxin
TEQ = Toxic Equivalence Quotient

Summary of the Human Health Risk-Based Screening Levels (RBSLs) for Chemicals in Soil
Area IV/NBZ
Santa Susana Field Laboratory

Chemical Name	Units	Suburban Residential RBSL[1]
Inorganic Compounds		
Aluminum	mg/kg	75,300
Antimony	mg/kg	26.4
Arsenic	mg/kg	0.0658
Barium	mg/kg	11,000
Beryllium	mg/kg	31.2
Boron	mg/kg	15,200
Cadmium	mg/kg	4.6
Chromium	mg/kg	37,200
Cobalt	mg/kg	22.8
Copper	mg/kg	3,040
Hexavalent chromium	mg/kg	1.29
Lead	mg/kg	80
Lithium	mg/kg	152
Manganese	mg/kg	6,130
Mercury	mg/kg	16.8
Methyl Mercury	mg/kg	7.61
Molybdenum	mg/kg	380
Nickel	mg/kg	908
Selenium	mg/kg	380
Silver	mg/kg	230
Strontium	mg/kg	45,600
Thallium	mg/kg	0.76
Vanadium	mg/kg	188
Zinc	mg/kg	22,800
Zirconium	mg/kg	6.09
Perchlorate		
Perchlorate	ug/kg	53,300
Energetic Constituents		
RDX	ug/kg	5,940

Summary of the Human Health Risk-Based Screening Levels (RBSLs) for Chemicals in Soil
Area IV/NBZ
Santa Susana Field Laboratory

Chemical Name	Units	Suburban Residential RBSL[1]
Volatile Organic Compounds		
1,1-Dichloroethene	ug/kg	55,800
2-Hexanone	ug/kg	170,000
1,4-Dioxane	ug/kg	19,300
Hexachlorobutadiene	ug/kg	6,670
Acetone	ug/kg	60,100,000
Benzene	ug/kg	115
cis-1,2-Dichloroethene	ug/kg	9,220
Ethylbenzene	ug/kg	2,310
Methylene chloride	ug/kg	2,970
Tetrachloroethene	ug/kg	416
Toluene	ug/kg	3,740,000
Trichloroethene	ug/kg	797
Vinyl chloride	ug/kg	20
Formaldehyde		
Formaldehyde	ug/kg	12,200,000
Semi-Volatile Organic Compounds		
Benzoic acid	ug/kg	244,000,000
bis(2-Ethylhexyl) phthalate	ug/kg	173,000
Butyl benzyl phthalate	ug/kg	274,000
Diethyl phthalate	ug/kg	48,900,000
Dimethyl phthalate	ug/kg	48,900,000
Di-n-butyl phthalate	ug/kg	6,110,000
Di-n-octyl phthalate	ug/kg	611,000
N-Nitrosodimethylamine	ug/kg	33
Phenol	ug/kg	18,300,000
Polycyclic Aromatic Hydrocarbons		
1-Methyl naphthalene	ug/kg	7,290
2-Methylnaphthalene	ug/kg	162,000
Acenaphthene	ug/kg	3,230,000
Acenaphthylene	ug/kg	2,980,000
Anthracene	ug/kg	16,400,000
Benzo(a)anthracene	ug/kg	387

Summary of the Human Health Risk-Based Screening Levels (RBSLs) for Chemicals in Soil
Area IV/NBZ
Santa Susana Field Laboratory

Chemical Name	Units	Suburban Residential RBSL[1]
Benzo(a)pyrene	ug/kg	39
Benzo(b)fluoranthene	ug/kg	387
Benzo(ghi)perylene	ug/kg	1,650,000
Benzo(k)fluoranthene	ug/kg	387
Chrysene	ug/kg	3,870
Dibenzo(a,h)anthracene	ug/kg	113
Fluoranthene	ug/kg	2,200,000
Fluorene	ug/kg	2,180,000
Indeno(1,2,3-cd)pyrene	ug/kg	387
Naphthalene	ug/kg	14,600
Phenanthrene	ug/kg	16,400,000
Pyrene	ug/kg	1,650,000
Pesticides		
p,p-DDD	ug/kg	2,460
p,p-DDE	ug/kg	1,740
p,p-DDT	ug/kg	1,740
Aldrin	ug/kg	34.8
alpha-BHC	ug/kg	219
beta-BHC	ug/kg	394
delta-BHC	ug/kg	328
Chlordane	ug/kg	1,690
Dieldrin	ug/kg	36.9
Endosulfan I	ug/kg	412,000
Endosulfan II	ug/kg	412,000
Endosulfan sulfate	ug/kg	412,000
Endrin	ug/kg	20,600
Endrin aldehyde	ug/kg	20,600
Endrin ketone	ug/kg	20,600
gamma-BHC (Lindane)	ug/kg	537
Heptachlor	ug/kg	144
Heptachlor epoxide	ug/kg	107
Mirex	ug/kg	32.8
Methoxychlor	ug/kg	343,000
Toxaphene	ug/kg	493

Summary of the Human Health Risk-Based Screening Levels (RBSLs) for Chemicals in Soil
Area IV/NBZ
Santa Susana Field Laboratory

Chemical Name	Units	Suburban Residential RBSL[1]
Herbicides		
2,4,5-T	ug/kg	686,000
2,4,5-TP (Silvex)	ug/kg	549,000
2,4-Dichlorophenoxyacetic Acid (2,4-D)	ug/kg	686,000
2,4-Dichlorophenoxybutyric acid (2,4-DB)	ug/kg	549,000
Dalapon	ug/kg	2,060,000
Dicamba	ug/kg	2,060,000
2,4-DP (Dichlorprop)	ug/kg	686,000
Dinoseb	ug/kg	68,600
MCPA (2-Methyl-4-Chlorophenoxyacetic Acid)	ug/kg	34,300
MCPP	ug/kg	68,600
Pentachlorophenol	ug/kg	21,200
Terphenyls		
o-Terphenyl	mg/kg	65
PCDD/PCDFs		
2,3,7,8-TCDD TEQ	pg/g	4.8
Polychlorinated Biphenyls (PCBs)		
Aroclor 1016	ug/kg	3,860
Aroclor 1242	ug/kg	232
Aroclor 1248	ug/kg	232
Aroclor 1254	ug/kg	232
Aroclor 1260	ug/kg	232
Aroclor 5460	ug/kg	232
Anions		
Fluoride	mg/kg	3,040
Cyanide		
Cyanide	mg/kg	45.6

Summary of the Human Health Risk-Based Screening Levels (RBSLs) for Chemicals in Soil
Area IV/NBZ
Santa Susana Field Laboratory

Chemical Name	Units	Suburban Residential RBSL[1]

[1] Suburban Residential Soil RBSLs include the following pathways: ingestion of soil, dermal contact with soil, and inhalation of dust and volatiles from soil.
mg/kg - milligrams per kilogram
PCDD/PCDF - polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans
RBSL - Risk-based Screening Level
TCDD - 2,3,7,8-Tetrachlorodibenzo-p-dioxin
TEQ - toxic equivalency quotient

Attachment B

Environmental Footprint Analysis Development

This page intentionally left blank.

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	MAH & AIS
JOB NO.:	94489.1204	DATE:	4/22/2016	DATE CHECKED:	4/27/2016
CLIENT:	DOE			WRKSHT NO.:	General Assumptions

Sitewise™ Environmental Footprint Analysis
Area IV / Northern Buffer Zone Soil Remedial Action Alternative Comparison
Santa Susana Field Laboratory

General assumptions that apply to all alternatives:

1 See cost benefit analysis for descriptions of the alternatives and comprehensive summary of assumptions.
2 Duration and labor hours are based on cost estimate from cost benefit analysis for Area IV and Northern Buffer Zone (NBZ).
3 Equipment hours are based on input from the second generation of the Micro-Computer Aided Cost Estimating System (MII), which was used to develop the cost estimate for Area IV/NBZ.
4 Costs are based on remedial action cost estimate for Area IV/NBZ.
5 No footprint reduction is assumed (e.g. regular diesel will be used instead of biodiesel, no hybrid trucks, no solar equipment, etc.).
6 10% of backfill volume from onsite rock excavation and crushing.
7 Average personnel distance from job site per round trip is 100 miles.
8 Average equipment distance from job site per round trip for mob/demob is 300 miles.
9 Woosley Canyon Road will be maintained/repaired as needed. Assume average of 2.5 miles to be repaired.

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	MAH & AIS
JOB NO.:	94489.1204	DATE:	4/22/2016	DATE CHECKED:	4/27/2016
CLIENT:	DOE			WRKSHT NO.:	Cleanup to AOC LUT

To be copied to Sitewise Input Sheet
Input values to be entered

Cleanup to AOC LUT Values Alternative

Component 1 - Removal, Transportation/Disposal, and Backfill Duration, YR: 10

TRANSPORTATION

Personnel Transportation - Road

Assumption 1: % time calculated based on hours of personnel on Site (from cost estimate) relative to duration of remedy.
Assumption 2: % time is used to determine the number of round trips to be taken to the site.
Assumption 3: Daily commuting is assumed.

Job Site Personnel	Number of Personnel	Vehicle Type	Number of Vehicle	Fuel	% Time	# trips (round)	# traveler	Source
Superintendent	1	Light Truck	1	Gasoline	100%	2,600	1	from cost estimate
Project Engineer	1	SUV	1	Gasoline	100%	2,600	1	from cost estimate
QC Engineer	1	Cars	1	Gasoline	100%	2,600	1	from cost estimate
Safety Engineer	1	Light Truck	1	Gasoline	100%	2,600	1	from cost estimate
Civil Engineer	1	Light Truck	1	Gasoline	40%	1,040	1	from cost estimate
Staff Scientist	1	SUV	1	Gasoline	60%	1,560	1	from cost estimate
Field QC and Lab Tech	1	Heavy Duty	1	Gasoline	100%	2,600	1	from cost estimate
Equipment Operators	23	Light Truck	23	Gasoline	100%	59,800	23	assumed based on # of equipment mobilized
Other Construction Laborers	10	Heavy Duty	10	Gasoline	100%	26,000	10	assumed
Administrative Staff	1	Cars	1	Gasoline	100%	2,600	1	from cost estimate

Miles per Trip: 100 miles round trip

Inputs	Heavy Duty	Light Truck	SUV	Cars
Input distance traveled per trip (miles)	100	100	100	100
Input number of trips taken	28,600	66,040	4,160	5,200
Input number of travelers	11	26	2	2

Equipment Transportation - Shared Load Road

Assumption 1: The weight of a hydraulic excavator with 4.25 CY bucket and 27.83' digging depth (133,160 lbs) is assumed for heavy equipment.
Assumption 2: The weight of a hydraulic excavator with 3.25 CY bucket and 25.58' digging depth (75,000 lbs) is assumed for medium equipment.
Assumption 3: The weight of a flatbed truck (75,000 lb) is assumed for self-propelled equipment.
Assumption 4: Equipment is available from vendors within 100 miles of the Site (200 miles round trip).

Equipment	Quantity	Weight (ton/piece)	Distance (miles/rd trip)	Total Wt (ton)	Source
Heavy Equipment	10	66.58	200	665.8	quantity from cost estimate, weight from MII equipment list.
Medium Equipment	10	37.5	200	375	quantity from cost estimate, weight from MII equipment list.
Self-propelled Equipment	3	37.5	200	112.5	quantity from cost estimate, weight from MII equipment list.
Truck cab with trailer for transport	15	40	200	600	assume 1 cab w/ trailer for heavy equipment; and 2 cab w/ trailer for 2 pieces of medium equipment.

	Trip 1 (hvy)	Trip 2 (med)	Trip 3 (SP)
Input distance traveled, MI:	200	200	200
Input weight of equipment transported, TON:	1065.8	575	112.5

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	MAH & AIS
JOB NO.:	94489.1204	DATE:	4/22/2016	DATE CHECKED:	4/27/2016
CLIENT:	DOE			WRKSHT NO.:	Cleanup to AOC LUT

To be copied to Sitewise Input Sheet (yellow)
Input values to be entered (blue)

Cleanup to AOC LUT Values Alternative

EQUIPMENT USE

Earthwork

Assumption 1: Excavator for all excavation work
Assumption 2: Loader for all backfilling work
Assumption 3:

Soil for Removal, CY:	933,000	*from alternative description*
Soil for Backfill, CY:	700,000	*from alternative description*

	Excavator	Loader/Backhoe
Input volume of material to be removed, CY:	933,000	700,000

Generator

Assumption 1: Assume 100% time for duration of project, 52 weeks a year, 40 hours a week.
Assumption 2: 40 kW *from cost estimate equipment list, for rock crushing plant.*

Horsepower range, HP:	53.6	
Choose horsepower range from drop down menu:	50 to 75	- use drop down menu
Hours, HR:	20,800	*assumes 40 hours a week and 52 weeks a year.*

Capping Equipment (Paving)

Assumption 1: Length, MI:	2.5	*from cost estimate*
Assumption 2: Width, FT:	24.634	*back calculated*
Assumption 3: Area, SF:	325,169	*calculated*
Assumption 3: Area, SY:	36,130	*from cost estimate*
Assumption 4: Hours, HR:	279	*from cost estimate*
Assumption 4: Days, DY:	35	

Choose stabilization equipment type from drop down menu:	Paver
Choose fuel type from drop down menu:	Diesel
Input area, SF:	325,169
Input time available, DY:	35

Other Fueled Equipment

Assumption 1: Other field equipment include all other equipment not covered under other categories:
a. Mob/Demob equipment is accounted for under equipment transportation - shared load road.
b. Equipment for removal of soil (e.g. no grading or compaction) is accounted for under equipment use - earthwork.
c. Personnel transport equipment is accounted for under transportation - personnel transport.
d. Electricity run equipment (e.g. rock crushing plant) is accounted for under equipment use - generator.
e. Paving equipment is accounted for under equipment use - paving equipment.
f. Waste hauling equipment is accounted for under residual handling - residual recycling/disposal.

Assumption 2: If the same type of equipment with slightly different specifications are used for different tasks, the fuel consumption rate of the equipment that utilizes the most hours is used.
Assumption 4: Hours from equipment hours from cost report backup

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	MAH & AIS
JOB NO.:	94489.1204	DATE:	4/22/2016	DATE CHECKED:	4/27/2016
CLIENT:	DOE			WRKSHT NO.:	Cleanup to AOC LUT

To be copied to Sitewise Input Sheet (yellow)
Input values to be entered (blue)

Cleanup to AOC LUT Values Alternative

	Hours	Gallons Diesel
Excavator Small	1,320	15,890
Dozer	403	2,664
Excavator	4,214	50,719
Rock Hauler	811	5,364
Asphalt Hauler	235	2,826
Hauler	32,296	388,744
Loader	811	2,940
Flatbed Truck	4,225	27,950
Pickup	3,413	12,374
Roller	8,443	30,614
Sweeper	10,400	68,806
Tractor	606	1,068
Water Truck	40,000	264,640

Input volume (scf for Natural gas, gallons for all others): 874,599

Operator Labor

Assumption 1: see Labor Hours tab for hours assumptions from Cost Estimate
Assumption 2: 20% of "mixed" on-site and off-site operator labor (e.g. hauler) is assumed to be performed on-site.

Choose occupation from drop-down menu	Construction laborers	Operating engineers	Waste management services	Scientific and Technical Services	
Input total time worked onsite, HR:	279,628.73	0.00	124,929.43	149,056	*see labor hours tab*
assumptions					

Laboratory Analysis

Input dollars spent on laboratory analysis ($): $6,918,600 from cost estimate, based on present worth cost.

RESIDUAL HANDLING

Residue Disposal/Recycling

	Total Tonnage	Total Round Trips	Miles per Trip (1-way)	Miles per Trip round trip	
Soil Cat 1 & 2	1,190,000	59,500	135	270	*from calculation (tonnage and miles) and from calculation (trips)*
Soil Cat 3	73,500	3,700	300	600	*from calculation (tonnage and miles) and from calculation (trips)*
Soil Cat 4	66,000	3,300	780	1,560	*from calculation (tonnage and miles) and from calculation (trips)*
Soil Cat 5	66,000	3,300	780	1,560	*from calculation (tonnage and miles) and from calculation (trips)*
Soil Cat 6	4,500	230	780	1,560	*from calculation (tonnage and miles) and from calculation (trips)*
TPH/PAH Soil (cat 1&2)	0	0	0	0	*from calculation (tonnage and miles) and from calculation (trips)*

	Soil Residue	Soil Residue	Soil Residue	Residual Water	
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	
Input weight of the waste transported to landfill or recycling per trip, TON:	20	20	20		
Choose fuel used from drop down menu	Diesel	Diesel	Diesel	Diesel	
Input total number of trips:	59,500	3,700	6,830		
Input number of miles per trip:	270	600	1,560		roundtrip

Landfill Operations

Choose landfill type for waste disposal	Non-Hazardous	Hazardous
Input amount of waste disposed in landfill, TON:	1,190,000	210,000
Input landfill methane emissions, Metric Tons CH4:		

Thermal/Catalytic Oxidizers PROBABLY NOT NEEDED? ASSUME NO INCINERATION?

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	MAH & AIS
JOB NO.:	94489.1204	DATE:	4/22/2016	DATE CHECKED:	4/27/2016
CLIENT:	DOE			WRKSHT NO.:	Cleanup to AOC LUT

To be copied to Sitewise Input Sheet
Input values to be entered

Cleanup to AOC LUT Values Alternative

Assumption 1:	0%	of cat 3 and cat 5 soil require incineration
Assumption 2:	139,500	tons of soil require incineration
Assumption 3:	4	hours at scfm below for each 100 tons

Choose oxidizer type from drop down menu:	Simple Thermal Oxidizer
Choose fuel type from drop down menu:	Natural gas
Input waste gas flow rate, SCFM:	-
Input time running, HR:	-
Input waste gas inlet temperature, F:	-
Input contaminant concentration, ppmV:	-

RESOURCE CONSUMPTION

Water Consumption

Water for Dust control, GAL/DY:	16,000	*From cost estimate.*	
Water for Dust control, GAL/YR:	4,000,000	*From cost estimate.*	250

	Treatment System 1	Treatment System 2	Treatment System 3
Input total water consumed from potable water treatment facility, GAL:	40,000,000	*From cost estimate calculations.*	
Input total water disposed to wastewater treatment facility, GAL:	0		

Onsite Land and Water Resource Consumption

Input volume of topsoil brought to site, CY:	700,000	*LCY, from cost estimate, from off-site sources*
Input volume of groundwater or surface water lost, GAL:	0	

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	MAH & AIS
JOB NO.:	94489.1204	DATE:	4/22/2016	DATE CHECKED:	4/27/2016
CLIENT:	DOE			WRKSHT NO.:	Cleanup to Revised LUT

(yellow) To be copied to Sitewise Input Sheet
(blue) Input values to be entered

Cleanup to Revised LUT Values Alternative

Component 1 - Removal, Transportation/Disposal, and Backfill Duration, YR: 2

Transportation

Personnel Transportation - Road

Assumption 1: % time calculated based on hours of personnel on Site (from cost estimate) relative to duration of remedy.
Assumption 2: % time is used to determine the number of round trips to be taken to the site.
Assumption 3: Daily commuting is assumed.

Job Site Personnel	Number of Personnel	Vehicle Type	Number of Vehicle	Fuel	% Time	# trips (round)	# traveler	Source
Superintendent	1	Light Truck	1	Gasoline	100%	520	1	from cost estimate
Project Engineer	1	SUV	1	Gasoline	100%	520	1	from cost estimate
QC Engineer	1	Cars	1	Gasoline	100%	520	1	from cost estimate
Safety Engineer	1	Light Truck	1	Gasoline	100%	520	1	from cost estimate
Civil Engineer	1	Light Truck	1	Gasoline	40%	208	1	from cost estimate
Staff Scientist	1	SUV	1	Gasoline	60%	312	1	from cost estimate
Field QC and Lab Tech	1	Heavy Duty	1	Gasoline	100%	520	1	from cost estimate
Equipment Operators	23	Light Truck	23	Gasoline	100%	11,960	23	assumed based on # of equipment mobilized
Other Construction Laborers	10	Heavy Duty	10	Gasoline	100%	5,200	10	assumed
Administrative Staff	1	Cars	1	Gasoline	100%	520	1	from cost estimate

Miles per Trip: 100 miles round trip

Inputs	Heavy Duty	Light Truck	SUV	Cars
Input distance traveled per trip (miles)	100	100	100	100
Input number of trips taken	5,720	13,208	832	1,040
Input number of travelers	11	26	2	2

Equipment Transportation - Shared Load Road

Assumption 1: The weight of a hydraulic excavator with 4.25 CY bucket and 27.83' digging depth (133,160 lbs) is assumed for heavy equipment.
Assumption 2: The weight of a hydraulic excavator with 3.25 CY bucket and 25.58' digging depth (75,000 lbs) is assumed for medium equipment.
Assumption 3: The weight of a flatbed truck (75,000 lb) is assumed for self-propelled equipment.
Assumption 4: Equipment is available from vendors within 100 miles of the Site (200 miles round trip).

Equipment	Quantity	Weight (ton/piece)	Distance (miles/rd trip)	Total Wt (ton)	Source
Heavy Equipment	10	66.58	200	665.8	quantity from cost estimate, weight from MII equipment list.
Medium Equipment	10	37.5	200	375	quantity from cost estimate, weight from MII equipment list.
Self-propelled Equipment	3	37.5	200	112.5	quantity from cost estimate, weight from MII equipment list.
Truck cab with trailer for transport	15	40	200	600	assume 1 cab w/ trailer for heavy equipment; and 2 cab w/ trailer for 2 pieces of medium equipment.

	Trip 1 (hvy)	Trip 2 (med)	Trip 3 (SP)
Input distance traveled, MI:	200	200	200
Input weight of equipment transported, TON:	1065.8	575	112.5

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL		CHECKED BY:	MAH & AIS
JOB NO.:	94489.1204	DATE:	4/22/2016		DATE CHECKED:	4/27/2016
CLIENT:	DOE				WRKSHT NO.:	Cleanup to Revised LUT

To be copied to Sitewise Input Sheet (yellow)
Input values to be entered (blue)

Cleanup to Revised LUT Values Alternative

Equipment Use

Earthwork

Assumption 1: Excavator for all excavation work
Assumption 2: Loader for all backfilling work
Assumption 3:

Soil for Removal, CY:	192,000	*from alternative description*
Soil for Backfill, CY:	144,000	*from alternative description*

	Excavator	Loader/Backhoe
Input volume of material to be removed, CY:	192,000	144,000

Generator

Assumption 1: Assume 100% time for duration of project, 52 weeks a year, 40 hours a week.
Assumption 2: 40 kW *from cost estimate equipment list, for rock crushing plant.*

Horsepower range, HP:	53.6	
Choose horsepower range from drop down menu:	50 to 75	- use drop down menu
Hours, HR:	4,160	assumes 40 hours a week and 52 weeks a year.

Capping Equipment (Paving)

Assumption 1: Length, MI:	2.5	*from cost estimate*
Assumption 2: Width, FT:	24.634	*back calculated*
Assumption 3: Area, SF:	325,169	*calculated*
Assumption 3: Area, SY:	36,130	*from cost estimate*
Assumption 4: Hours, HR:	279	
Assumption 4: Hours, DY:	35	

Choose stabilization equipment type from drop down menu:	Paver
Choose fuel type from drop down menu:	Diesel
Input area, SF:	325168.8
Input time available, DY:	35

Other Fueled Equipment

Assumption 1: Other field equipment include all other equipment not covered under other categories:
a. Mob/Demob equipment is accounted for under equipment transportation - shared load road.
b. Equipment for removal of soil (e.g. no grading or compaction) is accounted for under equipment use - earthwork.
c. Personnel transport equipment is accounted for under transportation - personnel transport.
d. Electricity run equipment (e.g. rock crushing plant) is accounted for under equipment use - generator.
e. Paving equipment is accounted for under equipment use - paving equipment.
f. Waste hauling equipment is accounted for under residual handling - residual recycling/disposal.

Assumption 2: If the same type of equipment with slightly different specifications are used for different tasks, the fuel consumption rate of the equipment that utilizes the most hours is used.
Assumption 4: Hours from equipment hours from cost report backup

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	MAH & AIS
JOB NO.:	94489.1204	DATE:	4/22/2016	DATE CHECKED:	4/27/2016
CLIENT:	DOE			WRKSHT NO.:	Cleanup to Revised LUT

To be copied to Sitewise Input Sheet
Input values to be entered

Cleanup to Revised LUT Values Alternative

	Hours	Gallons Diesel
Excavator Small	278	3,352
Dozer	130	862
Excavator	872	10,491
Rock Hauler	170	1,124
Asphalt Hauler	235	2,826
Hauler	6,009	72,326
Loader	170	616
Flatbed Truck	1,029	6,806
Pickup	609	2,207
Roller	1,862	6,753
Sweeper	2,080	13,761
Tractor	228	402
Water Truck	8,000	52,928

Input volume (scf for Natural gas, gallons for all others): 174,453

Operator Labor

Assumption 1: see Labor Hours tab for hours assumptions from Cost Estimate

Assumption 2: 20% of "mixed" on-site and off-site operator labor (e.g. hauler) is assumed to be performed on-site.

Choose occupation from drop-down menu	Construction laborers	Operating engineers	Waste management services	Scientific and technical services	
Input total time worked onsite, HR: assumptions	57,917.02	0.00	53,219.76	32,576	*see labor hours tab*

Laboratory Analysis

Input dollars spent on laboratory analysis ($): $1,059,500 from cost estimate, based on present worth cost.

RESIDUAL HANDLING

Residue Disposal/Recycling

	Total Tonnage	Total Round Trips	Miles per Trip (1-way)	Miles per Trip round trip	
Soil Cat 1 & 2	78,000	3,900	135	270	*from calculation (tonnage and miles) and from calculation (trips)*
Soil Cat 3	73,500	3,700	300	600	*from calculation (tonnage and miles) and from calculation (trips)*
Soil Cat 4	66,000	3,300	780	1,560	*from calculation (tonnage and miles) and from calculation (trips)*
Soil Cat 5	66,000	3,300	780	1,560	*from calculation (tonnage and miles) and from calculation (trips)*
Soil Cat 6	4,500	230	780	1,560	*from calculation (tonnage and miles) and from calculation (trips)*
TPH/PAH Soil	0	0	0	0	*from calculation (tonnage and miles) and from calculation (trips)*

	Soil Residue	Soil Residue	Soil Residue	Residual Water
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip, TON:	20	20	20	
Choose fuel used from drop down menu	Diesel	Diesel	Diesel	Diesel
Input total number of trips:	3,900	3,700	6,830	
Input number of miles per trip:	270	600	1,560	

Landfill Operations

Choose landfill type for waste disposal	Non-Hazardous	Hazardous
Input amount of waste disposed in landfill, TON:	78,000	210,000

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	MAH & AIS
JOB NO.:	94489.1204	DATE:	4/22/2016	DATE CHECKED:	4/27/2016
CLIENT:	DOE			WRKSHT NO.:	Cleanup to Revised LUT

To be copied to Sitewise Input Sheet
Input values to be entered

Cleanup to Revised LUT Values Alternative

Input landfill methane emissions, Metric Tons CH4:

Thermal/Catalytic Oxidizers PROBABLY NOT NEEDED? ASSUME NO INCINERATION?

Assumption 1:	0%	of cat 3 and cat 5 soil require incineration
Assumption 2:	139,500	tons of soil require incineration
Assumption 3:	4	hours at scfm below for each 100 tons

Choose oxidizer type from drop down menu:	Simple Thermal Oxidizer
Choose fuel type from drop down menu:	Natural gas
Input waste gas flow rate, SCFM:	-
Input time running, HR:	-
Input waste gas inlet temperature, F:	-
Input contaminant concentration, ppmV:	-

RESOURCE CONSUMPTION

Water Consumption

Water for Dust control, GAL/DY:	16,000	*From cost estimate.*
Water for Dust control, GAL/YR:	4,000,000	*From cost estimate.*

	Treatment System 1	Treatment System 2	Treatment System 3
Input total water consumed from potable water treatment facility, GAL:	8,000,000	*From cost estimate calculations.*	
Input total water disposed to wastewater treatment facility, GAL:	0		

ONSITE LAND AND WATER RESOURCE CONSUMPTION

Input volume of topsoil brought to site, CY:	144,000	*LCY, from cost estimate, from off-site sources*
Input volume of groundwater or surface water lost, GAL:	0	

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	MAH & AIS
JOB NO.:	94489.1204	DATE:	4/22/2016	DATE CHECKED:	4/27/2016
CLIENT:	DOE			WRKSHT NO.:	Conservation of Nat Resources

To be copied to Sitewise Input Sheet
Input values to be entered

Conservation of Natural Resources Alternative

Component 1 - Removal, Transportation/Disposal, and Backfill Duration, YR: 2

Transportation

Personnel Transportation - Road

Assumption 1: % time calculated based on hours of personnel on Site (from cost estimate) relative to duration of remedy.
Assumption 2: % time is used to determine the number of round trips to be taken to the site.
Assumption 3: Daily commuting is assumed.

Job Site Personnel	Number of Personnel	Vehicle Type	Number of Vehicle	Fuel	% Time	# trips (round)	# traveler	Source
Superintendent	1	Light Truck	1	Gasoline	100%	520	1	from cost estimate
Project Engineer	1	SUV	1	Gasoline	100%	520	1	from cost estimate
QC Engineer	1	Cars	1	Gasoline	100%	520	1	from cost estimate
Safety Engineer	1	Light Truck	1	Gasoline	100%	520	1	from cost estimate
Civil Engineer	1	Light Truck	1	Gasoline	40%	208	1	from cost estimate
Staff Scientist	1	SUV	1	Gasoline	60%	312	1	from cost estimate
Field QC and Lab Tech	1	Heavy Duty	1	Gasoline	100%	520	1	from cost estimate
Equipment Operators	23	Light Truck	23	Gasoline	100%	11,960	23	assumed based on # of equipment mobilized
Other Construction Laborers	10	Heavy Duty	10	Gasoline	100%	5,200	10	assumed
Administrative Staff	1	Cars	1	Gasoline	100%	520	1	from cost estimate

Miles per Trip: 100 miles round trip

Inputs	Heavy Duty	Light Truck	SUV	Cars
Input distance traveled per trip (miles)	100	100	100	100
Input number of trips taken	5,720	13,208	832	1,040
Input number of travelers	11	26	2	2

Equipment Transportation - Shared Load Road

Assumption 1: The weight of a hydraulic excavator with 4.25 CY bucket and 27.83' digging depth (133,160 lbs) is assumed for heavy equipment.
Assumption 2: The weight of a hydraulic excavator with 3.25 CY bucket and 25.58' digging depth (75,000 lbs) is assumed for medium equipment.
Assumption 3: The weight of a flatbed truck (75,000 lb) is assumed for self-propelled equipment.
Assumption 4: Equipment is available from vendors within 100 miles of the Site (200 miles round trip).

Equipment	Quantity	Weight (ton/piece)	Distance (miles/rd trip)	Total Wt (ton)	Source
Heavy Equipment	10	66.58	200	665.8	quantity from cost estimate, weight from MII equipment list.
Medium Equipment	10	37.5	200	375	quantity from cost estimate, weight from MII equipment list.
Self-propelled Equipment	3	37.5	200	112.5	quantity from cost estimate, weight from MII equipment list.
Truck cab with trailer for transport	15	40	200	600	assume 1 cab w/ trailer for heavy equipment; and 2 cab w/ trailer for 2 pieces of medium equipment.

	Trip 1 (hvy)	Trip 2 (med)	Trip 3 (SP)
Input distance traveled, MI:	200	200	200
Input weight of equipment transported, TON:	1065.8	575	112.5

PROJECT:	SSFL Area IV Soils CBA	**COMPUTED BY:**	IL	**CHECKED BY:**	MAH & AIS
JOB NO.:	94489.1204	**DATE:**	4/22/2016	**DATE CHECKED:**	4/27/2016
CLIENT:	DOE			**WRKSHT NO.:**	Conservation of Nat Resources

To be copied to Sitewise Input Sheet
Input values to be entered

Conservation of Natural Resources Alternative

Equipment Use

Earthwork

Assumption 1: Excavator for all excavation work
Assumption 2: Loader for all backfilling work
Assumption 3:

Soil for Removal, CY:	148,000	*from alternative description*
Soil for Backfill, CY:	111,000	*from alternative description*

	Excavator	**Loader/Backhoe**
Input volume of material to be removed, CY:	148,000	111,000

Generator

Assumption 1: Assume 100% time for duration of project, 52 weeks a year, 40 hours a week.
Assumption 2: 40 kW *from cost estimate equipment list, for rock crushing plant.*

Horsepower range, HP:	53.6	
Choose horsepower range from drop down menu:	50 to 75	- use drop down menu
Hours, HR:	4,160	*assumes 40 hours a week and 52 weeks a year.*

Capping Equipment (Paving)

Assumption 1: Length, MI:	2.5	*from cost estimate*
Assumption 2: Width, FT:	24.634	*back calculated*
Assumption 3: Area, SF:	325,169	*calculated*
Assumption 3: Area, SY:	36,130	*from cost estimate*
Assumption 4: Hours, HR:	279	
Assumption 4: Hours, DY:	35	

Choose stabilization equipment type from drop down menu:	Paver
Choose fuel type from drop down menu:	Diesel
Input area, SF:	325,169
Input time available, DY:	35

Other Fueled Equipment

Assumption 1: Other field equipment include all other equipment not covered under other categories:

a. Mob/Demob equipment is accounted for under equipment transportation - shared load road.
b. Equipment for removal of soil (e.g. no grading or compaction) is accounted for under equipment use - earthwork.
c. Personnel transport equipment is accounted for under transportation - personnel transport.
d. Electricity run equipment (e.g. rock crushing plant) is accounted for under equipment use - generator.
e. Paving equipment is accounted for under equipment use - paving equipment.
f. Waste hauling equipment is accounted for under residual handling - residual recycling/disposal.

Assumption 2: If the same type of equipment with slightly different specifications are used for different tasks, the fuel consumption rate of the equipment that utilizes the most hours is used.
Assumption 4: Hours from equipment hours from cost report backup

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	MAH & AIS
JOB NO.:	94489.1204	DATE:	4/22/2016	DATE CHECKED:	4/27/2016
CLIENT:	DOE			WRKSHT NO.:	Conservation of Nat Resources

To be copied to Sitewise Input Sheet

Input values to be entered

Conservation of Natural Resources Alternative

	Hours	Gallons Diesel
Excavator Small	278	3,352
Dozer	106	703
Excavator	673	8,104
Rock Hauler	131	868
Asphalt Hauler	235	2,826
Hauler	4,631	55,746
Loader	131	476
Flatbed Truck	995	6,583
Pickup	392	1,420
Roller	1,448	5,249
Sweeper	2,080	13,761
Tractor	194	343
Water Truck	8,000	52,928

Input volume (scf for Natural gas, gallons for all others): 152,359

Operator Labor

Assumption 1: see Labor Hours tab for hours assumptions from Cost Estimate

Assumption 2: 20% of "mixed" on-site and off-site operator labor (e.g. hauler) is assumed to be performed on-site.

Choose occupation from drop-down menu	Construction laborers	Operating engineers	Waste management services	Scientific and technical services	
Input total time worked onsite, HR: assumptions	55,004.65	0.00	34,362.61	32,576	*see labor hours tab*

Laboratory Analysis

Input dollars spent on laboratory analysis ($): $608,700 from cost estimate, based on present worth cost.

RESIDUAL HANDLING

Residue Disposal/Recycling

	Total Tonnage	Total Round Trips	Miles per Trip (1-way)	Miles per Trip round trip	
Soil Cat 1 & 2	78,000	3,900	135	270	*from calculation (tonnage and miles) and from calculation (trips)*
Soil Cat 3	73,500	3,700	300	600	*from calculation (tonnage and miles) and from calculation (trips)*
Soil Cat 4	0	0	0	0	*from calculation (tonnage and miles) and from calculation (trips)*
Soil Cat 5	66,000	3,300	780	1,560	*from calculation (tonnage and miles) and from calculation (trips)*
Soil Cat 6	4,500	230	780	1,560	*from calculation (tonnage and miles) and from calculation (trips)*
TPH/PAH Soil	0	0	0	0	*from calculation (tonnage and miles) and from calculation (trips)*

	Soil Residue	Soil Residue	Soil Residue	Residual Water
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip, TON:	20	20	20	
Choose fuel used from drop down menu	Diesel	Diesel	Diesel	Diesel
Input total number of trips:	3,900	3,700	3,530	
Input number of miles per trip:	270	600	1,560	

Landfill Operations

Choose landfill type for waste disposal	Non-Hazardous	Hazardous
Input amount of waste disposed in landfill, TON:	78,000	144,000
Input landfill methane emissions, Metric Tons CH4:		

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	MAH & AIS
JOB NO.:	94489.1204	DATE:	4/22/2016	DATE CHECKED:	4/27/2016
CLIENT:	DOE			WRKSHT NO.:	Conservation of Nat Resources

To be copied to Sitewise Input Sheet
Input values to be entered

Conservation of Natural Resources Alternative

Thermal/Catalytic Oxidizers PROBABLY NOT NEEDED? ASSUME NO INCINERATION?

Assumption 1:	0%	of cat 3 and cat 5 soil require incineration
Assumption 2:	139,500	tons of soil require incineration
Assumption 3:	4	hours at scfm below for each 100 tons

Choose oxidizer type from drop down menu:	Simple Thermal Oxidizer
Choose fuel type from drop down menu:	Natural gas
Input waste gas flow rate, SCFM:	-
Input time running, HR:	-
Input waste gas inlet temperature, F:	-
Input contaminant concentration, ppmV:	-

RESOURCE CONSUMPTION

Water Consumption

Water for Dust control, GAL/DY:	16,000	*From cost estimate.*
Water for Dust control, GAL/YR:	4,000,000	*From cost estimate.*

	Treatment System 1	eatment System 2	Treatment System 3	
Input total water consumed from potable water treatment facility, GAL:		8,000,000	*gallons*	From cost estimate calculations.
Input total water disposed to wastewater treatment facility, GAL:		0	gallons	

Onsite Land and Water Resource Consumption

Input volume of topsoil brought to site, CY:	111,000	*LCY, from cost estimate, from off-site sources*
Input volume of groundwater or surface water lost, GAL:	0	

PROJECT: SSFL Area IV Soils CBA | COMPUTED BY: IL | CHECKED BY: MAH & AIS
JOB NO.: 94489.1204 | DATE: 4/22/2016 | DATE CHECKED: 4/27/2016
CLIENT: DOE | WRKSHT NO.: Labor Hr

Labor Hours

	Percentage of Time On-Site for Mixed Location	20%	Cleanup to AOC LUT Values Alternative				Cleanup to Revised LUT Values Alternative				Conservation of Natural Resources Alternative			
	Item	Location	Construction laborers	Operating engineers	Waste management services	Scientific and technical services	Construction laborers	Operating engineers	Waste management services	Scientific and technical services	Construction laborers	Operating engineers	Waste management services	Scientific and technical services
01	**General Conditions**													
	05 WP and Submittals													
	05 Project Meeitings and Scheduling	Off-Site				2,210				442				442
	10 WPs	Off-Site				1,600				1,600				1,600
	15 Submittals	Off-Site				384				384				384
	20 Post-RA Completion Rpts	Off-Site				492				492				492
	10 Home Office Personnel	Off-Site				12,480				2,496				2,496
	15 Job Site Personnel	On-Site				145,600				31,616				31,616
	20 Temp Facilities													
	05 Project Sign	On-Site	16				16				16			
	10 Staging Area and Fencing	On-Site	16				16				16			
	15 Temporary Facilities	On-Site	0				0				0			
	20 Removal of Temp. Construction Facilities	On-Site	120				120				120			
02	**Mob and Demob**													
	05 Site Mob	On-Site	176				176				176			
	10 Site Demob	On-Site												
	05 Equipment Demob	On-Site	144				144				144			
	10 Site Cleanup	On-Site	120				120				120			
03	**BMPs**													
	05 SWPPP Implementation and Maintenance													
	05 SWPPP Prep	Off-Site				184				184				184
	10 SWPPP Oversight and Maintenance	On-Site				960				384				384
	10 Temp. Erosion and Sediment Control													
	05 Silt Fence	On-Site	2,987				920				819			
	10 Wattles	On-Site	150				53				53			
	15 Sediment Trap	On-Site	93				37				37			
	20 Rock Filter Dam	On-Site	51				20				20			
	25 Track-Out Prevention	On-Site	7				3				3			
	30 Temp. Seeding	On-Site	65				20				16			
	35 Inspection and Maintenance	On-Site	4,160				832				832			
	15 Existing Tree Protection													
	05 Arborist and Care for Existing Trees	On-Site				2,496				576				576
	10 Tree Protection Fencing	On-Site	225				79				79			
	20 Dust Control	On-Site	20,000				4,000				4,000			
	25 Air Monitoring	On-Site	0				0				0			
	30 Decon/Wash Station													
	05 Decon/Wash Station Purchase/Setup	On-Site	0				0				0			
	10 Decon/Wash Station Operation	On-Site	20,800				4,160				4,160			
	35 Street Sweeping	On-Site	10,400				2,080				2,080			
	40 Traffic Control													
	05 Preconstruction Video Survey	On-Site	32				32				32			
	10 Traffic Control Signs / Barricades	On-Site	256				64				64			
	15 Traffic Control	On-Site	160,000				32,000				32,000			
04	**Excavation and Hauling**													
	05 Soil Cat 1 & 2, TPH/PAH Soil													
	05 Soil Cat 1&2													
	05 Construction Survey and Staking	On-Site	1,131				111				111			
	10 Excavation	On-Site	8,201				538				538			
	15 Hauling	Mixed			383,710				25,161				25,161	
	20 Conf Sampling	On-Site	2,433				116				87			
	25 Sampling Analysis	Off-Site				0	0				0			
	10 Soil Cat 3													
	05 Construction Survey and Staking	On-Site	70				104				108			
	10 Excavation	On-Site	507				507				507			
	15 Hauling	Mixed			45,938				45,938				45,938	

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY: IL	CHECKED BY:	MAH & AIS
JOB NO.:	94489.1204	DATE: 4/22/2016	DATE CHECKED:	4/27/2016
CLIENT:	DOE		WRKSHT NO.:	Labor Hr

Labor Hours

	Percentage of Time On-Site for Mixed Location	20%	Cleanup to AOC LUT Values Alternative				Cleanup to Revised LUT Values Alternative				Conservation of Natural Resources Alternative			
	Item	Location	Construction laborers	Operating engineers	Waste management services	Scientific and technical services	Construction laborers	Operating engineers	Waste management services	Scientific and technical services	Construction laborers	Operating engineers	Waste management services	Scientific and technical services
	20 Conf Sampling	On-Site	151				109				82			
	25 Sampling Analysis	Off-Site				0				0				0
	15 Soil Cat 4													
	05 Construction Survey and Staking	On-Site	63				94				0			
	10 Excavation	On-Site	455				455				0			
	15 Hauling	Mixed			94,286				94,286				0	
	20 Conf Sampling	On-Site	136				98				0			
	25 Sampling Analysis	Off-Site				0				0				0
	20 Soil Cat 5													
	05 Construction Survey and Staking	On-Site	63				94				97			
	10 Excavation	On-Site	455				455				455			
	15 Hauling	Mixed			94,286				94,286				94,286	
	20 Conf Sampling	On-Site	136				98				73			
	25 Sampling Analysis	Off-Site				0				0				0
	25 Soil Cat 6													
	05 Construction Survey and Staking	On-Site	4				6				7			
	10 Excavation	On-Site	31				31				31			
	15 Hauling	Mixed			6,429				6,429				6,429	
	20 Conf Sampling	On-Site	10				7				5			
	25 Sampling Analysis	Off-Site				0				0				0
05	**Disposal**													
	05 Soil Cat 1/2	Off-Site	0				0				0			
	10 Soil Cat 3	Off-Site	0				0				0			
	15 Soil Cat 4	Off-Site	0				0				0			
	20 Soil Cat 5	Off-Site	0				0				0			
	25 Soil Cat 6	Off-Site	0				0				0			
06	**Backfill**													
	05 Backfill from Onsite Sources													
	05 Rock Excavation	On-Site	4,781				994				768			
	10 Rock Crushing and Screening	On-Site	8,640				1,800				1,389			
	15 Fill	On-Site	2,711				619				483			
	10 Backfill from Offsite Sources													
	05 Import Fill Material	Mixed	31,485				5,839				4,500			
	10 Fill	On-Site	22,324				4,551				3,521			
	15 QC and Testing	On-Site	0				0				0			
07	**Restoration**													
	05 Seeding	On-Site	208				64				51			
	10 Allowance for Street/Pavement Repair	On-Site	1,006				1,006				1,006			

	Cleanup to AOC LUT Values Alternative				Cleanup to Revised LUT Values Alternative				Conservation of Natural Resource Alternative			
	Construction laborers	Operating engineers	Waste management services	Scientific and technical services	Construction laborers	Operating engineers	Waste management services	Scientific and technical services	Construction laborers	Operating engineers	Waste management services	Scientific and technical services
On-Site Total	273,332	0	0	149,056	56,749	0	0	32,576	54,105	0	0	32,576
Off-Site Total	0	0	0	17,350	0	0	0	5,598	0	0	0	5,598
Mixed Total (on-Site and off-site total)	31,485	0	624,647	0	5,839	0	266,099	0	4,500	0	171,813	0
Mixed Total (on-site only)	6,297	0	124,929	0	1,168	0	53,220	0	900	0	34,363	0
Total On-Site Hours	279,629	0	124,929	149,056	57,917	0	53,220	32,576	55,005	0	34,363	32,576

PROJECT: SSFL Area IV Soils CBA | COMPUTED BY: IL | CHECKED BY: MAH & AIS

JOB NO.: 94489.1204 | DATE: 4/22/2016 | DATE CHECKED: 4/27/2016

CLIENT: DOE | WRKSHT NO.: AOC Equip Hr

Cleanup to AOC LUT Values Alternative Equipment Hours

			Equipment 1			Equipment 2			Equipment 3			Equipment 4		
	Item	Acounted for in:	Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours
01	**General Conditions**													
	05 WP and Submittals													
	05 Project Meeitings and Scheduling													
	10 WPs													
	15 Submittals													
	20 Post-RA Completion Rpts													
	10 Home Office Personnel													
	15 Job Site Personnel	Personal Transportation	EP T50XX004 TRUCK, HIGHWAY, CONVENTIONAL, 1/2 TON PICKUP, 4X4	Pickup	148,096									
	20 Temp Facilities													
	05 Project Sign	Other fueled Equipment	USR SI-LE-001 Project sign installation	Flatbed Truck	16									
	10 Staging Area and Fencing	Other fueled Equipment	USR TF-LE-002 Spread gravel with dozer	Dozer	9	USR TF-LE-003 Compact gravel material with roller	Roller	7						
	15 Temporary Facilities													
	20 Removal of Temp. Construction Facilities	Other fueled Equipment	USR USR-LE-EW-SR-001 Remove and restore temporary staging area	Flatbed Truck	48									
02	**Mob and Demob**													
	05 Site Mob	Equipment Transportation - Shared Load	USR USR-MB-LE-001 Mobilization or demobilization of heavy equipment	Cab with Trailer	80	USR USR-MB-LE-002 Mobilization or demobilization of medium equipment	Cab with Trailer	80	USR USR-MB-LE-003 Mobilization or demobilization of self-propelled equipment	Misc.	12	USR U-MB-LE-100 Pre-construction video survey of road	Pickup	16
	10 Site Demob													
	05 Equipment Demob	Equipment Transportation - Shared Load	USR USR-MB-LE-001 Mobilization or demobilization of heavy equipment	Cab with Trailer	80	USR USR-MB-LE-002 Mobilization or demobilization of medium equipment	Cab with Trailer	80	USR USR-MB-LE-003 Mobilization or demobilization of self-propelled equipment	Misc.	12			
	10 Site Cleanup	Other fueled Equipment	USR MDM-06 Site Cleanup	Tractor	60									
03	**BMPs**													
	05 SWPPP Implementation and Maintenance													
	05 SWPPP Prep													
	10 SWPPP Oversight and Maintenance													
	10 Temp. Erosion and Sediment Control													
	05 Silt Fence	Other fueled Equipment	USR SP-ESC-LE-001 Silt Fence Installation	Flatbed Truck	996									
	10 Wattles	Other fueled Equipment	USR SP-ESC-LE-100 Wattle Installation	Flatbed Truck	50									
	15 Sediment Trap	Other fueled Equipment	USR EW-EX-LE-002 Excavating sediment trap	Excavator Small	47									
	20 Rock Filter Dam	Other fueled Equipment	USR EW-RP-LE-004 Rock filter dam placement	Excavator Small	25									
	25 Track-Out Prevention	Other fueled Equipment	USR TF-LE-002 Spread gravel with dozer	Dozer	4	USR TF-LE-003 Compact gravel material with roller	Roller	3						
	30 Temp. Seeding	Other fueled Equipment	USR SR-SD-LE-002B Temporary Seeding	Tractor	130									
	35 Inspection and Maintenance	Other fueled Equipment	USR SP-ESC-LE-008 Inspection and maintenance of erosion and sediment control measures.	Flatbed Truck	2,912	USR SP-ESC-LE-008 Inspection and maintenance of erosion and sediment control measures.	Excavator Small	1248						
	15 Existing Tree Protection													
	05 Arborist and Care for Existing Trees													
	10 Tree Protection Fencing	Other fueled Equipment	USR FN-SF-LE-001 Safety fence installation	Flatbed Truck	50	USR FN-SF-LE-002 Safety fence removal	Flatbed Truck	25						
	20 Dust Control	Other fueled Equipment	USR TR-MT-100 Water for Dust Control	Water Truck	40,000									
	25 Air Monitoring													

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY: MAH & AIS
JOB NO.:	94489.1204	DATE:	4/22/2016	DATE CHECKED: 4/27/2016
CLIENT:	DOE			WRKSHT NO.: AOC Equip Hr

Cleanup to AOC LUT Values Alternative Equipment Hours

	Item	Acounted for in:	Equipment 1			Equipment 2			Equipment 3			Equipment 4		
			Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours
	30 Decon/Wash Station													
	05 Decon/Wash Station Purchase/Setup													
	10 Decon/Wash Station Operation													
	35 Street Sweeping	Other fueled Equipment	USR TR-LE-004 Street sweeper	Sweeper	10,400									
	40 Traffic Control													
	05 Preconstruction Video Survey	Other fueled Equipment	USR TR-LE-003 Preconstruction video survey of roadway	Pickup	16									
	10 Traffic Control Signs / Barricades	Other fueled Equipment	USR TR-LE-002 Setup signs and barricades	Flatbed Truck	8	USR TR-LE-001 Traffic control sign and barricade maintenance	Flatbed Truck	120						
	15 Traffic Control													
04	**Excavation and Hauling**													
	05 Soil Cat 1 & 2, TPH/PAH Soil													
	05 Soil Cat 1&2													
	05 Construction Survey and Staking	Other fueled Equipment	USR SUR-02 Surveying Crew	Pickup	452									
	10 Excavation	Equipment Use - Earthwork	USR EW-EX-A5-100 Excavation - Non-Hazardous/Non-Radioactive Waste	Excavator	4,100									
	15 Hauling	Residue Disposal / Recycling	USR EW-HL-A5-100 Hauling - Non-Hazardous/Non-Radioactive Waste	Hauler	383,710									
	20 Conf Sampling	Other fueled Equipment	USR EW-CS-001 Confirmation sampling	Pickup	2,433									
	25 Sampling Analysis													
	10 Soil Cat 3													
	05 Construction Survey and Staking	Other fueled Equipment	USR SUR-02 Surveying Crew	Pickup	28									
	10 Excavation	Equipment Use - Earthwork	USR EW-EX-200 Excavation - RCRA Hazardous Waste	Excavator	253									
	15 Hauling	Residue Disposal / Recycling	USR EW-HL-200 Hauling - RCRA Hazardous Waste	Hauler	45,938									
	20 Conf Sampling	Other fueled Equipment	USR EW-CS-001 Confirmation sampling	Pickup	151									
	25 Sampling Analysis													
	15 Soil Cat 4													
	05 Construction Survey and Staking	Other fueled Equipment	USR SUR-02 Surveying Crew	Pickup	25									
	10 Excavation	Equipment Use - Earthwork	USR EW-EX-400 Excavation - Low-level Radioactive Waste (LLW)	Excavator	228									
	15 Hauling	Residue Disposal / Recycling	USR EW-HL-400 Hauling - Low-level Radioactive Waste (LLW)	Hauler	94,286									
	20 Conf Sampling	Other fueled Equipment	USR EW-CS-001 Confirmation sampling	Pickup	136									
	25 Sampling Analysis													
	20 Soil Cat 5													
	05 Construction Survey and Staking	Other fueled Equipment	USR SUR-02 Surveying Crew	Pickup	25									
	10 Excavation	Equipment Use - Earthwork	USR EW-EX-500 Excavation - Mixed low-level radioactive waste (MLLW)	Excavator	228									
	15 Hauling	Residue Disposal / Recycling	USR EW-HL-500 Hauling - Mixed low-level radioactive waste (MLLW)	Hauler	94,286									
	20 Conf Sampling	Other fueled Equipment	USR EW-CS-001 Confirmation sampling	Pickup	136									

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	MAH & AIS
JOB NO.:	94489.1204	DATE:	4/22/2016	DATE CHECKED:	4/27/2016
CLIENT:	DOE			WRKSHT NO.:	AOC Equip Hr

Cleanup to AOC LUT Values Alternative Equipment Hours

	Item	Acounted for in:	Equipment 1			Equipment 2			Equipment 3			Equipment 4		
			Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours
	25 Sampling Analysis													
	25 Soil Cat 6													
	05 Construction Survey and Staking	Other fueled Equipment	USR SUR-02 Surveying Crew	Pickup	2									
	10 Excavation	Equipment Use - Earthwork	USR EW-EX-410 Excavation - Low-level Radioactive Waste (LLW)	Excavator	16									
	15 Hauling	Residue Disposal / Recycling	USR EW-HL-410 Hauling - Low-level Radioactive Waste (LLW)	Hauler	6,429									
	20 Conf Sampling	Other fueled Equipment	USR EW-CS-001 Confirmation sampling	Pickup	10									
	25 Sampling Analysis													
05	**Disposal**													
	05 Soil Cat 1/2													
	05 Soil Cat 1/2													
	10 TPH/PAHs Impacted Soil													
	10 Soil Cat 3													
	15 Soil Cat 4													
	20 Soil Cat 5													
	25 Soil Cat 6													
06	**Backfill**													
	05 Backfill from Onsite Sources													
	05 Rock Excavation	Other fueled Equipment	USR EX-200 Rock Breaking	Excavator	3,245	USR EX-210 Rock Excavation	Excavator	968	USR EX-220 Rock Loading	Loader	811	USR EX-230 Rock Onsite Hauling	Hauler	811
	10 Rock Crushing and Screening	Equipment - Generator	USR 312316306120 Rock Crusher, 25 Tons/ HR operation	Rocker Crusher, Electricity Run	12,096									
	15 Fill (splitted to 2 entries)	Equipment Use - Earthwork	USR EW-BM-LE-200 Fill - Spreading	Loader	920									
	15 Fill (splitted to 2 entries)	Other fueled Equipment	USR EX-230 Rock Onsite Hauling	Rock Hauler	811	USR SD-SP-LE-004B Site Grading - Rough	Roller	390						
	10 Backfill from Offsite Sources													
	05 Import Fill Material	Other fueled Equipment	USR EW-HL-010 Haul Imported Soil	Hauler	31,485									
	10 Fill (splited to 2 entries)	Equipment Use - Earthwork	USR EW-BM-LE-200 Fill - Spreading	Loader	6,580									
	10 Fill (splited to 2 entries)	Other fueled Equipment	USR SD-SP-LE-004B Site Grading - Rough	Dozer	390	USR EW-BM-LE-202 Fill - Compaction	Roller	7262	USR SD-SP-LE-005 Site Grading - Finish	Roller	780			
	15 QC and Testing													
07	**Restoration**													
	05 Seeding	Other fueled Equipment	USR SR-SD-LE-002 Seeding	Tractor	416									
	10 Allowance for Street/Pavement Repair (splitte	Other fueled Equipment	USR SR-PV-300 Hauling for asphalt cold milling and paving	Asphalt Hauler	235									
	10 Allowance for Street/Pavement Repair (splitte	Capping Equipment	USR SR-PV-410 Cold milling asphalt paving, profile grooving, asphalt pavement, 2" deep, load and sweep	Paver	96	USR SR-PV-510 Plant-mix asphalt paving, for highways and large paved areas, wearing course, 2" thick, no hauling included	Paver	182.22						

PROJECT: SSFL Area IV Soils CBA
JOB NO.: 94489.1204
CLIENT: DOE

COMPUTED BY: IL
DATE: 4/22/2016

CHECKED BY: MAH & AIS
DATE CHECKED: 4/27/2016
WRKSHT NO.: Rev LUT Equip Hr

Cleanup to Revised LUT Values Alternative Equipment Hours

	Item	Acounted for in:	Equipment 1			Equipment 2			Equipment 3			Equipment 4		
			Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours
01	**General Conditions**													
	05 WP and Submittals													
	05 Project Meeitings and Scheduling													
	10 WPs													
	15 Submittals													
	20 Post-RA Completion Rpts													
	10 Home Office Personnel													
	15 Job Site Personnel	Personal Transportation	EP T50XX004 TRUCK, HIGHWAY, CONVENTIONAL, 1/2 TON PICKUP, 4X4	Pickup	29,696									
	20 Temp Facilities													
	05 Project Sign	Other fueled Equipment	USR SI-LE-001 Project sign installation	Flatbed Truck	16									
	10 Staging Area and Fencing	Other fueled Equipment	USR TF-LE-002 Spread gravel with dozer	Dozer	9	USR TF-LE-003 Compact gravel material with roller	Roller	7						
	15 Temporary Facilities													
	20 Removal of Temp. Construction Facilities	Other fueled Equipment	USR USR-LE-EW-SR-001 Remove and restore temporary staging area	Flatbed Truck	48									
02	**Mob and Demob**													
	05 Site Mob	Equipment Transportation - Shared Load	USR USR-MB-LE-001 Mobilization or demobilization of heavy equipment	Cab with Trailer	80	USR USR-MB-LE-002 Mobilization or demobilization of medium equipment	Cab with Trailer	80	USR USR-MB-LE-003 Mobilization or demobilization of self-propelled equipment	Misc.	12	USR U-MB-LE-100 Pre-construction video survey of road	Pickup	16
	10 Site Demob													
	05 Equipment Demob	Equipment Transportation - Shared Load	USR USR-MB-LE-001 Mobilization or demobilization of heavy equipment	Cab with Trailer	80	USR USR-MB-LE-002 Mobilization or demobilization of medium equipment	Cab with Trailer	80	USR USR-MB-LE-003 Mobilization or demobilization of self-propelled equipment	Misc.	12			
	10 Site Cleanup	Other fueled Equipment	USR MDM-06 Site Cleanup	Tractor	60									
03	**BMPs**													
	05 SWPPP Implementation and Maintenance													
	05 SWPPP Prep													
	10 SWPPP Oversight and Maintenance													
	10 Temp. Erosion and Sediment Control													
	05 Silt Fence	Other fueled Equipment	USR SP-ESC-LE-001 Silt Fence Installation	Flatbed Truck	307									
	10 Wattles	Other fueled Equipment	USR SP-ESC-LE-100 Wattle Installation	Flatbed Truck	18									
	15 Sediment Trap	Other fueled Equipment	USR EW-EX-LE-002 Excavating sediment trap	Excavator Small	19									
	20 Rock Filter Dam	Other fueled Equipment	USR EW-RP-LE-004 Rock filter dam placement	Excavator Small	10									
	25 Track-Out Prevention	Other fueled Equipment	USR TF-LE-002 Spread gravel with dozer	Dozer	2	USR TF-LE-003 Compact gravel material with roller	Roller	1						
	30 Temp. Seeding	Other fueled Equipment	USR SR-SD-LE-002B Temporary Seeding	Tractor	40									
	35 Inspection and Maintenance	Other fueled Equipment	USR SP-ESC-LE-008 Inspection and maintenance of erosion and sediment control measures.	Flatbed Truck	582	USR SP-ESC-LE-008 Inspection and maintenance of erosion and sediment control measures.	Excavator Small	249.6						
	15 Existing Tree Protection													
	05 Arborist and Care for Existing Trees													
	10 Tree Protection Fencing	Other fueled Equipment	USR FN-SF-LE-001 Safety fence installation	Flatbed Truck	18	USR FN-SF-LE-002 Safety fence removal	Flatbed Truck	8.75						
	20 Dust Control	Other fueled Equipment	USR TR-MT-100 Water for Dust Control	Water Truck	8,000									
	25 Air Monitoring													

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	MAH & AIS
JOB NO.:	94489.1204	DATE:	4/22/2016	DATE CHECKED:	4/27/2016
CLIENT:	DOE			WRKSHT NO.:	Rev LUT Equip Hr

Cleanup to Revised LUT Values Alternative Equipment Hours

	Item	Acounted for in:	Equipment 1			Equipment 2			Equipment 3			Equipment 4		
			Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours
	30 Decon/Wash Station													
	05 Decon/Wash Station Purchase/Setup													
	10 Decon/Wash Station Operation													
	35 Street Sweeping	Other fueled Equipment	USR TR-LE-004 Street sweeper	Sweeper	2,080									
	40 Traffic Control													
	05 Preconstruction Video Survey	Other fueled Equipment	USR TR-LE-003 Preconstruction video survey of roadway	Pickup	16									
	10 Traffic Control Signs / Barricades	Other fueled Equipment	USR TR-LE-002 Setup signs and barricades	Flatbed Truck	8	USR TR-LE-001 Traffic control sign and barricade maintenance	Flatbed Truck	24						
	15 Traffic Control													
04	**Excavation and Hauling**													
	05 Soil Cat 1 & 2, TPH/PAH Soil													
	05 Soil Cat 1&2													
	05 Construction Survey and Staking	Other fueled Equipment	USR SUR-02 Surveying Crew	Pickup	44									
	10 Excavation	Equipment Use - Earthwork	USR EW-EX-A5-100 Excavation - Non-Hazardous/Non-Radioactive Waste	Excavator	269									
	15 Hauling	Residue Disposal / Recycling	USR EW-HL-A5-100 Hauling - Non-Hazardous/Non-Radioactive Waste	Hauler	25,161									
	20 Conf Sampling	Other fueled Equipment	USR EW-CS-001 Confirmation sampling	Pickup	116									
	25 Sampling Analysis													
	10 Soil Cat 3													
	05 Construction Survey and Staking	Other fueled Equipment	USR SUR-02 Surveying Crew	Pickup	42									
	10 Excavation	Equipment Use - Earthwork	USR EW-EX-200 Excavation - RCRA Hazardous Waste	Excavator	253									
	15 Hauling	Residue Disposal / Recycling	USR EW-HL-200 Hauling - RCRA Hazardous Waste	Hauler	45,938									
	20 Conf Sampling	Other fueled Equipment	USR EW-CS-001 Confirmation sampling	Pickup	109									
	25 Sampling Analysis													
	15 Soil Cat 4													
	05 Construction Survey and Staking	Other fueled Equipment	USR SUR-02 Surveying Crew	Pickup	38									
	10 Excavation	Equipment Use - Earthwork	USR EW-EX-400 Excavation - Low-level Radioactive Waste (LLW)	Excavator	228									
	15 Hauling	Residue Disposal / Recycling	USR EW-HL-400 Hauling - Low-level Radioactive Waste (LLW)	Hauler	94,286									
	20 Conf Sampling	Other fueled Equipment	USR EW-CS-001 Confirmation sampling	Pickup	98									
	25 Sampling Analysis													
	20 Soil Cat 5													
	05 Construction Survey and Staking	Other fueled Equipment	USR SUR-02 Surveying Crew	Pickup	38									
	10 Excavation	Equipment Use - Earthwork	USR EW-EX-500 Excavation - Mixed low-level radioactive waste (MLLW)	Excavator	228									
	15 Hauling	Residue Disposal / Recycling	USR EW-HL-500 Hauling - Mixed low-level radioactive waste (MLLW)	Hauler	94,286									
	20 Conf Sampling	Other fueled Equipment	USR EW-CS-001 Confirmation sampling	Pickup	98									

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY: IL	CHECKED BY: MAH & AIS
JOB NO.:	94489.1204	DATE: 4/22/2016	DATE CHECKED: 4/27/2016
CLIENT:	DOE		WRKSHT NO.: Rev LUT Equip Hr

Cleanup to Revised LUT Values Alternative Equipment Hours

	Item	Acounted for in:	Equipment 1			Equipment 2			Equipment 3			Equipment 4		
			Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours
	25 Sampling Analysis													
	25 Soil Cat 6													
	05 Construction Survey and Staking	Other fueled Equipment	USR SUR-02 Surveying Crew	Pickup	2									
	10 Excavation	Equipment Use - Earthwork	USR EW-EX-410 Excavation - Low-level Radioactive Waste (LLW)	Excavator	16									
	15 Hauling	Residue Disposal / Recycling	USR EW-HL-410 Hauling - Low-level Radioactive Waste (LLW)	Hauler	6,429									
	20 Conf Sampling	Other fueled Equipment	USR EW-CS-001 Confirmation sampling	Pickup	7									
	25 Sampling Analysis													
05	**Disposal**													
	05 Soil Cat 1/2													
	05 Soil Cat 1/2													
	10 TPH/PAHs Impacted Soil													
	10 Soil Cat 3													
	15 Soil Cat 4													
	20 Soil Cat 5													
	25 Soil Cat 6													
06	**Backfill**													
	05 Backfill from Onsite Sources													
	05 Rock Excavation	Other fueled Equipment	USR EX-200 Rock Breaking	Excavator	671	USR EX-210 Rock Excavation	Excavator	200	USR EX-220 Rock Loading	Loader	170	USR EX-230 Rock Onsite Hauling	Hauler	170
	10 Rock Crushing and Screening	Equipment - Generator	USR 312316306120 Rock Crusher, 25 Tons/ HR operation	Rocker Crusher, Electricity Run	2,520									
	15 Fill (splitted to 2 entries)	Equipment Use - Earthwork	USR EW-BM-LE-200 Fill - Spreading	Loader	193									
	15 Fill (splitted to 2 entries)	Other fueled Equipment	USR EX-230 Rock Onsite Hauling	Rock Hauler	170	USR SD-SP-LE-004B Site Grading - Rough	Roller	120						
	10 Backfill from Offsite Sources													
	05 Import Fill Material	Other fueled Equipment	USR EW-HL-010 Haul Imported Soil	Hauler	5,839									
	10 Fill (splited to 2 entries)	Equipment Use - Earthwork	USR EW-BM-LE-200 Fill - Spreading	Loader	1,220									
	10 Fill (splited to 2 entries)	Other fueled Equipment	USR SD-SP-LE-004B Site Grading - Rough	Dozer	120	USR EW-BM-LE-202 Fill - Compaction	Roller	1494	USR SD-SP-LE-005 Site Grading - Finish	Roller	240			
	15 QC and Testing													
07	**Restoration**													
	05 Seeding	Other fueled Equipment	USR SR-SD-LE-002 Seeding	Tractor	128									
	10 Allowance for Street/Pavement Repair (splitte	Other fueled Equipment	USR SR-PV-300 Hauling for asphalt cold milling and paving	Asphalt Hauler	235									
	10 Allowance for Street/Pavement Repair (splitte	Capping Equipment	USR SR-PV-410 Cold milling asphalt paving, profile grooving, asphalt pavement, 2" deep, load and sweep	Paver	96	USR SR-PV-510 Plant-mix asphalt paving, for highways and large paved areas, wearing course, 2" thick, no hauling included	Paver	182						

PROJECT: SSFL Area IV Soils CBA   COMPUTED BY: IL   CHECKED BY: MAH & AIS
JOB NO.: 94489.1204   DATE: 4/22/2016   DATE CHECKED: 4/27/2016
CLIENT: DOE   WRKSHT NO.: Conserv. Resource Equip Hr

Conservation of Natural Resources Alternative Equipment Hours

			Equipment 1			Equipment 2			Equipment 3			Equipment 4		
	Item	Acounted for in:	Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours
01	**General Conditions**													
	05 WP and Submittals													
	05 Project Meeitings and Scheduling													
	10 WPs													
	15 Submittals													
	20 Post-RA Completion Rpts													
	10 Home Office Personnel													
	15 Job Site Personnel	Personal Transportation	EP T50XX004 TRUCK, HIGHWAY, CONVENTIONAL, 1/2 TON PICKUP, 4X4	Pickup	29,696									
	20 Temp Facilities													
	05 Project Sign	Other fueled Equipment	USR SI-LE-001 Project sign installation	Flatbed Truck	16									
	10 Staging Area and Fencing	Other fueled Equipment	USR TF-LE-002 Spread gravel with dozer	Dozer	9	USR TF-LE-003 Compact gravel material with roller	Roller	7.41						
	15 Temporary Facilities													
	20 Removal of Temp. Construction Facilities	Other fueled Equipment	USR USR-LE-EW-SR-001 Remove and restore temporary staging area	Flatbed Truck	48									
02	**Mob and Demob**													
	05 Site Mob	Equipment Transportation - Shared Load	USR USR-MB-LE-001 Mobilization or demobilization of heavy equipment	Cab with Trailer	80	USR USR-MB-LE-002 Mobilization or demobilization of medium equipment	Cab with Trailer	80	USR USR-MB-LE-003 Mobilization or demobilization of self-propelled equipment	Misc.	12	USR U-MB-LE-100 Pre-construction video survey of road	Pickup	16
	10 Site Demob													
	05 Equipment Demob	Equipment Transportation - Shared Load	USR USR-MB-LE-001 Mobilization or demobilization of heavy equipment	Cab with Trailer	80	USR USR-MB-LE-002 Mobilization or demobilization of medium equipment	Cab with Trailer	80	USR USR-MB-LE-003 Mobilization or demobilization of self-propelled equipment	Misc.	12			
	10 Site Cleanup	Other fueled Equipment	USR MDM-06 Site Cleanup	Tractor	60									
03	**BMPs**													
	05 SWPPP Implementation and Maintenance													
	05 SWPPP Prep													
	10 SWPPP Oversight and Maintenance													
	10 Temp. Erosion and Sediment Control													
	05 Silt Fence	Other fueled Equipment	USR SP-ESC-LE-001 Silt Fence Installation	Flatbed Truck	273									
	10 Wattles	Other fueled Equipment	USR SP-ESC-LE-100 Wattle Installation	Flatbed Truck	18									
	15 Sediment Trap	Other fueled Equipment	USR EW-EX-LE-002 Excavating sediment trap	Excavator Small	19									
	20 Rock Filter Dam	Other fueled Equipment	USR EW-RP-LE-004 Rock filter dam placement	Excavator Small	10									
	25 Track-Out Prevention	Other fueled Equipment	USR TF-LE-002 Spread gravel with dozer	Dozer	2	USR TF-LE-003 Compact gravel material with roller	Roller	1						
	30 Temp. Seeding	Other fueled Equipment	USR SR-SD-LE-002B Temporary Seeding	Tractor	32									
	35 Inspection and Maintenance	Other fueled Equipment	USR SP-ESC-LE-008 Inspection and maintenance of erosion and sediment control measures.	Flatbed Truck	582	USR SP-ESC-LE-008 Inspection and maintenance of erosion and sediment control measures.	Excavator Small	249.6						
	15 Existing Tree Protection													
	05 Arborist and Care for Existing Trees													
	10 Tree Protection Fencing	Other fueled Equipment	USR FN-SF-LE-001 Safety fence installation	Flatbed Truck	18	USR FN-SF-LE-002 Safety fence removal	Flatbed Truck	8.75						
	20 Dust Control	Other fueled Equipment	USR TR-MT-100 Water for Dust Control	Water Truck	8,000									
	25 Air Monitoring													

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY: IL	CHECKED BY:	MAH & AIS
JOB NO.:	94489.1204	DATE: 4/22/2016	DATE CHECKED:	4/27/2016
CLIENT:	DOE		WRKSHT NO.:	Conserv. Resource Equip Hr

Conservation of Natural Resources Alternative Equipment Hours

	Item	Acounted for in:	Equipment 1			Equipment 2			Equipment 3			Equipment 4		
			Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours
	30 Decon/Wash Station													
	05 Decon/Wash Station Purchase/Setup													
	10 Decon/Wash Station Operation													
	35 Street Sweeping	Other fueled Equipment	USR TR-LE-004 Street sweeper	Sweeper	2,080									
	40 Traffic Control													
	05 Preconstruction Video Survey	Other fueled Equipment	USR TR-LE-003 Preconstruction video survey of roadway	Pickup	16									
	10 Traffic Control Signs / Barricades	Other fueled Equipment	USR TR-LE-002 Setup signs and barricades	Flatbed Truck	8	USR TR-LE-001 Traffic control sign and barricade maintenance	Flatbed Truck	24						
	15 Traffic Control													
04	**Excavation and Hauling**													
	05 Soil Cat 1 & 2, TPH/PAH Soil													
	05 Soil Cat 1&2													
	05 Construction Survey and Staking	Other fueled Equipment	USR SUR-02 Surveying Crew	Pickup	44									
	10 Excavation	Equipment Use - Earthwork	USR EW-EX-A5-100 Excavation - Non-Hazardous/Non-Radioactive Waste	Excavator	269									
	15 Hauling	Residue Disposal / Recycling	USR EW-HL-A5-100 Hauling - Non-Hazardous/Non-Radioactive Waste	Hauler	25,161									
	20 Conf Sampling	Other fueled Equipment	USR EW-CS-001 Confirmation sampling	Pickup	87									
	25 Sampling Analysis													
	10 Soil Cat 3													
	05 Construction Survey and Staking	Other fueled Equipment	USR SUR-02 Surveying Crew	Pickup	43									
	10 Excavation	Equipment Use - Earthwork	USR EW-EX-200 Excavation - RCRA Hazardous Waste	Excavator	253									
	15 Hauling	Residue Disposal / Recycling	USR EW-HL-200 Hauling - RCRA Hazardous Waste	Hauler	45,938									
	20 Conf Sampling	Other fueled Equipment	USR EW-CS-001 Confirmation sampling	Pickup	82									
	25 Sampling Analysis													
	15 Soil Cat 4													
	05 Construction Survey and Staking	Other fueled Equipment	USR SUR-02 Surveying Crew	Pickup	0									
	10 Excavation	Equipment Use - Earthwork	USR EW-EX-400 Excavation - Low-level Radioactive Waste (LLW)	Excavator	0									
	15 Hauling	Residue Disposal / Recycling	USR EW-HL-400 Hauling - Low-level Radioactive Waste (LLW)	Hauler	0									
	20 Conf Sampling	Other fueled Equipment	USR EW-CS-001 Confirmation sampling	Pickup	0									
	25 Sampling Analysis													
	20 Soil Cat 5													
	05 Construction Survey and Staking	Other fueled Equipment	USR SUR-02 Surveying Crew	Pickup	39									
	10 Excavation	Equipment Use - Earthwork	USR EW-EX-500 Excavation - Mixed low-level radioactive waste (MLLW)	Excavator	228									

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	MAH & AIS
JOB NO.:	94489.1204	DATE:	4/22/2016	DATE CHECKED:	4/27/2016
CLIENT:	DOE			WRKSHT NO.:	Conserv. Resource Equip Hr

Conservation of Natural Resources Alternative Equipment Hours

	Item	Acounted for in:	Equipment 1			Equipment 2			Equipment 3			Equipment 4		
			Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours	Task/Equipment Name	Type	Hours
	15 Hauling	Residue Disposal / Recycling	USR EW-HL-500 Hauling - Mixed low-level radioactive waste (MLLW)	Hauler	94,286									
	20 Conf Sampling	Other fueled Equipment	USR EW-CS-001 Confirmation sampling	Pickup	73									
	25 Sampling Analysis													
	25 Soil Cat 6													
	05 Construction Survey and Staking	Other fueled Equipment	USR SUR-02 Surveying Crew	Pickup	3									
	10 Excavation	Equipment Use - Earthwork	USR EW-EX-410 Excavation - Low-level Radioactive Waste (LLW)	Excavator	16									
	15 Hauling	Residue Disposal / Recycling	USR EW-HL-410 Hauling - Low-level Radioactive Waste (LLW)	Hauler	6,429									
	20 Conf Sampling	Other fueled Equipment	USR EW-CS-001 Confirmation sampling	Pickup	5									
	25 Sampling Analysis													
05	**Disposal**													
	05 Soil Cat 1/2													
	05 Soil Cat 1/2													
	10 TPH/PAHs Impacted Soil													
	10 Soil Cat 3													
	15 Soil Cat 4													
	20 Soil Cat 5													
	25 Soil Cat 6													
06	**Backfill**													
	05 Backfill from Onsite Sources													
	05 Rock Excavation	Other fueled Equipment	USR EX-200 Rock Breaking	Excavator	519	USR EX-210 Rock Excavation	Excavator	155	USR EX-220 Rock Loading	Loader	131	USR EX-230 Rock Onsite Hauling	Hauler	131
	10 Rock Crushing and Screening	Equipment - Generator	USR 312316306120 Rock Crusher, 25 Tons/ HR operation	Rocker Crusher, Electricity Run	1,944									
	15 Fill (splitted to 2 entries)	Equipment Use - Earthwork	USR EW-BM-LE-200 Fill - Spreading	Loader	149									
	15 Fill (splitted to 2 entries)	Other fueled Equipment	USR EX-230 Rock Onsite Hauling	Rock Hauler	131	USR SD-SP-LE-004B Site Grading - Rough	Roller	96						
	10 Backfill from Offsite Sources													
	05 Import Fill Material	Other fueled Equipment	USR EW-HL-010 Haul Imported Soil	Hauler	4,500									
	10 Fill (splited to 2 entries)	Equipment Use - Earthwork	USR EW-BM-LE-200 Fill - Spreading	Loader	940									
	10 Fill (splited to 2 entries)	Other fueled Equipment	USR SD-SP-LE-004B Site Grading - Rough	Dozer	96	USR EW-BM-LE-202 Fill - Compaction	Roller	1151	USR SD-SP-LE-005 Site Grading - Finish	Roller	192			
	15 QC and Testing													
07	**Restoration**													
	05 Seeding	Other fueled Equipment	USR SR-SD-LE-002 Seeding	Tractor	102									
	10 Allowance for Street/Pavement Repair (splitte	Other fueled Equipment	USR SR-PV-300 Hauling for asphalt cold milling and paving	Asphalt Hauler	235									
	10 Allowance for Street/Pavement Repair (splitte	Capping Equipment	USR SR-PV-410 Cold milling asphalt paving, profile grooving, asphalt pavement, 2" deep, load and sweep	Paver	96	USR SR-PV-510 Plant-mix asphalt paving, for highways and large paved areas, wearing course, 2" thick, no hauling included	Paver	182.22						

Other Fueled Equipment Hours[3]

Equipment Type	Cleanup to AOC LUT Values Alternative Total Hours	Cleanup to Revised LUT Values Alternative Total Hours	Conservation of Natural Resources Alternative Total Hours	Assumed Equipment Specs[2]	HP	Estimated Fuel Consumption (gallon/hour)[1] Calculated based on horsepower	Total Fuel Consumption (gallon)[1] Cleanup to AOC LUT Values Alternative	Total Fuel Consumption (gallon)[1] Cleanup to Revised LUT Values Alternative	Total Fuel Consumption (gallon)[1] Conservation of Natural Resources Alternative
Excavator Small	1,320	278	278	MAP H25KM015 HYDRAULIC EXCAVATOR, CRAWLER, 133,160 LBS, 4.25 CY BUCKET, 27.83' MAX DIGGING DEPTH	433	12.037	15,890	3,352	3,352
Dozer	403	130	106	GEN T15Z6520 TRACTOR, CRAWLER (DOZER), 181-250 HP (135-186 KW), POWERSHIFT, LGP, W/UNIVERSAL BLADE	258	6.616	2,664	862	703
Excavator	4,214	872	673	MAP **H25KC024** HYDRAULIC EXCAVATOR, CRAWLER, 101,900 LBS 3.06 CY BUCKET, 25.58' MAX DIGGING DEPTH. EP **H10NP017** HAMMERS, HYDRAULIC, 8,000 FT-LBS, IMPACT FREQUENCY 430 BPM (ADD 33-50 TON HYDRAULIC EXCAVATOR H25)(ADD COST FOR POINT WEAR)	306	12.037	50,719	10,491	8,104
Rock Hauler	811	170	131	EP T55CA011 TRUCK, OFF-HIGHWAY, ARTICULATED FRAME, 22 CY, 30 TON, 6X6, REAR DUMP	260	6.616	5,364	1,124	868
Asphalt Hauler	235	235	235	GEN T50Z7710 DUMP TRUCK, HIGHWAY, 16 - 20 CY (12.2 - 15.3 M3) DUMP BODY, 75,000 LBS (34,000 KG) GVW, 2 AXLE, 6X4	400	12.037	2,826	2,826	2,826
Hauler	32,296	6,009	4,631	MAP T50XX033 DUMP TRUCK, HIGHWAY, 75,000 LBS GVW, 3 AXLE, 6X4 WITH REAR 16 - 20 CY DUMP BODY	400	12.037	388,744	72,326	55,746
Loader	811	170	131	GEN L35Z4250 LOADER, FRONT END, CRAWLER, 2.00 CY (1.5 M3) BUCKET	148	3.626	2,940	616	476
Flatbed Truck	4,225	1,029	995	GEN T50Z7360 TRUCK, HIGHWAY, 20,000 LBS (9,000 KG) GVW, 2 AXLE, 4X2 WITH FLATBED	210	6.616	27,950	6,806	6,583
Pickup	3,413	609	392	MAP T50XX001 TRUCK, HIGHWAY, CONVENTIONAL, 1/2 TON PICKUP, 4X2	130	3.626	12,374	2,207	1,420
Roller	8,443	1,862	1,448	MAP R50CA012 ROLLER, VIBRATORY, SELF-PROPELLED, SINGLE DRUM, PAD FOOT, 12.5 TON, 84" WIDE, 3X2, SOIL COMPACTOR	150	3.626	30,614	6,753	5,249
Sweeper	10,400	2,080	2,080	EP B15FS001 STREET SWEEPER, 12' BROOM PATH, 4.5 CY HOPPER, 350 GAL WATER TANK, SELF PROPELLED	230	6.616	68,806	13,761	13,761
Tractor	606	228	194	EP T25JD016 TRACTOR, AGRICULTURAL, WHEEL, 56 HP, 4X2, PTO, 3 POINT HITCH . GEN L15Z4040 LANDSCAPING EQUIPMENT, SPREADER, 85 CF (2.4 M3), DRY CHEMICAL (ADD 55 HP (41 KW) FARM TRACTOR)	56	1.762	1,068	402	343
Water Truck	40,000	8,000	8,000	GEN T50Z7680 TRUCK, HIGHWAY, WITH 3-ARM ARTICULATING CRAN, 3.5 TON (3.2 MT), 32' (9.8 M) BOOM, WITH 8' X 20' (2.4 X 6 M) FLATBED, 30,000 LBS (13,600 KG) GVW, 2 AXLE, 4X2. EP T40RS001 TRUCK OPTIONS, WATER TANK, 2,000 GAL (ADD 28,000 GVW TRUCK)	210	6.616	264,640	52,928	52,928
Total Fuel Consumption							**874,599**	**174,453**	**152,359**

Notes:

1. Fuel consumption is based on average fuel consumption for equipment with various horsepower range from EPA's 2010 Construction Fleet Inventory Guide.
2. Equipment specification is based on the specified equipment with the highest hour usage under the equipment type.
3. Equipment not included in this table have been accounted for under other evaluation criteria as detailed below:
   a. Mob/Demob equipment is accounted for under equipment transportation - shared load road.
   b. Equipment for removal of soil is accounted for under equipment use - earthwork.
   c. Personnel transport equipment is accounted for under transportation - personnel transport.
   d. Electricity run equipment is accounted for under equipment use - generator.
   e. Paving equipment is accounted for under equipment use - paving equipment.
   f. Waste hauling equipment is accounted for under residual handling - residual recycling/disposal.

Horsepower Range from greater than (>)	Assumes 1,000 hours per year. to less than or equal to (<=)	Fuel Consumption (gal/yr)	Fuel Consumption (gal/hr)
3	6	154	0.154
6	11	240	0.24
11	16	395	0.395
16	25	603	0.603
25	40	950	0.95
40	50	1290	1.29
50	75	1762	1.762
75	100	2471	2.471
100	175	3626	3.626
175	300	6616	6.616
300	600	12037	12.037
600	750	19939	19.939
750	1000	24831	24.831
1000	1200	32262	32.262
1200	2000	48312	48.312
2000	3000	71679	71.679

Notes:

1. From EPA Construction Fleet Inventory Guide, July 2010
   EPA-420-B-10-025
   Appendix D - Average Fuel Consumption
   Average fuel consumption examples were generated with the U.S. EPA NONROAD2008a model, using default load factors and emission factors. The model run used 2010 as the episode year and assumed all other inputs were default, except population, which was set to one for all equipment types and horsepower ranges, and activity, which was set to 1,000 hours for all equipment types.
2. the average fuel consumption (in gallons per year) used by a single piece of diesel construction equipment, by horsepower range and assumes a single unitworks 1,000 hours/year.

APPENDIX K
CONTRACTOR DISCLOSURE STATEMENTS

NEPA DISCLOSURE STATEMENT FOR PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT FOR REMEDIATION OF AREA IV OF THE SANTA SUSANA FIELD LABORATORY

CEQ regulations at 40 CFR 1506.5(c), which have been adopted by DOE (10 CFR 1021), require contractors who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term "financial interest or other interest in the outcome of the project," for the purposes of this disclosure, is defined in the March 23, 1981 guidance "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," 46 FR 18026-18038 at Question 17a and b.

"Financial or other interest in the outcome of the project 'includes' any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm=s other clients)," 46 FR 18026-18038 at 18031.

In accordance with these requirements, the offeror and any proposed subcontractors hereby certify as follows: (check either (a) or (b) to assure consideration of your proposal)

(a) ___X___ Offeror and any proposed subcontractor have no financial interest in the outcome of the project.

(b) ________ Offeror and any proposed subcontractor have the following financial or other interest in the outcome of the project and hereby agree to divest themselves of such interest prior to award of this contract.

Financial or Other Interests:

1.
2.
3.

Certified by:

Signature

[signature]

Name CDM Smith

Jan 18, 2015

Date

NEPA DISCLOSURE STATEMENT FOR PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT FOR REMEDIATION OF AREA IV OF THE SANTA SUSANA FIELD LABORATORY

CEQ regulations at 40 CFR 1506.5(c), which have been adopted by DOE (10 CFR 1021), require contractors who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term "financial interest or other interest in the outcome of the project," for the purposes of this disclosure, is defined in the March 23, 1981 guidance "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," 46 FR 18026-18038 at Question 17a and b.

"Financial or other interest in the outcome of the project 'includes' any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm=s other clients)," 46 FR 18026-18038 at 18031.

In accordance with these requirements, the offeror and any proposed subcontractors hereby certify as follows: (check either (a) or (b) to assure consideration of your proposal)

(a) ___X_________ Offeror and any proposed subcontractor have no financial interest in the outcome of the project.

(b) _____________ Offeror and any proposed subcontractor have the following financial or other interest in the outcome of the project and hereby agree to divest themselves of such interest prior to award of this contract.

Financial or Other Interests:

1.
2.
3.

Certified by:

Sheila B. Maglaque

Signature

Sheila B. Maglaque, Senior Contracts Representative

Name Leidos, Inc.

30 Mar 2015

Date