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

Volume 2
(Appendices A through M)

U.S. Department of Energy
Office of Environmental Management

AVAILABILITY OF THE
FINAL ENVIRONMENTAL IMPACT STATEMENT FOR REMEDIATION OF AREA IV AND THE NORTHERN BUFFER ZONE OF THE SANTA SUSANA FIELD LABORATORY (SSFL Area IV EIS)

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Location: Ventura County, California

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Abstract:

This *Final 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 laws, regulations, orders, and agreements. The alternatives analyzed in this environmental impact statement (EIS) involve the disposition of remaining DOE facilities and support buildings, remediation of soil and groundwater, and disposal of all resulting materials 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's preferred alternative for soils remediation is the Conservation of Natural Resources, Open Space Scenario. DOE is identifying this as the preferred alternative because it would be consistent with the risk assessment approach typically used at other DOE sites, other California Department of Toxic Substances Control- (DTSC-) regulated sites, and U.S. Environmental Protection Agency (EPA) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites, which accounts for the specific future land use of the site. Use of a risk assessment

approach would be consistent with the process being used by Boeing for the land it owns at SSFL and recognizes the Grant Deeds of Conservation Easement and Agreements that commit Boeing's SSFL property, including Area IV and the NBZ, to remaining as open space. This scenario would use a CERCLA risk assessment approach that would be protective of human health and the environment rather than look-up table values (action levels). The 2010 *Administrative Order on Consent for Remedial Action* (AOC) between DOE and the DTSC allows DOE and DTSC to agree upon changes to the AOC to better meet cleanup objectives. DOE expects to engage DTSC in discussions about such changes in order to implement this soil remediation alternative.

For building demolition, DOE's preferred alternative is the Building Removal Alternative. Under this alternative DOE would demolish the 18 DOE-owned buildings in Area IV and transport the resulting waste off site for disposal. Demolition of thirteen facilities and disposition of the resulting debris would be in accordance with DOE requirements and applicable laws and regulations. Three facilities at the Radioactive Materials Handling Facility (RMHF) and the two facilities comprising the Hazardous Waste Management Facility would be closed in accordance with DTSC-approved Resource Conservation and Recovery Act (RCRA) facility closure plans.

DOE's preferred alternative for groundwater remediation is a combination of the Treatment Alternative and the Monitored Natural Attenuation Alternative. DOE would treat the groundwater plumes with higher concentrations of contaminants (the Former Sodium Disposal Facility, Hazardous Materials Storage Area, Building 4100/56, and Building 4057 plumes) in accordance with the results of the final RCRA Groundwater Corrective Measures Study. Source removal is the preferred alternative for the strontium-90 source. Monitored natural attenuation would be used for plumes that are not amenable to active treatment – the two plumes with the lowest concentrations of trichloroethylene (the Metals Clarifier and RMHF plumes) and the tritium plume. DOE's proposed groundwater remedial actions would be included in the final Corrective Measures Study submitted to DTSC for approval.

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 EPA and changes in cleanup requirements (as a result of the 2010 AOC), 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 the draft EIS.

In preparing this *Final SSFL Area IV EIS*, DOE considered comments received during the public comment period on the *Draft SSFL Area IV EIS* (January 13 through March 14, 2017) and late comments received after the close of the public comment period. Public hearings on the *Draft SSFL Area IV EIS* were held in Simi Valley, California and Van Nuys, California and a meeting with Native American tribal members was held in Simi Valley, California. DOE considered every comment received

at the public hearings and by U.S. mail, email, and through the website during preparation of this *Final SSFL Area IV EIS*.

This *Final SSFL Area IV EIS* contains revisions and new information based in part on comments received on the *Draft SSFL Area IV EIS*. Volume 3 contains the comments received on the *Draft SSFL Area IV EIS* and DOE's responses to the comments. DOE will use the analysis presented in this *Final SSFL Area IV EIS*, as well as other information, in preparing one or more Records of Decision (RODs) regarding cleanup activities in Area IV of the SSFL and the adjoining NBZ. DOE will is ROD(s) no sooner than 30 days after the U.S. Environmental Protection Agency publishes a Notice of Availability of this *Final SSFL Area IV EIS* in the *Federal Register*.

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TABLE OF CONTENTS

TABLE OF CONTENTS

Volume 2
(Appendices A through M)

List of Figures xiv
List of Tables xv
Acronyms, Abbreviations, and Conversion Charts xxi

Appendix A
Federal Register Notices **A-1**

A.1 Advance Notice of Intent – October 17, 2007 ..... **A-1**
A.2 Notice of Intent – May 16, 2008 ..... **A-4**
A.3 Amended Notice of Intent – February 7, 2014 ..... **A-9**
A.4 Notice of Availability – January 13, 2017 ..... **A-14**
A.5 Amended Notice Extending the Comment Period – March 17, 2017 ..... **A-15**

Appendix B
Environmental Consequences Methodologies **B-1**

B.1 Land Resources **B-1**
B.1.1 Description of Resource and Region of Influence B-1
B.1.2 Description of Impact Drivers B-1
B.1.3 Impact Assessment Protocol B-2
B.1.3.1 Land Use B-2
B.1.3.2 Recreation B-2
B.1.3.3 Infrastructure B-3
B.1.3.4 Aesthetics and Visual Quality B-3
B.1.4 Evaluation of Impacts B-5

B.2 Geology and Soils **B-7**
B.2.1 Description of Resource and Region of Influence B-7
B.2.2 Description of Impact Drivers B-7
B.2.3 Impact Assessment Protocol B-7
B.2.3.1 Affected Environment B-7
B.2.3.2 Methods Used to Analyze and Quantify Impact B-8
B.2.4 Evaluation of Impacts B-10

B.3 Surface Water Resources **B-10**
B.3.1 Description of Resource and Region of Influence B-10
B.3.2 Description of Impact Drivers B-10
B.3.3 Impact Assessment Protocol B-11
B.3.3.1 Affected Environment B-11
B.3.3.2 Methods Used to Analyze and Quantify Impacts B-11
B.3.4 Evaluation of Impacts B-11

B.4 Groundwater Resources **B-12**
B.4.1 Description of Resource and Region of Influence B-12
B.4.2 Description of Impact Drivers B-12
B.4.3 Impact Assessment Protocol B-12
B.4.3.1 Affected Environment B-12
B.4.3.2 Methods Used to Analyze and Quantify Impacts B-13
B.4.4 Evaluation of Impacts B-15

B.5 Biological Resources B-15
B.5.1 Description of Resource and Region of Influence B-15
B.5.2 Description of Impact Drivers B-15
B.5.3 Impact Assessment Protocol B-16
B.5.3.1 Affected Environment B-16
B.5.3.2 Methods Used to Analyze and Quantify Impacts B-16
B.5.4 Evaluation of Impacts B-18

B.6 Air Quality and Climate B-19
B.6.1 Description of Resource and Region of Influence B-19
B.6.1.1 Air Quality B-19
B.6.1.2 Climate Change B-19
B.6.2 Description of Impact Drivers B-20
B.6.3 Impact Assessment Methodology B-20
B.6.3.1 Affected Environment B-20
B.6.3.2 Methods Used to Analyze Impacts B-21
B.6.4 Evaluation of Impacts B-22

B.7 Noise B-22
B.7.1 Description of Resource and Region of Influence B-22
B.7.2 Description of Impact Drivers B-23
B.7.3 Impact Assessment Protocol B-23
B.7.3.1 Affected Environment B-23
B.7.3.2 Methods Used to Analyze and Quantify Impacts B-23
B.7.4 Evaluation of Impacts B-24

B.8 Transportation and Traffic B-24
B.8.1 Description of Resource and Region of Influence B-24
B.8.2 Description of Impact Drivers B-24
B.8.3 Impact Assessment Protocol B-24
B.8.3.1 Affected Environment B-24
B.8.3.2 Methods Used to Analyze and Quantify Impacts B-25
B.8.4 Evaluation of Impacts B-25

B.9 Human Health B-26
B.9.1 Description of Resource and Region of Influence B-26
B.9.2 Description of Impact Drivers B-26
B.9.3 Impact Assessment Protocol B-26
B.9.3.1 Affected Environment B-26
B.9.3.2 Methods Used to Analyze and Quantify Impacts B-26
B.9.4 Evaluation of Impacts B-28

B.10 Waste Management B-29
B.10.1 Description of Resource and Region of Influence B-29
B.10.2 Description of Impact Drivers B-29
B.10.3 Impact Assessment Protocol B-29
B.10.3.1 Affected Environment B-29
B.10.3.2 Methods Used to Analyze and Quantify Impacts B-29
B.10.4 Evaluation of Impacts B-31

B.11 Cultural Resources B-31
B.11.1 Description of Resource and Region of Influence B-31
B.11.2 Description of Impact Drivers B-32
B.11.3 Impact Assessment Protocol B-33
B.11.3.1 Affected Environment B-33
B.11.3.2 Methods Used to Analyze and Quantify Impacts B-34
B.11.4 Evaluation of Impacts B-36

B.12 Socioeconomics B-37
B.12.1 Description of Resource and Region of Influence B-38
B.12.2 Description of Impact Drivers B-38
B.12.3 Impact Assessment Protocol B-39
B.12.3.1 Affected Environment B-39

B.12.3.2 Methods Used to Analyze and Quantify Impacts B-39
B.12.4 Evaluation of Impacts B-40

B.13 Environmental Justice B-40
B.13.1 Description of Resource and Region of Influence B-40
B.13.2 Description of Impact Drivers B-40
B.13.3 Impact Assessment Protocol B-41
B.13.3.1 Affected Environment B-41
B.13.3.2 Methods Used to Analyze and Quantify Impacts B-42
B.13.4 Evaluation of Impacts B-42

B.14 Sensitive-aged Populations B-43
B.14.1 Description of Resource and Region of Influence B-43
B.14.2 Description of Impact Drivers B-43
B.14.3 Impact Assessment Protocol B-43
B.14.3.1 Affected Environment B-43
B.14.3.2 Methods Used to Analyze and Quantify Impacts B-44
B.14.4 Evaluation of Impacts B-44

B.15 Cumulative Impacts B-45
B.15.1 Description of Resource and Region of Influence B-45
B.15.2 Description of Impact Drivers B-45
B.15.3 Impact Assessment Protocol B-45
B.15.3.1 Affected Environment B-45
B.15.3.2 Methods Used to Analyze and Quantify Impacts B-45
B.15.4 Evaluation of Impacts B-47

B.16 References B-48

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

C.1 Introduction and Summary C-1

C.2 Community Input into Draft SSFL Area IV EIS Alternatives C-2
C.2.1 Community Alternatives Development Workshops C-3
C.2.2 2014 Scoping Comments Concerning Alternatives Development C-4

C.3 Prime Directives C-5

C.4 Criteria Development C-6

C.5 Screening Process C-10

C.6 Final SSFL Area IV EIS Alternatives C-14

C.7 References C-16

ATTACHMENT C1 Community Alternatives Development Workshops Alternative Concepts C1-1

ATTACHMENT C2 Scoping Comments Pertaining to Development of Alternatives for the *Draft SSFL Area IV EIS* C2-1

Appendix D
Detailed Project Information D-1

D.1 Area IV Structures D-1

D.2 Chemical and Radiological Cleanup Levels D-6
D.2.1 Chemical and Radiological AOC Look-Up Tables D-6
D.2.2 Revised Look-Up Table Values and Chemicals of Concern D-12
D.2.3 Comparison of Background Soil with AOC Look-Up Table Values D-15

D.3 Comparison to Other Cleanup Projects in California D-17

D.4 Disposal Facility Selection for Analysis D-18

D.5 Cumulative Impacts Candidates D-24

D.6 Principal Analysis Assumptions D-41
D.6.1 Soil Volumes Exceeding AOC LUT Values Requiring Removal under the 2010 AOC D-41
D.6.2 Alternatives Development D-50
D.6.3 Assumptions for Backfill Volumes D-68
D.6.4 Assumptions for Water Use D-69
D.6.5 Assumptions for Groundwater Remediation Alternatives D-69
D.6.6 Assumptions for Transportation of Waste and Materials D-72

D.7 References D-79

Appendix E
Consultations E-1

E.1 Cultural Resources E-1
E.1.1 Regulatory Environment E-1
E.1.2 Federal, State, Local Agency, and Public Consultation E-1
E.1.3 Native American Consultation E-6

E.2 Biological Resources E-16
E.2.1 Regulatory Environment E-16
E.2.2 Endangered Species Consultation and Coordination E-19

E.3 References E-21

Appendix F
Cultural Resources F-1

F.1 Culture History/Historic Setting F-1
F.1.1 Pre-Contact Era F-1
F.1.1.1 Paleo-Coastal Period (11000 to 7000 calibrated B.C.E.) F-1
F.1.1.2 Millingstone Horizon (7000 to 5000 cal. B.C.E.) F-1
F.1.1.3 Early Period (5000 to 500 cal. B.C.E.) F-2
F.1.1.4 Middle Period (500 cal. B.C.E. to ca. 1100 C.E.) F-2
F.1.1.5 Late Period (ca. 1100 to 1840 C.E.) F-2
F.1.2 Ethnographic Era F-3
F.1.2.1 Chumash F-4
F.1.2.2 Fernandeño Tataviam F-6
F.1.2.3 Gabrielino Tongva F-7
F.1.3 Post-Contact Era F-8
F.1.3.1 Early Exploration and Settlement F-8
F.1.3.2 Euro-American Settlement F-8
F.1.3.3 Santa Susana Field Laboratory F-10

F.2 Background Research F-10
F.2.1 Records Search and Summary of Results F-10
F.2.2 Previous Studies within the Region of Influence F-11
F.2.3 Archaeological Resources within the Region of Influence F-14
F.2.4 Architectural Resources within the Area of Potential Effects F-22
F.2.5 Traditional Cultural Properties F-23
F.2.6 Consultations F-23

F.3 References F-25

Appendix G
Evaluation of Remediation Activity Impacts on Human Health G-1

G.1 Introduction G-1

G.2 Emission from Onsite Sources for Remediation Alternatives G-2
G.2.1 Source Emissions – No Action Alternative G-4
G.2.2 Source Emissions – Soil Remediation Alternatives G-4

G.2.3 Source Emissions – Building Demolition G-4
G.2.4 Source Emissions – Groundwater Remediation – Bedrock Excavation Alternative G-5
G.2.5 Source Emissions – Summary G-5

G.3 Representative Concentrations of Constituents in Contaminated material G-6
G.3.1 Identification of Chemical Contaminants of Concern in Source Areas G-6
G.3.2 Identification of Radiological Contaminants of Concern in Source Areas G-6
G.3.3 Identification of Radiological Contaminants of Concern for Building Surfaces G-7
G.3.4 Identification of Radiological Contaminants of Concern for Bedrock Excavation G-7

G.4 Meteorological Data Evaluation G-9

G.5 Atmospheric Dispersion Modeling G-9
G.5.1 Atmospheric Stability Class G-11

G.6 Receptor Locations G-11
G.6.1 Offsite Suburban Resident G-12
G.6.2 Offsite Recreational User G-12
G.6.3 Onsite Worker G-12

G.7 Offsite Media Concentrations G-13
G.7.1 Offsite Air Concentrations G-13
G.7.2 Offsite Soil Concentrations G-13
G.7.3 Offsite Media Concentrations for Carcinogenic Evaluation G-14
G.7.4 Offsite Media Concentrations for Radiological Dose Evaluation G-14
G.7.5 Offsite Media Concentrations for Toxic Effects Evaluation G-14

G.8 Risk-Based Screening Levels G-15
G.8.1 RBSLs for Offsite Receptors G-15
G.8.1.1 Particulate Emission Factor G-16
G.8.1.2 Produce Ingestion G-16
G.8.2 RBSLs for Onsite Receptor G-16

G.9 Calculation of Human Health Effects G-17
G.9.1 Carcinogenic Risk G-17
G.9.2 Toxic Effects G-17
G.9.3 Radiological Dose G-18

G.10 Remediation Activity Impacts G-18
G.10.1 Onsite Impacts G-18
G.10.1.1 Building Demolition Worker G-18
G.10.1.2 Bedrock Excavation Worker G-19
G.10.2 Offsite Impacts G-19
G.10.2.1 No Action Alternative G-20
G.10.2.2 Cleanup to AOC LUT Values Alternative G-20
G.10.2.3 Cleanup to Revised LUT Values Alternative G-20
G.10.2.4 Conservation of Natural Resources Alternative – Residential Scenario G-20
G.10.2.5 Conservation of Natural Resources Alternative – Open Space Scenario G-20
G.10.2.6 Building Demolition G-21
G.10.2.7 Bedrock Removal G-21

G.11 Summary G-21

G.12 Uncertainties G-21
G.12.1 Emissions G-21
G.12.1.1 Santa Ana Effects G-22
G.12.2 Representative Constituent Concentrations in Source Areas G-22
G.12.3 Meteorological Data G-22
G.12.3.1 Santa Ana Wind Conditions G-22
G.12.4 Atmospheric Dispersion Modeling G-23
G.12.4.1 Santa Ana Winds G-24
G.12.5 Offsite Media Concentrations G-24
G.12.6 Risk Based Screening Levels G-24
G.12.7 Calculation of Offsite Human Health Effects G-24
G.12.8 Offsite Impact Assessment G-24

G.12.8.1 Santa Ana Winds G-25
G.12.8.2 Location of Onsite Emissions Source at Site Center versus Subarea Centers G-25
G.12.8.3 Increased Soil Volume Scenario Sensitivity Analysis G-26

G.13 Risk Assessment Tables G-26

G.14 References G-156

Appendix H
Evaluation of Transportation and Traffic Impacts H-1

H.1 Introduction H-1

H.2 Scope of Assessment H-1
H.2.1 Transportation Related Activities H-1
H.2.2 Radiological Impacts H-1
H.2.3 Nonradiological Impacts H-2
H.2.4 Transportation Modes H-2
H.2.5 Receptors H-3

H.3 Packaging and Transportation Regulations H-3
H.3.1 Radiological Packaging Regulations H-3
H.3.2 Transportation Regulations H-4

H.4 Emergency Response H-5

H.5 Methodology H-6
H.5.1 Transportation Routes H-8
H.5.1.1 Offsite Route Characteristics H-8
H.5.2 Radioactive and Hazardous Waste Shipments H-11
H.5.3 Radionuclide Inventories H-12

H.6 Incident-Free Transportation Risks H-13
H.6.1 Radiological Risk H-13
H.6.2 Nonradiological Risk H-14
H.6.3 Maximally Exposed Individual Exposure Scenarios H-14

H.7 Transportation Accident Risks H-15
H.7.1 Methodology H-15
H.7.2 Accident Rates H-16
H.7.3 Accident Severity Categories and Conditional Probabilities H-17
H.7.4 Atmospheric Conditions H-18
H.7.5 Acts of Sabotage or Terrorism H-19

H.8 Risk Analysis Results H-19
H.8.1 Radioactive Release Characteristics H-29

H.9 Long-Term Impacts of Radioactive Material Transportation H-30

H.10 Impacts from Transporting Hazardous Waste, Nonhazardous Waste, and Backfill H-31

H.11 Conclusions H-34

H.12 Uncertainty and Conservatism in Estimated Impacts H-35
H.12.1 Uncertainties in Material Inventory and Characterization H-35
H.12.2 Uncertainties in Containers, Shipment Capacities, and Number of Shipments H-36
H.12.3 Uncertainties in Route Determination H-36
H.12.4 Uncertainties in the Calculation of Radiation Doses H-36
H.12.5 Uncertainties in Traffic Fatality Rates H-37

H.13 Traffic H-37
H.13.1 Region of Influence H-37
H.13.2 Description of Impact Drivers H-37
H.13.3 Impact Assessment Protocol H-39
H.13.3.1 Affected Environment H-39
H.13.3.2 Methods Used to Analyze and Quantify Impacts H-43

H.13.4 Impact Analysis Results H-60
H.13.4.1 SSFL Vicinity H-60
H.13.4.2 Intermodal Facilities H-69
H.13.4.3 Pavement Deterioration H-72
H.13.4.4 Disposal and Recycle Facilities H-73

H.14 References H-78

Appendix I
Wetlands Assessment I-1

I.1 Introduction I-1
I.1.1 Project Location I-1
I.1.2 Project Description I-3
I.1.3 Existing Setting I-3

I.2 Regulatory Requirements, Guidelines, and Definitions I-8

I.3 Methods I-12

I.4 Results I-13

I.5 Assessment of Impacts and Mitigation Measures I-18
I.5.1 Impact Assessment I-18
I.5.1.1 Soil Remediation I-18
I.5.1.2 Building Removal I-22
I.5.1.3 Groundwater Remediation I-23
I.5.2 Mitigation Measures I-23

I.6 Summary I-24

I.7 References I-25

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. I1-1

Attachment I2 Wetland Determination Data Forms I2-1

Attachment I3 Photographs I3-1

Appendix J
U.S. Fish and Wildlife Biological Opinion J-1

Appendix K
Cost-Benefit Analysis Report K-1

Appendix L
Sensitivity Evaluation L-1

Appendix M
Contractor Disclosure Statements

LIST OF FIGURES

Appendix D

Figure D–1 Remaining Structures in Area IV D-2
Figure D–2 Radioactive Materials Handling Facility Overview D-2
Figure D–3 Locations of Other Actions in the Santa Susana Field Laboratory Region of Influence D-25
Figure D–4 Area IV 2010 AOC Chemical Preliminary Remediation Areas D-42
Figure D–5 Area IV 2010 AOC Radiological Preliminary Remediation Areas D-45
Figure D–6 Extent of Radiological and Chemical Constituents Above AOC Look Up Table Values D-47
Figure D–7 Area IV Radiological/Chemical Look-Up Table Areas and Proposed Exemption Areas D-48
Figure D–8 Area IV Total Petroleum Hydrocarbons Results D-52

Appendix F

Figure F–1 Historic Linguistic Boundaries in Relation to the Santa Susana Field Laboratory F-3

Appendix G

Figure G–1 Location of Approximate Center of Area IV/NBZ and SSFL Weather Tower G-3
Figure G–2 SSFL Wind Rose for 2009 through 2012 ..... G-10
Figure G–3 SSFL Dispersion Modeling – Chi over Q (X/Q) at Selected Distances from Emissions Source Meteorological Data – 2009 through 2012 ..... G-12
Figure G–4 Hourly Observations from Onsite Meteorological Station by Month 2009 through 2012 ..... G-23

Appendix H

Figure H–1 Transportation Risk Assessment H-7
Figure H–2 Analyzed National and Regional Truck Routes from the Santa Susana Field Laboratory H-10
Figure H–3 Analyzed National and Regional Rail Routes from the Santa Susana Field Laboratory H-11
Figure H–4 Local Transportation Routes for Waste Transportation Vehicles H-41
Figure H–5 Evaluated Intersections and Road Segments in the SSFL Vicinity H-52

Appendix I

Figure I–1 Project Location, Santa Susana Field Laboratory I-2
Figure I–2 Santa Susana Field Laboratory and Surrounding Communities I-3
Figure I–3 Area IV Surface Water I-6
Figure I–4 Regional Drainage Basins I-7
Figure I–5 Wetlands, Vernal Pools, and Jurisdictional Waters of the U.S. I-17
Figure I–6 Impacts to Wetlands and Waters of the U.S. under the Cleanup to AOC LUT Values Alternative I-19
Figure I–7 Impacts to Wetlands and Waters of the U.S. under the Cleanup to Revised LUT Values Alternative I-21

LIST OF TABLES

Appendix B

Table B–1 Impact Intensity and Public Sensitivity as a Measure of Intensity B-6
Table B–2 Waste Class Definitions and Typical Waste Streams B-30

Appendix C

Table C–1 Draft SSFL Area IV EIS Alternatives Development and Selection Criteria Alternative Component: Soil Contamination C-12
Table C–2 Draft SSFL Area IV EIS Alternatives Development and Selection Criteria Alternative Component: Structures and Infrastructure C-13

Appendix D

Table D–1 DOE Buildings in Santa Susana Field Laboratory Area IV to be Removed D-3
Table D–2 Provisional Radiological Look-Up Table Values D-7
Table D–3 Chemical AOC Look-Up Table Values and Risk-Based Screening Level Values D-8
Table D–4 Chemicals of Concern by Alternative D-13
Table D–5 Chemicals in Background Samples with Values Above LUT Values D-15
Table D–6 Comparison of SSFL Area IV Soil Cleanup Levels with Hunter's Point Naval Shipyard and McClellan Air Force Base Residential Scenario Cleanup Values D-17
Table D–7 Candidate Facilities D-19
Table D–8 Key Information for Other Actions in the Santa Susana Field Laboratory Region of Influence D-26
Table D–9 Results of a Soil Sample from Gillibrand in Simi Valley, California D-54
Table D–10 Results of a Soil Sample from Tapo Fill in Simi Valley, California D-57
Table D–11 Results of Samples of Malibou Lake Sediments in Agora, California (Trace Metals) D-61
Table D–12 Results of Samples of Malibou Lake Sediments in Agora, California (Polycyclic Aromatic Hydrocarbons) D-62
Table D–13 Results of Samples of Commercial Available Soil Amendment Products D-63
Table D–14 Total Waste, Recycle Material, and Backfill Volumes and Shipments D-75

Appendix E

Table E–1 SHPO and Other Section 106 Consultation-Related Contacts E-2
Table E–2 Summary of Native American Meetings at the Santa Susana Field Laboratory E-8
Table E–3 Summary of Native American and Related Formal Contacts E-13
Table E–4 Biological Resources Meetings and Teleconferences E-16

Appendix F

Table F–1 Previous Studies within the Region of Influence F-11
Table F–2 Previously Recorded Archaeological Sites within the Region of Influence F-14
Table F–3 Previously Recorded Isolated Finds within the Region of Influence F-19

Appendix G

Table G–1 Suspended Soil Emission Factors – No Action Alternative G-27
Table G–2 Source Area Emissions and Offsite Media Concentrations – No Action Emissions G-28
Table G–3 Suspended Soil Emission Factors – Soil Remediation Alternatives G-28
Table G–4 Source Areas and Emissions – Soil Remediation Alternatives G-29
Table G–5 Source Area Emissions and Offsite Media Concentrations of Contaminated Material – Remediation Emissions G-30
Table G–6 Emissions from Building Demolition G-31
Table G–7 Bedrock Excavation Emissions and Exposure Concentrations for Remediation Worker G-32
Table G–8 Onsite Source Concentrations of Chemicals for the Evaluation of Soil Remediation Alternatives G-33
Table G–9 Onsite Source Concentrations of Radionuclides for the Evaluation of Soil Excavation Alternatives G-35
Table G–10 Summary of Building Radiological Survey Sources G-36

Table G–11 Building Interior Surfaces – Radiological Survey Results G-37
Table G–12 Isotopic Data for Building Surface Surveys G-38
Table G–13 Criteria for Estimating Atmospheric Stability Classes G-39
Table G–14 Offsite Air Concentrations per Unit Emission Rate (X/Q) G-40
Table G–15 General Description of Atmospheric Stability Classes G-41
Table G–16 Summary of Site Meteorological Observations of Wind Speed – 2009 through 2012 ..... G-41
Table G–17 Offsite Air Concentrations of Chemicals for the Suburban Resident Cancer Risk Evaluation of Soil Excavation Alternatives G-42
Table G–18 Offsite Air Concentrations of Chemicals for the Suburban Resident Hazard Evaluation of Soil Excavation Alternatives G-45
Table G–19 Offsite Air Concentrations of Radionuclides for the Suburban Resident Cancer Risk Evaluation of Soil Excavation Alternatives G-48
Table G–20 Offsite Air Concentrations of Radionuclides for the Suburban Resident Dose Evaluation of Soil Excavation Alternatives G-49
Table G–21 Building Emissions During Demolition and Offsite Media Concentrations – Offsite Suburban Resident G-50
Table G–22 Offsite Media Concentrations – Bedrock Excavation G-51
Table G–23 Offsite Air Concentrations of Chemicals for the Recreational User Cancer Risk Evaluation of Soil Excavation Alternatives G-52
Table G–24 Offsite Air Concentrations of Chemicals for the Recreational User Hazard Evaluation of Soil Excavation Alternatives G-55
Table G–25 Offsite Air Concentrations of Radionuclides for the Recreational User Cancer Risk Evaluation of Soil Excavation Alternatives G-58
Table G–26 Offsite Air Concentrations of Radionuclides for the Recreational User Dose Evaluation of Soil Excavation Alternatives G-59
Table G–27 Building Emissions During Demolition and Offsite Media Concentrations – Offsite Recreational User G-60
Table G–28 Offsite Soil Concentrations of Chemicals for the Suburban Resident Cancer Risk Evaluation of Soil Excavation Alternatives G-61
Table G–29 Offsite Soil Concentrations of Radionuclides for the Suburban Resident Cancer Risk Evaluation of Soil Excavation Alternatives G-64
Table G–30 Offsite Soil Concentrations of Chemicals for the Recreational User Cancer Risk Evaluation of Soil Excavation Alternatives G-65
Table G–31 Offsite Soil Concentrations of Radionuclides for the Recreational User Cancer Risk Evaluation of Soil Excavation Alternatives G-68
Table G–32 Suburban Resident – Exposure Parameters G-69
Table G–33 Recreational User– Exposure Parameters G-70
Table G–34 Offsite Impacts – Chemicals – Risk Based Screening Levels – Suburban Resident – Carcinogens G-71
Table G–35 Offsite Impacts – Chemicals – Noncarcinogenic Screening Levels – Suburban Resident – Toxic Effects G-74
Table G–36 Offsite Impacts – Radionuclides – Risk Based Screening Levels – Suburban Resident G-77
Table G–37 Offsite Impacts – Chemicals – Risk Based Screening Levels –Recreational User– Carcinogens G-78
Table G–38 Offsite Impacts – Chemicals – Risk Based Screening Levels –Recreational User– Toxic Effects G-81
Table G–39 Offsite Impacts – Radionuclides – Risk Based Screening Levels –Recreational User - Carcinogens G-84
Table G–40 Building Preliminary Remediation Goals for Onsite Worker Exposure G-85
Table G–41 Offsite Impacts – Radionuclides – Risk Based Screening Levels – Suburban Resident – Building Radionuclides G-86
Table G–42 Offsite Impacts – Radionuclides – Risk Based Screening Levels – Recreational User – Building Radionuclides G-87
Table G–43 Sources for Morbidity, Mortality, and Dose Coefficients for Human Health Assessments G-88
Table G–44 Ratio of Morbidity to Dose for Decontamination and Decommissioning Worker Exposure Pathways G-89
Table G–45 Cancer Incidence Risk from Building Demolition – Onsite Worker G-90
Table G–46 Radiological Dose from Building Demolition – Onsite Worker G-91
Table G–47 Impact Assessment for Bedrock Excavation –Onsite Worker G-92
Table G–48 Offsite Impacts – Suburban Resident – Chemicals – Remedial Actions – Cancer Incidence Risk – Direct Air G-93

Table G–49 Offsite Impacts – Suburban Resident – Chemicals – Remedial Actions – Cancer Incidence Risk – Direct Soil G-96
Table G–50 Offsite Impacts – Suburban Resident – Chemicals – Remedial Actions – Cancer Incidence Risk – Produce G-99
Table G–51 Offsite Impacts – Suburban Resident – Chemicals – Remedial Actions – Cancer Incidence Risk – Total G-102
Table G–52 Offsite Impacts – Suburban Resident – Chemicals – Remedial Actions – Noncarcinogenic Hazards – Direct Air G-105
Table G–53 Offsite Impacts – Suburban Resident – Chemicals – Remedial Actions – Noncarcinogenic Hazards – Direct Soil G-108
Table G–54 Offsite Impacts – Suburban Resident – Chemicals – Remedial Actions – Noncarcinogenic Hazards – Produce G-111
Table G–55 Offsite Impacts – Suburban Resident – Chemicals – Remedial Actions – Noncarcinogenic Hazards – Total G-114
Table G–56 Offsite Impacts – Suburban Resident – Radionuclides – Remedial Actions – Cancer Incidence Risk – Direct Air G-117
Table G–57 Offsite Impacts – Suburban Resident – Radionuclides – Remedial Actions – Cancer Incidence Risk – Direct Soil G-118
Table G–58 Offsite Impacts – Suburban Resident – Radionuclides – Remedial Actions – Cancer Incidence Risk – Produce G-119
Table G–59 Offsite Impacts – Suburban Resident – Radionuclides – Remedial Actions – Cancer Incidence Risk – Total G-120
Table G–60 Offsite Impacts – Suburban Resident – Radionuclides – Remedial Actions – Radiological Dose – Air G-121
Table G–61 Offsite Impacts – Suburban Resident – Radionuclides – Remedial Actions – Radiological Dose – Soil G-122
Table G–62 Offsite Impacts – Suburban Resident – Radionuclides – Remedial Actions – Radiological Dose – Produce G-123
Table G–63 Offsite Impacts – Suburban Resident – Radionuclides – Remedial Actions – Radiological Dose – Total G-124
Table G–64 Offsite Impacts –Recreational User– Chemicals – Remedial Actions – Cancer Incidence Risk – Direct Air G-125
Table G–65 Offsite Impacts –Recreational User– Chemicals – Remedial Actions – Cancer Incidence Risk – Direct Soil G-128
Table G–66 Offsite Impacts –Recreational User– Chemicals – Remedial Actions – Cancer Incidence Risk – Total G-131
Table G–67 Offsite Impacts –Recreational User– Chemicals – Remedial Actions – Noncarcinogenic Hazards – Direct Air G-134
Table G–68 Offsite Impacts –Recreational User– Chemicals – Remedial Actions – Noncarcinogenic Hazards – Direct Soil G-137
Table G–69 Offsite Impacts –Recreational User– Chemicals – Remedial Actions – Noncarcinogenic Hazards – Total G-140
Table G–70 Offsite Impacts –Recreational User– Radionuclides – Remedial Actions – Cancer Incidence Risk – Direct Air G-143
Table G–71 Offsite Impacts –Recreational User– Radionuclides – Remedial Actions – Cancer Incidence Risk – Direct Soil G-144
Table G–72 Offsite Impacts –Recreational User– Radionuclides – Remedial Actions – Cancer Incidence Risk – Total G-145
Table G–73 Offsite Impacts –Recreational User– Radionuclides – Remedial Actions – Radiological Dose – Air G-146
Table G–74 Offsite Impacts –Recreational User– Radionuclides – Remedial Actions – Radiological Dose – Soil G-147
Table G–75 Offsite Impacts –Recreational User– Radionuclides – Remedial Actions – Radiological Dose – Total G-148
Table G–76 Summary of Risk and Hazard Results for Offsite Impacts during Remedial Alternatives Implementation – Suburban Resident with Garden – Exposure to Chemicals G-149
Table G–77 Summary of Risk and Dose Results for Offsite Impacts during Remedial Alternatives Implementation – Suburban Resident with Garden – Exposure to Radionuclides G-149

Table G–78 Summary of Risk and Hazard Results for Offsite Impacts during Remedial Alternatives Implementation –Recreational User – Exposure to Chemicals G-150
Table G–79 Summary of Risk and Dose Results for Offsite Impacts during Remedial Alternatives Implementation – Recreational User– Exposure to Radionuclides G-150
Table G–80 Dispersion Model Results for Santa Ana Wind Evaluation G-151
Table G–81 Evaluation of Santa Ana Conditions G-151
Table G–82 Evaluation of Santa Ana Wind Conditions – Air Impacts G-152
Table G–83 Evaluation of Santa Ana Conditions – Soil Impacts G-152
Table G–84 Comparison of Emissions from Site Center and Subarea Centers – Subarea Emissions – AOC LUT Alternative G-153
Table G–85 Comparison of Emissions from Site Center and Subarea Centers - Air Concentration of Selected Chemical Constituents – AOC LUT Alternative G-154
Table G–86 Offsite Impacts – AOC LUT – Sensitivity Analysis G-155

Appendix H

Table H–1 Offsite Transport Truck/Rail Route Characteristics H-9
Table H–2 Waste Type and Associated Container Characteristics H-12
Table H–3 Low-Level and Mixed Low-Level Radioactive Waste Radionuclide Concentrations H-13
Table H–4 Risk Factors per Shipment of Radioactive Waste H-21
Table H–5 Risks to Crew Members and Populations from Transporting Radioactive Material and Waste under Each Alternative H-23
Table H–6 Total Doses and Risks from Transporting Radioactive Waste under Combined Action Alternatives H-26
Table H–7 Estimated Dose to Maximally Exposed Individuals under Incident Free Transportation Conditions H-27
Table H–8 Estimated Dose to the Population and to Maximally Exposed Individuals under the Maximum Reasonably Foreseeable Accident H-29
Table H–9 Cumulative Transportation Related Radiological Collective Doses and Latent Cancer Fatalities (1943 to 2073) H-31
Table H–10 Risks from Transporting Nonradioactive Waste and Miscellaneous Materials under Each Action Alternative H-32
Table H–11 Total Risks from Transporting Nonradioactive Waste and Material H-34
Table H–12 Level of Service Definitions H-38
Table H–13 Truck Classification System H-38
Table H–14 Routes and Road Segments Analyzed H-40
Table H–15 Annual Average Daily Traffic and Baseline Level of Service for Selected Road and Urban Freeway Segments near the Santa Susana Field Laboratory H-42
Table H–16 Traffic Volumes and Baseline Level of Service Ratings for Roads in the Vicinities of the Evaluated Disposal, Recycle, and Intermodal Facilities H-44
Table H–17 Vehicle Round Trips by Year for Soil, Waste, Backfill, Equipment, Supplies, and Commutes H-46
Table H–18 Forecasted Round Trips for Santa Susana Field Laboratory Action Alternatives H-47
Table H–19 Highest Number of Average Daily Shipments to the Evaluated Disposal, Recycle, and Intermodal Facilities H-49
Table H–20 Generalized Daily Service Volumes for Urban Freeway Facilities H-57
Table H–21 Generalized Daily Service Volumes for Urban Street Facilities H-58
Table H–22 Percent Increase in Average Daily Traffic Above Baseline Conditions under Each Action Alternative H-61
Table H–23 Percent Increase in Average Daily Traffic Above Baseline Conditions for Combinations of Action Alternatives H-65
Table H–24 Intersection and Road Segment Level of Service and Volume-to-Capacity Ratio Assuming 16 Heavy-Duty Truck Round Trips per Day H-67
Table H–25 Intersection and Road Segment Level of Service and Volume-to-Capacity Ratio Assuming 32 Heavy-Duty Truck Round Trips per Day H-68
Table H–26 Maximum Percent Increase in Average Daily Traffic at Each Intermodal Facility under Each Action Alternative and Low and High Impact Combination H-70
Table H–27 Comparison of Baseline Level of Service Ratings Against the Evaluated LOS Ratings for Roads in the Vicinities of Intermodal Facilities H-71
Table H–28 Equivalent Single Axle Loads under Each Action Alternative and Combination of Alternatives H-72

Table H–29 Maximum Percent Increase in Average Daily Traffic Along Evaluated Roads for Each Disposal and Recycle Facility by Action Alternative H-74
Table H–30 Maximum Percent Increase in Average Daily Traffic Along Evaluated Roads for Each Disposal and Recycle Facility by Action Alternative Combination H-76
Table H–31 Comparison of Baseline Level of Service Ratings Against the Evaluated LOS Ratings for Roads in the Vicinities of Disposal and Recycle Facilities H-77

Appendix I

Table I–1 Results of USACE Jurisdictional Determination Surveys–Wetlands I-16
Table I1–1 Observations at USACE Jurisdictional Determination Survey Points at SSFL Area IV and NBZ – Waters of the U.S. I1-3

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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
EIR	Environmental Impact Report
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
IP	industrial packages
ISO	International Organization for Standardization
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.	United States
U.S.C.	*United States Code*
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
V/C	volume-to-capacity
VOC	volatile organic compound
WCS	Waste Control Specialists

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

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.

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.

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.

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

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

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.

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.

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

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.

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;

- 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

A.4 Notice of Availability – January 13, 2017

ENVIRONMENTAL PROTECTION AGENCY

[ER–FRL–9031–3]

Environmental Impact Statements; Notice of Availability

Responsible Agency: Office of Federal Activities, General Information (202) 564–7146 or *http://www.epa.gov/nepa.*

Weekly receipt of Environmental Impact Statements (EISs)
Filed 01/02/2017 Through 01/06/2017
Pursuant to 40 CFR 1506.9.

Notice: Section 309(a) of the Clean Air Act requires that EPA make public its comments on EISs issued by other Federal agencies. EPA's comment letters on EISs are available at: *http://www.epa.gov/compliance/nepa/eisdata.html.*

EIS No. 20170000, Draft, NOAA, CA, Calam Monterey Peninsula Water Supply Project, Comment Period Ends: 02/27/2017, Contact: Karen Grimmer 831–647–4253.

EIS No. 20170001, Draft, USFS, MT, South Gravelly Allotment Management Plans, Comment Period Ends: 02/27/2017, Contact: Jake Stewart 406–682–4253.

EIS No. 20170002, Draft, DOE, CA, Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory, Comment Period Ends: 03/14/2017, Contact: Stephie Jennings 1–805–842–3864.

EIS No. 20170003, Draft Supplement, FHWA, DE, US 113 North South Study Millsboro South Area, Comment Period Ends: 02/27/2017, Contact: Nick Blendy 302–734–2966.

EIS No. 20170004, Draft, USFWS, NPS, WA, North Cascades Ecosystem Draft Grizzly Bear Restoration Plan, Comment Period Ends: 03/14/2017, Contact: Karen Taylor-Goodrich 360–854–7205.

The U.S. Department of Interior's National Park Service and the U.S. Fish and Wildlife Service are joint lead agencies for the above project.

EIS No. 20170005, Draft, BR, NM, Pojoaque Basin Regional Water System, Comment Period Ends: 02/27/2017, Contact: Lawrence Moore 505–462–3702.

EIS No. 20170006, Final, USFS, BLM, UT, Transwest Express Powerline (TWE), Review Period Ends: 02/27/2017, Contact: Charles Call 435–691–0768.

EIS No. 20170007, Final, NPS, UT, Glen Canyon National Recreation Area Off-Road Vehicle Management Plan, Review Period Ends: 02/13/2017, Contact: Lindsay Gillham 303–969–2085.

EIS No. 20170008, Final, BLM, USFS, UT, Energy Gateway South Powerline (EGS), Review Period Ends: 02/27/2017, Contact: Kenton Call 435–691–0768.

EIS No. 20170009, Draft Supplement, NOAA, AK, Management of the Subsistence Harvest of Northern Fur Seals on St. Paul Island, Alaska, Comment Period Ends: 02/27/2017, Contact: Michael Williams 907–271–5117.

EIS No. 20170010, Final, USFS, ID, Lookout Pass Ski Area Expansion EIS, Review Period Ends: 02/27/2017, Contact: Shoshana Cooper 208–765–7211.

Amended Notices

EIS No. 20160298, Draft, USFS, MT, Ten Lakes Travel Management Project, Comment Period Ends: 02/14/2017, Contact: Bryan Donner 406–296–2536.

Revision to FR Notice Published 12/16/2016; Extending Comment Period from 1/30/2017 to 2/14/2017.

EIS No. 20160321, Draft Supplement, FTA, CA, BART Silicon Valley Phase II Extension Project, Comment Period Ends: 02/21/2017, Contact: Mary Nguyen 213–202–3960.

Revision to FR Notice Published 01/06/2017; Correction to Comment Period Ends 02/21/2017.

EIS No. 20160328, Draft Supplement, USACE, LA, Mississippi River, Baton Rouge to the Gulf of Mexico Mississippi River-Gulf Outlet, Louisiana, New Industrial Canal Lock and Connecting Channels Project, Comment Period Ends: 02/21/2017, Contact: Mark Lahare 504–862–1344.

Revision to FR Notice Published 01/06/2017; Correction to Comment Period Ends 02/21/2017.

Dated: January 10, 2017.

Dawn Roberts,

Management Analyst, NEPA Compliance Division, Office of Federal Activities.

[FR Doc. 2017–00716 Filed 1–12–17; 8:45 am]

BILLING CODE 6560–50–P

A.5 Amended Notice Extending the Comment Period – March 17, 2017

Federal Register / Vol. 82, No. 51 / Friday, March 17, 2017 / Notices 14217

ENVIRONMENTAL PROTECTION AGENCY

[ER–FRL–9032–2]

Environmental Impact Statements; Notice of Availability

Responsible Agency: Office of Federal Activities, General Information (202) 564–7146 or *http://www.epa.gov/nepa.*

Weekly receipt of Environmental Impact Statements (EISs),
Filed 03/06/2017 Through 03/10/2017.

Pursuant to 40 CFR 1506.9.

Notice

Section 309(a) of the Clean Air Act requires that EPA make public its comments on EISs issued by other Federal agencies. EPA's comment letters on EISs are available at: *http://www.epa.gov/compliance/nepa/eisdata.html.*

EIS No. 20170032, Draft, USFS, OR, Ringo Project, Comment Period Ends: 05/01/2017, Contact: Lillian Cross, 541–433–3200.

[1] Order Granting Exemption from Licensing of a Small Hydroelectric Project of 5 MW or Less. *White Current Corporation,* 20 FERC ¶ 62,271 (1982).

EIS No. 20170033, Draft, BPA, WA, Melvin R. Sampson Hatchery Yakima Basin Coho Project, Comment Period Ends: 05/01/2017, Contact: Dave Goodman, 503–230–4764.

EIS No. 20170034, Draft, USFS, CA, Trinity Post Fire Hazard Reduction and Salvage, Comment Period Ends: 05/01/2017, Contact: Thomas Hall, 530–628–1200.

EIS No. 20170035, Final Supplement, USFS, ID, Johnson Bar Fire Salvage, Review Period Ends: 04/17/2017, Contact: Tam White, 208–926–6416.

EIS No. 20170036, Final, USFS, AK, Shoreline II Outfitter/Guide, Review Period Ends: 04/17/2017, Contact: Carey Case, 907–772–5906.

Amended Notices

EIS No. 20160261, Draft, USFS, ID, Coeur d Alene Basin Natural Resource Restoration Plan, Comment Period Ends: 04/17/2017, Contact: Jo Christensen, 208–765–7417.

Revision to FR Notice Published 11/10/2016; Reopening Comment Period to End 04/17/2017.

EIS No. 20170002, Draft, DOE, CA, Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory, Comment Period Ends: 04/13/2017, Contact: Stephie Jennings, 1–805–842–3864.

Revision to FR Notice Published 01/13/2017; Extending the Comment Period from 03/14/2017 to 04/13/2017.

EIS No. 20170004, Draft, USFWS, NPS, WA, North Cascades Ecosystem Draft Grizzly Bear Restoration Plan, Comment Period Ends: 04/28/2017, Contact: Karen Taylor-Goodrich, 360–854–7205.

Revision to FR Notice Published 01/13/2017; Extending the Comment Period from 03/14/2017 to 04/28/2017.

EIS No. 20170031, Draft, USFS, ID, Big Creek Hot Springs Geothermal Leasing, Comment Period Ends: 05/01/2017, Contact: Julie Hopkins, 208–756–5279.

Revision to FR Notice Published 03/10/2017; Reestablish the Comment Period to End 05/01/2017.

Dated: March 14, 2017.

Dawn Roberts,

Management Analyst, NEPA Compliance Division, Office of Federal Activities.

[FR Doc. 2017–05375 Filed 3–16–17; 8:45 am]

BILLING CODE 6560–50–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 *Final Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory (Final 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). That stated land use was recorded with Ventura County in April 2017 in two Grant Deeds for Conservation Easement and Agreements (conservation easements) between Boeing and North American Land Trust (Ventura County 2017a, 2017b) that permanently preserve as open space nearly 2,453 acres of land that Boeing owns at SSFL, including Area IV and the NBZ. The conservation easements are legally enforceable documents that, among other restrictions, forever prohibit residential, agricultural, or commercial development or uses of the site in perpetuity.

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. For example, use of water sources for onsite remediation technologies would add to the demand for this resource. The Southern California region has experienced drought conditions during the development of this environmental impact statement (EIS), and the region has been under orders in recent years 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. However, the conservation easements (Ventura County 2017a, 2017b) specify that much of the land at SSFL, including Area IV and the NBZ, is to be preserved as open space and prohibit residential, agricultural, or commercial development or uses of the site. 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 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 defined 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

	Public Sensitivity [c]			
Impact Magnitude [b]	***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;
- construction of groundwater treatment facilities and implementation of groundwater monitoring could result in loss of soil, or loosening or compaction of soil structure;
- 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 availability of 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.
- 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 (primarily 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 3–18, 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.

- Withdrawal of groundwater for *ex situ* treatment could result in less water available to local vegetation and to recharge the adjacent groundwater basins.
- The No Action Alternative could result in concentrations of contaminants that degrade the quality of groundwater.
- Injection of treated groundwater would replace water removed from the aquifer, negating the loss of water that was withdrawn for treatment.
- If treated groundwater were used for implementation of various soil remediation, building demolition, and groundwater remediation alternatives then groundwater treatment alternatives could decrease the amount of water from other sources that would be required to implement the alternatives.
- Under a monitored natural attenuation alternative, cleanup goals for groundwater would take much longer to achieve.

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 groundwater 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, as well as the *Draft RCRA Facility Groundwater Remedial Investigation Report, Area IV, Santa Susana Field Laboratory, Ventura County, California* (CDM Smith 2018a). Groundwater quality data collected in 2014 and 2015, augmented with data and evaluations in the Draft RCRA Facility Groundwater Remedial Investigation Report, 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. The combined area of the groundwater basins adjacent to SSFL is 157,100 acres (CDWR 2003). 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). Because of the size of Area IV and the NBZ (290 acres) relative to the sizes of the adjacent basins, they are not large contributors to groundwater recharge of the basins. Therefore, the small volume of water that would be withdrawn for groundwater treatment would not have a measurable effect on groundwater quantities in the water basins.

Treatment technologies and alternatives, including pump and treat, chemically enhanced contaminant destruction, bedrock 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 2018a). 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 bedrock vapor extraction system would have to operate for approximately 5 years to reduce the threat of volatile organic compounds (VOCs) in the soil above the aquifer migrating into the aquifer.
- The length of time required for monitored natural attenuation was estimated from the monitored natural attenuation evaluation in the *Draft RCRA Facility Groundwater Corrective Measure Study, Area IV, Santa Susana Field Laboratory, Ventura County, California* (CDM Smith 2018b). 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 8 years (CDM Smith 2018b).

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 and animals (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

The 2010 *Administrative Order on Consent for Remedial Action* (2010 AOC) (DTSC 2010) provides for exemptions to the remediation standard for cleanup of Area IV and the NBZ for the protection of sensitive biological and cultural resources. DOE has identified areas in which the exemption process would be applied based on identification of sensitive biological or cultural resources, as described more fully in Chapter 2, Section 2.3.2, of this EIS. Application of the exemption process for protecting sensitive biological resources would ensure compliance with applicable State and Federal laws and would reflect consultation with the U.S. Fish and Wildlife Service and concurrence by DTSC. Areas in which the exemption process would be applied (see Chapter 4, Figure 4–6) include 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; Ventura County Locally Important)
- Catalina mariposa lily (*Calochortus catalinae*) (CRPR 4.2)
- Ocellated Humboldt lily (*Lilium humboldtii* ssp. *ocellatum*) (CRPR 4.2)
- California red-legged frog (*Rana draytonii*) (ESA – Threatened)
  - Designated critical habitat

- Coastal California gnatcatcher (*Polioptila californica californica*) (ESA – Threatened; California Species of Special Concern)
- Least Bell's vireo (*Vireo bellii* ssp. *pusillus*) (ESA – Endangered)
- Southern California black walnut (*Juglans californica*) (CRPR 4.2)
- Golden eagle (*Aquila chrysaetos*) nest sites (ESA – Threatened; Bald and Golden Eagle Protection Act; California Fully Protected Species, California Species of Special Concern)
- Pallid bat (*Antrozous pallidus*) (California Species of Special Concern)
- Silvery legless lizard (*Anniella pulchra pulchra*) (California Species of Special Concern)
- Coastal whiptail (*Aspidoscelis tigris stejnegeri*) (California Species of Special Concern)
- Coast horned lizard (*Phrynosoma blainvillii*) (California Species of Special Concern)
- Coast patch-nosed snake (*Salvadora hexalepis virgultea*) (California Species of Special Concern)
- Western spadefoot (*Spea hammondii*) (California Species of Special Concern)
- Two-striped garter snake (*Thamnophis hammondii*) (California Species of Special Concern)
- 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)

Many of the species and resources listed above can be tied to specific portions of Area IV or the NBZ and, thus, can be protected by application of the exemption process. Other species, such as the California gnatcatcher and the least Bell's vireo, have not been documented from the site or cannot be tied to a particular location on the site at this time, but surveys would take place in the future and the exemption process would be applied if necessary.

The following assumptions were applied to the areas in which the exemption process would be applied:

- Remediation needed to protect human health or minimize ecological risk would occur via focused removal actions so that impacts within these areas would be less severe and extensive and restoration would be more feasible.
- 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 important species; (4) bald and golden eagles protected under the Bald and Golden Eagle Protection Act; (5) California Fully Protected Species;[1] and (6) California Species of Special Concern.[2] 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 (e.g., NEPA, ESA, Clean Water Act, CESA). 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 is 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

[1] California Fully Protected Species: The classification of "fully protected" was the State's initial effort in the 1960s to identify and provide additional protection to those animals that were rare or faced possible extinction. Fully protected species may not be taken or possessed at any time and no licenses or permits may be issued for their take except for collecting these species for necessary scientific research and relocation.

[2] California Species of Special Concern: This classification is given to a species, subspecies, or distinct population of an animal native to California that currently satisfies one or more of the following (not necessarily mutually exclusive) criteria: the animal (or animals)

- Is extirpated from the State or, in the case of birds, is extirpated in its primary season or breeding role;
- Is listed as Federally, but not State-, threatened or endangered; meets the State definition of threatened or endangered but has not formally been listed;
- Is experiencing, or formerly experienced, serious (noncyclical) population declines or range retractions (not reversed) that, if continued or resumed, could qualify it for State threatened or endangered status;
- Has naturally small populations exhibiting high susceptibility to risk from any factor(s), that if realized, could lead to declines that would qualify it for State threatened or endangered status.

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 2017). These data show that atmospheric carbon dioxide levels have risen an average of 1.5 parts per million per year over the last 59 years (NOAA 2017). As of 2016, carbon dioxide levels are about 33 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 2017).

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 2017).

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 used to calculate emissions for proposed activities are documented in the *Final Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory – Air Emissions Calculation Methods* (Leidos 2018). 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 (BREEZE Software 2017).

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

The analysis estimated GHG emissions generated from proposed activities for informational and comparative purposes among the alternatives and qualitatively estimated the potential for these emissions to contribute to climate change. 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 4.5.1.

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 and the California Highway Patrol. This information was used in Appendix H, "Traffic Study for Santa Susana Field Laboratory EIR, Los Angeles, CA," of the *Draft*

Program Environmental Impact Report for the Santa Susana Field Laboratory, Ventura County, California (draft program EIR) (DTSC 2017). The study was a resource to support level of service (LOS) analysis for segments and intersections within the roadway network in this EIS.

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 of this EIS, 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 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 of this EIS 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. Impacts are evaluated for an onsite resident (without a garden) and onsite recreational user following remediation and for an offsite resident (with a garden), offsite recreational user, and workers during remediation. In addition, an occupational health and safety analysis examines work-related industrial safety issues that determine potential death, illness, or injury resulting from construction and operation activities.

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, and bedrock.
- Reasonably foreseeable upset and accident conditions associated with the proposed activities could involve the release of radioactive and/or hazardous materials into the environment.
- Proposed remediation activities could release radioactive and/or hazardous materials into the air that could be carried off site and pose a threat to an offsite resident or recreational user.
- 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 description of the methodology used and supporting data for the impact assessment of human health effects from remedial actions is provided in Appendix G. Residual impacts in Area IV and the NBZ following remediation are addressed in Appendix K.

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.")
- 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 4.9.2 for incidence rates).

The risk analysis was performed using the following assumptions:

- Potential impacts on hypothetical receptors, an onsite resident, offsite resident with a garden, 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-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 for soil remediation, no institutional control of the site was assumed. 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 4.9.6). 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 resulting in exposure to the public in excess of DOE standards (i.e., DOE Order 458.1). DOE Order 458.1 limits public exposure to 100 millirem per year from all sources and further constrains the dose from DOE residual radioactive material on cleared real property to 25 millirem per year. DOE Order 458.1 also invokes the National Emissions Standard for Hazardous Air Pollutants limit of 10 millirem per year to any member of the public from emissions to the air from DOE facilities.
- 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 facilities 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 (including moderate-risk soil, as well as non-waste soil). 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.

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 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 25, 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.

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 or risk-based 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 or risk-based values, in addition to 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. Groundwater treatment media containing chemical constituents and warranting classification as hazardous waste.
Nonhazardous waste (as well as non-waste soil)	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 removal that is suitable for recycle (e.g., asphalt, concrete, steel). Moderate-risk soil and non-waste soil that contains chemical constituents in concentrations exceeding chemical LUT values, but is not classified as hazardous waste. Cuttings from well water installation and warranting classification as non-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 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 25, 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 (including moderate risk-soil, as well as non-waste soil) 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 facility capacities (including total available and projected waste capacities and other permitted quantity restrictions, if applicable), all candidate facilities 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 multiple 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. Non-waste soil may be disposed of at other DOE facilities or used as fill in other locations.

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 facility 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. DTSC researched and evaluated possible alternative transportation routes and modes for removing building debris and soils impacted by radionuclides or chemicals from SSFL in a Transportation Feasibility Analysis for the draft program

EIR (DTSC 2107, Appendix J). Based on conclusions from the feasibility analysis, the alternative routes and modes deemed to be feasible would have greater environmental impacts than from those using Woolsey Canyon Road. In addition to other environmental impacts, alternative routes and modes that would require ground disturbance have the potential to affect currently unknown cultural resources.

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.

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, which also identifies ongoing or projected work. The NRHP-eligibility status of resources in Area IV and the NBZ is discussed, and 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 is consulting with SHPO, the Santa Ynez Band of Chumash Indians, non-federally recognized tribes, and other consulting parties to develop a Programmatic Agreement that will establish procedures for addressing adverse effects on historic properties; the Programmatic Agreement will satisfy DOE's responsibilities under Section 106.

As required by the Section 106 process (36 CFR 800.2(d) and 800.3(e)), members of the public have been involved through special meetings for SSFL stakeholders and through avenues provided by the NEPA process.

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, non-federally recognized tribes, and other consulting parties, 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 consulted with the Santa Ynez Band of Chumash Indians and non-federally recognized tribes and will continue to consult until the conclusion of DOE's cleanup activities. 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 and NEPA; 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 through written contributions (see Chapter 9, "Native American Histories and Perspectives") and interactions (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 tribes view resources and archaeological sites under the jurisdiction of NASA and Boeing as directly connected to those on Area IV or the NBZ and

consider all of SSFL to be a sacred site. SSFL has the potential to contain all the following features, although not all have been documented at the facility (Santa Ynez Band of Chumash Indians 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 non-federally recognized tribes. 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 is consulting with SHPO, the Santa Ynez Band of Chumash Indians, non-federally recognized tribes, and other consulting parties to develop a Programmatic Agreement that will establish procedures for addressing adverse effects on historic properties; the Programmatic Agreement will satisfy DOE's responsibilities under Section 106. 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 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[3] and block groups[4] 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 (Census 2010) and *American Community Survey, 2016 5-Year Estimates* (Census 2016c), 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:

[3] 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 2016a).

[4] 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 2016b).

- 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.

  Minority populations are identified where either (1) the total minority[5] 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

[5] "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.

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 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, 2016 5-Year Estimates* (Census 2010, 2016c) 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, eight impact scenarios could result from the potential combinations of the four soil remediation alternatives/scenarios, one building removal alternative, and two groundwater remediation 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 – Open Space Scenario, 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.

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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

Alternatives analyzed in this *Final Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory* (*Final SSFL Area IV EIS*) reflect an ongoing process that has been responsive to changes that have occurred since the beginning of activities associated with the current efforts to remediate Area IV and the Northern Buffer Zone (NBZ) of the Santa Susana Field Laboratory (SSFL). Sections C.1 through C.5 of this appendix provide background and details of the process and activities that led to the development of the alternatives included in the *Draft SSFL Area IV EIS*. For this Final EIS, DOE retained the alternatives included in the Draft EIS, but in response to comments on the Draft and the now changed circumstances, DOE has added an additional scenario under one of the alternatives. As presented in more detail in Section C.6, DOE has added an Open Space Scenario under the Conservation of Natural Resources Alternative. At the time the Draft EIS was issued, The Boeing Company (Boeing) had indicated its intent to maintain its property at SSFL, which includes Area IV and the NBZ, as open space. That stated intent has now been formalized by two conservation easements and agreements that define acceptable uses and restrict development of Boeing's SSFL property. Specific details of the alternatives (e.g., soil volumes) are presented in Chapter 2 in the EIS and described in more detail in Appendix D.

The process for identifying alternatives included in the *Draft SSFL Area IV EIS* 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, the U.S. Department of Energy (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 SSFL's Area IV and 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

***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
  - Residential Scenario
  - Open Space Scenario

Building Demolition Alternatives
- No Action
- Building Removal Alternative

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

Note: For the *Final SSFL Area IV EIS* a second scenario was added to the Conservation of Natural Resources Alternative. See Section C.6 for further information.

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 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. The new scenarios added under the Conservation of Natural Resources Alternative in this *Final SSFL Area IV EIS*, and the rationale for its inclusion are included in Section C.6.

C.2 Community Input into Draft SSFL Area IV EIS 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).

Subsequently, 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 February 7 through April 2, 2014 scoping period, 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.

[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.

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 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) remediation 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 needs 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 initially 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:

Purpose and Need for Agency Action

DOE needs to complete remediation of SSFL Area IV and the NBZ to comply with applicable requirements for cleanup of radiological and hazardous substances. These requirements include regulations, orders, and agreements. 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 NBZ in a manner that is protective of the environment and the health and safety of the public and workers.

- 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. DTSC has the sole discretion to establish the LUT values for chemical and radiological constituents.
- 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.
- Recognized cultural resources will be protected to the extent practical. In consultation with the California State Historic Preservation Officer, Native American groups, and other stakeholders, historic properties will be identified and addressed in accordance with the National Historic Preservation Act. Historic properties and other cultural resources will be protected in accordance withthe 2010 AOC.
- 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 "[U]se the NEPA process to identify and assess the reasonable alternatives to proposed actions that will avoid or minimize adverse effects of these actions upon 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 criteria of the 2007 CO (DTSC 2007) (Clean up groundwater to risk-based levels.)
- **PN-3:** Compliance with criteria of 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) remediation requirements.

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

CB-6: Base cleanup on final land use (dropped for the Draft EIS because DOE is not the landowner and cannot determine final land use). After the Draft EIS was issued, Boeing formalized the open space designation as the final land use through two

conservation easements and agreements recorded with Ventura County (Ventura County 2017a, 2017b). Consequently, DOE added an Open Space Scenario under the Conservation of Natural Resources Alternative for evaluation in this Final EIS.

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 should 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. Related activities would include:

- retaining/replacing native flora to the extent possible and
- avoiding the introduction of 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 considered in this EIS based on analyses included in the DTSC *Draft Program Environmental Impact Report for the Santa Susana Field Laboratory, Ventura County, California* (*Draft PEIR*) (DTSC 2017). The *Draft PEIR*, Appendix J, "Transportation Feasibility Study," evaluates alternative means of transporting debris and soil from SSFL. A summary of the conclusions of DTSC's evaluation of transportation alternatives is addressed in Chapter 2, Section 2.4 of this EIS. 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 (CDM Smith 2018) includes an evaluation of groundwater treatment technologies. Therefore, groundwater treatment options were not subjected to the screening process described here. The

results of the screening 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.

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 evaluated a traditional risk-based cleanup to a suburban residential level. (For this Final EIS, DOE subsequently added an Open Space Scenario with cleanup to a recreational user level as discussed in Section C.6.)

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 Boeing have demonstrated that focused 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).

Table C–1 *Draft SSFL Area IV EIS* Alternatives Development and Selection Criteria
Alternative Component: Soil Contamination

PROPOSED ALTERNATIVE CONCEPTS / CRITERIA	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 *Draft SSFL Area IV EIS* 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.	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 "–").

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 Final SSFL Area IV EIS Alternatives

In preparing this *Final SSFL Area IV EIS*, DOE made revisions to the *Draft SSFL Area IV EIS* in response to comments received from other Federal agencies, State, and local government entities, Native American tribes, and the public. In addition, the Final EIS was revised to reflect changed conditions since issuance of the Draft EIS. One such changed condition was Boeing and the North American Land Trust executing a Grant Deeds of Conservation Easement and Agreements (see text box). To fully reflect the future land use in accordance with Boeing's conservation easements, DOE modified the Conservation of Natural Resources Alternative to include two scenarios. The first scenario reflects the exposure scenario as evaluated in the *Draft SSFL Area IV EIS*, that is, an onsite suburban resident with no garden. DOE added a second scenario that more accurately reflects the future use of the site as open space; it establishes risk-based cleanup levels commensurate with exposure of an onsite recreational user.

Boeing Grant Deed of Conservation Easement and Agreement

In April and November 2017, Boeing made legally binding commitments to conservation easements held by North American Land Trust to permanently preserve as open space habitat nearly 2,453 acres of land that Boeing owns at SSFL, which includes Area IV and the NBZ. The conservation easements require that Boeing's property be managed in perpetuity such that any use of the property is consistent with preservation and maintenance of the conservation values of the property. Those conservation values are identified as significant natural, ecological, cultural, historic, aesthetic, educational, scientific, scenic, and open space values. Towards that end, the conservation easements are legally enforceable documents that, among other restrictions, forever prohibit residential, agricultural, or commercial development or uses of the site (Ventura County 2017a, 2017b).

DOE also added sensitivity evaluations of the alternatives (see Appendix L). Responding to comments that asserted that the soil volume associated with the Cleanup to AOC LUT Values Alternative were underestimated and other comments that objected to setting aside areas in which the exemption process would be applied and areas where low concentrations of total petroleum hydrocarbons would be allowed to attenuate, DOE analyzed the potential impacts of the maximum soil volume that could reasonably be expected to be excavated. Under this scenario, ecological and cultural resources would not be protected as required by applicable laws, regulations, and the 2010 AOC. Sensitivity analyses were also added that evaluate the potential impacts from constraints (for example, budget constraints, longer-than-expected confirmation processes) that might result in soil remediation proceeding more slowly than evaluated in the baseline alternatives and scenarios. DOE

also evaluated a scenario that completed demolition and removal of the DOE buildings in Area IV on an accelerated schedule.

C.7 References

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ATTACHMENT C1
COMMUNITY ALTERNATIVES DEVELOPMENT WORKSHOPS ALTERNATIVE CONCEPTS

In May and June of 2012, DOE conducted a 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.

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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.

	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.*	
Condition of the Property at Transfer	– 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.	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.)	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.	– 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.	
				Building preservation variation: Keep uncontaminated buildings wherever possible.	***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.*	
Structure/Infrastructure	– Remove all structures except those that can be appropriately repurposed (for example, keep the million dollar hole [Building 56 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 [Simi Hills] 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 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 and 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.. 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 [to] 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 *Final Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory* (*Final SSFL Area IV EIS*). Appendix D has been revised from the Draft EIS to address comments received on the Draft EIS, changed conditions (e.g., Boeings Conservation Easement), refinements of soil volumes, and the rationale for changes. 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

Over its operating life, there have been 272 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** for all structures and **D–**2 for the Radioactive Materials Handling Facility), and four owned 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. Several of the buildings were used for nuclear research and/or radioactive waste storage. Radiological surveys were conducted using the radiological health and safety requirements and procedures that existed at the times of the surveys.

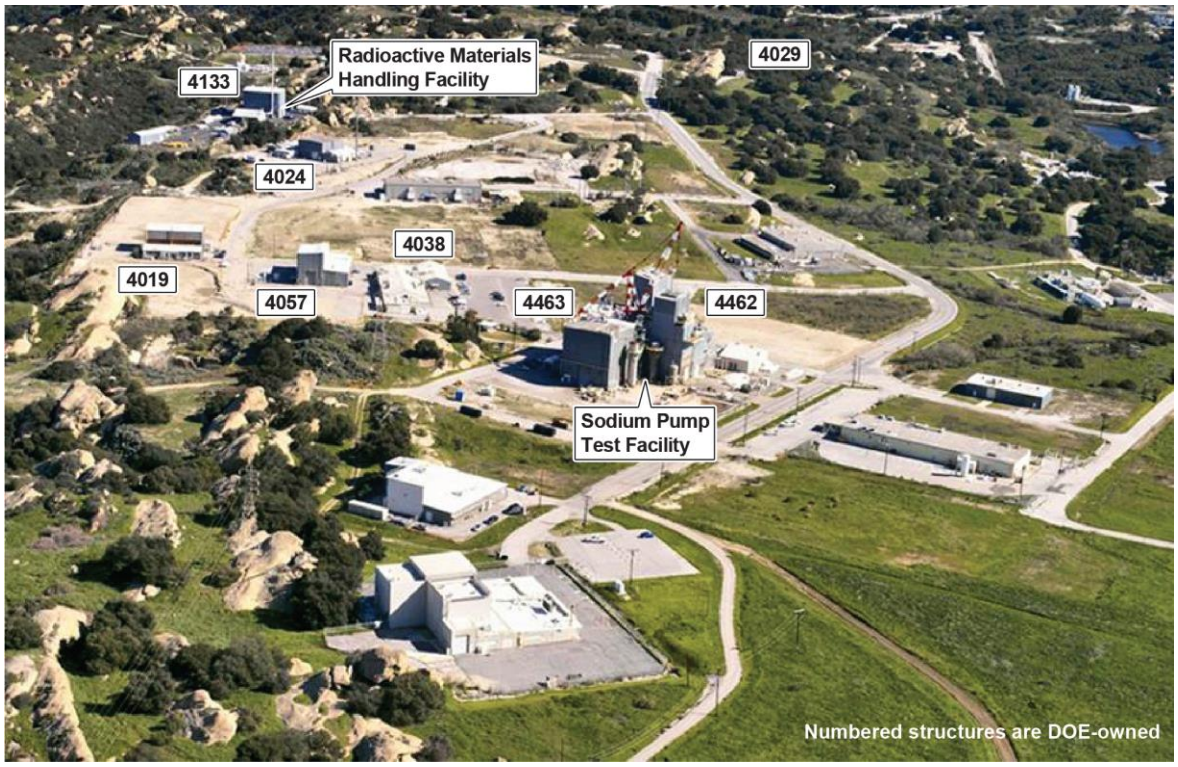


Figure D–1 Remaining Structures in Area IV

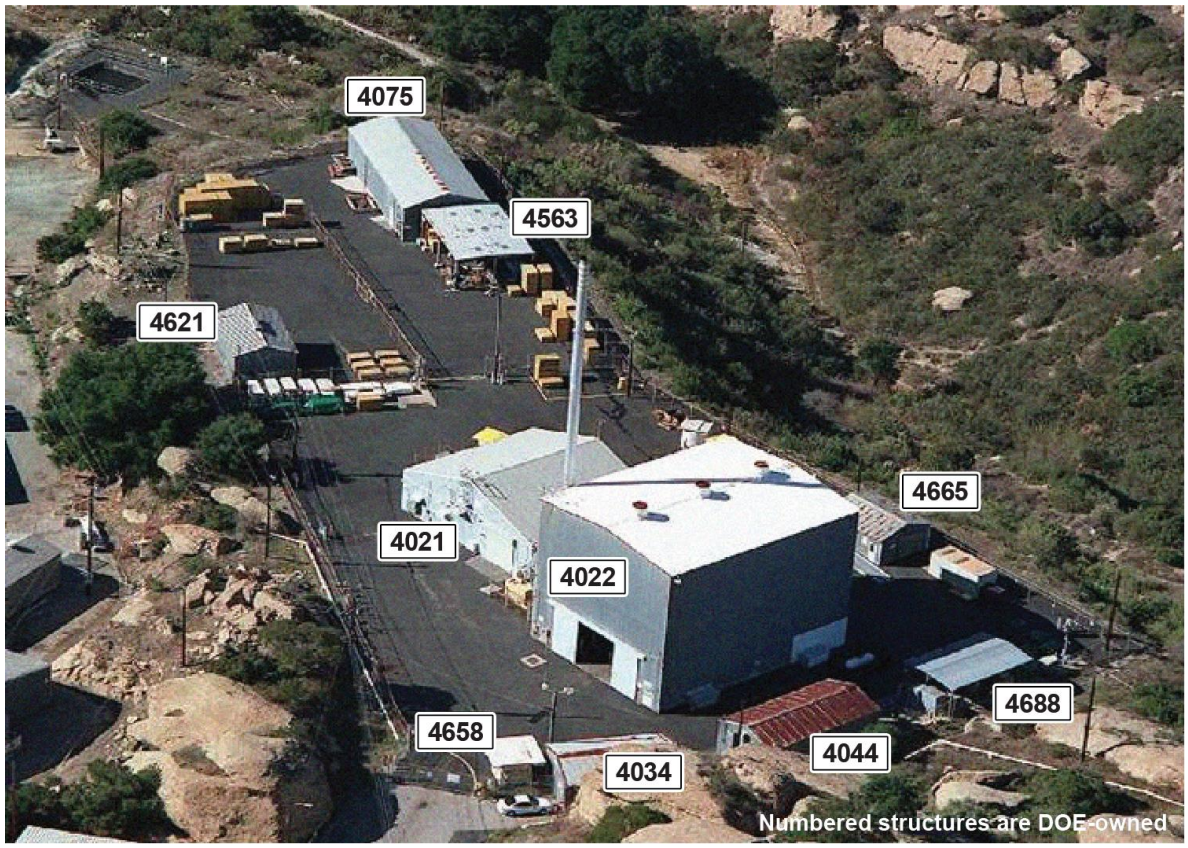
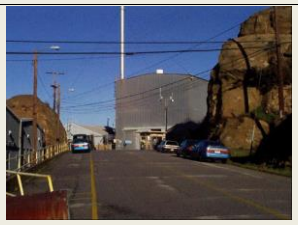


Figure D–2 Radioactive Materials Handling Facility Overview

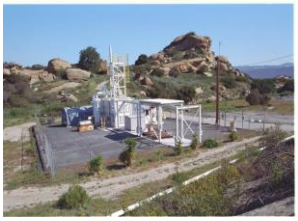
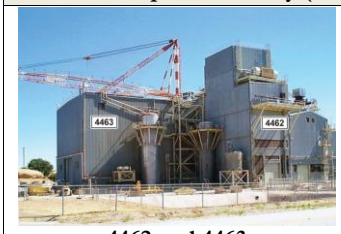
Irrespective of these past surveys and in accordance with decisions made pursuant to the analysis in this Final EIS, each DOE building in Area IV will be surveyed in accordance with an approved survey plan to determine the disposition of building materials during and after demolition. The radionuclide and chemical content on and within buildings or structures will be determined in accordance with decisions made pursuant to this Final EIS, DOE Orders, regulatory requirements, and approved procedures such as those established in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (NRC/EPA/DOE/DOD 2000). MARSSIM provides detailed U.S. Environmental Protection Agency (EPA), U.S. Nuclear Regulatory Commission (NRC), U.S. Department of Defense, and DOE guidance on how to demonstrate that a site is in compliance with a radiation dose- or risk-based public protection requirement. The approved plans and procedures will describe the activities that DOE will perform to sample and characterize DOE's remaining buildings to determine whether they are contaminated with radiological or chemical contaminants, and to determine appropriate methods for managing and disposing of demolition debris. **Table D–1** provides additional information and photographs of each remaining DOE building.

In August 2016, DOE provided to DTSC the Standard Operating Procedures for the Demolition of Facilities in Area IV at the Santa Susana Field Laboratory (Building Demo SOP). The Building Demo SOP provides the framework of procedures and protocols for the pre-demolition evaluation and demolition of Area IV buildings. On August 1, 2018, DTSC provided its acceptance of the Building Demo SOP (DTSC 2018b). Upon notification of DTSC and Ventura County of the schedule for demolition of the non-RCRA permitted buildings, DOE will begin demolition based on the schedule. In 2015, DOE provided to DTSC separate RCRA Closure Plans for the Radioactive Materials Handling Facility and the Hazardous Materials Management Facility. These documents are under DTSC review.

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

Building Number	*Building Description* [a]
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. The debris from this building is included in the radioactive waste volume estimate.
 **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. The debris from this building is included in the radioactive waste volume estimate.
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; however, due to its presence within the RMHF, debris from this building is included in the radioactive waste volume estimate.

Building Number	***Building Description*** [a]
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; however, due to its presence within the RMHF, debris from this building is included in the radioactive waste volume estimate.
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; however, due to its presence within the RMHF, debris from this building is included in the radioactive waste volume estimate.
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; however, due to its presence within the RMHF, debris from this building is included in the radioactive waste volume estimate.
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. Due to its presence within the RMHF, debris from this building is included in the radioactive waste volume estimate.
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; however, due to its presence within the RMHF, debris from this building is included in the radioactive waste volume estimate.
4665	Constructed in the mid-1960s, Building 4665 was used as an oxidation facility for RMHF. It is not considered a radioactively contaminated structure. Due to its presence within the RMHF, debris from this building is included in the radioactive waste volume estimate.
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; however, due to its presence within the RMHF, debris from this building is included in the low-level radioactive waste volume estimate.

Building Number	*Building Description* [a]
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 was surveyed using the radiological health and safety requirements and procedures that existed at the times of the surveys and is not considered a radioactively contaminated structure. Due to its history, however, debris from this building is included in the radioactive waste volume estimate.
 **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 was surveyed using the radiological health and safety requirements and procedures that existed at the times of the surveys and is not considered a radioactively contaminated structure; however, due to its history, debris from this building is included in the radioactive waste volume estimate.
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 using the radiological health and safety requirements and procedures that existed at the times of the surveys. The debris from this building is included in the 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. The debris from this building is included in the radioactive waste volume estimate.

Building Number	*Building Description* [a]
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 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 is not contaminated with radioactive material.

[a] Regardless of historical characterization data, all structures would undergo a radiological survey as part of the demolition process to ensure worker protection and proper characterization and disposition of resulting waste and debris.

Source: Sapere 2005.

D.2 Chemical and Radiological Cleanup Levels

D.2.1 Chemical and Radiological AOC 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[1] 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.[2]

In November 2012, the 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

[1] 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.

[2] 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."

the EPA recommendations and guidance, in January 2013, DTSC published a draft provisional LUT for radionuclides in soils. As implied in the *Draft Provisional 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.

Table D–2 Provisional Radiological Look-Up Table Values

Radionuclide	*Symbol*	*Provisional Look-Up Table*	
		Basis	*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 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[3] of 1 for direct exposure pathways for a suburban resident or recreational user risk assessment scenario. The direct pathways include inhalation, ingestion, and dermal contact.

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*	*Suburban Resident* [d]	*Recreational User*
Alcohols – EPA Method 8015B					
Ethanol	mg/kg	BG MRL	0.7	note 1	note 1
Methanol	mg/kg	BG MRL	0.7	note 1	note 1
Anions – EPA Methods 300.0/9056A					
Fluoride	mg/kg	BTV	10.2	3,040	14,200
Nitrate	mg/kg	BTV	22.3	note 1	note 1
Cyanide – EPA Method 9012A					
Cyanide	mg/kg	BG MRL	0.6	45.6	213
Dioxin-Furans – EPA Method 1613B					
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	note 2	note 3	note 3
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	--	note 2	note 3	note 3
1,2,3,4,7,8,9-HpCDF	pg/g	--	note 2	note 3	note 3
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	note 2	note 3	note 3
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	note 2	note 3	note 3
1,2,3,6,7,8-HxCDD	pg/g	--	note 2	note 3	note 3
1,2,3,6,7,8-HxCDF	pg/g	--	note 2	note 3	note 3
1,2,3,7,8,9-HxCDD	pg/g	--`	note 2	note 3	note 3
1,2,3,7,8,9-HxCDF	pg/g	--	note 2	note 3	note 3
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	note 2	note 3	note 3
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	note 2	note 3	note 3
2,3,4,6,7,8-HxCDF	pg/g	--	note 2	note 3	note 3
2,3,4,7,8-PeCDF	pg/g	--	note 2	note 3	note 3
2,3,7,8-Tetrachlorodibenzodioxin (TCDD)	pg/g	--	note 2	note 3	note 3
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	--	note 2	note 3	note 3
Octachlorodibenzodioxin (OCDD)	pg/g	--	note 2	note 3	note 3
Octachlorodibenzofuran (OCDF)	pg/g	--	note 2	note 3	note 3

[3] 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.

Chemical Constituent	*Units*	*AOC LUT Values* [a]		*RBSL Values* [c]	
		Basis [b]	*Value*	*Suburban Resident* [d]	*Recreational User*
2,3,7,8-Tetrachlorodibenzodioxin (TCDD) toxicity equivalence (TEQ)					
2,3,7,8-TCDD TEQ	pg/g	BTV-TEQ	0.912 note 2	4.8 note 3	18 note 3
Energetics – EPA Method 8330					
1,3,5-Trinitroperhydro-1,3,5-triazine (RDX)	µg/kg	M-L MRL	300	5,940	24,500
Formaldehyde – EPA Method 8315A					
Formaldehyde	µg/kg	BG MRL	1,870	12,200,000	57,000,000
Herbicides – EPA Method 8151A					
2,4,5-Trichlorophenoxyacetic acid (T)	µg/kg	BTV	1.2	686,000	3,200,000
2,4,5-Trichlorophenoxyace acid (TP)	µg/kg	BTV	0.63	549,000	2,560,000
2,4-Dichlorophenoxyacetic acid (D)	µg/kg	BTV	5.8	686,000	3,200,000
4-(2,4-dichlorophenoxy)butyric acid (2,4-DB)	µg/kg	BG MRL	2.4	549,000	2,560,000
2,4-Dichloroprop (DP)	µg/kg	BTV	2.4	686,000	3,200,000
Dalapon (2,2-dichloropropionic acid)	µg/kg	BG MRL	12.5	2,060,000	9,610,000
Dicamba	µg/kg	BTV	1.3	2,060,000	9,610,000
Dinoseb (Dinitrobutyl phenol)	µg/kg	BG MRL	3.3	68,600	320,000
2-methyl-4-chlorophenoxyacetic acid (MCPA)	µg/kg	BTV	761	34,300	160,000
Methylchlorophenoxypropionic acid (MCPP)	µg/kg	BTV	377	68,600	320,000
Pentachlorophenol	µg/kg	M-L MRL	170	21,200	43,800
Metals – EPA Methods 6010B/6020A					
Aluminum	mg/kg	BTV	58,600	75,300	354,000
Antimony	mg/kg	BTV	0.86	26.4	123
Arsenic	mg/kg	BTV	46	0.0658	0.246
Barium	mg/kg	BTV	371	11,000	51,900
Beryllium	mg/kg	BTV	2.2	31.2	146
Boron	mg/kg	BTV	34	15,200	71,000
Cadmium	mg/kg	BTV	0.7	4.6	9.06
Chromium	mg/kg	BTV	94	37,200	174,000
Cobalt	mg/kg	BTV	44	22.8	106
Copper	mg/kg	BTV	119	3,040	14,200
Lead	mg/kg	BTV	49	80	360
Lithium	mg/kg	BTV	91	152	710
Manganese	mg/kg	BTV	1,120	6,130	29,600
Molybdenum	mg/kg	BTV	3.2	380	1,780
Nickel	mg/kg	BTV	132	908	4,280
Potassium	mg/kg	BTV	14,400	NC	NC
Selenium	mg/kg	BTV	1	380	1,780
Silver	mg/kg	BTV	0.2	230	1,070
Sodium	mg/kg	BTV	1,780	note 1	note 1
Strontium	mg/kg	BTV	163	45,600	213,000
Thallium	mg/kg	BTV	1.2	0.761	3.55
Vanadium	mg/kg	BTV	175	188	878
Zinc	mg/kg	BTV	215	22,800	107,000
Zirconium	mg/kg	BTV	19	6.09	28.4
Hexavalent Chromium – EPA Methods 7199/7196A					
Hexavalent Chromium	mg/kg	BTV	2	1.29	6.27

Chemical Constituent	*Units*	*AOC LUT Values* [a]		*RBSL Values* [c]	
		Basis [b]	*Value*	*Suburban Resident* [d]	*Recreational User*
Mercury – EPA Methods 7471A/7470A					
Mercury	mg/kg	BG MRL	0.13	16.8	78.2
Methyl Mercury – EPA Method 1630 (Mod)					
Methyl Mercury	mg/kg	M-L MRL	0.05	7.61	35.5
PCBs/PCTs – EPA Method 8082					
Aroclor 1016	µg/kg	M-L MRL	17	3,860	16,100
Aroclor 1221	µg/kg	M-L MRL	33	ND	ND
Aroclor 1232	µg/kg	M-L MRL	17	ND	ND
Aroclor 1262	µg/kg	M-L MRL	33	ND	ND
Aroclor 1254	µg/kg	M-L MRL	17	232	564
Aroclor 1260	µg/kg	M-L MRL	17	232	564
Aroclor 1268	µg/kg	M-L MRL	33	ND	ND
Aroclor 1242	µg/kg	M-L MRL	17	232	564
Aroclor 1248	µg/kg	M-L MRL	17	232	564
Aroclor 5432	µg/kg	M-L MRL	50	ND	ND
Aroclor 5442	µg/kg	M-L MRL	50	ND	ND
Aroclor 5460	µg/kg	M-L MRL	50	232	564
Perchlorate – EPA Methods 6850/6860					
Perchlorate	µg/kg	BTV	1.63	53,300	249,000
Pesticides – EPA Method 8081A					
Aldrin	µg/kg	BG MRL	0.24	34.8	117
Alpha-Hexachlorocyclohexane (BHC)	µg/kg	BG MRL	0.24	219	734
Beta-BHC	µg/kg	BTV	0.23	394	1,320
Chlordane	µg/kg	BTV	7	1,690	5,660
Delta-BHC	µg/kg	BTV	0.22	328	1,100
Dieldrin	µg/kg	BG MRL	0.48	36.9	124
Endosulfan I	µg/kg	BG MRL	0.24	412,000	1,920,000
Endosulfan II	µg/kg	BG MRL	0.48	412,000	1,920,000
Endosulfan Sulfate	µg/kg	BG MRL	0.48	412,000	1,920,000
Endrin	µg/kg	BG MRL	0.48	20,600	96,100
Endrin Aldehyde	µg/kg	BTV	0.7	20,600	96,100
Endrin Ketone	µg/kg	BTV	0.7	20,600	96,100
Gamma-BHC – Lindane	µg/kg	BG MRL	0.24	537	1,800
Heptachlor	µg/kg	BG MRL	0.24	144	484
Heptachlor Epoxide	µg/kg	BG MRL	0.24	107	360
Methoxychlor	µg/kg	BG MRL	2.4	343,000	1,600,000
Mirex	µg/kg	BTV	0.5	32.8	110
p,p-Dichlorodiphenyldichloroethane (DDD)	µg/kg	BG MRL	0.48	2,460	8,260
p,p-Dichlorodiphenyldichloroethylene (DDE)	µg/kg	BTV	8.6	1,740	5,830
p,p-Dichlorodiphenyltrichloroethane (DDT)	µg/kg	BTV	13	1,740	5,830
Toxaphene	µg/kg	BG MRL	8.8	493	1,650
Semi-Volatiles (SVOCs)/PAHs [e] – EPA Method 8270C(SIM)					
Acenaphthylene	µg/kg	BG MRL	2.5	2,980,000	14,900,000
Anthracene	µg/kg	BG MRL	2.5	16,400,000	77,000,000
Benzo(a)anthracene	µg/kg	–	note 4	387	939
Benzo(a)pyrene	µg/kg	–	note 4	38.7	93.9

Chemical Constituent	*Units*	*AOC LUT Values* [a]		*RBSL Values* [c]	
		Basis [b]	*Value*	*Suburban Resident* [d]	*Recreational User*
Benzo(b)fluoranthene	µg/kg	–	note 4	387	939
Benzo(g,h,i)perylene	µg/kg	BG MRL	2.5	1,650,000	7,710,000
Benzo(k)fluoranthene	µg/kg	–	note 4	387	939
Bis(2-Ethylhexyl)phthalate	µg/kg	BTV	61	173,000	479,000
Butylbenzylphthalate	µg/kg	BTV	100	274,000	756,000
Chrysene	µg/kg	–	note 4	3,870	9,390
Dibenzo(a,h)anthracene	µg/kg	–	note 4	113	275
Diethyl phthalate	µg/kg	BG MRL	27	48,900,000	228,000,000
Dimethyl phthalate	µg/kg	BG MRL	27	48,900,000	228,000,000
Di-n-butylphthalate	µg/kg	BG MRL	27	6,110,000	28,500,000
Di-n-octylphthalate	µg/kg	BG MRL	27	611,000	2,850,000
Fluoranthene	µg/kg	BTV	5.2	2,200,000	10,300,000
Fluorene	µg/kg	BTV	3.8	2,180,000	10,200,000
Indeno(1,2,3-cd)pyrene	µg/kg	–	note 4	387	1,020
Naphthalene	µg/kg	BTV	3.6	14,600	20,400
Phenanthrene	µg/kg	BTV	3.9	16,400,000	77,000,000
Pyrene	µg/kg	BTV	5.6	1,650,000	7,710,000
1-Methyl naphthalene	µg/kg	BG MRL	2.5	7,290	32,200
2-Methylnaphthalene	µg/kg	BG MRL	2.5	162,000	918,000
Acenaphthene	µg/kg	BG MRL	2.5	3,230,000	15,300,000
Benzo(a)pyrene Equivalent					
Benzo(a)pyrene TEQ	µg/kg	BTV-TEQ	4.47 note 4	38.7	93.9
Other SVOCs					
Benzoic Acid - EPA 8270	µg/kg	M-L MRL	660	244,000,000	1,140,000,000
N-Nitrosodimethylamine – 8270C(SIM)	µg/kg	M-L MRL	10	32.5	89.8
Phenol – EPA 8270	µg/kg	M-L MRL	170	18,300,000	85,500,000
TPH – EPA Method 8015					
TPH EFH (C15-C20)	mg/kg	M-L MRL	5 note 5	note 5	note 5
Terphenyls – EPA Method 8015					
o-Terphenyl	mg/kg	M-L MRL	7	65	180
VOCs – EPA Method 8260					
1,1-Dichloroethene	µg/kg	M-L MRL	5	55,800	759,000
1,4-Dioxane – EPA 8260 (SIM)	µg/kg	M-L MRL	10	19,300	53,200
2-Hexanone	µg/kg	M-L MRL	10	170,000	1,270,000
Acetone	µg/kg	M-L MRL	20	60,100,000	311,000,000
Benzene	µg/kg	M-L MRL	5	115	1,560
cis-1,2-Dichloroethene	µg/kg	M-L MRL	5	9,220	115,000
Ethylbenzene	µg/kg	M-L MRL	5	2,310	30,100
Hexachlorobutadiene	µg/kg	M-L MRL	5	6,670	18,400
Methylene chloride	µg/kg	M-L MRL	10	2,970	37,100
Tetrachloroethene	µg/kg	M-L MRL	5	416	3,520
Toluene	µg/kg	M-L MRL	5	3,740,000	23,900,000
Trichloroethene	µg/kg	M-L MRL	5	797	10,100
Vinyl chloride	µg/kg	M-L MRL	5	20.4	282

Chemical Constituent	Units	AOC LUT Values [a]		RBSL Values [c]	
		Basis [b]	Value	Suburban Resident [d]	Recreational User

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 and recreational user 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.

[d] Exposure would be through the direct pathways of inhalation, ingestion, and dermal contact; does not include indirect pathway of ingestion of homegrown fruits and vegetables.

[e] Polycyclic aromatic hydrocarbons – PAHs – are large molecule organic compounds created naturally through burning of trees and brush, and are present in heavy petroleum products such as tars.

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. In footnote 3 of the DTSC LUT Memorandum (DTSC 2013b), DTSC states "For locations where TPH is the sole constituent, a cleanup strategy will be considered based on the findings of a soil treatability study." Although the soil treatability study was completed in 2015, DTSC has not corrected the TPH LUT value to be consistent with those findings.

D.2.2 Revised Look-Up Table Values and Chemicals of Concern

Identification of Chemicals of Concern – Area IV Final EIS

The AOC LUT for chemicals published by DTSC in June 2013 (DTSC 2013b), identified 116 chemicals pursuant to the AOC. Of these chemicals, seventeen were dioxin/furan congeners that were grouped into the 2,3,7,8 TCDD toxicity equivalency quotient (TEQ), and seven were polycyclic aromatic hydrocarbon (PAH) chemicals that were grouped into the benzo(a)pyrene TEQ (i.e., there is only one LUT value for dioxins/furans and one LUT value for the grouped carcinogenic PAHs). DTSC also grouped TPH, which is a mixture of chemicals composed of different numbers of carbon atoms, into one LUT value.

Using the chemical data base for Area IV that included more than 8,100 individual samples, DOE identified 62 chemicals meeting the definition of a chemical of concern (COC) for Area IV for the AOC LUT comparison (see *Draft Chemical Data Summary Report*, [CDM Smith 2017]). Adding TPH the number is 63 per the AOC LUT listing. The definition of an AOC LUT COC was based on frequency of detection that included consideration of uncertainty in decision making (DTSC 2013) and a review of the distribution of chemicals (i.e., identification of locations with elevated concentrations termed "hot spots"). The Cleanup to AOC LUT Values Alternative analyzed in this EIS includes all 62 chemicals (plus TPH) identified as COCs for Area IV.

The Cleanup to the Revised AOC LUT Values Alternative substitutes risk-based screening levels (RBSLs) for the LUT value. Using a 1 percent factor for identification of RBSL exceedance, not all of the 62 chemicals for Area IV exceeded their respective suburban resident soil RBSLs. The geographic information system (GIS) was used to identify "hot spot" locations so infrequently observed chemicals were still incorporated into the revised LUT listing. Based on these criteria, the list of chemicals of concern for the Cleanup to Revised LUT Values Alternative was reduced to 34 chemicals. The soil volume that would be removed under this alternative was based on estimates of the volume of soil removed at locations that exceeded the revised LUT values.

The CERCLA risk assessment process used under the Conservation of Natural Resources Alternative (Resident Scenario and Open Space Scenario) involves averaging soil concentrations within an exposure unit under the assumption of random future exposure. Exceeding the RBSL for a chemical was the primary criterion for identification of chemicals incorporated into the risk assessment. The assessment also incorporated data base reviews for locating "hot spots." There same 34 COCs identified for the Cleanup to Revised LUT Values Alternative were included in the suburban resident risk-assessment based soil cleanup scenario. Because several chemicals are more toxic to ecological receptors, the number of chemicals for the Open Space Scenario is 41. The soil volumes that would be removed under the two scenarios of this alternative were based on estimates of the volume of soil removed at locations that exceeded the cleanup criteria for protection of human health or ecological receptors as determined through a risk assessment.

Table D–4 provides the list of chemicals that are COCs based on the exceedance of AOC LUT values and their status relative to the three risk-based EIS soil alternatives.

Table D–4 Chemicals of Concern by Alternative

	Alternative			
			Conservation of Natural Resources	
Chemical	*Cleanup to AOC LUT Values*	*Cleanup to Revised LUT Values (RBSL > 1% total samples)*	*Residential Scenario*	*Open Space Scenario*
	Chemical Exceeds Criteria in Area IV			
Anions				
Fluoride	Yes	No	No	No
Dioxins-Furans				
1,2,3,4,6,7,8-HpCDD	Yes	Yes	Yes	Yes
1,2,3,4,6,7,8-HpCDF	Yes	Yes	Yes	Yes
1,2,3,4,6,8,9-HpCDD	Yes	Yes	Yes	Yes
1,2,3,4,7,8-HxCDD	Yes	Yes	Yes	Yes
1,2,3,4,7,8-HxCDF	Yes	Yes	Yes	Yes
1,2,3,6,7,8-HxCDD	Yes	Yes	Yes	Yes
1,2,3,6,7,8-HxCDF	Yes	Yes	Yes	Yes
1,2,3,7,8,9-HxCDD	Yes	Yes	Yes	Yes
1,2,3,7,8,9-HxCDF	Yes	Yes	Yes	Yes
1,2,3,7,8-PeCDD	Yes	Yes	Yes	Yes
1,2,3,7,8-PeCDF	Yes	Yes	Yes	Yes
2,3,4,6,7,8-HxCDF	Yes	Yes	Yes	Yes
2,3,4,7,8-PeCDF	Yes	Yes	Yes	Yes
2,3,7,8-TCDD	Yes	Yes	Yes	Yes
2,3,7,8-TCDF	Yes	Yes	Yes	Yes
OCDD	Yes	Yes	Yes	Yes
OCDF	Yes	Yes	Yes	Yes

	Alternative			
	Cleanup to AOC LUT Values	***Cleanup to Revised LUT Values (RBSL > 1% total samples)***	***Conservation of Natural Resources***	
			Residential Scenario	***Open Space Scenario***
Chemical	***Chemical Exceeds Criteria in Area IV***			
Formaldehyde				
Formaldehyde	Yes	No	No	No
Herbicides				
2,4-DB	Yes	No	No	No
MCPA [b]	Yes	No	No	Yes
MCPP	Yes	No	No	No
Metals				
Antimony [a]	Yes	Yes	Yes	Yes
Barium [b]	No	No	No	Yes
Cadmium [a,b]	Yes	Yes	Yes	Yes
Chromium VI	Yes	Yes	Yes	Yes
Lead [a]	Yes	Yes	Yes	Yes
Mercury [a]	Yes	Yes	Yes	Yes
Methyl Mercury	Yes	No	No	No
Molybdenum [b]	No	No	No	Yes
Selenium [b]	Yes	No	No	Yes
Silver [b]	Yes	No	No	Yes
Zinc [b]	Yes	No	No	Yes
Polychlorinated Biphenyls				
Aroclor 1254	Yes	Yes	Yes	Yes
Aroclor 1248 [a]	No	Yes	Yes	Yes
Aroclor 1260 [a]	Yes	Yes	Yes	Yes
Aroclor 5460 [a]	Yes	Yes	Yes	Yes
Perchlorate				
Perchlorate	Yes	No	No	No
Pesticides				
4,4'-DDD	Yes	No	No	No
4,4'-DDE	Yes	No	No	No
4,4'-DDT	Yes	No	No	No
Beta-BHC	Yes	No	No	No
Chlordane	Yes	No	No	No
Delta-BHC	Yes	No	No	No
Dieldrin	Yes	No	No	No
Polycyclic Aromatic Hydrocarbons				
1-Methylnaphthalene	Yes	No	No	No
2-Methylnaphthalene	Yes	No	No	No
Acenaphthene	Yes	No	No	No
Anthracene	Yes	No	No	No
Benzo(g,h,i)perylene	Yes	No	No	No
Fluoranthene	Yes	No	No	No
Fluorene	Yes	No	No	No
Naphthalene [a]	Yes	Yes	Yes	No
Phenanthrene [b]	Yes	No	No	Yes
Pyrene	Yes	No	No	No
Benzo(e)pyrene	Yes	No	No	No
Benzo(a)anthracene	Yes	Yes	Yes	Yes
Benzo(a)pyrene	Yes	Yes	Yes	Yes

Chemical	Alternative			
	Cleanup to AOC LUT Values	Cleanup to Revised LUT Values (RBSL > 1% total samples)	Conservation of Natural Resources	
			Residential Scenario	Open Space Scenario
	Chemical Exceeds Criteria in Area IV			
Benzo(b)fluoranthene	Yes	Yes	Yes	Yes
Benzo(k)fluoranthene [a]	Yes	Yes	Yes	Yes
Chrysene [a]	Yes	Yes	Yes	Yes
Dibenzo(a,h)anthracene [a]	Yes	Yes	Yes	Yes
Indeno(1,2,3-cd)pyrene [a]	Yes	Yes	Yes	Yes
Semi-Volatile Chemicals				
Bis(2-ethylhexyl)phthalate	Yes	No	No	Yes
Di-n-octylphthalate	Yes	No	No	No
Total Petroleum Hydrocarbons	Yes	No	No	No

[a] Identified as a risk-based COC through identification of localized sites with elevated contaminant concentration presence termed "hot spots".

[b] Identified as a COC primarily for ecological protection.

Note: Refer to Table D–3 for chemical abbreviations.

D.2.3 Comparison of Background Soil with AOC Look-Up Table Values

The 2010 AOC stipulates that the end state after soil cleanup shall be consistent with background. In accordance with the 2010 AOC, DTSC was to perform a chemical background study, using methods that were consistent with EPA guidance on determining local background concentration values (EPA 2002). Upon completion of the DTSC-led chemical background study, the "look-up" table of the chemical cleanup levels was prepared, which included both local background concentrations as well as minimum detection limits for specific contaminants whose minimum detection limits exceed local background concentrations (see Section D.2.1).

Two sites that are expected to have been unaffected by past SSFL operations were identified as background locations. Background LUT-chemical samples were taken at these two sites, one in the China Flats area and a second in the Wood Ranch area (URS 2012). Both sites are about 5 miles WSW of the SSFL site, and have no industrial operations (considered to be pristine locations). Samples were taken at 108 individual locations within the China Flats area and 102 locations within the Wood Ranch area. Thirty-three of the sample locations included at least one sample that exceeded an LUT value. As shown in **Table D–5**, samples for 46 of the 110 chemicals analyzed exceeded LUT values with a total of 91 individual samples exceeding LUT values.

Table D–5 Chemicals in Background Samples with Values Above LUT Values

Chemical Name	Number of Samples Analyzed	LUT Value	LUT Unit	Number of Detections above LUT
Fluoride	268	10.2	mg/kg	5
Cyanide	268	0.6	mg/kg	1
2,4,5-T	148	1.2	µg/kg	2
Silvex (2,4,5-TP)	148	0.63	µg/kg	3
2,4-D	148	5.8	µg/kg	1
2,4-DB	148	2.4	µg/kg	8
Dichlorprop	148	2.4	µg/kg	3
Dicamba	148	1.3	µg/kg	1
MCPA	148	761	µg/kg	1
MCPP	148	377	µg/kg	4

Chemical Name	*Number of Samples Analyzed*	*LUT Value*	*LUT Unit*	*Number of Detections above LUT*
Antimony	268	0.86	mg/kg	4
Arsenic	268	46	mg/kg	1
Beryllium	268	2.2	mg/kg	1
Chromium	268	94	mg/kg	1
Manganese	268	1120	mg/kg	2
Molybdenum	268	3.2	mg/kg	1
Selenium	268	1	mg/kg	2
Sodium	268	1780	mg/kg	2
Zirconium	268	19	mg/kg	2
Perchlorate	268	1.63	µg/kg	1
Beta-BHC	148	0.23	µg/kg	2
Chlordane (Technical)	148	7	µg/kg	1
Delta-BHC	148	0.22	µg/kg	5
Dieldrin	148	0.48	µg/kg	1
Endosulfan I	148	0.24	µg/kg	1
Endosulfan II	148	0.48	µg/kg	1
Endrin Aldehyde	148	0.7	µg/kg	1
Endrin Ketone	148	0.7	µg/kg	3
Gamma-BHC (Lindane)	148	0.24	µg/kg	1
Heptachlor Epoxide	148	0.24	µg/kg	1
Mirex	148	0.5	µg/kg	4
4,4'-DDD	148	0.48	µg/kg	1
4,4'-DDE	148	8.6	µg/kg	2
4,4'-DDT	148	13	µg/kg	2
Technical Toxaphene	148	8.8	µg/kg	1
Acenaphthylene	148	2.5	µg/kg	1
Benzo(a)pyrene	148	4.47	µg/kg	3
Benzo(g,h,i)perylene	148	2.5	µg/kg	3
Bis(2-ethylhexyl)phthalate	148	61	µg/kg	2
Butylbenzylphthalate	148	100	µg/kg	1
Dimethylphthalate	148	27	µg/kg	1
Fluoranthene	148	5.2	µg/kg	1
Fluorene	148	3.8	µg/kg	1
Naphthalene	148	3.6	µg/kg	2
Phenanthrene	148	3.9	µg/kg	1
Pyrene	148	5.6	µg/kg	2

LUT = Look-Up Table; mg/kg = milligrams per kilogram; µg/kg = micrograms per kilogram.

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–6** 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–6 Comparison of SSFL Area IV Soil Cleanup Levels with Hunter's Point Naval Shipyard and McClellan Air Force Base Residential Scenario Cleanup Values

	Santa Susana Field Laboratory			
Chemical of Concern	*Area IV AOC LUT Value* [a]	*SSFL RBSL* [b, c]	*Hunter's Point* [d]	*McClellan AFB* [e]
	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, and then a limited number of representative facilities were selected for analysis. **Table D–7** 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–7.[5] 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 and Waste Control Specialists (WCS) in Texas were selected as representative facilities for treatment and/or disposal of LLW and MLLW. A wide range of treatment services is available at the Energy*Solutions* and WCS facilities.

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.

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.

[5] 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 accepting only exempt waste under U.S. Nuclear Regulatory Commission or Agreement State regulations.

Table D–7 Candidate Facilities[a]

Facility	*Location*	*Distance (road miles)*	*Remarks*
Radioactive Waste Facilities			
Energy*Solutions*	Clive, UT	780	LLW and MLLW disposal; MLLW treatment; can accept waste by rail shipment
Hanford Site	Richland, WA	1,100	Disposal of DOE LLW and MLLW [b]
Nevada National Security Site	Nye County, NV	350	Disposal of DOE LLW and MLLW
Waste Control Specialists	Andrews, TX	1,160	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	330	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 rail shipment with intermodal transfer to trucks at a nearby company-owned, dedicated intermodal facility.
Waste Control Specialists	Andrews, TX	1,160	Hazardous waste treatment and disposal; can accept waste by direct rail shipment
Westmorland Landfill [d]	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	56	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 [e]	El Centro, CA	270	CA Class III landfill; can accept waste by direct rail shipment
McKittrick Waste Treatment Site	McKittrick, CA	134	CA Class II landfill
Ostrom Road Landfill	Wheatland, CA	420	CA Class II landfill
La Paz County Landfill	Parker, AZ	300	Nonhazardous waste landfill; can accept waste by rail shipment with intermodal transfer to trucks at a rail siding near the landfill
ECDC Environmental Landfill	East Carbon, UT	720	Nonhazardous waste landfill; can accept waste by direct rail shipment
Recycle Facilities			
Kramer Metals	Los Angeles, CA	44	Recycle facility
P.W. Gillibrand, Inc.	Simi Valley, CA	19	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.

Facility	*Location*	*Distance (road miles)*	*Remarks*

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

[d] The Westmorland facility is currently not accepting waste due to low demand in the California market, but could accept waste in the future if market conditions improve.

[e] 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.

Three hazardous waste facilities were selected as representative for detailed analysis: the Buttonwillow and Westmorland Class I facilities in California[6] 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).[7] 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 by rail delivery 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 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 rail shipment,[9] 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

[6] 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.

[7] In consideration of Executive Order D-62-02, the EIS evaluates the impacts of transporting nonhazardous waste by truck transport to the Buttonwillow and Westmorland facilities.

[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.

[9] Rail shipments to U.S. Ecology in Idaho are sent to a company-owned, dedicated intermodal facility at Mountain Home, Idaho, for transfer of waste to trucks for transport to the nearby disposal facility.

in Idaho and were not considered preferable for analysis as representative facilities for hazardous waste management.[10]

For disposal of SSFL nonhazardous waste, 10 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),[11] as well as two landfills located outside of California. Considering the large quantity of nonhazardous waste that could result from an Area IV AOC LUT remediation, seven landfills were 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 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 seven landfills include two Class II facilities, four 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. The La Paz County Landfill at Parker, Arizona, and the ECDC Landfill at East Carbon, Utah, were identified because both can receive nonhazardous waste 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. The Azusa Land Reclamation Project is closer to SSFL than the Antelope Valley and Chiquita Canyon Landfills, but is 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 under the Cleanup to AOC LUT Alternative, two California 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.

[10] In consideration of California Executive Order D-62-02, the EIS evaluates the impacts of transporting nonhazardous waste by a combination of rail and truck transport to US Ecology in Idaho.

[11] In the Draft EIS, 11 California nonhazardous waste facilities were identified. The NuWay Arrow Landfill was eliminated for the final EIS because it is closed and not accepting waste for disposal.

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. (It is also designed to accept waste by truck delivery.) The facility was selected for detailed analysis because of the possible large volume of nonhazardous waste from the Cleanup to the AOC LUT Alternative 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 disposal capacity for nonhazardous waste from the Los Angeles area.

Because the date for acceptance of waste at the Mesquite Regional Landfill is uncertain, two additional nonhazardous waste landfills were identified that can accept waste by rail delivery. Both the La Paz County Landfill at Parker, Arizona, and the ECDC Landfill at East Carbon, Utah, are operated by Republic Services. Rail delivery to the La Paz County Landfill, which is about 300 road miles from SSFL, would require transfer from railcars to trucks at a rail siding near the landfill, for delivery of waste to the landfill. The ECDC Environmental Landfill, located about 720 road miles from SSFL, can accept waste by direct rail delivery. The nonhazardous waste capacity of the La Paz County Landfill was about 22,735,000 cubic yards as or December 15, 2011; the nonhazardous waste capacity of the ECDC Environmental Landfill is about 300 million cubic yards (Republic Services 2017, 2018).

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 the Cleanup to the AOC LUT Alternative 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. The waste would be shipped in a manner which would minimize the potential for dispersion of shipped material during truck and train transport and truck-to-rail transfer operations, such as shipment within International Organization for Standards (ISO) 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, because it 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, was 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).

Because the startup date for the Puente Hills facility is uncertain, DOE also considered the potential use of other locations for intermodal transfer of containers from trucks to railcars. There are 6 rail yards operated by the Union Pacific and Burlington Northern Santa Fe Railroads in the Los Angeles area that could be potentially used for intermodal transfer, and all are located at distances from SSFL that are comparable to or less than that for Puente Hills. An additional rail yard is located in San Bernardino at about 90 miles from SSFL. Furthermore, there are 6 operational intermodal facilities at the ports of Long Beach and San Pedro that are less than 60 miles from SSFL, although these facilities are oriented toward transfer of containers from cargo ships (Load Match 2018). Thus, the assumption of the Puente Hills Intermodal Facility as representative for the *Final SSFL Area IV EIS* serves to envelope the impacts from truck transport of waste from SSFL to a regional intermodal facility. Impacts from rail transport of waste from one of these additional facilities to a disposal facility would be expected to be comparable to impacts from rail transport from Puente Hills.

For analysis, it was assumed that each shipment from SSFL would be transferred to railcars without repackaging or consolidation – e.g., an ISO container containing SSFL waste would be transferred directly to a railcar without opening the container. Another option, however, and which could be suitable for nonhazardous soil, could be to transfer the contents of the container into a higher-capacity gondola. A gondola having a capacity of about 150 cubic yards, for example, might receive the soil contents of 4 to 5 ISO containers, which would reduce the number of rail shipments to offsite disposal facilities (Lindsey 2017).

Waste shipment by a combination of truck and rail was evaluated for five disposal facilities:

- Energy*Solutions* at Clive, Utah, for LLW and MLLW;
- Waste Control Specialists at Andrews, Texas, for LLW and MLLW;
- NNSS for LLW and LLW; and

- US Ecology at Grand View, Idaho, for hazardous and nonhazardous waste; and
- Mesquite Regional Landfill near El Centro, California, for nonhazardous waste.[12]

Although NNSS does not have direct rail delivery capability, 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 110,000 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.

Energy*Solutions* in Utah, Waste Control Specialists in Texas, and the Mesquite Regional Landfill all have the capability of direct rail delivery. Rail shipments to US Ecology in Idaho would require transfer to trucks at a nearby company-owned, dedicated intermodal facility, for final transfer to the disposal facility.

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 (DTSC 2017; ESA 2015). **Figure D–3** shows the locations of the other reasonably foreseeable actions in the ROI. **Table D–8** presents key information for each of these actions (numbers in the first column of Table D–8 correspond to locations on Figure D–3).

[12] 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.

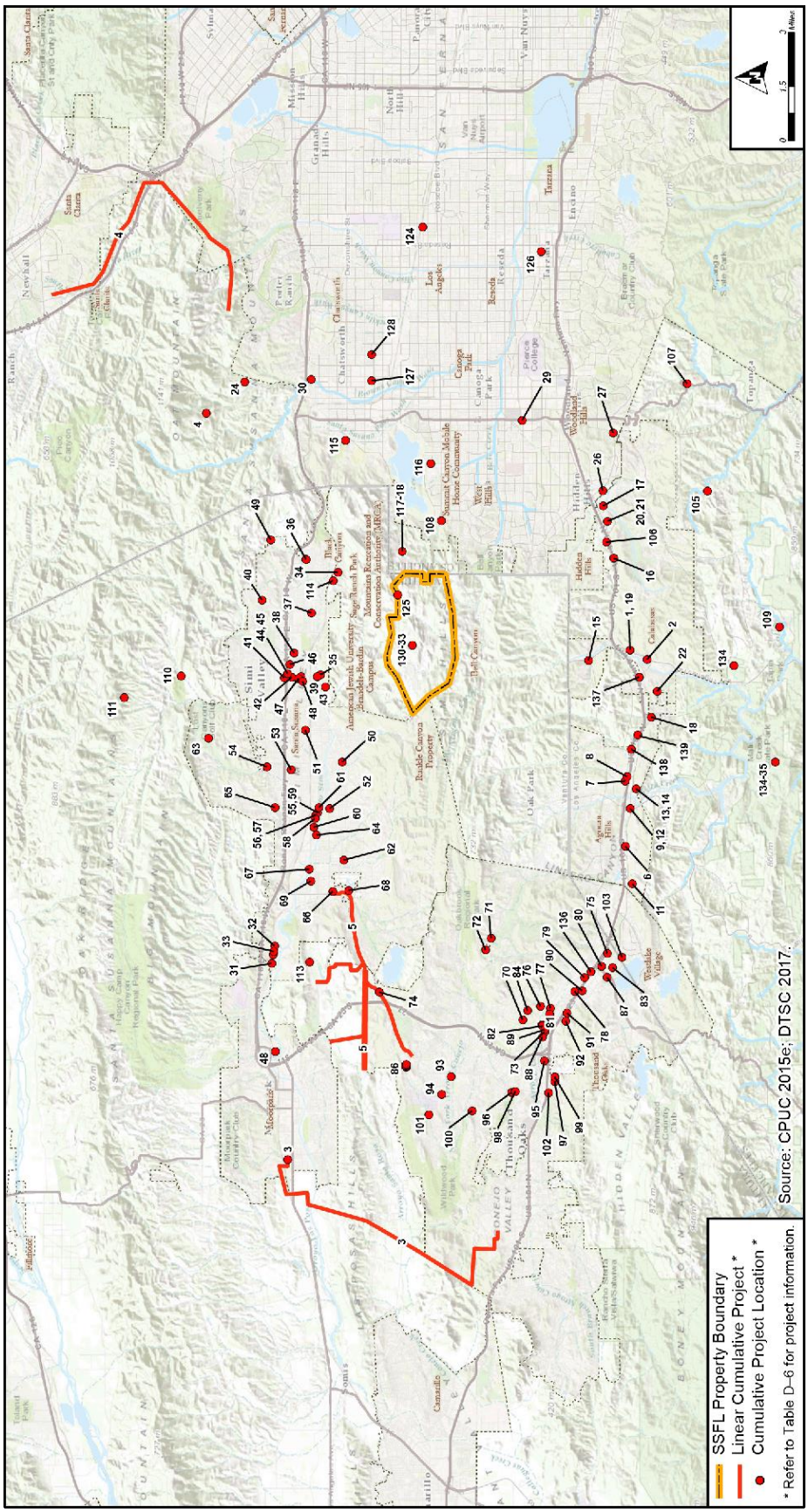


Figure D–3 Locations of Other Actions in the Santa Susana Field Laboratory Region of Influence

Table D–8 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 Area IV (miles) [a]	Implementation Status	Address	Included in the Cumulative Impacts Analysis
1	Hotel	City of Calabasas	Canyon Oaks - Hotel	New hotel – 120 rooms		10,700	3	5.5 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.				10 miles west	Completed in October 2017	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	7.5 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 Area IV (miles) [a]	Implementation Status	Address	Included in the Cumulative Impacts Analysis
5	T-Line	CPUC - Southern California Edison	Presidential Substation Project	The Public Utilities Commission approved a project alternative that would upgrade existing Potrero and Royal substations with higher-capacity equipment and additional circuits.				5–6 miles northwest	Approved for construction	All substations are located in Westlake Village and Simi Valley.	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 acre.		30,000	4	6.5 miles southwest	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	6 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	6 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	6 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	7 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 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		4.5 miles south	Construction permit obtained	5741 Las Virgenes Road, Calabasas, CA	
16	Commercial	City of Calabasas	Malamut Vintage Auto	Retail (auto sales)		20, 983		6 miles south	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		6.5 miles southeast	Under construction	23500 Park Sorrento, Calabasas, CA	
18	Hotel	City of Calabasas	Rondell Oasis Hotel Project	Hotel – 127 rooms		72,954	4	6 miles south	Application filed with the City	26300 Rondell Road, Calabasas, CA	
19	Residential	City of Calabasas	Canyon Oaks Residential	Single-family – 71 units	71		13	5.5 miles south	Draft EIR under review	4790 Las Virgenes Road, Calabasas, CA	
20	Hotel	City of Calabasas	Hilton Garden Inn Expansion	Construct hotel expansion – 51 rooms.		28,787		6 miles southeast	Application filed with the City	24150 Park Sorrento, 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 Area IV (miles) [a]	Implementation Status	Address	Included in the Cumulative Impacts Analysis
21	Park	City of Calabasas	Calabasas Senior Center	Construct community Center		9,500		6 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		8.5 miles south	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 northeast	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	7.5 miles northeast	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	6.5 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	7.5 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	8.5 miles southeast	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 Area IV (miles) [a]	Implementation 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	6.5 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.				7 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		6.5 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.				7 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 miles north	Under construction	Katherine Road South, Simi Valley, CA	
36	Residential	City of Simi Valley	Savannah	Construct 66 condominiums.	66			3 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			2.5 miles north	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			2.5 miles north	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			2 miles north	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.				3.5 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		3 miles north	Under construction	4370 Eve Road, Simi Valley, CA	

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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		2.5 miles north	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		2 miles north	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	3 miles north	In plan check stage	4453 Apricot Road, Simi Valley, CA	
45	Residential	City of Simi Valley	Apricot Development	Construct seven townhomes.	7			3 miles north	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			3 miles north	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			2.5 miles north	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.				2.5-8.5 miles north	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	4 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.				2.5 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	3 miles northwest	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	3.5 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.				3.5 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		4 miles northwest	Under construction	2975 Sycamore Drive, Simi Valley, CA	
55	Residential	City of Simi Valley	River Run	Construct 40 townhomes.	40		2	3.5 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			3.5 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 Area IV (miles) [a]	Implementation Status	Address	Included in the Cumulative Impacts Analysis
57	Residential	City of Simi Valley	Information Unavailable	Construct a six-unit apartment complex.	6			3.5 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			3.5 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			3.5 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			4 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	3.5 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			4 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	5 miles north	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			4 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			4.5 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		4.5 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		4.5 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.				4.5 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	5 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		7.5 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 Area IV (miles) [a]	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	8 miles southwest	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	6.5 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		7.5 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	7.5 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			7.5 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	8 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.				7.5 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.				8 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 Area IV (miles) [a]	Implementation 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	7.5 miles southwest	Pre-application stage	600 Lone Oak Drive, Thousand Oaks, CA	
85				Removed for the Final EIS [b]							
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 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 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 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 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 miles southwest	Pending	2650 Willow Lane, Thousand Oaks, CA	
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 miles southwest	Pending	SE of Willow Lane on Conejo Ridge 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 Area IV (miles) [a]	Implementation Status	Address	Included in the Cumulative Impacts Analysis
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			8.5 miles west	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 west	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			8.5 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 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 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 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 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 west	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 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.				9.5 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	8 miles southwest	Approved by the City	4415 Lakeview Canyon Road, Westlake Village, CA	
104				Removed for the Final EIS [b]							

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 Area IV (miles) [a]	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).				9 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.				6 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.				10 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	3.5 miles 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			10 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	5.5 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	7.5 miles north	Application in process	No address	

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 Area IV (miles) [a]	Implementation Status	Address	Included in the Cumulative Impacts Analysis
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 mile north	Remediation plan requested by County	South of the City of Simi Valley	
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	6.5 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			2 miles 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	5 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	4.5 miles east	Active	8433 Fallbrook Ave Canoga Park, 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 Area IV (miles) [a]	Implementation Status	Address	Included in the Cumulative Impacts Analysis
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	Adjacent	Active	Woolsey Canyon Road, Simi Valley, CA	Yes
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	Adjacent	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	9.5 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	Adjacent	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	10 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	6 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	6.5 miles east	Active	9737 Mason Avenue, Chatsworth, CA	
129				Removed for the Final EIS [b]							
130	Remediation	Department of Toxic Substances Control	Boeing Demolition at SSFL	Demolish various structures at SSFL.				Adjacent	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.				Adjacent	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	Adjacent	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 Area IV (miles) [a]	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.				8.5 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.				9.5 miles south	Draft EIR being prepared	Santa Monica Mountains National Recreation Area	

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 Area IV (miles) [a]	Implementation Status	Address	Included in the Cumulative Impacts Analysis
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.				7.5 miles southwest	Completed in June 2017	U.S. Highway 101/ State Route 23 Interchange	Yes
137	Transportation	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.				6 miles south	Completed in August 2018	Lost Hills Road/ U.S. Highway 101 Lost Hills Road Bridge	Yes
138	Transportation	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.				5.5 miles south	Under construction	U.S. Highway 101/ Palo Comado Canyon Road	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 Area IV (miles) [a]	Implementation Status	Address	Included in the Cumulative Impacts Analysis
139	Transpor-tation	Caltrans	U.S. Highway 101 Liberty Canyon Wildlife Crossing Project	Caltrans proposes to build a wildlife crossing across U.S. Highway 101 just west of Liberty Canyon Road in the city of Agoura Hills, about 7 miles south-southwest of Area IV. The purpose of the project is to provide a safe and lasting passage across the freeway to help maintain wildlife populations that travel between the Santa Monica Mountains and Simi Hills, and ultimately to the Sierra Madre Mountain Range.				5.5 miles south-southwest	Initial Study with Environmental Assessment	U.S. Highway 101 near Liberty Canyon Road	Yes
Total					**3,432**	**4,048,215**	**10,263**				

>= 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, 2018a, 2018b; CEC 2015, 2018a, 2018b; City of Agoura Hills 2015, 2018; City of Calabasas 2015, 2018; City of Los Angeles 2015; City of Simi Valley 2015; City of Thousand Oaks 2015a, 2015b, 2017; County of Ventura 2015a, 2015b, 2015c 2015d; CPUC 2015a, 2015b, 2015c, 2015d, 2018a, 2018b; DTSC 2015, 2017; ESA 2015; LCMTA 2015; NPS 2015a, 2015b, 2015c, 2015d, 2015e; Southern California Edison 2018a, 2018b.

[a] Distances are to the nearest 0.5 mile.

[b] Project numbers 85, 104, and 129 were removed from the table for the Final EIS because of (1) double counting, (2) cancellation, or (3) being outside the SSFL region of interest. Project number 139 was added for the Final EIS.

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 remediation criteria (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 in which the exemption process would be applied to protect biological and cultural resources or that contain total petroleum hydrocarbons (TPH) that are either naturally occurring or 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 remediation criteria.

Preliminary Volumes of Soil Exceeding AOC LUT Values for Chemicals. The 2010 AOC remediation criteria require 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.[13] 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 to be present in over 2.5 percent of total samples or are present as part of the "hot spot" evaluation. However, 50 of those chemicals have either a natural or an external source for their presence in Area IV. For the Draft EIS, DOE tasked MWH Americas, Inc., (MWH) with plotting the footprints of all locations within Area IV and the NBZ that exhibit a soil chemical concentration exceeding an LUT value. MWH evaluated the soil characterization results for the entirety of the soil chemistry database involving approximately 8,000 soil samples. MWH used the Area IV GIS to illustrate and plot locations exceeding any LUT value. 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 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.

[13] *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.

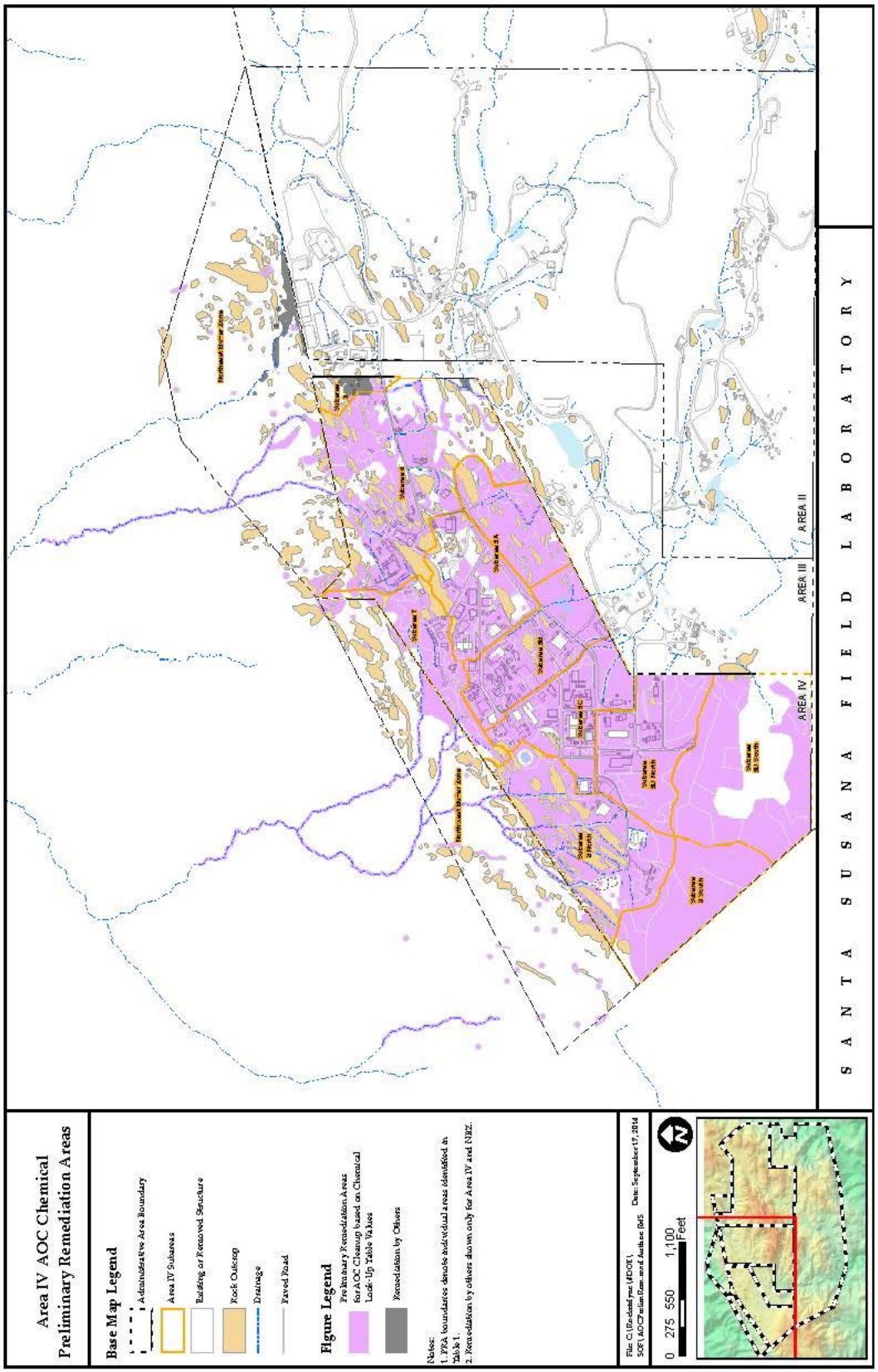

Figure D–4 Area IV 2010 AOC Chemical Preliminary Remediation Areas

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. Most soil samples exhibiting values exceeding an LUT level were surface samples, indicating LUT levels that extend only a few inches below the surface. However, some subsurface soil samples were taken that exhibited values exceeding an LUT value. Subsurface samples with values exceeding an LUT value were taken generally at a depth of 10 feet or less below ground surface, although a few samples (less than 20) were taken at depths exceeding 10 feet (CDM Smith 2017). 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[14]). Considering analysis assumptions and uncertainties, from the 393 locations MWH estimated 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 used in the Draft EIS was 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.

DOE received comments on the Draft EIS that implied that DOE had either underestimated or overestimated the soil volumes for chemicals exceeding the LUT values, depending on the perspective of the commenter. To determine whether the volumes originally estimated by MWH accurately reflected the volume of soil exceeding LUT values, DOE used a similar process as was done by MWH. The GIS database was queried to identify all Area IV and NBZ soil sample locations that had at least one chemical exceeding its LUT value. This re-analysis of the spatial data identified a volume of 1,342,725 cubic yards of soil exceeding the LUT.

Because there is always some level of uncertainty in what the final soil volumes will be, as predicted from the sample database, remedial volumes are typically presented as a range below and above the original estimate. For the EIS impact analysis, to address the potential likely maximum soil volume impact, the upper end of the estimated volume range is most important. Because the soil data base for Area IV is much larger than for most remedial sites and therefore there is less uncertainty in the estimate, DOE elected to use a 20 percent factor to increase the estimated volumes increasing the volume to 1,611,270 cubic yards. DOE then rounded this volume to 1,612,000 cubic yards of chemically impacted soil for impact analysis in this Final EIS. This volume remains within the range estimated by MWH for the Draft EIS.

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 stated in the 2010 AOC was to have EPA establish the radionuclide LUT values. However, in completing its radiological

[14] The 30 percent expansion factor was confirmed by DOE cost estimating engineers (DOE 2018).

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,[15] 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' responses were that they could meet the EPA Lab A MDCs, but would have difficulty in achieving the EPA Lab B MDCs (SAIC 2012).

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 was 120,000 cubic yards with a range from 80,000 to 180,000 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.

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

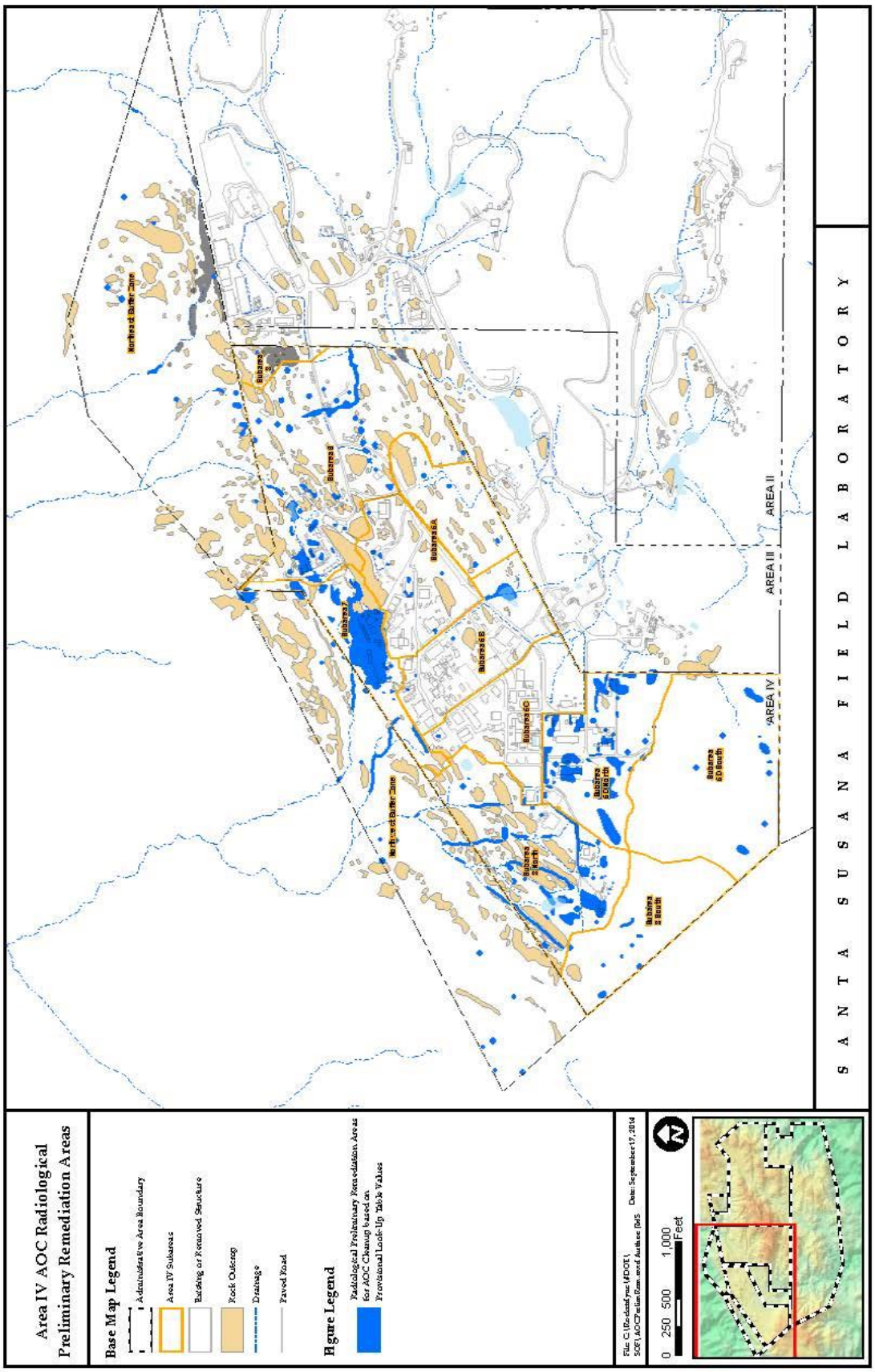

Figure D–5 Area IV 2010 AOC Radiological Preliminary Remediation Areas

As part of re-evaluation of soil volumes for analysis in the Final EIS, DOE re-assessed the MWH-calculated volume of soil exceeding provisional AOC LUT values for radionuclides and determined that they were sufficient for Final EIS impact analysis. No changes to the radiologically impacted volume of soil have been made with the exception of adding the 20 percent uncertainty factor, resulting in a rounded value of 110,000 cubic yards.

Final Soil Volumes Considering the Overlap Between Chemically and Radiologically Impacted Soil. For the Draft EIS, 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. MWH estimated the volume of soil exceeding chemical LUT values (MWH 2014a), and the soil volume exceeding provisional radionuclide LUT values (MWH 2014b).

For this Final EIS, using the same process (but additional evaluation and a more detailed analysis of the sampling data), DOE refined the soil volume estimates and determined the volume of soil exceeding chemical LUT values (including the 20 percent uncertainty) to be about 1,612,000 cubic yards and the soil volume exceeding provisional radionuclide LUT values to be about 110,000 cubic yards (including the 20 percent uncertainty factor). 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**), DOE analysts estimated that there was a 96 percent overlap of radionuclides with chemically impacted soil. That is, 96 percent of areas with radionuclides above the provisional LUT values overlapped with chemically impacted soil. Only 4 percent of the soil exceeding provision AOC LUT values for radionuclides is located in areas where the soil meets chemical AOC LUT values. This leaves an estimated 4,000 cubic yards of radiologically impacted soil that does not have chemicals exceeding LUT values. Therefore, the total estimated quantity of chemically and/or radiologically impacted soil exceeding AOC LUT values is about 1,616,000 cubic yards.

Reductions in Soil Volume Considering Proposed Areas in Which the Exemption Process Would Be Applied 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. The 2010 AOC also allows for in-situ treatment as determined appropriate by soil treatability studies. DOE adjusted the soil volume being considered for cleanup in the Draft EIS and this Final EIS to reflect proposed areas in which the exemption process would be applied for protection of biological and cultural resources. DOE also identified locations where TPH is the only chemical exceeding its LUT value, primarily in non-operational areas. DOE did not identify TPH-only areas for soil excavation but instead is proposing to allow TPH to naturally attenuate in situ. Within operational areas, DOE identified locations where TPH and non-carcinogenic PAHs were the primary soil constituents. In those locations, DOE is proposing to allow both constituents to naturally attenuate. As shown in **Figure D–7**, there is an overlap of those areas in which the exemption process would be applied and areas that exceed the AOC LUT value for TPH. In the Draft EIS, the adjustment was calculated first for areas in which the exemption process would be applied (330,000 cubic yards), followed by an estimate of areas that exceed the TPH AOC LUT value only that are outside those areas in which the exemption process would be applied (150,000 cubic yards). Because of a better understanding of the distribution of soils in which only the AOC LUT value for TPH is exceeded,

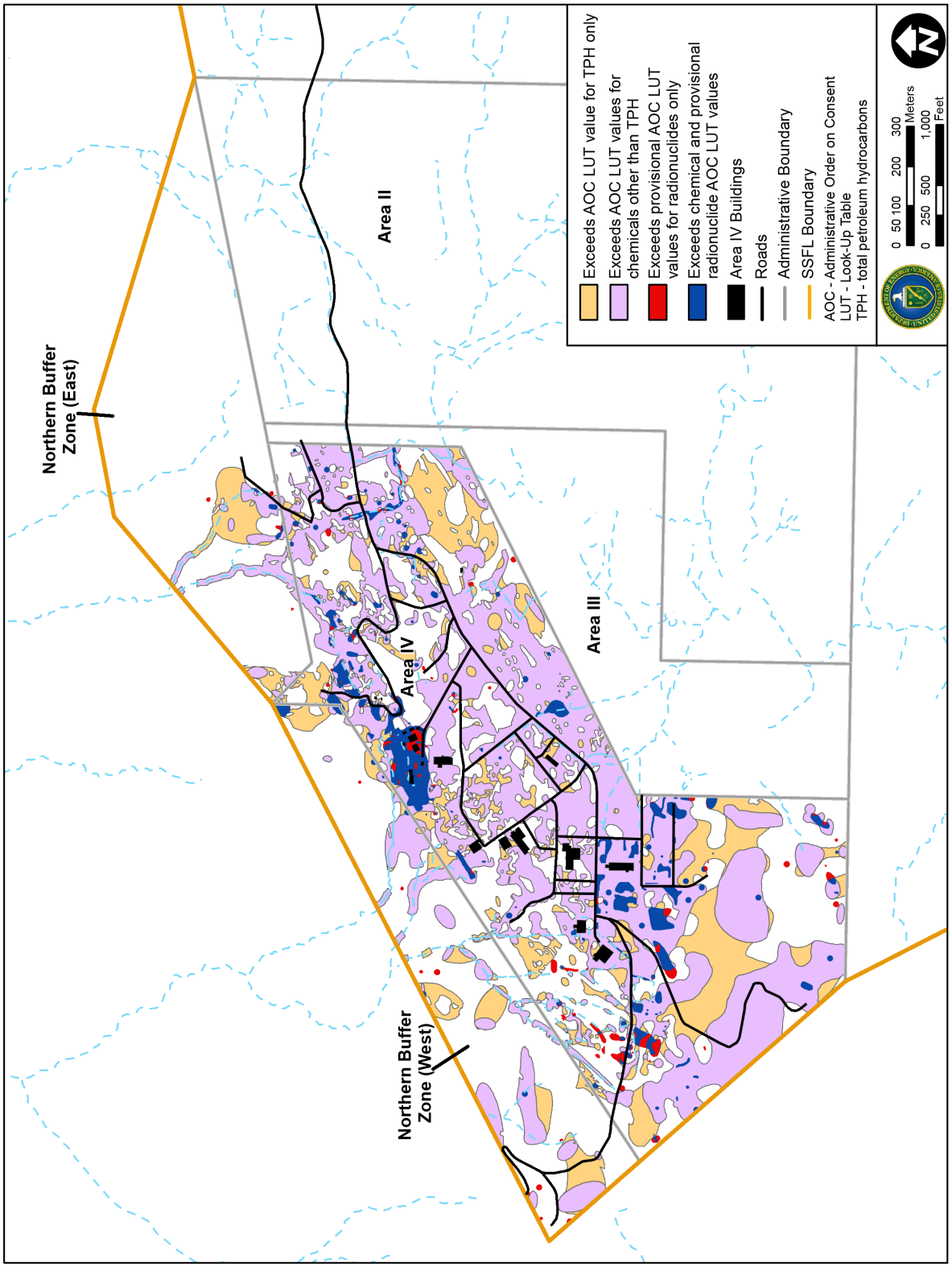

Figure D–6 Extent of Radiological and Chemical Constituents Above AOC Look-Up Table Values

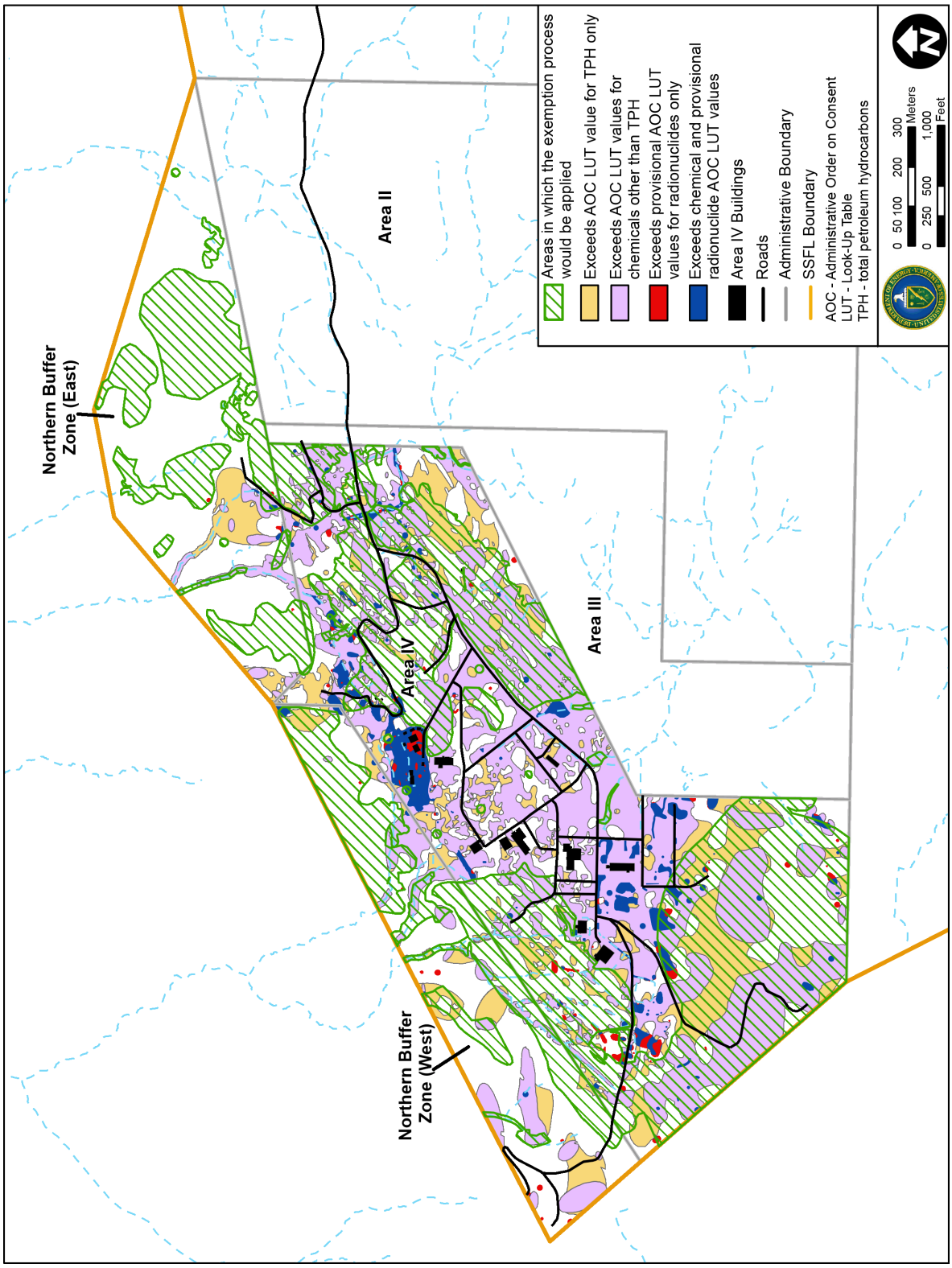

Figure D–7 Area IV Radiological/Chemical Look-Up Table Areas and Proposed Exemption Areas

in this Final EIS, the adjustment to soil volumes was performed in the opposite order – first for areas in which the AOC LUT value is exceeded only for TPH, followed by areas in which the exemption process would be applied (that are in addition to those in which only the AOC LUT value is exceeded).

For this Final EIS, DOE contractor specialists performed additional evaluation using GIS and a more in-depth analysis of the sampling data to develop a more-detailed understanding of the distribution of areas in which the only constituent exceeding its AOC LUT value is TPH. Based on the updated analysis, DOE estimates that 620,000 cubic yards of soil exceeds the AOC LUT value for TPH only. Soil treatability studies found evidence that natural attenuation (degradation) of chemicals has been occurring at SSFL since they were first released and predicted that natural processes will continue (Nelson et al. 2015a). Studies also determined that TPH could not reliably be detected at the AOC LUT level and that a portion of the detected TPH was from natural sources. DOE therefore concluded that natural attenuation could be effective for managing certain low-concentration TPH soils.

DOE formally consulted with the U.S. Fish and Wildlife Service to identify areas in which the exemption process would be applied for protection of federally protected species in accordance with the Endangered Species Act. During the consultation process, California Department of Fish and Wildlife (CDFW) and DTSC participated in a series of meetings during which the exemption process for protecting endangered species was developed. In a letter to DOE, dated December 8, 2016, CDFW provided its recommendation to DOE to establish exemption areas to protect the endangered tar plant (CDFW 2016). To protect California state-listed endangered species and state and local sensitive habitats, DOE applied the same process to identify non-federally protected species and habitats that also need to be protected during soil cleanup actions.[16]. Concerning the Native American artifacts exemption in the AOC, the particular application and scope of the phrase "Native American artifacts that are formally recognized as Cultural Resources" will be determined in cooperation with DTSC and in consultation with the California State Historic Preservation Officer, Santa Ynez Band of Chumash Indians, other tribes, and other consulting parties in the Section 106 process. DOE plans to propose exemptions for historic properties in soil remediation plans submitted to DTSC for its review and approval.

Using GIS mapping, DOE contractor analysts re-evaluated the site chemical characterization data to more accurately determined the locations and estimate the volume of soil where TPH was the only constituent exceeding its respective AOC LUT value. The impacted soil volume found in those areas, which included locations within the areas in which the exemption process would be applied (see Figure D–7), was approximately 620,000 cubic yards. Per the 2010 AOC, this volume is being considered for natural attenuation of this constituent.

Proposed areas in which the exemption process would be applied were developed by DOE contractor biologists and cultural resource specialists. Using GIS, a map showing the proposed exemption areas was overlaid on a map of the remediation areas (Figure D–7). Soil depth for most of the areas in which the exemption process would be applied is shallower than in the main part of Area IV, and soil results show that contamination is primarily near the surface in these areas. Considering the expected soil and contamination depth, DOE contractor analysts estimated that up to 115,000 cubic yards of soil with at least one chemical exceeding an AOC LUT value (other than TPH) may be subject to application of the 2010 AOC exemption process. This volume does not

[16] The 2010 AOC requires DOE to comply with all local, state, and federal laws during the implementation of the AOC.

include volumes of soil within the areas where the exemption process would be applied that only exceed the AOC LUT value for TPH; those volumes were accounted for in the previous paragraph.

Total Soil Volume Exceeding AOC LUT Values and Subject to Removal. Assuming 115,000 cubic yards of soil would be subject to the 2010 AOC exemption process and 620,000 cubic yards would be allowed to naturally attenuate, the quantity of soil that would potentially be excavated and removed from Area IV/NBZ would be 881,000 cubic yards (1,616,000 cubic yards minus 115,000 cubic yards for the areas where the exemption process would be considered and 620,000 cubic yards for natural attenuation).

D.6.2 Alternatives Development

This subsection summarizes four analyses performed to support the development of the alternatives evaluated in this EIS. The first analysis supports DOE's decisions in Chapter 2, Section 2.2.3, regarding an alternative considered but dismissed from detailed study in this EIS. The analysis addresses the implications in terms of project duration and water use for treatment of contaminated soil by soil washing processes. The second and third 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. The fourth analysis discusses the process for identifying the quantity of soil to be remediated under the Conservation of Natural Resources Alternative.

The 2010 AOC (DTSC 2010a), signed by DOE and DTSC, requires soil cleanup to be completed by 2017. Subsequent to the 2010 AOC, significant efforts to characterize Area IV, the NBZ, and background soils were undertaken by DOE, EPA, and DTSC. Soil characterization and background studies were necessary precursors to developing the AOC LUT values, developing preliminary remediation designs, and preparing required environmental documents. Appendix D of the Draft EIS provided a brief assessment of the soil excavation effort and truck traffic requirements necessary to complete soil remediation by 2017. Cleanup by 2017 was not feasible because before cleanup could begin, DOE needs to complete and issue this Final EIS and a Record of Decision (ROD) pursuant to Section 6.2 of the AOC, and DTSC needs to issue a California Environmental Quality Act (CEQA) program environmental impact report (EIR).[17] DOE remains under a Federal court order that enjoins the Department from transferring possession, or otherwise relinquishing control over, any portion of Area IV until DOE issues a Final EIS and a ROD. Additionally, DOE must obtain regulatory approval of documents required by the 2010 AOC (for example, Soils Remedial Action Implementation Plans [SRAIPs]). These documents and decisions apply to all of the soil action alternatives DOE evaluated in this EIS. In June 2017, DOE submitted a letter to DTSC documenting the mutually acknowledged situation that cleanup cannot proceed until the required environmental documents are completed and that DOE was therefore unable to meet the 2017 cleanup expectations as described in the 2010 AOC (DOE 2017).

[17] DTSC is preparing a program EIR for the entire SSFL (Areas I through IV, the NBZ, and the Southern Buffer Zone). The program EIR will evaluate the remediation activities of DOE, NASA, and Boeing. The draft program EIR was issued for review on September 7, 2017 (DTSC 2017).

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 881,000 cubic yards (approximately 1,350,000 tons) of soil to be treated and 250 working days per year, it would take approximately 8,470 working days (about 34 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 34 years, for a total water use, assuming 250 working days per year, of 680 million to 1.36 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. As can be seen in **Figure D–8**, there are non-operational locations within Area IV and the NBZ where TPH is the only chemical exceeding an LUT value. Using GIS data, DOE has identified that up to 620,000 cubic yards of soil (517,000 cubic yards plus the 20 percent uncertainty factor) within 54 acres of Area IV/NBZ exhibits TPH contamination as the only AOC LUT constituent. 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. 2015b). 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 recognized in its comments on the DOE Area IV Chemical Data Summary Report (DTSC 2018a) the presence of TPH as naturally occurring matter in Area IV soil.[18] DTSC, however, has yet to discuss a strategy with DOE based on the findings of the soil treatability study to adjust the TPH soil cleanup values per the stated requirements in the AOC.

[18] Letter from Roger Paulsen, DTSC, to John Jones, DOE, "Department of Toxic Substances Control's Comments on the Department of Energy's Draft Chemical Data Summary Report, Santa Susana Field Laboratory, Ventura County, California," April 24, 2018.

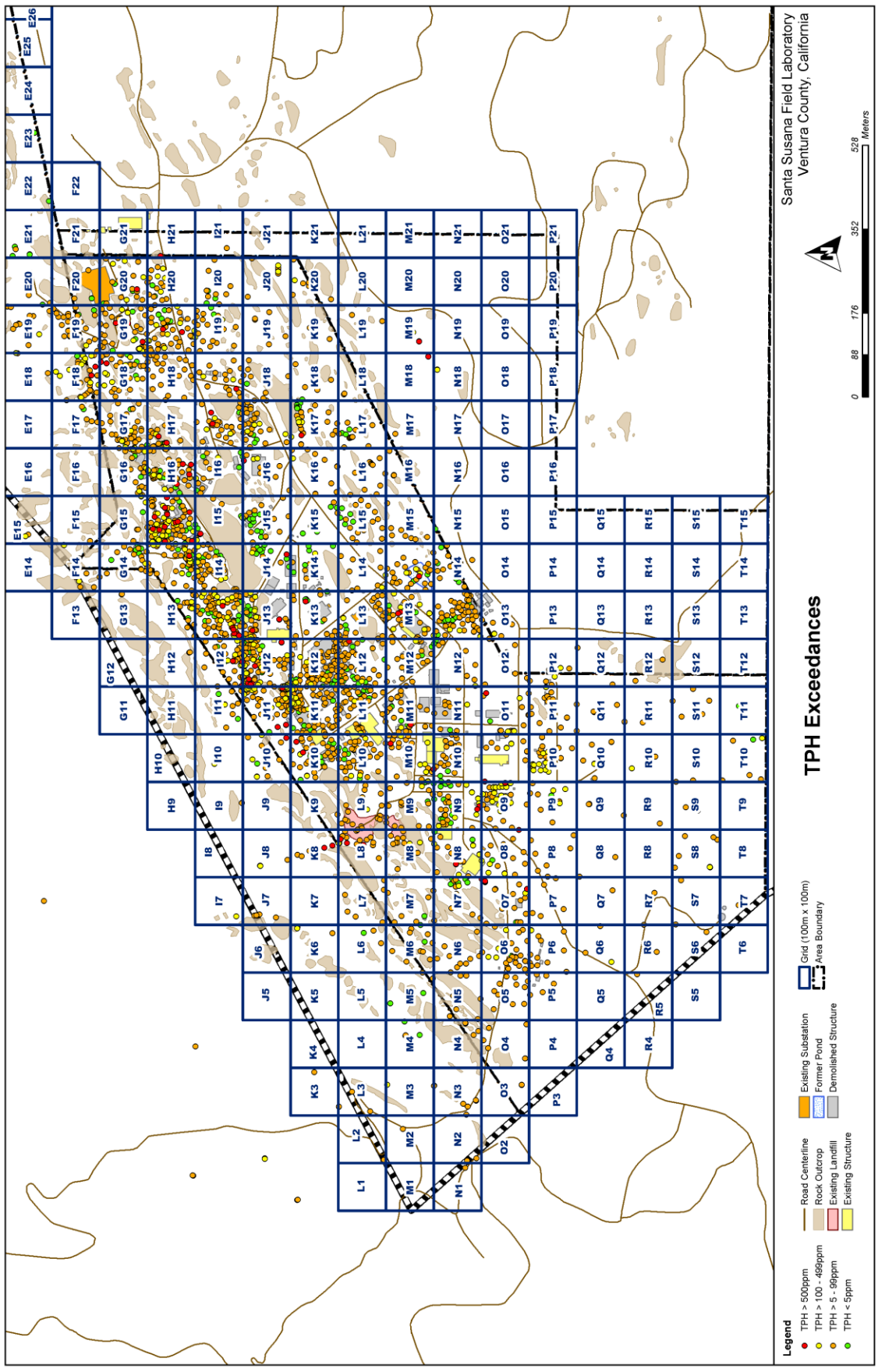

Figure D–8 Area IV Total Petroleum Hydrocarbons Results

The Draft EIS included a soil volume for TPH present in soil (that may include non-carcinogenic PAHs[21]) of 150,000 cubic yards, with a portion of the 350,000 cubic yards of soil in exemption areas also containing only TPH (see Figure D–8). Re-evaluating this number using the GIS determined that there are 620,000 cubic yards of soil containing TPH above 5 ppm (non-carcinogenic PAHs also of natural origin,[22] may also be present). Soil treatability studies demonstrated that two chemical groups (TPH and PAHs) will decompose naturally in soils. In addition to TPH, DOE is considering natural attenuation for only the non-carcinogenic PAHs (i.e., carcinogenic PAHs would be remediated in accordance with the decision criteria for the applicable soil remediation alternative).

Concerns about Locating Backfill Material Meeting AOC LUT Values. The 2010 AOC (DTSC 2010a) states that any backfill replacing soil removed as part of an AOC 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–9**. 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–10**. The sample of fill soil exceeds LUT values for pyrene, benzo(g,h,i)perylene, dieldrin, chlordane, Arochlor 1254, p,p-dichlorodiphenyldichloroethylene, p,p-dichlorodiphenyldichloroethane, and petroleum hydrocarbons. None of these results is at a level that would pose a risk to human health or the environment.

[21] TPH was identified as the only constituent over large areas of Area IV and the NBZ. There are small areas that include non-carcinogenic species of polycyclic aromatic hydrocarbons (PAH). The focus of the discussion and analysis is on the large areas where TPH exceeds its AOC LUT value; however, DOE proposes that the non-carcinogenic PAH may also be managed by natural attenuation.

[22] Because contaminants typical of Area IV such as PCBs, metals, and dioxins are not present with the TPH above LUT values, it is assumed that the TPH or PAHs reflect chemicals from decaying organic matter.

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

Analyte Group	*Analyte Name*	*Unit*	*AOC 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*	*AOC 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

Analyte Group	*Analyte Name*	*Unit*	*AOC LUT Value*	*Result*		*MDL*
Metals	Arsenic	mg/kg	46	3.77	J	0.621
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		

AOC LUT = Administrative Order on Consent Look-Up Table; B = the analyte was also found in a blank sample; J = the value is an estimate; 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 AOC LUT values are in bold text and shaded cells.

Table D–10 Results of a Soil Sample from Tapo Fill in Simi Valley, California

Analyte Group	*Analyte*	*Unit*	*AOC 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*	*AOC 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*	*AOC 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
VOC	Ethanol	ug/kg	0.7	500	U

Analyte Group	*Analyte*	*Unit*	*AOC LUT Value*	*Result*	
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	

AOC LUT = Administrative Order on Consent Look-Up Table; B = the analyte was also found in a blank sample; J = the value is an estimate; 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 AOC LUT values are in bold text and shaded cells.

- *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–11** provides a summary of their data for metals. LUT values are exceeded for antimony, cadmium, manganese, molybdenum, and selenium. **Table D–12** 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–13** provides the results and, as shown, the commercial products exhibit chemical concentrations exceeding LUT values for many chemicals.

Table D–11 Results of Samples of Malibou Lake Sediments in Agora, California (Trace Metals)

Analyte	*AOC LUT Value*	*Sample Designator*			
		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
Beryllium	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; AOC LUT = Administrative Order on Consent Look-Up Table.
Note: Values that exceed AOC LUT values are in bold text and shaded cells.

DOE sent a letter to DTSC in December 2016 identifying the difficulty of finding suitable backfill soil (DOE 2016) and met with DTSC on July 26, 2017 to discuss the issue. DTSC's is in the process of developing a response regarding finding AOC-suitable backfill soil, but has indicated it may be several years before DTSC will fully address this issue. DOE would not undertake a large-scale excavation operation unless a DTSC-approved source of backfill is identified. This could potentially delay the beginning of soil remediation.

It should also be noted that samples of background soil did not meet the 2010 AOC LUT values, see Section D.2.3.

Table D–12 Results of Samples of Malibou Lake Sediments in Agora, California (Polycyclic Aromatic Hydrocarbons)

Analyte	*AOC LUT Value*	*Sample Designator*			
		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; AOC LUT = Administrative Order on Consent Look-Up Table; J = the value is an estimate.
Note: Values that exceed AOC LUT values are in bold text and shaded cells.

Table D–13 Results of Samples of Commercial Available Soil Amendment Products

Chemical Name	Units	AOC LUT Value	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

Chemical Name	Units	AOC LUT Value	Product 1			Product 2			Product 3			Product 4			Product 3 – Duplicate		
			Result		MRL	Result		MRL	Result		MRL	Result		MRL	Result		MRL
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
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

Chemical Name	Units	AOC LUT Value	Product 1			Product 2			Product 3			Product 4			Product 3 – Duplicate		
			Result		MRL	Result		MRL	Result		MRL	Result		MRL	Result		MRL
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
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

Chemical Name	Units	AOC LUT Value	Product 1			Product 2			Product 3			Product 4			Product 3 – Duplicate		
			Result		MRL	Result		MRL	Result		MRL	Result		MRL	Result		MRL
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
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

Chemical Name	Units	AOC LUT Value	Product 1			Product 2			Product 3			Product 4			Product 3 – Duplicate		
			Result		MRL	Result		MRL	Result		MRL	Result		MRL	Result		MRL
1,2,3,4,6,7,8-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
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**		

AOC LUT = Administrative Order on Consent Look-Up Table; 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; 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 AOC LUT values are in bold text and shaded cells

Volumes of Soil for the Conservation of Natural Resources Alternative. The Draft EIS contained an evaluation of the quantity of soil that would be removed under the Conservation of Natural Resources Alternative for soil remediation. That evaluation considered the risk assessment results of a scenario for an onsite suburban resident, which included the direct exposure pathways of inhalation and incidental ingestion of chemical and radioactive constituents, dermal chemical exposure, and direct radiation exposure. DOE first calculated risks using three unequally sized exposure units within the approximately 372 acres of Area IV and the NBZ. These areas were selected because they contained sample locations with the highest concentrations of chemicals and radionuclides listed in the AOC LUT tables. To calculate the total volume of soil to be removed under this alternative, DOE then extrapolated this risk throughout Area IV assuming the risks for the three exposure units were comparable to the remainder of Area IV. The extrapolation of the risk analysis resulted in the estimated 148,000 cubic yards of soil requiring removal that was identified in the Draft EIS.

For this Final EIS, DOE revisited this analysis and increased the number of exposure units explicitly evaluated through the risk analysis from 3 to 19. Each of these 19 exposure units were of equal size, 10,000 square meters or 2.47 acres. In expanding the number of exposure units evaluated, DOE was able to better assess the impact of a broader range of chemicals and radionuclides, both in number of constituents and quantity present, against the risk assessment criteria. The increased knowledge allowed DOE to refine the extrapolations, identifying where contamination exists and allowing for an improved identification of the size of the area that would require soil removal. The results of the additional risk analyses indicated that the original evaluation performed in the Draft EIS was overly conservative and identified more soil for removal than would be necessary to meet risk-based cleanup criteria. The revised analysis estimated that 52,000 cubic yards of soil would need to be removed under the Conservation of Natural Resources Alternative, Residential Scenario (the same alternative analyzed in the Draft EIS), and 38,200 cubic yards of soil would need to be removed under the Open Space Scenario. This second scenario was added to the Final EIS to address a cleanup standard based on the risk to a recreational user of the property in keeping with the planned future use of the site as open space.[23]

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 resemble the original topography, 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;

[23] Boeing and the North American Land Trust recorded Grant Deeds of Conservation Easement and Agreements to permanently preserve the 2,453 acres of land that Boeing owns at SSFL as open space (Ventura County 2017a, 2017b).

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 impact analysis (e.g., 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. It was assumed that the volume of backfill after excavation of the bedrock would be about the same volume of bedrock removed; after which the cover soil which was removed for access to the bedrock would be replaced.

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 strontium-90-impacted bedrock at the Remote Materials Handling Facility (RMHF) leach field. A 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 7,000 gallons per day, considering Boeing's experience during its remediation and soil removal efforts at SSFL (derived from Leidos 2015). Assuming 250 working days per year, about 1.75 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 day during demolition operations (only). It was assumed that building removal would require 2 to 3 years. Active building demolition was estimated to occur during all years; backfill of excavations would occur in the final two years. It was assumed that about 250,000 gallons of water would be required during each of the first two years and about 130,000 gallons would be required during the third year. Over the duration of building removal, 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 24,000 gallons.

D.6.5 Assumptions for Groundwater Remediation Alternatives

Remediation of Area IV and the NBZ will include remediation of seven locations with impacted groundwater at Area IV that contain hazardous or radioactive constituents. The suite of groundwater treatment technologies to be implemented at Area IV was evaluated jointly with EIS development by incorporating the recommendations of the Area IV Resource Conservation and Recovery Act Corrective Measures Study (CMS) (see Chapter 2, Section 2.6). A draft CMS was

released by DOE for comment in September 2018 (CDM Smith 2018b). The CMS first looked at a broad suite of potential groundwater actions (e.g., thermal treatment, bedrock removal, pump and treat, chemical treatment, pump and treat, vapor extraction, monitored natural attenuation). The CMS recommended that DOE focus on groundwater pump and treat, contaminated bedrock removal, and monitored natural attenuation as the most likely groundwater remedies. These recommendations are used in this Final EIS for impact assessment to present the potential impacts of implementing those remedies. Implementing the groundwater alternatives included generation of waste from 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 include groundwater extraction and treatment, including installation of treatment systems. Assuming both groundwater remediation action alternatives were implemented, DOE expects that existing wells and wells installed under the Groundwater Monitored Natural Attenuation Alternative would be used as part of groundwater treatment under the Groundwater Treatment Alternative. If treatment system design necessitated the installation of new wells, well installation impacts would be the same as those evaluated for the Groundwater Monitored Natural Attenuation Alternative. The impacts of removal of bedrock at the RMHF leach field to address the strontium-90 source are also addressed in the Final EIS. The Groundwater Treatment Alternative would generate a moderate quantity of waste from bedrock excavation and the operation of groundwater treatment systems. DOE will submit a final corrective measures study identifying the action to be taken at each groundwater plume and the strontium-90 source to DTSC for approval. DOE's decision regarding groundwater remediation at Area IV will be announced in a ROD for this EIS.

Waste Generation from Installation of Additional Monitoring Wells. Wastes from installation of five additional monitoring wells under the Groundwater Monitored Natural Attenuation Alternative or the Groundwater Treatment Alternative would primarily consist of drill "cuttings" and well development waste 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 be 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 2015), it was assumed that installation of each well would require delivery of 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. About 100 gallons of well development waste water would be generated per well, which would be collected and transported offsite for treatment.

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 that requires handling and disposal are produced for each well during sampling. For purposes of this EIS, it was assumed that 40 wells would be annually sampled, resulting in an annual production of about 200 gallons of waste water which would be collected and transported offsite for treatment.

RMHF Leach Field Bedrock Excavation. Site investigation data for the RMHF leach field site show bedrock contamination to extend to about 35 feet below ground surface (CDM Smith 2018a). The predicted excavation depth to remove impacted bedrock would be 45 feet. The footprint of the bedrock excavation would be approximately 30 feet wide by 60 feet long. The volume of impacted bedrock at the leach field site to be excavated to remove the strontium-90 source is estimated to be 1,185 cubic yards. (The amount of bedrock actually impacted by strontium-90 will not be known until after the bedrock is excavated.) The soil excavation footprint would be larger (approximately 40 feet by 100 feet) than the bedrock footprint in order to build a ramp for the excavator to reach the top of the bedrock and provide room to maneuver around the rock excavation. Accounting for larger footprint, an estimated 3,000 cubic yards of soil and rock would be excavated and placed in containers for offsite disposal. 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 4,500 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 60 days to reach and remove the impacted bedrock, with 20 days of active bedrock removal.

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, two 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, so that operation of two pump and treat systems would annually generate about 42,000 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. After 5 years, the effectiveness of the remedy would be evaluated relative to contaminant reduction. If the remedy is determined to have been effective, a decision may be made to discontinue additional groundwater treatment and shift to an ongoing sampling (monitoring program) to collect data to confirm the remedy has been effective. If the remedy assessment indicates that more activity is necessary, DOE would evaluate continuing the current remedy, or identify another remedy to address the groundwater issue.

The purpose of groundwater pump and treat actions is to reduce significant contaminant mass that is present within bedrock fractures. It is usually not possible for the actions to quickly meet final cleanup standards due to some residual contaminants being present within the sandstone bedrock matrix. A period of back diffusion of contaminants from the bedrock matrix into bedrock fractures is anticipated. 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. In 2017, the concentration was at about 6 parts per billion (cleanup level of 5 parts per billion), reflecting residual contamination diffusing 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 was less than 3 parts per billion in 2017.

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 avoid 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 soil shipments) 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*.

23-ton Payload for Soil Shipment. For purposes of analysis, DOE assumed an average payload of 23 tons for shipment of soil under the soil remediation action alternatives. The DOE Environmental Management Consolidated Business Center prepared a construction estimators' evaluation of possible soil removal operations in Area IV and the NBZ (DOE 2018). The evaluation included consideration of commercially available and viable vehicles for transporting soil form the site. That assessment determined that a payload could be as much as 24 tons. This value

re-affirms the reasonableness of the 23-ton average from Boeing's experience as discussed in the preceding paragraph.[24]

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 engineering construction data and judgment. It was decided to continue using a soil density of 1.5 tons per cubic yard.

Using the lower density (1.5 tons per cubic yard), about 6 percent fewer trucks would be required for soil removal than if the suggested density (1.6 tons per cubic yard) were assumed. This difference in estimated soil density has the same proportional effect on the estimates of truck trips across all soil remediation alternatives. DOE has determined that the assumption of 1.5 tons per cubic yard is reasonable.

An Average of 16 Daily Truck Round Trips for Soil Removal. In DOE's *Draft SSFL Area IV EIS*, DOE assumed that it would fully use its allotment in accordance with the *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 2015) and make 32 daily truck round trips for the first 2 years of the project and an average of 48 daily round trips thereafter. Based on an evaluation of the rate of excavation and disposal of soil by DOE's Environmental Management Consolidated Business Center (DOE 2018), DOE revised the estimated average number of daily truck round trips to 16 in this Final EIS. DOE also recognized that the daily number of truck round trips could occasionally exceed 16, but would not exceed 32.

Peak Number of 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,[25] 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 2015). This agreement states the anticipation

[24] There may be a requirement to place some of the waste – particularly soil classified as hazardous waste or some of the soil classified as LLW or MLLW – into containers before shipment, which could result in payloads smaller than 23 tons. Conservatively assuming all soil classified as hazardous or radioactive waste was placed into smaller containers before shipment, and assuming a payload of 20 tons (which is considered to be reasonable considering the variety of waste containers that could be used, the total number of offsite shipments of soil would be increased by only about 2 percent for the Cleanup to AOC LUT Values Alternative, 9 percent for the Cleanup to Revised LUT Values Alternative, or 1 percent for either scenario under the Conservation of Natural Resources Alternative.

[25] DOE's contribution to the cumulative truck round trip total would be an average of 16 truck round trips per day.

that trucks[26] 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 2015). [27] 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 equipment to the site.

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 cumulatively (DOE, NASA, and Boeing), and that this limit would be applied to all heavy-duty truck shipments of waste, equipment (including well drill rigs), or backfill to or from the site. This limit was assumed because it was recognized that traffic impacts (e.g., 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–14** for radioactive waste (LLW and MLLW), hazardous waste, nonhazardous waste, recycle material, and backfill.[28] For the DOE entries, a range of values indicates that the volume of waste would be dependent upon the combination of alternatives selected for soil remediation, groundwater remediation, and building demolition.

Estimates of DOE waste volumes and shipments are from Chapter 4, Table 4–81, of this EIS, based on the waste volumes and shipments that would result from implementing the eight evaluated combinations of action alternatives and scenarios. Waste volumes for NASA and Boeing were obtained from NASA 2014, NASA 2017, and Boeing 2017 and are summarized in this EIS in Chapter 5, Table 5–13, 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.

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 eight 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 2017 and Boeing 2017. Estimates of the number of

[26] 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 2015). Class 7 and 8 trucks are termed heavy-duty trucks in this EIS.

[27] 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 2015).

[28] 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.

Boeing backfill shipments were obtained from Boeing 2017; the number of NASA backfill shipments was obtained from NASA 2017.

Table D–14 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	10,800 to 125,000	2,100	37,200 to 770,000	3,540	42,100 to 677,000	95,800 to 1,580,000
NASA	26,000	455,000 to 699,000	177,000	34,300 [b]	206,000 to 290,000	898,000 to 1,230,000
Boeing	6,540	29,800	169,000	58,200	51,300	315,000
Total	43,400 to 158,000	487,000 to 731,000	383,000 to 1,120,000	96,000	299,000 to 1,020,000	1,310,000 to 3,120,000
Number of Shipments						
DOE	1,040 to 8,500	140 to 260	2,500 to 50,300	340	2,700 to 44,200	6,800 to 104,000
NASA	1,700	28,800 to 45,600	12,400	2,060	13,100 to 19,100	58,100 to 80,800
Boeing	430	1,630	8,520	520	3,700	14,800
Total	3,200 to 10,700	30,600 to 47,500	23,400 to 70,200	2,900	19,000 to 67,000	79,600 to 199,000

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.

Note: Values reflect data from listed sources and DOE's estimates based on the source data. Boeing and NASA volumes of LLW and MLLW are believed to be conservatively high estimates and were based on Boeing and NASA data and information in DTSC 2017.

Sources: Boeing 2017; DTSC 2017; NASA, 2014, 2017.

It was assumed for analysis that:

(1) DOE could possibly start non-RCRA regulated building demolition promptly following completion of its first NEPA ROD. NASA has completed the first phase of its building demolition; and the timing of the second phase has not been set. Boeing's final building demolition in Area IV is pending finalization of DTSC's CEQA document;

(2) DOE (soils and RCRA buildings), NASA (soil removals only), and Boeing (Area I and III soil remediation and Area IV buildings) would start in about 2021 following DTSC's finalization of the CEQA process and its approval of the DOE, NASA, and Boeing soil remediation plans and any needed RCRA closure plans;

(3) all backfill for DOE, NASA, and Boeing would be delivered to SSFL from offsite sources;

(4) the schedule for DOE's soil and building debris transport from Area IV would be maintained (1,500 building debris shipments [averaging less than 16 per day] during the first 2 to 3 years and an average of 16 daily soil shipments starting in the third year);

(5) based on the rate of remediation presented in the *Final Environmental Impact Statement for Proposed Demolition and Environmental Cleanup Activities at Santa Susana Field Laboratory, Ventura County, California* (NASA 2014) and subsequent information provided to DOE (NASA 2017), NASA remediation would require 5 to 7 years, depending on NASA's projected range in waste volumes; and

(6) Boeing remediation activities would require 2 years – a year was projected for soil remediation and about a year for building demolition (Boeing 2017).

For the cumulative project transportation analysis and in accordance with the Transportation Agreement among DOE, NASA, and Boeing (Boeing 2015), 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 years of combined site remediation, assuming truck trips were allotted equally among DOE, NASA, and Boeing, each party could make 32 daily truck round trips—that is, a theoretical 8,000 round trips per year each (32 × 250 working days per year = 8,000). However, on average, daily truck round trips from DOE activities would average less than the daily 32 allotted to it and NASA or Boeing could use the extra capacity, should they generate that much waste.

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 assuming Boeing and NASA shipments would begin in the same year as that assumed for DOE to begin offsite shipments of soil. It was conservatively assumed for DOE shipments that shipments of soil would overlap with shipments of building demolition debris during the final year of the Building Removal Alternative, and that soil shipments would overlap with shipments of strontium-90-contaminated bedrock under the Groundwater Treatment Alternative. It was assumed that Boeing shipments would require 2 years to complete remediation and that NASA shipments would require 5 to 7 years to ship depending on NASA's projected range of waste to be generated. Thus, during two years the shipments from DOE would overlap with those of Boeing and NASA, resulting in a daily average of 96 heavy-duty truck round trips to and from SSFL, and in an additional 3 to 5 years the shipments from DOE would overlap with those of NASA, resulting in an daily average of 48 to 64 heavy-duty truck round trips. Assuming implementation of the Cleanup to AOC LUT Values Alternative, after completion of the Boeing and NASA shipments, DOE would continue shipping soil offsite at a daily average of 16 heavy-duty truck round trips.

These assumptions result in conservatively high average daily number of shipments. Nonetheless, as needed, Boeing, NASA, and DOE could make use of unused capacity allotted to another party as long as the total number of heavy-duty truck round trips remained below 96 per day. 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:

- *Fifteen 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 13; see Chapter 4, Section 4.10, of this EIS). For purposes of evaluating a conservatively high level of impacts, the cumulative impacts analysis is based on an assumption that Boeing and NASA would ship LLW or MLLW for offsite disposal as indicated the DTSC draft program EIR (DTSC 2017). NASA was assumed to ship about 26,000 cubic yards of LLW[29] in about

[29] 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).

1,700 shipments out of about 58,100 to 80,800 total NASA shipments (waste and recycle material). Assuming the LLW would be shipped over 5 to 7 years, there would be about 240 to 340 shipments of LLW from NASA per year, or up to about 1 to 2 shipments per day. Boeing was assumed to ship about 6,500 cubic yards of LLW in about 430 shipments. Assuming that Boeing LLW shipments occurred over the projected 2 years for soil and building remediation, Boeing would average 0.9 daily LLW shipments. Considering DOE, NASA, and Boeing shipments, there would be a maximum of about 15 daily deliveries, as rounded, to an assumed single LLW/MLLW facility.

- *Thirty daily deliveries to an assumed single hazardous waste facility.* NASA would make the largest daily shipments of hazardous waste to a single assumed hazardous waste facility. From Table D–14, NASA is projected to ship 455,000 to 699,000 cubic yards of hazardous waste (28,800 to 45,600 shipments out of 58,100 to 80,800 total shipments [waste, recycle material, and backfill]). Assuming shipments would occur over 5 to 7 years, there would be about 5,800 to 6,500 annual shipments of hazardous waste, or up to 26 shipments per day (6,500 shipments per year/250 working days per year = 26). Boeing is projected to ship about 29,800 cubic yards of hazardous waste in about 1,630 truckloads, out of about 14,800 total shipments (waste and backfill). Assuming 1,630 Boeing hazardous waste shipments occurred over a 2-year period, the average number of yearly shipments would be 815 and there would be about 3.3 shipments per day. Most of DOE's 2,100 cubic yards of hazardous waste (2,000 cubic yards) would be targeted for removal in the first year of soil remediation. Shipment of 2,100 cubic yards of DOE hazardous waste would require 130 shipments and would result in about 0.5 shipments per day. The result would be a total of about 30 shipments per day.

- *Thirty-five daily deliveries to an assumed single nonhazardous waste facility.* Boeing would make the largest number of daily deliveries of nonhazardous waste. From Table D–14, assuming Boeing would make 8,520 nonhazardous waste shipments over a two-year period, Boeing would make about 17 deliveries per day (4,260 shipments per year/250 working days per year = 17). DOE's estimated highest daily number of nonhazardous waste shipments is 9 (see Chapter 4, Table 4–81). To provide a conservatively high estimate, it was assumed that NASA would make 11,500 shipments of nonhazardous waste over a 5-year period (rather than the longer 7-year remediation duration). NASA would therefore make an average of 2,300 nonhazardous waste shipments in a year, or about 9 per day (2,300 shipments/250 working days per year = 9.2). The total of daily deliveries from all three parties would be about 35.

- *Three daily deliveries to an assumed single recycle facility.* DOE deliveries of 340 shipments of recycle material would occur during building removal (during the first 2 to 3 years of combined site remediation), resulting in less than 1 daily delivery (calculated value of about 0.5). Boeing is projected to make 520 shipments of recycle material. Assuming these shipments occur over the 2 years assumed for soil remediation and building demolition would result in less than 1 daily delivery (calculated value of 0.5). NASA is projected to ship about 34,300 cubic yards of recycle material, including export and reuse material in about 2,060 shipments. Assuming NASA would make these shipments over a 5-year period (rather than the longer 7-year remediation duration) would result in 418 shipments per year (2,090/5 = 418), or an average of about 2 daily shipments (418 shipments/250 working days per year = 1.7). The result would be about 3 daily shipments of recycle material.

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).

D.7 References

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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 *Final Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory (Final 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 is consulting with SHPO, the Santa Ynez Band of Chumash Indians, non-federally recognized tribes, and other consulting parties to develop a Programmatic Agreement that will establish procedures for addressing adverse effects on historic properties. As required by the Section 106 process (36 CFR 800.2(d) and 800.3(e)), members of the public have been involved

through special meetings for Santa Susana Field Laboratory (SSFL) stakeholders and through avenues provided by the NEPA process.

Table E–1 SHPO and Other Section 106 Consultation-Related Contacts

Date	Recipient	From	Subject/Notes
April 20, 2009	M. W. Donaldson, California SHPO	Stephanie Jennings, DOE	Request from DOE to initiate Section 106 and NEPA consultation with the California SHPO
June 3, 2009	Stephanie Jennings, DOE NEPA Manager	Cheryl Foster-Curley, SHPO	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.
November 2009	*Federal, State, and local agencies and members of interested public* – California OHP/SHPO – California State University Northridge – California Department of Fish and Game, Region 5 [a] – 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 – 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	Invitation to participate in a tour and workshop focused on cultural and natural resources found within Area IV and the NBZ at SSFL
December 2, 2009	*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 – U.S. Fish & Wildlife Service – West Hills Neighborhood Council – EPA – GSA – NASA	DOE	Tour and workshop focused on cultural and natural resources found within Area IV and the NBZ at SSFL

Date	***Recipient***	***From***	***Subject/Notes***
June 3, 2010	M. W. Donaldson, SHPO	Craig Cooper, EPA	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.
July 15, 2010	Craig Cooper, EPA	Susan Stratton for M. W. Donaldson, SHPO	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."
October 15, 2010	M. W. Donaldson, SHPO	Craig Cooper, EPA	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.
September 28, 2011	M. W. Donaldson, SHPO	Stephanie Jennings, DOE	Package of information regarding consultation with tribes
October 24, 2011	M. W. Donaldson, SHPO	Stephanie Jennings, DOE	Package of information regarding location of geological trenching and archaeological sites
February 11, 2013	Carol Roland-Nawi, SHPO	Stephanie Jennings, DOE	Requests initiation of Section 106 and NEPA consultation
February 15, 2013	Stephanie Jennings, DOE	Susan K. Stratton for Carol Roland-Nawi, SHPO	Requests clarification of whether DOE intends to substitute NEPA for Section 106
May 2013	Carol Roland-Nawi, SHPO	Stephanie Jennings, DOE	Clarifies that DOE does not intend to use "substitution" to comply with Section 106
April 2, 2014	Stephanie Jennings, DOE	Kathleen Martyn Goforth, EPA, Region IX, Environmental Review Section	Reiterates Section 106 and tribal consultation concerns per Executive Order 13007, *Indian Sacred Sites*
April 24, 2014	Carol Roland-Nawi, SHPO, represented on the tour by Susan K. Stratton and Ed Carroll, OHP	DOE, plus NASA, Boeing, and DTSC	SHPO tour. Includes representatives of DOE, NASA, Boeing, and DTSC cultural resources
December 16, 2014	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	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).
February 25, 2015	John Jones, DOE, ETEC Director	Carol Roland-Nawi, SHPO	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.

Date	***Recipient***	***From***	***Subject/Notes***
April 10, 2015	Ed Carroll, Brendon Greenaway, OHP	Stephanie Jennings, DOE; Sandy Enyeart, Lorraine Gross, Stephen Bryne, Leidos	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.
November 5, 2015	Ed Carroll, Timothy Grant, Brendon Greenaway, and Annmarie Medin, OHP	John Jones and Stephanie Jennings, DOE; John Wondolleck, CDM Smith; Stephen Bryne, Leidos	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.
May 5, 2016	Julianne Polanco, SHPO	John Jones, DOE	Invitation to serve as a signatory on the Section 106 Programmatic Agreement.
May 5, 2016	Advisory Council on Historic Preservation	Stephanie Jennings, DOE	Invitation to participate in Section 106 consultation to develop a Programmatic Agreement to resolve adverse effects to historic properties.
May 5, 2016	Kathleen Martyn Goforth, EPA Region IX; John Luker, Teena Takata, Santa Susana Mountain Park Association; 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, 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; Anthony Zepeda; Sam Cohen, Santa Ynez Band of Chumash Indians; Barbara Tejada; Christina Walsh	John Jones, DOE	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.
May 10, 2016	Stephanie Jennings, DOE	Christina Walsh	Accepting invitation to participate in Section 106 Programmatic Agreement development
May 10, 2016	Stephanie Jennings, DOE	Gary Brown Santa Monica Mountains National Recreation Area, National Park Service	Accepting invitation to participate in Section 106 Programmatic Agreement development
May 12, 2016	Stephanie Jennings, DOE	Christine Rowe Individual	Accepting invitation to participate in Section 106 Programmatic Agreement development
May 19, 2016	Stephanie Jennings, DOE	Abe Weitzberg SSFL Community Advisory Group	Accepting invitation to participate in Section 106 Programmatic Agreement development
May 20, 2016	Stephanie Jennings, DOE	Albert Knight Santa Barbara Museum of Natural History, Anthropology Department	Accepting invitation to participate in Section 106 Programmatic Agreement development

Date	***Recipient***	***From***	***Subject/Notes***
May 26, 2016	Stephanie Jennings, DOE	Advisory Council on Historic Preservation	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
May 31, 2016	John Jones, DOE	Karen DiBiase	Accepting invitation to participate in Section 106 Programmatic Agreement development
June 15, 2016	Stephanie Jennings, John Jones, and Debbie Kramer, DOE; Wendy Lowe, P2 Solutions	Edward Carroll, State Historic Preservation Office; Brendon Greenaway and Annmarie Medin, California Department of Parks	Meeting with SHPO to discuss Section 106 consultation process and Programmatic Agreement
July 14, 2016	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	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
August 17, 2016	Gary Brown, Santa Monica Mountains National Recreation Area, National Park Service; 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; Christina Walsh, SSFL National Monument Project; Alec Uzemeck, Ronald Ziman, SSFL Citizens Advisory Committee	John Jones and Stephanie Jennings, DOE	Programmatic Agreement Development Meeting
June 25, 2018	John Jones, DOE	David Dassler, Boeing	Accepting invitation to participate in Section 106 Programmatic Agreement development.
June 25, 2018	Julianne Polanco, SHPO	John Jones, DOE	Transmitting a draft Programmatic Agreement and requesting review and input.
August 1, 2018	Ed Carroll, OHP Brendon Greenaway, OHP Tim Brandt, OHP	John Jones, DOE Stephanie Jennings, DOE Rachel Rosenthal, DOE John Wondolleck, CDM Smith Joe Jimenez, Leidos Kirk Owens, Leidos	Phone call to discuss the Programmatic Agreement, including the scope and strategy for NHPA, Section 106 consultation, comments on the draft Programmatic Agreement, and interface with protecting non-NHPA resources,

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; NHPA = National Historic Preservation Act; OHP = Office of Historic Preservation; SHPO = State Historic Preservation Officer.

[a] Effective January 1, 2013, the California Department of Fish and Game changed its name to California Department of Fish and Wildlife.

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 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 will be an ongoing process among DOE, SHPO, Native American groups, and other stakeholders. Consultation will continue as required in the development of the Section 106 Programmatic Agreement and until DOE's cleanup responsibilities are completed.

E.1.3 Native American Consultation

DOE conducts consultation with federally recognized tribes as required by law. The Santa Ynez Band of Chumash Indians is a federally recognized tribe that attaches religious and cultural significance to affected historic properties at SSFL. DOE has engaged in consultation with the Santa Ynez Band of Chumash Indians, as well as non-federally recognized tribes regarding the cleanup of SSFL since 2009. In January 2014, DOE initiated Government-to-Government consultation with the Santa Ynez Band of Chumash Indians, and initiated consultation in compliance with Section 106 of the NHPA. At the same time, DOE also formally issued an invitation to the Santa Ynez Band of Chumash Indians to be a cooperating agency for this EIS, and the invitation was accepted (letter dated February 9, 2014) (Santa Ynez Band of Chumash Indians 2014). Additionally, DOE continues to conduct informal consultation with non-federally recognized tribes throughout the NEPA and NHPA, Section 106, processes.

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 archaeological 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.

DOE considered these concerns during analysis of impacts and will apply them to develop the Section 106 Programmatic Agreement for resolving adverse effects to historic properties affected by the proposed cleanup.

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 – 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 – Los Angeles City/County Native American Indian Commission *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	*Attendee affiliations:* – 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 (by phone) – California Department of Toxic Substances Control
July 18-19, 2014	Native American Sacred Sites Summit Meeting	*Invited affiliations:* – 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 – Bureau of Indian Affairs

Native American Meetings at SSFL		
Date	***Event***	***Invited and Attendee Affiliation in addition to DOE*** [a]
		– National Park Service – Native American Heritage Commission – California State Historic Preservation Officer – California Department of Toxic Substances Control – California Environmental Protection Agency – California State Parks – Los Angeles City/County Native American Indian Commission – Boeing – National Aeronautics and Space Administration – CH2M Hill – Environmental Science Associates – John Minch & Associates – Leidos – Thomas King (author and consultant) *Attendee affiliations:* – 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 – Bureau of Indian Affairs – National Park Service – Native American Heritage Commission – California State Historic Preservation Officer – California Department of Toxic Substances Control – California Environmental Protection Agency – California State Parks – Los Angeles City/County Native American Indian Commission – Boeing – National Aeronautics and Space Administration – CH2M Hill – John Minch & Associates – Leidos – Thomas King (author and consultant)
September 4, 2014	Santa Susana Field Laboratory Sacred Sites Council Meeting with DOE	*Attendee affiliations:* – 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 – California Department of Toxic Substances Control – Leidos – MWH Americas, Inc.

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 – California Department of Toxic Substances Control – Leidos – MWH Americas, Inc.
November 21, 2014	Site tour	*Attendee affiliations:* – 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	*Attendee affiliations:* – 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*	*Attendee affiliations:* – 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 – CDM Smith – Leidos
April 7, 2015	Santa Susana Field Laboratory Sacred Sites Council Meeting with DOE	*Attendee affiliations:* – 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 – Tataviam – Chumash/Tataviam – Gabrielino Tongva Indians of California – Chumash/Gabrielino – California Department of Toxic Substances Control – Leidos (monitor) – MWH Americas, Inc. – P2 Solutions (facilitator)
January 21, 2016	Santa Susana Field Laboratory Sacred Sites Council Meeting with DOE	*Attendee affiliations:* – Santa Ynez Band of Chumash Indians – Santa Ynez Chumash – Chumash – Fernandeño/Tataviam – Fernandeño/Tataviam/Chumash – Gabrieleno and Kizh – Kizh Nation – Native American Monitoring Group – California Department of Toxic Substances Control (by phone) – National Aeronautics and Space Administration, Marshall Space Flight Center – National Aeronautics and Space Administration, Headquarters

Native American Meetings at SSFL		
Date	***Event***	***Invited and Attendee Affiliation in addition to DOE*** [a]
		– National Aeronautics and Space Administration, SSFL – National Aeronautics and Space Administration (by phone) – CH2M – Environmental Science Associates (by phone) – John Minch & Associates – Leidos (monitor) – P2 Solutions (facilitator)
July 7, 2016	Programmatic Agreement Development Meeting	*Attendee affiliations:* – Santa Ynez Band of Chumash Indians – Fernandeño Tataviam Band of Mission Indians – Barbareño/Ventureño Band of Mission Indians – Kizh Gabrieleno Band of Mission Indians – Chumash, Fernandeño Tataviam, Shoshone Paiute, Yaqui – Chumash, Fernandeño Tataviam – Kizh Gabrieleno Band of Mission Indians – Gabrielino Tongva Indians of California – Gabrielino/Tongva Nation – Santa Ynez Band Tribal Elders Council – Tongva Ancestral Territorial Tribal Nation – Chumash, Fernandeño Tataviam – Coastal Band of the Chumash Nation – Leidos (monitor) – P2 Solutions (facilitator)
August 16, 2016	Programmatic Agreement Development Meeting	*Attendee affiliations:* – Santa Ynez Band of Chumash Indians – Government Affairs and Legal Officer for the Santa Ynez Band of Chumash Indians – Public Affairs Director for the Fernandeño Tataviam Band of Mission Indians – Tribal Historic and Cultural Preservation Director for the Fernandeño Tataviam Band of Mission Indians – Barbareño/Ventureño Band of Mission Indians – Chumash, Fernandeño Tataviam – Gabrielino Tongva/Chumash – Cultural Preservation Consultant for the Santa Ynez Band Tribal Elders Council – Fernandeño Tataviam/Ventureño Chumash – Leidos (monitor) – P2 Solutions (facilitator)
October 4, 2016	Programmatic Agreement Development Meeting	*Attendee affiliations:* – Santa Ynez Band of Chumash Indians – Government Affairs and Legal Officer for the Santa Ynez Band of Chumash Indians – Fernandeño Tataviam Band of Mission Indians – Public Affairs Director for the Fernandeño Tataviam Band of Mission Indians – Barbareño/Ventureño Band of Mission Indians – Chumash, Fernandeño Tataviam – Gabrielino Tongva/Chumash – Cultural Preservation Consultant for the Santa Ynez Band Tribal Elders Council – Fernandeño Tataviam/Ventureño Chumash – Leidos (monitor) – P2 Solutions (facilitator)

Native American Meetings at SSFL		
Date	***Event***	***Invited and Attendee Affiliation in addition to DOE*** [a]
March 8, 2017	Draft EIS Hearing for Native Americans	*Attendee affiliations:* – Government Affairs and Legal Officer for the Santa Ynez Band of Chumash Indians – Public Affairs Director, Fernandeño Tataviam Band of Mission Indians – Barbareño/Ventureño Band of Mission Indians – Archaeologist, Kizh Gabrieleno Band of Mission Indians – Fernandeño Tataviam/Ventureño Chumash – Chumash, Fernandeño Tataviam
March 16, 2017	SSFL Tour of Selected Archaeological Sites	*Attendee affiliations:* – Santa Ynez Band of Chumash Indians – Government Affairs and Legal Officer for the Santa Ynez Band of Chumash Indians – Public Affairs Director for the Fernandeño Tataviam Band of Mission Indians – Barbareño/Ventureño Band of Mission Indians – Kizh Gabrieleno Band of Mission Indians – Chumash, Fernandeño Tataviam – Gabrielino Tongva/Chumash – DOE-Headquarters – Leidos – P2 Solutions
September 28, 2017	Programmatic Agreement Development Meeting	*Attendee affiliations:* – Santa Ynez Band of Chumash Indians – Tribal President, Fernandeño Tataviam Band of Mission Indians – Public Affairs Director, Fernandeño Tataviam Band of Mission Indians – Chumash, Fernandeño Tataviam – Barbareño/Ventureño Band of Mission Indians – Cultural Preservation Consultant, Santa Ynez Band Tribal Elders Council – Archaeologist, Kizh Gabrieleno Band of Mission Indians – Leidos (monitor) – P2 Solutions (facilitator)
November 16, 2017	Programmatic Agreement Development Meeting	*Attendee affiliations:* – Government Affairs and Legal Officer for the Santa Ynez Band of Chumash Indians – Public Affairs Director for the Fernandeño Tataviam Band of Mission Indians – Fernandeño Tataviam Band of Mission Indians – Barbareño/Ventureño Band of Mission Indians – Gabrielino Tongva/Chumash – Cultural Preservation Consultant for the Santa Ynez Band Tribal Elders Council – Leidos (monitor) – P2 Solutions (facilitator)

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			
Date	***Recipient***	***From***	***Subject***
April 20, 2009	Larry Myers, NAHC	Stephanie Jennings, DOE	Request for Tribal Consultation List and information on sacred lands.
November 3, 2009	Stephanie Jennings, DOE	Katy Sanchez, NAHC	Response to April 20, 2009, letter from DOE. Includes Native American Tribal Consultation List.
May 10, 2010	Stephanie Jennings, DOE	Fernandeño Tataviam Band of Mission Indians, William Gonzalez, Chairman	Thanks for tour of April 2010.
June 12, 2010	Milford Wayne Donaldson, SHPO	Fernandeño Tataviam Band of Mission Indians William Gonzalez, Chairman	Regarding concerns about EPA's characterization program and cultural resources protocols.
February 11, 2013	Cynthia Gomez, Executive Director, NAHC	Stephanie Jennings, DOE	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."
February 15, 2013	Stephanie Jennings, DOE	Dave Singleton, NAHC	Reply to request for sacred lands search and Native American contacts.
November 27, 2013	Wendy Green Lowe, P2 Solutions	Dave Singleton, NAHC	Reply to request for Sacred Lands search and Native American contacts.
January 20, 2014	Stephanie Jennings, DOE	Vincent Armenta, Tribal Chairman, Santa Ynez Band of Chumash Indians	Requesting Section 106 consultation from DOE.
January 20, 2014	Stephanie Jennings, DOE	Vincent Armenta, Tribal Chairman, Santa Ynez Band of Chumash Indians	Designates the DOE portion of SSFL as an Indian sacred site pursuant to Executive Order 13007, *Indian Sacred Sites*.
February 5, 2014	Vincent Armenta, Santa Ynez Band of Chumash Indians	David Huizenga, DOE, Senior Advisor for Environmental Management	Invitation to be cooperating agency for the EIS for Area IV and NBZ.
February 9, 2014	Stephanie Jennings, DOE	Vincent Armenta, Tribal Chairman, Santa Ynez Band of Chumash Indians	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.
February 20, 2014	Vincent Armenta, Santa Ynez Band of Chumash Indians, and Sam Cohen Tribal Counsel	Stephanie Jennings, DOE	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.

Section 106, Government-to-Government, NEPA			
Date	***Recipient***	***From***	***Subject***
March 30, 2014	Stephanie Jennings, DOE	Sam Cohen, Santa Ynez Band of Chumash Indians	Santa Ynez Band of Chumash Indians provides additional scoping comments on the EIS.
December 3, 2014	Stephanie Jennings, DOE	Sam Cohen, Santa Ynez Band of Chumash Indians	Via e-mail, "RE: Santa Susana Field Laboratory (SSFL), Area IV and Northern Buffer Zone EIS and other issues for Secretary."
May 5, 2016	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, Fernandeño Tataviam Band of Mission Indians; Rudy Ortega, Fernandeño Tataviam Band of Mission Indians; Steve Ortega, Fernandeño 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, Fernandeño; 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	Invitation to participate in development of the Section 106 Programmatic Agreement
May 6, 2016	Stephanie Jennings, DOE	John Tommy Rosas	Accepting invitation to participate in Section 106 Programmatic Agreement development

Section 106, Government-to-Government, NEPA			
Date	***Recipient***	***From***	***Subject***
May 9, 2016	Stephanie Jennings, DOE	Alan Salazar	Accepting invitation to participate in Section 106 Programmatic Agreement development
May 9, 2016	Stephanie Jennings, DOE	Freddie Romero	Accepting invitation to participate in Section 106 Programmatic Agreement development
May 10, 2016	Stephanie Jennings, DOE	Patrick Tumamait	Accepting invitation to participate in Section 106 Programmatic Agreement development
May 10, 2016	Stephanie Jennings, DOE	Sam Cohen	Accepting invitation to participate in Section 106 Programmatic Agreement development
May 14, 2016	Stephanie Jennings, DOE	Kathleen Pappo	Accepting invitation to participate in Section 106 Programmatic Agreement development
May 17, 2016	Stephanie Jennings, DOE	Brian Holguin	Accepting invitation to participate in Section 106 Programmatic Agreement development
May 17, 2016	Stephanie Jennings, DOE	Caitlin Gulley	Accepting invitation to participate in Section 106 Programmatic Agreement development
May 18, 2016	Stephanie Jennings, DOE	Beverly Folkes	Accepting invitation to participate in Section 106 Programmatic Agreement development
May 18, 2016	Stephanie Jennings, DOE	Colin Cloud Hampson	Accepting invitation to participate in Section 106 Programmatic Agreement development
May 24, 2016	Stephanie Jennings, DOE	Joe Calderon	Accepting invitation to participate in Section 106 Programmatic Agreement development
May 25, 2016	Stephanie Jennings, DOE	Andy Salas	Accepting invitation to participate in Section 106 Programmatic Agreement development
August 24, 2016	Stephanie Jennings, DOE	Kenneth Kahn, Santa Ynez Band of Chumash Indians Tribal Chairman	Letter requesting Section 106 consultation for the SSFL and proposed undertaking by DOE
August 26, 2016	Kenneth Kahn, Santa Ynez Band of Chumash Indians Tribal Chairman	John Jones	Reaffirming DOE's commitment to enter into formal consultation, as stated in previous letters of February 20, 2016 and May 5, 2016

Section 106, Government-to-Government, NEPA			
Date	**Recipient**	**From**	**Subject**
August 9, 2017	Santa Ynez Band of Chumash Indians Tribal Council	John Jones, Stephanie Jennings	Visit to Santa Ynez Band of Chumash Indians Tribal Council to provide an update on DOE activities; status of the EIS; progress of the Programmatic Agreement; and invitation to be signatory to the Section 106 Programmatic Agreement

EIS = environmental impact statement; EPA = U.S. Environmental Protection Agency; NAHC = Native American Heritage Commission; NBZ = Northern Buffer Zone; NEPA = National Environmental Policy Act; 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 threatened or endangered species, DOE consulted with USFWS in compliance with Section 7 of the ESA. Informal consultation was initiated with USFWS and the California Department of Fish and Wildlife (CDFW, formerly called the California Department of Fish and Game) in 2009, as described below in **Table E–4**, and continued throughout the development of this EIS.

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 NBZ) (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 – EPA: Craig Cooper, Gregg Dempsey – DOE: Stephanie Jennings, Lance Martin, Thomas Johnson – Boeing: Ravnesh Amar, Paul Costa, Randy Ueshiro – California Native Plant Society: Betsey Landis, Snowdy Dodson – CDM Smith (for DOE): John Wondolleck – SAIC (now Leidos) (for DOE): Tom Mulroy, Debra Barringer – HydroGeoLogic, Inc. (for EPA): 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 (for DOE): John Wondolleck – SAIC (for DOE): Tom Mulroy – HydroGeoLogic, Inc. (for EPA): Eric Evans

Date	***Event***	***Participants***
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 – DTSC: Brian Faulkner (Ecological Risk Assessor), Laura Rainey (Project Manager) – DOE: Stephanie Jennings, John Jones, Jazmin Bell – California Native Plant Society: Mark Osokow – San Fernando Valley Audubon Society: Mark Osokow – Santa Susana Mountain Park Association: John Luker, (Vice-President) – Southwestern Herpetological Society: Mark Osokow – CDM Smith (for DOE): John Wondolleck – Leidos (for DOE): 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 – DOE: Stephanie Jennings, John Jones – CDM Smith (for DOE): John Wondolleck – Leidos (for DOE): Tom Mulroy, Tara Schoenwetter – MWH Americas, Inc. (for Boeing): David Collins, Dixie Hambrick
November 6, 2014	Meeting with USFWS, CDFW, and USACE, at USFWS offices, 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, Christine Found-Jackson – USACE: Antal Szijj, Jeff Phillips – DTSC: Brian Faulkner, Laura Rainey – DOE: Stephanie Jennings, John Jones – CDM Smith (for DOE): John Wondolleck – Leidos (for DOE): Tom Mulroy, Tara Schoenwetter – MWH Americas, Inc. (for Boeing): David Collins, Dixie Hambrick
November 4, 2015	Meeting with USFWS, CDFW, and USACE, at USFWS offices, 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 – USACE: Antal Szijj, – DTSC: Matt Wetter, Brian Faulkner, Laura Rainey, Roger Paulson, – DOE: Stephanie Jennings, John Jones, Steve Tetreault – NASA: Allen Elliott – CDM Smith (for DOE): John Wondolleck – Leidos (for DOE): Tom Mulroy, Tara Schoenwetter, Lauren Brown – CH2M Hill (for NASA): Steven Long, Gary Santolo – Padre (for Boeing): Chris Dunn
December 9, 2015	Meeting with USFWS, CDFW, DTSC, DOE, NASA, and Boeing, at DOE offices Simi Valley, California. Topics: Discuss the SSFL site-wide biological assessment and chemicals of concern. 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 – CDFW: Jeff Humble, Christine Found-Jackson – DTSC: Matt Wetter, Laura Rainey, Brian Faulkner, Roger Paulson, Kim Hudson – DOE: John Jones, Stephanie Jennings – Boeing: Paul Costa – NASA: Allen Elliott – CDM Smith (for DOE): John Wondolleck, Rebecca Farmer, Catherine Love – Leidos (for DOE): Tom Mulroy, Tara Schoenwetter – CH2M (for NASA): Randy Dean – ESA (for DTSC): May Lau, Deanna Hansen

Date	***Event***	***Participants***
June 16, 2016	Meeting with USFWS, DTSC, DOE, Boeing, and NASA at USFWS offices, 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 – DTSC: Mark Malinowski Matt Wetter, Brian Faulkner, Kim Hudson – DOE: John Jones, Stephanie Jennings – Boeing: Paul Costa – NASA: Peter Zorba – CDM Smith (for DOE): John Wondolleck – Leidos (for DOE): Tom Mulroy, Tara Schoenwetter, Mike Barta – MWHA (for Boeing): Dixie Hambrick – CH2M (for NASA): Steve Long – ESA (for DTSC): Jason Ricks, May Lau
July 6, 2016	Meeting with CDFW, DTSC, and DOE, NASA, and Boeing 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 – DTSC: Mark Malinowski, Matt Wetter, Brian Faulkner – DOE: John Jones, Stephanie Jennings – Boeing: Paul Costa, Mark Zeller – NASA: Peter Zorba – CDM Smith (for DOE): John Wondolleck, Wardah Azhar – Leidos (for DOE): Tom Mulroy, Tara Schoenwetter, Lauren Brown, Mike Barta – CH2M (for NASA): Beth Vaughn, Steve Long, Gary Santolo, Mike Bedan, Kelly Teplitsky – ESA (for DTSC): Jason Ricks, Greg Ainsworth
September 26, 2017	Meeting with USFWS, USACE, CDFW, USACE, DTSC, DOE, NASA, and Boeing, at USFWS office, Ventura, California Topics include: Overview and discussion of the draft biological assessment; Braunton's milk vetch critical habitat and southern buffer zone; golden eagle, migratory birds, and California Species of Special Concern; vernal pools; exemption areas; process for Section 7 consultation; process for species listed under the California Native Plant Protection Act and California Endangered Species Act; Migratory Bird Treaty Act; and approach to USACE 404 permitting and CDFG Section 1600 Streambed Alteration Agreement	– USFWS: Jenny Marek, Mark Elvin, Lena Chang, Rick Farris, Steve Henry – CDFW: Mary Meyer, Christine Found-Jackson, Andrew Valand – USACE: Antal Szijj – DTSC: Ray Leclerc, Brian Faulkner, Laura Rainey, Roger Paulson – DOE: John Jones, Stephie Jennings – NASA: Pete Zorba, Keith Thomsen – CDM Smith (for DOE): John Wondolleck – Leidos (for DOE): Tom Mulroy, Katelyn Nyberg, Catrina Gomez – CH2M (for NASA): Beth Vaughn – Padre (for Boeing): Chris Dunn
November 7, 2017	Onsite (Area IV) meeting with USACE, DOE, and Boeing to discuss delineation of jurisdictional waters and wetlands in Area IV and the process of satisfying Clean Water Act requirements in regards to remediation of Area IV and the NBZ.	– USACE: Antal Szijj – DOE: John Jones – CDM Smith (for DOE): John Wondolleck – Leidos (for DOE): Tara Schoenwetter, Tom Mulroy – Padre (for Boeing): Chris Dunn, Matt Ingamells

Date	Event	Participants
May 3, 2018	Onsite meeting (Boeing offices) to review data needs and requirements for Federal and State endangered species compliance at SSFL. The meeting was followed by a field visit of milk vetch habitat in Area IV.	– USFWS: Jenny Marek, Mark Elvin, Steve Henry – CDFW: Christine Found-Jackson, Andrew Valand – DTSC: Roger Paulson, Paul Carpenter, Laura Rainey, Brian Faulkner – DOE: John Jones, Stephanie Jennings – Boeing: Mike Bower, Paul Costa, Dave Dassler – NASA: Peter Zorba, Keith Thomsen – CDM Smith (for DOE): John Wondolleck – Leidos (for DOE): Tara Schoenwetter, Catrina Gomez – Jacobs (for NASA): Michelle Rau, Gary Santolo, Beth Vaughn – Padre (for Boeing): Chris Dunn – ESA (for DTSC): Jason Ricks, May Lau, Greg Ainsworth
July 16, 2018	Onsite meeting in Area IV to discuss the project that USWFS-DOE were consulting on; to introduce some USFWS personnel to the project and site; and for the USFWS staff to conduct a survey the milk vetch habitat at SSFL (as part of a regional habitat check). The meeting led to DOE's project consultation clarification letter of July 20, 2018.	– USFWS: Jenny Marek, Mark Elvin, Steve Henry, Christopher Diel, Damien Higgins, and Rick Burgess – DOE: John Jones, Stephie Jennings – CDM Smith (for DOE): John Wondolleck, Steven Fundingsland

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; 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; NBZ = Northern Buffer Zone; 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 *Final SSFL Area IV EIS*.

E.2.2 Endangered Species Consultation and Coordination

Table E–4 summarizes informal consultation meetings and teleconferences held among DOE, USFWS, CDFW, and others since 2009. These meetings guided the conduct of biological surveys of SSFL and the development of a site-wide biological assessment. As part of ESA compliance, DOE completed the biological assessment and submitted it to USFWS; the biological assessment was provided to CDFW as well. Formal consultation with USFWS addressing DOE's proposed action (remediation of Area IV and the Northern Buffer Zone) was initiated in early 2018. The consultation process resulted in the issuance of a USFWS biological opinion in compliance with the ESA. The biological opinion established protective measures that DOE must implement during remediation (see Appendix J for a copy of the biological opinion).

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 actively sought input from agencies and groups regarding biological resources. Representatives of the 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, participated in meetings, reviewed the proposed project actions, and provided input for onsite biological resources.

Throughout the process concerns expressed by agencies and groups 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
- 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).

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.

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 assumed boundaries of the Chumash, Tataviam, and Gabrielino (Tongva) Native American linguistic groups (see the blue dot in **Figure F–1**). Figure F–1, based on the map prepared by the Native American Heritage Commission (NAHC 2015) (originally from Hinton [1994]), shows conceptual linguistic boundaries and should not be construed literally. Some tribes dispute these historic territorial divisions. Spanish mission settlements disrupted and displaced tribes, making the reconstruction of boundaries a complex task beyond the scope of this environmental impact statement (EIS).

The Chumash, Fernandeño Tataviam, and Gabrielino Tongva ethnographic groups are discussed individually in this section. In addition, Chapter 9 of this *Final Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory (Final SSFL Area IV EIS)* was written by the Chumash, Fernandeño Tataviam, and Gabrielino Tongva Tribes and provides Native American perspectives.

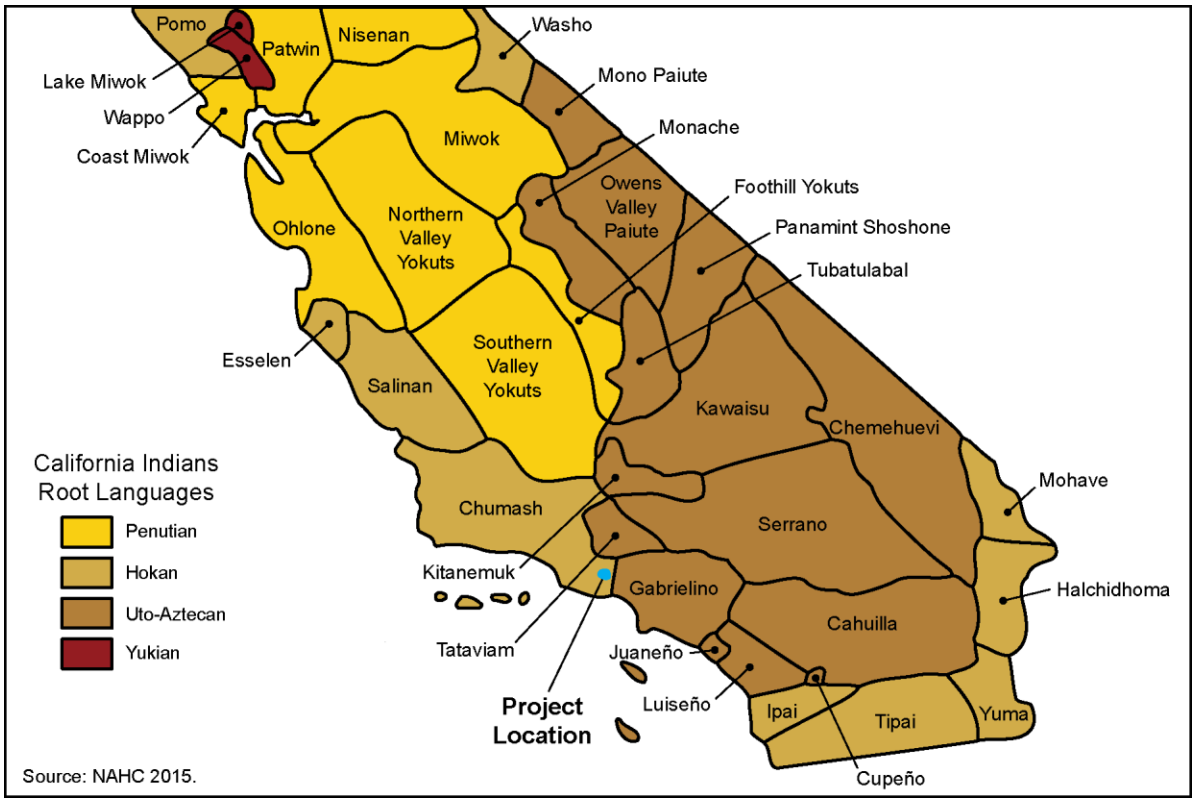

Figure F–1 Historic Linguistic Boundaries in Relation to the Santa Susana Field Laboratory

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 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 the 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. Motifs include 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 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 was 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, located near the mouth of Bell Creek in Bell Canyon. Chumash, Fernandeño Tataviam, and Gabrielino Tongva congregated at El Escorpión, also known as Huwam (by the Chumash) or Jucjauynga (Johnson 2006; Roderick 2001). The Fernandeño Tataviam, Serrano, and Gabrielino Tongva referred 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 from Chumash and Fernandeño Tataviam groups (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 what is now Ventura, was established on the coast, west of the project area in March 31, 1782. It was the first Spanish mission in the immediate 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. Mission San Fernando, established in 1797 to the east of the project area in the Mission Hills area of Los Angeles, and Mission San Gabriel Arcángel, established to the southeast in 1771 in what is now San Gabriel, brought the Native American population under their influence, attaching mission names to native group names.

F.1.3.2 Euro-American Settlement

In the early 1800s, farming and ranching were the area's primary economic mainstays. The Secularization Act of 1834 removed most land from the jurisdiction of the missions. Although the Act was written so as to result in holdings that would be held for communal use, the land was instead distributed primarily to upper class Mexican citizens (Lawson et al. 2017). 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 and the Treaty of Guadalupe Hidalgo, 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). 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).

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 (Valley) and Santa Susana both resulted from the real estate boom of the late 19th and early 20th centuries (Hoover et al. 1966). 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, funded nuclear energy research that primarily involved testing of small pilot-scale reactors on a 90-acre portion of Area IV owned by Rocketdyne. 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 (except for the portion owned by the Federal Government), 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 *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, augmented by recent studies, identified 39 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 SSFL		
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*

Author(s)/Entity	Year	Title and Pertinent Information
Emmick, Jamelon and James C. Bard	2008	*Final Cultural Resources Inventory of Santa Susana Field Laboratory NASA Areas I and II, Ventura County, California*
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*
Corbett, Ray, Richard B. Guttenberg, and Devlin A. Gandy	2015	*Phase I Archaeological Survey Santa Susana Field Laboratory Area II and LOX Area I*
Lockwood, Chris	2016	*Santa Susana Field Laboratory Project Draft Archaeological Assessment*
CH2M Hill, Inc.	2017	*Archaeological Site Boundary Determinations at NASA-Administered Areas I and II, Santa Susana Field Laboratory, Ventura County, California.* Recording and boundary determination at Site CA-VEN-1072, including Stage 1 investigations of the Burro Flats Site Complex and an Extended Phase I survey of 13 additional sites.
Bray, Madeleine, Monica Strauss, Christopher Lockwood, and Candace Ehringer	2017	*Santa Susana Field Laboratory Project Archaeological District Study.* SSFL-wide evaluation of Archaeological District.
Lawson, Natalie, Jennifer Whiteman, and Dorothea Theodoratus, and the local Native American Communities	2017	*Ethnographic Overview of the Native American Communities in the Simi Hills and Vicinity.* Detailed background and narrative from the Native American perspective.
NASA	2017	*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 and updated in 2017. 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.
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 NRHP. 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.

Author(s)/Entity	Year	Title and Pertinent Information
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.
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

As shown in Table F–2, archaeological evidence is common in the vicinity of SSFL. Numerous archaeological sites have been located within the ROI, which includes SSFL and land within a 1-mile radius of SSFL. Prehistoric-era rockshelters with artifacts, features, or rock art dominate the recorded sites, but other prehistoric-era site types include lithic scatters, lithic quarries, bedrock milling stations, and midden deposits. Historic (post-contact) sites are not as common in the ROI, but there are a few sites with the remnants of historic structures and/or historic debris (e.g., bottles, ammunition).

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. The NBZ has a similar complement of open-air lithic scatters and rockshelters with artifacts. The abundance of rockshelters in the APE reflects the rugged nature of the topography. Isolated artifacts found throughout Area IV and the NBZ indicate the widespread use of the area during pre-contact times. Only one site recorded in the APE has a historic component, consisting of a rock shelter with a historic pictograph and historic-era artifacts, which suggests a more limited use of the area during post-contact times.

DOE developed and implemented an extended phase 1 testing program to evaluate the NRHP eligibility of 10 archaeological sites in the APE (Area IV and the NBZ). The 10 sites were chosen based on: (1) the extent of the contamination known at the time the testing program was designed; (2) sites where NRHP eligibility was unclear; and (3) consultation with Native American representatives. This program of limited subsurface excavation was developed in consultation with SHPO and EIS cooperating agencies, including the federally recognized Santa Ynez Band of Chumash Indians, as well as non-federally recognized tribes. Based on this evaluation program DOE determined that 8 of the 10 archaeological sites were individually eligible for inclusion on the NRHP and 2 sites were individually ineligible for listing on the NRHP.

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.

Efforts are currently under way to further define the relationship of archaeological resources at SSFL. NASA is developing a proposal to the California SHPO for an NRHP-eligible Burro Flats Archaeological District that includes several archaeological sites in Area IV. In addition, the Department of Toxic Substances Control discussed the NRHP-eligibility of an SSFL-wide archaeological district, the Simi Hills Archaeological District, in its *Draft Program Environmental Impact Report for the Santa Susana Field Laboratory, Ventura County, California* (DTSC 2017).

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
56-001465	VEN-1465	Rockshelter; shell fragment and looter's screen	Unevaluated
56-001568	VEN-1568	Sandstone boulder with artifact cache	Unevaluated
56-001569	VEN-1569	Cave with basket fragment	Unevaluated
56-004378	VEN-4378/H	Historic habitation; concrete slab, stone foundation, refuse concentration; brick and mortar wall rubble concentration	Unevaluated
Within SSFL but outside Area IV and NBZ			
SSFL, Southern Undeveloped Land			
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; ground stone arrow shaft straightener	Unevaluated
56-001437	VEN-1437	Lithic scatter	Unevaluated
56-001438	VEN-1438	Rockshelter with 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
56-001445	VEN-1445	Rockshelter with lithic scatter	Unevaluated
56-001446	VEN-1446	Open-air lithic scatter	Unevaluated
56-001448	VEN-1448	Rockshelter; stacked rock feature, asphaltum fragment with basketry impression	Unevaluated
56-001450	VEN-1450	Open-air lithic scatter	Unevaluated
56-001463	VEN-1463	Two rockshelters with lithics	Unevaluated
56-001464	VEN-1464	Rockshelter; two ground stone comal fragments	Unevaluated
56-001466	VEN-1466	Rockshelter with modern camping gear; open air lithic scatter	Unevaluated
56-001473	VEN-1473	Open-air lithic scatter and quarry	Unevaluated
56-001492	VEN-1492	Rockshelter; lithic scatter	Unevaluated
56-001493	VEN-1493	Rockshelter; asphaltum fragments; faunal remains	Unevaluated
56-001494	VEN-1494	Open-air lithic scatter	Unevaluated
56-001495	VEN-1495	Lithic scatter	Unevaluated

Primary Number	*Trinomial Site Number* [a]	*Site Description*	*NRHP and California Register Eligibility*
SSFL, Area I			
56-001444	VEN-1444	Rockshelter with lithic scatter	Unevaluated
56-001447	VEN-1447	Open-air lithic scatter	Unevaluated
56-001451	VEN-1451	Rockshelter with bone and lithics	Unevaluated
56-001453	VEN-1453	Rockshelter with lithic scatter	Unevaluated
56-001454	VEN-1454	Rock with lithic scatter	Unevaluated
56-001458	VEN-1458	Open-air lithic scatter	Unevaluated
56-001459	VEN-1459	Rockshelter with cake of asphaltum	Unevaluated
56-001461	VEN-1461	Open-air lithic scatter	Unevaluated
56-001462	VEN-1462	Lithic scatter with historic ammunition round	Unevaluated
56-001467	VEN-1467	Open-air lithic scatter	Unevaluated
56-001468	VEN-1468	Rockshelter with lump of asphaltum	Unevaluated
56-001484	VEN-1484	Three rockshelters; basketry fragments, lithic artifacts	Unevaluated
56-001485	VEN-1485	Rockshelter; lithic scatter	Unevaluated
56-001488	VEN-1488/H	Inscribed sandstone outcrop	Unevaluated
56-001490	VEN-1490	Rockshelter with one associated lithic artifact	Unevaluated
56-001491	VEN-1491H	Sandstone boulder with historic inscriptions	Unevaluated
56-001496	VEN-1496	Open-air lithic scatter	Unevaluated
56-001816	VEN-1816	Rockshelter with tested cobble	Unevaluated
56-001830	VEN-1830	Rockshelter with asphaltum	Unevaluated
56-001831	VEN-1831	Rockshelter with lithic artifacts	Unevaluated
56-001832	VEN-1832	Open air lithic scatter	Unevaluated
56-001833	VEN-1833	Open air lithic scatter with bird bone	Unevaluated
56-001834	VEN-1834	Open air lithic scatter	Unevaluated
56-001837	VEN-1837	Open air lithic scatter	Unevaluated
56-001839	VEN-1839/H	Open air site with modern graffiti ("D+D" within a heart)	Unevaluated
SSFL, Area II			
56-000151 [b]	VEN-151	Midden deposit	Listed [c]
56-000152 [b]	VEN-152	Midden, pictographs	Listed [c]
56-000153 [b]	VEN-153	Midden, pictographs	Listed [c]
56-000154 [b]	VEN-154	Midden, bedrock mortars, petroglyphs	Listed [c]
56-000155 [b]	VEN-155	Petroglyphs	Listed [c]
56-000156 [b]	VEN-156	Pictograph, rockshelter	Listed [c]
56-000157 [b]	VEN-157	Pictograph, rockshelter	Listed [c]
56-000158 [b]	VEN-158	Pictograph, rockshelter	Listed [c]
56-000159 [b]	VEN-159	Pictograph, rockshelter	Listed [c]
56-000160 [b]	VEN-160	Pictograph, rockshelter	Listed [c]
56-000161 [b]	VEN-161	Pictograph, rockshelter	Listed [c]
56-001065 [b]	VEN-1065	Two rockshelters with midden and associated artifacts	Listed [c]
56-001066 [b]	VEN-1066	Rockshelter with pictograph	Listed [c]
56-001067 [b]	VEN-1067	Pre-contact trail	Listed [c]
56-001068 [b]	VEN-1068	Rockshelter with three bedrock milling stations	Listed [c]
56-001072 [c]	VEN-1072	Burro Flats Painted Cave site	Listed [c]
56-001486	VEN-1486	Rockshelter; lithic scatter	Unevaluated
56-001800	VEN-1800	Rockshelter with associated artifacts	Unevaluated
56-001809	VEN-1809	Rockshelter with faunal material	Unevaluated
56-001810	VEN-1810	Open air lithic scatter	Unevaluated

Primary Number	*Trinomial Site Number* [a]	*Site Description*	*NRHP and California Register Eligibility*
56-001811	VEN-1811	Rockshelter with lithics, asphaltum and mammal bone	Unevaluated
56-001812	VEN-1812	Rockshelter with lithics	Unevaluated
56-001813	VEN-1813	Two rockshelters with a lithic scatter	Unevaluated
56-001814	VEN-1814	Rockshelter with shell, asphaltum	Unevaluated
56-001815	VEN-1815	Rockshelter with chert flake	Unevaluated
56-001817	VEN-1817	Rockshelter with flake	Unevaluated
56-001818	VEN-1818	Rockshelter with associated lithic artifacts	Unevaluated
56-001819	VEN-1819	Open air lithic scatter	Unevaluated
56-001820	VEN-1820	Rockshelter with mammal bone, lithic artifacts	Unevaluated
56-001821	VEN-1821	Open air lithic scatter	Unevaluated
56-001822	VEN-1822	Open air lithic scatter	Unevaluated
56-001823[b]	VEN-1823	Rockshelter with a pictograph panel, lithic artifacts, bone awl	Unevaluated
56-001824[b]	VEN-1824	Rockshelter with pictograph panel, bedrock mortar, lithic artifacts	Unevaluated
56-001825[b]	VEN-1825	Open air lithic scatter	Unevaluated
56-001826	VEN-1826	Rockshelter with chopper	Unevaluated
56-001827	VEN-1827	Rockshelter with quartzite cobble	Unevaluated
56-001828	VEN-1828	Rockshelter with quartzite flake	Unevaluated
56-001829	VEN-1829	Rockshelter with basketry	Unevaluated
56-001835	VEN-1835	Rockshelter with lithic artifacts	Unevaluated
56-001836	VEN-1836	Rockshelter with asphaltum, lithic artifacts	Unevaluated
56-001838	VEN-1838	Rockshelter with shell	Unevaluated
56-001840	VEN-1840	Rockshelter with asphaltum-coated basketry, shell, ground stone, lithics	Unevaluated
56-001841[b]	VEN-1841	Rockshelter with pictograph panel, lithic artifacts, ground stone	Unevaluated
SSFL, Area III			
56-001303	VEN-1303H	Building foundations, structure pads	Unevaluated
56-001443	VEN-1443H	Rockshelter with historic etchings	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
56-001483	VEN-1483	Open-air lithic scatter with 3 concentrations	Unevaluated
56-001487	VEN-1487/H	Inscribed boulders with one associated lithic artifact	Unevaluated
56-001489	VEN-1489	Rockshelter with associated lithic scatter, midden, fire hearth, and pictographs	Unevaluated
56-001497	VEN-1497	Rockshelter; lithic scatter	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	Eligible [d]
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	Eligible [d]
56-001414	VEN-1414	Bedrock mortar with associated lithic scatter	Eligible [d]
56-001415	VEN-1415	Lithic scatter	Unevaluated
56-001416	VEN-1416	Rockshelter with associated lithic scatter	Eligible [d]
56-001418	VEN-1418	Rockshelter with one associated lithic artifact	Eligible [d]
56-001420	VEN-1420	Lithic scatter	Ineligible [d]
56-001428	VEN-1428	Lithic scatter	Ineligible [d]
56-001772	VEN-1772	Rockshelter with historic pictograph and artifacts	Eligible [d]
56-001773	VEN-1773	Rockshelter with associated artifacts	Eligible [d]
56-001774	VEN-1774	Single bedrock mortar	Unevaluated
56-001775	VEN-1775	Rockshelter with midden and associated artifacts	Eligible [d]
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.

[d] DOE determined that 8 sites are individually eligible and 2 sites are individually ineligible for listing on the NRHP based on limited subsurface testing (Leidos 2015).

[e] Listed on the NRHP and California Register.

Notes:

The region of influence consists of SSFL and land within a 1-mile radius of SSFL; the APE comprises Area IV and the NBZ. This summary is based on a June 2014 record search, augmented by research on file at SSFL through 2017.

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			
56-100344	Area I	Isolate—quartzite core/scraper plane	Unevaluated
56-100345	Area I	Isolate—cobble with polish/battering	Unevaluated
56-100346	Area I	Isolate—cobble with polish/battering	Unevaluated
56-100353	Area I	Isolate—chert shatter	Unevaluated
56-100363	Area I	Isolate—red quartzite flake	Unevaluated
56-100364	Area I	Isolate—pink quartzite flake	Unevaluated
56-100365	Area I	Isolate—red/gray quartzite flake	Unevaluated
56-100366	Area I	Isolate—gray quartzite flake	Unevaluated
56-100367	Area I	Isolate—blue quartzite flake	Unevaluated
56-100368	Area I	Isolate—gray quartzite core	Unevaluated
56-100369	Area I	Isolate—gray quartzite flake	Unevaluated
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
56-100202	Area III	Isolate—chalcedony 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
56-100340	SBZ	Isolate—quartzite core fragment	Unevaluated
56-100341	SBZ	Isolate—gray quartzite flake	Unevaluated
56-100342	SBZ	Isolate—red/black quartzite flake	Unevaluated
56-100343	SBZ	Isolate—gray quartzite flake	Unevaluated
56-100347	SBZ	Isolate—metavolcanic core	Unevaluated
56-100348	SBZ	Isolate—gray quartzite flake	Unevaluated
56-100349	SBZ	Isolate—red/black flake	Unevaluated
56-100350	SBZ	Isolate—white quartz flake	Unevaluated

Primary Number [a]	*Location*	*Isolate Description*	*NRHP Eligibility*
56-100351	SBZ	Isolate—gray quartzite flake	Unevaluated
56-100352	SBZ	Isolate—pink quartzite flake	Unevaluated
56-100354	SBZ	Isolate—pink quartzite flake	Unevaluated
56-100355	SBZ	Isolate—gray/pink quartzite flake	Unevaluated
56-100356	SBZ	Isolate—pink quartzite flake	Unevaluated
56-100357	SBZ	Isolate—red quartzite flake	Unevaluated
56-100358	SBZ	Isolate—gray/pink quartzite flake	Unevaluated
56-100359	SBZ	Isolate—blue/gray quartzite flake	Unevaluated
56-100360	SBZ	Isolate—red quartzite flake	Unevaluated
56-100361	SBZ	Isolate—white quartzite flake	Unevaluated
56-100362	SBZ	Isolate—black quartzite flake	Unevaluated
56-100370	SBZ	Isolate—quartzite cobble	Unevaluated
56-100371	SBZ	Isolate—quartzite flake	Unevaluated
56-100372	SBZ	Isolate—quartzite flake	Unevaluated
56-100373	SBZ	Isolate—pink 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
56-100387	SBZ	Isolate—sandstone pestle	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
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

Primary Number [a]	Location	Isolate Description	NRHP Eligibility
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.

Notes:

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).

Although the isolates are listed as "unevaluated," they are considered ineligible by definition.

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 Resources

The Santa Ynez Band of Chumash Indians, a federally recognized tribe, has identified the entire SSFL as a Native American sacred site (referred to herein as the Santa Susana Sacred Sites and Traditional Cultural Property). In 2014, the tribe filed paperwork nominating the site to be included in the *State of California Native American Heritage Commission Sacred Lands Inventory* (NAHC 2014), and also notified DOE of its identification of a portion of SSFL as an Indian sacred site for consideration consistent with Executive Order 13007, *Indian Sacred Sites*. Executive Order 13007 requires that, in managing Federal lands and activities, Federal agencies "shall, to the extent practicable, permitted by law, and not clearly inconsistent with essential agency function . . . accommodate access to and ceremonial use of Indian sacred sites" and avoid adversely affecting the physical integrity of the sacred sites. While DOE does not own property at Area IV, DOE is working with the Native American tribes with ties to the SSFL area to preserve the cultural resources and the sacred nature of SSFL Area IV.

The draft nomination form 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 the Santa Susana Sacred Sites and Traditional Cultural Property, by the State of California.

There have been additional efforts by NASA, the Santa Ynez Band of Chumash Indians, non-federally recognized tribes, and others related to documenting SSFL's special significance to Native Americans. These efforts may result in the designation of one or more NRHP-eligible traditional cultural properties.

F.2.6 Consultations

DOE conducts consultation with federally recognized tribes as required by law. The Santa Ynez Band of Chumash Indians is a federally recognized tribe that attaches religious and cultural significance to affected historic properties at SSFL. DOE has engaged in consultation with the Santa Ynez Band of Chumash Indians, as well as non-federally recognized tribes regarding the cleanup of SSFL since 2009. In January 2014, DOE initiated Government-to-Government consultation with the Santa Ynez Band of Chumash Indians and initiated consultation in compliance with Section 106 of the NHPA. In 2014, DOE also formally issued an invitation to the Santa Ynez Band of Chumash Indians to be a cooperating agency in DOE's NEPA process for this EIS and the invitation was accepted (Santa Ynez Band of Chumash Indians 2014). DOE continues to conduct informal consultation with non-federally recognized tribes throughout the NEPA and NHPA, 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. They have contributed to this EIS, including preparing their tribal histories and perspectives (see Chapter 9, "Native American Histories and Perspectives").

DOE is consulting with SHPO, the Santa Ynez Band of Chumash Indians, non-federally recognized tribes, and other consulting parties to develop a Programmatic Agreement that will establish procedures for addressing adverse effects on historic properties; the Programmatic Agreement will satisfy DOE's responsibilities under NHPA, Section 106.[3] As required by the Section 106 process (36 CFR 800.2(d) and 800.3(e)), members of the public have been involved through special meetings for SSFL stakeholders and through avenues provided by the NEPA process.

[3] A Programmatic Agreement pursuant to 36 CFR 800.14(b) is the most suitable agreement document for DOE's remediation at SSFL because the effects on historic properties cannot be fully determined prior to approval of the undertaking.

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Appendix G
Evaluation of Remediation Activity Impacts on Human Health

APPENDIX G
EVALUATION OF REMEDIATION ACTIVITY IMPACTS ON HUMAN HEALTH

G.1 Introduction

This appendix to the *Final 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 impacts on human health due to chemical and radionuclide exposures resulting from remediation activities at the Santa Susana Field Laboratory (SSFL) Area IV and the Northern Boundary Zone (NBZ). Human health impacts were evaluated at onsite locations (to workers) during remediation and offsite locations both during and after remediation. Human health impacts for onsite locations after remediation is completed are addressed in Appendix K.

Onsite worker impacts were estimated from external exposure, dermal contact, incidental ingestion, and inhalation pathways based on the emission of material from onsite sources into onsite air. Offsite impacts were estimated based on the emission of material from onsite sources, atmospheric transport of material to offsite locations, and subsequent exposure of offsite receptors. Offsite exposures occur both directly through inhalation and submersion and through soil exposure pathways following deposition to soil. Exposure pathways for the offsite receptors include inhalation, incidental ingestion, dermal contact (for chemicals), and external exposure (for radionuclides). Offsite exposures also occur indirectly from ingestion through a fruit and vegetable garden pathway.

The emission rates of contaminated material were determined from site-specific soil parameters, as well as the quantity of contaminated material associated with each alternative. Atmospheric transport was modeled using site-specific meteorological data from a weather tower within SSFL to provide estimates of air and soil concentrations at offsite receptor locations. The media concentrations were then compared to site-specific, risk-based screening levels (RBSLs) for each exposure pathway to determine the potential for adverse human health impacts on the receptors.

In summary, the impacts were evaluated from:

- Estimated emissions from onsite source areas,
- Modeled atmospheric transport of source emissions to offsite locations,
- Calculated offsite media concentrations at hypothetical offsite receptor locations, and
- Estimated human health impacts on both onsite workers and offsite receptors.

Methods used in this evaluation are consistent with U.S. Environmental Protection Agency (EPA) guidance and use default values where no appropriate site-specific information is available for use in the calculation of offsite impacts (e.g., contaminant emissions equations, dispersion model inputs, human exposure parameters). In general, parameter values used in the calculations were selected to represent a maximum reasonably foreseeable exposure scenario, intended to reflect an upper bound estimate of impacts that are unlikely to be exceeded.

The remediation worker is considered the only onsite receptor during remediation activities, while two receptors were considered in the offsite impact assessment, a suburban resident and a recreational user. For the offsite impacts, the location of each receptor was determined from the meteorological data to represent a maximum exposure based on prevailing wind directions and atmospheric conditions (see Section G.5).

The evaluation of human health impacts was based on estimates of:

- Cancer incidence risk from exposure to chemicals and radionuclides,
- Potential for toxic effects from exposure to chemicals, and
- Radiological dose from exposure to radionuclides.

The radiological doses presented in these assessments are estimates based on conversion of cancer incidence risks, using dose conversion factors for specific radionuclides and exposure pathways (see Section G.9.3). Therefore, the dose estimates should be considered rough approximations intended to provide a measure for comparison of remediation alternatives.

The following sections present details regarding each step in the evaluation of human health impacts from remediation activities.

G.2 Emission from Onsite Sources for Remediation Alternatives

For each of the remediation alternatives, the emission rate of contaminated material was estimated from the SSFL site-specific soil properties, assumed material handling practices, and the total area or volume of contaminated material handled. For the No Action Alternative, emissions of chemicals and radionuclides were based on the total surface area of the sources, as no soil is disturbed. For the soil action alternatives, emissions of chemicals and radionuclides were based on the volume of material removed and loaded into trucks. Building demolition emissions were based on assumed releases of radiological material from interior building surfaces during remediation actions. Finally, radiological emissions from bedrock excavation were estimated based on assumptions regarding the technical implementation of overburden and bedrock removal. For simplicity and conservatism, offsite transport modeling assumed that all emissions originated from the approximate center of Area IV/NBZ (see **Figure G–1**).

Another consideration is the duration of the emissions, which is based on the anticipated time to complete particular remediation actions, as well as the exposure period for the offsite receptors. As discussed in Section G.7, the estimate of impacts considered both long-term (e.g., cancer incidence over a lifetime) and shorter-term (e.g., peak dose) health effects.

> *Example*: A remediation action emission of 2,600 grams over a 2-year period is evaluated both as an emission rate of 100 grams per year over a 26-year exposure period to address carcinogenic impacts, as well as an emission rate of 1,300 grams per year to estimate a peak radiological dose. These are identical intakes, but are calculated this way to facilitate the use of the risk/dose slope factors.

The estimated emissions rates for the remediation alternatives utilized conservative assumptions regarding soil parameters to generate a maximum reasonably foreseeable value. Emission estimates were also generated with additional sets of parameter values to provide more likely and less conservative results (see **Tables G–1** through **G–3**). The uncertainty in the emissions estimates covers many orders of magnitude and indicates that emissions are more likely to be significantly lower than the highly conservative values used in the offsite impact assessment, as further discussed in Section G.12.

The emission rates used to determine the offsite human health impacts are further described in the following sections.

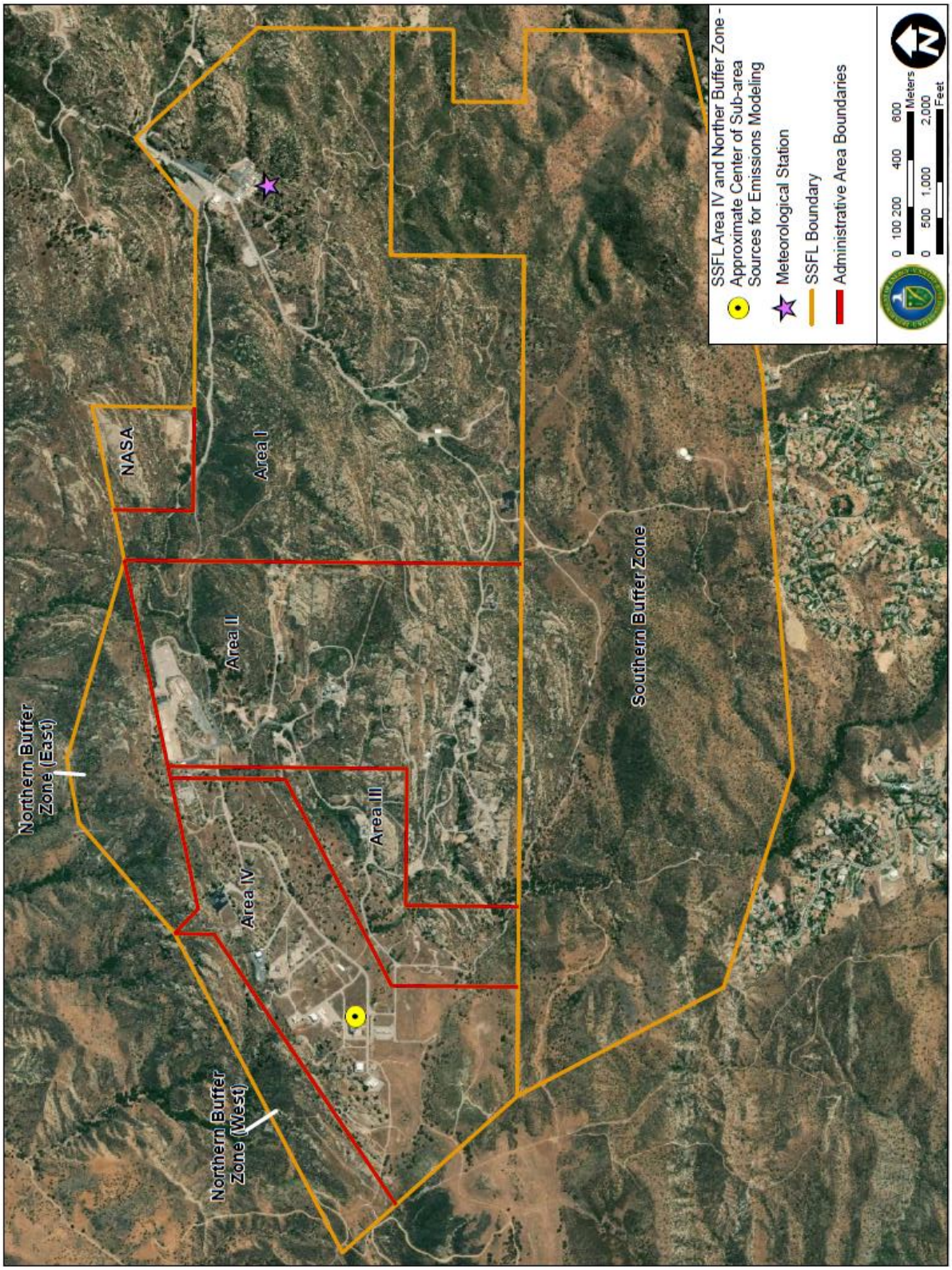

Figure G–1 Location of Approximate Center of Area IV/NBZ and SSFL Weather Tower

G.2.1 Source Emissions – No Action Alternative

Under the No Action Alternative, contaminated material would be left in place and may be subject to wind scour, resulting in suspension of surface soil in air. The methods used to estimate wind scour soil emissions are based on Cowherd et al. 1985, using the following input parameters:

- soil silt content
- average wind speed
- fraction of vegetative cover
- average particle size
- fraction of non-erodible elements in soil
- soil roughness height

Table G–1 presents the values used in the No Action Alternative soil emission calculations, as well as the estimated soil emission rate. For the No Action Alternative, the maximum reasonably foreseeable areal emission rate is estimated to be 1.2×10^{-10}grams per square meter-second or 1.1×10^{-4} grams per second for a 222-acre (~900,000-square meter) source. The analysis of offsite impacts for the No Action Alternative was based on an average wind speed from data collected from 2009 through 2012 (see Section G.4). Table G–2 presents the estimated offsite air and soil concentrations of suspended contaminated material based on the atmospheric modeling presented in Section G.5, with media concentrations for each constituent presented in Section G.7. An additional analysis of extreme wind conditions that represent Santa Ana winds was also conducted and is presented in Section G.12.

G.2.2 Source Emissions – Soil Remediation Alternatives

For the soil remediation alternatives, soil emission rates were based on the volume of material excavated and loaded into trucks for transport. It was assumed that the only source of emissions were associated with the dumping of material from the excavator to the transport vehicle. It was assumed that vehicle traffic would not be allowed to drive over contaminated areas and that no stockpiles of contaminated materials would be maintained onsite after excavations. The calculated maximum reasonably foreseeable emission factor for the excavation alternatives was 1.75×10^{-4} grams per kilogram (see **Table G–3**). The resulting soil emission rates are presented in **Table G–4** for each alternative. **Table G–5** presents the estimated offsite air and soil concentration of suspended contaminated material based on the atmospheric modeling presented in Section G.5 as applied to the onsite media concentrations for each constituent as discussed in Section G.7.

G.2.3 Source Emissions – Building Demolition

The amount of material that may become suspended in air during building demolition was estimated from radiation 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 assumed to be suspended in air during demolition activities. Additionally, it was assumed that 50 percent of the removable material is 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. **Table G–6** presents the emissions of material associated with contaminated building demolition. Offsite media concentrations of each constituent are discussed in Section G.7.

During remediation actions associated with building demolition, it was assumed that mitigation measures would be used to reduce the amount of material suspended in air or minimize worker exposure. Water spraying has the potential to reduce the airborne particulate concentrations by 50 percent in all buildings (EPA 1996). For Buildings 4021 and 4022 sub-grade vaults, was assumed that workers would wear respiratory protection that would provide 99 percent efficiency in particulate removal. For other buildings, respiratory protection was not deemed likely and all emissions were included in the evaluation.

G.2.4 Source Emissions – Groundwater Remediation - Bedrock Excavation Alternative

The remediation worker exposure to bedrock was based on the following assumptions:

- The remediation worker is present in a 30×60×45-foot bedrock excavation plus a 40×100×22.5-foot ramp, for a total 171,000-cubic-foot excavation extending to the bottom of the excavated bedrock.
- Bedrock is removed in approximately 1-cubic-foot sections that contain strontium-90 contamination at 516 picocuries per gram. The total volume of bedrock to be removed was assumed to be 30 by 60 by 45 feet, for a total of 73,800 cubic feet or 2,733 cubic yards (volume of rock 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 4,428 cubic feet (164 cubic yards).

Exposure to radioactive material on bedrock surfaces is considered analogous to exposure from radioactive contamination on hard surfaces such as walls or floors. Offsite media concentrations of each constituent are presented in Section G.7. **Table G–7** presents the estimated emissions associated with bedrock excavation.

G.2.5 Source Emissions – Summary

For the offsite impacts assessment, the emissions of contaminated material associated with each remediation alternative was combined with results from atmospheric dispersion modeling to generate estimated offsite media concentrations, as discussed in the following sections. For the onsite impacts assessment, the emissions from building demolition and bedrock excavation were used to estimate air concentrations near the emissions source.

G.3 Representative Concentrations of Constituents in Contaminated material

To estimate specific concentrations of constituents in media, a representative concentration of each chemical and radionuclide was developed for the contaminated material that may be emitted to the atmosphere. A 95 percent upper confidence limit on the mean (UCL95) was determined for each constituent in the contaminated material for each soil alternative (see **Tables G–8** and **G–9**), which was used in the calculation of media concentrations. Where the UCL95 exceeded the maximum detected value for a source area, the maximum detected value was use as the representative concentration for that constituent.

A soil partitioning and treatability study investigated soil within Area IV and the NBZ (Matsumoto and Martin 2015). The results indicated the potential for preferential partitioning of constituents in the smaller particle sizes that are most prone to suspension in air, specifically those less than 10 micrometers in diameter (PM_{10}). Therefore, representative concentrations calculated for constituents in bulk soil were increased by a factor of two to reflect potential constituent concentration in the small grain size particulates in the contaminated material. The adjustment to the PM_{10} constituent concentrations in contaminated material produces estimates of impacts on offsite receptors that are unlikely to be exceeded. This adjustment applies only to the soil remediation alternatives.

For the soil No Action Alternative, it was assumed that the source of wind scour emission was a 222-acre area that contained both chemical and radiological materials.

For the soil remediation action alternatives, two distinct source areas were considered. It was assumed that areas identified as sources of radiological constituents would be remediated in the initial phases of soil excavation alternatives. Since there may be a maximum short-term dose that is associated with excavation of these radiological sources, the calculation of maximum annual dose is based on representative concentrations within the radiological area. A second area consisting of the combined chemical and the radiological sources was significantly larger and served as the basis for developing representative concentrations for the evaluation of the long-term health effects associated with risk of cancer incidence (see Section G.7).

G.3.1 Identification of Chemical Contaminants of Concern in Source Areas

Chemical contaminants of concern (COCs) were contaminants that passed background and frequency of detection (2.5 percent or greater) screening in any subarea onsite. The frequency of detection criterion corresponds to expected false positive rates based on formulas used for detection decisions.

G.3.2 Identification of Radiological Contaminants of Concern in Source Areas

Radiological COCs were contaminants that passed background, had a frequency of detection (5 percent or greater) in any subarea onsite, and data quality assessment screens as documented in the *Radionuclide Data Assessment Report* (Leidos 2018). The frequency of detection criterion corresponds to expected false positive rates based on formulas used for detection decisions (different formulas were used for chemicals and radionuclides; see Chapter 4, Section 4.9.1.2.1).

G.3.3 Identification of Radiological Contaminants of Concern for Building Surfaces

Sampling of the building interior surfaces has quantified the level of total fixed and removable contamination. A list of radiological constituents determined to be associated with these building surfaces was used to determine the specific concentrations of radionuclides within each building.

The radiological surveys conducted on the building interior surfaces are presented in **Table G–10**, with the results presented in **Table G–11** for the fixed and removable contamination in each building.

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–12**. 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 and the total interior air volume. Interior floors, walls, and ceilings were assumed to be contaminated; exterior surfaces of most buildings were generally assumed to be insignificantly contaminated, however potential contamination on the roofs of Buildings 4075, 4621, 4665, and 4688 were assumed to be contaminated based on past surveys (see Table G–11).

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.3.4 Identification of Radiological Contaminants of Concern for Bedrock Excavation

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.

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 millicuries 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 millicuries. 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 ofstrontium-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 Section G.2.4) to determine the potential for adverse health effects.

G.4 Meteorological Data Evaluation

Meteorological measurements were collected from a 10-meter tower located within Area IV, with data obtained for the years 2001 through 2012. Data from years since 2012 were not readily available, but a review of recent data from offsite stations indicate that regional weather patterns have generally remained consistent (see Section G.12.3).

Observations were collected for the following parameters:

- barometric pressure
- air temperature
- wind direction (scalar and vector means, standard deviation)
- wind speed (scalar and vector means)
- relative humidity
- precipitation

The observations presented in the meteorological data set are hourly averages, which were summarized to provide specific inputs to the atmospheric modeling. An evaluation of the data required for dispersion modeling was conducted to identify data that were of sufficient quality for the assessment. Per EPA guidance (EPA 2000), multiple years of site-specific data are preferable for modeling applications and quarterly data were determined to be acceptable if they had greater than 90 percent capture rates of the modeling parameters (wind speed, wind direction, standard deviation of wind direction). A valid year of data was four consecutive quarters of valid data. The meteorological data evaluation indicated that the years 2009 through 2012 were acceptable for modeling applications.

The meteorological data indicate that the prevailing winds and atmospheric conditions would likely produce maximum impacts in the northwest or southeast direction for any given distance from the emissions source (see **Figure G–2**).

G.5 Atmospheric Dispersion Modeling

A Gaussian plume dispersion model was used to estimate the offsite air concentrations. The EPA model CAP88 was selected for this application (EPA 2013). Meteorological data used in the model were:

- Scalar average wind speed
- Scalar-averaged wind direction
- Estimated atmospheric stability class

The criteria used to estimate the stability class is presented in **Table G–13**.

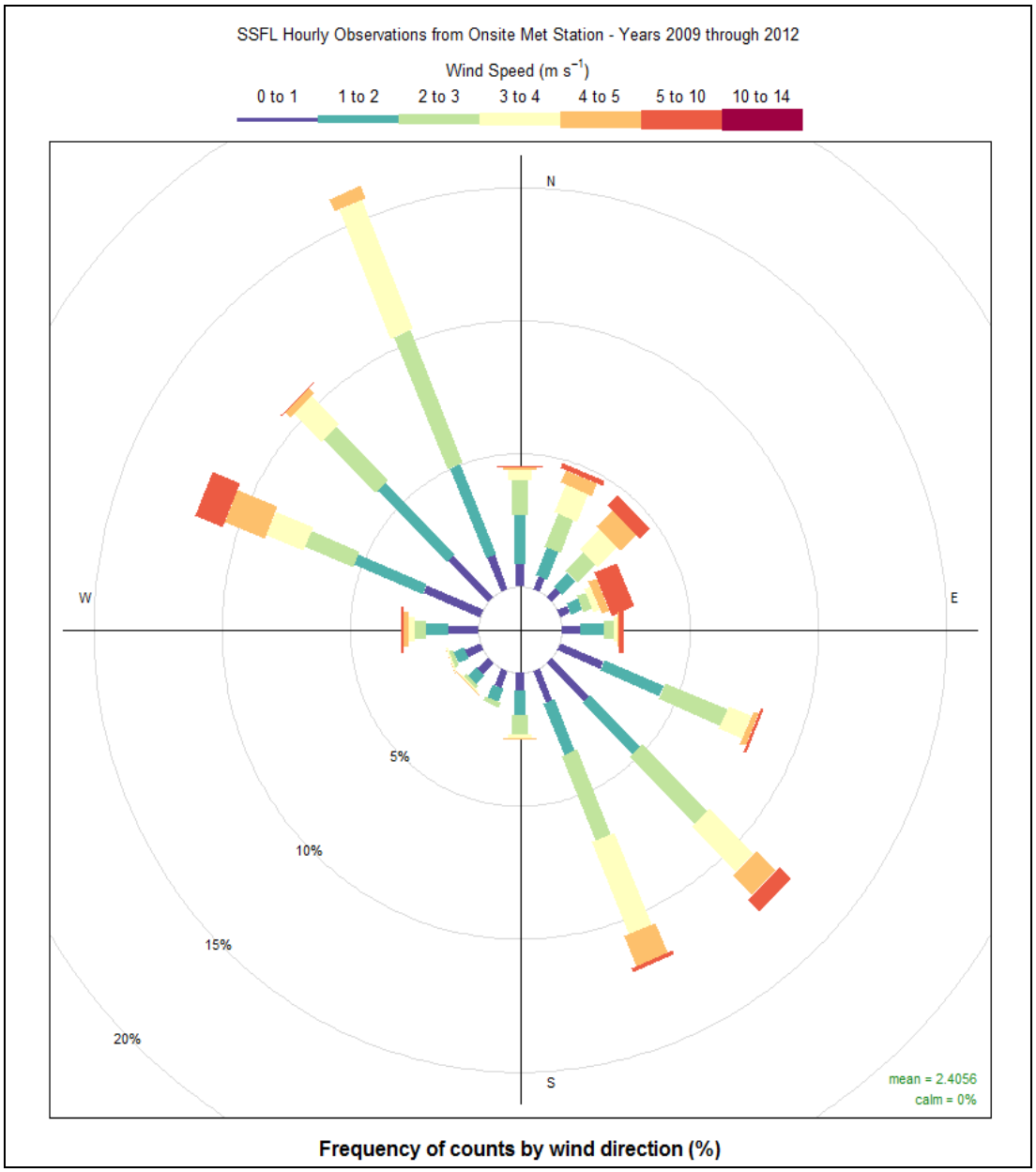

Figure G–2 SSFL Wind Rose for 2009 through 2012

The dispersion model output is the estimated air concentration for a unit emission rate, referred to as the X/Q (chi over Q), with X representing the air concentration and Q representing the emission rate. The X/Qs are specific to a wind direction and distance from the emission source and are expressed in units of seconds per cubic meter (s/m^3), based on an X in grams per cubic meter (g/m^3) and a Q in grams per second (g/s). **Table G–14** presents the estimated X/Q values generated by the dispersion model for the receptor locations presented in Section G.6.

G.5.1 Atmospheric Stability Class

Modeling of atmospheric transport utilizes assumptions regarding the dispersion of contaminants at downwind distances from the source. Contaminants originate as emissions from a source and are transported downwind as a plume that travels along a centerline and disperses vertically and laterally. The atmospheric stability determines the extent of dispersion acting on a plume, and is dependent on the time of day, wind speed, and degree of atmospheric mixing. Where the atmosphere is unstable and significant mixing of contaminated and ambient air occurs, the concentration along the plume centerline is reduced due to greater dispersion. Conversely, a very stable atmosphere results in plume centerline concentrations that are higher due to less mixing.

The stability classes represent the degree of mixing/dispersion in the atmosphere and are described as:

- Class A - Very Unstable
- Class B - Unstable
- Class C - Slightly Unstable
- Class D - Neutral
- Class E - Slightly Stable
- Class F - Very Stable

Therefore, for a given distance and direction, the concentration in the center of the plume will be significantly higher if the atmosphere is very stable (Class F) as opposed to lower concentration if the atmosphere is very unstable (Class A). Class A, B, and C occur exclusively during daylight hours and Classes E and F are observed only at night, with Class D observed during all hours. The meteorological data set was further analyzed to determine the frequency of occurrence of these stability classes and the associated wind speed/direction. **Table G–15** presents general characteristics for each of the Pasquill-Gifford Stability Classes used in this analysis.

Dispersion modeling based on 2009 through 2012 SSFL meteorological data indicate that locations to the northwest of an emissions source would receive the maximum impacts (see **Figure G–3**), based on the prevailing wind direction, wind speeds, and atmospheric stability class. **Table G–16** provides a summary of the meteorological data collected from 2009 through 2012.

All constituents were modeled as ground level emissions of particulates. The dispersion modeling results were then used to identify receptor location that may represent the maximum offsite impacts associated with emissions from Area IV and NBZ sources, as discussed in the following section.

G.6 Receptor Locations

The anticipated offsite receptor locations were selected based on the observed land-use and activity patterns from the area surrounding Area IV and the NBZ and results of the atmospheric dispersion modeling. The assumed receptor locations were based on conservative assumptions to provide upper bound estimates of potential impacts. The onsite receptor is a worker who is assumed to be present in the vicinity of each building during demolition or immediately adjacent to the bedrock excavation.

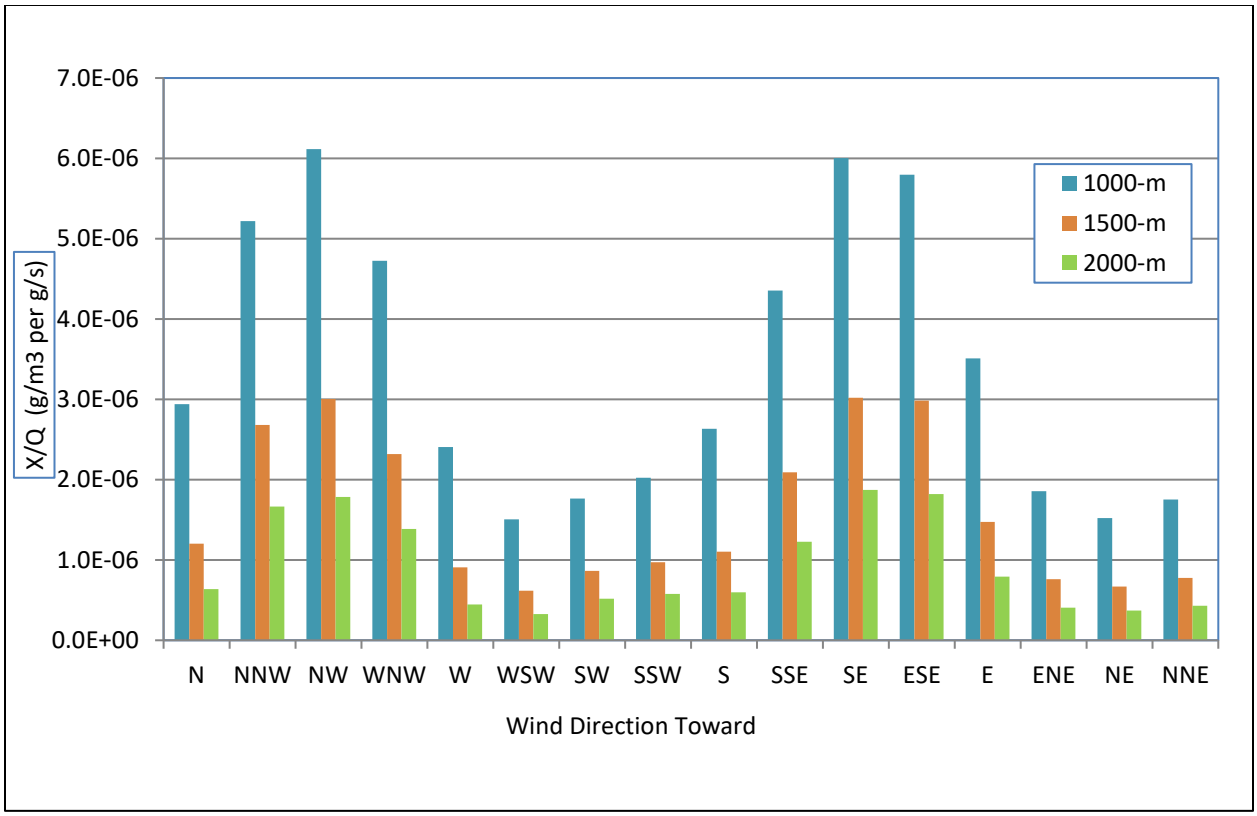

Figure G–3 SSFL Dispersion Modeling – Chi over Q (X/Q) at Selected Distances from Emissions Source Meteorological Data – 2009 through 2012

G.6.1 Offsite Suburban Resident

The location of the offsite suburban resident was based on the direction of maximum predicted X/Q, which was to the northwest. Existing residential developments and projected future developments were used to identify a location to the northwest that could plausibly support a suburban resident with a home garden. It was determined that a distance of 1,800 meters to the northwest would be the nearest that a development could approach the SSFL Area IV/NBZ source areas, based on topography and neighboring conservation lands (see Figure G–1). The location of the offsite suburban resident in this evaluation was selected to represent an upper bound exposure, and the general population would likely experience significantly lower offsite impacts.

G.6.2 Offsite Recreational User

The offsite recreational user was an individual who was assumed to spend time along the SSFL fence line; therefore, a location 500 meters from the center of SSFL to the northwest was selected to provide a likely maximum exposure (see Figure G–1). It is more likely that the offsite recreational user would move around the entire perimeter of the site and be exposed at varying distances and directions from the emission source. However, it was conservatively assumed that the offsite recreational user is regularly exposed at the point of maximum impact to the northwest.

G.6.3 Onsite Worker

The onsite worker was assumed to be in the immediate vicinity of each building during demolition activities at a location impacted by emissions of radiological material from the interior building surfaces. Similarly, an onsite worker was assumed to be in close proximity to the bedrock excavation at a location impacted by emissions of bedrock material during removal.

G.7 Offsite Media Concentrations

Offsite media concentrations were calculated for each constituent in the source area for each alternative by combining the: emission rate of contaminated material, estimated offsite air and soil concentration predicted by dispersion modeling, and representative concentrations of each constituent in the contaminated material. Modeled air concentration were the basis for estimating the deposition and buildup of constituents in soil.

For the remediation action alternatives, the duration of the emission associated with remediation were incorporated into the calculation of media concentrations. Media concentrations used to evaluate carcinogenic effects were calculated differently from those used to evaluate radiological dose or toxic effects (see Sections G.7.4 and G.7.5).

The following sections present the estimated offsite air and soil concentrations.

G.7.1 Offsite Air Concentrations

The offsite air concentrations of specific constituents were based on the emission rates of suspended soil, dispersion modeling results, and the concentration of each constituent in the suspended soil, as presented in the following example calculation.

> *Example:* A dispersion model predicts a suspended soil air concentration (X/Q) of 10 grams per cubic meter-second (or 10 seconds per cubic meter) is emitted from a source. Therefore, a suspended soil emission rate (Q) of 20 grams per second would generate an air concentration (X) of 200 grams per cubic meter of suspended soil. If the emitted contaminated material had a soil exposure point concentration (EPC) of 4 picocuries per gram for constituent x, the offsite air concentration of constituent x would be estimated as 800 picocuries per cubic meter.
>
> The air concentration is calculated as:
>
> $$\text{Air concentration}_{\text{constituent x}} = X/Q_{\text{suspended soil}} \times Q_{\text{suspended soil}} \times EPC_{\text{constituent x}}$$
>
> 800 picocuries/cubic meter = 10 second/cubic meter × 20 grams/second × 4 picocuries/gram
>
> Offsite air concentrations were estimated for each constituent in source areas associated with each remediation action for each offsite receptor location.

Tables G–17 through **G–27** present the offsite air concentrations for chemicals and radionuclides associated with contaminated materials for each remediation alternative. These offsite media concentrations were then compared with RBSLs to estimate the offsite impacts on human health.

G.7.2 Offsite Soil Concentrations

The soil concentration at the offsite receptor locations was calculated from the offsite suspended soil air concentration, assuming a dry deposition rate of 1.8×10^{-3} meters per second and buildup period reflective of the duration of the remediation actions. The onsite material that is transported and deposited offsite was assumed to mix with unimpacted soil at the offsite location, assuming mixing of deposited material to a depth of 0.025 meters. The resulting soil concentration represents the mass of contaminated material per mass of total soil and was calculated as follows:

> *Example:* A suspended soil air concentration of $1\times10^{-3}\text{grams}_{\text{source}}$ per cubic meter results in an areal deposition rate of $1.8\times10^{-6}\,\text{grams}_{\text{source}}$ per square meter-second. Over a 30-year (9.5×10^{8} seconds) deposition period, the total areal deposition is $1.7\times 10^{3}\,\text{grams}_{\text{source}}$ per square meter.

Assuming an areal mixing mass of soil at the offsite location of 4×10^{-4} $grams_{soil}$ per square meter, the offsite soil concentration of deposited contaminated material is 4.3×10^{-2} $grams_{source}$ per $gram_{soil}$, which is calculated as follows:

Offsite soil concentration of contaminated material = air concentration of source × deposition rate × deposition time/soil mixing mass per area

4.3×10^{-2} $grams_{source}/grams_{soil}$ = 1×10^{-3} $grams_{source}$/cubic meter × 1.8×10^{-3} meters/second × 9.5×10^{8} second/4×10^{4} $gram_{soil}$/square meter

The mixing mass of offsite soil was based on a soil density of 1.6×10^{6} grams per cubic meter and a mixing depth of 0.025 meters, resulting in 4×10^{4} grams per square meter.

The concentration of particular constituents in offsite soil is calculated as the offsite soil concentration of contaminated material, multiplied by the constituent concentration in the contaminated material. For the above example of 4.3×10^{-2} $gram_{source}$ per $gram_{soil}$, if the contaminated material concentration of constituent x is 10 picocuries per $gram_{source}$, then the offsite soil concentration of constituent x is 4.3×10^{-1} picocuries per $gram_{soil}$.

Offsite soil concentrations were estimated for each constituent in source areas associated with each remediation action for each offsite receptor location.

Tables G–28 through **G–31** present the offsite soil concentrations for chemicals and radionuclides associated with contaminated materials for each alternative. Soil concentrations for the building demolition and bedrock remediation alternatives are presented in Tables G–21 and G–22, respectively, for the offsite suburban resident and in Tables G–27 and G–22, respectively, for the offsite recreational user. These offsite media concentrations were then compared with RBSLs to estimate the offsite impacts on human health.

G.7.3 Offsite Media Concentrations for Carcinogenic Evaluation

The evaluation of long-term impacts related to cancer incidence assumes an exposure to air and soil over a period of 26 years because the RBSLs are based on a 26-year exposure. Therefore, representative air and soil concentration that reflect a 26-year exposure were developed by generating an emission rate for each alternative that reflects an average over the 26-year duration of the exposure (see Section G.9).

The soil action alternative emissions used to evaluate cancer incidence risk were based on an emissions source composed of all chemical sources and radiological sources remediated over the entire period of excavation.

G.7.4 Offsite Media Concentrations for Radiological Dose Evaluation

The offsite media concentrations used to evaluate the annual radiological air dose were based on soil remediation action alternative emissions from the primary radiological source areas, which would be removed in the first 2 to 3 years of the soil remediation alternatives. These air concentration estimates were used to estimate maximum annual radiological doses that represent an upper bound during remediation actions.

G.7.5 Offsite Media Concentrations for Toxic Effects Evaluation

Toxic effects are determined based on annual exposures to offsite media concentrations and reflect short-term impacts. Therefore, the offsite impacts associated with toxic effects were based on emissions of shorter duration, but from areas with higher chemical concentrations.

G.8 Risk-Based Screening Levels

RBSLs are media concentrations that represent a specific level of cancer risk or toxic effects for a specific set of exposure parameters. RBSLs were calculated for both the offsite receptors (suburban resident and recreational user) and the onsite worker, as described below.

G.8.1 RBSLs for Offsite Receptors

The calculation of RBSLs for the offsite receptors utilized online tools available from the Risk Assessment Information System (RAIS), which is developed and maintained by the Oak Ridge National Laboratory (RAIS 2018). Online calculators are also available from the EPA; however, the exposure scenarios and available pathways are not consistently available for chemical and radiological constituents on the EPA site. As an example, for radionuclides the produce exposure pathway is available for both the residential and farmer scenarios, but for chemicals there is no produce pathway available for the resident and the farmer scenario from the EPA website. The RAIS calculators use methodologies consistent with EPA methods, but at the time of publication of this Final EIS, only the RAIS calculators offered a residential produce pathway for both chemicals and radionuclides. Note that the online calculators refer to RBSL as Preliminary Remediation Goals or PRGs.

RBSLs were generated for the following scenarios and exposure pathways:

- Offsite Suburban Resident
  - Direct Soil Exposure
    - Ingestion, inhalation, dermal contact/external exposure
  - Direct Air Exposure
    - Inhalation, external exposure due to submersion
  - Produce Exposure
    - Ingestion of homegrown fruits and vegetables.
- Offsite Recreational user
  - Direct Soil Exposure
    - Ingestion, inhalation, dermal contact/external exposure
  - Direct Air Exposure
    - Inhalation, external exposure due to submersion.

RBSLs were calculated to evaluate both carcinogenic and noncarcinogenic effects for the receptor scenarios. Carcinogenic RBSLs were calculated for an incremental cancer incidence risk of 1×10^{-6}, or 1 additional cancer incidence per 1,000,000 exposures. Noncarcinogenic RBSLs were calculated for a hazard quotient of 1, representing the threshold for an increased likelihood of toxic effects.

The evaluation of carcinogenic effects is based on risks over a lifetime from an exposure over a 26-year period. The evaluation of toxic effects is based on exposures that occur on an annual basis, which includes 0 to 26 years (6 years with child parameters and 20 years with adult parameters). Since children represent more sensitive receptors, toxicity RBSLs are typically lower for children. Therefore, the calculation of hazards associated with SSFL exposures were based on the child included in the RBSLs.

The calculations of RBSLs are also dependent on the specific exposure parameters used to evaluate each exposure pathway (e.g., soil ingestion rate, skin surface area available for dermal contact). Default exposure parameters were generally used; however, site-specific soil parameters were used to calculate the rate of particulate emissions from soil, as were site-specific produce ingestion rates cited in the

Final Standardized Risk Assessment Methodology, Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California (SRAM) (MWH 2014). **Tables G–32** and **G–33** present the exposure parameters used in the RBSLs for the offsite receptors. **Tables G–34** through **G–39** present the RBSLs for each of the offsite receptor scenarios and exposure pathways. **Tables G–41** and **G–42** present the RBSLs for the offsite suburban resident and recreational user for the list of isotopes associated with the building interiors.

Potential adverse health effects were estimated by comparing the media concentrations of specific constituents with their respective RBSLs (see Section G.9).

G.8.1.1 Particulate Emission Factor

Sampling of site soil along with local meteorological data provided site-specific parameters that were used to develop the particulate emission factor (PEF). The PEF is used in the evaluation of the direct soil inhalation pathway and represents the amount of soil that may become resuspended at the receptor location. The PEF is an intermediate calculation used in the RAIS calculator and is based on the following site-specific soil parameters:

- mean annual wind speed: 2.3 meters per second
- location of site: Los Angeles, California
- threshold equivalent wind speed: 9.22 meters per second
- site area: 2.5 acres
- fraction of vegetative cover: 0.25

The resulting site-specific PEF of 1.84×10^{12} cubic meter per kilogram was incorporated into the RBSL for the direct soil inhalation pathway. The threshold equivalent wind speed (the wind speed at 10 meters that would exceed the threshold required for suspended soil emission) of 9.22 meters per second was previously calculated in the source area emission calculation (see Section G.2), with the same value used in the RBSL calculation for consistency.

G.8.1.2 Produce Ingestion

The offsite suburban resident receptor includes the produce ingestion pathway, which is based on ingestion of fruits and vegetables grown in a home garden. The evaluation of the produce pathway was based on parameters presented in the SRAM (MWH 2014), which incorporated site-specific considerations and is consistent with previously completed evaluations. The SRAM references site-specific information from the EPA Exposure Factors Handbook for the following:

- Adult fruit ingestion rate: 377.3 grams per day
- Adult vegetable ingestion rate: 324.8 grams per day
- Child fruit ingestion rate: 81.5 grams per day
- Child vegetable ingestion rate: 84.9 grams per day

It was conservatively assumed that all the fruits and vegetables ingested were grown in the impacted soil at the suburban resident offsite location.

G.8.2 RBSLs for Onsite Receptor

The RBSLs used for the onsite worker exposed to building interior surfaces were obtained from the EPA website (EPA 2018), based on the indoor worker scenario using default exposure parameters. Because the available building RBSLs (i.e., building PRGs) are based on a default set of exposure parameters that do not reflect the assumed exposure for a building remediation worker, the building

RBSLs were adjusted to provide a more accurate estimate of the potential risks and doses associated with the remediation actions for each individual building. These adjustments were necessary because the building RBSLs are based on a default exposure scenario of 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 building RBSLs were multiplied by 6,250 days and divided by the remediation action duration for each building (see **Table G–40**). The default building RBSLs are those associated with cancer incidence risk. Radiation doses were estimated using the methods presented in Section G.9.3.

G.9 Calculation of Human Health Effects

Potential adverse health effects were estimated by scaling the media concentrations of specific constituents to their respective RBSLs. The overall risks and hazards for all pathways for a particular constituent were generated by summing the impacts for each individual pathway. The total risks and hazards for a particular remediation action were estimated by summing the results for all constituents included in the contaminated material emissions. Section G.10 presents the evaluation of cancer risks, toxic effects, and radiological doses for individual constituents, as well as a summation of the overall impacts for each remediation action.

G.9.1 Carcinogenic Risk

Cancer incidence risks were estimated by comparing the media concentrations of specific constituents with their respective RBSL.

> *Example:* For constituent x, the cancer incidence RBSL for the direct air inhalation pathway was calculated as 10 micrograms per cubic meter at a risk level of 1×10^{-6}. Therefore, a constituent x air concentration of 50 micrograms per cubic meter would result in a cancer incidence risk of 5×10^{-6} for the direct air inhalation pathway. The cancer incidence risk is the ratio of the media concentration to the RBSL, times the risk level represented by the RBSL and is calculated as:
>
> Cancer risk – direct air inhalation = air concentration/RBSL-direct air inhalation × risk level
>
> 5×10^{-6} = (50 micrograms/cubic meter / 10 microgram/cubic meter) × 1×10^{-6}
>
> Similar calculations were performed for each constituent and exposure pathway, based on the offsite media concentrations specific to each remediation action.

The cancer incidence risk represents the potential for an increased cancer incidence relative to a rate of exposure, such as 1 additional cancer incidence per 1,000,000 exposures, expressed as a fraction. A cancer incidence risk of 1×10^{-7} indicates 1 additional cancer incidence per 10,000,000 exposures. The total cancer incidence risk is compared with the target risk range for remediation alternatives range of 1 in 10,000 (1×10^{-4}) to 1 in 1,000,000 (1×10^{-6}) (EPA 1991) to determine the potential for adverse health effects from carcinogenic constituents.

The carcinogenic risks were summed for chemicals and radionuclides separately for each remediation alternative to provide an overall estimate of offsite impacts (see Section G.10).

G.9.2 Toxic Effects

The potential for toxic effects was estimated by scaling the media concentrations of specific constituents to their respective RBSLs for noncarcinogens.

Example: For constituent x, the toxic effects RBSL for the direct soil ingestion pathway was calculated as 10 micrograms per gram for a hazard quotient of 1. Therefore, a constituent x soil concentration of 2 micrograms per gram would result in a hazard quotient of 0.2 for the direct soil ingestion pathway. The hazard quotient is the ratio of the RBSL to the media concentration, times the hazard quotient represented by the RBSL and is calculated as:

Hazard quotient – direct soil ingestion = soil concentration/$RBSL_{\text{direct soil ingestion}}$ × hazard quotient

0.2 = 2 micrograms/gram / 10 micrograms/gram × 1

Similar calculations were performed for each constituent and exposure pathway based on the offsite media concentrations specific to each remediation alternative.

Toxic effects are expressed as a hazard quotient for individual constituents and pathway calculation, with the sum of several hazard quotients identified as a hazard index. Where the total hazard index for a constituent exceeded 1, the potential for adverse health effects is increased. The calculated total hazard index for all constituents associated with a particular alternative is also compared to a value of 1 to indicate the significance of offsite impacts.

G.9.3 Radiological Dose

The radiological dose was calculated from the carcinogenic risks using conversion factors for each radionuclide and exposure pathway. The conversion factors were developed by comparing reference dose and cancer incidence values to obtain ratios of dose-to-incidence rates. **Table G–43** presents the sources of the reference factors; **Table G–44** presents the dose-to-cancer incidence factors.

Example: For a soil ingestion cancer incidence risk of 1×10^{-5}, constituent x has a dose-to-cancer risk conversion factor of 200 millirem per incidence and the soil ingestion dose for constituent x is 2×10^{-3} millirem.

Dose = cancer incidence risk × dose-to-cancer risk conversion factor

2×10^{-3} millirem = 1×10^{-5} incidence risk × 200 millirem/incidence risk

The radiological doses were summed for each radionuclide and pathway to develop an overall estimate of offsite impacts. The total doses were divided by the number of years of exposure to obtain the annual dose.

G.10 Remediation Activity Impacts

The estimated human health impacts from remediation activities are presented in the following section for the onsite worker, as well as for the offsite suburban resident and recreational user.

G.10.1 Onsite Impacts

The onsite impacts assessment was based on worker exposures during building demolition and bedrock excavation and included estimates of the cancer incidence risk and radiological dose.

G.10.1.1 Building Demolition Worker

The building demolition worker exposures were calculated for each individual pathway and summed to determine the overall cancer incidence risk, as well as the radiological dose. It was assumed that a

single worker would be exposed in all buildings and that the risks and doses are cumulative over the duration of building demolition activities.

Table G–45 presents the cancer incidence risks to the onsite worker and indicates a total risk of 1.2×10^{-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 2.5×10^{-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 target risk range for remediation alternatives; however, these results are based on conservative assumptions that are likely to overestimate potential impacts.

Table G–46 presents the total radiological doses for the total worker exposure from building demolition. 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 building demolition worker would be approximately 250 millirem each year.

The impacts estimated for the onsite worker considered mitigation measures, such as water spraying that would reduce suspended particle emissions by 50 percent. It was also assumed that the use of respirators would reduce inhalation exposures by an order of magnitude for two buildings (RMHF decontamination facility and sub-grade vaults) where additional mitigation measures are likely to be necessary. This evaluation assumes that the same worker would be present for demolition of all buildings. Radiation exposures could be reduced by rotating workers to other tasks.

G.10.1.2 Bedrock Excavation Worker

The evaluation of onsite impacts on the bedrock excavation worker indicate cancer incidence risks for the ingestion, inhalation and external exposure pathways of 7.9×10^{-8}, 2.8×10^{-5}, and 2.0×10^{-11}, respectively (see **Table G–47**), with associated annual doses of 1.2 millirem, 350 millirem, and 0.00018 millirem. These results are based on a reduction of air exposures, assuming a 50 percent decrease in emission from dust suppression and a 99 percent reduction in air concentrations from respirator use.

G.10.2 Offsite Impacts

Offsite impacts were estimated for the combination of each constituent, exposure pathway, receptor, and remediation action. Chemical and radiological impacts were summarized independently and a total of impacts for each remediation action and receptor were developed. The offsite impacts were calculated from a set of conservative assumptions intended to provide an upper bound estimate representative of maximum reasonably foreseeable exposures that are unlikely to be exceeded.

Tables G–48 through **G–75** present the detailed cancer incidence risks, hazards, and doses for specific exposure pathways for the offsite suburban resident and recreational user. **Tables G–76** through **G–79** present summaries of potential impacts on a hypothetical offsite suburban resident and a recreational user.

In general, the offsite impacts on the hypothetical suburban resident and recreational user from both chemicals and radionuclides were many orders of magnitude below the target risk range for remediation alternatives of 1 in 10,000 to 1 in 1,000,000 incidences of cancer for all alternatives. Similarly, the estimated hazard indices for chemicals were many orders of magnitude below 1 for both the hypothetical suburban resident and recreational user. Radiological doses for all alternatives were estimated to be less than 1×10^{-5} millirem.

The exception was the Building Removal Alternative for which the calculated radiological risks were 2×10^{-7} and 9×10^{-8} for the hypothetical suburban resident and recreational user, respectively. These estimated risks are higher than for other remediation actions, but still within the acceptable cancer

incidence range. The estimated annual doses were approximately 0.4 and 0.2 millirem for the hypothetical suburban resident and recreational user, respectively.

G.10.2.1 No Action Alternative

Offsite impacts for the No Action Alternative indicate a low likelihood for adverse health effects to the suburban resident and recreational user. The cancer incidence risks and hazards from chemical constituents were estimated to be 1.2×10^{-11} and 2×10^{-7}, respectively, for the suburban resident and 4.9×10^{-12} and 4.8×10^{-8} for the recreational user. The radiological cancer incidence risks and annual doses were estimated to be 1.4×10^{-13} and 2.2×10^{-7} millirem, respectively, for the suburban resident and 1.2×10^{-13} and 1.9×10^{-7} millirem for the recreational user.

G.10.2.2 Cleanup to AOC LUT Values Alternative

Under the Cleanup to AOC LUT Values Alternative, the chemical cancer incidence risks and hazards, respectively, were estimated to be 9.6×10^{-11} and 1.8×10^{-6}, respectively, for the suburban resident and 4.6×10^{-11} and 5.0×10^{-7} for the recreational user. For the radiological constituents, the cancer incidence risks and annual doses were estimated to be 1.8×10^{-12} and 1.1×10^{-7} millirem, respectively, for the suburban resident and 1.6×10^{-12} and 1.0×10^{-7} millirem for the recreational user. The results for the Cleanup to AOC LUT Values Alternative indicate a low likelihood of adverse offsite impacts on human health from onsite source area emissions.

G.10.2.3 Cleanup to Revised LUT Values Alternative

For the Cleanup to Revise LUT Values Alternative, the chemical cancer incidence risks and hazards were estimated to be approximately 2.9×10^{-11} and 1.4×10^{-6}, respectively, for the suburban resident and approximately 1.3×10^{-11} and 7.4×10^{-7} for the recreational user. For the radiological constituents, the cancer incidence risks and annual doses were estimated to be 5.1×10^{-13} and 5.2×10^{-8} millirem, respectively, for the suburban resident and 4.7×10^{-13} and 4.5×10^{-8} millirem for the recreational user. The results for the Cleanup to Revised LUT Values Alternative indicate a low likelihood of adverse offsite impacts on human health from onsite source area emissions.

G.10.2.4 Conservation of Natural Resources Alternative – Residential Scenario

Results for the Conservation of Natural Resources, Residential Scenario, indicate that the chemical cancer incidence risks and hazards would be 1.4×10^{-11} and 2.3×10^{-6}, respectively, for the hypothetical suburban resident and 5.3×10^{-12} and 1.5×10^{-6} for the recreational user. For the radiological constituents, the cancer incidence risks and annual doses were estimated to be 3.8×10^{-13} and 4.3×10^{-8} millirem, respectively, for the suburban resident and 5.1×10^{-13} and 2.9×10^{-8} millirem for the recreational user. The results for the Conservation of Natural Resources, Residential Scenario indicate a low likelihood of adverse offsite impacts on human health from onsite source area emissions.

G.10.2.5 Conservation of Natural Resources Alternative– Open Space Scenario

Results for the Conservation of Natural Resources, Open Space Scenario indicate that the chemical cancer incidence risks and hazards would be 1.1×10^{-11} and 3.4×10^{-6}, respectively, for the hypothetical suburban resident and 4.1×10^{-12} and 2.4×10^{-6} for the recreational user. For the radiological constituents, the cancer incidence risks and annual doses were estimated to be 3.1×10^{-13} and 1.7×10^{-8} millirem, respectively, for the suburban resident and 4.2×10^{-13} and 2.4×10^{-8} millirem for the recreational user. The results for the Conservation of Natural Resources, Open Space Scenario indicate a low likelihood of adverse offsite impacts on human health from onsite source area emissions.

G.10.2.6 Building Demolition

Offsite impacts calculated for the Building Removal Alternative indicated that the cancer risks and annual doses would be approximately 1×10^{-7} and a total of 0.5 millirem (0.25 millirem in each of 2 years), respectively, for the hypothetical suburban resident and 8.2×10^{-9} and a total of 0.27 millirem (14 millirem in each of 2 years) for the recreational user. The results for building demolition indicate a low likelihood of adverse offsite impacts on human health from onsite source area emissions.

G.10.2.7 Bedrock Removal

An evaluation of the offsite impacts from excavating the strontium-90-impacted bedrock indicated that the cancer risks and annual doses would be 1.3×10^{-9} and 1.7×10^{-3} millirem, respectively, for the hypothetical suburban resident and 5.8×10^{-10} and 7.4×10^{-4} millirem for the recreational user. The results for the bedrock removal indicate a low likelihood of adverse offsite impacts on human health from onsite source area emissions.

G.11 Summary

The offsite impacts on a hypothetical suburban resident or recreational user from both chemicals and radionuclides would be below the target risk range for remediation alternatives of 1 in 10,000 to 1 in 1,000,000 incidences of cancer for all alternatives. For all of the soil remediation alternatives and the bedrock excavation activity, the risk were orders of magnitude below the target risk range for remediation alternatives. Similarly, the estimated hazard indices for chemicals were many orders of magnitude below 1 for both the hypothetical suburban resident and recreational user. Radiological doses for all alternatives were estimated to be less than 1×10^{-5} millirem.

The offsite impacts for the Building Removal Alternative radiological risks were estimated to be 1.0×10^{-7} and 8.2×10^{-9} for the hypothetical suburban resident and recreational user, respectively, which were higher than for other actions, but still within the acceptable cancer incidence range. The estimated annual dose were estimated to be approximately 0.25 and 0.14 millirem for the suburban resident and recreational user.

Results for the onsite worker indicate a cancer incidence risk of 1.2×10^{-4} and a dose of approximately 250 millirem associated with building demolition exposures. These estimated impacts are based on an assumption that the same worker was exposed during demolition of all of the radioactively contaminated buildings. The onsite worker exposure from bedrock excavation would result in a cancer incidence risk of approximately 2.8×10^{-5} and a dose of 350 millirem. Uncertainties

G.12 Uncertainties

The evaluation of offsite impacts was conducted to incorporate uncertainties in the assessment and to provide a conservative estimate of human health effects. At each step in the process, the uncertainty in the methods was incorporated into conservative assumptions used in the calculations. The results of the impact evaluation represent an upper bound estimate that is unlikely to be exceeded. The uncertainty associated with particular assumptions used in the offsite impact evaluation are presented in the following sections.

G.12.1 Emissions

The estimated emissions rates for the remediation alternatives utilized conservative assumptions regarding soil parameters to generate a maximum reasonably foreseeable value. Emission estimates were also generated with additional sets of parameter values to provide more likely and less conservative results (see Tables G–1 through G–3). The uncertainty in the emissions estimates covers

many orders of magnitude and indicates that emissions are more likely to be significantly lower than the conservative values used in the offsite impact assessment.

It was assumed that the soil excavation alternatives resulted in no emissions after implementation of the remediation action. However, in some cases, there may be remaining contaminated material available for wind scour in areas that were not subject to active remediation. These unremediated areas were assumed to represent a small fraction of the overall sources and would therefore result in negligible potential for adverse health impacts at offsite locations (i.e., they would be less than the impacts associated with the No Action Alternative for soil remediation).

G.12.1.1 Santa Ana Effects

Santa Ana winds represent an extreme atmospheric condition, where maximum suspended soil emissions could occur over a short duration. Typical Santa Ana conditions are associated with localized winds that significantly exceed long-term average wind speeds. Because of the extreme wind conditions associated with Santa Ana conditions, it is likely that remediation actions would be suspended to protect workers and equipment; therefore the Santa Ana wind evaluation was limited to the No Action Alternative.

Suspended soil emissions due to Santa Ana wind scour were estimated for several potential wind speeds (see Table G–41) in order to bound the results and potential offsite impacts. These Santa Ana wind emission rates were then used as input to the dispersion model (see Section 12.4.1) to estimate the offsite media concentrations.

G.12.2 Representative Constituent Concentrations in Source Areas

The list of COCs included in the offsite impacts evaluation were based on comparisons of sampling data with background data, process information, and estimates of onsite impacts (see Section G.3). The constituent UCL95s calculated for each remediation alternative were based on the particular soil samples located within each source area identified in the excavation footprint. Where a limited number of samples were available and the UCL95 exceeded the maximum detection, the maximum detection was used as representative of the source concentration.

Additionally, the total volume of material excavated and depth removed will be dependent on the implementation of each alternative in the field. The representative source concentrations were selected to provide conservative estimates that would account for variations in actual source area excavated during remediation actions.

G.12.3 Meteorological Data

Meteorological data collected from the site were of sufficient quality and quantity to provide data from 2009 through 2012 suitable for dispersion modeling. Data from local weather stations outside of SSFL (e.g., Los Angeles Airport) were reviewed for significant changes in wind distributions over time. This review indicated that long-term meteorological data have remained reasonably consistent through 2018.

G.12.3.1 Santa Ana Wind Conditions

Santa Ana winds may develop from October through March and were analyzed in addition to the evaluation of general atmospheric conditions.

Figure G–4 presents several wind roses for the 2009 through 2012 meteorological data, broken out by season of the year. From September through April (wind roses 1 and 4), there are a significant number of observations representing higher wind speeds that blow from the northeast toward the southwest. The prevalent wind direction for the Santa Ana wind evaluation was therefore assumed to be toward the southwest, which served as the basis for identifying a receptor location (see Section G.12.4.1).

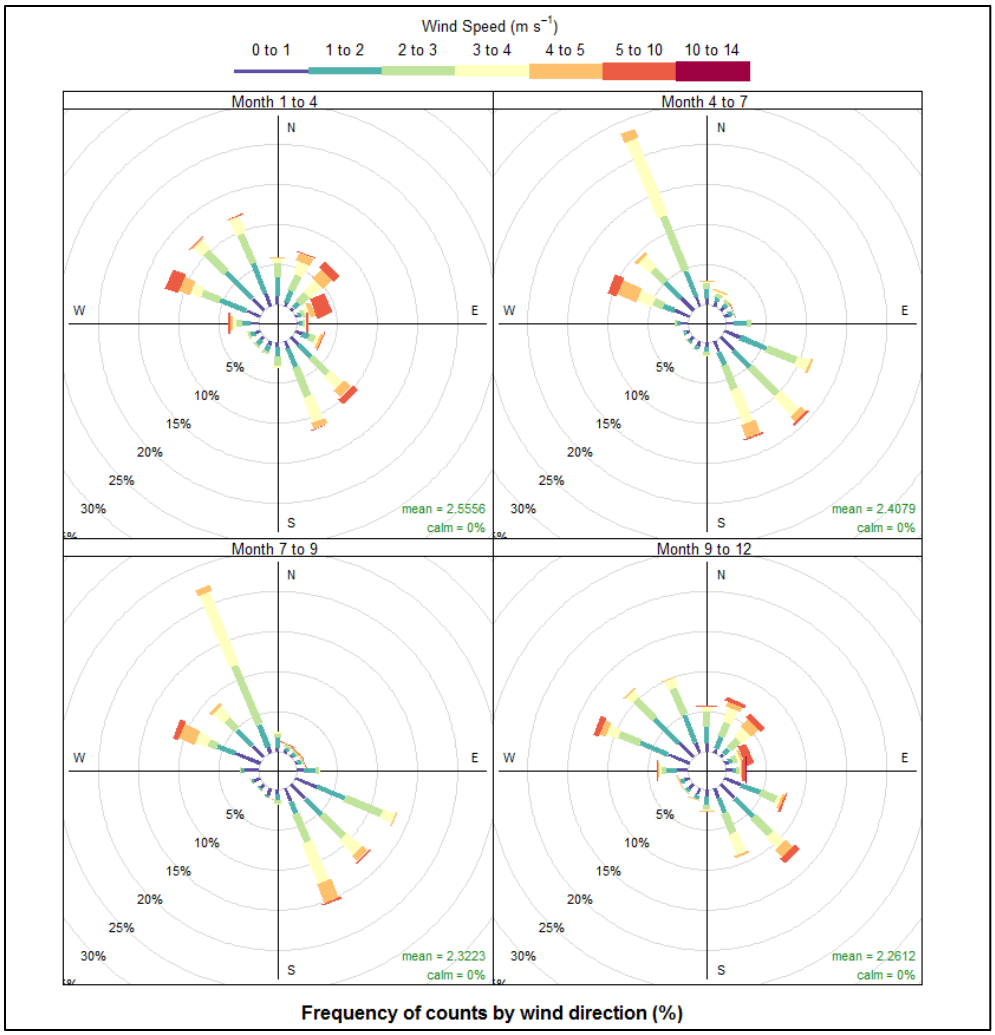

Figure G–4 Hourly Observations from Onsite Meteorological Station by Month 2009 through 2012

G.12.4 Atmospheric Dispersion Modeling

The atmospheric dispersion model was used to estimate offsite air concentrations based on a simple set of input parameters for a ground level emission of material, and did not account for the complex topography surrounding SSFL. The model produced results for steady state conditions under idealized atmospheric transport conditions appropriate for evaluation of long-term impacts.

The atmospheric model was also used to address uncertainty in the evaluation, where extreme weather events may occur that are not reflected in long-term average meteorology, specifically Santa Ana wind conditions.

G.12.4.1 Santa Ana Winds

The evaluation of Santa Ana winds at SSFL assumed meteorological conditions based on observations from the SSFL onsite meteorological station. The data from 2009 to 2012, which included periods of Santa Ana conditions, indicate a maximum hourly average wind speed of 14 meters per second, with only 11 hourly observations (0.03 percent of the data) above 10 meters per second.

Table G–80 presents results of atmospheric dispersion modeling for the Santa Ana evaluation. Winds were assumed to blow toward the southwest at daily average wind speeds of 5, 10 and 20 meters per second for conservative stability classes C and D.

Based on winds blowing toward the southwest, the nearest likely receptor location is 5,500 meters from the approximate center of Area IV/NBZ (see Figure G–1). To evaluate a range of possible Santa Ana conditions, the analysis was based on several wind speeds and used conservative assumptions for the atmospheric stability classes to estimate potential offsite impacts (see Section G.12.8.1).

G.12.5 Offsite Media Concentrations

The calculation of offsite media concentrations were based on available site source data, meteorological data, emission rates of contaminated material, and assumed receptor locations; therefore, estimates of offsite media concentrations are subject to uncertainty associated with related assumptions. Additionally, the offsite media concentrations were calculated from emission of contaminated material only. However, it is likely that uncontaminated suspended soil would be transported through the atmosphere and deposited at the receptor locations in addition to contaminated material. Therefore, the predicted offsite media concentrations are likely to overestimate the concentration of source-related constituents.

Offsite soil concentrations were based on a buildup of material over 30 years for the No Action Alternative, or a buildup from the total emissions for remediation alternatives prior to exposure to an offsite receptor, to provide conservative estimates of offsite impacts. The constituents in soil may be subject to mechanisms that would reduce concentrations in soil, including biodegradation, surface runoff, and radiological decay.

G.12.6 Risk Based Screening Levels

The RBSLs were developed based on site-specific data and assumptions regarding the activities of the offsite suburban resident and recreational user. The exposure parameters used to calculate the RBSLs were selected to reflect an upper bound of the potential impacts associated with each receptor. It is likely that the actual exposures experienced by an offsite individual in the SSFL area would be significantly lower than those represented by the RBSLs.

G.12.7 Calculation of Offsite Human Health Effects

The calculation of human health effects was based on a number of assumptions regarding the quantification of carcinogenic risk, toxic effects, and radiological dose. There is significant uncertainty associated with many aspects of the risk assessment process, including, but not limited to: interpretation of toxicity data, applicability of exposure assumptions, impacts of simultaneous exposure to multiple constituents, and summation of risks and hazards across exposure pathways.

G.12.8 Offsite Impact Assessment

Offsite impacts were developed for several additional scenarios to address uncertainty in the evaluation, including Santa Ana winds and an additional remedial alternative.

G.12.8.1 Santa Ana Winds

The estimate of offsite impacts associated with Santa Ana wind conditions was based on a comparison of suspended soil concentrations in air and soil compared with the soil No Action Alternative results for average meteorological condition observed from 2009 through 2012. **Table G–81** presents the estimated air and soil concentrations for several atmospheric conditions.

Offsite impacts associated with air exposure during Santa Ana conditions are presented in **Table G–82** and indicate that each day of continuous exposure would result in a chemical hazard on the order of 1×10^{-5} and a dose of approximately 4×10^{-5} millirem, based on a 20 meter per second average wind speed and maximum reasonably foreseeable assumptions for soil emissions. Therefore, even for many days of continuous air exposure per year, a receptor located 5,500 meters to the southwest is unlikely to be adversely impacted. Additionally, it is highly unlikely that an individual would be outdoors for extended periods of time during such high wind events.

Estimated produce ingestion risks are presented in **Table G–83** and indicate that for a 20 meters-per-second daily average wind speed, the chemical and radiological risks would be about 1×10^{-10} and 1×10^{-12} respectively, for each day of Santa Ana wind emissions. The results indicate that adverse health effects would be highly unlikely for a location 5,500 meters to the southwest of an emissions source impacted by several days of Santa Ana events.

G.12.8.2 Location of Onsite Emissions Source at Site Center versus Subarea Centers

The location of the onsite emissions is an uncertainty in the evaluation of offsite impacts. While individual source areas are dispersed across the site, the offsite impact calculations were based on emissions from a location near the approximate center of Area IV and the NBZ (see Figure G–1). To evaluate the uncertainty associated with this assumption, air concentrations were calculated assuming emissions from the approximate center of each subarea based on the associated source area sizes, constituent concentrations, and distances to the offsite receptor located 1800 meters to the northwest.

Table G–84 presents the emissions for each subarea and the calculated offsite air concentration of suspended soil associated with the Cleanup to AOC LUT Values Alternative. The calculation assumes that the remediation volume from each source area is related to the surface area of all sources within that subarea and the emissions factor is assumed to be 1.75×10^{-4} grams per kilogram (see Section G.2.2 and Table G–3).

Table G–85 provides a comparison between the calculation of offsite impacts from the site center versus the subarea centers for cadmium, chromium, and aroclor-1260. These chemical constituents were selected for the evaluation because they represent the majority of the cancer incidence risk for the direct air inhalation pathway for the suburban resident exposure scenario. Results based on emissions from the site center for cadmium, chromium and aroclor-1260 were 5.6×10^{-11}, 1.8×10^{-12}, and 2.5×10^{-13}, respectively, out of a total direct air inhalation cancer incidence risk of 5.9×10^{-11} (see Table G–46). For emissions from the subarea centers, the cancer incidence risk for cadmium was 6.5×10^{-11} as compared with 5.6×10^{-11} for the site center, indicating that the overall results are similar and the simplifying assumption of emissions from the site center is a reasonable approximation (cadmium was the risk driver for the inhalation pathway). Comparison of cancer incidence risks estimated for chromium and aroclor-1260 indicated greater variability, however results were within an order of magnitude. The overall cancer incidence risks for the direct air inhalation pathway were for emissions from the site center were in close agreement to the risk from emissions from the center of each subarea.

G.12.8.3 Increased Soil Volume Scenario Sensitivity Analysis

An additional alternative evaluation was included to assess the sensitivity of the offsite impacts to the remediation assumptions for the Cleanup to AOC LUT Values Alternative. For the Increased Soil Volume Scenario, it was assumed that the remediation volume for chemical contamination would be increased from 8.8×10^5 (881,000) to 1.62×10^6 (1,616,000) cubic yards, with an increase of the remediation duration from 26 to 47 years. Table G–86 presents the estimated offsite impacts for the Cleanup to AOC LUT Values Alternative and results for the sensitivity analysis. The results indicate that the chemical impacts would increase slightly, but would be unlikely to cause adverse effects to the hypothetical suburban residential or recreational user.

G.13 Risk Assessment Tables

Key to Radionuclide Abbreviations

Am-241	americium-241	H-3	tritium	Pu-241	plutonium-241
Cm-243	curium-243	Na-22	sodium-22	Pu-242	plutonium-242
Cm-244	curium-244	Ni-59	nickel-59	Sr-90	strontium-90
Co-60	cobalt-60	Ni-63	nickel-63	Th-232	thorium-232
Cs-134	cesium-134	Np-237	neptunium-237	Th-234	thorium-234
Cs-137	cesium 137	Pa-234	protactinium-234	U-234	uranium-234
Eu-152	europium-152	Pu-238	plutonium-238	U-235	uranium-235
Eu-154	europium-154	Pu-239	plutonium-239	U-238	uranium-238
Eu-155	europium-155	Pu-240	plutonium-240	+D	plus daughters
Fe-55	iron-55				

Table G–1 Suspended Soil Emission Factors – No Action Alternative

Parameters	Aggregate Soil Grain Size Mode (mm)	Threshold Friction Velocity (Ut*) (m/s)	Non-Erodible Element Ratio (unitless)	Correction Factor for Non-Erodible Elements (unitless)	Corrected Friction Velocity (m/s)	Suggested Erosion Model (unitless)	Roughness Height (Z0) (cm)	Equivalent Value of Threshold Wind Speed at 10-m (m/s)	Measured Average Wind Speed at 10-m (Um) (m/s)	Dimensionless Parameter Derived from Wind Speeds (unitless)	Function Evaluating Dimensionless Parameter (RAIS Interpretation) (unitless)	Fraction of Vegetative Cover (unitless)	Emission Rate per Unit Area (g/m^2-s)
Maximum Reasonably Foreseeable	***0.15***	***2.97×10^{-1}***	***0.001***	***2.00***	***0.59***	***UNLIMITED***	***2.00***	***9.22***	***2.40***	***3.55***	***2.40×10^{-4}***	***0.25***	***2.80×10^{-11}***
More Likely	0.25	3.67×10^{-1}	0.010	2.00	0.73	UNLIMITED	1.00	12.69	2.4	4.58	1.18×10^{-7}	0.33	5.35×10^{-15}
Less Conservative	0.4	4.47×10^{-1}	0.01	5.00	2.23	limited	0.30	45.32	2.4	16.35	4.74×10^{-113}	0.5	3.52×10^{-122}

cm = centimeters; g = grams; hr = hour; m = meters; m^2 = square meters; mm = millimeters; s = second; yr = year.

Notes:

– Particle size of 0.01 mm is midpoint for fine silt, 0.03 mm is boundary of coarse/med silt.
– Fraction of vegetative cover is assumed.
– Average wind speed is arithmetic mean of WSA measurements from SSFL met tower during 2009 and 2012, assumed to have been collected at a height of 10m.
– Roughness height of 0.5 cm is the midpoint between the values for a snowfield and plowed field.
– Threshold friction velocity based on Figure 3-4 of Cowherd et al.1985.
– Non-erodible element ratio is the ratio of the surface area of non-erodible elements facing the wind divided by the surface area of the erodible elements on the ground surface, based on Figures A-1 to A-3 in Cowherd et al. 1985.
– Correction factor for non-erodible elements from Appendix A of Cowherd et al. 1985.
– Corrected friction velocity is calculated from friction velocity and correction factor.
– The suggested erosion model is "unlimited" for corrected threshold friction velocities <75 cm/s (p. 21 of Cowherd et al. 1985).
Equivalent value of threshold wind speed at 7m (Ut*7) calculated from corrected threshold friction velocity (Uf*) and roughness height (Z0) as: Ut* at 10m = (Ut*/0.4)ln(10/Z0) : in units of m/s and m.
– Dimensionless parameter derived from wind speeds is calculated as 0.866 × Equivalent Value of Threshold Wind Speed/Measured average wind speed (p.34 Cowherd et al. 1985).
– Function evaluating dimensionless parameter from Figure 4-3 of Cowherd et al. 1985 as interpreted by RAIS (see online calculator https://rais.ornl.gov/).
– Equations from EPA Soil Screening Guidance (EPA 1996) on page E-23 using Equation E-20.
– Emission rate calculation based on unlimited reservoir emission equation (Equation 4-4 on p.24 of Cowherd et al. 1985) and conversion from units of g/m^2-hr to g/m^2-s.

Table G–2 Source Area Emissions and Offsite Media Concentrations – No Action Emissions

Parameters	Emission Rate per Unit Area (g/m^2-s)	Source Area (m^2)	Emission Rate (g/s)	Receptor Direction	Receptor Distance (m)	X_Q (g/m^3 per g/s)	Offsite SS Air Concentration (g/m^3)	Offsite Areal Deposition Rate ($g/s\text{-}m^2$)	Deposition Duration (years)	Offsite Areal Deposition (g/m^2)	Offsite Soil Areal Mixing Mass (g/m^2)	Offsite SS Soil Concentration (g/g)
Maximum Reasonably Foreseeable	**2.8×10^{-11}**	**898,212**	**2.5×10^{-5}**	**NW**	**1800**	**2.2×10^{-6}**	**5.5×10^{-11}**	**9.9×10^{-14}**	**30**	**9.4×10^{-5}**	**40000**	**2.3×10^{-9}**
More Likely	3.0×10^{-16}	898,212	2.7×10^{-10}	NW	1800	2.2×10^{-6}	6.0×10^{-16}	1.1×10^{-18}	30	1.0×10^{-9}	40000	2.6×10^{-14}
Less Conservative	2.2×10^{-138}	898,212	2.0×10^{-132}	NW	1800	2.2×10^{-6}	4.4×10^{-138}	8.0×10^{-141}	30	7.5×10^{-132}	40000	1.9×10^{-136}

g = grams; m = meters; m^2 = square meters; m^3 = cubic meters; s = second; X/Q = chi over Q.

Notes:

– Emission rates per unit area from site-specific soil parameters and methods presented in Cowherd et al. 1985.
– Source area assumed to be 222 acres.
– X/Q values based on atmospheric dispersion modeling using site meteorological data from 2009-2012 for the hypothetical suburban resident location.
– Assumed deposition duration of 30 years for soil buildup prior to offsite exposures.
– Offsite soil concentration based on the air concentration, a deposition rate of 1.8×10^{-3} m/s, and a soil mixing mass of 4×10^{4} g/m² (from 1,600 g/m³ with a depth of 0.025m).

Table G–3 Suspended Soil Emission Factors – Soil Remediation Alternatives

Scenario	PM_{10} Particle Size Multiplier (unitless)	Silt Content (percent)	Mean Wind Speed at 10 Meters (meters per second)	Drop Height (meters)	Material Moisture Content (percent)	Dumping Device Capacity (cubic meters)	Emissions (grams per kilogram)
Maximum Reasonably Foreseeable	***0.36***	***7***	***2.4***	***2***	***5***	***1***	***1.75×10^{-4}***
More Likely	0.36	5	2.4	1	10	2	1.24×10^{-5}
Less Conservative	0.36	3	2.4	0.5	15	3	1.45×10^{-6}

PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– Calculated from page E-7 of Cowherd et al. 1985.
– Silt and moisture content were estimated from available site soil data.
– Drop height and dumping capacity were assumed.
– Mean wind speed calculated with SSFL tower observations collected from 2009-2012.

Table G–4 Source Areas and Emissions – Soil Remediation Alternatives

Alternative	*Combined Chemical and Radiological Source Cleanup Volume (yards)*	*Radiological Only Source Cleanup Volume (cubic yards)*	*Combined Chemical and Radiological Source Cleanup Volume (cubic meters)*	*Radiological Only Source Cleanup Volume (cubic meters)*	*Remedial Mass of Chemical and Radiological Sources (kilograms)*	*Emissions of Soil from Chemical and Radiological Sources (grams)*	*Remedial Mass of Only Radiological Sources (kilograms)*	*Emissions of Soil from Radiological Sources (grams)*
Cleanup to AOC LUT Values	881,000	110,000	673,965	84,150	1,078,344,000	1.88×10^{5}	134,640,000	2.35×10^{4}
Cleanup to Revised LUT Values	190,000	110,000	145,350	84,150	232,560,000	4.06×10^{4}	134,640,000	2.35×10^{4}
Conservative of Natural Resources – Residential Option	52,000	1,000	39,780	765	63,648,000	1.11×10^{4}	1,224,000	2.14×10^{2}
Conservative of Natural Resources – Open Space Option	38,200	200	29,223	153	46,756,800	8.17×10^{3}	244,800	4.28×10^{1}

Notes:

– Emission factor of 1.75×10^{-4} grams per kilogram calculated for site-specific soil and excavation assumptions (see Table G–3).

– Emissions from radiological only areas are used to estimate a peak radiological dose during the remedial action.

– Volumes converted based on 0.765 cubic meters per cubic yard, with soil density assumed to be 1,600 kilograms per cubic meter.

Table G–5 Source Area Emissions and Offsite Media Concentrations of Contaminated Material – Remediation Emissions

Receptor	Alternative	Emissions of Soil from Chemical and Radiological Sources (grams)	Emissions of Soil from Only Radiological Sources (grams)	Radiological Impacts During Remedial Action		Impacts Over Long Term Exposure		Offsite Soil After Deposition (grams per gram)
				Emission Rate During Remediation (grams per second)	Offsite Air Suspended Soil Concentration During Remediation (grams per cubic meter)	Emission Rate Averaged Over Exposure Period (grams per second)	Offsite Air Suspended Soil Concentration During Long Term Exposure (grams per cubic meter)	
Resident	Cleanup to AOC LUT Values	1.88×10^{5}	2.35×10^{4}	7.5×10^{-4}	1.7×10^{-8}	2.3×10^{-4}	5.3×10^{-9}	1.97×10^{-7}
	Cleanup to Revised LUT Values	4.06×10^{4}	2.35×10^{4}	7.5×10^{-4}	1.7×10^{-8}	5.0×10^{-5}	1.2×10^{-9}	4.25×10^{-8}
	Conservative of Natural Resources – Residential Option	1.11×10^{4}	2.14×10^{2}	6.8×10^{-6}	1.6×10^{-10}	1.4×10^{-5}	3.2×10^{-10}	1.16×10^{-8}
	Conservative of Natural Resources – Open Space Option	8.17×10^{3}	4.28×10^{1}	1.4×10^{-6}	3.2×10^{-11}	1.0×10^{-5}	2.3×10^{-10}	8.54×10^{-9}
Recreational User	Cleanup to AOC LUT Values	1.88×10^{5}	2.35×10^{4}	7.5×10^{-4}	1.6×10^{-9}	2.3×10^{-4}	5.0×10^{-10}	1.86×10^{-8}
	Cleanup to Revised LUT Values	4.06×10^{4}	2.35×10^{4}	7.5×10^{-4}	1.6×10^{-9}	5.0×10^{-5}	1.1×10^{-10}	4.01×10^{-9}
	Conservative of Natural Resources – Residential Option	1.11×10^{4}	2.14×10^{2}	6.8×10^{-6}	1.5×10^{-11}	1.4×10^{-5}	3.0×10^{-11}	1.10×10^{-9}
	Conservative of Natural Resources – Open Space Option	8.17×10^{3}	4.28×10^{1}	1.4×10^{-6}	3.0×10^{-12}	1.0×10^{-5}	2.2×10^{-11}	8.07×10^{-10}

Notes:

– Emission rate during remediation assumes a 1-year duration for radiological sources.

– Emissions rate during exposure period assumes a 26-year duration for receptor exposures to sources with both chemical and radiological constituents.

– X/Q (chi over Q) for receptor locations were: 2.3×10^{-5} second per cubic meter at 500 meters northwest and 2.2×10^{-6} second per cubic meter at 1,800 meters northwest.

– Offsite soil concentration based on the long-term air concentration, a deposition rate of 1.8×10^{-3} meters per second, and a soil mixing mass of 4×10^{4} grams per square meter (from 1,600 grams per cubic meter with a depth of 0.025 meters).

– Suspended soil PM_{10} (particulate matter less than 10 microns) emissions from p.E-7 of Cowherd et al. 1985, with: 7 percent silt content, 5 percent moisture content, 2.4 meters-per-second wind speed, 1-cubic-meter batch volume, 2-meter drop height, and an aerodynamic particle size multiplier of 0.36 for PM_{10}.

Table G–6 Emissions from Building Demolition[a]

Isotope	*4019 SNAP System Nuclear Qualification Test Facility*	*4021 (RMHF); Decon-tamination 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*	*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 Emissions*
H-3	2.9×10^{5}	2.8×10^{7}	4.3×10^{5}	4.6×10^{6}	3.5×10^{5}	7.7×10^{4}	2.5×10^{3}	4.7×10^{3}	4.7×10^{3}	0	1.3×10^{4}	2.1×10^{3}	**3.4×10^{7}**
Na-22	1.3×10^{-6}	1.3×10^{-4}	2.0×10^{-6}	2.1×10^{-5}	1.6×10^{-6}	3.5×10^{-7}	1.1×10^{-8}	2.2×10^{-8}	2.2×10^{-8}	0	6.1×10^{-8}	9.6×10^{-9}	**1.6×10^{-4}**
Fe-55	4.4×10^{2}	4.3×10^{4}	6.6×10^{2}	7.0×10^{3}	5.3×10^{2}	1.2×10^{2}	3.8	7.2	7.1	0	2.0×10^{1}	3.2	**5.2×10^{4}**
Ni-63	9.8×10^{6}	9.5×10^{8}	1.5×10^{7}	1.6×10^{8}	1.2×10^{7}	2.6×10^{6}	8.4×10^{4}	1.6×10^{5}	1.6×10^{5}	0	4.5×10^{5}	7.1×10^{4}	**1.1×10^{9}**
Co-60	1.4×10^{6}	1.3×10^{8}	2.1×10^{6}	2.2×10^{7}	1.7×10^{6}	3.7×10^{5}	1.2×10^{4}	2.3×10^{4}	2.3×10^{4}	0	6.4×10^{4}	1.0×10^{4}	**1.6×10^{8}**
Sr-90	1.8×10^{8}	1.8×10^{10}	2.8×10^{8}	2.9×10^{9}	2.2×10^{8}	4.9×10^{7}	1.6×10^{6}	3.0×10^{6}	3.0×10^{6}	0	8.4×10^{6}	1.3×10^{6}	**2.1×10^{10}**
Cs-134	6.0×10^{1}	5.9×10^{3}	9.1×10^{1}	9.6×10^{2}	7.3×10^{1}	1.6×10^{1}	5.2×10^{-1}	9.9×10^{-1}	9.8×10^{-1}	0	2.8	4.4×10^{-1}	**7.1×10^{3}**
Cs-137	4.3×10^{6}	4.2×10^{8}	6.5×10^{6}	6.8×10^{7}	5.2×10^{6}	1.1×10^{6}	3.7×10^{4}	7.0×10^{4}	6.9×10^{4}	0	2.0×10^{5}	3.1×10^{4}	**5.0×10^{8}**
Eu-152	1.3×10^{4}	1.3×10^{6}	2.0×10^{4}	2.1×10^{5}	1.6×10^{4}	3.6×10^{3}	1.2×10^{2}	2.2×10^{2}	2.2×10^{2}	0	6.2×10^{2}	9.8×10^{1}	**1.6×10^{6}**
Eu-154	1.4×10^{3}	1.4×10^{5}	2.2×10^{3}	2.3×10^{4}	1.7×10^{3}	3.8×10^{2}	1.2×10^{1}	2.4×10^{1}	2.3×10^{1}	0	6.6×10^{1}	1.0×10^{1}	**1.7×10^{5}**
Eu-155	9.6×10^{1}	9.3×10^{3}	1.4×10^{2}	1.5×10^{3}	1.2×10^{2}	2.6×10^{1}	8.2×10^{-1}	1.6	1.6	0	4.4	7.0×10^{-1}	**1.1×10^{4}**
Th-232	1.1×10^{4}	6.0×10^{4}	2.3×10^{4}	9.4×10^{3}	0	8.0×10^{3}	1.9×10^{3}	2.5×10^{3}	1.8×10^{3}	0	1.6×10^{3}	2.6×10^{3}	**1.2×10^{5}**
U-234	7.8×10^{4}	4.1×10^{5}	1.6×10^{5}	6.5×10^{4}	0	5.5×10^{4}	1.3×10^{4}	1.8×10^{4}	1.2×10^{4}	0	1.1×10^{4}	1.8×10^{4}	**8.4×10^{5}**
U-235	7.1×10^{3}	3.8×10^{4}	1.5×10^{4}	6.0×10^{3}	0	5.1×10^{3}	1.2×10^{3}	1.6×10^{3}	1.1×10^{3}	0	1.0×10^{3}	1.6×10^{3}	**7.7×10^{4}**
U-238	8.9×10^{4}	4.8×10^{5}	1.8×10^{5}	7.5×10^{4}	0	6.4×10^{4}	1.5×10^{4}	2.0×10^{4}	1.4×10^{4}	0	1.3×10^{4}	2.1×10^{4}	**9.7×10^{5}**
Pu-238	1.3×10^{5}	7.0×10^{5}	2.7×10^{5}	1.1×10^{5}	0	9.4×10^{4}	2.3×10^{4}	3.0×10^{4}	2.1×10^{4}	0	1.9×10^{4}	3.0×10^{4}	**1.4×10^{6}**
Pu-239	3.4×10^{6}	1.8×10^{7}	6.8×10^{6}	2.8×10^{6}	0	2.4×10^{6}	5.7×10^{5}	7.6×10^{5}	5.4×10^{5}	0	4.8×10^{5}	7.7×10^{5}	**3.6×10^{7}**
Pu-240	1.2×10^{6}	6.6×10^{6}	2.5×10^{6}	1.0×10^{6}	0	8.9×10^{5}	2.1×10^{5}	2.8×10^{5}	2.0×10^{5}	0	1.8×10^{5}	2.9×10^{5}	**1.4×10^{7}**
Pu-241	9.0×10^{4}	8.8×10^{6}	1.4×10^{5}	1.4×10^{6}	1.1×10^{5}	2.4×10^{4}	7.8×10^{2}	1.5×10^{3}	1.5×10^{3}	0	4.2×10^{3}	6.6×10^{2}	**1.1×10^{7}**
Pu-242	8.4×10^{3}	4.5×10^{4}	1.7×10^{4}	7.1×10^{3}	0	6.0×10^{3}	1.4×10^{3}	1.9×10^{3}	1.3×10^{3}	0	1.2×10^{3}	1.9×10^{3}	**9.1×10^{4}**
Am-241	1.4×10^{6}	7.7×10^{6}	2.9×10^{6}	1.2×10^{6}	0	1.0×10^{6}	2.5×10^{5}	3.2×10^{5}	2.3×10^{5}	0	2.0×10^{5}	3.3×10^{5}	**1.6×10^{7}**

RMHF = Radioactive Materials Handling Facility; SNAP = Systems for Nuclear Auxiliary Power.

[a] See Chapter 4, Section 4.9.3 for the rationale of selecting these 11 buildings and one yard as the facilities with significant radioactive contamination.

Notes:

– All values in picocuries.

– Based on emission fractions of 0.001 and 0.005 and respirable fraction of 1 and 0.5 for total and removable contamination, respectively.

Table G–7 Bedrock Excavation Emissions and Exposure Concentrations for Remediation Worker

Parameter	*Value*	*Units*	*Description*
Contaminated material in excavated bedrock surface area	1.56×10^{11}	picocuries	Volume of potential release material times mass concentration, density, and mass conversion
Area concentration on surface of excavated bedrock	3.51×10^{5}	picocuries per square foot	Contaminated material in excavated surface area divided by excavated bedrock surface area
Area concentration for external exposures	378	picocuries per square centimeter	Converted area concentration
Bedrock contaminated material release fraction	1.0×10^{-3}	unitless	Assumed portion of surface area of contaminated material that is available for release
Area concentration for ingestion exposures	0.38	picocuries per square centimeter	Area concentration for external exposures times release fraction
Bedrock material release source term	1.56×10^{8}	picocuries	Contaminated 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	1.6×10^{4}	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	161	picocuries per cubic meter	Air concentration times reduction factor

Notes:

– Bedrock density of 150 pounds per cubic feet.
– Bedrock concentration of strontium-90 of 516 picocuries per gram.
– Total volume of excavated bedrock of 2,733 cubic yards assuming removal of 30×60×25 feet.
– Surface area of contaminated material equals 442,800 square feet in source term for external and ingestion exposure.
– Volume of contaminated material equals 4,428 cubic feet in source term for inhalation exposure.
– Volume of air in excavation area for inhalation exposures of 171,000 cubic feet, including the volume of bedrock removed and a 40×100×22.5-foot ramp.

Table G–8 Onsite Source Concentrations of Chemicals for the Evaluation of Soil Remediation Alternatives

Type	Constituent	Alternatives				
		No Action	Cleanup to AOC LUT Values	Cleanup to Revised LUT Values	CONR, Residential Scenario	CONR, Open Space Scenario
Anions	Fluoride	3.4	4.0	3.9	3.9	4.0
Anions	Perchlorate	4.8×10^{-3}	4.8×10^{-3}	5.1×10^{-3}	7.5×10^{-3}	7.5×10^{-3}
Dioxins/Furans	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	2.8×10^{-4}	3.4×10^{-4}	6.8×10^{-4}	1.8×10^{-3}	2.0×10^{-3}
Dioxins/Furans	1,2,3,4,6,7,8-HPCDF	3.8×10^{-5}	4.6×10^{-5}	9.3×10^{-5}	2.5×10^{-4}	2.9×10^{-4}
Dioxins/Furans	1,2,3,4,7,8,9-HPCDF	4.4×10^{-6}	5.3×10^{-6}	1.0×10^{-5}	2.7×10^{-5}	3.0×10^{-5}
Dioxins/Furans	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	1.2×10^{-5}	1.5×10^{-5}	3.1×10^{-5}	9.1×10^{-5}	1.1×10^{-4}
Dioxins/Furans	1,2,3,4,7,8-HXCDF	3.0×10^{-6}	3.4×10^{-6}	6.3×10^{-6}	1.5×10^{-5}	1.5×10^{-5}
Dioxins/Furans	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	1.1×10^{-5}	1.4×10^{-5}	2.7×10^{-5}	7.3×10^{-5}	8.3×10^{-5}
Dioxins/Furans	1,2,3,6,7,8-HXCDF	2.2×10^{-6}	2.6×10^{-6}	4.7×10^{-6}	1.2×10^{-5}	1.2×10^{-5}
Dioxins/Furans	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	5.7×10^{-6}	6.7×10^{-6}	1.3×10^{-5}	3.4×10^{-5}	3.8×10^{-5}
Dioxins/Furans	1,2,3,7,8,9-HXCDF	9.5×10^{-7}	1.1×10^{-6}	1.7×10^{-6}	3.8×10^{-6}	3.5×10^{-6}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzofuran	1.7×10^{-6}	1.7×10^{-6}	2.8×10^{-6}	5.5×10^{-6}	5.1×10^{-6}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	2.1×10^{-6}	2.6×10^{-6}	5.0×10^{-6}	1.3×10^{-5}	1.5×10^{-5}
Dioxins/Furans	2,3,4,6,7,8-HXCDF	3.0×10^{-6}	3.6×10^{-6}	6.8×10^{-6}	1.8×10^{-5}	1.7×10^{-5}
Dioxins/Furans	2,3,4,7,8-PECDF	2.2×10^{-6}	2.5×10^{-6}	4.4×10^{-6}	1.0×10^{-5}	1.0×10^{-5}
Dioxins/Furans	2,3,7,8-TCDD	3.9×10^{-7}	4.6×10^{-7}	8.5×10^{-7}	2.2×10^{-6}	2.4×10^{-6}
Dioxins/Furans	2,3,7,8-Tetrachlorodibenzofuran	9.1×10^{-7}	9.4×10^{-7}	1.7×10^{-6}	3.3×10^{-6}	3.0×10^{-6}
Dioxins/Furans	OCDD	3.3×10^{-3}	4.0×10^{-3}	8.1×10^{-3}	2.1×10^{-2}	2.4×10^{-2}
Dioxins/Furans	OCDF	1.0×10^{-4}	1.2×10^{-4}	2.5×10^{-4}	6.8×10^{-4}	7.7×10^{-4}
Dioxins/Furans	Total TEQ_Dioxin	9.2×10^{-6}	1.1×10^{-5}	2.3×10^{-5}	6.1×10^{-5}	6.8×10^{-5}
Herbicides	2,4-DB	6.6×10^{-3}	6.8×10^{-3}	8.4×10^{-3}	1.2×10^{-2}	1.2×10^{-2}
Herbicides	MCPA	6.5×10^{-1}	6.7×10^{-1}	8.3×10^{-1}	8.7×10^{-1}	9.1×10^{-1}
Herbicides	MCPP	4.6×10^{-1}	5.1×10^{-1}	6.7×10^{-1}	1.2	1.4
Metals	Antimony	3.1	3.8	8.1	2.5×10^{1}	2.8×10^{1}
Metals	Barium	1.2×10^{2}	1.2×10^{2}	1.3×10^{2}	1.7×10^{2}	1.4×10^{2}
Metals	Cadmium	2.3	2.8	5.8	1.7×10^{1}	2.0×10^{1}
Metals	Chromium (Hexavalent Compounds)	6.6×10^{-1}	6.7×10^{-1}	8.4×10^{-1}	1.1	1.2
Metals	Lead	1.0×10^{2}	1.3×10^{2}	2.6×10^{2}	7.7×10^{2}	8.7×10^{2}
Metals	Mercury	5.8×10^{-1}	7.1×10^{-1}	1.5	4.0	1.9
Metals	Molybdenum	2.3	2.7	5.3	1.4×10^{1}	2.0
Metals	Selenium	3.2×10^{-1}	3.1×10^{-1}	3.2×10^{-1}	3.2×10^{-1}	3.2×10^{-1}
Metals	Silver	1.0×10^{1}	1.2×10^{1}	2.7×10^{1}	8.2×10^{1}	9.1×10^{1}
Metals	Zinc	1.1×10^{2}	1.2×10^{2}	1.8×10^{2}	3.1×10^{2}	2.9×10^{2}
Other Inorganics	Methyl Mercury	3.6×10^{-3}	3.6×10^{-3}	3.3×10^{-3}	3.6×10^{-3}	3.6×10^{-3}
Pesticides	4,4'-DDD	1.6×10^{-3}	2.1×10^{-3}	1.6×10^{-3}	2.8×10^{-3}	3.1×10^{-3}

Type	Constituent	Alternatives				
		No Action	Cleanup to AOC LUT Values	Cleanup to Revised LUT Values	CONR, Residential Scenario	CONR, Open Space Scenario
Pesticides	4,4'-DDE	1.3×10^{-2}	1.7×10^{-2}	3.0×10^{-2}	6.6×10^{-2}	7.4×10^{-2}
Pesticides	4,4'-DDT	1.1×10^{-2}	1.3×10^{-2}	2.1×10^{-2}	4.6×10^{-2}	5.1×10^{-2}
Pesticides	Beta-Bhc	3.5×10^{-4}	4.2×10^{-4}	4.2×10^{-4}	6.1×10^{-4}	6.7×10^{-4}
Pesticides	Chlordane	1.0×10^{-2}	1.2×10^{-2}	1.5×10^{-2}	1.3×10^{-2}	1.4×10^{-2}
Pesticides	Delta-Bhc	2.5×10^{-4}	2.3×10^{-4}	2.7×10^{-4}	4.8×10^{-4}	5.3×10^{-4}
Pesticides	Dieldrin	1.4×10^{-3}	1.7×10^{-3}	2.7×10^{-3}	6.1×10^{-3}	6.7×10^{-3}
Polychlorinated Biphenyls	Aroclor 1248	4.1×10^{-2}	4.8×10^{-2}	1.0×10^{-1}	2.8×10^{-1}	3.1×10^{-1}
Polychlorinated Biphenyls	Aroclor 1254	5.3×10^{-2}	5.6×10^{-2}	1.1×10^{-1}	2.9×10^{-1}	2.4×10^{-1}
Polychlorinated Biphenyls	Aroclor 1260	9.8×10^{-1}	1.2	2.7	8.5	9.8
Polychlorinated Biphenyls	Aroclor 5460	4.4×10^{-2}	4.9×10^{-2}	1.0×10^{-1}	2.7×10^{-1}	3.0×10^{-1}
Semivolatile Organics	1-Methylnaphthalene	4.7×10^{-2}	5.8×10^{-2}	1.3×10^{-1}	3.9×10^{-1}	2.2×10^{-2}
Semivolatile Organics	2-Methylnaphthalene	5.8×10^{-2}	7.3×10^{-2}	1.6×10^{-1}	4.9×10^{-1}	2.6×10^{-2}
Semivolatile Organics	Acenaphthene	9.1×10^{-3}	1.1×10^{-2}	2.2×10^{-2}	6.8×10^{-2}	6.6×10^{-2}
Semivolatile Organics	Anthracene	2.8×10^{-2}	3.4×10^{-2}	6.8×10^{-2}	2.2×10^{-1}	2.1×10^{-1}
Semivolatile Organics	Benzo(a)anthracene	8.2×10^{-2}	1.0×10^{-1}	2.2×10^{-1}	6.3×10^{-1}	6.6×10^{-1}
Semivolatile Organics	Benzo(a)pyrene	1.2×10^{-1}	1.5×10^{-1}	3.2×10^{-1}	9.3×10^{-1}	1.0
Semivolatile Organics	Benzo(b)fluoranthene	1.3×10^{-1}	1.7×10^{-1}	3.6×10^{-1}	1.0	1.1
Semivolatile Organics	Benzo(g,h,i)perylene	2.1×10^{-1}	2.6×10^{-1}	5.7×10^{-1}	1.7	2.0
Semivolatile Organics	Benzo(k)fluoranthene	6.1×10^{-2}	7.7×10^{-2}	1.7×10^{-1}	4.9×10^{-1}	5.3×10^{-1}
Semivolatile Organics	Bis(2-ethylhexyl)phthalate	3.0×10^{-1}	3.8×10^{-1}	7.2×10^{-1}	2.0	1.6
Semivolatile Organics	Chrysene	1.2×10^{-1}	1.5×10^{-1}	3.1×10^{-1}	9.0×10^{-1}	9.7×10^{-1}
Semivolatile Organics	Dibenzo(a,h)anthracene	1.3×10^{-2}	1.7×10^{-2}	3.3×10^{-2}	1.0×10^{-1}	8.4×10^{-2}
Semivolatile Organics	Di-n-octylphthalate	4.4×10^{-2}	5.2×10^{-2}	9.4×10^{-2}	2.4×10^{-1}	3.0×10^{-1}
Semivolatile Organics	Fluoranthene	1.8×10^{-1}	2.2×10^{-1}	4.8×10^{-1}	1.4	1.5
Semivolatile Organics	Fluorene	9.3×10^{-3}	1.1×10^{-2}	2.2×10^{-2}	6.9×10^{-2}	5.4×10^{-2}
Semivolatile Organics	Indeno(1,2,3-cd)pyrene	1.8×10^{-1}	2.3×10^{-1}	5.0×10^{-1}	1.5	1.7
Semivolatile Organics	Naphthalene	1.6×10^{-2}	1.9×10^{-2}	4.0×10^{-2}	1.2×10^{-1}	4.1×10^{-2}
Semivolatile Organics	N-Nitrosodimethylamine	3.4×10^{-4}	2.4×10^{-4}	3.2×10^{-4}	4.5×10^{-4}	5.1×10^{-4}
Semivolatile Organics	Phenanthrene	1.1×10^{-1}	1.3×10^{-1}	2.8×10^{-1}	8.2×10^{-1}	8.9×10^{-1}
Semivolatile Organics	Pyrene	1.7×10^{-1}	2.1×10^{-1}	4.4×10^{-1}	1.3	1.4
Semivolatile Organics	Total TEQ_BAP	1.6×10^{-1}	2.0×10^{-1}	4.4×10^{-1}	1.3	1.4
Volatile Organics	Formaldehyde	1.7	1.7	1.8	2.3	1.2

CONR = Conservation of Natural Resources.

Notes:

– All values in micrograms per gram.

– Values represent the 95 percent upper confidence level on the mean (UCL95) of the applicable data set for each alternative.

Table G–9 Onsite Source Concentrations of Radionuclides for the Evaluation of Soil Excavation Alternatives

	Alternatives					
Constituent	No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario	Radiological Only Sources
Am-241	4.3×10^{-3}	5.1×10^{-3}	5.8×10^{-3}	6.4×10^{-3}	7.2×10^{-3}	4.2×10^{-3}
Cm-243/244	2.1×10^{-3}	2.7×10^{-3}	3.2×10^{-3}	3.7×10^{-3}	3.8×10^{-3}	2.0×10^{-3}
Co-60	8.1×10^{-4}	9.4×10^{-4}	9.0×10^{-4}	2.3×10^{-3}	2.8×10^{-3}	7.9×10^{-4}
Cs-137	5.2×10^{-1}	9.7×10^{-1}	1.3	6.0	6.8	3.4×10^{-2}
H-3	1.3	1.7	2.2	2.3	2.1	1.3
Ni-59	9.8×10^{-1}	5.1×10^{-2}	1.3×10^{-1}	5.2×10^{-1}	7.6×10^{-1}	0
Np-237	1.9×10^{-3}	2.9×10^{-3}	2.9×10^{-3}	0	0	1.9×10^{-3}
Pu-238	1.6×10^{-3}	2.1×10^{-3}	2.4×10^{-3}	2.8×10^{-3}	3.4×10^{-3}	1.5×10^{-3}
Pu-239/240	4.0×10^{-3}	5.0×10^{-3}	6.2×10^{-3}	7.4×10^{-3}	8.0×10^{-3}	3.4×10^{-3}
Sr-90	1.5×10^{-1}	2.6×10^{-1}	3.4×10^{-1}	3.1×10^{-1}	2.8×10^{-1}	2.4×10^{-2}

CONR = Conservation of Natural Resources.

Notes:
– All values in picocuries per gram.
– Values represent the 95 percent upper confidence limit on the mean of the applicable dataset for each alternative.
– Np-237 not detected in samples associated with the Conservation of Natural Resources Alternative scenarios.

Table G–10 Summary of Building Radiological Survey Sources[a]

Building	Reference
4019 (SNAP = Systems for Nuclear Auxiliary Power, System Nuclear Qualification Test Facility)	*Final Historical Site Assessment, Santa Susana Field Laboratory Site, Area IV Radiological Study, Ventura County, California* (HGL 2012)
4021 (Radioactive Materials Handling Facility [RMHF]); Decontamination Facility	*Radioactive Materials Handling Facility, Current Radiological Status*, (Boeing 2007a).
4022 (RMHF)	*Final Combined Summary Report: Radioactive Materials Handling Facility Building Surveys* (Boeing 2007b).
4022 (RMHF) Sub-grade Vaults	*Radioactive Materials Handling Facility Current Radiological Status* (Boeing 2007a). Spreadsheets RMHF_B4022_vault 7 block D pre-fixative_732-A_2012-02-07.xlsx; and RMHF_B4022_vault 7 Shield Blocks_732-A_2011-10-19.xlsx (Boeing 2014b).
4024 Including Test Cells and Core Bores (SNAP)	*Report of Radiological Characterization and Confirmatory Survey Results for the SNAP Environmental Test Facility – Building 4024* (Areva 2008).
4024 Paved Yard and Concrete Slabs (SNAP)	*Report of Radiological Characterization and Confirmatory Survey Results for the SNAP Environmental Test Facility – Building 4024* (Areva 2008).
4075 (RMHF); Radioactive Waste Storage	*Final Combined Summary Report: Radioactive Materials Handling Facility Building Survey*, (Boeing 2007b).
4563 (RMHF); Open-walled Storage Area	*Final Combined Summary Report: Radioactive Materials Handling Facility Building Survey*, (Boeing 2007b).
4621 (RMHF); Contaminated Equipment Storage	*Final Combined Summary Report: Radioactive Materials Handling Facility Building Survey*, (Boeing 2007b).
4665 (RMHF); Oxidation Facility and Nonradioactive Waste Storage	*Final Combined Summary Report: Radioactive Materials Handling Facility Building Surveys* (Total) (Boeing 2007b). *Radioactive Materials Handling Facility, Current Radiological Status* (Removable) (Boeing 2007a).
4688 (RMHF); Open-walled Cleaning Station and Radioactive Materials Storage	*Final Combined Summary Report: Radioactive Materials Handling Facility Building Surveys*, (Boeing 2007b).

[a] See Chapter 4, Section 4.9.3 for the rationale of selecting these 11 buildings and one yard as the facilities with significant radioactive contamination.

Table G–11 Building Interior Surfaces – Radiological Survey Results[a]

Parameter	Buildings											
	4019 (SNAP) System Nuclear Qualification Test Facility	***4021 (RMHF); Decontamination 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); Contam-inated 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.

[a] See Chapter 4, Section 4.9.3 for the rationale of selecting these 11 buildings and one yard as the facilities with significant radioactive contamination.

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 Building Removal Alternative.

Table G–12 Isotopic Data for Building Surface Surveys

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 2014a).

– "--" indicates that the decay type is not applicable for that radionuclide.

Table G–13 Criteria for Estimating Atmospheric Stability Classes

Time	*Standard Deviation of Wind Direction (degrees)*	*Scalar Average Wind Speed (meters per second)*	*Final Class*
Day	22.5<=	<3	A
		3 to <=4	B
		4 to <=6	C
		6<=	D
	17.5 to <22.5	<4	B
		4 to <6	C
		6<=	D
	12.5 to <17.5	<6	C
		6<=	D
	<12.5	Any	D
Night	22.5<=	<2.9	F
		2.9 to <3.6	E
		3.6<=	D
	17.5 to <22.5	<2.4	F
		2.4 to <3	E
		3<=	D
	12.5 to <17.5	<2.4	E
		2.4<=	D
	7.5 to <12.5	Any	D
	3.8 to <7.5	<5	E
		5<=	D
	<3.8	<3	F
		3 to <5	E
		5<=	D

Note: Derived from Tables 6-9a and 6-9b of EPA meteorological modeling guidance (EPA 2000).

Table G–14 Offsite Air Concentrations per Unit Emission Rate (X/Q)

Wind Direction Toward	*Downwind Distance (meters)*			
	500	***1,000***	***1,500***	***1,800***
N	1.5×10^{-5}	2.9×10^{-6}	1.2×10^{-6}	7.8×10^{-7}
NNW	2.1×10^{-5}	5.2×10^{-6}	2.7×10^{-6}	2.0×10^{-6}
NW	**2.3×10^{-5}**	**6.1×10^{-6}**	**3.0×10^{-6}**	**2.2×10^{-6}**
WNW	2.0×10^{-5}	4.7×10^{-6}	2.3×10^{-6}	1.7×10^{-6}
W	1.4×10^{-5}	2.4×10^{-6}	9.1×10^{-7}	5.5×10^{-7}
WSW	8.9×10^{-6}	1.5×10^{-6}	6.2×10^{-7}	4.1×10^{-7}
SW	7.8×10^{-6}	1.8×10^{-6}	8.6×10^{-7}	6.3×10^{-7}
SSW	9.4×10^{-6}	2.0×10^{-6}	9.7×10^{-7}	7.0×10^{-7}
S	1.3×10^{-5}	2.6×10^{-6}	1.1×10^{-6}	7.3×10^{-7}
SSE	1.9×10^{-5}	4.4×10^{-6}	2.1×10^{-6}	1.5×10^{-6}
SE	2.3×10^{-5}	6.0×10^{-6}	3.0×10^{-6}	2.3×10^{-6}
ESE	2.2×10^{-5}	5.8×10^{-6}	3.0×10^{-6}	2.2×10^{-6}
E	1.7×10^{-5}	3.5×10^{-6}	1.5×10^{-6}	9.8×10^{-7}
ENE	1.1×10^{-5}	1.9×10^{-6}	7.6×10^{-7}	5.0×10^{-7}
NE	8.1×10^{-6}	1.5×10^{-6}	6.7×10^{-7}	4.6×10^{-7}
NNE	9.6×10^{-6}	1.8×10^{-6}	7.7×10^{-7}	5.3×10^{-7}

X/Q = chi over Q.

Notes:

– Results are in units of g/m3 per g/s (or s/m3) and represent the air concentration per unit emission rate (or X/Q).

– The X/Q values presented for SSFL Area IV/NBZ emissions are based on atmospheric dispersion modeling using data from an onsite weather station.

– Values in bold represent the X/Q selected as representative of the recreational user at 500 meters and the suburban resident at 1,800 meters.

Table G–15 General Description of Atmospheric Stability Classes

Stability Class	*Description*	*General Information*
A	Extremely unstable conditions	Daytime with strong to moderate sun at low wind speeds (<3 m/s)
B	Moderately unstable conditions	Daytime with strong to moderate sun at moderate wind speeds (<5 m/s)
C	Slightly unstable conditions	Daytime with high wind speeds (3< m/s)
D	Neutral conditions	Cloudy days or nights with high wind (3< m/s)
E	Slightly stable conditions	Night time with moderate wind speeds (<5 m/s)
F	Moderately stable conditions	Night time with low wind speeds (<3 m/s)
G	Extremely stable	Worst case conditions used to evaluate accidental release emergencies

m/s = meters per second.

Note: Atmospheric stability classes are not directly measured, but were estimated from the available data collected at the SSFL Area IV meteorological tower. Hourly average observations of the horizontal wind direction variability and wind speed measurements were used with the following algorithm to determine the stability classes:

Table G–16 Summary of Site Meteorological Observations of Wind Speed – 2009 through 2012

Month	*2009*		*2010*		*2011*		*2012*	
	Arithmetic Mean	*Harmonic Mean*	*Arithmetic Mean*	*Harmonic Mean*	*Arithmetic Mean*	*Harmonic Mean*	*Arithmetic Mean*	*Harmonic Mean*
January	3.1	2.1	2.6	1.8	2.8	2.0	2.3	0.9
February	2.4	1.8	2.3	1.7	2.9	1.9	2.4	1.3
March	2.3	1.6	2.6	1.8	2.5	1.8	2.4	1.1
April	2.5	1.8	2.8	2.0	2.5	1.5	2.4	1.3
May	2.4	1.8	2.7	2.0	2.6	1.5	2.1	0.7
June	2.4	1.6	2.5	1.8	2.2	1.1	2.2	0.8
July	2.6	1.9	2.5	1.7	2.4	1.3	2.2	0.8
August	2.6	1.8	2.5	1.7	2.3	1.2	2.3	0.8
September	2.5	1.8	2.3	1.5	2.1	1.2	2.0	0.6
October	2.5	1.8	2.3	1.7	2.0	1.4	2.2	0.5
November	2.4	1.8	2.8	2.0	2.2	1.2	1.6	0.4
December	2.4	1.7	2.6	1.9	2.5	1.0	1.5	0.5

Notes:

– Results (in meters per second) are based on hourly average observations of wind speed from 2009 through 2012 at the SSFL onsite meteorological station.

Table G–17 Offsite Air Concentrations of Chemicals for the Suburban Resident Cancer Risk Evaluation of Soil Excavation Alternatives

Type	*Constituent*	*Alternatives*				
		No Action	*AOC LUT*	*Revised LUT*	*CONR Residential Scenario*	*CONR Open Space Scenario*
Anions	Fluoride	3.8×10^{-10}	4.0×10^{-9}	8.5×10^{-10}	2.3×10^{-10}	1.8×10^{-10}
Anions	Perchlorate	5.3×10^{-13}	4.8×10^{-12}	1.1×10^{-12}	4.5×10^{-13}	3.3×10^{-13}
Dioxins/Furans	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	3.0×10^{-14}	3.4×10^{-13}	1.5×10^{-13}	1.1×10^{-13}	9.0×10^{-14}
Dioxins/Furans	1,2,3,4,6,7,8-HPCDF	4.2×10^{-15}	4.7×10^{-14}	2.0×10^{-14}	1.5×10^{-14}	1.2×10^{-14}
Dioxins/Furans	1,2,3,4,7,8,9-HPCDF	4.9×10^{-16}	5.4×10^{-15}	2.2×10^{-15}	1.6×10^{-15}	1.3×10^{-15}
Dioxins/Furans	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	1.3×10^{-15}	1.5×10^{-14}	6.8×10^{-15}	5.4×10^{-15}	4.6×10^{-15}
Dioxins/Furans	1,2,3,4,7,8-HXCDF	3.3×10^{-16}	3.4×10^{-15}	1.4×10^{-15}	9.1×10^{-16}	6.7×10^{-16}
Dioxins/Furans	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	1.2×10^{-15}	1.4×10^{-14}	5.9×10^{-15}	4.4×10^{-15}	3.6×10^{-15}
Dioxins/Furans	1,2,3,6,7,8-HXCDF	2.4×10^{-16}	2.6×10^{-15}	1.0×10^{-15}	7.0×10^{-16}	5.1×10^{-16}
Dioxins/Furans	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	6.3×10^{-16}	6.7×10^{-15}	2.8×10^{-15}	2.0×10^{-15}	1.7×10^{-15}
Dioxins/Furans	1,2,3,7,8,9-HXCDF	1.0×10^{-16}	1.1×10^{-15}	3.7×10^{-16}	2.2×10^{-16}	1.5×10^{-16}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzofuran	1.8×10^{-16}	1.7×10^{-15}	6.1×10^{-16}	3.3×10^{-16}	2.2×10^{-16}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	2.4×10^{-16}	2.6×10^{-15}	1.1×10^{-15}	7.8×10^{-16}	6.4×10^{-16}
Dioxins/Furans	2,3,4,6,7,8-HXCDF	3.3×10^{-16}	3.6×10^{-15}	1.5×10^{-15}	1.1×10^{-15}	7.5×10^{-16}
Dioxins/Furans	2,3,4,7,8-PECDF	2.4×10^{-16}	2.5×10^{-15}	9.5×10^{-16}	6.2×10^{-16}	4.5×10^{-16}
Dioxins/Furans	2,3,7,8-TCDD	4.3×10^{-17}	4.6×10^{-16}	1.8×10^{-16}	1.3×10^{-16}	1.1×10^{-16}
Dioxins/Furans	2,3,7,8-Tetrachlorodibenzofuran	1.0×10^{-16}	9.5×10^{-16}	3.7×10^{-16}	2.0×10^{-16}	1.3×10^{-16}
Dioxins/Furans	OCDD	3.6×10^{-13}	4.0×10^{-12}	1.8×10^{-12}	1.3×10^{-12}	1.1×10^{-12}
Dioxins/Furans	OCDF	1.1×10^{-14}	1.2×10^{-13}	5.4×10^{-14}	4.1×10^{-14}	3.4×10^{-14}
Dioxins/Furans	Total TEQ_Dioxin	1.0×10^{-15}	1.1×10^{-14}	4.9×10^{-15}	3.7×10^{-15}	3.0×10^{-15}
Herbicides	2,4-DB	7.3×10^{-13}	6.8×10^{-12}	1.8×10^{-12}	7.2×10^{-13}	5.1×10^{-13}
Herbicides	MCPA	7.2×10^{-11}	6.8×10^{-10}	1.8×10^{-10}	5.2×10^{-11}	4.0×10^{-11}
Herbicides	MCPP	5.1×10^{-11}	5.1×10^{-10}	1.4×10^{-10}	7.1×10^{-11}	5.9×10^{-11}
Metals	Antimony	3.4×10^{-10}	3.9×10^{-9}	1.8×10^{-9}	1.5×10^{-9}	1.2×10^{-9}
Metals	Barium	1.3×10^{-8}	1.2×10^{-7}	2.9×10^{-8}	1.0×10^{-8}	6.1×10^{-9}
Metals	Cadmium	2.5×10^{-10}	2.8×10^{-9}	1.3×10^{-9}	1.0×10^{-9}	8.6×10^{-10}
Metals	Chromium (Hexavalent Compounds)	7.3×10^{-11}	6.7×10^{-10}	1.8×10^{-10}	6.6×10^{-11}	5.0×10^{-11}
Metals	Lead	1.1×10^{-8}	1.3×10^{-7}	5.7×10^{-8}	4.6×10^{-8}	3.8×10^{-8}
Metals	Mercury	6.4×10^{-11}	7.1×10^{-10}	3.2×10^{-10}	2.4×10^{-10}	8.3×10^{-11}
Metals	Molybdenum	2.6×10^{-10}	2.8×10^{-9}	1.1×10^{-9}	8.1×10^{-10}	9.0×10^{-11}
Metals	Selenium	3.5×10^{-11}	3.1×10^{-10}	7.0×10^{-11}	1.9×10^{-11}	1.4×10^{-11}

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Metals	Silver	1.1×10^{-9}	1.3×10^{-8}	5.9×10^{-9}	4.9×10^{-9}	4.0×10^{-9}
Metals	Zinc	1.2×10^{-8}	1.2×10^{-7}	3.8×10^{-8}	1.8×10^{-8}	1.3×10^{-8}
Other Inorganics	Methyl Mercury	4.0×10^{-13}	3.7×10^{-12}	7.2×10^{-13}	2.2×10^{-13}	1.6×10^{-13}
Pesticides	4,4'-DDD	1.8×10^{-13}	2.1×10^{-12}	3.4×10^{-13}	1.7×10^{-13}	1.3×10^{-13}
Pesticides	4,4'-DDE	1.4×10^{-12}	1.8×10^{-11}	6.5×10^{-12}	3.9×10^{-12}	3.2×10^{-12}
Pesticides	4,4'-DDT	1.2×10^{-12}	1.3×10^{-11}	4.6×10^{-12}	2.7×10^{-12}	2.2×10^{-12}
Pesticides	Beta-Bhc	3.9×10^{-14}	4.2×10^{-13}	9.2×10^{-14}	3.6×10^{-14}	2.9×10^{-14}
Pesticides	Chlordane	1.1×10^{-12}	1.2×10^{-11}	3.2×10^{-12}	7.6×10^{-13}	6.0×10^{-13}
Pesticides	Delta-Bhc	2.7×10^{-14}	2.3×10^{-13}	5.8×10^{-14}	2.9×10^{-14}	2.3×10^{-14}
Pesticides	Dieldrin	1.6×10^{-13}	1.7×10^{-12}	6.0×10^{-13}	3.6×10^{-13}	3.0×10^{-13}
Polychlorinated Biphenyls	Aroclor 1248	4.5×10^{-12}	4.8×10^{-11}	2.2×10^{-11}	1.7×10^{-11}	1.4×10^{-11}
Polychlorinated Biphenyls	Aroclor 1254	5.9×10^{-12}	5.6×10^{-11}	2.4×10^{-11}	1.7×10^{-11}	1.0×10^{-11}
Polychlorinated Biphenyls	Aroclor 1260	1.1×10^{-10}	1.3×10^{-9}	5.9×10^{-10}	5.0×10^{-10}	4.3×10^{-10}
Polychlorinated Biphenyls	Aroclor 5460	4.8×10^{-12}	5.0×10^{-11}	2.2×10^{-11}	1.6×10^{-11}	1.3×10^{-11}
Semivolatile Organics	1-Methylnaphthalene	5.1×10^{-12}	5.9×10^{-11}	2.8×10^{-11}	2.3×10^{-11}	9.7×10^{-13}
Semivolatile Organics	2-Methylnaphthalene	6.4×10^{-12}	7.4×10^{-11}	3.4×10^{-11}	2.9×10^{-11}	1.1×10^{-12}
Semivolatile Organics	Acenaphthene	1.0×10^{-12}	1.1×10^{-11}	4.8×10^{-12}	4.1×10^{-12}	2.9×10^{-12}
Semivolatile Organics	Anthracene	3.0×10^{-12}	3.4×10^{-11}	1.5×10^{-11}	1.3×10^{-11}	9.1×10^{-12}
Semivolatile Organics	Benzo(a)anthracene	9.0×10^{-12}	1.0×10^{-10}	4.7×10^{-11}	3.7×10^{-11}	2.9×10^{-11}
Semivolatile Organics	Benzo(a)pyrene	1.3×10^{-11}	1.5×10^{-10}	6.9×10^{-11}	5.6×10^{-11}	4.5×10^{-11}
Semivolatile Organics	Benzo(b)fluoranthene	1.5×10^{-11}	1.7×10^{-10}	7.9×10^{-11}	6.2×10^{-11}	4.8×10^{-11}
Semivolatile Organics	Benzo(g,h,i)perylene	2.3×10^{-11}	2.7×10^{-10}	1.2×10^{-10}	1.0×10^{-10}	8.6×10^{-11}
Semivolatile Organics	Benzo(k)fluoranthene	6.8×10^{-12}	7.7×10^{-11}	3.6×10^{-11}	2.9×10^{-11}	2.3×10^{-11}
Semivolatile Organics	Bis(2-ethylhexyl)phthalate	3.4×10^{-11}	3.8×10^{-10}	1.6×10^{-10}	1.2×10^{-10}	6.8×10^{-11}
Semivolatile Organics	Chrysene	1.3×10^{-11}	1.5×10^{-10}	6.8×10^{-11}	5.3×10^{-11}	4.2×10^{-11}
Semivolatile Organics	Dibenzo(a,h)anthracene	1.5×10^{-12}	1.7×10^{-11}	7.1×10^{-12}	6.1×10^{-12}	3.7×10^{-12}
Semivolatile Organics	Di-n-octylphthalate	4.9×10^{-12}	5.2×10^{-11}	2.1×10^{-11}	1.4×10^{-11}	1.3×10^{-11}
Semivolatile Organics	Fluoranthene	2.0×10^{-11}	2.2×10^{-10}	1.0×10^{-10}	8.3×10^{-11}	6.6×10^{-11}
Semivolatile Organics	Fluorene	1.0×10^{-12}	1.1×10^{-11}	4.9×10^{-12}	4.1×10^{-12}	2.4×10^{-12}
Semivolatile Organics	Indeno(1,2,3-cd)pyrene	2.0×10^{-11}	2.4×10^{-10}	1.1×10^{-10}	9.2×10^{-11}	7.6×10^{-11}
Semivolatile Organics	Naphthalene	1.8×10^{-12}	1.9×10^{-11}	8.6×10^{-12}	7.0×10^{-12}	1.8×10^{-12}
Semivolatile Organics	N-Nitrosodimethylamine	3.7×10^{-14}	2.4×10^{-13}	7.0×10^{-14}	2.7×10^{-14}	2.2×10^{-14}
Semivolatile Organics	Phenanthrene	1.2×10^{-11}	1.3×10^{-10}	6.1×10^{-11}	4.9×10^{-11}	3.9×10^{-11}
Semivolatile Organics	Pyrene	1.8×10^{-11}	2.1×10^{-10}	9.7×10^{-11}	7.7×10^{-11}	6.1×10^{-11}

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Semivolatile Organics	Total TEQ_BAP	1.8×10^{-11}	2.1×10^{-10}	9.7×10^{-11}	7.8×10^{-11}	6.2×10^{-11}
Volatile Organics	Formaldehyde	1.9×10^{-10}	1.7×10^{-9}	4.0×10^{-10}	1.4×10^{-10}	5.2×10^{-11}

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– All values in micrograms per cubic meter.
– Suburban resident located 1,800 meters to the northwest of emissions source.
– Air concentrations for cancer risk evaluation based on total emission and a 26-year exposure period.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).

Table G–18 Offsite Air Concentrations of Chemicals for the Suburban Resident Hazard Evaluation of Soil Excavation Alternatives

Type	*Constituent*	*Alternatives*				
		No Action	***AOC LUT***	***Revised LUT***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Anions	Fluoride	3.8×10^{-10}	4.0×10^{-9}	3.7×10^{-9}	3.0×10^{-9}	4.6×10^{-9}
Anions	Perchlorate	5.3×10^{-13}	4.8×10^{-12}	4.8×10^{-12}	5.8×10^{-12}	8.5×10^{-12}
Dioxins/Furans	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	3.0×10^{-14}	3.4×10^{-13}	6.4×10^{-13}	1.4×10^{-12}	2.3×10^{-12}
Dioxins/Furans	1,2,3,4,6,7,8-HPCDF	4.2×10^{-15}	4.7×10^{-14}	8.8×10^{-14}	2.0×10^{-13}	3.2×10^{-13}
Dioxins/Furans	1,2,3,4,7,8,9-HPCDF	4.9×10^{-16}	5.4×10^{-15}	9.7×10^{-15}	2.1×10^{-14}	3.4×10^{-14}
Dioxins/Furans	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	1.3×10^{-15}	1.5×10^{-14}	2.9×10^{-14}	7.1×10^{-14}	1.2×10^{-13}
Dioxins/Furans	1,2,3,4,7,8-HXCDF	3.3×10^{-16}	3.4×10^{-15}	5.9×10^{-15}	1.2×10^{-14}	1.7×10^{-14}
Dioxins/Furans	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	1.2×10^{-15}	1.4×10^{-14}	2.6×10^{-14}	5.7×10^{-14}	9.4×10^{-14}
Dioxins/Furans	1,2,3,6,7,8-HXCDF	2.4×10^{-16}	2.6×10^{-15}	4.5×10^{-15}	9.1×10^{-15}	1.3×10^{-14}
Dioxins/Furans	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	6.3×10^{-16}	6.7×10^{-15}	1.2×10^{-14}	2.6×10^{-14}	4.3×10^{-14}
Dioxins/Furans	1,2,3,7,8,9-HXCDF	1.0×10^{-16}	1.1×10^{-15}	1.6×10^{-15}	2.9×10^{-15}	4.0×10^{-15}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzofuran	1.8×10^{-16}	1.7×10^{-15}	2.7×10^{-15}	4.2×10^{-15}	5.8×10^{-15}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	2.4×10^{-16}	2.6×10^{-15}	4.7×10^{-15}	1.0×10^{-14}	1.7×10^{-14}
Dioxins/Furans	2,3,4,6,7,8-HXCDF	3.3×10^{-16}	3.6×10^{-15}	6.4×10^{-15}	1.4×10^{-14}	2.0×10^{-14}
Dioxins/Furans	2,3,4,7,8-PECDF	2.4×10^{-16}	2.5×10^{-15}	4.1×10^{-15}	8.1×10^{-15}	1.2×10^{-14}
Dioxins/Furans	2,3,7,8-TCDD	4.3×10^{-17}	4.6×10^{-16}	8.0×10^{-16}	1.7×10^{-15}	2.8×10^{-15}
Dioxins/Furans	2,3,7,8-Tetrachlorodibenzofuran	1.0×10^{-16}	9.5×10^{-16}	1.6×10^{-15}	2.6×10^{-15}	3.4×10^{-15}
Dioxins/Furans	OCDD	3.6×10^{-13}	4.0×10^{-12}	7.6×10^{-12}	1.7×10^{-11}	2.7×10^{-11}
Dioxins/Furans	OCDF	1.1×10^{-14}	1.2×10^{-13}	2.4×10^{-13}	5.3×10^{-13}	8.7×10^{-13}
Dioxins/Furans	Total TEQ_Dioxin	1.0×10^{-15}	1.1×10^{-14}	2.1×10^{-14}	4.8×10^{-14}	7.8×10^{-14}
Herbicides	2,4-DB	7.3×10^{-13}	6.8×10^{-12}	7.9×10^{-12}	9.3×10^{-12}	1.3×10^{-11}
Herbicides	MCPA	7.2×10^{-11}	6.8×10^{-10}	7.9×10^{-10}	6.7×10^{-10}	1.0×10^{-9}
Herbicides	MCPP	5.1×10^{-11}	5.1×10^{-10}	6.3×10^{-10}	9.3×10^{-10}	1.5×10^{-9}
Metals	Antimony	3.4×10^{-10}	3.9×10^{-9}	7.6×10^{-9}	1.9×10^{-8}	3.2×10^{-8}
Metals	Barium	1.3×10^{-8}	1.2×10^{-7}	1.3×10^{-7}	1.3×10^{-7}	1.6×10^{-7}
Metals	Cadmium	2.5×10^{-10}	2.8×10^{-9}	5.4×10^{-9}	1.3×10^{-8}	2.2×10^{-8}
Metals	Chromium (Hexavalent Compounds)	7.3×10^{-11}	6.7×10^{-10}	7.9×10^{-10}	8.5×10^{-10}	1.3×10^{-9}
Metals	Lead	1.1×10^{-8}	1.3×10^{-7}	2.5×10^{-7}	6.0×10^{-7}	9.9×10^{-7}
Metals	Mercury	6.4×10^{-11}	7.1×10^{-10}	1.4×10^{-9}	3.1×10^{-9}	2.2×10^{-9}
Metals	Molybdenum	2.6×10^{-10}	2.8×10^{-9}	5.0×10^{-9}	1.1×10^{-8}	2.3×10^{-9}
Metals	Selenium	3.5×10^{-11}	3.1×10^{-10}	3.1×10^{-10}	2.5×10^{-10}	3.6×10^{-10}

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Metals	Silver	1.1×10^{-9}	1.3×10^{-8}	2.6×10^{-8}	6.4×10^{-8}	1.0×10^{-7}
Metals	Zinc	1.2×10^{-8}	1.2×10^{-7}	1.7×10^{-7}	2.4×10^{-7}	3.4×10^{-7}
Other Inorganics	Methyl Mercury	4.0×10^{-13}	3.7×10^{-12}	3.1×10^{-12}	2.8×10^{-12}	4.1×10^{-12}
Pesticides	4,4'-DDD	1.8×10^{-13}	2.1×10^{-12}	1.5×10^{-12}	2.2×10^{-12}	3.5×10^{-12}
Pesticides	4,4'-DDE	1.4×10^{-12}	1.8×10^{-11}	2.8×10^{-11}	5.1×10^{-11}	8.4×10^{-11}
Pesticides	4,4'-DDT	1.2×10^{-12}	1.3×10^{-11}	2.0×10^{-11}	3.6×10^{-11}	5.8×10^{-11}
Pesticides	Beta-Bhc	3.9×10^{-14}	4.2×10^{-13}	4.0×10^{-13}	4.7×10^{-13}	7.6×10^{-13}
Pesticides	Chlordane	1.1×10^{-12}	1.2×10^{-11}	1.4×10^{-11}	9.9×10^{-12}	1.6×10^{-11}
Pesticides	Delta-Bhc	2.7×10^{-14}	2.3×10^{-13}	2.5×10^{-13}	3.7×10^{-13}	6.0×10^{-13}
Pesticides	Dieldrin	1.6×10^{-13}	1.7×10^{-12}	2.6×10^{-12}	4.7×10^{-12}	7.7×10^{-12}
Polychlorinated Biphenyls	Aroclor 1248	4.5×10^{-12}	4.8×10^{-11}	9.5×10^{-11}	2.2×10^{-10}	3.5×10^{-10}
Polychlorinated Biphenyls	Aroclor 1254	5.9×10^{-12}	5.6×10^{-11}	1.1×10^{-10}	2.3×10^{-10}	2.7×10^{-10}
Polychlorinated Biphenyls	Aroclor 1260	1.1×10^{-10}	1.3×10^{-9}	2.5×10^{-9}	6.5×10^{-9}	1.1×10^{-8}
Polychlorinated Biphenyls	Aroclor 5460	4.8×10^{-12}	5.0×10^{-11}	9.5×10^{-11}	2.1×10^{-10}	3.4×10^{-10}
Semivolatile Organics	1-Methylnaphthalene	5.1×10^{-12}	5.9×10^{-11}	1.2×10^{-10}	3.0×10^{-10}	2.5×10^{-11}
Semivolatile Organics	2-Methylnaphthalene	6.4×10^{-12}	7.4×10^{-11}	1.5×10^{-10}	3.8×10^{-10}	2.9×10^{-11}
Semivolatile Organics	Acenaphthene	1.0×10^{-12}	1.1×10^{-11}	2.1×10^{-11}	5.3×10^{-11}	7.5×10^{-11}
Semivolatile Organics	Anthracene	3.0×10^{-12}	3.4×10^{-11}	6.4×10^{-11}	1.7×10^{-10}	2.4×10^{-10}
Semivolatile Organics	Benzo(a)anthracene	9.0×10^{-12}	1.0×10^{-10}	2.0×10^{-10}	4.9×10^{-10}	7.5×10^{-10}
Semivolatile Organics	Benzo(a)pyrene	1.3×10^{-11}	1.5×10^{-10}	3.0×10^{-10}	7.2×10^{-10}	1.2×10^{-9}
Semivolatile Organics	Benzo(b)fluoranthene	1.5×10^{-11}	1.7×10^{-10}	3.4×10^{-10}	8.1×10^{-10}	1.3×10^{-9}
Semivolatile Organics	Benzo(g,h,i)perylene	2.3×10^{-11}	2.7×10^{-10}	5.4×10^{-10}	1.3×10^{-9}	2.2×10^{-9}
Semivolatile Organics	Benzo(k)fluoranthene	6.8×10^{-12}	7.7×10^{-11}	1.6×10^{-10}	3.8×10^{-10}	6.0×10^{-10}
Semivolatile Organics	Bis(2-ethylhexyl)phthalate	3.4×10^{-11}	3.8×10^{-10}	6.8×10^{-10}	1.6×10^{-9}	1.8×10^{-9}
Semivolatile Organics	Chrysene	1.3×10^{-11}	1.5×10^{-10}	3.0×10^{-10}	7.0×10^{-10}	1.1×10^{-9}
Semivolatile Organics	Dibenzo(a,h)anthracene	1.5×10^{-12}	1.7×10^{-11}	3.1×10^{-11}	8.0×10^{-11}	9.5×10^{-11}
Semivolatile Organics	Di-n-octylphthalate	4.9×10^{-12}	5.2×10^{-11}	8.9×10^{-11}	1.9×10^{-10}	3.4×10^{-10}
Semivolatile Organics	Fluoranthene	2.0×10^{-11}	2.2×10^{-10}	4.5×10^{-10}	1.1×10^{-9}	1.7×10^{-9}
Semivolatile Organics	Fluorene	1.0×10^{-12}	1.1×10^{-11}	2.1×10^{-11}	5.4×10^{-11}	6.1×10^{-11}
Semivolatile Organics	Indeno(1,2,3-cd)pyrene	2.0×10^{-11}	2.4×10^{-10}	4.8×10^{-10}	1.2×10^{-9}	2.0×10^{-9}
Semivolatile Organics	Naphthalene	1.8×10^{-12}	1.9×10^{-11}	3.7×10^{-11}	9.1×10^{-11}	4.7×10^{-11}
Semivolatile Organics	N-Nitrosodimethylamine	3.7×10^{-14}	2.4×10^{-13}	3.0×10^{-13}	3.5×10^{-13}	5.8×10^{-13}
Semivolatile Organics	Phenanthrene	1.2×10^{-11}	1.3×10^{-10}	2.6×10^{-10}	6.4×10^{-10}	1.0×10^{-9}

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Semivolatile Organics	Pyrene	1.8×10^{-11}	2.1×10^{-10}	4.2×10^{-10}	1.0×10^{-9}	1.6×10^{-9}
Semivolatile Organics	Total TEQ_BAP	1.8×10^{-11}	2.1×10^{-10}	4.2×10^{-10}	1.0×10^{-9}	1.6×10^{-9}
Volatile Organics	Formaldehyde	1.9×10^{-10}	1.7×10^{-9}	1.7×10^{-9}	1.8×10^{-9}	1.4×10^{-9}

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– All values in micrograms per cubic meter.

– Suburban resident located 1,800 meters to the northwest of emissions source.

– Air concentrations for dose evaluation assume a 1-year emission period for radiological sources.

– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).

Table G–19 Offsite Air Concentrations of Radionuclides for the Suburban Resident Cancer Risk Evaluation of Soil Excavation Alternatives

	Alternatives				
Constituent	***No Action***	***AOC LUT***	***Revised LUT***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Am-241	4.7×10^{-13}	5.1×10^{-12}	1.3×10^{-12}	3.8×10^{-13}	3.1×10^{-13}
Cm-243/244	2.3×10^{-13}	2.7×10^{-12}	6.9×10^{-13}	2.2×10^{-13}	1.7×10^{-13}
Co-60	8.9×10^{-14}	9.5×10^{-13}	2.0×10^{-13}	1.4×10^{-13}	1.2×10^{-13}
Cs-137	5.8×10^{-11}	9.8×10^{-10}	2.8×10^{-10}	3.6×10^{-10}	3.0×10^{-10}
H-3	1.4×10^{-10}	1.7×10^{-9}	4.8×10^{-10}	1.3×10^{-10}	9.1×10^{-11}
Ni-59	1.1×10^{-10}	5.2×10^{-11}	2.9×10^{-11}	3.1×10^{-11}	3.3×10^{-11}
Np-237	2.1×10^{-13}	2.9×10^{-12}	6.3×10^{-13}	NA	NA
Pu-238	1.8×10^{-13}	2.1×10^{-12}	5.3×10^{-13}	1.6×10^{-13}	1.5×10^{-13}
Pu-239/240	4.4×10^{-13}	5.0×10^{-12}	1.3×10^{-12}	4.4×10^{-13}	3.5×10^{-13}
Sr-90	1.6×10^{-11}	2.6×10^{-10}	7.4×10^{-11}	1.9×10^{-11}	1.2×10^{-11}

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– All values in picocuries per cubic meter.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).
– Suburban resident located 1,800 meters to the northwest of emissions source.
– Np-237 not detected in samples associated with the Conservation of Natural Resources Alternative scenarios.
– Air concentrations for cancer risk evaluation based on a 26-year emission period.

Table G–20 Offsite Air Concentrations of Radionuclides for the Suburban Resident Dose Evaluation of Soil Excavation Alternatives

Constituent	Alternatives				
	No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Am-241	4.7×10^{-13}	6.9×10^{-12}	6.9×10^{-12}	9.6×10^{-14}	2.1×10^{-14}
Cm-243/244	2.3×10^{-13}	3.3×10^{-12}	3.3×10^{-12}	5.5×10^{-14}	1.1×10^{-14}
Co-60	8.9×10^{-14}	1.3×10^{-12}	1.3×10^{-12}	3.4×10^{-14}	8.3×10^{-15}
Cs-137	5.8×10^{-11}	5.6×10^{-11}	5.6×10^{-11}	9.0×10^{-11}	2.0×10^{-11}
H-3	1.4×10^{-10}	2.1×10^{-9}	2.1×10^{-9}	3.4×10^{-11}	6.2×10^{-12}
Ni-59	1.1×10^{-10}	NA	NA	7.7×10^{-12}	2.3×10^{-12}
Np-237	2.1×10^{-13}	3.1×10^{-12}	3.1×10^{-12}	NA	NA
Pu-238	1.8×10^{-13}	2.5×10^{-12}	2.5×10^{-12}	4.1×10^{-14}	1.0×10^{-14}
Pu-239/240	4.4×10^{-13}	5.6×10^{-12}	5.6×10^{-12}	1.1×10^{-13}	2.4×10^{-14}
Sr-90	1.6×10^{-11}	3.9×10^{-11}	3.9×10^{-11}	4.7×10^{-12}	8.2×10^{-13}

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– All values in picocuries per cubic meter.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).
– Suburban resident located 1,800 meters to the northwest of emissions source.
– Ni-59 has a 95 percent upper confidence limit on the mean below 0 in source areas with only radiological constituents for the Cleanup to AOC LUT Values and Cleanup to Revised LUT Values Alternatives.
– Np-237 not detected in samples associated with the Conservation of Natural Resources Alternative scenarios.
– Air concentrations for dose evaluation assume a 2-year emission period for radiological sources.

Table G–21 Building Emissions During Demolition and Offsite Media Concentrations – Offsite Suburban Resident

Radio-nuclide	Total Emissions (pCi)	Direction	Distance (m)	X/Q (g/m³ per g/s)	Emission Duration (yr)	Exposure Duration (yr)	Emission Rate During Remediation (pCi/s)	Offsite Air Concentration During Remediation (pCi/m³)	Emission Rate Averaged Over Exposure Period (pCi/s)	Offsite Air Concentration During Long Term Exposure (pCi/m3)	Areal Deposition Rate (pCi/s-m²)	Duration of Deposition (yr)	Total Areal Deposition (pCi/m²)	Offsite Soil Mixing Mass per Area (g/m²)	Offsite Soil Concentration After Deposition (pCi/g)
Am-241	1.6×10^{7}	NW	1800	2.2×10^{-6}	1	26	4.9×10^{-1}	1.1×10^{-6}	1.9×10^{-2}	4.2×10^{-8}	2.0×10^{-9}	1	6.2×10^{-2}	4.0×10^{4}	1.5×10^{-6}
Co-60	1.6×10^{8}	NW	1800	2.2×10^{-6}	1	26	5.2	1.1×10^{-5}	2.0×10^{-1}	4.4×10^{-7}	2.0×10^{-8}	1	6.4×10^{-1}	4.0×10^{4}	1.6×10^{-5}
Cs-134	7.1×10^{3}	NW	1800	2.2×10^{-6}	1	26	2.2×10^{-4}	4.9×10^{-10}	8.6×10^{-6}	1.9×10^{-11}	8.9×10^{-13}	1	2.8×10^{-5}	4.0×10^{4}	7.0×10^{-10}
Cs-137	5.0×10^{8}	NW	1800	2.2×10^{-6}	1	26	1.6×10^{1}	3.5×10^{-5}	6.1×10^{-1}	1.3×10^{-6}	6.3×10^{-8}	1	2.0	4.0×10^{4}	4.9×10^{-5}
Eu-152	1.6×10^{6}	NW	1800	2.2×10^{-6}	1	26	5.0×10^{-2}	1.1×10^{-7}	1.9×10^{-3}	4.2×10^{-9}	2.0×10^{-10}	1	6.2×10^{-3}	4.0×10^{4}	1.6×10^{-7}
Eu-154	1.7×10^{5}	NW	1800	2.2×10^{-6}	1	26	5.3×10^{-3}	1.2×10^{-8}	2.1×10^{-4}	4.5×10^{-10}	2.1×10^{-11}	1	6.6×10^{-4}	4.0×10^{4}	1.7×10^{-8}
Eu-155	1.1×10^{4}	NW	1800	2.2×10^{-6}	1	26	3.6×10^{-4}	7.8×10^{-10}	1.4×10^{-5}	3.0×10^{-11}	1.4×10^{-12}	1	4.4×10^{-5}	4.0×10^{4}	1.1×10^{-9}
Fe-55	5.2×10^{4}	NW	1800	2.2×10^{-6}	1	26	1.6×10^{-3}	3.6×10^{-9}	6.3×10^{-5}	1.4×10^{-10}	6.5×10^{-12}	1	2.0×10^{-4}	4.0×10^{4}	5.1×10^{-9}
H-3	3.4×10^{7}	NW	1800	2.2×10^{-6}	1	26	1.1	2.3×10^{-6}	4.1×10^{-2}	9.0×10^{-8}	4.2×10^{-9}	1	1.3×10^{-1}	4.0×10^{4}	3.3×10^{-6}
Na-22	1.6×10^{-4}	NW	1800	2.2×10^{-6}	1	26	4.9×10^{-12}	1.1×10^{-17}	1.9×10^{-13}	4.2×10^{-19}	1.9×10^{-20}	1	6.1×10^{-13}	4.0×10^{4}	1.5×10^{-17}
Ni-63	1.1×10^{9}	NW	1800	2.2×10^{-6}	1	26	3.6×10^{1}	8.0×10^{-5}	1.4	3.1×10^{-6}	1.4×10^{-7}	1	4.5	4.0×10^{4}	1.1×10^{-4}
Pu-238	1.4×10^{6}	NW	1800	2.2×10^{-6}	1	26	4.5×10^{-2}	1.0×10^{-7}	1.7×10^{-3}	3.8×10^{-9}	1.8×10^{-10}	1	5.7×10^{-3}	4.0×10^{4}	1.4×10^{-7}
Pu-239	3.6×10^{7}	NW	1800	2.2×10^{-6}	1	26	1.2	2.5×10^{-6}	4.4×10^{-2}	9.7×10^{-8}	4.6×10^{-9}	1	1.4×10^{-1}	4.0×10^{4}	3.6×10^{-6}
Pu-240	1.4×10^{7}	NW	1800	2.2×10^{-6}	1	26	4.3×10^{-1}	9.4×10^{-7}	1.7×10^{-2}	3.6×10^{-8}	1.7×10^{-9}	1	5.3×10^{-2}	4.0×10^{4}	1.3×10^{-6}
Pu-241	1.1×10^{7}	NW	1800	2.2×10^{-6}	1	26	3.4×10^{-1}	7.4×10^{-7}	1.3×10^{-2}	2.8×10^{-8}	1.3×10^{-9}	1	4.2×10^{-2}	4.0×10^{4}	1.0×10^{-6}
Pu-242	9.1×10^{4}	NW	1800	2.2×10^{-6}	1	26	2.9×10^{-3}	6.4×10^{-9}	1.1×10^{-4}	2.4×10^{-10}	1.1×10^{-11}	1	3.6×10^{-4}	4.0×10^{4}	9.0×10^{-9}
Sr-90	2.1×10^{10}	NW	1800	2.2×10^{-6}	1	26	6.8×10^{2}	1.5×10^{-3}	2.6×10^{1}	5.7×10^{-5}	2.7×10^{-6}	1	8.4×10^{1}	4.0×10^{4}	2.1×10^{-3}
Th-232	1.2×10^{5}	NW	1800	2.2×10^{-6}	1	26	3.9×10^{-3}	8.5×10^{-9}	1.5×10^{-4}	3.3×10^{-10}	1.5×10^{-11}	1	4.8×10^{-4}	4.0×10^{4}	1.2×10^{-8}
U-234	8.4×10^{5}	NW	1800	2.2×10^{-6}	1	26	2.7×10^{-2}	5.9×10^{-8}	1.0×10^{-3}	2.3×10^{-9}	1.1×10^{-10}	1	3.3×10^{-3}	4.0×10^{4}	8.3×10^{-8}
U-235	7.7×10^{4}	NW	1800	2.2×10^{-6}	1	26	2.4×10^{-3}	5.4×10^{-9}	9.4×10^{-5}	2.1×10^{-10}	9.7×10^{-12}	1	3.0×10^{-4}	4.0×10^{4}	7.6×10^{-9}
U-238	9.7×10^{5}	NW	1800	2.2×10^{-6}	1	26	3.1×10^{-2}	6.8×10^{-8}	1.2×10^{-3}	2.6×10^{-9}	1.2×10^{-10}	1	3.8×10^{-3}	4.0×10^{4}	9.6×10^{-8}

g = gram; m = meters; m^2 = square meters; m^3 = cubic meters; pCi = picocuries; s = second; X/Q = chi over Q; yr = year.

Notes:

– Deposition based on air concentration and settling velocity of 1.8×10^{-3} m/s.

– Mixing mass assumes 1,600 g/m^3 to a depth of 0.025m.

Table G–22 Offsite Media Concentrations – Bedrock Excavation

Radio-nuclide	*Total Emissions (pCi)*	*Direction*	*Distance (m)*	*X/Q (g/m^3 per g/s)*	*Emission Duration (yr)*	*Exposure Duration (yr)*	*Emission Rate During Remediation (pCi/s)*	*Offsite Air Concentration During Remediation (pCi/m^3)*	*Emission Rate Averaged Over Exposure Period (pCi/s)*	*Offsite Air Concentration During Long Term Exposure (pCi/m^3)*	*Areal Deposition Rate ($pCi/s\text{-}m^2$)*	*Duration of Deposition (yr)*	*Total Areal Deposition (pCi/m^2)*	*Offsite Soil Mixing Mass per Area (g/m^2)*	*Offsite Soil Concentration After Deposition (pCi/g)*
Offsite Suburban Resident															
Sr-90	1.6×10^{8}	NW	1800	2.2×10^{-6}	1	26	4.9	1.1×10^{-5}	1.9×10^{-1}	4.2×10^{-7}	2.0×10^{-8}	1	6.2×10^{-1}	4.0×10^{4}	1.5×10^{-5}
Offsite Recreational User															
Sr-90	1.6×10^{8}	NW	500	2.3×10^{-5}	1	26	4.9	1.2×10^{-4}	1.9×10^{-1}	4.4×10^{-6}	2.1×10^{-7}	1	6.5	4.0×10^{4}	1.6×10^{-4}

g = grams; m = meters; m^2 = square meters; m^3 = cubic meters; pCi = picocuries; s = seconds; X/Q = chi over Q; yr = year.

Notes:

– Deposition based on air concentration and settling velocity of 1.8×10^{-3} m/s.

– Mixing mass assumes 1,600 g/m^3 to a depth of 0.025m.

Table G–23 Offsite Air Concentrations of Chemicals for the Recreational User Cancer Risk Evaluation of Soil Excavation Alternatives

Type	*Constituent*	*Alternatives*				
		No Action	*AOC LUT*	*Revised LUT*	*CONR Residential Scenario*	*CONR Open Space Scenario*
Anions	Fluoride	4.0×10^{-9}	4.2×10^{-8}	9.1×10^{-9}	2.5×10^{-9}	1.9×10^{-9}
Anions	Perchlorate	5.6×10^{-12}	5.1×10^{-11}	1.2×10^{-11}	4.7×10^{-12}	3.5×10^{-12}
Dioxins/Furans	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	3.2×10^{-13}	3.6×10^{-12}	1.6×10^{-12}	1.1×10^{-12}	9.5×10^{-13}
Dioxins/Furans	1,2,3,4,6,7,8-HPCDF	4.5×10^{-14}	5.0×10^{-13}	2.2×10^{-13}	1.6×10^{-13}	1.3×10^{-13}
Dioxins/Furans	1,2,3,4,7,8,9-HPCDF	5.2×10^{-15}	5.7×10^{-14}	2.4×10^{-14}	1.7×10^{-14}	1.4×10^{-14}
Dioxins/Furans	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	1.4×10^{-14}	1.6×10^{-13}	7.2×10^{-14}	5.8×10^{-14}	4.9×10^{-14}
Dioxins/Furans	1,2,3,4,7,8-HXCDF	3.5×10^{-15}	3.6×10^{-14}	1.4×10^{-14}	9.6×10^{-15}	7.1×10^{-15}
Dioxins/Furans	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	1.3×10^{-14}	1.5×10^{-13}	6.3×10^{-14}	4.6×10^{-14}	3.8×10^{-14}
Dioxins/Furans	1,2,3,6,7,8-HXCDF	2.6×10^{-15}	2.7×10^{-14}	1.1×10^{-14}	7.4×10^{-15}	5.4×10^{-15}
Dioxins/Furans	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	6.6×10^{-15}	7.1×10^{-14}	3.0×10^{-14}	2.1×10^{-14}	1.8×10^{-14}
Dioxins/Furans	1,2,3,7,8,9-HXCDF	1.1×10^{-15}	1.2×10^{-14}	3.9×10^{-15}	2.4×10^{-15}	1.6×10^{-15}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzofuran	1.9×10^{-15}	1.8×10^{-14}	6.5×10^{-15}	3.5×10^{-15}	2.4×10^{-15}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	2.5×10^{-15}	2.8×10^{-14}	1.1×10^{-14}	8.2×10^{-15}	6.8×10^{-15}
Dioxins/Furans	2,3,4,6,7,8-HXCDF	3.5×10^{-15}	3.8×10^{-14}	1.6×10^{-14}	1.1×10^{-14}	8.0×10^{-15}
Dioxins/Furans	2,3,4,7,8-PECDF	2.5×10^{-15}	2.6×10^{-14}	1.0×10^{-14}	6.6×10^{-15}	4.8×10^{-15}
Dioxins/Furans	2,3,7,8-TCDD	4.6×10^{-16}	4.9×10^{-15}	2.0×10^{-15}	1.4×10^{-15}	1.1×10^{-15}
Dioxins/Furans	2,3,7,8-Tetrachlorodibenzofuran	1.1×10^{-15}	1.0×10^{-14}	4.0×10^{-15}	2.1×10^{-15}	1.4×10^{-15}
Dioxins/Furans	OCDD	3.9×10^{-12}	4.2×10^{-11}	1.9×10^{-11}	1.4×10^{-11}	1.1×10^{-11}
Dioxins/Furans	OCDF	1.2×10^{-13}	1.3×10^{-12}	5.8×10^{-13}	4.3×10^{-13}	3.6×10^{-13}
Dioxins/Furans	Total TEQ_Dioxin	1.1×10^{-14}	1.2×10^{-13}	5.2×10^{-14}	3.9×10^{-14}	3.2×10^{-14}
Herbicides	2,4-DB	7.7×10^{-12}	7.2×10^{-11}	1.9×10^{-11}	7.6×10^{-12}	5.4×10^{-12}
Herbicides	MCPA	7.6×10^{-10}	7.2×10^{-9}	1.9×10^{-9}	5.5×10^{-10}	4.2×10^{-10}
Herbicides	MCPP	5.4×10^{-10}	5.4×10^{-9}	1.5×10^{-9}	7.6×10^{-10}	6.3×10^{-10}
Metals	Antimony	3.6×10^{-9}	4.1×10^{-8}	1.9×10^{-8}	1.5×10^{-8}	1.3×10^{-8}
Metals	Barium	1.4×10^{-7}	1.3×10^{-6}	3.1×10^{-7}	1.1×10^{-7}	6.5×10^{-8}
Metals	Cadmium	2.7×10^{-9}	3.0×10^{-8}	1.3×10^{-8}	1.1×10^{-8}	9.1×10^{-9}
Metals	Chromium (Hexavalent Compounds)	7.7×10^{-10}	7.1×10^{-9}	1.9×10^{-9}	7.0×10^{-10}	5.3×10^{-10}
Metals	Lead	1.2×10^{-7}	1.3×10^{-6}	6.0×10^{-7}	4.9×10^{-7}	4.0×10^{-7}
Metals	Mercury	6.8×10^{-10}	7.6×10^{-9}	3.4×10^{-9}	2.5×10^{-9}	8.8×10^{-10}
Metals	Molybdenum	2.7×10^{-9}	2.9×10^{-8}	1.2×10^{-8}	8.6×10^{-9}	9.5×10^{-10}
Metals	Selenium	3.7×10^{-10}	3.3×10^{-9}	7.5×10^{-10}	2.0×10^{-10}	1.5×10^{-10}

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Metals	Silver	1.2×10^{-8}	1.3×10^{-7}	6.2×10^{-8}	5.2×10^{-8}	4.2×10^{-8}
Metals	Zinc	1.3×10^{-7}	1.3×10^{-6}	4.1×10^{-7}	1.9×10^{-7}	1.4×10^{-7}
Other Inorganics	Methyl Mercury	4.2×10^{-12}	3.9×10^{-11}	7.6×10^{-12}	2.3×10^{-12}	1.7×10^{-12}
Pesticides	4,4'-DDD	1.9×10^{-12}	2.2×10^{-11}	3.6×10^{-12}	1.8×10^{-12}	1.4×10^{-12}
Pesticides	4,4'-DDE	1.5×10^{-11}	1.9×10^{-10}	6.9×10^{-11}	4.1×10^{-11}	3.4×10^{-11}
Pesticides	4,4'-DDT	1.3×10^{-11}	1.3×10^{-10}	4.9×10^{-11}	2.9×10^{-11}	2.4×10^{-11}
Pesticides	Beta-Bhc	4.1×10^{-13}	4.4×10^{-12}	9.8×10^{-13}	3.8×10^{-13}	3.1×10^{-13}
Pesticides	Chlordane	1.2×10^{-11}	1.3×10^{-10}	3.4×10^{-11}	8.1×10^{-12}	6.3×10^{-12}
Pesticides	Delta-Bhc	2.9×10^{-13}	2.5×10^{-12}	6.1×10^{-13}	3.0×10^{-13}	2.5×10^{-13}
Pesticides	Dieldrin	1.7×10^{-12}	1.8×10^{-11}	6.3×10^{-12}	3.8×10^{-12}	3.1×10^{-12}
Polychlorinated Biphenyls	Aroclor 1248	4.7×10^{-11}	5.1×10^{-10}	2.3×10^{-10}	1.8×10^{-10}	1.4×10^{-10}
Polychlorinated Biphenyls	Aroclor 1254	6.2×10^{-11}	5.9×10^{-10}	2.6×10^{-10}	1.8×10^{-10}	1.1×10^{-10}
Polychlorinated Biphenyls	Aroclor 1260	1.1×10^{-9}	1.3×10^{-8}	6.2×10^{-9}	5.3×10^{-9}	4.5×10^{-9}
Polychlorinated Biphenyls	Aroclor 5460	5.1×10^{-11}	5.3×10^{-10}	2.3×10^{-10}	1.7×10^{-10}	1.4×10^{-10}
Semivolatile Organics	1-Methylnaphthalene	5.4×10^{-11}	6.2×10^{-10}	2.9×10^{-10}	2.5×10^{-10}	1.0×10^{-11}
Semivolatile Organics	2-Methylnaphthalene	6.8×10^{-11}	7.8×10^{-10}	3.6×10^{-10}	3.1×10^{-10}	1.2×10^{-11}
Semivolatile Organics	Acenaphthene	1.1×10^{-11}	1.2×10^{-10}	5.1×10^{-11}	4.3×10^{-11}	3.1×10^{-11}
Semivolatile Organics	Anthracene	3.2×10^{-11}	3.6×10^{-10}	1.6×10^{-10}	1.4×10^{-10}	9.6×10^{-11}
Semivolatile Organics	Benzo(a)anthracene	9.5×10^{-11}	1.1×10^{-9}	5.0×10^{-10}	4.0×10^{-10}	3.1×10^{-10}
Semivolatile Organics	Benzo(a)pyrene	1.4×10^{-10}	1.6×10^{-9}	7.3×10^{-10}	5.9×10^{-10}	4.7×10^{-10}
Semivolatile Organics	Benzo(b)fluoranthene	1.6×10^{-10}	1.8×10^{-9}	8.4×10^{-10}	6.6×10^{-10}	5.1×10^{-10}
Semivolatile Organics	Benzo(g,h,i)perylene	2.4×10^{-10}	2.8×10^{-9}	1.3×10^{-9}	1.1×10^{-9}	9.1×10^{-10}
Semivolatile Organics	Benzo(k)fluoranthene	7.2×10^{-11}	8.2×10^{-10}	3.8×10^{-10}	3.1×10^{-10}	2.5×10^{-10}
Semivolatile Organics	Bis(2-ethylhexyl)phthalate	3.6×10^{-10}	4.0×10^{-9}	1.7×10^{-9}	1.3×10^{-9}	7.2×10^{-10}
Semivolatile Organics	Chrysene	1.4×10^{-10}	1.6×10^{-9}	7.2×10^{-10}	5.7×10^{-10}	4.5×10^{-10}
Semivolatile Organics	Dibenzo(a,h)anthracene	1.5×10^{-11}	1.8×10^{-10}	7.6×10^{-11}	6.5×10^{-11}	3.9×10^{-11}
Semivolatile Organics	Di-n-octylphthalate	5.2×10^{-11}	5.5×10^{-10}	2.2×10^{-10}	1.5×10^{-10}	1.4×10^{-10}
Semivolatile Organics	Fluoranthene	2.1×10^{-10}	2.4×10^{-9}	1.1×10^{-9}	8.8×10^{-10}	7.0×10^{-10}
Semivolatile Organics	Fluorene	1.1×10^{-11}	1.2×10^{-10}	5.2×10^{-11}	4.4×10^{-11}	2.5×10^{-11}
Semivolatile Organics	Indeno(1,2,3-cd)pyrene	2.1×10^{-10}	2.5×10^{-9}	1.2×10^{-9}	9.7×10^{-10}	8.0×10^{-10}
Semivolatile Organics	Naphthalene	1.9×10^{-11}	2.0×10^{-10}	9.1×10^{-11}	7.4×10^{-11}	1.9×10^{-11}
Semivolatile Organics	N-Nitrosodimethylamine	3.9×10^{-13}	2.5×10^{-12}	7.4×10^{-13}	2.9×10^{-13}	2.4×10^{-13}
Semivolatile Organics	Phenanthrene	1.2×10^{-10}	1.4×10^{-9}	6.5×10^{-10}	5.2×10^{-10}	4.1×10^{-10}

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Semivolatile Organics	Pyrene	1.9×10^{-10}	2.2×10^{-9}	1.0×10^{-9}	8.1×10^{-10}	6.4×10^{-10}
Semivolatile Organics	Total TEQ_BAP	1.9×10^{-10}	2.2×10^{-9}	1.0×10^{-9}	8.2×10^{-10}	6.6×10^{-10}
Volatile Organics	Formaldehyde	2.0×10^{-9}	1.8×10^{-8}	4.2×10^{-9}	1.5×10^{-9}	5.6×10^{-10}

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– All values in micrograms per cubic meter.
– Recreational user located 500 meters to the northwest of emissions source.
– Air concentrations for cancer risk evaluation based on total emission and a 26-year exposure period.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).

Table G–24 Offsite Air Concentrations of Chemicals for the Recreational User Hazard Evaluation of Soil Excavation Alternatives

Type	*Constituent*	*Alternatives*				
		No Action	*AOC LUT*	*Revised LUT*	*CONR Residential Scenario*	*CONR Open Space Scenario*
Anions	Fluoride	4.0×10^{-9}	4.2×10^{-8}	3.9×10^{-8}	3.2×10^{-8}	4.8×10^{-8}
Anions	Perchlorate	5.6×10^{-12}	5.1×10^{-11}	5.1×10^{-11}	6.1×10^{-11}	9.0×10^{-11}
Dioxins/Furans	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	3.2×10^{-13}	3.6×10^{-12}	6.8×10^{-12}	1.5×10^{-11}	2.5×10^{-11}
Dioxins/Furans	1,2,3,4,6,7,8-HPCDF	4.5×10^{-14}	5.0×10^{-13}	9.3×10^{-13}	2.1×10^{-12}	3.4×10^{-12}
Dioxins/Furans	1,2,3,4,7,8,9-HPCDF	5.2×10^{-15}	5.7×10^{-14}	1.0×10^{-13}	2.2×10^{-13}	3.6×10^{-13}
Dioxins/Furans	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	1.4×10^{-14}	1.6×10^{-13}	3.1×10^{-13}	7.5×10^{-13}	1.3×10^{-12}
Dioxins/Furans	1,2,3,4,7,8-HXCDF	3.5×10^{-15}	3.6×10^{-14}	6.3×10^{-14}	1.2×10^{-13}	1.8×10^{-13}
Dioxins/Furans	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	1.3×10^{-14}	1.5×10^{-13}	2.7×10^{-13}	6.0×10^{-13}	1.0×10^{-12}
Dioxins/Furans	1,2,3,6,7,8-HXCDF	2.6×10^{-15}	2.7×10^{-14}	4.7×10^{-14}	9.6×10^{-14}	1.4×10^{-13}
Dioxins/Furans	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	6.6×10^{-15}	7.1×10^{-14}	1.3×10^{-13}	2.8×10^{-13}	4.6×10^{-13}
Dioxins/Furans	1,2,3,7,8,9-HXCDF	1.1×10^{-15}	1.2×10^{-14}	1.7×10^{-14}	3.1×10^{-14}	4.2×10^{-14}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzofuran	1.9×10^{-15}	1.8×10^{-14}	2.8×10^{-14}	4.5×10^{-14}	6.1×10^{-14}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	2.5×10^{-15}	2.8×10^{-14}	4.9×10^{-14}	1.1×10^{-13}	1.8×10^{-13}
Dioxins/Furans	2,3,4,6,7,8-HXCDF	3.5×10^{-15}	3.8×10^{-14}	6.8×10^{-14}	1.5×10^{-13}	2.1×10^{-13}
Dioxins/Furans	2,3,4,7,8-PECDF	2.5×10^{-15}	2.6×10^{-14}	4.4×10^{-14}	8.6×10^{-14}	1.2×10^{-13}
Dioxins/Furans	2,3,7,8-TCDD	4.6×10^{-16}	4.9×10^{-15}	8.5×10^{-15}	1.8×10^{-14}	2.9×10^{-14}
Dioxins/Furans	2,3,7,8-Tetrachlorodibenzofuran	1.1×10^{-15}	1.0×10^{-14}	1.7×10^{-14}	2.7×10^{-14}	3.6×10^{-14}
Dioxins/Furans	OCDD	3.9×10^{-12}	4.2×10^{-11}	8.1×10^{-11}	1.8×10^{-10}	2.9×10^{-10}
Dioxins/Furans	OCDF	1.2×10^{-13}	1.3×10^{-12}	2.5×10^{-12}	5.6×10^{-12}	9.3×10^{-12}
Dioxins/Furans	Total TEQ_Dioxin	1.1×10^{-14}	1.2×10^{-13}	2.3×10^{-13}	5.0×10^{-13}	8.2×10^{-13}
Herbicides	2,4-DB	7.7×10^{-12}	7.2×10^{-11}	8.3×10^{-11}	9.9×10^{-11}	1.4×10^{-10}
Herbicides	MCPA	7.6×10^{-10}	7.2×10^{-9}	8.3×10^{-9}	7.1×10^{-9}	1.1×10^{-8}
Herbicides	MCPP	5.4×10^{-10}	5.4×10^{-9}	6.6×10^{-9}	9.8×10^{-9}	1.6×10^{-8}
Metals	Antimony	3.6×10^{-9}	4.1×10^{-8}	8.1×10^{-8}	2.0×10^{-7}	3.4×10^{-7}
Metals	Barium	1.4×10^{-7}	1.3×10^{-6}	1.3×10^{-6}	1.4×10^{-6}	1.7×10^{-6}
Metals	Cadmium	2.7×10^{-9}	3.0×10^{-8}	5.8×10^{-8}	1.4×10^{-7}	2.4×10^{-7}
Metals	Chromium (Hexavalent Compounds)	7.7×10^{-10}	7.1×10^{-9}	8.4×10^{-9}	9.0×10^{-9}	1.4×10^{-8}
Metals	Lead	1.2×10^{-7}	1.3×10^{-6}	2.6×10^{-6}	6.3×10^{-6}	1.1×10^{-5}
Metals	Mercury	6.8×10^{-10}	7.6×10^{-9}	1.5×10^{-8}	3.3×10^{-8}	2.3×10^{-8}
Metals	Molybdenum	2.7×10^{-9}	2.9×10^{-8}	5.3×10^{-8}	1.1×10^{-7}	2.5×10^{-8}
Metals	Selenium	3.7×10^{-10}	3.3×10^{-9}	3.2×10^{-9}	2.6×10^{-9}	3.8×10^{-9}

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Metals	Silver	1.2×10^{-8}	1.3×10^{-7}	2.7×10^{-7}	6.7×10^{-7}	1.1×10^{-6}
Metals	Zinc	1.3×10^{-7}	1.3×10^{-6}	1.8×10^{-6}	2.5×10^{-6}	3.6×10^{-6}
Other Inorganics	Methyl Mercury	4.2×10^{-12}	3.9×10^{-11}	3.3×10^{-11}	3.0×10^{-11}	4.4×10^{-11}
Pesticides	4,4'-DDD	1.9×10^{-12}	2.2×10^{-11}	1.6×10^{-11}	2.3×10^{-11}	3.7×10^{-11}
Pesticides	4,4'-DDE	1.5×10^{-11}	1.9×10^{-10}	3.0×10^{-10}	5.4×10^{-10}	8.9×10^{-10}
Pesticides	4,4'-DDT	1.3×10^{-11}	1.3×10^{-10}	2.1×10^{-10}	3.8×10^{-10}	6.2×10^{-10}
Pesticides	Beta-Bhc	4.1×10^{-13}	4.4×10^{-12}	4.2×10^{-12}	5.0×10^{-12}	8.1×10^{-12}
Pesticides	Chlordane	1.2×10^{-11}	1.3×10^{-10}	1.5×10^{-10}	1.1×10^{-10}	1.6×10^{-10}
Pesticides	Delta-Bhc	2.9×10^{-13}	2.5×10^{-12}	2.7×10^{-12}	4.0×10^{-12}	6.4×10^{-12}
Pesticides	Dieldrin	1.7×10^{-12}	1.8×10^{-11}	2.7×10^{-11}	5.0×10^{-11}	8.1×10^{-11}
Polychlorinated Biphenyls	Aroclor 1248	4.7×10^{-11}	5.1×10^{-10}	1.0×10^{-9}	2.3×10^{-9}	3.7×10^{-9}
Polychlorinated Biphenyls	Aroclor 1254	6.2×10^{-11}	5.9×10^{-10}	1.1×10^{-9}	2.4×10^{-9}	2.9×10^{-9}
Polychlorinated Biphenyls	Aroclor 1260	1.1×10^{-9}	1.3×10^{-8}	2.7×10^{-8}	6.9×10^{-8}	1.2×10^{-7}
Polychlorinated Biphenyls	Aroclor 5460	5.1×10^{-11}	5.3×10^{-10}	1.0×10^{-9}	2.2×10^{-9}	3.6×10^{-9}
Semivolatile Organics	1-Methylnaphthalene	5.4×10^{-11}	6.2×10^{-10}	1.3×10^{-9}	3.2×10^{-9}	2.7×10^{-10}
Semivolatile Organics	2-Methylnaphthalene	6.8×10^{-11}	7.8×10^{-10}	1.6×10^{-9}	4.0×10^{-9}	3.1×10^{-10}
Semivolatile Organics	Acenaphthene	1.1×10^{-11}	1.2×10^{-10}	2.2×10^{-10}	5.6×10^{-10}	8.0×10^{-10}
Semivolatile Organics	Anthracene	3.2×10^{-11}	3.6×10^{-10}	6.8×10^{-10}	1.8×10^{-9}	2.5×10^{-9}
Semivolatile Organics	Benzo(a)anthracene	9.5×10^{-11}	1.1×10^{-9}	2.2×10^{-9}	5.2×10^{-9}	7.9×10^{-9}
Semivolatile Organics	Benzo(a)pyrene	1.4×10^{-10}	1.6×10^{-9}	3.2×10^{-9}	7.6×10^{-9}	1.2×10^{-8}
Semivolatile Organics	Benzo(b)fluoranthene	1.6×10^{-10}	1.8×10^{-9}	3.6×10^{-9}	8.5×10^{-9}	1.3×10^{-8}
Semivolatile Organics	Benzo(g,h,i)perylene	2.4×10^{-10}	2.8×10^{-9}	5.7×10^{-9}	1.4×10^{-8}	2.4×10^{-8}
Semivolatile Organics	Benzo(k)fluoranthene	7.2×10^{-11}	8.2×10^{-10}	1.7×10^{-9}	4.0×10^{-9}	6.4×10^{-9}
Semivolatile Organics	Bis(2-ethylhexyl)phthalate	3.6×10^{-10}	4.0×10^{-9}	7.2×10^{-9}	1.7×10^{-8}	1.9×10^{-8}
Semivolatile Organics	Chrysene	1.4×10^{-10}	1.6×10^{-9}	3.1×10^{-9}	7.4×10^{-9}	1.2×10^{-8}
Semivolatile Organics	Dibenzo(a,h)anthracene	1.5×10^{-11}	1.8×10^{-10}	3.3×10^{-10}	8.5×10^{-10}	1.0×10^{-9}
Semivolatile Organics	Di-n-octylphthalate	5.2×10^{-11}	5.5×10^{-10}	9.4×10^{-10}	2.0×10^{-9}	3.6×10^{-9}
Semivolatile Organics	Fluoranthene	2.1×10^{-10}	2.4×10^{-9}	4.8×10^{-9}	1.1×10^{-8}	1.8×10^{-8}
Semivolatile Organics	Fluorene	1.1×10^{-11}	1.2×10^{-10}	2.2×10^{-10}	5.7×10^{-10}	6.5×10^{-10}
Semivolatile Organics	Indeno(1,2,3-cd)pyrene	2.1×10^{-10}	2.5×10^{-9}	5.0×10^{-9}	1.3×10^{-8}	2.1×10^{-8}
Semivolatile Organics	Naphthalene	1.9×10^{-11}	2.0×10^{-10}	4.0×10^{-10}	9.6×10^{-10}	4.9×10^{-10}
Semivolatile Organics	N-Nitrosodimethylamine	3.9×10^{-13}	2.5×10^{-12}	3.2×10^{-12}	3.7×10^{-12}	6.2×10^{-12}
Semivolatile Organics	Phenanthrene	1.2×10^{-10}	1.4×10^{-9}	2.8×10^{-9}	6.7×10^{-9}	1.1×10^{-8}
Semivolatile Organics	Pyrene	1.9×10^{-10}	2.2×10^{-9}	4.4×10^{-9}	1.1×10^{-8}	1.7×10^{-8}

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Semivolatile Organics	Total TEQ_BAP	1.9×10^{-10}	2.2×10^{-9}	4.4×10^{-9}	1.1×10^{-8}	1.7×10^{-8}
Volatile Organics	Formaldehyde	2.0×10^{-9}	1.8×10^{-8}	1.8×10^{-8}	1.9×10^{-8}	1.4×10^{-8}

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– All values in micrograms per cubic meter.
– Recreational user located 500 meters to the northwest of emissions source.
– Air concentrations for dose evaluation assume a 1-year emission period for radiological sources.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).

Table G–25 Offsite Air Concentrations of Radionuclides for the Recreational User Cancer Risk Evaluation of Soil Excavation Alternatives

	Alternatives				
Constituent	No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Am-241	5.0×10^{-12}	5.4×10^{-11}	1.3×10^{-11}	4.1×10^{-12}	3.3×10^{-12}
Cm-243/244	2.4×10^{-12}	2.9×10^{-11}	7.4×10^{-12}	2.3×10^{-12}	1.8×10^{-12}
Co-60	9.4×10^{-13}	1.0×10^{-11}	2.1×10^{-12}	1.4×10^{-12}	1.3×10^{-12}
Cs-137	6.1×10^{-10}	1.0×10^{-8}	3.0×10^{-9}	3.8×10^{-9}	3.2×10^{-9}
H-3	1.5×10^{-9}	1.8×10^{-8}	5.1×10^{-9}	1.4×10^{-9}	9.7×10^{-10}
Ni-59	1.1×10^{-9}	5.5×10^{-10}	3.1×10^{-10}	3.3×10^{-10}	3.5×10^{-10}
Np-237	2.2×10^{-12}	3.1×10^{-11}	6.7×10^{-12}	NA	NA
Pu-238	1.9×10^{-12}	2.2×10^{-11}	5.6×10^{-12}	1.7×10^{-12}	1.6×10^{-12}
Pu-239/240	4.7×10^{-12}	5.3×10^{-11}	1.4×10^{-11}	4.7×10^{-12}	3.7×10^{-12}
Sr-90	1.7×10^{-10}	2.7×10^{-9}	7.9×10^{-10}	2.0×10^{-10}	1.3×10^{-10}

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– All values in picocuries per cubic meter.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).
– Recreational user located 500 meters to the northwest of emissions source.
– Np-237 not detected in samples associated with the Conservation of Natural Resources Alternative scenarios.
– Air concentrations for cancer risk evaluation based on a 26-year emission period.

Table G–26 Offsite Air Concentrations of Radionuclides for the Recreational User Dose Evaluation of Soil Excavation Alternatives

Constituent	Alternatives				
	No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Am-241	5.0×10^{-12}	7.3×10^{-11}	7.3×10^{-11}	1.0×10^{-12}	2.3×10^{-13}
Cm-243/244	2.4×10^{-12}	3.5×10^{-11}	3.5×10^{-11}	5.8×10^{-13}	1.2×10^{-13}
Co-60	9.4×10^{-13}	1.4×10^{-11}	1.4×10^{-11}	3.6×10^{-13}	8.8×10^{-14}
Cs-137	6.1×10^{-10}	6.0×10^{-10}	6.0×10^{-10}	9.5×10^{-10}	2.2×10^{-10}
H-3	1.5×10^{-9}	2.3×10^{-8}	2.3×10^{-8}	3.6×10^{-10}	6.6×10^{-11}
Ni-59	1.1×10^{-9}	NA	NA	8.2×10^{-11}	2.4×10^{-11}
Np-237	2.2×10^{-12}	3.3×10^{-11}	3.3×10^{-11}	NA	NA
Pu-238	1.9×10^{-12}	2.7×10^{-11}	2.7×10^{-11}	4.4×10^{-13}	1.1×10^{-13}
Pu-239/240	4.7×10^{-12}	5.9×10^{-11}	5.9×10^{-11}	1.2×10^{-12}	2.5×10^{-13}
Sr-90	1.7×10^{-10}	4.1×10^{-10}	4.1×10^{-10}	4.9×10^{-11}	8.7×10^{-12}

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– All values in picocuries per cubic meter.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).
– Recreational user located 500 meters to the northwest of emissions source.
– Ni-59 has a 95 percent upper confidence limit on the mean below 0 in source areas with only radiological constituents for the Cleanup to AOC LUT Values and Cleanup to Revised LUT Values Alternatives.
– Np-237 not detected in samples associated with the Conservation of Natural Resources Alternative scenarios.
– Air concentrations for dose evaluation assume a 2-year emission period for radiological sources.

Table G–27 Building Emissions During Demolition and Offsite Media Concentrations – Offsite Recreational User

Radio-nuclide	Total Emissions (pCi)	Direction	Distance (m)	X/Q (g/m3 per g/s)	Emission Duration (yr)	Exposure Duration (yr)	Emission Rate During Remediation (pCi/s)	Offsite Air Concentra-tion During Remediation (pCi/m³)	Emission Rate Averaged Over Exposure Period (pCi/s)	Offsite Air Concentrati on During Long Term Exposure (pCi/m³)	Areal Deposition Rate (pCi/s-m²)	Duration of Deposition (yr)	Total Areal Deposition (pCi/m²)	Offsite Soil Mixing Mass per Area (g/m²)	Offsite Soil Concentra-tion After Deposition (pCi/g)
Am-241	1.6×10^{7}	NW	500	2.3×10^{-5}	1	26	4.9×10^{-1}	1.1×10^{-5}	1.9×10^{-2}	4.4×10^{-7}	2.1×10^{-8}	1	6.5×10^{-1}	4.0×10^{4}	1.6×10^{-5}
Co-60	1.6×10^{8}	NW	500	2.3×10^{-5}	1	26	5.2	1.2×10^{-4}	2.0×10^{-1}	4.6×10^{-6}	2.2×10^{-7}	1	6.8	4.0×10^{4}	1.7×10^{-4}
Cs-134	7.1×10^{3}	NW	500	2.3×10^{-5}	1	26	2.2×10^{-4}	5.2×10^{-9}	8.6×10^{-6}	2.0×10^{-10}	9.4×10^{-12}	1	3.0×10^{-4}	4.0×10^{4}	7.4×10^{-9}
Cs-137	5.0×10^{8}	NW	500	2.3×10^{-5}	1	26	1.6×10^{1}	3.7×10^{-4}	6.1×10^{-1}	1.4×10^{-5}	6.6×10^{-7}	1	2.1×10^{1}	4.0×10^{4}	5.2×10^{-4}
Eu-152	1.6×10^{6}	NW	500	2.3×10^{-5}	1	26	5.0×10^{-2}	1.2×10^{-6}	1.9×10^{-3}	4.5×10^{-8}	2.1×10^{-9}	1	6.6×10^{-2}	4.0×10^{4}	1.7×10^{-6}
Eu-154	1.7×10^{5}	NW	500	2.3×10^{-5}	1	26	5.3×10^{-3}	1.2×10^{-7}	2.1×10^{-4}	4.8×10^{-9}	2.2×10^{-10}	1	7.0×10^{-3}	4.0×10^{4}	1.8×10^{-7}
Eu-155	1.1×10^{4}	NW	500	2.3×10^{-5}	1	26	3.6×10^{-4}	8.3×10^{-9}	1.4×10^{-5}	3.2×10^{-10}	1.5×10^{-11}	1	4.7×10^{-4}	4.0×10^{4}	1.2×10^{-8}
Fe-55	5.2×10^{4}	NW	500	2.3×10^{-5}	1	26	1.6×10^{-3}	3.8×10^{-8}	6.3×10^{-5}	1.5×10^{-9}	6.8×10^{-11}	1	2.2×10^{-3}	4.0×10^{4}	5.4×10^{-8}
H-3	3.4×10^{7}	NW	500	2.3×10^{-5}	1	26	1.1	2.5×10^{-5}	4.1×10^{-2}	9.6×10^{-7}	4.5×10^{-8}	1	1.4	4.0×10^{4}	3.5×10^{-5}
Na-22	1.6×10^{-4}	NW	500	2.3×10^{-5}	1	26	4.9×10^{-12}	1.1×10^{-16}	1.9×10^{-13}	4.4×10^{-18}	2.1×10^{-19}	1	6.5×10^{-12}	4.0×10^{4}	1.6×10^{-16}
Ni-63	1.1×10^{9}	NW	500	2.3×10^{-5}	1	26	3.6×10^{1}	8.5×10^{-4}	1.4	3.3×10^{-5}	1.5×10^{-6}	1	4.8×10^{1}	4.0×10^{4}	1.2×10^{-3}
Pu-238	1.4×10^{6}	NW	500	2.3×10^{-5}	1	26	4.5×10^{-2}	1.1×10^{-6}	1.7×10^{-3}	4.1×10^{-8}	1.9×10^{-9}	1	6.0×10^{-2}	4.0×10^{4}	1.5×10^{-6}
Pu-239	3.6×10^{7}	NW	500	2.3×10^{-5}	1	26	1.2	2.7×10^{-5}	4.4×10^{-2}	1.0×10^{-6}	4.8×10^{-8}	1	1.5	4.0×10^{4}	3.8×10^{-5}
Pu-240	1.4×10^{7}	NW	500	2.3×10^{-5}	1	26	4.3×10^{-1}	1.0×10^{-5}	1.7×10^{-2}	3.8×10^{-7}	1.8×10^{-8}	1	5.7×10^{-1}	4.0×10^{4}	1.4×10^{-5}
Pu-241	1.1×10^{7}	NW	500	2.3×10^{-5}	1	26	3.4×10^{-1}	7.8×10^{-6}	1.3×10^{-2}	3.0×10^{-7}	1.4×10^{-8}	1	4.4×10^{-1}	4.0×10^{4}	1.1×10^{-5}
Pu-242	9.1×10^{4}	NW	500	2.3×10^{-5}	1	26	2.9×10^{-3}	6.7×10^{-8}	1.1×10^{-4}	2.6×10^{-9}	1.2×10^{-10}	1	3.8×10^{-3}	4.0×10^{4}	9.6×10^{-8}
Sr-90	2.1×10^{10}	NW	500	2.3×10^{-5}	1	26	6.8×10^{2}	1.6×10^{-2}	2.6×10^{1}	6.1×10^{-4}	2.8×10^{-5}	1	8.9×10^{2}	4.0×10^{4}	2.2×10^{-2}
Th-232	1.2×10^{5}	NW	500	2.3×10^{-5}	1	26	3.9×10^{-3}	9.0×10^{-8}	1.5×10^{-4}	3.4×10^{-9}	1.6×10^{-10}	1	5.1×10^{-3}	4.0×10^{4}	1.3×10^{-7}
U-234	8.4×10^{5}	NW	500	2.3×10^{-5}	1	26	2.7×10^{-2}	6.2×10^{-7}	1.0×10^{-3}	2.4×10^{-8}	1.1×10^{-9}	1	3.5×10^{-2}	4.0×10^{4}	8.8×10^{-7}
U-235	7.7×10^{4}	NW	500	2.3×10^{-5}	1	26	2.4×10^{-3}	5.7×10^{-8}	9.4×10^{-5}	2.2×10^{-9}	1.0×10^{-10}	1	3.2×10^{-3}	4.0×10^{4}	8.1×10^{-8}
U-238	9.7×10^{5}	NW	500	2.3×10^{-5}	1	26	3.1×10^{-2}	7.2×10^{-7}	1.2×10^{-3}	2.8×10^{-8}	1.3×10^{-9}	1	4.1×10^{-2}	4.0×10^{4}	1.0×10^{-6}

g = grams; m = meters; m^2 = square meters; m^3 = cubic meters; pCi = picocuries; s = seconds; X/Q = chi over Q; yr = year.

Notes:

– Deposition based on air concentration and settling velocity of 1.8×10^{-3} m/s.

– Mixing mass assumes 1,600 g/m3 to a depth of 0.025m.

Table G–28 Offsite Soil Concentrations of Chemicals for the Suburban Resident Cancer Risk Evaluation of Soil Excavation Alternatives

Type	*Constituent*	*Alternatives*				
		No Action	***AOC LUT***	***Revised LUT***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Anions	Fluoride	1.6×10^{-8}	1.5×10^{-7}	3.2×10^{-8}	8.6×10^{-9}	6.5×10^{-9}
Anions	Perchlorate	2.2×10^{-11}	1.8×10^{-10}	4.1×10^{-11}	1.6×10^{-11}	1.2×10^{-11}
Dioxins/Furans	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	1.3×10^{-12}	1.2×10^{-11}	5.5×10^{-12}	4.0×10^{-12}	3.3×10^{-12}
Dioxins/Furans	1,2,3,4,6,7,8-HPCDF	1.8×10^{-13}	1.7×10^{-12}	7.5×10^{-13}	5.6×10^{-13}	4.6×10^{-13}
Dioxins/Furans	1,2,3,4,7,8,9-HPCDF	2.1×10^{-14}	2.0×10^{-13}	8.2×10^{-14}	5.9×10^{-14}	4.9×10^{-14}
Dioxins/Furans	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	5.6×10^{-14}	5.6×10^{-13}	2.5×10^{-13}	2.0×10^{-13}	1.7×10^{-13}
Dioxins/Furans	1,2,3,4,7,8-HXCDF	1.4×10^{-14}	1.3×10^{-13}	5.0×10^{-14}	3.3×10^{-14}	2.5×10^{-14}
Dioxins/Furans	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	5.3×10^{-14}	5.1×10^{-13}	2.2×10^{-13}	1.6×10^{-13}	1.3×10^{-13}
Dioxins/Furans	1,2,3,6,7,8-HXCDF	1.0×10^{-14}	9.5×10^{-14}	3.8×10^{-14}	2.6×10^{-14}	1.9×10^{-14}
Dioxins/Furans	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	2.7×10^{-14}	2.5×10^{-13}	1.0×10^{-13}	7.4×10^{-14}	6.1×10^{-14}
Dioxins/Furans	1,2,3,7,8,9-HXCDF	4.4×10^{-15}	4.1×10^{-14}	1.4×10^{-14}	8.3×10^{-15}	5.6×10^{-15}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzofuran	7.8×10^{-15}	6.3×10^{-14}	2.3×10^{-14}	1.2×10^{-14}	8.2×10^{-15}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1.0×10^{-14}	9.6×10^{-14}	4.0×10^{-14}	2.9×10^{-14}	2.4×10^{-14}
Dioxins/Furans	2,3,4,6,7,8-HXCDF	1.4×10^{-14}	1.3×10^{-13}	5.4×10^{-14}	3.9×10^{-14}	2.8×10^{-14}
Dioxins/Furans	2,3,4,7,8-PECDF	1.0×10^{-14}	9.2×10^{-14}	3.5×10^{-14}	2.3×10^{-14}	1.7×10^{-14}
Dioxins/Furans	2,3,7,8-TCDD	1.8×10^{-15}	1.7×10^{-14}	6.8×10^{-15}	4.8×10^{-15}	3.9×10^{-15}
Dioxins/Furans	2,3,7,8-Tetrachlorodibenzofuran	4.3×10^{-15}	3.5×10^{-14}	1.4×10^{-14}	7.3×10^{-15}	4.8×10^{-15}
Dioxins/Furans	OCDD	1.6×10^{-11}	1.5×10^{-10}	6.5×10^{-11}	4.7×10^{-11}	3.9×10^{-11}
Dioxins/Furans	OCDF	4.8×10^{-13}	4.6×10^{-12}	2.0×10^{-12}	1.5×10^{-12}	1.2×10^{-12}
Dioxins/Furans	Total TEQ_Dioxin	4.3×10^{-14}	4.2×10^{-13}	1.8×10^{-13}	1.3×10^{-13}	1.1×10^{-13}
Herbicides	2,4-DB	3.1×10^{-11}	2.5×10^{-10}	6.7×10^{-11}	2.6×10^{-11}	1.9×10^{-11}
Herbicides	MCPA	3.1×10^{-9}	2.5×10^{-8}	6.7×10^{-9}	1.9×10^{-9}	1.5×10^{-9}
Herbicides	MCPP	2.2×10^{-9}	1.9×10^{-8}	5.3×10^{-9}	2.6×10^{-9}	2.2×10^{-9}
Metals	Antimony	1.5×10^{-8}	1.4×10^{-7}	6.5×10^{-8}	5.4×10^{-8}	4.6×10^{-8}
Metals	Barium	5.5×10^{-7}	4.5×10^{-6}	1.1×10^{-6}	3.8×10^{-7}	2.3×10^{-7}
Metals	Cadmium	1.1×10^{-8}	1.0×10^{-7}	4.6×10^{-8}	3.8×10^{-8}	3.2×10^{-8}
Metals	Chromium (Hexavalent Compounds)	3.1×10^{-9}	2.5×10^{-8}	6.7×10^{-9}	2.4×10^{-9}	1.9×10^{-9}
Metals	Lead	4.8×10^{-7}	4.7×10^{-6}	2.1×10^{-6}	1.7×10^{-6}	1.4×10^{-6}
Metals	Mercury	2.7×10^{-9}	2.6×10^{-8}	1.2×10^{-8}	8.8×10^{-9}	3.1×10^{-9}
Metals	Molybdenum	1.1×10^{-8}	1.0×10^{-7}	4.2×10^{-8}	3.0×10^{-8}	3.3×10^{-9}
Metals	Selenium	1.5×10^{-9}	1.1×10^{-8}	2.6×10^{-9}	7.0×10^{-10}	5.1×10^{-10}

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Metals	Silver	4.7×10^{-8}	4.6×10^{-7}	2.2×10^{-7}	1.8×10^{-7}	1.5×10^{-7}
Metals	Zinc	5.2×10^{-7}	4.4×10^{-6}	1.4×10^{-6}	6.8×10^{-7}	4.8×10^{-7}
Other Inorganics	Methyl Mercury	1.7×10^{-11}	1.3×10^{-10}	2.7×10^{-11}	8.0×10^{-12}	5.8×10^{-12}
Pesticides	4,4'-DDD	7.5×10^{-12}	7.7×10^{-11}	1.3×10^{-11}	6.1×10^{-12}	5.0×10^{-12}
Pesticides	4,4'-DDE	6.0×10^{-11}	6.5×10^{-10}	2.4×10^{-10}	1.4×10^{-10}	1.2×10^{-10}
Pesticides	4,4'-DDT	5.2×10^{-11}	4.7×10^{-10}	1.7×10^{-10}	1.0×10^{-10}	8.3×10^{-11}
Pesticides	Beta-Bhc	1.7×10^{-12}	1.5×10^{-11}	3.4×10^{-12}	1.3×10^{-12}	1.1×10^{-12}
Pesticides	Chlordane	4.7×10^{-11}	4.6×10^{-10}	1.2×10^{-10}	2.8×10^{-11}	2.2×10^{-11}
Pesticides	Delta-Bhc	1.2×10^{-12}	8.7×10^{-12}	2.1×10^{-12}	1.1×10^{-12}	8.6×10^{-13}
Pesticides	Dieldrin	6.6×10^{-12}	6.3×10^{-11}	2.2×10^{-11}	1.3×10^{-11}	1.1×10^{-11}
Polychlorinated Biphenyls	Aroclor 1248	1.9×10^{-10}	1.8×10^{-9}	8.1×10^{-10}	6.2×10^{-10}	5.0×10^{-10}
Polychlorinated Biphenyls	Aroclor 1254	2.5×10^{-10}	2.1×10^{-9}	9.0×10^{-10}	6.4×10^{-10}	3.8×10^{-10}
Polychlorinated Biphenyls	Aroclor 1260	4.6×10^{-9}	4.6×10^{-8}	2.2×10^{-8}	1.9×10^{-8}	1.6×10^{-8}
Polychlorinated Biphenyls	Aroclor 5460	2.1×10^{-10}	1.8×10^{-9}	8.1×10^{-10}	5.9×10^{-10}	4.9×10^{-10}
Semivolatile Organics	1-Methylnaphthalene	2.2×10^{-10}	2.2×10^{-9}	1.0×10^{-9}	8.6×10^{-10}	3.6×10^{-11}
Semivolatile Organics	2-Methylnaphthalene	2.7×10^{-10}	2.7×10^{-9}	1.3×10^{-9}	1.1×10^{-9}	4.2×10^{-11}
Semivolatile Organics	Acenaphthene	4.3×10^{-11}	4.1×10^{-10}	1.8×10^{-10}	1.5×10^{-10}	1.1×10^{-10}
Semivolatile Organics	Anthracene	1.3×10^{-10}	1.3×10^{-9}	5.5×10^{-10}	4.8×10^{-10}	3.4×10^{-10}
Semivolatile Organics	Benzo(a)anthracene	3.8×10^{-10}	3.8×10^{-9}	1.7×10^{-9}	1.4×10^{-9}	1.1×10^{-9}
Semivolatile Organics	Benzo(a)pyrene	5.5×10^{-10}	5.4×10^{-9}	2.5×10^{-9}	2.0×10^{-9}	1.7×10^{-9}
Semivolatile Organics	Benzo(b)fluoranthene	6.3×10^{-10}	6.3×10^{-9}	2.9×10^{-9}	2.3×10^{-9}	1.8×10^{-9}
Semivolatile Organics	Benzo(g,h,i)perylene	9.7×10^{-10}	9.8×10^{-9}	4.6×10^{-9}	3.8×10^{-9}	3.2×10^{-9}
Semivolatile Organics	Benzo(k)fluoranthene	2.9×10^{-10}	2.9×10^{-9}	1.3×10^{-9}	1.1×10^{-9}	8.6×10^{-10}
Semivolatile Organics	Bis(2-ethylhexyl)phthalate	1.4×10^{-9}	1.4×10^{-8}	5.8×10^{-9}	4.4×10^{-9}	2.5×10^{-9}
Semivolatile Organics	Chrysene	5.6×10^{-10}	5.4×10^{-9}	2.5×10^{-9}	2.0×10^{-9}	1.6×10^{-9}
Semivolatile Organics	Dibenzo(a,h)anthracene	6.2×10^{-11}	6.4×10^{-10}	2.6×10^{-10}	2.3×10^{-10}	1.4×10^{-10}
Semivolatile Organics	Di-n-octylphthalate	2.1×10^{-10}	1.9×10^{-9}	7.6×10^{-10}	5.3×10^{-10}	4.8×10^{-10}
Semivolatile Organics	Fluoranthene	8.4×10^{-10}	8.3×10^{-9}	3.9×10^{-9}	3.1×10^{-9}	2.4×10^{-9}
Semivolatile Organics	Fluorene	4.4×10^{-11}	4.2×10^{-10}	1.8×10^{-10}	1.5×10^{-10}	8.7×10^{-11}
Semivolatile Organics	Indeno(1,2,3-cd)pyrene	8.6×10^{-10}	8.7×10^{-9}	4.1×10^{-9}	3.4×10^{-9}	2.8×10^{-9}
Semivolatile Organics	Naphthalene	7.6×10^{-11}	7.0×10^{-10}	3.2×10^{-10}	2.6×10^{-10}	6.6×10^{-11}
Semivolatile Organics	N-Nitrosodimethylamine	1.6×10^{-12}	8.8×10^{-12}	2.6×10^{-12}	1.0×10^{-12}	8.3×10^{-13}
Semivolatile Organics	Phenanthrene	4.9×10^{-10}	4.9×10^{-9}	2.3×10^{-9}	1.8×10^{-9}	1.4×10^{-9}
Semivolatile Organics	Pyrene	7.8×10^{-10}	7.6×10^{-9}	3.6×10^{-9}	2.8×10^{-9}	2.2×10^{-9}

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Semivolatile Organics	Total TEQ_BAP	7.6×10^{-10}	7.6×10^{-9}	3.6×10^{-9}	2.9×10^{-9}	2.3×10^{-9}
Volatile Organics	Formaldehyde	7.9×10^{-9}	6.4×10^{-8}	1.5×10^{-8}	5.1×10^{-9}	1.9×10^{-9}

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– All values in micrograms per gram.

– Suburban resident located 1,800 meters to the northwest of emissions source.

– Buildup in soil based on 30 years for No Action and total emission for action alternatives.

– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).

Table G–29 Offsite Soil Concentrations of Radionuclides for the Suburban Resident Cancer Risk Evaluation of Soil Excavation Alternatives

	Alternatives				
Constituent	***No Action***	***AOC LUT***	***Revised LUT***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Am-241	2.0×10^{-11}	1.9×10^{-10}	4.7×10^{-11}	1.4×10^{-11}	1.2×10^{-11}
Cm-243/244	9.7×10^{-12}	1.0×10^{-10}	2.6×10^{-11}	8.1×10^{-12}	6.1×10^{-12}
Co-60	3.8×10^{-12}	3.5×10^{-11}	7.2×10^{-12}	5.0×10^{-12}	4.5×10^{-12}
Cs-137	2.5×10^{-9}	3.6×10^{-8}	1.0×10^{-8}	1.3×10^{-8}	1.1×10^{-8}
H-3	6.1×10^{-9}	6.4×10^{-8}	1.8×10^{-8}	4.9×10^{-9}	3.4×10^{-9}
Ni-59	4.6×10^{-9}	1.9×10^{-9}	1.1×10^{-9}	1.1×10^{-9}	1.2×10^{-9}
Np-237	8.8×10^{-12}	1.1×10^{-10}	2.3×10^{-11}	NA	NA
Pu-238	7.6×10^{-12}	7.7×10^{-11}	2.0×10^{-11}	6.1×10^{-12}	5.4×10^{-12}
Pu-239/240	1.9×10^{-11}	1.9×10^{-10}	4.9×10^{-11}	1.6×10^{-11}	1.3×10^{-11}
Sr-90	6.9×10^{-10}	9.5×10^{-9}	2.7×10^{-9}	6.9×10^{-10}	4.5×10^{-10}

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– All values in picocuries per gram.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).
– Suburban resident located 1,800 meters to the northwest of emissions source.
– Np-237 not detected in samples associated with the Conservation of Natural Resources Alternative scenarios.

Table G–30 Offsite Soil Concentrations of Chemicals for the Recreational User Cancer Risk Evaluation of Soil Excavation Alternatives

Type	*Constituent*	*Alternatives*				
		No Action	***AOC LUT***	***Revised LUT***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Anions	Fluoride	1.7×10^{-7}	1.6×10^{-6}	3.3×10^{-7}	9.1×10^{-8}	6.9×10^{-8}
Anions	Perchlorate	2.4×10^{-10}	1.9×10^{-9}	4.3×10^{-10}	1.7×10^{-10}	1.3×10^{-10}
Dioxins/Furans	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	1.4×10^{-11}	1.3×10^{-10}	5.8×10^{-11}	4.2×10^{-11}	3.5×10^{-11}
Dioxins/Furans	1,2,3,4,6,7,8-HPCDF	1.9×10^{-12}	1.8×10^{-11}	7.9×10^{-12}	5.9×10^{-12}	4.9×10^{-12}
Dioxins/Furans	1,2,3,4,7,8,9-HPCDF	2.2×10^{-13}	2.1×10^{-12}	8.7×10^{-13}	6.3×10^{-13}	5.1×10^{-13}
Dioxins/Furans	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	6.0×10^{-13}	6.0×10^{-12}	2.7×10^{-12}	2.1×10^{-12}	1.8×10^{-12}
Dioxins/Furans	1,2,3,4,7,8-HXCDF	1.5×10^{-13}	1.3×10^{-12}	5.3×10^{-13}	3.5×10^{-13}	2.6×10^{-13}
Dioxins/Furans	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	5.6×10^{-13}	5.4×10^{-12}	2.3×10^{-12}	1.7×10^{-12}	1.4×10^{-12}
Dioxins/Furans	1,2,3,6,7,8-HXCDF	1.1×10^{-13}	1.0×10^{-12}	4.0×10^{-13}	2.7×10^{-13}	2.0×10^{-13}
Dioxins/Furans	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	2.8×10^{-13}	2.6×10^{-12}	1.1×10^{-12}	7.8×10^{-13}	6.5×10^{-13}
Dioxins/Furans	1,2,3,7,8,9-HXCDF	4.7×10^{-14}	4.3×10^{-13}	1.5×10^{-13}	8.7×10^{-14}	6.0×10^{-14}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzofuran	8.3×10^{-14}	6.7×10^{-13}	2.4×10^{-13}	1.3×10^{-13}	8.7×10^{-14}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1.1×10^{-13}	1.0×10^{-12}	4.2×10^{-13}	3.0×10^{-13}	2.5×10^{-13}
Dioxins/Furans	2,3,4,6,7,8-HXCDF	1.5×10^{-13}	1.4×10^{-12}	5.8×10^{-13}	4.1×10^{-13}	2.9×10^{-13}
Dioxins/Furans	2,3,4,7,8-PECDF	1.1×10^{-13}	9.7×10^{-13}	3.7×10^{-13}	2.4×10^{-13}	1.8×10^{-13}
Dioxins/Furans	2,3,7,8-TCDD	1.9×10^{-14}	1.8×10^{-13}	7.2×10^{-14}	5.0×10^{-14}	4.2×10^{-14}
Dioxins/Furans	2,3,7,8-Tetrachlorodibenzofuran	4.5×10^{-14}	3.7×10^{-13}	1.5×10^{-13}	7.7×10^{-14}	5.1×10^{-14}
Dioxins/Furans	OCDD	1.6×10^{-10}	1.6×10^{-9}	6.9×10^{-10}	5.0×10^{-10}	4.1×10^{-10}
Dioxins/Furans	OCDF	5.1×10^{-12}	4.9×10^{-11}	2.1×10^{-11}	1.6×10^{-11}	1.3×10^{-11}
Dioxins/Furans	Total TEQ_Dioxin	4.6×10^{-13}	4.4×10^{-12}	1.9×10^{-12}	1.4×10^{-12}	1.2×10^{-12}
Herbicides	2,4-DB	3.3×10^{-10}	2.7×10^{-9}	7.1×10^{-10}	2.8×10^{-10}	2.0×10^{-10}
Herbicides	MCPA	3.2×10^{-8}	2.6×10^{-7}	7.1×10^{-8}	2.0×10^{-8}	1.5×10^{-8}
Herbicides	MCPP	2.3×10^{-8}	2.0×10^{-7}	5.7×10^{-8}	2.8×10^{-8}	2.3×10^{-8}
Metals	Antimony	1.5×10^{-7}	1.5×10^{-6}	6.9×10^{-7}	5.7×10^{-7}	4.8×10^{-7}
Metals	Barium	5.8×10^{-6}	4.8×10^{-5}	1.1×10^{-5}	4.1×10^{-6}	2.4×10^{-6}
Metals	Cadmium	1.1×10^{-7}	1.1×10^{-6}	4.9×10^{-7}	4.0×10^{-7}	3.3×10^{-7}
Metals	Chromium (Hexavalent Compounds)	3.3×10^{-8}	2.6×10^{-7}	7.1×10^{-8}	2.6×10^{-8}	2.0×10^{-8}
Metals	Lead	5.1×10^{-6}	4.9×10^{-5}	2.2×10^{-5}	1.8×10^{-5}	1.5×10^{-5}
Metals	Mercury	2.9×10^{-8}	2.8×10^{-7}	1.3×10^{-7}	9.3×10^{-8}	3.3×10^{-8}
Metals	Molybdenum	1.2×10^{-7}	1.1×10^{-6}	4.5×10^{-7}	3.2×10^{-7}	3.5×10^{-8}
Metals	Selenium	1.6×10^{-8}	1.2×10^{-7}	2.8×10^{-8}	7.4×10^{-9}	5.4×10^{-9}

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Metals	Silver	5.0×10^{-7}	4.9×10^{-6}	2.3×10^{-6}	1.9×10^{-6}	1.6×10^{-6}
Metals	Zinc	5.5×10^{-6}	4.7×10^{-5}	1.5×10^{-5}	7.2×10^{-6}	5.0×10^{-6}
Other Inorganics	Methyl Mercury	1.8×10^{-10}	1.4×10^{-9}	2.8×10^{-10}	8.4×10^{-11}	6.2×10^{-11}
Pesticides	4,4'-DDD	7.9×10^{-11}	8.2×10^{-10}	1.3×10^{-10}	6.5×10^{-11}	5.2×10^{-11}
Pesticides	4,4'-DDE	6.4×10^{-10}	6.9×10^{-9}	2.6×10^{-9}	1.5×10^{-9}	1.3×10^{-9}
Pesticides	4,4'-DDT	5.5×10^{-10}	5.0×10^{-9}	1.8×10^{-9}	1.1×10^{-9}	8.8×10^{-10}
Pesticides	Beta-Bhc	1.8×10^{-11}	1.6×10^{-10}	3.6×10^{-11}	1.4×10^{-11}	1.1×10^{-11}
Pesticides	Chlordane	5.0×10^{-10}	4.8×10^{-9}	1.3×10^{-9}	3.0×10^{-10}	2.3×10^{-10}
Pesticides	Delta-Bhc	1.2×10^{-11}	9.2×10^{-11}	2.3×10^{-11}	1.1×10^{-11}	9.1×10^{-12}
Pesticides	Dieldrin	7.0×10^{-11}	6.7×10^{-10}	2.3×10^{-10}	1.4×10^{-10}	1.2×10^{-10}
Polychlorinated Biphenyls	Aroclor 1248	2.0×10^{-9}	1.9×10^{-8}	8.5×10^{-9}	6.6×10^{-9}	5.3×10^{-9}
Polychlorinated Biphenyls	Aroclor 1254	2.6×10^{-9}	2.2×10^{-8}	9.5×10^{-9}	6.8×10^{-9}	4.1×10^{-9}
Polychlorinated Biphenyls	Aroclor 1260	4.9×10^{-8}	4.9×10^{-7}	2.3×10^{-7}	2.0×10^{-7}	1.7×10^{-7}
Polychlorinated Biphenyls	Aroclor 5460	2.2×10^{-9}	1.9×10^{-8}	8.5×10^{-9}	6.2×10^{-9}	5.2×10^{-9}
Semivolatile Organics	1-Methylnaphthalene	2.3×10^{-9}	2.3×10^{-8}	1.1×10^{-8}	9.1×10^{-9}	3.8×10^{-10}
Semivolatile Organics	2-Methylnaphthalene	2.9×10^{-9}	2.9×10^{-8}	1.3×10^{-8}	1.1×10^{-8}	4.4×10^{-10}
Semivolatile Organics	Acenaphthene	4.5×10^{-10}	4.3×10^{-9}	1.9×10^{-9}	1.6×10^{-9}	1.1×10^{-9}
Semivolatile Organics	Anthracene	1.4×10^{-9}	1.3×10^{-8}	5.8×10^{-9}	5.1×10^{-9}	3.6×10^{-9}
Semivolatile Organics	Benzo(a)anthracene	4.1×10^{-9}	4.0×10^{-8}	1.8×10^{-8}	1.5×10^{-8}	1.1×10^{-8}
Semivolatile Organics	Benzo(a)pyrene	5.8×10^{-9}	5.8×10^{-8}	2.7×10^{-8}	2.2×10^{-8}	1.7×10^{-8}
Semivolatile Organics	Benzo(b)fluoranthene	6.7×10^{-9}	6.6×10^{-8}	3.1×10^{-8}	2.4×10^{-8}	1.9×10^{-8}
Semivolatile Organics	Benzo(g,h,i)perylene	1.0×10^{-8}	1.0×10^{-7}	4.8×10^{-8}	4.0×10^{-8}	3.4×10^{-8}
Semivolatile Organics	Benzo(k)fluoranthene	3.1×10^{-9}	3.0×10^{-8}	1.4×10^{-8}	1.1×10^{-8}	9.1×10^{-9}
Semivolatile Organics	Bis(2-ethylhexyl)phthalate	1.5×10^{-8}	1.5×10^{-7}	6.1×10^{-8}	4.7×10^{-8}	2.6×10^{-8}
Semivolatile Organics	Chrysene	5.9×10^{-9}	5.7×10^{-8}	2.7×10^{-8}	2.1×10^{-8}	1.7×10^{-8}
Semivolatile Organics	Dibenzo(a,h)anthracene	6.6×10^{-10}	6.8×10^{-9}	2.8×10^{-9}	2.4×10^{-9}	1.4×10^{-9}
Semivolatile Organics	Di-n-octylphthalate	2.2×10^{-9}	2.0×10^{-8}	8.0×10^{-9}	5.6×10^{-9}	5.1×10^{-9}
Semivolatile Organics	Fluoranthene	8.9×10^{-9}	8.8×10^{-8}	4.1×10^{-8}	3.3×10^{-8}	2.6×10^{-8}
Semivolatile Organics	Fluorene	4.6×10^{-10}	4.5×10^{-9}	1.9×10^{-9}	1.6×10^{-9}	9.2×10^{-10}
Semivolatile Organics	Indeno(1,2,3-cd)pyrene	9.1×10^{-9}	9.2×10^{-8}	4.3×10^{-8}	3.6×10^{-8}	3.0×10^{-8}
Semivolatile Organics	Naphthalene	8.1×10^{-10}	7.5×10^{-9}	3.4×10^{-9}	2.7×10^{-9}	7.0×10^{-10}
Semivolatile Organics	N-Nitrosodimethylamine	1.7×10^{-11}	9.3×10^{-11}	2.7×10^{-11}	1.1×10^{-11}	8.8×10^{-12}
Semivolatile Organics	Phenanthrene	5.2×10^{-9}	5.1×10^{-8}	2.4×10^{-8}	1.9×10^{-8}	1.5×10^{-8}

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Semivolatile Organics	Pyrene	8.3×10^{-9}	8.1×10^{-8}	3.8×10^{-8}	3.0×10^{-8}	2.4×10^{-8}
Semivolatile Organics	Total TEQ_BAP	8.1×10^{-9}	8.1×10^{-8}	3.8×10^{-8}	3.0×10^{-8}	2.4×10^{-8}
Volatile Organics	Formaldehyde	8.4×10^{-8}	6.8×10^{-7}	1.6×10^{-7}	5.5×10^{-8}	2.1×10^{-8}

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– All values in micrograms per gram.
– Recreational user located 500 meters to the northwest of emissions source.
– Buildup in soil based on 30 years for No Action and total emission for action alternatives.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).

Table G–31 Offsite Soil Concentrations of Radionuclides for the Recreational User Cancer Risk Evaluation of Soil Excavation Alternatives

	Alternatives				
Constituent	***No Action***	***AOC LUT***	***Revised LUT***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Am-241	2.1×10^{-10}	2.0×10^{-9}	4.9×10^{-10}	1.5×10^{-10}	1.2×10^{-10}
Cm-243/244	1.0×10^{-10}	1.1×10^{-9}	2.7×10^{-10}	8.6×10^{-11}	6.5×10^{-11}
Co-60	4.0×10^{-11}	3.7×10^{-10}	7.7×10^{-11}	5.3×10^{-11}	4.8×10^{-11}
Cs-137	2.6×10^{-8}	3.8×10^{-7}	1.1×10^{-7}	1.4×10^{-7}	1.2×10^{-7}
H-3	6.5×10^{-8}	6.8×10^{-7}	1.9×10^{-7}	5.2×10^{-8}	3.6×10^{-8}
Ni-59	4.9×10^{-8}	2.0×10^{-8}	1.1×10^{-8}	1.2×10^{-8}	1.3×10^{-8}
Np-237	9.3×10^{-11}	1.1×10^{-9}	2.5×10^{-10}	NA	NA
Pu-238	8.1×10^{-11}	8.2×10^{-10}	2.1×10^{-10}	6.4×10^{-11}	5.8×10^{-11}
Pu-239/240	2.0×10^{-10}	2.0×10^{-9}	5.2×10^{-10}	1.7×10^{-10}	1.4×10^{-10}
Sr-90	7.3×10^{-9}	1.0×10^{-7}	2.9×10^{-8}	7.3×10^{-9}	4.7×10^{-9}

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– All values in picocuries per gram.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).
– Recreational user located 500 meters to the northwest of emissions source.
– Np-237 not detected in samples associated with the Conservation of Natural Resources Alternative scenarios.

Table G–32 Suburban Resident – Exposure Parameters

Exposure	*Pathway*	*Constituent*	*Site-Specific Parameters*	*Additional Information*
Direct Air	Inhalation	Chemical and Radionuclides	None	Chemical defaults: 26 years, 350 day/year, 24 hour/day Additional radiological defaults: 20 and 10 m3/day adult and child inhalation rate
	Submersion	Radionuclides	None	Radiological defaults: gamma shielding factor of 1
Direct Soil	Ingestion	Chemical and Radionuclides	None	Chemical and radiological defaults: 100 and 200 mg/day adult and child ingestion rate, 80 and 15 kg adult and child body weight
	Inhalation	Chemical and Radionuclides	City = Los Angeles, CA	Chemical defaults: 26 years, 350 day/year, 24 hour/day Additional radiological defaults: 20 and 10 m3/day adult and child inhalation rate
			Site area = 2.5 acres	Site-specific factors used to calculate the particulate emission factor of 1.84E12 m3/kg.
			Average wind speed = 2.3 meters/second	
			Equivalent threshold wind speed = 9.22 meters/second	
			Fraction of vegetative cover = 0.25	
	Dermal	Chemical	None	Chemical defaults: 0.07 and 0.02 mg/cm2 adherence factor for adult and child, 6032 and 2373 cm2/day skin surface area for adult and child
	External	Radionuclides	Area for Area Correction Factor = 1,000,000 m2	Maximum area selected for diffuse deposited constituents
			Clean soil thickness = 0 cm	Radionuclide defaults: 16.4 hours per day indoor, 1.75 hours per day outdoor, 0.4 indoor gamma shielding factor
Produce	Ingestion	Chemical and Radionuclides	Adult fruit ingestion rate = 377.3 grams/day	Chemical and radiological defaults: 0.0135 produce mass loading factor
			Adult vegetable ingestion rate = 324.8 grams/day	RAIS chemical calculator for the Farmer scenario set all food item ingestion rates to 0 except for fruits and vegetables.
			Child fruit ingestion rate = 81.45 grams/day	Fruit and vegetable ingestion rates and fractions obtained from the SRAM (MWH 2014).
			Child vegetable ingestion rate = 84.9 grams/day	
			Fraction from contaminated source = 1.0	
			Exposure Duration - Adult = 20 years	

Notes:

– Exposure parameters were used to generate RBSL for the suburban resident using the following RAIS online calculators:
– Chemicals were evaluated using the Resident scenario for direct air and direct soil, and the Farmer scenario for produce ingestion (based on the 'Combined Soil and Biota' option to generate soil RBSL).
– [https://rais.ornl.gov/cgi-bin/prg/PRG_search?select=chem]
– Radionuclides were evaluated using the residential scenario for all media pathways.
– [https://rais.ornl.gov/cgi-bin/prg/PRG_search?select=rad]
– All RBSL calculations were based on chronic exposures and used site-specific values as presented above.
– RBSL were based on a cancer incidence of 1×10^{-6} and a hazard quotient of 1.
– MWH 2014: *Final Standardized Risk Assessment Methodology, Revision 2 Addendum, Santa Susana Field Laboratory, Ventura County, California,* August.

Table G–33 Recreational User– Exposure Parameters

Exposure	*Pathway*	*Constituent*	*Site-Specific Parameters*	*Additional Information*
Direct Air	Inhalation	Chemical and Radionuclides	Exposure Time = 8 hours per day	Chemical defaults: 26 years, 75 day/year, 8 hour/day Additional radiological defaults: 20 and 10 m3/day adult and child inhalation rate.
	Submersion	Radionuclides	Exposure Time = 8 hours per day	Radiological defaults: gamma shielding factor of 1.
Direct Soil	Ingestion	Chemical and Radionuclides	None	Chemical and radiological defaults: 100 and 200 mg/day adult and child ingestion rate, 80 and 15 kg adult and child body weight.
	Inhalation	Chemical and Radionuclides	City = Los Angeles, California	Chemical defaults: 26 years, 75 day/year Additional radiological defaults: 20 and 10 m3/day adult and child inhalation rate.
			Site area = 2.5 acres	Site-specific factors used to calculate the particulate emission factor of $1.84E^{12}$ m3/kg.
			Average wind speed = 2.3 meters/second	
			Equivalent threshold wind speed = 9.22 meters/second	
			Fraction of vegetative cover = 0.25	
			Exposure Time = 8 hours per day	
	Dermal	Chemical	None	Chemical defaults: 0.07 and 0.02 mg/cm2 adherence factor for adult and child, 6032 and 2373 cm2/day skin surface area for adult and child.
	External	Radionuclides	Area for Area Correction Factor = 1,000,000 m2	Maximum area selected for diffuse deposited constituents.
			Clean soil thickness = 0 cm	
			Exposure Time = 8 hours per day	

Notes:

– Exposure parameters were used to generate RBSL for the recreational user using the following RAIS online calculators:
– Chemicals were evaluated using the recreational user scenario for direct soil and the Resident scenario for direct air.
– [https://rais.ornl.gov/cgi-bin/prg/PRG_search?select=chem]
– Radionuclides were evaluated using the recreational user scenario for all media pathways.
– [https://rais.ornl.gov/cgi-bin/prg/PRG_search?select=rad]
– RBSL are based on a cancer incidence of 1×10^{-6} and a hazard quotient of 1.
– All RBSL calculations are based on chronic exposures and use site-specific values as presented above.

Table G–34 Offsite Impacts – Chemicals – Risk Based Screening Levels – Suburban Resident – Carcinogens

Type	Constituent	Lookup Name	Direct Air	Direct Soil			Produce
			Inhalation	Ingestion	Inhalation	Dermal	Ingestion
Anions	Fluoride	Fluoride	-	-	-	-	-
Anions	Perchlorate	Perchlorate and Perchlorate Salts	-	-	-	-	-
Dioxins/Furans	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	HCDD, 1,2,3,4,6,7,8,-	7.4×10^{-6}	5.4×10^{-4}	1.4×10^{-2}	6.3×10^{-3}	1.7×10^{-5}
Dioxins/Furans	1,2,3,4,6,7,8-HPCDF	HpCDF, 1,2,3,4,7,8,9-	7.4×10^{-6}	5.4×10^{-4}	3.5×10^{-2}	6.3×10^{-3}	1.7×10^{-5}
Dioxins/Furans	1,2,3,4,7,8,9-HPCDF	HpCDF, 1,2,3,4,7,8,9-	7.4×10^{-6}	5.4×10^{-4}	3.5×10^{-2}	6.3×10^{-3}	1.7×10^{-5}
Dioxins/Furans	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	Hexachlorodibenzo-p-dioxin, 1,2,3,4,7,8-	7.4×10^{-7}	5.4×10^{-5}	1.4×10^{3}	6.3×10^{-4}	1.7×10^{-6}
Dioxins/Furans	1,2,3,4,7,8-HXCDF	Hexachlorodibenzofuran, 1,2,3,4,7,8-	7.4×10^{-7}	5.4×10^{-5}	1.6×10^{-3}	6.3×10^{-4}	1.7×10^{-6}
Dioxins/Furans	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	HxCDD, 1,2,3,6,7,8-	7.4×10^{-7}	5.4×10^{-5}	1.4×10^{3}	6.3×10^{-4}	1.7×10^{-6}
Dioxins/Furans	1,2,3,6,7,8-HXCDF	HxCDF, 1,2,3,6,7,8-	7.4×10^{-7}	5.4×10^{-5}	1.6×10^{-3}	6.3×10^{-4}	1.7×10^{-6}
Dioxins/Furans	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	HxCDD, 1,2,3,7,8,9-	7.4×10^{-7}	5.4×10^{-5}	1.4×10^{3}	6.3×10^{-4}	1.7×10^{-6}
Dioxins/Furans	1,2,3,7,8,9-HXCDF	HxCDF, 1,2,3,7,8,9-	7.4×10^{-7}	5.4×10^{-5}	1.4×10^{3}	6.3×10^{-4}	1.7×10^{-6}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzofuran	PeCDF, 1,2,3,7,8-	2.5×10^{-6}	1.8×10^{-4}	4.5×10^{3}	2.1×10^{-3}	5.4×10^{-6}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	Pentachlorodibenzo-p-dioxin, 1,2,3,7,8-	7.4×10^{-8}	5.4×10^{-6}	1.4×10^{2}	6.3×10^{-5}	1.6×10^{-7}
Dioxins/Furans	2,3,4,6,7,8-HXCDF	HxCDF, 2,3,4,6,7,8-	7.4×10^{-7}	5.4×10^{-5}	1.4×10^{3}	6.3×10^{-4}	1.7×10^{-6}
Dioxins/Furans	2,3,4,7,8-PECDF	PeCDF, 2,3,4,7,8-	2.5×10^{-7}	1.8×10^{-5}	4.5×10^{2}	2.1×10^{-4}	5.4×10^{-7}
Dioxins/Furans	2,3,7,8-TCDD	TCDD, 2,3,7,8-	7.4×10^{-8}	5.4×10^{-6}	1.1×10^{-4}	6.3×10^{-5}	1.6×10^{-7}
Dioxins/Furans	2,3,7,8-Tetrachlorodibenzofuran	TCDF, 2,3,7,8-	7.4×10^{-7}	5.4×10^{-5}	1.4×10^{-3}	6.3×10^{-4}	1.6×10^{-6}
Dioxins/Furans	OCDD	OCDD	2.5×10^{-4}	1.8×10^{-2}	4.5×10^{5}	2.1×10^{-1}	5.7×10^{-4}
Dioxins/Furans	OCDF	OCDF	2.5×10^{-4}	1.8×10^{-2}	4.5×10^{5}	2.1×10^{-1}	5.7×10^{-4}
Dioxins/Furans	Total TEQ_Dioxin	Total TEQ_Dioxin	NA	NA	NA	NA	NA
Herbicides	2,4-DB	Dichlorophenoxy)butyric Acid, 4-(2,4- Dimethylamine (2,4-DB)	-	-	-	-	-
Herbicides	MCPA	MCPA	-	-	-	-	-
Herbicides	MCPP	MCPP	-	-	-	-	-
Metals	Antimony	Antimony (metallic)	-	-	-	-	-
Metals	Barium	Barium	-	-	-	-	-
Metals	Cadmium	Cadmium	1.6×10^{-3}	NA	2.9×10^{6}	NA	NA
Metals	Chromium (Hexavalent Compounds)	Chromium(VI)	1.2×10^{-5}	3.1×10^{-1}	2.2×10^{4}	-	3.9×10^{-2}
Metals	Lead	Lead and Compounds	2.3×10^{-1}	8.2×10^{1}	4.3×10^{8}	-	1.4
Metals	Mercury	Mercury, Inorganic Salts	-	-	-	-	-
Metals	Molybdenum	Molybdenum	-	-	-	-	-

Type	Constituent	Lookup Name	Direct Air Inhalation	Direct Soil			Produce Ingestion
				Ingestion	Inhalation	Dermal	
Metals	Selenium	Selenium	-	-	-	-	-
Metals	Silver	Silver	-	-	-	-	-
Metals	Zinc	Zinc and compounds	-	-	-	-	-
Other Inorganics	Methyl Mercury	Methyl Mercury	-	-	-	-	-
Pesticides	4,4'-DDD	DDD, p,p`- (DDD)	4.1×10^{-2}	2.9	7.5×10^{7}	1.0×10^{1}	7.9×10^{-2}
Pesticides	4,4'-DDE	DDE, p,p'-	2.9×10^{-2}	2.0	4.6×10^{1}	-	6.0×10^{-2}
Pesticides	4,4'-DDT	DDT	2.9×10^{-2}	2.0	5.3×10^{7}	2.4×10^{1}	6.2×10^{-2}
Pesticides	Beta-Bhc	Hexachlorocyclohexane, Beta-	5.3×10^{-3}	3.9×10^{-1}	9.8×10^{6}	1.4	2.7×10^{-3}
Pesticides	Chlordane	Chlordane	2.8×10^{-2}	2.0	3.2×10^{1}	1.8×10^{1}	5.5×10^{-2}
Pesticides	Delta-Bhc	Hexachlorocyclohexane, Delta-	-	-	-	-	-
Pesticides	Dieldrin	Dieldrin	6.1×10^{-4}	4.4×10^{-2}	1.1×10^{6}	1.5×10^{-1}	9.8×10^{-4}
Polychlorinated Biphenyls	Aroclor 1248	Aroclor 1248	4.9×10^{-3}	3.5×10^{-1}	2.3	8.8×10^{-1}	9.8×10^{-3}
Polychlorinated Biphenyls	Aroclor 1254	Aroclor 1254	4.9×10^{-3}	3.5×10^{-1}	3.1	8.8×10^{-1}	1.0×10^{-2}
Polychlorinated Biphenyls	Aroclor 1260	Aroclor 1260	4.9×10^{-3}	3.5×10^{-1}	4.9	8.8×10^{-1}	1.1×10^{-2}
Polychlorinated Biphenyls	Aroclor 5460	Aroclor 5460	-	-	-	-	-
Semivolatile Organics	1-Methylnaphthalene	Methylnaphthalene, 1-	-	2.4×10^{1}	-	6.6×10^{1}	1.8×10^{-1}
Semivolatile Organics	2-Methylnaphthalene	Methylnaphthalene, 2-	-	-	-	-	-
Semivolatile Organics	Acenaphthene	Acenaphthene	-	-	-	-	-
Semivolatile Organics	Anthracene	Anthracene	-	-	-	-	-
Semivolatile Organics	Benzo(a)anthracene	Benz[a]anthracene	1.7×10^{-2}	1.5	5.6×10^{1}	4.6	1.8×10^{-1}
Semivolatile Organics	Benzo(a)pyrene	Benzo[a]pyrene	1.7×10^{-3}	1.5×10^{-1}	3.1×10^{6}	4.6×10^{-1}	1.9×10^{-2}
Semivolatile Organics	Benzo(b)fluoranthene	Benzo[b]fluoranthene	1.7×10^{-2}	1.5	3.1×10^{7}	4.6	1.8×10^{-1}
Semivolatile Organics	Benzo(g,h,i)perylene	Benzo[g,h,i]perylene	-	-	-	-	-
Semivolatile Organics	Benzo(k)fluoranthene	Benzo[k]fluoranthene	1.7×10^{-1}	1.5×10^{1}	3.1×10^{8}	4.6×10^{1}	1.9
Semivolatile Organics	Bis(2-ethylhexyl)phthalate	Bis(2-ethylhexyl)phthalate	1.2	5.0×10^{1}	2.2×10^{9}	1.8×10^{2}	1.6
Semivolatile Organics	Chrysene	Chrysene	1.7	1.5×10^{2}	3.1×10^{9}	4.6×10^{2}	1.8×10^{1}
Semivolatile Organics	Dibenzo(a,h)anthracene	Dibenz[a,h]anthracene	1.7×10^{-3}	1.5×10^{-1}	3.1×10^{6}	4.6×10^{-1}	2.1×10^{-2}
Semivolatile Organics	Di-n-octylphthalate	Octyl Phthalate, di-N-	-	-	-	-	-
Semivolatile Organics	Fluoranthene	Fluoranthene	-	-	-	-	-
Semivolatile Organics	Fluorene	Fluorene	-	-	-	-	-
Semivolatile Organics	Indeno(1,2,3-cd)pyrene	Indeno[1,2,3-cd]pyrene	1.7×10^{-2}	1.5	3.1×10^{7}	4.6	2.1×10^{-1}
Semivolatile Organics	Naphthalene	Naphthalene	8.3×10^{-2}	-	2.9	-	-
Semivolatile Organics	N-Nitrosodimethylamine	Nitrosodimethylamine, N-	7.2×10^{-5}	3.0×10^{-3}	4.5×10^{-3}	-	3.6×10^{-7}
Semivolatile Organics	Phenanthrene	Phenanthrene	-	-	-	-	-

Type	Constituent	Lookup Name	Direct Air Inhalation	Direct Soil			Produce Ingestion
				Ingestion	Inhalation	Dermal	
Semivolatile Organics	Pyrene	Pyrene	-	-	-	-	-
Semivolatile Organics	Total TEQ_BAP	Total TEQ_BAP	NA	NA	NA	NA	NA
Volatile Organics	Formaldehyde	Formaldehyde	2.2×10^{-1}	-	1.3×10^{1}	-	-

Notes:

– Values in micrograms per cubic meter for air and micrograms per gram for soil or produce.

– Values generated by the RAIS online chemical calculator (https://rais.ornl.gov/cgi-bin/prg/PRG_search?select=chem), based on the exposure parameters presented in Table G-32.

– RAIS scenario for the resident used to calculate the direct air and direct soil RBSL, with the Farmer scenario used to calculate the produce ingestion.

– Screening levels are calculated for a cancer incidence risk of 1×10^{-6}.

– NA - screening levels not available for a particular chemical pathway.

– Lookup name matches constituents in soil data to the RAIS chemical names used in the impact assessment.

Table G–35 Offsite Impacts – Chemicals – Noncarcinogenic Screening Levels – Suburban Resident – Toxic Effects

Type	Constituent	Lookup Name	Direct Air Inhalation	Direct Soil			Produce Ingestion
				Ingestion	Inhalation	Dermal	
Anions	Fluoride	Fluoride	1.4×10^{1}	3.1×10^{3}	2.5×10^{10}	-	1.3×10^{2}
Anions	Perchlorate	Perchlorate and Perchlorate Salts	-	5.5×10^{1}	-	-	4.9
Dioxins/Furans	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	HCDD, 1,2,3,4,6,7,8,-	4.2×10^{-3}	7.8×10^{-2}	7.7	1.1	6.9×10^{-3}
Dioxins/Furans	1,2,3,4,6,7,8-HPCDF	HpCDF, 1,2,3,4,7,8,9-	4.2×10^{-3}	5.5×10^{-3}	2.0×10^{1}	7.7×10^{-2}	4.8×10^{-4}
Dioxins/Furans	1,2,3,4,7,8,9-HPCDF	HpCDF, 1,2,3,4,7,8,9-	4.2×10^{-3}	5.5×10^{-3}	2.0×10^{1}	7.7×10^{-2}	4.8×10^{-4}
Dioxins/Furans	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	Hexachlorodibenzo-p-dioxin, 1,2,3,4,7,8-	4.2×10^{-4}	5.5×10^{-4}	7.7×10^{5}	7.7×10^{-3}	4.8×10^{-5}
Dioxins/Furans	1,2,3,4,7,8-HXCDF	Hexachlorodibenzofuran, 1,2,3,4,7,8-	4.2×10^{-4}	5.5×10^{-4}	9.1×10^{-1}	7.7×10^{-3}	4.8×10^{-5}
Dioxins/Furans	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	HxCDD, 1,2,3,6,7,8-	4.2×10^{-4}	5.5×10^{-4}	7.7×10^{5}	7.7×10^{-3}	4.8×10^{-5}
Dioxins/Furans	1,2,3,6,7,8-HXCDF	HxCDF, 1,2,3,6,7,8-	4.2×10^{-4}	5.5×10^{-4}	9.1×10^{-1}	7.7×10^{-3}	4.8×10^{-5}
Dioxins/Furans	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	HxCDD, 1,2,3,7,8,9-	4.2×10^{-4}	5.5×10^{-4}	7.7×10^{5}	7.7×10^{-3}	4.8×10^{-5}
Dioxins/Furans	1,2,3,7,8,9-HXCDF	HxCDF, 1,2,3,7,8,9-	4.2×10^{-4}	5.5×10^{-4}	7.7×10^{5}	7.7×10^{-3}	4.8×10^{-5}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzofuran	PeCDF, 1,2,3,7,8-	1.4×10^{-3}	1.8×10^{-3}	2.6×10^{6}	2.6×10^{-2}	1.5×10^{-4}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	Pentachlorodibenzo-p-dioxin, 1,2,3,7,8-	4.2×10^{-5}	5.5×10^{-5}	7.7×10^{4}	7.7×10^{-4}	4.5×10^{-6}
Dioxins/Furans	2,3,4,6,7,8-HXCDF	HxCDF, 2,3,4,6,7,8-	4.2×10^{-4}	5.5×10^{-4}	7.7×10^{5}	7.7×10^{-3}	4.8×10^{-5}
Dioxins/Furans	2,3,4,7,8-PECDF	PeCDF, 2,3,4,7,8-	1.4×10^{-4}	1.8×10^{-4}	2.6×10^{5}	2.6×10^{-3}	1.5×10^{-5}
Dioxins/Furans	2,3,7,8-TCDD	TCDD, 2,3,7,8-	4.2×10^{-5}	5.5×10^{-5}	6.2×10^{-2}	7.7×10^{-4}	4.6×10^{-6}
Dioxins/Furans	2,3,7,8-Tetrachlorodibenzofuran	TCDF, 2,3,7,8-	4.2×10^{-4}	5.5×10^{-4}	7.8×10^{-1}	7.7×10^{-3}	4.5×10^{-5}
Dioxins/Furans	OCDD	OCDD	1.4×10^{-1}	1.8×10^{-1}	2.6×10^{8}	2.6	1.6×10^{-2}
Dioxins/Furans	OCDF	OCDF	1.4×10^{-1}	1.8×10^{-1}	2.6×10^{8}	2.6	1.6×10^{-2}
Dioxins/Furans	Total TEQ_Dioxin	Total TEQ_Dioxin	NA	NA	NA	NA	NA
Herbicides	2,4-DB	Dichlorophenoxy)butyric Acid, 4-(2,4- Dimethylamine (2,4-DB)	-	2.4×10^{3}	-	-	2.1×10^{2}
Herbicides	MCPA	MCPA	-	3.9×10^{1}	-	1.7×10^{2}	4.1×10^{-1}
Herbicides	MCPP	MCPP	-	7.8×10^{1}	-	3.3×10^{2}	7.2×10^{-1}
Metals	Antimony	Antimony (metallic)	3.1×10^{-1}	3.1×10^{1}	5.8×10^{8}	-	5.9×10^{-1}
Metals	Barium	Barium	5.2×10^{-1}	1.6×10^{4}	9.6×10^{8}	-	3.7×10^{2}
Metals	Cadmium	Cadmium	1.0×10^{-2}	7.8×10^{1}	1.9×10^{7}	8.2×10^{2}	6.8×10^{-1}
Metals	Chromium (Hexavalent Compounds)	Chromium(VI)	1.0×10^{-1}	2.4×10^{2}	1.9×10^{8}	-	1.8×10^{1}

Type	Constituent	Lookup Name	Direct Air Inhalation	Direct Soil			Produce Ingestion
				Ingestion	Inhalation	Dermal	
Metals	Lead	Lead and Compounds	-	-	-	-	-
Metals	Mercury	Mercury, Inorganic Salts	-	2.4×10^{1}	-	-	1.2×10^{-1}
Metals	Molybdenum	Molybdenum	4.2×10^{-1}	3.9×10^{2}	7.7×10^{8}	-	6.2
Metals	Selenium	Selenium	2.1×10^{1}	3.9×10^{2}	3.8×10^{10}	-	2.4×10^{1}
Metals	Silver	Silver	-	3.9×10^{2}	-	-	4.1
Metals	Zinc	Zinc and compounds	-	2.4×10^{4}	-	-	1.0×10^{2}
Other Inorganics	Methyl Mercury	Methyl Mercury	-	7.8	-	-	7.0×10^{-1}
Pesticides	4,4'-DDD	DDD, p,p`- (DDD)	-	2.4	-	9.9	1.8×10^{-1}
Pesticides	4,4'-DDE	DDE, p,p'-	-	2.4×10^{1}	-	-	1.9
Pesticides	4,4'-DDT	DDT	-	3.9×10^{1}	-	5.5×10^{2}	3.3
Pesticides	Beta-Bhc	Hexachlorocyclohexane, Beta-	-	-	-	-	-
Pesticides	Chlordane	Chlordane	7.3×10^{-1}	3.9×10^{1}	8.4×10^{2}	4.1×10^{2}	3.0
Pesticides	Delta-Bhc	Hexachlorocyclohexane, Delta-	-	-	-	-	-
Pesticides	Dieldrin	Dieldrin	-	3.9	-	1.7×10^{1}	2.5×10^{-1}
Polychlorinated Biphenyls	Aroclor 1248	Aroclor 1248	-	-	-	-	-
Polychlorinated Biphenyls	Aroclor 1254	Aroclor 1254	-	1.6	-	4.7	1.3×10^{-1}
Polychlorinated Biphenyls	Aroclor 1260	Aroclor 1260	-	-	-	-	-
Polychlorinated Biphenyls	Aroclor 5460	Aroclor 5460	-	4.7×10^{1}	-	1.4×10^{2}	3.7
Semivolatile Organics	1-Methylnaphthalene	Methylnaphthalene, 1-	-	5.5×10^{3}	-	1.8×10^{4}	1.2×10^{2}
Semivolatile Organics	2-Methylnaphthalene	Methylnaphthalene, 2-	-	3.1×10^{2}	-	1.0×10^{3}	6.5
Semivolatile Organics	Acenaphthene	Acenaphthene	-	4.7×10^{3}	-	1.5×10^{4}	1.0×10^{2}
Semivolatile Organics	Anthracene	Anthracene	-	2.4×10^{4}	-	7.6×10^{4}	8.4×10^{2}
Semivolatile Organics	Benzo(a)anthracene	Benz[a]anthracene	-	-	-	-	-
Semivolatile Organics	Benzo(a)pyrene	Benzo[a]pyrene	2.1×10^{-3}	2.4×10^{1}	3.8×10^{6}	7.6×10^{1}	1.8
Semivolatile Organics	Benzo(b)fluoranthene	Benzo[b]fluoranthene	-	-	-	-	-
Semivolatile Organics	Benzo(g,h,i)perylene	Benzo[g,h,i]perylene	-	-	-	-	-
Semivolatile Organics	Benzo(k)fluoranthene	Benzo[k]fluoranthene	-	-	-	-	-
Semivolatile Organics	Bis(2-ethylhexyl)phthalate	Bis(2-ethylhexyl)phthalate	-	1.6×10^{3}	-	6.6×10^{3}	1.4×10^{2}
Semivolatile Organics	Chrysene	Chrysene	-	-	-	-	-
Semivolatile Organics	Dibenzo(a,h)anthracene	Dibenz[a,h]anthracene	-	-	-	-	-
Semivolatile Organics	Di-n-octylphthalate	Octyl Phthalate, di-N-	-	7.8×10^{2}	-	3.3×10^{3}	6.9×10^{1}

Type	Constituent	Lookup Name	Direct Air Inhalation	Direct Soil			Produce Ingestion
				Ingestion	Inhalation	Dermal	
Semivolatile Organics	Fluoranthene	Fluoranthene	-	3.1×10^{3}	-	1.0×10^{4}	1.8×10^{2}
Semivolatile Organics	Fluorene	Fluorene	-	3.1×10^{3}	-	1.0×10^{4}	8.9×10^{1}
Semivolatile Organics	Indeno(1,2,3-cd)pyrene	Indeno[1,2,3-cd]pyrene	-	-	-	-	-
Semivolatile Organics	Naphthalene	Naphthalene	3.1	1.6×10^{3}	1.1×10^{2}	5.1×10^{3}	1.8×10^{1}
Semivolatile Organics	N-Nitrosodimethylamine	Nitrosodimethylamine, N-	4.2×10^{-2}	6.3×10^{-1}	2.6	-	4.6×10^{-5}
Semivolatile Organics	Phenanthrene	Phenanthrene	-	-	-	-	-
Semivolatile Organics	Pyrene	Pyrene	-	2.4×10^{3}	-	7.6×10^{3}	1.1×10^{2}
Semivolatile Organics	Total TEQ_BAP	Total TEQ_BAP	NA	NA	NA	NA	NA
Volatile Organics	Formaldehyde	Formaldehyde	1.0×10^{1}	1.6×10^{4}	6.0×10^{2}	-	3.9

Notes:

– Values in micrograms per cubic meter for air and micrograms per gram for soil or produce.
– Values generated by the RAIS online chemical calculator (https://rais.ornl.gov/cgi-bin/prg/PRG_search?select=chem), based on the exposure parameters presented in Table G-32
– RAIS scenario for the resident used to calculate the direct air and direct soil RBSL, with the Farmer scenario used to calculate the produce ingestion.
– Screening levels are calculated for a hazard quotient of 1 for each exposure pathway.
– NA - screening levels not available for a particular chemical pathway.
– Lookup name matches constituents in soil data to the RAIS chemical names used in the impact assessment.
– Values represent those developed for the child, as those are more conservative than the adult or age-adjusted values.

Table G–36 Offsite Impacts – Radionuclides – Risk Based Screening Levels – Suburban Resident

Constituent	Lookup Name	Direct Air		Direct Soil			Produce Ingestion
		Inhalation	Submersion	Ingestion	Inhalation	External	
Am-241	Am-241	1.7×10^{-4}	7.1×10^{2}	5.0	3.1×10^{5}	4.3	1.1×10^{-1}
Cm-243/244	Cm-243	2.3×10^{-4}	1.1×10^{2}	6.8	4.2×10^{5}	3.7×10^{-1}	1.5×10^{-1}
Co-60	Co-60	2.2×10^{-1}	1.3×10^{1}	8.3×10^{1}	4.0×10^{8}	3.3×10^{-2}	1.4
Cs-137	Cs-137+D	7.3×10^{-2}	2.2×10^{1}	2.8×10^{1}	1.4×10^{8}	6.1×10^{-2}	1.6×10^{-1}
H-3	H-3	1.4×10^{1}	NA	1.9×10^{4}	2.4×10^{-1}	NA	5.2×10^{-1}
Ni-59	Ni-59	NA	NA	1.3×10^{3}	4.8×10^{9}	1.7×10^{3}	1.2×10^{1}
Np-237	Np-237+D	2.2×10^{-4}	4.3×10^{1}	6.3	4.0×10^{5}	1.4×10^{-1}	1.3×10^{-1}
Pu-238	Pu-238	1.3×10^{-4}	1.7×10^{5}	4.4	2.4×10^{5}	1.9×10^{3}	9.2×10^{-2}
Pu-239/240	Pu-239+D	1.1×10^{-4}	1.3×10^{5}	3.9	2.1×10^{5}	5.5×10^{2}	8.1×10^{-2}
Sr-90	Sr-90+D	1.9×10^{-2}	2.2×10^{3}	8.9	3.6×10^{7}	8.0	2.2×10^{-2}

Notes:

– Values in picocuries per cubic meter for air and picocuries per gram for soil or produce.
– Values generated by the RAIS online radiological calculator (https://rais.ornl.gov/cgi-bin/prg/PRG_search?select=rad), based on the exposure parameters presented in Table G-32.
– Screening levels are calculated for a cancer incidence risk of 1×10^{-6}.
– NA - screening levels not available for a particular radionuclide pathway.
– Lookup name matches constituents in soil data to the RAIS radionuclide names used in the impact assessment.

Table G–37 Offsite Impacts – Chemicals – Risk Based Screening Levels –Recreational User– Carcinogens

Type	Constituent	Lookup Name	Direct Air Inhalation	Direct Soil		
				Ingestion	Inhalation	Dermal
Anions	Fluoride	Fluoride	-	-	-	-
Anions	Perchlorate	Perchlorate and Perchlorate Salts	-	-	-	-
Dioxins/Furans	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	HCDD, 1,2,3,4,6,7,8,-	1.0×10^{-4}	2.5×10^{-3}	1.9×10^{-1}	3.0×10^{-2}
Dioxins/Furans	1,2,3,4,6,7,8-HPCDF	HpCDF, 1,2,3,4,7,8,9-	1.0×10^{-4}	2.5×10^{-3}	4.9×10^{-1}	3.0×10^{-2}
Dioxins/Furans	1,2,3,4,7,8,9-HPCDF	HpCDF, 1,2,3,4,7,8,9-	1.0×10^{-4}	2.5×10^{-3}	4.9×10^{-1}	3.0×10^{-2}
Dioxins/Furans	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	Hexachlorodibenzo-p-dioxin, 1,2,3,4,7,8-	1.0×10^{-5}	2.5×10^{-4}	1.9×10^{4}	3.0×10^{-3}
Dioxins/Furans	1,2,3,4,7,8-HXCDF	Hexachlorodibenzofuran, 1,2,3,4,7,8-	1.0×10^{-5}	2.5×10^{-4}	2.3×10^{-2}	3.0×10^{-3}
Dioxins/Furans	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	HxCDD, 1,2,3,6,7,8-	1.0×10^{-5}	2.5×10^{-4}	1.9×10^{4}	3.0×10^{-3}
Dioxins/Furans	1,2,3,6,7,8-HXCDF	HxCDF, 1,2,3,6,7,8-	1.0×10^{-5}	2.5×10^{-4}	2.3×10^{-2}	3.0×10^{-3}
Dioxins/Furans	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	HxCDD, 1,2,3,7,8,9-	1.0×10^{-5}	2.5×10^{-4}	1.9×10^{4}	3.0×10^{-3}
Dioxins/Furans	1,2,3,7,8,9-HXCDF	HxCDF, 1,2,3,7,8,9-	1.0×10^{-5}	2.5×10^{-4}	1.9×10^{4}	3.0×10^{-3}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzofuran	PeCDF, 1,2,3,7,8-	3.5×10^{-5}	8.3×10^{-4}	6.4×10^{4}	9.9×10^{-3}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	Pentachlorodibenzo-p-dioxin, 1,2,3,7,8-	1.0×10^{-6}	2.5×10^{-5}	1.9×10^{3}	3.0×10^{-4}
Dioxins/Furans	2,3,4,6,7,8-HXCDF	HxCDF, 2,3,4,6,7,8-	1.0×10^{-5}	2.5×10^{-4}	1.9×10^{4}	3.0×10^{-3}
Dioxins/Furans	2,3,4,7,8-PECDF	PeCDF, 2,3,4,7,8-	3.5×10^{-6}	8.3×10^{-5}	6.4×10^{3}	9.9×10^{-4}
Dioxins/Furans	2,3,7,8-TCDD	TCDD, 2,3,7,8-	1.0×10^{-6}	2.5×10^{-5}	1.5×10^{-3}	3.0×10^{-4}
Dioxins/Furans	2,3,7,8-Tetrachlorodibenzofuran	TCDF, 2,3,7,8-	1.0×10^{-5}	2.5×10^{-4}	1.9×10^{-2}	3.0×10^{-3}
Dioxins/Furans	OCDD	OCDD	3.5×10^{-3}	8.3×10^{-2}	6.4×10^{6}	9.9×10^{-1}
Dioxins/Furans	OCDF	OCDF	3.5×10^{-3}	8.3×10^{-2}	6.4×10^{6}	9.9×10^{-1}
Dioxins/Furans	Total TEQ_Dioxin	Total TEQ_Dioxin	NA	NA	NA	NA
Herbicides	2,4-DB	Dichlorophenoxy)butyric Acid, 4-(2,4-Dimethylamine (2,4-DB)	-	-	-	-
Herbicides	MCPA	MCPA	-	-	-	-
Herbicides	MCPP	MCPP	-	-	-	-
Metals	Antimony	Antimony (metallic)	-	-	-	-
Metals	Barium	Barium	-	-	-	-
Metals	Cadmium	Cadmium	2.2×10^{-2}	NA	4.0×10^{7}	NA
Metals	Chromium (Hexavalent Compounds)	Chromium(VI)	1.7×10^{-4}	1.4	3.1×10^{5}	-
Metals	Lead	Lead and Compounds	3.3	3.8×10^{2}	6.0×10^{9}	-

Type	Constituent	Lookup Name	Direct Air Inhalation	Direct Soil		
				Ingestion	Inhalation	Dermal
Metals	Mercury	Mercury, Inorganic Salts	-	-	-	-
Metals	Molybdenum	Molybdenum	-	-	-	-
Metals	Selenium	Selenium	-	-	-	-
Metals	Silver	Silver	-	-	-	-
Metals	Zinc	Zinc and compounds	-	-	-	-
Other Inorganics	Methyl Mercury	Methyl Mercury	-	-	-	-
Pesticides	4,4'-DDD	DDD, p,p`- (DDD)	5.7×10^{-1}	1.4×10^{1}	1.1×10^{9}	4.8×10^{1}
Pesticides	4,4'-DDE	DDE, p,p'-	4.1×10^{-1}	9.5	6.4×10^{2}	-
Pesticides	4,4'-DDT	DDT	4.1×10^{-1}	9.5	7.5×10^{8}	1.1×10^{2}
Pesticides	Beta-Bhc	Hexachlorocyclohexane, Beta-	7.4×10^{-2}	1.8	1.4×10^{8}	6.4
Pesticides	Chlordane	Chlordane	3.9×10^{-1}	9.3	4.5×10^{2}	8.2×10^{1}
Pesticides	Delta-Bhc	Hexachlorocyclohexane, Delta-	-	-	-	-
Pesticides	Dieldrin	Dieldrin	8.6×10^{-3}	2.0×10^{-1}	1.6×10^{7}	7.2×10^{-1}
Polychlorinated Biphenyls	Aroclor 1248	Aroclor 1248	6.9×10^{-2}	1.6	3.3×10^{1}	4.1
Polychlorinated Biphenyls	Aroclor 1254	Aroclor 1254	6.9×10^{-2}	1.6	4.4×10^{1}	4.1
Polychlorinated Biphenyls	Aroclor 1260	Aroclor 1260	6.9×10^{-2}	1.6	6.8×10^{1}	4.1
Polychlorinated Biphenyls	Aroclor 5460	Aroclor 5460	-	-	-	-
Semivolatile Organics	1-Methylnaphthalene	Methylnaphthalene, 1-	-	1.1×10^{2}	-	3.1×10^{2}
Semivolatile Organics	2-Methylnaphthalene	Methylnaphthalene, 2-	-	-	-	-
Semivolatile Organics	Acenaphthene	Acenaphthene	-	-	-	-
Semivolatile Organics	Anthracene	Anthracene	-	-	-	-
Semivolatile Organics	Benzo(a)anthracene	Benz[a]anthracene	2.4×10^{-1}	7.2	7.9×10^{2}	2.1×10^{1}
Semivolatile Organics	Benzo(a)pyrene	Benzo[a]pyrene	2.4×10^{-2}	7.2×10^{-1}	4.4×10^{7}	2.1
Semivolatile Organics	Benzo(b)fluoranthene	Benzo[b]fluoranthene	2.4×10^{-1}	7.2	4.4×10^{8}	2.1×10^{1}
Semivolatile Organics	Benzo(g,h,i)perylene	Benzo[g,h,i]perylene	-	-	-	-
Semivolatile Organics	Benzo(k)fluoranthene	Benzo[k]fluoranthene	2.4	7.2×10^{1}	4.4×10^{9}	2.1×10^{2}
Semivolatile Organics	Bis(2-ethylhexyl)phthalate	Bis(2-ethylhexyl)phthalate	1.6×10^{1}	2.3×10^{2}	3.0×10^{10}	8.2×10^{2}
Semivolatile Organics	Chrysene	Chrysene	2.4×10^{1}	7.2×10^{2}	4.4×10^{10}	2.1×10^{3}
Semivolatile Organics	Dibenzo(a,h)anthracene	Dibenz[a,h]anthracene	2.4×10^{-2}	7.2×10^{-1}	4.4×10^{7}	2.1
Semivolatile Organics	Di-n-octylphthalate	Octyl Phthalate, di-N-	-	-	-	-
Semivolatile Organics	Fluoranthene	Fluoranthene	-	-	-	-
Semivolatile Organics	Fluorene	Fluorene	-	-	-	-
Semivolatile Organics	Indeno(1,2,3-cd)pyrene	Indeno[1,2,3-cd]pyrene	2.4×10^{-1}	7.2	4.4×10^{8}	2.1×10^{1}
Semivolatile Organics	Naphthalene	Naphthalene	1.2	-	4.0×10^{1}	-

Type	Constituent	Lookup Name	Direct Air Inhalation	Direct Soil		
				Ingestion	Inhalation	Dermal
Semivolatile Organics	N-Nitrosodimethylamine	Nitrosodimethylamine, N-	1.0×10^{-3}	1.4×10^{-2}	6.3×10^{-2}	-
Semivolatile Organics	Phenanthrene	Phenanthrene	-	-	-	-
Semivolatile Organics	Pyrene	Pyrene	-	-	-	-
Semivolatile Organics	Total TEQ_BAP	Total TEQ_BAP	NA	NA	NA	NA
Volatile Organics	Formaldehyde	Formaldehyde	3.0	-	1.8×10^{2}	-

Notes:

– Values in micrograms per cubic meter for air and micrograms per gram for soil.

– Values generated by the RAIS online chemical calculator (https://rais.ornl.gov/cgi-bin/prg/PRG_search?select=chem), based on the exposure parameters presented in Table G-33.

– Screening levels are calculated for a cancer incidence risk of 1×10^{-6}.

– NA - screening levels not available for a particular chemical pathway.

– Lookup name matches constituents in soil data to the RAIS chemical names used in the impact assessment.

Table G–38 Offsite Impacts – Chemicals – Risk Based Screening Levels –Recreational User– Toxic Effects

Type	Constituent	Lookup Name	Direct Air Inhalation	Direct Soil		
				Ingestion	Inhalation	Dermal
Anions	Fluoride	Fluoride	1.9×10^{2}	1.5×10^{4}	3.5×10^{11}	-
Anions	Perchlorate	Perchlorate and Perchlorate Salts	-	2.6×10^{2}	-	-
Dioxins/Furans	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	HCDD, 1,2,3,4,6,7,8,-	5.8×10^{-2}	3.7×10^{-1}	1.1×10^{2}	5.1
Dioxins/Furans	1,2,3,4,6,7,8-HPCDF	HpCDF, 1,2,3,4,7,8,9-	5.8×10^{-2}	2.6×10^{-2}	2.8×10^{2}	3.6×10^{-1}
Dioxins/Furans	1,2,3,4,7,8,9-HPCDF	HpCDF, 1,2,3,4,7,8,9-	5.8×10^{-2}	2.6×10^{-2}	2.8×10^{2}	3.6×10^{-1}
Dioxins/Furans	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	Hexachlorodibenzo-p-dioxin, 1,2,3,4,7,8-	5.8×10^{-3}	2.6×10^{-3}	1.1×10^{7}	3.6×10^{-2}
Dioxins/Furans	1,2,3,4,7,8-HXCDF	Hexachlorodibenzofuran, 1,2,3,4,7,8-	5.8×10^{-3}	2.6×10^{-3}	1.3×10^{1}	3.6×10^{-2}
Dioxins/Furans	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	HxCDD, 1,2,3,6,7,8-	5.8×10^{-3}	2.6×10^{-3}	1.1×10^{7}	3.6×10^{-2}
Dioxins/Furans	1,2,3,6,7,8-HXCDF	HxCDF, 1,2,3,6,7,8-	5.8×10^{-3}	2.6×10^{-3}	1.3×10^{1}	3.6×10^{-2}
Dioxins/Furans	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	HxCDD, 1,2,3,7,8,9-	5.8×10^{-3}	2.6×10^{-3}	1.1×10^{7}	3.6×10^{-2}
Dioxins/Furans	1,2,3,7,8,9-HXCDF	HxCDF, 1,2,3,7,8,9-	5.8×10^{-3}	2.6×10^{-3}	1.1×10^{7}	3.6×10^{-2}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzofuran	PeCDF, 1,2,3,7,8-	2.0×10^{-2}	8.5×10^{-3}	3.6×10^{7}	1.2×10^{-1}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	Pentachlorodibenzo-p-dioxin, 1,2,3,7,8-	5.8×10^{-4}	2.6×10^{-4}	1.1×10^{6}	3.6×10^{-3}
Dioxins/Furans	2,3,4,6,7,8-HXCDF	HxCDF, 2,3,4,6,7,8-	5.8×10^{-3}	2.6×10^{-3}	1.1×10^{7}	3.6×10^{-2}
Dioxins/Furans	2,3,4,7,8-PECDF	PeCDF, 2,3,4,7,8-	2.0×10^{-3}	8.5×10^{-4}	3.6×10^{6}	1.2×10^{-2}
Dioxins/Furans	2,3,7,8-TCDD	TCDD, 2,3,7,8-	5.8×10^{-4}	2.6×10^{-4}	8.7×10^{-1}	3.6×10^{-3}
Dioxins/Furans	2,3,7,8-Tetrachlorodibenzofuran	TCDF, 2,3,7,8-	5.8×10^{-3}	2.6×10^{-3}	1.1×10^{1}	3.6×10^{-2}
Dioxins/Furans	OCDD	OCDD	2.0	8.5×10^{-1}	3.6×10^{9}	1.2×10^{1}
Dioxins/Furans	OCDF	OCDF	2.0	8.5×10^{-1}	3.6×10^{9}	1.2×10^{1}
Dioxins/Furans	Total TEQ_Dioxin	Total TEQ_Dioxin	NA	NA	NA	NA
Herbicides	2,4-DB	Dichlorophenoxy)butyric Acid, 4-(2,4-Dimethylamine (2,4-DB)	-	1.1×10^{4}	-	-
Herbicides	MCPA	MCPA	-	1.8×10^{2}	-	7.7×10^{2}
Herbicides	MCPP	MCPP	-	3.7×10^{2}	-	1.5×10^{3}
Metals	Antimony	Antimony (metallic)	4.4	1.5×10^{2}	8.1×10^{9}	-
Metals	Barium	Barium	7.3	7.3×10^{4}	1.4×10^{10}	-
Metals	Cadmium	Cadmium	1.5×10^{-1}	NA	2.7×10^{8}	NA
Metals	Chromium (Hexavalent Compounds)	Chromium(VI)	1.5	1.1×10^{3}	2.7×10^{9}	-
Metals	Lead	Lead and Compounds	-	-	-	-
Metals	Mercury	Mercury, Inorganic Salts	-	1.1×10^{2}	-	-

Type	Constituent	Lookup Name	Direct Air Inhalation	Direct Soil		
				Ingestion	Inhalation	Dermal
Metals	Molybdenum	Molybdenum	5.8	1.8×10^{3}	1.1×10^{10}	-
Metals	Selenium	Selenium	2.9×10^{2}	1.8×10^{3}	5.4×10^{11}	-
Metals	Silver	Silver	-	1.8×10^{3}	-	-
Metals	Zinc	Zinc and compounds	-	1.1×10^{5}	-	-
Other Inorganics	Methyl Mercury	Methyl Mercury	-	3.7×10^{1}	-	-
Pesticides	4,4'-DDD	DDD, p,p`- (DDD)	-	1.1×10^{1}	-	4.6×10^{1}
Pesticides	4,4'-DDE	DDE, p,p'-	-	1.1×10^{2}	-	-
Pesticides	4,4'-DDT	DDT	-	1.8×10^{2}	-	2.6×10^{3}
Pesticides	Beta-Bhc	Hexachlorocyclohexane, Beta-	-	-	-	-
Pesticides	Chlordane	Chlordane	1.0×10^{1}	1.8×10^{2}	1.2×10^{4}	1.9×10^{3}
Pesticides	Delta-Bhc	Hexachlorocyclohexane, Delta-	-	-	-	-
Pesticides	Dieldrin	Dieldrin	-	1.8×10^{1}	-	7.7×10^{1}
Polychlorinated Biphenyls	Aroclor 1248	Aroclor 1248	-	-	-	-
Polychlorinated Biphenyls	Aroclor 1254	Aroclor 1254	-	7.3	-	2.2×10^{1}
Polychlorinated Biphenyls	Aroclor 1260	Aroclor 1260	-	-	-	-
Polychlorinated Biphenyls	Aroclor 5460	Aroclor 5460	-	2.2×10^{2}	-	6.6×10^{2}
Semivolatile Organics	1-Methylnaphthalene	Methylnaphthalene, 1-	-	2.6×10^{4}	-	8.3×10^{4}
Semivolatile Organics	2-Methylnaphthalene	Methylnaphthalene, 2-	-	1.5×10^{3}	-	4.7×10^{3}
Semivolatile Organics	Acenaphthene	Acenaphthene	-	2.2×10^{4}	-	7.1×10^{4}
Semivolatile Organics	Anthracene	Anthracene	-	1.1×10^{5}	-	3.6×10^{5}
Semivolatile Organics	Benzo(a)anthracene	Benz[a]anthracene	-	-	-	-
Semivolatile Organics	Benzo(a)pyrene	Benzo[a]pyrene	2.9×10^{-2}	1.1×10^{2}	5.4×10^{7}	3.6×10^{2}
Semivolatile Organics	Benzo(b)fluoranthene	Benzo[b]fluoranthene	-	-	-	-
Semivolatile Organics	Benzo(g,h,i)perylene	Benzo[g,h,i]perylene	-	-	-	-
Semivolatile Organics	Benzo(k)fluoranthene	Benzo[k]fluoranthene	-	-	-	-
Semivolatile Organics	Bis(2-ethylhexyl)phthalate	Bis(2-ethylhexyl)phthalate	-	7.3×10^{3}	-	3.1×10^{4}
Semivolatile Organics	Chrysene	Chrysene	-	-	-	-
Semivolatile Organics	Dibenzo(a,h)anthracene	Dibenz[a,h]anthracene	-	-	-	-
Semivolatile Organics	Di-n-octylphthalate	Octyl Phthalate, di-N-	-	3.7×10^{3}	-	1.5×10^{4}
Semivolatile Organics	Fluoranthene	Fluoranthene	-	1.5×10^{4}	-	4.7×10^{4}
Semivolatile Organics	Fluorene	Fluorene	-	1.5×10^{4}	-	4.7×10^{4}
Semivolatile Organics	Indeno(1,2,3-cd)pyrene	Indeno[1,2,3-cd]pyrene	-	-	-	-
Semivolatile Organics	Naphthalene	Naphthalene	4.4×10^{1}	7.3×10^{3}	1.5×10^{3}	2.4×10^{4}
Semivolatile Organics	N-Nitrosodimethylamine	Nitrosodimethylamine, N-	5.8×10^{-1}	2.9	3.6×10^{1}	-

Type	Constituent	Lookup Name	Direct Air Inhalation	Direct Soil		
				Ingestion	Inhalation	Dermal
Semivolatile Organics	Phenanthrene	Phenanthrene	-	-	-	-
Semivolatile Organics	Pyrene	Pyrene	-	1.1×10^{4}	-	3.6×10^{4}
Semivolatile Organics	Total TEQ_BAP	Total TEQ_BAP	NA	NA	NA	NA
Volatile Organics	Formaldehyde	Formaldehyde	1.4×10^{2}	7.3×10^{4}	8.4×10^{3}	-

Notes:
– Values in micrograms per cubic meter for air and micrograms per gram for soil.
– Values generated by the RAIS online chemical calculator (https://rais.ornl.gov/cgi-bin/prg/PRG_search?select=chem), based on the exposure parameters presented in Table G-33.
– Screening levels are calculated for a hazard quotient of 1 for each exposure pathway.
– NA - screening levels not available for a particular chemical pathway.
– Lookup name matches constituents in soil data to the RAIS chemical names used in the impact assessment.
– Values represent those developed for the child, as those are more conservative than the adult or age-adjusted values.

Table G–39 Offsite Impacts – Radionuclides – Risk Based Screening Levels –Recreational User - Carcinogens

			Direct Air		Direct Soil		
Type	Constituent	Lookup Name	Inhalation	Submersion	Ingestion	Inhalation	External
Radionuclide	Am-241	Am-241	2.3×10^{-3}	9.7×10^{3}	2.3×10^{1}	4.3×10^{6}	2.1×10^{1}
Radionuclide	Cm-243/244	Cm-243	2.4×10^{-3}	1.2×10^{3}	3.2×10^{1}	5.8×10^{6}	1.8
Radionuclide	Co-60	Co-60	8.6×10^{-1}	5.0×10^{1}	3.9×10^{2}	5.6×10^{9}	1.6×10^{-1}
Radionuclide	Cs-137	Cs-137+D	7.7×10^{-1}	2.4×10^{2}	1.3×10^{2}	1.9×10^{9}	2.9×10^{-1}
Radionuclide	H-3	H-3	1.0×10^{2}	-	8.8×10^{4}	3.3	-
Radionuclide	Ni-59	Ni-59	3.6×10^{1}	8.7×10^{6}	6.2×10^{3}	6.7×10^{10}	8.3×10^{3}
Radionuclide	Np-237	Np-237+D	3.0×10^{-3}	6.0×10^{2}	3.0×10^{1}	5.6×10^{6}	6.6×10^{-1}
Radionuclide	Pu-238	Pu-238	1.7×10^{-3}	2.2×10^{6}	2.1×10^{1}	3.4×10^{6}	9.0×10^{3}
Radionuclide	Pu-239/240	Pu-239+D	1.6×10^{-3}	1.7×10^{6}	1.8×10^{1}	2.9×10^{6}	2.7×10^{3}
Radionuclide	Sr-90	Sr-90+D	2.0×10^{-1}	2.3×10^{4}	4.1×10^{1}	5.0×10^{8}	3.9×10^{1}

Notes:

– RBSLs in picocuries per cubic meter for direct air and picocuries per gram for direct soil pathways

– Values generated by the RAIS online radiological calculator (https://rais.ornl.gov/cgi-bin/prg/PRG_search?select=rad), based on the exposure parameters presented in Table G-33.

– Screening levels are calculated for a cancer incidence risk of 1×10^{-6}.

– Lookup name matches constituents in soil data to the RAIS radionuclide names used in the impact assessment.

Table G–40 Building Preliminary Remediation Goals for Onsite Worker Exposure

Radionuclide	*Progeny Equilibrium Assumption*	*Daughters Included*	*Dust Ingestion (pCi/cm2)*	*Ambient Air Inhalation (pCi/m3)*	*3-D Ground Plane External Exposure (pCi/cm2)*
H-3	Parent in Secular Equilibrium	All	2.0E+01	9.4E+00	--
Na-22	Parent in Secular Equilibrium	All	5.2E-02	8.2E-02	5.7E-02
Fe-55	Parent in Secular Equilibrium	All	1.8E+00	5.4E+00	1.9E+09
Ni-63	Parent in Secular Equilibrium	All	2.6E+00	1.4E+00	--
Co-60	Parent in Secular Equilibrium	All	4.9E-02	7.9E-02	2.5E-02
Sr-90	Parent in Secular Equilibrium	All	1.5E-02	1.8E-02	6.1E+04
Cs-134	Parent in Secular Equilibrium	All	1.8E-02	1.1E-01	3.6E-02
Cs-137	Parent in Secular Equilibrium	All	2.6E-02	7.1E-02	2.2E-01
Eu-152	Parent Only	None	1.1E-01	4.2E-02	3.4E-02
Eu-154	Parent in Secular Equilibrium	All	8.9E-02	3.9E-02	4.2E-02
Eu-155	Parent in Secular Equilibrium	All	8.4E-01	4.2E-01	1.7E+00
Th-232	Parent in Secular Equilibrium	All	9.8E-04	3.5E-05	2.6E-02
U-234	Parent Only	None	1.8E-02	2.9E-04	1.8E+02
U-235	Parent Only	None	1.6E-02	3.2E-04	4.9E-01
U-238	Parent and Selected Daughters	Pa-234, Pa-234m, Th-234	3.6E-04	3.4E-04	7.4E+00
Pu-238	Parent Only	None	7.8E-03	1.5E-04	1.3E+03
Pu-239	Parent Only	None	7.5E-03	1.4E-04	3.9E+03
Pu-240	Parent Only	None	7.5E-03	1.4E-04	1.4E+03
Pu-241	Parent Only	None	5.2E-01	9.2E-03	1.6E+09
Pu-242	Parent Only	None	7.9E-03	1.5E-04	1.6E+03
Am-241	Parent Only	None	1.0E-02	2.1E-04	3.8E+00

cm^2 = square centimeter; m^3 = cubic meter; pCi = picocuries.

Notes:

– RBSL for building surfaces (a.k.a. BPRGs [Building Preliminary Remediation Goals] or PRG) are generated from https://epa-bprg.ornl.gov, using default exposure parameters for the indoor worker scenario.

– Building RBSLs were generated for each isotope based on the progeny equilibrium assumptions with daughters as indicated. Equilibrium assumptions are based on the ingrowth time required due to the progeny half-lives.

Table G–41 Offsite Impacts – Radionuclides – Risk Based Screening Levels – Suburban Resident – Building Radionuclides

Constituent	Lookup Name	Direct Air		Direct Soil			Produce Ingestion
		Inhalation	Submersion	Ingestion	Inhalation	External	
Am-241	Am-241	1.7×10^{-4}	6.9×10^{2}	5.0	3.1×10^{5}	4.3	1.1×10^{-1}
Co-60	Co-60	6.2×10^{-2}	3.6	8.3×10^{1}	4.0×10^{8}	3.3×10^{-2}	1.4
Cs-134	Cs-134	8.9×10^{-2}	6.1	1.4×10^{2}	1.4×10^{9}	1.4×10^{-1}	7.5×10^{-1}
Cs-137	Cs-137+D	5.5×10^{-2}	1.7×10^{1}	2.8×10^{1}	1.4×10^{8}	6.1×10^{-2}	1.6×10^{-1}
Eu-152	Eu-152	3.3×10^{-2}	7.9	1.1×10^{2}	1.1×10^{8}	3.9×10^{-2}	2.7
Eu-154	Eu-154	3.0×10^{-2}	7.4	8.4×10^{1}	1.3×10^{8}	4.7×10^{-2}	2.1
Eu-155	Eu-155	3.2×10^{-1}	2.1×10^{2}	6.7×10^{2}	2.3×10^{9}	3.6	1.7×10^{1}
Fe-55	Fe-55	4.2	6.6×10^{10}	3.1×10^{3}	5.1×10^{10}	1.6×10^{9}	7.9×10^{1}
H-3	H-3	7.3	-	-	2.4×10^{-1}	-	5.2×10^{-1}
Na-22	Na-22	6.4×10^{-2}	4.2	3.3×10^{2}	8.2×10^{8}	7.8×10^{-2}	4.4
Ni-63	Ni-63	-	-	5.7×10^{2}	2.1×10^{9}	-	5.3
Pu-238	Pu-238	1.2×10^{-4}	1.6×10^{5}	4.4	2.4×10^{5}	1.9×10^{3}	9.2×10^{-2}
Pu-239	Pu-239+D	1.1×10^{-4}	1.2×10^{5}	3.9	2.1×10^{5}	5.5×10^{2}	8.1×10^{-2}
Pu-240	Pu-240	1.1×10^{-4}	1.6×10^{5}	3.9	2.1×10^{5}	1.6×10^{3}	8.1×10^{-2}
Pu-241	Pu-241	7.2×10^{-3}	7.2×10^{6}	5.8×10^{2}	2.3×10^{7}	5.0×10^{4}	1.1×10^{1}
Pu-242	Pu-242	1.2×10^{-4}	7.2×10^{4}	4.1	2.2×10^{5}	2.7×10^{2}	8.5×10^{-2}
Sr-90	Sr-90+D	1.4×10^{-2}	1.6×10^{3}	8.9	3.6×10^{7}	8.0	2.2×10^{-2}
Th-232	Th-232+D	7.1×10^{-5}	1.1×10^{1}	4.1×10^{-1}	1.3×10^{5}	2.9×10^{-2}	7.8×10^{-3}
U-234	U-234	2.2×10^{-4}	7.8×10^{4}	6.0	4.1×10^{5}	4.6×10^{2}	1.0×10^{-1}
U-235	U-235+D	2.5×10^{-4}	6.0×10^{1}	5.8	4.6×10^{5}	2.0×10^{-1}	9.9×10^{-2}
U-238	U-238+D	2.6×10^{-4}	3.2×10^{2}	4.5	4.8×10^{5}	9.7×10^{-1}	8.0×10^{-2}

Notes:

– Values in picocuries per cubic meter for air and picocuries per gram for soil or produce.

– Values generated by the RAIS online radiological calculator (https://rais.ornl.gov/cgi-bin/prg/PRG_search?select=rad), based on the exposure parameters presented in Table G-32.

– Screening levels are calculated for a cancer incidence risk of 1×10^{-6}.

– NA - screening levels not available for a particular radionuclide pathway.

– Lookup name matches constituents in soil data to the RAIS radionuclide names used in the impact assessment.

Table G–42 Offsite Impacts – Radionuclides – Risk Based Screening Levels – Recreational User – Building Radionuclides

Constituent	Lookup Name	Direct Air		Direct Soil		
		Inhalation	Submersion	Ingestion	Inhalation	External
Am-241	Am-241	2.3×10^{-3}	9.7×10^{3}	2.3×10^{1}	4.3×10^{6}	2.1×10^{1}
Co-60	Co-60	8.6×10^{-1}	5.0×10^{1}	3.9×10^{2}	5.6×10^{9}	1.6×10^{-1}
Cs-134	Cs-134	1.2	8.5×10^{1}	6.3×10^{2}	2.0×10^{10}	6.9×10^{-1}
Cs-137	Cs-137+D	7.7×10^{-1}	2.4×10^{2}	1.3×10^{2}	1.9×10^{9}	2.9×10^{-1}
Eu-152	Eu-152	4.6×10^{-1}	1.1×10^{2}	5.2×10^{2}	1.5×10^{9}	1.9×10^{-1}
Eu-154	Eu-154	4.2×10^{-1}	1.0×10^{2}	3.9×10^{2}	1.9×10^{9}	2.3×10^{-1}
Eu-155	Eu-155	4.5	2.9×10^{3}	3.1×10^{3}	3.2×10^{10}	1.7×10^{1}
Fe-55	Fe-55	5.9×10^{1}	9.2×10^{11}	1.5×10^{4}	7.1×10^{11}	7.7×10^{9}
H-3	H-3	1.0×10^{2}	-	8.8×10^{4}	3.3	-
Na-22	Na-22	8.9×10^{-1}	5.9×10^{1}	1.5×10^{3}	1.1×10^{10}	3.8×10^{-1}
Ni-63	Ni-63	1.5×10^{1}	-	2.7×10^{3}	3.0×10^{10}	-
Pu-238	Pu-238	1.7×10^{-3}	2.2×10^{6}	2.1×10^{1}	3.4×10^{6}	9.0×10^{3}
Pu-239	Pu-239+D	1.6×10^{-3}	1.7×10^{6}	1.8×10^{1}	2.9×10^{6}	2.7×10^{3}
Pu-240	Pu-240	1.6×10^{-3}	2.2×10^{6}	1.8×10^{1}	2.9×10^{6}	7.9×10^{3}
Pu-241	Pu-241	1.0×10^{-1}	1.0×10^{8}	2.7×10^{3}	3.3×10^{8}	2.4×10^{5}
Pu-242	Pu-242	1.7×10^{-3}	1.0×10^{6}	1.9×10^{1}	3.1×10^{6}	1.3×10^{3}
Sr-90	Sr-90+D	2.0×10^{-1}	2.3×10^{4}	4.1×10^{1}	5.0×10^{8}	3.9×10^{1}
Th-232	Th-232+D	1.0×10^{-3}	1.5×10^{2}	1.9	1.8×10^{6}	1.4×10^{-1}
U-234	U-234	3.1×10^{-3}	1.1×10^{6}	2.8×10^{1}	5.8×10^{6}	2.2×10^{3}
U-235	U-235+D	3.5×10^{-3}	8.4×10^{2}	2.7×10^{1}	6.4×10^{6}	9.8×10^{-1}
U-238	U-238+D	3.7×10^{-3}	4.4×10^{3}	2.1×10^{1}	6.8×10^{6}	4.7

Notes:
– RBSLs in picocuries per cubic meter for direct air and picocuries per gram for direct soil pathways
– Values generated by the RAIS online radiological calculator (https://rais.ornl.gov/cgi-bin/prg/PRG_search?select=rad), based on the exposure parameters presented in Table G-33.
– Screening levels are calculated for a cancer incidence risk of 1×10^{-6}.
– Lookup name matches constituents in soil data to the RAIS radionuclide names used in the impact assessment.

Table G–43 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–44 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–45 Cancer Incidence Risk from Building Demolition – Onsite Worker[a]

Exposure Pathway	Buildings											Total Building D&D Project
	4019 (SNAP) System Nuclear Qualification Test Facility	4021 (RMHF); Decontamination 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}	3.8×10^{-7}	6.5×10^{-8}	3.9×10^{-8}	2.9×10^{-9}	9.5×10^{-11}	7.6×10^{-9}	4.9×10^{-10}	1.6×10^{-10}	1.8×10^{-8}	8.7×10^{-9}	5.3×10^{-7}
Inhalation	2.5×10^{-5}	1.4×10^{-5}	2.3×10^{-5}	3.8×10^{-6}	5.3×10^{-6}	6.2×10^{-7}	5.0×10^{-6}	1.2×10^{-6}	1.2×10^{-5}	2.0×10^{-5}	9.0×10^{-6}	1.2×10^{-4}
External Exposure	3.0×10^{-9}	8.4×10^{-7}	1.4×10^{-8}	1.9×10^{-7}	1.8×10^{-8}	4.9×10^{-10}	5.8×10^{-12}	1.1×10^{-10}	2.4×10^{-10}	7.9×10^{-10}	3.8×10^{-10}	1.1×10^{-6}
Total	**2.5×10^{-5}**	**1.5×10^{-5}**	**2.3×10^{-5}**	**4.0×10^{-6}**	**5.3×10^{-6}**	**6.2×10^{-7}**	**5.0×10^{-6}**	**1.2×10^{-6}**	**1.2×10^{-5}**	**2.0×10^{-5}**	**9.0×10^{-6}**	**1.2×10^{-4}**

D&D = decontamination and decommissioning; RMHF = Radioactive Materials Handling Facility; SNAP = Systems for Nuclear Auxiliary Power.

[a] See Chapter 4, Section 4.9.3 for the rationale of selecting these 11 buildings and one yard as the facilities with significant radioactive contamination.

Note: Cancer incidence risk represents the frequency of additional cancers occurring in an exposed individual and is compared with the target risk range for remediation alternatives of 1 cancer per 10,000 to 1 cancer per 1,000,000 exposures (1×10^{-4} to 1×10^{-6}).

Table G–46 Radiological Dose from Building Demolition – Onsite Worker

Exposure Pathway	Buildings											Total Building D&D Project
	4019 (SNAP) System Nuclear Qualification Test Facility	4021 (RMHF); Decontamination 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}	6.7×10^{-1}	1.9×10^{-1}	9.0×10^{-1}	4.4×10^{-3}	2.0×10^{-4}	1.8×10^{-2}	2.2×10^{-3}	6.2×10^{-4}	5.3×10^{-2}	3.2×10^{-2}	1.9
Inhalation	1.1×10^{2}	2.7×10^{1}	1.0×10^{2}	8.0	6.8	3.0	2.5×10^{1}	6.1	5.9×10^{1}	9.6×10^{1}	4.6×10^{1}	4.9×10^{2}
External Exposure	1.7×10^{-3}	9.2×10^{-1}	1.5×10^{-2}	2.1×10^{-1}	2.0×10^{-2}	5.5×10^{-4}	1.1×10^{-5}	1.3×10^{-4}	2.8×10^{-4}	8.8×10^{-4}	4.9×10^{-4}	1.2
Total	**1.1×10^{2}**	**2.9×10^{1}**	**1.0×10^{2}**	**9.1**	**6.8**	**3.0**	**2.5×10^{1}**	**6.1**	**5.9×10^{1}**	**9.6×10^{1}**	**4.6×10^{1}**	**5.0×10^{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–47 Impact Assessment for Bedrock Excavation –Onsite Worker

Pathway Parameters	*Ingestion*	*Inhalation*	*External*	*Total*
Exposure Concentration Units	pCi/cm^2	pCi/m^3	pCi/cm^2	
Exposure Concentration	0.38	160	380	
Default BPRG	0.015	0.018	61,000	
Adjusted BPRG	4.8	5.8	19,000,000	
Cancer Incidence to Dose Ratio (millirem/risk)	0.07	0.08	0.11	
Cancer Incidence Risk	7.9×10^{-8}	2.8×10^{-5}	2.0×10^{-11}	**2.8×10^{-5}**
Radiological Dose (millirem)	1.2	350	0.00018	**350**

BPRG = Building Preliminary Remediation Goals; cm^2 = square centimeter; m^3 = cubic meter; pCi = picocuries.

Notes:

– BPRGs are for a cancer incidence rate of 1×10^{-6} and were adjusted from the default exposure duration of 6,250 days to 20 days 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.

Table G–48 Offsite Impacts – Suburban Resident – Chemicals – Remedial Actions – Cancer Incidence Risk – Direct Air

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Anions	Fluoride	NA	NA	NA	NA	NA
Anions	Perchlorate	NA	NA	NA	NA	NA
Dioxins/Furans	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	4.1×10^{-15}	4.6×10^{-14}	2.0×10^{-14}	1.5×10^{-14}	1.2×10^{-14}
Dioxins/Furans	1,2,3,4,6,7,8-HPCDF	5.7×10^{-16}	6.3×10^{-15}	2.7×10^{-15}	2.0×10^{-15}	1.7×10^{-15}
Dioxins/Furans	1,2,3,4,7,8,9-HPCDF	6.6×10^{-17}	7.3×10^{-16}	3.0×10^{-16}	2.2×10^{-16}	1.8×10^{-16}
Dioxins/Furans	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	1.8×10^{-15}	2.1×10^{-14}	9.2×10^{-15}	7.4×10^{-15}	6.2×10^{-15}
Dioxins/Furans	1,2,3,4,7,8-HXCDF	4.4×10^{-16}	4.7×10^{-15}	1.8×10^{-15}	1.2×10^{-15}	9.1×10^{-16}
Dioxins/Furans	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	1.7×10^{-15}	1.9×10^{-14}	8.0×10^{-15}	5.9×10^{-15}	4.9×10^{-15}
Dioxins/Furans	1,2,3,6,7,8-HXCDF	3.3×10^{-16}	3.5×10^{-15}	1.4×10^{-15}	9.4×10^{-16}	6.9×10^{-16}
Dioxins/Furans	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	8.5×10^{-16}	9.1×10^{-15}	3.8×10^{-15}	2.7×10^{-15}	2.2×10^{-15}
Dioxins/Furans	1,2,3,7,8,9-HXCDF	1.4×10^{-16}	1.5×10^{-15}	5.0×10^{-16}	3.0×10^{-16}	2.1×10^{-16}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzofuran	7.4×10^{-17}	7.0×10^{-16}	2.5×10^{-16}	1.3×10^{-16}	9.0×10^{-17}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	3.2×10^{-15}	3.5×10^{-14}	1.5×10^{-14}	1.1×10^{-14}	8.7×10^{-15}
Dioxins/Furans	2,3,4,6,7,8-HXCDF	4.5×10^{-16}	4.9×10^{-15}	2.0×10^{-15}	1.4×10^{-15}	1.0×10^{-15}
Dioxins/Furans	2,3,4,7,8-PECDF	9.8×10^{-16}	1.0×10^{-14}	3.9×10^{-15}	2.5×10^{-15}	1.8×10^{-15}
Dioxins/Furans	2,3,7,8-TCDD	5.8×10^{-16}	6.3×10^{-15}	2.5×10^{-15}	1.7×10^{-15}	1.4×10^{-15}
Dioxins/Furans	2,3,7,8-Tetrachlorodibenzofuran	1.4×10^{-16}	1.3×10^{-15}	5.1×10^{-16}	2.7×10^{-16}	1.8×10^{-16}
Dioxins/Furans	OCDD	1.5×10^{-15}	1.6×10^{-14}	7.1×10^{-15}	5.2×10^{-15}	4.3×10^{-15}
Dioxins/Furans	OCDF	4.6×10^{-17}	5.1×10^{-16}	2.2×10^{-16}	1.7×10^{-16}	1.4×10^{-16}
Dioxins/Furans	Total TEQ_Dioxin	NA	NA	NA	NA	NA
Herbicides	2,4-DB	NA	NA	NA	NA	NA
Herbicides	MCPA	NA	NA	NA	NA	NA
Herbicides	MCPP	NA	NA	NA	NA	NA
Metals	Antimony	NA	NA	NA	NA	NA
Metals	Barium	NA	NA	NA	NA	NA
Metals	Cadmium	1.6×10^{-13}	1.8×10^{-12}	8.0×10^{-13}	6.5×10^{-13}	5.5×10^{-13}
Metals	Chromium (Hexavalent Compounds)	6.0×10^{-12}	5.6×10^{-11}	1.5×10^{-11}	5.4×10^{-12}	4.2×10^{-12}
Metals	Lead	4.8×10^{-14}	5.4×10^{-13}	2.4×10^{-13}	2.0×10^{-13}	1.6×10^{-13}
Metals	Mercury	NA	NA	NA	NA	NA
Metals	Molybdenum	NA	NA	NA	NA	NA
Metals	Selenium	NA	NA	NA	NA	NA
Metals	Silver	NA	NA	NA	NA	NA

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Metals	Zinc	NA	NA	NA	NA	NA
Other Inorganics	Methyl Mercury	NA	NA	NA	NA	NA
Pesticides	4,4'-DDD	4.3×10^{-18}	5.1×10^{-17}	8.4×10^{-18}	4.1×10^{-18}	3.3×10^{-18}
Pesticides	4,4'-DDE	4.9×10^{-17}	6.1×10^{-16}	2.3×10^{-16}	1.4×10^{-16}	1.1×10^{-16}
Pesticides	4,4'-DDT	4.2×10^{-17}	4.4×10^{-16}	1.6×10^{-16}	9.5×10^{-17}	7.8×10^{-17}
Pesticides	Beta-Bhc	7.3×10^{-18}	7.9×10^{-17}	1.7×10^{-17}	6.8×10^{-18}	5.5×10^{-18}
Pesticides	Chlordane	3.9×10^{-17}	4.4×10^{-16}	1.2×10^{-16}	2.7×10^{-17}	2.1×10^{-17}
Pesticides	Delta-Bhc	NA	NA	NA	NA	NA
Pesticides	Dieldrin	2.6×10^{-16}	2.8×10^{-15}	9.8×10^{-16}	5.9×10^{-16}	4.8×10^{-16}
Polychlorinated Biphenyls	Aroclor 1248	9.1×10^{-16}	9.8×10^{-15}	4.4×10^{-15}	3.4×10^{-15}	2.8×10^{-15}
Polychlorinated Biphenyls	Aroclor 1254	1.2×10^{-15}	1.1×10^{-14}	5.0×10^{-15}	3.6×10^{-15}	2.1×10^{-15}
Polychlorinated Biphenyls	Aroclor 1260	2.2×10^{-14}	2.5×10^{-13}	1.2×10^{-13}	1.0×10^{-13}	8.7×10^{-14}
Polychlorinated Biphenyls	Aroclor 5460	NA	NA	NA	NA	NA
Semivolatile Organics	1-Methylnaphthalene	NA	NA	NA	NA	NA
Semivolatile Organics	2-Methylnaphthalene	NA	NA	NA	NA	NA
Semivolatile Organics	Acenaphthene	NA	NA	NA	NA	NA
Semivolatile Organics	Anthracene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(a)anthracene	5.3×10^{-16}	6.0×10^{-15}	2.8×10^{-15}	2.2×10^{-15}	1.7×10^{-15}
Semivolatile Organics	Benzo(a)pyrene	7.6×10^{-15}	8.7×10^{-14}	4.1×10^{-14}	3.3×10^{-14}	2.6×10^{-14}
Semivolatile Organics	Benzo(b)fluoranthene	8.7×10^{-16}	1.0×10^{-14}	4.7×10^{-15}	3.7×10^{-15}	2.9×10^{-15}
Semivolatile Organics	Benzo(g,h,i)perylene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(k)fluoranthene	4.0×10^{-17}	4.6×10^{-16}	2.1×10^{-16}	1.7×10^{-16}	1.4×10^{-16}
Semivolatile Organics	Bis(2-ethylhexyl)phthalate	2.9×10^{-17}	3.3×10^{-16}	1.3×10^{-16}	1.0×10^{-16}	5.8×10^{-17}
Semivolatile Organics	Chrysene	7.7×10^{-18}	8.7×10^{-17}	4.0×10^{-17}	3.2×10^{-17}	2.5×10^{-17}
Semivolatile Organics	Dibenzo(a,h)anthracene	8.6×10^{-16}	1.0×10^{-14}	4.2×10^{-15}	3.6×10^{-15}	2.2×10^{-15}
Semivolatile Organics	Di-n-octylphthalate	NA	NA	NA	NA	NA
Semivolatile Organics	Fluoranthene	NA	NA	NA	NA	NA
Semivolatile Organics	Fluorene	NA	NA	NA	NA	NA
Semivolatile Organics	Indeno(1,2,3-cd)pyrene	1.2×10^{-15}	1.4×10^{-14}	6.5×10^{-15}	5.4×10^{-15}	4.5×10^{-15}
Semivolatile Organics	Naphthalene	2.2×10^{-17}	2.3×10^{-16}	1.0×10^{-16}	8.4×10^{-17}	2.2×10^{-17}
Semivolatile Organics	N-Nitrosodimethylamine	5.1×10^{-16}	3.3×10^{-15}	9.7×10^{-16}	3.7×10^{-16}	3.1×10^{-16}
Semivolatile Organics	Phenanthrene	NA	NA	NA	NA	NA
Semivolatile Organics	Pyrene	NA	NA	NA	NA	NA

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Semivolatile Organics	Total TEQ_BAP	NA	NA	NA	NA	NA
Volatile Organics	Formaldehyde	8.6×10^{-16}	8.0×10^{-15}	1.8×10^{-15}	6.5×10^{-16}	2.4×10^{-16}
Total		**6.3×10^{-12}**	**5.9×10^{-11}**	**1.6×10^{-11}**	**6.5×10^{-12}**	**5.1×10^{-12}**

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– Exposure pathways include inhalation of air and external exposure due to submersion.
– Suburban resident located 1,800 meters to the northwest of emissions source.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).
– Air concentrations for cancer risk evaluation based on a 26-year emission period.

Table G–49 Offsite Impacts – Suburban Resident – Chemicals – Remedial Actions – Cancer Incidence Risk – Direct Soil

Type	*Constituent*	*Alternatives*				
		No Action	***AOC LUT***	***Revised LUT***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Anions	Fluoride	NA	NA	NA	NA	NA
Anions	Perchlorate	NA	NA	NA	NA	NA
Dioxins/Furans	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	2.7×10^{-15}	2.6×10^{-14}	1.1×10^{-14}	8.4×10^{-15}	6.9×10^{-15}
Dioxins/Furans	1,2,3,4,6,7,8-HPCDF	3.7×10^{-16}	3.6×10^{-15}	1.5×10^{-15}	1.1×10^{-15}	9.5×10^{-16}
Dioxins/Furans	1,2,3,4,7,8,9-HPCDF	4.3×10^{-17}	4.1×10^{-16}	1.7×10^{-16}	1.2×10^{-16}	1.0×10^{-16}
Dioxins/Furans	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	1.1×10^{-15}	1.1×10^{-14}	5.1×10^{-15}	4.1×10^{-15}	3.4×10^{-15}
Dioxins/Furans	1,2,3,4,7,8-HXCDF	2.9×10^{-16}	2.7×10^{-15}	1.1×10^{-15}	7.0×10^{-16}	5.2×10^{-16}
Dioxins/Furans	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	1.1×10^{-15}	1.0×10^{-14}	4.4×10^{-15}	3.3×10^{-15}	2.7×10^{-15}
Dioxins/Furans	1,2,3,6,7,8-HXCDF	2.2×10^{-16}	2.0×10^{-15}	8.0×10^{-16}	5.4×10^{-16}	3.9×10^{-16}
Dioxins/Furans	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	5.4×10^{-16}	5.0×10^{-15}	2.1×10^{-15}	1.5×10^{-15}	1.2×10^{-15}
Dioxins/Furans	1,2,3,7,8,9-HXCDF	9.0×10^{-17}	8.2×10^{-16}	2.8×10^{-16}	1.7×10^{-16}	1.1×10^{-16}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzofuran	4.8×10^{-17}	3.8×10^{-16}	1.4×10^{-16}	7.3×10^{-17}	5.0×10^{-17}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	2.0×10^{-15}	1.9×10^{-14}	8.1×10^{-15}	5.8×10^{-15}	4.8×10^{-15}
Dioxins/Furans	2,3,4,6,7,8-HXCDF	2.8×10^{-16}	2.7×10^{-15}	1.1×10^{-15}	7.9×10^{-16}	5.6×10^{-16}
Dioxins/Furans	2,3,4,7,8-PECDF	6.2×10^{-16}	5.6×10^{-15}	2.1×10^{-15}	1.4×10^{-15}	1.0×10^{-15}
Dioxins/Furans	2,3,7,8-TCDD	3.9×10^{-16}	3.6×10^{-15}	1.4×10^{-15}	1.0×10^{-15}	8.3×10^{-16}
Dioxins/Furans	2,3,7,8-Tetrachlorodibenzofuran	8.9×10^{-17}	7.3×10^{-16}	2.9×10^{-16}	1.5×10^{-16}	1.0×10^{-16}
Dioxins/Furans	OCDD	9.5×10^{-16}	9.0×10^{-15}	3.9×10^{-15}	2.9×10^{-15}	2.4×10^{-15}
Dioxins/Furans	OCDF	2.9×10^{-17}	2.8×10^{-16}	1.2×10^{-16}	9.1×10^{-17}	7.6×10^{-17}
Dioxins/Furans	Total TEQ_Dioxin	NA	NA	NA	NA	NA
Herbicides	2,4-DB	NA	NA	NA	NA	NA
Herbicides	MCPA	NA	NA	NA	NA	NA
Herbicides	MCPP	NA	NA	NA	NA	NA
Metals	Antimony	NA	NA	NA	NA	NA
Metals	Barium	NA	NA	NA	NA	NA
Metals	Cadmium	3.7×10^{-21}	3.6×10^{-20}	1.6×10^{-20}	1.3×10^{-20}	1.1×10^{-20}
Metals	Chromium (Hexavalent Compounds)	1.0×10^{-14}	8.1×10^{-14}	2.2×10^{-14}	7.9×10^{-15}	6.1×10^{-15}
Metals	Lead	5.9×10^{-15}	5.7×10^{-14}	2.6×10^{-14}	2.1×10^{-14}	1.7×10^{-14}
Metals	Mercury	NA	NA	NA	NA	NA
Metals	Molybdenum	NA	NA	NA	NA	NA
Metals	Selenium	NA	NA	NA	NA	NA

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Metals	Silver	NA	NA	NA	NA	NA
Metals	Zinc	NA	NA	NA	NA	NA
Other Inorganics	Methyl Mercury	NA	NA	NA	NA	NA
Pesticides	4,4'-DDD	3.3×10^{-18}	3.4×10^{-17}	5.6×10^{-18}	2.7×10^{-18}	2.2×10^{-18}
Pesticides	4,4'-DDE	3.1×10^{-17}	3.3×10^{-16}	1.2×10^{-16}	7.4×10^{-17}	6.1×10^{-17}
Pesticides	4,4'-DDT	2.7×10^{-17}	2.5×10^{-16}	9.1×10^{-17}	5.4×10^{-17}	4.4×10^{-17}
Pesticides	Beta-Bhc	5.5×10^{-18}	5.1×10^{-17}	1.1×10^{-17}	4.4×10^{-18}	3.6×10^{-18}
Pesticides	Chlordane	2.8×10^{-17}	2.7×10^{-16}	7.1×10^{-17}	1.7×10^{-17}	1.3×10^{-17}
Pesticides	Delta-Bhc	NA	NA	NA	NA	NA
Pesticides	Dieldrin	2.0×10^{-16}	1.9×10^{-15}	6.5×10^{-16}	3.9×10^{-16}	3.2×10^{-16}
Polychlorinated Biphenyls	Aroclor 1248	8.4×10^{-16}	7.9×10^{-15}	3.6×10^{-15}	2.8×10^{-15}	2.2×10^{-15}
Polychlorinated Biphenyls	Aroclor 1254	1.1×10^{-15}	9.0×10^{-15}	3.9×10^{-15}	2.8×10^{-15}	1.7×10^{-15}
Polychlorinated Biphenyls	Aroclor 1260	1.9×10^{-14}	1.9×10^{-13}	9.1×10^{-14}	7.8×10^{-14}	6.7×10^{-14}
Polychlorinated Biphenyls	Aroclor 5460	NA	NA	NA	NA	NA
Semivolatile Organics	1-Methylnaphthalene	1.2×10^{-17}	1.2×10^{-16}	5.8×10^{-17}	4.9×10^{-17}	2.0×10^{-18}
Semivolatile Organics	2-Methylnaphthalene	NA	NA	NA	NA	NA
Semivolatile Organics	Acenaphthene	NA	NA	NA	NA	NA
Semivolatile Organics	Anthracene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(a)anthracene	3.4×10^{-16}	3.3×10^{-15}	1.5×10^{-15}	1.2×10^{-15}	9.5×10^{-16}
Semivolatile Organics	Benzo(a)pyrene	4.8×10^{-15}	4.7×10^{-14}	2.2×10^{-14}	1.8×10^{-14}	1.4×10^{-14}
Semivolatile Organics	Benzo(b)fluoranthene	5.5×10^{-16}	5.5×10^{-15}	2.5×10^{-15}	2.0×10^{-15}	1.6×10^{-15}
Semivolatile Organics	Benzo(g,h,i)perylene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(k)fluoranthene	2.5×10^{-17}	2.5×10^{-16}	1.2×10^{-16}	9.4×10^{-17}	7.5×10^{-17}
Semivolatile Organics	Bis(2-ethylhexyl)phthalate	3.7×10^{-17}	3.6×10^{-16}	1.5×10^{-16}	1.1×10^{-16}	6.4×10^{-17}
Semivolatile Organics	Chrysene	4.9×10^{-18}	4.7×10^{-17}	2.2×10^{-17}	1.7×10^{-17}	1.4×10^{-17}
Semivolatile Organics	Dibenzo(a,h)anthracene	5.4×10^{-16}	5.6×10^{-15}	2.3×10^{-15}	2.0×10^{-15}	1.2×10^{-15}
Semivolatile Organics	Di-n-octylphthalate	NA	NA	NA	NA	NA
Semivolatile Organics	Fluoranthene	NA	NA	NA	NA	NA
Semivolatile Organics	Fluorene	NA	NA	NA	NA	NA
Semivolatile Organics	Indeno(1,2,3-cd)pyrene	7.5×10^{-16}	7.6×10^{-15}	3.5×10^{-15}	2.9×10^{-15}	2.4×10^{-15}
Semivolatile Organics	Naphthalene	2.6×10^{-17}	2.4×10^{-16}	1.1×10^{-16}	8.9×10^{-17}	2.3×10^{-17}
Semivolatile Organics	N-Nitrosodimethylamine	8.8×10^{-16}	4.9×10^{-15}	1.4×10^{-15}	5.5×10^{-16}	4.6×10^{-16}
Semivolatile Organics	Phenanthrene	NA	NA	NA	NA	NA

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Semivolatile Organics	Pyrene	NA	NA	NA	NA	NA
Semivolatile Organics	Total TEQ_BAP	NA	NA	NA	NA	NA
Volatile Organics	Formaldehyde	6.2×10^{-16}	5.0×10^{-15}	1.2×10^{-15}	4.1×10^{-16}	1.5×10^{-16}
Total		**5.7×10^{-14}**	**5.4×10^{-13}**	**2.3×10^{-13}**	**1.7×10^{-13}**	**1.4×10^{-13}**

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– Exposure pathways include ingestion of soil, inhalation of air, and dermal contact with soil.
– Suburban resident located 1,800 meters to the northwest of emissions source.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).

Table G–50 Offsite Impacts – Suburban Resident – Chemicals – Remedial Actions – Cancer Incidence Risk – Produce

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Anions	Fluoride	NA	NA	NA	NA	NA
Anions	Perchlorate	NA	NA	NA	NA	NA
Dioxins/Furans	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	7.6×10^{-14}	7.3×10^{-13}	3.2×10^{-13}	2.4×10^{-13}	1.9×10^{-13}
Dioxins/Furans	1,2,3,4,6,7,8-HPCDF	1.1×10^{-14}	1.0×10^{-13}	4.4×10^{-14}	3.3×10^{-14}	2.7×10^{-14}
Dioxins/Furans	1,2,3,4,7,8,9-HPCDF	1.2×10^{-15}	1.2×10^{-14}	4.9×10^{-15}	3.5×10^{-15}	2.9×10^{-15}
Dioxins/Furans	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	3.3×10^{-14}	3.3×10^{-13}	1.5×10^{-13}	1.2×10^{-13}	1.0×10^{-13}
Dioxins/Furans	1,2,3,4,7,8-HXCDF	8.2×10^{-15}	7.5×10^{-14}	3.0×10^{-14}	2.0×10^{-14}	1.5×10^{-14}
Dioxins/Furans	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	3.1×10^{-14}	3.0×10^{-13}	1.3×10^{-13}	9.5×10^{-14}	7.9×10^{-14}
Dioxins/Furans	1,2,3,6,7,8-HXCDF	6.2×10^{-15}	5.6×10^{-14}	2.3×10^{-14}	1.5×10^{-14}	1.1×10^{-14}
Dioxins/Furans	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	1.6×10^{-14}	1.5×10^{-13}	6.1×10^{-14}	4.4×10^{-14}	3.6×10^{-14}
Dioxins/Furans	1,2,3,7,8,9-HXCDF	2.6×10^{-15}	2.4×10^{-14}	8.2×10^{-15}	4.9×10^{-15}	3.4×10^{-15}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzofuran	1.5×10^{-15}	1.2×10^{-14}	4.2×10^{-15}	2.2×10^{-15}	1.5×10^{-15}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	6.3×10^{-14}	6.0×10^{-13}	2.5×10^{-13}	1.8×10^{-13}	1.5×10^{-13}
Dioxins/Furans	2,3,4,6,7,8-HXCDF	8.3×10^{-15}	7.9×10^{-14}	3.2×10^{-14}	2.3×10^{-14}	1.6×10^{-14}
Dioxins/Furans	2,3,4,7,8-PECDF	1.9×10^{-14}	1.7×10^{-13}	6.5×10^{-14}	4.2×10^{-14}	3.1×10^{-14}
Dioxins/Furans	2,3,7,8-TCDD	1.1×10^{-14}	1.1×10^{-13}	4.2×10^{-14}	3.0×10^{-14}	2.4×10^{-14}
Dioxins/Furans	2,3,7,8-Tetrachlorodibenzofuran	2.7×10^{-15}	2.2×10^{-14}	8.8×10^{-15}	4.7×10^{-15}	3.1×10^{-15}
Dioxins/Furans	OCDD	2.7×10^{-14}	2.6×10^{-13}	1.1×10^{-13}	8.3×10^{-14}	6.9×10^{-14}
Dioxins/Furans	OCDF	8.4×10^{-16}	8.1×10^{-15}	3.5×10^{-15}	2.6×10^{-15}	2.2×10^{-15}
Dioxins/Furans	Total TEQ_Dioxin	NA	NA	NA	NA	NA
Herbicides	2,4-DB	NA	NA	NA	NA	NA
Herbicides	MCPA	NA	NA	NA	NA	NA
Herbicides	MCPP	NA	NA	NA	NA	NA
Metals	Antimony	NA	NA	NA	NA	NA
Metals	Barium	NA	NA	NA	NA	NA
Metals	Cadmium	NA	NA	NA	NA	NA
Metals	Chromium (Hexavalent Compounds)	7.9×10^{-14}	6.3×10^{-13}	1.7×10^{-13}	6.2×10^{-14}	4.7×10^{-14}
Metals	Lead	3.4×10^{-13}	3.3×10^{-12}	1.5×10^{-12}	1.2×10^{-12}	9.9×10^{-13}
Metals	Mercury	NA	NA	NA	NA	NA
Metals	Molybdenum	NA	NA	NA	NA	NA
Metals	Selenium	NA	NA	NA	NA	NA
Metals	Silver	NA	NA	NA	NA	NA

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Metals	Zinc	NA	NA	NA	NA	NA
Other Inorganics	Methyl Mercury	NA	NA	NA	NA	NA
Pesticides	4,4'-DDD	9.5×10^{-17}	9.8×10^{-16}	1.6×10^{-16}	7.8×10^{-17}	6.3×10^{-17}
Pesticides	4,4'-DDE	1.0×10^{-15}	1.1×10^{-14}	4.0×10^{-15}	2.4×10^{-15}	2.0×10^{-15}
Pesticides	4,4'-DDT	8.3×10^{-16}	7.5×10^{-15}	2.8×10^{-15}	1.6×10^{-15}	1.3×10^{-15}
Pesticides	Beta-Bhc	6.2×10^{-16}	5.8×10^{-15}	1.3×10^{-15}	5.0×10^{-16}	4.1×10^{-16}
Pesticides	Chlordane	8.5×10^{-16}	8.2×10^{-15}	2.2×10^{-15}	5.1×10^{-16}	4.0×10^{-16}
Pesticides	Delta-Bhc	NA	NA	NA	NA	NA
Pesticides	Dieldrin	6.7×10^{-15}	6.4×10^{-14}	2.2×10^{-14}	1.4×10^{-14}	1.1×10^{-14}
Polychlorinated Biphenyls	Aroclor 1248	2.0×10^{-14}	1.8×10^{-13}	8.3×10^{-14}	6.4×10^{-14}	5.1×10^{-14}
Polychlorinated Biphenyls	Aroclor 1254	2.4×10^{-14}	2.0×10^{-13}	8.8×10^{-14}	6.3×10^{-14}	3.8×10^{-14}
Polychlorinated Biphenyls	Aroclor 1260	4.2×10^{-13}	4.2×10^{-12}	2.0×10^{-12}	1.7×10^{-12}	1.4×10^{-12}
Polychlorinated Biphenyls	Aroclor 5460	NA	NA	NA	NA	NA
Semivolatile Organics	1-Methylnaphthalene	1.2×10^{-15}	1.2×10^{-14}	5.6×10^{-15}	4.8×10^{-15}	2.0×10^{-16}
Semivolatile Organics	2-Methylnaphthalene	NA	NA	NA	NA	NA
Semivolatile Organics	Acenaphthene	NA	NA	NA	NA	NA
Semivolatile Organics	Anthracene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(a)anthracene	2.2×10^{-15}	2.1×10^{-14}	9.8×10^{-15}	7.8×10^{-15}	6.0×10^{-15}
Semivolatile Organics	Benzo(a)pyrene	2.8×10^{-14}	2.8×10^{-13}	1.3×10^{-13}	1.1×10^{-13}	8.6×10^{-14}
Semivolatile Organics	Benzo(b)fluoranthene	3.5×10^{-15}	3.5×10^{-14}	1.6×10^{-14}	1.3×10^{-14}	1.0×10^{-14}
Semivolatile Organics	Benzo(g,h,i)perylene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(k)fluoranthene	1.5×10^{-16}	1.5×10^{-15}	7.0×10^{-16}	5.6×10^{-16}	4.5×10^{-16}
Semivolatile Organics	Bis(2-ethylhexyl)phthalate	9.1×10^{-16}	9.0×10^{-15}	3.7×10^{-15}	2.8×10^{-15}	1.6×10^{-15}
Semivolatile Organics	Chrysene	3.1×10^{-17}	3.0×10^{-16}	1.4×10^{-16}	1.1×10^{-16}	8.7×10^{-17}
Semivolatile Organics	Dibenzo(a,h)anthracene	3.0×10^{-15}	3.1×10^{-14}	1.3×10^{-14}	1.1×10^{-14}	6.5×10^{-15}
Semivolatile Organics	Di-n-octylphthalate	NA	NA	NA	NA	NA
Semivolatile Organics	Fluoranthene	NA	NA	NA	NA	NA
Semivolatile Organics	Fluorene	NA	NA	NA	NA	NA
Semivolatile Organics	Indeno(1,2,3-cd)pyrene	4.1×10^{-15}	4.2×10^{-14}	1.9×10^{-14}	1.6×10^{-14}	1.3×10^{-14}
Semivolatile Organics	Naphthalene	NA	NA	NA	NA	NA
Semivolatile Organics	N-Nitrosodimethylamine	4.4×10^{-12}	2.5×10^{-11}	7.2×10^{-12}	2.8×10^{-12}	2.3×10^{-12}
Semivolatile Organics	Phenanthrene	NA	NA	NA	NA	NA
Semivolatile Organics	Pyrene	NA	NA	NA	NA	NA

Type	*Constituent*	*Alternatives*				
		No Action	***AOC LUT***	***Revised LUT***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Semivolatile Organics	Total TEQ_BAP	NA	NA	NA	NA	NA
Volatile Organics	Formaldehyde	NA	NA	NA	NA	NA
Total		**5.7×10^{-12}**	**3.7×10^{-11}**	**1.3×10^{-11}**	**7.0×10^{-12}**	**5.8×10^{-12}**

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– Exposure pathways include ingestion of produce.
– Suburban resident located 1,800 meters to the northwest of emissions source.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).
– Air concentrations for cancer risk evaluation based on a 26-year emission period.

Table G–51 Offsite Impacts – Suburban Resident – Chemicals – Remedial Actions – Cancer Incidence Risk – Total

		Alternatives				
Type	**Constituent**	**No Action**	**AOC LUT**	**Revised LUT**	**CONR Residential Scenario**	**CONR Open Space Scenario**
Anions	Fluoride	NA	NA	NA	NA	NA
Anions	Perchlorate	NA	NA	NA	NA	NA
Dioxins/Furans	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	8.3×10^{-14}	8.1×10^{-13}	3.5×10^{-13}	2.6×10^{-13}	2.1×10^{-13}
Dioxins/Furans	1,2,3,4,6,7,8-HPCDF	1.2×10^{-14}	1.1×10^{-13}	4.9×10^{-14}	3.6×10^{-14}	3.0×10^{-14}
Dioxins/Furans	1,2,3,4,7,8,9-HPCDF	1.3×10^{-15}	1.3×10^{-14}	5.3×10^{-15}	3.8×10^{-15}	3.1×10^{-15}
Dioxins/Furans	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	3.6×10^{-14}	3.7×10^{-13}	1.6×10^{-13}	1.3×10^{-13}	1.1×10^{-13}
Dioxins/Furans	1,2,3,4,7,8-HXCDF	8.9×10^{-15}	8.2×10^{-14}	3.3×10^{-14}	2.2×10^{-14}	1.6×10^{-14}
Dioxins/Furans	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	3.4×10^{-14}	3.3×10^{-13}	1.4×10^{-13}	1.0×10^{-13}	8.6×10^{-14}
Dioxins/Furans	1,2,3,6,7,8-HXCDF	6.7×10^{-15}	6.2×10^{-14}	2.5×10^{-14}	1.7×10^{-14}	1.2×10^{-14}
Dioxins/Furans	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	1.7×10^{-14}	1.6×10^{-13}	6.7×10^{-14}	4.8×10^{-14}	3.9×10^{-14}
Dioxins/Furans	1,2,3,7,8,9-HXCDF	2.9×10^{-15}	2.6×10^{-14}	8.9×10^{-15}	5.4×10^{-15}	3.7×10^{-15}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzofuran	1.6×10^{-15}	1.3×10^{-14}	4.6×10^{-15}	2.4×10^{-15}	1.7×10^{-15}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	6.9×10^{-14}	6.6×10^{-13}	2.7×10^{-13}	2.0×10^{-13}	1.6×10^{-13}
Dioxins/Furans	2,3,4,6,7,8-HXCDF	9.0×10^{-15}	8.6×10^{-14}	3.5×10^{-14}	2.5×10^{-14}	1.8×10^{-14}
Dioxins/Furans	2,3,4,7,8-PECDF	2.0×10^{-14}	1.9×10^{-13}	7.1×10^{-14}	4.6×10^{-14}	3.3×10^{-14}
Dioxins/Furans	2,3,7,8-TCDD	1.2×10^{-14}	1.2×10^{-13}	4.6×10^{-14}	3.2×10^{-14}	2.7×10^{-14}
Dioxins/Furans	2,3,7,8-Tetrachlorodibenzofuran	2.9×10^{-15}	2.4×10^{-14}	9.6×10^{-15}	5.1×10^{-15}	3.3×10^{-15}
Dioxins/Furans	OCDD	3.0×10^{-14}	2.9×10^{-13}	1.3×10^{-13}	9.1×10^{-14}	7.5×10^{-14}
Dioxins/Furans	OCDF	9.2×10^{-16}	8.9×10^{-15}	3.9×10^{-15}	2.9×10^{-15}	2.4×10^{-15}
Dioxins/Furans	Total TEQ_Dioxin	NA	NA	NA	NA	NA
Herbicides	2,4-DB	NA	NA	NA	NA	NA
Herbicides	MCPA	NA	NA	NA	NA	NA
Herbicides	MCPP	NA	NA	NA	NA	NA
Metals	Antimony	NA	NA	NA	NA	NA
Metals	Barium	NA	NA	NA	NA	NA
Metals	Cadmium	1.6×10^{-13}	1.8×10^{-12}	8.0×10^{-13}	6.5×10^{-13}	5.5×10^{-13}
Metals	Chromium (Hexavalent Compounds)	6.1×10^{-12}	5.6×10^{-11}	1.5×10^{-11}	5.5×10^{-12}	4.2×10^{-12}
Metals	Lead	3.9×10^{-13}	3.9×10^{-12}	1.7×10^{-12}	1.4×10^{-12}	1.2×10^{-12}
Metals	Mercury	NA	NA	NA	NA	NA
Metals	Molybdenum	NA	NA	NA	NA	NA
Metals	Selenium	NA	NA	NA	NA	NA
Metals	Silver	NA	NA	NA	NA	NA

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Metals	Zinc	NA	NA	NA	NA	NA
Other Inorganics	Methyl Mercury	NA	NA	NA	NA	NA
Pesticides	4,4'-DDD	1.0×10^{-16}	1.1×10^{-15}	1.7×10^{-16}	8.5×10^{-17}	6.9×10^{-17}
Pesticides	4,4'-DDE	1.1×10^{-15}	1.2×10^{-14}	4.4×10^{-15}	2.6×10^{-15}	2.2×10^{-15}
Pesticides	4,4'-DDT	9.0×10^{-16}	8.2×10^{-15}	3.0×10^{-15}	1.8×10^{-15}	1.5×10^{-15}
Pesticides	Beta-Bhc	6.3×10^{-16}	5.9×10^{-15}	1.3×10^{-15}	5.1×10^{-16}	4.2×10^{-16}
Pesticides	Chlordane	9.2×10^{-16}	8.9×10^{-15}	2.3×10^{-15}	5.5×10^{-16}	4.3×10^{-16}
Pesticides	Delta-Bhc	NA	NA	NA	NA	NA
Pesticides	Dieldrin	7.2×10^{-15}	6.9×10^{-14}	2.4×10^{-14}	1.5×10^{-14}	1.2×10^{-14}
Polychlorinated Biphenyls	Aroclor 1248	2.1×10^{-14}	2.0×10^{-13}	9.1×10^{-14}	7.0×10^{-14}	5.6×10^{-14}
Polychlorinated Biphenyls	Aroclor 1254	2.7×10^{-14}	2.2×10^{-13}	9.7×10^{-14}	6.9×10^{-14}	4.1×10^{-14}
Polychlorinated Biphenyls	Aroclor 1260	4.6×10^{-13}	4.7×10^{-12}	2.2×10^{-12}	1.9×10^{-12}	1.6×10^{-12}
Polychlorinated Biphenyls	Aroclor 5460	NA	NA	NA	NA	NA
Semivolatile Organics	1-Methylnaphthalene	1.2×10^{-15}	1.2×10^{-14}	5.7×10^{-15}	4.8×10^{-15}	2.0×10^{-16}
Semivolatile Organics	2-Methylnaphthalene	NA	NA	NA	NA	NA
Semivolatile Organics	Acenaphthene	NA	NA	NA	NA	NA
Semivolatile Organics	Anthracene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(a)anthracene	3.0×10^{-15}	3.1×10^{-14}	1.4×10^{-14}	1.1×10^{-14}	8.7×10^{-15}
Semivolatile Organics	Benzo(a)pyrene	4.1×10^{-14}	4.2×10^{-13}	1.9×10^{-13}	1.6×10^{-13}	1.3×10^{-13}
Semivolatile Organics	Benzo(b)fluoranthene	4.9×10^{-15}	5.1×10^{-14}	2.4×10^{-14}	1.9×10^{-14}	1.4×10^{-14}
Semivolatile Organics	Benzo(g,h,i)perylene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(k)fluoranthene	2.2×10^{-16}	2.2×10^{-15}	1.0×10^{-15}	8.3×10^{-16}	6.6×10^{-16}
Semivolatile Organics	Bis(2-ethylhexyl)phthalate	9.8×10^{-16}	9.7×10^{-15}	4.0×10^{-15}	3.1×10^{-15}	1.7×10^{-15}
Semivolatile Organics	Chrysene	4.4×10^{-17}	4.4×10^{-16}	2.0×10^{-16}	1.6×10^{-16}	1.3×10^{-16}
Semivolatile Organics	Dibenzo(a,h)anthracene	4.4×10^{-15}	4.7×10^{-14}	1.9×10^{-14}	1.6×10^{-14}	9.8×10^{-15}
Semivolatile Organics	Di-n-octylphthalate	NA	NA	NA	NA	NA
Semivolatile Organics	Fluoranthene	NA	NA	NA	NA	NA
Semivolatile Organics	Fluorene	NA	NA	NA	NA	NA
Semivolatile Organics	Indeno(1,2,3-cd)pyrene	6.1×10^{-15}	6.3×10^{-14}	2.9×10^{-14}	2.5×10^{-14}	2.0×10^{-14}
Semivolatile Organics	Naphthalene	4.8×10^{-17}	4.7×10^{-16}	2.1×10^{-16}	1.7×10^{-16}	4.5×10^{-17}
Semivolatile Organics	N-Nitrosodimethylamine	4.4×10^{-12}	2.5×10^{-11}	7.2×10^{-12}	2.8×10^{-12}	2.3×10^{-12}
Semivolatile Organics	Phenanthrene	NA	NA	NA	NA	NA
Semivolatile Organics	Pyrene	NA	NA	NA	NA	NA

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Semivolatile Organics	Total TEQ_BAP	NA	NA	NA	NA	NA
Volatile Organics	Formaldehyde	1.5×10^{-15}	1.3×10^{-14}	3.0×10^{-15}	1.1×10^{-15}	4.0×10^{-16}
Total		**1.2×10^{-11}**	**9.6×10^{-11}**	**2.9×10^{-11}**	**1.4×10^{-11}**	**1.1×10^{-11}**

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– Exposure pathways include direct air (inhalation/submersion), direct soil (ingestion, inhalation, external exposure), and produce ingestion.

– Suburban resident located 1,800 meters to the northwest of emissions source.

– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).

Table G–52 Offsite Impacts – Suburban Resident – Chemicals – Remedial Actions – Noncarcinogenic Hazards – Direct Air

Type	*Constituent*	*Alternatives*				
		No Action	***AOC LUT***	***Revised LUT***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Anions	Fluoride	2.8×10^{-11}	2.9×10^{-10}	2.7×10^{-10}	2.2×10^{-10}	3.4×10^{-10}
Anions	Perchlorate	NA	NA	NA	NA	NA
Dioxins/Furans	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	7.3×10^{-12}	8.1×10^{-11}	1.5×10^{-10}	3.4×10^{-10}	5.6×10^{-10}
Dioxins/Furans	1,2,3,4,6,7,8-HPCDF	1.0×10^{-12}	1.1×10^{-11}	2.1×10^{-11}	4.7×10^{-11}	7.8×10^{-11}
Dioxins/Furans	1,2,3,4,7,8,9-HPCDF	1.2×10^{-13}	1.3×10^{-12}	2.3×10^{-12}	5.0×10^{-12}	8.2×10^{-12}
Dioxins/Furans	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	3.2×10^{-12}	3.7×10^{-11}	7.1×10^{-11}	1.7×10^{-10}	2.9×10^{-10}
Dioxins/Furans	1,2,3,4,7,8-HXCDF	7.8×10^{-13}	8.3×10^{-12}	1.4×10^{-11}	2.8×10^{-11}	4.2×10^{-11}
Dioxins/Furans	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	3.0×10^{-12}	3.3×10^{-11}	6.2×10^{-11}	1.4×10^{-10}	2.3×10^{-10}
Dioxins/Furans	1,2,3,6,7,8-HXCDF	5.9×10^{-13}	6.2×10^{-12}	1.1×10^{-11}	2.2×10^{-11}	3.2×10^{-11}
Dioxins/Furans	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	1.5×10^{-12}	1.6×10^{-11}	2.9×10^{-11}	6.3×10^{-11}	1.0×10^{-10}
Dioxins/Furans	1,2,3,7,8,9-HXCDF	2.5×10^{-13}	2.6×10^{-12}	3.9×10^{-12}	7.0×10^{-12}	9.5×10^{-12}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzofuran	1.3×10^{-13}	1.2×10^{-12}	1.9×10^{-12}	3.1×10^{-12}	4.2×10^{-12}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	5.7×10^{-12}	6.2×10^{-11}	1.1×10^{-10}	2.4×10^{-10}	4.0×10^{-10}
Dioxins/Furans	2,3,4,6,7,8-HXCDF	7.9×10^{-13}	8.6×10^{-12}	1.5×10^{-11}	3.3×10^{-11}	4.7×10^{-11}
Dioxins/Furans	2,3,4,7,8-PECDF	1.7×10^{-12}	1.8×10^{-11}	3.0×10^{-11}	5.8×10^{-11}	8.4×10^{-11}
Dioxins/Furans	2,3,7,8-TCDD	1.0×10^{-12}	1.1×10^{-11}	1.9×10^{-11}	4.0×10^{-11}	6.6×10^{-11}
Dioxins/Furans	2,3,7,8-Tetrachlorodibenzofuran	2.4×10^{-13}	2.3×10^{-12}	3.9×10^{-12}	6.2×10^{-12}	8.1×10^{-12}
Dioxins/Furans	OCDD	2.6×10^{-12}	2.9×10^{-11}	5.5×10^{-11}	1.2×10^{-10}	2.0×10^{-10}
Dioxins/Furans	OCDF	8.1×10^{-14}	9.0×10^{-13}	1.7×10^{-12}	3.8×10^{-12}	6.3×10^{-12}
Dioxins/Furans	Total TEQ_Dioxin	NA	NA	NA	NA	NA
Herbicides	2,4-DB	NA	NA	NA	NA	NA
Herbicides	MCPA	NA	NA	NA	NA	NA
Herbicides	MCPP	NA	NA	NA	NA	NA
Metals	Antimony	1.1×10^{-9}	1.2×10^{-8}	2.4×10^{-8}	6.1×10^{-8}	1.0×10^{-7}
Metals	Barium	2.5×10^{-8}	2.3×10^{-7}	2.4×10^{-7}	2.6×10^{-7}	3.0×10^{-7}
Metals	Cadmium	2.4×10^{-8}	2.7×10^{-7}	5.2×10^{-7}	1.3×10^{-6}	2.1×10^{-6}
Metals	Chromium (Hexavalent Compounds)	7.0×10^{-10}	6.5×10^{-9}	7.6×10^{-9}	8.2×10^{-9}	1.3×10^{-8}
Metals	Lead	NA	NA	NA	NA	NA
Metals	Mercury	NA	NA	NA	NA	NA
Metals	Molybdenum	6.2×10^{-10}	6.6×10^{-9}	1.2×10^{-8}	2.5×10^{-8}	5.6×10^{-9}
Metals	Selenium	1.7×10^{-12}	1.5×10^{-11}	1.5×10^{-11}	1.2×10^{-11}	1.7×10^{-11}

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Metals	Silver	NA	NA	NA	NA	NA
Metals	Zinc	NA	NA	NA	NA	NA
Other Inorganics	Methyl Mercury	NA	NA	NA	NA	NA
Pesticides	4,4'-DDD	NA	NA	NA	NA	NA
Pesticides	4,4'-DDE	NA	NA	NA	NA	NA
Pesticides	4,4'-DDT	NA	NA	NA	NA	NA
Pesticides	Beta-Bhc	NA	NA	NA	NA	NA
Pesticides	Chlordane	1.5×10^{-12}	1.7×10^{-11}	1.9×10^{-11}	1.4×10^{-11}	2.1×10^{-11}
Pesticides	Delta-Bhc	NA	NA	NA	NA	NA
Pesticides	Dieldrin	NA	NA	NA	NA	NA
Polychlorinated Biphenyls	Aroclor 1248	NA	NA	NA	NA	NA
Polychlorinated Biphenyls	Aroclor 1254	NA	NA	NA	NA	NA
Polychlorinated Biphenyls	Aroclor 1260	NA	NA	NA	NA	NA
Polychlorinated Biphenyls	Aroclor 5460	NA	NA	NA	NA	NA
Semivolatile Organics	1-Methylnaphthalene	NA	NA	NA	NA	NA
Semivolatile Organics	2-Methylnaphthalene	NA	NA	NA	NA	NA
Semivolatile Organics	Acenaphthene	NA	NA	NA	NA	NA
Semivolatile Organics	Anthracene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(a)anthracene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(a)pyrene	6.1×10^{-9}	7.1×10^{-8}	1.4×10^{-7}	3.5×10^{-7}	5.6×10^{-7}
Semivolatile Organics	Benzo(b)fluoranthene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(g,h,i)perylene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(k)fluoranthene	NA	NA	NA	NA	NA
Semivolatile Organics	Bis(2-ethylhexyl)phthalate	NA	NA	NA	NA	NA
Semivolatile Organics	Chrysene	NA	NA	NA	NA	NA
Semivolatile Organics	Dibenzo(a,h)anthracene	NA	NA	NA	NA	NA
Semivolatile Organics	Di-n-octylphthalate	NA	NA	NA	NA	NA
Semivolatile Organics	Fluoranthene	NA	NA	NA	NA	NA
Semivolatile Organics	Fluorene	NA	NA	NA	NA	NA
Semivolatile Organics	Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA
Semivolatile Organics	Naphthalene	5.7×10^{-13}	6.1×10^{-12}	1.2×10^{-11}	2.9×10^{-11}	1.5×10^{-11}
Semivolatile Organics	N-Nitrosodimethylamine	8.9×10^{-13}	5.7×10^{-12}	7.3×10^{-12}	8.4×10^{-12}	1.4×10^{-11}
Semivolatile Organics	Phenanthrene	NA	NA	NA	NA	NA

Type	*Constituent*	*Alternatives*				
		No Action	***AOC LUT***	***Revised LUT***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Semivolatile Organics	Pyrene	NA	NA	NA	NA	NA
Semivolatile Organics	Total TEQ_BAP	NA	NA	NA	NA	NA
Volatile Organics	Formaldehyde	1.8×10^{-11}	1.7×10^{-10}	1.7×10^{-10}	1.8×10^{-10}	1.3×10^{-10}
Total		**5.8×10^{-8}**	**6.0×10^{-7}**	**9.5×10^{-7}**	**2.0×10^{-6}**	**3.1×10^{-6}**

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– Exposure pathways include inhalation of air and external exposure due to submersion.
– Suburban resident located 1,800 meters to the northwest of emissions source.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).
– Air concentrations for cancer risk evaluation based on a 26-year emission period.

Table G–53 Offsite Impacts – Suburban Resident – Chemicals – Remedial Actions – Noncarcinogenic Hazards – Direct Soil

Type	*Constituent*	*Alternatives*				
		No Action	***AOC LUT***	***Revised LUT***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Anions	Fluoride	5.1×10^{-12}	4.7×10^{-11}	1.0×10^{-11}	2.7×10^{-12}	2.1×10^{-12}
Anions	Perchlorate	4.1×10^{-13}	3.2×10^{-12}	7.5×10^{-13}	3.0×10^{-13}	2.2×10^{-13}
Dioxins/Furans	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	1.8×10^{-11}	1.7×10^{-10}	7.5×10^{-11}	5.5×10^{-11}	4.6×10^{-11}
Dioxins/Furans	1,2,3,4,6,7,8-HPCDF	3.5×10^{-11}	3.4×10^{-10}	1.5×10^{-10}	1.1×10^{-10}	9.0×10^{-11}
Dioxins/Furans	1,2,3,4,7,8,9-HPCDF	4.1×10^{-12}	3.9×10^{-11}	1.6×10^{-11}	1.2×10^{-11}	9.5×10^{-12}
Dioxins/Furans	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	1.1×10^{-10}	1.1×10^{-9}	4.9×10^{-10}	3.9×10^{-10}	3.3×10^{-10}
Dioxins/Furans	1,2,3,4,7,8-HXCDF	2.7×10^{-11}	2.5×10^{-10}	9.8×10^{-11}	6.5×10^{-11}	4.8×10^{-11}
Dioxins/Furans	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	1.0×10^{-10}	9.9×10^{-10}	4.3×10^{-10}	3.1×10^{-10}	2.6×10^{-10}
Dioxins/Furans	1,2,3,6,7,8-HXCDF	2.0×10^{-11}	1.9×10^{-10}	7.4×10^{-11}	5.0×10^{-11}	3.7×10^{-11}
Dioxins/Furans	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	5.2×10^{-11}	4.9×10^{-10}	2.0×10^{-10}	1.4×10^{-10}	1.2×10^{-10}
Dioxins/Furans	1,2,3,7,8,9-HXCDF	8.7×10^{-12}	7.9×10^{-11}	2.7×10^{-11}	1.6×10^{-11}	1.1×10^{-11}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzofuran	4.6×10^{-12}	3.7×10^{-11}	1.3×10^{-11}	7.0×10^{-12}	4.8×10^{-12}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	2.0×10^{-10}	1.9×10^{-9}	7.8×10^{-10}	5.6×10^{-10}	4.6×10^{-10}
Dioxins/Furans	2,3,4,6,7,8-HXCDF	2.7×10^{-11}	2.6×10^{-10}	1.1×10^{-10}	7.6×10^{-11}	5.4×10^{-11}
Dioxins/Furans	2,3,4,7,8-PECDF	6.0×10^{-11}	5.4×10^{-10}	2.1×10^{-10}	1.3×10^{-10}	9.7×10^{-11}
Dioxins/Furans	2,3,7,8-TCDD	3.6×10^{-11}	3.3×10^{-10}	1.3×10^{-10}	9.3×10^{-11}	7.7×10^{-11}
Dioxins/Furans	2,3,7,8-Tetrachlorodibenzofuran	8.3×10^{-12}	6.8×10^{-11}	2.7×10^{-11}	1.4×10^{-11}	9.4×10^{-12}
Dioxins/Furans	OCDD	9.1×10^{-11}	8.7×10^{-10}	3.8×10^{-10}	2.8×10^{-10}	2.3×10^{-10}
Dioxins/Furans	OCDF	2.8×10^{-12}	2.7×10^{-11}	1.2×10^{-11}	8.8×10^{-12}	7.3×10^{-12}
Dioxins/Furans	Total TEQ_Dioxin	NA	NA	NA	NA	NA
Herbicides	2,4-DB	1.3×10^{-14}	1.1×10^{-13}	2.9×10^{-14}	1.1×10^{-14}	7.9×10^{-15}
Herbicides	MCPA	9.7×10^{-11}	7.9×10^{-10}	2.1×10^{-10}	6.0×10^{-11}	4.6×10^{-11}
Herbicides	MCPP	3.4×10^{-11}	3.0×10^{-10}	8.4×10^{-11}	4.2×10^{-11}	3.5×10^{-11}
Metals	Antimony	4.7×10^{-10}	4.5×10^{-9}	2.1×10^{-9}	1.7×10^{-9}	1.5×10^{-9}
Metals	Barium	3.5×10^{-11}	2.9×10^{-10}	6.9×10^{-11}	2.5×10^{-11}	1.4×10^{-11}
Metals	Cadmium	1.5×10^{-10}	1.4×10^{-9}	6.5×10^{-10}	5.3×10^{-10}	4.4×10^{-10}
Metals	Chromium (Hexavalent Compounds)	1.3×10^{-11}	1.1×10^{-10}	2.9×10^{-11}	1.0×10^{-11}	7.9×10^{-12}
Metals	Lead	NA	NA	NA	NA	NA
Metals	Mercury	1.2×10^{-10}	1.1×10^{-9}	5.1×10^{-10}	3.7×10^{-10}	1.3×10^{-10}
Metals	Molybdenum	2.8×10^{-11}	2.6×10^{-10}	1.1×10^{-10}	7.7×10^{-11}	8.5×10^{-12}
Metals	Selenium	3.8×10^{-12}	2.9×10^{-11}	6.6×10^{-12}	1.8×10^{-12}	1.3×10^{-12}

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Metals	Silver	1.2×10^{-10}	1.2×10^{-9}	5.6×10^{-10}	4.6×10^{-10}	3.7×10^{-10}
Metals	Zinc	2.2×10^{-11}	1.9×10^{-10}	6.0×10^{-11}	2.9×10^{-11}	2.0×10^{-11}
Other Inorganics	Methyl Mercury	2.2×10^{-12}	1.7×10^{-11}	3.4×10^{-12}	1.0×10^{-12}	7.5×10^{-13}
Pesticides	4,4'-DDD	3.9×10^{-12}	4.1×10^{-11}	6.6×10^{-12}	3.2×10^{-12}	2.6×10^{-12}
Pesticides	4,4'-DDE	2.6×10^{-12}	2.8×10^{-11}	1.0×10^{-11}	6.1×10^{-12}	5.1×10^{-12}
Pesticides	4,4'-DDT	1.4×10^{-12}	1.3×10^{-11}	4.7×10^{-12}	2.8×10^{-12}	2.3×10^{-12}
Pesticides	Beta-Bhc	NA	NA	NA	NA	NA
Pesticides	Chlordane	1.4×10^{-12}	1.3×10^{-11}	3.5×10^{-12}	8.2×10^{-13}	6.4×10^{-13}
Pesticides	Delta-Bhc	NA	NA	NA	NA	NA
Pesticides	Dieldrin	2.1×10^{-12}	2.0×10^{-11}	6.9×10^{-12}	4.2×10^{-12}	3.4×10^{-12}
Polychlorinated Biphenyls	Aroclor 1248	NA	NA	NA	NA	NA
Polychlorinated Biphenyls	Aroclor 1254	2.1×10^{-10}	1.8×10^{-9}	7.7×10^{-10}	5.5×10^{-10}	3.3×10^{-10}
Polychlorinated Biphenyls	Aroclor 1260	NA	NA	NA	NA	NA
Polychlorinated Biphenyls	Aroclor 5460	5.8×10^{-12}	5.2×10^{-11}	2.3×10^{-11}	1.7×10^{-11}	1.4×10^{-11}
Semivolatile Organics	1-Methylnaphthalene	5.2×10^{-14}	5.2×10^{-13}	2.4×10^{-13}	2.1×10^{-13}	8.6×10^{-15}
Semivolatile Organics	2-Methylnaphthalene	1.1×10^{-12}	1.1×10^{-11}	5.3×10^{-12}	4.5×10^{-12}	1.7×10^{-13}
Semivolatile Organics	Acenaphthene	1.2×10^{-14}	1.1×10^{-13}	4.9×10^{-14}	4.2×10^{-14}	3.0×10^{-14}
Semivolatile Organics	Anthracene	7.2×10^{-15}	7.1×10^{-14}	3.0×10^{-14}	2.7×10^{-14}	1.9×10^{-14}
Semivolatile Organics	Benzo(a)anthracene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(a)pyrene	3.0×10^{-11}	3.0×10^{-10}	1.4×10^{-10}	1.1×10^{-10}	9.2×10^{-11}
Semivolatile Organics	Benzo(b)fluoranthene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(g,h,i)perylene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(k)fluoranthene	NA	NA	NA	NA	NA
Semivolatile Organics	Bis(2-ethylhexyl)phthalate	1.1×10^{-12}	1.1×10^{-11}	4.6×10^{-12}	3.5×10^{-12}	2.0×10^{-12}
Semivolatile Organics	Chrysene	NA	NA	NA	NA	NA
Semivolatile Organics	Dibenzo(a,h)anthracene	NA	NA	NA	NA	NA
Semivolatile Organics	Di-n-octylphthalate	3.3×10^{-13}	3.1×10^{-12}	1.2×10^{-12}	8.4×10^{-13}	7.6×10^{-13}
Semivolatile Organics	Fluoranthene	3.5×10^{-13}	3.5×10^{-12}	1.6×10^{-12}	1.3×10^{-12}	1.0×10^{-12}
Semivolatile Organics	Fluorene	1.8×10^{-14}	1.8×10^{-13}	7.5×10^{-14}	6.4×10^{-14}	3.6×10^{-14}
Semivolatile Organics	Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA
Semivolatile Organics	Naphthalene	7.6×10^{-13}	7.0×10^{-12}	3.2×10^{-12}	2.6×10^{-12}	6.6×10^{-13}
Semivolatile Organics	N-Nitrosodimethylamine	3.1×10^{-12}	1.7×10^{-11}	5.1×10^{-12}	2.0×10^{-12}	1.6×10^{-12}
Semivolatile Organics	Phenanthrene	NA	NA	NA	NA	NA
Semivolatile Organics	Pyrene	4.3×10^{-13}	4.3×10^{-12}	2.0×10^{-12}	1.6×10^{-12}	1.2×10^{-12}

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Semivolatile Organics	Total TEQ_BAP	NA	NA	NA	NA	NA
Volatile Organics	Formaldehyde	1.4×10^{-11}	1.1×10^{-10}	2.5×10^{-11}	8.9×10^{-12}	3.3×10^{-12}
Total		**2.2×10^{-9}**	**2.0×10^{-8}**	**8.6×10^{-9}**	**6.4×10^{-9}**	**4.9×10^{-9}**

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– Exposure pathways include ingestion of soil, inhalation of air, and dermal contact with soil.

– Suburban resident located 1,800 meters to the northwest of emissions source.

– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).

Table G–54 Offsite Impacts – Suburban Resident – Chemicals – Remedial Actions – Noncarcinogenic Hazards – Produce

Type	*Constituent*	*Alternatives*				
		No Action	***AOC LUT***	***Revised LUT***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Anions	Fluoride	1.2×10^{-10}	1.1×10^{-9}	2.4×10^{-10}	6.5×10^{-11}	4.9×10^{-11}
Anions	Perchlorate	4.6×10^{-12}	3.6×10^{-11}	8.4×10^{-12}	3.4×10^{-12}	2.5×10^{-12}
Dioxins/Furans	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	1.9×10^{-10}	1.8×10^{-9}	7.9×10^{-10}	5.8×10^{-10}	4.8×10^{-10}
Dioxins/Furans	1,2,3,4,6,7,8-HPCDF	3.7×10^{-10}	3.6×10^{-9}	1.6×10^{-9}	1.2×10^{-9}	9.6×10^{-10}
Dioxins/Furans	1,2,3,4,7,8,9-HPCDF	4.3×10^{-11}	4.1×10^{-10}	1.7×10^{-10}	1.2×10^{-10}	1.0×10^{-10}
Dioxins/Furans	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	1.2×10^{-9}	1.2×10^{-8}	5.2×10^{-9}	4.2×10^{-9}	3.5×10^{-9}
Dioxins/Furans	1,2,3,4,7,8-HXCDF	2.9×10^{-10}	2.6×10^{-9}	1.0×10^{-9}	7.0×10^{-10}	5.1×10^{-10}
Dioxins/Furans	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	1.1×10^{-9}	1.1×10^{-8}	4.5×10^{-9}	3.3×10^{-9}	2.8×10^{-9}
Dioxins/Furans	1,2,3,6,7,8-HXCDF	2.2×10^{-10}	2.0×10^{-9}	7.9×10^{-10}	5.4×10^{-10}	3.9×10^{-10}
Dioxins/Furans	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	5.5×10^{-10}	5.2×10^{-9}	2.2×10^{-9}	1.5×10^{-9}	1.3×10^{-9}
Dioxins/Furans	1,2,3,7,8,9-HXCDF	9.3×10^{-11}	8.5×10^{-10}	2.9×10^{-10}	1.7×10^{-10}	1.2×10^{-10}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzofuran	5.1×10^{-11}	4.1×10^{-10}	1.5×10^{-10}	7.9×10^{-11}	5.4×10^{-11}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	2.2×10^{-9}	2.1×10^{-8}	8.8×10^{-9}	6.4×10^{-9}	5.3×10^{-9}
Dioxins/Furans	2,3,4,6,7,8-HXCDF	2.9×10^{-10}	2.8×10^{-9}	1.1×10^{-9}	8.1×10^{-10}	5.8×10^{-10}
Dioxins/Furans	2,3,4,7,8-PECDF	6.6×10^{-10}	6.0×10^{-9}	2.3×10^{-9}	1.5×10^{-9}	1.1×10^{-9}
Dioxins/Furans	2,3,7,8-TCDD	4.0×10^{-10}	3.7×10^{-9}	1.5×10^{-9}	1.0×10^{-9}	8.6×10^{-10}
Dioxins/Furans	2,3,7,8-Tetrachlorodibenzofuran	9.5×10^{-11}	7.9×10^{-10}	3.1×10^{-10}	1.6×10^{-10}	1.1×10^{-10}
Dioxins/Furans	OCDD	9.6×10^{-10}	9.2×10^{-9}	4.0×10^{-9}	2.9×10^{-9}	2.4×10^{-9}
Dioxins/Furans	OCDF	3.0×10^{-11}	2.8×10^{-10}	1.2×10^{-10}	9.3×10^{-11}	7.7×10^{-11}
Dioxins/Furans	Total TEQ_Dioxin	NA	NA	NA	NA	NA
Herbicides	2,4-DB	1.5×10^{-13}	1.2×10^{-12}	3.2×10^{-13}	1.3×10^{-13}	8.9×10^{-14}
Herbicides	MCPA	7.4×10^{-9}	6.0×10^{-8}	1.6×10^{-8}	4.6×10^{-9}	3.5×10^{-9}
Herbicides	MCPP	3.0×10^{-9}	2.6×10^{-8}	7.5×10^{-9}	3.7×10^{-9}	3.0×10^{-9}
Metals	Antimony	2.5×10^{-8}	2.4×10^{-7}	1.1×10^{-7}	9.1×10^{-8}	7.7×10^{-8}
Metals	Barium	1.5×10^{-9}	1.2×10^{-8}	2.9×10^{-9}	1.0×10^{-9}	6.1×10^{-10}
Metals	Cadmium	1.6×10^{-8}	1.5×10^{-7}	6.8×10^{-8}	5.5×10^{-8}	4.7×10^{-8}
Metals	Chromium (Hexavalent Compounds)	1.7×10^{-10}	1.4×10^{-9}	3.7×10^{-10}	1.3×10^{-10}	1.0×10^{-10}
Metals	Lead	NA	NA	NA	NA	NA
Metals	Mercury	2.3×10^{-8}	2.2×10^{-7}	1.0×10^{-7}	7.4×10^{-8}	2.6×10^{-8}
Metals	Molybdenum	1.8×10^{-9}	1.6×10^{-8}	6.8×10^{-9}	4.8×10^{-9}	5.3×10^{-10}

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Metals	Selenium	6.3×10^{-11}	4.8×10^{-10}	1.1×10^{-10}	2.9×10^{-11}	2.1×10^{-11}
Metals	Silver	1.1×10^{-8}	1.1×10^{-7}	5.2×10^{-8}	4.4×10^{-8}	3.5×10^{-8}
Metals	Zinc	5.1×10^{-9}	4.3×10^{-8}	1.4×10^{-8}	6.7×10^{-9}	4.7×10^{-9}
Other Inorganics	Methyl Mercury	2.4×10^{-11}	1.9×10^{-10}	3.8×10^{-11}	1.1×10^{-11}	8.4×10^{-12}
Pesticides	4,4'-DDD	4.2×10^{-11}	4.4×10^{-10}	7.1×10^{-11}	3.5×10^{-11}	2.8×10^{-11}
Pesticides	4,4'-DDE	3.2×10^{-11}	3.4×10^{-10}	1.3×10^{-10}	7.6×10^{-11}	6.2×10^{-11}
Pesticides	4,4'-DDT	1.6×10^{-11}	1.4×10^{-10}	5.2×10^{-11}	3.1×10^{-11}	2.5×10^{-11}
Pesticides	Beta-Bhc	NA	NA	NA	NA	NA
Pesticides	Chlordane	1.6×10^{-11}	1.5×10^{-10}	4.0×10^{-11}	9.3×10^{-12}	7.3×10^{-12}
Pesticides	Delta-Bhc	NA	NA	NA	NA	NA
Pesticides	Dieldrin	2.7×10^{-11}	2.6×10^{-10}	9.0×10^{-11}	5.4×10^{-11}	4.4×10^{-11}
Polychlorinated Biphenyls	Aroclor 1248	NA	NA	NA	NA	NA
Polychlorinated Biphenyls	Aroclor 1254	2.0×10^{-9}	1.6×10^{-8}	7.1×10^{-9}	5.1×10^{-9}	3.0×10^{-9}
Polychlorinated Biphenyls	Aroclor 1260	NA	NA	NA	NA	NA
Polychlorinated Biphenyls	Aroclor 5460	5.5×10^{-11}	4.9×10^{-10}	2.2×10^{-10}	1.6×10^{-10}	1.3×10^{-10}
Semivolatile Organics	1-Methylnaphthalene	1.9×10^{-12}	1.9×10^{-11}	8.8×10^{-12}	7.5×10^{-12}	3.1×10^{-13}
Semivolatile Organics	2-Methylnaphthalene	4.2×10^{-11}	4.2×10^{-10}	2.0×10^{-10}	1.7×10^{-10}	6.4×10^{-12}
Semivolatile Organics	Acenaphthene	4.1×10^{-13}	3.9×10^{-12}	1.7×10^{-12}	1.4×10^{-12}	1.0×10^{-12}
Semivolatile Organics	Anthracene	1.5×10^{-13}	1.5×10^{-12}	6.5×10^{-13}	5.7×10^{-13}	4.0×10^{-13}
Semivolatile Organics	Benzo(a)anthracene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(a)pyrene	3.0×10^{-10}	3.0×10^{-9}	1.4×10^{-9}	1.1×10^{-9}	9.2×10^{-10}
Semivolatile Organics	Benzo(b)fluoranthene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(g,h,i)perylene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(k)fluoranthene	NA	NA	NA	NA	NA
Semivolatile Organics	Bis(2-ethylhexyl)phthalate	1.0×10^{-11}	1.0×10^{-10}	4.3×10^{-11}	3.3×10^{-11}	1.8×10^{-11}
Semivolatile Organics	Chrysene	NA	NA	NA	NA	NA
Semivolatile Organics	Dibenzo(a,h)anthracene	NA	NA	NA	NA	NA
Semivolatile Organics	Di-n-octylphthalate	3.0×10^{-12}	2.8×10^{-11}	1.1×10^{-11}	7.7×10^{-12}	6.9×10^{-12}
Semivolatile Organics	Fluoranthene	4.8×10^{-12}	4.7×10^{-11}	2.2×10^{-11}	1.7×10^{-11}	1.4×10^{-11}
Semivolatile Organics	Fluorene	4.9×10^{-13}	4.8×10^{-12}	2.0×10^{-12}	1.7×10^{-12}	9.9×10^{-13}
Semivolatile Organics	Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA
Semivolatile Organics	Naphthalene	4.4×10^{-12}	4.0×10^{-11}	1.8×10^{-11}	1.5×10^{-11}	3.8×10^{-12}

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Semivolatile Organics	N-Nitrosodimethylamine	3.5×10^{-8}	1.9×10^{-7}	5.7×10^{-8}	2.2×10^{-8}	1.8×10^{-8}
Semivolatile Organics	Phenanthrene	NA	NA	NA	NA	NA
Semivolatile Organics	Pyrene	6.9×10^{-12}	6.8×10^{-11}	3.2×10^{-11}	2.5×10^{-11}	2.0×10^{-11}
Semivolatile Organics	Total TEQ_BAP	NA	NA	NA	NA	NA
Volatile Organics	Formaldehyde	2.0×10^{-9}	1.6×10^{-8}	3.8×10^{-9}	1.3×10^{-9}	5.0×10^{-10}
Total		**1.4×10^{-7}**	**1.2×10^{-6}**	**4.8×10^{-7}**	**3.4×10^{-7}**	**2.4×10^{-7}**

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– Exposure pathways include ingestion of produce.
– Suburban resident located 1,800 meters to the northwest of emissions source.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).
– Air concentrations for cancer risk evaluation based on a 26-year emission period.

Table G–55 Offsite Impacts – Suburban Resident – Chemicals – Remedial Actions – Noncarcinogenic Hazards – Total

Type	*Constituent*	*Alternatives*				
		No Action	***AOC LUT***	***Revised LUT***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Anions	Fluoride	1.5×10^{-10}	1.5×10^{-9}	5.2×10^{-10}	2.9×10^{-10}	3.9×10^{-10}
Anions	Perchlorate	5.0×10^{-12}	4.0×10^{-11}	9.1×10^{-12}	3.7×10^{-12}	2.7×10^{-12}
Dioxins/Furans	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	2.1×10^{-10}	2.1×10^{-9}	1.0×10^{-9}	9.7×10^{-10}	1.1×10^{-9}
Dioxins/Furans	1,2,3,4,6,7,8-HPCDF	4.1×10^{-10}	3.9×10^{-9}	1.7×10^{-9}	1.3×10^{-9}	1.1×10^{-9}
Dioxins/Furans	1,2,3,4,7,8,9-HPCDF	4.8×10^{-11}	4.5×10^{-10}	1.9×10^{-10}	1.4×10^{-10}	1.2×10^{-10}
Dioxins/Furans	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	1.3×10^{-9}	1.3×10^{-8}	5.8×10^{-9}	4.7×10^{-9}	4.2×10^{-9}
Dioxins/Furans	1,2,3,4,7,8-HXCDF	3.2×10^{-10}	2.9×10^{-9}	1.2×10^{-9}	7.9×10^{-10}	6.0×10^{-10}
Dioxins/Furans	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	1.2×10^{-9}	1.2×10^{-8}	5.0×10^{-9}	3.8×10^{-9}	3.3×10^{-9}
Dioxins/Furans	1,2,3,6,7,8-HXCDF	2.4×10^{-10}	2.2×10^{-9}	8.8×10^{-10}	6.1×10^{-10}	4.6×10^{-10}
Dioxins/Furans	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	6.0×10^{-10}	5.7×10^{-9}	2.4×10^{-9}	1.7×10^{-9}	1.5×10^{-9}
Dioxins/Furans	1,2,3,7,8,9-HXCDF	1.0×10^{-10}	9.3×10^{-10}	3.2×10^{-10}	2.0×10^{-10}	1.4×10^{-10}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzofuran	5.6×10^{-11}	4.5×10^{-10}	1.6×10^{-10}	8.9×10^{-11}	6.3×10^{-11}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	2.4×10^{-9}	2.3×10^{-8}	9.7×10^{-9}	7.2×10^{-9}	6.1×10^{-9}
Dioxins/Furans	2,3,4,6,7,8-HXCDF	3.2×10^{-10}	3.0×10^{-9}	1.3×10^{-9}	9.2×10^{-10}	6.8×10^{-10}
Dioxins/Furans	2,3,4,7,8-PECDF	7.3×10^{-10}	6.5×10^{-9}	2.5×10^{-9}	1.7×10^{-9}	1.3×10^{-9}
Dioxins/Furans	2,3,7,8-TCDD	4.4×10^{-10}	4.1×10^{-9}	1.6×10^{-9}	1.2×10^{-9}	1.0×10^{-9}
Dioxins/Furans	2,3,7,8-Tetrachlorodibenzofuran	1.0×10^{-10}	8.6×10^{-10}	3.4×10^{-10}	1.8×10^{-10}	1.3×10^{-10}
Dioxins/Furans	OCDD	1.1×10^{-9}	1.0×10^{-8}	4.5×10^{-9}	3.3×10^{-9}	2.8×10^{-9}
Dioxins/Furans	OCDF	3.3×10^{-11}	3.1×10^{-10}	1.4×10^{-10}	1.1×10^{-10}	9.0×10^{-11}
Dioxins/Furans	Total TEQ_Dioxin	NA	NA	NA	NA	NA
Herbicides	2,4-DB	1.6×10^{-13}	1.3×10^{-12}	3.5×10^{-13}	1.4×10^{-13}	9.7×10^{-14}
Herbicides	MCPA	7.5×10^{-9}	6.1×10^{-8}	1.6×10^{-8}	4.7×10^{-9}	3.6×10^{-9}
Herbicides	MCPP	3.1×10^{-9}	2.7×10^{-8}	7.5×10^{-9}	3.7×10^{-9}	3.1×10^{-9}
Metals	Antimony	2.6×10^{-8}	2.6×10^{-7}	1.4×10^{-7}	1.5×10^{-7}	1.8×10^{-7}
Metals	Barium	2.6×10^{-8}	2.5×10^{-7}	2.4×10^{-7}	2.6×10^{-7}	3.1×10^{-7}
Metals	Cadmium	4.0×10^{-8}	4.2×10^{-7}	5.9×10^{-7}	1.3×10^{-6}	2.2×10^{-6}
Metals	Chromium (Hexavalent Compounds)	8.8×10^{-10}	7.9×10^{-9}	8.0×10^{-9}	8.3×10^{-9}	1.3×10^{-8}
Metals	Lead	NA	NA	NA	NA	NA
Metals	Mercury	2.3×10^{-8}	2.2×10^{-7}	1.0×10^{-7}	7.5×10^{-8}	2.6×10^{-8}
Metals	Molybdenum	2.4×10^{-9}	2.3×10^{-8}	1.9×10^{-8}	3.0×10^{-8}	6.1×10^{-9}
Metals	Selenium	6.8×10^{-11}	5.2×10^{-10}	1.3×10^{-10}	4.3×10^{-11}	4.0×10^{-11}

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Metals	Silver	1.1×10^{-8}	1.1×10^{-7}	5.3×10^{-8}	4.4×10^{-8}	3.6×10^{-8}
Metals	Zinc	5.1×10^{-9}	4.3×10^{-8}	1.4×10^{-8}	6.7×10^{-9}	4.7×10^{-9}
Other Inorganics	Methyl Mercury	2.7×10^{-11}	2.1×10^{-10}	4.2×10^{-11}	1.2×10^{-11}	9.1×10^{-12}
Pesticides	4,4'-DDD	4.6×10^{-11}	4.8×10^{-10}	7.8×10^{-11}	3.8×10^{-11}	3.1×10^{-11}
Pesticides	4,4'-DDE	3.4×10^{-11}	3.7×10^{-10}	1.4×10^{-10}	8.2×10^{-11}	6.8×10^{-11}
Pesticides	4,4'-DDT	1.7×10^{-11}	1.6×10^{-10}	5.7×10^{-11}	3.3×10^{-11}	2.7×10^{-11}
Pesticides	Beta-Bhc	NA	NA	NA	NA	NA
Pesticides	Chlordane	1.9×10^{-11}	1.8×10^{-10}	6.2×10^{-11}	2.4×10^{-11}	2.9×10^{-11}
Pesticides	Delta-Bhc	NA	NA	NA	NA	NA
Pesticides	Dieldrin	2.9×10^{-11}	2.8×10^{-10}	9.7×10^{-11}	5.9×10^{-11}	4.8×10^{-11}
Polychlorinated Biphenyls	Aroclor 1248	NA	NA	NA	NA	NA
Polychlorinated Biphenyls	Aroclor 1254	2.2×10^{-9}	1.8×10^{-8}	7.9×10^{-9}	5.6×10^{-9}	3.3×10^{-9}
Polychlorinated Biphenyls	Aroclor 1260	NA	NA	NA	NA	NA
Polychlorinated Biphenyls	Aroclor 5460	6.1×10^{-11}	5.4×10^{-10}	2.4×10^{-10}	1.7×10^{-10}	1.4×10^{-10}
Semivolatile Organics	1-Methylnaphthalene	2.0×10^{-12}	1.9×10^{-11}	9.1×10^{-12}	7.7×10^{-12}	3.2×10^{-13}
Semivolatile Organics	2-Methylnaphthalene	4.3×10^{-11}	4.3×10^{-10}	2.0×10^{-10}	1.7×10^{-10}	6.6×10^{-12}
Semivolatile Organics	Acenaphthene	4.2×10^{-13}	4.0×10^{-12}	1.7×10^{-12}	1.5×10^{-12}	1.1×10^{-12}
Semivolatile Organics	Anthracene	1.6×10^{-13}	1.6×10^{-12}	6.8×10^{-13}	6.0×10^{-13}	4.2×10^{-13}
Semivolatile Organics	Benzo(a)anthracene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(a)pyrene	6.5×10^{-9}	7.4×10^{-8}	1.4×10^{-7}	3.5×10^{-7}	5.6×10^{-7}
Semivolatile Organics	Benzo(b)fluoranthene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(g,h,i)perylene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(k)fluoranthene	NA	NA	NA	NA	NA
Semivolatile Organics	Bis(2-ethylhexyl)phthalate	1.2×10^{-11}	1.1×10^{-10}	4.7×10^{-11}	3.6×10^{-11}	2.0×10^{-11}
Semivolatile Organics	Chrysene	NA	NA	NA	NA	NA
Semivolatile Organics	Dibenzo(a,h)anthracene	NA	NA	NA	NA	NA
Semivolatile Organics	Di-n-octylphthalate	3.4×10^{-12}	3.1×10^{-11}	1.2×10^{-11}	8.5×10^{-12}	7.7×10^{-12}
Semivolatile Organics	Fluoranthene	5.2×10^{-12}	5.0×10^{-11}	2.4×10^{-11}	1.9×10^{-11}	1.5×10^{-11}
Semivolatile Organics	Fluorene	5.1×10^{-13}	4.9×10^{-12}	2.1×10^{-12}	1.8×10^{-12}	1.0×10^{-12}
Semivolatile Organics	Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA
Semivolatile Organics	Naphthalene	5.7×10^{-12}	5.3×10^{-11}	3.3×10^{-11}	4.6×10^{-11}	1.9×10^{-11}
Semivolatile Organics	N-Nitrosodimethylamine	3.5×10^{-8}	1.9×10^{-7}	5.7×10^{-8}	2.2×10^{-8}	1.8×10^{-8}

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Semivolatile Organics	Phenanthrene	NA	NA	NA	NA	NA
Semivolatile Organics	Pyrene	7.3×10^{-12}	7.2×10^{-11}	3.4×10^{-11}	2.7×10^{-11}	2.1×10^{-11}
Semivolatile Organics	Total TEQ_BAP	NA	NA	NA	NA	NA
Volatile Organics	Formaldehyde	2.1×10^{-9}	1.7×10^{-8}	4.0×10^{-9}	1.5×10^{-9}	6.3×10^{-10}
Total		**2.0×10^{-7}**	**1.8×10^{-6}**	**1.4×10^{-6}**	**2.3×10^{-6}**	**3.4×10^{-6}**

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– Exposure pathways include direct air (inhalation/submersion), direct soil (ingestion, inhalation, external exposure), and produce ingestion.

– Suburban resident located 1,800 meters to the northwest of emissions source.

– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).

Table G–56 Offsite Impacts – Suburban Resident – Radionuclides – Remedial Actions – Cancer Incidence Risk – Direct Air

Constituent	*Alternatives*				
	No Action	***AOC LUT***	***Revised LUT***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Am-241	2.8×10^{-15}	3.0×10^{-14}	7.5×10^{-15}	2.3×10^{-15}	1.9×10^{-15}
Cm-243/244	1.0×10^{-15}	1.2×10^{-14}	3.1×10^{-15}	9.6×10^{-16}	7.3×10^{-16}
Co-60	4.1×10^{-19}	4.4×10^{-18}	9.1×10^{-19}	6.4×10^{-19}	5.7×10^{-19}
Cs-137	7.9×10^{-16}	1.3×10^{-14}	3.9×10^{-15}	4.9×10^{-15}	4.1×10^{-15}
H-3	1.0×10^{-17}	1.2×10^{-16}	3.4×10^{-17}	9.6×10^{-18}	6.5×10^{-18}
Ni-59	0	NA	NA	NA	NA
Np-237	9.5×10^{-16}	1.4×10^{-14}	2.9×10^{-15}	NA	NA
Pu-238	1.4×10^{-15}	1.6×10^{-14}	4.0×10^{-15}	1.2×10^{-15}	1.1×10^{-15}
Pu-239/240	4.0×10^{-15}	4.5×10^{-14}	1.2×10^{-14}	3.9×10^{-15}	3.1×10^{-15}
Sr-90	8.4×10^{-16}	1.3×10^{-14}	3.9×10^{-15}	9.6×10^{-16}	6.3×10^{-16}
Total	$\mathbf{1.2\times10^{-14}}$	$\mathbf{1.4\times10^{-13}}$	$\mathbf{3.7\times10^{-14}}$	$\mathbf{1.4\times10^{-14}}$	$\mathbf{1.2\times10^{-14}}$

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– Exposure pathways include inhalation of air and external exposure due to submersion.
– Suburban resident located 1,800 meters to the northwest of emissions source.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).
– Ni-59 has a 95 percent upper confidence limit on the mean below 0 in source areas with only radiological constituents for the Cleanup to AOC LUT Values and Cleanup to Revised LUT Values Alternatives.
– Np-237 not detected in samples associated with the Conservation of Natural Resources Alternative scenarios.
– Air concentrations for cancer risk evaluation based on a 26-year emission period.

Table G–57 Offsite Impacts – Suburban Resident – Radionuclides – Remedial Actions – Cancer Incidence Risk – Direct Soil

	Alternatives				
Constituent	***No Action***	***AOC LUT***	***Revised LUT***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Am-241	8.8×10^{-18}	8.2×10^{-17}	2.0×10^{-17}	6.2×10^{-18}	5.1×10^{-18}
Cm-243/244	2.8×10^{-17}	2.9×10^{-16}	7.3×10^{-17}	2.3×10^{-17}	1.8×10^{-17}
Co-60	1.1×10^{-16}	1.1×10^{-15}	2.2×10^{-16}	1.5×10^{-16}	1.4×10^{-16}
Cs-137	4.1×10^{-14}	6.0×10^{-13}	1.7×10^{-13}	2.2×10^{-13}	1.8×10^{-13}
H-3	2.6×10^{-14}	2.7×10^{-13}	7.5×10^{-14}	2.1×10^{-14}	1.4×10^{-14}
Ni-59	6.2×10^{-18}	2.6×10^{-18}	1.4×10^{-18}	1.5×10^{-18}	1.6×10^{-18}
Np-237	6.7×10^{-17}	8.2×10^{-16}	1.8×10^{-16}	NA	NA
Pu-238	1.7×10^{-18}	1.8×10^{-17}	4.5×10^{-18}	1.4×10^{-18}	1.2×10^{-18}
Pu-239/240	4.9×10^{-18}	4.8×10^{-17}	1.3×10^{-17}	4.2×10^{-18}	3.3×10^{-18}
Sr-90	1.6×10^{-16}	2.3×10^{-15}	6.5×10^{-16}	1.6×10^{-16}	1.1×10^{-16}
Total	**6.7×10^{-14}**	**8.7×10^{-13}**	**2.5×10^{-13}**	**2.4×10^{-13}**	**2.0×10^{-13}**

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– Exposure pathways include ingestion of soil, inhalation of air, and external exposure to soil.
– Suburban resident located 1,800 meters to the northwest of emissions source.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).
– Np-237 not detected in samples associated with the Conservation of Natural Resources Alternative scenarios.

Table G–58 Offsite Impacts – Suburban Resident – Radionuclides – Remedial Actions – Cancer Incidence Risk – Produce

	Alternatives				
Constituent	***No Action***	***AOC LUT***	***Revised LUT***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Am-241	1.9×10^{-16}	1.8×10^{-15}	4.4×10^{-16}	1.3×10^{-16}	1.1×10^{-16}
Cm-243/244	6.4×10^{-17}	6.6×10^{-16}	1.7×10^{-16}	5.3×10^{-17}	4.0×10^{-17}
Co-60	2.8×10^{-18}	2.6×10^{-17}	5.3×10^{-18}	3.7×10^{-18}	3.3×10^{-18}
Cs-137	1.5×10^{-14}	2.3×10^{-13}	6.6×10^{-14}	8.3×10^{-14}	6.9×10^{-14}
H-3	1.2×10^{-14}	1.2×10^{-13}	3.4×10^{-14}	9.5×10^{-15}	6.5×10^{-15}
Ni-59	3.8×10^{-16}	1.6×10^{-16}	8.7×10^{-17}	9.3×10^{-17}	1.0×10^{-16}
Np-237	7.0×10^{-17}	8.6×10^{-16}	1.9×10^{-16}	NA	NA
Pu-238	8.3×10^{-17}	8.4×10^{-16}	2.1×10^{-16}	6.6×10^{-17}	5.9×10^{-17}
Pu-239/240	2.3×10^{-16}	2.3×10^{-15}	6.1×10^{-16}	2.0×10^{-16}	1.6×10^{-16}
Sr-90	3.2×10^{-14}	4.4×10^{-13}	1.3×10^{-13}	3.2×10^{-14}	2.0×10^{-14}
Total	**6.0×10^{-14}**	**7.9×10^{-13}**	**2.3×10^{-13}**	**1.3×10^{-13}**	**9.7×10^{-14}**

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– Exposure pathways include ingestion of produce.
– Suburban resident located 1,800 meters to the northwest of emissions source.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).
– Np-237 not detected in samples associated with the Conservation of Natural Resources Alternative scenarios.
– Air concentrations for cancer risk evaluation based on a 26-year emission period.

Table G–59 Offsite Impacts – Suburban Resident – Radionuclides – Remedial Actions – Cancer Incidence Risk – Total

	Alternatives				
Constituent	***No Action***	***AOC LUT***	***Revised LUT***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Am-241	3.0×10^{-15}	3.2×10^{-14}	8.0×10^{-15}	2.4×10^{-15}	2.0×10^{-15}
Cm-243/244	1.1×10^{-15}	1.3×10^{-14}	3.3×10^{-15}	1.0×10^{-15}	7.9×10^{-16}
Co-60	1.2×10^{-16}	1.1×10^{-15}	2.3×10^{-16}	1.6×10^{-16}	1.4×10^{-16}
Cs-137	5.7×10^{-14}	8.4×10^{-13}	2.4×10^{-13}	3.1×10^{-13}	2.6×10^{-13}
H-3	3.8×10^{-14}	3.9×10^{-13}	1.1×10^{-13}	3.0×10^{-14}	2.1×10^{-14}
Ni-59	3.8×10^{-16}	1.6×10^{-16}	8.9×10^{-17}	9.5×10^{-17}	1.0×10^{-16}
Np-237	1.1×10^{-15}	1.5×10^{-14}	3.3×10^{-15}	NA	NA
Pu-238	1.4×10^{-15}	1.7×10^{-14}	4.3×10^{-15}	1.3×10^{-15}	1.2×10^{-15}
Pu-239/240	4.2×10^{-15}	4.7×10^{-14}	1.3×10^{-14}	4.2×10^{-15}	3.3×10^{-15}
Sr-90	3.3×10^{-14}	4.5×10^{-13}	1.3×10^{-13}	3.3×10^{-14}	2.1×10^{-14}
Total	**1.4×10^{-13}**	**1.8×10^{-12}**	**5.1×10^{-13}**	**3.8×10^{-13}**	**3.1×10^{-13}**

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– Exposure pathways include direct air (inhalation/submersion), direct soil (ingestion, inhalation, external exposure), and produce ingestion.
– Suburban resident located 1,800 meters to the northwest of emissions source.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).
– Np-237 not detected in samples associated with the Conservation of Natural Resources Alternative scenarios.

Table G–60 Offsite Impacts – Suburban Resident – Radionuclides – Remedial Actions – Radiological Dose – Air

	Alternatives				
Constituent	***No Action***	***AOC LUT***	***Revised LUT***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Am-241	1.6×10^{-8}	8.7×10^{-9}	8.7×10^{-9}	9.7×10^{-10}	4.0×10^{-10}
Cm-243/244	4.3×10^{-9}	2.4×10^{-9}	2.4×10^{-9}	3.2×10^{-10}	1.2×10^{-10}
Co-60	4.3×10^{-13}	2.4×10^{-13}	2.4×10^{-13}	5.1×10^{-14}	2.3×10^{-14}
Cs-137	1.1×10^{-9}	4.2×10^{-11}	4.2×10^{-11}	5.4×10^{-10}	2.3×10^{-10}
H-3	8.6×10^{-12}	4.9×10^{-12}	4.9×10^{-12}	6.2×10^{-13}	2.1×10^{-13}
Ni-59	0.0×10+0	NA	NA	NA	NA
Np-237	4.1×10^{-9}	2.3×10^{-9}	2.3×10^{-9}	NA	NA
Pu-238	6.9×10^{-9}	3.7×10^{-9}	3.7×10^{-9}	4.9×10^{-10}	2.2×10^{-10}
Pu-239/240	2.2×10^{-8}	1.1×10^{-8}	1.1×10^{-8}	1.7×10^{-9}	6.7×10^{-10}
Sr-90	1.1×10^{-9}	9.8×10^{-11}	9.8×10^{-11}	9.4×10^{-11}	3.1×10^{-11}
Total	**5.5×10^{-8}**	**2.8×10^{-8}**	**2.8×10^{-8}**	**4.1×10^{-9}**	**1.7×10^{-9}**

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– All doses in units of millirem.
– Exposure pathways include inhalation of air and external exposure due to submersion.
– Suburban resident located 1,800 meters to the northwest of emissions source.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).
– Ni-59 has a 95 percent upper confidence limit on the mean below 0 in source areas with only radiological constituents for the Cleanup to AOC LUT Values and Cleanup to Revised LUT Values Alternatives.
– Np-237 not detected in samples associated with the Conservation of Natural Resources Alternative scenarios.
– Air concentrations for dose evaluation assume a 2-year emission period for radiological sources.

Table G–61 Offsite Impacts – Suburban Resident – Radionuclides – Remedial Actions – Radiological Dose – Soil

	Alternatives				
Constituent	***No Action***	***AOC LUT***	***Revised LUT***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Am-241	3.0×10^{-11}	1.1×10^{-11}	2.7×10^{-12}	1.6×10^{-12}	6.7×10^{-13}
Cm-243/244	4.4×10^{-11}	1.8×10^{-11}	4.5×10^{-12}	2.8×10^{-12}	1.1×10^{-12}
Co-60	1.5×10^{-10}	5.5×10^{-11}	1.1×10^{-11}	1.6×10^{-11}	7.1×10^{-12}
Cs-137	5.9×10^{-8}	3.3×10^{-8}	9.6×10^{-9}	2.5×10^{-8}	1.0×10^{-8}
H-3	2.2×10^{-8}	8.7×10^{-9}	2.4×10^{-9}	1.3×10^{-9}	4.6×10^{-10}
Ni-59	2.4×10^{-12}	3.8×10^{-14}	2.1×10^{-14}	4.5×10^{-14}	2.4×10^{-14}
Np-237	1.0×10^{-10}	4.9×10^{-11}	1.1×10^{-11}	NA	NA
Pu-238	8.7×10^{-12}	3.4×10^{-12}	8.6×10^{-13}	5.3×10^{-13}	2.4×10^{-13}
Pu-239/240	2.6×10^{-11}	9.7×10^{-12}	2.6×10^{-12}	1.7×10^{-12}	6.8×10^{-13}
Sr-90	2.5×10^{-10}	1.3×10^{-10}	3.8×10^{-11}	1.9×10^{-11}	6.1×10^{-12}
Total	**8.1×10^{-8}**	**4.2×10^{-8}**	**1.2×10^{-8}**	**2.6×10^{-8}**	**1.1×10^{-8}**

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– All doses in units of millirem.
– Exposure pathways include inhalation of air and external exposure due to submersion.
– Suburban resident located 1,800 meters to the northwest of emissions source.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).
– Ni-59 has a 95 percent upper confidence limit on the mean below 0 in source areas with only radiological constituents for the Cleanup to AOC LUT Values and Cleanup to Revised LUT Values Alternatives.
– Np-237 not detected in samples associated with the Conservation of Natural Resources Alternative scenarios.
– Air concentrations for dose evaluation assume a 2-year emission period for radiological sources.

Table G–62 Offsite Impacts – Suburban Resident – Radionuclides – Remedial Actions – Radiological Dose – Produce

	Alternatives				
Constituent	**No Action**	**AOC LUT**	**Revised LUT**	**CONR Residential Scenario**	**CONR Open Space Scenario**
Am-241	1.0×10^{-9}	3.7×10^{-10}	9.2×10^{-11}	5.6×10^{-11}	2.3×10^{-11}
Cm-243/244	2.9×10^{-10}	1.1×10^{-10}	2.9×10^{-11}	1.8×10^{-11}	7.0×10^{-12}
Co-60	1.6×10^{-12}	5.5×10^{-13}	1.1×10^{-13}	1.6×10^{-13}	7.1×10^{-14}
Cs-137	2.0×10^{-8}	1.1×10^{-8}	3.3×10^{-9}	8.3×10^{-9}	3.4×10^{-9}
H-3	1.2×10^{-8}	4.8×10^{-9}	1.3×10^{-9}	7.5×10^{-10}	2.5×10^{-10}
Ni-59	2.3×10^{-10}	3.6×10^{-12}	2.0×10^{-12}	4.3×10^{-12}	2.3×10^{-12}
Np-237	3.4×10^{-10}	1.6×10^{-10}	3.5×10^{-11}	NA	NA
Pu-238	4.2×10^{-10}	1.6×10^{-10}	4.1×10^{-11}	2.6×10^{-11}	1.1×10^{-11}
Pu-239/240	1.2×10^{-9}	4.7×10^{-10}	1.3×10^{-10}	8.3×10^{-11}	3.3×10^{-11}
Sr-90	4.8×10^{-8}	2.5×10^{-8}	7.3×10^{-9}	3.6×10^{-9}	1.2×10^{-9}
Total	**8.3×10^{-8}**	**4.3×10^{-8}**	**1.2×10^{-8}**	**1.3×10^{-8}**	**5.0×10^{-9}**

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:
– All doses in units of millirem.
– Exposure pathways include inhalation of air and external exposure due to submersion.
– Suburban resident located 1,800 meters to the northwest of emissions source.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).
– Ni-59 has a 95 percent upper confidence limit on the mean below 0 in source areas with only radiological constituents for the Cleanup to AOC LUT Values and Cleanup to Revised LUT Values Alternatives.
– Np-237 not detected in samples associated with the Conservation of Natural Resources Alternative scenarios.
– Air concentrations for dose evaluation assume a 2-year emission period for radiological sources.

Table G–63 Offsite Impacts – Suburban Resident – Radionuclides – Remedial Actions – Radiological Dose – Total

	Alternatives				
Constituent	No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Am-241	1.7×10^{-8}	9.1×10^{-9}	8.8×10^{-9}	1.0×10^{-9}	4.2×10^{-10}
Cm-243/244	4.6×10^{-9}	2.5×10^{-9}	2.4×10^{-9}	3.4×10^{-10}	1.3×10^{-10}
Co-60	1.6×10^{-10}	5.6×10^{-11}	1.2×10^{-11}	1.6×10^{-11}	7.2×10^{-12}
Cs-137	8.0×10^{-8}	4.5×10^{-8}	1.3×10^{-8}	3.3×10^{-8}	1.4×10^{-8}
H-3	3.4×10^{-8}	1.3×10^{-8}	3.7×10^{-9}	2.1×10^{-9}	7.1×10^{-10}
Ni-59	2.3×10^{-10}	3.6×10^{-12}	2.0×10^{-12}	4.3×10^{-12}	2.3×10^{-12}
Np-237	4.5×10^{-9}	2.5×10^{-9}	2.4×10^{-9}	NA	NA
Pu-238	7.3×10^{-9}	3.9×10^{-9}	3.8×10^{-9}	5.1×10^{-10}	2.3×10^{-10}
Pu-239/240	2.3×10^{-8}	1.1×10^{-8}	1.1×10^{-8}	1.8×10^{-9}	7.0×10^{-10}
Sr-90	4.9×10^{-8}	2.6×10^{-8}	7.4×10^{-9}	3.8×10^{-9}	1.2×10^{-9}
Total	**2.2×10^{-7}**	**1.1×10^{-7}**	**5.2×10^{-8}**	**4.3×10^{-8}**	**1.7×10^{-8}**

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– All doses in units of millirem.
– Exposure pathways include inhalation of air and external exposure due to submersion.
– Suburban resident located 1,800 meters to the northwest of emissions source.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).
– Ni-59 has a 95 percent upper confidence limit on the mean below 0 in source areas with only radiological constituents for the Cleanup to AOC LUT Values and Cleanup to Revised LUT Values Alternatives.
– Np-237 not detected in samples associated with the Conservation of Natural Resources Alternative scenarios.
– Air concentrations for dose evaluation assume a 2-year emission period for radiological sources.

Table G–64 Offsite Impacts –Recreational User– Chemicals – Remedial Actions – Cancer Incidence Risk – Direct Air

Type	*Constituent*	*Alternatives*				
		No Action	***AOC LUT***	***Revised LUT***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Anions	Fluoride	NA	NA	NA	NA	NA
Anions	Perchlorate	NA	NA	NA	NA	NA
Dioxins/Furans	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	3.1×10^{-15}	3.5×10^{-14}	1.5×10^{-14}	1.1×10^{-14}	9.2×10^{-15}
Dioxins/Furans	1,2,3,4,6,7,8-HPCDF	4.3×10^{-16}	4.8×10^{-15}	2.1×10^{-15}	1.6×10^{-15}	1.3×10^{-15}
Dioxins/Furans	1,2,3,4,7,8,9-HPCDF	5.0×10^{-17}	5.5×10^{-16}	2.3×10^{-16}	1.7×10^{-16}	1.4×10^{-16}
Dioxins/Furans	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	1.4×10^{-15}	1.6×10^{-14}	7.0×10^{-15}	5.6×10^{-15}	4.7×10^{-15}
Dioxins/Furans	1,2,3,4,7,8-HXCDF	3.3×10^{-16}	3.5×10^{-15}	1.4×10^{-15}	9.3×10^{-16}	6.9×10^{-16}
Dioxins/Furans	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	1.3×10^{-15}	1.4×10^{-14}	6.1×10^{-15}	4.5×10^{-15}	3.7×10^{-15}
Dioxins/Furans	1,2,3,6,7,8-HXCDF	2.5×10^{-16}	2.7×10^{-15}	1.1×10^{-15}	7.2×10^{-16}	5.2×10^{-16}
Dioxins/Furans	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	6.4×10^{-16}	6.9×10^{-15}	2.9×10^{-15}	2.1×10^{-15}	1.7×10^{-15}
Dioxins/Furans	1,2,3,7,8,9-HXCDF	1.1×10^{-16}	1.1×10^{-15}	3.8×10^{-16}	2.3×10^{-16}	1.6×10^{-16}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzofuran	5.6×10^{-17}	5.3×10^{-16}	1.9×10^{-16}	1.0×10^{-16}	6.8×10^{-17}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	2.4×10^{-15}	2.7×10^{-14}	1.1×10^{-14}	8.0×10^{-15}	6.6×10^{-15}
Dioxins/Furans	2,3,4,6,7,8-HXCDF	3.4×10^{-16}	3.7×10^{-15}	1.5×10^{-15}	1.1×10^{-15}	7.8×10^{-16}
Dioxins/Furans	2,3,4,7,8-PECDF	7.4×10^{-16}	7.7×10^{-15}	2.9×10^{-15}	1.9×10^{-15}	1.4×10^{-15}
Dioxins/Furans	2,3,7,8-TCDD	4.4×10^{-16}	4.8×10^{-15}	1.9×10^{-15}	1.3×10^{-15}	1.1×10^{-15}
Dioxins/Furans	2,3,7,8-Tetrachlorodibenzofuran	1.0×10^{-16}	9.8×10^{-16}	3.9×10^{-16}	2.0×10^{-16}	1.3×10^{-16}
Dioxins/Furans	OCDD	1.1×10^{-15}	1.2×10^{-14}	5.4×10^{-15}	3.9×10^{-15}	3.2×10^{-15}
Dioxins/Furans	OCDF	3.5×10^{-17}	3.8×10^{-16}	1.7×10^{-16}	1.2×10^{-16}	1.0×10^{-16}
Dioxins/Furans	Total TEQ_Dioxin	NA	NA	NA	NA	NA
Herbicides	2,4-DB	NA	NA	NA	NA	NA
Herbicides	MCPA	NA	NA	NA	NA	NA
Herbicides	MCPP	NA	NA	NA	NA	NA
Metals	Antimony	NA	NA	NA	NA	NA
Metals	Barium	NA	NA	NA	NA	NA
Metals	Cadmium	1.2×10^{-13}	1.4×10^{-12}	6.1×10^{-13}	5.0×10^{-13}	4.2×10^{-13}
Metals	Chromium (Hexavalent Compounds)	4.5×10^{-12}	4.2×10^{-11}	1.1×10^{-11}	4.1×10^{-12}	3.2×10^{-12}
Metals	Lead	3.6×10^{-14}	4.1×10^{-13}	1.8×10^{-13}	1.5×10^{-13}	1.2×10^{-13}
Metals	Mercury	NA	NA	NA	NA	NA
Metals	Molybdenum	NA	NA	NA	NA	NA
Metals	Selenium	NA	NA	NA	NA	NA

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Metals	Silver	NA	NA	NA	NA	NA
Metals	Zinc	NA	NA	NA	NA	NA
Other Inorganics	Methyl Mercury	NA	NA	NA	NA	NA
Pesticides	4,4'-DDD	3.3×10^{-18}	3.9×10^{-17}	6.3×10^{-18}	3.1×10^{-18}	2.5×10^{-18}
Pesticides	4,4'-DDE	3.7×10^{-17}	4.6×10^{-16}	1.7×10^{-16}	1.0×10^{-16}	8.5×10^{-17}
Pesticides	4,4'-DDT	3.2×10^{-17}	3.3×10^{-16}	1.2×10^{-16}	7.2×10^{-17}	5.9×10^{-17}
Pesticides	Beta-Bhc	5.5×10^{-18}	6.0×10^{-17}	1.3×10^{-17}	5.2×10^{-18}	4.2×10^{-18}
Pesticides	Chlordane	3.0×10^{-17}	3.3×10^{-16}	8.7×10^{-17}	2.1×10^{-17}	1.6×10^{-17}
Pesticides	Delta-Bhc	NA	NA	NA	NA	NA
Pesticides	Dieldrin	1.9×10^{-16}	2.1×10^{-15}	7.4×10^{-16}	4.5×10^{-16}	3.7×10^{-16}
Polychlorinated Biphenyls	Aroclor 1248	6.9×10^{-16}	7.4×10^{-15}	3.4×10^{-15}	2.6×10^{-15}	2.1×10^{-15}
Polychlorinated Biphenyls	Aroclor 1254	9.0×10^{-16}	8.6×10^{-15}	3.8×10^{-15}	2.7×10^{-15}	1.6×10^{-15}
Polychlorinated Biphenyls	Aroclor 1260	1.7×10^{-14}	1.9×10^{-13}	9.0×10^{-14}	7.8×10^{-14}	6.6×10^{-14}
Polychlorinated Biphenyls	Aroclor 5460	NA	NA	NA	NA	NA
Semivolatile Organics	1-Methylnaphthalene	NA	NA	NA	NA	NA
Semivolatile Organics	2-Methylnaphthalene	NA	NA	NA	NA	NA
Semivolatile Organics	Acenaphthene	NA	NA	NA	NA	NA
Semivolatile Organics	Anthracene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(a)anthracene	4.0×10^{-16}	4.6×10^{-15}	2.1×10^{-15}	1.7×10^{-15}	1.3×10^{-15}
Semivolatile Organics	Benzo(a)pyrene	5.7×10^{-15}	6.6×10^{-14}	3.1×10^{-14}	2.5×10^{-14}	2.0×10^{-14}
Semivolatile Organics	Benzo(b)fluoranthene	6.6×10^{-16}	7.6×10^{-15}	3.5×10^{-15}	2.8×10^{-15}	2.2×10^{-15}
Semivolatile Organics	Benzo(g,h,i)perylene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(k)fluoranthene	3.0×10^{-17}	3.5×10^{-16}	1.6×10^{-16}	1.3×10^{-16}	1.0×10^{-16}
Semivolatile Organics	Bis(2-ethylhexyl)phthalate	2.2×10^{-17}	2.5×10^{-16}	1.0×10^{-16}	7.8×10^{-17}	4.4×10^{-17}
Semivolatile Organics	Chrysene	5.9×10^{-18}	6.6×10^{-17}	3.0×10^{-17}	2.4×10^{-17}	1.9×10^{-17}
Semivolatile Organics	Dibenzo(a,h)anthracene	6.5×10^{-16}	7.8×10^{-15}	3.2×10^{-15}	2.7×10^{-15}	1.6×10^{-15}
Semivolatile Organics	Di-n-octylphthalate	NA	NA	NA	NA	NA
Semivolatile Organics	Fluoranthene	NA	NA	NA	NA	NA
Semivolatile Organics	Fluorene	NA	NA	NA	NA	NA
Semivolatile Organics	Indeno(1,2,3-cd)pyrene	9.0×10^{-16}	1.1×10^{-14}	4.9×10^{-15}	4.1×10^{-15}	3.4×10^{-15}
Semivolatile Organics	Naphthalene	1.6×10^{-17}	1.7×10^{-16}	7.9×10^{-17}	6.4×10^{-17}	1.6×10^{-17}
Semivolatile Organics	N-Nitrosodimethylamine	3.9×10^{-16}	2.5×10^{-15}	7.3×10^{-16}	2.8×10^{-16}	2.4×10^{-16}
Semivolatile Organics	Phenanthrene	NA	NA	NA	NA	NA
Semivolatile Organics	Pyrene	NA	NA	NA	NA	NA

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Semivolatile Organics	Total TEQ_BAP	NA	NA	NA	NA	NA
Volatile Organics	Formaldehyde	6.5×10^{-16}	6.1×10^{-15}	1.4×10^{-15}	4.9×10^{-16}	1.8×10^{-16}
Total		**4.7×10^{-12}**	**4.4×10^{-11}**	**1.2×10^{-11}**	**4.9×10^{-12}**	**3.8×10^{-12}**

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– Exposure pathways include inhalation of air and external exposure due to submersion.
– Recreational user located 500 meters to the northwest of emissions source.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).
– Air concentrations for cancer risk evaluation based on a 26-year emission period.

Table G–65 Offsite Impacts –Recreational User– Chemicals – Remedial Actions – Cancer Incidence Risk – Direct Soil

Type	*Constituent*	*Alternatives*				
		No Action	***AOC LUT***	***Revised LUT***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Anions	Fluoride	NA	NA	NA	NA	NA
Anions	Perchlorate	NA	NA	NA	NA	NA
Dioxins/Furans	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	6.0×10^{-15}	5.8×10^{-14}	2.5×10^{-14}	1.9×10^{-14}	1.5×10^{-14}
Dioxins/Furans	1,2,3,4,6,7,8-HPCDF	8.3×10^{-16}	8.0×10^{-15}	3.5×10^{-15}	2.6×10^{-15}	2.1×10^{-15}
Dioxins/Furans	1,2,3,4,7,8,9-HPCDF	9.6×10^{-17}	9.1×10^{-16}	3.8×10^{-16}	2.7×10^{-16}	2.2×10^{-16}
Dioxins/Furans	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	2.6×10^{-15}	2.6×10^{-14}	1.2×10^{-14}	9.2×10^{-15}	7.8×10^{-15}
Dioxins/Furans	1,2,3,4,7,8-HXCDF	6.4×10^{-16}	5.9×10^{-15}	2.3×10^{-15}	1.6×10^{-15}	1.1×10^{-15}
Dioxins/Furans	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	2.4×10^{-15}	2.3×10^{-14}	1.0×10^{-14}	7.4×10^{-15}	6.1×10^{-15}
Dioxins/Furans	1,2,3,6,7,8-HXCDF	4.8×10^{-16}	4.4×10^{-15}	1.8×10^{-15}	1.2×10^{-15}	8.7×10^{-16}
Dioxins/Furans	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	1.2×10^{-15}	1.1×10^{-14}	4.8×10^{-15}	3.4×10^{-15}	2.8×10^{-15}
Dioxins/Furans	1,2,3,7,8,9-HXCDF	2.0×10^{-16}	1.9×10^{-15}	6.3×10^{-16}	3.8×10^{-16}	2.6×10^{-16}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzofuran	1.1×10^{-16}	8.7×10^{-16}	3.1×10^{-16}	1.7×10^{-16}	1.1×10^{-16}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	4.6×10^{-15}	4.4×10^{-14}	1.8×10^{-14}	1.3×10^{-14}	1.1×10^{-14}
Dioxins/Furans	2,3,4,6,7,8-HXCDF	6.5×10^{-16}	6.1×10^{-15}	2.5×10^{-15}	1.8×10^{-15}	1.3×10^{-15}
Dioxins/Furans	2,3,4,7,8-PECDF	1.4×10^{-15}	1.3×10^{-14}	4.9×10^{-15}	3.2×10^{-15}	2.3×10^{-15}
Dioxins/Furans	2,3,7,8-TCDD	8.6×10^{-16}	8.0×10^{-15}	3.2×10^{-15}	2.2×10^{-15}	1.8×10^{-15}
Dioxins/Furans	2,3,7,8-Tetrachlorodibenzofuran	2.0×10^{-16}	1.6×10^{-15}	6.4×10^{-16}	3.4×10^{-16}	2.2×10^{-16}
Dioxins/Furans	OCDD	2.1×10^{-15}	2.0×10^{-14}	8.9×10^{-15}	6.5×10^{-15}	5.4×10^{-15}
Dioxins/Furans	OCDF	6.6×10^{-17}	6.4×10^{-16}	2.8×10^{-16}	2.1×10^{-16}	1.7×10^{-16}
Dioxins/Furans	Total TEQ_Dioxin	NA	NA	NA	NA	NA
Herbicides	2,4-DB	NA	NA	NA	NA	NA
Herbicides	MCPA	NA	NA	NA	NA	NA
Herbicides	MCPP	NA	NA	NA	NA	NA
Metals	Antimony	NA	NA	NA	NA	NA
Metals	Barium	NA	NA	NA	NA	NA
Metals	Cadmium	2.8×10^{-21}	2.7×10^{-20}	1.2×10^{-20}	9.9×10^{-21}	8.3×10^{-21}
Metals	Chromium (Hexavalent Compounds)	2.3×10^{-14}	1.8×10^{-13}	5.0×10^{-14}	1.8×10^{-14}	1.4×10^{-14}
Metals	Lead	1.3×10^{-14}	1.3×10^{-13}	5.8×10^{-14}	4.7×10^{-14}	3.9×10^{-14}
Metals	Mercury	NA	NA	NA	NA	NA
Metals	Molybdenum	NA	NA	NA	NA	NA
Metals	Selenium	NA	NA	NA	NA	NA

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Metals	Silver	NA	NA	NA	NA	NA
Metals	Zinc	NA	NA	NA	NA	NA
Other Inorganics	Methyl Mercury	NA	NA	NA	NA	NA
Pesticides	4,4'-DDD	7.5×10^{-18}	7.8×10^{-17}	1.3×10^{-17}	6.2×10^{-18}	5.0×10^{-18}
Pesticides	4,4'-DDE	6.8×10^{-17}	7.3×10^{-16}	2.7×10^{-16}	1.6×10^{-16}	1.3×10^{-16}
Pesticides	4,4'-DDT	6.2×10^{-17}	5.7×10^{-16}	2.1×10^{-16}	1.2×10^{-16}	1.0×10^{-16}
Pesticides	Beta-Bhc	1.2×10^{-17}	1.2×10^{-16}	2.6×10^{-17}	1.0×10^{-17}	8.2×10^{-18}
Pesticides	Chlordane	6.1×10^{-17}	5.9×10^{-16}	1.5×10^{-16}	3.6×10^{-17}	2.9×10^{-17}
Pesticides	Delta-Bhc	NA	NA	NA	NA	NA
Pesticides	Dieldrin	4.4×10^{-16}	4.2×10^{-15}	1.5×10^{-15}	8.9×10^{-16}	7.3×10^{-16}
Polychlorinated Biphenyls	Aroclor 1248	1.8×10^{-15}	1.7×10^{-14}	7.6×10^{-15}	5.9×10^{-15}	4.7×10^{-15}
Polychlorinated Biphenyls	Aroclor 1254	2.3×10^{-15}	1.9×10^{-14}	8.4×10^{-15}	6.0×10^{-15}	3.6×10^{-15}
Polychlorinated Biphenyls	Aroclor 1260	4.3×10^{-14}	4.3×10^{-13}	2.0×10^{-13}	1.7×10^{-13}	1.5×10^{-13}
Polychlorinated Biphenyls	Aroclor 5460	NA	NA	NA	NA	NA
Semivolatile Organics	1-Methylnaphthalene	2.8×10^{-17}	2.8×10^{-16}	1.3×10^{-16}	1.1×10^{-16}	4.6×10^{-18}
Semivolatile Organics	2-Methylnaphthalene	NA	NA	NA	NA	NA
Semivolatile Organics	Acenaphthene	NA	NA	NA	NA	NA
Semivolatile Organics	Anthracene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(a)anthracene	7.6×10^{-16}	7.5×10^{-15}	3.5×10^{-15}	2.8×10^{-15}	2.1×10^{-15}
Semivolatile Organics	Benzo(a)pyrene	1.1×10^{-14}	1.1×10^{-13}	5.0×10^{-14}	4.0×10^{-14}	3.3×10^{-14}
Semivolatile Organics	Benzo(b)fluoranthene	1.2×10^{-15}	1.2×10^{-14}	5.8×10^{-15}	4.5×10^{-15}	3.5×10^{-15}
Semivolatile Organics	Benzo(g,h,i)perylene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(k)fluoranthene	5.7×10^{-17}	5.6×10^{-16}	2.6×10^{-16}	2.1×10^{-16}	1.7×10^{-16}
Semivolatile Organics	Bis(2-ethylhexyl)phthalate	8.3×10^{-17}	8.2×10^{-16}	3.4×10^{-16}	2.6×10^{-16}	1.5×10^{-16}
Semivolatile Organics	Chrysene	1.1×10^{-17}	1.1×10^{-16}	5.0×10^{-17}	3.9×10^{-17}	3.1×10^{-17}
Semivolatile Organics	Dibenzo(a,h)anthracene	1.2×10^{-15}	1.3×10^{-14}	5.2×10^{-15}	4.5×10^{-15}	2.7×10^{-15}
Semivolatile Organics	Di-n-octylphthalate	NA	NA	NA	NA	NA
Semivolatile Organics	Fluoranthene	NA	NA	NA	NA	NA
Semivolatile Organics	Fluorene	NA	NA	NA	NA	NA
Semivolatile Organics	Indeno(1,2,3-cd)pyrene	1.7×10^{-15}	1.7×10^{-14}	8.0×10^{-15}	6.7×10^{-15}	5.5×10^{-15}
Semivolatile Organics	Naphthalene	2.0×10^{-17}	1.8×10^{-16}	8.3×10^{-17}	6.7×10^{-17}	1.7×10^{-17}
Semivolatile Organics	N-Nitrosodimethylamine	1.5×10^{-15}	8.1×10^{-15}	2.4×10^{-15}	9.2×10^{-16}	7.6×10^{-16}

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Semivolatile Organics	Phenanthrene	NA	NA	NA	NA	NA
Semivolatile Organics	Pyrene	NA	NA	NA	NA	NA
Semivolatile Organics	Total TEQ_BAP	NA	NA	NA	NA	NA
Volatile Organics	Formaldehyde	4.7×10^{-16}	3.8×10^{-15}	8.8×10^{-16}	3.1×10^{-16}	1.2×10^{-16}
Total		**1.3×10^{-13}**	**1.2×10^{-12}**	**5.0×10^{-13}**	**3.8×10^{-13}**	**3.2×10^{-13}**

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– Exposure pathways include ingestion of soil, inhalation of air, and external exposure to soil.
– Recreational user located 500 meters to the northwest of emissions source.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).

Table G–66 Offsite Impacts –Recreational User– Chemicals – Remedial Actions – Cancer Incidence Risk – Total

Type	*Constituent*	*Alternatives*				
		No Action	*AOC LUT*	*Revised LUT*	*CONR Residential Scenario*	*CONR Open Space Scenario*
Anions	Fluoride	NA	NA	NA	NA	NA
Anions	Perchlorate	NA	NA	NA	NA	NA
Dioxins/Furans	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	9.1×10^{-15}	9.3×10^{-14}	4.1×10^{-14}	3.0×10^{-14}	2.5×10^{-14}
Dioxins/Furans	1,2,3,4,6,7,8-HPCDF	1.3×10^{-15}	1.3×10^{-14}	5.6×10^{-15}	4.1×10^{-15}	3.4×10^{-15}
Dioxins/Furans	1,2,3,4,7,8,9-HPCDF	1.5×10^{-16}	1.5×10^{-15}	6.1×10^{-16}	4.4×10^{-16}	3.6×10^{-16}
Dioxins/Furans	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	3.9×10^{-15}	4.2×10^{-14}	1.9×10^{-14}	1.5×10^{-14}	1.3×10^{-14}
Dioxins/Furans	1,2,3,4,7,8-HXCDF	9.8×10^{-16}	9.4×10^{-15}	3.7×10^{-15}	2.5×10^{-15}	1.8×10^{-15}
Dioxins/Furans	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	3.7×10^{-15}	3.7×10^{-14}	1.6×10^{-14}	1.2×10^{-14}	9.9×10^{-15}
Dioxins/Furans	1,2,3,6,7,8-HXCDF	7.4×10^{-16}	7.1×10^{-15}	2.8×10^{-15}	1.9×10^{-15}	1.4×10^{-15}
Dioxins/Furans	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	1.9×10^{-15}	1.8×10^{-14}	7.7×10^{-15}	5.5×10^{-15}	4.5×10^{-15}
Dioxins/Furans	1,2,3,7,8,9-HXCDF	3.1×10^{-16}	3.0×10^{-15}	1.0×10^{-15}	6.1×10^{-16}	4.2×10^{-16}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzofuran	1.6×10^{-16}	1.4×10^{-15}	5.0×10^{-16}	2.7×10^{-16}	1.8×10^{-16}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	7.1×10^{-15}	7.1×10^{-14}	2.9×10^{-14}	2.1×10^{-14}	1.8×10^{-14}
Dioxins/Furans	2,3,4,6,7,8-HXCDF	9.8×10^{-16}	9.8×10^{-15}	4.0×10^{-15}	2.9×10^{-15}	2.1×10^{-15}
Dioxins/Furans	2,3,4,7,8-PECDF	2.1×10^{-15}	2.0×10^{-14}	7.8×10^{-15}	5.1×10^{-15}	3.7×10^{-15}
Dioxins/Furans	2,3,7,8-TCDD	1.3×10^{-15}	1.3×10^{-14}	5.1×10^{-15}	3.5×10^{-15}	2.9×10^{-15}
Dioxins/Furans	2,3,7,8-Tetrachlorodibenzofuran	3.0×10^{-16}	2.6×10^{-15}	1.0×10^{-15}	5.4×10^{-16}	3.6×10^{-16}
Dioxins/Furans	OCDD	3.3×10^{-15}	3.3×10^{-14}	1.4×10^{-14}	1.0×10^{-14}	8.6×10^{-15}
Dioxins/Furans	OCDF	1.0×10^{-16}	1.0×10^{-15}	4.4×10^{-16}	3.3×10^{-16}	2.7×10^{-16}
Dioxins/Furans	Total TEQ_Dioxin	NA	NA	NA	NA	NA
Herbicides	2,4-DB	NA	NA	NA	NA	NA
Herbicides	MCPA	NA	NA	NA	NA	NA
Herbicides	MCPP	NA	NA	NA	NA	NA
Metals	Antimony	NA	NA	NA	NA	NA
Metals	Barium	NA	NA	NA	NA	NA
Metals	Cadmium	1.2×10^{-13}	1.4×10^{-12}	6.1×10^{-13}	5.0×10^{-13}	4.2×10^{-13}
Metals	Chromium (Hexavalent Compounds)	4.6×10^{-12}	4.2×10^{-11}	1.2×10^{-11}	4.1×10^{-12}	3.2×10^{-12}
Metals	Lead	5.0×10^{-14}	5.4×10^{-13}	2.4×10^{-13}	1.9×10^{-13}	1.6×10^{-13}
Metals	Mercury	NA	NA	NA	NA	NA
Metals	Molybdenum	NA	NA	NA	NA	NA
Metals	Selenium	NA	NA	NA	NA	NA

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Metals	Silver	NA	NA	NA	NA	NA
Metals	Zinc	NA	NA	NA	NA	NA
Other Inorganics	Methyl Mercury	NA	NA	NA	NA	NA
Pesticides	4,4'-DDD	1.1×10^{-17}	1.2×10^{-16}	1.9×10^{-17}	9.2×10^{-18}	7.5×10^{-18}
Pesticides	4,4'-DDE	1.1×10^{-16}	1.2×10^{-15}	4.4×10^{-16}	2.6×10^{-16}	2.2×10^{-16}
Pesticides	4,4'-DDT	9.4×10^{-17}	9.0×10^{-16}	3.3×10^{-16}	1.9×10^{-16}	1.6×10^{-16}
Pesticides	Beta-Bhc	1.8×10^{-17}	1.8×10^{-16}	3.9×10^{-17}	1.5×10^{-17}	1.2×10^{-17}
Pesticides	Chlordane	9.1×10^{-17}	9.2×10^{-16}	2.4×10^{-16}	5.7×10^{-17}	4.5×10^{-17}
Pesticides	Delta-Bhc	NA	NA	NA	NA	NA
Pesticides	Dieldrin	6.4×10^{-16}	6.4×10^{-15}	2.2×10^{-15}	1.3×10^{-15}	1.1×10^{-15}
Polychlorinated Biphenyls	Aroclor 1248	2.5×10^{-15}	2.4×10^{-14}	1.1×10^{-14}	8.5×10^{-15}	6.8×10^{-15}
Polychlorinated Biphenyls	Aroclor 1254	3.2×10^{-15}	2.8×10^{-14}	1.2×10^{-14}	8.7×10^{-15}	5.2×10^{-15}
Polychlorinated Biphenyls	Aroclor 1260	5.9×10^{-14}	6.2×10^{-13}	2.9×10^{-13}	2.5×10^{-13}	2.1×10^{-13}
Polychlorinated Biphenyls	Aroclor 5460	NA	NA	NA	NA	NA
Semivolatile Organics	1-Methylnaphthalene	2.8×10^{-17}	2.8×10^{-16}	1.3×10^{-16}	1.1×10^{-16}	4.6×10^{-18}
Semivolatile Organics	2-Methylnaphthalene	NA	NA	NA	NA	NA
Semivolatile Organics	Acenaphthene	NA	NA	NA	NA	NA
Semivolatile Organics	Anthracene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(a)anthracene	1.2×10^{-15}	1.2×10^{-14}	5.6×10^{-15}	4.4×10^{-15}	3.4×10^{-15}
Semivolatile Organics	Benzo(a)pyrene	1.7×10^{-14}	1.7×10^{-13}	8.1×10^{-14}	6.5×10^{-14}	5.3×10^{-14}
Semivolatile Organics	Benzo(b)fluoranthene	1.9×10^{-15}	2.0×10^{-14}	9.3×10^{-15}	7.3×10^{-15}	5.7×10^{-15}
Semivolatile Organics	Benzo(g,h,i)perylene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(k)fluoranthene	8.7×10^{-17}	9.1×10^{-16}	4.3×10^{-16}	3.5×10^{-16}	2.7×10^{-16}
Semivolatile Organics	Bis(2-ethylhexyl)phthalate	1.1×10^{-16}	1.1×10^{-15}	4.4×10^{-16}	3.4×10^{-16}	1.9×10^{-16}
Semivolatile Organics	Chrysene	1.7×10^{-17}	1.7×10^{-16}	8.0×10^{-17}	6.3×10^{-17}	5.0×10^{-17}
Semivolatile Organics	Dibenzo(a,h)anthracene	1.9×10^{-15}	2.0×10^{-14}	8.4×10^{-15}	7.2×10^{-15}	4.3×10^{-15}
Semivolatile Organics	Di-n-octylphthalate	NA	NA	NA	NA	NA
Semivolatile Organics	Fluoranthene	NA	NA	NA	NA	NA
Semivolatile Organics	Fluorene	NA	NA	NA	NA	NA
Semivolatile Organics	Indeno(1,2,3-cd)pyrene	2.6×10^{-15}	2.8×10^{-14}	1.3×10^{-14}	1.1×10^{-14}	8.9×10^{-15}
Semivolatile Organics	Naphthalene	3.6×10^{-17}	3.6×10^{-16}	1.6×10^{-16}	1.3×10^{-16}	3.4×10^{-17}
Semivolatile Organics	N-Nitrosodimethylamine	1.9×10^{-15}	1.1×10^{-14}	3.1×10^{-15}	1.2×10^{-15}	1.0×10^{-15}

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Semivolatile Organics	Phenanthrene	NA	NA	NA	NA	NA
Semivolatile Organics	Pyrene	NA	NA	NA	NA	NA
Semivolatile Organics	Total TEQ_BAP	NA	NA	NA	NA	NA
Volatile Organics	Formaldehyde	1.1×10^{-15}	9.9×10^{-15}	2.3×10^{-15}	8.0×10^{-16}	3.0×10^{-16}
Total		**4.9×10^{-12}**	**4.6×10^{-11}**	**1.3×10^{-11}**	**5.3×10^{-12}**	**4.1×10^{-12}**

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– Exposure pathways include inhalation/submersion in air and direct soil (ingestion, inhalation, and external exposure to soil).
– Recreational user located 500 meters to the northwest of emissions source.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).

Table G–67 Offsite Impacts –Recreational User– Chemicals – Remedial Actions – Noncarcinogenic Hazards – Direct Air

Type	*Constituent*	*Alternatives*				
		No Action	***AOC LUT***	***Revised LUT***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Anions	Fluoride	2.1×10^{-11}	2.2×10^{-10}	2.1×10^{-10}	1.7×10^{-10}	2.5×10^{-10}
Anions	Perchlorate	NA	NA	NA	NA	NA
Dioxins/Furans	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	5.5×10^{-12}	6.1×10^{-11}	1.2×10^{-10}	2.6×10^{-10}	4.2×10^{-10}
Dioxins/Furans	1,2,3,4,6,7,8-HPCDF	7.7×10^{-13}	8.5×10^{-12}	1.6×10^{-11}	3.6×10^{-11}	5.9×10^{-11}
Dioxins/Furans	1,2,3,4,7,8,9-HPCDF	8.9×10^{-14}	9.7×10^{-13}	1.8×10^{-12}	3.8×10^{-12}	6.2×10^{-12}
Dioxins/Furans	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	2.4×10^{-12}	2.8×10^{-11}	5.3×10^{-11}	1.3×10^{-10}	2.2×10^{-10}
Dioxins/Furans	1,2,3,4,7,8-HXCDF	5.9×10^{-13}	6.2×10^{-12}	1.1×10^{-11}	2.1×10^{-11}	3.2×10^{-11}
Dioxins/Furans	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	2.2×10^{-12}	2.5×10^{-11}	4.7×10^{-11}	1.0×10^{-10}	1.7×10^{-10}
Dioxins/Furans	1,2,3,6,7,8-HXCDF	4.4×10^{-13}	4.7×10^{-12}	8.1×10^{-12}	1.6×10^{-11}	2.4×10^{-11}
Dioxins/Furans	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	1.1×10^{-12}	1.2×10^{-11}	2.2×10^{-11}	4.7×10^{-11}	7.8×10^{-11}
Dioxins/Furans	1,2,3,7,8,9-HXCDF	1.9×10^{-13}	2.0×10^{-12}	2.9×10^{-12}	5.3×10^{-12}	7.2×10^{-12}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzofuran	9.9×10^{-14}	9.3×10^{-13}	1.4×10^{-12}	2.3×10^{-12}	3.1×10^{-12}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	4.3×10^{-12}	4.7×10^{-11}	8.5×10^{-11}	1.8×10^{-10}	3.0×10^{-10}
Dioxins/Furans	2,3,4,6,7,8-HXCDF	6.0×10^{-13}	6.5×10^{-12}	1.2×10^{-11}	2.5×10^{-11}	3.6×10^{-11}
Dioxins/Furans	2,3,4,7,8-PECDF	1.3×10^{-12}	1.4×10^{-11}	2.2×10^{-11}	4.4×10^{-11}	6.4×10^{-11}
Dioxins/Furans	2,3,7,8-TCDD	7.8×10^{-13}	8.4×10^{-12}	1.5×10^{-11}	3.0×10^{-11}	5.0×10^{-11}
Dioxins/Furans	2,3,7,8-Tetrachlorodibenzofuran	1.8×10^{-13}	1.7×10^{-12}	2.9×10^{-12}	4.7×10^{-12}	6.1×10^{-12}
Dioxins/Furans	OCDD	2.0×10^{-12}	2.2×10^{-11}	4.1×10^{-11}	9.0×10^{-11}	1.5×10^{-10}
Dioxins/Furans	OCDF	6.1×10^{-14}	6.8×10^{-13}	1.3×10^{-12}	2.9×10^{-12}	4.8×10^{-12}
Dioxins/Furans	Total TEQ_Dioxin	NA	NA	NA	NA	NA
Herbicides	2,4-DB	NA	NA	NA	NA	NA
Herbicides	MCPA	NA	NA	NA	NA	NA
Herbicides	MCPP	NA	NA	NA	NA	NA
Metals	Antimony	8.3×10^{-10}	9.3×10^{-9}	1.8×10^{-8}	4.6×10^{-8}	7.8×10^{-8}
Metals	Barium	1.9×10^{-8}	1.8×10^{-7}	1.8×10^{-7}	2.0×10^{-7}	2.3×10^{-7}
Metals	Cadmium	1.8×10^{-8}	2.0×10^{-7}	3.9×10^{-7}	9.6×10^{-7}	1.6×10^{-6}
Metals	Chromium (Hexavalent Compounds)	5.3×10^{-10}	4.9×10^{-9}	5.7×10^{-9}	6.2×10^{-9}	9.5×10^{-9}
Metals	Lead	NA	NA	NA	NA	NA
Metals	Mercury	NA	NA	NA	NA	NA
Metals	Molybdenum	4.7×10^{-10}	5.0×10^{-9}	9.0×10^{-9}	1.9×10^{-8}	4.2×10^{-9}
Metals	Selenium	1.3×10^{-12}	1.1×10^{-11}	1.1×10^{-11}	8.9×10^{-12}	1.3×10^{-11}

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Metals	Silver	NA	NA	NA	NA	NA
Metals	Zinc	NA	NA	NA	NA	NA
Other Inorganics	Methyl Mercury	NA	NA	NA	NA	NA
Pesticides	4,4'-DDD	NA	NA	NA	NA	NA
Pesticides	4,4'-DDE	NA	NA	NA	NA	NA
Pesticides	4,4'-DDT	NA	NA	NA	NA	NA
Pesticides	Beta-Bhc	NA	NA	NA	NA	NA
Pesticides	Chlordane	1.2×10^{-12}	1.3×10^{-11}	1.5×10^{-11}	1.0×10^{-11}	1.6×10^{-11}
Pesticides	Delta-Bhc	NA	NA	NA	NA	NA
Pesticides	Dieldrin	NA	NA	NA	NA	NA
Polychlorinated Biphenyls	Aroclor 1248	NA	NA	NA	NA	NA
Polychlorinated Biphenyls	Aroclor 1254	NA	NA	NA	NA	NA
Polychlorinated Biphenyls	Aroclor 1260	NA	NA	NA	NA	NA
Polychlorinated Biphenyls	Aroclor 5460	NA	NA	NA	NA	NA
Semivolatile Organics	1-Methylnaphthalene	NA	NA	NA	NA	NA
Semivolatile Organics	2-Methylnaphthalene	NA	NA	NA	NA	NA
Semivolatile Organics	Acenaphthene	NA	NA	NA	NA	NA
Semivolatile Organics	Anthracene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(a)anthracene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(a)pyrene	4.6×10^{-9}	5.4×10^{-8}	1.1×10^{-7}	2.6×10^{-7}	4.2×10^{-7}
Semivolatile Organics	Benzo(b)fluoranthene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(g,h,i)perylene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(k)fluoranthene	NA	NA	NA	NA	NA
Semivolatile Organics	Bis(2-ethylhexyl)phthalate	NA	NA	NA	NA	NA
Semivolatile Organics	Chrysene	NA	NA	NA	NA	NA
Semivolatile Organics	Dibenzo(a,h)anthracene	NA	NA	NA	NA	NA
Semivolatile Organics	Di-n-octylphthalate	NA	NA	NA	NA	NA
Semivolatile Organics	Fluoranthene	NA	NA	NA	NA	NA
Semivolatile Organics	Fluorene	NA	NA	NA	NA	NA
Semivolatile Organics	Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA
Semivolatile Organics	Naphthalene	4.3×10^{-13}	4.6×10^{-12}	9.0×10^{-12}	2.2×10^{-11}	1.1×10^{-11}
Semivolatile Organics	N-Nitrosodimethylamine	6.8×10^{-13}	4.3×10^{-12}	5.5×10^{-12}	6.4×10^{-12}	1.1×10^{-11}
Semivolatile Organics	Phenanthrene	NA	NA	NA	NA	NA
Semivolatile Organics	Pyrene	NA	NA	NA	NA	NA

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Semivolatile Organics	Total TEQ_BAP	NA	NA	NA	NA	NA
Volatile Organics	Formaldehyde	1.4×10^{-11}	1.3×10^{-10}	1.3×10^{-10}	1.3×10^{-10}	1.0×10^{-10}
Total		**4.4×10^{-8}**	**4.5×10^{-7}**	**7.2×10^{-7}**	**1.5×10^{-6}**	**2.4×10^{-6}**

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– Exposure pathways include inhalation of air and external exposure due to submersion.
– Recreational user located 500 meters to the northwest of emissions source.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).
– Air concentrations for cancer risk evaluation based on a 26-year emission period.

Table G–68 Offsite Impacts –Recreational User– Chemicals – Remedial Actions – Noncarcinogenic Hazards – Direct Soil

Type	*Constituent*	*Alternatives*				
		No Action	***AOC LUT***	***Revised LUT***	***CONR, Residential Scenario***	***CONR, Open Space Scenario***
Anions	Fluoride	1.2×10^{-11}	1.1×10^{-10}	2.3×10^{-11}	6.2×10^{-12}	4.7×10^{-12}
Anions	Perchlorate	9.3×10^{-13}	7.4×10^{-12}	1.7×10^{-12}	6.8×10^{-13}	5.0×10^{-13}
Dioxins/Furans	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	4.0×10^{-11}	3.9×10^{-10}	1.7×10^{-10}	1.2×10^{-10}	1.0×10^{-10}
Dioxins/Furans	1,2,3,4,6,7,8-HPCDF	8.0×10^{-11}	7.7×10^{-10}	3.3×10^{-10}	2.5×10^{-10}	2.0×10^{-10}
Dioxins/Furans	1,2,3,4,7,8,9-HPCDF	9.2×10^{-12}	8.8×10^{-11}	3.6×10^{-11}	2.6×10^{-11}	2.2×10^{-11}
Dioxins/Furans	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	2.5×10^{-10}	2.5×10^{-9}	1.1×10^{-9}	8.9×10^{-10}	7.5×10^{-10}
Dioxins/Furans	1,2,3,4,7,8-HXCDF	6.1×10^{-11}	5.6×10^{-10}	2.2×10^{-10}	1.5×10^{-10}	1.1×10^{-10}
Dioxins/Furans	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	2.3×10^{-10}	2.2×10^{-9}	9.7×10^{-10}	7.1×10^{-10}	5.9×10^{-10}
Dioxins/Furans	1,2,3,6,7,8-HXCDF	4.6×10^{-11}	4.2×10^{-10}	1.7×10^{-10}	1.1×10^{-10}	8.3×10^{-11}
Dioxins/Furans	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	1.2×10^{-10}	1.1×10^{-9}	4.6×10^{-10}	3.3×10^{-10}	2.7×10^{-10}
Dioxins/Furans	1,2,3,7,8,9-HXCDF	2.0×10^{-11}	1.8×10^{-10}	6.1×10^{-11}	3.7×10^{-11}	2.5×10^{-11}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzofuran	1.0×10^{-11}	8.4×10^{-11}	3.0×10^{-11}	1.6×10^{-11}	1.1×10^{-11}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	4.5×10^{-10}	4.3×10^{-9}	1.8×10^{-9}	1.3×10^{-9}	1.1×10^{-9}
Dioxins/Furans	2,3,4,6,7,8-HXCDF	6.2×10^{-11}	5.9×10^{-10}	2.4×10^{-10}	1.7×10^{-10}	1.2×10^{-10}
Dioxins/Furans	2,3,4,7,8-PECDF	1.4×10^{-10}	1.2×10^{-9}	4.7×10^{-10}	3.1×10^{-10}	2.2×10^{-10}
Dioxins/Furans	2,3,7,8-TCDD	8.2×10^{-11}	7.6×10^{-10}	3.0×10^{-10}	2.1×10^{-10}	1.7×10^{-10}
Dioxins/Furans	2,3,7,8-Tetrachlorodibenzofuran	1.9×10^{-11}	1.6×10^{-10}	6.1×10^{-11}	3.2×10^{-11}	2.1×10^{-11}
Dioxins/Furans	OCDD	2.1×10^{-10}	2.0×10^{-9}	8.6×10^{-10}	6.3×10^{-10}	5.2×10^{-10}
Dioxins/Furans	OCDF	6.4×10^{-12}	6.1×10^{-11}	2.7×10^{-11}	2.0×10^{-11}	1.7×10^{-11}
Dioxins/Furans	Total TEQ_Dioxin	NA	NA	NA	NA	NA
Herbicides	2,4-DB	3.0×10^{-14}	2.4×10^{-13}	6.5×10^{-14}	2.6×10^{-14}	1.8×10^{-14}
Herbicides	MCPA	2.2×10^{-10}	1.8×10^{-9}	4.8×10^{-10}	1.4×10^{-10}	1.0×10^{-10}
Herbicides	MCPP	7.8×10^{-11}	6.8×10^{-10}	1.9×10^{-10}	9.5×10^{-11}	7.8×10^{-11}
Metals	Antimony	1.1×10^{-9}	1.0×10^{-8}	4.7×10^{-9}	3.9×10^{-9}	3.3×10^{-9}
Metals	Barium	8.0×10^{-11}	6.5×10^{-10}	1.6×10^{-10}	5.5×10^{-11}	3.3×10^{-11}
Metals	Cadmium	4.2×10^{-16}	4.1×10^{-15}	1.8×10^{-15}	1.5×10^{-15}	1.2×10^{-15}
Metals	Chromium (Hexavalent Compounds)	3.0×10^{-11}	2.4×10^{-10}	6.5×10^{-11}	2.3×10^{-11}	1.8×10^{-11}
Metals	Lead	NA	NA	NA	NA	NA
Metals	Mercury	2.6×10^{-10}	2.5×10^{-9}	1.2×10^{-9}	8.4×10^{-10}	3.0×10^{-10}
Metals	Molybdenum	6.3×10^{-11}	5.9×10^{-10}	2.4×10^{-10}	1.7×10^{-10}	1.9×10^{-11}
Metals	Selenium	8.6×10^{-12}	6.6×10^{-11}	1.5×10^{-11}	4.0×10^{-12}	2.9×10^{-12}

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR, Residential Scenario	CONR, Open Space Scenario
Metals	Silver	2.7×10^{-10}	2.7×10^{-9}	1.3×10^{-9}	1.0×10^{-9}	8.5×10^{-10}
Metals	Zinc	5.0×10^{-11}	4.2×10^{-10}	1.4×10^{-10}	6.5×10^{-11}	4.6×10^{-11}
Other Inorganics	Methyl Mercury	4.9×10^{-12}	3.9×10^{-11}	7.7×10^{-12}	2.3×10^{-12}	1.7×10^{-12}
Pesticides	4,4'-DDD	8.9×10^{-12}	9.2×10^{-11}	1.5×10^{-11}	7.3×10^{-12}	5.9×10^{-12}
Pesticides	4,4'-DDE	5.8×10^{-12}	6.2×10^{-11}	2.3×10^{-11}	1.4×10^{-11}	1.1×10^{-11}
Pesticides	4,4'-DDT	3.2×10^{-12}	2.9×10^{-11}	1.1×10^{-11}	6.3×10^{-12}	5.1×10^{-12}
Pesticides	Beta-Bhc	NA	NA	NA	NA	NA
Pesticides	Chlordane	3.0×10^{-12}	2.9×10^{-11}	7.7×10^{-12}	1.8×10^{-12}	1.4×10^{-12}
Pesticides	Delta-Bhc	NA	NA	NA	NA	NA
Pesticides	Dieldrin	4.8×10^{-12}	4.5×10^{-11}	1.6×10^{-11}	9.6×10^{-12}	7.8×10^{-12}
Polychlorinated Biphenyls	Aroclor 1248	NA	NA	NA	NA	NA
Polychlorinated Biphenyls	Aroclor 1254	4.8×10^{-10}	4.0×10^{-9}	1.7×10^{-9}	1.2×10^{-9}	7.4×10^{-10}
Polychlorinated Biphenyls	Aroclor 1260	NA	NA	NA	NA	NA
Polychlorinated Biphenyls	Aroclor 5460	1.3×10^{-11}	1.2×10^{-10}	5.2×10^{-11}	3.8×10^{-11}	3.1×10^{-11}
Semivolatile Organics	1-Methylnaphthalene	1.2×10^{-13}	1.2×10^{-12}	5.5×10^{-13}	4.7×10^{-13}	1.9×10^{-14}
Semivolatile Organics	2-Methylnaphthalene	2.6×10^{-12}	2.6×10^{-11}	1.2×10^{-11}	1.0×10^{-11}	4.0×10^{-13}
Semivolatile Organics	Acenaphthene	2.7×10^{-14}	2.6×10^{-13}	1.1×10^{-13}	9.5×10^{-14}	6.8×10^{-14}
Semivolatile Organics	Anthracene	1.6×10^{-14}	1.6×10^{-13}	6.9×10^{-14}	6.0×10^{-14}	4.2×10^{-14}
Semivolatile Organics	Benzo(a)anthracene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(a)pyrene	6.9×10^{-11}	6.9×10^{-10}	3.2×10^{-10}	2.6×10^{-10}	2.1×10^{-10}
Semivolatile Organics	Benzo(b)fluoranthene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(g,h,i)perylene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(k)fluoranthene	NA	NA	NA	NA	NA
Semivolatile Organics	Bis(2-ethylhexyl)phthalate	2.6×10^{-12}	2.5×10^{-11}	1.0×10^{-11}	8.0×10^{-12}	4.5×10^{-12}
Semivolatile Organics	Chrysene	NA	NA	NA	NA	NA
Semivolatile Organics	Dibenzo(a,h)anthracene	NA	NA	NA	NA	NA
Semivolatile Organics	Di-n-octylphthalate	7.5×10^{-13}	6.9×10^{-12}	2.7×10^{-12}	1.9×10^{-12}	1.7×10^{-12}
Semivolatile Organics	Fluoranthene	8.0×10^{-13}	7.9×10^{-12}	3.7×10^{-12}	2.9×10^{-12}	2.3×10^{-12}
Semivolatile Organics	Fluorene	4.1×10^{-14}	4.0×10^{-13}	1.7×10^{-13}	1.4×10^{-13}	8.3×10^{-14}
Semivolatile Organics	Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA
Semivolatile Organics	Naphthalene	6.7×10^{-13}	6.2×10^{-12}	2.8×10^{-12}	2.3×10^{-12}	5.8×10^{-13}
Semivolatile Organics	N-Nitrosodimethylamine	6.2×10^{-12}	3.4×10^{-11}	1.0×10^{-11}	3.9×10^{-12}	3.2×10^{-12}
Semivolatile Organics	Phenanthrene	NA	NA	NA	NA	NA
Semivolatile Organics	Pyrene	9.8×10^{-13}	9.6×10^{-12}	4.5×10^{-12}	3.6×10^{-12}	2.8×10^{-12}

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR, Residential Scenario	CONR, Open Space Scenario
Semivolatile Organics	Total TEQ_BAP	NA	NA	NA	NA	NA
Volatile Organics	Formaldehyde	1.1×10^{-11}	9.0×10^{-11}	2.1×10^{-11}	7.2×10^{-12}	2.7×10^{-12}
Total		**4.6×10^{-9}**	**4.3×10^{-8}**	**1.8×10^{-8}**	**1.3×10^{-8}**	**1.0×10^{-8}**

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– Exposure pathways include ingestion of soil, inhalation of air, and external exposure to soil.

– Recreational user located 500 meters to the northwest of emissions source.

– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).

Table G–69 Offsite Impacts –Recreational User– Chemicals – Remedial Actions – Noncarcinogenic Hazards – Total

Type	*Constituent*	*Alternatives*				
		No Action	***AOC LUT***	***Revised LUT***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Anions	Fluoride	3.3×10^{-11}	3.3×10^{-10}	2.3×10^{-10}	1.7×10^{-10}	2.6×10^{-10}
Anions	Perchlorate	9.3×10^{-13}	7.4×10^{-12}	1.7×10^{-12}	6.8×10^{-13}	5.0×10^{-13}
Dioxins/Furans	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	4.6×10^{-11}	4.5×10^{-10}	2.9×10^{-10}	3.8×10^{-10}	5.3×10^{-10}
Dioxins/Furans	1,2,3,4,6,7,8-HPCDF	8.1×10^{-11}	7.7×10^{-10}	3.5×10^{-10}	2.8×10^{-10}	2.6×10^{-10}
Dioxins/Furans	1,2,3,4,7,8,9-HPCDF	9.3×10^{-12}	8.9×10^{-11}	3.8×10^{-11}	3.0×10^{-11}	2.8×10^{-11}
Dioxins/Furans	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	2.5×10^{-10}	2.5×10^{-9}	1.2×10^{-9}	1.0×10^{-9}	9.7×10^{-10}
Dioxins/Furans	1,2,3,4,7,8-HXCDF	6.2×10^{-11}	5.7×10^{-10}	2.3×10^{-10}	1.7×10^{-10}	1.4×10^{-10}
Dioxins/Furans	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	2.4×10^{-10}	2.3×10^{-9}	1.0×10^{-9}	8.2×10^{-10}	7.6×10^{-10}
Dioxins/Furans	1,2,3,6,7,8-HXCDF	4.7×10^{-11}	4.3×10^{-10}	1.8×10^{-10}	1.3×10^{-10}	1.1×10^{-10}
Dioxins/Furans	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	1.2×10^{-10}	1.1×10^{-9}	4.8×10^{-10}	3.8×10^{-10}	3.5×10^{-10}
Dioxins/Furans	1,2,3,7,8,9-HXCDF	2.0×10^{-11}	1.8×10^{-10}	6.4×10^{-11}	4.2×10^{-11}	3.2×10^{-11}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzofuran	1.0×10^{-11}	8.5×10^{-11}	3.2×10^{-11}	1.8×10^{-11}	1.4×10^{-11}
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	4.5×10^{-10}	4.3×10^{-9}	1.8×10^{-9}	1.5×10^{-9}	1.4×10^{-9}
Dioxins/Furans	2,3,4,6,7,8-HXCDF	6.3×10^{-11}	6.0×10^{-10}	2.5×10^{-10}	2.0×10^{-10}	1.6×10^{-10}
Dioxins/Furans	2,3,4,7,8-PECDF	1.4×10^{-10}	1.2×10^{-9}	4.9×10^{-10}	3.5×10^{-10}	2.8×10^{-10}
Dioxins/Furans	2,3,7,8-TCDD	8.2×10^{-11}	7.7×10^{-10}	3.2×10^{-10}	2.4×10^{-10}	2.2×10^{-10}
Dioxins/Furans	2,3,7,8-Tetrachlorodibenzofuran	1.9×10^{-11}	1.6×10^{-10}	6.4×10^{-11}	3.7×10^{-11}	2.7×10^{-11}
Dioxins/Furans	OCDD	2.1×10^{-10}	2.0×10^{-9}	9.0×10^{-10}	7.2×10^{-10}	6.7×10^{-10}
Dioxins/Furans	OCDF	6.5×10^{-12}	6.2×10^{-11}	2.8×10^{-11}	2.3×10^{-11}	2.1×10^{-11}
Dioxins/Furans	Total TEQ_Dioxin	NA	NA	NA	NA	NA
Herbicides	2,4-DB	3.0×10^{-14}	2.4×10^{-13}	6.5×10^{-14}	2.6×10^{-14}	1.8×10^{-14}
Herbicides	MCPA	2.2×10^{-10}	1.8×10^{-9}	4.8×10^{-10}	1.4×10^{-10}	1.0×10^{-10}
Herbicides	MCPP	7.8×10^{-11}	6.8×10^{-10}	1.9×10^{-10}	9.5×10^{-11}	7.8×10^{-11}
Metals	Antimony	1.9×10^{-9}	2.0×10^{-8}	2.3×10^{-8}	5.0×10^{-8}	8.1×10^{-8}
Metals	Barium	1.9×10^{-8}	1.8×10^{-7}	1.8×10^{-7}	2.0×10^{-7}	2.3×10^{-7}
Metals	Cadmium	1.8×10^{-8}	2.0×10^{-7}	3.9×10^{-7}	9.6×10^{-7}	1.6×10^{-6}
Metals	Chromium (Hexavalent Compounds)	5.6×10^{-10}	5.1×10^{-9}	5.8×10^{-9}	6.2×10^{-9}	9.5×10^{-9}
Metals	Lead	NA	NA	NA	NA	NA
Metals	Mercury	2.6×10^{-10}	2.5×10^{-9}	1.2×10^{-9}	8.4×10^{-10}	3.0×10^{-10}
Metals	Molybdenum	5.3×10^{-10}	5.6×10^{-9}	9.3×10^{-9}	1.9×10^{-8}	4.2×10^{-9}
Metals	Selenium	9.9×10^{-12}	7.7×10^{-11}	2.6×10^{-11}	1.3×10^{-11}	1.6×10^{-11}

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Metals	Silver	2.7×10^{-10}	2.7×10^{-9}	1.3×10^{-9}	1.0×10^{-9}	8.5×10^{-10}
Metals	Zinc	5.0×10^{-11}	4.2×10^{-10}	1.4×10^{-10}	6.5×10^{-11}	4.6×10^{-11}
Other Inorganics	Methyl Mercury	4.9×10^{-12}	3.9×10^{-11}	7.7×10^{-12}	2.3×10^{-12}	1.7×10^{-12}
Pesticides	4,4'-DDD	8.9×10^{-12}	9.2×10^{-11}	1.5×10^{-11}	7.3×10^{-12}	5.9×10^{-12}
Pesticides	4,4'-DDE	5.8×10^{-12}	6.2×10^{-11}	2.3×10^{-11}	1.4×10^{-11}	1.1×10^{-11}
Pesticides	4,4'-DDT	3.2×10^{-12}	2.9×10^{-11}	1.1×10^{-11}	6.3×10^{-12}	5.1×10^{-12}
Pesticides	Beta-Bhc	NA	NA	NA	NA	NA
Pesticides	Chlordane	4.2×10^{-12}	4.2×10^{-11}	2.2×10^{-11}	1.2×10^{-11}	1.8×10^{-11}
Pesticides	Delta-Bhc	NA	NA	NA	NA	NA
Pesticides	Dieldrin	4.8×10^{-12}	4.5×10^{-11}	1.6×10^{-11}	9.6×10^{-12}	7.8×10^{-12}
Polychlorinated Biphenyls	Aroclor 1248	NA	NA	NA	NA	NA
Polychlorinated Biphenyls	Aroclor 1254	4.8×10^{-10}	4.0×10^{-9}	1.7×10^{-9}	1.2×10^{-9}	7.4×10^{-10}
Polychlorinated Biphenyls	Aroclor 1260	NA	NA	NA	NA	NA
Polychlorinated Biphenyls	Aroclor 5460	1.3×10^{-11}	1.2×10^{-10}	5.2×10^{-11}	3.8×10^{-11}	3.1×10^{-11}
Semivolatile Organics	1-Methylnaphthalene	1.2×10^{-13}	1.2×10^{-12}	5.5×10^{-13}	4.7×10^{-13}	1.9×10^{-14}
Semivolatile Organics	2-Methylnaphthalene	2.6×10^{-12}	2.6×10^{-11}	1.2×10^{-11}	1.0×10^{-11}	4.0×10^{-13}
Semivolatile Organics	Acenaphthene	2.7×10^{-14}	2.6×10^{-13}	1.1×10^{-13}	9.5×10^{-14}	6.8×10^{-14}
Semivolatile Organics	Anthracene	1.6×10^{-14}	1.6×10^{-13}	6.9×10^{-14}	6.0×10^{-14}	4.2×10^{-14}
Semivolatile Organics	Benzo(a)anthracene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(a)pyrene	4.7×10^{-9}	5.4×10^{-8}	1.1×10^{-7}	2.6×10^{-7}	4.2×10^{-7}
Semivolatile Organics	Benzo(b)fluoranthene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(g,h,i)perylene	NA	NA	NA	NA	NA
Semivolatile Organics	Benzo(k)fluoranthene	NA	NA	NA	NA	NA
Semivolatile Organics	Bis(2-ethylhexyl)phthalate	2.6×10^{-12}	2.5×10^{-11}	1.0×10^{-11}	8.0×10^{-12}	4.5×10^{-12}
Semivolatile Organics	Chrysene	NA	NA	NA	NA	NA
Semivolatile Organics	Dibenzo(a,h)anthracene	NA	NA	NA	NA	NA
Semivolatile Organics	Di-n-octylphthalate	7.5×10^{-13}	6.9×10^{-12}	2.7×10^{-12}	1.9×10^{-12}	1.7×10^{-12}
Semivolatile Organics	Fluoranthene	8.0×10^{-13}	7.9×10^{-12}	3.7×10^{-12}	2.9×10^{-12}	2.3×10^{-12}
Semivolatile Organics	Fluorene	4.1×10^{-14}	4.0×10^{-13}	1.7×10^{-13}	1.4×10^{-13}	8.3×10^{-14}
Semivolatile Organics	Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA
Semivolatile Organics	Naphthalene	1.1×10^{-12}	1.1×10^{-11}	1.2×10^{-11}	2.4×10^{-11}	1.2×10^{-11}
Semivolatile Organics	N-Nitrosodimethylamine	6.9×10^{-12}	3.9×10^{-11}	1.6×10^{-11}	1.0×10^{-11}	1.4×10^{-11}

Type	Constituent	Alternatives				
		No Action	AOC LUT	Revised LUT	CONR Residential Scenario	CONR Open Space Scenario
Semivolatile Organics	Phenanthrene	NA	NA	NA	NA	NA
Semivolatile Organics	Pyrene	9.8×10^{-13}	9.6×10^{-12}	4.5×10^{-12}	3.6×10^{-12}	2.8×10^{-12}
Semivolatile Organics	Total TEQ_BAP	NA	NA	NA	NA	NA
Volatile Organics	Formaldehyde	2.5×10^{-11}	2.2×10^{-10}	1.5×10^{-10}	1.4×10^{-10}	1.0×10^{-10}
Total		**4.8×10^{-8}**	**5.0×10^{-7}**	**7.4×10^{-7}**	**1.5×10^{-6}**	**2.4×10^{-6}**

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– Exposure pathways include inhalation/submersion in air and direct soil (ingestion, inhalation, and external exposure to soil).
– Recreational user located 500 meters to the northwest of emissions source.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).

Table G–70 Offsite Impacts –Recreational User– Radionuclides – Remedial Actions – Cancer Incidence Risk – Direct Air

	Alternatives				
Constituent	***No Action***	***AOC LUT***	***Revised LUT***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Am-241	2.2×10^{-15}	2.4×10^{-14}	5.8×10^{-15}	1.8×10^{-15}	1.4×10^{-15}
Cm-243/244	1.0×10^{-15}	1.2×10^{-14}	3.1×10^{-15}	9.8×10^{-16}	7.5×10^{-16}
Co-60	1.1×10^{-18}	1.2×10^{-17}	2.4×10^{-18}	1.7×10^{-18}	1.5×10^{-18}
Cs-137	7.9×10^{-16}	1.3×10^{-14}	3.9×10^{-15}	4.9×10^{-15}	4.1×10^{-15}
H-3	1.5×10^{-17}	1.8×10^{-16}	4.9×10^{-17}	1.4×10^{-17}	9.4×10^{-18}
Ni-59	3.1×10^{-17}	1.5×10^{-17}	8.4×10^{-18}	9.0×10^{-18}	9.6×10^{-18}
Np-237	7.2×10^{-16}	1.0×10^{-14}	2.2×10^{-15}	NA	NA
Pu-238	1.1×10^{-15}	1.3×10^{-14}	3.4×10^{-15}	1.0×10^{-15}	9.3×10^{-16}
Pu-239/240	3.0×10^{-15}	3.4×10^{-14}	9.0×10^{-15}	3.0×10^{-15}	2.4×10^{-15}
Sr-90	8.5×10^{-16}	1.4×10^{-14}	3.9×10^{-15}	9.8×10^{-16}	6.4×10^{-16}
Total	**9.7×10^{-15}**	**1.2×10^{-13}**	**3.1×10^{-14}**	**1.3×10^{-14}**	**1.0×10^{-14}**

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– Exposure pathways include inhalation of air and external exposure due to submersion.
– Recreational user located 500 meters to the northwest of emissions source.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).
– Ni-59 has a 95 percent upper confidence limit on the mean below 0 in source areas with only radiological constituents for the Cleanup to AOC LUT Values and Cleanup to Revised LUT Values Alternatives.
– Np-237 not detected in samples associated with the Conservation of Natural Resources Alternative scenarios.
– Air concentrations for cancer risk evaluation based on a 26-year emission period.

Table G–71 Offsite Impacts –Recreational User– Radionuclides – Remedial Actions – Cancer Incidence Risk – Direct Soil

	Alternatives				
Constituent	***No Action***	***AOC LUT***	***Revised LUT***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Am-241	2.0×10^{-17}	1.8×10^{-16}	4.5×10^{-17}	1.4×10^{-17}	1.1×10^{-17}
Cm-243/244	6.1×10^{-17}	6.3×10^{-16}	1.6×10^{-16}	5.0×10^{-17}	3.8×10^{-17}
Co-60	2.5×10^{-16}	2.3×10^{-15}	4.8×10^{-16}	3.3×10^{-16}	3.0×10^{-16}
Cs-137	8.9×10^{-14}	1.3×10^{-12}	3.8×10^{-13}	4.8×10^{-13}	4.0×10^{-13}
H-3	2.0×10^{-14}	2.0×10^{-13}	5.6×10^{-14}	1.6×10^{-14}	1.1×10^{-14}
Ni-59	1.4×10^{-17}	5.7×10^{-18}	3.2×10^{-18}	3.4×10^{-18}	3.7×10^{-18}
Np-237	1.5×10^{-16}	1.8×10^{-15}	3.8×10^{-16}	NA	NA
Pu-238	3.9×10^{-18}	4.0×10^{-17}	1.0×10^{-17}	3.2×10^{-18}	2.8×10^{-18}
Pu-239/240	1.1×10^{-17}	1.1×10^{-16}	2.9×10^{-17}	9.5×10^{-18}	7.5×10^{-18}
Sr-90	3.7×10^{-16}	5.0×10^{-15}	1.5×10^{-15}	3.6×10^{-16}	2.4×10^{-16}
Total	**1.1×10^{-13}**	**1.5×10^{-12}**	**4.4×10^{-13}**	**5.0×10^{-13}**	**4.1×10^{-13}**

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– Exposure pathways include ingestion of soil, inhalation of air, and external exposure to soil.
– Recreational user located 500 meters to the northwest of emissions source.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).
– Np-237 not detected in samples associated with the Conservation of Natural Resources Alternative scenarios.

Table G–72 Offsite Impacts –Recreational User– Radionuclides – Remedial Actions – Cancer Incidence Risk – Total

	Alternatives				
Constituent	***No Action***	***AOC LUT***	***Revised LUT***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Am-241	2.2×10^{-15}	2.4×10^{-14}	5.9×10^{-15}	1.8×10^{-15}	1.5×10^{-15}
Cm-243/244	1.1×10^{-15}	1.3×10^{-14}	3.3×10^{-15}	1.0×10^{-15}	7.8×10^{-16}
Co-60	2.5×10^{-16}	2.3×10^{-15}	4.8×10^{-16}	3.4×10^{-16}	3.0×10^{-16}
Cs-137	8.9×10^{-14}	1.3×10^{-12}	3.8×10^{-13}	4.8×10^{-13}	4.0×10^{-13}
H-3	2.0×10^{-14}	2.0×10^{-13}	5.6×10^{-14}	1.6×10^{-14}	1.1×10^{-14}
Ni-59	4.5×10^{-17}	2.1×10^{-17}	1.2×10^{-17}	1.2×10^{-17}	1.3×10^{-17}
Np-237	8.7×10^{-16}	1.2×10^{-14}	2.6×10^{-15}	NA	NA
Pu-238	1.1×10^{-15}	1.3×10^{-14}	3.4×10^{-15}	1.0×10^{-15}	9.4×10^{-16}
Pu-239/240	3.0×10^{-15}	3.4×10^{-14}	9.1×10^{-15}	3.0×10^{-15}	2.4×10^{-15}
Sr-90	1.2×10^{-15}	1.9×10^{-14}	5.4×10^{-15}	1.3×10^{-15}	8.7×10^{-16}
Total	$\mathbf{1.2\times10^{-13}}$	$\mathbf{1.6\times10^{-12}}$	$\mathbf{4.7\times10^{-13}}$	$\mathbf{5.1\times10^{-13}}$	$\mathbf{4.2\times10^{-13}}$

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– Exposure pathways include inhalation/submersion in air and direct soil (ingestion, inhalation, and external exposure to soil).
– Recreational user located 500 meters to the northwest of emissions source.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).
– Np-237 not detected in samples associated with the Conservation of Natural Resources Alternative scenarios.

Table G–73 Offsite Impacts –Recreational User– Radionuclides – Remedial Actions – Radiological Dose – Air

Constituent	Alternatives				
	No Action	Cleanup to AOC LUT Values	Cleanup to Revised LUT Values	CONR Residential Scenario	CONR Open Space Scenario
Am-241	1.2×10^{-8}	6.7×10^{-9}	6.7×10^{-9}	3.8×10^{-10}	3.1×10^{-10}
Cm-243/244	4.4×10^{-9}	2.4×10^{-9}	2.4×10^{-9}	1.6×10^{-10}	1.2×10^{-10}
Co-60	1.1×10^{-12}	6.4×10^{-13}	6.4×10^{-13}	6.8×10^{-14}	6.1×10^{-14}
Cs-137	1.1×10^{-9}	4.2×10^{-11}	4.2×10^{-11}	2.7×10^{-10}	2.3×10^{-10}
H-3	1.2×10^{-11}	7.1×10^{-12}	7.1×10^{-12}	4.4×10^{-13}	3.0×10^{-13}
Ni-59	3.2×10^{-11}	NA	NA	3.6×10^{-13}	3.8×10^{-13}
Np-237	3.1×10^{-9}	1.8×10^{-9}	1.8×10^{-9}	NA	NA
Pu-238	5.7×10^{-9}	3.1×10^{-9}	3.1×10^{-9}	2.0×10^{-10}	1.8×10^{-10}
Pu-239/240	1.7×10^{-8}	8.0×10^{-9}	8.0×10^{-9}	6.4×10^{-10}	5.1×10^{-10}
Sr-90	1.1×10^{-9}	1.0×10^{-10}	1.0×10^{-10}	4.8×10^{-11}	3.1×10^{-11}
Total	**4.4×10^{-8}**	**2.2×10^{-8}**	**2.2×10^{-8}**	**1.7×10^{-9}**	**1.4×10^{-9}**

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– All doses in units of millirem.
– Exposure pathways include inhalation of air and external exposure due to submersion.
– Recreational user located 500 meters to the northwest of emissions source.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).
– Ni-59 has a 95 percent upper confidence limit on the mean below 0 in source areas with only radiological constituents for the Cleanup to AOC LUT Values and Cleanup to Revised LUT Values Alternatives.
– Np-237 not detected in samples associated with the Conservation of Natural Resources Alternative scenarios.
– Air concentrations for dose evaluation assume a 2-year emission period for radiological sources.

Table G–74 Offsite Impacts –Recreational User– Radionuclides – Remedial Actions – Radiological Dose – Soil

Constituent	Alternatives				
	No Action	Cleanup to AOC LUT Values	Cleanup to Revised LUT Values	CONR Residential Scenario	CONR Open Space Scenario
Am-241	6.8×10^{-11}	2.4×10^{-11}	6.0×10^{-12}	1.8×10^{-12}	1.5×10^{-12}
Cm-243/244	9.7×10^{-11}	3.9×10^{-11}	9.9×10^{-12}	3.1×10^{-12}	2.4×10^{-12}
Co-60	3.4×10^{-10}	1.2×10^{-10}	2.5×10^{-11}	1.7×10^{-11}	1.5×10^{-11}
Cs-137	1.3×10^{-7}	7.3×10^{-8}	2.1×10^{-8}	2.7×10^{-8}	2.2×10^{-8}
H-3	1.6×10^{-8}	6.5×10^{-9}	1.8×10^{-9}	5.1×10^{-10}	3.5×10^{-10}
Ni-59	5.3×10^{-12}	8.5×10^{-14}	4.8×10^{-14}	5.1×10^{-14}	5.4×10^{-14}
Np-237	2.3×10^{-10}	1.1×10^{-10}	2.3×10^{-11}	NA	NA
Pu-238	2.0×10^{-11}	7.7×10^{-12}	2.0×10^{-12}	6.1×10^{-13}	5.4×10^{-13}
Pu-239/240	5.8×10^{-11}	2.2×10^{-11}	5.9×10^{-12}	1.9×10^{-12}	1.5×10^{-12}
Sr-90	5.5×10^{-10}	2.9×10^{-10}	8.4×10^{-11}	2.1×10^{-11}	1.4×10^{-11}
Total	**1.5×10^{-7}**	**8.0×10^{-8}**	**2.3×10^{-8}**	**2.7×10^{-8}**	**2.3×10^{-8}**

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:
- All doses in units of millirem.
- Exposure pathways include inhalation of air and external exposure due to submersion.
- Recreational user located 500 meters to the northwest of emissions source.
- Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).
- Ni-59 has a 95 percent upper confidence limit on the mean below 0 in source areas with only radiological constituents for the Cleanup to AOC LUT Values and Cleanup to Revised LUT Values Alternatives.
- Np-237 not detected in samples associated with the Conservation of Natural Resources Alternative scenarios.
- Air concentrations for dose evaluation assume a 1-year emission period for radiological sources.

Table G–75 Offsite Impacts –Recreational User– Radionuclides – Remedial Actions – Radiological Dose – Total

	Alternatives				
Constituent	***No Action***	***Cleanup to AOC LUT Values***	***Cleanup to Revised LUT Values***	***CONR Residential Scenario***	***CONR Open Space Scenario***
Am-241	1.2×10^{-8}	6.7×10^{-9}	6.7×10^{-9}	3.8×10^{-10}	3.1×10^{-10}
Cm-243/244	4.5×10^{-9}	2.5×10^{-9}	2.4×10^{-9}	1.6×10^{-10}	1.2×10^{-10}
Co-60	3.4×10^{-10}	1.2×10^{-10}	2.6×10^{-11}	1.7×10^{-11}	1.6×10^{-11}
Cs-137	1.3×10^{-7}	7.3×10^{-8}	2.1×10^{-8}	2.7×10^{-8}	2.3×10^{-8}
H-3	1.6×10^{-8}	6.6×10^{-9}	1.8×10^{-9}	5.1×10^{-10}	3.5×10^{-10}
Ni-59	3.8×10^{-11}	8.5×10^{-14}	4.8×10^{-14}	4.1×10^{-13}	4.4×10^{-13}
Np-237	3.3×10^{-9}	1.9×10^{-9}	1.8×10^{-9}	NA	NA
Pu-238	5.8×10^{-9}	3.1×10^{-9}	3.1×10^{-9}	2.0×10^{-10}	1.8×10^{-10}
Pu-239/240	1.7×10^{-8}	8.1×10^{-9}	8.0×10^{-9}	6.4×10^{-10}	5.1×10^{-10}
Sr-90	1.6×10^{-9}	3.9×10^{-10}	1.8×10^{-10}	6.9×10^{-11}	4.5×10^{-11}
Total	**1.9×10^{-7}**	**1.0×10^{-7}**	**4.5×10^{-8}**	**2.9×10^{-8}**	**2.4×10^{-8}**

CONR = Conservation of Natural Resources; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– All doses in units of millirem
– Exposure pathways include inhalation of air and external exposure due to submersion.
– Recreational user located 500 meters to the northwest of emissions source.
– Assumed that PM_{10} contaminated material has twice the concentration as the bulk soil, based on SSFL soil partitioning study (Matsumoto and Martin 2015).
– Ni-59 has a 95 percent upper confidence limit on the mean below 0 in source areas with only radiological constituents for the Cleanup to AOC LUT Values and Cleanup to Revised LUT Values Alternatives.
– Np-237 was not detected in samples associated with the Conservation of Natural Resources Alternative scenarios.
– Air concentrations for dose evaluation assume a 2-year emission period for radiological sources

Table G–76 Summary of Risk and Hazard Results for Offsite Impacts during Remedial Alternatives Implementation – Suburban Resident with Garden – Exposure to Chemicals

Alternative	Chemical Risks				Chemical Hazards			
	Air	Soil	Produce	Total	Air	Soil	Produce	Total
No Action	6.3×10^{-12}	5.7×10^{-14}	5.7×10^{-12}	**1.2×10^{-11}**	5.8×10^{-8}	2.2×10^{-9}	1.4×10^{-7}	**2.0×10^{-7}**
AOC LUT	5.9×10^{-11}	5.4×10^{-13}	3.7×10^{-11}	**9.6×10^{-11}**	6.0×10^{-7}	2.0×10^{-8}	1.2×10^{-6}	**1.8×10^{-6}**
Revised LUT	1.6×10^{-11}	2.3×10^{-13}	1.3×10^{-11}	**2.9×10^{-11}**	9.5×10^{-7}	8.6×10^{-9}	4.8×10^{-7}	**1.4×10^{-6}**
CONR Residential Scenario	6.5×10^{-12}	1.7×10^{-13}	7.0×10^{-12}	**1.4×10^{-11}**	2.0×10^{-6}	6.4×10^{-9}	3.4×10^{-7}	**2.3×10^{-6}**
CONR Open Space Scenario	5.1×10^{-12}	1.4×10^{-13}	5.8×10^{-12}	**1.1×10^{-11}**	3.1×10^{-6}	4.9×10^{-9}	2.4×10^{-7}	**3.4×10^{-6}**
Building Demolition	NA	NA	NA	**NA**	NA	NA	NA	**NA**
Bedrock Excavation	NA	NA	NA	**NA**	NA	NA	NA	**NA**

CONR = Conservation of Natural Resources; m = meter; m^3 = cubic meters; mps = meters per second; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– Remedial alternatives emissions based on 7 percent silt content, 2.4 mps wind speed, 2-m drop, 5 percent moisture content, 1-m^3 drop volume.

– Results based on increased partitioning of constituents in PM_{10} as a factor of 2 higher than bulk contaminated material.

– Remediation of sources with only radiological constituents is assumed to occur over 2 years.

– Suburban resident located 1,800 meters northwest of onsite emissions source.

Table G–77 Summary of Risk and Dose Results for Offsite Impacts during Remedial Alternatives Implementation – Suburban Resident with Garden – Exposure to Radionuclides

Alternative	Radiological Risks				Radiological Doses (millirem)			
	Air	Soil	Produce	Total	Air	Soil	Produce	Total
No Action	1.2×10^{-14}	6.7×10^{-14}	6.0×10^{-14}	**1.4×10^{-13}**	5.5×10^{-8}	8.1×10^{-8}	8.3×10^{-8}	**2.2×10^{-7}**
AOC LUT	1.4×10^{-13}	8.7×10^{-13}	7.9×10^{-13}	**1.8×10^{-12}**	2.8×10^{-8}	4.2×10^{-8}	4.3×10^{-8}	**1.1×10^{-7}**
Revised LUT	3.7×10^{-14}	2.5×10^{-13}	2.3×10^{-13}	**5.1×10^{-13}**	2.8×10^{-8}	1.2×10^{-8}	1.2×10^{-8}	**5.2×10^{-8}**
CONR Residential Scenario	1.4×10^{-14}	2.4×10^{-13}	1.3×10^{-13}	**3.8×10^{-13}**	4.1×10^{-9}	2.6×10^{-8}	1.3×10^{-8}	**4.3×10^{-8}**
CONR Open Space Scenario	1.2×10^{-14}	2.0×10^{-13}	9.7×10^{-14}	**3.1×10^{-13}**	1.7×10^{-9}	1.1×10^{-8}	5.0×10^{-9}	**1.7×10^{-8}**
Building Demolition	5.5×10^{-9}	1.8×10^{-9}	9.7×10^{-8}	**1.0×10^{-7}**	3.5×10^{-1}	2.6×10^{-3}	1.5×10^{-1}	**2.5×10^{-1}**
Bedrock Excavation	7.6×10^{-10}	2.6×10^{-12}	5.0×10^{-10}	**1.3×10^{-9}**	9.7×10^{-4}	3.9×10^{-6}	7.5×10^{-4}	**1.7×10^{-3}**

CONR = Conservation of Natural Resources; m = meter; m^3 = cubic meters; mps = meters per second; PM_{10} = particulate matter less than 10 microns in diameter.

Notes:

– Remediation alternatives emissions based on 7 percent silt content, 2.4 mps wind speed, 2-m drop, 5 percent moisture content, 1-m^3 drop volume.

– Results based on increased partitioning of constituents in PM_{10} as a factor of 2 higher than bulk contaminated material.

– Remediation of sources with only radiological constituents is assumed to occur over 2 years.

– Suburban resident located 1,800 meters northwest of onsite emissions source.

Table G–78 Summary of Risk and Hazard Results for Offsite Impacts during Remedial Alternatives Implementation – Recreational User – Exposure to Chemicals

Alternative	Chemical Risks			Chemical Hazards		
	Air	Soil	Total	Air	Soil	Total
No Action	4.7×10^{-12}	1.3×10^{-13}	**4.9×10^{-12}**	4.4×10^{-8}	4.6×10^{-9}	**4.8×10^{-8}**
AOC LUT	4.4×10^{-11}	1.2×10^{-12}	**4.6×10^{-11}**	4.5×10^{-7}	4.3×10^{-8}	**5.0×10^{-7}**
Revised LUT	1.2×10^{-11}	5.0×10^{-13}	**1.3×10^{-11}**	7.2×10^{-7}	1.8×10^{-8}	**7.4×10^{-7}**
CONR Residential Scenario	4.9×10^{-12}	3.8×10^{-13}	**5.3×10^{-12}**	1.5×10^{-6}	1.3×10^{-8}	**1.5×10^{-6}**
CONR Open Space Scenario	3.8×10^{-12}	3.2×10^{-13}	**4.1×10^{-12}**	2.4×10^{-6}	1.0×10^{-8}	**2.4×10^{-6}**
Building Demolition	NA	NA	**NA**	NA	NA	**NA**
Bedrock Excavation	NA	NA	**NA**	NA	NA	**NA**

CONR = Conservation of Natural Resources; m = meter; m^3 = cubic meters; mps = meters per second; PM_{10} = particulate matter less than 10 microns in diameter.
Notes:
– Remedial alternatives emissions based on 7 percent silt content, 2.4 mps wind speed, 2-m drop, 5 percent moisture content, 1-m^3 drop volume.
– Results based on increased partitioning of constituents in PM_{10} as a factor of 2 higher than bulk contaminated material.
– Remediation of sources with only radiological constituents is assumed to occur over 2 years.
– Recreational user located 500 meters northwest of onsite emissions source.

Table G–79 Summary of Risk and Dose Results for Offsite Impacts during Remedial Alternatives Implementation – Recreational User– Exposure to Radionuclides

Alternative	Radiological Risks			Radiological Doses (millirem)		
	Air	Soil	Total	Air	Soil	Total
No Action	9.7×10^{-15}	1.1×10^{-13}	**1.2×10^{-13}**	4.4×10^{-8}	1.5×10^{-7}	**1.9×10^{-7}**
AOC LUT	1.2×10^{-13}	1.5×10^{-12}	**1.6×10^{-12}**	2.2×10^{-8}	8.0×10^{-8}	**1.0×10^{-7}**
Revised LUT	3.1×10^{-14}	4.4×10^{-13}	**4.7×10^{-13}**	2.2×10^{-8}	2.3×10^{-8}	**4.5×10^{-8}**
CONR Residential Scenario	1.3×10^{-14}	5.0×10^{-13}	**5.1×10^{-13}**	1.7×10^{-9}	2.7×10^{-8}	**2.9×10^{-8}**
CONR Open Space Scenario	1.0×10^{-14}	4.1×10^{-13}	**4.2×10^{-13}**	1.4×10^{-9}	2.3×10^{-8}	**2.4×10^{-8}**
Building Demolition	4.2×10^{-9}	4.0×10^{-9}	**8.2×10^{-9}**	2.6×10^{-1}	5.8×10^{-3}	**1.4×10^{-1}**
Bedrock Excavation	5.7×10^{-10}	5.7×10^{-12}	**5.8×10^{-10}**	7.3×10^{-4}	8.7×10^{-6}	**7.4×10^{-4}**

CONR = Conservation of Natural Resources; m = meter; m^3 = cubic meters; mps = meters per second; PM_{10} = particulate matter less than 10 microns in diameter.
Notes:
– Remedial alternatives emissions based on 7 percent silt content, 2.4 mps wind speed, 2-m drop, 5 percent moisture content, 1-m^3 drop volume.
– Results based on increased partitioning of constituents in PM_{10} as a factor of 2 higher than bulk contaminated material.
– Remediation of sources with only radiological constituents is assumed to occur over 2 years.
– Recreational user located 500 meters northwest of onsite emissions source.

Table G–80 Dispersion Model Results for Santa Ana Wind Evaluation

Wind Speed (mps)	Stability Class	X/Q Values (s/m3) for Downwind Distances (m)										
		500	1800	2000	2500	3000	3500	4000	4500	5000	5500	6000
5	C	7.1×10^{-6}	1.9×10^{-6}	1.5×10^{-6}	1.0×10^{-6}	7.3×10^{-7}	5.5×10^{-7}	4.3×10^{-7}	3.5×10^{-7}	2.8×10^{-7}	2.4×10^{-7}	2.0×10^{-7}
5	C and D	1.0×10^{-5}	3.0×10^{-6}	2.5×10^{-6}	1.7×10^{-6}	1.2×10^{-6}	9.7×10^{-7}	7.8×10^{-7}	6.5×10^{-7}	5.5×10^{-7}	4.7×10^{-7}	4.1×10^{-7}
10	C and D	5.1×10^{-6}	1.5×10^{-6}	1.3×10^{-6}	8.7×10^{-7}	6.3×10^{-7}	4.9×10^{-7}	4.0×10^{-7}	3.3×10^{-7}	2.8×10^{-7}	2.4×10^{-7}	2.1×10^{-7}
20	C and D	2.6×10^{-6}	7.7×10^{-7}	6.4×10^{-7}	4.4×10^{-7}	3.2×10^{-7}	2.5×10^{-7}	2.0×10^{-7}	1.7×10^{-7}	1.4×10^{-7}	1.2×10^{-7}	1.1×10^{-7}

X/Q = chi over Q.

Notes:

– Wind speeds represent assumed averages over a 24-hour period.
– Wind assumed to blow toward the southwest based on observation from SSFL onsite meteorological station.
– Stability class assumed for Santa Ana wind conditions were Class C, as well as 50 percent C and 50 percent D for comparison.
– The X/Q values (in s/m^3) represent the air concentration of suspended contaminated material (in g/m^3) per unit of emission (in g/s).

Table G–81 Evaluation of Santa Ana Conditions

Scenario	Wind Speed (mps)	Emission Rate per Unit Area (g/m^2-s)	Emission Rate (g/s)	X/Q (g/m^3 per g/s)	Offsite SS Air Concentration (g/m^3)	Deposition Duration	Offsite SS Soil Concentration (g/g)
Santa Ana	5	9.0×10^{-7}	8.1×10^{-1}	4.7×10^{-7}	3.8×10^{-7}	1 day	1.5×10^{-9}
	10	1.7×10^{-5}	1.5×10^{1}	2.4×10^{-7}	3.6×10^{-6}	1 day	1.4×10^{-8}
	20	1.5×10^{-4}	1.3×10^{2}	1.1×10^{-7}	1.4×10^{-5}	1 day	5.4×10^{-8}
No Action	2.3	2.8×10^{-11}	2.5×10^{-5}	2.2×10^{-6}	5.5×10^{-11}	30 year	2.3×10^{-9}

g = gram; m= meter; m^2 = square meters; m^3 = cubic meters; mps = meters per second; X/Q = chi over Q; s = second.

Notes:

– Results based on use of maximum reasonably foreseeable parameter values (see Section G.1).
– Assumed source area of ~900,000 square meters for chemical and radiological contamination.
– Santa Ana winds offsite suburban resident is assumed to be 5,500 meters to the southwest; the No Action Alternative offsite suburban resident is assumed to be 1,800 meters northwest (see Section G.6).
– Soil concentration of deposited contaminated material is based on a deposition rate of 1.8×10^{-3} meters per second, a soil density of 1.6×10^{6} grams per cubic meter, and a mixing depth of 0.025 meters.

Table G–82 Evaluation of Santa Ana Wind Conditions – Air Impacts

Scenario	Wind Speed (mps)	Offsite SS Air Concentration (g/m^3)	Exposure Duration (days)	Exposure Air Concentration (g/m^3)	Difference from No Action	Chemical Air Hazard	Radiological Air Dose (millirem)
Santa Ana winds	5	3.8×10^{-7}	1	1.0×10^{-9}	1.9×10^{1}	8.3×10^{-7}	8.3×10^{-7}
	10	3.6×10^{-6}	1	9.9×10^{-9}	1.8×10^{2}	7.9×10^{-6}	7.9×10^{-6}
	20	1.4×10^{-5}	1	3.8×10^{-8}	6.9×10^{2}	3.0×10^{-5}	3.0×10^{-5}
No Action Alternative	2.3	5.5×10^{-11}	365	5.5×10^{-11}	1.0	4.4×10^{-8}	4.4×10^{-8}

g = gram; m= meter; m^2 = square meters; m^3 = cubic meters; mps = meters per second.

Notes:

– Results based on use of maximum reasonably foreseeable parameters (see Section G.1).
– Assumed source area of ~900,000 square meters for chemical and radiological contamination.
– Santa Ana winds offsite suburban resident is assumed to be 5,500 meters to the southwest; the No Action Alternative offsite suburban resident is assumed to be 1,800 meters northwest (see Section G.6).
– Soil concentration of deposited contaminated material is based on a deposition rate of 1.8×10^{-3} meters per second, a soil density of 1.6×10^{6} grams per cubic meter, and a mixing depth of 0.025 meters.
– Results for the No Action Alternative are based on average meteorology from 2009 through 2012.
– No Action Alternative hazard and dose results based on 365 days per year exposure.
– Santa Ana scenario results represent hazard and dose for each day of continuous exposure.
– Exposure air concentration is average concentration during a year of exposure.
– Santa Ana wind hazard and risk are based on a ratio to the No Action Alternative results, based on the relative exposure air concentrations.
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Table G–83 Evaluation of Santa Ana Conditions – Soil Impacts

Scenario	Wind Speed (mps)	Offsite SS Soil Concentration (g/g)	Difference from No Action	Chemical Produce Risks	Radiological Produce Risks
Santa Ana	5	1.5×10^{-9}	6.3×10^{-1}	3.6×10^{-12}	3.8×10^{-14}
	10	1.4×10^{-8}	6.0×10	3.4×10^{-11}	3.6×10^{-13}
	20	5.4×10^{-8}	2.3×10^{1}	1.3×10^{-10}	1.4×10^{-12}
No Action	2.3	2.3×10^{-9}	1.0×10	5.7×10^{-12}	6.0×10^{-14}

g = gram; mps = meters per second.

Notes:

– Results based on use of maximum reasonably foreseeable parameters (see Section G.1).
– Assumed source area of ~900,000 square meters for chemical and radiological contamination.
– Santa Ana winds offsite suburban resident is assumed to be 5,500 meters to the southwest; the No Action Alternative offsite suburban resident is assumed to be 1,800 meters northwest (see Section G.6).
– Soil concentration of deposited contaminated material is based on a deposition rate of 1.8×10^{-3} meters per second, a soil density of 1.6×10^{6} grams per cubic meter, and a mixing depth of 0.025 meters.
– Results for the Santa Ana condition are based on a 24-hour period of emissions and deposition.
– Results for the No Action Alternative are based on 30 years of emissions and deposition.
– Santa Ana risks are based on a ratio to the No Action Alternative results, based on the relative offsite soil concentrations.

Table G–84 Comparison of Emissions from Site Center and Subarea Centers – Subarea Emissions – AOC LUT Alternative

Subarea	*Area of Subarea Sources (acres)*	*Fraction of Total Remediation*	*Remedial Mass (kg)*	*Suspended Soil Emissions from Excavation (g)*	*Emission Rate (g/s)*	*Direction*	*Distance (m)*	*X/Q (s/m3)*	*Suspended Soil Air Concentration (g/m3)*
3	4.2×10^{-1}	4.6×10^{-3}	5.0×10^{6}	8.7×10^{2}	1.1×10^{-6}	W	2.4×10^{3}	3.1×10^{-7}	3.4×10^{-13}
5A	7.6×10	8.4×10^{-2}	9.0×10^{7}	1.6×10^{4}	1.9×10^{-5}	WNW	2.0×10^{3}	1.4×10^{-6}	2.7×10^{-11}
5B	1.4×10^{1}	1.5×10^{-1}	1.6×10^{8}	2.8×10^{4}	3.5×10^{-5}	WNW	1.8×10^{3}	1.7×10^{-6}	5.9×10^{-11}
5C	1.3×10^{1}	1.4×10^{-1}	1.5×10^{8}	2.7×10^{4}	3.3×10^{-5}	NW	1.7×10^{3}	2.4×10^{-6}	7.9×10^{-11}
5D	1.5×10^{1}	1.7×10^{-1}	1.8×10^{8}	3.2×10^{4}	3.9×10^{-5}	NW	1.7×10^{3}	2.4×10^{-6}	9.4×10^{-11}
6	1.3×10^{1}	1.5×10^{-1}	1.6×10^{8}	2.7×10^{4}	3.3×10^{-5}	W	2.1×10^{3}	4.1×10^{-7}	1.4×10^{-11}
7	8.8×10	9.7×10^{-2}	1.0×10^{8}	1.8×10^{4}	2.2×10^{-5}	WNW	1.8×10^{3}	1.7×10^{-6}	3.8×10^{-11}
8	5.9×10	6.6×10^{-2}	7.1×10^{7}	1.2×10^{4}	1.5×10^{-5}	NW	1.5×10^{3}	3.0×10^{-6}	4.5×10^{-11}
NBZ	1.3×10^{1}	1.4×10^{-1}	1.5×10^{8}	2.7×10^{4}	3.3×10^{-5}	NW	1.4×10^{3}	3.4×10^{-6}	1.1×10^{-10}
Overall Total	**9.0×10^{1}**		**1.1×10^{9}**	**1.9×10^{5}**	**2.3×10^{-4}**				

g = gram; m= meter; m^3 = cubic meters; X/Q = chi over Q; s = second.

Notes:

– Fraction of total remediation for each subarea is based on the surface area of the sources.
– Remedial masses based on total Cleanup to AOC LUT Values Alternative volume of 881,000 cubic yards and fraction of total contamination associated with each subarea.
– Emission factor for excavation of 1.75×10^{-4} grams per kilogram, calculated from site-specific soil parameters and wind speed.
– Emission rate based on a 26-year remedial period for the Cleanup to AOC LUT Values Alternative.
– Direction and downwind distance to hypothetical receptor located approximately 1,800 meters to the northwest of Area IV/NBZ.
– X/Q based on dispersion modeling with 2009-2012 SSFL meteorological data from onsite station.

Table G–85 Comparison of Emissions from Site Center and Subarea Centers - Air Concentration of Selected Chemical Constituents – AOC LUT Alternative

		Chromium			*Cadmium*			*Aroclor-1260*		
Subarea	***Suspended Soil Air Concentration* (g/m3)**	***Onsite Source Concentration* (µg/g)**	***Offsite Air Concentration* (µg/m3)**	***Direct Air Inhalation Risk***	***Onsite Source Concentration* (µg/g)**	***Offsite Air Concentration* (µg/m3)**	***Direct Air Inhalation Risk***	***Onsite Source Concentration* (µg/g)**	***Offsite Air Concentration* (µg/m3)**	***Direct Air Inhalation Risk***
3	3.4×10^{-13}	2.7×10^{-1}	9.1×10^{-14}	1.5×10^{-14}	8.1×10^{-1}	2.7×10^{-13}	3.5×10^{-16}	4.2×10^{-2}	1.4×10^{-14}	5.9×10^{-18}
5A	2.7×10^{-11}	1.2×10	3.3×10^{-11}	5.5×10^{-12}	1.3×10	3.4×10^{-11}	4.5×10^{-14}	1.1×10^{-1}	3.0×10^{-12}	1.3×10^{-15}
5B	5.9×10^{-11}	6.0×10^{-1}	3.6×10^{-11}	6.0×10^{-12}	3.5×10^{-1}	2.1×10^{-11}	2.7×10^{-14}	4.3×10^{-2}	2.5×10^{-12}	1.0×10^{-15}
5C	7.9×10^{-11}	8.0×10^{-1}	6.4×10^{-11}	1.1×10^{-11}	6.7×10^{-1}	5.3×10^{-11}	6.9×10^{-14}	2.6×10^{-2}	2.1×10^{-12}	8.6×10^{-16}
5D	9.4×10^{-11}	7.1×10^{-1}	6.7×10^{-11}	1.1×10^{-11}	4.5×10^{-1}	4.2×10^{-11}	5.5×10^{-14}	1.1×10^{-2}	1.0×10^{-12}	4.2×10^{-16}
6	1.4×10^{-11}	8.4×10^{-1}	1.1×10^{-11}	1.9×10^{-12}	1.8×10^{1}	2.4×10^{-10}	3.1×10^{-13}	2.9×10^{-1}	3.9×10^{-12}	1.6×10^{-15}
7	3.8×10^{-11}	1.0×10	4.0×10^{-11}	6.6×10^{-12}	4.3×10^{-1}	1.7×10^{-11}	2.1×10^{-14}	1.4×10^{-1}	5.5×10^{-12}	2.3×10^{-15}
8	4.5×10^{-11}	7.0×10^{-1}	3.2×10^{-11}	5.3×10^{-12}	4.7×10^{-1}	2.1×10^{-11}	2.8×10^{-14}	1.1×10^{-2}	4.8×10^{-13}	2.0×10^{-16}
NBZ	1.1×10^{-10}	9.5×10^{-1}	1.1×10^{-10}	1.8×10^{-11}	2.7×10^{-1}	3.0×10^{-11}	3.9×10^{-14}	3.7×10^{1}	4.1×10^{-9}	1.7×10^{-12}
Subarea Total Results			**3.9×10^{-10}**	**6.5×10^{-11}**		**4.6×10^{-10}**	**5.9×10^{-13}**		**4.1×10^{-9}**	**1.7×10^{-12}**
Site Center Results	**5.0×10^{-10}**	**6.7×10^{-1}**	**3.4×10^{-10}**	**5.6×10^{-11}**	**2.8×10**	**1.4×10^{-9}**	**1.8×10^{-12}**	**1.2×10**	**6.0×10^{-10}**	**2.5×10^{-13}**

g = gram; m^3 = cubic meters; µg = micrograms.

Notes:

– Suspended soil air concentration based on remedial mass in each subarea, an emissions factor of 1.75×10^{-4} grams per kilogram, and dispersion modeling.
– Onsite source concentrations are UCL95 for applicable samples from each subarea
– Constituents selected represent the drivers of cancer incidence risk for the direct air inhalation exposure pathway for the offsite resident associated with the Cleanup to AOC LUT Values Alternative.
– The total direct inhalation cancer incidence risk to the suburban resident was 5.9×10^{-11}, based on site center emissions.

Table G–86 SSFL FEIS – Offsite Impacts – AOC LUT – Sensitivity Analysis

Human Health Impact	*Exposure Pathway*	*Increased Soil Volume Scenario Sensitivity Evaluation*		*Cleanup to AOC LUT Values Alternative*	
		Suburban Resident	*Recreational User*	*Suburban Resident*	*Recreational User*
Chemical Risks	Air	5.8×10^{-11}	8.0×10^{-11}	5.9×10^{-11}	4.4×10^{-11}
	Soil	8.3×10^{-13}	1.8×10^{-12}	5.4×10^{-13}	1.2×10^{-12}
	Produce	8.3×10^{-11}	NA	3.7×10^{-11}	NA
	Total	**1.4×10^{-10}**	**8.1×10^{-11}**	**9.6×10^{-11}**	**4.6×10^{-11}**
Chemical Hazards	Air	5.4×10^{-7}	7.3×10^{-7}	6.0×10^{-7}	4.5×10^{-7}
	Soil	3.2×10^{-8}	6.7×10^{-8}	2.0×10^{-8}	4.3×10^{-8}
	Produce	2.1×10^{-6}	NA	1.2×10^{-6}	NA
	Total	**2.6×10^{-6}**	**8.0×10^{-7}**	**1.8×10^{-6}**	**5.0×10^{-7}**
Radiological Risks	Air	1.1×10^{-13}	1.7×10^{-13}	1.4×10^{-13}	1.2×10^{-13}
	Soil	1.1×10^{-12}	1.8×10^{-12}	8.7×10^{-13}	1.5×10^{-12}
	Produce	9.4×10^{-13}	NA	7.9×10^{-13}	NA
	Total	**2.1×10^{-12}**	**1.9×10^{-12}**	**1.8×10^{-12}**	**1.6×10^{-12}**
Radiological Doses (millirem)	Air	5.6×10^{-8}	4.5×10^{-8}	2.8×10^{-8}	2.2×10^{-8}
	Soil	5.0×10^{-8}	9.2×10^{-8}	4.2×10^{-8}	8.0×10^{-8}
	Produce	5.0×10^{-8}	NA	4.3×10^{-8}	NA
	Total	**1.6×10^{-7}**	**1.4×10^{-7}**	**1.1×10^{-7}**	**1.0×10^{-7}**

Notes:

– Cleanup to AOC LUT Values Alternative based on chemical and radiological remediation volumes of 8.8×10^5 and 1.1×10^5 cubic yards, respectively, with a remediation duration of 26 years.

– Increased Soil Volume Scenario sensitivity analysis considered chemical and radiological remedial volumes of 1.62×10^6 and 1.1×10^5 cubic yards, respectively, with a remediation duration of 47 years.

– Constituent concentrations were based on statistical analysis of samples associated with each remediation volume under consideration.

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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 *Final Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory (Final 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:

- Nevada National Security Site (NNSS) in Nevada, Energy*Solutions* in Clive, Utah, and Waste Control Specialists (WCS) in Andrews, Texas, for low-level radioactive waste (LLW) and mixed low-level radioactive waste (MLLW);
- Buttonwillow and Westmorland landfills in California and the US Ecology facility in Grand View, Idaho, for hazardous wastes;
- Chiquita Canyon, Antelope Valley, and McKittrick landfills 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]

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 50 miles from the 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* in Utah, for LLW and MLLW;
- WCS in Texas for LLW and MLLW; and
- US Ecology in Idaho, for hazardous and nonhazardous wastes.

[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 truck/rail shipment to Energy*Solutions* in Utah and WCS in Texas, waste delivered by railcar may be sent directly to the disposal facilities. But 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. In addition, for truck/rail shipments to US Ecology in Idaho, waste would be transferred to trucks from the railcars at the intermodal facility operated by US Ecology in Mountain Home, Idaho, and then delivered to the disposal facility. The impacts of the additional truck transport required for truck/rail delivery to NNSS or US Ecology in Idaho are evaluated in this appendix. 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.

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.

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.

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.

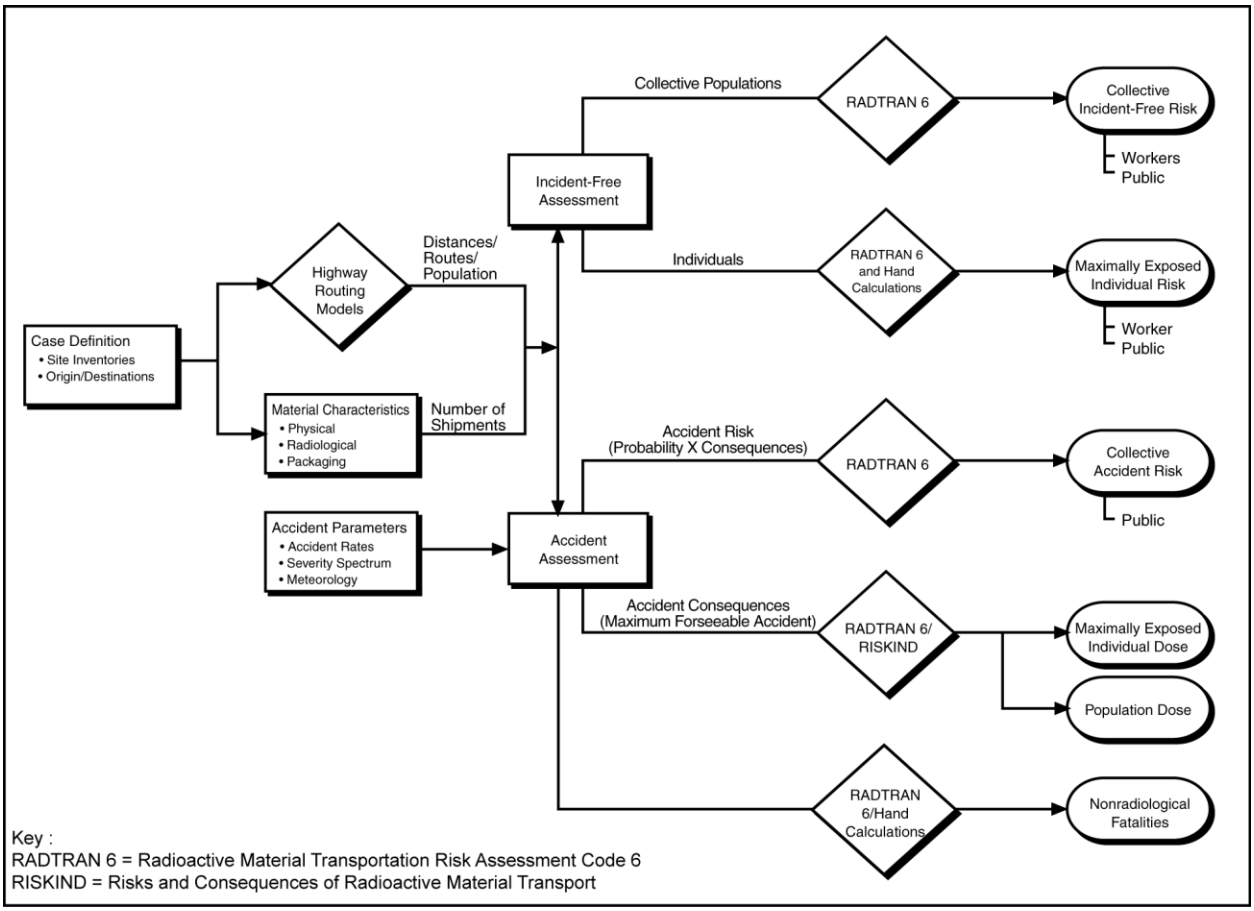

Figure H–1 Transportation Risk Assessment

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; WCS, Texas; or Energy*Solutions*, Clive, Utah; and
- MLLW from SSFL to NNSS, Nevada; WCS, Texas; or 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.

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, f]	210	196	13	1	12	741	5514	15,540
Truck (total)									
SSFL	Energy*Solutions*, UT	775	466	189	119	43	1,552	10,093	1,518,885
	NNSS, NV	349	245	33	77	33	869	10,167	768,811
	WCS, TX	1,158	838	199	122	21	1,442	8,727	1,368,310
Rail									
SSFL [g]	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
	WCS, TX	1,111	883	181	48	20	1,581	7,230	642,241

CA = California; NNSS = Nevada National Security Site; NV = Nevada; TX = Texas; UT = Utah; WCS=Waste Control Specialists.

[a] Population densities were projected to 2030 using State-level data from the 2010 census (Census 2010) and assuming State population growth rates from 2000 to 2010 continue to 2030.

[b] For offsite shipments, the estimated number of persons residing within 0.5 miles along the transportation route, projected to 2030.

[c] Route characteristics used for truck shipments.

[d] Route characteristics used for rail shipments.

[e] Because NNSS does not have a rail yard, truck transport from a nearby rail yard would be required.

[f] Truck routes to NNSS follow the specified routes prescribed for the site.

[g] There is no rail connection 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, therefore, the cited distances are from Puente Hills to the facility destination.

Note: Because the individual distances are rounded to the nearest mile, the sums of individual distances may be different from the listed total distances.

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.

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 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.

[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).

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, a weighted average accident and fatality rate was calculated based on the State-level distances travelled and their associated accident and fatality rates. The accident and fatality rates 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 un-breached. 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 non-dispersible 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 0.6 fatalities for the duration of the analysis. Considering the radioactive waste transportation activities analyzed in this EIS would occur over at most a 4-year period for any of the alternatives and the average number of traffic fatalities in the United States is about 35,000 per year (DOT 2017), the traffic fatality risk under all alternatives would be very small. See Section H.10 for further discussion of accident fatality rates.

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 WCS in Texas, with risk factors of 1×10^{-3} and 3×10^{-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 WCS, with a risk factor of 2×10^{-4} for populations. These risk factors are essentially equivalent to zero risk.

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	350	5.0×10^{-5}	3×10^{-8}	2.3×10^{-5}	1×10^{-8}	4×10^{-14}	7×10^{-6}
	Lift liner	Truck	350	6.8×10^{-5}	4×10^{-8}	1.9×10^{-5}	1×10^{-8}	3×10^{-14}	7×10^{-6}
	Intermodal container	Truck	350	8.3×10^{-5}	5×10^{-8}	2.3×10^{-5}	1×10^{-8}	4×10^{-14}	7×10^{-6}
WCS	B-25 box	Truck	1,160	1.9×10^{-4}	1×10^{-7}	7.6×10^{-5}	5×10^{-8}	9×10^{-13}	8×10^{-6}
	Lift liner	Truck	1,160	2.2×10^{-4}	1×10^{-7}	6.3×10^{-5}	4×10^{-8}	7×10^{-13}	8×10^{-6}
	Intermodal container	Truck	1,160	2.8×10^{-4}	2×10^{-7}	7.6×10^{-5}	5×10^{-8}	9×10^{-13}	8×10^{-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**	$\mathbf{4.1 \times 10^{-4}}$	$\mathbf{2 \times 10^{-7}}$	$\mathbf{5.2 \times 10^{-4}}$	$\mathbf{3 \times 10^{-7}}$	$\mathbf{6 \times 10^{-13}}$	$\mathbf{5 \times 10^{-4}}$
	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**	$\mathbf{3.7 \times 10^{-4}}$	$\mathbf{2 \times 10^{-7}}$	$\mathbf{4.4 \times 10^{-4}}$	$\mathbf{3 \times 10^{-7}}$	$\mathbf{5 \times 10^{-13}}$	$\mathbf{5 \times 10^{-4}}$
	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**	$\mathbf{4.7 \times 10^{-4}}$	$\mathbf{3 \times 10^{-7}}$	$\mathbf{5.2 \times 10^{-4}}$	$\mathbf{3 \times 10^{-7}}$	$\mathbf{6 \times 10^{-13}}$	$\mathbf{5 \times 10^{-4}}$
NNSS [e]	B-25 box	Truck	260	6.6×10^{-4}	4×10^{-7}	7.6×10^{-5}	4×10^{-8}	4×10^{-13}	8×10^{-5}
		Rail	120	5.5×10^{-5}	3×10^{-8}	3.5×10^{-4}	2×10^{-7}	2×10^{-13}	1×10^{-4}
		TOTAL	**380**	$\mathbf{7.2 \times 10^{-4}}$	$\mathbf{4 \times 10^{-7}}$	$\mathbf{4.2 \times 10^{-4}}$	$\mathbf{2 \times 10^{-7}}$	$\mathbf{6 \times 10^{-13}}$	$\mathbf{2 \times 10^{-4}}$
	Lift liner	Truck	260	8.0×10^{-4}	5×10^{-7}	5.8×10^{-5}	3×10^{-8}	3×10^{-13}	8×10^{-5}
		Rail	120	4.3×10^{-5}	3×10^{-8}	2.9×10^{-4}	2×10^{-7}	2×10^{-13}	1×10^{-4}
		TOTAL	**380**	$\mathbf{8.4 \times 10^{-4}}$	$\mathbf{5 \times 10^{-7}}$	$\mathbf{3.5 \times 10^{-4}}$	$\mathbf{2 \times 10^{-7}}$	$\mathbf{5 \times 10^{-13}}$	$\mathbf{2 \times 10^{-4}}$
	Intermodal container	Truck	260	9.8×10^{-4}	6×10^{-7}	7.1×10^{-5}	4×10^{-8}	4×10^{-13}	8×10^{-5}
		Rail	120	5.4×10^{-5}	3×10^{-8}	3.4×10^{-4}	2×10^{-7}	2×10^{-13}	1×10^{-4}
		TOTAL	**380**	$\mathbf{1.0 \times 10^{-3}}$	$\mathbf{6 \times 10^{-7}}$	$\mathbf{4.1 \times 10^{-4}}$	$\mathbf{2 \times 10^{-7}}$	$\mathbf{6 \times 10^{-13}}$	$\mathbf{2 \times 10^{-4}}$

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]
WCS	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	1,110	3.7×10^{-4}	2×10^{-7}	6.6×10^{-4}	4×10^{-7}	5×10^{-13}	5×10^{-4}
		TOTAL	1,160	**5.1×10^{-4}**	**3×10^{-7}**	**7.0×10^{-4}**	**4×10^{-7}**	**7×10^{-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	1,110	3.0×10^{-4}	2×10^{-7}	5.6×10^{-4}	3×10^{-7}	4×10^{-13}	5×10^{-4}
		TOTAL	**1,1160**	**4.5×10^{-4}**	**3×10^{-7}**	**5.9×10^{-4}**	**4×10^{-7}**	**6×10^{-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	1,110	3.7×10^{-4}	3×10^{-7}	6.6×10^{-4}	4×10^{-7}	5×10^{-13}	5×10^{-4}
		TOTAL	**1,1160**	**5.7×10^{-4}**	**3×10^{-7}**	**7.0×10^{-4}**	**4×10^{-7}**	**8×10^{-13}**	**5×10^{-4}**

LCF = latent cancer fatality; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; NNSS = Nevada National Security Site; rem = roentgen equivalent man; WCS=Waste Control Specialists.

[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 (assumed for analysis to be Barstow, California) to NNSS via truck.

Table H–5 Risks to Crew Members and Populations from Transporting Radioactive Material and Waste under Each Alternative

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]
Cleanup to AOC LUT Values Alternatives [e]								
Truck								
Energy*Solutions*	7,170	5,560,000	1.3	8×10^{-4}	0.35	2×10^{-4}	5×10^{-9}	3×10^{-1}
NNSS	7,170	2,490,000	0.60	4×10^{-4}	0.16	1×10^{-4}	3×10^{-10}	5×10^{-2}
WCS	7,170	8,328,000	2.0	1×10^{-3}	0.54	3×10^{-4}	6×10^{-9}	6×10^{-1}
Rail/Truck [d]								
Energy*Solutions*	450	702,000	0.21	1×10^{-4}	0.23	1×10^{-4}	3×10^{-10}	2×10^{-1}
NNSS	450	1,910,000	0.46	3×10^{-4}	0.19	1×10^{-4}	3×10^{-10}	9×10^{-2}
WCS	450	845,000	0.25	2×10^{-4}	0.31	2×10^{-4}	3×10^{-10}	2×10^{-1}
Cleanup to Revised LUT Values Alternatives [e]								
Truck								
Energy*Solutions*	7,170	5,560,000	1.3	8×10^{-4}	0.35	2×10^{-4}	5×10^{-9}	3×10^{-1}
NNSS	7,170	2,490,000	0.60	4×10^{-4}	0.16	1×10^{-4}	3×10^{-10}	5×10^{-2}
WCS	7,170	8,328,000	2.0	1×10^{-3}	0.54	3×10^{-4}	6×10^{-9}	6×10^{-1}
Rail/Truck [d]								
Energy*Solutions*	450	702,000	0.21	1×10^{-4}	0.23	1×10^{-4}	3×10^{-10}	2×10^{-1}
NNSS	450	1,910,000	0.46	3×10^{-4}	0.19	1×10^{-4}	3×10^{-10}	9×10^{-2}
WCS	450	845,000	0.25	2×10^{-4}	0.31	2×10^{-4}	3×10^{-10}	2×10^{-1}
Conservation of Natural Resources Alternative – Residential								
Truck								
Energy*Solutions*	65	50,000	0.012	7×10^{-6}	0.0032	2×10^{-6}	4×10^{-11}	2×10^{-3}
NNSS	65	21,000	0.0054	3×10^{-6}	0.0015	9×10^{-7}	3×10^{-12}	4×10^{-4}
WCS	65	75,000	0.018	1×10^{-5}	0.0049	3×10^{-6}	6×10^{-11}	5×10^{-3}
Rail/Truck [d]								
Energy*Solutions*	5	8,000	0.0023	1×10^{-6}	0.0026	2×10^{-6}	3×10^{-12}	2×10^{-3}
NNSS	5	23,000	0.0052	3×10^{-6}	0.0021	1×10^{-6}	3×10^{-12}	1×10^{-3}
WCS	5	9,000	0.0028	2×10^{-6}	0.0035	2×10^{-6}	4×10^{-12}	3×10^{-3}

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]
Conservation of Natural Resources Alternative – Open Space								
Truck								
Energy*Solutions*	13	10,000	2.4×10^{-3}	1×10^{-6}	6.3×10^{-4}	4×10^{-7}	8×10^{-12}	5×10^{-4}
NNSS	13	4,500	1.1×10^{-3}	7×10^{-7}	2.9×10^{-4}	2×10^{-7}	5×10^{-13}	9×10^{-5}
WCS	13	15,100	3.6×10^{-3}	2×10^{-6}	9.8×10^{-4}	6×10^{-7}	1×10^{-11}	1×10^{-3}
Rail/Truck [d]								
Energy*Solutions*	1	1,600	4.7×10^{-4}	3×10^{-7}	5.2×10^{-4}	3×10^{-7}	6×10^{-13}	5×10^{-4}
NNSS	1	4,200	1.0×10^{-3}	6×10^{-7}	4.2×10^{-4}	2×10^{-7}	6×10^{-13}	2×10^{-4}
WCS	1	1,900	5.7×10^{-4}	3×10^{-7}	7×10^{-4}	4×10^{-7}	8×10^{-13}	5×10^{-4}
Building Removal Alternative								
Truck								
Energy*Solutions*	1,030	808,000	0.19	1×10^{-4}	0.05	3×10^{-5}	6×10^{-10}	4×10^{-2}
NNSS	1,030	360,000	0.086	5×10^{-5}	0.023	1×10^{-5}	4×10^{-11}	7×10^{-3}
WCS	1,030	1,193,000	0.28	2×10^{-4}	0.078	5×10^{-5}	9×10^{-10}	8×10^{-2}
Rail/Truck [d]								
Energy*Solutions*	65	101,000	0.03	2×10^{-5}	0.034	2×10^{-5}	3×10^{-11}	3×10^{-2}
NNSS	65	275,000	0.067	4×10^{-5}	0.027	2×10^{-5}	4×10^{-11}	1×10^{-2}
WCS	65	122,000	0.037	2×10^{-5}	0.045	3×10^{-5}	5×10^{-11}	3×10^{-2}
Groundwater Treatment Alternative [f]								
Truck								
Energy*Solutions*	340	263,400	6.4×10^{-2}	4×10^{-5}	1.7×10^{-2}	1×10^{-5}	2×10^{-10}	1×10^{-2}
NNSS	340	118,700	2.8×10^{-2}	2×10^{-5}	7.7×10^{-3}	5×10^{-6}	1×10^{-11}	2×10^{-3}
WCS	340	394,000	9.4×10^{-2}	6×10^{-5}	2.6×10^{-2}	2×10^{-5}	3×10^{-10}	3×10^{-2}
Rail/Truck [d]								
Energy*Solutions*	30	46,700	1.4×10^{-2}	8×10^{-6}	1.6×10^{-2}	9×10^{-6}	2×10^{-11}	1×10^{-2}
NNSS	30	127,200	2.2×10^{-2}	1×10^{-5}	1.2×10^{-2}	7×10^{-6}	2×10^{-11}	6×10^{-3}
WCS	30	56,000	1.7×10^{-2}	1×10^{-5}	2.1×10^{-2}	1×10^{-5}	2×10^{-11}	2×10^{-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]

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; WCS = Waste Control Specialists.

[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, well installation wastewater, and groundwater sampling purge water 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 Total Doses and Risks from Transporting Radioactive Waste under Combined Action Alternatives

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]	Non-radiological Risk [b]
High Impact Combinations [d]								
Truck								
Energy*Solutions*	8,540	6,631,000	1.6	1×10^{-3}	0.42	2×10^{-4}	5×10^{-9}	3×10^{-1}
NNSS	8,540	2,969,000	0.71	4×10^{-4}	0.19	1×10^{-4}	4×10^{-10}	6×10^{-2}
WCS	8,540	9,915,000	2.36	1×10^{-3}	0.65	4×10^{-4}	7×10^{-9}	7×10^{-1}
Rail/Truck [e]								
Energy*Solutions*	550	850,000	0.25	2×10^{-4}	0.28	2×10^{-4}	3×10^{-10}	3×10^{-1}
NNSS	550	2,310,000	0.55	3×10^{-4}	0.23	1×10^{-4}	3×10^{-10}	1×10^{-1}
WCS	550	1,020,000	0.31	2×10^{-4}	0.38	2×10^{-4}	4×10^{-10}	3×10^{-1}
Low Impact Combination [f]								
Truck								
Energy*Solutions*	1,380	1,081,400	0.26	2×10^{-4}	0.07	4×10^{-5}	9×10^{-10}	5×10^{-2}
NNSS	1,380	483,200	0.12	7×10^{-5}	0.03	2×10^{-5}	5×10^{-11}	1×10^{-2}
WCS	1,380	1,602,100	0.38	2×10^{-4}	0.10	6×10^{-5}	1×10^{-9}	1×10^{-1}
Rail/Truck [e]								
Energy*Solutions*	100	149,300	0.04	3×10^{-5}	0.05	3×10^{-5}	5×10^{-11}	5×10^{-2}
NNSS	100	406,400	0.09	5×10^{-5}	0.04	2×10^{-5}	6×10^{-11}	2×10^{-2}
WCS	100	179,900	0.05	3×10^{-5}	0.07	4×10^{-5}	7×10^{-11}	5×10^{-2}

LCF = latent cancer fatality; NNSS = Nevada National Security Site; rem = roentgen equivalent man; WCS = Waste Control Specialists.

[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, the Building Removal Alternative, and the 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 (Open Space), 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. This dose was calculated assuming that the resident was present for every shipment and was unshielded at a distance of about 98 feet from the truck. 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 3.5×10^{-3} millirem for the Cleanup to AOC LUT Values Alternative or Cleanup to Revised LUT Values Alternative, about 3.2×10^{-5} millirem for the Conservation of Natural Resources Alternative – Residential Scenario, about 6.4×10^{-6} millirem for the Conservation of Natural Resources – Open Space Scenario, about 5.0×10^{-4} millirem for the Building Removal Alternative, and about 5.0×10^{-4} 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 4.4×10^{-4} millirem for the Cleanup to AOC LUT Values Alternative or Cleanup to Revised LUT

Values Alternative, 4.9×10^{-6} for the Conservation of Natural Resources Alternative – Residential Scenario, about 1.3×10^{-5} millirem for the Conservation of Natural Resources – Open Space Scenario, about 6.4×10^{-5} millirem for the Building Removal Alternative, and 3.0×10^{-5} 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]	1.2×10^{-6}	Urban	3.0×10^{-4}	2×10^{-7}	3.0×10^{-7}	2×10^{-10}
Rail transport to disposal facility [c]	LLW/MLLW (soil)	All [d]	2.5×10^{-7}	Urban	7.4×10^{-3}	4×10^{-6}	4.8×10^{-6}	3×10^{-9}
Truck transport to disposal facility [c]	LLW/MLLW (building debris)	All	3.3×10^{-7}	Urban	4.7×10^{-4}	3×10^{-7}	2.0×10^{-7}	1×10^{-10}
Rail transport to disposal facility [e]	LLW/MLLW (building debris)	All	1.7×10^{-7}	Suburban	1.3×10^{-3}	8×10^{-7}	3.1×10^{-6}	2×10^{-9}
Truck transport through LA metropolitan area (disposal via truck)	LLW/MLLW (soil)	All [d]	3.3×10^{-7}	Urban	3.0×10^{-4}	2×10^{-7}	3.0×10^{-7}	2×10^{-10}
Truck transport through LA metropolitan area (disposal via truck/rail)	LLW/MLLW (soil)	All [d]	2.1×10^{-7}	Urban	4.7×10^{-4}	3×10^{-7}	3.0×10^{-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; rem = roentgen equivalent man.

[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 WCS in Texas.

[d] The likelihood of the accident is only applicable to the Cleanup to AOC LUT or the Revised LUT Alternatives. The maximum likelihood of a maximum reasonably foreseeable accident for other alternatives would be less, because of the lower annual number of shipments, even if it were assumed that all shipments would occur over 1 year.

[e] The maximum dose and frequency would occur for transports to NNSS in Nevada.

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 non-dispersible.

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.

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 78 million people would die from cancer, based on the average annual number of cancer deaths in the United States of about 598,000, with about 1 percent fluctuation year to year (CDC 2015a, 2016a, 2016b, 2017, 2018). 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.

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]	0.12 to 2.4 [b] 0.04 to 0.55 [c]	0.03 to 0.65 [b] 0.04 to 0.38 [c]
Transportation impacts from NASA actions [d]	0.50	0.19
Transportation impacts from Boeing actions [e]	0.13	0.05
Subtotal	**0.67 to 3.0**	**0.28 to 0.89**
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; NASA = National Aeronautics and Space Administration; rem = roentgen equivalent man.

[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 expected to transport relatively small quantities of LLW/MLLW from SSFL. The calculations are based on the similar assumptions as that used for the NASA radioactive wastes.

[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).

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 (to US Ecology in Idaho), 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 4.5 accidents per 10 million truck-kilometers and 2.0 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 and

nonhazardous wastes transport by rail, accident and fatality rates were taken from Saricks and Tompkins, similar to the rates 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. Because the disposal facility at the US Ecology in Grandview, Idaho does not have a direct rail connection, the waste materials would be transported to this facility from the US Ecology intermodal facility at Mountain Home, Idaho. For the truck route in Idaho, truck accident and fatality rates are those listed for the State of Idaho in Saricks and Tompkins with values of 6.48 accidents per 100 million rail-kilometers and 3.91 fatalities per 100 million rail-kilometers, respectively (Saricks and Tompkins 1999). For nonhazardous material transported by truck, truck accident and fatality rates are those listed for the State of California in Saricks and Tompkins with values of 4.98 accidents per 100 million rail-kilometers and 3.52 fatalities per 100 million rail-kilometers, respectively (Saricks and Tompkins 1999).

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, with an expected number of approximately 2 traffic fatalities for the 26-year duration of the activities for this alternative. As indicated in Table H–10, this fatality rate is essentially estimated for the transport of nonhazardous waste to the US Ecology disposal facility in Grand View, Idaho, using a combination of truck and rail covering about 15,400,000 miles. The estimated number of fatalities is very small when compared against the annual number of traffic fatalities in the United States, which was over 35,000 in calendar year 2015 (DOT 2017).

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	**93,430**	**NA**	**28,000,000**	**6.17**	**0.26**
Hazardous	130	NA	265,520	0.18	0.01
Nonhazardous	50,150	NA	23,061,700	5.05	0.21
Backfill/Equipment/Supplies	43,140	NA	4,286,960	0.94	0.04
Cleanup to Revised LUT Values	**14,560**	**NA**	**3,500,000**	**0.90**	**0.04**
Hazardous	130	NA	265,520	0.18	0.01
Nonhazardous	5,090	NA	2,339,190	0.51	0.02
Backfill/Equipment/Supplies	9,340	NA	926,530	0.20	0.01
Conservation of Natural Resources – Residential	**5,920**	**NA**	**2,000,000**	**0.56**	**0.02**
Hazardous	130	NA	265,520	0.18	0.01
Nonhazardous	3,200	NA	1,469,640	0.32	0.01
Backfill/Equipment/Supplies	2,590	NA	255,420	0.06	2.3×10^{-3}
Conservation of Natural Resources – Open Space	**4,400**	**NA**	**1,500,000**	**0.46**	**0.02**
Hazardous	130	NA	265,520	0.18	0.01
Nonhazardous	2,350	NA	1,079,700	0.24	0.01
Backfill/Equipment/Supplies	1,920	NA	188,300	0.04	1.7×10^{-3}
Building Removal	**1,400**	**NA**	**201,000**	**5.5×10^{-2}**	**2.3×10^{-3}**
Hazardous	10	NA	23,400	1.6×10^{-2}	7.1×10^{-4}
Nonhazardous	120	NA	53,300	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	89,200	2.0×10^{-2}	8.1×10^{-4}

Alternative	*Number of Truck Shipments* [a]	*Number of Rail Shipments* [a]	*Two-Way Miles Traveled*	*Number of Accidents*	*Number of Traffic Fatalities*
Groundwater Monitored Natural Attenuation [b]	**620**	**NA**	**34,000**	**7.5×10^{-3}**	**3.1×10^{-4}**
Hazardous	0	NA	0	0	0
Nonhazardous	40	NA	5,580	1.2×10^{-3}	5.1×10^{-5}
Equipment/Supplies	580 [c]	NA	28,830	6.3×10^{-3}	2.6×10^{-4}
Groundwater Treatment	**320**	**NA**	**145,400**	**9.0×10^{-2}**	**3.9×10^{-3}**
Hazardous [d]	60	NA	122,550	8.5×10^{-2}	3.7×10^{-3}
Nonhazardous	0	NA	0	0	0
Backfill/Equipment/Supplies	260	NA	22,820	5.0×10^{-3}	2.1×10^{-4}
Truck/Rail					
Cleanup to AOC LUT Values	**93,430**	**3,150**	**19,700,000**	**10.1**	**2.3**
Hazardous	130	10	41,800	0.025	6.3×10^{-3}
Nonhazardous	50,150	3,140	15,375,000	9.1	2.2
Backfill/Equipment/Supplies [e]	43,140	NA	4,287,000	0.94	0.039
Cleanup to Revised LUT Values	**14,560**	**330**	**2,530,000**	**1.15**	**0.24**
Hazardous	130	10	41,800	0.025	6.3×10^{-3}
Nonhazardous	5,090	320	1,559,500	0.92	0.23
Backfill/Equipment/Supplies [e]	9,340	NA	926,500	0.20	8.4×10^{-3}
Conservation of Natural Resources – Residential	**5,920**	**210**	**1,280,000**	**066**	**0.15**
Hazardous	130	10	41,800	0.025	6.3×10^{-3}
Nonhazardous	3,200	200	980,300	0.58	0.14
Backfill/Equipment/Supplies [e]	2,590	NA	255,420	0.056	2.3×10^{-3}
Conservation of Natural Resources – Open Space	**4,400**	**160**	**950,000**	**0.49**	**0.11**
Hazardous	130	10	41,800	0.025	6.3×10^{-3}
Nonhazardous	2,350	150	720,300	0.43	0.10
Backfill/Equipment/Supplies e	1,920	NA	188,300	0.041	1.7×10^{-3}
Building Removal	**1,400**	**10**	**165,000**	**5.2×10^{-2}**	**7.4×10^{-3}**
Hazardous	10	1	4,100	2.5×10^{-3}	6.8×10^{-4}
Nonhazardous	120	8	37,600	2.2×10^{-2}	5.6×10^{-3}
Building Recycle Material [e]	340	NA	34,000	7.5×10^{-3}	3.1×10^{-4}
Backfill/Equipment/Supplies [e]	920	NA	89,200	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; if less than 10, the actual number is cited.

[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-Open Space,[5] the Building Removal Alternative, and Groundwater Treatment Alternative. The numbers of accidents that could result from transporting nonradioactive waste and material by truck range from 0.61 to 6.3, with no expected fatalities (calculated maximum value of 0.26). The numbers of accidents that could result from transporting nonradioactive waste and material by truck/rail range from 0.63 to 10, while the number of fatalities range from 0 (calculated value: 0.12) to 2 (calculated value: 2.3).

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	95,000	NA	28,346,400	6.3	0.26
Truck/Rail [b]	95,000	3,850	20,010,400	10.0	2.3
Low Impact Combination [c]					
Truck	6,100	NA	1,846,400	0.61	0.026
Truck/Rail [b]	6,100	170	1,260,400	0.63	0.12

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-Open Space, Building Removal, and Groundwater Treatment 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 7,170 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 2015, there were over 4,000 fatalities due to crashes involving large trucks (DOT 2017) and over 35,000 traffic fatalities due to all vehicular crashes (DOT 2017). The

[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.

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 includes roads and rail lines that could be used to transport LLW, MLLW, hazardous waste, and nonhazardous waste and recycle material 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 disposal, recycle, and intermodal facilities.

H.13.2 Description of Impact Drivers

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 (primarily expressed as a level of service [LOS] rating (defined below) for evaluated roads and intersections), 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.

The quality of traffic 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 *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–12**). 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 congestion and delays occur. The impact evaluation identifies when these conditions could occur.

Table H–12 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.	Minimal
D	Approaching unstable flow; speeds tolerable, but subject to sudden and considerable variation; less maneuverability and driver comfort.	Minimal
E	Unstable traffic flow with rapidly fluctuating speeds and flow rates; short headways; low maneuverability; and lower driver comfort.	Significant
F	Forced traffic flow; speed and flow may drop to zero with high densities.	Considerable

Source: TRB 2010.

Three primary types of trucks having the characteristics summarized in **Table H–13** 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–13 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.

It was assumed that waste from soil remediation would be transported off site for disposal using heavy-duty trucks with 23 tons of waste per truck;[7] while waste from building removal would be transported offsite with approximately 16 tons of waste per truck.[8] The lower payloads for building removal waste reflect the heterogeneous nature of the waste and placement of waste into containers before shipment. Depending on the type of waste, waste from groundwater remediation could be

[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.

[7] It was assumed that shipment of all waste from soil remediation would occur using trucks with average 23-ton loads. However, if soil waste is shipped in containers, which could occur for transport of radioactive and hazardous waste soil, then it may be more difficult to average payloads at 23 tons. Assuming the payloads for all shipments of radioactive or hazardous soil averaged 20 rather than 23 tons, and all shipments of nonhazardous soil averaged 23 tons, the total number of truck round trips for shipment of waste would be increased by about 2 percent under the Cleanup to AOC LUT Values Alternative, 9 percent under the Cleanup to Revised LUT Values Alternative, and 1 percent for both options under the Conservation of Natural Resources Alternative.

[8] Building demolition under the Building Removal Alternative is projected to require 1,500 shipments of 15,500 cubic yards of waste and recycle material to offsite facilities. Assuming an average waste density of 1.5 tons per cubic yard, the average payload in the 1,500 shipments would be rounded to about 16 tons per truck.

shipped in light-duty, medium-duty, or heavy-duty trucks with payloads ranging from several hundred pounds per truck to payloads comparable to those for waste from building removal. All backfill would be transported to SSFL using heavy-duty trucks with 23-ton payloads. 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.

Transport of waste to one or more offsite facilities was evaluated under two options. Under the truck option for all action alternatives, waste would be transported directly to an offsite facility. Under the truck/rail option for all alternatives except the Groundwater Monitored Natural Attenuation Alternative,[9] some or all of the waste would be sent to an intermodal facility 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 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. Cars or light-duty trucks would be used by site workers commuting to SSFL. One worker per vehicle was assumed; 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).

[9] Waste from the Groundwater Monitored Natural Attenuation Alternative consists of very small quantities of nonhazardous drill cuttings and well installation and purge wastewater; the truck/rail option would not be a reasonable mode of transport of this waste to offsite facilities.

- 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 evaluated routes and road segments are summarized in **Table H–14** and illustrated in **Figure H–4**. Daily average traffic volumes and baseline LOS ratings for the evaluated road segments and urban freeways in the vicinity of SSFL are summarized in **Table H–15**.[10] The listed LOS ratings are for baseline conditions, assuming on typical conditions, and represent a planning level of analysis.

Table H–14 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.

[10] The listed LOS ratings were determined for this table using procedures from the *Highway Capacity Manual*, issued by the Transportation Research Board (TRB 2010) considering the current (baseline) average daily traffic levels for each road segment, the generalized service volume tables that are provided in this reference, and the assumed K- and D-factors for these road segments. The generalized service volume tables in the *Highway Capacity Manual* (TRB 2010) can be used to determine LOS ratings for specified types of roads (e.g., freeways, urban streets) and terrain (e.g., level, rolling) based on the projected traffic volumes on these roads. The projected LOS ratings are affected by the percentage of traffic that occurs during peak hours (termed the K-Factor) and by the distribution of traffic in a given direction (termed the D-Factor). See Section H.13.3.2.2 for additional information.

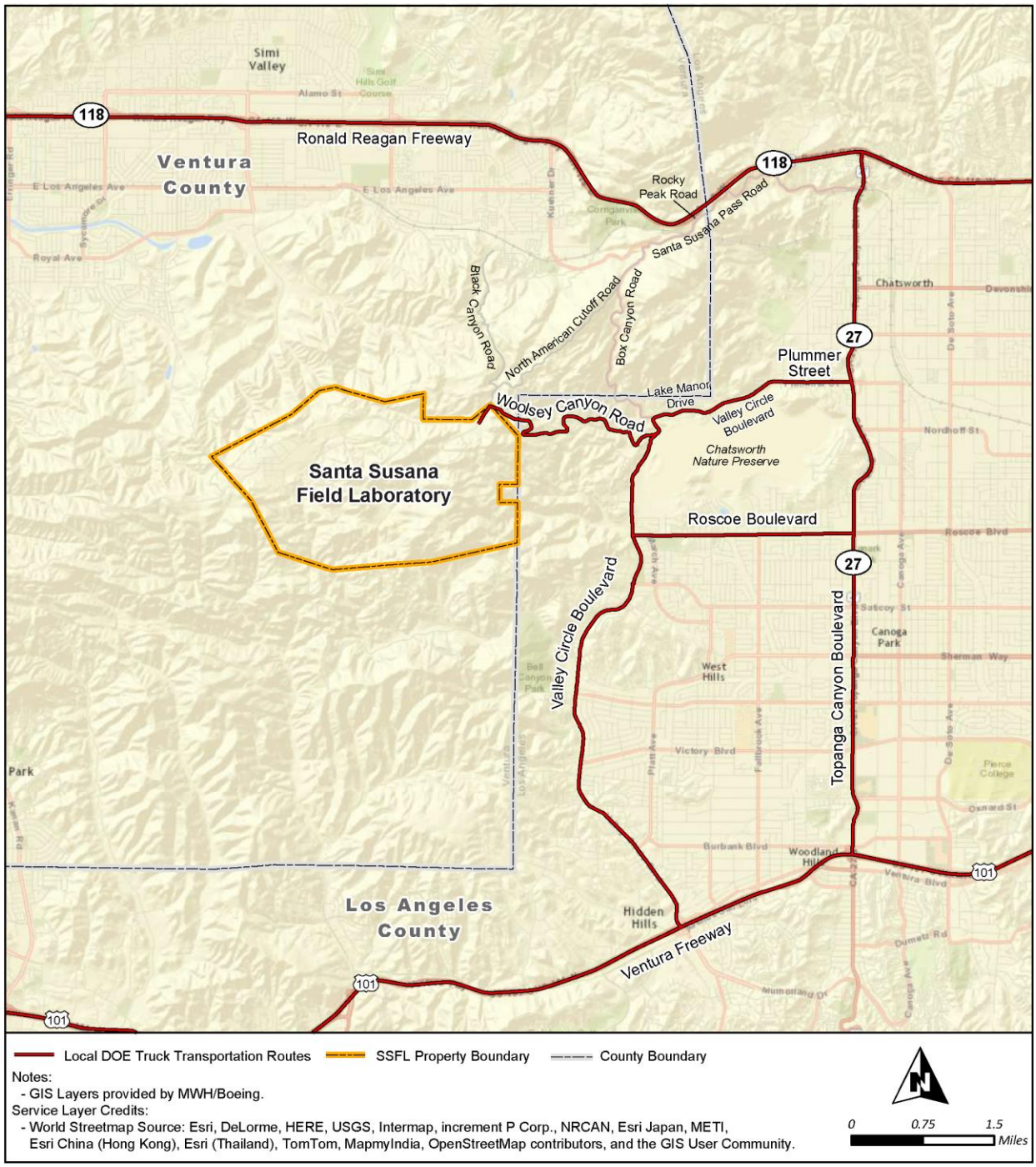

Figure H–4 Local Transportation Routes for Waste Transportation Vehicles

Table H–15 Annual Average Daily Traffic and Baseline Level of Service for Selected Road and Urban Freeway Segments near the Santa Susana Field Laboratory

Road	Segment	Posted Speed Limit	Lanes	K-Factor	D-Factor	Average Daily Traffic	Baseline LOS [a]
Woolsey Canyon Road [b]	SSFL entrance to Valley Circle Blvd	30	2	0.08	0.55	2,490	B
Valley Circle Blvd [c]	Woosley Canyon to Plummer Street	35	2	0.10	0.55	6,316	D
Plummer Street [b]	Valley Circle Drive to Topanga Canyon Blvd	35	2 to 4	0.10	0.55	5,437	D
Topanga Canyon Blvd [b]	Topanga Canyon Boulevard Plummer St to SR 118 (Ronald Regan Freeway)	45	6	0.10	0.55	42,500	D
Topanga Canyon Blvd [b]	Roscoe Blvd to SR 118	45	6	0.10	0.55	47,885	D
Topanga Canyon Blvd [b]	Roscoe Blvd to U.S. Highway 101	45	6	0.10	0.55	46,000	D
SR 118 (Ronald Reagan Freeway) [d]	Junction with Topanga Canyon Boulevard	55	8	0.11	0.55	130,000	E
Valley Circle Blvd [c]	Woosley Canyon to Roscoe Blvd	35	2	0.10	0.55	9,000	D
Roscoe Boulevard [b]	Valley Circle Blvd to Topanga Canyon Blvd	45	4	0.10	0.55	7,996	C
Valley Circle Blvd [c]	Roscoe Blvd to Victory Blvd	35	4	0.10	0.55	20,341	D
Valley Circle Blvd [c]	Victory Blvd to U.S. Highway 101	35	4	0.10	0.55	36,237	E
U.S. Highway 101 (Ventura Freeway) [d]	Junction with Topanga Canyon Blvd	55	8	0.09	0.55	240,000	F

Blvd = Boulevard; D-Factor = directional distribution of traffic; K-Factor = traffic in peak hour; LOS = level of service; SR = State Route.

[a] The baseline LOS was estimated using procedures from the *Highway Capacity Manual* including the generalized service volume tables (Exhibit 16-14 or Exhibit 15-30) (TRB 2010). Additional information is in Section H.13.3.2.2. See Table H–12 for an explanation of LOS.

[b] Data source Urban Crossroads 2011.

[c] Data source Caltrans 2013.

[d] Data source Caltrans 2012.

Intermodal Facility Vicinities

Intermodal facilities in the SSFL area and/or elsewhere would only be used for transfer of waste between trucks and rail cars under the truck/rail option.[11] 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 as representative. This does not mean that other intermodal transfer facilities

[11] The truck/rail option is not considered for transfer of recycle material to recycle facilities under the Building Removal Alternative because of the small quantity of material to be recycled and the nearness of the evaluated recycle facilities to SSFL. It is also not considered for the very small quantities of waste generated under the Groundwater Remediation Alternative including nonhazardous well cuttings from well installation, well installation and purge water, and hazardous waste from operation of groundwater treatment systems. The truck/rail option is considered for transfer of waste from removal of bedrock under the Groundwater Treatment Alternative.

would not be suitable,[12] 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. Daily traffic volumes and baseline LOS ratings for roads in the vicinity of the Puente Hills Intermodal Facility are summarized in **Table H–16**.

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 as this second intermodal facility for purposes of analysis of traffic impacts. Daily traffic volumes and baseline LOS ratings for a selected road in the vicinity of the Barstow, California, rail yard are summarized in Table H–16.

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. Daily traffic volumes and baseline LOS ratings for selected vicinity roads were obtained from various sources and are summarized in Table H–16.

H.13.3.2 Methods Used to Analyze and Quantify Impacts

The traffic impact assessment incorporates three sets of analyses: (1) an analysis of increased traffic on affected roads as expressed as a percentage of traffic volumes above baseline conditions; (2) an analysis of the quality of traffic flow as expressed primarily as potential changes in LOS ratings for affected roads and intersections; and (3) an analysis of the potential for increased traffic on affected roads to damage road pavement.

[12] The Puente Hills Intermodal Facility is approximately 50 miles from SSFL. The Union Pacific and Burlington Northern Santa Fe rail lines both operate intermodal transfer facilities at comparable or closer distances to SSFL.

Table H–16 Traffic Volumes and Baseline Level of Service Ratings for Roads in the Vicinities of the Evaluated Disposal, Recycle, and Intermodal Facilities[a]

Facility (State)	*Road Segment*	*Average Daily Traffic*	*Capacity*	*Baseline Level of Service[b]*
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	B
Buttonwillow (CA)	SR 33 at Lokern Road	1,900	16,400	A
	SR 58 at Lokern Road	2,550	16,400	B
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	A
NNSS (NV)	U.S. Highway 95, 4 miles north of the Mercury interchange	3,200	16,400	B
WCS (TX)	SR 176 (Eunice Highway) at New Mexico border	2,624	16,400	B
Kramer Metals (CA)	Alameda Street at Slauson Avenue	24,000	34,000	B
Standard Industries (CA)	SR 232 junction with SR 118	14,600	16,400	A
P.W. Gillibrand (CA)	Tapo Canyon Road north of Presidio Drive	2,500	20,000	B
Intermodal Facilities				
Puente Hills (CA)	Pellissier Place west of Workman Mill Road	19,471	28,000	A
	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	A
	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; TX = Texas; UT = Utah; WCS = Waste Control Specialists.

[a] The Mesquite Regional Landfill is not included in this table because all deliveries to this facility would occur by direct rail delivery under the truck/rail option.

[b] Baseline LOS ratings were estimated using procedures from the *Highway Capacity Manual* including the generalized service volume tables (Exhibit 16-14 or Exhibit 15-30) (TRB 2010). Additional information is in Section H.13.3.2.2. See Table H-12 for an explanation of level of service.

Source: Caltrans 2015; City of Industry 2008; ITD 2015; LA 2015, NDOT 2015; SV 2007; TDT 2018; UDOT 2015.

H.13.3.2.1 Increased Traffic as a Percentage of Traffic Above Baseline Conditions

The analysis of increased traffic on affected roads as expressed as a percentage above baseline (i.e., 2018) traffic conditions was performed by comparing the projected increase in average daily traffic volumes on these roads for each of the action alternatives against baseline average daily traffic levels. This analysis was performed for the roads and road segments identified in Table H–15 for the SSFL vicinity and the roads and road segments identified in Table H–16 for the evaluated disposal, recycle, and intermodal facilities. Baseline average daily traffic levels for the affected roads are listed in these tables.

SSFL Area

The impact of increased traffic in the SSFL area was annually determined as a percentage above baseline traffic conditions by comparing average daily traffic volumes for each of the action alternatives against the baseline (2018) average daily traffic levels summarized in Table H–15. The

average daily traffic volumes for each of the action alternatives include light-, medium-, and heavy-duty trucks required to haul waste from Area IV and the NBZ and transport equipment and supplies to Area IV, heavy-duty trucks required to transport backfill to SSFL, and light-duty vehicles such as cars or pickup trucks that may be used by site workers or to transport environmental samples for offsite analysis. **Table H–17** summarizes by year, the total number of round trips for heavy-duty, medium-duty, and light-duty trucks (including trucks and cars used by workers) by action alternative. **Table H–18** summarizes by year, 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 values in Tables H–17 and H–18 are presented on an annual basis because of the complexity of the road network in the SSFL area and the potential magnitude of the additional traffic in the SSFL area that could result from DOE activities. Using this information and the baseline daily traffic levels listed in Table H–15, the corresponding percent increase in traffic above baseline conditions was determined for each action alternative and combination of action alternatives on an annual basis (see Section H.13.3.4.1).

Disposal, Recycle, and Intermodal Facilities

The impact of increased traffic in the vicinities of the evaluated disposal, recycle, and intermodal facilities was determined for each of the action alternatives as a percentage above baseline traffic conditions by: (1) determining the highest average daily truck volume that could occur at a particular facility over all operational years for an alternative, and (2) comparing the highest average daily truck volume against the baseline average daily traffic levels summarized in Table H–16. The highest average daily truck volume that could occur at a particular facility depends on the types of waste assumed to be sent to that facility. Under the Cleanup to AOC LUT Values Alternative, for example, and assuming the truck option, each type of soil waste (radioactive, hazardous, or nonhazardous) is assumed to be sent by truck directly to separate disposal facilities each authorized to receive that type of waste. But under the truck/rail option, all of the removed radioactive, hazardous, and nonhazardous soil is assumed for analysis to be sent by truck to the Puente Hills Intermodal Facility (or another facility in the SSFL area). At that intermodal facility, the different types of waste would be sent by rail to disposal facilities authorized to receive that waste. During the years of soil removal, which is assumed to comprise 26 years for this alternative, the average daily number of waste trucks sent to a disposal or intermodal facility is expected to vary. The highest average daily truck volume was determined as the highest over all 26 years.

The comparisons against baseline conditions were made for each action alternative against the highest average daily traffic volumes over the entire duration of the action alternative, rather than annual traffic volumes as was done for the SSFL area (see above), for two main reasons. First, the road networks in the vicinities of most evaluated facilities are far less complex than that for SSFL. Second, the traffic volumes associated with DOE remediation activities in the vicinities of the evaluated facilities are far smaller for each action alternative than those in the SSFL vicinity. Under the Cleanup to AOC LUT Values Alternative, for example, the traffic volumes in the SSFL vicinity under either the truck or the truck/rail option include shipments of waste, equipment, and backfill, as well as commuting SSFL workers. But traffic volumes in the vicinities of the evaluated disposal, recycle, and intermodal facilities are only comprised of truck shipments to the facilities.

The highest average number of daily shipments to the evaluated disposal, recycle, and intermodal facilities were determined for each action alternative and combination of alternatives; this information is summarized in **Table H–19**.

Table H–17 Vehicle Round Trips by Year for Soil, Waste, Backfill, Equipment, Supplies, and Commutes

Vehicle	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*	*Year 6*	*Year 7*	*Year 8*	*Year 9*	*Year 10*	*Year 11*	*Years 12-27*	*Year 28*	*Total*
Cleanup to AOC LUT Values Alternative														
Heavy [a]	0	26	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000/yr	570	101,000
Light	0	0	6,250	6,250	6,250	6,250	6,250	6,250	6,250	6,250	6,250	6,250/yr	6,250	163,000
Total	0	26	10,250	10,250	10,250	10,250	10,250	10,250	10,250	10,250	10,250	10,250/yr	6,800	263,000
Cleanup to Revised LUT Values Alternative														
Heavy [a]	0	26	4,000	4,000	4,000	4,000	4,000	1,700	0	0	0	0	0	22,000
Light	0	0	6,250	6,250	6,250	6,250	6,250	6,250	0	0	0	0	0	38,000
Total	0	26	10,250	10,250	10,250	10,250	10,250	8,000	0	0	0	0	0	59,000
Conservation of Natural Resources – Residential Alternative														
Heavy [a]	0	26	4,000	2,000	0	0	0	0	0	0	0	0	0	6,000
Light	0	0	6,250	6,250	0	0	0	0	0	0	0	0	0	13,000
Total	0	26	10,250	8,200	0	0	0	0	0	0	0	0	0	19,000
Conservation of Natural Resources – Open Space Alternative														
Heavy [a]	0	26	4,000	390	0	0	0	0	0	0	0	0	0	4,400
Light	0	0	6,250	6,250	0	0	0	0	0	0	0	0	0	13,000
Total	0	26	10,250	6,600	0	0	0	0	0	0	0	0	0	17,000
Building Removal Alternative														
Heavy [a]	620	1,200	610	0	0	0	0	0	0	0	0	0	0	2,400
Light	15,000	15,000	7,500	0	0	0	0	0	0	0	0	0	0	38,000
Total	15,600	16,200	8,100	0	0	0	0	0	0	0	0	0	0	40,000
Groundwater Monitored Natural Attenuation Alternative														
Heavy	0	0	5	0	0	0	0	0	0	0	0	0	0	5
Medium	1	1	21	1	1	1	1	1	1	1	1	1/yr	1	48
Light	140	140	300	140	140	140	140	140	140	140	140	140/yr	140	4,100
Tanker	0	0	5	0	0	0	0	0	0	0	0	0	0	5
Total	140	140	330	140	140	140	140	140	140	140	140	140/yr	140	4,100
Groundwater Treatment Alternative														
Heavy	0	15	0	530	0	0	0	0	0	0	0	0	0	550
Medium	0	4	24	24	24	24	24	0	0	0	0	0	0	120
Light	0	200	140	240	140	140	140	0	0	0	0	0	0	980
Total	0	200	160	790	160	160	160	0	0	0	0	0	0	1,700

AOC = *Administrative Order on Consent for Remedial Action*; LUT = Look-Up Table; yr = year.

[a] During the first and last year of activities, there would be shipments of equipment by heavy-duty truck to support soil remediation operations (26) and building demolition (19).

Note: Totals have been rounded.

Table H–18 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*	*Years 12–27*	*Year 28*
Average Daily Truck Round Trips for Waste													
Soil Remediation Alternatives													
Cleanup to AOC LUT Values	0	0	9	9	9	9	9	9	9	9	9	9	1
Cleanup to Revised LUT Values	0	0	9	9	9	9	9	4	0	0	0	0	0
CNR – Residential	0	0	9	4	0	0	0	0	0	0	0	0	0
CNR – Open Space	0	0	9	1	0	0	0	0	0	0	0	0	0
Building Demolition Alternatives													
Building Removal	2.4 [a]	2.4 [a]	2.4 [b]	0	0	0	0	0	0	0	0	0	0
Groundwater Remediation Alternatives													
Groundwater Monitored Natural Attenuation	0.004	0.004	0.044	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004/yr	0.004
Groundwater Treatment Alternative	0	0	0.10	6	0.10	0.10	0.10	0	0	0	0	0	0
Average Daily Round Trips for Backfill, Equipment, and Supplies [b]													
Soil Remediation Alternatives													
Cleanup to AOC LUT Values	0	0.1[c]	7	7	7	7	7	7	7	7	7	7/yr	7
Cleanup to Revised LUT Values	0	0.1[c]	7	7	7	7	7	3	0	0	0	0	0
CNR – Residential	0	0.1[c]	7	3	0	0	0	0	0	0	0	0	0
CNR – Open Space	0	0.1[c]	1	1	0	0	0	0	0	0	0	0	0
Building Demolition Alternatives													
Building Removal	0.08 [b]	2.3 [a]	2.5 [b]	0	0	0	0	0	0	0	0	0	0
Groundwater Remediation Alternatives													
Groundwater Monitored Natural Attenuation	0.08	0.08	0.2	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08/yr	0.08
Groundwater Treatment Alternative	0	0.02	0.06	3.3	0.06	0.06	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/yr	6,250
Cleanup to Revised LUT Values	0	0	6.250	6.250	6.250	6.250	6.250	6.250	0	0	0	0	0
CNR – Residential	0	0	6,250	6,250	0	0	0	0	0	0	0	0	0
CNR – Open Space	0	0	6,250	6,250	0	0	0	0	0	0	0	0	0

Action Alternative	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*	*Year 6*	Year 7	*Year 8*	*Year 9*	*Year 10*	*Year 11*	*Years 12–27*	*Year 28*
Building Demolition Alternatives													
Building Removal	15,000	15,000	7,500	0	0	0	0	0	0	0	0	0	0
Groundwater Remediation Alternatives													
Groundwater Monitored Natural Attenuation	120	120	270	120	120	120	120	120	120	120	120	120/yr	120
Groundwater Treatment Alternative	0	200	120	220	120	120	120	0	0	0	0	0	0

AOC = *Administrative Order on Consent for Remedial Action*; CNR = Conservation of Natural Resources; LUT = Look-Up Table; yr = year.

[a] Reflects waste and backfill shipments averaged over 250 working days per year, or an average of approximately 5 daily waste and backfill shipments. On some days these shipments could increase to approximately 12 per day.

[b] Includes for the Groundwater Monitored Natural Attenuation Alternative the offsite shipment of groundwater monitoring samples by car or light-duty truck.

[c] During the second year of the project activities there would be approximately 26 shipments of equipment by heavy-duty truck to support soil remediation operations.

Table H–19 Highest Number of Average Daily Shipments to the Evaluated Disposal, Recycle, and Intermodal Facilities

Waste	Facility	Soil Remediation Alternatives				Building Removal Alternative	Groundwater Remediation Alternative		Combination of Alternatives	
		Cleanup to AOC LUT Values	Cleanup to Revised LUT Values	Conservation of Natural Resources (Residential Scenario)	Conservation of Natural Resources (Open Space Scenario)		Monitored Natural Attenuation	Groundwater Treatment	Low Impact Combination [a]	High Impact Combination [b]
Disposal and Recycle Facilities [e]										
LLW/MLLW	All authorized [c]	7	7	0.3	0.1	0.2	0	6	2	9
Hazardous	All authorized [c]	0.5	0.5	0.5	0.5	0.02	0	0.1	0.5	0.6
Nonhazardous	All authorized [c]	9	9	8	9	0.2	0.02	0	9	9
Recycle	All authorized [c]	0	0	0	0	0.5	0	0	0.5	0.5
Intermodal Facilities [d]										
Combined [e]	Puente Hills	9	9	9	9	2.4	0	6	12	15
LLW/MLLW	Barstow	7	7	0.3	0.1	0.2	0	6	2	9

AOC = 2010 Administrative Order on Consent; LLW = low-level radioactive waste; LUT = Lookup Table; LLMW = low-level mixed level waste.

[a] Consists of the Conservation of Natural Resources (Open Space Scenario), Building Removal, and Groundwater Monitored Natural Attenuation Alternatives.

[b] Consists of the Cleanup to AOC LUT Values, Building Removal, and Groundwater Treatment Alternatives.

[c] All evaluated facilities authorized for disposal of the specified waste.

[d] Applicable to the Truck Option.

[e] Combined waste shipments refers to all wastes addressed under each action alternative and considered for the truck/rail option. Combined waste under the soil remediation action alternatives and considered for the truck/rail option consists of all radioactive, hazardous, and nonhazardous soil; combined waste under the Building Removal Alternative consists of all waste but not recycle material; combined waste under the Groundwater Treatment Alternative consists of removed contaminated bedrock.

H.13.3.2.2 Quality of Traffic Flow

The analyses of the quality of traffic flow in the SSFL vicinity and the vicinities of the evaluated disposal, recycle, and intermodal facilities were performed using procedures contained in the *Highway Capacity Manual* (TRB 2010) published by the Transportation Research Board. The *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 (see text box). DOE applied two analytical approaches in accordance with the *Highway Capacity Manual*: (1) a detailed analysis of traffic flow quality was performed for selected intersections and road segments in the SSFL vicinity considering operational factors such as control delay, LOS, and volume-to-capacity (V/C) ratios; and (2) a generalized planning analysis of traffic flow quality was performed for the roads and road segments in the vicinities of the evaluated disposal, recycle, and intermodal facilities.

Highway Capacity Manual

Issued by the Transportation Research Board, the *Highway Capacity Manual* contains concepts, guidelines, and computational procedures for computing the capacity and quality of service of highway features including signalized and unsignalized intersections, highways, freeways, arterial roads, roundabouts, and the effects of pedestrians, bicycles, and mass transport on the performance of these systems. The *Highway Capacity Manual* is a worldwide reference for transportation and traffic engineering scholars and practitioners. Several editions with improved and updated procedures have been issued since 1950.

Under the *Highway Capacity Manual*, there are many methods for computing capacity and quality of service, ranging from generalized service volume tables (the simplest to use) to complex analytical tools that are precise but time consuming and data intensive. The types of analysis performed under the *Highway Capacity Manual* could include:

- Planning and preliminary engineering analysis, typically focusing on future conditions, where it is desired to evaluate a series of alternatives quickly or when specific input values to procedures are not known, requiring the extensive use of default values.
- Design analysis, typically using *Highway Capacity Manual* procedures to identify the required characteristics of a transportation facility that will allow it to operate at a desired LOS, with some use of default values.
- Operational analysis, typically focusing on current or near-term conditions, involving detailed inputs to *Highway Capacity Manual* procedures, with no or minimal use of default values.

Selecting the appropriate level of analysis for a given situation requires considering the tradeoffs among study purposes, accuracy and precision of results, data requirements, etc. No one analytical approach is appropriate for all situations.

Analysis of LOS and Volume-to-Capacity Ratios in the SSFL Vicinity

A detailed analysis of traffic flow quality was performed for selected intersections and road segments considering operational factors such as control delay, LOS, and V/C ratios. Control delay is the component of delay that results from the type of control at the intersection, such as a traffic signal or a stop sign, as measured by comparison with the uncontrolled condition. It is the difference between the travel time that would have occurred in the absence of the intersection control, and the travel time that results because of the presence of the intersection control. Capacity is the maximum rate of flow that can pass through a given intersection under prevailing traffic and road conditions. The sum of all critical movements (that is, left turns, right turns, or through movements) on a critical lane basis is used to determine the total intersection V/C ratio and corresponding LOS. An intersection or road is at capacity (V/C ratio of 1.0) when flow decreases due to congested conditions. This V/C ratio is based on traffic volumes by lane, signal phase timing patterns, and lane configuration. Traffic engineers frequently perform detailed analyses similar to those performed for this EIS to provide an

accurate assessment of complex traffic conditions which could occur, for example, in a city or community.

A detailed analysis was performed for this EIS because the routes in the SSFL area that would be used for transport of waste, material, and personnel transit urbanized areas wherein traffic flow would be significantly affected by the presence of signalized and unsignalized intersections and where traffic volumes on the roads and at intersections may significantly vary depending on the time of day (e.g., AM and PM "rush hour" conditions). Vehicles must transit several intersections while in the SSFL vicinity. The need to transit these intersections would contribute to potential traffic delays experienced by haul trucks transporting waste to offsite facilities until the trucks could leave the SSFL vicinity. Similarly, the need to transit these intersections would contribute to potential traffic delays in the SSFL vicinity experienced by trucks delivering backfill, equipment, or supplies to SSFL, or by site workers commuting to and from SSFL. The traffic associated with DOE remediation activities in the SSFL vicinity is expected for any of the action alternatives to be much larger than the traffic levels at the evaluated disposal, recycle, and intermodal facilities.

DOE performed this detailed analysis using Highway Capacity Software for selected road segments and signalized and unsignalized intersections (Highway Capacity Software Version 7, University of Florida McTrans Center). The Highway Capacity Software contains modules that implement the concepts, guidelines, and computational procedures of the Highway Capacity Manual, and enables an in-depth analysis of traffic conditions in an area which could be used -- for example, for planning and engineering of roads and intersections for optimum traffic flow. The Software can evaluate traffic conditions such as LOS for signalized and unsignalized intersections, urban streets, roundabouts, or freeways.

Except for Woolsey Canyon Road (see below), the intersections and road segments in the SSFL vicinity to be evaluated in this EIS were selected from those intersections and road segments that showed existing (year 2018) or future year LOS levels of E or F as determined in the 2017 Traffic Study prepared for the DTSC *Draft Program Environmental Impact Report* (EIR) (DTSC 2017b) (see text box). Four intersections and four road segments were evaluated in this EIS:

Intersections:

I1 – Woolsey Canyon Road and Valley Circle Boulevard (unsignalized)
I2 – Topanga Boulevard and State Route 118 westbound ramps (signalized)
I3 – Topanga Canyon Boulevard and State Route 118 eastbound ramps (signalized)
I4 – Roscoe Boulevard and Topanga Canyon Boulevard (signalized)

Road Segments:

RS1 – Woolsey Canyon Road from Knapp Ranch Road to Valley Circle Boulevard
RS2 – Valley Circle Boulevard from Woolsey Canyon Road to Box Canyon Road
RS3 – Valley Circle Boulevard from Woolsey Canyon Road to Chatlake Drive
RS4 – Roscoe Boulevard from Shoup Avenue to Farralone Avenue

The evaluated intersections and road segments are shown in **Figure H–5**, where the intersection and road segment designators indicated above correspond to those in the figure.

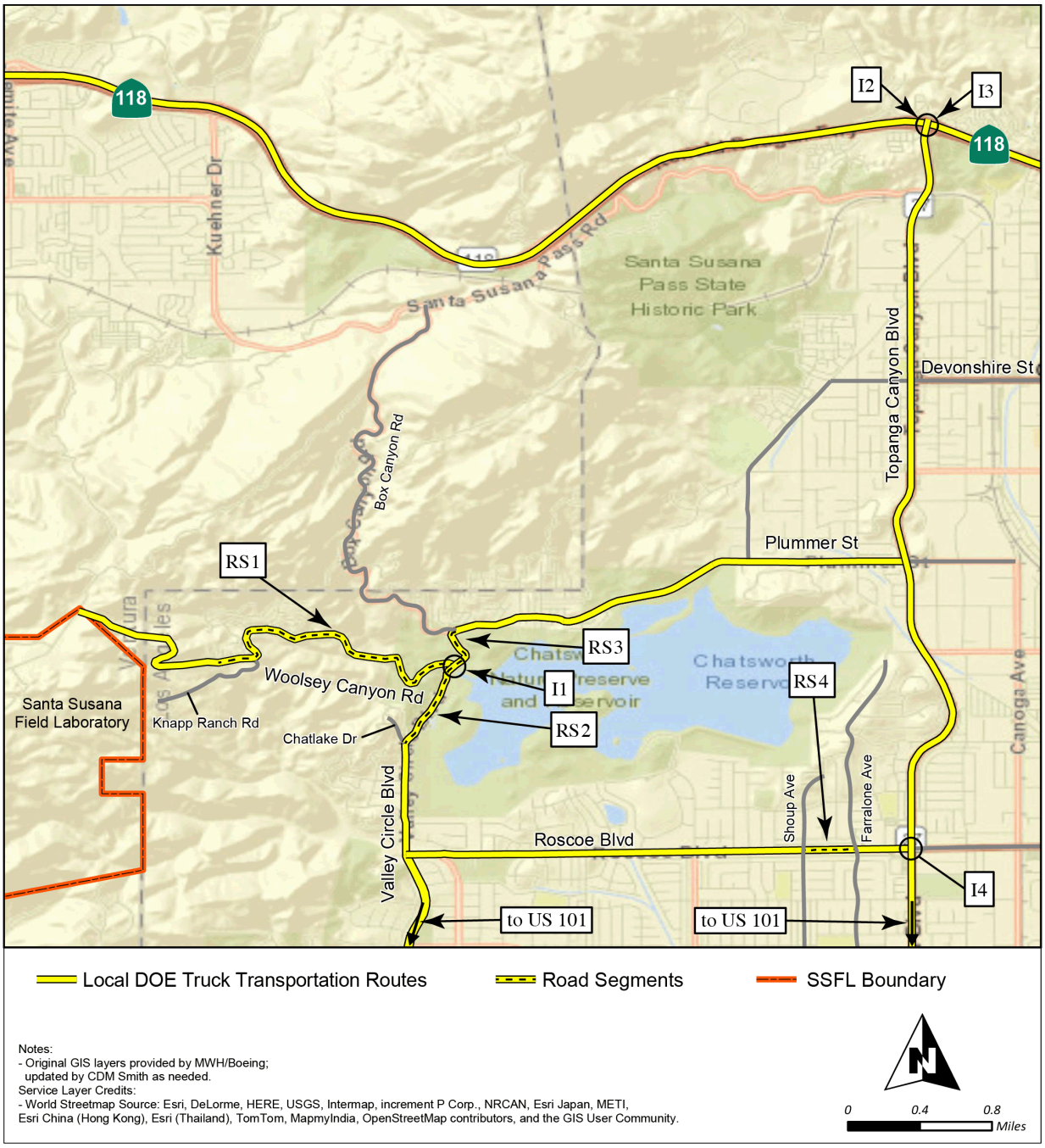

Figure H–5 Evaluated Intersections and Road Segments in the SSFL Vicinity

2017 Traffic Study

The 2017 Traffic Study (DTSC 2017b) evaluated traffic impacts during AM and PM peak traffic conditions for 16 intersections and 11 road segments. Six intersections and four road segments were determined to operate at LOS ratings of E (near or at capacity) or F (above capacity) under 2018 baseline traffic conditions:

Intersections:

- Topanga Canyon Boulevard and the State Route 118 eastbound ramps (LOS F, AM and PM peaks)
- Valley Circle Boulevard and Woolsey Canyon Road (LOS E, AM peak)
- Topanga Canyon Boulevard and Victory Boulevard (LOS E, AM peak)
- Topanga Canyon Boulevard and Burbank Road (LOS E, PM peak)
- Topanga Canyon Boulevard and U.S. Highway 101 northbound off ramp (LOS F, AM and PM peaks)
- Valley Circle Boulevard and U.S. Highway 101 northbound off ramp (Long Valley Road) (LOS F, AM peak)

Road segments:

- Valley Circle Boulevard, from Box Canyon Road to Woolsey Canyon Road (LOS F, AM peak)
- Valley Circle Boulevard, from Woolsey Canyon Road to Chatlake Drive (LOS F, AM peak; LOS E, PM peak)
- Roscoe Boulevard, from Shoup Avenue to Farralone Avenue (LOS F, AM peak)
- Valley Circle Boulevard, from Burbank Boulevard to U.S. Highway 101 (LOS F, AM and PM peaks)

To assess the potential impacts of SSFL project activities, the study used the Transportation Research Board's Circular 212 Planning or Critical Movement Analysis, assuming 96 daily heavy-duty truck round trips plus 250 round trips in light-duty vehicles by site personnel, reflecting the combined daily truck traffic and worker commutes assumed in the DTSC draft program Environmental Impact Report for DOE, NASA, and Boeing (DTSC 2017a). Under these conditions, the LOS rating for the intersection of Valley Circle Boulevard with Woolsey Canyon Road would degrade from E to F during AM and PM peak traffic conditions; the LOS for Valley Circle Boulevard from Box Canyon Road to Woolsey Canyon Road would degrade to E during the PM peak, the LOS rating for Roscoe Boulevard from Shoup Avenue to Farralone Avenue would degrade from D to E during AM peak traffic conditions, and the LOS rating for Valley Circle Boulevard from Vanowen Street to Victory Boulevard would degrade from D to E during AM peak traffic conditions.

The study also projected traffic conditions in the year 2032 assuming a 1 percent ambient traffic growth rate. Without considering additional traffic from SSFL activities, four additional intersections and one additional road segment (compared to 2018 baseline conditions) would experience an LOS rating of E or F during AM and/or PM peak traffic conditions:

- Topanga Canyon Boulevard and State Route 118 westbound ramps (LOS F, AM and PM peaks)
- Topanga Canyon Boulevard ant Roscoe Boulevard (LOS E, PM peak)
- Topanga Canyon Boulevard and Sherman Way (LOS E, AM and PM peaks)
- Valley Circle Boulevard and Calabasas Road/Avenue San Luis (LOS E, PM peak)
- Valley Circle Boulevard from Vanowen Street to Victory Boulevard (LOS F, AM peak)

Assuming 96 daily heavy duty truck and 250 employee round trips, the LOS rating for AM peak traffic conditions for the intersection of Topanga Canyon Boulevard and Roscoe Boulevard would further degrade to D. The LOS rating for PM peak traffic conditions for Valley Circle Boulevard from Box Canyon Road to Woolsey Canyon Road would further degrade to F.

All of the evaluated intersections and roads are present on the projected truck routes evaluated in this EIS (see Table H–13). The Woolsey Canyon Road segment was not projected to experience LOS levels of E or F at any time in the 2017 Traffic Study (DTSC 2017b), but was evaluated in this EIS because it is the road most heavily traveled by trucks. The unsignalized intersection with Woolsey Canyon Road and Valley Circle Boulevard was evaluated in this EIS because all trucks entering or leaving SSFL would use this intersection. (It was also evaluated in the 2017 Traffic Study.) To further assess the potential traffic impacts near this intersection, the analysis addresses the Valley Circle

Boulevard segments north and south of this intersection – that is, from Woolsey Canyon Road to Box Canyon Road and from Woolsey Canyon Road to Chatlake Drive. (Trucks leaving SSFL must turn either north or south on Valley Circle Boulevard.) Roscoe Boulevard and its intersection with Topanga Canyon Boulevard were evaluated because of the potential use of Roscoe Boulevard as a haul route; and the intersections of Topanga Canyon Boulevard and the State Route 118 interchanges were evaluated because State Route 118 lies on a direct route between SSFL and offsite waste management facilities.

For analysis in this EIS, two scenarios for heavy-duty truck traffic were considered: (1) an average of 16 daily truck round trips (or 2 round trips per hour assuming an 8-hour working day), and (2) an average of 32 daily truck round trips (or 4 round trips per hour assuming an 8-hour working day). For both scenarios traffic from 25 site workers was included. The average of 16 daily truck roundtrips corresponds to the daily average expected shipping rate of any soil remediation action alternatives. As discussed in Chapter 2, this average shipping rate was assumed for all soil remediation action alternatives based on input from DOE's Office of Environmental Management Consolidated Business Center. This average shipping rate would be bounding for all soil remediation action alternatives as well as the Building Removal Alternative and both groundwater remediation action alternatives. Under the Building Removal Alternative, the average daily heavy-duty truck shipping rate for waste and backfill would be about 5 per day, although the rate could spike to 12 per day on some days. Under the Groundwater Remediation Action Alternatives, average heavy-duty truck shipments would be much less than 1 per day for the Groundwater Monitored Natural Attenuation Alternative and only a few per day for the Groundwater Treatment Alternative. An average of 32 daily truck roundtrips (4 round trips per hour) reflects a hypothetical assumption that over the course of a year, DOE could occasionally achieve a shipping rate for soil remediation that is twice the maximum expected sustained average shipping rate. As discussed in Chapter 2, Section 2.2.3, the assumption of an occasional increase to 32 daily truck round trips is made to provide an upper bound on impacts that could result from the traffic associated with DOE remediation activities.

As shown in the 2017 Traffic Study (see text box), traffic congestion currently exists in the SSFL area at some intersections and roads and some times of the day. And if the population in the SSFL area grows during the time required for SSFL remediation, then the level of traffic congestion could also grow in the SSFL area independent of any remediation activity. Therefore, the analysis for this EIS was performed assuming traffic corresponding to the above scenarios was added to 2018 baseline conditions, as well as to future traffic in the SSFL area assuming a 1 percent traffic growth rate until the year 2032. This 1 percent traffic growth rate is independent of DOE activities. The assumptions of 2018 baseline conditions, a 1 percent traffic growth rate, and a cutoff of the analysis in 2032 are the same as those in the 2017 Traffic Study (DTSC 2017b).

The 1 percent traffic growth rate assumed for this EIS is conservative. As noted in DTSC's 2017 *Draft Program EIR* (DTSC 2017a) and Traffic Study (DTSC 2017b), traffic growth projections for the West San Fernando Valley area in the County of Los Angeles Congestion Management Program (as of 2010) is 0.41 percent per year (DTSC 2017a). In addition, the California Department of Finance has projected that the populations in Los Angeles and Ventura Counties would increase by 9 percent from 2016 through 2030 (California Department of Finance 2018), which is equivalent to an annual growth rate of about 0.6 percent.

DOE assumed a 2032 cutoff of analysis in the interest of consistency with the 2017 Traffic Study and because DOE believes that traffic projections to 2032 would be sufficient to reach meaningful conclusions from the analysis. Under the Cleanup to AOC LUT Values Alternative, remediation activities and the traffic associated with these activities are projected to continue for several years past 2032. Nonetheless, DOE believes the number of years evaluated (from 2018 through 2032) is

sufficient to analyze the effects of the traffic associated with this alternative. Also, DOE doubts the utility of extending a 1 percent growth rate over all 28 years of soil removal that are projected for this alternative. At some point the growth assumption would become invalid because if such growth occurred without modifications to the traffic system, there could be gridlock throughout the SSFL area.[13]

The City of Los Angeles guidelines on transportation impact studies (LDOT 2016) include guidance on determining transportation impact thresholds of significance. For signalized intersections, a determination of significance depends on the LOS for that intersection, the V/C ratio, and the project-related increase in the V/C ratio as summarized in the text box. Unsignalized intersections can also be evaluated to determine LOS based on minor street delay; if the resultant LOS for a "future with project scenario" is E or F, the intersection can be evaluated for the potential installation of a new traffic signal. A proposal for installation of a new traffic signal would be based on a transportation impact study prepared in accordance with City of Los Angeles Department of Transportation procedures that would include a traffic signal warrant analysis (LDOT 2016). The Federal Highway Administration Manual on Uniform Traffic Control Devices (https://mutcd.fhwa.dot.gov/pdfs/2009r1r2/pdf_index.htm), also outlines criteria for evaluating the need for converting an unsignalized intersection to a signalized intersection based on warrant analysis.

Significant Transportation Impact Thresholds

Level of Service	Final Volume-to-Capacity Ratio	Project-Related Increase in Volume-to-Capacity Ratio
C	0.701 to 0.800	Equal to or greater than 0.040
D	0.801 to 0.900	Equal to or greater than 0.020
E	0.901 to 1.000	Equal to or greater than 0.010
F	Greater than 1.000	Equal to or greater than 0.010

Source: LDOT 2016.

Analysis of Traffic Flow Quality at Disposal, Recycle, and Intermodal Facilities

A generalized planning analysis of traffic flow quality was performed for the roads and road segments in the vicinities of the evaluated disposal, recycle, and intermodal facilities using the guidance and procedures contained in the *Highway Capacity Manual* (TRB 2010). A generalized planning analysis is often used by traffic engineers when estimating future traffic conditions when a generalized (high level) assessment of LOS and road capacity is appropriate – for example, when data is limited or when traffic conditions must be projected years into an uncertain future. First, baseline LOS ratings were determined for the roads considering average baseline daily traffic levels for the roads, appropriate K- and D-Factors for the roads, and the generalized service volume level data provided in the *Highway Capacity Manual* (TRB 2010) (see below). Second, the potential change in LOS ratings on these roads were determined considering the additional traffic on the evaluated roads under each action alternative and assuming the same K- and D-Factors and the same generalized service volume level data that was considered for determining the baseline LOS ratings.

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 *Highway Capacity Manual* (TRB 2010) account for these differences by converting heavy-duty truck volumes into passenger car

[13] DTSC's draft Program EIR and Traffic Study evaluated a 15-year period of SSFL remediation by DOE, NASA, and Boeing, beginning in 2015 and ending in 2032. This 15-year period was assumed based on the site remediation plans and waste projections as estimated by DOE, NASA, and Boeing at the time of preparation of the draft program EIR and Traffic Study. Since that time, these remediation plans and waste projections have changed. DTSC selected the year 2032 for analysis because DTSC believed it to represent the furthest point in the future within the remediation timeline that would provide the greatest amount of background traffic growth based on time to define a conservative analysis baseline (DTSC 2017a, 2017b).

equivalents. **Table H–20** presents LOS average daily traffic service volume threshold values for six-lane and eight-lane urban freeway facilities located on level and rolling terrain.[14] **Table H–21** 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–20, for example, a six-lane urban freeway with an average daily traffic of 85,000, a peak hour factor (K-Factor) of 0.08 (i.e., 8 percent of the traffic occurs during the peak hour), and a directional distribution (D-Factor) 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). The K- and D-Factors assumed for analysis were 0.10 and 0.60, respectively.

A generalized planning analysis is appropriate for these roads and road segments because the evaluated facilities are nearly all located in rural areas having low population densities and low baseline levels of traffic on the vicinity roads that would be likely used to access the facilities. In general, few intersections would need be traversed near the facilities. The facilities are generally immediately adjacent to or readily accessible[15] from freeways or highways, including interstates or divided highways with medians or turn lanes or controlled exit ramps, or four-lane roads with turning lanes. To access most disposal or recycle facilities, there is little or no requirement to transit urban areas. Generally, the entry road to the facility is a simple and direct exit from the access road. One merely turns off the access road, generally a highway, directly into the facility. In addition, the daily levels of heavy-duty truck traffic at the evaluated facilities are expected to be small. Table H–19 lists the highest average number of daily shipments to the evaluated disposal and recycle facilities under each action alternative.

Generalized planning LOS analyses were also performed for roads near the intermodal facilities. Although the Puente Hills Intermodal Facility is located in an urban area, the roads providing access to the facility are designed to accommodate large daily numbers of heavy-duty trucks without significant delays at intersections. As discussed above, operation of Puente Hills was analyzed in the *PHIF EIR* and *PHIF EIR Addendum* (City of Industry 2018, 2019) which determined that the construction or operation of the Puente Hills Intermodal Facility would not result in significant impacts to local traffic, assuming that mitigation measures were implemented. Any shipments from SSFL to the Puente Hills Intermodal Facility would be expected to be within the total daily or annual number of trucks evaluated and authorized for the facility. In addition, low traffic levels would be expected. For example, under the soil remediation action alternatives, an average of only 16 heavy-duty trucks would leave or arrive at Area IV on a daily basis, of which approximately 7 of these trucks would consist of backfill deliveries to Area IV, leaving approximately 9 daily waste shipments to Puente Hills (see Table H–19). This is a small number of daily trucks. Assuming operation of the facility over an 8-hour day, there would be slightly over 1 truck delivery per hour. During remediation, the daily shipment levels may vary. Table H–19 lists the highest number of average daily shipments to the evaluated intermodal facilities under each action alternative.

[14] LOS estimated by Highway Capacity Manual 2010 Exhibit 16-14 or Exhibit 15-30.

[15] As used in this paragraph, "readily accessible" means that after existing a freeway or highway, only a short distance would need be traveled on a secondary, low-traffic-density road access the facility.

Table H–20 Generalized Daily Service Volumes for Urban Freeway Facilities

K-Factor	D-Factor	Six-Lane Freeway				Eight-Lane Freeway			
		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: *Highway Capacity Manual,* Exhibit 10-8 (TRB 2010).

Table H–21 Generalized Daily Service Volumes for Urban Street Facilities

K-Factor	D-Factor	Two-Lane Streets				Four-Lane Streets				Six-Lane Streets			
		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: *Highway Capacity Manual,* Exhibit 16-14 (TRB 2010).

Generalized planning LOS analyses were performed for roads near the disposal and recycle facilities because of the less importance of intersectional traffic analysis (as compared to that for the SSFL area) and the expected low traffic levels from DOE action alternatives. The evaluated disposal and recycle facilities are generally in rural areas having low population densities and low-levels of traffic on the roads providing access to the facilities. Access roads are frequently highways, including interstates or divided highways having controlled exit ramps, or four-lane roads with turning lanes. To access most disposal or recycle facilities, there is little or no requirement to transit urban areas. Generally, the entry road to the facility is a simple and direct exit from the access road. One merely turns off the access road, generally a highway, directly into the facility.

In addition, the daily levels of heavy-duty truck traffic at the evaluated facilities are expected to be small. Table H–19 lists the highest average number of daily shipments to the evaluated disposal and recycle facilities under each action alternative.

H.13.3.2.3 Analysis of Pavement Deterioration

The physical impact of vehicles, particularly heavy-duty trucks, can result in pavement deterioration.[16] DOE made for each action alternative a qualitative estimate of the potential for pavement deterioration resulting from traffic associated with DOE remediation activities, as guided and supported by a quantitative estimate of the impact of traffic on pavement as measured by the number of Equivalent Single Axle Loads (ESALs) that could be imposed. 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 and an 18,000 pound axle load has an equivalency factor of 1.0 (lighter loads have values lower than 1.0, and heavier loads have values higher than 1.0). The larger the number of ESALs over a road segment, the higher the pavement damage associated with traffic flow. The number of ESALs was determined for each action alternative using the procedures outlined in the *AASHTO Guide for Design of Pavement Structures* (AASHTO 1993), published by the American Association of Highway Transportation Officials (AASHTO).

ESAL values are a function of pavement type (concrete or flexible), structural properties, 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, 1.08, and 1.08, respectively.[17] The total ESAL value of the truck is 2.349. 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.

	Per Vehicle ESALs	
Truck Type	Loaded	Unloaded
Semi (5 axle)	2.349	0.213
End Dump (5 axle)	2.349	0.213
Medium Duty (3 axle)	1.456	0.614
Light Duty (2 axle)	0.0004	0.0004
Tanker (3 axle)	1.679	0.213
Drill Rig (3 axle)	0.213	0.213

A three-axle, 48,000-pound, medium-duty delivery truck with 16,000 pounds on the front axle and 32,000 pounds on the rear tandem axles has an ESAL equivalent of 1.456, which means that one semi-trailer truck does pavement damage similar to approximately 1.6 medium-duty trucks. The estimated ESAL value for an empty 3-axle, medium-duty truck weighing 22,000 pounds is 0.614. Analysis of

[16] Pavements are designed to accommodate a design number of ESALs over a projected service length, and when design ESALs are exceeded, the result is a decrease in pavement service life. For example, if a pavement that is designed to carry 100 million ESALs over a 20-year service life carries 100 million ESALs over 18 years, pavement deterioration would occur sooner than planned.

[17] Based on flexible pavements; Structural Number (N) = 5, Pavement terminal serviceability rating (p) = 2.5.

pavement deterioration was based on estimating the number of additional trucks and other vehicles (e.g., worker cars), and therefore ESALs, associated with material shipments over the road network. ESALs were developed for each road and alternative considering the number of years that heavy-duty trucks and other vehicles would traverse the roads.

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.

H.13.4 Impact Analysis Results

H.13.4.1 SSFL Vicinity

Percent Increase in Traffic in the SSFL Vicinity

The vehicle trips summarized in Tables H–17 and H–18 were used to determine the percent increase in average daily traffic for each route under each alternative and scenario, as shown in **Table H–22**. 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 3.3 percent in nearly all years under the Cleanup to AOC LUT Values and Cleanup to Revised LUT Values Alternative. This peak increase in traffic would occur for only 1 year for both scenarios under the Conservation of Natural Resources Alternative. With respect to the Building Removal Alternative, the percent increase in traffic is given for each year as an average across a working year, reflecting a daily average of about daily waste and backfill shipments. However, the number of daily shipments would likely vary. For example, there could be a larger daily number of shipments if DOE were shipping nonhazardous building demolition debris and recycle material than if DOE were shipping hazardous or radioactive waste. Assuming for brief intervals that the daily shipping rate were 12 waste and backfill trucks, the maximum increase on Woolsey Canyon Road would be approximately 5.8 percent rather than the 5.2 percent listed in Table H–22. The difference between a 5.8 percent increase and a 5.2 percent increase is not believed to be significant. With respect to the Groundwater Treatment Alternative, shipment of removed bedrock and backfill was assumed to be shipped in the fourth year over a 60-day working period. However, if the shipments were spread over a working year, the maximum increase in traffic on Woolsey Canyon Road would be approximately 0.22 percent rather than 0.80 percent. The traffic increase on other roads would also be proportionately decreased.

Table H–23 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 8.6 percent in the third year of project activities. During the fourth year the increase would be 4.4 percent; and for the additional years required under this combination the increase would be 3.3 percent. Under the combination of the Conservation of Natural Resources (Open Space Scenario), Building Removal, and Groundwater Monitored Natural Attenuation Alternatives (Low Impact Combination), the average daily traffic on Woolsey Canyon Road would again increase by 8.6 percent in the third year of project activities with smaller increases in later years (no larger than 2.2 percent). The percentages during the third year reflect an assumed overlap between the end of building removal and the start of soil removal, and the percentages during the fourth year reflect an assumed overlap between removal of contaminated bedrock and soil removal.

Table H–22 Percent Increase in Average Daily Traffic Above Baseline Conditions under Each Action Alternative

Road	*Segment*	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*	*Year 6*	*Year 7*	*Year 8*	*Year 9*	*Years 10–26*[a]	*Year 27*	*Year 28*
Cleanup to AOC LUT Values Alternative													
Woolsey Canyon Rd	SSFL entrance to Valley Circle Blvd	-	0.0084	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	2.2
Valley Circle Blvd	Woolsey Canyon to Plummer Street	-	0.0033	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	0.86
	Woolsey Canyon to Roscoe Blvd	-	0.0023	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.61
	Roscoe Blvd to Victory Blvd	-	0.0010	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.27
	Victory Blvd to U.S. Highway 101	-	0.00058	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.15
Roscoe Blvd	Valley Circle Blvd to Topanga Canyon Blvd	-	0.0026	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.68
Plummer Street	Valley Circle Blvd to Topanga Canyon Blvd	-	0.0038	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.0
Topanga Canyon Blvd	Plummer Street to SR 118 (Ronald Reagan Freeway)	-	0.00049	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.13
	Roscoe Blvd to SR 118 (Ronald Reagan Freeway)	-	0.00049	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.13
	Roscoe Blvd to U.S. Highway 101	-	0.00045	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.12
SR 118	Junction with Topanga Canyon Blvd	-	0.00016	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.042
U.S. Highway 101	Junction with Topanga Canyon Blvd	-	0.00009	0.034	0.034	0.034	0.034	0.034	0.034	0.034	0.034	0.034	0.023
Cleanup to Revised LUT Values Alternative													
Woolsey Canyon Rd	SSFL entrance to Valley Circle Blvd	-	0.0084	3.3	3.3	3.3	3.3	3.3	2.5	-	-	-	-
Valley Circle Blvd	Woolsey Canyon to Plummer Street	-	0.0033	1.3	1.3	1.3	1.3	1.3	1.0	-	-	-	-
	Woolsey Canyon to Roscoe Blvd	-	0.0023	0.91	0.91	0.91	0.91	0.91	0.71	-	-	-	-
	Roscoe Blvd to Victory Blvd	-	0.0010	0.40	0.40	0.40	0.40	0.40	0.31	-	-	-	-
	Victory Blvd to U.S. Highway 101	-	0.00058	0.23	0.23	0.23	0.23	0.23	0.18	-	-	-	-
Roscoe Blvd	Valley Circle Blvd to Topanga Canyon Blvd	-	0.0026	1.0	1.0	1.0	1.0	1.0	0.79	-	-	-	-
Plummer Street	Valley Circle Blvd to Topanga Canyon Blvd	-	0.0038	1.5	1.5	1.5	1.5	1.5	1.2	-	-	-	-
Topanga Canyon Blvd	Plummer Street to SR 118 (Ronald Reagan Freeway)	-	0.00049	0.19	0.19	0.19	0.19	0.19	0.15	-	-	-	-
	Roscoe Blvd to SR 118 (Ronald Reagan Freeway)	-	0.00049	0.19	0.19	0.19	0.19	0.19	0.15	-	-	-	-
	Roscoe Blvd to U.S. Highway 101	-	0.00045	0.18	0.18	0.18	0.18	0.18	0.14				
SR 118	Junction with Topanga Canyon Blvd	-	0.00016	0.063	0.063	0.063	0.063	0.063	0.049	-	-	-	-
U.S. Highway 101	Junction with Topanga Canyon Blvd	-	0.00009	0.034	0.034	0.034	0.034	0.034	0.026	-	-	-	-

Road	*Segment*	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*	*Year 6*	*Year 7*	*Year 8*	*Year 9*	*Years 10–26*[a]	*Year 27*	*Year 28*
Conservation of Natural Resources Alternative (Residential Scenario)													
Woolsey Canyon Rd	SSFL entrance to Valley Circle Blvd	-	0.0084	3.3	2.6	-	-	-	-	-	-	-	-
Valley Circle Blvd	Woolsey Canyon to Plummer Street	-	0.0033	1.3	1.0	-	-	-	-	-	-	-	-
	Woolsey Canyon to Roscoe Blvd	-	0.0023	0.91	0.73	-	-	-	-	-	-	-	-
	Roscoe Blvd to Victory Blvd	-	0.0010	0.40	0.32	-	-	-	-	-	-	-	-
	Victory Blvd to U.S. Highway 101	-	0.00058	0.23	0.18	-	-	-	-	-	-	-	-
Roscoe Blvd	Valley Circle Blvd to Topanga Canyon Blvd	-	0.0026	1.0	0.82	-	-	-	-	-	-	-	-
Plummer Street	Valley Circle Blvd to Topanga Canyon Blvd	-	0.0038	1.5	1.2	-	-	-	-	-	-	-	-
Topanga Canyon Blvd	Plummer Street to SR 118 (Ronald Reagan Freeway)	-	0.00049	0.19	0.15	-	-	-	-	-	-	-	-
	Roscoe Blvd to SR 118 (Ronald Reagan Freeway)	-	0.00049	0.19	0.15	-	-	-	-	-	-	-	-
	Roscoe Blvd to U.S. Highway 101	-	0.00045	0.18	0.14	-	-	-	-	-	-	-	-
SR 118	Junction with Topanga Canyon Blvd	-	0.00016	0.063	0.051	-	-	-	-	-	-	-	-
U.S. Highway 101	Junction with Topanga Canyon Blvd	-	0.00009	0.034	0.027	-	-	-	-	-	-	-	-
Conservation of Natural Resources Alternative (Open Space Scenario)													
Woolsey Canyon Rd	SSFL entrance to Valley Circle Blvd		0.0084	3.3	2.1	-	-	-	-	-	-	-	-
Valley Circle Blvd	Woolsey Canyon to Plummer Street		0.0033	1.3	0.84	-	-	-	-	-	-	-	-
	Woolsey Canyon to Roscoe Blvd		0.0023	0.91	0.59	-	-	-	-	-	-	-	-
	Roscoe Blvd to Victory Blvd		0.0010	0.40	0.26	-	-	-	-	-	-	-	-
	Victory Blvd to U.S. Highway 101		0.00058	0.23	0.15	-	-	-	-	-	-	-	-
Roscoe Blvd	Valley Circle Blvd to Topanga Canyon Blvd		0.0026	1.0	0.66	-	-	-	-	-	-	-	-
Plummer Street	Valley Circle Blvd to Topanga Canyon Blvd		0.0038	1.5	1.0	-	-	-	-	-	-	-	-
Topanga Canyon Blvd	Plummer Street to SR 118 (Ronald Reagan Freeway)		0.00049	0.19	0.12	-	-	-	-	-	-	-	-
	Roscoe Blvd to SR 118 (Ronald Reagan Freeway)		0.00049	0.19	0.12	-	-	-	-	-	-	-	-
	Roscoe Blvd to U.S. Highway 101		0.00045	0.18	0.12	-	-	-	-	-	-	-	-
SR 118	Junction with Topanga Canyon Blvd		0.00016	0.06	0.041	-	-	-	-	-	-	-	-
U.S. Highway 101	Junction with Topanga Canyon Blvd		0.00009	0.034	0.022	-	-	-	-	-	-	-	-

Road	Segment	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Years 10–26[a]	Year 27	Year 28
Building Removal Alternative [b]													
Woolsey Canyon Rd	SSFL entrance to Valley Circle Blvd	5.0	5.2	5.2	-	-	-	-	-	-	-	-	-
Valley Circle Blvd	Woolsey Canyon to Plummer Street	2.0	2.1	2.1	-	-	-	-	-	-	-	-	-
	Woolsey Canyon to Roscoe Blvd	1.4	1.4	1.4	-	-	-	-	-	-	-	-	-
	Roscoe Blvd to Victory Blvd	0.61	0.64	0.64	-	-	-	-	-	-	-	-	-
	Victory Blvd to U.S. Highway 101	0.35	0.36	0.36	-	-	-	-	-	-	-	-	-
Roscoe Blvd	Valley Circle Blvd to Topanga Canyon Blvd	1.6	1.6	1.6	-	-	-	-	-	-	-	-	-
Plummer Street	Valley Circle Blvd to Topanga Canyon Blvd	2.3	2.4	2.4	-	-	-	-	-	-	-	-	-
Topanga Canyon Blvd	Plummer Street to SR 118 (Ronald Reagan Freeway)	0.29	0.30	0.31	-	-	-	-	-	-	-	-	-
	Roscoe Blvd to SR 118 (Ronald Reagan Freeway)	0.29	0.30	0.31	-	-	-	-	-	-	-	-	-
	Roscoe Blvd to U.S. Highway 101	0.27	0.28	0.28									
SR 118	Junction with Topanga Canyon Blvd	0.096	0.100	0.10	-	-	-	-	-	-	-	-	-
U.S. Highway 101	Junction with Topanga Canyon Blvd	0.052	0.054	0.05	-	-	-	-	-	-	-	-	-
Groundwater Monitored Natural Attenuation Alternative													
Woolsey Canyon Rd	SSFL entrance to Valley Circle Blvd	0.045	0.045	0.10	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045
Valley Circle Blvd	Woolsey Canyon to Plummer Street	0.018	0.018	0.041	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018
	Woolsey Canyon to Roscoe Blvd	0.013	0.013	0.029	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
	Roscoe Blvd to Victory Blvd	0.0055	0.0055	0.013	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055
	Victory Blvd to U.S. Highway 101	0.0031	0.0031	0.0072	0.0031	0.0031	0.0031	0.0031	0.0031	0.0031	0.0031	0.0031	0.0031
Roscoe Blvd	Valley Circle Blvd to Topanga Canyon Blvd	0.014	0.014	0.033	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Plummer Street	Valley Circle Blvd to Topanga Canyon Blvd	0.021	0.021	0.048	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
Topanga Canyon Blvd	Plummer Street to SR 118 (Ronald Reagan Freeway)	0.0027	0.0027	0.0061	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027
	Roscoe Blvd to SR 118 (Ronald Reagan Freeway)	0.0027	0.0027	0.0061	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027
	Roscoe Blvd to U.S. Highway 101	0.0025	0.0025	0.0057	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025
SR 118	Junction with Topanga Canyon Blvd	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009
U.S. Highway 101	Junction with Topanga Canyon Blvd	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005

Road	Segment	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Years 10–26[a]	Year 27	Year 28
Groundwater Treatment Alternative													
Woolsey Canyon Rd	SSFL entrance to Valley Circle Blvd	-	0.066	0.051	0.80	0.051	0.051	0.051	-	-	-	-	-
Valley Circle Blvd	Woolsey Canyon to Plummer Street	-	0.026	0.020	0.31	0.020	0.020	0.020	-	-	-	-	-
	Woolsey Canyon to Roscoe Blvd	-	0.018	0.014	0.22	0.014	0.014	0.014	-	-	-	-	-
	Roscoe Blvd to Victory Blvd	-	0.0080	0.0063	0.098	0.0063	0.0063	0.0063	-	-	-	-	-
	Victory Blvd to U.S. Highway 101	-	0.0045	0.0035	0.055	0.0035	0.0035	0.0035	-	-	-	-	-
Roscoe Blvd	Valley Circle Blvd to Topanga Canyon Blvd	-	0.020	0.016	0.25	0.016	0.016	0.016	-	-	-	-	-
Plummer Street	Valley Circle Blvd to Topanga Canyon Blvd	-	0.030	0.024	0.37	0.024	0.024	0.024	-	-	-	-	-
Topanga Canyon Blvd	Plummer Street to SR 118 (Ronald Reagan Freeway)	-	0.0038	0.0030	0.047	0.0030	0.0030	0.0030	-	-	-	-	-
	Roscoe Blvd to SR 118 (Ronald Reagan Freeway)	-	0.0038	0.0030	0.047	0.0030	0.0030	0.0030	-	-	-	-	-
	Roscoe Blvd to U.S. Highway 101	-	0.0035	0.0028	0.043	0.0028	0.0028	0.0028					
SR 118	Junction with Topanga Canyon Blvd	-	0.0013	0.0010	0.015	0.00098	0.00098	0.00098	-	-	-	-	-
U.S. Highway 101	Junction with Topanga Canyon Blvd	-	0.00068	0.00053	0.0083	0.00053	0.00053	0.00053	-	-	-	-	-

- = No additional vehicle trips would occur during this year; AOC = *Administrative Order on Consent for Remedial Action*; Blvd = Boulevard; LUT = Look-Up Table; Rd = Road; SR = State Route.

[a] Values for years 10 through 26 are given as a percent for each of these years.

[b] Assuming backfill would be shipped to SSFL under the Building Removal Alternative during the last 2 years of this alternative, the percent increase in average daily traffic was determined for the Building Removal Alternative as an average of two heavy-duty truck round trips for shipment of waste and backfill across the first working year. For the final 2 years, the daily average was five heavy-duty truck round trips. About 94 percent of the percent increase in traffic over all years is due to worker commute vehicles (cars or light-duty trucks) rather than heavy-duty trucks. On occasion, the shipping rate for heavy duty trucks could increase to 12 per day, such as during shipments of nonhazardous waste and recycle material.

Table H–23 Percent Increase in Average Daily Traffic Above Baseline Conditions for Combinations of Action Alternatives

Road	*Segment*	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*	*Year 6*	*Year 7*	*Year 8*	*Year 9*	*Years 10 – 26* [a]	*Year 27*	*Year 28*
High Impact Combination [b]													
Woolsey Canyon Rd	SSFL entrance to Valley Circle Blvd	5.0	5.3	8.6	3.5	3.3	3.3	3.3	3.3	3.3	3.3	3.3	2.2
Valley Circle Blvd	Woolsey Canyon to Plummer Street	2.0	2.1	3.4	1.4	1.3	1.3	1.3	1.3	1.3	1.3	1.3	0.9
	Woolsey Canyon to Roscoe Blvd	1.4	1.5	2.4	0.98	0.93	0.91	0.91	0.91	0.91	0.91	0.91	0.61
	Roscoe Blvd to Victory Blvd	0.61	0.65	1.05	0.43	0.41	0.40	0.40	0.40	0.40	0.40	0.40	0.27
	Victory Blvd to U.S. Highway 101	0.35	0.36	0.59	0.24	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.15
Roscoe Blvd	Valley Circle Blvd to Topanga Canyon Blvd	1.6	1.6	2.7	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.68
Plummer Street	Valley Circle Blvd to Topanga Canyon Blvd	2.3	2.4	3.9	1.6	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.0
Topanga Canyon Blvd	Plummer Street to SR 118 (Ronald Reagan Freeway)	0.29	0.31	0.50	0.21	0.20	0.19	0.19	0.19	0.19	0.19	0.19	0.13
	Roscoe Blvd to SR 118 (Ronald Reagan Freeway)	0.29	0.31	0.50	0.21	0.20	0.19	0.19	0.19	0.19	0.19	0.19	0.13
	Roscoe Blvd to U.S. Highway 101	0.27	0.29	0.46	0.19	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.12
SR 118	Junction with Topanga Canyon Blvd	0.10	0.10	0.16	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.04
U.S. Highway 101	Junction with Topanga Canyon Blvd	0.052	0.055	0.089	0.037	0.035	0.034	0.034	0.034	0.034	0.034	0.034	0.023
Low Impact Combination [c]													
Woolsey Canyon Rd	SSFL entrance to Valley Circle Blvd	5.1	5.3	8.6	2.2	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045
Valley Circle Blvd	Woolsey Canyon to Plummer Street	2.0	2.1	3.4	0.86	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018
	Woolsey Canyon to Roscoe Blvd	1.4	1.5	2.4	0.60	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
	Roscoe Blvd to Victory Blvd	0.6	0.6	1.1	0.27	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
	Victory Blvd to U.S. Highway 101	0.35	0.36	0.59	0.15	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Roscoe Blvd	Valley Circle Blvd to Topanga Canyon Blvd	1.6	1.6	2.7	0.68	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Plummer Street	Valley Circle Blvd to Topanga Canyon Blvd	2.3	2.4	3.9	1.0	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
Topanga Canyon Blvd	Plummer Street to SR 118 (Ronald Reagan Freeway)	0.30	0.31	0.50	0.13	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
	Roscoe Blvd to SR 118 (Ronald Reagan Freeway)	0.30	0.31	0.50	0.13	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
	Roscoe Blvd to U.S. Highway 101	0.27	0.28	0.47	0.12	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
SR 118	Junction with Topanga Canyon Blvd	0.10	0.10	0.16	0.04	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	0.053	0.055	0.089	0.023	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005

Blvd = Boulevard; Rd = Road; SR = State Route.

[a] Values for years 10 through 26 are given as a percent for each of these years.

[b] Impacts if DOE implemented the Cleanup to AOC LUT Values, Building Removal, and Groundwater Treatment Alternatives.

[c] Impacts if DOE implemented the Conservation of Natural Resources (Open Space Scenario), Building Removal, and Groundwater Monitored Natural Attenuation Alternatives.

LOS Ratings and V/C Ratios for the SSFL Vicinity

The results of the analysis are shown in **Tables H–24** and **H–25** respectively, for the 16 daily truck roundtrips and the 32 daily truck roundtrips scenarios. (Both scenarios include the traffic associated with 25 site workers.) LOS values and V/C ratios are shown for baseline 2018 conditions as well as for the addition of DOE traffic to the 2018 baseline conditions. The results of the analysis for the years 2022, 2026, and 2032 are also shown. In both Table H–24 and H–25, LOS ratings and V/C ratios for peak AM traffic conditions are shown above LOS ratings and V/C ratios for peak PM traffic conditions.

Table H–24 shows that to the extent that traffic conditions would worsen in the SSFL area, these conditions would primarily have less to do with traffic associated with DOE remediation activities and more to do with traffic growth in the area independent of traffic associated with DOE remediation activities. In comparison to baseline traffic conditions in 2018, the addition of 16 daily DOE truck round trips during this year would not change the LOS rating for AM or PM peak traffic conditions for any of the evaluated intersections. However, the V/C ratio for the intersection of Topanga Canyon Boulevard with the State Route 118 eastbound ramp would increase by 0.02 during PM traffic, and the V/C ratio for the intersection of Woolsey Canyon road with Valley Circle Boulevard could increase by 0.07 during PM traffic conditions. Both projected increases in V/C ratios would be considered significant under City of Los Angeles guidance (LADOT 2016).

The LOS rating for AM peak traffic conditions for the intersection of Valley Circle Boulevard with Woolsey Canyon Road would degrade to an E level in 2026 and an F level in 2032, primarily due to assumed 1 percent traffic growth rate in the SSFL vicinity. The LOS rating for AM peak traffic conditions for the intersection of Topanga Canyon Boulevard with the State Route 118 eastbound ramp would degrade from a D rating to an E rating in 2026 and an F rating in 2032. The LOS rating for PM peak traffic conditions for this intersection would degrade to an F rating in 2032. The V/C ratios for AM and PM peak traffic conditions would increase by values larger than 0.02 in the years subsequent to 2018. Like the changes in LOS ratings, these increases in V/C ratios are primarily due to the projected 1 percent traffic growth in the SSFL area, and would be considered significant under City of Los Angeles guidance (LADOT 2016).

In comparison to 2018 baseline conditions, the addition of DOE traffic assuming 16 daily round trips would cause a potential change in the LOS rating for Woolsey Canyon Road from an A rating to a B rating during AM traffic conditions, and an increase in the V/C ratio for this road segment by 0.02 during PM peak traffic conditions. The V/C ratio for Valley Circle Boulevard from Box Canyon Road to Woolsey Canyon Road would increase by 0.02 during AM traffic conditions, but there would be no change in the LOS rating. Both projected increases in V/C ratios would be considered significant under City of Los Angeles guidance (LADOT 2016).

Considering the projected area traffic for the years 2022, 2026, and 2032, there would be some additional increases in V/C ratios but no additional changes in the LOS rating in any evaluated year. For Valley Circle Boulevard in comparison to 2018 baseline conditions, the addition of DOE traffic would cause only a slight increase in the V/C ratios but no changes to the LOS rating in any analyzed year. In comparison with 2018 baseline traffic levels, the LOS rating for Roscoe Boulevard in 2018 would not change from a B rating with the addition of DOE traffic, but could change in 2022, 2026, and 2032 to a C rating, assuming 1 percent growth of traffic in the SSFL Area. The V/C ratios as evaluated to 2032 could increase for Valley Circle Boulevard from Box Canyon road to Woolsey Canyon Road, Valley Circle Boulevard from Woolsey Canyon Road to Chatlake Drive, and Roscoe Boulevard from Shoup Avenue to Farralone Avenue by values greater than 0.02. These increases would be considered significant under City of Los Angeles guidance (LADOT 2016).

Table H–24 Intersection and Road Segment Level of Service and Volume-to-Capacity Ratio Assuming 16 Heavy-Duty Truck Round Trips per Day[a]

Intersection	Analysis Year									
	2018 (Baseline)[b]		2018[b]		2022[b]		2026[b]		2032[b]	
	LOS	V/C Ratio[c]	LOS	V/C Ratio[c]	LOS	V/C Ratio[c]	LOS	V/C Ratio[c]	LOS	V/C Ratio[c]
Intersection										
Topanga Canyon Blvd and SR 118 Westbound Ramp	F F	1.59 1.25	F F	1.60 1.25	F F	1.67 1.30	F F	1.73 1.35	F F	1.84 1.44
Topanga Canyon Blvd and SR 118 Eastbound Ramp	D D	1.03 1.12	D D	1.03 1.14	D D	1.07 1.18	E D	1.10 1.23	F E	1.21 1.31
Valley Circle Blvd and Woolsey Canyon Rd	D C	0.58 0.25	D C	0.60 0.32	E C	0.67 0.35	F C	0.74 0.38	F C	0.86 0.43
Topanga Canyon Blvd and Roscoe Blvd	C D	0.95 0.90	C D	0.97 0.90	D D	1.05 0.97	D D	1.13 1.05	D E	1.27 1.13
Road Segment										
Woolsey Canyon Rd from Valley Circle to Knapp Ranch Rd	A B	0.09 0.10	B B	0.10 0.12	B B	0.10 0.12	B B	0.11 0.13	B B	0.11 0.13
Valley Circle Blvd from Box Canyon Rd to Woolsey Canyon Rd	D D	0.49 0.37	D D	0.51 0.38	D D	0.52 0.39	D D	0.54 0.41	D D	0.57 0.43
Valley Circle Blvd from Woolsey Canyon Rd to Chatlake Dr	D D	0.53 0.41	D D	0.54 0.42	D D	0.56 0.43	D D	0.58 0.45	D D	0.61 0.48
Roscoe Blvd from Shoup Ave to Farralone Ave	B B	0.36 0.44	B B	0.37 0.45	B C	0.38 0.46	B C	0.39 0.48	B C	0.42 0.51

Ave = Avenue; Blvd = Boulevard; Dr = Drive; LOS = level of service; Rd = Road; V/C ratio = volume-to-capacity ratio.

[a] The traffic analyzed includes the contribution by 25 site workers.

[b] The 2018 baseline columns refer to existing traffic conditions without the addition of DOE traffic; the columns for the year 2018 refer to 2018 baseline conditions with the addition of DOE traffic. The columns for 2022 through 2032 refer to the traffic conditions projected for these years with the addition of DOE traffic.

[c] Representing the highest lane group volume-to-capacity ratio (left turns, right turns, or through movements).

Note: For each column, the LOS rating and V/C ratio for AM peak traffic conditions are shown above the LOS rating and V/C ratio for PM peak traffic conditions.

Table H–25 tells a similar story as Table H–24. Except for the intersection of Valley Circle Boulevard with Woolsey Canyon Road, to the extent that traffic conditions would worsen in the SSFL area, the reason would primarily have less to do with traffic associated with DOE remediation activities and more to do with traffic growth in the area independent of traffic associated with DOE remediation activities. Comparing Table H–25 with Table H–24, the only projected difference in LOS rating on any evaluated intersection or road segment assuming 32 daily truck round trips is the LOS rating for the intersection of Woolsey Canyon Road with Valley Circle Boulevard. This LOS rating could change from a D rating to an E rating during AM peak traffic conditions. However, the V/C ratios for 2 of the 4 evaluated intersections (Topanga Canyon Boulevard and State Route 118 Eastbound Ramp and Valley Circle Boulevard and Woolsey Canyon Road) would increase by 0.02 or larger values during AM or PM peak traffic conditions, which would be considered significant under City of Los Angeles guidance (LADOT 2016). The LOS rating for the intersection of Woolsey Canyon Road with Valley Circle Boulevard could further degrade to an F rating in 2028 and 2032. The LOS ratings for AM and PM peak traffic conditions for the intersection of Topanga Canyon Boulevard with the State Route

118 interchange would degrade during 2026 and 2032 in the same pattern as that shown in Table H–24. V/C ratios would also further increase in value and would be considered significant under City of Los Angeles guidance (LADOT 2016).

Table H–25 Intersection and Road Segment Level of Service and Volume-to-Capacity Ratio Assuming 32 Heavy-Duty Truck Round Trips per Day[a]

Intersection	Analysis Year [a]									
	2018 (Baseline)		2018		2022		2026		2032	
	LOS	V/C Ratio [c]	LOS	V/C Ratio [c]	LOS	V/C Ratio [c]	LOS	V/C Ratio [c]	LOS	V/C Ratio [c]
Intersection										
Topanga Canyon Blvd and SR 118 Westbound Ramp	F F	1.59 1.25	F F	1.60 1.25	F F	1.67 1.30	F F	1.73 1.35	F F	1.84 1.44
Topanga Canyon Blvd and SR 118 Eastbound Ramp	D D	1.03 1.12	D D	1.03 1.14	D D	1.07 1.19	E D	1.12 1.23	F E	1.21 1.31
Valley Circle Blvd and Woolsey Canyon Rd	D C	0.58 0.25	E C	0.61 0.33	E C	0.67 0.36	F C	0.74 0.39	F C	0.87 0.44
Topanga Canyon Blvd and Roscoe Blvd	C D	0.98 0.90	C D	0.98 0.90	D D	1.05 0.97	D D	1.13 1.05	D E	1.28 1.13
Road Segment										
Woolsey Canyon Rd from Valley Circle to Knapp Ranch Rd	A B	0.09 0.10	B B	0.10 0.12	B B	0.10 0.12	B B	0.11 0.13	B B	0.11 0.13
Valley Circle Blvd from Box Canyon Rd to Woolsey Canyon Rd	D D	0.49 0.37	D D	0.51 0.38	D D	0.52 0.39	D D	0.54 0.41	D D	0.58 0.43
Valley Circle Blvd from Woolsey Canyon Rd to Chatlake Dr	D D	0.53 0.41	D D	0.54 0.42	D D	0.56 0.43	D D	0.58 0.45	D D	0.61 0.48
Roscoe Blvd from Shoup Ave to Farralone Ave	B B	0.36 0.44	B B	0.37 0.45	B C	0.38 0.46	B C	0.39 0.48	B C	0.42 0.51

Ave = Avenue; Blvd = Boulevard; Dr = Drive; LOS = level of service; Rd = Road; SR = State Route; V/C ratio = volume-to-capacity ratio.

[a] The traffic analyzed includes the contribution by 25 site workers.

[b] The 2018 baseline columns refer to existing traffic conditions without the addition of traffic associated with DOE remediation activities; the columns for the year 2018 refer to 2018 baseline conditions with the addition of traffic associated with DOE remediation activities. The columns for 2022 through 2032 refer to the traffic conditions projected for these years with the addition of traffic associated with DOE remediation activities.

[c] Representing the highest lane group volume-to-capacity ratio (left turns, right turns, or through movements).

Note: For each column, the LOS rating and V/C ratio for AM peak traffic conditions are shown above the LOS rating and V/C ratio for PM peak traffic conditions.

Comparing Table H–25 with Table H–24, the addition of 32 daily DOE truck round trips during this year would not cause a change the LOS rating for AM or PM peak traffic conditions for any of the evaluated road segments. However, similar to Table H–16, there could be a potential change in the LOS rating for Woolsey Canyon Road from an A rating to a B rating during PM peak traffic conditions in 2018. In comparison to 2018 baseline conditions, the addition of DOE traffic assuming 32 daily truck round trips during this year would cause an increase of 0.02 in the V/C ratio for Woolsey Canyon Road under AM peak traffic conditions and on Valley Circle Boulevard from Box Canyon Road to Woolsey Canyon Road under AM peak traffic conditions. Both projected increases in V/C ratios

would be considered significant under City of Los Angeles guidance (LADOT 2016). Considering the projected area traffic for the years 2022, 2026, and 2032, and in comparison with 2018 baseline traffic conditions, the LOS rating for Roscoe Boulevard in 2018 would not change from a B rating with the addition of traffic associated with DOE remediation activities, but could change in 2022, 2026, and 2032 to a C rating assuming a 1 percent growth of traffic in the SSFL Area. There would be some additional increases in V/C ratios for some road segments, which would be considered significant under City of Los Angeles guidance (LADOT 2016).

H.13.4.2 Intermodal Facilities

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 containers 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 the waste containers and the distance between the public and the transfer activities.

Percent Increase in Traffic in the Vicinities of the Intermodal Facilities

Table H–26 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–16. This analysis was performed for each action alternative as well as those combinations of action alternatives expected to result in the lowest and highest impacts.

LOS Ratings for the Intermodal Vicinities

Table H–27 compares the baseline LOS ratings for roads in the vicinities of the evaluated intermodal facilities to the evaluated LOS ratings for these roads, where the evaluated LOS ratings reflect the additional DOE traffic that would occur at the facilities under each action alternative and for combinations of alternatives. The table shows that for all action alternatives, DOE traffic would not cause a change in LOS rating for any evaluated road. Similarly for combinations of alternatives, DOE traffic would not cause a change in LOS rating for any evaluated road under either the Low Impact Combination or the High Impact Combination of alternatives.

Table H–26 Maximum Percent Increase in Average Daily Traffic at Each Intermodal Facility under Each Action Alternative and Low and High Impact Combination[a]

Action Alternative	*Waste*	*Site*	*Percent Increase*
Action Alternatives			
Cleanup to AOC LUT Values	LLW/MLLW	Puente Hills	0.17
	Hazardous waste	Puente Hills	0.012
	Nonhazardous waste	Puente Hills	0.21
	All waste [b]	Puente Hills	0.21
	LLW MLLW	Barstow	0.020
Cleanup to Revised LUT Values	LLW/MLLW	Puente Hills	0.17
	Hazardous waste	Puente Hills	0.012
	Nonhazardous waste	Puente Hills	0.21
	All waste [b]	Puente Hills	0.21
	LLW/MLLW	Barstow	0.020
Conservation of Natural Resources – Residential Scenario	LLW/MLLW	Puente Hills	0.0061
	Hazardous waste	Puente Hills	0.012
	Nonhazardous waste	Puente Hills	0.19
	All waste [b]	Puente Hills	0.21
	LLW/MLLW	Barstow	0.00073
Conservation of Natural Resources – Open Space Scenario	LLW/MLLW	Puente Hills	0.0012
	Hazardous waste	Puente Hills	0.012
	Nonhazardous waste	Puente Hills	0.20
	All waste [b]	Puente Hills	0.21
	LLW/MLLW	Barstow	0.00015
Building Removal	LLW/MLLW	Puente Hills	0.038
	Hazardous waste	Puente Hills	0.00042
	Nonhazardous	Puente Hills	0.0044
	All waste [b]	Puente Hills	0.043
	LLW/MLLW	Barstow	0.0046
Groundwater Treatment	LLW/MLLW	Puente Hills	0.13
		Barstow	0.016
Combination of Alternatives			
Low Impact Combination [c]	All waste	Puente Hills	0.27
	LLW/MLLW	Barstow	0.0048
High Impact Combination [d]	All waste	Puente Hills	0.35
	LLW/MLLW	Barstow	0.036

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.

[b] All waste refers to all LLW/MLLW, hazardous waste, and/or nonhazardous waste that may be delivered to Puente Hills for transfer to rail cars. The all waste total percentage may not reflect the sum of the percentages of the individual types of waste because the maximum percentage for each type of waste may occur in different years, while the maximum percentage for all waste reflect the maximum percentage in any single year considering the combined shipment of all types of waste during that year.

[c] Reflects the combination of the Conservation of Natural Resources Alternative (Open Space Scenario), Building Removal Alternative, and the Groundwater Monitored Natural Attenuation Alternative.

[d] Reflects the combination of the Cleanup to AOC LUT Values Alternative, the Building Removal Alternative, and the Groundwater Treatment Alternative.

Table H–27 Comparison of Baseline Level of Service Ratings Against the Evaluated LOS Ratings for Roads in the Vicinities of Intermodal Facilities

Facility (State)	Road Segment	Baseline LOS	Planning LOS								
			Soil Remediation Alternatives				Building Removal Alternative	Groundwater Remediation Alternatives		Low Impact Combination [a]	High Impact Combination [b]
			AOC LUT	Revised LUT	C of NR (Res)	C of NR (OS)		GW MNA	GWT		
Puente Hills (CA)	Pellissier Place west of Workman Mill Road	A	A	A	A	A	A	A	A	A	A
	Crossroads Parkway South just south of SR 60 Eastbound On/Off Ramps	A	A	A	A	A	A	A	A	A	A
	Workman Mill Road at SR 60 Overcrossing	A	A	A	A	A	A	A	A	A	A
	Workman Mill Road north of Crossroads Parkway South	A	A	A	A	A	A	A	A	A	A
	Workman Mill Road south of Crossroads Parkway South	A	A	A	A	A	A	A	A	A	A
Barstow (CA)	Interstate 15 at L Street	C	C	C	C	C	C	C	C	C	C

AOC LUT = Cleanup to AOC LUT Values Alternative; C of NR (Res) = Conservation of Natural Resources Alternative (Residential Scenario); C of NR (OS) = Conservation of Natural Resources Alterative (Open Space Scenario); GW MNA = Groundwater Monitored Natural Attenuation Alternative; GWT = Groundwater Treatment Alternative; LOS = level of service; Revised LUT = Cleanup to Revised LUT Values Alternative.

[a] Reflects the combination of the Conservation of Natural Resources Alternative (Open Space Scenario), Building Removal Alternative, and the Groundwater Monitored Natural Attenuation Alternative.

[b] Reflects the combination of the Cleanup to AOC LUT Values Alternative, the Building Removal Alternative, and the Groundwater Treatment Alternative.

H.13.4.3 Pavement Deterioration

During the period of remediation of each action alternative and independent of any traffic associated with DOE remediation activities, roads in the SSFL area would experience traffic by trucks and other vehicles that would impact pavement integrity. In addition to this baseline traffic, traffic associated with DOE remediation activities would lead to additional impacts on pavement. As discussed in Section H.13.3.2.3, the impact that traffic associated with DOE remediation activities could have on pavement is measured using ESALs.

To determine the ESALs that would occur due to DOE remediation activities under each alternative, the vehicle trips obtained from Tables H–17 and H–18 were converted into ESALs using the conversion factors defined in Section H.13.3.2.3 (see **Table H–28**). The Cleanup to AOC LUT Values Alternative would have the largest number of additional ESALs (about 219,000) 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, are judged to potentially cause damage to the surrounding roads that may need to be repaired sooner than currently anticipated. The number of ESALs associated with these alternatives is much smaller than those of any of the other alternatives.

Table H–28 Equivalent Single Axle Loads under Each Action Alternative and Combination of Alternatives

Alternative	*Years* [a]	*Route 1*	*Route 2*	*Route 3*	*Route 4*
Soil Remediation Alternatives					
Cleanup to AOC LUT Values	26	258,000	258,000	258,000	258,000
Cleanup to Revised LUT Values	6	56,000	56,000	56,000	56,000
Conservation of Natural Resources – Residential	2	15,000	15,000	15,000	15,000
Conservation of Natural Resources – Open Space	2	11,000	11,000	11,000	11,000
Building Demolition Alternatives					
Building Removal	3[b]	6,200	6,200	6,200	6,200
Groundwater Remediation Alternatives					
Groundwater Monitored Natural Attenuation	28	56	56	56	56
Groundwater Treatment	6	1,700	1,700	1,700	1,700
Combination of Alternatives					
Low Impact Combination [c]	6	18,000	18,000	18,000	18,000
High Impact Combination [d]	28	266,000	266,000	266,000	266,000

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] Building removal is projected to require 2 to 3 years.

[c] Additional ESALs that would occur if the Conservation of Natural Resources – Open Space, Building Removal, and Groundwater Treatment Alternatives were implemented.

[d] Additional ESALs that would occur if the Cleanup to AOC LUT Values, Building Removal, and Groundwater Monitored Natural Attenuation Alternatives were implemented.

Note: Calculated ESAL values have been rounded.

ESALs would increase by about 15,000 if DOE implemented the Conservation of Natural Resources (Open Space Scenario), Building Removal, and Groundwater Monitored Natural Attenuation Alternatives (Low Impact Combination). ESALs would increase by about 226,000 if DOE implemented the combination of the Cleanup to AOC LUT Values, Building Removal, and Groundwater Treatment Alternatives (High Impact Combination). If DOE implemented both groundwater action alternatives, there would be no noticeable further increase in ESALs. Either of these combinations of alternatives could further damage roads in the SSFL vicinity that may need to be repaired sooner than currently anticipated.

H.13.4.4 Disposal and Recycle Facilities

Percent Increase in Traffic in the Vicinities of the Disposal and Recycle Facilities

Assuming all waste was delivered to the disposal and recycle facilities by truck, **Table H–29** summarizes by action alternative the maximum percent increases in average daily traffic volumes for roads in the vicinity of each facility by action alternative. Current average daily traffic volumes for the roads evaluated for each facility are summarized in Table H–16. It was assumed for analysis 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 0.20 percent.

As shown in Table H–29, 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. The largest increase would be for the McKittrick Water Treatment Site if it received all nonhazardous waste from Area IV (up to a 5.2 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 2.7 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.

Table H–30 summarizes the maximum percent increase in average daily traffic for roads in the vicinity of each facility by action alternative combination. Shown are the percent increases for both the Low Impact Combination and the High Impact Combination, where the Low Impact Combination comprises the sum of the Conservation of Natural Resources (Open Space Scenario), Building Removal, and Groundwater Monitored Natural Attenuation Alternatives, and the High Impact Combination comprises the sum of the Cleanup to AOC `LUT Values, Building Removal, and Groundwater Treatment Alternatives.

LOS Ratings in the Vicinities of the Disposal and Recycle Facilities

Table H–31 compares the baseline LOS ratings for roads in the vicinities of the disposal and recycle facilities to the evaluated LOS ratings for these roads where the evaluated LOS ratings reflect the additional DOE traffic that would occur at the facilities under each action alternatives and for combinations of alternatives. The table shows that for all action alternatives, DOE traffic would not cause a change in LOS rating for any evaluated road. Similarly for combinations of alternatives, DOE traffic would not cause a change in LOS rating for any evaluated road under either the Low Impact Combination or the High Impact Combination of alternatives.

Table H–29 Maximum Percent Increase in Average Daily Traffic Along Evaluated Roads for Each Disposal and Recycle Facility by Action Alternative

Action Alternative	*Waste*	*Facility (State)*	*Percent Increase in Average Daily Traffic*
Cleanup to AOC LUT Values	LLW/MLLW	Energy*Solutions* (UT)	0.20
		NNSS (NV)	0.45
		WCS (TX)	0.55
	Hazardous waste	Buttonwillow (CA)	0.055
		Westmorland (CA)	0.16
		US Ecology (ID)	0.22
	Nonhazardous waste	Chiquita Canyon (CA)	0.082
		Antelope Valley (CA)	0.027
		McKittrick (CA)	5.2
		Buttonwillow (CA)	0.96
		Westmorland (CA)	2.7
Cleanup to Revised LUT Values	LLW/MLLW	Energy*Solutions* (UT)	0.20
		NNSS (NV)	0.45
		WCS (TX)	0.55
	Hazardous waste	Buttonwillow (CA)	0.055
		Westmorland (CA)	0.16
		US Ecology (ID)	0.22
	Nonhazardous waste	Chiquita Canyon (CA)	0.082
		Antelope Valley (CA)	0.027
		McKittrick (CA)	5.2
		Buttonwillow (CA)	0.96
		Westmorland (CA)	2.7
Conservation of Natural Resources – Residential Scenario	LLW/MLLW	Energy*Solutions* (UT)	0.0072
		NNSS (NV)	0.016
		WCS (TX)	0.020
	Hazardous waste	Buttonwillow (CA)	0.055
		Westmorland (CA)	0.16
		US Ecology (ID)	0.22
	Nonhazardous waste	Chiquita Canyon (CA)	0.075
		Antelope Valley (CA)	0.024
		McKittrick (CA)	4.8
		Buttonwillow (CA)	0.88
		Westmorland (CA)	2.5
Conservation of Natural Resources – Open Space Scenario	LLW/MLLW	EnergySolutions (UT)	0.0014
		NNSS (NV)	0.033
		WCS (TX)	0.0040
	Hazardous waste	Buttonwillow (CA)	0.055
		Westmorland (CA)	0.16
		US Ecology (ID)	0.22
	Nonhazardous waste	Chiquita Canyon (CA)	0.077
		Antelope Valley (CA)	0.025
		McKittrick (CA)	4.9
		Buttonwillow (CA)	0.90
		Westmorland (CA)	2.6

Action Alternative	***Waste***	***Facility (State)***	***Percent Increase in Average Daily Traffic***
Building Removal	LLW/MLLW	Energy*Solutions* (UT)	0.045
		NNSS (NV)	0.10
		WCS (TX)	0.13
	Hazardous waste	Buttonwillow (CA)	0.0019
		Westmorland (CA)	0.0055
		US Ecology (ID)	0.0076
	Nonhazardous waste	Chiquita Canyon (CA)	0.0017
		Antelope Valley (CA)	0.00055
		McKittrick (CA)	0.11
	Recycle	P.W. Gillibrand (CA)	0.044
		Kramer Metals (CA)	0.0046
		Standard Industries (CA)	0.0075
Groundwater Monitored Natural Attenuation	Nonhazardous waste	Chiquita Canyon (CA)	0.00018
		Antelope Valley (CA)	0.000058
		McKittrick (CA)	0.011
Groundwater Treatment	LLW/MLLW	Energy*Solutions* (UT)	0.16
		NNSS (NV)	0.35
		WCS (TX)	0.43
	Hazardous waste	Buttonwillow (CA)	0.010
		Westmorland (CA)	0.029
		US Ecology (ID)	0.040

AOC = 2010 Administrative Order on Consent; CA = California; ID – Idaho; LLW = low-level radioactive waste; LUT = Look-Up Table; MLLW = mixed low-level radioactive waste; NV = Nevada; TX = Texas; UT= Utah.

Table H–30 Maximum Percent Increase in Average Daily Traffic Along Evaluated Roads for Each Disposal and Recycle Facility by Action Alternative Combination

Action Alternative	*Waste*	*Facility (State)*	*Percent Increase in Average Daily Traffic*
Low Impact Combination [a]	LLW/MLLW	Energy*Solutions* (UT)	0.20
		NNSS (NV)	0.45
		WCS (TX)	0.55
	Hazardous waste	Buttonwillow (CA)	0.055
		Westmorland (CA)	0.16
		US Ecology (ID)	0.22
	Nonhazardous waste	Chiquita Canyon (CA)	0.082
		Antelope Valley (CA)	0.027
		McKittrick (CA)	5.2
		Buttonwillow (CA)	0.96
		Westmorland (CA)	2.7
High Impact Combination [b]	LLW/MLLW	Energy*Solutions* (UT)	0.20
		NNSS (NV)	0.45
		WCS (TX)	0.55
	Hazardous waste	Buttonwillow (CA)	0.055
		Westmorland (CA)	0.16
		US Ecology (ID)	0.22
	Nonhazardous waste	Chiquita Canyon (CA)	0.082
		Antelope Valley (CA)	0.027
		McKittrick (CA)	5.2
		Buttonwillow (CA)	0.96
		Westmorland (CA)	2.7

AOC = 2010 Administrative Order on Consent; CA = California; ID = Idaho; LLW = low-level radioactive waste; LUT = Lookup Table; MLLW = mixed low-level radioactive waste; NV = Nevada; TX = Texas; UT = Utah.

[a] Reflects the combination of the Conservation of Natural Resources Alternative (Open Space Scenario), Building Removal Alternative, and the Groundwater Monitored Natural Attenuation Alternative.

[b] Reflects the combination of the Cleanup to AOC LUT Values Alternative, the Building Removal Alternative, and the Groundwater Treatment Alternative.

Table H–31 Comparison of Baseline Level of Service Ratings Against the Evaluated LOS Ratings for Roads in the Vicinities of Disposal and Recycle Facilities

Facility (State)	Road Segment	Baseline LOS	Planning LOS								
			Soil Remediation Alternatives				Building Removal Alternative	Groundwater Remediation Alternatives		Low Impact Combination [a]	High Impact Combination [b]
			AOC LUT	Revised LUT	C of NR (Res)	C of NR (OS)		GW MNA	GWT		
Antelope Valley (CA)	SR 14 at Avenue S	C	C	C	C	C	C	C	C	C	C
Chiquita Canyon (CA)	SR 126 at Commerce Center Drive	B	B	B	B	B	B	B	B	B	B
Buttonwillow (CA)	SR 33 at Lokern Road	A	A	A	A	A	A	A	A	A	A
	SR 58 at Lokern Road	B	B	B	B	B	B	B	B	B	B
Westmorland (CA)	SR 78 junction with SR 86	A	A	A	A	A	A	A	A	A	A
McKittrick (CA)	SR 58 at junction of SR 33	A	A	A	A	A	A	A	A	A	A
US Ecology (ID)	SR 78 northwest of Grandview Road	A	A	A	A	A	A	A	A	A	A
EnergySolutions (UT)	Interstate 80 north of Clive, Utah	A	A	A	A	A	A	A	A	A	A
NNSS (NV)	U.S. Highway 95, 4 miles north of the Mercury interchange	B	B	B	B	B	B	B	B	B	B
WCS (TX)	SR 176 (Eunice Highway) at New Mexico border	B	B	B	B	B	B	B	B	B	B
Kramer Metals (CA)	Alameda Street at Slauson Avenue	B	B	B	B	B	B	B	B	B	B
Standard Industries (CA)	SR 232 junction with SR 118	A	A	A	A	A	A	A	A	A	A
P.W. Gillibrand (CA)	Tapo Canyon Road north of Presidio Drive	B	B	B	B	B	B	B	B	B	B

AOC LUT = Cleanup to AOC LUT Values Alternative; C of NR (Res) = Conservation of Natural Resources Alternative (Residential Scenario); C of NR (OS) = Conservation of Natural Resources Alterative (Open Space Scenario); GW MNA = Groundwater Monitored Natural Attenuation Alternative; GWT = Groundwater Treatment Alternative; LOS = level of service; Revised LUT = Cleanup to Revised LUT Values Alternative.

[a] Reflects the combination of the Conservation of Natural Resources Alternative (Open Space Scenario), Building Removal Alternative, and the Groundwater Monitored Natural Attenuation Alternative.

[b] Reflects the combination of the Cleanup to AOC LUT Values Alternative, the Building Removal Alternative, and the Groundwater Treatment Alternative.

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Appendix I
Wetlands Assessment

APPENDIX I
WETLANDS ASSESSMENT

I.1 Introduction

This appendix of this *Final Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory (Final 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).

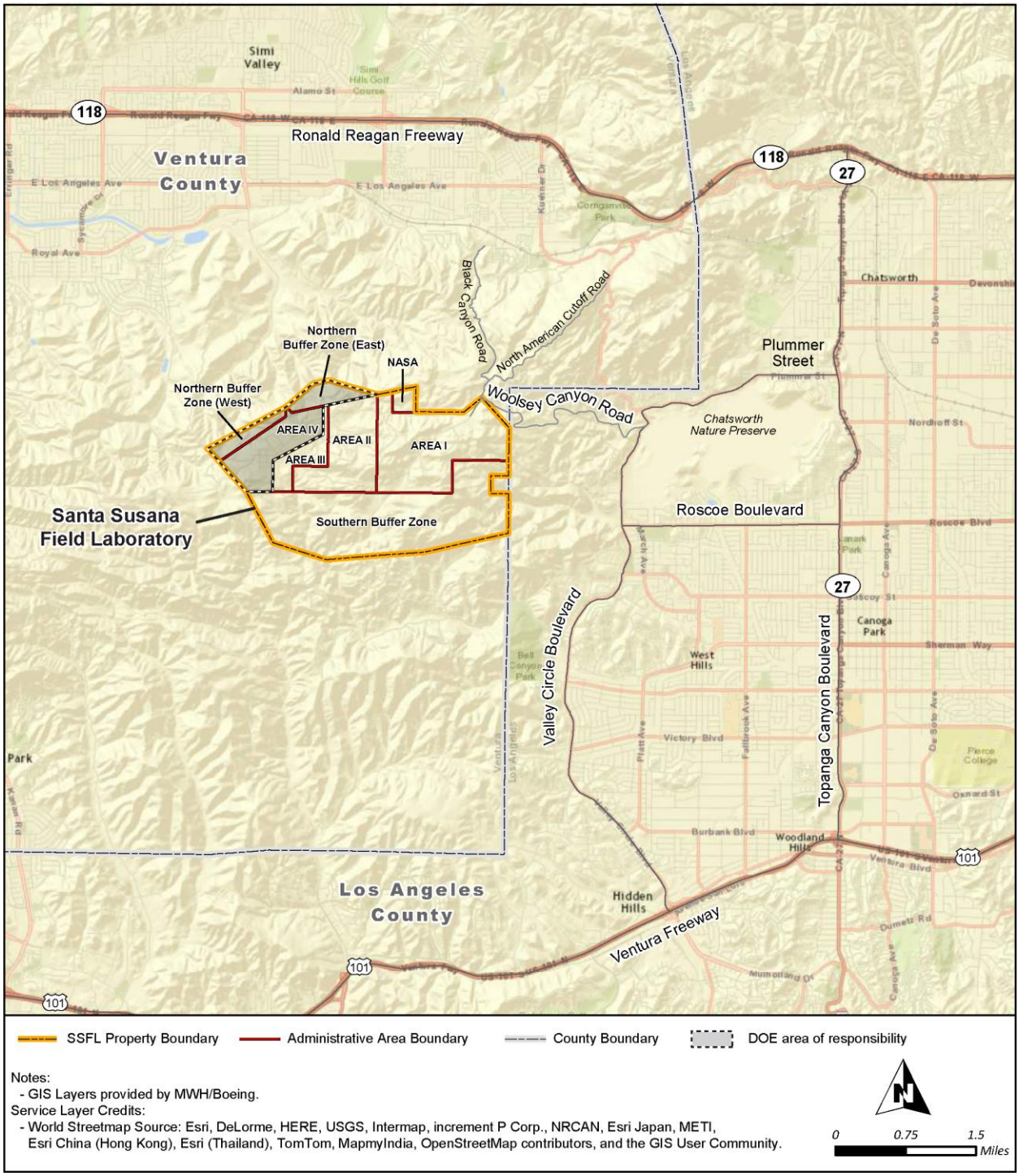

Figure I–1 Project Location, Santa Susana Field Laboratory

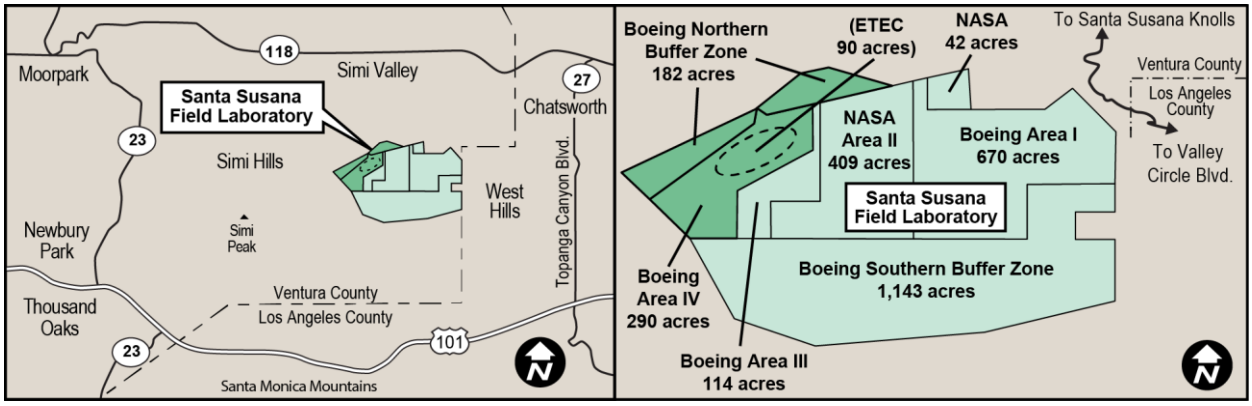

Figure I–2 Santa Susana Field Laboratory and Surrounding Communities

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 provide cleanup standards for SSFL Area IV soil and groundwater. 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.[1]

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, and risk-based values for chemicals and 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

[1] In 2017, The Boeing Company (Boeing) and North American Land Trust recorded two Grant Deeds of Conservation Easement and Agreements with Ventura County (Ventura County 2017a, 2017b) that permanently preserve as open space nearly 2,453 acres of land that Boeing owns at SSFL, including Area IV and the NBZ. The conservation easements are legally enforceable documents that, among other restrictions, forever prohibit residential, agricultural, or commercial development or uses of the site.

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).

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.

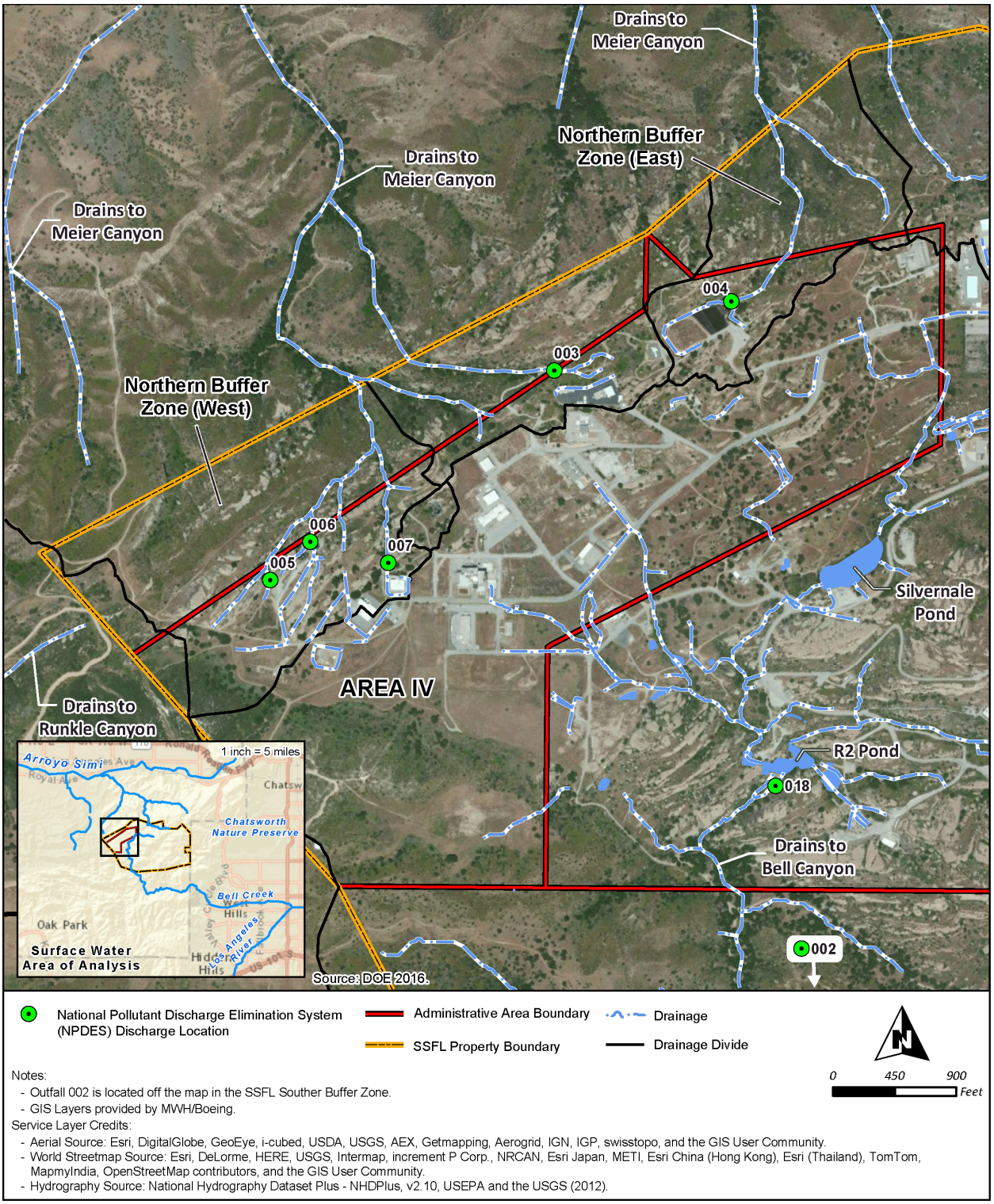

Figure I–3 Area IV Surface Water

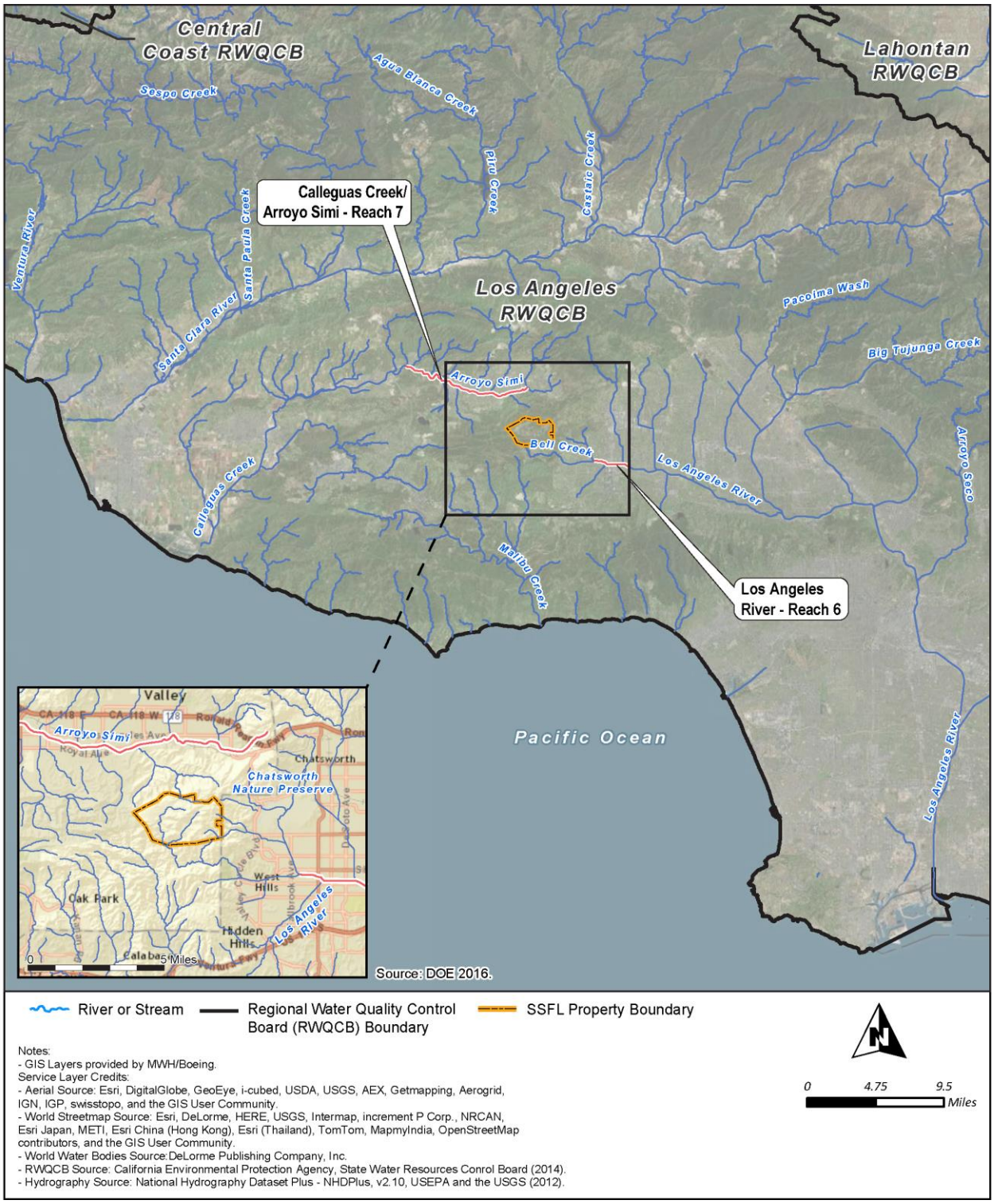

Figure I–4 Regional Drainage Basins

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 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 56) 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 56 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 56 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 56 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 56 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.

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 areas within which the exemption process would be applied, 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.

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 56 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.

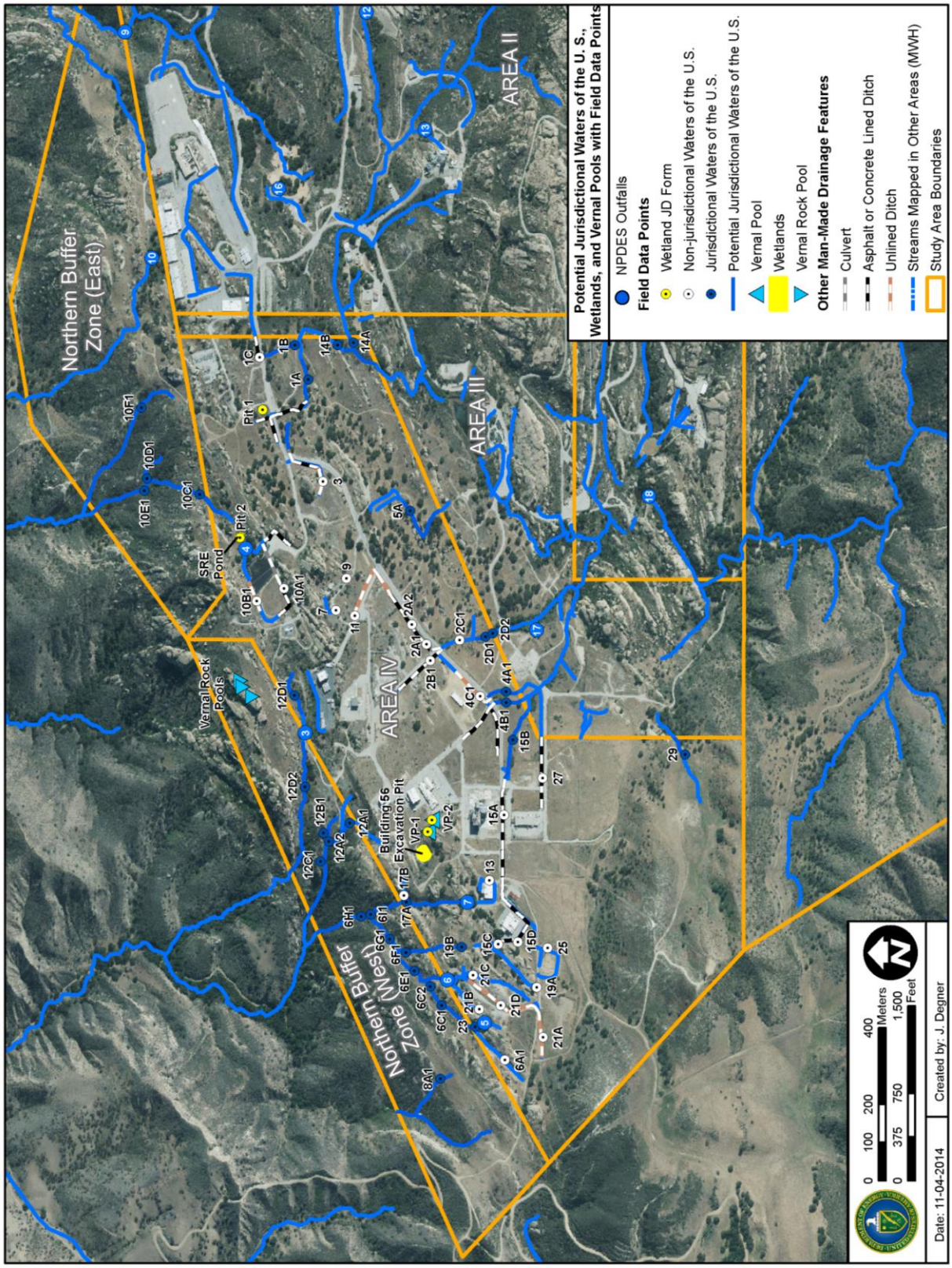

Figure I–5 Wetlands, Vernal Pools, and Jurisdictional Waters of the U.S.

I.5.1.1 Soil Remediation

Soil No Action Alternative	*Cleanup to AOC LUT Values Alternative*	*Cleanup to Revised LUT Values Alternative*	*Conservation of Natural Resources Alternative (both Residential and Open Space Scenarios)*
No adverse impacts on wetlands, waters of the U.S., or aquatic habitats and biota.	Direct impacts on: – 0.02 acres of wetlands – 0.16 acres of ephemeral streams – 0. 16 acres of man-made drainages	Direct impacts on: – 0.02 acres wetlands – 0.07 acres ephemeral streams – 0.09 acres man-made drainages	Direct impacts on: – 0.02 acres wetlands – 0.02 acres ephemeral streams – 0.02 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:

- Wetlands – 0.02 acres (the SRE wetland near Outfall 4). The Building 56 excavation and the adjacent vernal pools are within a proposed exemption area.
- Waters of the U.S.
  - 0.16 acres, 3,430 linear feet (natural ephemeral streams in Area IV and parts of the NBZ adjacent to Area IV)
  - 0.16 acres, 4,890 linear feet (man-made asphalt and concrete lined and unlined drainage ditches in Area IV)

The removal actions for the areas within which the exemption process would be applied exemption areas would avoid direct impacts on aquatic and wetland habitats and biota to the extent feasible, including the Building 56 excavation and adjacent vernal pools. The rock vernal pools are also within areas in which the exemption process would be applied but these pools are on top of a large sandstone outcrop and are outside any 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.

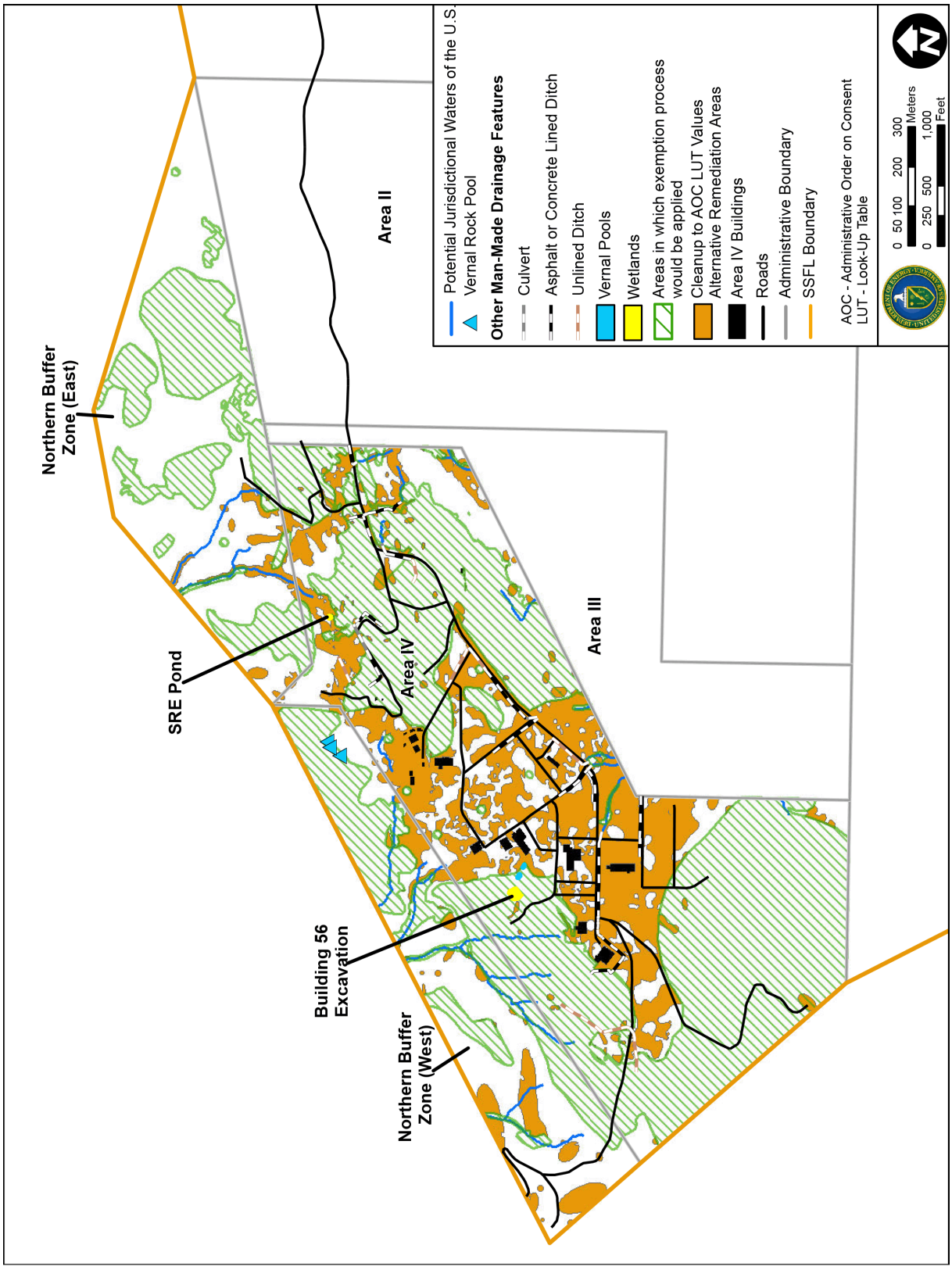

Figure I–6 Impacts to Wetlands and Waters of the U.S. under the Cleanup to AOC LUT Values Alternative

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:

- Wetlands 0.02 acres (the SRE wetland near Outfall 4)
- Waters of the U.S.
  - 0.07 acres, 1,570 linear feet (natural ephemeral streams)
  - 0.09 acres, 3,030 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 56 wetland and vernal pools within the areas within which the exemption process would be applied 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.

I.5.1.1.3 Conservation of Natural Resources Alternative

Figure I–8 and **I–9** illustrates areas projected for remediation under the Conservation of Natural Resources (Residential Scenario and Open Space Scenario). Areas projected for remediation of chemically impacted soil under the Conservation of Natural Resources Alternative are less than 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:

- Wetlands 0.02 acres (the SRE wetland near Outfall 4)
- Waters of the U.S.
  - 0.02 acres, 330 (Residential Scenario) – 320 (Open Space Scenario) linear feet (natural ephemeral streams)
  - 0.02 acres, 1,010 linear feet (both scenarios) (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.

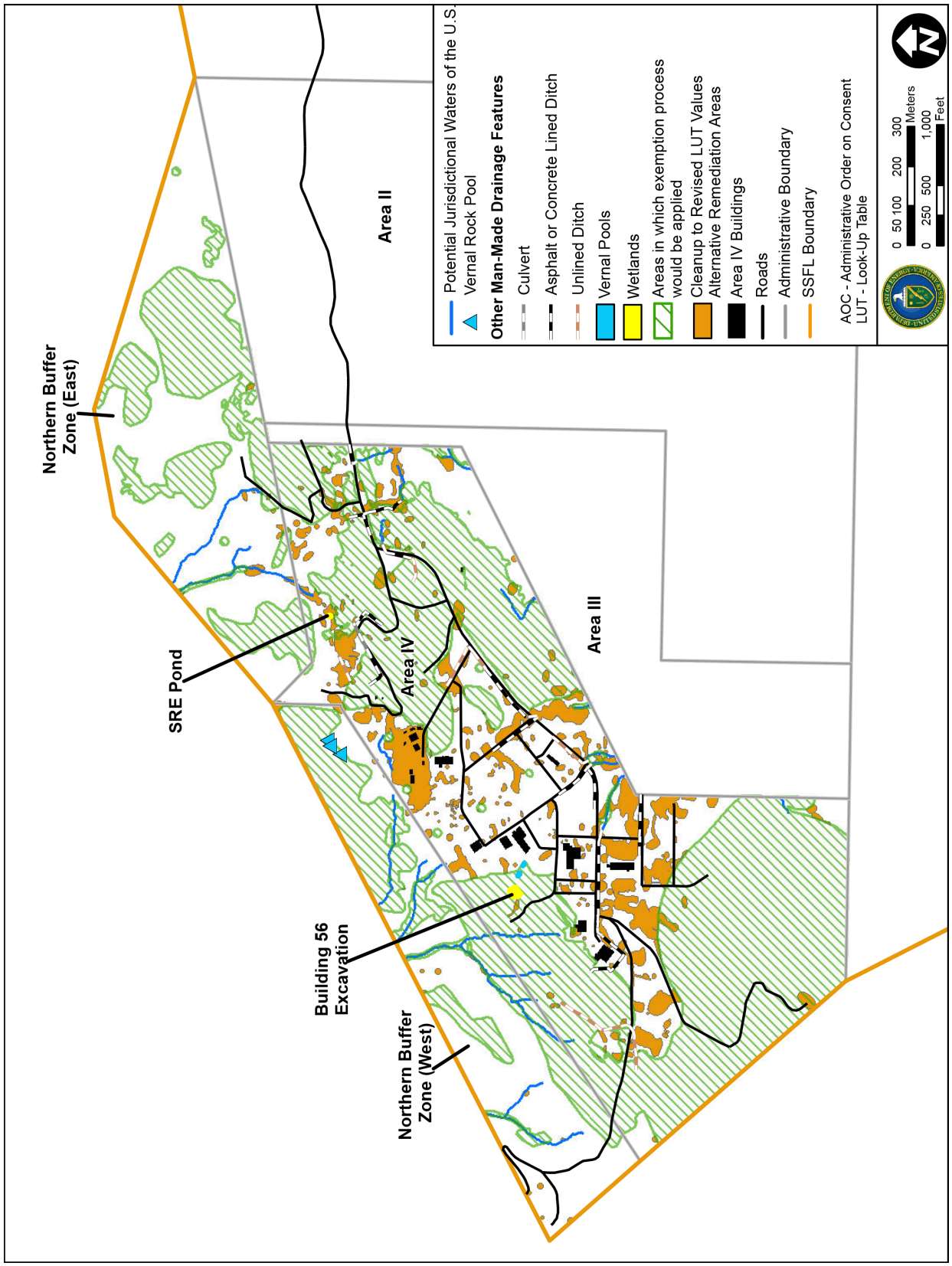

Figure I–7 Impacts to Wetlands and Waters of the U.S. under the Cleanup to Revised LUT Values Alternative

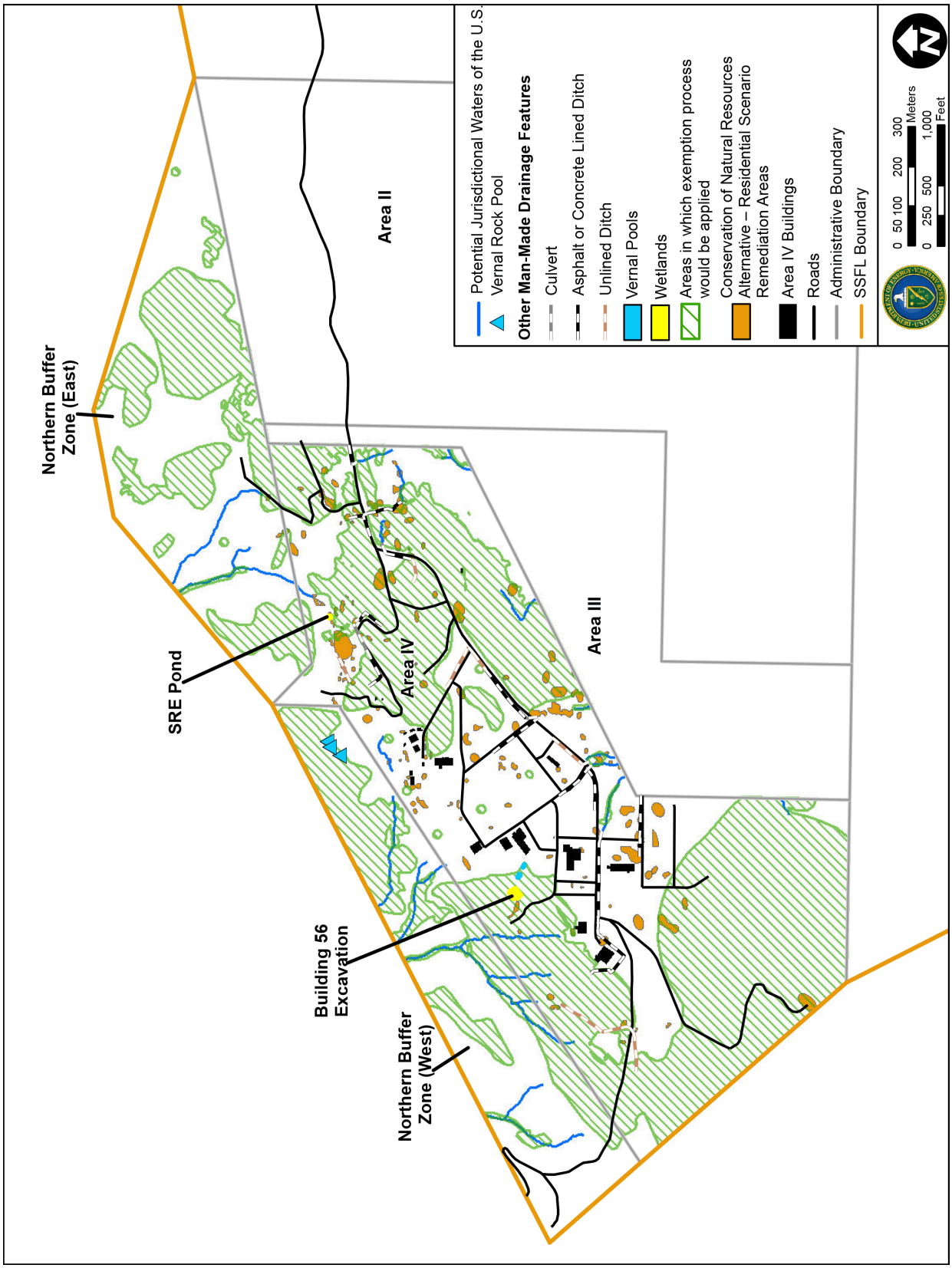

Figure I–8 Impacts to Wetlands and Waters of the U.S. under the Conservation of Natural Resources Alternative (Residential Scenario)

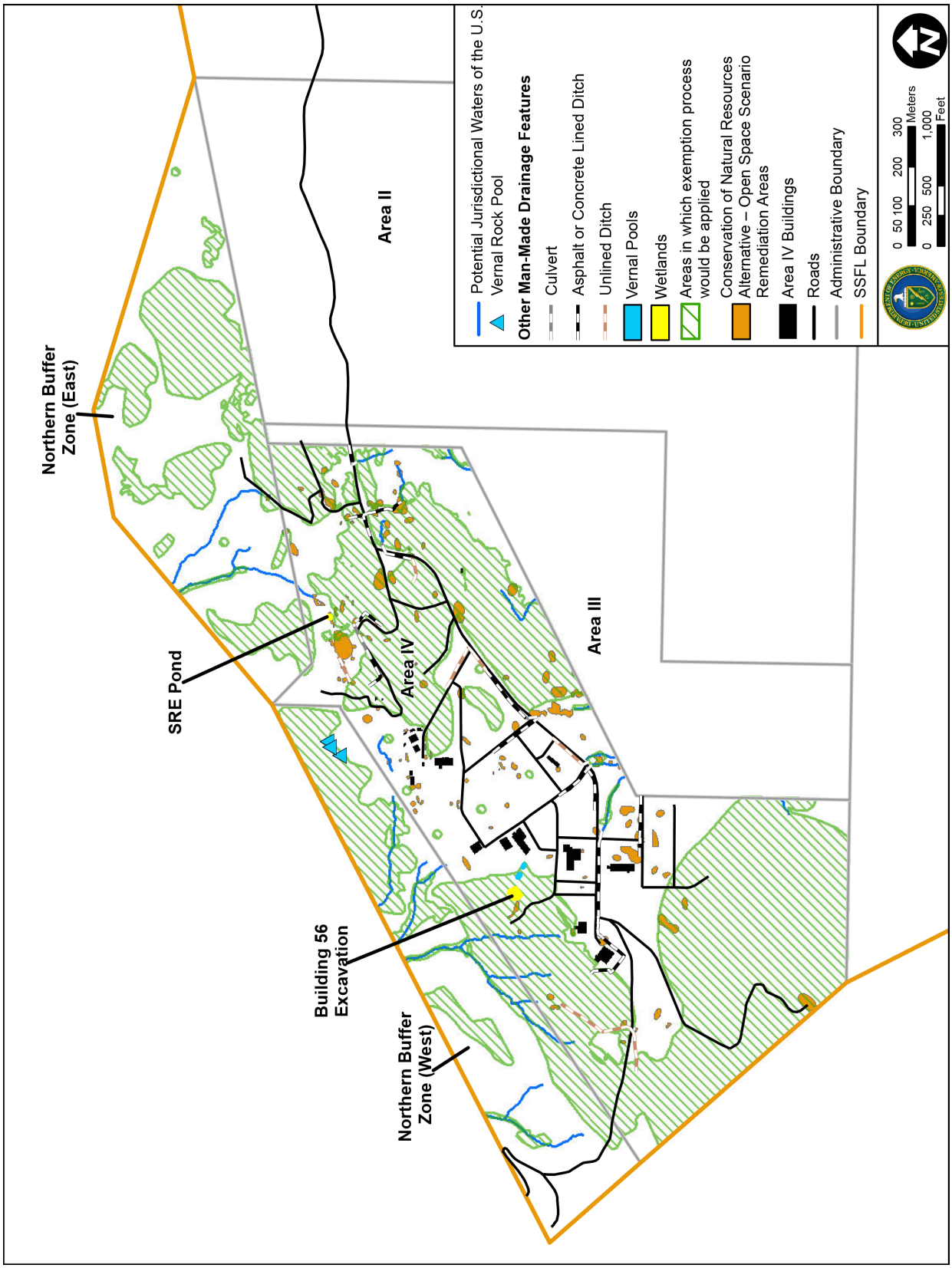

Figure I–9 Impacts to Wetlands and Waters of the U.S. under the Conservation of Natural Resources Alternative (Open Space Scenario)

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 56 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 approximately 0.34 acres, whereas the Cleanup to Revised LUT Values and Conservation of Resources Alternative would impact approximately 0.18 and 0.06 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. DOE will coordinate with USACE with respect to a final determination regarding 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.

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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.

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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

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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. Schmutter, J. Depper T. Miley 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 pond/stand 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: 30 m²)			
1. Baccharis salicifolia	20	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.			
	20 = Total Cover		

% 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 (1 m²); nearby is Stipa sp. Bromus madritensis ssp. rubens.

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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 flood 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 ephemeral stream flow.

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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 (SRF 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 man made, 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: 0)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 0)			
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: 0)			
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 also mulefat on outer rim.

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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)	%	Redox Features Color (moist)	%	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 ~~Soil~~ 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:

Surface Water Present? Yes ____ No X Depth (inches): ____

Water Table Present? Yes X No ____ Depth (inches): N/A

Saturation Present? (includes capillary fringe) Yes X No ____ Depth (inches): 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): Leitos - AB, TS JD, TM Section, Township, Range: Slightly concave
Landform (hillslope, terrace, etc.): knoll Local relief (concave, convex, none): _____ Slope (%): 0
Subregion (LRR): LRR C Lat: _____ Long: _____ Datum: _____
Soil Map Unit Name: Tamara 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 slope, compacted and cleared

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 0)	Absolute % Cover	Dominant Species?	Indicator Status
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. Eriogonum baileyi	2	N	FACU
3. Lotus purshiana	1	N	—
4.			
5.			
6.			
7.			
8.			
	17 = Total Cover		
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 Bmax, Asclepias, Heterotheca, Hypochaeris
Loefgrie, Bromus madritensis
area has scattered mulefat and Acmispon glaber

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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 convex Slope (%): 5
Subregion (LRR): LRR-C Lat: Long: Datum:
Soil Map Unit Name: Ramona 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. Elymus barbrys	30	Y	FACU
2. Malacothrix incana	2	N	FACU
3. Bromus madritensis	4	Y	UPL
4. Agoseris (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 (shrub) 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 Convex Slope (%): 3
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? No 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. Elymus barbyi	30	Y	FACU
2. Malvaviscus arboreus	2	N	FACU
3. Bromus madritensis	4	Y	UPL
4. Hypochaeris (SP?)	1	N	FACU(?)
5. Juncus pusillus	2	N	—
6. Tricostema 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 (shrub) present

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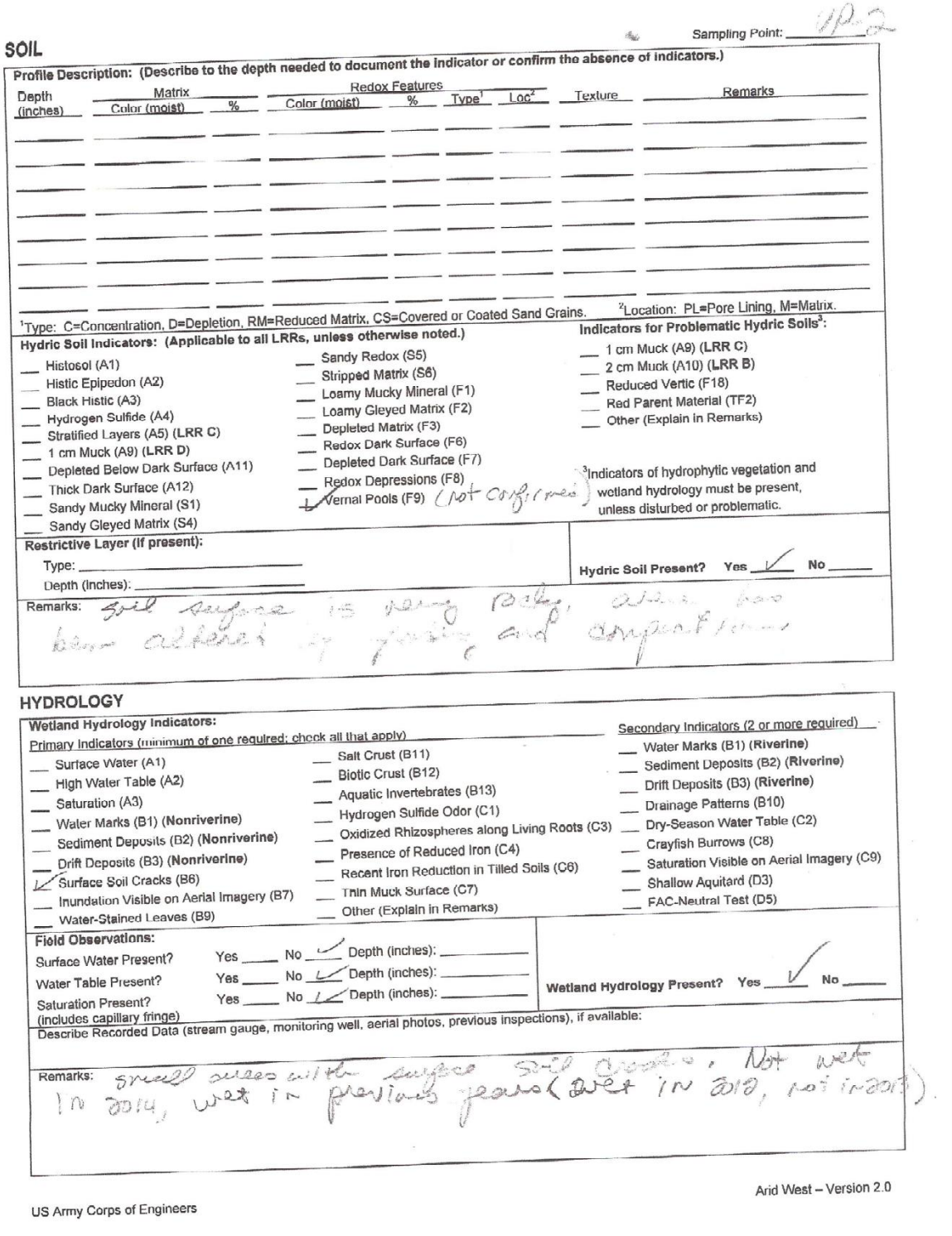

SOIL

Sampling Point: VP-2

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

[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, and has been altered by grazing and vegetation.

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 surface soil cracks. Not wet in 2014, wet in previous years (wet in 2013, not in 2011).

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Attachment I3
PHOTOGRAPHS

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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.

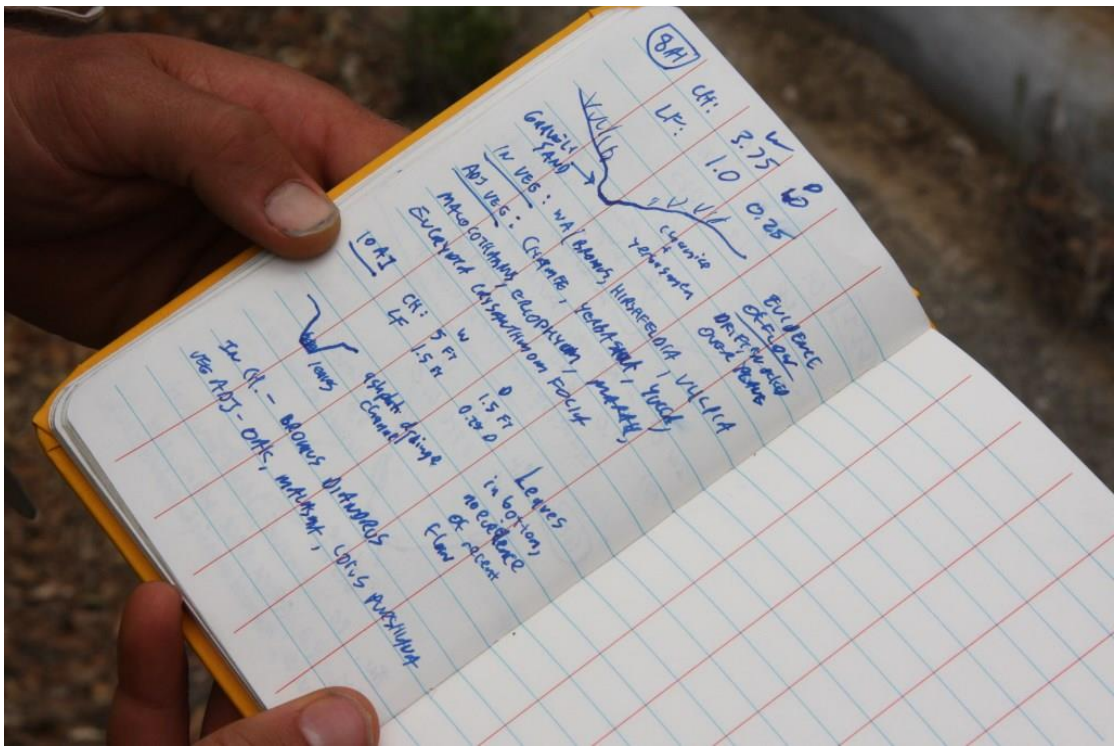

Photo 9 (May 6, 2014) above is the location of soil Pit 1, in an area of mulefat scrub that was investigated for wetland determination. Soil Pit 1 is also shown in Photo 10 (May 6, 2014) below; the soils did not have any positive indicators for hydric soils, and the site did not meet the three criteria 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
U.S. FISH AND WILDLIFE SERVICE BIOLOGICAL OPINION

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ventura Fish and Wildlife Office
2493 Portola Road, Suite B
Ventura, California 93003

IN REPLY REFER TO:
08EVEN00-2018-F-0407

August 31, 2018

John Jones, Director
Energy Technology Engineering Center
U.S. Department of Energy
4100 Guardian Street, Suite 160
Simi Valley, California 93063

Subject: Biological Opinion for the Cleanup of Area IV of the Santa Susana Field Laboratory, Ventura County, California (2018-F-0407)

Dear Mr. Jones:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion based on our review of the U.S. Department of Energy's (DOE) proposal for soil cleanup, groundwater cleanup, building and infrastructure removal, and habitat restoration within Area IV and the northern buffer zone of the Santa Susana Field Laboratory (SSFL) under DOE's jurisdiction and its effects on the federally endangered least Bell's vireo (*Vireo bellii pusillus*), Riverside fairy shrimp (*Streptocephalus woottoni*) and Braunton's milkvetch (*Astragalus brauntonii*) and its designated critical habitat and the federally threatened coastal California gnatcatcher (*Polioptila californica californica*), California red-legged frog (*Rana draytonii*), and vernal pool fairy shrimp (*Branchinecta lynchi*), in accordance with section 7 of the Endangered Species Act of 1973, as amended (Act) (16 U.S.C. 1531 et seq.). We received your request for formal consultation on January 31, 2018.

In 2010, the California Department of Toxic Substances control signed an Administrative Order on Consent (AOC) with DOE that defines the remediation standards for DOE's administrative units within the SSFL. The AOC requires "no contaminants shall remain in the soil above local background levels." For purposes of section 7 consultation, the AOC provides that impacts to species or habitat protected under the Endangered Species Act may be considered as possible exemptions from the cleanup standard specified herein only to the extent that the federal Fish and Wildlife Service, in response to a request by DOE for consultation, issues a Biological Opinion with a determination that implementation of the cleanup action would violate Section 7(a)(2) or Section 9 of the ESA, and no reasonable and prudent measures or reasonable and prudent alternatives exist that would allow for the use of the specified cleanup standard in that portion of the site. In areas covered by an exemption, soil cleanup would occur in areas where contamination poses a risk to human health or the environment as oppose to soil cleanup to background levels.

We have based this biological opinion on information that accompanied your January 31, 2018, request for consultation, including the revised biological assessment (BA) with attachments, dated January 30, 2018 (DOE 2018); Geographic Information System (GIS) data supporting the BA (DOE 2017); other clarifications and responses to questions, meetings, telephone calls, and electronic messages between DOE and the Service; and your July 20, 2018, letter clarifying the project description on which you requested formal consultation. Upon request, a record of this consultation can be made available at the Ventura Fish and Wildlife Office.

You determined the proposed project may affect, but is not likely to adversely affect, critical habitat for the federally threatened California red-legged frog. We concur with your determination regarding this critical habitat because (1) there is only a small amount of designated California red-legged frog critical habitat within the project boundary, approximately 0.6 acre at the upslope periphery of the 5,000-acre VEN-3 critical habitat unit; (2) the proposed project site is a long distance (approximately 3 miles) from aquatic portions of the drainage that have been known to support California red-legged frog breeding; and (3) you have proposed protective measures to avoid and minimize effects to the designated California red-legged frog critical habitat.

We note that you made No Effect determinations for the following species in your BA and letter requesting initiation of consultation: the federally endangered California condor (*Gymnogyps californianus*), Quino checkerspot butterfly (*Euphydryas editha quino*), California Orcutt grass (*Orcuttia californica*), and Lyon's pentachaeta (*Pentachaeta lyonii*); the federally threatened Conejo dudleya (*Dudleya parva*), Santa Monica Mountains dudleya (*Dudleya cymosa* subsp. *ovatifolia* [inclusive of *D. cymosa* subsp. *agourensis*]), marcescent dudleya (*Dudleya cymosa* subsp. *marcescens*), and spreading navarretia (*Navarretia fossalis*); and the San Fernando Valley spineflower (*Chorizanthe parryi* var. *fernandina*) which, at the time, was proposed threatened. The regulations implementing section 7(a)(2) of the Endangered Species Act (50 Code of Federal Regulations (CFR) 402) do not require our concurrence with a "no effect" determination made by a Federal agency. Consequently, we are not providing our concurrence with your determination on the effects of the proposed project on these species; however, we appreciate and thank you for informing us of these determinations and considering them in your analysis. We will not discuss these species for the remainder of this biological opinion.

Abbreviations/Acronyms/Definitions

The following abbreviations, acronyms, and terms occur frequently throughout this document. We define them here for clarification.

Act	Endangered Species Act of 1973, as amended
AOC	Administrative Order on Consent
BA	Biological Assessment
BMP	Best Management Practices
CDFW	California Department of Fish and Wildlife
CFR	*Code of Federal Regulations*

CNDDB	California Natural Diversity Data Base
CO	Consent Order
Corps	U.S. Army Corps of Engineers
DOE	U.S. Department of Energy
DTSC	California Department of Toxic Substance Control
EPA	U.S. Environmental Protections Agency
FR	Federal Register
GIS	Geographic Information System
LUT	Look Up Table
MBTA	Migratory Bird Treaty Act
NASA	National Aeronautics and Space Administration
NBZ	Northern buffer zone
NPDES	National Pollutant Discharge Elimination System
PEIR	Programmatic Environmental Impact Report
RMHF	Radioactive Materials Handling Facility
SAIC	Science Applications International Corporation
SBZ	Southern buffer zone
SCE	Southern California Edison
Service	U.S. Fish and Wildlife Service
SSFL	Santa Susana Field Laboratory
SWPPP	Storm Water Pollution Prevention Plan
U.S.	United States

Consultation History

2009-2011	Consultation with U.S. Environmental Protection Agency (EPA) regarding radiological scanning project in Area IV of SSFL (EPA 2010, Service 2010a).
2009-2018	Numerous meetings and project coordination calls with the DOE, Service, California Department of Fish and Wildlife (CDFW), and California Department of Toxic Substances Control (DTSC). See the BA (DOE 2018) for a more detailed description of the consultation history.
2013	National Aeronautics and Space Administration (NASA) Site Area II remediation project consultation (NASA 2013, Service 2013).
2015-2016	The Boeing Company (Boeing) and DOE jointly participated in the production of the draft biological assessment, dated August 19, 2017, regarding the site remediation project.
Feb. 2, 2017	We responded to a request from DOE for technical assistance on potential effects to the Braunton's milkvetch and its critical habitat during cleanup activities within Area IV. We provided the following recommendations for minimizing impacts from the cleanup and remediation on Braunton's milkvetch:

> *"We recommend that DOE and DTSC consider exercising an exemption to the AOC [Administrative Order on Consent] within Braunton's milk-vetch habitat, such that cleanup actions are only conducted in areas where contamination poses a risk to human health or the environment. We understand the intent of cleanup to background as remediating the site to conditions which existed prior to the industrial activities; however, there is the possibility that chemicals may exist in the soil at concentrations that are above background but pose no appreciable risk to humans or the environment. In these instances, soil excavation would pose a far greater environmental risk than allowing low levels of soil contamination to persist. We recommend that DOE conduct human health and ecological risk assessments to identify areas where soil contamination exceed risk thresholds, and target soil excavation in those areas only."*

Dec. 12, 2017 We commented to DTSC in a letter regarding the effects of cleanup activities on listed species and critical habitat identified in the DTSC draft Environmental Impact Report:

> *"Biological resources will be severely impacted in all areas that are subject to excavation of soil, import of backfill, and implementation of restoration. We do not expect that the biological resources that exist before the project can be replaced with the same ecological integrity following the extensive AOC background cleanup."*

The Service recommended that, in line with the AOC provisions referenced above, DTSC exercise biological exemption in sensitive habitat to focus soil excavation in areas where chemicals and radionuclides pose a hazard to human health and the environment. The Service recommended that DTSC exercise biological exemptions in Braunton's milk-vetch habitat, coastal California gnatcatcher habitat, and for the protection of migratory birds.

Referencing its February 2, 2017, letter, concerning Braunton's milkvetch and its critical habitat, the Service reiterated

> *"We concluded that the effects to Braunton's milkvetch and its critical habitat would be substantial, and recommended a biological [exemption] to limit soil removal in Braunton's milkvetch habitat to only the soils that contain contamination to levels that pose a risk to human health and the environment."*

Aug. 28, 2017 DOE sent a letter and draft BA requesting initiation of formal consultation.

Oct. 30, 2017 The Service responded with a request for additional information.

Dec. 18, 2017 DOE provided additional information.

Jan. 17, 2018 The Service and DOE discussed the effects determinations and information necessary to finalize the BA. The Service requested a final copy of the BA.

Jan. 31, 2018 DOE submitted a revised request for consultation and a Final revised BA with attachments that addressed the information requested.

Mar. 8, 2018 We sent an acknowledgement letter identifying that all information necessary for the consultation was received, and indicating that consultation was initiated effective January 31, 2018. We also requested a 60-day extension via phone conversation, to which DOE verbally agreed.

July 16, 2018 We met with DOE onsite and discussed issues regarding the proposed project and the different options for the cleanup process, specifically the differences between effects from a background-based cleanup process (with a cleanup to background standards) versus a risk-based cleanup process (with a cleanup to human and environmental health standards).

July 20, 2018 We received a letter from DOE clarifying the scope of the project description, specifically requesting consultation on the proposed process identified in the BA for the protection of listed species. In the BA, DOE identified a systematic process approach that would allow cleanup of chemicals and radionuclides to levels protective of human and ecological health within the proposed exemption area for the protection of Braunton's milkvetch and its critical habitat.

July 24, 2018 We had a conference call with DOE to clarify the scope of the consultation. We agreed that the consultation on the proposed project would include an exemption for Braunton's milkvetch and a range of exemptions for all other listed species (i.e. ranging from no additional exemptions to all proposed exemptions).

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

Background

The Santa Susana Field Laboratory (SSFL) is located in Ventura County, California, on approximately 2,850 acres in the hills between Chatsworth and Simi Valley. The SSFL was developed as a remote site to test rocket engines and conduct nuclear research. Rockwell

International's Rocketdyne Division began rocket engine testing in the Area I portion of SSFL in 1947. Rockwell created Atomics International in the early 1950s to conduct nuclear research in Area IV for the Atomic Energy Commission (a predecessor agency of the Department of Energy (DOE)) and commercial entities. In 1996, Rockwell International sold its aerospace and defense business, including Area IV of SSFL, to Boeing.

The SSFL is divided into four administrative areas and two contiguous buffer zones north and south of the administrative areas. Figure 1 shows SSFL and the surrounding communities, including the layout of SSFL (Areas I, II, III, and IV and the adjacent buffer zones) and land ownership. The majority of Area I is owned and operated by Boeing. Area II and a 42-acre parcel within Area I are owned by the Federal Government and administered by the NASA. Areas III, IV, and the contiguous buffer zone areas to the north and south are owned by Boeing. DOE does not own any land at SSFL but is the owner of 18 buildings in Area IV and is responsible for building demolition and cleanup of soils and groundwater in Area IV and the Northern Buffer Zone (NBZ).

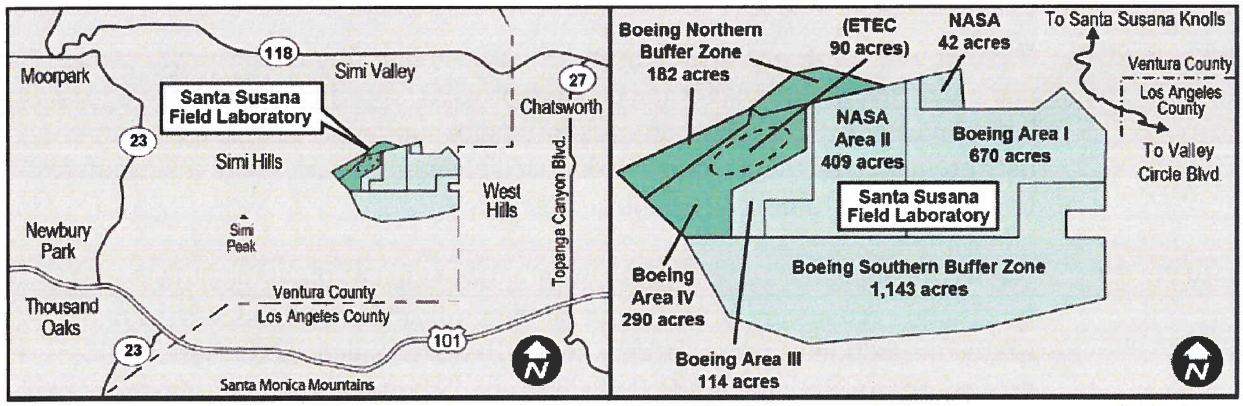

Figure 1. Santa Susana Field Laboratory, surrounding communities, and administrative units onsite (DOE 2018).

Starting in the mid-1950s, the Atomic Energy Commission funded nuclear energy research on a 90-acre parcel of land in what is now SSFL Area IV, which was leased from Rocketdyne. The Energy Technology Engineering Center (ETEC) was established by the Atomic Energy Commission on this parcel in the early 1960s. In support of that mission, DOE built and operated 10 small nuclear reactors for various research activities over the years. As a result of operating these research reactors and conducting nuclear research, chemicals and radionuclides were released into the soil, bedrock, and groundwater.

Cleanup activities have been ongoing since the 1960s. DOE decontaminated and demolished several of its structures and facilities in Area IV to the standards in effect at the time decommissioning occurred. By 1980, all reactor operations had ceased, and nuclear research at ETEC was terminated in 1988. DOE has removed all nuclear materials from the site. By the time non-nuclear liquid metals research ended in 1998, many facilities had been decontaminated, decommissioned, and demolished, and contaminated materials had been removed.

In 2007, DTSC issued the Consent Order (CO) for Corrective Action (DTSC 2007) to DOE, NASA, and Boeing (as respondents), pursuant to DTSC's authority over hazardous waste under the California Health and Safety Code, Section 25187. The 2007 order requires the respondents to clean up all chemically contaminated soils and groundwater at SSFL to risk-assessment-based levels. The SSFL Standardized Risk Assessment Methodology (MWH Americas, Inc. 2014) describes a risk-assessment methodology for determining the areas that would need remediation. A hypothetical future suburban residential land use was identified for the evaluation of risk; other plausible receptors (such as recreational users or workers) were also identified.

In 2010, DOE entered into the 2010 AOC (DTSC 2010a) with DTSC. The 2010 AOC superseded the 2007 CO with respect to soil remediation and changed the framework for the soils characterization and cleanup process for Area IV and the NBZ. The 2010 AOC stipulated that the soils cleanup standard would be based on Look Up Table (LUT) values, which are: (1) for chemicals, local background concentrations or method detection limits 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 indicates that, for soil remediation decisions, DOE is to compare the concentration of any chemical or radionuclide in each individual sample (not an average of samples in an area) with its respective LUT value. Thus, any soil samples that exceed the LUT values for any chemicals or radionuclides would require a cleanup action to be taken.

The 2010 AOC (DTSC 2010a) identified characterization activities for both chemical and radiological contaminants and requires DOE to prepare a Soils Remedial Action Implementation Plan (SRAIP) describing where soil cleanup will occur, any areas proposed for exemptions to protect biological or cultural resources, and any areas proposed for in situ or onsite treatment to achieve cleanup goals. The 2010 AOC specifies that no "leave-in-place" alternative (onsite burial or landfill) is allowed. Chemicals and radionuclides in soil brought in as backfill also must meet the LUT values. Verification of cleanup levels and the acceptability of the backfill are required by DTSC for chemicals and by the U.S. Environmental Protection Agency (EPA) for radioactive constituents.

Not all of the energy research conducted in Area IV was performed for DOE; some energy research was performed by Boeing and its predecessors for other customers. DOE has responsibility for cleanup of soils in the 290-acre Area IV. DOE shares responsibility with NASA for cleanup of soil in the 182-acre NBZ; NASA is responsible for cleanup of contamination in the NBZ that emanates from areas that it administers (DTSC 2010b). DOE shares responsibility with Boeing for groundwater remediation in Area IV and the NBZ, as defined in the 2007 CO (DTSC 2007). Boeing is responsible for management decisions regarding the Area IV buildings it owns.

The California DTSC has prepared a Programmatic Environmental Impact Report (PEIR) under the California Environmental Quality Act to evaluate the potential impacts of proposed remedial actions at SSFL from the combined actions of Boeing, NASA, and DOE. The Draft PEIR was

released for public review during the fall of 2017. The Final PEIR is currently under development and must be completed before Boeing, NASA, and DOE can begin their soil cleanups.

Project Overview

As described above, Boeing, NASA, and DOE are Responsible Parties for the investigation and cleanup of contaminants released from past activities at the SSFL project site. The proposed project only focuses on activities conducted by DOE, and does not cover cleanup actions by Boeing or NASA. The proposed project involves DOE's cleanup and remediation of approximately 472 acres of the 2,850-acre SSFL site and adjacent offsite locations.

In April 2017, Boeing recorded a Conservation Easement over nearly 2,400 acres of the SSFL that it owns in favor of the North American Land Trust that expressly prohibits the Boeing-owned property from ever being developed or used for residential, commercial, industrial or agricultural purposes. This includes all of Area IV and all of the NBZ. Open space is the only future use of the property (Boeing 2017).

The proposed project consists of the following components, which would be conducted in accordance with applicable laws, orders, regulations, and agreements with the State of California:

- Soil cleanup - clean up or treat radiologically and chemically impacted soil and dispose of contaminated materials and resulting waste;
- Groundwater cleanup - clean up or treat radiologically and chemically impacted groundwater and dispose of contaminated materials and resulting waste;
- Building and infrastructure removal - demolish and remove existing buildings and infrastructure; and
- Habitat restoration - restore the environment affected by the removal and transport of contaminated materials and waste.

The descriptions of DOE's cleanup activities are based on current information (as included in DOE's draft Environmental Impact Statement, its final BA, and its July 20, 2018, letter clarifying the proposed project description on which DOE requested consultation), and the descriptions are expected to become more detailed over time as sampling, plans, and analyses develop. The approaches and technologies continue to be evaluated and refined as the nature and extent of the contaminants becomes clearer. A variety of remedial technologies would be needed to address the multiple affected media and the wide variety of contaminants present.

Soil Cleanup

This activity is anticipated to be conducted for up to 20 years and would include removing vegetation, grubbing to clear debris, excavating soils and transporting waste for off-site disposal. Supporting activities to facilitate soil excavation and disposal include improving roads as necessary, stockpiling soils, loading and unloading trucks. Soil excavation and disposal activities

are anticipated to occur in the areas identified in pink and blue in Figure 2. Approximately 1,413,000 cubic yards of soil within 227 acres of Area IV and the NBZ would be subject to excavation under the AOC, if no exemptions were exercised for the protection of biological and cultural resources.

Soil removal would be the primary method for cleanup of soil to address the AOC LUT values, with onsite treatment (monitored natural attenuation) used where feasible for selected, low-concentration chemicals such as petroleum hydrocarbons. Vegetation would need to be cleared before soil could be excavated. Clearing and grubbing (removing belowground components such as roots) would be performed as necessary. Soil would be removed on a systematic basis until all of the soil removal required to meet AOC LUT values is accomplished. Following confirmation that cleanup standards have been met, excavated areas would be backfilled and graded, slopes would be stabilized, and disturbed areas would be revegetated using native plant species. It was assumed that approximately 75 percent of the soil volume removed would be backfilled to accomplish contouring and slope stabilization. Backfill would be trucked to the site.

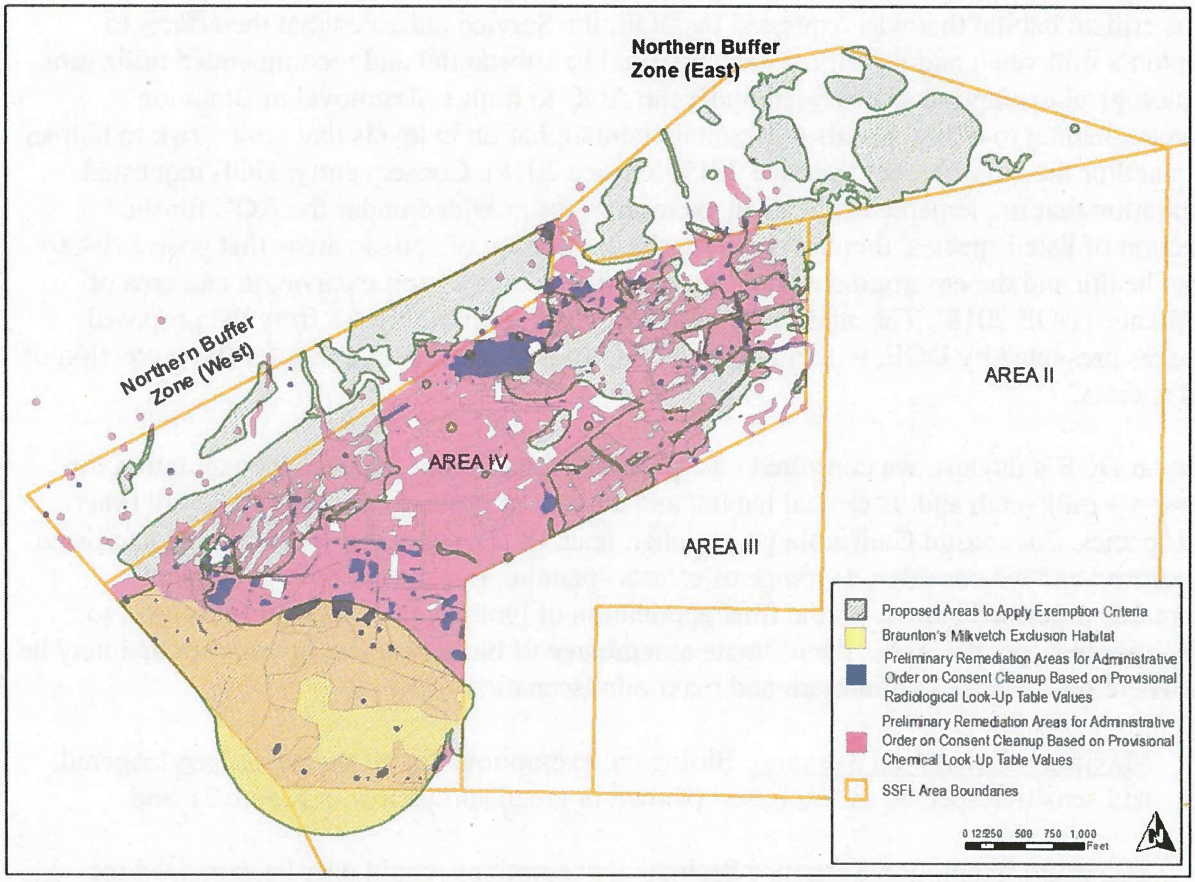

Figure 2. Areas in purple are subject to soil excavation, per the AOC look-up table exceedances. Areas in yellow represent the "minimum exemption scenario" and the areas shown in yellow and green represent the "maximum exemption scenario" (adapted from DOE 2017).

Suitable sources of backfill meeting AOC LUT values have not been located. Because the AOC LUT values are very low, finding soil meeting LUT levels, especially soil that is comparable to

the existing local soil (i.e. that would support the native plant communities), is expected to remain a challenge. If a source of backfill that meets all of the AOC LUT values cannot be reasonably found, then DTSC, DOE, and EPA would enter into a consultation process, and DTSC would determine the best available source of backfill (DTSC 2010a). DOE would not proceed with large-scale excavation of soil until an acceptable source of backfill material is identified. Up to 25 workers would be involved with soil removal activities at any one time, not including the truck drivers hauling the debris off site.

The DOE proposed areas to be protected by biological and cultural exemptions (green and yellow areas in Figure 2). These areas include habitat for threatened, endangered, and sensitive species and culturally sensitive areas. During the development of the BA, DOE requested technical assistance regarding the extent of effects from soil cleanup on listed species. Because of the potential magnitude of effects to Braunton's milkvetch and its critical habitat, this was a focal species of the discussion.

Following a preliminary review of the impacts of this proposed cleanup to Braunton's milkvetch and its critical habitat that was requested by DOE, the Service indicated that the effects to Braunton's milkvetch and its critical habitat would be substantial and recommended utilization of a biological exemption as provided under the AOC to limit soil removal in Braunton's milkvetch habitat to only the soils that contain contamination in levels that pose a risk to human health and/or the environment (Service 2017, Service 2018). Consequently, DOE requested consultation that implemented biological exemptions as provided under the AOC for the protection of listed species, thereby targeting the excavation of soils to areas that pose a risk to human health and the environment, and lowering the amount of soil excavation and area of disturbance (DOE 2018). The analysis in this biological opinion follows from the proposed action, as presented by DOE, to include the requested biological exemption for the protection of listed species.

Based on DOE's request, we consulted on a proposed project that included an exemption for Braunton's milkvetch and its critical habitat and a range of possible exemptions for all other listed species. For coastal California gnatcatcher, least Bell's vireo, red-legged frogs, and listed fairy shrimp and we considered a range of effects spanning two scenarios of biological exemptions described below. As the final application of biological exemptions is subject to DTSC approval, per the AOC, the ultimate assemblage of biological exemptions applied may lie somewhere between these minimum and maximum scenarios:

> Maximum Exemption Scenario: Biological exemptions for all threatened, endangered, and sensitive species are exercised (shown in green and yellow in Figure 2), and
>
> Minimum Exemption Scenario: Biological exemptions would only be exercised for Braunton's milkvetch and its critical habitat (shown in yellow in Figure 2).

Under DOE's revised proposed action, in areas covered by a biological exemption, such as within occupied habitat for Braunton's milkvetch (including areas where a seedbank occurs),

DOE would not take action unless it is demonstrated that levels of chemical or radiological constituents in the soil would pose a risk to human health or the environment in consideration of the future land use as open space habitat as required by the legally-binding conservation easement on Boeing-owned property which includes Area IV and the NBZ. DOE has developed a process for addressing impacted soil within AOC exemption areas.

Within the areas in which the exemption process would be applied, DOE would remove chemical and radioactive constituents in the soil that pose a risk to human health or ecological resources as determined using a traditional risk assessment, while minimizing disturbance to the surrounding areas. Areas in which the exemption process would be applied include areas with TPH soil that DOE proposes to leave in place and remediate through monitored natural attenuation.

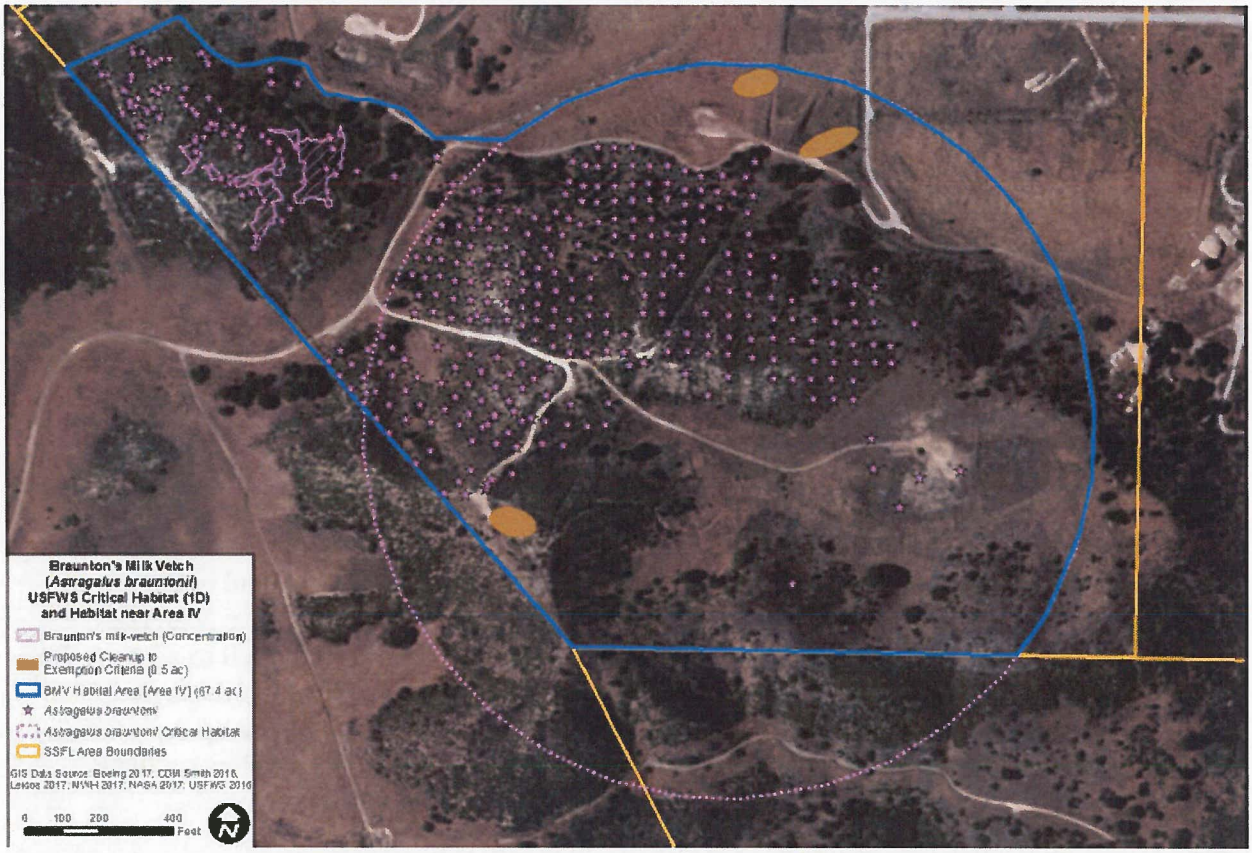

Figure 3. Orange/brown polygons identify locations where soil excavation and disposal would be conducted within Braunton's milk vetch habitat of Area IV (outlined in blue). The purple circle identifies critical habitat for Braunton's milkvetch, and the purple stars represent the locations where plants have been observed over time (one star may represent multiple plants).

In general, the sampling data will be reviewed to determine where soil impacts from contaminants are possible based on exceedance of a Look Up Table (LUT) value and an Ecological and/or Human Health risk-based screening level. These exceedance locations will be reviewed individually to determine whether the benefits from remediation would offset the

habitat destruction associated with the soil removal. If it appears that remediation is needed based on the risk evaluation, then a qualified biologist will visit these locations within the proposed exemption area and assess the habitat condition and occurrence of sensitive plants. If the habitat is in "good condition" (supporting a preponderance of native species, soil profile appears intact) and/or the sensitive plant species is present at the exceedance, then the assumption will be made that the elevated level of the chemical is not adversely affecting the biota and species of concern sufficiently to warrant removal, under the assumption that human health risk is also being protected. For Braunton's milkvetch habitat, the results of the preliminary application of the risk-based process described above (and included in the final BA), would require the excavation and disposal of soil in the areas shown in orange in Figure 3.

Following confirmation that cleanup standards have been met, excavated areas would be backfilled and graded, slopes would be stabilized, and disturbed areas would be revegetated using native plant species. It was assumed that approximately 75 percent of the soil volume removed would be backfilled to accomplish contouring and slope stabilization.

Groundwater cleanup

Groundwater at the project site has been contaminated from surficial releases and spills, and dissolved contaminants have subsequently been transported by groundwater flow. The same risk-based groundwater cleanup requirements apply to all areas throughout the site. Groundwater cleanup will be required to some extent in each of the administrative areas but the locations of localized surface facilities required for groundwater cleanup have not been determined. Existing wells and infrastructure would be used whenever available. Additionally, there is some flexibility in siting new wells and pipelines enabling them to be placed in previously disturbed areas with existing access.

Groundwater monitoring in Area IV would include the installation of five additional monitoring wells. Groundwater treatment methods would generally involve installation and operation of localized pumps and treatment units near existing wellheads. In the Radioactive Materials Handling Facility (RMHF) area, DOE proposes that bedrock would be removed to address the Strontium-90 source, impacting up to 0.25 acre of previously disturbed habitat through excavation, stockpiling, and operation of equipment. Treatment options involving dewatering would include extraction and treatment of groundwater and disposal of treated water in an environmentally safe manner, in compliance with permit conditions.

Buildings and Infrastructure Removal

<u>Buildings/Facilities</u>
The proposed action includes removal of existing facilities, buildings, support structures, and infrastructure no longer in use at the SSFL properties, over the course of 2 years. Demolition and removal of some of the SSFL facilities, buildings and infrastructure will require the mobilization and operation of heavy construction equipment and the generation, transport, and disposal of large volumes of debris and waste to offsite treatment, storage, and/or disposal facilities. The

scale of these operations will depend on the size of the facility and the area affected by facility operations. The schedules for these activities may overlap with portion of the soil and groundwater cleanup program, exacerbating the biological impacts of these activities.

Roads

The project site includes a network of paved and unpaved roads with dirt roads that will be used to access remote, undeveloped areas during wildfires and to conduct monitoring activities. It is expected that most roads will remain in place for the duration of the proposed action, except for those associated with specific buildings or facilities that can be removed without affecting ongoing access needs for remediation, monitoring and safety.

Water Supply

Water is supplied from municipal sources via pipeline to SSFL at the main gate and is supplied to the Boeing offices in Area I. Potable water for Area III and IV is supplied by truck. As part of the site closure activities, the majority of formerly used water supply wells will be properly abandoned by their owners, in accordance with existing regulations. Some existing wells may be used for monitoring, extraction, or injection as part of the final groundwater cleanup.

Electrical

Southern California Edison (SCE) would provide electricity to the project site from the Chatsworth Substation, located in Area IV, and electricity would be distributed to smaller substations in Area I via aboveground transmission lines. At the present time, electricity either is not supplied to or it has been disconnected from most buildings; however, the majority of the existing transmission lines and transformers are still in service and/or energized. The SCE substation, along with easements for its electrical system, would remain until SCE decides otherwise. Unneeded electrical infrastructure may be removed.

Sewer Pipelines

All onsite sewage treatment plants have been removed. The remaining sewer pipelines are vitreous clay and cast iron, with ductile iron and steel force mains. Pipeline diameters range from 2 to 10 inches, with the majority of the segments being 4 and 6 inches in diameter. The pipelines are generally 3 to 5 feet below grade, with some pipelines up to 10 feet deep. Some sewer system pipelines are also above the ground surface. All aboveground sewer pipelines would be removed, and below ground sewer pipelines would be either removed or decommissioned in place.

Leach Fields

Several inactive sanitary leach fields are located within the SSFL site. If these leach fields are co-located with soil requiring cleanup, they would be removed during site cleanup requirements; otherwise, they would be left in place. Boeing is currently attempting to locate 8 of the 19 inactive leach fields for which location information is uncertain. The site of the former RMHF leach field in Area IV has been affected by Strontium-90 and remediation is currently under investigation by DOE. Investigation of other leach fields has been completed and those with impacts above applicable cleanup requirements will be addressed. Specific cleanup methods for leach fields will be defined in the remediation planning documents.

Existing Surface Water Treatment Systems

Stormwater treatment at the project site is governed by the Waste Discharge Requirements and National Pollutant Discharge Elimination System (NPDES) permit issued to Boeing by the Los Angeles Regional Water Quality Control Board. Although the current NPDES permit is issued to Boeing, it governs the entire SSFL area and the DOE supports compliance with its provisions because discharges from their activities are also covered by the permit. Active treatment is performed on water collected in the onsite ponds using two surface water treatment systems that employ filters and chemical treatment. A passive biofilter system has been implemented that uses soil, naturally occurring bacteria, and native plants to filter the surface water. Each Responsible Party has implemented drainage culvert modifications, stream bank stabilization, revegetation of disturbed soil areas, installation of detention bioswales, and placement of smaller-scale erosion control measures to comply with NPDES requirements. Surface drainage that would lead offsite into the NBZ is captured at the outfalls and piped back to Silvernale Pond for detention and treatment. The DOE expects that this system would remain in place for the duration of onsite remediation and treatment.

Restoration of the Affected Environment

The proposed action requires the removal, hauling, and disposal of impacted soils to approved off-site locations. DOE estimates backfill volume to be approximately 75 percent of the total excavation volume within Area IV and the NBZ, which would have implications for restoration (e.g. re-contouring the land and drainages, revegetation/habitat restoration). Restoration actions would further require the replacement of removed impacted soils with non-impacted backfill, sourced and hauled from off-site locations. Borrow sites for backfill have not been identified for DOE, but they would either be from existing sites operating under permits or new sites that would need separate environmental review and permitting.

DOE proposes to develop a revegetation and habitat restoration plan that would address all revegetation efforts associated with the soil disturbances. Restoration activities would occur following all cleanup and backfill activities and are anticipated to be conducted for 5 years or more. The plan would include specific erosion control measures, irrigation requirements, species composition, seed mix origins and ratios for particular habitats, weed control, water regimes, maintenance activities, success criteria, and monitoring requirements. DOE proposes to develop the plan with input from the Service and the California Department of Fish and Wildlife. Full parameters for the development of the revegetation and habitat restoration plan are outlined in Conservation Measure 9 (see Appendix A).

Protective Measures

The proposed action incorporates a number of general and species-specific measures DOE and its contractors would implement to avoid, minimize, and/or compensate for adverse effects on federally listed and proposed species and designated critical habitat. A summary of the protective measures is provided below, full text is shown in Appendix A.

Conservation Measure 1. Biological Monitoring during Project Construction and Pre-Project Clearance Surveys. One or more qualified Project Biologists (monitoring team), approved by the Service, CDFW, and U.S. Army Corps of Engineers (Corps) would be retained by DOE for the duration of construction activities. The Project Biologist will be on site as needed during building demolition and clearing and grubbing of vegetation in habitats that have the potential to support sensitive species, including federally or state-listed species. The monitoring team will include a Project Biologist and staff members qualified to perform particular tasks under the direction of the Project Biologist.

Conservation Measure 2. Site Access Restrictions to Minimize Impacts to Sensitive Biological Resources.

a) The project work areas will be accessed using existing roads to the extent possible.

b) The demolition, remediation, and restoration contractors will stage equipment in areas away from sensitive habitat areas and endangered species.

c) Where access must be through native habitats, the project biologist will be consulted to determine the least environmentally damaging and safe access route to the site.

d) Limits of the action area will be clearly marked and delineated in the field by the biologist. No unauthorized personnel or equipment (including off-road vehicle access) will be allowed.

e) Disturbance in the 2010 AOC proposed biological exemption areas would be kept to a minimum.

f) Biologically sensitive areas will be clearly marked on plans and on site and avoided by personnel and equipment.

g) Before project initiation, the project boundary, including temporary features such as staging areas, will be clearly marked with flagging, fencing, or signposts.

h) DOE will cease all construction activities from sunset and to sunrise to the maximum extent practicable.

i) All trash will be disposed of properly or removed from the site regularly. Following initial project construction, all equipment, waste, and construction debris will be removed from the site, and the soil will be re-contoured prior to habitat restoration.

Conservation Measure 3. Environmental Education Program. All members of action related crews will participate in an Environmental Education Program to be administered by the Project Biologist. The Education Program will be conducted during all project phases for any new crew personnel brought to the site. Species-specific training will be administered to crews who will be performing activities within areas occupied, or presumed to be occupied, by listed species.

Conservation Measure 4. Vehicle and Operation Restrictions to Prevent Unintentional Fire. Trucks will carry water and shovels or fire extinguishers in the field, and wildfires will be prevented by exercising care when driving and by not parking vehicles in grass or other dry vegetation where catalytic converters can ignite it.

Conservation Measure 5. Conduct Vegetation Removal or Heavy Equipment Operation Adjacent to Vegetated Habitat Outside of Nesting Season for Those Species Protected by the Migratory Bird Treaty Act.

a) Project activities involving heavy equipment in or adjacent to vegetated areas will not be scheduled during the nesting season for song birds, between February 15 and August 31 to avoid potential impacts on nesting birds, whenever feasible. Areas within the project site where migratory birds roost or nest will be surveyed by qualified biologist prior to vegetation removal. If nesting birds are identified that may be affected by the proposed activities, then an appropriate work buffer will be established or work will be delayed until nesting activity has been completed to ensure that the nesting bird activity is not adversely impacted.

b) A qualified biologist will perform a nesting bird survey and confirm that active nests would not be affected.

Conservation Measure 6. Minimize the Potential for Establishment of Invasive Plant Species. Project activities will minimize the potential for invasive plant species (i.e. weeds) or soil pathogens to become established in disturbed areas and spread into restoration areas or natural areas. Equipment and/or vehicles used for remediation activities in off-road locations will utilize dry-truck cleaning measures (e.g. rumble strips, brushing) upon entering SSFL and/or the project site.

Conservation Measure 7. Avoid, Minimize, and Mitigate for Disturbance to Corps Jurisdictional Wetlands and Waters of the U.S. and wetlands and waters under CDFW jurisdiction.

a) No dumping or fill will be placed in any Clean Water Act (CWA) Section 404 Waters of the U.S. except as authorized by a permit from the Corps.

b) Erosion and sediment control best management practices (BMPs) would be implemented during soil remediation, building demolition, and any other ground disturbance activities.

c) When soil disturbance occurs during the rainy season (November 1 to May 1), erosion and sedimentation BMPs will be installed and maintained immediately downslope of work areas.

d) Natural ephemeral drainages that are within the soil disturbance areas will be reconstructed as soon as possible to restore drainage patterns.

e) If man-made drainage features need to be restored to pre-disturbance condition, they will be restored in a manner that mimics the natural drainage on the site.

f) Protective measures will 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.

Conservation Measure 8. Avoid and Minimize Disturbance to Sensitive Upland Vegetation. Disturbance to Venturan coastal sage scrub, dipslope grassland, sandstone outcrops (including vegetated sandstone outcrops), chaparral, southern California walnut woodland, coast live oak woodland, southern willow scrub, mulefat scrub, and coast live oak riparian woodland, will be avoided and minimized to the extent practicable. Proper functioning of these habitats is necessary to support overall ecosystem functioning on SSFL including the site's ability to support endangered, threatened, and sensitive species and designated critical habitat.

Conservation Measure 9. Develop a Revegetation and Habitat Restoration Plan. A qualified biologist will prepare a site-specific Revegetation and Habitat Restoration Plan (RHRP), in consultation with the Service and CDFW that includes a description of existing conditions in the action area, areas of impact, site preparation and revegetation methods, maintenance and monitoring criteria, performance standards, and adaptive management practices.

The RHRP will be developed and approved by appropriate agencies prior to the initiation of ground disturbance or construction activities. The RHRP will address all revegetation efforts associated with the soil disturbances. It will include specific irrigation requirements, species composition, seed mix origins and ratios for that particular habitat, weed control, water regimes, maintenance activities, success criteria, and monitoring requirements.

Conservation Measure 10. Develop a Tree Management and Preservation Plan. A Tree Management and Preservation Plan will be developed to offset tree impacts through a sustainable, customized plan that is suitable for the site's unique opportunities for tree preservation, enhancement, and establishment. The plan will identify trees protected by Ventura County, including coast live oak (*Quercus agrifolia*), sycamore (*Platanus racemosa*), historical and heritage trees (protected trees), or special-status trees (e.g. southern California black walnut [*Juglans californica*]) that could be impacted within or adjacent to remediation areas, as well as those located outside of the project footprint that would be preserved.

Conservation Measure 11. Soil Stabilization. In conjunction with reseeding and when topsoil is unavailable, soil stabilization BMPs will be used when and where applicable. An updated Storm Water Pollution Prevention Plan (SWPPP) will guide erosion control measures for all project activities (e.g. demolition and remediation activities). Dust control measures would be developed and implemented to minimize fugitive dust and limit soil losses due to wind.

Conservation Measure 12. Avoidance and Minimization of Impacts to Braunton's milkvetch, Santa Susana tarplant, other Sensitive Plant Species and Associated Critical Habitat.

a) Prior to access, excavation, demolition, remediation, installation of equipment, or any other activity associated with the proposed project, the Project Biologist will survey all

proposed remediation, staging, and access areas, plus a buffer of 100 feet, for presence of federally and state-listed threatened or endangered plants and other sensitive plant species.

b) Remediation access routes will be adjusted as needed to maximize avoidance of impacts to individuals or populations of Braunton's milkvetch or any other sensitive plant species and associated critical habitat.

c) Dust migration in or adjacent to areas that support sensitive species will be minimized during excavation activities when weather conditions require the use of dust control measures.

d) The project biologist will flag the locations of sensitive plants that occur within 100 feet of a proposed demolition or remediation area and work with the project team to avoid or minimize impacts to the species.

e) Where impacts to Braunton's milkvetch or other sensitive plant species are unavoidable, a salvage, propagation, and replanting program will be developed and implemented as part of the RHRP.

Conservation Measure 13. Avoidance of Vernal Pools and Vernal Rock Pools Potentially Occupied by Listed Vernal Pool Species including Riverside Fairy Shrimp and/or Vernal Pool Fairy Shrimp.

a) Surveys would be conducted during the appropriate season(s) to determine the presence of federally listed Riverside and vernal pool fairy shrimp prior to any work within 250 feet of vernal pools or vernal rock pools, and depressional features that support a hydroperiod sufficient to complete the fairy shrimp lifecycle. Surveys must be conducted by a Service approved biologist.

b) Occupied fairy shrimp habitat (vernal pools and vernal rock pools) within 250 feet of the project footprint will be clearly identified in the field with flagging or exclusion fencing.

c) Any demolition or remediation that could indirectly affect vernal pools or potential suitable habitat for federally listed fairy shrimp associated with vernal pools, rock pools, and vernal pool watersheds will occur outside of the rainy season (about November 1 to June 1) and in dry conditions only.

d) Fueling of equipment and vehicle washing will be allowed only in designated areas and will not occur within 100 feet of any vernal pool or vernal rock pool or other aquatic habitat, including intermittent drainages.
e) Stockpiled soils will be placed on top of heavy-duty plastic sheeting on areas with an impervious surface. All stockpiles will be covered with material adequate to prevent soil transport by wind or rainwater. Covers will be maintained in good condition.

Conservation Measure 14. Avoidance of California Red-legged Frog and associated Critical Habitat. A qualified biologist will conduct pre-demolition and pre-remediation surveys within work areas containing suitable habitat, as well as biological monitoring during demolition and remediation activities. If the California red-legged frog is discovered in work zones before or during demolition and remediation activities, the species will be avoided; demolition and remediation activities will be immediately halted; and consultation will be initiated with the Service to determine an appropriate response before demolition and remediation activities can begin/restart.

Conservation Measure 15. Avoidance of Least Bell's Vireo. Any required clearing of woody riparian vegetation will take place outside of the breeding season for the least Bell's vireo (March 15 to August 31). If avoidance is not practicable, the measures will be implemented to minimize effects to least Bell's vireos. Pre-project surveys, when applicable, will adhere to the Service's (2001) least Bell's vireo survey guidelines as a recognized method to determine presence or absence of the species and its habitat and be conducted during the April 10 to July 31 ideal survey window within one year in advance of construction activity. If an active nest occurs within 300 feet of the proposed project activity, then project activities other than the use of existing roads will be delayed until after young fledge from the nest.

Conservation Measure 16. Avoidance of Coastal California Gnatcatcher. Prior to any clearing of vegetation or soil removal in Venturan coastal sage scrub or other suitable habitat for the coastal California gnatcatcher, the Service's presence/absence survey protocol (Service 1997a) will be implemented.

a) Pre-activity surveys in all suitable coastal California gnatcatcher habitats will be conducted by a qualified biologist. If an active nest occurs within 300 feet of the proposed activity, the project activities in the vicinity of the nest (other than the use of existing roads) will be delayed until after young fledge from the nest.

b) A qualified biologist will monitor nest progress and activities in and adjacent to coastal California gnatcatcher habitat to ensure compliance.

Conservation Measure 17. Environmental Mitigation Requirements and Monitoring Program. DOE will be in consultation with oversight agencies including the Service, CDFW, Corps, DTSC, and County of Ventura, as appropriate, and will be responsible for coordinating and implementing the conservation and protection measures and permit requirements.

ANALYTICAL FRAMEWORK FOR THE JEOPARDY AND ADVERSE MODIFICATION DETERMINATIONS

Jeopardy Determination

Section 7(a)(2) of the Endangered Species Act requires that Federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of listed species. "Jeopardize the continued existence of" means "to engage in an action that

reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02).

The jeopardy analysis in this biological opinion relies on four components: (1) the Status of the Species, which describes the range-wide condition of the least Bell's vireo, coastal California gnatcatcher, California red-legged frog, Riverside fairy shrimp, vernal pool fairy shrimp, and Braunton's milkvetch, the factors responsible for that condition, and its survival and recovery needs; (2) the Environmental Baseline, which analyzes the condition of the least Bell's vireo, coastal California gnatcatcher, California red-legged frog, Riverside fairy shrimp, vernal pool fairy shrimp, and Braunton's milkvetch in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the least Bell's vireo, coastal California gnatcatcher, California red-legged frog, Riverside fairy shrimp, vernal pool fairy shrimp, and Braunton's milkvetch; (3) the Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the least Bell's vireo, coastal California gnatcatcher, California red-legged frog, Riverside fairy shrimp, vernal pool fairy shrimp, and Braunton's milkvetch; and (4) the Cumulative Effects, which evaluates the effects of future, non-Federal activities, that are reasonably certain to occur in the action area, on the least Bell's vireo, coastal California gnatcatcher, California red-legged frog, Riverside fairy shrimp, vernal pool fairy shrimp, and Braunton's milkvetch.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the current status of the least Bell's vireo, coastal California gnatcatcher, California red-legged frog, Riverside fairy shrimp, vernal pool fairy shrimp, and Braunton's milkvetch, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to reduce appreciably the likelihood of both the survival and recovery of the least Bell's vireo, coastal California gnatcatcher, California red-legged frog, Riverside fairy shrimp, vernal pool fairy shrimp, and Braunton's milkvetch in the wild by reducing the reproduction, numbers, and distribution of that species.

Adverse Modification Determination

Section 7(a)(2) of the Act requires that Federal agencies insure that any action they authorize, fund, or carry out is not likely to destroy or to adversely modify designated critical habitat. A final rule revising the regulatory definition of "destruction or adverse modification" was published on February 11, 2016 (81 FR 7214). The final rule became effective on March 14, 2016. The revised definition states:

> "Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features."

The "destruction or adverse modification" analysis in this biological opinion relies on four components: (1) the Status of Critical Habitat, which describes the range-wide condition of the critical habitat in terms of the key components (i.e. essential habitat features, primary constituent elements, or physical and biological features) that provide for the conservation of the listed species, the factors responsible for that condition, and the intended value of the critical habitat overall for the conservation/recovery of the listed species; (2) the Environmental Baseline, which analyzes the condition of the critical habitat in the action area, the factors responsible for that condition, and the value of the critical habitat in the action area for the conservation/recovery of the listed species; (3) the Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated and interdependent activities on the key components of critical habitat that provide for the conservation of the listed species, and how those impacts are likely to influence the conservation value of the affected critical habitat; and (4) Cumulative Effects, which evaluate the effects of future non-Federal activities that are reasonably certain to occur in the action area on the key components of critical habitat that provide for the conservation of the listed species and how those impacts are likely to influence the conservation value of the affected critical habitat.

For purposes of making the "destruction or adverse modification" determination, the Service evaluates if the effects of the proposed Federal action, taken together with cumulative effects, are likely to impair or preclude the capacity of critical habitat in the action area to serve its intended conservation function to an extent that appreciably diminishes the rangewide value of critical habitat for the conservation of the listed species. The key to making that finding is understanding the value (i.e. the role) of the critical habitat in the action area for the conservation/recovery of the listed species based on the Environmental Baseline analysis.

STATUS OF THE SPECIES AND ITS CRITICAL HABITAT

Least Bell's Vireo

Legal Status

The least Bell's vireo was federally listed as endangered in 1986 (51 Federal Register (FR) 16474), and critical habitat was designated in 1994 (59 FR 4845). Although a final recovery plan has not been published, a draft recovery plan was completed in 1998 (Service 1998a). The Service issued a 5-year review in 2006 (Service 2006) in which we recommended downlisting to threatened status because of a 10-fold increase in population size since listing, expansion of locations with breeding pairs throughout southern California, and conservation and management of suitable breeding habitat throughout its range. The final rule for designation of critical habitat describes 10 localities, encompassing approximately 38,000 acres, in six counties in California. Critical habitat is designated in Ventura County; however, it is not designated in the project area and will not be discussed further in this biological opinion. Additional information on the least Bell's vireo may be found in Wilbur (1980), Garrett and Dunn (1981), Zembal et al. (1985), Miner (1989), Pike and Hays (1992), and Service (1998).

Natural History

The least Bell's vireo is a small, migratory songbird that nests and forages almost exclusively in riparian woodland. It is one of four subspecies (American Ornithologists' Union 1957), and each is isolated from another throughout the year (Hamilton 1962, Service 1998a). Least Bell's vireos are site-tenacious across breeding seasons and highly territorial. They typically inhabit structurally diverse woodlands along watercourses that feature dense cover within 3 to 6 feet of the ground and a dense, stratified canopy (Goldwasser 1981, Salata 1983, Gray and Greaves 1984, Service 1998a). The understory of the habitat is typically dominated by mulefat (*Baccharis salicifolia*), California wild rose (*Rosa californica*), poison oak (*Toxicodendron diversiloba*), sandbar willow (*Salix hindsiana*), young individuals of other willow (*Salix*) species, and several perennial species (Service 1998a). Important canopy species include mature arroyo willow (*Salix lasiolepis*) and black willow (*Salix gooddingii*), and occasional cottonwood (*Populus* spp.), western sycamore, and coast live oak.

Least Bell's vireos feed primarily on insects, especially lepidopteran (butterfly) larvae within willow stands or associated riparian vegetation (Miner 1989, Brown 1993). The feeding behavior consists largely of gleaning prey from leaves or woody surfaces while perched or hovering, and less frequently by aerial pursuit (Salata 1983, Miner 1989). Least Bell's vireos concentrate most of their foraging between 0 to 20 feet above ground level (Salata 1983, Miner 1989).

Least Bell's vireos generally arrive in breeding areas in southern California from mid-March to early April, with males arriving before females and older birds arriving before first-year breeders (Service 1998a). Least Bell's vireos generally remain on the breeding grounds until late September, although some post-breeding migration may begin as early as late July (Service 1998a). Males establish and defend breeding territories by singing and chasing intruders (Barlow 1962, Beck 1996, Service 1998a). Although territories typically range in size from 0.5 to 7.5 acres (Service 1998a), no relationship appears to exist between size and quality of the territory (Newman 1992). Most passerine birds, including least Bell's vireo, tend to be most active 1 hour prior to sunrise until 4 hours after sunrise and again in the late evening hours until 1 hour after sunset (Ralph et al. 1993, Gill 1995).

Nest building commences a few days after pair formation, with the female selecting a nest site and both sexes constructing the nest (Pitelka and Koestner 1942, Barlow 1962, Service 1998a). Nests are typically suspended in forked branches within 3 feet above the ground and with no preference for any particular plant species as the nest host (Nolan 1960, Barlow 1962, Gray and Greaves 1984, Service 1998a). Typically 3 or 4 eggs are laid on successive days shortly after nest construction (Service 1998a). The eggs are incubated by both parents for approximately 14 days with the young remaining in the nest for another 10 to 12 days (Pitelka and Koestner 1942, Nolan 1960, Barlow 1962). Each nest appears to be used only once (Greaves 1987). Least Bell's vireos may attempt up to five nests within a breeding season, but they are typically limited to one or two successful nests within a breeding season (Service 1998a).

Multiple long-term monitoring studies indicate that approximately 59 percent of nests successfully produce fledglings, with an average of 1.8 chicks fledging per nest (Service 1998a).

Although nests appear to be more accessible to terrestrial predators because of their relatively low placement (Franzreb 1989), western scrub-jays (*Aphelocoma californica*) account for the majority of documented predation (Peterson 2002, Peterson et al. 2004). Predation rates can exceed 60 percent of the total nests in an area within a year (Kus 1999), but typical nest predation rates average around 30 percent (Franzreb 1989), which is comparable to predation rates for other North American passerines (Martin and Clobert 1996, Grishaver et al. 1998, Ferree 2002).

Nest parasitism by brown-headed cowbirds (*Molothrus ater*) is another major source of failure for nests of least Bell's vireos (Franzreb 1989; Service 1998a; Kus 1999, 2002; Griffith and Griffith 2000; Sharp 2002). The nests that are parasitized are either abandoned or fledge cowbirds chicks rather than least Bell's vireos. Cowbirds did not historically occur within the range of the least Bell's vireo, which may explain why least Bell's vireos have not evolved adequate defenses to avoid loss of productivity due to their parasitism (Franzreb 1989, Kus 2002). Cowbird trapping and focused nest monitoring can substantially reduce parasitism or its effects (Franzreb 1989, Service 1998a, Griffith and Griffith 2000, Kus 2002).

Cowbird trapping has proven a successful tool to halt least Bell's vireo population declines over the short term within a limited area, but Kus and Whitfield (2005) have argued that trapping may not be the best method for long-term recovery of the least Bell's vireo because maintaining cowbird populations at low levels may not allow the least Bell's vireo to evolve resistance to cowbird parasitism. The best way to manage this threat over the long term is not apparent, and additional research is needed to determine whether there are any alternatives to the intensive cowbird trapping programs currently being implemented (Service 2006).

Fledgling least Bell's vireos expand their dispersal distances from approximately 35 feet the first day to approximately 200 feet several weeks after fledging (Hensley 1950, Nolan 1960). This distance has been shown to increase to at least 1 mile prior to their first fall migration (Gray and Greaves 1984). Banding records indicate that while most first-year breeding individuals return to their natal drainage after winter migration, some disperse considerable distances to other breeding locations (Greaves and Labinger 1997, Service 1998a, Kus and Beck 1998). Movement by least Bell's vireos between drainages within San Diego County is not uncommon (Kus and Beck 1998). Additionally, several least Bell's vireos banded as nestlings in San Diego County have been sighted as breeding adults in Ventura County, and the opposite movement from Ventura to San Diego has been observed also (Greaves and Labinger 1997). The maximum, documented dispersal distance is approximately 130 miles (Service 1998a). Although movement between sites by older birds may occur, site fidelity by least Bell's vireos after the first breeding season is generally high. Most dispersal occurs prior to the first breeding season (Service 1998a).

Rangewide Status

The least Bell's vireo historically occurred from Tehama County in northern California to northwestern Baja California, Mexico, and eastward to Owens Valley, Death Valley and the Mojave River (Grinnell and Miller 1944, Service 1998a). Although previously considered to be abundant locally, regional declines were observed by the 1940s (Grinnell and Miller 1944), and

it was believed to be extirpated from California's Central Valley by the early 1980s (Franzreb 1989). Except for a few outlying pairs, by 2002 the least Bell's vireo was mostly restricted to southern California south of the Tehachapi Mountains and northwestern Baja California (Wilbur 1980, Garrett and Dunn 1981, Franzreb 1989, U.S. Geological Survey (USGS) 2002). The largest current concentrations of least Bell's vireos are in San Diego County along the Santa Margarita River on Camp Pendleton and in Riverside County at the Prado flood control basin (Service 2006).

Historically, the San Joaquin and Sacramento Valleys were considered to be the center of the least Bell's vireo's breeding range (60 to 80 percent of the historical population; 51 FR 16474), but the least Bell's vireo has not yet meaningfully re-colonized those areas. In 2005 and 2006, the first breeding pair of least Bell's vireos detected in the San Joaquin Valley since listing successfully bred at the San Joaquin National Wildlife Refuge in Stanislaus County (Service 2006). There have been no sightings of least Bell's vireos in the Sacramento Valley since prior to listing, and it is unlikely that breeding has occurred within recent years in the Sacramento Valley (Service 2006).

At the time of listing (51 FR 16474), 99 percent of the remaining least Bell's vireos were in southern California (Santa Barbara County and southward), with 77 percent in San Diego County. Ninety-nine percent still remain in southern California (Service 2006), although 54 percent are in San Diego County and 30 percent in Riverside County. Thus, despite a significant increase in overall numbers, the species remains mostly restricted to the southern portion of its historical range (Service 2006).

The least Bell's vireo's decline is due to destruction or degradation of habitat, river channelization, water diversions, lowered water tables, gravel mining, agricultural development, and cowbird parasitism (51 FR 16474, 59 FR 4845, Service 1998a). Habitat losses have fragmented most remaining populations into small, disjunct, widely dispersed subpopulations (Franzreb 1989). Habitat fragmentation negatively affects abundance and distribution of neotropical migratory songbirds by increasing incidence of nest predation and parasitism (Whitcomb et al. 1981, Small and Hunter 1988, Yahner and DeLong 1992, Sharp 2002, Peterson 2002). Males establish breeding territories that range from 0.5 to 4.2 acres (Franzreb 1989). Least Bell's vireos nesting in smaller areas or areas with degraded habitat have lower productivity (e.g. hatching success) than those in areas with high quality habitat (Pike and Hays 1992). Since listing, the least Bell's vireo population in California has increased 10-fold as indicated by the number of known territories (from 291 to 2,968 known territories; Service 2006). The population has grown during each 5-year period since listing, although the rate of increase has slowed over the last 10 years. Population growth has been greatest in San Diego County and Riverside County, with lesser but substantial increases in Orange County, Ventura County, San Bernardino County, and Los Angeles County. The population in Santa Barbara County has declined since listing in 1986. Kern, San Luis Obispo, Monterey, San Benito and Stanislaus Counties have each had a few isolated individuals and/or breeding pairs since listing, but these counties have not supported sustained populations.

Least Bell's Vireo Recovery

Draft Recovery Plan for the Least Bell's Vireo

The 1998 draft recovery plan for the least Bell's vireo states that the goal of recovery efforts is the reclassification of the subspecies from endangered to threatened and, ultimately, delisting of the subspecies. The draft plan states that reclassification to threatened status may be considered when there are stable or increasing population/metapopulations of least Bell's vireos for a period of 5 consecutive years, each consisting of several hundred or more breeding pairs at the following sites: Tijuana River, Dulzura/Jamul Creek/Otay River, Sweetwater River, San Diego River, San Luis Rey River, Camp Pendleton/Santa Margarita River, Santa Ana River, an Orange County/Los Angeles County metapopulation, Santa River, Santa Ynez River, and an Anza Borrego Desert metapopulation. The draft plan states that each of these populations and metapopulations should be protected and managed.

The draft plan states that delisting of the least Bell's vireo may be considered when the subspecies meets the criterion for downlisting and there are stable or increasing least Bell's vireo population/metapopulations for a period of 5 consecutive years established at the following currently unoccupied areas of the species' historical range: Salinas River, a San Joaquin Valley metapopulation, and a Sacramento Valley metapopulation. The draft plan states that each of these populations and metapopulations should be protected and managed.

Lastly, the draft plan states that threats to the least Bell's vireo at the aforementioned sites should be reduced or eliminated so that these populations/metapopulations are capable of persisting without significant human intervention, or perpetual endowments are secured for cowbird trapping and exotic plant control in riparian habitat occupied by the least Bell's vireos.

The draft recovery plan describes a strategy for reclassification, recovery, and delisting. Instrumental to this strategy is securing and managing riparian habitat within the historical breeding range of the least Bell's vireo, annual monitoring and rangewide surveys, and research activities necessary to monitor and guide the recovery effort.

Coastal California Gnatcatcher

Legal Status

The Service listed the coastal California gnatcatcher as threatened on March 30, 1993 (58 FR 16742) and published a final rule designating critical habitat for the coastal California gnatcatcher on October 24, 2000 (65 FR 63680). As a result of various lawsuits and court decisions, the Service re-proposed critical habitat on April 24, 2003 (68 FR 20228), and the final rule designating critical habitat was published on December 19, 2007 (72 FR 72010).

In September 2010, the Service completed a 5-Year Review addressing the status of the coastal California gnatcatcher (Service 2010b). In the 5-Year Review, we found that implementation of large-scale, multi-species, regional Natural Community Conservation Plans/Habitat Conservation Plans (NCCPs/HCPs) has reduced the magnitude of threats associated with urban

and agricultural development; however, the threat of habitat type-conversion is increasing due to multiple factors. Because of the increased magnitude of the threat of habitat type conversion, the 5-Year Review recommended no change to the listing status of the species.

On June 11, 2014, we received a petition requesting the coastal California gnatcatcher be delisted. After reviewing the available information, the Service determined the petitioned action was not warranted (81 FR 59952) and the coastal California gnatcatcher remains listed as threatened.

Natural History

The coastal California gnatcatcher is endemic to cismontane southern California and northwestern Baja California, Mexico (Atwood 1991). It typically occurs in or near coastal sage scrub, comprising relatively low-growing, dry-season deciduous and succulent plants. Characteristic plants of these communities include California sagebrush (*Artemisia californica*), California buckwheat (*Eriogonum fasciculatum*), laurel sumac (*Malosma laurina*), lemonade berry (*Rhus integrifolia*), snapdragon penstemon (*Keckiella antirrhinoides*), sages (*Salvia* spp.), sunflowers (*Encelia* spp.), and cacti (*Opuntia* spp.) (Weaver 1998). The coastal California gnatcatcher may also use chaparral, grassland, and riparian plant communities where they occur adjacent to or intermixed with coastal sage scrub, especially during the non-breeding season (Campbell et al. 1998). Potential factors contributing to the coastal California gnatcatcher's use of alternative habitats may include more abundant food resources, higher survival rates during dispersal, fire avoidance, and cooler microclimate during heat stress (Campbell et al. 1998); however, coastal California gnatcatchers are closely tied to sage scrub habitats for reproduction (Atwood 1993).

The coastal California gnatcatcher is primarily insectivorous. Based on fecal sample analysis, its diet consists of small arthropods, especially leaf-hoppers (Homoptera) and spiders (Araneae), while true bugs (Hemiptera) and wasps, bees, and ants (Hymenoptera) are minor components (Burger et al. 1999).

Coastal California gnatcatchers are non-migratory and exhibit strong site tenacity (Atwood 1993). Breeding season territories range widely in size, from less than 2.5 acres to 37 acres (Atwood et al. 1998, Preston et al. 1998), with mean territory size generally greater for inland populations than coastal populations (Preston et al. 1998). The mean territory size for inland areas during the breeding season generally ranges from 12 to 27 acres per pair (Preston et al. 1998). During the non-breeding season, coastal California gnatcatchers have been observed to wander in adjacent territories and unoccupied habitat increasing their home range size to approximately 78 percent larger than their breeding territory (Preston et al. 1998).

The breeding season of the coastal California gnatcatcher extends from late-February through early August, with the peak of nesting attempts occurring from mid-March through mid-May (Atwood and Bontrager 2001). Most coastal California gnatcatchers first breed at 1 year of age (Atwood and Bontrager 2001). Nests are constructed over a 4- to 10-day period and are most often placed in California sagebrush about 3 feet above the ground (Atwood 1993). Clutch size

averages approximately 4 eggs (Atwood and Bontrager 2001). The egg incubation period is 14 days, and the nestling period is 10 to 15 days (Grishaver et al. 1998). Both sexes participate in all phases of the nesting cycle, and some pairs may produce more than one brood in one nesting season (Atwood and Bontrager 2001).

Juveniles stay within their natal territories 21 to 35 days after fledging from the nest (Grishaver et al. 1998), with juveniles subsequently dispersing to find their own foraging and nesting territories, if available. Juveniles usually disperse less than 6.2 miles from their natal territory (Atwood and Bontrager 2001), but they generally disperse less than 2 miles on average (Bailey and Mock 1998; Galvin 1998; Atwood and Bontrager 2001). Dispersing coastal California gnatcatchers are apparently able to traverse human-modified landscapes for at least short distances (Bailey and Mock 1998). Juveniles begin to vie for territories as early as late spring, and will have established territories by the end of October (Preston et al. 1998).

Similar to other songbirds, mortality of coastal California gnatcatchers is highest for the youngest age class, with much of this attributable to predation of young in nests. Mean average survivorship of coastal California gnatcatchers during their first year is estimated to be 29 percent, with annual survivorship for adults 57 percent, although there is probably a high annual variation within and between populations. The oldest documented individual was a female at least 8 years old (Atwood and Bontrager 2001).

Rangewide Status

The range of the coastal California gnatcatcher extends from southern Ventura and San Bernardino counties, California, south to near El Rosario, Mexico, at about 30 degrees north latitude (Service 2010b). The northern and eastern limits of the coastal scrub vegetation communities used by the coastal California gnatcatcher are bound by mountainous areas, while the southern limit is defined by the transition to the Vizcaíno Desert. Most of the coastal California gnatcatchers in the United States are found in Orange, western Riverside, and San Diego counties. Relatively isolated populations also remain in portions of its former range in Los Angeles, San Bernardino, and southern Ventura counties (Atwood and Bontrager 2001). The current overall range is roughly the same as it was at the time of listing (Service 2010b). While the species' overall distribution has not changed much over time, the amount of suitable habitat within that range has declined which led to the species' listing as threatened in 1993 (58 FR 16742).

Coastal California gnatcatchers were considered locally common in the mid-1940s, but they had declined substantially in the United States by the 1960s (Atwood and Bontrager 2001). In 1993, the Service estimated that about 2,562 coastal California gnatcatcher pairs remained in the United States, with the highest densities occurring in Orange and San Diego counties (58 FR 16742). In a study using more rigorous sampling techniques, Winchell and Doherty (2008) found a mean of 1,324 pairs of coastal California gnatcatchers over four sampling periods in an 111,006-acre area on public and quasi-public lands in Orange and San Diego counties. Their sampling frame covered only a portion of the U.S. range, focusing on the coast, and was limited to 1 year. Although it is not valid to extrapolate beyond the sampling area, especially in light of

known differences in population densities across the range of the coastal California gnatcatcher (Atwood 1992), we conclude it is likely there are more coastal California gnatcatchers in the U.S. portion of the range than was suggested by earlier estimates. For example, new locations are being recorded in Ventura and Los Angeles counties where the species was thought to be extirpated or only present in very low numbers. We are not aware of any recent estimates of coastal California gnatcatcher populations in Baja California.

The population estimates described above are based on surveys conducted prior to catastrophic fires in San Diego County in 2003 and San Diego and Orange counties in 2007. These fires may have temporarily reduced the overall coastal California gnatcatcher population because of the temporary loss of coastal California gnatcatcher occupied habitat. In the 2007 fires, a total of approximately 112,375 acres of coastal sage scrub burned in several separate locations.

The 5-Year Review for coastal California gnatcatcher includes a detailed evaluation of the current threats and conservation needs of the species. The species was listed in 1993 because of habitat loss and fragmentation resulting from urban and agricultural development (58 FR 16742). The direct loss of habitat reduces the amount of breeding, sheltering, and foraging area available, thereby proportionally reducing the population size and overall reproductive capacity of the species. Habitats that are fragmented have reduced biological integrity due to the increased potential for human-generated disturbance. Directly associated with development is an increase in recreational use of habitats, fire frequency, waste dumping, air pollution, exotic plant and animal species, predators, cowbird parasitism, domestic pets, and night lighting, all of which can have adverse impacts on the quality of habitat for the coastal California gnatcatcher.

Several stressors, including livestock grazing, anthropogenic atmospheric pollutants, and wildfire, promote habitat type conversion within the range of the coastal California gnatcatcher. Wildfire in particular is a major contributor because it promotes a feedback loop. That is, wildfire allows non-native grasses to outcompete re-growing native shrubs, which leads to an increase in non-native grasses, which makes the area more susceptible to wildfire, which allows the process to repeat, but with successively fewer native shrubs with each iteration. The number of wildfires has increased dramatically as urbanization (with its multitude of ignition sources) has come into greater contact with open space areas. Thus, the threat of habitat type conversion has increased throughout the range of the coastal California gnatcatcher since listing (Service 2010b).

Coastal California Gnatcatcher Recovery

The Service has not developed a recovery plan for the coastal California gnatcatcher. The 5-year review (Service 2010b) and the final rule on the petition to delist the species (59 FR 59952) both contain information relative to this discussion, so we rely on those documents to assess the coastal California gnatcatcher's current recovery status and needs. The final rule on the delisting petition analyzes a 50-year timeframe with regard to the current threats to the coastal California gnatcatcher (59 FR 59952).

Long-term management is required to address the numerous threats posed by the interface between the coastal California gnatcatcher's habitat and the urban interface. Some long-term management actions that will address identified threats include development and implementation of fire management plans, homeowner education programs (for residences adjacent to occupied habitat), predator control, cowbird trapping, routine invasive vegetation removal, limited public access in areas of high quality habitat, and control of irrigation water and other urban runoff adjacent to preserved habitat. Monitoring of the species distribution over time will assist in determining the effectiveness of management actions at reducing threats and will allow for changes in approach in the event that threats have not been adequately reduced.

Development continues throughout the range of the coastal California gnatcatcher. However, the implementation of regional NCCPs/HCPs in southern California has directed growth into certain areas, while establishing habitat preserves consisting of large "core" areas of coastal California gnatcatcher habitat and connecting "linkage" areas. Five regional plans are finalized and once fully implemented should preserve in perpetuity over 182,976 acres of coastal California gnatcatcher habitat (Service 2010b). Preserved habitat will be managed for the benefit of the coastal California gnatcatcher, thereby reducing the magnitude of the threat to the species due to habitat loss. Large Federal landholdings that support coastal California gnatcatcher habitat also contribute to core and linkage areas. These lands include Marine Corps Base Camp Pendleton, Marine Corps Air Station Miramar, Cleveland National Forest, and San Diego National Wildlife Refuge.

Another recovery concern is habitat type conversion. This occurs when native habitat is disturbed (e.g. fire, discing) that does not result in permanent ground disturbance but allows other plant communities (usually invasive, exotics plants) to convert the habitat into areas unsuitable for occupancy by coastal California gnatcatchers. Type conversion can affect all areas of habitat, even in those areas otherwise considered preserved. Because habitat type conversion is a threat of high magnitude, particularly given the increasing occurrence of wildfire, the 5-year review (Service 2010b) concluded that additional time is needed to evaluate the adequacy of existing management programs for reducing this threat.

California Red-legged Frog

Legal Status

The California red-legged frog was federally listed as threatened on May 23, 1996 (61 FR 25813). Revised critical habitat for the California red-legged frog was designated on March 17, 2010 (75 FR 12816). The Service issued a recovery plan for the species on May 28, 2002 (Service 2002).

Natural History

The California red-legged frog uses a variety of habitat types, including various aquatic systems, riparian, and upland habitats. They have been found at elevations ranging from sea level to approximately 5,000 feet. California red-legged frogs use the environment in a variety of ways, and in many cases they may complete their entire life cycle in a particular area without using

other components (i.e. a pond is suitable for each life stage and use of upland habitat or a riparian corridor is not necessary). Populations appear to persist where a mosaic of habitat elements exists, embedded within a matrix of dispersal habitat. Adults are often associated with dense, shrubby riparian or emergent vegetation and areas with deep (greater than 1.6 feet) still or slow-moving water; the largest summer densities of California red-legged frogs are associated with deep-water pools with dense stands of overhanging willows and an intermixed fringe of cattails (*Typha latifolia*) (Hayes and Jennings 1988). Hayes and Tennant (1985) found juveniles to seek prey diurnally and nocturnally, whereas adults were largely nocturnal.

California red-legged frog breed in aquatic habitats; larvae, juveniles, and adult frogs have been collected from streams, creeks, ponds, marshes, deep pools and backwaters within streams and creeks, dune ponds, lagoons, and estuaries. They frequently breed in artificial impoundments such as stock ponds, given the proper management of hydro-period, pond structure, vegetative cover, and control of exotic predators. While frogs successfully breed in streams and riparian systems, high spring flows and cold temperatures in streams often make these sites risky egg and tadpole environments. An important factor influencing the suitability of aquatic breeding sites is the general lack of introduced aquatic predators. Accessibility to sheltering habitat is essential for the survival of California red-legged frogs within a watershed, and can be a factor limiting population numbers and distribution.

During periods of wet weather, starting with the first rains of fall, some individual California red-legged frogs may make long-distance overland excursions through upland habitats to reach breeding sites. In Santa Cruz County, Bulger et al. (2003) found marked California red-legged frogs moving up to 1.7 miles through upland habitats, via point-to-point, straight-line migrations without apparent regard to topography, rather than following riparian corridors. Most of these overland movements occurred at night and took up to 2 months. Similarly, in San Luis Obispo County, Rathbun and Schneider (2001) documented the movement of a male California red-legged frog between two ponds that were 1.78 miles apart in less than 32 days; however, most California red-legged frogs in the Bulger et al. (2003) study were non-migrating frogs and always remained within 426 feet of their aquatic site of residence (half of the frogs always stayed within 82 feet of water). Rathbun et al. (1993) radio-tracked three California red-legged frogs near the coast in San Luis Obispo County at various times between July and January; these frogs also stayed rather close to water and never strayed more than 85 feet into upland vegetation. Scott (2002) radio-tracked nine California red-legged frogs in East Las Virgenes Creek in Ventura County from January to June 2001, which remained relatively sedentary as well; the longest within-channel movement was 280 feet and the farthest movement away from the stream was 30 feet.

After breeding, California red-legged frogs often disperse from their breeding habitat to forage and seek suitable dry-season habitat. Cover within dry-season aquatic habitat could include boulders, downed trees, and logs; agricultural features such as drains, watering troughs, spring boxes, abandoned sheds, or hay-ricks, and industrial debris. California red-legged frogs use small mammal burrows and moist leaf litter (Rathbun et al. 1993, Jennings and Hayes 1994); incised stream channels with portions narrower and deeper than 18 inches may also provide habitat (61

FR 25814). This type of dispersal and habitat use, however, is not observed in all California red-legged frogs and is most likely dependent on the year-to-year variations in climate and habitat suitability and varying requisites per life stage.

Although the presence of California red-legged frogs is correlated with still water deeper than approximately 1.6 feet, riparian shrubbery, and emergent vegetation (Jennings and Hayes 1994), California red-legged frogs appear to be absent from numerous locations in the species' historical range where these elements are well represented. The cause of local extirpations does not appear to be restricted solely to loss of aquatic habitat. The most likely causes of local extirpation are thought to be changes in faunal composition of aquatic ecosystems (i.e. the introduction of non-native predators and competitors) and landscape-scale disturbances that disrupt California red-legged frog population processes, such as dispersal and colonization. The introduction of contaminants or changes in water temperature may also play a role in local extirpations. These changes may also promote the spread of predators, competitors, parasites, and diseases.

Rangewide Status

The historical range of the California red-legged frog extended coastally from southern Mendocino County and inland from the vicinity of Redding, California, southward to northwestern Baja California, Mexico (Storer 1925, Jennings and Hayes 1985, Shaffer et al. 2004). The California red-legged frog has sustained a 70 percent reduction in its geographic range because of several factors acting singly or in combination (Davidson et al. 2001).

Over-harvesting, habitat loss, non-native species introduction, and urban encroachment are the primary factors that have negatively affected the California red-legged frog throughout its range (Jennings and Hayes 1985, Hayes and Jennings 1988). Habitat loss and degradation, combined with over-exploitation and introduction of exotic predators, were important factors in the decline of the California red-legged frog in the early to mid-1900s. Continuing threats to the California red-legged frog include direct habitat loss due to stream alteration and loss of aquatic habitat, indirect effects of expanding urbanization, competition or predation from non-native species including the bullfrog (*Lithobates* [*Rana*] *catesbeianus*), catfish (*Ictalurus* spp.), bass (*Micropterus* spp.), mosquito fish (*Gambusia affinis*), red swamp crayfish (*Procambarus clarkii*), and signal crayfish (*Pacifastacus leniusculus*). Chytrid fungus (*Batrachochytrium dendrobatidis*) is a waterborne fungus that can decimate amphibian populations, and is considered a threat to California red-legged frog populations.

A 5-year review of the status of the California red-legged frog was initiated in May 2011, but has not yet been completed.

California Red-legged Frog Recovery

The 2002 final recovery plan for the California red-legged frog (Service 2002) states that the goal of recovery efforts is to reduce threats and improve the population status of the California red-legged frog sufficiently to warrant delisting. The recovery plan describes a strategy for delisting, which includes: (1) protecting known populations and reestablishing historical

populations; (2) protecting suitable habitat, corridors, and core areas; (3) developing and implementing management plans for preserved habitat, occupied watersheds, and core areas; (4) developing land use guidelines; (5) gathering biological and ecological data necessary for conservation of the species; (6) monitoring existing populations and conducting surveys for new populations; and (7) establishing an outreach program. The California red-legged frog will be considered for delisting when:

1. Suitable habitats within all core areas are protected and/or managed for California red-legged frogs in perpetuity, and the ecological integrity of these areas is not threatened by adverse anthropogenic habitat modification (including indirect effects of upstream/downstream land uses).

2. Existing populations throughout the range are stable (i.e. reproductive rates allow for long-term viability without human intervention). Population status will be documented through establishment and implementation of a scientifically acceptable population monitoring program for at least a 15-year period, which is approximately 4 to 5 generations of the California red-legged frog. This 15-year period should coincide with an average precipitation cycle.

3. Populations are geographically distributed in a manner that allows for the continued existence of viable metapopulations despite fluctuations in the status of individual populations (i.e. when populations are stable or increasing at each core area).

4. The species is successfully reestablished in portions of its historical range such that at least one reestablished population is stable/increasing at each core area where California red-legged frog are currently absent.

5. The amount of additional habitat needed for population connectivity, recolonization, and dispersal has been determined, protected, and managed for California red-legged frogs.

The recovery plan identifies eight recovery units based on the assumption that various regional areas of the species' range are essential to its survival and recovery. The recovery status of the California red-legged frog is considered within the smaller scale of recovery units as opposed to the overall range. These recovery units correspond to major watershed boundaries as defined by USGS hydrologic units and the limits of the range of the California red-legged frog. The goal of the recovery plan is to protect the long-term viability of all extant populations within each recovery unit.

Within each recovery unit, core areas have been delineated and represent contiguous areas of moderate to high California red-legged frog densities that are relatively free of exotic species such as bullfrogs. The goal of designating core areas is to protect metapopulations that, combined with suitable dispersal habitat, will support long-term viability within existing populations. This management strategy allows for the recolonization of habitat within and

adjacent to core areas that are naturally subjected to periodic localized extinctions, thus assuring the long-term survival and recovery of the California red-legged frog.

Riverside Fairy Shrimp

Legal Status

The Service listed the Riverside fairy shrimp as endangered on August 3, 1993 (58 FR 41391). We published a final rule designating critical habitat for the species on May 30, 2001 (66 FR 29384). Critical habitat for this species was vacated on October 30, 2002, by order of the Federal District Court for the District of Colombia. We published a revised critical habitat designation on April 12, 2005 (70 FR 19153). The Recovery Plan for Vernal Pools of Southern California was completed in September 1998 and included Riverside fairy shrimp (Service 1998b).

Natural History

The Riverside fairy shrimp is a small freshwater crustacean of the family Streptocephalidae that is endemic to ephemeral basins and vernal pool habitat in southern California and northern Baja California, Mexico (Eriksen and Belk 1999). In southern California, the range of the species is currently restricted to Riverside, Orange, Los Angeles, San Diego, and Ventura counties. Loss of vernal pool habitat in San Diego County is estimated at around 95 to 97 percent because of intensive cultivation and urbanization (Bauder and McMillan 1998). Lack of historical data precludes the same depth of analysis for Los Angeles, Riverside and Orange counties, but losses are estimated at nearly 100 percent (58 FR 41384).

The Riverside fairy shrimp is distinguished from similar species by its red colored cercopods (anterior appendages) which occur on all of the ninth and 30 to 40 percent of the eighth abdominal segments (Eng et al. 1990). Adult fairy shrimp may grow to a length of 0.5 to 1.0 inch (Eng et al. 1990). They feed by filtering suspended solids from the water column (Eriksen and Belk 1999). Riverside fairy shrimp require 48 to 56 days to reach sexual maturity in contrast to other fairy shrimp that can reach maturity in less than 2 weeks (Hathaway and Simovich 1996). Fairy shrimp mate upon reaching maturity, and female Riverside fairy shrimp produce between 17 and 427 cysts over their lifetime (Simovich and Hathaway 1997). The cysts are either dropped by the females to settle into the mud at the bottom of the pool, or they remain in the brood sac until the female dies and sinks to the bottom (Eriksen and Belk, 1999). Fairy shrimp cysts may persist in the soil for several years until conditions are favorable for successful reproduction (66 FR 29384). The cysts will hatch in 7 to 12 days when water temperatures are between 50 and 68 degrees Fahrenheit (Hathaway and Simovich 1996). Not all cysts are likely to hatch in a season, thus providing a mechanism for survival if the inundation period is too short in a given year (Simovich and Hathaway 1997).

The Riverside fairy shrimp is restricted to vernal pools and vernal pool-like ephemeral basins. Vernal pools are a type of ephemeral wetland that occurs within a range that extends from southern Oregon through California into northern Baja California, Mexico (Service 1998b). They require a unique combination of climatic, topographic, geologic, and evolutionary factors for their formation and continued existence. Vernal pools form in regions with Mediterranean

climates where shallow depressions fill with water during fall and winter rains and then dry up when the water evaporates in the spring (Holland and Jain 1988). Downward percolation of water within the pools is prevented by the presence of an impervious subsurface layer consisting of claypan, hardpan, or volcanic stratum (Holland and Jain 1988). Seasonal inundation makes vernal pools too wet for adjacent upland plant species adapted to drier soil conditions, while rapid drying during late spring makes pool basins unsuitable for typical marsh or aquatic species that require a more permanent source of water. Upland vegetation communities associated with vernal pools include needlegrass grassland, annual grassland, coastal sage scrub, maritime succulent scrub and chaparral (Service 1998b).

Because of its long maturation, the Riverside fairy shrimp is found in deep (greater than 25 centimeters in depth), vernal pools (58 FR 41391, Eng et al. 1990). Water within pools supporting fairy shrimp may be clear, but more commonly it is moderately turbid (Eriksen and Belk 1999). Typically, pools supporting this species have low total dissolved solids and alkalinity (means of 77 and 65 parts per million, respectively), corroborated by pH at neutral or just below (7.1-6.4) (Eng et al. 1990, Gonzalez et al. 1996, Eriksen and Belk 1999). Riverside fairy shrimp may also be found in disturbed vernal pool habitats where basins have been compacted or artificially deepened and, therefore, hold water for longer periods of time. Although basins supporting populations often appear to be artificially created or enhanced, such basins are located within soils that are capable of seasonal ponding and are often surrounded by naturally occurring vernal pool complexes. These "artificial basins" function in the same manner as naturally occurring vernal pools by filling with late fall, winter and/or spring rains that gradually dry up during the spring and/or summer (Service 1998b).

Rangewide Status

The distribution of the Riverside fairy shrimp is limited (Eng et al. 1990, Simovich and Fugate 1992). Riverside fairy shrimp populations are found in Ventura, Los Angeles, Riverside, Orange, and San Diego Counties in California (69 FR 19154, California Natural Diversity Data Base [CNDDB] 2010a). The northern distribution limits extend to Cruzan Mesa, Los Angeles County, and the former Carlsberg Ranch, Ventura County (66 FR 29384, CNDDB 2010a). The southern distribution limits for the species extend into Baja California, Mexico, where it is found at Valle de las Palmas south of Tecate, and Baja mar, north of Ensenada (Brown et al. 1993). All known populations lie between 98 and 1,362 feet in elevation (Eriksen and Belk 1999).

Riverside Fairy Shrimp Recovery

Threats to the Riverside fairy shrimp can be divided into three major categories: (1) direct destruction of vernal pools as a result of construction, vehicle traffic, domestic animal grazing, dumping, and deep plowing; (2) indirect threats which degrade or destroy vernal pools over time including altered hydrology (e.g. damming, draining), invasion of alien species, habitat fragmentation, and associated deleterious effects resulting from adjoining urban land uses; and (3) potentially catastrophic long-term threats including the effect of isolation on genetic diversity and locally adapted genotypes, air and water pollution, drastic climatic variations, and changes in nutrient availability (58 FR 41391, Bauder 1986).

Conservation efforts for the Riverside fairy shrimp should address the major causes of decline for the species; habitat loss and degradation resulting from both direct and indirect impacts to vernal pools, and long-term threats resulting from the greatly reduced distribution of the species. Existing vernal pools occupied by fairy shrimp and their associated watersheds should be secured from further loss and degradation in a configuration that maintains habitat function and species viability (Service 1998b).

Vernal Pool Fairy Shrimp

Legal Status

The Service listed the vernal pool fairy shrimp (*Branchinecta lynchi*) as threatened on September 19, 1994 (59 FR 48136). We designated critical habitat for the vernal pool fairy shrimp on August 6, 2003 (68 FR 46683). We published a revised final rule for critical habitat with a re-evaluation of non-economic exclusions on March 8, 2005 (70 FR 11140). Economic exclusions from the 2003 final rule were evaluated and published on August 11, 2005 (70 FR 46923). We published administrative revisions with species-by-unit designations on February 10, 2006 (71 FR 7117). The 2003 final critical habitat designation was remanded on November 2, 2006. The court ordered the Service to reconsider its decision and issue a new critical habitat rule. During this time, the existing critical habitat was to remain in place. On May 31, 2007 (72 FR 30269) we published a clarification of the economic and non-economic exclusions for the 2005 final critical habitat designation for 4 vernal pool crustaceans and 11 vernal pool plants in California and southern Oregon. The recovery plan for vernal pool ecosystems of California and southern Oregon (Service 2005) also addresses this species; however, populations in coastal San Luis Obispo County were not known at the time the recovery plan was made final. The following account summarizes information contained in the final rules for listing and designation of critical habitat, as well as the recovery plan and also as supplemented by information that has become available since the publication of the listing rules and completion of the recovery plan.

Natural History

The vernal pool fairy shrimp is a small freshwater crustacean in the family Branchinectidae of the order Anostraca. Adults range in size from 0.4 to 1.0 inch and are distinguished from a similar species, the Colorado fairy shrimp (*Branchinecta coloradensis*), by the male's ridge-like outgrowth on the basal segment of the antennae and the female's shorter, pyriform brood pouch.

Habitat for vernal pool fairy shrimp consists of vernal pools and ephemeral wetlands that pond for that period of time sufficient to complete their life cycle. Under optimal conditions this can be as little as 18 days; however, 41 days is more typical of usual seasonal conditions. The species often occurs in habitat that exhibits an unpredictable and short-lived inundation pattern and includes vernal pools and vernal pool-like depressions, depressions in sandstone rock outcrops, earth slumps, and grassy swales and depression basins. Upland vegetation communities associated with vernal pool fairy shrimp habitat include native and non-native grassland, alkaline grassland, alkaline scrub, and coastal sage scrub.

Anostracans, including the vernal pool fairy shrimp, are non-selective filter-feeders that filter suspended solids from the water column. Detritus, bacteria, algal cells, and other items between 0.000012 and 0.00039 inch may be filtered and ingested. Vernal pool fairy shrimp co-occur with other fairy shrimp species rarely, and when they do, they are never the numerically dominant species. Vernal pool fairy shrimp have been observed with the versatile fairy shrimp (*Branchinecta lindahli*) and Santa Rosa Plateau fairy shrimp (*Linderiella santarosae*) as well as the federally-listed conservancy fairy shrimp (*Branchinecta conservatio*) and longhorn fairy shrimp (*Branchinecta longiantenna*). Fairy shrimp are food for a wide variety of wildlife, including beetles, insect larvae, frogs, salamanders, toad tadpoles, shorebirds, ducks, and even other fairy shrimp. Freshwater crustaceans, including the vernal pool fairy shrimp, have a two-stage life cycle with the majority of their life cycle spent in the cyst (egg) stage. Vernal pool fairy shrimp females produce an unknown number of cysts per clutch and over their lifetime. The cysts are either dropped to the pool bottom or remain in the brood sac until the female dies and sinks. Fairy shrimp cysts are capable of withstanding heat, cold, and prolonged desiccation and may persist in the soil for an unknown number of years until conditions are favorable for successful hatching. The cysts hatch when the vernal pools/seasonal depressions fill with rainwater. Not all cysts are likely to hatch in a season, thus providing a mechanism for survival if the inundation period is too short in a given year. This species can mature quickly, allowing it to persist in short-lived shallow pools; however, the species also persists later into the spring when pool inundation persists.

Rangewide Status

Although vernal pool fairy shrimp are more widely distributed than most other fairy shrimp species, the species is generally uncommon throughout its range and rarely abundant where it is found. The species currently occurs predominantly in a variety of vernal pool and ephemerally ponded habitats in the Central Valley and Coast Range of California, with a limited number of sites in the Transverse Range and on the Santa Rosa Plateau and in Hemet, Riverside County. There is also one disjunct occurrence in Jackson County, southern Oregon. California counties where extant records occur include Alameda, Butte, Contra Costa, El Dorado, Fresno, Glenn, Kings, Los Angeles, Madera, Merced, Monterey, Napa, Placer, Riverside, Sacramento, San Benito, San Joaquin, San Luis Obispo, Santa Barbara, Shasta, Solano, Stanislaus, Tehama, Tulare, Ventura, and Yuba. Elevations at which the species is typically found range from 33 to 4,000 feet, although it has been found at 5,600 feet in the Los Padres National Forest.

Within ephemerally ponded and vernal pool habitat on the Central Coast of California (e.g. Monterey, San Luis Obispo, and Santa Barbara Counties), vernal pool fairy shrimp are known to occupy in at least 55 basins on Fort Hunter Liggett, at least 46 basins at Camp Roberts, Soda Lake at the Carrizo Plain National Monument, several areas in the vicinity of Paso Robles, at least two sites in the Los Padres National Forest, at least 60 natural or man-made features at the Unocal-Chevron tank farm and an isolated nearby area, at least two vernal pools at the Santa Maria Airport, and in at least 12 complexes on Vandenberg Air Force Base. Branchinectid cysts presumed to represent vernal pool fairy shrimp have also been found in seasonal depressions at the San Luis Obispo County Regional Airport. A number of these sites were discovered after the publication of the listing and critical habitat rules and recovery plan.

Vernal Pool Fairy Shrimp Recovery

Maintaining the integrity of surrounding upland habitat is critical to the proper ecological functioning of vernal pool fairy shrimp habitat. Habitat loss and fragmentation is the largest threat to the survival and recovery of vernal pool fairy shrimp and other species restricted to vernal pool and other ephemeral wetland habitats. Habitat loss is generally a result of urbanization, agricultural conversion, and mining although loss also occurs in the form of habitat alteration and degradation as a result of changes to natural hydrology, competition from invasive species, incompatible grazing regimes (including insufficient grazing for prolonged periods), infrastructure projects (e.g. roads, water storage and conveyance, utilities), recreational activities (e.g. off-highway vehicles and hiking), erosion, mosquito abatement activities, climatic and environmental change, and contamination.

Braunton's Milkvetch

Legal Status

The Service listed Braunton's milkvetch as endangered on January 29, 1997 (62 FR 4172). We designated critical habitat for this species on November 14, 2006 (71 FR 66374). Braunton's milkvetch is included in The Recovery Plan for Six Plants Surrounding the Los Angeles Basin, which we completed in September 1999 (Service 1999). We completed a 5-year review for this species in 2009 (Service 2009).

Natural History

Braunton's milkvetch is a robust, short-lived perennial in the pea family (Fabaceae). It is one of the tallest members of the genus *Astragalus*, reaching a height of 60 inches. It has a thick taproot and woody basal stem from which numerous stems arise. Several similar perennial *Astragalus* species occur within the range of Braunton's milkvetch. The woolly stems and leaves and its two-chambered pods help distinguish Braunton's milkvetch from the other similar *Astragalus* in its range, (e.g. locoweed (*A. trichopodus*), Pomona milkvetch (*A. pomonensis*), Douglas' milkvetch (*A. douglasii*), which are glabrous to slightly pubescent (Barneby 1964, Wojciechowski and Spellenberg 2012).

Braunton's milkvetch is associated with chaparral and coastal sage scrub plant communities. It generally occurs along the tops of knolls between 800 and 2,100 feet in elevation (Fotheringham and Keeley 1998, CNDDB 2016). Braunton's milkvetch is believed to be a limestone endemic, although limestone outcrops are rare within the limits of known distribution of the species. There is some evidence that the species may occur in other soils, such as the specimen collected from a location along a fire road in Monrovia, California (CNDDB 2016, without page numbers); however, most known locations of the species are composed of calcareous soils.

Fire is believed to stimulate germination of Braunton's milkvetch, as the plants sometimes appear after prescribed burns. The natural frequency of fire in the habitat of Braunton's milkvetch is estimated to be once every 20 to over 100 years, with an average interval of 70 years (Van de Water and Safford 2011, O'Leary 1990). The average frequency of fires in natural areas of the Santa Monica Mountains from 1925 through 2001 was once every 32 years (Witter

et al. 2007). The plants have a life span of 2 to 5 years, and depending on fire interval, a given population may be visible only once in 20 to 50 years or longer. In some parts of its range, higher fire frequencies have resulted from the increasing human population in southern California, associated arson, and accidental fires. Conversely, fire suppression may have also increased the interval in some locations. Disruption of fire cycles that stimulate the species' germination may be detrimental as either the seed bank may become less viable or depleted by seed predation if fires become infrequent; or, if fires increase in frequency, the natural community may be altered to where the plants and animals associated with Braunton's milkvetch decline and the species' life history needs are not met.

Braunton's milkvetch plants may also germinate after mechanical disturbance; such occurred at Oak Park in Ventura County in 1997, when a previously undiscovered seed bank was excavated and spread at a development site. More than 1,000 individual plants germinated, but they were graded to accommodate a baseball park before they could set seed. This predilection of Braunton's milkvetch to germinate after disturbance (fire or mechanical) and the ability of the seeds to lie dormant for long periods complicate attempts to manage the species. Unless the plants are already known from the location or are visible, a ground disturbance may have an impact on the species before it is known to be present as a seed bank (e.g. if the seeds are excavated and buried). When Braunton's milkvetch germinates in an area following disturbance, or if such germination is anticipated, steps should be taken to manage the germinated plants and the habitat to conserve the seed bank that will be formed when the plants complete their life cycle.

For additional information regarding Braunton's milkvetch and its biology, see the recovery plan (Service 1999), the 5-year review (Service 2009), and the final listing rule (62 FR 4172).

Rangewide Status

Braunton's milkvetch is endemic to coastal southern California and is known from five disjunct geographic areas in Ventura, Los Angeles, and Orange Counties, California. These areas include: (1) the Simi Hills in eastern Ventura and western Los Angeles Counties; (2) eastern Santa Monica Mountains in Los Angeles County; (3) San Gabriel Mountains in Monrovia, Los Angeles County; and (4) Santa Ana Mountains in Orange County. Braunton's milkvetch historically occurred in the coastal plains of the greater Santa Monica region of southwestern/central western Los Angeles County from Cienega to Pacific Palisades.

Between the time of listing in 1997, and the completion of the 5-year review in 2009, seven additional occurrences had been added to the CNDDB (2007, 2010b). In the CNDDB database, "occurrences" are groups of plants that are geographically separated from other groups, by at least 400 meters. Since 2009, an additional 22 occurrences have been added to the CNDDB (2018), most of those new occurrences were based on herbarium specimens that were collected previously but databased recently. There are currently 37 known, extant occurrences within these 5 geographic areas. There are 5 occurrences that are considered extirpated and an additional 4 occurrences have not been observed in 25 or more years and may also be extirpated.

Approximately 70 percent of the Braunton's milkvetch occurrences consist of 25 or fewer plants during most years, but they can contain hundreds to thousands of plants following a disturbance event, e.g. wildfire (CNDDB 2018). Following a disturbance event, most Braunton's milkvetch occurrences decline back to fewer than 25 plants within several years. Approximately 40 percent of the occurrences have shown declines to 10 or fewer plants within several years after a known disturbance event.

Because of the unique life history, ecological, and edaphic soil conditions that this species exhibits/requires, it is difficult to determine the true size (or magnitude) of given occurrence, population, or metapopulation. These conditions also make it difficult to determine the relative size of an occurrence compared to any other occurrence, and it makes it difficult to determine which population(s) qualify as a core population. For this species, we use three different methods to compare an occurrence's relative size to other occurrences:

- Largest Number of Plants Method – compares the largest number of plants ever recorded at each occurrence.
- Average Number of Plants Method – compares the average number of plants observed over time at each occurrence (excluding years where no plants were observed).
- Post-competition Event Number of Plants Method – compares only populations that were all impacted by the same the number of plants in a given occurrence during the year(s) immediately following an event that removes competition from other vegetation. For example, this method may compare all occurrences that were affected by a fire to determine population size in the year(s) following a competition removal event).

Braunton's Milkvetch Recovery

The recovery plan for Braunton's milkvetch (Service 1999) states that it should be evaluated for downlisting to threatened when: (1) all current sites (including seedbanks) with the species are fully protected and managed with the primary intention of preserving the populations in perpetuity; (2) seed collected from all populations is stored at a certified Center for Plant Conservation botanical garden; and (3) reliable seed germination and propagation techniques for the species are understood. It should be evaluated for delisting when populations are shown to be self-sustaining over a minimum of 15 years or longer, because life history data shows that this species grows for 5 years and exists as seed banks from 15 to 95 years.

Three of these recovery criteria have not been met and approximately half of the known occurrences still remain unprotected (Service 2009). Braunton's milkvetch continues to be threatened by direct loss of habitat and populations from urban development, fragmentation of habitat, fragmented ownership of individual populations, alterations of fire cycles, and extinction events from naturally occurring events due to small population sizes (Mistretta 1992, Skinner and Pavlik 1994). Many of the Braunton's milkvetch occurrences (and the species as a whole) appear to have a declining trend; however, we do not have sufficient data that are comparable qualitatively, spatially, or temporally to determine this with certainty. The threats to Braunton's

milkvetch are pervasive and difficult to overcome. It will take considerable conservation efforts to recover this species. Based on this information, Braunton's milkvetch remains threatened with extinction.

Braunton's Milkvetch Designated Critical Habitat

The Service designated critical habitat for Braunton's milkvetch on November 14, 2006 (71 FR 66374). We designated approximately 3,300 acres within 6 units in Ventura, Los Angeles, and Orange Counties, California. The designated critical habitat identifies Braunton's milkvetch habitat area containing the Primary Constituent Elements (PCEs) to support and maintain self-sustaining populations and metapopulations throughout its range.

The Braunton's milkvetch critical habitat PCEs are: (1) calcium carbonate soils derived from marine sediment; (2) a low proportion (less than 10 percent) of shrub cover directly around the plant; and (3) chaparral and coastal sage scrub communities characterized by periodic disturbances that stimulate seed germination (e.g. fire, flooding, erosion) and reduce vegetative cover.

The final rule (71 FR 66374) designated critical habitat at all known Braunton's milkvetch occurrences that still contained the PCEs. This was deemed necessary to reduce fragmentation and help maintain genetic connectivity between populations and increase the chance of recolonization from neighboring patches if one patch becomes extirpated. According to Noss et al. (1997), a species distributed across multiple sites within its range is less susceptible to extinction than another similar species confined to far fewer sites.

Much of the areas within designated critical habitat for Braunton's milkvetch continue to be threatened by direct loss of habitat from urban development, fragmentation of habitat, alterations of fire cycles, and type conversion of habitat. We do not have the comparative data (qualitative, spatial, or temporal) to say with certainty, but the trend for critical habitat appears to be consistent with that of the plant, which is decreasing.

In the final rule (71 FR 66374), the Service also outlined an analytical framework for applying the Jeopardy and Adverse Modification standards for actions involving effects to Braunton's milkvetch. The framework emphasizes the importance of core area populations for the survival and recovery of the species. With regard to the Jeopardy standard, the rule states, "Generally, if a proposed Federal action is incompatible with the viability of the affected core area population(s), inclusive of associated habitat conditions, a jeopardy finding is warranted because of the relationship of each core area population to the survival and recovery of the species as a whole". With regard to the Adverse Modification standard, the rule states, "the key factor related to the adverse modification determination is whether, with implementation of the proposed Federal action, the affected critical habitat would remain functional (or retain the current ability for the primary constituent elements to be functionally established) to serve the intended conservation role for the species. Generally, the conservation role of A. Brauntonii critical habitat units are to support viable core area populations."

For specific or additional information regarding the PCEs essential to the conservation of Braunton's milkvetch, see the Recovery Plan (Service 1999), 5-Year Review (Service 2009), and the final critical habitat rule (71 FR 66374).

ENVIRONMENTAL BASELINE

Action Area

The implementing regulations for section 7(a)(2) of the Act define the "action area" as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The action area for this biological opinion comprises all areas within and adjacent to where people and equipment will be working or staging as described in the Description of the Proposed Action portion of this biological opinion (both on and off the SSFL property). This primarily comprises Area IV of the SSFL (Area IV) and an adjacent undeveloped area to the north referred to as the NBZ, but it also includes access and staging areas in other parts of the SSFL site (i.e. in Areas I, II, III, and/or Southern Buffer Zone), as well as offsite areas where listed species could be adversely affected by soil or groundwater remediation, noise, dust, nighttime lighting, sedimentation, and changes and water quality or quantity.

Existing Conditions and Habitat Characteristics in the Action Area

The proposed project area is located in and adjacent to a portion of the SSFL in an unincorporated area of the Simi Hills in southeastern Ventura County, California. The entire SSFL site comprises approximately 2,850 acres of open, mostly undisturbed, hilly terrain and developed areas, which include roads, buildings, and other infrastructure associated with its past use as a scientific research and test facility. The geologic units within the SSFL site are predominantly the Chatsworth Formation, which forms conspicuous tilted sandstone outcrops jutting upward from the landscape, with smaller areas of sedimentary rock representing the Santa Susana, Simi Conglomerate, Las Virgenes, and Calabasas formations. Alluvial sediments have accumulated over about 11 percent of the project site, generally limited to topographic lows and ephemeral streams. Vegetation throughout the project site is composed mainly of shrub-dominated plant communities, oak woodland and savanna, and annual grassland. Substantial portions of the site are located within areas of exposed bedrock or previously developed areas with sparse vegetation (Figure 4).

Numerous ephemeral stream channels and drainages are present throughout the SSFL site. Most surface water is intermittently present only during the winter rainy season and is conveyed offsite via one of four drainage areas: the Northwestern, Northern, Happy Valley, and Southern. Vegetation and wildlife habitats on the SSFL site include widespread plant communities characteristic of the region such as chaparral, grasslands, oak and walnut woodlands, as well as communities that are localized in distribution and are associated with the prominent sandstone outcrops on SSFL and nearby areas.

As described above, the Action Area only consists of a portion of the SSFL site, in and immediately adjacent to Area IV and the NBZ. Area IV consists of approximately 290 acres and the NBZ consists of approximately 182 acres (DOE 2018, Table 3-1).

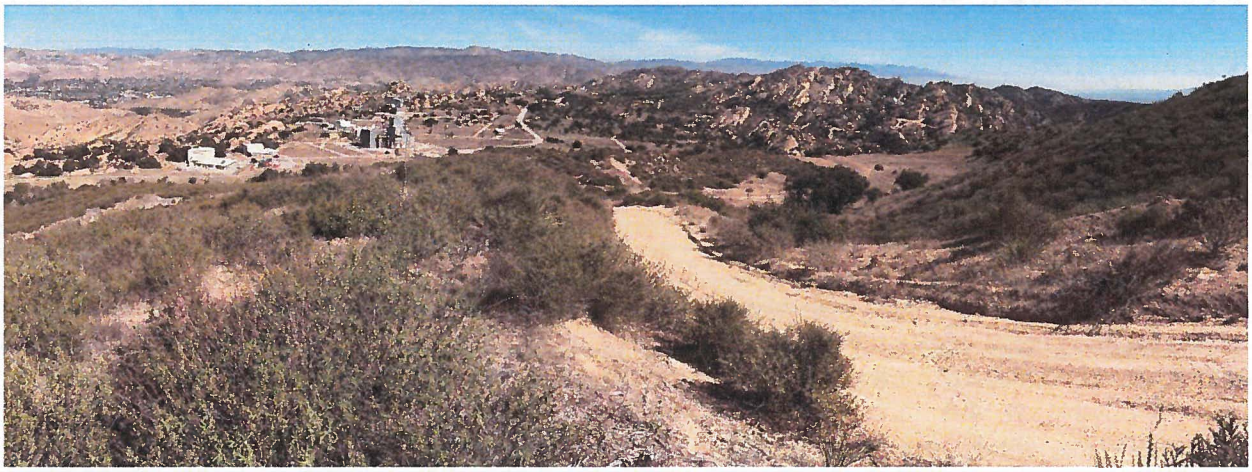

Figure 4. Habitat within Area IV and the NBZ, from Braunton's milkvetch critical habitat looking into Area IV (buildings on the left) and Area III (rock outcrops and rocket test stand in the distance on the right).

Previous Consultations in the Action Area

We have issued one individual biological opinion for projects that had an action area that overlapped the current action area. We issued a biological opinion to the U.S. Environmental Protection Agency (EPA) (Service 2010a, 8-8-10-F-12) for their implementation of the Santa Susana Field Laboratory Area IV Radiological Study Project, Ventura County, California [EPA Contract # EP-S7-05-05]. We determined that the proposed project was not likely to jeopardize the continued existence of Braunton's milkvetch, Lyon's pentachaeta, spreading navarretia, California Orcutt grass Riverside fairy shrimp, vernal pool fairy shrimp, California red-legged frog, and coastal California gnatcatcher or adversely modify critical habitat for California red-legged frogs and Braunton's milkvetch. To the best of our knowledge, the EPA completed the proposed action. A post-project report stated that the EPA action impacted 129 individual Braunton's milkvetch plants (HydroGeoLogic and Envicom 2012, DOE 2018). The number of Braunton's milkvetch plants onsite consisted of approximately 33,500 plants in 2006 (following the Topanga fire), 18,500 plants in 2009, before the project began, and a few hundred plants in 2011, at the end of the project (HydroGeoLogic and Envicom 2012, CNDDB 2018, DOE 2018).

Status of the Species and Critical Habitat in the Action Area

Least Bell's Vireo

Least Bell's vireo has been documented at SSFL, but not in the action area. A single individual least Bell's vireo was observed in August 2011, in Area II by NASA consultants (Service 2013). It was observed in coyote brush adjacent to coast live oak woodland (DOE 2018 as in NASA

2014). A protocol survey (Werner 2012) conducted on Area IV did not find least Bell's vireos, nor have any additional individuals been observed during other field surveys and monitoring conducted on SSFL.

There are approximately 45.1 acres of riparian habitat on the entire SSFL site that could support least Bell's vireos. These areas are comprised of coast live oak riparian woodland, southern willow scrub, and mulefat scrub (Table 4–1 of the BA). Area IV and the NBZ have about 0.97 of an acre of riparian habitat (Figure 5) in seasonal drainages and fragmented mulefat riparian scrub that support potential habitat for least Bell's vireo (DOE 2017). These areas, including the suitable habitat within the action area, would likely support one to a few single least Bell's vireos that are roosting or moving through the area (DOE 2018). While there is a sufficient quantity of habitat to support a breeding pair (at least 0.5 of an acre), the likelihood of nesting activity is low because most of the suitable habitat is in small patches, fragmented, or degraded. However, these habitat areas may support unpaired least Bell's vireos, during migration or during the residency season. Furthermore, due to the long duration of the proposed action, habitat conditions and the status of the species may change over time such that vireos may nest within the project area or become more common in the vicinity of the proposed project.

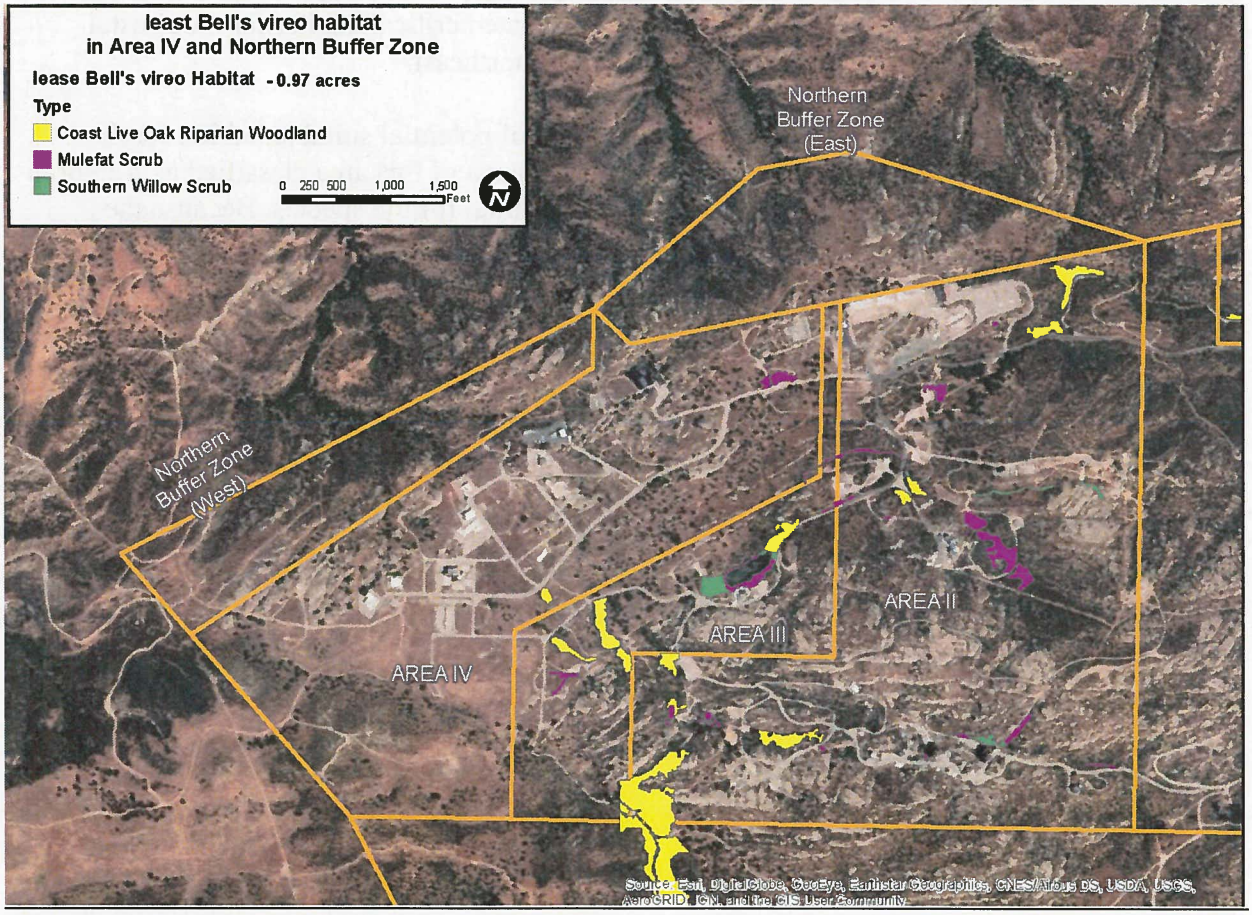

Figure 5. Potentially suitable habitat for least Bell's vireo.

Coastal California Gnatcatcher

While no coastal California gnatcatchers were detected during protocol level surveys on the SSFL site in 2010, 2011, or 2012 (EPA 2010); coastal California gnatcatcher was heard during a site visit in Area IV by Service biologist Robert McMorran on December 2, 2009 (McMorran, pers. obs. 2009). The number of coastal California gnatcatchers and their status onsite is not known, i.e. whether they are resident in established territories or dispersing individuals (EPA 2010). HydroGeoLogic and Envicom (2010) estimated that the SSFL site could contain up to between 12 and 122 breeding pairs of coastal California gnatcatchers based on the habitat at that time. The mean territory size for inland areas during the breeding season generally ranges from 12 to 27 acres per pair (Preston et al. 1998). Based on the 33.2 acres of Venturan coastal sage scrub and an additional 247 acres of potential suitable scrub habitat, and the proximity of the action area to other occupied habitats, the action area may support 20 to 46 coastal California gnatcatcher individuals (or 10 to 23 pairs) throughout the life of the project if all suitable habitat is occupied. According to information from our records and the CNDDB, other nearby records for the coastal California gnatcatcher to the project area are located approximately 3.9 miles south in Las Virgenes Canyon; approximately 9.2 miles west near Little Simi Valley, northwest of State Route 23 and Tierra Rejada Road, Moorpark; and approximately 10 miles west near California Lutheran University (CNDDB 2010c). Designated critical habitat for the coastal California gnatcatcher occurs 2.5 miles to the north and northeast.

Area IV and the NBZ supports approximately 280 acres of potential suitable habitat for the coastal California gnatcatcher, with approximately 33.2 acres of this area classified as Venturan coastal scrub (DOE 2017) which is the most preferred habitat for the species. Because the Topanga Fire burned much of the site in October 2005, several other plant communities onsite are recovering from this fire and contain aspects of habitat suitable for coastal California gnatcatchers. Because the project duration is expected to be greater than 20 years, habitat conditions for coastal California gnatcatcher will change over time and the acres of suitable habitat within the action area will also change. The Service considers the following plant communities to be potentially suitable for use by coastal California gnatcatchers on the SSFL site: Ventura coastal sage scrub, coast live oak woodland, California walnut woodland, steep dipslope grassland, and chaparral. For the purposes of this consultation, we consider all of these vegetation communities, totaling 280 acres, within Area IV and the NBZ, to be potentially suitable for California gnatcatchers. The current spatial distribution of these vegetation categories within the action area is shown in Figure 6.

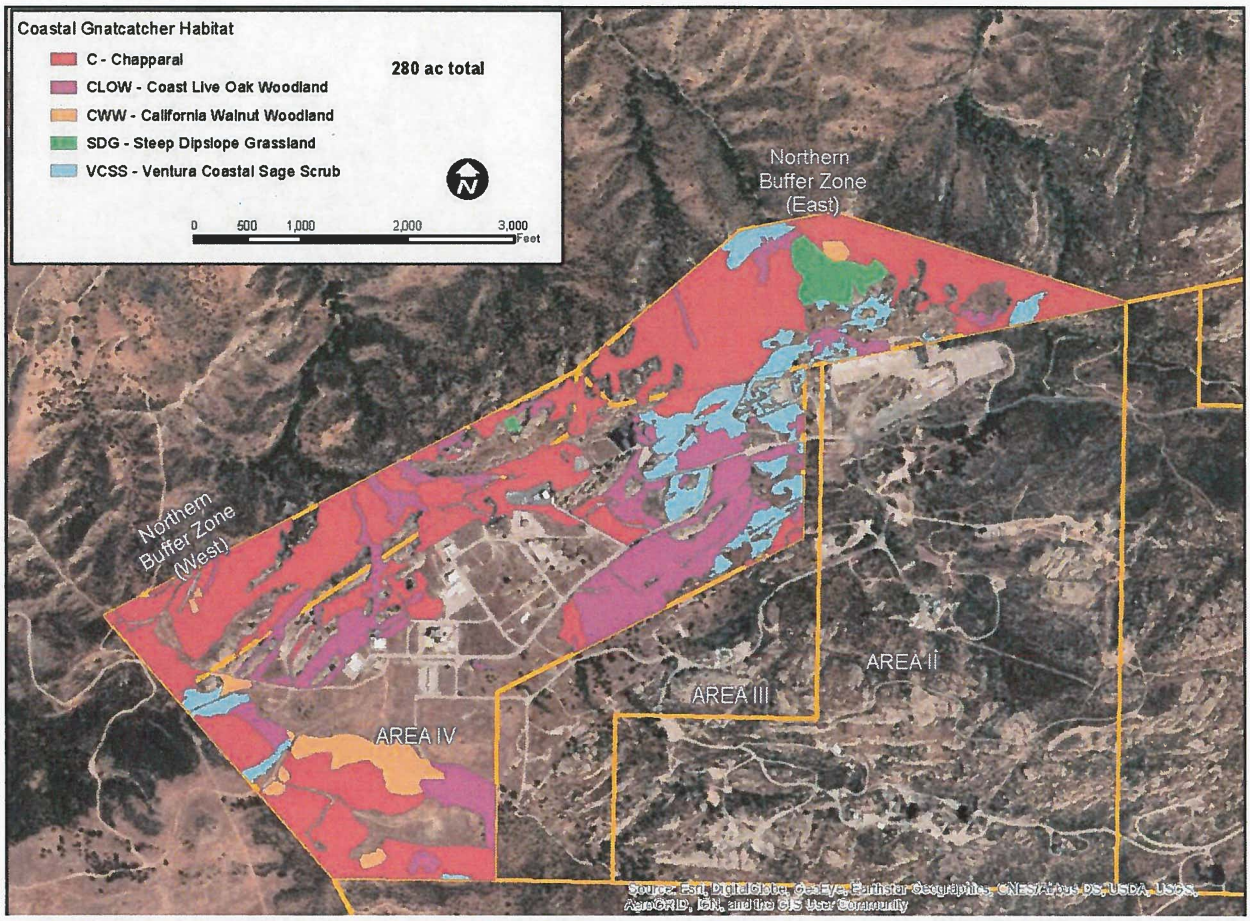

Figure 6. Potential suitable habitat for coastal California gnatcatcher within Area IV and the NBZ (Adapted from DOE 2017).

California Red-legged Frog

California red-legged frogs have not been documented within the action area, nor have they been recorded during biological surveys on the SSFL (DOE 2018). Protocol level surveys have not been performed onsite for California red-legged frogs (EPA 2010). The nearest recorded California red-legged frog observations in the CNDDB are in East Las Virgenes Creek and nearby in the main stem of Las Virgenes Creek (CNDDB 2010d). We are aware of two records of California red-legged frogs within 3 miles of the project area to the south (75 FR 12816, CNDDB 2010d) (Figure 7).

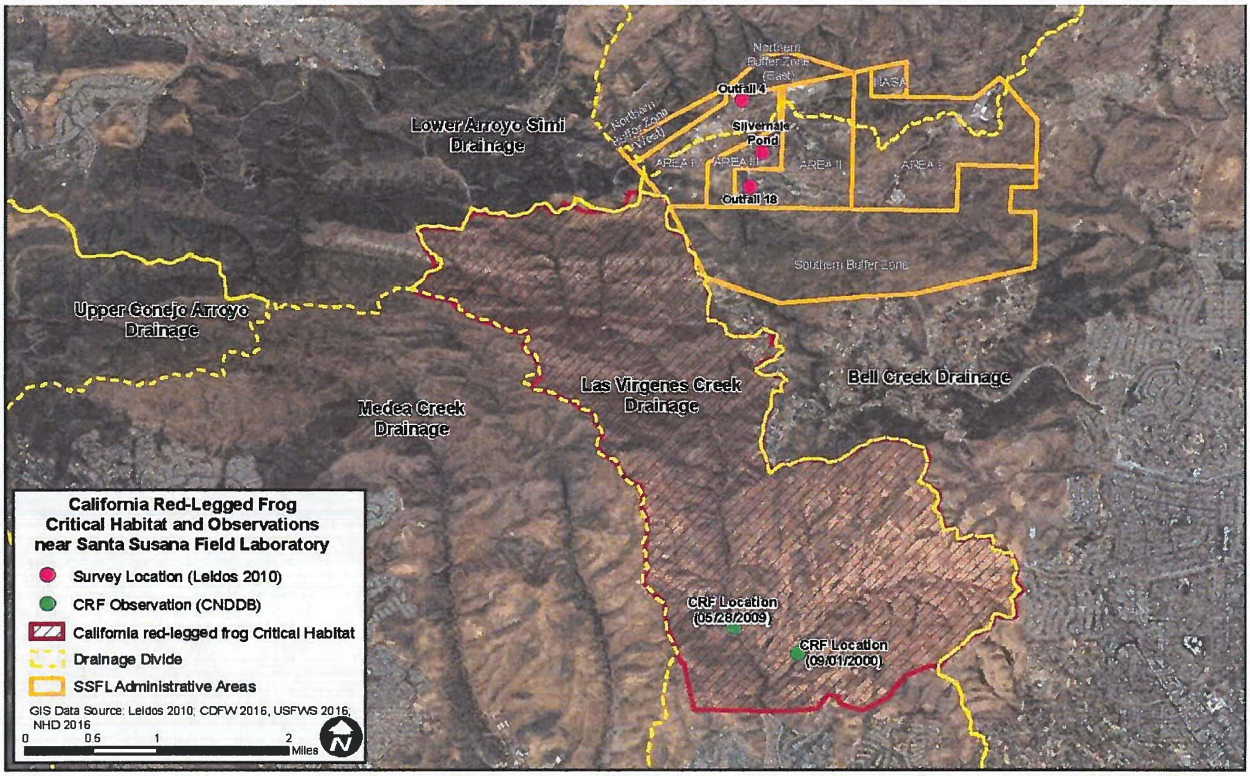

Figure 7. Known California red-legged frog occurrences (in green) and designated critical habitat (in red cross-hatch), relative to the Santa Susana Field Lab (DOE 2018).

Ponded areas may attract California red-legged frogs, regardless of habitat conditions or water quality. Currently within Area IV, ponded habitats occur at the SRE pond (shown as "outfall 4" in Figure 7). This and other ponded features that currently exist, or that may be created in the future for the remediation of groundwater, may attract California red-legged frogs to the site. During the life of this project, California red-legged frogs may occur traversing the action area during dispersal. Although California red-legged frogs may be attracted to ponded features at the site, based on the current conditions in the action area (the low quality of suitable breeding habitat, and relatively long distance from known occupied habitat), we anticipate that the likelihood that California red-legged frogs would breed within Area IV and NBZ during the life of the project is low.

Riverside Fairy Shrimp and Vernal Pool Fairy Shrimp

Riverside fairy shrimp and vernal pool fairy shrimp have not been documented within the action area; however, protocol level surveys have not been conducted within the action area for this species (DOE 2018). Fairy shrimp habitat assessments have been conducted only on portions of SSFL, including portions of Area IV, the NBZ, and NASA (DOE 2018, NASA 2013). In 2010, four vernal pools were identified in Area IV and three were documented to contain versatile fairy shrimp, an unlisted species (Padre 2010); however, protocol level surveys were not conducted for listed fairy shrimp species. Subsequent habitat surveys were conducted in 2014 that noted

fairy shrimp presence in some pools, but protocol surveys were not conducted and the fairy shrimp were not identified. The locations of potential vernal pool habitats are shown in Figure 8.

There are no documented occurrence of Riverside fairy shrimp or vernal pool fairy shrimp within the SSFL site. The nearest documented occurrence of Riverside fairy shrimp is west of Simi Valley at Tierra Rejada Preserve (Service 2008b). Riverside fairy shrimp and vernal pool fairy shrimp are both known to occur in the Carlsberg vernal pools approximately 9 miles northwest of the project area (Service 1998b, EPA 2010). Because the action area falls within the range of the species, it is known to occur in the region, and areas capable of supporting fairy shrimp occur onsite, Riverside fairy shrimp and vernal pool fairy shrimp may occur within the action area during the duration of the proposed project.

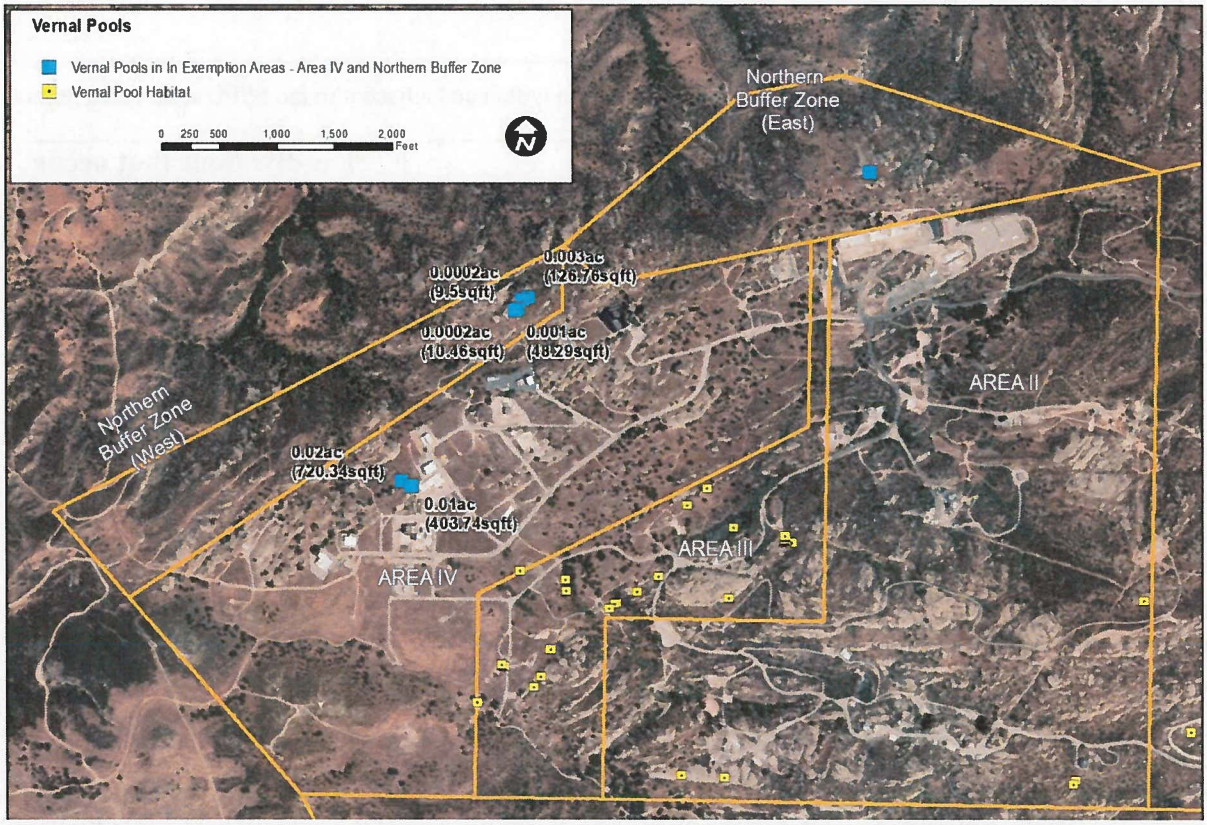

Figure 8. Locations of known or potential habitat for fairy shrimp (Adapted from DOE 2017).

Braunton's Milkvetch

Braunton's milkvetch currently occurs within the action area for the proposed project, primarily in Area IV within chaparral scrub, coastal sage scrub, and coast live oak and walnut woodlands. Common associated species here include chamise (*Adenostoma fasciculatum*), sugar bush (*Rhus ovata*), manzanita (*Arctostaphylos* spp.), Malibu baccharis (*Baccharis malibuensis*), chaparral yucca (*Hesperoyucca whipplei*) and black sage (*Salvia mellifera*) (SAIC 2009, EPA 2010, CNDDB 2018, DOE 2018). Biologists for DOE observe that the cycle of growth, flowering, and

production of seed to replenish the seed bank at SSFL is approximately 4 to 5 years with some individuals possibly living longer (DOE 2018). Plants have been noted onsite in all stages of growth.

Because of the unique life history, ecological, and edaphic soil conditions that this species requires, it is difficult to determine the true size (or magnitude) of any Braunton's milkvetch occurrence. This variability also makes it difficult to determine the relative size of an occurrence compared to any other occurrence. As described above, the final critical habitat rule emphasizes an analytical framework for the Jeopardy and Adverse Modification standards that rely on "core area populations". We applied three different methods to compare the relative size of the Santa Susana Field Lab occurrence to other 41 occurrences listed in the CNDDB. We conducted this analysis to help determine whether the action area contains a core area population. The results are summarized in Table 1.

Table 1. Three methods of calculating the size of the population within and adjacent to the SSFL action area relative to the entire known population.

Calculation Method	**% individuals that occur on SSFL**
Largest number of plants method: Using the largest number of plants ever documented at each of the 42 occurrences (CNDDB 2018), the maximum number of plants at SSFL is 33,500 among a total observed population of 55,538 plants.	60% of all known plants
Average number of plants method: Using the average number of plants observed at each of the 42 occurrences (for years when the number of plants is greater than 0), the average population at SSFL is 10,421 plants compared to an average at all sites of 402 plants.	62% of all known plants
Post-competition method: Considering only populations that were burned by the Topanga fire and were surveyed in the years immediately following the fire, the SSFL site supported 33,500 plants, compared with the next highest population of 4,400 plants.	78% of all plants from 7 populations affected by the Topanga fire

The CNDDB refers to the SSFL Braunton's milkvetch plants to element occurrence (EO) number 7 (CNDDB 2018). The CNDDB attributes a herbarium specimen from 1949 (*O. Kappler 2037*, UCR-11596) to this occurrence, which indicates its presence in 1949. The CNDDB also attributes three plants found in 1999 (along a proposed access road alignment in Burro Flats) to this occurrence. An estimation of several hundred plants were reported from critical habitat Subunit 1d at SSFL after a wildfire (the Topanga Fire) burned the site in October 2005 (EPA 2010, 71 FR 66374). Biologists estimated that, after the fire, this Braunton's milkvetch occurrence was estimated to occupy approximately 16.6 acres, (MWH Global, Inc. 2009). At that time, there were also two isolated plants noted in other parts of the SSFL site, one in the southern portion of Unit 1d and another just west of Unit 2f (MWH Global, Inc. 2009).

Later in 2006, biologists with SWCA Environmental Consultants conducted a detailed population analysis by counting plants within 10 quadrats, then extrapolating to the occupied 16.6 acres (EPA 2010). From this sample, they determined that there were 33,500 plants within these 16.6 acres onsite (MWH Global, Inc. 2009). Subsequent Braunton's milkvetch surveys were conducted October – November 2009 in critical habitat Unit 1d within Area IV (SAIC 2009). According to the 2009 surveys, the areas occupied by individual Braunton's milkvetch plants were similar to those reported from the 2006 surveys, except that the area occupied by Braunton's milkvetch expanded slightly to the north. They determined that Braunton's milkvetch occupied approximately 17.5 acres and contained approximately 18,500 plants (SAIC 2009). Beyond this area, two isolated plants were documented in formerly developed areas of Area IV (SAIC 2009). Biologists with SAIC theorized that these two plants may have been transported as seeds when soil from an established borrow area within Braunton's milkvetch critical habitat was taken to backfill other remediated sites on the SSFL (SAIC 2009).

By 2009, Braunton's milkvetch plants in Area IV appeared to be nearing the end of their life span (SAIC 2009). In 2006, most (49.4 percent) of the plants were small (less than 10 centimeters) and by 2009 the majority of the plants were large (greater than 70 centimeters) and thought to be fully mature (MWH Global, Inc. 2009). During 2009, no seedling recruitment of the stand from the previous spring season was noted and a majority of the plants (greater than 50 percent) appeared to be dead based on their dried out brittle condition and lack of live tissue; especially those on south-facing slopes in the occupied area.

From 2010 to 2012, the EPA conducted a radiological study (EPA 2010, Service 2010a) involving vegetation cutting, gamma scanning, geophysical survey, surface and subsurface soil sampling, groundwater monitoring well sampling, and surface water and sediment sampling within the critical Habitat Unit 1d. In our biological opinion form this consultation, we estimated that approximately 5 percent of the 2009 living Braunton's milkvetch plants, or approximately 462 plants, were anticipated to be impacted by the radiological study (HydroGeoLogic and Envicom 2012).

During the two years of the radiological project activities, 129 live Braunton's milkvetch were directly impacted (HydroGeoLogic and Envicom 2012). Of these impacts, four plants were destroyed by vegetation clearance activities or by mule-mounted gamma scanning. Damage was described as uprooted plants, trimmed, destroyed, stem cuts, damaged root base, or soil disturbed by mule hoof prints. There was no record of any impacts made to plants that were senescent to dead. Evaluating the impacts of project activities on the Braunton's milkvetch population based on the conclusions of the BO, project activities impacted 0.4 to 0.7 percent of the estimated 18,500 to 33,500 Braunton's milkvetch plants on the project site in 2009 and 2006 respectively. Therefore, project impacts to this species were below the amount expected to be affected as anticipated in the biological opinion and there was no record of any seed being collected.

During spring 2011, and subsequently in 2012 and 2013, Braunton's milkvetch germinated in a previously undocumented location that had been cleared of chaparral vegetation in late 2010 for the radiological survey, resulting in hundreds of new emergent plants on a hill along the property

boundary north of critical habitat Unit 1d. The hill, unburned by the 2005 Topanga fire, had been covered with dense chaparral, scrub, and oak woodland vegetation prior to U.S. Environmental Protection Agency's (EPA) vegetation clearing activities. The Braunton's milkvetch plants that emerged, presumably had been in the seedbank and were stimulated to germinate by removal of the thick vegetation and ground disturbance associated with the vegetation clearing and subsequent radiological survey. The number of plants that established on the hill subsequent to clearing in 2011 was estimated to be a few hundred Braunton's milkvetch plants (HydroGeoLogic and Envicom 2012).

In March 2014, about 100 plants were observed by Leidos biologists. At least 40 plants (of the 100 observed) had multiple flowering stalks that had not been browsed and appeared to have set seed based on the presence of open bracts (where seed pods had been, but were no longer present). Some plants appeared to have been browsed by mule deer (EPA 2010, Leidos 2016, DOE 2018). To minimize further damage to the plants, DOE and Leidos biologists put protective fencing around a total of 13 surviving plants in 2014 and 2015 (Leidos 2016). Two additional plants were recorded but not fenced due to the difficulty of isolating the plant without destroying native vegetation. As of November 2015, results suggest the protective fencing was effective and had minimized browsing damage to those Braunton's milkvetch plants. All plants protected did not show any new evidence of browsing, appeared healthy (determined by evidence of new growth), and many showed signs of flowering, suggesting that they set seed; though this was only a visual observation and cannot be confirmed. In June 2017, the remaining Braunton's milkvetch fenced plants and known suitable habitat in Area IV was surveyed. Based on the information known about the biology of the plant it was expected that most plants had completed their life cycle and had gone dormant and that the next germination would occur after some type of event that removed competition from other vegetation. However, approximately 70 new plants were recorded. Most of the plants were located on the hill adjacent to critical habitat, but some were also documented within critical habitat. As of 2018, there were 80 Braunton's milkvetch plants living, and an additional 20 were fenced (DOE 2018, Schoenwetter personal communication 2018). Surveys of a portion of Area IV in 2018 recorded six individual plants, all within protective fencing (R.A. Burgess, biologist, in litt. 2018). However, the surveys did not include the portion of the site where the approximately 70 new plants had been recorded in 2017.

On other portions of SSFL, there have been numerous biological surveys and monitoring activities conducted, especially in Areas I, II, III, and the Southern Buffer Zone (SBZ) (DOE 2018). These surveys have resulted in no additional observations of Braunton's milkvetch plants within SSFL. Although select areas of SSFL have been the subject of focused surveys for Braunton's milkvetch, e.g. Area IV, NBZ, there have been no site-wide focused surveys for Braunton's milkvetch to determine if it occurs outside the known areas (Padre 2014; NASA 2014, DOE 2018).

Braunton's milkvetch is also known from locations 2.3 miles to the east, 1.7 miles to the south, and 1.3 miles to the west of the project area (CNDDB 2018). If soil and underlying bedrock conditions are suitable, it is possible that Braunton's milkvetch could occur elsewhere on SSFL,

such as within the SBZ, the northeastern portion of Area II, and the southern portion of Area I (NASA 2014, DOE 2018).

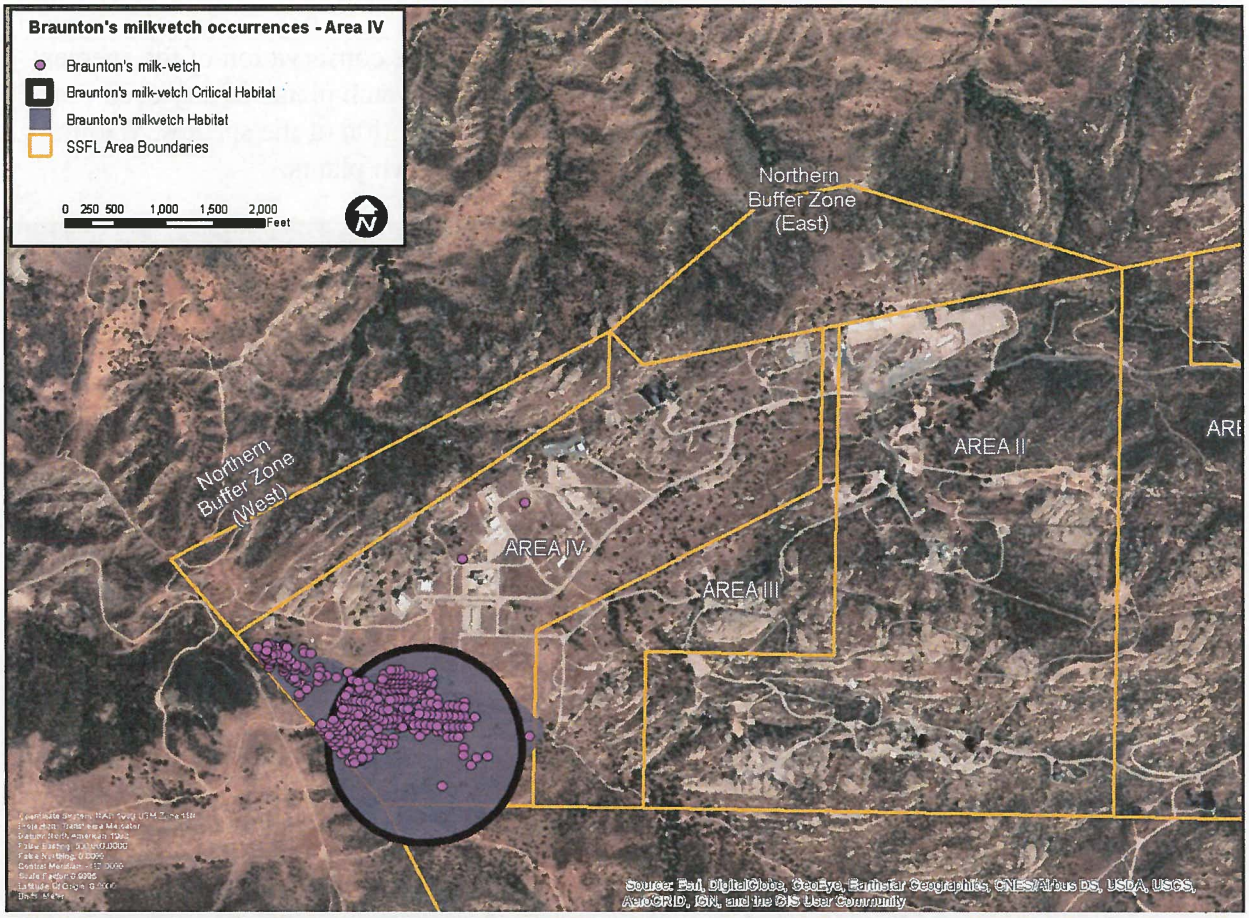

Figure 9. Locations of Braunton's milkvetch, individual plants (pink dots), critical habitat subunit 1d (circle). Braunton's milkvetch habitat is shown in grey shading, and includes 69.14 acres within Area IV. Map adapted from DOE 2018 and DOE 2017.

Condition of Braunton's Milkvetch Designated Critical Habitat in the Action Area

The action area includes a majority of designated critical habitat Subunit 1d, within the Northern Simi Hills Unit, designated Unit 1 (71 FR 66374). Unit 1 as a whole contains approximately 434 acres, Subunit 1d contains approximately 70 acres. Approximately 56 acres of Subunit 1d are within the action area (Figure 10). At the time the critical habitat rule was finalized, Subunit 1d was known to contain at least two of the PCEs (2 and 3); but whether it contained PCE 1 was unknown. Geologic maps of the Los Angeles area indicate that the formations on the SSFL site contain clay shale and fractured mudrock, gray limestone concretions common in shale, and benthic foraminifera from mudstones with molluscan and gastropod faunas (USGS 2005), which are all indicative of calcareous components. Furthermore, "whitish" soils, generally indicative of

calcareous substrates, were observed onsite on the hill within the critical habitat unit (Mark A. Elvin, Service biologist, pers. obs. 16 September 2009) indicating the presence of PCE 1 within Subunit 1d.

We consider the Northern Simi Hills Unit (Unit 1) essential for the conservation of the species because it supports the largest known number of Braunton's milkvetch plants of any occurrence and these plants represent the core of the northernmost metapopulation of the species. Within Unit 1, Subunit 1d contains an overwhelming majority of the known plants.

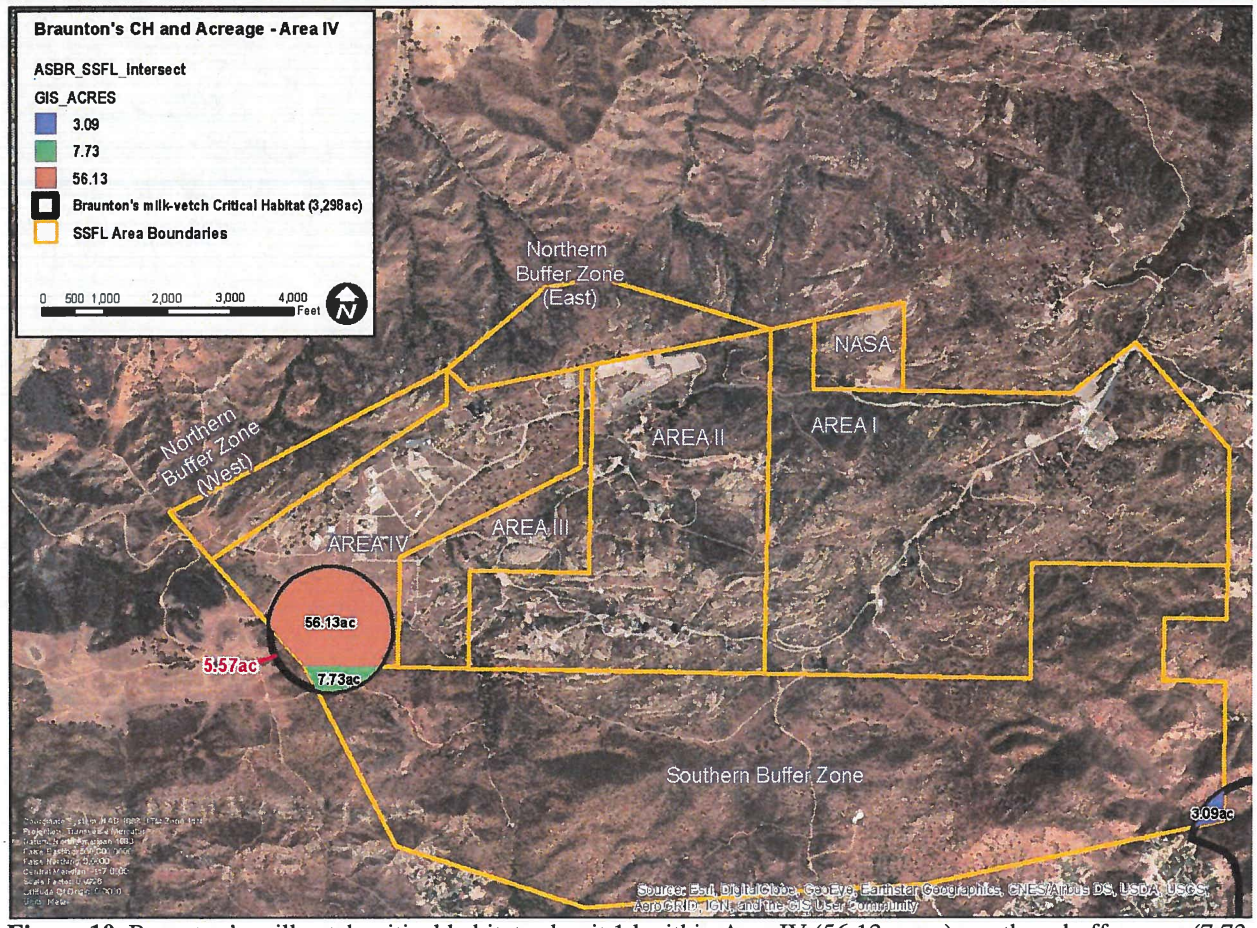

Figure 10. Braunton's milkvetch critical habitat subunit 1d within Area IV (56.13 acres), southern buffer zone (7.73 acres), and outside the SSFL boundary (5.57 acres). An additional 3.09 acres of critical habitat within subunit 1f occurs in the southern buffer zone.

EFFECTS OF THE ACTION

General Effects

In general, soil cleanup, groundwater cleanup, and building/infrastructure removal within Area IV and NBZ of the SSFL would be conducted over a period up to 20 years, and habitat restoration activities would take an additional 5 years or more. This section analyzes the effects to listed species and critical habitat from the wide breadth of activities necessary to implement the proposed action. We describe the general nature of the effects from the cleanup and restoration actions, but recognize that exact methods of achieving these actions may vary through time. For this analysis, we assume that location of listed species as well as the location and condition of suitable habitat for those species will change over time. DOE's suite of proposed conservation measures are designed to be flexible to adapt these changing conditions to minimize impacts to listed species over the course of the project. DOE has also proposed biological exemptions under the AOC for the protection of listed species, and this analysis considers a range of exemptions between "minimum exemption scenario" including only biological exemptions focused on protecting Braunton's milkvetch, and "maximum exemption scenario" focusing on Braunton's milkvetch and a suite of other state and federally protected species.

Least Bell's Vireo

All project-related activities (i.e. soil cleanup, groundwater cleanup, building and infrastructure removal, and restoration) that occur within portions of the action area that support least Bell's vireo habitat could adversely affect least Bell's vireos. Area IV and the NBZ contain about 0.97 acre of potential habitat for least Bell's vireos to roost or forage (SAIC 2009). We do not expect that the habitat in Area IV and the NBZ is likely to support a breeding pair or a nest; however, one to a few individual least Bell's vireos may occasionally occur within the action area. These individuals would be expected to be roosting or moving through the area. We expect that all least Bell's vireo habitat may be removed as a result of project implementation; however, some habitat may be replaced in the future, if restoration efforts are successful. Due to the long duration of the proposed project, habitat conditions and the distribution of the species will likely change over time. Riparian habitat onsite may become more abundant, and least Bell's vireo use of the action area could increase as a result.

DOE proposes to implement Conservation Measure 15, which directs removal of suitable habitat for least Bell's vireo to occur outside of the breeding season (March 15 – August 31). If the breeding season cannot be avoided, surveys pursuant to Service protocol for detecting presence/absence of least Bell's vireo will be conducted. If least Bell's vireos are detected, DOE would postpone habitat removal until after the breeding season. As stated above, we consider the probability of occurrence to be low, especially for breeding. However, should least Bell's vireos nesting occur onsite, removal of habitat outside of the breeding season could adversely affect the pair returning to their territory the following year. Due to the small amount of suitable habitat onsite (0.97 acres) and the typical range of territory sizes (0.5 to 7.5 acres), we anticipate this

adverse effect to be limited to a maximum of one pair, or two individuals, and that other suitable nesting habitat could be found outside of the action area.

Least Bell's vireo individuals or pairs that do occur within the action area during project implementation may be impacted by predators, night lighting, and noise. Human presence may attract predators to an area. Predators as well as parasitic cowbirds may be able to "home in" on least Bell's vireos that become agitated by human presence and destroy or parasitize vireo nests (The Nature Conservancy 1997, Chace et al. 2002). Trash left during or after project activities could attract predators including coyotes (*Canis latrans*) and raccoons (*Procyon lotor*) that could prey on least Bell's vireo eggs or nestlings. This potential impact would be reduced or avoided by the proposed control and removal of trash during the project, outlined in Conservation Measure 2.

Nighttime lighting and activity could cause behavioral disturbance and temporary avoidance of the area by least Bell's vireos, and in turn could preclude nesting in illuminated riparian habitat, cause nighttime disorientation, and increase vulnerability to predators. Conservation Measure 2 directs activities to occur during daylight hours, unless night work is required and outlines lighting guidelines to minimize wildlife impacts.

Activities including excavation, compaction and grading occurring within or adjacent to riparian habitat may produce noise and negatively affect least Bell's vireos. Many songbirds, including the least Bell's vireo, are sensitive to prolonged, loud noises; construction-related noise and vibrations can adversely affect breeding and nesting behavior and reduce nesting success. If construction noise increases after a least Bell's vireo has established a nest or breeding territory near the project, nest abandonment could occur, resulting in a failed breeding attempt, death of eggs and fledglings, and exposure of adults to increased predation risk. Moreover, least Bell's vireos rely on auditory signals in the form of songs, alarm and scolding calls to establish and defend territories, attract a mate, feed and care for young at the nest, and locate and evade potential predators (Scherzinger 1979). Increased ambient noise levels may hinder the ability of the species to cue in on these signals. Regional Environmental Consultants (RECON, 1989) estimated that noise levels above 60 dB from March 15 to September 15 may impact least Bell's vireo reproductive success. The Service uses 60 decibels (dB) as a practical threshold above which substantial impacts to the least Bell's vireo may occur. Limiting noise levels in occupied riparian habitat by establishing adequate buffers and phasing of work would reduce these impacts.

Effects on Recovery of the Least Bell's Vireo

The action area lies outside of currently and historically occupied sites for which recovery targets were established in the draft recovery plan. Project impacts would affect a small amount of marginal least Bell's vireo habitat (less than 1 acre), and would result in minimal or no change in population numbers and distribution. No long-term effects to the species or to recovery are expected as a result of the proposed project. Therefore, we expect that effects on recovery of the least Bell's vireo will be minimal.

Summary of Effects on the Least Bell's Vireo

The proposed activities would adversely affect all least Bell's vireos within the action area, primarily in the form of habitat removal, exposure to predators, night lighting, and construction noise. However, the likelihood that the species would be present is low, and the DOE has proposed avoidance and minimization measures to reduce potential impacts. Based on these factors, the likelihood that any least Bell's vireos would be killed or injured is low. These effects may be minimized by implementing the proposed biological exemption, which would focus soil removal only in areas where contamination poses a risk to human health and/or the environment. Under the "maximum exemption scenario," effects to least Bell's vireo habitats may be reduced if soil contamination does not pose a risk to human health or the environment within the habitat that supports least Bell's vireo. Under the "minimum exemption scenario," effect to this species would not be reduced because no least Bell's vireo habitat is included in this exemption (i.e. least Bell's vireo habitat does not overlap with Braunton's milk-vetch habitat).

Coastal California Gnatcatcher

Coastal California gnatcatchers have been reported in the action area, but were not detected during protocol level surveys. All project-related activities (i.e. soil cleanup, groundwater cleanup, building and infrastructure removal, and restoration) that occur within portions of the action area that support habitat for coastal California gnatcatchers could adversely affect the species. Area IV and the NBZ support approximately 280 acres of potential suitable habitat for the coastal California gnatcatcher with approximately 33.2 acres of this area classified as Venturan coastal scrub, which is preferred by the species (DOE 2017). As indicated in the Environmental Baseline section, we anticipate that between 20 and 46 individual coastal California gnatcatchers (or 10 to 23 pairs) may occur within the action area, if the suitable habitat were fully occupied. Currently, we expect that the habitat is not fully occupied; however, due to changing habitat conditions over time, additional populations within close proximity to the site (~3.9 miles away), and long duration of the project, the species may increase their use of the site at some point during project implementation.

DOE proposes to implement biological exemptions for the protection of listed species, but the extent of the biological exemptions that will be implemented range between the "minimum exemptions scenario" and "maximum exemptions scenario." Under the "minimum exemptions scenario," approximately 46 acres of potential coastal California gnatcatcher habitat that overlaps Braunton's milkvetch habitat will be subject to the risk-based cleanup process (green areas in Figure 11). Within this 46-acre area, we anticipate that a maximum of 0.5 acre would be affected, during the risk-based cleanup in Braunton's milk-vetch habitat (Figure 3). This scenario assumes that no other biological exemptions will be exercised; therefore, we anticipate that a total of approximately 72 acres of coastal California gnatcatcher habitat would be impacted by the cleanup (71.4 acres shown in purple in Figure 11, plus 0.5 acre shown in orange in Figure 3). Based on the mean range of inland breeding territory sizes for coastal California gnatcatchers, we anticipate that between 6 and 12 individuals (or 3 to 6 breeding pairs) may be impacted by the proposed project under this scenario.

Under the "maximum exemptions scenario" a majority of coastal California gnatcatcher habitat would be subject to the risk-based cleanup process, thereby reducing the total amount of habitat impacted by soil cleanup activities. The amount of coastal California gnatcatcher habitat impacted under this scenario would be less than 72 acres; however, a precise calculation depends on the results of DOE's risk-based process that would be applied in these areas. Similarly, the number of coastal California gnatcatchers expected to be impacted by this scenario is lower than between 6 and 12 individuals (or 3 to 6 breeding pairs).

Based on these two possible scenarios for how biological exemptions will be applied, we will assume that up to 72 acres of coastal California gnatcatcher habitat may be affected by project activities. We anticipate that this habitat may support between 6 and 12 costal California gnatcatcher individuals (or 3 to 6 breeding pairs) over the life of the project.

The project activities could result in disturbance or possibly direct injury or mortality of transitory, resident, or nesting coastal California gnatcatchers, including, but not limited to, disturbance of individuals or nesting behavior resulting in unsuccessful breeding and nest formation, abandonment of an active nest by adult birds, mortality of eggs and young birds within a nest, dispersal of adults to other suitable habitat because of temporary loss or degradation of habitat within the action area, and reduction in the value of the habitat for cover and foraging. The loss or degradation of habitat for cover, forage, and reproduction could cause individuals to abandon their territory to disperse to other suitable habitat.

Coastal California gnatcatchers are non-migratory and highly territorial. A loss of habitat due to excavation or other disturbance may cause the birds to seek out another area in which to forage and nest, either permanently or until the vegetation on the site regenerates. Such relocation may adversely affect the birds by causing an increase in energy expenditure necessary to locate, establish and defend a new territory. Unlike migratory species, coastal California gnatcatchers remain in their local habitat year-round. Habitat-disturbing activities can be timed to avoid the breeding season, but the species may occupy suitable habitat year-round.

These effects would be reduced through the implementation of Conservation Measure 16. The Service interprets this measure to mean that DOE will conduct surveys pursuant to Service guidance for all activities that disturb Venturan coastal sage scrub, and will avoid active nests until chicks have fledged. Additionally, other vegetation classes suitable for coastal California gnatcatchers will also be subject to this level of survey prior to disturbance. A qualified biologist familiar with coastal California gnatcatchers must determine which habitat areas may support the species at the time when surveys are needed. The coastal California gnatcatcher habitat areas outlined in Figure 6 are an estimate only. The spatial distribution and assemblage of vegetation throughout the action area will change over time, making this habitat assessment a critical step in appropriately targeting surveys to the most likely locations where coastal California gnatcatchers may occur. All potentially suitable habitat, as identified by the qualified biologist, will be surveyed prior to any ground disturbing activities through either breeding or non-breeding season surveys. This measure will minimize the likelihood of killing or injuring coastal California

gnatcatcher during project actions; however, there is a low possibility that a nest could go undetected during surveys and may be adversely affected.

The project could also indirectly affect suitable coastal California gnatcatcher habitat through introduction of non-native plants, increased fire frequency or fire suppression (i.e. brush clearance), and human intrusions. These indirect effects would make the habitat less suitable for coastal California gnatcatchers. During the duration of the project, some activities may attract non-native predators or increase the numbers of native predators that could prey upon coastal California gnatcatchers. Food-related trash and open containers attract raccoons, coyotes, ravens (*Corvus corax*), crows (*Corvus brachyrhynchos*), and other predators. Any increase in normal predation levels could have great effects on the small population of coastal California gnatcatchers that could occupy the site. This potential impact would be minimized or avoided by the careful control of waste products at all work sites as discussed in the Description of the Proposed Action.

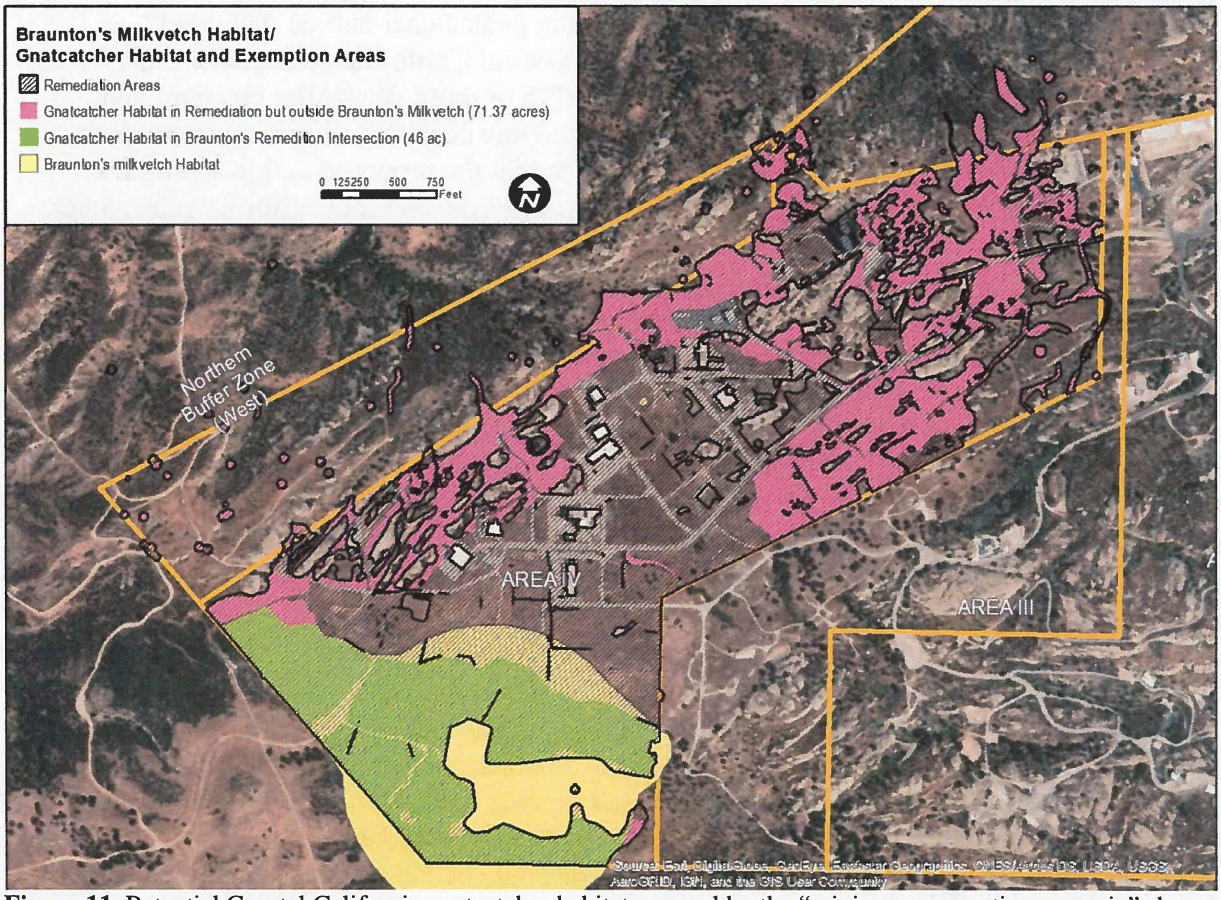

Figure 11. Potential Coastal California gnatcatcher habitat covered by the "minimum exemption scenario" shown in green, and habitat covered by the "maximum exemption scenario" shown in purple and green (Adapted from DOE 2017).

Due to the large amount of potentially suitable habitat for coastal California gnatcatchers within the action area, and based on the range of effects we analyzed, we estimate that up to 72 acres of habitat for coastal California gnatcatchers may be disturbed by project activities during soil cleanup, groundwater cleanup, building and infrastructure removal, and restoration. We estimate that between 6 and 12 individuals (or 3 to 6 breeding pairs) may be affected by these activities. Implementing the "maximum exemptions scenario" would reduce this impact by targeting soil cleanup in areas where soil contamination poses a risk to human health or the environment, and thereby reducing effects to coastal California gnatcatchers that occupy those habitats.

Effects on Recovery of the Coastal California Gnatcatcher

A recovery plan for the coastal California gnatcatcher has not been prepared. According to the Spotlight Species Action Plan (SSAP) for the coastal California Gnatcatcher, the action area is not within any regional NCCP/ HCP. Therefore, we do not expect the proposed action to interfere with the goals of the SSAP. In general the action area is at the northern edge of the coastal California gnatcatcher's distribution and likely represents the species at the extreme of its historical range. We estimate that the coastal California gnatcatcher habitat that would be affected by project activities likely contains up to 12 coastal California gnatcatcher individuals; however, the action area would eventually be restored (5 or more years after cleanup) and preserved as open space, and would remain available to any coastal California gnatcatchers should they attempt to colonize this area. We conclude that the proposed action should not reduce the contribution of the action area to the recovery of the coastal California gnatcatcher.

Summary of Effects on the Coastal California Gnatcatcher

The proposed activities would affect all coastal California gnatcatchers within the action area, but with the implementation of the conservation measures, nesting activities will be avoided (unless nests go undetected during surveys). Non-nesting individuals are able to disperse into and use unaffected suitable habitat; therefore, the likelihood that the proposed project would result in the direct death of any gnatcatcher individuals is low. Because a small portion of habitat of the entire range of the coastal California gnatcatcher would be affected by the project and the likelihood of mortality is low, we do not expect the effects to be substantial.

California Red-legged Frog

California red-legged frogs have not been observed in the action area to date. Over the life of the project, California red-legged frogs may be attracted to ponded habitat at SSFL, including the SRE (Sodium Reactor Experiment) pond, as well as to other ponded features that may be created in the future. All project-related activities in the action area (e.g. soil cleanup, groundwater cleanup, building and infrastructure removal, and restoration) could adversely affect California red-legged frogs. Although California red-legged frogs may be attracted to ponded features at the site, based on the current conditions in the action area (the low quality of suitable breeding habitat, and relatively long distance from known occupied breeding habitat), we anticipate that the likelihood that California red-legged frogs would breed within Area IV and NBZ during the life of the project is low. However, during the life of the proposed project, it is possible that California red-legged frogs may occur traversing the action area during dispersal.

The proposed activities may have direct effects on the California red-legged frog through injury or mortality from animals being crushed by heavy equipment, vehicles, debris, and worker foot traffic and activities such as excavation, stockpiling of materials and fill, and vegetation clearing. Individuals could become trapped and die in upland sheltering habitat or exposed to predators if burrows are crushed or covered. California red-legged frogs may experience a significant disruption of normal behavioral patterns from worker foot traffic and activities and their associated noise and vibration to the point that reaches the level of harassment. This disruption could cause individuals to leave or avoid suitable habitat and may increase the potential for predation, desiccation, competition for food and shelter, or strike by vehicles. The DOE would minimize these effects by implementing Conservation Measure 14, which includes conducting surveys for California red-legged frogs before disturbing potential suitable habitat.

California red-legged frogs can disperse overland in mesic conditions if substantial rainfall (greater than 0.5 inch of rain in a 24-hour period) occurs. During such periods of rainfall, we expect a higher likelihood of California red-legged frogs occurring within the action area. Any amphibians moving through the action area would be at risk of injury or death caused by vehicles, equipment, or workers, and fencing could entrap frogs and interfere with their movement. The DOE would minimize these effects by implementing Conservation Measure 1, which outlines provisions for biological monitoring within work zones.

Capture and relocation of California red-legged frogs could result in injury or death as a result of improper handling, containment, transport, or release into unsuitable habitat. Although survivorship for translocated California red-legged frogs has not been estimated, survivorship of translocated wildlife in general is reduced due to intraspecific competition, lack of familiarity with the location of potential breeding, feeding, and sheltering habitats, and increased risk of predation. Using qualified biologists, limiting the duration of handling, and requiring proper transport of individuals should reduce these impacts, and overall the relocation of individuals from work areas should reduce the level of mortality that otherwise would occur if individuals were not removed.

Soil and sand stockpiles and erosion control materials such as straw bales stored onsite can attract California red-legged frogs seeking upland refugia, and lead to injury or death if individuals become entrapped or are present when these materials are moved. The DOE would minimize these effects by implementing Conservation Measure 1, which outlines provisions for biological monitoring in work zones.

Accidental spills of hazardous materials or careless fueling or oiling of vehicles or equipment could degrade water quality or upland habitat to a degree where California red-legged frogs are injured or killed. Additionally, trash left during or after Project activities could attract predators to the work site, which could in turn prey upon California red-legged frogs. For example, raccoons and feral cats (*Felis catus*) are attracted to trash and also prey opportunistically on the California red-legged frog. The DOE would minimize these effects by implementing Conservation Measure 2, which directs all trash to be disposed of properly and limits the location of site activities that occur in sensitive habitat areas.

Uninformed workers could disturb, injure, or kill California red-legged frogs. The potential for this to occur would be reduced by educating workers on the presence and protected status of these species and the measures that are being implemented to protect them during Project activities. The use of flagging to demarcate work areas would further reduce these potential impacts by preventing workers from encroaching into environmentally sensitive habitat. The DOE would minimize these effects by implementing Conservation Measure 3, which outlines an environmental education program for all crews working on site, with additional education for crews working in habitat occupied or potentially occupied by listed species.

The proposed activities may have direct and indirect effects on the California red-legged frog through a reduction in dispersal habitat quality through vegetation removal. The proposed project may also involve the creation of ponded features through backfilling/re-contouring activities following remediation, or from groundwater cleanup or surface water control facilities that act as an attractive nuisance to California red-legged frogs during their operation. These effects would be minimized by implementing the proposed biological exemptions, and thereby focusing soil removal only in areas where contamination poses a risk to human health and/or the environment. The "maximum exemption scenario" would provide the greatest reduction in effects to habitats that the California red-legged frog may utilize onsite, and the "minimum exemption scenario" would provide somewhat less reduction in adverse effects because of the higher level of cleanup and greater disturbance to habitat.

Effects on Recovery of the California Red-legged Frog

The Service's (2002) recovery plan divides the California red-legged frog recovery units into 35 core areas. The proposed project is adjacent to, but not within, Recovery Core Area 27. The conservation needs for these units include protecting existing populations, protecting habitat connectivity, controlling non-native predators, reducing the impacts of agriculture, improving water quality and reducing impacts of urbanization. The proposed project is expected to result in long-term (up to 20 years of cleanup plus an additional 5 years or more for restoration) impacts to all California red-legged frogs and California red-legged frog habitat within the action area, which is anticipated to be a small number of individuals. With the implementation of the proposed avoidance and minimization measures, the project's direct and indirect effects on the California red-legged frog would likely be low and not diminish the chances of recovery for the species within Core Recovery Area 27.

Summary of Effects on the Red-legged Frog

In summary, construction activities and dispersal habitat removal could adversely affect California red-legged frogs. However, the number of individuals that are likely to use the site is small. With the implementation of the proposed avoidance and minimization measures, the direct and indirect effects of the project on the California red-legged frog would likely be low. Therefore, these effects are not likely to substantially diminish the chances of recovery for the California red-legged frog within Core Recovery Area 27 or species-wide.

Riverside Fairy Shrimp and Vernal Pool Fairy Shrimp

No records of Riverside fairy shrimp or vernal pool fairy shrimp are currently known from within the project area. However, if Riverside fairy shrimp or vernal pool fairy shrimp occur in the action area, all project related activities (e.g. soil cleanup, groundwater cleanup, building and infrastructure removal, and habitat restoration) that impact their habitat could have adverse effects to Riverside fairy shrimp or vernal pool fairy shrimp from temporary and permanent disturbance to ponded areas or riparian or upland habitat in their watersheds. Fairy shrimp were observed in three of the four pools mapped on one sandstone outcrop in Area IV of the SSFL (Padre 2010). While few of the proposed project activities are expected to occur in rocky outcrop areas, three of the pools in Area IV are expected to be affected by project activities (DOE 2018). All known vernal pools occur within the proposed "maximum exemption scenario" footprint, and may be protected if this scenario is applied (Figure 12). No habitat suitable for listed vernal pool species is contained within the proposed "minimum exemption scenario," and therefore this scenario does not reduce effects to listed vernal pool species. Any work within habitat suitable for listed vernal pool species could kill or injure fairy shrimp adults or cysts, or change the hydrology of the feature such that it may no longer support the species.

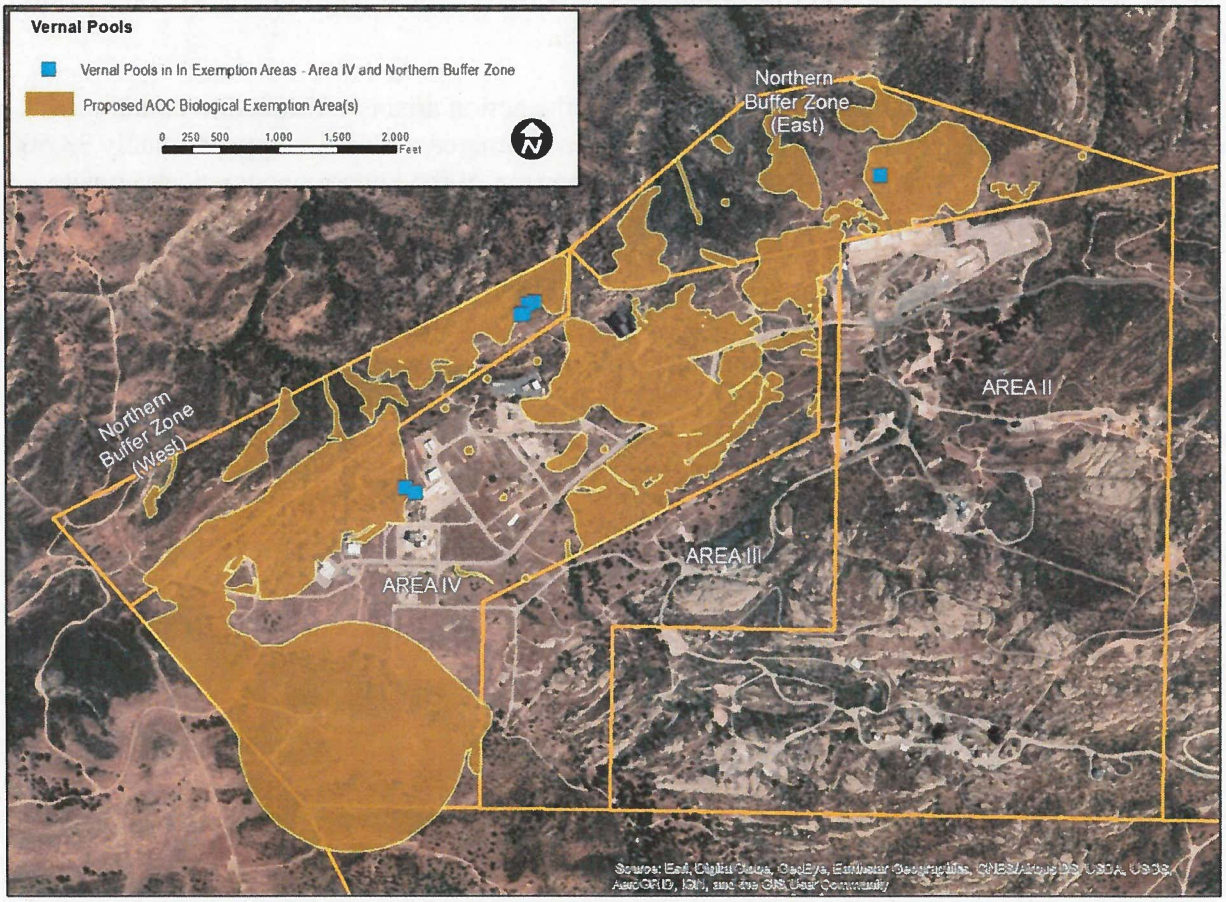

Figure 12. Location of vernal pools (blue) relative to proposed "maximum exemption scenario" (brown polygons) (Adapted from DOE 2017).

Effects on Recovery of the Riverside Fairy Shrimp and Vernal Pool Fairy Shrimp
The Service's (2005) recovery plan divides recovery units for the different vernal pool species into vernal pool regions that are geographically oriented. The SSFL does not occur within any of the vernal pool recovery regions (Service 2005). Because the proposed project would affect a small area and number of pools and the proposed project does not occur within a vernal pool recovery region, the proposed project is not likely to affect the recovery of either the Riverside fairy shrimp or the vernal pool fairy shrimp.

Summary of Effects on the Riverside Fairy Shrimp and Vernal Pool Fairy Shrimp
With the implementation of the proposed avoidance and minimization measures, the direct and indirect effects of the project on the Riverside fairy shrimp and the vernal pool fairy shrimp would likely be low and are not likely to appreciably diminish the chances of recovery for either the Riverside fairy shrimp or the vernal pool fairy shrimp species-wide.

Braunton's Milkvetch

All project related activities (e.g. soil cleanup, groundwater cleanup, building and infrastructure removal, and restoration) that occur in Braunton's milkvetch habitat within in the action area are likely to have direct and indirect effects to the species.

As described in the Environmental Baseline section, the action area is estimated to contain the largest Braunton's milkvetch occurrence and has been estimated to contain approximately 33,500 above-ground plants during suitable conditions in a portion of the known occupied area onsite. This is the largest number of Braunton's milkvetch plants ever reported at a single site. This occurrence is over 6.5 times larger than the second largest occurrence (5,092 plants) and approximately 28 times larger than the average occurrence (~1,200 plants). Braunton's milkvetch occurs throughout the region in smaller numbers, including areas adjacent to the SSFL site, such as the Upper Las Virgenes Canyon Open Space Reserve and Sage Ranch Park, located in the Simi Hills, Ventura and Los Angeles Counties, California. Braunton's milkvetch individuals (seeds and plants) may occur throughout the action area, but above-ground plants are generally concentrated in the southwestern portion of Area IV.

Based on mapping conducted during previous surveys and the implementation of the biological exemption for the protection of Braunton's milkvetch, a small amount of known occupied habitat (0.5 of an acre) would be subject to soil cleanup. According to the BA (DOE 2018), there are approximately 1,000 to 2,000 Braunton's milkvetch plants per acre during the growth phase of this short-lived perennial. With the implementation of the biological exemption for Braunton's milkvetch, DOE expects to remove 0.5 acre (or 0.7 percent of the occupied habitat onsite).

Acknowledging the limitations using the rounded numbers for plant densities, the DOE cleanup would result in the loss of approximately 500 to 1,000 plants as a result of soil removal alone. The loss of 500 to 1,000 plants onsite represents approximately between 0.65 and 0.86 percent of the Braunton's milkvetch plants rangewide (based on the three plant estimation methods discussed in the Status of the Species section above).

An additional 5 acres of occupied Braunton's milkvetch habitat may be temporarily disturbed by supporting activities necessary to implement the soil cleanup, groundwater cleanup, and restoration activities. We do not anticipate soil removal within these areas (causing no loss of the seedbank), and that through implementing Conservation Measure 12, living plants within this 5 acre area would be almost entirely avoided. We expect that over the life of the project Braunton's milkvetch plants may germinate in disturbed work areas, and that these plants may be impacted by project activities. We expect that up to 100 living plants may be adversely affected by these activities through crushing, trimming, or other damage.

As noted in the Status of the Species section above, Braunton's milkvetch plants tend to germinate after events that remove competition or cause mechanical disturbance. The proposed project may stimulate the germination of seeds within the action area during soil excavation, vegetation removal, and other ground disturbance activities. This would result in additional plants germinating and being injured or killed during project activities because the excavation of contaminated soils alone is expected to take up to 20 years to complete.

Direct adverse effects to Braunton's milkvetch plants in the action area may include injury or mortality from being cut or pruned during brush removal, soil sampling, water sampling, or other support activities; collection of seed and its temporary removal from the population; or crushing by heavy equipment, vegetation removal to allow access for remediation activities, or worker foot traffic. Soil excavation within occupied habitat could kill, crush, or otherwise injure Braunton's milkvetch or their seeds or damage the soil structure necessary for the survival of the plants. These activities are expected to result in the removal of up to 1,000 plants (i.e. 0.5 acres affected, with estimated 2,000 plants per acre).

Direct adverse effects to Braunton's milkvetch seeds in the action area may include injury or mortality from being removed or crushed. Removal of soil from areas occupied by Braunton's milkvetch seeds could also remove the seeds to areas that lack suitable conditions for germination and survival, thus causing their inevitable death.

In areas subject to excavation, we expect all biological and abiotic factors necessary for Braunton's milkvetch germination, growth, reproduction, recruitment, and survival to be removed from the areas affected by soil removal, rendering it unsuitable for the reestablishment of Braunton's milkvetch. Even with the implementation of the proposed habitat restoration and revegetation measures, as well as additional minimization and avoidance measures, impacts to Braunton's milkvetch would be reduced, but would still remain substantial in the 0.5 acre area subject to soil cleanup. DOE expects the backfill volume to be approximately 75 percent of the total volume that would be removed from Area IV and the NBZ. Backfill and soil deposition within occupied habitat could kill, crush, or otherwise injure Braunton's milkvetch plants or seeds or it could damage the soil structure necessary for the survival of the plants. Vegetation removal immediately adjacent to the existing roads and trails may result in the accidental cutting or removing of Braunton's milkvetch plants. These activities are expected to result in reduced reproductive success of Braunton's milkvetch plants too.

The removal of vegetation associated with this project could also increase the predation on Braunton's milkvetch by reducing available forage to resident herbivores and increase herbivore access to Braunton's milkvetch by removing adjacent vegetation and cover that might protect it from being eaten. Nonnative plants that out compete Braunton's milkvetch may be introduced from project equipment, project debris, and worker foot traffic. Pollinators may be affected or lost due to these activities.

Indirect effects to Braunton's milkvetch may occur as a result of the proposed project or any of its related activities, such as dust deposition from soil cleanup activities or invasion of nonnative plant species. Dust migration is associated with coating the flowers' female parts, which could reduce the reproductive success of Braunton's milkvetch plants that are not removed. Nonnative plants that out-compete Braunton's milkvetch may be introduced from project equipment, project debris, and worker foot traffic. The DOE would only use clean soil for fill and restoration efforts to try to prevent introducing seeds of nonnative invasive plants; however, disturbance to the periphery of the roads and access routes may lead to an increase in nonnative invasive plants in the action area because the disturbance may open up new patches of habitat for existing invasive species in the action area to colonize.

The potential for these impacts (both direct and indirect) to occur should be reduced by implementing the proposed protective measures (see Appendix A). These include general measures, such as monitoring activities, environmental education, and habitat and species specific measures (particularly Conservation Measure 12), such as habitat restoration, soil stabilization, seed salvage, plant salvage, propagation, and replanting.

The Braunton's milkvetch occurrence on the SSFL is the largest known population for the species and consists of well over half of all of the known Braunton's milkvetch plants throughout its range. It has been estimated to contain between 60 and 78 percent of all Braunton's milkvetch individuals (plants and seeds) in existence. With the expected loss of 0.5 acre (0.7 percent of the occupied habitat for this occurrence), we do not expect the survival of this occurrence to be reduced considerably, but we do expect to lose all of the plants and the entire seed bank within the 0.5 of an acre, as well as additional plants in adjacent areas to other direct and indirect effects. This loss of individuals, coupled with the loss of the precise environmental and soil (edaphic) necessities for this species from a small area (0.5 acre), is expected to have relatively low adverse effect on this population's long-term viability. In the 5 acre area subject to temporary disturbance, a relatively small number of plants (up to 100) may be adversely affected; however the seedbank and habitat conditions will remain suitable to support the species in the future. Based on the level of this effect to this population, we do not expect the effects to be substantial to the species as a whole.

Effects on Recovery of Braunton's Milkvetch

The recovery plan for Braunton's milkvetch recommends the following: (1) Protect and secure all current sites (including seedbanks); (2) Manage and monitor protected areas where plants occur; (3) Survey historic locations and other potential habitat where plant species may occur; (4) Conduct biological and ecological research to define life history strategies, population

dynamics, and to guide recovery/conservation efforts; and (5) Develop public outreach plans to enhance the public's understanding of conservation needs of these endangered species (Service 1999). The goal of the Recovery Plan for Six Plants from the Mountains Surrounding the Los Angeles Basin, which includes Braunton's milkvetch, is to stabilize, protect, and/or restore all populations in their current locations (including seed banks). Accomplishing the conservation and preservation of all Braunton's milkvetch populations would allow for its reclassification to threatened status.

We expect that the proposed project would not substantially affect the recovery of Braunton's milkvetch, because: (1) most of the Braunton's milkvetch individuals would be left in place at the SSFL (including its seedbank) and would be covered by a conservation easement; (2) the SSFL Braunton's milkvetch population would be covered under the restoration program for the proposed project; (3) the Braunton's milkvetch plants in the action area would be surveyed/monitored as part of the restoration and management plan; (4) biological and ecological research would be possible because greater than 99 percent of the plants are expected to survive; and (5) the proposed project would not preclude the development of public outreach plans to enhance the public's understanding of conservation needs of this endangered species.

In addition, measures proposed by the DOE (and Boeing) will promote the long-term viability of the population because the site will be conserved in perpetuity, and adverse effects caused by this project will not occur throughout a significant portion of the range of the species (only plants in less than 1 percent of the range of Braunton's milkvetch would be affected by the project).

Summary of Effects on Braunton's Milkvetch

With the implementation of the biological exemption for the protection of Braunton's milkvetch and the proposed conservation measures, the direct and indirect effects of the project on Braunton's milkvetch would likely be low and are not likely to appreciably diminish the chances of recovery for the species or species-wide.

Braunton's Milkvetch Designated Critical Habitat

The action area encompasses approximately 56.1 acres of the Northern Simi Hills Unit (Subunit 1d) of designated critical habitat for Braunton's milkvetch (71 FR 66374). Unit 1 as a whole contains a total of 434 acres, of which 70 acres are in Subunit 1d (71 FR 66374). With the implementation of the biological exemption for Braunton's milkvetch and its critical habitat, approximately 0.5 of an acre of critical habitat would be directly removed by implementation of the proposed project. As noted in the Environmental Baseline section of this biological opinion, the action area also contains three of the PCEs described in the designation of critical habitat for Braunton's milkvetch (71 FR 66374).

Project activities are expected to remove the PCEs from approximately 0.5 of an acre, within the 56.1 acres of designated critical habitat for Braunton's milkvetch in Area IV. The proposed project may also temporarily disturb up to 5 acres of designated critical habitat through vegetation clearing and ground disturbance associated with support activities for the soil cleanup,

groundwater cleanup, or habitat restoration. The project could also indirectly affect the critical habitat through introduction of non-native plants, increased fire frequency or fire suppression (i.e. brush clearance), and human intrusions. These effects would be minimized by DOE's Conservation Measure 9 and 12 which includes developing and implementing a habitat restoration plan, and minimizing impacts to Braunton's milkvetch and its critical habitat.

Summary of Effects on the Braunton's Milkvetch Designated Critical Habitat

In summary, the proposed action would remove the PCEs from approximately 0.5 acre (in 3 separate polygons) of the 56.13 acres of critical habitat for Braunton's milkvetch during project implementation. These areas are occupied by living Braunton's milkvetch plants and an unknown amount of Braunton's milkvetch seeds. These areas contain the primary biological features of Braunton's milkvetch critical habitat. The project activities would remove all vegetation and soils associated with Braunton's milkvetch critical habitat in these areas (0.5 acre). We expect additional temporary disturbance of up to 5 acres of designated critical habitat through vegetation clearing and ground disturbance associated with support activities for the soil cleanup, groundwater remediation, and/or habitat restoration activities.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. We do not consider future Federal actions that are unrelated to the proposed action in this section because they require separate consultation pursuant to section 7 of the Act. We believe that it is reasonably likely that future actions may occur within the action area and that these potential future actions may adversely affect listed species or designated critical habitat for listed species. However, the scope of any potential future actions and the action agency for any future investigation(s) and remedial actions are not known at this time. The need for consultation regarding future actions will be determined at which time their scope has been defined based on data obtained in this project.

CONCLUSION

The regulatory definition of "to jeopardize the continued existence of the species" focuses on assessing the effects of the proposed action on the reproduction, numbers, and distribution, and their effect on the survival and recovery of the species being considered in the biological opinion. For that reason, we have used those aspects of the least Bell's vireo, coastal California gnatcatcher, California red-legged frog, Riverside fairy shrimp, vernal pool fairy shrimp, and Braunton's milkvetch status as the basis to assess the overall effect of the proposed action on the species.

Least Bell's Vireo

Reproduction

Removal of riparian vegetation would reduce availability of breeding or non-breeding habitat. Few least Bell's vireos are expected to be present in the action area and breeding is not anticipated given the small amount and marginal quality of riparian habitat and near-absence of the species in prior surveys. To minimize the project's effects on reproduction of the least Bell's vireo, the DOE proposes to conduct surveys, set protective buffers around nests, control trash that may attract nest predators, and contact the Service if least Bell's vireos are detected. These actions should effectively reduce any project related impacts to the species reproduction. Proposed habitat restoration may attract least Bell's vireos and lead them to breed on the site in the future. Therefore, we expect the local effect of the proposed action on reproduction of the least Bell's vireo to be minimal in the short-term and minimal or potentially positive in the long-term, and conclude that the proposed action will not appreciably reduce the species' ability to reproduce rangewide.

Numbers

The area of direct impacts encompasses a small fraction of least Bell's vireo foraging and breeding habitat available locally and regionally. DOE also proposes measures to reduce indirect impacts that could disturb individuals or nests, such as establishing buffers around nests and limiting nighttime work. The species has been observed only once in the action area, but occurs regularly in the surrounding region. We expect through implementation of the proposed conservation measures, adverse effects from the project would be minimal, and no least Bell's vireos would be killed or injured by the proposed action. The proposed action would eventually restore riparian habitat that could lead to a net long term gain in habitat quantity and quality, if restoration efforts are successful. This may attract least Bell's vireos to the project site in the future and promote local occupancy. Cleanup and restoration activities could adversely affect least Bell's vireos attracted to the project site, but implementation of protective measures should minimize these impacts. Therefore, we have determined that implementation of the proposed action is not expected to appreciably reduce the numbers of the least Bell's vireos locally or rangewide, and it may eventually increase the numbers of least Bell's vireos onsite over the long term, pending successful restoration.

Distribution

The proposed action would temporarily reduce the habitat available to the least Bell's vireo. However, the amount of habitat reduced is small, suitable habitat would remain available around the project site, and the overall distribution of the least Bell's vireo would remain unchanged. Accordingly, the proposed action would have a negligible effect on the distribution of the least Bell's vireo. Therefore, we have determined that the proposed action would not appreciably reduce the distribution of the least Bell's vireo.

Recovery

The proposed action does not occur in any of the planned recovery areas for the least Bell's vireo (e.g. recovery units, critical habitat units). The proposed action site contains a very small amount

of riparian habitat that is of marginal quality. Direct effects to least Bell's vireos are unlikely. Accordingly, the proposed action would have a negligible effect on recovery efforts for the least Bell's vireo. Therefore, we have determined that the proposed action would not appreciably reduce the likelihood of recovery of the least Bell's vireo.

After reviewing the current status of the least Bell's vireo, the environmental baseline for the action area, the effects of DOE's proposed cleanup and restoration within Area IV and the NBZ of the SSFL and the cumulative effects, it is the Service's biological opinion that soil cleanup, groundwater cleanup, building and infrastructure removal, and habitat restoration on the Santa Susana Field Laboratory (SSFL) on the portion of the site under DOE's jurisdiction, including Area IV and the northern buffer zone, as proposed, is not likely to jeopardize the continued existence of the least Bell's vireo.

Coastal California Gnatcatcher

Reproduction

Removal of scrub vegetation would reduce availability of breeding and home range habitat. Few coastal California gnatcatchers are expected to be present currently; however, a more numerous population may move into the site over the life of the project. To minimize the project's effects on reproduction of the coastal California gnatcatchers, the DOE proposes to conduct surveys, set protective buffers around nests, and control trash that may attract nest predators. These measures should reduce project related impacts to the species reproduction; however, if a nest goes undetected during surveys there is the potential for the loss of eggs or young during the implementation of the action. Furthermore, DOE has proposed biological exemptions that include substantial portions of potentially suitable habitat for coastal California gnatcatchers, thereby reducing the overall impact to habitat that could be used for reproduction. Proposed habitat restoration may bring back suitable habitat for coastal California gnatcatchers following cleanup activities. Therefore, we expect the local effect of the proposed action on reproduction of the coastal California gnatcatchers to be minimal, and conclude that the proposed action will not appreciably reduce the species' ability to reproduce rangewide.

Numbers

The area of direct impacts encompasses a small portion of coastal California gnatcatchers foraging and breeding habitat available locally and regionally. DOE also proposes measures to reduce indirect impacts that could disturb individuals or nests, such as establishing buffers around nests and limiting nighttime work. The species has been reported in the action area, but not during protocol level surveys. It occurs nearby in the surrounding region. We expect that with the proposed conservation measures, adverse effects from the project would be minimal and few coastal California gnatcatchers would be killed or injured by the proposed action. Cleanup and restoration activities could adversely affect coastal California gnatcatchers attracted to the project site, but implementation of protective measures should minimize these impacts. Therefore, we have determined that implementation of the proposed action is not expected to appreciably reduce the numbers of coastal California gnatcatchers locally or rangewide.

Distribution
The proposed action would temporarily reduce the habitat available to the coastal California gnatcatcher. However, suitable habitat would remain available around the project site and the overall distribution of the coastal California gnatcatcher would remain substantially unchanged. Accordingly, the proposed action would have a negligible effect on the distribution of the coastal California gnatcatcher. Therefore, we have determined that the proposed action would not appreciably reduce the distribution of the coastal California gnatcatcher.

Recovery
The proposed action occurs near, but not within planned recovery areas for the coastal California gnatcatcher (e.g. critical habitat units). The proposed action site contains a limited amount of scrub habitat that is of marginal to medium quality. Direct impacts to coastal California gnatcatchers would be low. Accordingly, the proposed action would have a negligible effect on recovery efforts for the coastal California gnatcatcher. Therefore, we have determined that the proposed action would not appreciably reduce the likelihood of recovery of the coastal California gnatcatcher.

After reviewing the current status of the coastal California gnatcatcher, the environmental baseline for the action area, the effects of DOE's proposed cleanup and restoration within Area IV and the NBZ of the SSFL and the cumulative effects, it is the Service's biological opinion that the soil cleanup, groundwater cleanup, building and infrastructure removal, and habitat restoration on the Santa Susana Field Laboratory (SSFL) within the portion of the site under DOE's jurisdiction, including Area IV and the NBZ, as proposed, is not likely to jeopardize the continued existence of the coastal California gnatcatcher.

California Red-legged Frog

Reproduction
We do not expect that the proposed action would affect reproduction of the California red-legged frog. Removal of riparian vegetation would reduce availability of potential breeding habitat. Few California red-legged frogs are expected to be present in the action area and breeding is not anticipated given the small amount and marginal quality of riparian habitat, the absence of the species in prior surveys, and the distance from known breeding locations (greater than 3 miles). To minimize the project's effects on reproduction of the California red-legged frog, the DOE proposes to conduct surveys to detect and avoid individuals, control trash that may attract predators, and implement additional protective measures (see Appendix A). These actions should effectively reduce any project related impacts to the species reproduction. Creation of management of any ponded water features may attract California red-legged frogs and lead them to attempt to breed on the site in the future. Therefore, we expect the local effect of the proposed action on reproduction of the California red-legged frog to be minimal, and conclude that the proposed action will not appreciably reduce the species' ability to reproduce rangewide.

Numbers
The proposed action may result in a small reduction in numbers of the California red-legged frog due to the potential for individuals to be killed during project activities. Cleanup and restoration activities could adversely affect California red-legged frogs attracted to the project site, but implementation of conservation measures should minimize these impacts. Therefore, we expect that implementation of the proposed action is not likely to appreciably reduce the numbers of California red-legged frogs locally or rangewide.

Distribution
The proposed action would temporarily reduce the habitat (upland dispersal and riparian non-breeding) available to the California red-legged frog. However, suitable habitat would remain available around the project site and the overall distribution of the California red-legged frog would remain unchanged. Any individuals found within the area to be excavated would likely be relocated any individuals not detected could be injured or killed. We anticipate the number of individuals in the action area would be few if any. Accordingly, the proposed action would have a negligible effect on the distribution of the California red-legged frog. Therefore, we have determined that the proposed action would not appreciably reduce the distribution of the California red-legged frog.

Recovery
We expect the proposed action to have little to no effect on recovery of the California red-legged frog. The action area is adjacent to, but not within, Recovery Core Area 27. The proposed action is expected to result in long-term (up to 20 years) impacts to all California red-legged frogs and California red-legged frog habitat within the action area. With the implementation of the proposed avoidance and minimization measures, the project's direct and indirect effects on the California red-legged frog would likely be low and not diminish the chances of recovery for the species within Core Recovery Area 27. The open space status of the area would contribute to habitat connectivity in the area, which is beneficial to the recovery of the species.

After reviewing the current status of the California red-legged frog, the environmental baseline for the action area, the effects of DOE's proposed cleanup and restoration within Area IV and the NBZ of the SSFL and the cumulative effects, it is the Service's biological opinion that the soil cleanup, groundwater cleanup, building and infrastructure removal, and habitat restoration on the Santa Susana Field Laboratory (SSFL) on the portion of the site under DOE's jurisdiction, including Area IV and the northern buffer zone, as proposed, is not likely to jeopardize the continued existence of the California red-legged frog.

Riverside Fairy Shrimp and Vernal Pool Fairy Shrimp

Reproduction
Removal of vernally mesic habitat would reduce availability of breeding habitat for both Riverside fairy shrimp and vernal pool fairy shrimp. Few Riverside fairy shrimp and vernal pool fairy shrimp are expected to be present in the action area. To minimize the project's effects on reproduction of the Riverside fairy shrimp and vernal pool fairy shrimp, DOE proposes to

conduct surveys and set protective buffers around pools. Furthermore, DOE has proposed biological exemptions for the protection of vernal pools. These measures should effectively reduce project related impacts to the species reproduction. Therefore, we expect the local effect of the proposed action on reproduction of Riverside fairy shrimp and vernal pool fairy shrimp to be minimal, and conclude that the proposed action will not appreciably reduce the species' ability to reproduce rangewide.

Numbers

The area of direct impacts encompasses a small fraction of Riverside fairy shrimp and vernal pool fairy shrimp habitat available locally and regionally. DOE also proposes measures to reduce indirect impacts that could disturb individuals or pools, such as establishing buffers around pools. The species have not been documented in the action area, but they occur in the surrounding region. We do not have estimates to the number of individuals that could be affected by project activities; however, we expect that with the proposed conservation measures adverse effects from the project would be minimal, and few, if any, Riverside fairy shrimp or vernal pool fairy shrimp would be killed or injured by the proposed action. Cleanup and restoration activities could adversely affect Riverside fairy shrimp and vernal pool fairy shrimp should they occur the project site, but implementation of protective measures would minimize these impacts. Therefore, we have determined that implementation of the proposed action is not expected to appreciably reduce the numbers of Riverside fairy shrimp or vernal pool fairy shrimp locally or rangewide.

Distribution

The proposed action would temporarily reduce vernal pool habitat available to the Riverside fairy shrimp and vernal pool fairy shrimp. However, suitable habitat would remain available around the project site and the overall distribution of the Riverside fairy shrimp and vernal pool fairy shrimp would remain unchanged. Accordingly, the proposed action would have a negligible effect on the distribution of the Riverside fairy shrimp and vernal pool fairy shrimp. Therefore, we have determined that the proposed action would not appreciably reduce the distribution of either the Riverside fairy shrimp or the vernal pool fairy shrimp.

Recovery

We expect the proposed action to have little to no effect on recovery of either the Riverside fairy shrimp or the vernal pool fairy shrimp. The SSFL does not occur within any of the vernal pool recovery regions (Service 2005). Because the proposed action would affect a small area and number of pools, no Riverside fairy shrimp or vernal pool fairy shrimp have been documented onsite, and the proposed action does not occur within a vernal pool recovery region, the proposed action is not likely to appreciably affect the recovery of either the Riverside fairy shrimp or the vernal pool fairy shrimp.

After reviewing the current status of the Riverside fairy shrimp and vernal pool fairy shrimp, the environmental baseline for the action area, the effects of DOE's proposed cleanup and restoration within Area IV and the NBZ of the SSFL and the cumulative effects, it is the Service's biological opinion that the soil cleanup, groundwater cleanup, building and

infrastructure removal, and habitat restoration on the Santa Susana Field Laboratory (SSFL) on the portion of the site under DOE's jurisdiction, including Area IV and the northern buffer zone, as proposed, is not likely to jeopardize the continued existence of the Riverside fairy shrimp.

Braunton's Milkvetch

Reproduction
The proposed action, including a biological exemption for the protection of Braunton's milkvetch, would affect reproduction in the 0.5 acre area that would be subject to soil cleanup. This represents a small area of this core population (0.5 acre) out of the 69.14 acres of suitable Braunton's milkvetch habitat within the action area. An additional 5 acres may be affected by support activities that would affect vegetation and live plants, but is not anticipated to remove the soil and seedbank that supports the core population. Therefore, we do not expect the proposed action to appreciably reduce the reproduction within the action area or throughout the range of the species.

Numbers
Only a small area (0.5 of an acre) containing plants would be removed by the proposed action. Using estimates from the BA, the 0.5 acre could support up to between 500 and 1,000 Braunton's milkvetch plants. This is a small percentage compared to the 33,500 that were reported at one time for this site. Therefore, we do not expect the proposed action to appreciably reduce the numbers of Braunton's milkvetch within the action area or throughout the range of the species.

Distribution
The proposed action would remove a small amount of Braunton's milkvetch habitat (0.5 of an acre). However, up to 68.64 acres of Braunton's milkvetch habitat would remain available within the action area and the overall distribution of Braunton's milkvetch would remain unchanged. Accordingly, the proposed action would have a small effect on the distribution of Braunton's milkvetch. Therefore, we have determined that the proposed action would not appreciably reduce the distribution of Braunton's milkvetch.

Recovery
We expect that the proposed action would not substantially affect the recovery of Braunton's milkvetch, because: (1) most of the Braunton's milkvetch individuals would be left in place at the SSFL (including its seedbank) and would be covered by a conservation easement; (2) the SSFL Braunton's milkvetch population would be covered under the restoration program for the proposed action; (3) the Braunton's milkvetch plants in the action area would be surveyed/monitored as part of the restoration and management plan; (4) biological and ecological research would be possible because greater than 99 percent of the plants are expected to survive; and (5) the proposed action would not preclude the development of public outreach plans to enhance the public's understanding of conservation needs of this endangered species. In addition, measures proposed by the DOE (and Boeing) will ensure that the long-term viability of the population because the site will be conserved in perpetuity, and adverse effects caused by this

project will not occur throughout a significant portion of the range of the species (only plants in less than 1 percent of the range of Braunton's milkvetch would be affected by the project). Therefore, the proposed action is not likely to appreciably affect the recovery of Braunton's milkvetch.

After reviewing the current status of Braunton's milkvetch, the environmental baseline for the action area, the effects of DOE's proposed cleanup and restoration within Area IV and the NBZ of the SSFL (inclusive of the biological exemption in Braunton's milkvetch habitat and all of the protective measures DOE has committed to implement), and the cumulative effects, it is the Service's biological opinion that the soil cleanup, groundwater cleanup, building and infrastructure removal, and habitat restoration on the Santa Susana Field Laboratory (SSFL) on the portion of the site under DOE's jurisdiction, including Area IV and the northern buffer zone, as proposed, is not likely to jeopardize the continued existence of Braunton's milkvetch. This conclusion is contingent upon the implementation of the biological exemption for Braunton's milkvetch, if the exemption for Braunton's milkvetch is not applied, impacts would be much greater and that would invalidate this analysis.

Braunton's Milkvetch Critical Habitat

After reviewing the current status of Braunton's Milkvetch critical habitat, the environmental baseline of critical habitat in the action area, the effects of DOE's proposed cleanup (inclusive of the biological exemption in Braunton's milkvetch critical habitat, and all of the protective measures DOE has committed to implement), and the cumulative effects, it is the Service's biological opinion that the DOE's Cleanup of Area IV of the Santa Susana Field Laboratory Project, as proposed, is not likely to result in the destruction or adverse modification of critical habitat of Braunton's milkvetch because:

1. The proposed action would have small permanent effects on habitat areas that have the PCEs (calcium carbonate soils, low proportion of shrub cover, and that contains chaparral and coastal sage scrub communities), totaling 0.5 acres out of 56.1 acres within the action area and of approximately 3,300 acres of all Braunton's milkvetch designated critical habitat); and

2. The proposed action would have little effect on the conservation value and function of the habitat and the PCEs within this critical habitat unit because the permanent impacts would be small (approximately 0.5 acre), temporary impacts within an additional 5 acre area are anticipated to have only minor adverse effects to the PCEs, and DOE would implement protective measures for Braunton's milkvetch critical habitat.

This conclusion is contingent upon the implementation of the exemption process for Braunton's milkvetch, if the exemption process for Braunton's milkvetch is not applied, impacts would be much greater and that would invalidate this analysis.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened wildlife species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not the purpose of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this incidental take statement.

In June 2015, the Service finalized new regulations implementing the incidental take provisions of section 7(a)(2) of the Act. The new regulations also clarify the standard regarding when the Service formulates an Incidental Take Statement [50 CFR 402.14(g)(7)], from "…if such take may occur" to "…if such take is reasonably certain to occur." This is not a new standard, but merely a clarification and codification of the applicable standard that the Service has been using and is consistent with case law. The standard does not require a guarantee that take will result; only that the Service establishes a rational basis for a finding of take. The Service continues to rely on the best available scientific and commercial data, as well as professional judgment, in reaching these determinations and resolving uncertainties or information gaps.

AMOUNT OR EXTENT OF TAKE

Least Bell's vireo

We anticipate that few least Bell's vireos could be taken as a result of the proposed action. We expect the incidental take to be in the form of harm from effects associated with noise, vibration and visual disturbance from project activities, lighting from night work if unavoidable, and attraction of nest predators and cowbirds to the project site. All least Bell's vireos occurring within the action area would be subject to these effects.

Additionally, Least Bell's vireo adults and juveniles may be killed or injured outright by the removal of vegetation, or if disturbed by work activities and displaced from the action area into unfamiliar habitat, they may be forced into less suitable habitat where they would be at increased risk of predation, starvation, or other injury.

We cannot quantify the precise number of least Bell's vireos that may be taken as a result of DOE's proposed action because least Bell's vireos move over time; for example, animals may enter or leave the action area over the duration of the project (20 years) and after the time of pre-construction surveys. Least Bell's vireos may be difficult to detect due to their preference for dense riparian habitat, and death or injury of individuals displaced to areas outside of the action

area would be difficult to observe. Finding a dead or injured least Bell's vireo may also be unlikely due to their small size, potentially large territory, and the likelihood that dead individuals would be quickly scavenged. We anticipate the protective measures proposed by DOE are likely to prevent mortality or injury of most individuals.

Consequently, we are unable to reasonably anticipate the actual number of least Bell's vireos that would be taken by the proposed project; however, we must provide a level at which formal consultation would have to be reinitiated. The Environmental Baseline and Effects Analysis sections of this biological opinion indicate that we expect few, if any, least Bell's vireos to be observed in the action area, and that adverse effects to the species would likely be low given the nature of the proposed activities. Therefore, we anticipate that take of least Bell's vireos would also be low. We also recognize that for every least Bell's vireo found dead or injured, other individuals may be killed or injured that are not detected, so when we determine an appropriate take level we are anticipating that the actual take would be higher and we set the number below that level.

Therefore, the Service anticipates two (2) least Bell's vireos, as adult, subadult, or egg, could be taken as a result of the proposed action through death or injury. Project activities that are likely to cause additional take should cease as the exemption provided pursuant to section 7(o)(2) may lapse and any further take could be a violation of section 4(d) or 9. We do not anticipate, nor do we exempt, take for any other activities not analyzed in this consultation for the least Bell's vireo.

Coastal California Gnatcatcher

The proposed action may cause the injury or death of coastal California gnatcatchers. The number of coastal California gnatcatchers affected would be low, but the exact number is unknown because the population is likely to fluctuate through time, and coastal California gnatcatchers have only been reported from the site (McMorran 2010), but not confirmed by formal surveys. The project would have direct effects by removing up to 71.4 acres of potential suitable scrub habitat for the coastal California gnatcatcher within Area IV and NBZ (DOE 2017, DOE2018). Because the mean territory size for inland areas during the breeding season generally ranges from 12 to 27 acres per pair (Preston et al. 1998), we anticipate that the affected habitat could support up to 12 individuals (or 6 pairs) of coastal California gnatcatchers.

Consequently, we believe that 12 individuals (or 6 pairs) of coastal California gnatcatchers could be taken in the form of harm through the disturbance or loss of habitat within the action area. We expect that even with the implementation of the conservation measures proposed by the DOE, project related activities still have the potential to take up to 5 adults, subadults, nestlings, or eggs of coastal California gnatcatchers in the form of mortality if a nest is not detected during nesting bird or protocol coastal California gnatcatcher surveys.

Therefore, the Service anticipates five (5) coastal California gnatcatcher adults, subadults, or eggs could be taken as a result of the proposed action through death or injury. Project activities

that are likely to cause additional take should cease as the exemption provided pursuant to section 7(o)(2) may lapse and any further take could be a violation of section 4(d) or 9. We do not anticipate, nor do we exempt, take for any other activities not analyzed in this consultation.

California Red-legged Frog

We anticipate that some California red-legged frogs could be taken as a result of the proposed action. We expect the incidental take to be in the form of capture during relocation activities, and in the form of harm, injury, or death as a result of project activities if individuals are accidentally injured or killed during capture and relocation or are unable to be collected for relocation and remain in active project areas. Any California red-legged frogs that go undetected and remain in the action area could be killed by project activities. We expect this number to be low due to the avoidance and minimizations measures proposed by DOE and the status of the species in the action area. The probability of these risks may be increased if substantial rainfall (greater than 0.2 inch of rain in a 24-hour period) occurs and California red-legged frogs are dispersing through the area during work activities, though many activities would occur outside of the rainy season. California red-legged frogs could also be killed or wounded by predators if they abandon habitat within or adjacent to work areas and be subject to desiccation if they leave shelter sites.

We cannot quantify the precise number of California red-legged frogs that may be taken as a result of the DOE's proposed action because the species moves over time; for example, animals may enter or leave the action area over the duration of the project (up to 20 years) or after pre-activity surveys. California red-legged frogs may be difficult to detect due to their small body size and use of aquatic habitats, underground burrows, or dense cover. Animals injured or killed during capture efforts are likely to be observed; however, mortality from other sources, including the indirect effects of relocation (e.g. unable to find food in a new location) or displacement from the action area, would be difficult to observe. Finding a dead or injured California red-legged frog may also be unlikely due to their cryptic coloration and potential to be quickly scavenged. The protective measures proposed by DOE are likely to prevent mortality or injury of most individuals.

Consequently, we are unable to reasonably anticipate the actual number of California red-legged frogs that would be taken by the proposed Project; however, we must provide a level at which formal consultation would have to be reinitiated. The Environmental Baseline and Effects Analysis sections of this biological opinion indicate that adverse effects to the species would likely be low given the quality and quantity of available habitat, nature of the proposed activities, and conservation measures. Therefore, we anticipate that take of California red-legged frogs would also be low. We also recognize that for every California red-legged frog found dead or injured, other individuals may be killed or injured that are not detected, so when we determine an appropriate take level we are anticipating that the actual take would be higher and we set the number below that level.

Similarly, for estimating the number of California red-legged frogs that would be taken by capture, we cannot predict how many may be encountered for reasons stated earlier. While the

benefits of relocation (i.e. minimizing mortality) outweigh the risk of capture, we must provide a limit for take by capture at which consultation would be reinitiated because high rates of capture may indicate that some important information about the species in the action area was not apparent (i.e. it is much more abundant than previously believed). Conversely, because capture and relocation can be highly variable, depending upon the species and the timing of the activity, we do not anticipate a number so low that reinitiation would be triggered before the effects of the activity were greater than what we determined in the Effects Analysis.

Therefore, the Service anticipates two (2) adult or juvenile California red-legged frogs could be taken as a result of the proposed action through death or injury, or five (5) adult or juvenile California red-legged frogs could be taken as a result of the proposed action through capture and relocation. Also, if any other life stages of the California red-legged frog are identified within the action area that are completely dependent on water (i.e. egg masses or tadpoles), DOE must contact our office immediately. We do not expect egg masses or tadpoles to be present in the action area and are not exempting take for these life stages. Project activities that are likely to cause additional take should cease as the exemption provided pursuant to section 7(o)(2) may lapse and any further take could be a violation of section 4(d) or 9. We do not anticipate, nor do we exempt, take for any other activities not analyzed in this consultation.

Riverside Fairy Shrimp and Vernal Pool Fairy Shrimp

We anticipate that all Riverside fairy shrimp and/or vernal pool fairy shrimp cysts, adults, and juveniles within up to three pools within the action area could be taken as a result of the proposed action. We expect the incidental take to be in the form of being crushed, buried or displaced from any occupied habitat as a result of proposed project activities.

We cannot quantify the precise number of Riverside fairy shrimp and/or vernal pool fairy shrimp that may be taken within those three pools as a result of DOE's proposed action because Riverside fairy shrimp and/or vernal pool fairy shrimp are small and difficult to detect. Finding dead or injured Riverside fairy shrimp or vernal pool fairy shrimp is unlikely because they would be difficult to observe. The protective measures proposed by the DOE expected to prevent mortality or injury of most individuals.

Consequently, we are unable to reasonably anticipate the actual number of Riverside fairy shrimp and vernal pool fairy shrimp that would be taken by the proposed project. The Environmental Baseline and Effects Analysis sections of this biological opinion indicate that we expect few, if any, Riverside fairy shrimp and vernal pool fairy shrimp to be observed in the action area, and that adverse effects to the species would likely be low given the nature of the proposed activities. Therefore, we anticipate that take of Riverside fairy shrimp and vernal pool fairy shrimp would also be low. We also recognize that for every Riverside fairy shrimp or vernal pool fairy shrimp found dead or injured, other individuals may be killed or injured that are not detected, so when we determine an appropriate take level we are anticipating that the actual take would be higher and we set the number below that level.

Therefore, because of the difficulty in detecting incidental take of vernal pool species, we quantify take by measuring impacts to their habitat features. We anticipate three (3) vernal pools containing listed fairy shrimp may be impacted such that these features can no longer support fairy shrimp species. Project activities that are likely to cause additional take should cease as the exemption provided pursuant to section 7(o)(2) may lapse and any further take could be a violation of section 4(d) or 9. We do not anticipate, nor do we exempt, take for any other activities not analyzed in this consultation.

Braunton's Milkvetch

Sections 7(b)(4) and 7(o)(2) of the Act generally do not apply to listed plant species; however, limited protection of listed plants is provided at section 9(a)(2) to the extent that the Act prohibits the removal and reduction to possession of federally listed plants from areas under Federal jurisdiction, the malicious damage or destruction of such plants on areas under Federal jurisdiction, and the destruction of listed plants on non-Federal areas in violation of State law or regulation or in the course of a violation of a State criminal trespass law.

EFFECT OF THE TAKE

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species or adverse modification of critical habitat.

REASONABLE AND PRUDENT MEASURES

The measures described below are non-discretionary, and must be undertaken by the DOE or made binding conditions of any grant or permit issued to the DOE, as appropriate, for the exemption in section 7(o)(2) to apply. The DOE has a continuing duty to regulate the activity covered by this incidental take statement. If the DOE (1) fails to assume and implement the terms and conditions or (2) fails to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. To monitor the impact of incidental take, the DOE must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR 402.14(i)(3)].

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize the impacts of the incidental take of least Bell's vireo, coastal California gnatcatcher, California red-legged frog, Riverside fairy shrimp, and vernal pool fairy shrimp:

1. Biologists must be authorized by the Service before they survey for least Bell's vireo, coastal California gnatcatcher, California red-legged frog, Riverside fairy shrimp, or vernal pool fairy shrimp, and before they capture and move California red-legged frogs, Riverside fairy shrimp, or vernal pool fairy shrimp in the action area, as described in the terms and conditions below.

2. The DOE and authorized biologists must implement measures to reduce effects to and take of the least Bell's vireo, coastal California gnatcatcher, California red-legged frog, Riverside fairy shrimp, and vernal pool fairy shrimp in the action area as described in the Terms and Conditions below.

TERMS AND CONDITIONS

To be exempt from the prohibitions of section 9 of the Act, the DOE must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline reporting and monitoring requirements. These terms and conditions are non-discretionary.

1. The following term and condition implements reasonable and prudent measure 1:

   The DOE must request our approval of any biologists that conduct project activities (e.g. survey, capture, relocate) associated with the least Bell's vireo, coastal California gnatcatcher, California red-legged frog, Riverside fairy shrimp, or vernal pool fairy shrimp pursuant to this biological opinion in the action area. Such requests must be in writing, and be received by the Ventura Fish and Wildlife Office at least 30 days prior to any such activities being conducted. Information included in a request for authorization should include: (1) relevant education; (2) relevant training on species identification, survey techniques, handling individuals of different age classes, and handling of different life stages by a permitted biologist or recognized species expert authorized for such activities by the Service; (3) a summary of field experience conducting requested activities (to include project/research information); (4) a summary of biological opinions under which they were authorized to work with the listed species and at what level (such as construction monitoring versus handling), this should also include the names and qualifications of persons under which the work was supervised as well as the amount of work experience on the actual project; (5) any Federal Recovery Permits [10(a)1(A)] authorizing the individual to work with the species (to include permit #, authorized activities, and name of permit holder); and (6) any relevant professional references with contact information.

   Please be advised that possession of a 10(a)(1)(A) permit for least Bell's vireo, coastal California gnatcatcher, California red-legged frog, Riverside fairy shrimp, or vernal pool fairy shrimp does not substitute for the implementation of this measure.

2. The following terms and conditions implement reasonable and prudent measure 2:

   a. Prior to the onset of project-related activities in areas of suitable habitat for California red-legged frogs, Riverside fairy shrimps, or vernal pool fairy shrimps, a Service-approved biologist must identify appropriate relocation areas in the event these species are detected during the proposed action. These locations must be in proximity to the project site, contain suitable habitat for the respective species, not be affected

by project activities, and be free of exotic predatory species (e.g. bullfrogs, crayfish) to the best of the approved biologist's knowledge.

b. If Riverside fairy shrimps, and/or vernal pool fairy shrimps are found within a habitat area that must be impacted by the action, every effort will be made to collect all cysts (cyst-bearing soil) from the entire work area of each impacted pool. The substrate will be removed in chunks and will be segregated separately for each pool. The cysts will be stored in labeled bags or boxes that are adequately ventilated. The cysts will be kept out of direct sunlight to prevent excessive heating of the soil. When excavation activities are complete, the inoculum will be returned to the corresponding pool or another suitable receptor site if the impacted pool no longer supports the appropriate conditions for fairy shrimp. Inoculum will be placed in a manner that preserved the orientation of the cysts within the surface layer of the soil. The inoculum will be shallowly distributed within the vernal pools so that the cysts have the potential to be brought into solution when inundated.

c. Authorized biologists must have the authority to stop work if any least Bell's vireo, coastal California gnatcatcher, California red-legged frog, Riverside fairy shrimp, or vernal pool fairy shrimp are found in harm's way.

d. In areas where there is no speed limit posted, all vehicles and equipment should not exceed 20-mile per hour speed limit, to minimize wildlife collisions.

e. If project activities occur between November 1 and April 1, the authorized biologist or designated biological monitor must survey work areas following any precipitation events before construction activities resume, to ensure California red-legged frogs have not moved into a work area overnight.

REPORTING REQUIREMENTS

Pursuant to 50 CFR 402.14(i)(3), the DOE must report the progress of the action and its impact on the species to the Service as specified in this incidental take statement. The DOE must provide us a written annual report for each year that activities are conducted pursuant to this biological opinion. The timing of this annual report can be specified by DOE, to align with other reporting requirements; however, the Service must be informed of the proposed reporting schedule.

The report must state the number of least Bell's vireo, coastal California gnatcatcher, California red-legged frog, Riverside fairy shrimp, and vernal pool fairy shrimp killed or injured, describing the circumstances of the mortalities or injuries if known. The report must contain information on the following: (1) the type, location, and habitat characteristics of activities that occurred in the action area (e.g., construction activities, monitoring); (2) the results of any surveys conducted for any listed species and their habitats; (3) the number of California red-legged frog, Riverside fairy shrimp, or vernal pool fairy shrimp captured and relocated; (4) the locations from which

California red-legged frog, Riverside fairy shrimp, or vernal pool fairy shrimp were moved and where they were relocated to; (5) an analysis of the effectiveness of the avoidance and minimization measures and recommendations for future measures; and (6) any other pertinent information. This reporting is not in lieu of reporting required immediately upon the take of least Bell's vireo, coastal California gnatcatcher, California red-legged frog, Riverside fairy shrimp, or vernal pool fairy shrimp as described below.

DISPOSITION OF DEAD OR INJURED SPECIMENS

As part of this incidental take statement and pursuant to 50 CFR 402.14(i)(1)(v), upon locating a dead or injured least Bell's vireo, coastal California gnatcatcher, California red-legged frog, Riverside fairy shrimp, or vernal pool fairy shrimp, initial notification within 3 working days of its finding must be made by telephone and in writing to the Ventura Fish and Wildlife Office (805-644-1766). The report must include the date, time, location of the carcass, a photograph, cause of death or injury, if known, and any other pertinent information.

The DOE must take care in handling injured animals to ensure effective treatment and care, and in handling dead specimens to preserve biological material in the best possible state. The DOE must transport injured animals to a qualified veterinarian. Should any treated least Bell's vireo, coastal California gnatcatcher, California red-legged frog, Riverside fairy shrimp, or vernal pool fairy shrimp survive, the DOE must contact the Service regarding the final disposition of the animal(s). The remains of listed species must be placed with educational or research institutions holding the appropriate State and Federal permits, such as the Santa Barbara Natural History Museum (Contact: Paul Collins, Santa Barbara Natural History Museum, Vertebrate Zoology Department, 2559 Puesta Del Sol, Santa Barbara, California 93460, (805) 682-4711, extension 321).

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

1. We recommend that the DOE create California red-legged frog habitat (aquatic breeding and aquatic non-breeding) following cleanup during the restoration activities, where feasible.

2. We recommend that the DOE relocate any native reptiles and amphibians found within the action area to nearby suitable habitat, conducting such activities in a manner that complies with State laws. This would help conserve the native wildlife in the region.

3. We recommend that non-native predators of the California red-legged frog, such as bullfrogs, be removed permanently from the wild during project activities, if they can be captured and if such activities are in compliance with State laws.

4. To the extent possible, we recommend that DOE schedule project activities (especially those that would be conducted at night) such that they avoid rainy weather.

5. We recommend that native plants and seed be collected from the various species (sensitive and common) before the vegetation is removed, and that these plants and seeds be used for restoration efforts onsite to maintain genetic diversity of the local flora and to minimize long-term adverse effects. Creation of an onsite plant nursery could be helpful in maintaining these plants and seeds.

6. We recommend that the DOE work with local agencies and governments to implement recovery actions identified in the coastal California gnatcatcher Spotlight Species Action Plan.

The Service requests notification of the implementation of any conservation recommendations within the annual reports so we may be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats.

REINITIATION NOTICE

This concludes formal consultation on the action(s) outlined in the request. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, the exemption issued pursuant to section 7(o)(2) may have lapsed and any further take could be a violation of section 4(d) or 9. Consequently, we recommend that any operations causing such take cease pending reinitiation.

If you have any questions about this biological opinion, please contact Jenny Marek of my staff at 805-677-3313, or by e-mail at jenny_marek@fws.gov.

Sincerely,

Stephen P. Henry
Field Supervisor

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PERSONAL COMMUNICATIONS

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Appendix A. Conservation Measures

The Biological Assessment (DOE 2018) incorporates a number of general and species-specific measures that DOE would implement to avoid, minimize, and/or compensate for adverse effects to federally listed species and designated critical habitat. The full text of these measures is presented in this appendix.

General Conservation Measures

Conservation Measure 1. *Biological Monitoring during Project Construction and Pre-Project Clearance Surveys.*

One or more qualified Project Biologist(s), approved by the Service, CDFW, and Corps would be retained by Boeing and DOE for the duration of construction activities. The Project Biologist will have experience with sensitive species that occur or have the potential to occur on the project site. The Project Biologist will be on site as needed during building demolition, and clearing and grubbing of vegetation in habitats that have the potential to support sensitive species, including federally or state-listed species. Given the scope of the project, level of potential impacts, and number of sensitive resources potentially affected by project activities, it is expected that a monitoring team may be required to adequately cover simultaneously-occurring project activities and provide the expertise needed to ensure protection of all environmental resources at the SSFL. The monitoring team will include a Project Biologist and staff members qualified to perform particular tasks under the direction of the Project Biologist.

a) The Project Biologist will identify work areas, monitor work activity, and provide "tailgate" sessions/education program (see Measure 3) for construction contractor personnel, and will oversee and execute the conservation protection measures pertaining to biological resources.

b) Prior to the ground disturbance associated with the initial phases of building demolition, soil remediation, and ground-disturbing aspects of ground water activities, the Project Biologist will conduct pre-project clearance surveys to ascertain the buildings are not being used by bats and native bird species, including owls and raptors. Vegetated areas will be surveyed for active bird nests (see Measure 5) and sensitive plant (see Measure 12) and wildlife species (see Measures 5, 13, 14, 15 and 16). Humane methods will be used to haze owls, raptors, native songbirds, and bats out of the structures prior to initial phases of construction. Effective methods of deterrence 611 may include the use of exclusionary netting, reflective flagging and/or flight diverters, sonic bird control devices, or a falconry service program. Building demolition will be conducted outside the breeding seasons of birds protected by the Migratory Bird Treaty Act (MBTA) and bats unless the buildings can be completely confirmed for the absence of nesting birds or roosting bats.

Wildlife will be protected during work activities. Direct impacts to general wildlife species, such as snakes, other reptiles, and small mammals will be minimized during remediation.

a) Prior to clearing and grubbing in a remediation area, the Project Biologist will walk through the area and attempt to locate and capture or otherwise humanely move out of harm's way sedentary species such as reptiles and amphibians, with special attention paid to species of conservation concern such as silvery legless lizards (*Anniella pulchra pulchra*) and coast horned lizards (*Phrynosoma blainvillii*).

b) A Project Biologist will be on-site to monitor work zones for presence of wildlife periodically during work activities (such as vegetation removal or earth moving). Should an endangered, threatened, or sensitive animal species be observed in harm's way, the contractor will stop work until the Project Biologist can move the animal to a safe location, when work can resume.

Conservation Measure 2. *Site Access Restrictions to Minimize Impacts to Sensitive Biological Resources.*

a) The project work areas will be accessed using existing roads to the extent possible. Parking, driving, lay-down, stockpiling, and vehicle and equipment storage will be limited to previously compacted and developed areas, or non-sensitive habitat areas (see Measure 8), and the designated staging areas as much as feasible.

b) The demolition, remediation, and restoration contractors will stage equipment in areas that will create the greatest distance practical between demolition- and remediation-related noise sources and noise-sensitive receptors (e.g. sensitive habitat areas for endangered species or species of special concern) during all project demolition and remediation activities.

c) Where access must be through native habitats, such as within the 2010 AOC (DTSC 2010a) proposed biological exemption areas (discussed in Section 4.2.2 and 4.2.3 below), the Project Biologist will be consulted to determine the least environmentally damaging and safe access route to the site. This access route will be clearly marked and will be considered part of the construction zone/action area.

d) Limits of the action area will be clearly marked and delineated in the field by the biologist. No unauthorized personnel or equipment (including off-road vehicle access) will be allowed in native habitats outside the construction limits or designated access routes.

e) Disturbance in the 2010 AOC proposed biological exemption areas, or similar areas identified in Boeing areas of responsibility, would be kept to a minimum, including consideration of using special methods such as the use of balloon-tired, all-terrain-vehicles to access sites and remove affected soil.

f) Biologically sensitive areas (discussed in Section 4.2.2, below) will be clearly marked on plans and on site and avoided by personnel and equipment.

g) Before project initiation, the project boundary, including temporary features such as staging areas, will be clearly marked with flagging, fencing, or signposts. All project-related activities will occur within the designated construction boundary.

h) Boeing and DOE will cease all construction activities (e.g. confirmation sampling, vegetation removal, mapping, surveying, sample analysis, excavation and stockpiling) from sunset and to sunrise. If night work is required, the Responsible Party will implement the following minimization measures:

1. Exterior lighting will be of the lowest illumination allowed for human safety, selectively placed, shielded, and directed away from native habitat to the maximum extent practicable. The number of sites subject to night work at any given time and the total work area affected will be minimized to the maximum extent possible.

2. Project vehicle traffic will proceed at minimum speed to avoid impacts on nocturnal wildlife.

3. The on-site Project Biologist will inspect the surrounding area to ensure that illumination is limited to within 250 feet of the work area.

i) All trash will be disposed of properly. All food-related trash will be placed in sealed bins or removed from the site regularly. Following initial project construction, all equipment, waste, and construction debris will be removed from the site, and the soil will be re-contoured prior to habitat restoration.

Conservation Measure 3. *Environmental Education Program.*

All members of action related crews will participate in an Environmental Education Program to be administered by the Project Biologist. The Education Program will be conducted during all project phases for any new crew personnel brought to the site and will cover the potential presence of listed species; the requirements and boundaries of the project; the importance of complying with avoidance, minimization, and compensation measures; and problem reporting and resolution methods. Species-specific training will be administered to crews who will be performing activities within areas occupied, or presumed to be occupied, by listed species.

Conservation Measure 4. *Vehicle and Operation Restrictions to Prevent Unintentional Fire.*

To ensure fire does not commence due to project activities, trucks will carry water and shovels or fire extinguishers in the field. Shields, protective mats, or other fire prevention equipment will be used during grinding and welding, and wildfires will be prevented by exercising care when driving and by not parking vehicles in grass or other dry vegetation where catalytic converters can ignite it. Procedures for changing or halting operations when the fire hazard reaches a critical

level will be developed by the remediation contractor. No smoking or disposal of cigarette butts or other smoking materials will take place within vegetated areas.

Conservation Measure 5. *Conduct Vegetation Removal or Heavy Equipment Operation Adjacent to Vegetated Habitat Outside of Nesting Season for Those Species Protected by the Migratory Bird Treaty Act.*

a) Due to the presence of habitat for MBTA species within and adjacent to the project site and access routes, any grubbing, mowing, removal of surface vegetation, excavation, or other activity involving heavy equipment in or adjacent to vegetated areas will not be scheduled during the nesting season for song birds, between February 15 and August 31 to avoid potential impacts on nesting birds, whenever feasible. Nesting season for owls, hawks, and eagles may begin earlier than songbirds, as early as October. Areas within the project site where these birds roost or nest, including dead trees with snags and natural cavities, will be surveyed by qualified biologist prior to vegetation removal. If nesting birds are identified that may be affected by the proposed activities, then an appropriate work buffer will be established or work will be delayed until nesting activity has been completed to ensure that the nesting bird activity is not adversely impacted.

b) A qualified biologist, hired by the Responsible Party will perform a nesting bird survey and confirm that active nests would not be affected. The results of the survey would be submitted to the CDFW and the Service, as appropriate. See Conservation 700 Measures 15 and 16 for further measures to avoid effects on least Bell's vireo and coastal California gnatcatcher.

Habitat Protection and Restoration Measures

Conservation Measure 6. *Minimize the Potential for Establishment of Invasive Plant Species.*

Project activities will minimize the potential for invasive plant species (i.e. weeds) or soil pathogens to become established in disturbed areas and spread into restoration areas or natural areas. Weeds generally include those species listed by the California Invasive Plant Council and any species that can invade natural or restoration areas, and replace or preclude the establishment of native or other more desirable species. Equipment and/or vehicles used for remediation activities in off-road locations will utilize dry-truck cleaning measures (e.g. rumble strips, brushing) upon entering SSFL and/or the project site.

Conservation Measure 7. *Avoid, Minimize, and Mitigate for Disturbance to Corps Jurisdictional Wetlands and Waters of the U.S. and wetlands and waters under CDFW jurisdiction.*

This measure is included because proper functioning of drainages and wetland features is necessary to support overall ecosystem functioning, including the ability to support endangered,

threatened, and sensitive species onsite. Additionally, some of these features may have potential to provide habitat for threatened and endangered species.

a) No dumping or fill will be placed in any Clean Water Act (CWA) Section 404 Waters of the U.S. except as authorized by a permit from the Corps in support of the CWA (33) *United States Code* (U.S.C.) 1251 - 1387 Section 404, 33 CFR 328.3, 40 CFR 122.2, the Soil and Water Conservation Act (16) U.S.C. 2001 - 2009, and MCO P5090.2A, 11201.3.

b) Implement erosion BMPs for erosion and sediment control during soil remediation, building demolition, and any other ground disturbance activities in order to stop excess sediment flow into drainages, Waters of the U.S., and wetland features.

c) When soil disturbance occurs during the rainy season (November 1 to May 1), erosion and sedimentation BMPs will be installed and maintained immediately downslope of work areas until work is completed and disturbed areas have been re-contoured and physically stabilized.

d) Natural ephemeral drainages that are within the soil disturbance areas will be reconstructed as soon as possible to restore drainage patterns.

e) Man-made drainage features that are impacted by project activities may not need to be restored to pre-disturbance condition, but may need to be replaced to restore the drainage patterns from the site. If drainage needs to be restored, it will be done in a manner that mimics the natural drainage on the site.

f) In accordance with the Corps 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. A SWPPP will be prepared and will incorporate BMPs, such as silt fences, silt basins, and gravel bags, or other measures to control erosion and prevent the release of sediment and contaminants that have the potential to move downstream or could be harmful to aquatic resources, such as vernal pools that may support listed species.

Conservation Measure 8. *Avoid and Minimize Disturbance to Sensitive Upland Vegetation.*

Disturbance to Venturan coastal sage scrub, dipslope grassland, sandstone outcrops (including vegetated sandstone outcrops), chaparral, southern California walnut woodland, coast live oak woodland, southern willow scrub, mulefat scrub, and coast live oak riparian woodland, will be avoided and minimized to the extent practicable. Avoiding or minimizing adverse impacts to these relatively undisturbed native habitats is emphasized because of the difficulty and time involved in restoring their function, once the soil has been removed. Although restoration has been done on some interim remediation sites within SSFL, these sites were restored using topsoil obtained from elsewhere on SSFL. Boeing has identified onsite borrow areas suitable for providing backfill for their remediation activities and the effects of using the onsite borrow areas

are addressed in this BA. For remediation to be performed pursuant to the AOC, DOE is required to use suitable backfill soil; however, offsite sources of soils to be used as backfill and in restoration by DOE have not been identified. Proper functioning of these habitats is necessary to support overall ecosystem functioning on SSFL including the site's ability to support endangered, threatened, and sensitive species and designated critical habitat.

a) Design the final project to avoid or minimize impacts to sensitive native habitats by reducing disturbance footprints to the maximum extent practicable. Staging areas, laydown areas, and/or other temporary construction-related requirements will be located within already disturbed areas or non-sensitive habitat types.

b) Restore sensitive habitats that are temporarily disturbed as a result of project implementation to pre-project conditions as soon as possible to prevent net loss of habitat. Areas that cannot be restored within a short period of time (long-term impact) or are permanently impacted by project activities may require additional measures to compensate for temporary or permanent loss of sensitive habitats.

c) Topsoil below allowable chemical and radionuclide levels, if available, will be salvaged if practicable for eventual use in onsite habitat restoration.

Conservation Measure 9. *Develop a Revegetation and Habitat Restoration Plan.*

A qualified biologist will prepare a site-specific Revegetation and Habitat Restoration Plan (RHRP), in consultation with the Service and CDFW that includes a description of existing conditions in the action area, areas of impact, site preparation and revegetation methods, maintenance and monitoring criteria, performance standards, and adaptive management practices. Cover standards will be developed for each plant community target, and cover values will be established for each layer (i.e. herb, shrub, and/or tree layers).

The RHRP will be developed and approved by appropriate agencies prior to the initiation of ground disturbance or construction activities. The RHRP will address all revegetation efforts associated with the soil disturbances. It will include specific erosion control measures, irrigation requirements, species composition, seed mix origins and ratios for that particular habitat, weed control, water regimes, maintenance activities, success criteria, and monitoring requirements. The RHRP will, at a minimum, include the following:

a) Specification of revegetation methods, including seeding and/or planting of container stock, salvaged plants, cuttings, or other propagules collected or propagated from onsite sources, including any sensitive plant species that would be impacted during soil disturbance or other construction activities.

b) Establishment of an onsite nursery and use of onsite sources for growing medium (i.e. clean, weed-free soil) and propagules to avoid risk of introducing foreign pathogens, such as

water mold (*Phytophthora* spp.), and unwanted pests, such as Argentine ants (*Linepithema humile*), into restoration areas that may subsequently disperse and establish in undisturbed natural areas adjacent to restoration areas.

c) A schedule for seed and propagule collection for use in revegetation, as well as a schedule for construction and operation of the onsite propagation and growing facility. Propagule collection and propagation of plants in the growing facility will need to be initiated sufficiently in advance of remediation activities (a minimum of two growing seasons prior to the initial need for post-remediation revegetation) in order to generate adequate seed stock and container stock for use in revegetation.

d) Seed mixes will include only species native to the site and will be collected from onsite or nearby sources. The species mix to be used will contain species capable of providing self-sustaining native vegetation; for example, a suggested seed mix for Venturan coastal sage scrub could include the following species: California sagebrush, California buckwheat, coyote brush (*Baccharis pilularis*), black sage, purple sage (*S. leucophylla*), and deerweed (*Acmispon glaber*).

e) Topsoil below allowable chemical and radionuclide levels, if available, will be salvaged if practicable using two lifts: the first to salvage the seed bank and the second to salvage the soil biota in the root zone. The topsoil will be saved in two separate covered stockpiles close to the project site and replaced accordingly after final reconfiguration of disturbed areas.

f) Salvage uncontaminated and pest- or disease-free organic debris, including trees and shrubs downed during site clearing, for use as fill, mulch, compost, or habitat creation.

g) After completion of topsoil replacement and related grading and prior to initiation of restoration, graded areas will be inspected by a Project Biologist (or revegetation specialist) to determine whether any remedial measures are required prior to initiation of revegetation. Remedial measures may include re-grading, installation of erosion control methods, weed control, and installation of irrigation, if needed.

h) Revegetation of disturbed areas will be initiated the first fall after completion of final grading activities and before the winter rainfall season if feasible to minimize the need for watering and encourage early establishment of plants to reduce the potential for erosion associated with rain events. Supplemental watering may be required if reseeding/replanting must be conducted after the start of the rainy season.

i) Incorporate monitoring procedures, including periodic qualitative and quantitative assessments and minimum performance criteria, for revegetation and erosion control. The performance criteria and remedial actions need to consider the uncertainties of revegetation and restoration of sensitive habitats and sensitive plant species.

j) Appropriate remedial measures will be identified if the restoration is not progressing as expected. At a minimum, remedial measures may include invasive species control (e.g. hand removal, mechanical and herbicide control), reseeding/replanting, supplemental irrigation, and erosion control. The use of pesticides will be minimized through the use of green alternatives (for example, non-chemical solarizing technique) and an integrated pest management plan.

k) The monitoring and maintenance program duration and frequency will be specified to ensure the restoration sites are successful. RHRP Progress Reports will be submitted annually to all approval agencies. The progress reports will include an introduction, methods, results, and a summary of activities, findings, trends, and recommendations. There will be a period of monitoring, with no maintenance (including irrigation and weed control) to ensure the project site is self-sustaining and will not fail without maintenance (including supplemental water) or will not decline due to the presence of aggressive weedy species.

l) Minimize removal of existing vegetation during remediation.

Conservation Measure 10. *Develop a Tree Management and Preservation Plan.*

A Tree Management and Preservation Plan will be developed using a certified arborist. The goal of the plan is to offset tree impacts through a sustainable, customized plan that is suitable for the site's unique opportunities for tree preservation, enhancement, and establishment. The plan will identify trees protected by Ventura County, including coast live oak, sycamore, historical and heritage trees (protected trees), or special-status trees (e.g. southern California black walnut) that could be impacted within or adjacent to remediation areas, as well as those located outside of the project footprint that would be preserved. The plan will define direct and indirect impacts and include protection measures and options (such as tree relocation or replacement) within and outside of cleanup areas and the locations of mitigation areas within the project area boundary. Some flexibility will be required in applying protection measures to allow necessary contamination removal, and it is recognized that it is preferable to retain a tree rather than removing it even when contamination needs to be removed within its protective zone. The following protection measures may be used:

a) Fencing of oak and other protected trees adjacent to demolition and remediation activities areas.

b) Placement of fill, storage of equipment, and grading prohibited within the protective zone (minimum of 5 feet from the drip line or 15 feet from the trunk of the tree, whichever distance is greater) of a tree proposed for preservation.

c) Limit grade changes near the protective zones of trees.

d) Temporary retaining walls may be built to protect trees proposed for preservation from surrounding cut and fill. Retaining walls may be placed outside of the protective zone of the tree to be preserved.

For trees impacted by project activities, where mitigation is required, the Tree Management and Preservation Plan, which may be separate from or incorporated into the RHRP (see Conservation Measure 9), will specify performance measures, maintenance and monitoring requirements, adaptive management, and regulatory authorities.

Conservation Measure 11. *Soil Stabilization.*

In conjunction with reseeding and when topsoil is unavailable, soil stabilization BMPs will be used, including soil binders, erosion mats, gabion walls (outside of stream channels), and erosion control check dams, where applicable. An updated SWPPP will guide erosion control measures for all activities (e.g. demolition and remediation activities). Dust control measures would be developed and implemented to minimize fugitive dust and limit soil losses due to wind. The SWPPP will require all structural and non-structural BMPs to be installed and implemented in accordance with approved plans and specifications prior to the beginning of demolition and remediation activities. The project plans specified above will incorporate the following specific measures when and if applicable:

a) Use geotextile bags or nets to contain excavated sediment, facilitate sediment drying, and increased ease of sediment placement or transport, when appropriate.

b) Utilize erosion control products such as silt fences, sand bags, straw wattles, basins, and fiber rolls to aid in capturing sediment runoff, particularly along the bases of slopes, runoff pathways, and drainage ditches.

c) Provide contaminant control by using de-watering, runoff controls, tire washes, containment for chemical storage areas, demolition and remediation equipment decontamination, stockpile management, spill prevention and control measures, and protective sheeting or tarps on steep slopes prior to rain events.

d) Restore and maintain surface water banks that mirror natural conditions.

e) Install and maintain basins to capture sediment runoff along sloped areas and use excavated areas to serve as temporary retention basins; develop rain water retention basins or a collection system with barrels or cisterns to capture precipitation for potential onsite use. Retention basins should be designed in a way and appropriately treated to avoid creating mosquito breeding grounds.

f) Install earthen berms that utilize onsite/local materials to manage run-on and/or runoff stormwater.

g) Use gravel roads, porous pavement, and separated pervious surfaces rather than impermeable materials to maximize infiltration.

h) Cover filled excavations with an appropriate erosion control fabric (preferably biodegradable) or mulch to stabilize soil (prevent erosion) and serve as a substrate for ecosystems.

i) Use soil stabilization BMPs to help in reseeding success, including soil binders, erosion mats, and erosion control check dams.

j) Use captured rainwater, uncontaminated wastewater, or treated water for building demolition and soil and groundwater remediation activities or site restoration activities when possible (e.g. for wash water, irrigation, dust control, constructed wetlands, or other uses).

k) Establish protocols for proper storage and use of hazardous materials during the building demolition and soil and groundwater remediation phase.

l) Establish spill response procedures.

m) Use dust control measures to prevent soil erosion during the remediation phases.

n) Provide for erosion control through planting and maintenance of native vegetation within the disturbed areas.

Include design features that replicate the natural site drainage patterns to the extent possible, with minimal constructed features to allow for long-term erosion control and successful revegetation.

Special Conservation Measures for Listed and Sensitive Plant and Wildlife Species

Conservation Measure 12. *Avoidance and Minimization of Impacts to Braunton's milkvetch, Santa Susana tarplant, other Sensitive Plant Species and Associated Critical Habitat.*

a) Prior to access, excavation, demolition, remediation, installation of equipment, or any other activity associated with the proposed project, the Project Biologist will survey all proposed remediation, staging, and access areas, plus a buffer of 100 feet, for presence of federally and state-listed threatened or endangered plants, including Braunton's milkvetch and Santa Susana tarplant, and other sensitive plant species such as Malibu baccharis, Catalina mariposa lily (*Calochortus catalinae*), slender mariposa lily (*Calochortus clavatus* var. *gracilis*, Plummer's mariposa lily (*Calochortus plummerae*), or other mariposa lily (*Calochortus* spp.), California screw moss (*Tortula californica)*, and any *Dudleya* species (other than chalk dudleya [*Dudleya pulverulenta*] or lance-leaved dudleya [*D. lanceolata*]).

Plants will be mapped and clearly marked, and numbers of individuals and their condition will be determined and recorded.

b) Remediation access routes will be adjusted as needed to maximize avoidance of impacts to individuals or populations of Braunton's milkvetch or any other sensitive plant species and associated critical habitat. The Project Biologist will be responsible for overseeing demolition and remediation to ensure compliance with the conservation measures for preventing unanticipated impacts to Braunton's milkvetch and any other sensitive plant species. The Project Biologist will be on site during access, vegetation removal, and any other remediation activities with the potential to impact sensitive plant species.

c) Dust migration in or adjacent to areas that support sensitive species will be minimized by lightly spraying areas of exposed soil with water during excavation activities when weather conditions require the use of dust control measures.

d) If any sensitive plants occur within 100 feet of a proposed demolition or remediation area, the Project Biologist will flag their locations and work with the project team to avoid or minimize impacts to the species.

e) Where impacts to Braunton's milkvetch or other sensitive plant species are unavoidable, a salvage, propagation, and replanting program will be developed and implemented as part of the RHRP. That plan will include the following aspects:

- Utilize both seed and salvaged (excavated) plants, constituting an ample and representative sample of each colony of the species that would be impacted. The program should consider perpetuating the genetic lines represented on the impacted sites by obtaining an adequate sample prior to construction, propagating them, and using them in the restoration of that site. The program should also consider that the salvage and transplant of listed species is experimental and often has low success.

- Incorporate provisions for recreating suitable habitat and measures for re-establishing self-sustaining colonies of Braunton's milkvetch and other sensitive plant species on the site.

- Include provisions for monitoring and performance assessment, including standards that will allow annual assessment of progress and provide for remedial action should the species fail to re-establish successfully.

- The program would require approval from the Service and CDFW prior to its implementation, and activities involving handling of sensitive plant species will require appropriate permits from CDFW.

Conservation Measure 13. *Avoidance of Vernal Pools and Vernal Rock Pools Potentially Occupied by Listed Vernal Pool Species including Riverside Fairy Shrimp and/or Vernal Pool Fairy Shrimp.*

a) Prior to any work within 250 feet of vernal pools or vernal rock pools, and depressional features that support a hydroperiod sufficient to complete the fairy shrimp lifecycle, surveys should be conducted during the appropriate season(s) to determine the presence of federally listed Riverside and vernal pool fairy shrimp. Surveys must be conducted by a Service permitted fairy shrimp biologist. If listed fairy shrimp are identified, the Service would be notified by the permitted biologist within 10 working days of the discovery and work within 250 feet of occupied habitat (other than protective measures identified below) will not proceed until Responsible Party consultation with the Service on how to proceed has concluded.

b) To avoid impacts to federally listed fairy shrimp, occupied vernal pools and vernal rock pools, and depressional features that support a hydroperiod sufficient to complete the fairy shrimp lifecycle, within 250 feet of the project boundary will be identified on project construction plans. Occupied fairy shrimp habitat (vernal pools and vernal rock pools) within 250 feet of the project footprint will be clearly identified in the field with flagging or exclusion fencing. Pools occupied by fairy shrimp and vernal pool features in the proposed AOC biological exemption areas, or similar locations identified in Boeing's areas of responsibility, will be monitored by the Project Biologist during construction; the Project Biologist will be responsible for ensuring compliance with conservation measures and preventing unanticipated impacts to vernal pools, rock pools and vernal pool species.

c) Any demolition or remediation that could indirectly affect vernal pools or potential suitable habitat for federally listed fairy shrimp associated with vernal pools, rock pools, and vernal pool watersheds will occur outside of the rainy season (about November 1 to June 1) and in dry conditions only. Following the initial clearing of features, ongoing demolition and remediation activities can occur in the wet season by incorporating specific measures to protect surface water quality in vernal pools (e.g. use of jute netting into the SWPPP, geotextiles, wattling, and other materials), as determined by the Project Biologist, to avoid an increase or decrease of water quantity, sediment transport, and change in water quality runoff to pool basins. Sedimentation into basins will be prevented and soil-disturbing activities during the rainy season or when ground is wet (about November 1 to June 1) will be minimized.

d) Fueling of equipment and vehicle washing will be allowed only in designated areas and will not occur within 100 feet of any vernal pool or vernal rock pool or other aquatic habitat, including intermittent drainages.

e) Stockpiled soils will be placed on top of heavy-duty plastic sheeting on areas with an impervious surface. All stockpiles will be covered with material adequate to prevent soil transport by wind or rainwater. Covers will be maintained in good condition.

Conservation Measure 14. *Avoidance of California Red-legged Frog and associated Critical Habitat.*

To ensure that the unlikely event of the California red-legged frog migrating into the proposed work areas does not result in an impact to the species, a qualified biologist will conduct pre-demolition and pre-remediation surveys within work areas containing suitable habitat, as well as biological monitoring during demolition and remediation activities. the Service's (2005) guidance on habitat assessment and field surveys will be followed to determine presence/absence of the species and suitable habitat. If the California red-legged frog is discovered in work zones before or during demolition and remediation activities, the species will be avoided; demolition and remediation activities will be immediately halted; and consultation will be initiated with the Service to determine an appropriate response before demolition and remediation activities can begin/restart.

Conservation Measure 15. *Avoidance of Least Bell's Vireo.*

Any required clearing of woody riparian vegetation will take place outside of the breeding season for the least Bell's vireo (March 15 to August 31). When avoidance is not practicable, the following measures will be implemented:

a) If activities cannot occur outside of the breeding season, then pre-activity surveys will be conducted by a qualified biologist for all individual active nests of listed species in all suitable habitats within 300 feet of the proposed activities.

b) If an active nest occurs within 300 feet of the proposed activity, then project activities other than the use of existing roads will be delayed until after young fledge from the nest.

c) A qualified biologist will monitor nest progress and activities in and adjacent to riparian habitats to ensure compliance.

Pre-project surveys, when applicable, will adhere to the Service's (2001) least Bell's vireo survey guidelines as a recognized method to determine presence or absence of the species and its habitat and be conducted during the April 10 to July 31 ideal survey window within one year in advance of construction activity.

Conservation Measure 16. *Avoidance of Coastal California Gnatcatcher.*

Prior to any clearing of vegetation or soil removal in Venturan coastal sage scrub or other suitable habitat for the coastal California gnatcatcher, the Service's presence/absence survey

protocol (Service 1997a) will be implemented. Suitable habitat for coastal California gnatcatcher includes sage scrub communities dominated by species of sagebrush (*Artemisia* spp.), sage (*Salvia* spp.), buckwheat (*Eriogonum* spp.), and bush sunflower as described in Section 4.2.1.1, of the final BA. Because surveys could be required years from now, the identification of suitable habitat to be surveyed will be made by individuals permitted to conduct coastal California gnatcatchers presence/absence surveys and will be based on conditions existing at the time of the survey. If surveys are conducted during the ideal survey window (March 15 to June 30) with a negative finding, they will be valid for a period of 1 year.

a) Pre-activity surveys in all suitable coastal California gnatcatcher habitats will be conducted by a qualified biologist. If an active nest occurs within 300 feet of the proposed activity, the biologist will immediately notify the Responsible Party, and the project activities in the vicinity of the nest other than the use of existing roads will be delayed until after young fledge from the nest. If active nests are observed, the biologist, in coordination with the Service, will determine adequate set-backs from nests to prevent nest disturbance.

b) A qualified biologist will monitor nest progress and activities in and adjacent to coastal California gnatcatcher habitat to ensure compliance.

Conservation Measure 17. *Environmental Mitigation Requirements and Monitoring Program.*

DOE and Boeing will be in consultation with oversight agencies including the Service, CDFW, Corps, CDTSC, and County of Ventura, as appropriate, and will be responsible for coordinating and implementing the conservation and protection measures and permit requirements. Each respective Responsible Party will consult with their project biologist and other qualified staff as appropriate.

APPENDIX K
COST-BENEFIT ANALYSIS REPORT

Cost-Benefit Analysis Report
Area IV Santa Susana Field Laboratory
Ventura County, California

Prepared for:

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US Department of Energy
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Contract DE-EM0001128
CDM Smith Task Order DE-DT0003515

September 28, 2018
Version 5

Cost-Benefit Analysis Report
Area IV Santa Susana Field Laboratory
Ventura County, California

Contract DE-EM0001128

CDM Smith Task Order DE-DT0003515

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Table of Contents

Acronyms and Abbreviations ..... K-v

Executive Summary K-1

ES.1 Purpose and Scope K-1
ES.2 Risk Management K-1
ES.3 Cost/Risk Analysis K-4
ES.3.1 Cost Estimate Approach K-4
ES.3.2 Risk Analysis Approach K-4
ES.3.3 Cost/Risk Analysis Results K-4
ES.4 Uncertainty in Cleanup Decisions K-8
ES.4.1 Rationale for Evaluating Uncertainty in Cleanup Decisions K-8
ES.4.2 Results of Uncertainty Analysis K-8
ES.5 Green and Sustainable Remediation K-9
ES.5.1 Green and Sustainable Remediation Evaluation Approach K-9
ES.5.2 Green and Sustainable Remediation Evaluation Results K-10
ES.5.3 GSR Best Management Practices K-10
ES.6 Summary of Cost Benefit Analysis K-11

Section 1 Introduction K-1-1

1.1 Purpose K-1-1
1.2 Scope K-1-1
1.3 CBA Structure K-1-2

Section 2 Risk Management K-2-1

2.1 Use of Risk Assessment to Support Risk Management K-2-2
2.2 Cleanup Standards Scenarios K-2-3
2.2.1 Cleanup to AOC Look-Up Table Values Alternative K-2-3
2.2.2 Cleanup to Revised LUT Values Alternative K-2-4
2.2.3 Conservation of Natural Resources Alternative – Residential and Open Space Scenarios K-2-4
2.3 Risk Management Approaches Applied to Similar California Sites K-2-5
2.3.1 Hunters Point Naval Shipyard Risk Management Approach K-2-6
2.3.2 Former McClellan Air Force Base Risk Management Approach K-2-7

Section 3 Cost Estimate K-3-1

3.1 Basis of Estimate K-3-1
3.2 Approach K-3-1
3.3 Assumptions K-3-2
3.4 Cost Estimate Summary K-3-4

Section 4 Cost/Risk Analysis K-4-1

4.1 Cost/Risk Analysis Methodology K-4-1
4.1.1 Cost Estimates for Area IV/NBZ K-4-1
4.1.2 Risk Estimates for Select Exposure Areas K-4-1

4.2 Cost/Risk Analysis for Remedial Alternatives K-4-8
4.2.1 Residential Scenario K-4-8
4.2.2 Recreational Scenario K-4-11
4.3 Comparative Cost Benefit Analysis K-4-12
4.3.1 Remaining Cancer Risk, Remaining Non-Cancer Hazard, and Remedial Action Cost Comparison K-4-13
4.3.2 Reduction of Cancer Risk, Reduction of Non-Cancer Hazard, and Cost Comparison K-4-15

Section 5 Uncertainty in Cleanup Decisions K-5-1
5.1 Cleanup to AOC LUT Values Alternative K-5-1
5.1.1 Compounding Decision Error K-5-2
5.1.2 Comparison of DTSC Background Locations to AOC LUT Values K-5-3
5.1.3 Derivation of BTVs K-5-4
5.2 Cleanup to Revised LUT Values Alternative K-5-4
5.3 Conservation of Natural Resources Alternative – Residential Scenario and Recreational Scenario K-5-5

Section 6 Green and Sustainable Remediation K-6-1
6.1 Green and Sustainable Remediation Evaluation K-6-1
6.1.1 Approach and Methodology K-6-1
6.1.2 Results from Environmental Footprint Analysis K-6-4
6.1.3 Results from Enhanced Cost Analysis K-6-4
6.2 Incorporation of Green and Sustainable Remediation Elements K-6-5
Selection of Best Management Practices K-6-6

Section 7 References K-7-1

List of Figures

Figure ES-1 Remaining Cancer Risk and Remedial Action Cost among Remedial Action Alternatives – Residential Scenario
Figure ES-2 Remaining Cancer Risk and Remedial Action Cost among Remedial Action Alternatives – Recreational Scenario
Figure ES-3 Remaining Non-Cancer Hazard and Remedial Action Cost among Remedial Action Alternatives – Residential Scenario
Figure ES-4 Remaining Non-Cancer Hazard and Remedial Action Cost among Remedial Action Alternatives – Recreational Scenario
Figure 1-1 Site Location Figure
Figure 3-1 Estimated Present Worth and Accuracy Ranges of Total Life-Cycle Costs for Remedial Action Alternatives
Figure 4-1 Representative Exposure Areas
Figure 4-2 Remaining Cancer Risk and Remedial Action Cost among Remedial Action Alternatives – Residential Scenario
Figure 4-3 Remaining Non-Cancer Hazard and Remedial Action Cost among Remedial Action Alternatives – Residential Scenario
Figure 4-4 Remaining Cancer Risk and Remedial Action Cost among Remedial Action Alternatives – Recreational Scenario
Figure 4-5 Remaining Non-Cancer Hazard and Remedial Action Cost among Remedial Action Alternatives – Recreational Scenario
Figure 4-6 Percent Reduction in Cancer Risk and Remedial Action Cost among the Remedial Alternatives – Residential Scenario
Figure 4-7 Percent Reduction in Cancer Risk and Remedial Action Cost among the Remedial Alternatives – Recreational Scenario
Figure 4-8 Percent Reduction in Non-Cancer Hazard and Remedial Action Cost among the Remedial Alternatives – Residential Scenario
Figure 4-9 Percent Reduction in Non-Cancer Hazard and Remedial Action Cost among the Remedial Alternatives – Recreational Scenario
Figure 5-1 Probability of False Positive Decision Error as a Function of Proximity to the RBSL
Figure 6-1 Footprint Analysis Results - Sustainability Metrics
Figure 6-2 Footprint Analysis Results - Normalized Sustainability Metrics

List of Tables

Table ES-1 Cost Benefit Analysis Summary
Table 3-1 Remediation Soil Quantities by Alternative
Table 3-2 Remedial Action Alternatives Cost Summary
Table 4-1 Exposure Areas Risk Assessment Results – Residential Scenario
Table 4-2 Exposure Areas Risk Assessment Results – Recreational Scenario
Table 5-1 Monte Carlo Simulation Results of False Positive Error Rates
Table 6-1 Societal Disamenities and Unit Social Costs for Environmental Metrics
Table 6-2 Footprint Analysis - Sustainability Metric Results and Relative Impact
Table 6-3 Enhanced Cost Analysis - Social Cost
Table 6-4 Green and Sustainable Remediation Best Management Practices

Attachments

Attachment A AOC LUT Values and RBSLs
Attachment B Environmental Footprint Analysis Development

Acronyms and Abbreviations

AFB	Air Force Base
AOC	Administrative Order on Consent
B4064	Building 4064
BaP	benzo(a)pyrene
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 Regulations
CNY	New Conservation Yard
COC	contaminant of concern
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
ELCR	excess lifetime cancer risk
EPC	exposure point concentration
EQuIS	Environmental Quality Information System
ESADA	Empire State Atomic Development Authority
FDA	U.S. Food and Drug Administration
FSDF	Former Sodium Disposal Facility
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
MDC	minimum detectable concentration

M-L MRL	multi laboratory method reporting limit
MLLW	mixed low level radioactive waste
MM	million
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
OSWER	Office of Solid Waste and Emergency Response
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
RESRAD	residual radioactive
RfD	reference dose
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
TCR	target excess lifetime cancer risk
TEQ	toxicity equivalent quotient
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 *Final 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) would conduct the remedial action.

This CBA was developed in accordance with 40 Code of Regulations (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 receptors 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 alternative. 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 Green and Sustainable Remediation (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 the United States Environmental Protection Agency (USEPA). The 40 CFR 300.430 (j) of the NCP states that:

> *For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 10^{-4} and 10^{-6} using information on the relationship between dose and response. The 10^{-6} risk level shall be used as the point of departure for determining remediation goals for alternatives when applicable or relevant and appropriate requirements (ARARs) are not available or are not sufficiently protective because of the presence of multiple contaminants at a site or multiple pathways of exposure;*

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 within 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 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. However, no "bright line[1]" 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.

According to EPA guidance, remediation goals are developed based on hazard index (HI) values equal to one for noncarcinogens (USEPA, 1991a). Therefore, in calculating remediation goals at a site to protect for non-cancer effects, remediation goals are generally set at an HI at or below 1.

Based on the above, for the purpose of this CBA, the USEPA target cancer risk range of 1×10^{-4} to 1×10^{-6} and non-cancer hazard as indicated by HI of 1 or less were used as reference values for cost/risk analysis to provide input into risk management decisions.

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.

No Action Alternative

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.

Cleanup to AOC LUT Values Alternative

Under this alternative, risk assessment is not employed as a basis for cleanup decisions. Cleanup decisions are based on a point-by-point and analyte-by-analyte comparisons with respect to AOC Look-Up Table (LUT) values established from background soil data for chemicals (established by DTSC) and radionuclides (provisional values 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). Any soil sample location that exceeds the AOC LUT for one or more contaminants of concern (COCs) would be included in the cleanup for this alternative.

[1] Bright line – The phase "bright line" is meant to indicate a clear line or point where one thing may be distinguished from another (i.e., there isn't an exact risk level that should be used in remedial decision-making).

Cleanup to Revised LUT Values Alternative

Under this alternative, soil risk-based screening level (RBSL) values are used as instead of 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 for this alternative were calculated for a suburban residential and ecological exposure scenario established for SSFL (see *Final Standardized Risk Assessment Methodology [SRAM],* MWH 2014). The Cleanup to Revised LUT Values Alternative addresses removal of impacted soil based on a point-by-point evaluation of the exceedance of human health and ecological RBSL values for chemicals and AOC LUT values for radionuclides. Any soil sample location exceeding these criteria for one or more COCs would be included in the cleanup for this alternative.

Conservation of Natural Resources Alternative – Residential Scenario

Under the Conservation of Natural Resources Alternative – Residential Scenario, 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 nineteen 10,000 m^2 representative exposure areas for the respective COCs determined for each exposure area. Exposure areas were selected because of the presence of radionuclide contamination, a history of prior cleanup actions, a demonstrated range of chemicals that is characteristic of Area IV operations, and localized hotspots (locations with concentrations exceeding 10 times RBSL values). The COCs for each exposure area were identified using a multistep COC selection process. RBSLs for suburban residential were derived as outlined in the SRAM (MWH 2014). Human health cancer risks and non-cancer hazards associated with exposure to COCs in each exposure area were evaluated. The resulting risks are compared with a cancer risk between 1×10^{-6} and 1×10^{-4} and non-cancer HI of 1 to determine if risk reduction is warranted. If risks are greater than a 1×10^{-4} risk, or an 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.

Conservation of Natural Resources Alternative – Open Space Scenario

The Conservation of Natural Resources Alternative – Open Space Scenario is similar to the Conservation of Natural Resources Alternative – Residential Scenario, except the RBSLs for recreators were used in place of RBSLs for suburban residents.

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 (AFB). 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 2018a) 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 under either the residential scenario or the recreational scenario. As such, the CBA quantifies risk levels under a No Action Alternative and risk reduction under the four remedial action alternatives for each exposure scenario. For each remedial action alternative, the risk analysis evaluates risks to human receptor associated with exposure to COCs in surface soil from a subset of Area IV comprised of 19 exposure areas.

The steps conducted for this risk analysis include: 1) identification of representative exposure areas, 2) selection of COCs, 3) estimation of exposure point concentrations, and 4) estimation of cancer risks and non-cancer hazards. The risk analysis is the same under either the residential scenario or the recreational scenario, except the respective exposure assumptions and RBSLs used under each scenario.

Two sets of cancer risk and non-cancer hazards values were developed for the alternatives: one for suburban residential scenario and another for recreational scenario. The No Action Alternative and the Cleanup to AOC LUT Values Alternative were evaluated for both sets of exposure scenarios. It is noted that the Cleanup to Revised LUT Values Alternative is specific to the residential scenario (i.e. developed based on exposure frequency for a suburban resident); the recreational scenario was not evaluated under this alternative. Likewise, for the Conservation of Natural Resources Alternative – Residential Scenario, only the residential scenario was evaluated. For the Conservation of Natural Resources Alternative – Open Space Scenario, the recreational scenario was evaluated.

The cost/risk analysis then compares the reduction in cancer risk and non-cancer hazard for the 19 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

Residential Scenario

Cancer risk for suburban residents under the current conditions (same as No Action Alternative) at the 19 exposure areas would range between 5×10^{-6} to 2×10^{-3}. Of the 19 exposure areas evaluated, only 3 exposure areas (SRE Grid H15, 17th Street Pond Grid M14, and Building 4064 NE

Grid I18) have cancer risk above the USEPA target cancer risk range of 1 x 10^{-4} to 1 x 10^{-6}. The estimated present worth of the life cycle costs for No Action is $3.3 million (MM).

Cancer risk for all remedial action alternatives would fall within the USEPA target cancer risk range of 1 x 10^{-4} to 1 x 10^{-6}. The estimated present worth of the life cycle costs for the remedial action alternatives are $774 million (MM) for the Cleanup to AOC LUT Values Alternative; $230 MM for the Cleanup to Revised LUT Values Alternative, and $50 MM for the Conservation of Natural Resources Alternative – Residential Scenario (See **Figure ES-1** and **Table ES-1**) (CDM Smith 2018a). The incremental increase in cost to reduce average cancer risk from 1 x 10^{-5} (Conservation of Natural Resources Alternative – Residential Scenario) to 8 x 10^{-6} (Cleanup to Revised LUT Values Alternative) is approximately $180 MM. The remaining average cancer risk in the Cleanup to Revised LUT Values Alternative (8 x 10^{-6}) and in the Cleanup to AOC LUT Values Alternative (7 x 10^{-6}) are similar (difference of 1 x 10^{-6}), but the cost of the Cleanup to AOC LUT Values Alternative is $543 MM greater, an increase of 236% over the Cleanup to Revised LUT Values Alternative cost. The remaining average cancer risk under the Cleanup to AOC LUT Values Alternative is above the NCP point of departure of 1 x 10^{-6} (the cancer risk value from which remediation goal is determined under NCP).

In addition to evaluation of remaining cancer risk under each alternative, the percent reduction of remaining cancer risk relative to the Cleanup to AOC LUT Values Alternative were also evaluated. 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. The results show that in 14 out of 19 exposure areas evaluated, the Conservation of Natural Resources Alternative – Residential Scenario would achieve approximately 80% or more of the average cancer risk reduction compared to the Cleanup to AOC LUT Values Alternative. In the 5 exposure areas with percent cancer risk reduction of less than 80%, all have initial cancer risks (e.g. cancer risks under the No Action Alternative) within the USEPA target cancer risk range between 1 x 10^{-6} and 1 x 10^{-4}. It is also noted that in the three exposure areas with initial cancer risk above USEPA target cancer risk range (SRE Grid H15, 17th Street Pond Grid M14, and Building 4064 NE Grid I18), all have percent cancer risk reduction of greater than 93% under the Conservation of Natural Resources Alternative – Residential Scenario. Overall, the average percent cancer risk reduction across the 19 exposure areas relative to the Cleanup to AOC LUT Values Alternative is 80%. The cost for the above cancer risk reduction benefit under the Conservation of Natural Resources Alternative – Residential Scenario for the entire Area IV/NBZ is estimated to be $50 MM.

Under the Cleanup to Revised LUT Values Alternative, an average percent cancer risk reduction of 99% relative to the Cleanup to AOC LUT Values Alternative is achieved across the 19 exposure areas. Relative to the Conservation of Natural Resources Alternative– Residential Scenario, the average increase in percent risk reduction comparing to the Conservation of Natural Resources Alternative – Residential Scenario is 19% across the 19 exposure areas. The cost for the Cleanup to Revised LUT Values Alternative is $230 MM, which is an additional $180 MM over the cost of the Conservation of Natural Resources Alternative – Residential Scenario.

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% on average among the 19 exposure units due to <100% reduction in 4 exposure units). The cost for the Cleanup to AOC LUT Values Alternative is $774 MM, which is an additional $543 MM over the cost of the Cleanup to Revised LUT Values Alternative.

Recreational Scenario

Cancer risk for recreators under current conditions (same as No Action Alternative) at the 19 exposure areas would range between 1×10^{-6} to 2×10^{-4}. Of the 19 exposure areas evaluated, only one exposure area (Building 4064 NE Grid I18) would have cancer risk above the USEPA target cancer risk range of 1×10^{-4} to 1×10^{-6}. The estimated present worth of the life cycle costs for No Action is $3.3 million (MM).

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 $774 million (MM) for the Cleanup to AOC LUT Values Alternative and $43 MM for the Conservation of Natural Resources Alternative – Open Space Scenario (See **Figure ES-2** and **Table ES-2**) (CDM Smith 2018a). The incremental increase in cost to reduce average cancer risk from 2×10^{-6} (Conservation of Natural Resources Alternative – Open Space Scenario) to 1×10^{-6} (Cleanup to AOC LUT Values Alternative) is approximately $731 MM.

In addition to evaluation of remaining cancer risk under each alternative, the percent reduction of remaining cancer risk relative to the Cleanup to AOC LUT Values Alternative were also evaluated. The results show that in 14 out of 19 exposure areas evaluated, the Conservation of Natural Resources Alternative – Open Space Scenario would achieve approximately 87% or more of the average cancer risk reduction compared to the Cleanup to AOC LUT Values Alternative. In the 5 exposure areas with percent cancer risk reduction of less than 87%, all have initial cancer risks (e.g. cancer risks under the No Action Alternative) within the USEPA target cancer risk range between 1×10^{-6} and 1×10^{-4}. It is also noted that in the one exposure area with initial cancer risk above USEPA target cancer risk range (Building 4064 NE Grid I18), the percent cancer risk reduction was 99.8% under the Conservation of Natural Resources Alternative – Open Space Scenario. Overall, the average percent cancer risk reduction across the 19 exposure areas relative to the Cleanup to AOC LUT Values Alternative is 74%. The cost for the above cancer risk reduction benefit under the Conservation of Natural Resources Alternative – Open Space Scenario for the entire Area IV/NBZ is estimated to be $43 MM.

Under the Cleanup to AOC LUT Values Alternative, an average percent cancer risk reduction is 100% by definition across the 19 exposure areas. Relative to the Conservation of Natural Resources Alternative– Open Space Scenario, the average increase in percent risk reduction is

26% across the 19 exposure areas. The cost for the Cleanup to AOC LUT Values Alternative is $774 MM, which is an additional $731 MM over the cost of the Conservation of Natural Resources Alternative – Open Space Scenario.

Non-Cancer Hazard and Remedial Action Cost

Residential Scenario

Non-cancer HI values under the current conditions (same as No Action Alternative) at the 19 exposure areas would range between 0.1 to 100. Of the 19 exposure areas evaluated, 6 exposure areas (Building 4064 NW Grid I17, Building 4064 NE Grid I18, Building 4064 SW Grid J17, O10, G17, I14) have HI values at or below the USEPA target of 1. The estimated present worth of the life cycle costs for the No Action Alternative is $3.3 million (MM).

All remedial action alternatives would meet the non-cancer hazard threshold with an HI of 1 or below. In fact, the average HI values across the 19 exposure units for the three remedial alternatives are identical at 0.4 (after rounding to one significant figure). As presented previously, the estimated present worth of the life cycle costs for the remedial action alternatives range from $50 MM to $774 MM (See **Figure ES-3** and **Table ES-1**) (CDM Smith 2018a). Given the USEPA's target non-cancer HI of 1, any further reduction of HI value below 1 is only an added benefit, but not a cleanup driver. As such, cleanup for non-cancer hazard under the Conservation of Natural Resources Alternative – Residential Scenario would meet the goal of limiting non-cancer hazard to HI of 1, and that any additional cleanup effort, if required, would be driven by cancer risk.

The results show that across the 19 exposure areas evaluated, the Conservation of Natural Resources Alternative – Residential Scenario would achieve an average HI percent reduction of 90% (percent reduction is calculated similar to cancer risk percent reduction defined above). The cost for the Conservation of Natural Resources Alternative – Residential Scenario for the entire Area IV/NBZ is estimated to be $50 MM. Under the Cleanup to Revised LUT Values Alternative, an average percent HI reduction 99.6% across the 19 exposure areas is achieved. The cost for the Cleanup to Revised LUT Values Alternative is $230 MM, which is an additional $180 MM over the cost of the Conservation of Natural Resources Alternative – Residential Scenario. Under the Cleanup to AOC LUT Values Alternative, the average HI percent reduction is 100% by definition. The cost for the Cleanup to AOC LUT Values Alternative is $774 MM, an additional $543 MM over the Cleanup to Revised LUT Values Alternative.

Recreational Scenario

HI values under current conditions (same as No Action Alternative) at the 19 exposure areas would range between 0.02 to 30. Of the 19 exposure areas evaluated, only 3 exposure areas (RMHF Grid I13, F18, and P6) have non-cancer hazard above the USEPA target HI of 1 under the No Action Alternative. The estimated present worth of the life cycle costs for the No Action Alternative is $3.3 million (MM).

All remedial action alternatives would meet the non-cancer hazard threshold with an HI of 1 or below. In fact, the average HI values across the 19 exposure units for the both remedial alternative under the recreational scenario are identical at 0.1 (after rounding to one significant figure). As presented previously, the estimated present worth of the life cycle costs for the remedial action alternatives range from $43 MM to $774 MM (See **Figure ES-4** and **Table ES-2**)

(CDM Smith 2018a). Given the USEPA's target non-cancer hazard as indicated by an HI of 1, any further reduction of the HI below 1 is only an added benefit, but not a cleanup driver. As such, cleanup for non-cancer hazard under the Conservation of Natural Resources Alternative – Residential Scenario would meet the goal of limiting non-cancer hazard to an HI of 1, and that any additional cleanup effort, if required, would be driven by cancer risk.

The results show that across the 19 exposure areas evaluated, the Conservation of Natural Resources Alternative – Open Space Scenario would achieve an average HI reduction of 91%. The cost for the Conservation of Natural Resources Alternative – Open Space Scenario for the entire Area IV/NBZ is estimated to be $43 MM. Under the Cleanup to AOC LUT Values Alternative, the average percent HI reduction is 100% by definition. The cost for the Cleanup to AOC LUT Values Alternative is $774 MM, an additional $731 MM over the Conservation of Natural Resources Alternative – Open Space Scenario.

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 is to limit the false positive decision error rate due to measurement uncertainty to 5% or less for each constituent.

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 (discussed in Section 5.1.1) 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 (11% to 93% across all analytes using simulated data,

but will vary based on actual data), 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 (66% to 96% lower across all analytes using simulated data, but will vary based on actual data), and would tend to limit the false positive decision error rate. However, the false positive error rate for the Cleanup to Revised LUT Values Alternative would 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 (either exposure scenario), soil remediation determinations are made in terms of the exposure area, such that the mean concentration that remains in the exposure area after cleanup would be within the specified limit of acceptability (i.e., associated risks would meet USEPA target cancer risk range and non-cancer hazard). To minimize chances of underestimating the true amount of exposure and risk, risk calculations are based on the 95% upper confidence limit[2] (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 would depend on how close the exposure area concentration mean is to the limit of acceptability and the underlying concentration 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 would 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 would decrease. However, if the underlying concentration 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 collecting more data samples towards reducing the 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 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 and a socioeconomic impact assessment for each remedial action alternative.

[2] 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 a risk manager can be confident is health protective when it is used to calculate risks and hazards.

Three of four remedial alternatives were evaluated for environmental footprint and socioeconomic impacts. GSR evaluation for the Conservation of Natural Resources Alternative – Open Space Scenario was not evaluated because it has similar duration and excavation/backfill volume as the Conservation of Natural Resources Alternative – Residential Scenario. The environmental footprint and socioeconomic impacts for the Conservation of Natural Resources Alternative – Open Space Scenario was therefore assumed to be similar to or slightly less than the environmental footprint of the Conservation of Natural Resources Alternative – Residential Scenario.

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 three remedial action alternatives evaluated indicate that the Cleanup to AOC LUT Values Alternative emits the most greenhouse gases (GHGs, 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 – Residential Scenario 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 – Residential Scenario.

Results of Socioeconomic Analysis

Socioeconomic impacts were evaluated using an enhanced cost analysis that considered the social cost of various environmental metrics among the proposed remedial alternatives. The Conservation of Natural Resources Alternative – Residential Scenario produces the least long-term global impacts (production of greenhouse gas and other harmful waste products) and has the least associated social costs (an estimated $1.6 MM), while the Cleanup to AOC LUT Values Alternative produces the most long-term global impacts and has the highest associated social costs (an estimated $25 MM). A comparison of the social cost among the proposed alternatives results in an approximately 94% reduction in monetized global impacts by implementing the Conservation of Natural Resources Alternative – Residential Scenario in lieu of the Cleanup to AOC LUT Values Alternative, and approximately 72% reduction in monetized global impacts by implementing Cleanup to Revised LUT Values Alternative in lieu of the Cleanup to AOC LUT Values Alternative.

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, environmental 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**.

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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 - Open Space Scenario	Conservation of Natural Resources Alternative - Residential Scenario	Cleanup to Revised LUT Values Alternative	Cleanup to AOC LUT Values Alternative	
Scenario			Recreational	Residential	Recreational	Residential	Residential	Recreational / Residential	
Risk Management Approach	Risk Management Approach		No risk management approach is utilized.		Cancer risks and non-cancer hazards are calculated for recreators exposed to surface soil within defined exposure areas. The resulting risks are compared with the USEPA target cancer risk range 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 above USEPA target levels, soil associated with soil samples containing risk drivers are removed in an iterative process until the resulting risk and hazards fall within USEPA target levels.	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 USEPA target cancer risk range 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 above USEPA target levels, soil associated with soil samples containing risk drivers are removed in an iterative process until the resulting risk and hazards fall within USEPA target levels.	The AOC LUT values for chemicals are replaced with risk-based screening levels (RBSLs) calculated for a suburban residential exposure scenario established for 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 x 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)		$3.3MM		$43MM	$50MM	$230MM	$774MM	3
Risk Analysis	Remaining Cancer Risk in the 19 exposure areas evaluated[3]	Minimum	1E-06	5E-06	3E-07	1E-06	5E-07	1E-07 / 4E-07	4
		Maximum	2E-04	2E-03	1E-05	5E-05	5E-05	5E-06 / 5E-05	
		Average	2E-05	2E-04	2E-06	1E-05	8E-06	1E-06 / 7E-06	
	Remaining Non-Cancer Hazard Index (HI) in the 19 exposure areas evaluated[3]	Minimum	0.02	0.1	0.01	0.06	0.06	0.01 / 0.05	
		Maximum	30	100	0.3	1	0.9	0.2 / 0.9	
		Average	2	9	0.1	0.4	0.4	0.1 / 0.4	
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	Lowest	Moderate	Highest; > 5%	
Green and Sustainability	Environmental Footprint (largest, moderate, smallest)		Not Applicable (no cleanup)		Smallest	Smallest	Moderate	Largest	6
	Estimated Social Cost (million dollars)		Not Applicable (no cleanup)		Less than $1.6MM	$1.6MM	$7.1MM	$25MM	

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. Cancer risks and HI's 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

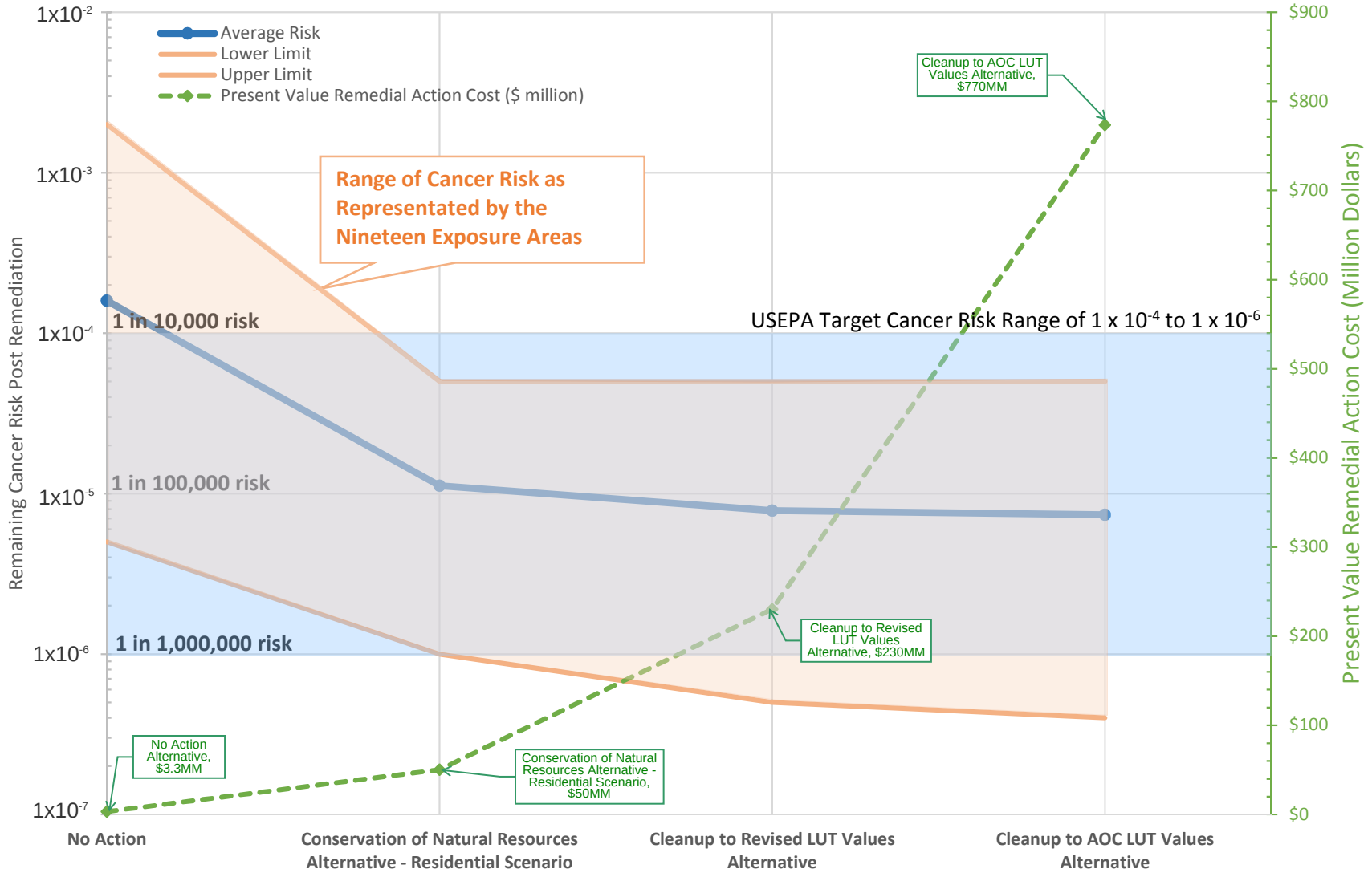


Figure ES-1 Remaining Cancer Risk and Remedial Action Cost among Remedial Alternatives - Residential Scenario

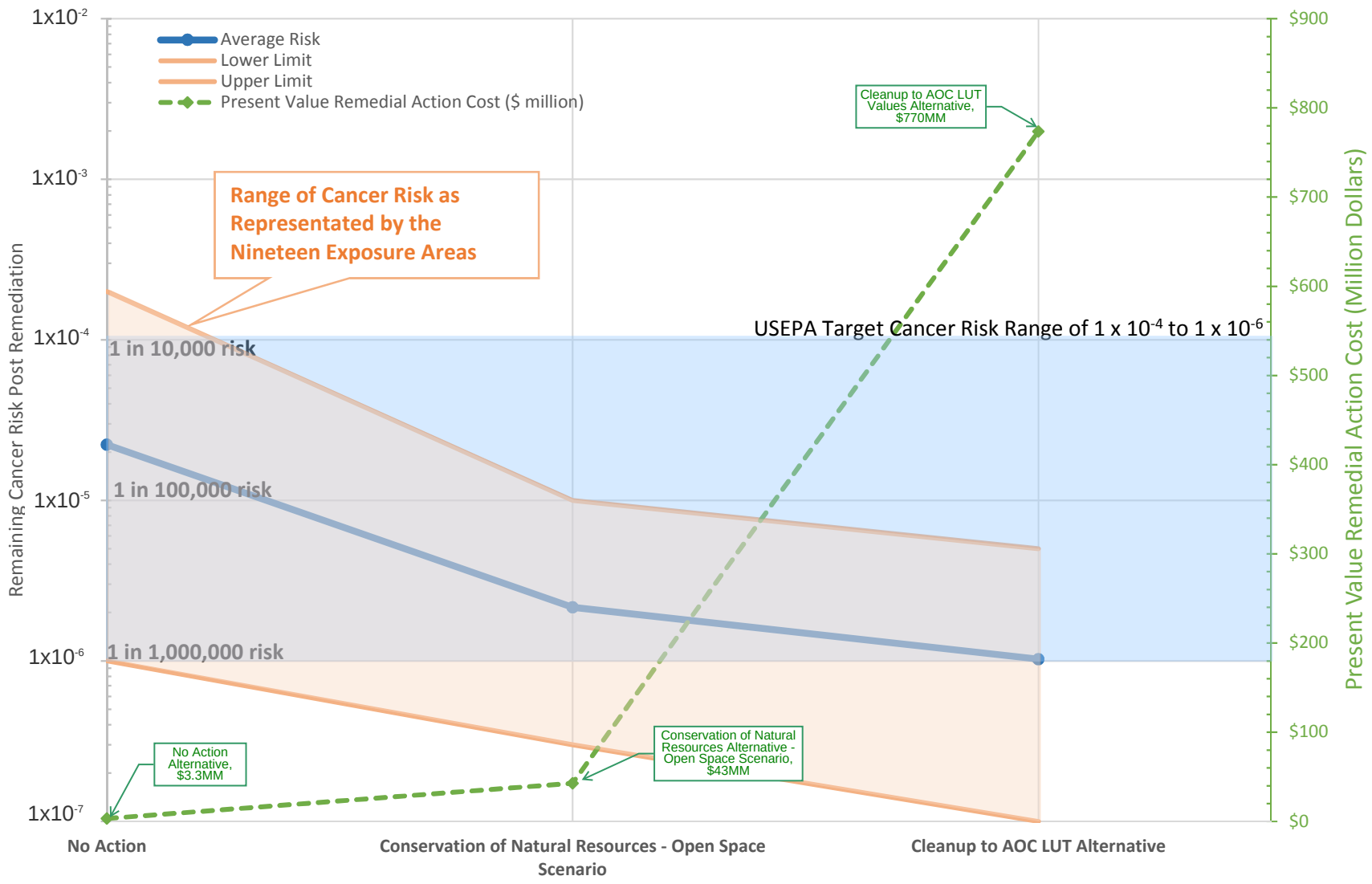


Figure ES-2 Remaining Cancer Risk and Remedial Action Cost among Remedial Alternatives - Recreational Scenario

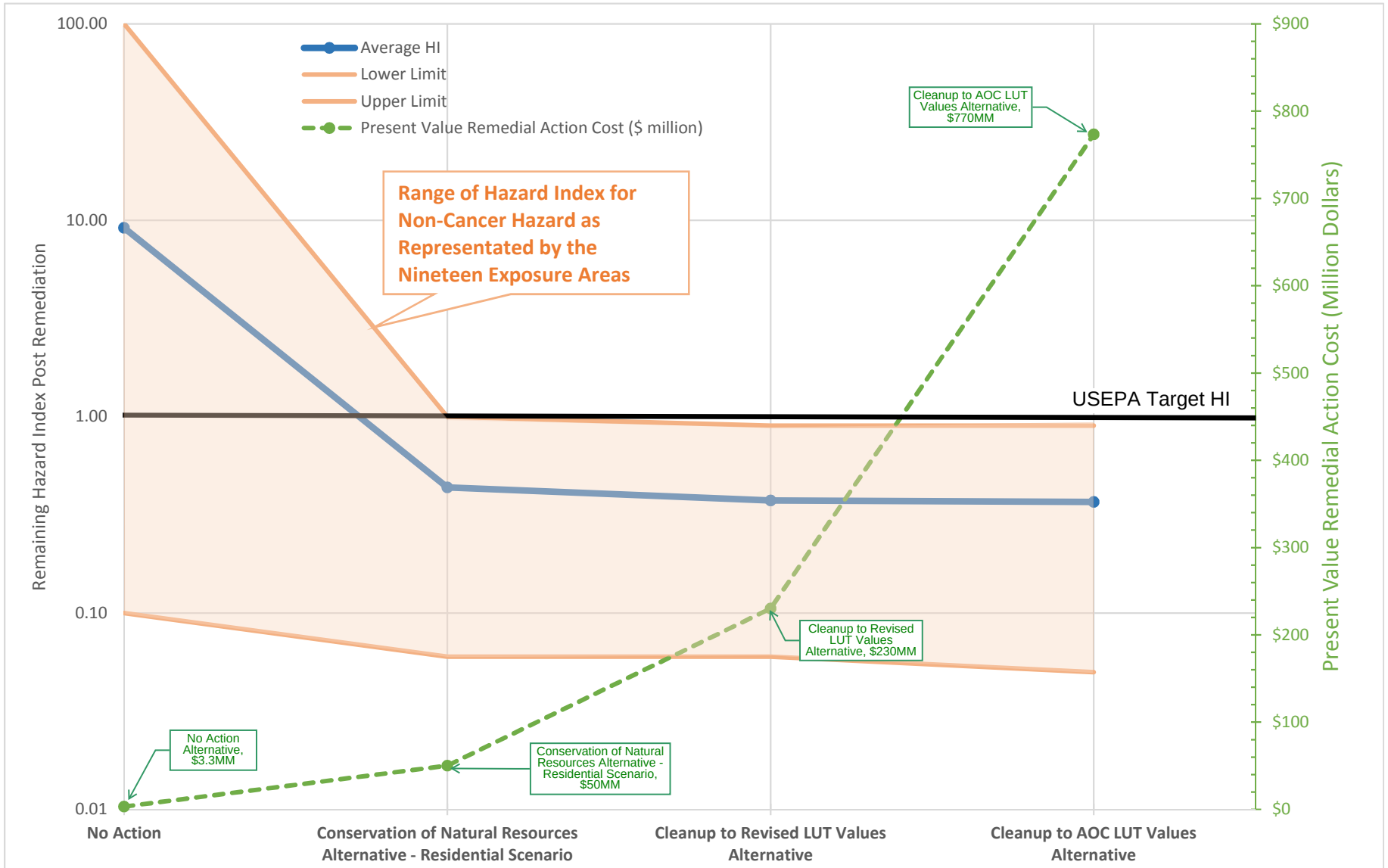


Figure ES-3 Remaining Non-Cancer Hazard and Remedial Action Cost among Remedial Alternatives - Residential Scenario

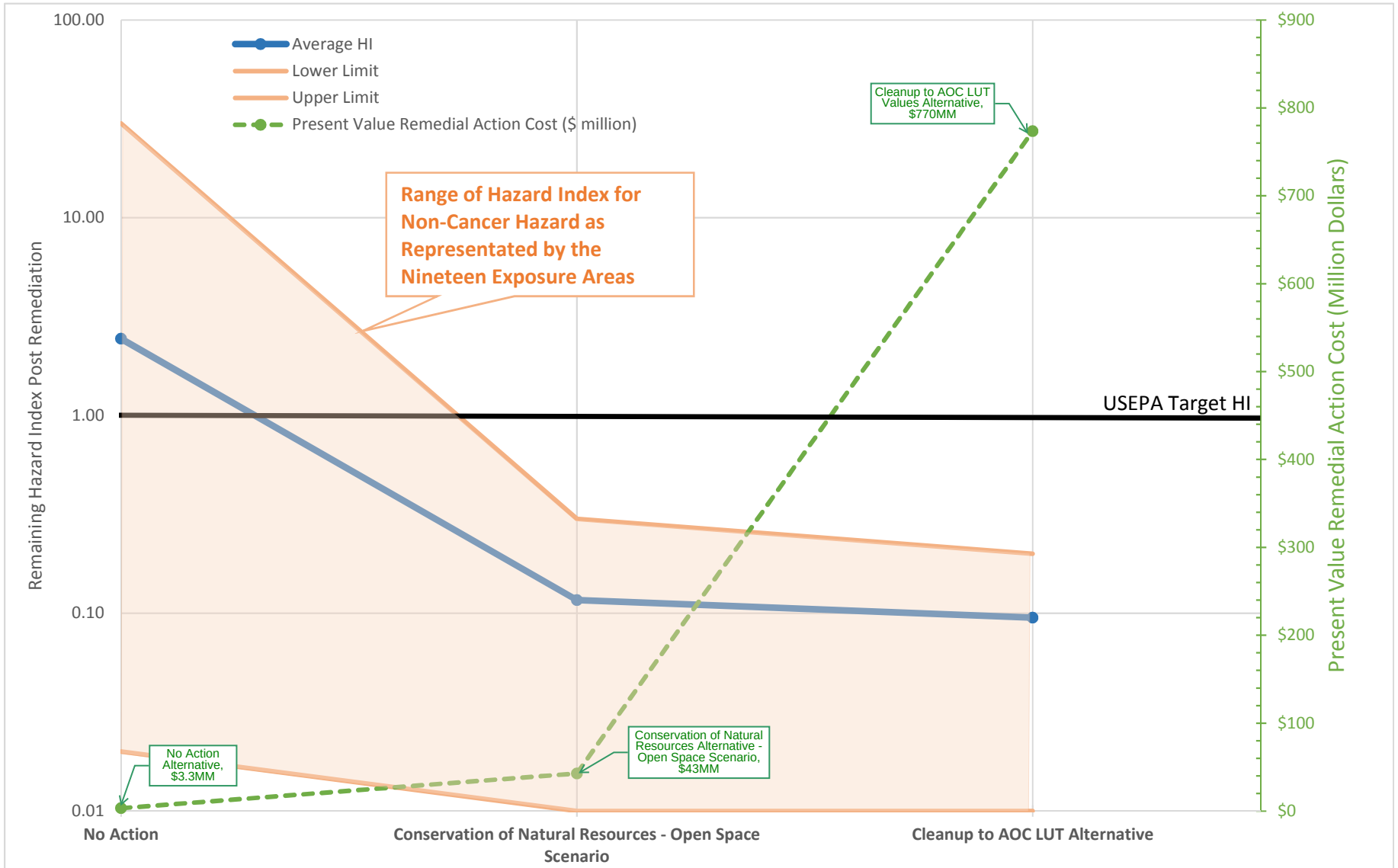


Figure ES-4 Remaining Non-Cancer Hazard and Remedial Action Cost among Remedial Alternatives - Recreational Scenario

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 and 2.4 of the *Final Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory* (EIS). The remedial action would 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 would 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 Final EIS as Appendix K.

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 receptors by

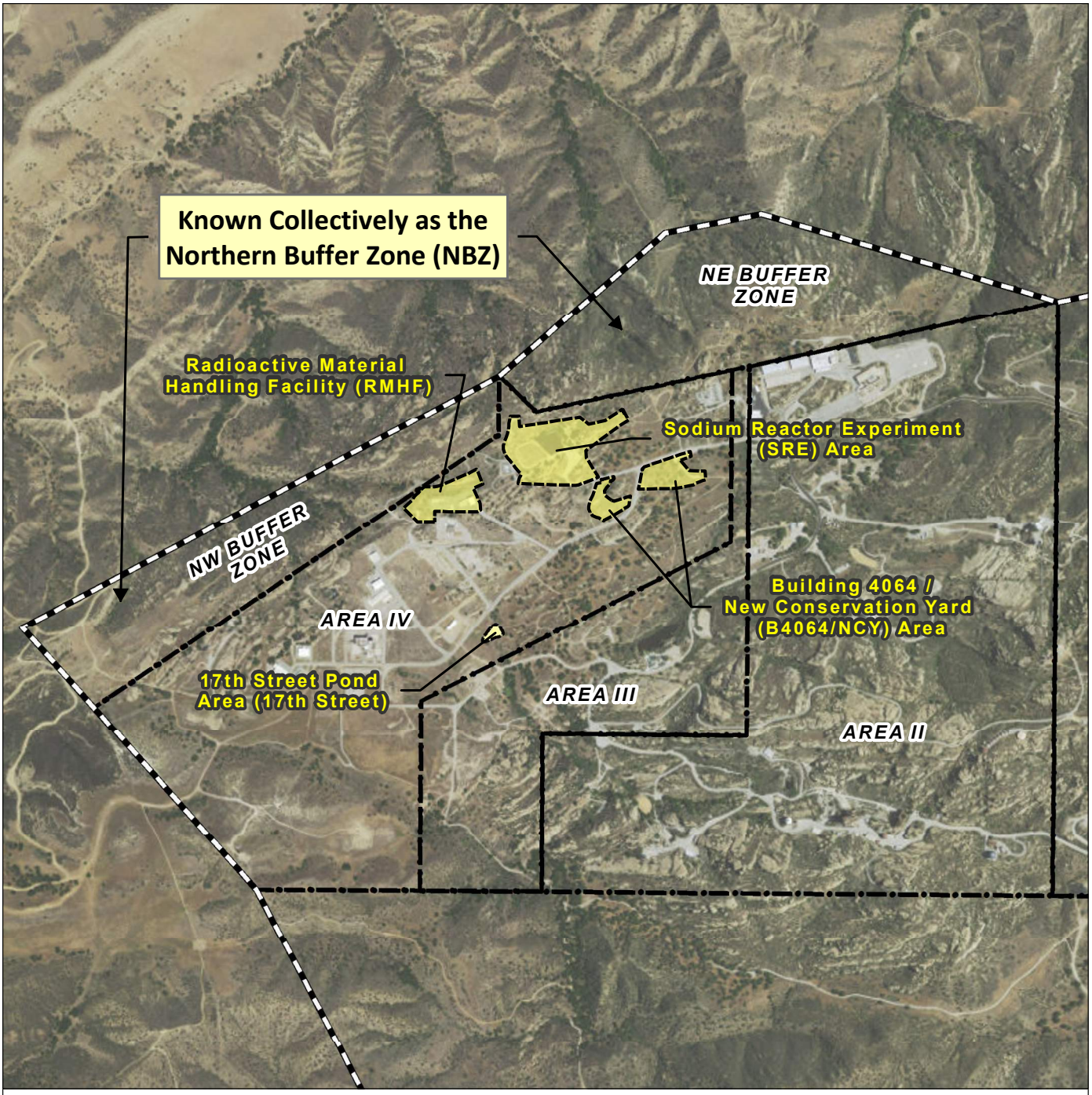
assessing cancer risks [1]and non-cancer hazards resulting from the implementation of each alternative. This CBA presents the estimated capital construction costs, surveillance and long-term maintenance costs, and total life-cycle costs of each alternative. These costs are compared to the risk reduction 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 Sustainable Remediation (GSR) Evaluation – this section evaluates the green and sustainability aspect of the remedial action alternatives, and considers the environmental footprint and socioeconomics impacts 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.

[1] Note that cancer risk evaluations were performed similar to standard CERCLA risk assessments, which only consider the rate of incident of cancer. It is to be distinguished from latent cancer fatalities, where the incident of cancer leads to patient death.



LEGEND

Area IV Key Location | Area IV Boundary | SSFL Property Boundary

Notes:
- 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.

N

0 700 1,400 Feet

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, under which two scenarios were evaluated:
  - Residential Scenario
  - Open Space Scenario

Each of the three soil remedial action alternatives 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, lifestyle, 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 members 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 alternatives 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 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 HI[1] of 1, a cleanup action under CERCLA is generally warranted at the site.

In general, USEPA considers excess cancer risks that are below 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 the 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, 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 uses 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

[1] An HI is the sum of the non-cancer HQs for individual COCs. HQ is defined in Section 4.1.2.

certain cases, USEPA may consider risk estimates slightly greater than 1×10^{-4} or an HI greater than 1 to be protective (USEPA 1991a).

The target cancer risk of 1×10^{-6} or an HI equal to or less than 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 a 1×10^{-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 (1×10^{-6}) the action level 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).

Based on the above, for the purpose of this CBA, the USEPA target cancer risk range of 1×10^{-4} to 1×10^{-6} and USEPA target non-cancer hazard as indicated by an HI of equal to or less than 1 were used as target values for cost/risk analysis to provide input into risk management decisions.

Note: This CBA focuses on risk reductions for human receptors because risk reduction for human receptors is one of the main drivers behind the final selection of cleanup decisions. However, final cleanup decisions for Area IV and the NBZ may also factor in risk reduction for ecological 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 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 is not based on 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 would 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).

The chemicals targeted under this alternative include the COCs identified in the Chemical Data Summary Report (CDSR) (CDM Smith 2017) and the radionuclides as described in USEPA's final soil investigation report (HGL 2012). Soil sample locations that exceed the AOC LUT value for one or more COCs or radionuclides would be included in the cleanup footprint. Cancer risks and non-cancer hazards for this alternative were calculated by removing these locations for the 19 representative exposure areas. The methodology and results of the risk assessment for this alternative is discussed in detail in Section 4.

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 scenario at SSFL (MWH 2014[2]) 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 HI of 1.

The cleanup footprint for this alternative was determined by removing sample locations that exceeded suburban residential and ecological RBSL values for any of the COCs identified in the CDSR (CDM Smith 2017). Similar to the AOC LUT Values Alternative, the cancer risks and non-cancer hazards for this alternative were calculated by removing locations exceeding the revised LUT criteria in the 19 representative exposure areas. The methodology and results of the risk assessment for this alternative is discussed in detail in Section 4.

2.2.3 Conservation of Natural Resources Alternative – Residential Scenario and Open Space Scenario

Under the Conservation of Natural Resources Alternative, cancer risks and non-cancer hazards are calculated for suburban residents (under the Residential Scenario) and recreators (under the Open Space Scenario) exposed to surface soil within 10,000 square meter (2.5 acre) exposure areas[3] (DOE 2011). The resulting risks are evaluated versus the 'target range' for risk management (see Section 2.1) to determine if risk reduction is warranted. If risks are above

[2]Site Risk Assessment Methodology (SRAM)
[3] 10,000 square meters is the suggested exposure area in the RESRAD risk computer model.

acceptable levels, soil associated soil samples containing risk drivers are removed in an iterative process until the resulting risk and hazards fall within USEPA target cancer risk range or USEPA target hazard level.

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 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 2018b).

The USEPA target cancer risk range used to evaluate this alternative is between 1×10^{-6} and 1×10^{-4}. The rationale for using this USEPA target cancer risk range as reference values in this CBA to provide input into risk management decisions is described in **Section 2.1**. As outlined in the Office of Solid Waste and Emergency Response (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[4]" 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 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. HIs 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 for adverse health effects. However, the HI should not be interpreted as a probability; generally, the greater the HI is above 1, 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

[4]Bright line - The phase "bright line" is meant to indicate a clear line or point where one thing may be distinguished from another (i.e., there isn't an exact risk level that should be used in remedial decision-making).

- 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 addressing contaminated soil as is provided by the Area IV/NBZ Cleanup to AOC LUT Values Alternative. Both of these sites are in California, require 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 are 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 CERCLA 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 1×10^{-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.

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Section 3
Cost Estimate

3.1 Basis of Estimate

The remedial action alternative cost estimates presented in this CBA are developed, maintained, and documented in a manner consistent with methods and the best practices identified in DOE G 413.3-21, April 2018 (DOE 2018); Cost Estimating Handbook (PM-HBK-08-2017), April 2017 (DOE 2017); and GAO Cost Estimating and Assessment Guide (GAO-09-3SP), March 2009 (GAO 2009).

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 4.4, Build 4.4.0.6) for various work activities, as presented in Section 2.3 of the Basis of Estimate (BOE) (CDM Smith 2018a). 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 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 2018a).

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 would 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 2018a) contains further detail on work activities along with the corresponding ECES identified.

3.3 Assumptions

Key technical approach assumptions that have significant cost impacts on the remedial action implementation are listed below. Assumptions made for the cost estimate are consistent with the assumptions made for the EIS. Refer to the BOE (CDM Smith 2018a) 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 low-hazard soil under the Conservation of Natural Resources Alternative and limited excavation/disposal of low-hazard soil under the Cleanup to Revised AOC LUT Values Alternative).

- Low-Hazard Soil: Soil under this category has chemicals above AOC LUT values, but below risk-based levels and hazardous waste standards. Radionuclides are at or below provisional AOC LUT values. This soil does not meet the definition of either chemical hazardous 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 low-hazard soil is 718,000 cubic yards under Cleanup to AOC LUT Values Alternative; 28,000 cubic yards under Cleanup to Revised LUT Values Alternative; and 0 cubic yards under Conservation of Natural Resources Alternative – Residential and Open Space Scenarios.
- Moderate-Hazard Soil: Soil under this category has chemicals above risk-based levels but below hazardous standards. Radionuclides are at or below provisional AOC LUT values. This soil does not meet the definition of either chemical hazardous or radioactive waste and is assumed to be transported to a permitted RCRA Class 2 or Class 3 disposal facility. The calculated volume for moderate-hazard soil is 51,000 cubic yards under Cleanup to AOC LUT Values Alternative; 50,000 cubic yards under Cleanup to Revised LUT Values Alternative; 49,000 cubic yards under Conservation of Natural Resources Alternative – Residential Scenario; and 36,000 cubic yards under Conservation of Natural Resources Alternative – Open Space Scenario.

- Hazardous Soil: Soil under this category has chemicals above hazardous waste standards. Radionuclides are at or below provisional AOC LUT values. 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 hazardous soil is 2,000 cubic yards under all four remedial alternatives.

- LLW/MLLW: Soil under this category has chemicals below or above AOC LUT values, but radionuclides are above the provisional AOC LUT values. This soil category is classified as low-level radioactive waste (LLW) or mixed low-level radioactive waste (MLLW), which is assumed to be transported for disposal outside of California. The calculated volume for LLW/MLLW is 110,000 cubic yards under Cleanup to AOC LUT Values Alternative and Cleanup to Revised LUT Values Alternative; 1,000 cubic yards under Conservation of Natural Resources Alternative – Residential Scenario; and 200 cubic yards under Conservation of Natural Resources Alternative – Open Space Scenario.

Excavation

It is assumed that the excavation would be completed using an excavator with a 3-cubic-yard or smaller bucket (CAT 345B or equal). Excavated soil would be direct-loaded in the trucks for off-site 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, 23-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:

- Low-Hazard Soil and Moderate-Hazard Soil – For purposes of this cost estimate, the excavated volume of these soil categories is assumed to be disposed within the State of California. Chiquita Canyon Landfill or Westmorland Landfill are used as representative disposal facility. Thus, an average one-way travel distance of 135 miles is assumed for disposal by road.

- Hazardous Soil – For purposes of this cost estimate, the excavated volume of this soil category can be disposed at multiple disposal facilities within or outside the state of California. Energy Solutions' Clive disposal facility in Utah is used as a representative disposal facility. The one-way travel distance by road for disposal is 780 miles.

- LLW/MLLW – For purposes of this cost estimate, the excavated volume of this soil category is assumed to be disposed at Nevada National Security Site, Nevada. The one-way travel distance by road for disposal is 300 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 and would be graded to self-drain. The backfill soil volume is assumed to be procured from an off-site commercial location(s)

outside of SSFL. The assumed one-way travel distance by road for of the off-site borrow source is 50 miles.

General Conditions
General conditions include cost for various work plans and submittals, home office and job site personnel, and on-site temporary construction facilities. These are based on assumed duration for each alternative.

Best Management Practices
It is assumed that the existing stormwater controls measure would 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 would be seeded using native grass and wildflower seed mix after placement of clean backfill.

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 calculations are included in the remedial action alternative cost estimates to perform the life-cycle cost analysis (LCCA) as described in Appendix F of *Cost Estimating Guide*, DOE G 413.3-21A (DOE 2018). A nominal discount rate of 2.6% (30-Year) was used for calculating PW cost. Nominal discount rates are based on the Appendix C (Revised November 2017 for Calendar Year 2018) 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 2018a).

3.4 Cost Estimate Summary

The cost estimate task is at a planning stage for this CBA and would 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 4 (Study or Feasibility) estimates based on cost estimate classification as presented in Table 4-2 of the *Cost Estimating Guide*, DOE G 413.3-21A (DOE

2018). The accuracy range of the Class 4 (Study or Feasibility) cost estimate is based on *AACE International Recommended Practice No. 18R-97, Rev. November 2011* as included in Appendix G of the *Cost Estimating Handbook*, PM-HBK-08-2017 (DOE 2017), where the Class 4 (Study or Feasibility) estimates has an Expected Accuracy Range of plus 20% to plus 50%(+20% to +50%) on the higher range to -15% to -30% on the lower range, of the final cost. For this cost estimate the accuracy range is projected to be +50%/-30% 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 2018) 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 (+50%/-30%) 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.

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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*	
			Residential Scenario	*Open Space Scenario*
Project Duration	26 years	6 years	About 2 years	Less than 2 years
Affected Area	90 acres	38 acres	10 acres	9 acres
Non-waste soil Chemicals above AOC LUT values, but below risk-based levels and hazardous waste standards. Radionuclides at or below provisional AOC LUT values.	718,000 cubic yards 1,077,000 tons 46,800 truckloads	28,000 cubic yards 42,000 tons 1,800 truckloads	See note a	See note a
Moderate-risk soil Chemicals above risk-based levels, but below hazardous standards. Radionuclides at or below provisional AOC LUT values.	51,000 cubic yards 76,500 tons 3,300 truckloads	50,000 cubic yards 75,000 tons 3,300 truckloads	49,000 cubic yards 73,500 tons 3,200 truckloads	36,000 cubic yards 54,000 tons 2,300 truckloads
Hazardous waste Chemicals above hazardous waste standards. Radionuclides at or below provisional AOC LUT values.	2,000 cubic yards 3,000 tons 130 truckloads	2,000 cubic yards 3,000 tons 130 truckloads	2,000 cubic yards 3,000 tons 130 truckloads	2,000 cubic yards 3,000 tons 130 truckloads
LLW/MLLW Chemicals below or above AOC LUT values. Radionuclides above provisional AOC LUT values.	110,000 cubic yards 165,000 tons 7,200 truckloads	110,000 cubic yards 165,000 tons 7,200 truckloads	1,000 cubic yards 1,500 tons 65 truckloads	200 cubic yards 300 tons 13 truckloads
Total Volume	881,000 cubic yards	190,000 cubic yards	52,000 cubic yards	38,200 cubic yards
Total Weight	1,322,000 tons	285,000 tons	78,000 tons	57,300 tons
Total Truck Round Trips [a]	57,500 truckloads	12,400 truckloads	3,400 truckloads	2,500 truckloads

AOC = *Administrative Order on Consent for Remedial Action*; LUT = Look-Up Table.

[a] Non-waste soils are those cleaned up because they exceed a specific LUT value even if they do not pose a risk. Under the Conservation of Natural Resources Alternative, soil is removed based on risk; therefore, no non-waste soil would be removed.

[b] Truck round trips were estimated based on transporting 23 tons of waste per truck. If 20-ton trucks were used for hazardous waste and radioactive waste, truck trips would be increased by 2 percent under the Cleanup to AOC LUT Values Alternative, 9 percent under the Cleanup to Revised LUT Values Alternative, and less than 1 percent under the Conservation of Natural Resources Alternative scenarios.

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 yard (see Appendix D).

TABLE 3-2
REMEDIAL ACTION ALTERNATIVES COST SUMMARY

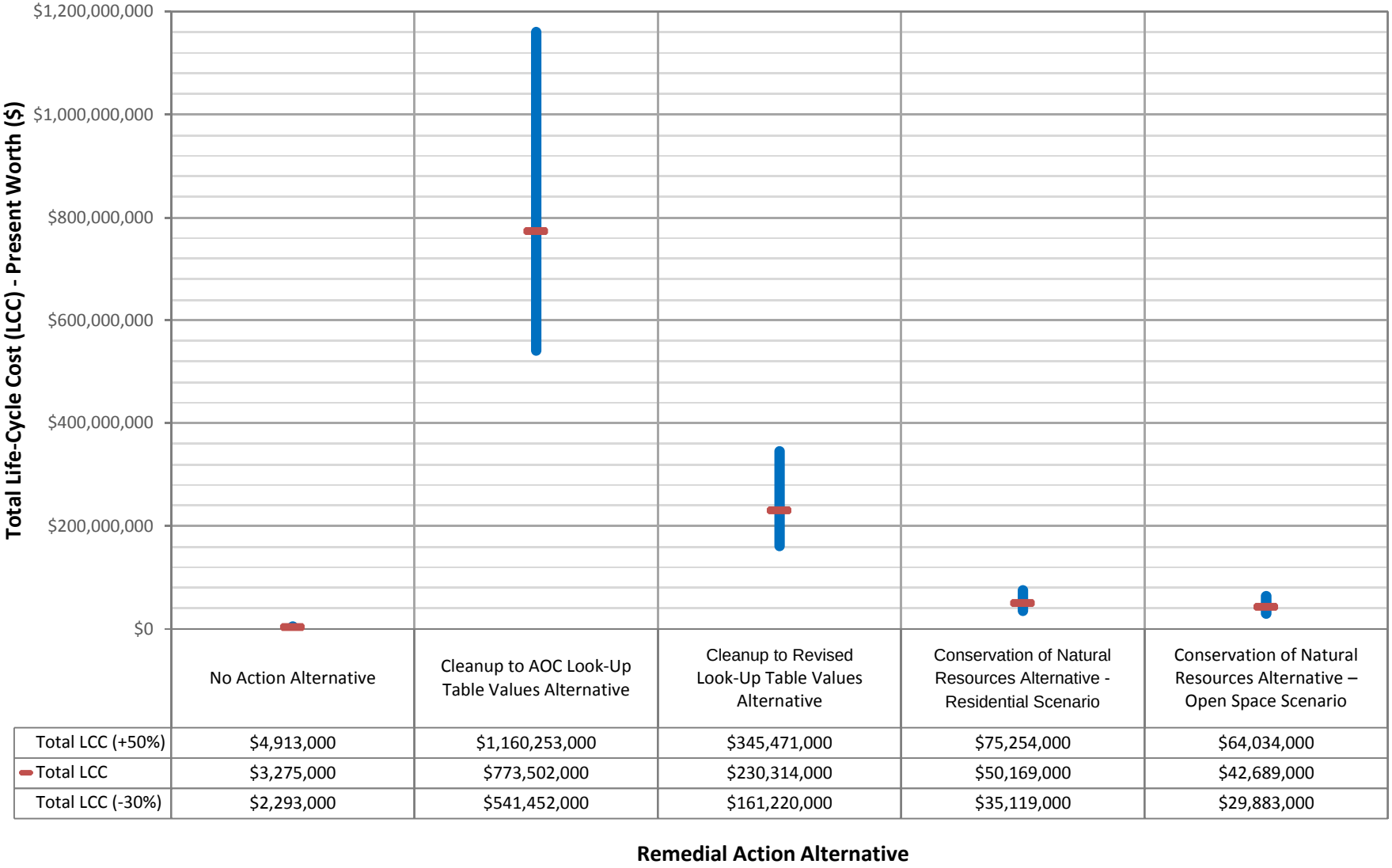
Site:	SSFL Area IV/NBZ
Location:	Ventura County, California
Document:	Basis of Estimate, Detailed Remedial Action Alternative Cost Estimates
Project/Program Life-Cycle Stage:	Critical Decision (CD)-1 [Approve Alternative Selection and Cost Range]
Cost Estimate Classification:	Class 4, Study or Feasibility (Level of Definition: 1% to 15%)
Base Year:	2018
Date of Estimate:	September 2018

ALTERNATIVE	CAPITAL CONSTRUCTION COST (AREA IV SOIL REMEDIATION)	
	CURRENT (CY 2018) COST	FUTURE COST
	Total Project Cost	Total Project Cost
No Action Alternative	$0	$0
Cleanup to AOC Look-Up Table Values Alternative	$724,682,000	$1,177,204,000
Cleanup to Revised Look-Up Table Values Alternative	$221,611,000	$269,121,000
Conservation of Natural Resources Alternative – Residential Scenario	$46,586,000	$51,662,000
Conservation of Natural Resources Alternative – Open Space Scenario	$39,209,000	$43,487,000

ALTERNATIVE	SURVEILLANCE AND LONG-TERM MAINTENANCE (SLTM) COST	
	CURRENT (CY 2018) COST	FUTURE COST
	Total Project Cost	Total Project Cost
No Action Alternative	$3,087,000	$5,013,000
Cleanup to AOC Look-Up Table Values Alternative	$2,736,000	$9,882,000
Cleanup to Revised Look-Up Table Values Alternative	$2,736,000	$5,655,000
Conservation of Natural Resources Alternative – Residential Scenario	$2,736,000	$4,736,000
Conservation of Natural Resources Alternative – Open Space Scenario	$2,736,000	$4,736,000

ALTERNATIVE	TOTAL LIFE-CYCLE COST (LCC)		LIFE-CYCLE COST ANALYSES (LCCA)[2]
	CURRENT (CY 2018) COST	FUTURE COST	PRESENT WORTH (PW)
	Total Project Cost	Total Project Cost	Total Project Cost
No Action Alternative	$3,087,000	$5,013,000	$3,275,000
Cleanup to AOC Look-Up Table Values Alternative	$727,418,000	$1,187,086,000	$773,502,000
Cleanup to Revised Look-Up Table Values Alternative	$224,347,000	$274,776,000	$230,314,000
Conservation of Natural Resources Alternative – Residential Scenario	$49,322,000	$56,398,000	$50,169,000
Conservation of Natural Resources Alternative – Open Space Scenario	$41,945,000	$48,223,000	$42,689,000

Notes:
1 - Current costs, life-cycle costs, and estimated remedial timeframes for each remedial action alternative are presented in Basis of Estimate, Final Detailed Remedial Action Alternative Cost Estimates (September 2018)
2 - Per the *DOE Cost Estimating Guide, DOE G 413.3-21A,* "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 - Residential Scenario	Conservation of Natural Resources Alternative – Open Space Scenario
Total LCC (+50%)	$4,913,000	$1,160,253,000	$345,471,000	$75,254,000	$64,034,000
Total LCC	$3,275,000	$773,502,000	$230,314,000	$50,169,000	$42,689,000
Total LCC (-30%)	$2,293,000	$541,452,000	$161,220,000	$35,119,000	$29,883,000

Figure 3-1
Estimated Present Worth and Accuracy Ranges of Total Life-Cycle Costs (LCC) 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

A primary objective of the risk assessment evaluations was to provide information to support risk management decisions. As described in the AOC, the remedial action at Area IV and NBZ would be conducted in accordance with Chapter 6.8 of Division 20 of the HSC, including Section 25359.20, which requires that any response action executed at SSFL be based upon the provisions of Section 25356.1.5. That section requires that any human health or ecological risk assessment prepared in conjunction with a response action be based upon Subpart E of the NCP 40 CFR 300.400 et seq. and the policies, guidelines, and practices of USEPA.

In this analysis, cancer risks and non-cancer hazard indices were back-calculated for 19 exposure areas using RBSLs for suburban residents, recreators, ecological receptors, and exposure point concentrations (EPCs) derived from the data collected within each of the separate exposure areas. This evaluation is consistent with the risk assessment process outlined in the SRAM (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 health risks due to exposure to chemicals present in various media at SSFL. Radionuclides are assessed in the same basic manner; however, screening levels comparable to RBSLs were estimated using DOE's RESidual RADioactivity (RESRAD) ONSITE model.

For each exposure area, risk calculations were performed individually for each contaminant of concern (COC), and risk values were summed to determine the total cumulative risk value. Cumulative risk and hazards for each exposure area were then compared with the USEPA target cancer risk range (1×10^{-6} to 1×10^{-4}) and the non-cancer target HI of 1 as described in Section 2.1 to provide input into risk management decisions.

The steps conducted for this risk analysis include: (1) identification of exposure areas, (2) selection of COCs, (3) estimation of EPCs, and (4) estimation of cancer risks and non-cancer hazard indices. These steps are described in detail in the document *Risk Estimate Development for Selected Areas of Santa Susana Field Laboratory Area IV* (Risk Estimate) (CDM Smith 2018b).

Step 1: Exposure Areas

Figure 4-1 shows the relative locations of the 19 selected exposure areas [1]within Area IV and NBZ. These 19 exposure areas were selected to be representative of Area IV because they had the following characteristics: the presence of radionuclide contamination, a history of prior cleanup actions, a demonstrated range of chemicals that is characteristic of Area IV operations, and localized hotspots (locations with concentrations exceeding 10 times RBSL values). These exposure areas reflected locations with relatively higher soil contaminant concentrations compared with soil contamination in Area IV overall. For this analysis, residential and recreational receptors are assumed to be exposed to contaminants in surface soil (i.e., 0 to 2.5 feet below ground surface) and subsurface soil (to 5 feet below ground surface).

Additional factors that influenced the selection of these exposure areas included the spatial distribution of soil samples containing concentrations exceeding AOC LUTs, the historical uses of the areas, and site features (e.g., drainages) considerations. An additional criterion for selection of an exposure area was the availability of a dataset that: (1) is representative of the exposure area's current condition and (2) contains a sufficient number of samples for chemicals and radionuclides that is adequate for statistical evaluation (i.e., a minimum of 20 samples each). Finally, the exposure areas selected for evaluation are representative of soil contamination in other operational areas; thus, the risk characterization for these areas can be extrapolated to other areas of Area IV/NBZ that are equally or less contaminated. The 19 exposure areas were selected mainly based on exceedances of 10 times RBSL values, so risks and hazards at the rest of Area IV/NBZ are expected to be less than the 19 exposure areas.

The largest contiguous area where soil contains radionuclides at concentrations above LUT values is found at the former Radioactive Materials Handling Facility(RMHF). Two sources of the radionuclides, largely strontium-90, are the former leach field and runoff from the RMHF. In 1978, the leach field and some bedrock were excavated and removed, but strontium-90 remains in the underlying rock and adjacent soils, particularly to the west of the leach field. Other areas where radioactive constituents in soil exceed the radionuclide LUT values include the Sodium Reactor Experiment (SRE) area northern drainage pathway that received runoff from former liquid hold-up tanks, the Building 4064 and New Conservation Yard Drainage (B4064/NCY) area and areas downslope of B4064, and 17th Street, including along the drainage pathway from the former Process Development Unit to the former pond. The 17th Street pond was partially excavated in 1979, but soil radionuclide activity above background is present above LUT values. These four areas lie within seven 10,000 m^2 grids (see Figure 2-1).

Twelve additional areas were selected based on the occurrence of chemical hotspots. For the purposes of this evaluation, a chemical hotspot is defined as a soil sampling location that has a contaminant concentration greater than 10 times a residential, recreational, or ecological RBSL. All 19 exposure areas selected based on these criteria included the following 10,000 m^2 grids (**Figure 4-1**):

[1] In the draft CBA risk assessment, four areas that USEPA determined to exhibit the highest radiological results were selected for risk evaluation. During the final CBA risk assessment, the number of risk assessment units was expanded to 19 to determine how representative the USEPA locations were to the remainder of Area IV, and to increase knowledge of distribution of contamination across Area IV.

- I13 (RMHF)
- H15 (SRE)
- M14 (17th Street Pond)
- I17 (B4064/NCY Northwest)
- I18 (B4064/NCY Northeast)
- J17 (B4064/NCY Southwest)
- J18 (B4064/NCY Southeast)
- H14 (SRE)
- H19 (NCY)
- N13 (17th Street Pond)
- O10 (Building 4055)
- F18 (Old Conservation Yard)
- G17 SRE Drainage
- H17 (Old Conservation Yard)
- I14 (RMHF)
- N10 (Sodium Pump Test Facility)
- O6 (FSDF)
- P6 (ESADA)
- P11 (DOE Leach Field 3)

Exposure areas for residential use can vary in size depending on the location of the site and local regulatory requirements. The size of each exposure area evaluated in this analysis is 10,000 m^2 or about 2.5 acres. The 10,000 m^2 area is the default exposure area used in the RESRAD model to evaluate residential exposures to radionuclides and was considered appropriate to assess chemical and radionuclide exposures for suburban residents in Area IV and NBZ. This lot size is also consistent with current nearby suburban residential land use, where residents own and maintain horses on their property. Consideration of lot-size exposure areas is generally adequate to evaluate long-term chronic health risks. Exposure is assumed to be relatively consistent across the residential lot, it is not necessary to investigate concentration trends at a property below the scale of the residential lot.

Step 2: Selection of COCs

After exposure areas were identified, COCs were selected for each exposure area. COCs in soils for the SSFL site are site-related chemicals or radionuclides that exist at concentrations above either the naturally occurring background or risk-determined levels above which a chemical or radionuclide poses a threat to human health or the environment. Identification of a chemical or radionuclide as a COC does not indicate that a health risk exists. Instead, identification as a COC indicates that additional analysis via quantitative risk assessment may be warranted.

The selection of COCs starts with a compilation of all analytical data for soils obtained through all sampling events and maintained in the Area IV Environmental Quality Information System (EQuIS) database. All chemical and radionuclide soil samples from all available depth ranges within each area were compiled for each exposure area for evaluation to retain COCs that may be present at depth and not at the surface for risk evaluation. The COC selection processes for chemicals and radionuclides differ and are explained in detail below.

The determination of chemical COCs is conducted in a multistep process, including an evaluation of frequency of detection, comparison to LUT values (i.e., background or detection limit values), and comparison to RBSLs. See Section 2.4 of the Risk Estimate for details (CDM Smith, 2018b).

Step 3: Estimation of Exposure Point Concentrations

The EPCs represent concentrations of COCs to which receptors may be exposed to if time is spent within the identified exposure area over the assumed exposure period. The EPCs were estimated for each COC selected for each exposure area. Typically, EPCs are estimated as the upper one-sided 95% confidence limit of the arithmetic mean (95% UCL) to help reduce the chance that the actual average concentration is not underestimated. The arithmetic mean is an appropriate statistic for characterizing exposure at an exposure point because it statistically represents random exposure within the exposure area. For this assessment for most COCs, EPCs were the 95% UCL as calculated by USEPA software program ProUCL version 5.1 (USEPA 2015). For some COCs, the recommended 95% UCL was above the maximum detected concentration. For these cases, the maximum detected concentration was used as the EPC instead of the 95% UCL.

The EPCs were calculated for surface soil datasets (i.e., 0 to 2.5 feet below ground surface) for each COC and each exposure area because the residents, recreators, and ecological receptors are more likely to be exposed to surface soil. For chemicals that were reported as not detected, the detection limit was used as the value in the EPC calculation. For total toxicity equivalent quotient benzo(a)pyrene (TEQ BAP) and total TEQ dioxins, if all congeners [2]were reported as non-detect, the assumed value was 0. For negative radionuclide results the method detection limit was used as the value in the EPC calculation.

Pre-soil cleanup EPCs were calculated under the No Action Alternative. The pre-soil cleanup EPCs were the same for all alternatives. ProUCL output, presenting statistics and the recommended EPCs for each COC by exposure area under pre-soil cleanup conditions, is presented separately in a supplemental data package.

[2] Congeners – Congeners are chemical substances that are related to each other by origin, structure, or function.

Post-soil cleanup EPCs were calculated for each of the alternatives as described below. ProUCL output, presenting statistics and the recommended EPCs for each COC by exposure area under post-soil cleanup conditions for each alternative, is presented separately in a supplemental data package.

- **Cleanup to AOC LUT Values Alternative**: The EPCs under this alternative were estimated by assuming that soil cleanup had removed all areas exceeding the LUT values. To calculate the risk following theoretical soil removal, the soil sample results for the removed samples were replaced with their respective AOC LUT values (i.e., background concentration or method detection limit). For several of the radionuclides, the AOC LUT value is the minimum detectable concentration (MDC) because the MDC was greater than the background value or a background value was not determined. An EPC was then estimated for the resulting post-soil cleanup dataset for each COC in each exposure area using ProUCL and the same methods as the pre-soil cleanup EPCs as described above. In some cases, the EPC for a COC was less than the AOC LUT value because majority of the detected results were less than the AOC LUT value.

- **Cleanup to Revised LUT Values Alternative**: The chemical EPCs under this alternative were estimated by assuming that soil cleanup had removed all areas exceeding the RBSL values. To calculate the risk following theoretical soil removal, the soil sample results for the removed samples were replaced with their respective AOC LUT values (i.e., background concentration or method detection limit). Radionuclide EPCs under this alternative were estimated by removing all soil samples within an exposure area with COC concentrations above their respective AOC LUT values and replacing those values with their respective background values (i.e., AOC LUT values). An EPC was then estimated for the resulting post-soil cleanup dataset for each COC in each exposure area using ProUCL and the same methods as the pre-soil cleanup EPCs as described above.

- **Conservation of Natural Resources Alternative – Residential Scenario**: The EPCs under this alternative were estimated by first determining risk drivers (i.e., soil samples with the highest concentrations) based on the suburban residential and/or ecological RBSLs. Then, individual soil samples with the highest concentrations were removed from the dataset (replacing those values with background values) in an iterative process until the resulting risk and hazards, which were based on post-cleanup EPCs computed in ProUCL, were within USEPA target range. For this analysis, the USEPA target cancer risk range's upper bound threshold was assumed to be 1×10^{-4} and the USEPA target non-cancer HI was assumed to be 1. For cancer risks that approached the upper bound limit of the USEPA cancer target risk range (i.e., 1×10^{-4}), additional soil samples were removed to provide a more protective or conservative risk reduction.

- **Conservation of Natural Resources Alternative – Open Space Scenario**: The EPCs under this alternative were estimated by first determining risk drivers based on recreational and/or ecological RBSLs and then removing soil samples for risk drivers (replacing those values with background values) in an iterative process until the resulting risk and hazards were within USEPA target range. For this analysis, the USEPA target cancer risk range's upper bound threshold was assumed to be 1×10^{-4} and the USEPA non-cancer HI was

assumed to be 1. For cancer risks that approached the upper bound limit of the USEPA target cancer 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

Cancer risk and non-cancer hazards were determined for each alternative. In brief, cancer risks and non-cancer hazards were calculated for each exposure area using receptor-specific (i.e., suburban residential or recreational) risk-based thresholds and EPCs. For chemicals, the risk-based threshold is equal to the RBSL. RBSLs for the suburban resident and recreational receptor were developed and presented in Appendix B of the SRAM using receptor-specific exposure parameters and chemical-specific toxicity information. Attachment 1 in Appendix B of the SRAM details all input parameters used to develop the RBSLs. The suburban residential and recreational RBSLs differ due to differences in the assumed exposure parameters (e.g., the exposure frequency for the resident is 350 days per year, while the exposure frequency for the recreational receptor is 75 days per year).

For radionuclides, PRGs were estimated for process-related radionuclides using the RESRAD-ONSITE model version 7.2 (DOE 2016), developed by DOE 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 generally consistent with the assumptions presented in the SRAM (MWH 2014) in conjunction with the unrevised portions of the SRAM Rev.2 (MWH 2005). Modifications to the exposure parameters were based on the Human Health Evaluation Manual OSWER Directive 9200.1-120 (USEPA 2014). See the Risk Estimate for a summary of the exposure parameters used to derive radionuclide PRGs (CDM Smith 2018b). The PRG for each radionuclide represents a soil concentration that would result in a maximum dose of 12 mrem/year. The 12 mrem/year dose corresponds to approximately a 1×10^{-4} cancer risk.

In this approach, because risk is proportional to concentration, the EPC for each COC was divided by its receptor-specific RBSL (for chemicals) or PRG (for radionuclides) and multiplied by the target cancer risk or non-cancer hazard value used to develop the RBSL or PRG as appropriate. Therefore, two sets of cancer risk and non-cancer hazards values were developed for the alternatives: one for suburban residential scenario and another for recreational scenario. The No Action Alternative and the Cleanup to AOC LUT Values Alternative were evaluated for both sets of exposure scenarios. It is noted that the Cleanup to Revised LUT Values Alternative is specific to the residential scenario (i.e. developed based on exposure frequency for a suburban resident); the recreational scenario was not evaluated under this alternative. Likewise, for the Conservation of Natural Resources Alternative – Residential Scenario, only the residential scenario was evaluated. For the Conservation of Natural Resources Alternative – Open Space Scenario, the recreational scenario was evaluated.

<u>Cancer Risk</u>

Cancer risks are estimated as the incremental probability of an individual to develop cancer over a lifetime as a result of exposure to a potential carcinogen. Excess lifetime cancer risks are generally expressed in scientific notation and are probabilities. An excess lifetime cancer risk of 1×10^{-6} (one in one million), for example, represents the incremental probability that an individual will develop cancer as a result of exposure to a carcinogenic chemical over a 70-year

lifetime under the specified exposure conditions. This increment is in addition to the risk of developing cancer from causes unrelated to the exposure. The total excess lifetime cancer risk for each exposure pathway is obtained by summing chemical-specific and radionuclide-specific risk estimates. In evaluating potential cancer risk, it is assumed that potential toxicity of chemical mixtures and radionuclides is additive.

For carcinogens, individual RBSLs (or PRGs) are based on an excess lifetime cancer risk of 1×10^{-6} for chemicals and 1×10^{-4} for radionuclides. Because risk is proportional to concentration, the conversion to risk equation is:

$$ELCR = \frac{Concentration}{RBSL\ (or\ PRG)} \times TCR$$

Where:

ELCR = Excess lifetime cancer risk

Concentration = Soil concentration (milligrams per kilogram [mg/kg], micrograms per kilogram [µg/kg], or nanograms per kilogram [ng/kg])

RBSL = Risk-based Screening Level for chemicals (mg/kg, µg/kg, or ng/kg)

PRG = Preliminary Remediation Goal for radionuclides (picocurie [pCi]/g)

TCR = Target excess lifetime cancer risk for individual carcinogens (i.e., 10^{-6} for chemicals and 10^{-4} for radionuclides)

Non-Cancer Hazard

The potential for non-cancer health effects is evaluated by comparing an exposure level (average daily dose) over a specified time with a reference dose (RfD) or concentration derived for a similar exposure period. This ratio of exposure to toxicity is referred to as a HQ. The HQ is a unitless ratio of a receptor's exposure level (or dose) to the "acceptable" (or allowable) exposure level. An HI is a summation of HQs for a particular pathway or from several pathways.

An HI less than 1 suggests that no adverse health effects are expected based on the exposure scenario evaluated. If the HI exceeds 1, further evaluation is required to group the chemicals according to target organ or mechanism of action. If the HI exceeds 1, HQs for individual COCs with similar toxicological effects or mechanism of action may be summed to yield a target organ/effect-specific HI (USEPA 1989). The target organ/effect-specific HI is calculated by summing HQs for chemicals with similar toxicological effects (e.g., developmental toxicity) or target organs (e.g., liver). The HI assumes that there is a level of exposure below which it is unlikely even for sensitive populations to experience adverse health effects. However, this value should not be interpreted as a probability. Generally, the greater the HI is above unity, the greater the level of concern.

For non-carcinogens, RBSLs are based on a target HQ of 1. The conversion from the RBSL to HQ is:

$$HQ = \frac{Concentration}{RBSL} \times 1$$

Where:

HQ = Hazard quotient

Concentration = Chemical concentration (mg/kg, µg/kg, or ng/kg)

RBSL = Risk-based concentration (mg/kg, µg/kg, or ng/kg)

1 = Target HQ

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** and **Table 4-2** present the results from the risk assessment of the 19 exposure areas as determined for the Alternatives under the residential scenario and recreational scenario, respectively. These results include:

- the estimated remaining cancer risk and non-cancer hazard (based on HI[3]) in each exposure area after implementation of the remedial action alternatives; and
- the calculated reduction in cancer risk and non-cancer hazard (based on HI) in each exposure area relative to the No Action Alternative; and
- the calculated reduction percentage in cancer risk and non-cancer hazard (based on HI) in each exposure area relative to the Cleanup to AOC LUT Alternative (further described in Section 4.3.2)

The range (minimum and maximum) and average of estimated remaining cancer risk and non-cancer HI values for the 19 exposure areas under each remedial action alternative are also presented in **Table 4-1** and **Table 4-2**. The order of alternatives listed in **Table 4-1** and **Table 4-2** 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) from left to right. The range of risk in these 19 exposure areas is expected to represent the upper boundary across Area IV/NBZ for cancer risk and for non-cancer hazard.

4.2.1 Residential Scenario

A cost/risk analysis was performed for four alternatives under the residential scenario: No Action Alternative, Cleanup to AOC LUT Values Alternative, Cleanup to Revised LUT Values Alternative and Conservation of Natural Resources Alternative – Residential Scenario. It is noted that the Conservation of Natural Resources Alternative – Open Space Scenario was not evaluated under the residential scenario because it is specific to the recreational scenario (see Section 4.2.2).

No Action Alternative

Cost Estimate

The present worth of the life cycle cost to implement remedial action under this alternative is approximately $3.3 million (MM) (see **Section 3.4**). There are no capital costs associated with

[3] For purposes of presentation in the CBA, all HIs as presented in Table 4-1 of *Risk Estimate Development* (CDM Smith 2016b) were rounded to the nearest one significant figure.

this alternative. The costs associated with this alternative are related to ongoing surveillance and long-term monitoring and maintenance.

Risk Reduction

Under this alternative, 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 19 exposure areas evaluated for risk, the cancer risk under this alternative range from 5 x 10^{-6} (at O10) to 2 x 10^{-3} (Building 4064 NE Grid I18), and the non-cancer HI values range from 0.1 (Building 4064 SW Grid J17) to 100 (P6).

In 16 out of 19 exposure areas evaluated, the current cancer risk is within the USEPA target cancer risk range of 1 x 10^{-6} and 1 x 10^{-4}. The other three areas (SRE Grid H15, 17th Street Pond Grid M14, and Building 4064 NE Grid I18) present a current cancer risk above the USEPA target cancer risk range of 1 x 10^{-6} to 1 x 10^{-4}.

Under the No Action Alternative, of the 18 exposure areas with non-cancer chemical COCs (Building 4064 SE Grid J18 did not have chemical COCs), 6 exposure areas had USEPA target non-cancer HI values of equal to or less than 1. The remaining 12 exposure areas have non-cancer hazards with HIs ranging from 2 to 100. Exposure areas RMHF Grid I13 and P6 have the highest HI values at 30 and 100, respectively.

The overall results of risk evaluation under the No Action Alternative suggest that in 6 of 19 exposure areas (Building 4064 NW Grid I17, Building 4064 SW Grid J17, Building 4064 SE Grid J18, O10, G17, I14), both cancer risk and non-cancer hazard are within USEPA target range without any cleanup. Cleanup of 2 of the remaining 13 exposure areas (SRE Grid H15 and 17th Street Pond Grid M14) would be driven by both cancer risk and non-cancer hazard. Cleanup of 1 exposure area (Building 4064 NE Grid I18) would be driven by cancer risk only. The cleanup of the remaining 10 exposure areas would be driven by non-cancer hazards.

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 $774 MM (see **Section 3.4**). The majority of the capital costs are associated with soil excavation and disposal costs.

Risk Reduction

The remaining cancer risk in the 19 exposure areas after the implementation of this alternative would range from 4 x 10^{-7} (O10) to 5 x 10^{-5} (Building 4064 SE Grid J18), and the HI for non-cancer hazard would range from 0.05 (O6) to 0.9 (H19). The cancer risk results for the Cleanup to AOC LUT Values Alternative suggest that the inherent cancer risk of background concentrations at Area IV/NBZ (e.g., the cancer risk if COC concentrations are at AOC LUT Values) is greater than 1 x 10^{-6} in 15 of 19 exposure areas.

The risk reduction benefit under this alternative is associated with the removal of soils containing COC 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 4×10^{-6} (G17 and P6) to 2×10^{-3} (Building 4064 NE Grid I18). The reduction in non-cancer HI values from these exposure areas would range from 0.03 (Building 4064 SW Grid J17) to above 99.4 (P6).

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 $230MM (see **Section 3.4**). The majority of the capital costs are associated with soil excavation and disposal costs.

Risk Reduction

The remaining cancer risk in the 19 exposure areas after the implementation of this alternative would range from 5×10^{-7} (F18) to 5×10^{-5} (Building 4064 SE Grid J18), and the non-cancer HI values would range from 0.06 (O6) to 0.9 (H19).

The risk reduction benefit under this alternative is associated with the removal of soils containing COC 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 4×10^{-6} (O10, G17, and P6) to 2×10^{-3} (Building 4064 NE Grid I18). The reduction in non-cancer HI values from these exposure areas would range from 0.03 (Building 4064 SW Grid J17) to above 99.4 (P6).

Conservation of Natural Resources Alternative – Residential Scenario

Cost Estimate

The present worth of the life cycle cost to implement remedial action under this alternative is $50MM (see **Section 3.4**). The majority of the capital costs are associated with soil excavation and disposal costs.

Risk Reduction

The remaining cancer risk in the 19 exposure areas after the implementation of this alternative would range from 1×10^{-6} (F18 and O6) to 5×10^{-5} (Building 4064 SE Grid J18), and the non-cancer HI values would range from 0.06 (O6) to 1 (H19).

The risk reduction benefit under this alternative is associated with the removal of soil containing COCs that drive the total residential risk within an exposure area to above the upper bound of the USEPA target cancer risk range of 1×10^{-4} and/or the USEPA target non-cancer HI 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 0 (Building 4064 SW Grid J17 and I14) to 2×10^{-3} (Building 4064 NE Grid I18). The reduction in non-cancer HI values from these exposure areas would range from 0 (Building 4064 SW Grid J17) to above 99.3 (P6).

4.2.2 Recreational Scenario

Cost/risk analysis was performed for three alternatives under the recreational scenario: The No Action Alternative, the Cleanup to AOC LUT Values Alternative, and the Conservation of Resources Alternative – Open Space Scenario. The Cleanup to Revised LUT Values Alternative and the Conservation of Natural Resources Alternative – Residential Scenario are both specific to the residential scenario, and were therefore not evaluated under the recreational scenario.

No Action Alternative

Cost Estimate

The present worth of the life cycle cost to implement remedial action under this alternative is approximately $3.3 million (MM) (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, Area IV/NBZ would be left as-is (i.e., no volume of contaminated soil would be removed); therefore, no risk reduction would be achieved. The remaining risk for recreators at Area IV/NBA would be the risk posed by the chemicals and radionuclide currently present in the soil.

For the 19 exposure areas evaluated for risk, the cancer risk under this alternative ranges from 1 x 10^{-6} (at Building 4064 SW Grid J17 and P6) to 2 x 10^{-4} (Building 4064 NE Grid I18), and the non-cancer HI values range from 0.02 (Building 4064 SW Grid J17) to 30 (P6).

In 18 out of 19 exposure areas evaluated, the current cancer risk is within the USEPA target cancer risk range of 1 x 10^{-6} and 1 x 10^{-4}. Only one exposure area (Building 4064 NE Grid I18) presents a current cancer risk above the USEPA target cancer risk range of 1 x 10^{-6} to 1 x 10^{-4}. The average cancer risk across the 19 exposure areas is 2 x 10^{-5}, which is within the USEPA target cancer risk range of 1 x 10^{-4} to 1 x 10^{-6}.

Under the No Action Alternative, of the 18 exposure areas with non-cancer COCs (Building 4064 SE Grid J18 did not have chemical COCs), 15 exposure areas had USEPA target non-cancer HI value of equal to or less than 1. The remaining 3 exposure areas (RMHF Grid I13, F18, and P6) have non-cancer HI values ranging from 2 to 30. Exposure area P6 have the highest HI values at 30.

The overall results of the risk evaluation for the recreational scenario under the No Action Alternative suggest that in 15 of 19 exposure areas, both cancer risk and non-cancer hazard are within USEPA target range without any cleanup. Cleanup of 1 exposure area (Building 4064 NE Grid I18) would be driven by cancer risk only. The cleanup of the remaining 3 exposure areas (RMHF Grid I13, F18, and P6) would be driven by non-cancer hazards.

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 $774 MM (see **Section 3.4**). The majority of the capital costs are associated with soil excavation and disposal costs.

Risk Reduction

The remaining cancer risk in the 19 exposure areas after the implementation of this alternative would range from 1 x 10^{-7} (O10) to 5 x 10^{-6} (Building 4064 SE Grid J18), and the non-cancer HI values would range from 0.01 (Building 4064 SW Grid J17 and O6) to 0.2 (H19). The cancer risk results for the Cleanup to AOC LUT Values Alternative suggest that the inherent cancer risk of background concentrations at Area IV/NBZ (e.g., the cancer risk if COC concentrations are at AOC LUT Values) is greater than 1 x 10^{-6} in 4 of 19 exposure areas.

The risk reduction benefit under this alternative is associated with the removal of soils containing COC 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 x 10^{-7} (Building 4064 SW Grid J17) to 2 x 10^{-4} (Building 4064 NE Grid I18). The reduction in non-cancer HI values for these exposure areas would range from 0.01 (Building 4064 SW Grid J17 and I14) to 29.9 (P6).

Conservation of Natural Resources Alternative – Open Space Scenario

Cost Opinion

The present worth of the life cycle cost to implement remedial action under this alternative is $43MM (see **Section 3.4**). The majority of the capital costs are associated with soil excavation and disposal costs.

Risk Reduction

The remaining cancer risk in the 19 exposure areas after the implementation of this alternative would range from 3 x 10^{-7} (P6) to 1 x 10^{-5} (Building 4064 SE Grid J18), and the non-cancer HI values would range from 0.01 (O6) to 0.3 (H19).

The risk reduction benefit under this alternative is associated with the removal of soil containing COCs that drive the total recreator risk within an exposure area to within the USEPA target cancer risk range of 1 × 10^{-4} to 1 x 10^{-6} and/or the non-cancer HI of equal to or less than 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 0 (Building 4064 SW Grid J17, Building 4064 SE Grid J18, O10, and I14) to 2 x 10^{-4} (Building 4064 NE Grid I18). The reduction in non-cancer HI values from these exposure areas would range from 0 (Building 4064 SW Grid J17) to 29.8 (P6).

4.3 Comparative Cost Benefit Analysis

This section compares the cancer risk and non-cancer HI values associated with the 19 exposure areas under the residential and recreational scenarios 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 19 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 19 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

Residential Scenario

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 HI of 1 under the residential scenario.

Figure 4-2 presents the estimated remaining cancer risk under the residential scenario 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. The range of estimated cancer risk from the 19 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 4-2** in light orange.

Figure 4-2 shows that all three remedial alternatives considered under the residential scenario 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 $50MM to $774MM. The figure shows that the cost to reduce average cancer risk from $1x10^{-5}$ (Conservation of Natural Resources Alternative – Residential Scenario) to $8x10^{-6}$ (Cleanup to Revised LUT Values Alternative) is roughly $180MM. It also shows that the estimated remaining cancer risk in the Cleanup to Revised LUT Values Alternative (8×10^{-6}) and in the Cleanup to AOC LUT Values Alternative (7×10^{-6}) is similar, but the increase in cost between the two alternatives is roughly $543MM, an increase of 236% over the Cleanup to Revised LUT Values Alternative cost.

None of the alternatives have average cancer risk that meet the NCP's point of departure target risk of 1×10^{-6}. Due to the way risk assessment was performed, with conservative assumptions and safety factors incorporated, soils with natural background concentration would have calculated cancer risk at above 1×10^{-6}. As such, under even the alternative with the most stringent cleanup levels, which is the Cleanup to AOC LUT Alternative, 15 out of 19 exposure units would still have remaining cancer risk of greater than 1×10^{-6}. This is because the inherent risk of the background soil prevents the reduction of cancer risk to below $1x10^{-6}$.

Figure 4-3 presents the remaining non-cancer hazard for the 19 exposure areas under each remedial action alternative as well as the associated present worth of the remedial action cost for the remedial alternatives. The figure shows that all alternatives except the No Action Alternative

would meet the USEPA target non-cancer hazard with an HI of 1 or below, and that the present worth of the remedial action costs for these alternatives range from $50MM to $774MM.

Since cleanup to an HI of 1 is commonly considered acceptable, and is a commonly used cleanup metric for non-cancer hazard, any further reduction of HI values 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 – Residential Scenario would meet USEPA target non-cancer hazard level, and that any additional cleanup effort, if required, would be driven by cancer risk.

Recreational Scenario

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 HI of 1 under the recreational scenario.

Figure 4-4 presents the estimated remaining cancer risk under the recreational scenario 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. The range of estimated cancer risk for the 19 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 4-2** in light orange.

Figure 4-4 shows that both the Conservation of Natural Resources Alternative – Open Space Scenario and the Cleanup to AOC LUT Values 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 $43MM to $774MM. The figure shows that the cost to reduce average cancer risk from $2 x10^{-6}$ (Conservation of Natural Resources Alternative – Open Space Scenario) to $1 x 10^{-6}$ (Cleanup to AOC LUT Values Alternative) is roughly $731MM, an increase of approximately 1,700% over the cost for the Conservation of Natural Resources Alternative – Open Space Scenario.

The Cleanup to AOC LUT Values Alternative under the recreational scenario would have associated average cancer risk (across the 19 exposure areas) equal to the NCP's point of departure target risk at $1 x 10^{-6}$. 4 out of 19 exposure units would still have remaining cancer risk greater than $1 x 10^{-6}$.

Figure 4-5 presents the remaining non-cancer hazard for the 19 exposure areas under each remedial action alternative as well as the associated present worth of the remedial action cost for the remedial alternatives. The figure shows that both the Conservation of Natural Resources Alternative – Open Space Scenario and the Cleanup to AOC LUT Values Alternative would meet the USEPA target non-cancer hazard with an HI of 1 or below, and that the present worth of the remedial action costs for these alternatives range from $43MM to $774MM.

Since cleanup to an HI of 1 is commonly considered acceptable, and is a commonly used cleanup metric for non-cancer hazard, any further reduction of an HI below 1 is only an 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 – Residential Scenario would meet USEPA

target non-cancer hazard level, 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 the 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 non-cancer HI under the Cleanup to AOC LUT Values Alternative are the greatest among the remedial action alternatives evaluated under both the residential and recreational scenarios, and are 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 and **Figure 4-7** present the estimated percent reduction in cancer risk of each remedial action alternative relative to the Cleanup to AOC LUT Values Alternative under the residential and recreational scenario, respectively. 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 reductions in cancer risk under the residential and recreational scenarios are presented in **Table 4-1** and **Table 4-2**, respectively, and are further discussed below.

Residential Scenario

The results show that in 14 out of 19 exposure areas evaluated, the Conservation of Natural Resources Alternative – Residential Scenario would achieve approximately 80% or more of the average cancer risk reduction compared to the Cleanup to AOC LUT Values Alternative under the residential scenario. In the 5 exposure areas with percent cancer risk reduction of less than 80%, all have initial cancer risks (e.g. cancer risks under the No Action Alternative) within the USEPA target cancer risk range between 1×10^{-6} and 1×10^{-4}. It is also noted that in the three exposure areas with initial cancer risk above USEPA target cancer risk range (SRE Grid H15, 17th Street Pond Grid M14, and Building 4064 NE Grid I18), all have percent cancer risk reduction of greater than 93% under the Conservation of Natural Resources Alternative – Residential Scenario. Overall, the average percent cancer risk reduction relative to the Cleanup to AOC LUT Values Alternative is 80%. The cost for the above cancer risk reduction benefit under the Conservation of Natural Resource Alternative – Residential Scenario for the entire Area IV/NBZ is estimated to be $50MM.

Under the Cleanup to Revised LUT Values Alternative, an average percent cancer risk reduction of 99% relative to the Cleanup to AOC LUT Values Alternative is achieved across the 19 exposure areas. Relative to the Conservation of Natural Resources Alternative– Residential Scenario, the average increase in percent risk reduction is 19% across the 19 exposure areas. The cost for the Cleanup to Revised LUT Values Alternative is $230MM, which is an additional $180MM over the cost of the Conservation of Natural Resources Alternative – Residential Scenario.

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% on average among the 19 exposure units). The cost for the Cleanup to AOC LUT Values Alternative is $774 MM, which is an additional $543 MM over the cost of the Cleanup to Revised LUT Values Alternative.

Recreational Scenario

The results show that in 14 out of 19 exposure areas evaluated, the Conservation of Natural Resources Alternative – Open Space Scenario would achieve approximately 87% or more of the average cancer risk reduction compared to the Cleanup to AOC LUT Values Alternative under the recreational scenario. In the 5 exposure areas with percent cancer risk reduction of less than 80%, all have initial cancer risks (e.g. cancer risks under the No Action Alternative) within the USEPA target cancer risk range between 1×10^{-6} and 1×10^{-4}. It is also noted that in the Building 4064 NE Grid I18 exposure area, which is the only exposure area with initial cancer risk above USEPA target cancer risk range, the percent cancer risk reduction of 99.8% is achieved under the Conservation of Natural Resources Alternative – Open Space Scenario. Overall, the average percent cancer risk reduction relative to the Cleanup to AOC LUT Values Alternative is 74%. The cost for the above cancer risk reduction benefit under the Conservation of Natural Resource Alternative – Open Space Scenario for the entire Area IV/NBZ is estimated to be $43MM.

Under the Cleanup to AOC LUT Values Alternative, the percent cancer risk reduction is by definition 100% across the 19 exposure areas. Relative to the Conservation of Natural Resources Alternative– Open Space Scenario, the increase in average percent risk reduction is 26% across the 19 exposure areas. The cost for the Cleanup to AOC LUT Values Alternative is $774MM, which is an additional $731MM over the cost of the Conservation of Natural Resources Alternative – Open Space Scenario.

Reduction of Non-Cancer Hazard and Cost Comparison

Figure 4-8 and **Figure 4-9** present the estimated percent reduction in HI values for each remedial action alternative relative to the Cleanup to AOC LUT Values Alternative under the residential and recreational scenario, respectively. 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 the 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 the HI under the residential and recreational scenario are presented in **Table 4-1** and **Table 4-2**, respectively, and are further discussed below.

Residential Scenario

The results show that across the 19 exposure areas evaluated, the Conservation of Natural Resources Alternative – Residential Scenario would achieve an average HI reduction of 90%. At the Building 4064 SW Grid J17, the HI percent reduction under the Conservation of Natural Resources Alternative – Residential Scenario is 0%. This is because the current non-cancer hazard at Building 4064 SW Grid J17 is 0.1, which is less than the USEPA target non-cancer HI of 1. Therefore, no further cleanup with respect to non-cancer hazard under the Conservation of Natural Resources Alternative – Residential Scenario is needed. The cost for the Conservation of Natural Resources Alternative – Residential Scenario for the entire Area IV/NBZ is estimated to be $50 MM.

Under the Cleanup to Revised LUT Values Alternative, an average HI reduction of 99.6% across the 19 exposure areas are achieved. Relative to the Conservation of Natural Resources Alternative – Residential Scenario, the average increase in percent HI reduction for the Cleanup to Revised LUT Values Alternative is 9.6%. The cost for the Cleanup to Revised LUT Values Alternative is $230 MM, which is an additional $180 MM over the cost of the Conservation of Natural Resources Alternative – Residential Scenario.

Under the Cleanup to AOC LUT Values Alternative, the average percent HI reduction is only 0.4% greater than the Cleanup to Revised LUT Values Alternative. The cost for the Cleanup to AOC LUT Values Alternative is $774 MM, an additional $543 MM over the Cleanup to Revised LUT Values Alternative.

Recreational Scenario

The results show that across the 19 exposure areas evaluated, the Conservation of Natural Resources Alternative – Open Space Scenario would achieve an average HI reduction of 91%. The cost for the Conservation of Natural Resources Alternative – Open Space Scenario for the entire Area IV/NBZ is estimated to be $43 MM.

At the Building 4064 SW Grid J17, the HI percent reduction under the Conservation of Natural Resources Alternative – Open Space Scenario is 0%. This is because the current non-cancer hazard at Building 4064 SW Grid J17 is 0.02, which is less than the USEPA target non-cancer HI of 1. Therefore, no further cleanup with respect to non-cancer hazard under the Conservation of Natural Resources Alternative – Open Space Scenario is needed.

Under the Cleanup to AOC LUT Values Alternative, an average HI reduction is 100% by definition across the 19 exposure areas. Relative to the Conservation of Natural Resources Alternative – Open Space Scenario, the average increase in percent HI reduction for the Cleanup to Revised LUT Values Alternative is 9%. The cost for the Cleanup to AOC LUT Values Alternative is $774 MM, which is an additional $731 MM over the cost of the Conservation of Natural Resources Alternative – Open Space Scenario.

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Table 4-1
Exposure Areas Risk Assessment Results - Residential Scenario

	Remaining Risk Post Remedial Action								Risk Reduction						% Risk Reduction							
	Residential Scenario								Residential Scenario						Residential Scenario							
	Cancer Risk				Non-Cancer Risk (HI)				Cancer Risk Reduction			Non-Cancer Risk (HI) Reduction			Cancer Risk Reduction %				Non-Cancer Risk (HI) Reduction %			
Exposure Area	No Action	Conservation of Natural Resources Alternative - Residential Scenario	Cleanup to Revised LUT Values Alternative	Cleanup to AOC LUT Values Alternative	No Action	Conservation of Natural Resources Alternative - Residential Scenario	Cleanup to Revised LUT Alternative	Cleanup to AOC LUT	Conservation of Natural Resources Alternative - Residential Scenario	Cleanup to Revised LUT Alternative	Cleanup to AOC LUT	Conservation of Natural Resources Alternative - Residential Scenario	Cleanup to Revised LUT Alternative	Cleanup to AOC LUT	No Action	Conservation of Natural Resources Alternative - Residential Scenario	Cleanup to Revised LUT Alternative	Cleanup to AOC LUT	No Action	Conservation of Natural Resources Alternative - Residential Scenario	Cleanup to Revised LUT Alternative	Cleanup to AOC LUT
RMHFGrid I13	**1E-04**	**2E-05**	**5E-06**	**5E-06**	**30**	**0.6**	**0.3**	**0.3**	**8E-05**	**1E-04**	**1E-04**	**29.4**	**29.7**	**29.7**	0.0%	84.2%	100%	100%	0.0%	99.0%	100%	100%
SREGrid H15	**2E-04**	**2E-05**	**9E-06**	**8E-06**	**2**	**0.5**	**0.5**	**0.5**	**2E-04**	**2E-04**	**2E-04**	**1.5**	**1.5**	**1.5**	0.0%	93.8%	99.5%	100%	0.0%	100%	100%	100%
17th Street PondGrid M14	**4E-04**	**1E-05**	**5E-06**	**5E-06**	**2**	**0.7**	**0.6**	**0.6**	**4E-04**	**4E-04**	**4E-04**	**1.3**	**1.4**	**1.4**	0.0%	98.7%	100%	100%	0.0%	92.9%	100%	100%
Building 4064 NWGrid I17	**1E-05**	**4E-06**	**4E-06**	**4E-06**	**1**	**0.1**	**0.1**	**0.1**	**6E-06**	**6E-06**	**6E-06**	**0.9**	**0.9**	**0.9**	0.0%	100%	100%	100%	0.0%	100%	100%	100%
Building 4064 NEGrid I18	**2E-03**	**1E-05**	**1E-05**	**4E-06**	**1**	**0.5**	**0.4**	**0.4**	**2E-03**	**2E-03**	**2E-03**	**0.5**	**0.6**	**0.6**	0.0%	99.7%	99.7%	100%	0.0%	83.3%	100%	100%
Building 4064 SWGrid J17	**1E-05**	**1E-05**	**3E-06**	**3E-06**	**0.1**	**0.1**	**0.07**	**0.07**	**0E+00**	**7E-06**	**7E-06**	**0**	**0.03**	**0.03**	0.0%	0.0%	100%	100%	0.0%	0.0%	100%	100%
Building 4064 SEGrid J18	**8E-05**	**5E-05**	**5E-05**	**5E-05**	**NC**	**NC**	**NC**	**NC**	**3E-05**	**3E-05**	**3E-05**	**NC**	**NC**	**NC**	0.0%	100%	100%	100%	NC	NC	NC	NC
H14	**4E-05**	**1E-05**	**1E-05**	**1E-05**	**2**	**0.1**	**0.1**	**0.1**	**3E-05**	**3E-05**	**3E-05**	**1.9**	**1.9**	**1.9**	0.0%	100%	100%	100%	0.0%	100%	100%	100%
H19	**3E-05**	**2E-05**	**1E-05**	**1E-05**	**2**	**1**	**0.9**	**0.9**	**1E-05**	**2E-05**	**2E-05**	**1**	**1.1**	**1.1**	0.0%	50.0%	100%	100%	0.0%	90.9%	100%	100%
N13	**2E-05**	**2E-06**	**2E-06**	**2E-06**	**2**	**0.8**	**0.6**	**0.6**	**2E-05**	**2E-05**	**2E-05**	**1.2**	**1.4**	**1.4**	0.0%	100%	100%	100%	0.0%	85.7%	100%	100%
O10	**5E-06**	**3E-06**	**7E-07**	**4E-07**	**1**	**0.3**	**0.2**	**0.2**	**2E-06**	**4E-06**	**5E-06**	**0.7**	**0.8**	**0.8**	0.0%	43.5%	93.5%	100%	0.0%	87.5%	100%	100%
F18	**1E-05**	**1E-06**	**5E-07**	**5E-07**	**10**	**0.5**	**0.5**	**0.5**	**9E-06**	**1E-05**	**1E-05**	**9.5**	**9.5**	**9.5**	0.0%	94.7%	100%	100%	0.0%	100%	100%	100%
G17	**7E-06**	**4E-06**	**3E-06**	**3E-06**	**0.7**	**0.2**	**0.2**	**0.2**	**3E-06**	**4E-06**	**4E-06**	**0.5**	**0.5**	**0.5**	0.0%	75.0%	100%	100%	0.0%	100%	100%	100%
H17	**3E-05**	**2E-05**	**2E-05**	**2E-05**	**3**	**0.2**	**0.2**	**0.2**	**1E-05**	**1E-05**	**1E-05**	**2.8**	**2.8**	**2.8**	0.0%	100%	100%	100%	0.0%	100%	100%	100%
I14	**2E-05**	**2E-05**	**1E-05**	**1E-05**	**0.8**	**0.7**	**0.7**	**0.7**	**0E+00**	**1E-05**	**1E-05**	**0.1**	**0.1**	**0.1**	0.0%	0.0%	100%	100%	0.0%	100%	100%	100%
N10	**2E-05**	**3E-06**	**2E-06**	**1E-06**	**2**	**0.6**	**0.5**	**0.4**	**2E-05**	**2E-05**	**2E-05**	**1.4**	**1.5**	**1.6**	0.0%	89.5%	94.7%	100%	0.0%	87.5%	93.8%	100%
O6	**2E-05**	**1E-06**	**6E-07**	**6E-07**	**3**	**0.06**	**0.06**	**0.05**	**2E-05**	**2E-05**	**2E-05**	**2.94**	**2.94**	**2.95**	0.0%	97.9%	100%	100%	0.0%	99.7%	99.7%	100%
P6	**6E-06**	**2E-06**	**2E-06**	**2E-06**	**100**	**0.7**	**0.6**	**0.6**	**4E-06**	**4E-06**	**4E-06**	**99.3**	**99.4**	**99.4**	0.0%	100%	100%	100%	0.0%	99.9%	100%	100%
P11	**2E-05**	**3E-06**	**2E-06**	**2E-06**	**2**	**0.2**	**0.2**	**0.2**	**2E-05**	**2E-05**	**2E-05**	**1.8**	**1.8**	**1.8**	0.0%	94.4%	100%	100%	0.0%	100%	100%	100%
min	5E-06	1E-06	5E-07	4E-07	0.1	0.06	0.06	0.05	0E+00	4E-06	4E-06	0	0.03	0.03	0%	0%	93%	100%	0%	0%	94%	100%
max	2E-03	5E-05	5E-05	5E-05	100	1	0.9	0.9	2E-03	2E-03	2E-03	99.3	99.4	99.4	0%	100%	100%	100%	0%	100%	100%	100%
average	2E-04	1E-05	8E-06	7E-06	9	0.4	0.4	0.4	1E-04	2E-04	2E-04	8.7	8.8	8.8	0%	80%	99%	100%	0%	90%	99.6%	100%

Notes:

1. The remedial action alternatives under each exposure scenario (residential and recreational) 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 HIs have been rounded to the nearest one significant figure.

Within USEPA target cancer risk range between 1E-4 and 1E-6 or within USPEA target non-cancer hazard (HI) of equal to or less than 1.

At or below cancer risk of 1E-6

Table 4-2

Exposure Areas Risk Assessment Results - Recreational Scenario

	Remaining Risk Post Remedial Action						Risk Reduction				% Risk Reduction					
	Recreational Scenario						Recreational Scenario				Recreational Scenario					
	Cancer Risk			Non-Cancer Risk (HI)			Cancer Risk		Non-Cancer Risk (HI)		Cancer Risk Reduction %			Non-Cancer Risk (HI) Reduction %		
F18	No Action	Conservation of Natural Resources - Open Space Scenario	Cleanup to AOC LUT Alternative	No Action	Conservation of Natural Resources - Open Space Scenario	Cleanup to AOC LUT Alternative	Conservation of Natural Resources - Open Space Scenario	Cleanup to AOC LUT Alternative	Conservation of Natural Resources - Open Space Scenario	Cleanup to AOC LUT Alternative	No Action	Conservation of Natural Resources - Open Space Scenario	Cleanup to AOC LUT Alternative	No Action	Conservation of Natural Resources - Open Space Scenario	Cleanup to AOC LUT Alternative
RMHFGrid I13	3E-05	4E-06	5E-07	6	0.2	0.09	3E-05	3E-05	5.8	5.9	0.0%	88.1%	100%	0.0%	98.1%	100%
SREGrid H15	2E-05	7E-06	1E-06	0.6	0.1	0.1	1E-05	2E-05	0.5	0.5	0.0%	68.4%	100%	0.0%	100%	100%
17th Street PondGrid M14	1E-04	2E-06	8E-07	0.4	0.2	0.2	1E-04	1E-04	0.2	0.2	0.0%	98.8%	100%	0.0%	100%	100%
Building 4064 NWGrid I17	3E-06	7E-07	7E-07	0.2	0.03	0.03	2E-06	2E-06	0.17	0.17	0.0%	100%	100%	0.0%	100%	100%
Building 4064 NEGrid I18	2E-04	1E-06	7E-07	0.3	0.1	0.09	2E-04	2E-04	0.2	0.21	0.0%	99.8%	100%	0.0%	95.2%	100%
Building 4064 SWGrid J17	1E-06	1E-06	5E-07	0.02	0.02	0.01	0E+00	5E-07	0	0.01	0.0%	0.0%	100%	0.0%	0.0%	100%
Building 4064 SEGrid J18	1E-05	1E-05	5E-06	NC	NC	NC	0E+00	5E-06	NC	NC	0.0%	0%	100%	NC	NC	NC
H14	8E-06	1E-06	1E-06	0.5	0.03	0.02	7E-06	7E-06	0.47	0.48	0.0%	100%	100%	0.0%	98%	100%
H19	6E-06	3E-06	3E-06	0.6	0.3	0.2	3E-06	3E-06	0.3	0.4	0.0%	100.0%	100%	0.0%	75.0%	100%
N13	6E-06	1E-06	7E-07	0.4	0.2	0.2	5E-06	5E-06	0.2	0.2	0.0%	94%	100%	0.0%	100%	100%
O10	2E-06	2E-06	1E-07	0.3	0.1	0.08	0E+00	2E-06	0.2	0.22	0.0%	0.0%	100%	0.0%	90.9%	100%
F18	4E-06	4E-07	2E-07	2	0.1	0.1	4E-06	4E-06	1.9	1.9	0.0%	94.7%	100%	0.0%	100%	100%
G17	2E-06	5E-07	4E-07	0.2	0.08	0.06	2E-06	2E-06	0.12	0.14	0.0%	93.8%	100%	0.0%	86%	100%
H17	8E-06	2E-06	2E-06	0.7	0.07	0.07	6E-06	6E-06	0.63	0.63	0.0%	100%	100%	0.0%	100%	100%
I14	3E-06	3E-06	2E-06	0.2	0.2	0.2	0E+00	1E-06	0.01	0.01	0.0%	0.0%	100%	0.0%	100%	100%
N10	7E-06	9E-07	3E-07	0.5	0.1	0.1	6E-06	7E-06	0.4	0.4	0.0%	91.0%	100%	0.0%	100%	100%
O6	6E-06	4E-07	2E-07	0.6	0.01	0.01	6E-06	6E-06	0.59	0.59	0.0%	96.6%	100%	0.0%	100%	100%
P6	1E-06	3E-07	2E-07	30	0.2	0.1	7E-07	8E-07	29.8	29.9	0.0%	88%	100%	0.0%	99.7%	100%
P11	5E-06	8E-07	2E-07	0.5	0.08	0.07	4E-06	5E-06	0.42	0.43	0.0%	87.5%	100%	0.0%	98%	100%
min	1E-06	3E-07	1E-07	0.02	0.01	0.01	0E+00	5E-07	0	0.01	0%	0%	100%	0%	0%	100%
max	2E-04	1E-05	5E-06	30	0.3	0.2	2E-04	2E-04	29.8	29.9	0%	100%	100%	0%	100%	100%
average	2E-05	2E-06	1E-06	2	0.1	0.1	2E-05	2E-05	2.3	2.4	0%	74%	100%	0%	91%	100.0%

Notes:

1. The remedial action alternatives under each exposure scenario (residential and recreational) 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 HIs have been rounded to the nearest one significant figure.

Within USEPA target cancer risk range between 1E-4 and 1E-6 or within USPEA target non-cancer hazard (HI) of equal to or less than 1.

At or below cancer risk of 1E-6

NE BUFFER ZONE

NW-BUFFER ZONE

AREA II

AREA III

AREA IV

LEGEND

Grid (100m x 100m)

Exposure Areas

Area Boundary

SSFL Property Boundary

Notes:
- Original GIS layers provided by MWH/Boeing; updated by CDM Smith as needed.

Representative Exposure Areas

Santa Susana Field Laboratory
Ventura County, California
Figure 4-1

0 100 200 400 Meters

CDM Smith

P:\Santa Susanna\GIS\MXD\EIS\Soil\SSFL_AreaIV_EIS_Alt_Risk_Grids_20180703.mxd 7/3/2018

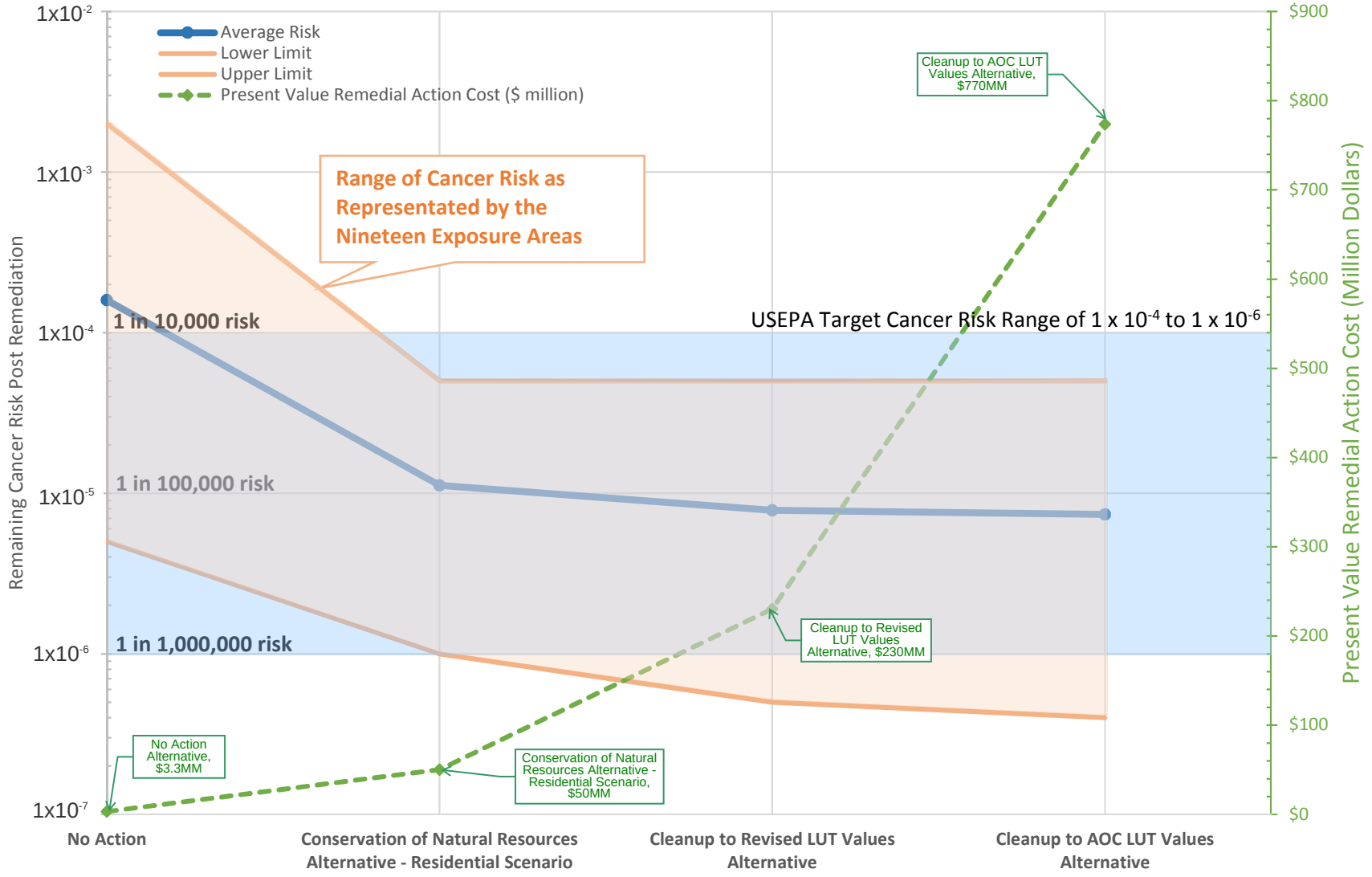

Figure 4-2 Remaining Cancer Risk and Remedial Action Cost among Remedial Alternatives - Residential Scenario

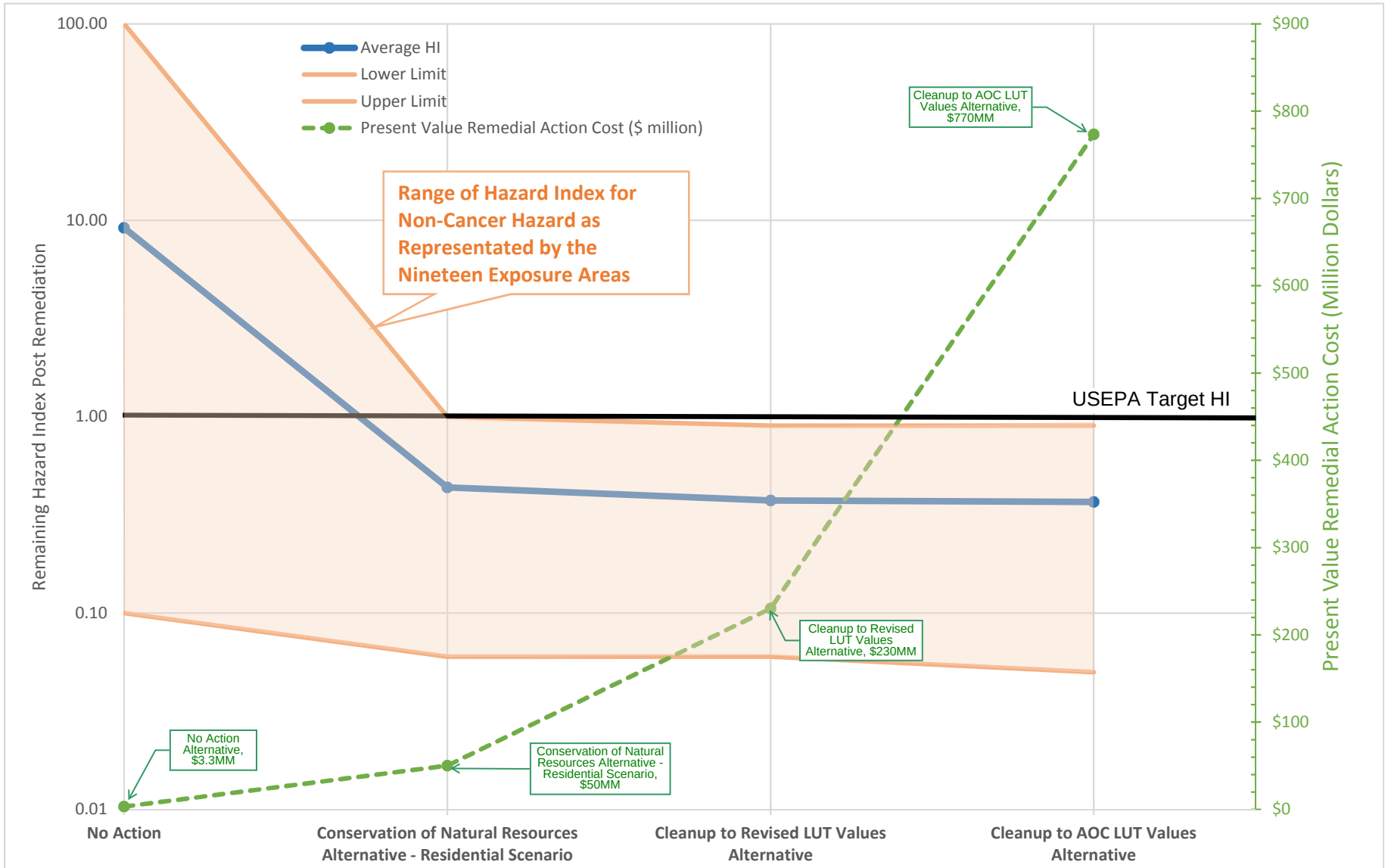

Figure 4-3 Remaining Non-Cancer Hazard and Remedial Action Cost among Remedial Alternatives - Residential Scenario

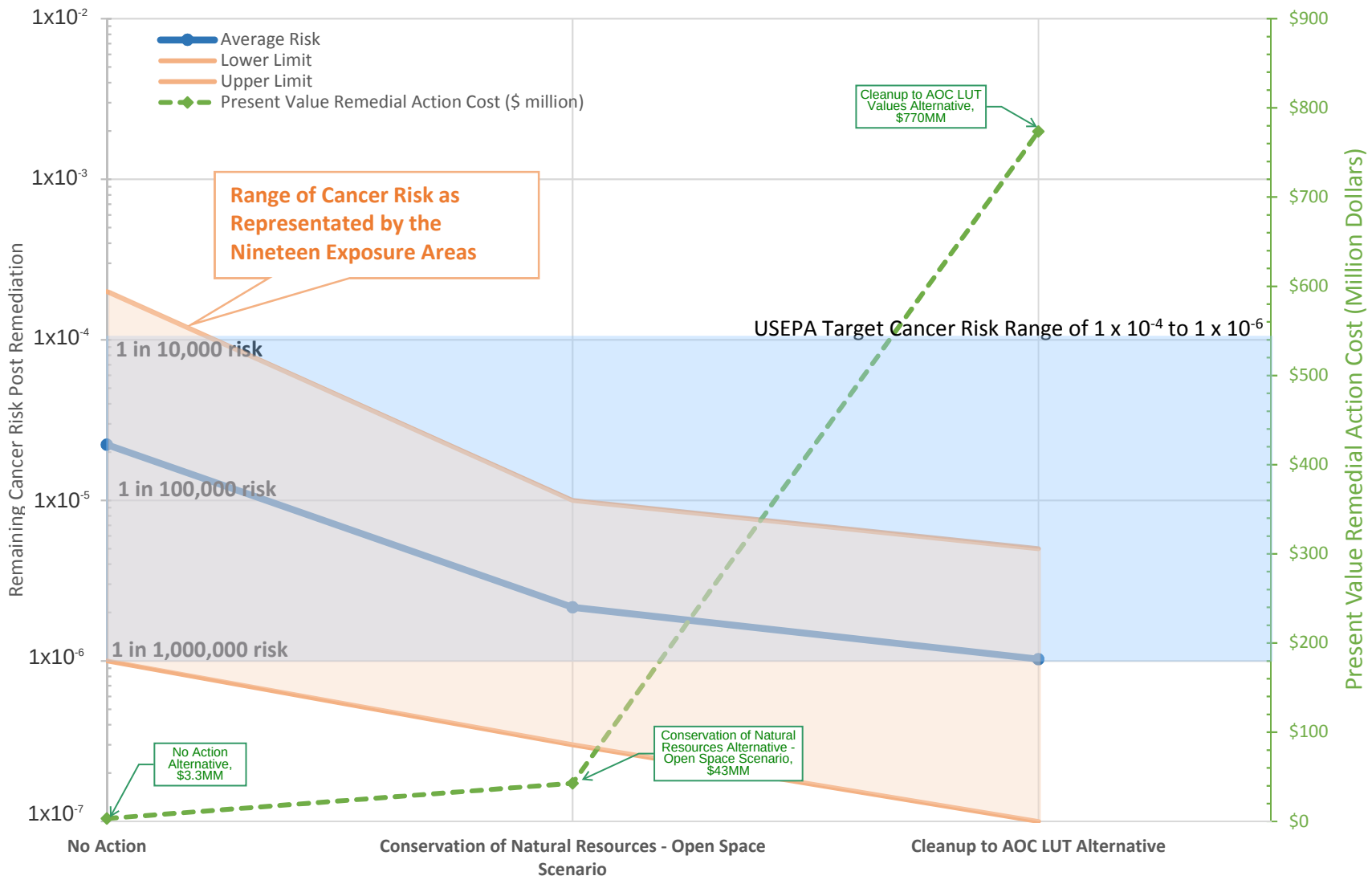

Figure 4-4 Remaining Cancer Risk and Remedial Action Cost among Remedial Alternatives - Recreational Scenario

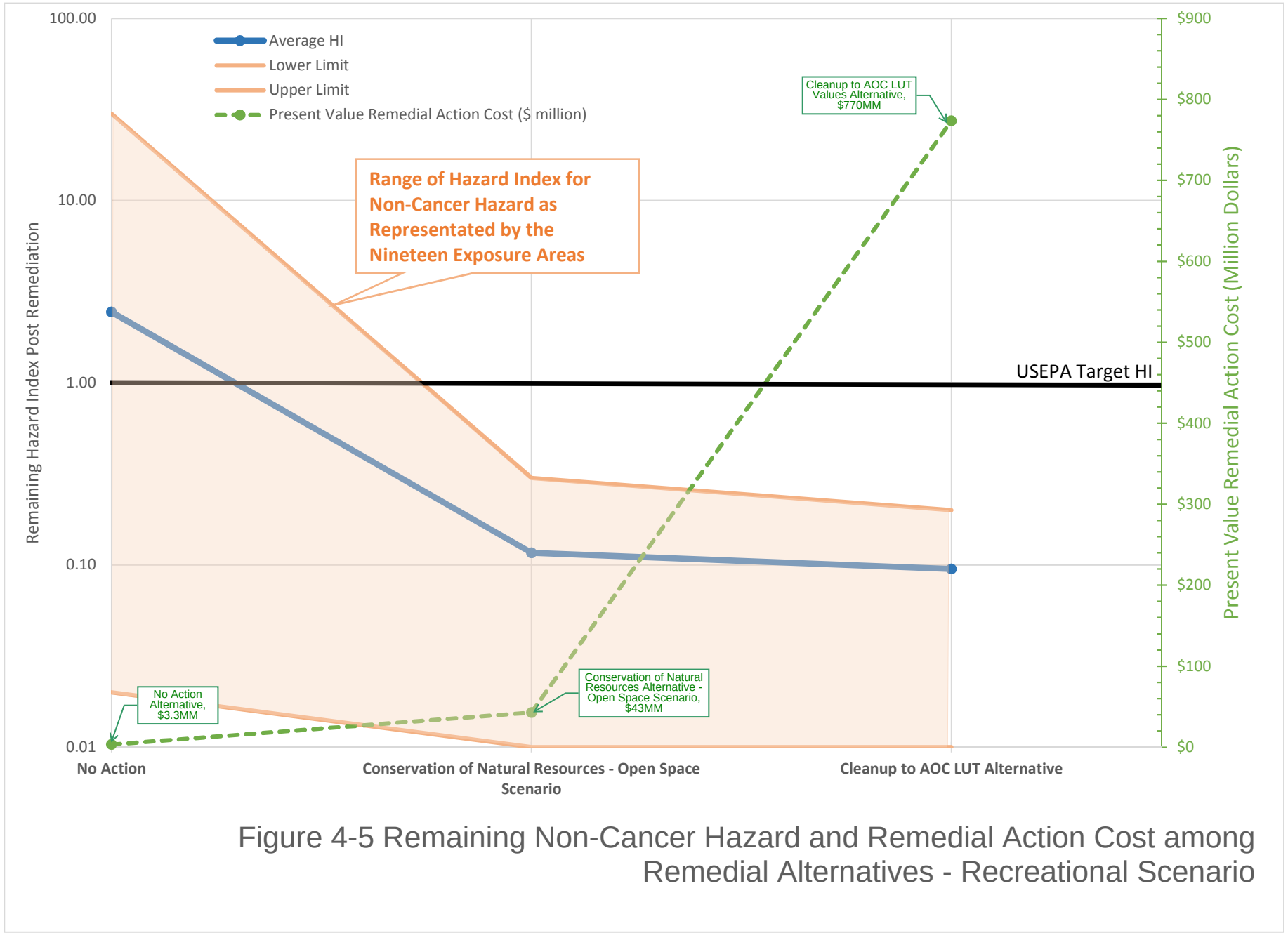

Figure 4-5 Remaining Non-Cancer Hazard and Remedial Action Cost among Remedial Alternatives - Recreational Scenario

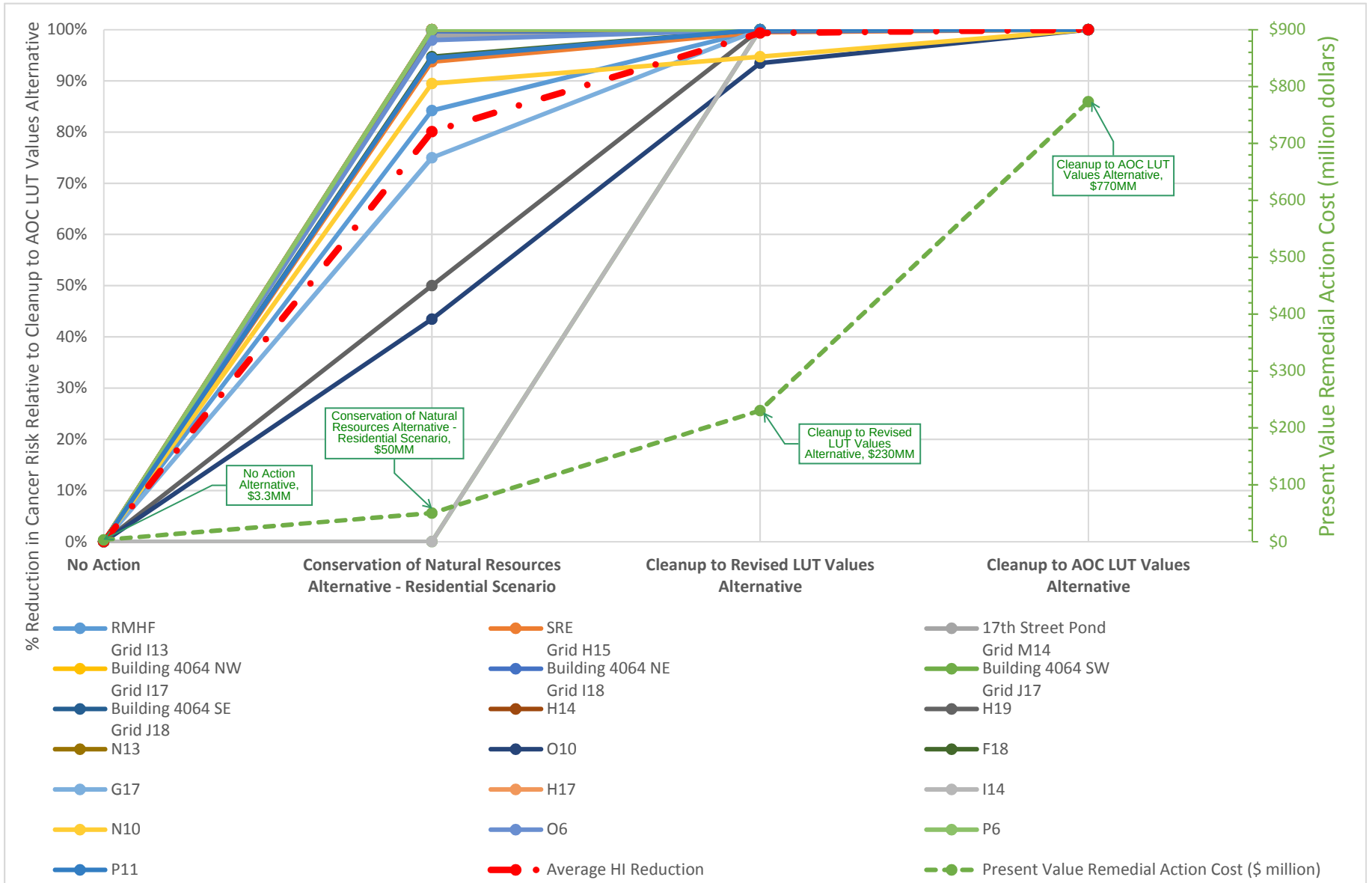

Figure 4-6 Percent Reduction in Cancer Risk and Remedial Action Cost among Remedial Alternatives - Residential Scenario

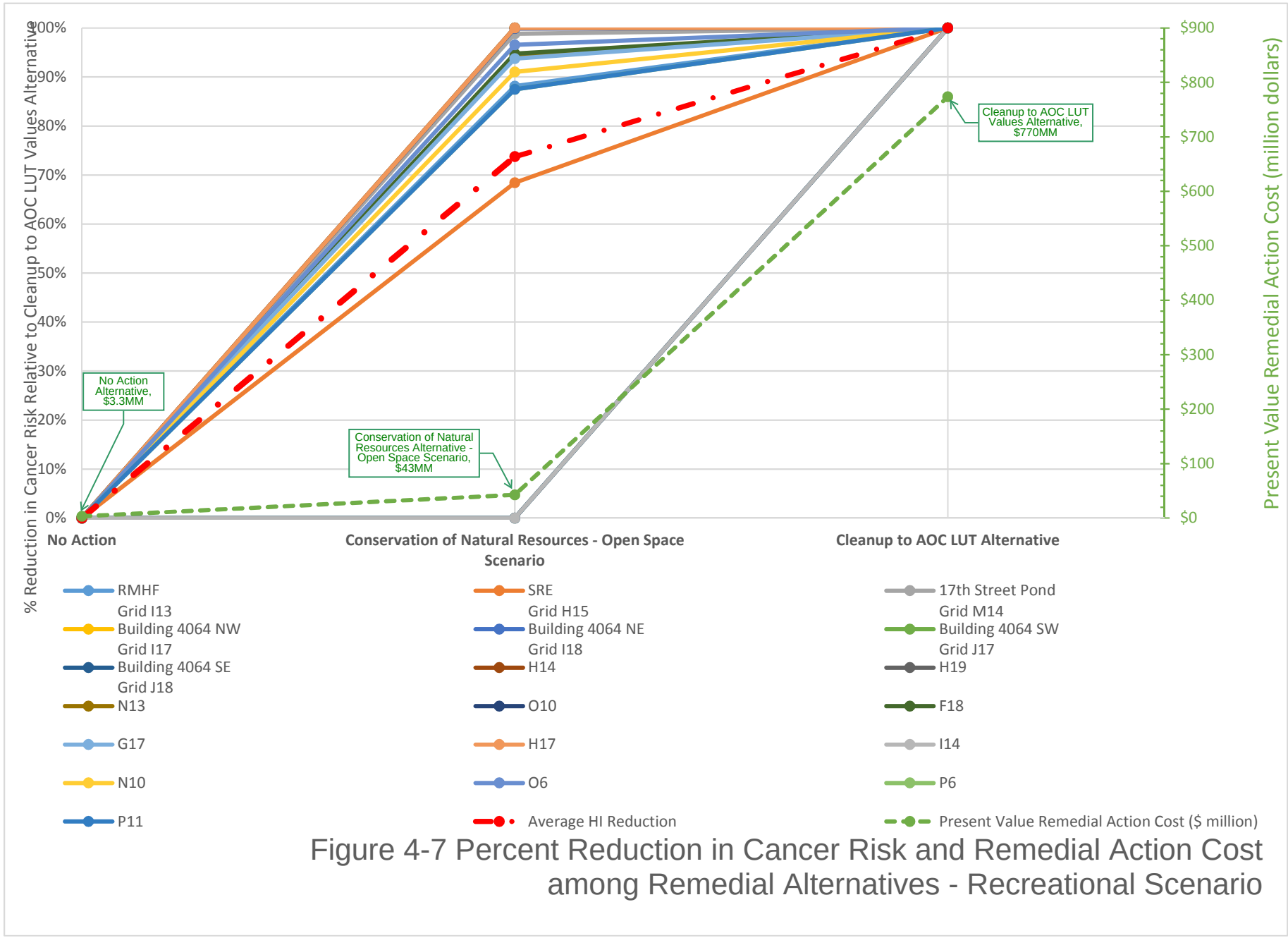

Figure 4-7 Percent Reduction in Cancer Risk and Remedial Action Cost among Remedial Alternatives - Recreational Scenario

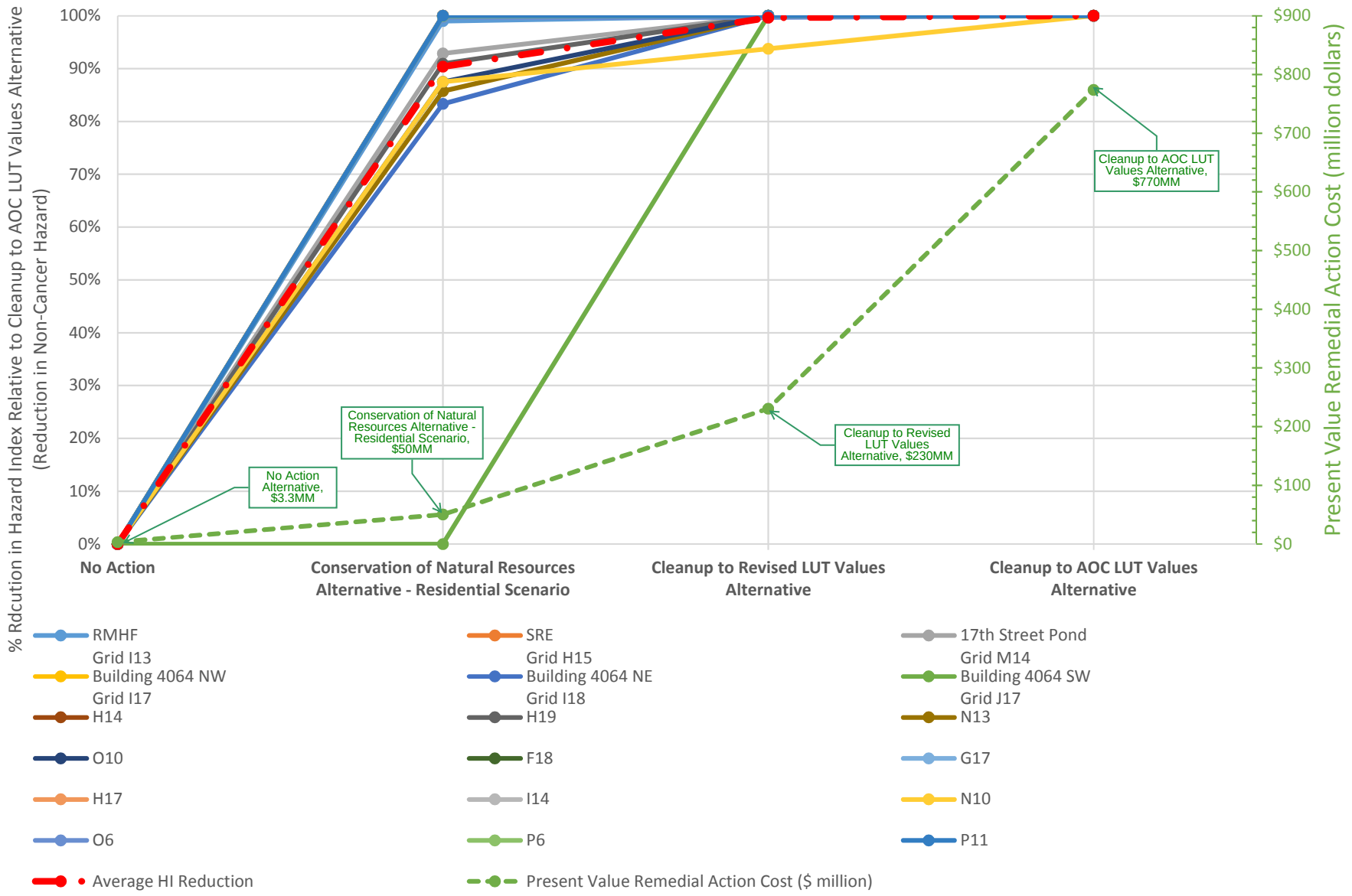

Figure 4-8 Percent Reduction in Non-Cancer Hazard and Remedial Action Cost among Remedial Alternatives - Residential Scenario

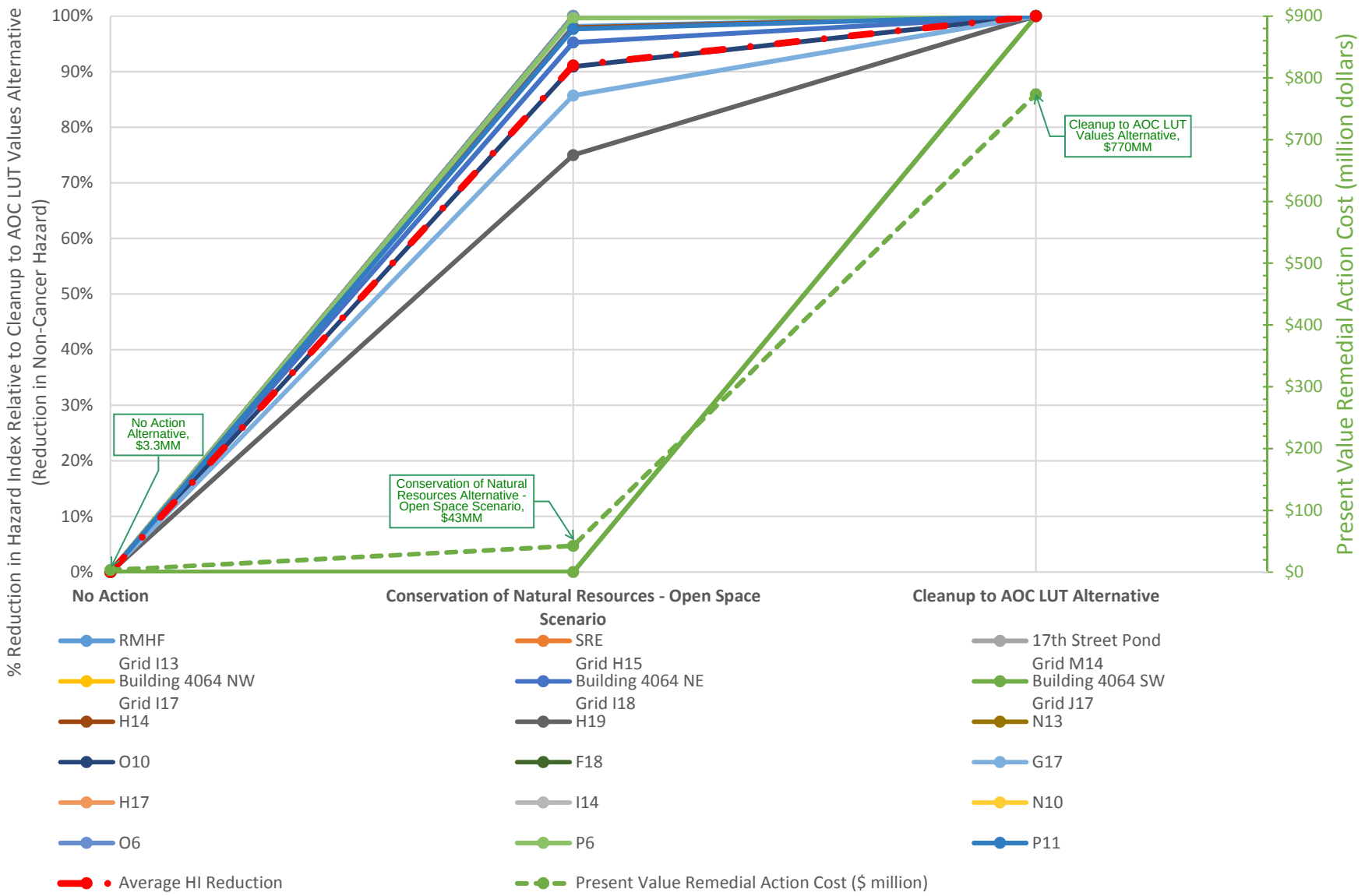

Figure 4-9 Percent Reduction in Non-Cancer Hazard and Remedial Action Cost among Remedial Alternatives - Recreational Scenario

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 COCs 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 Area IV/NBZ, the target is to limit the cumulative (across analytes) false positive decision error rate to 5% or less.

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 for each constituent 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 had specified the limit of false positive error rate to be 5% for each constituent (DTSC 2013), 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 cumulative 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[2] with the mean[3] and standard deviation[4] 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

[2] Lognormal distribution – A lognormal (log-normal or Galton) distribution is a continuous probability distribution of a variable whose logarithm is normally distributed.
[3] Mean – The average value that is used to define the central tendency of a dataset.
[4] Standard deviation – The standard deviation is a measure that is used to quantify the amount of variation or dispersion in a dataset.

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 would not limit the false positive decision error rate across all analytes 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% (as indicated by pink-highlighted cells in **Table 5-1**); 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. As an example, 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 example 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[5]. 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 COCs 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

[5] Gamma distribution – A gamma distribution is a family of right-skewed, continuous probability distributions.

cancer risk of 1 x 10^{-6} and a non-cancer HQ of 1 and assuming a default suburban residential 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[6].

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 would 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 – Residential Scenario and Conservation of Natural Resources Alternative – Open Space Scenario

As described above, the Cleanup to Revised LUT Values Alternative would 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, which is likely to be a highly conservative approach. The more likely exposure scenario is that a given receptor would be exposed in a larger area and the long-term exposure would be represented based on multiple sampling locations within that area.

According to risk assessment guidance (USEPA 1989), it is assumed a receptor would be randomly exposed across the entire exposure area; hence, the exposure concentration metric is

[6] If the RBSL was lower than the AOC LUT (e.g., arsenic), the AOC LUT was selected as the RBSL.

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 would be in relative proportion to their spatial extent within the area (i.e., a small area of high concentration would have only a small contribution to the exposure area mean, but a large area of high concentration would 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 would be within the specified limits of acceptability (i.e. associated risks would meet USEPA target cancer risk range and non-cancer hazard). 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 Schulz and Griffin (2001)[7].

The appropriate RAL would depend upon the nature and extent of contamination in any given exposure area. As part of the Conservation of Natural Resources Alternative – under either Residential Scenario or the Open Space Scenario, the RAL concept has been applied to 19 different exposure areas at Area IV/NBZ. 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 would 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 would 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) would be large. As the exposure area mean concentration approaches the RAL, the likelihood of a false positive decision error would 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.

[7] 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.:	Established Bkg*	Distinct Bkg**	Distinct Bkg**
	Cleanup Level:	AOC LUT	AOC LUT	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.:	Established Bkg*	Distinct Bkg**	Distinct Bkg**
	Cleanup Level:	AOC LUT	AOC LUT	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.:	**Established Bkg***	**Distinct Bkg****	**Distinct Bkg****
	Cleanup Level:	**AOC LUT**	**AOC LUT**	**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.

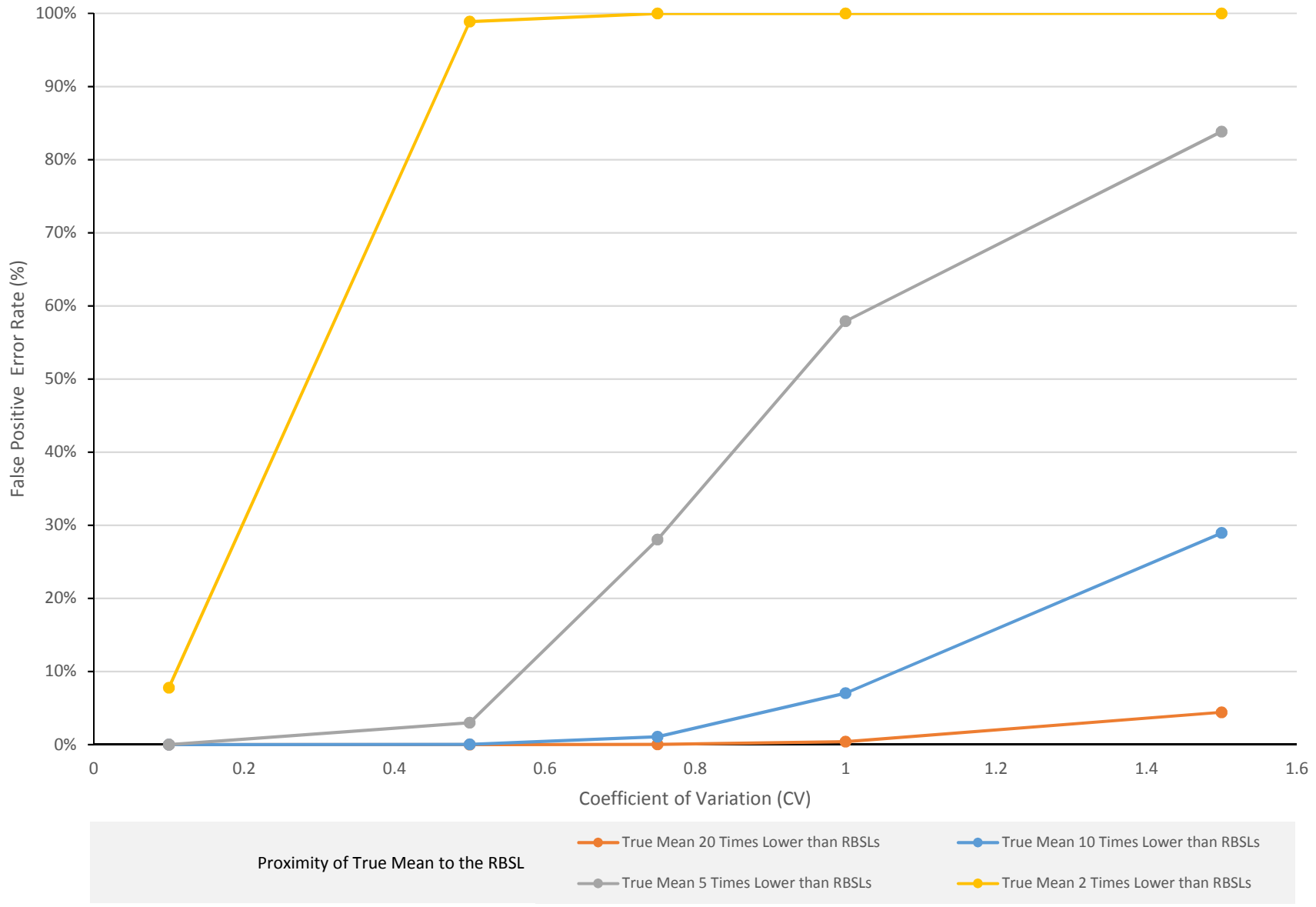

Figure 5-1 Probability of False Positive Decision Error as a Function of Proximity to the RBSL

Section 6
Green and Sustainable Remediation

Green and sustainable remediation (GSR) is the "s*ite-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 would consider the results from the GSR evaluation presented in **Section 6.1** during its decision-making process (i.e. the NEPA ROD) 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; and
- Socioeconomic impacts: enhanced cost analysis of social cost of environmental metrics.

Typically, a GSR assessment would also include qualitative evaluation of potential detrimental and beneficial impacts on the community. However, since such qualitative evaluation is already performed as part of Chapter 4 of the EIS, it will not be repeated in this CBA.

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 on-site 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, including generator use.
- Water consumption for dust control.
- Volume of backfill transported on-site.
- Landfill space and landfill operation.
- Labor hours associated with on-site activities.

Details on input parameters and assumptions are provided in **Attachment B**. These assumptions are in alignment with the EIS assumptions as well as the cost estimate, which is presented in **Section 3**.

It is noted that since the Conservation of Resources Alternative – Residential Scenario and the Conservation of Resources Alternative – Open Space Scenario are very similar from an excavation volume perspective and from a duration perspective, the GSR evaluation of the two alternatives would therefore also be similar. As such, of these two alternatives, only the Conservation of Resources Alternative – Residential Scenario is evaluated for GSR. The environmental footprint and associated social cost of the Conservation of Resources Alternative – Open Space Scenario is assumed to be similar to but slightly less than the Conservation of Resources Alternative – Residential Scenario.

Results from environmental footprint analysis using Sitewise™ is not directly comparable with results from the project air quality analysis presented in Chapter 4 of the EIS due to different boundary conditions of each assessment. The EIS project air quality analysis boundary is confined

to account for all mobile emission sources (emissions from trucks, excavators, vehicles, etc.) and is limited to chemical emission metrics. On the other hand, the Sitewise™ analysis boundary is expanded to account for mobile emission sources, generator use, and landfill space and operation. As such, the overall emissions quantified using the Sitewise™ tool are larger in comparison to the EIS air quality analysis. Due to the different boundary conditions, direct comparison between the EIS project air quality analysis and Sitewise™ chemical emission results is not appropriate. In addition, Sitewise™ also quantifies water consumption and energy usage metrics.

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 represents 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$) at discount rates of 2.5, 3, and 5 percent. A lower discount rate means society places higher value on future impacts (e.g., climate change and chronic risk to human receptors). While a higher discount rate means society places higher value on present impacts (e.g., daily traffic congestion and general inconvenience due to onsite activities taking place). The social costs with a discount rate of 2.5 percent were used in the enhanced cost analysis since the environmental footprint metrics (e.g., GHG emissions) used in this GSR assessment are associated with long-term and intergenerational societal impacts (Harclerode et al, 2015). In addition, the SiteWise™ tool quantifies GHG emissions in terms of CO_2 equivalents (eq) that already take into consideration the global warming potential associated with CO_2, CH_4, and N_2O. To avoid double counting of the radiative forcing factors associated with these emissions, only the social cost of carbon was utilized to quantify the societal cost associated with GHG emissions. Muller and Mendelsohn (2010) quantified the social cost of NOx, SOx, and PM_{10} (2002 US$) 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. At the time of this document preparation, there are no executive policies recommending consideration of social cost metrics. In addition, technical support documents

from the Interagency Working Group on Social Cost of Greenhouse Gases (including the Technical Update of Social Cost of Carbon for Regulatory Impact Analysis [USG 2016]) were withdrawn by Executive Order 13783.

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 – Residential Scenario 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 70% less in GHG emission and energy usage, while the Conservation of Natural Resources Alternative – Residential Scenario would result in approximately 93% less in GHG emission and energy usage. In terms of water consumption and total emissions of criteria pollutant, the Cleanup to Revised LUT Values Alternative would result in a reduction of approximately 70% or more when compared to the Cleanup to AOC LUT Values Alternative, while the Conservation of Natural Resources Alternative – Residential Scenario would result in a reduction of approximately 93% 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 – Residential Scenario.

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 – Residential Scenario contributes the least to long-term global impacts and their associated social costs (an estimated $1.6 MM), while the Cleanup to AOC LUT Values Alternative contributes the most (an estimated $25 MM).

A comparison of the social cost among the proposed alternatives results in an approximately 94% reduction in monetized global impacts by implementing the Conservation of Natural Resources

Alternative – Residential Scenario in lieu of the Cleanup to AOC LUT Values Alternative, and approximately 72% 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 – Residential Scenario has the least amount of residual handling and earthwork equipment use per the EIS, its GHG emissions and energy consumptions are the lowest.

6.2 Incorporation of Green and Sustainable Remediation Elements

During all four of the 2012 Community Alternatives Development Workshops for SSFL, 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 allows the consideration of GSR prior to selection of a remedy.

For this project, greener 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 a greener 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 ones developed as part of the EIS impact analysis, 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 GHG, 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 portion of SSFL that Boeing owns and administers. 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, environmental 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 would 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.

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Table 6-1 - Societal Disamenities and Unit Social Costs for Environmental Metrics
SSFL Area IV and NBZ

Environmental Metric		Societal Disamenities	Unit Social Costs (2018 US$)[1,2]
Greenhouse Gas (GHG)[3]	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).	$60 per metric ton
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).	$355 per metric ton
	Sulfur Oxides (SO_x)		$1,378 per metric ton
	Particulate Matter (PM_{10})		$242 per metric ton
Energy Consumption[4] (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).	$15 per MMBTU

Notes:

MMBTU - million British Thermal Unit

[1]Social cost of environmental metrics are based on:

- CO_2 (2007 US$, 2.5% discount rate): United States Government, Interagency Working Group on Social Cost of Greenhouse Gases. (2016). Technical support document: - Technical update of the social cost of carbon for regulatory impact analysis – Under Executive Order 12866.
- Carbon Dioxide (CO_2) (2007 US$, 2.5% discount rate)
- 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.

[3]The GHG emission footprint calculation in the SiteWise™ tool considers all three GHG emissions (i.e., CO_2, methane [CH_4], and nitrous oxicde [N_2O]) based on U.S. EPA's 2008 *Climate Leaders Program Direct Emissions from Stationary Combustion Sources* report. The tool quantifies GHG emissions in terms of CO_2 equivalents (eq) that already take into consideration the global warming potential associated with CO_2, CH_4, and N_2O. To avoid double counting of the radiative forcing factors associated with these emissions, only the social cost of carbon was utilized to quantify the societal cost associated with GHG emissions.

[4]The social cost of total energy quantified by Greenstone and Looney (2011) is comprised of the social cost of CO_2, NO_x, SO_x, PM_{10}, and fine particulate matter ($PM_{2.5}$). The tool quantifies engery conumpsion in terms of CO_2, NO_x, SO_x, and PM_{10} emission; and does not account for $PM_{2.5}$.

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
	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 Alternative	91,000	150	3.9	13	290	80	260	1,300,000	110,000,000	1,200,000	170,000	660,000
Cleanup to Revised LUT Values Alternative	27,000	60	1.3	5.5	91	16	62	362,000	32,000,000	120,000	170,000	140,000
Conservation of Natural Resources Alternative - Residential Scenario	6,000	16	0.34	1.47	24	3.9	16	82,000	8,000,000	74,000	4,500	39,000
Relative Impact:												
Cleanup to AOC LUT Values Alternative	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
Conservation of Natural Resources Alternative - Residential Scenario	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Medium	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	91,000	290	80	260	1,300,000	
Cleanup to Revised LUT Values Alternative	27,000	91	16	62	362,000	
Conservation of Natural Resources Alternative - Residential Scenario	6,000	24	4	16	82,000	
Unit Social Cost for Environmental Impact Metrics[3]						
Social Cost in 2018 US$	$ 60	$ 355	$ 1,378	$ 242	$ 15	
Social Cost of Environmental Impact Metrics for Each Alternative 2016 US$						**Total Social Cost[4]**
Cleanup to AOC LUT Values Alternative	$ 5,485,480	$ 102,994	$ 110,238	$ 62,790	$ 19,331,000	**$ 25,000,000**
Cleanup to Revised LUT Values Alternative	$ 1,627,560	$ 32,319	$ 22,048	$ 14,973	$ 5,382,940	**$ 7,100,000**
Conservation of Natural Resources Alternative - Residential Scenario	$ 361,680	$ 8,524	$ 5,512	$ 3,864	$ 1,219,340	**$ 1,600,000**

Notes:

[1]Based on results from footprint analysis using Sitewise™.

[2] GHG emissions in terms of carbon dioxide ($CO_{2)}$ equivalents (eq) that already take into consideration the global warming potential associated with CO_2, methane ($CH_{4)}$, and nitrous oxide (N_2O).

[4]Rounded to two significant figures.

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

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 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

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	
Minimize clearing of trees throughout investigation and cleanup	X						X						DOE will protect trees as necessary during cleanup.
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

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	
													certification requirements
– 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	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	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	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	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							– 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			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	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

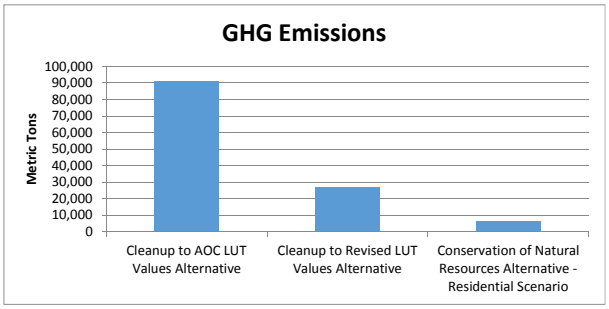
Table 6-4 Green and Sustainable Remediation Best Management Practices
SSFL Area IV/NBZ

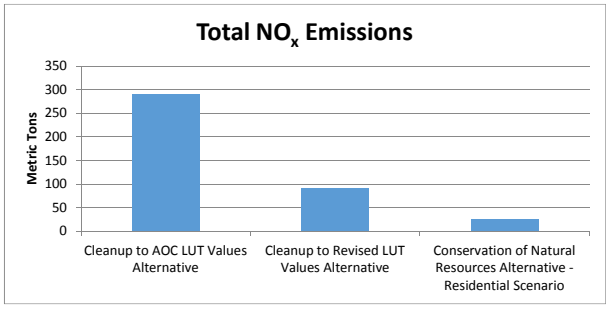
Green and Sustainable Remediation Best Management Practice	Resource Conservation				Protection of Environment				Waste Management			Optimizing Project Work	Applicability to Area IV Cleanup Actions
	Energy Conservation	Use of On-Site Materials	Water Conservation	Use of Natural Resources	Air Quality	Carbon 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				– 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

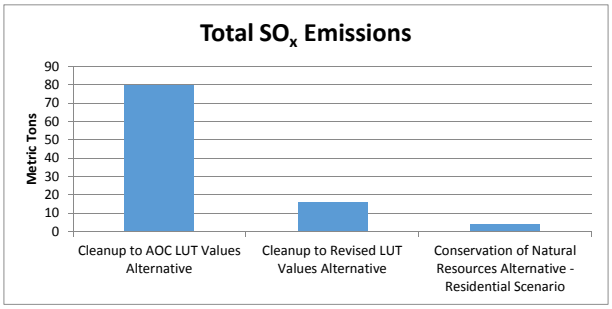
Table 6-4 Green and Sustainable Remediation Best Management Practices
SSFL Area IV/NBZ

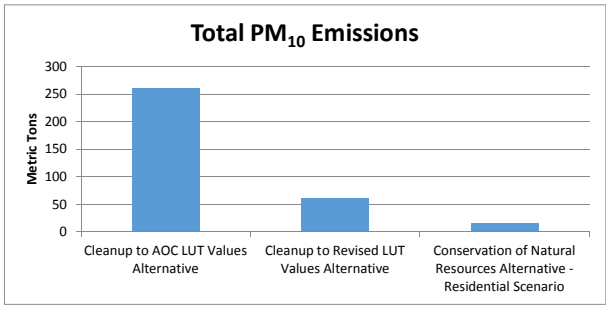
Green and Sustainable Remediation Best Management Practice	Resource Conservation				Protection of Environment				Waste Management			Optimizing Project Work	Applicability to Area IV Cleanup Actions
	Energy Conservation	Use of On-Site Materials	Water Conservation	Use of Natural Resources	Air Quality	Carbon 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					X	DOE will continue coordination with conservation groups

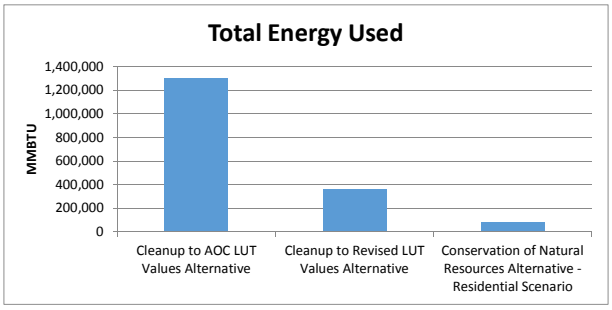
AOC = Administrative Order on Consent; BACT = best available control technology; BMP = best management practice; D&D = decontamination and decommissioning; DOE = Department of Energy; DTSC = Department of Toxic Substances Control; EPA = U.S. Environmental Protection Agency; FFS = Focused Feasibility 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.

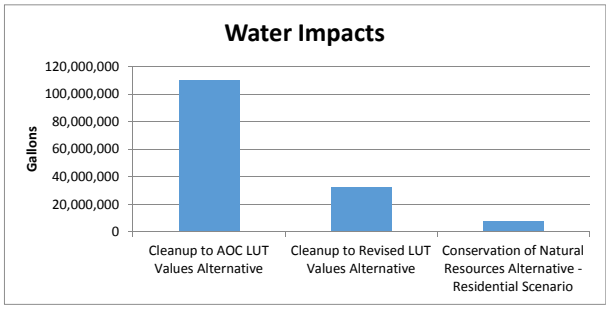


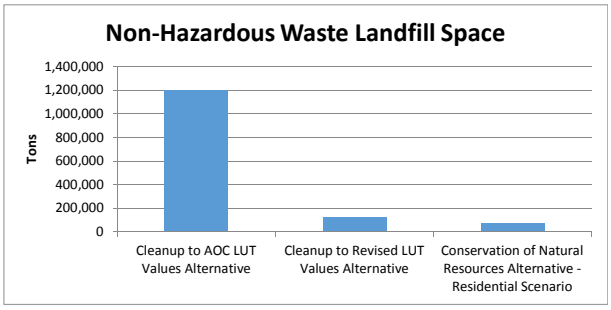


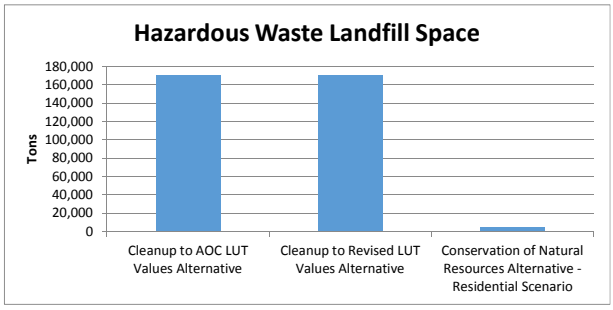


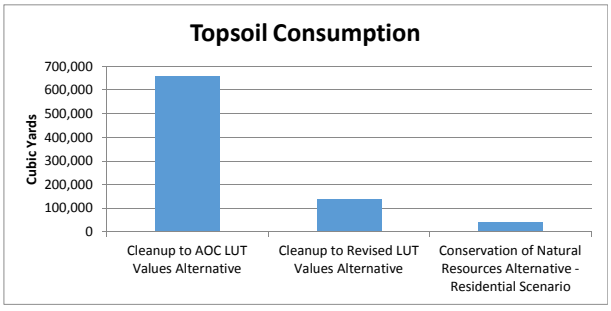






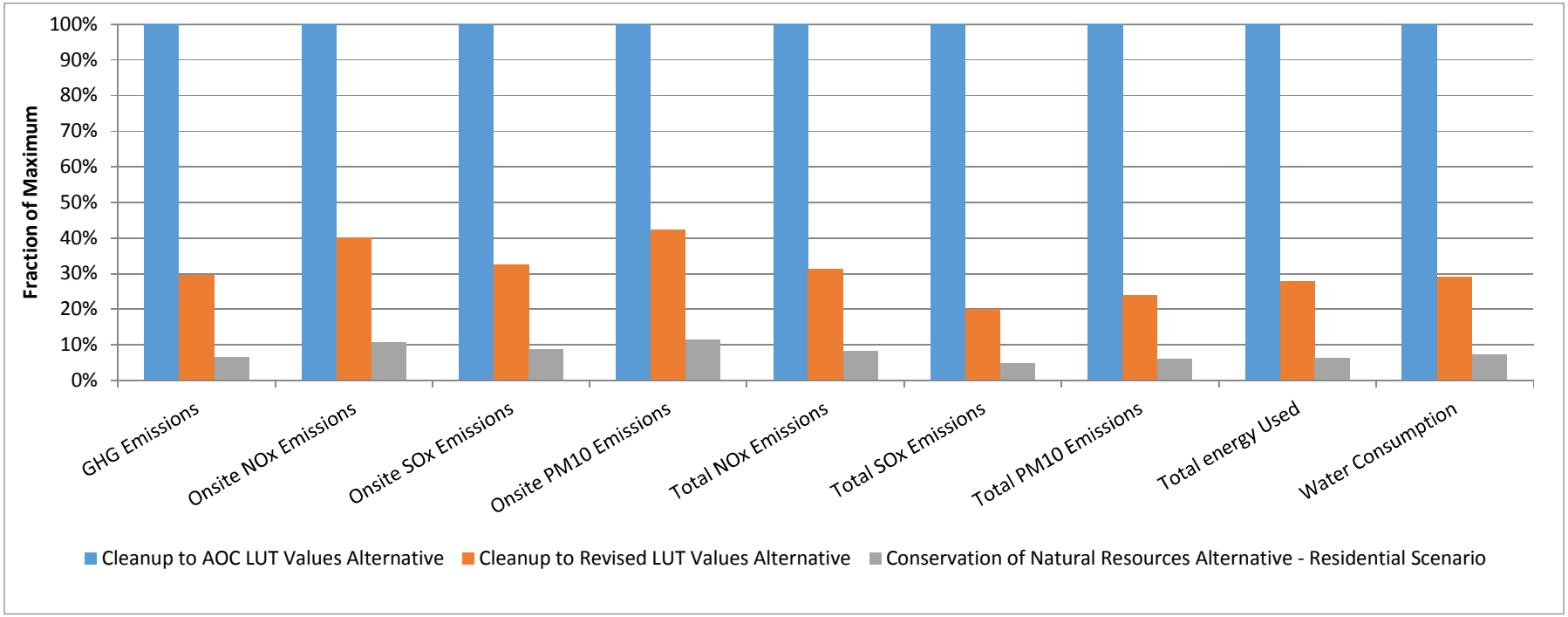






Notes:
GHG - greenhouse gas
MMBTU - million British Thermal Unit
NOx - nitrogen oxide
PM_{10} - matter particles with a diameter of 10 micrometers or less
SOx - sulfur oxide

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
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Attachment A

AOC LUT Values and RBSLs

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Attachment A - Summary of LUT and RBSL Values for Risk Assessment COCs

COC	Unit	LUT Value	Residential RBSL	Recreational RBSL	Ecological RBSL
Antimony	mg/kg	0.86	26.4	123	2
Aroclor 1248	µg/kg	17	232	564	64
Aroclor 1254	µg/kg	17	232	564	390
Aroclor 1260	µg/kg	17	232	564	250
Aroclor 5460	µg/kg	50	232	564	390
Barium	mg/kg	371	11000	51900	89
Benzo(a)anthracene	µg/kg	BaP TEQ	387	939	50000
Benzo(a)pyrene	µg/kg	4.47	38.7	93.9	310000
Benzo(b)fluoranthene	µg/kg	BaP TEQ	387	939	150000
Benzo(k)fluoranthene	µg/kg	BaP TEQ	387	939	310000
Bis(2-ethylhexyl)phthalate	µg/kg	61	173000	479000	65000
Cadmium	mg/kg	0.7	4.6	9.06	0.81
Chromium (Hexavalent Compounds)	mg/kg	2	1.29	6.27	30
Chrysene	µg/kg	BaP TEQ	3870	9390	76000
Dibenzo(a,h)anthracene	µg/kg	BaP TEQ	113	275	140000
Indeno(1,2,3-cd)pyrene	µg/kg	BaP TEQ	387	939	300000
Lead	mg/kg	49	80	360	39
MCPA	µg/kg	761	34300	160000	610
Mercury	mg/kg	0.13	16.8	78.2	1.7
Molybdenum	mg/kg	3.2	380	1780	1.3
Naphthalene	µg/kg	3.6	14600	204000	130000
Phenanthrene	µg/kg	3.9	16400000	77000000	13000
Selenium	mg/kg	1	380	1780	1.5
Silver	mg/kg	0.2	230	1070	29
BaP TEQ	µg/kg	4.47	39	93.9	310000
Dioxin TEQ	pg/g	0.912	4.81	18	5
Zinc	mg/kg	215	22800	107000	320

K-A-3

Notes:

mg/kg – milligrams per kilogram

µg/kg – micrograms per kilogram

pg/g – picograms per gram

Attachment B

Environmental Footprint Analysis Development

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PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	AIS
JOB NO.:	94489.1204	DATE:	9/12/2018	DATE CHECKED:	9/18/2018
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 (NE
3 Equipment hours are based on input from the second generation of the Micro-Computer Aided Cost Estimating System (K-B-3), 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.).
6 100% of backfill volume from offsite imports.
7 Average personnel distance from job site per round trip is 40 miles.
8 Average equipment distance from job site per round trip for mob/demob is 200 miles.
9 Woosley Canyon Road will be maintained/repaired as needed. Assume average of 2.5 miles to be repaired.
10 Environmental footprint of Conservation of Natural Resources Alternative - Open Space Scenario was assumed to be similar to but slightly less than Conservation of Natural Resources Alternative - Residential Scenario due to similar duration and excavation/backfill volume, and was therefore not evaluated.

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	AIS
JOB NO.:	94489.1204	DATE:	9/12/2018	DATE CHECKED:	9/18/2018
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: 26

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%	60	1	from cost estimate
Project Engineer	1	SUV	1	Gasoline	100%	60	1	from cost estimate
QC Engineer	1	Cars	1	Gasoline	100%	60	1	from cost estimate
Safety Engineer	1	Light Truck	1	Gasoline	100%	60	1	from cost estimate
Civil Engineer	1	Light Truck	1	Gasoline	40%	2,704	1	from cost estimate
Staff Scientist	1	SUV	1	Gasoline	60%	4,056	1	from cost estimate
Field QC and Lab Tech	1	Heavy Duty	1	Gasoline	100%	6,760	1	from cost estimate
Equipment Operators	18	Light Truck	18	Gasoline	100%	121,680	18	assumed based on # of equipment mobilized
Other Construction Laborers	10	Heavy Duty	10	Gasoline	100%	67,600	10	assumed
Administrative Staff	1	Cars	1	Gasoline	100%	6,760	1	from cost estimate

K-B-4

Miles per Trip: 100 miles round trip

Inputs	Heavy Duty	Light Truck	SUV	Cars
Input distance traveled per trip (miles)	40	40	40	40
Input number of trips taken	74,360	137,904	10,816	13,520
Input number of travelers	11	21	2	2

Equipment Transportation - Shared Load Road

Assumption 1: The weight of a hydraulic excavator with 3.00 CY bucket and 27.50' digging depth (110,000 lbs) is assumed for heavy equipment.
Assumption 2: Average weight of a earthwork equipment like loader/dozer/roller (34,000 lbs) is assumed for medium equipment.
Assumption 3: The weight of a truck (~22,000 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	5	55	200	275	quantity from cost estimate, weight from MII equipment list.
Medium Equipment	10	17	200	170	quantity from cost estimate, weight from MII equipment list.
Self-propelled Equipment	3	12	200	36	quantity from cost estimate, weight from MII equipment list.
Truck cab with trailer for transport	10	16	200	160	assume 1 cab w/ trailer for heavy equipment; and 1 cab w/ trailer for 2 pieces of medium equipment.

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	AIS
JOB NO.:	94489.1204	DATE:	9/12/2018	DATE CHECKED:	9/18/2018
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

	Trip 1 (hvy)	Trip 2 (med)	Trip 3 (SP)
Input distance traveled, MI:	1000	1000	600
Input weight of equipment transported, TON:	71	50	12

EQUIPMENT USE

Earthwork

Assumption 1: Excavator for all excavation work
Assumption 2: Loader for all backfilling work
Assumption 3:

Soil for Removal, CY:	881,000	*from alternative description*
Soil for Backfill, CY:	660,750	*from alternative description*

	Excavator	Loader/Backhoe
Input volume of material to be removed, CY:	881,000	660,750

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:	54,080	*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

K-B-5

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	AIS
JOB NO.:	94489.1204	DATE:	9/12/2018	DATE CHECKED:	9/18/2018
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

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 es the most hours is used.

K-B-6

Assumption 4: Hours from equipment hours from cost report backup

	Hours	Gallons Diesel
Excavator Small	3,317	39,926
Dozer	462	3,057
Excavator	0	0
Rock Hauler	0	0
Asphalt Hauler	235	2,826
Hauler	139,841	1,683,269
Loader	0	0
Flatbed Truck	11,068	73,226
Pickup	3,891	14,108
Roller	13,496	48,937
Sweeper	27,040	178,897
Tractor	690	1,216
Water Truck	104,000	688,064

Input volume (scf for Natural gas, gallons for all others): 2,733,526

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.

	Construction laborers	Operating engineers	Waste management services	Scientific and Technical Services	
Choose occupation from drop-down menu					
Input total time worked onsite, HR:	698,529.93	0.00	110,751.72	387,392	*see labor hours tab assumptions*

Laboratory Analysis

Input dollars spent on laboratory analysis ($): $15,749,000 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	1,153,500	50,151	135	270	*from calculation (tonnage and miles) and from calculation (trips)*
Soil Cat 3	3,000	130	780	1,560	*from calculation (tonnage and miles) and from calculation (trips)*
Soil Cat 4	165,000	7,174	300	600	*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:	23	23	23	

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	AIS
JOB NO.:	94489.1204	DATE:	9/12/2018	DATE CHECKED:	9/18/2018
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

Choose fuel used from drop down menu	Diesel	Diesel	Diesel	Diesel	
Input total number of trips:	50,151	130	7,174		
Input number of miles per trip:	270	1,560	600		roundtrip

Landfill Operations

Choose landfill type for waste disposal	Non-Hazardous	Hazardous
Input amount of waste disposed in landfill, TON:	1,153,500	168,000
Input landfill methane emissions, Metric Tons CH4:		

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:	104,000,000			*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:	660,750	*ECY, from cost estimate*
Input volume of groundwater or surface water lost, GAL:	0	

K-B-7

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	AIS
JOB NO.:	94489.1204	DATE:	9/12/2018	DATE CHECKED:	9/18/2018
CLIENT:	DOE			WRKSHT NO.:	Cleanup to Revised LUT

To be copied to Sitewise Input Sheet
Input values to be entered

Cleanup to Revised AOC LUT Values Alternative

Component 1 - Removal, Transportation/Disposal, and Backfill Duration, YR: 8

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%	2,080	1	from cost estimate
Project Engineer	1	SUV	1	Gasoline	100%	2,080	1	from cost estimate
QC Engineer	1	Cars	1	Gasoline	100%	2,080	1	from cost estimate
Safety Engineer	1	Light Truck	1	Gasoline	100%	2,080	1	from cost estimate
Civil Engineer	1	Light Truck	1	Gasoline	40%	832	1	from cost estimate
Staff Scientist	1	SUV	1	Gasoline	60%	1,248	1	from cost estimate
Field QC and Lab Tech	1	Heavy Duty	1	Gasoline	100%	2,080	1	from cost estimate
Equipment Operators	23	Light Truck	23	Gasoline	100%	47,840	23	assumed based on # of equipment mobilized
Other Construction Laborers	10	Heavy Duty	10	Gasoline	100%	20,800	10	assumed
Administrative Staff	1	Cars	1	Gasoline	100%	2,080	1	from cost estimate

K-B-8

Miles per Trip: 100 miles round trip

Inputs	Heavy Duty	Light Truck	SUV	Cars
Input distance traveled per trip (miles)	40	40	40	40
Input number of trips taken	22,880	52,832	3,328	4,160
Input number of travelers	11	26	2	2

Equipment Transportation - Shared Load Road

Assumption 1: The weight of a hydraulic excavator with 3.00 CY bucket and 27.50' digging depth (110,000 lbs) is assumed for heavy equipment.
Assumption 2: Average weight of a earthwork equipment like loader/dozer/roller (34,000 lbs) is assumed for medium equipment.
Assumption 3: The weight of a truck (~22,000 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	5	55	200	275	quantity from cost estimate, weight from MII equipment list.
Medium Equipment	10	17	200	170	quantity from cost estimate, weight from MII equipment list.
Self-propelled Equipment	3	12	200	36	quantity from cost estimate, weight from MII equipment list.
Truck cab with trailer for transport	10	16	200	160	assume 1 cab w/ trailer for heavy equipment; and 1 cab w/ trailer for 2 pieces of medium equipment.

	Trip 1 (hvy)	Trip 2 (med)	Trip 3 (SP)
Input distance traveled, MI:	1000	1000	600
Input weight of equipment transported, TON:	71	50	12

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	AIS
JOB NO.:	94489.1204	DATE:	9/12/2018	DATE CHECKED:	9/18/2018
CLIENT:	DOE			WRKSHT NO.:	Cleanup to Revised LUT

To be copied to Sitewise Input Sheet
Input values to be entered

Cleanup to Revised 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:	190,000	*from alternative description*
Soil for Backfill, CY:	142,500	*from alternative description*

	Excavator	Loader/Backhoe
Input volume of material to be removed, CY:	190,000	142,500

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:	16,640	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

K-B-9

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	AIS
JOB NO.:	94489.1204	DATE:	9/12/2018	DATE CHECKED:	9/18/2018
CLIENT:	DOE			WRKSHT NO.:	Cleanup to Revised LUT

To be copied to Sitewise Input Sheet
Input values to be entered

Cleanup to Revised AOC LUT Values Alternative

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

K-B-10

	Hours	Gallons Diesel
Excavator Small	1,027	12,365
Dozer	118	781
Excavator	0	0
Rock Hauler	0	0
Asphalt Hauler	235	2,826
Hauler	27,143	326,719
Loader	0	0
Flatbed Truck	3,299	21,826
Pickup	552	2,002
Roller	2,939	10,656
Sweeper	8,320	55,045
Tractor	211	372
Water Truck	32,000	211,712

Input volume (scf for Natural gas, gallons for all others): 644,304

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.

	Construction laborers	Operating engineers	Waste management services	Scientific and technical services	
Choose occupation from drop-down menu					
Input total time worked onsite, HR:	208,107.75	0.00	39,268.97	119,264	*see labor hours tab assumptions*

Laboratory Analysis

Input dollars spent on laboratory analysis ($): $1,358,100 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	117,000	5,087	135	270	*from calculation (tonnage and miles) and from calculation (trips)*
Soil Cat 3	3,000	130	780	1,560	*from calculation (tonnage and miles) and from calculation (trips)*
Soil Cat 4	165,000	7,174	300	600	*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:	23	23	23	

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	AIS
JOB NO.:	94489.1204	DATE:	9/12/2018	DATE CHECKED:	9/18/2018
CLIENT:	DOE			WRKSHT NO.:	Cleanup to Revised LUT

To be copied to Sitewise Input Sheet
Input values to be entered

Cleanup to Revised AOC LUT Values Alternative

Choose fuel used from drop down menu	Diesel	Diesel	Diesel	Diesel
Input total number of trips:	5,087	130	7,174	
Input number of miles per trip:	270	1,560	600	

Landfill Operations

Choose landfill type for waste disposal	Non-Hazardous	Hazardous
Input amount of waste disposed in landfill, TON:	117,000	168,000
Input landfill methane emissions, Metric Tons CH4:		

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:	32,000,000			*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:	142,500	*ECY, from cost estimate, from off-site sources*
Input volume of groundwater or surface water lost, GAL:	0	

K-B-11

PROJECT:	SSFL Area IV Soils CBA	**COMPUTED BY:**	IL	**CHECKED BY:**	AIS
JOB NO.:	94489.1204	**DATE:**	9/12/2018	**DATE CHECKED:**	9/18/2018
CLIENT:	DOE			**WRKSHT NO.:**	CNR-Residential

To be copied to Sitewise Input Sheet
Input values to be entered

Conservation of Natural Resources Alternative – Residential Scenario

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

K-B-12

Miles per Trip: 100 miles round trip

Inputs	Heavy Duty	Light Truck	SUV	Cars
Input distance traveled per trip (miles)	40	40	40	40
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 3.00 CY bucket and 27.50' digging depth (110,000 lbs) is assumed for heavy equipment.
Assumption 2: Average weight of a earthwork equipment like loader/dozer/roller (34,000 lbs) is assumed for medium equipment.
Assumption 3: The weight of a truck (~22,000 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	5	55	200	275	quantity from cost estimate, weight from MII equipment list.
Medium Equipment	10	17	200	170	quantity from cost estimate, weight from MII equipment list.
Self-propelled Equipment	3	12	200	36	quantity from cost estimate, weight from MII equipment list.
Truck cab with trailer for transport	10	16	200	160	assume 1 cab w/ trailer for heavy equipment; and 1 cab w/ trailer for 2 pieces of medium equipment.

	Trip 1 (hvy)	Trip 2 (med)	Trip 3 (SP)
Input distance traveled, MI:	1000	1000	600
Input weight of equipment transported, TON:	71	50	12

PROJECT:	SSFL Area IV Soils CBA	**COMPUTED BY:**	IL	**CHECKED BY:**	AIS
JOB NO.:	94489.1204	**DATE:**	9/12/2018	**DATE CHECKED:**	9/18/2018
CLIENT:	DOE			**WRKSHT NO.:**	CNR-Residential

To be copied to Sitewise Input Sheet
Input values to be entered

Conservation of Natural Resources Alternative – Residential Scenario

Equipment Use

Earthwork

Assumption 1: Excavator for all excavation work
Assumption 2: Loader for all backfilling work
Assumption 3:

Soil for Removal, CY:	52,000	*from alternative description*
Soil for Backfill, CY:	39,000	*from alternative description*

	Excavator	**Loader/Backhoe**
Input volume of material to be removed, CY:	52,000	39,000

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

K-B-13

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	AIS
JOB NO.:	94489.1204	DATE:	9/12/2018	DATE CHECKED:	9/18/2018
CLIENT:	DOE			WRKSHT NO.:	CNR-Residential

To be copied to Sitewise Input Sheet
Input values to be entered

Conservation of Natural Resources Alternative – Residential Scenario

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 utilize most hours is used.

K-B-14

Assumption 4: Hours from equipment hours from cost report backup

	Hours	Gallons Diesel
Excavator Small	278	3,352
Dozer	40	265
Excavator	0	0
Rock Hauler	0	0
Asphalt Hauler	235	2,826
Hauler	7,429	89,418
Loader	0	0
Flatbed Truck	947	6,268
Pickup	109	393
Roller	811	2,942
Sweeper	2,080	13,761
Tractor	102	180
Water Truck	8,000	52,928

Input volume (scf for Natural gas, gallons for all others): 172,333

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.

	Construction laborers	Operating engineers	Waste management services	Scientific and technical services	
Choose occupation from drop-down menu					
Input total time worked onsite, HR:	53,116.44	0.00	6,541.69	29,888	*see labor hours tab assumptions*

Laboratory Analysis

Input dollars spent on laboratory analysis ($): $163,100 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	73,500	3,196	135	270	*from calculation (tonnage and miles) and from calculation (trips)*
Soil Cat 3	3,000	130	780	1,560	*from calculation (tonnage and miles) and from calculation (trips)*
Soil Cat 4	1,500	65	300	600	*from calculation (tonnage and miles) and from calculation (trips)*

PROJECT:	SSFL Area IV Soils CBA	**COMPUTED BY:**	IL	**CHECKED BY:**	AIS
JOB NO.:	94489.1204	**DATE:**	9/12/2018	**DATE CHECKED:**	9/18/2018
CLIENT:	DOE			**WRKSHT NO.:**	CNR-Residential

To be copied to Sitewise Input Sheet
Input values to be entered

Conservation of Natural Resources Alternative – Residential Scenario

	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:	23	23	23	
Choose fuel used from drop down menu	**Diesel**	**Diesel**	**Diesel**	**Diesel**
Input total number of trips:	3,196	130	65	
Input number of miles per trip:	270	1,560	600	

Landfill Operations

	Non-Hazardous	Hazardous
Choose landfill type for waste disposal		
Input amount of waste disposed in landfill, TON:	73,500	4,500
Input landfill methane emissions, Metric Tons CH4:		

K-B-15

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:	39,000	*ECY, from cost estimate, from off-site sources*
Input volume of groundwater or surface water lost, GAL:	0	

CDM Smith

PROJECT: SSFL Area IV Soils CBA
JOB NO.: 94489.1204
CLIENT: DOE

COMPUTED BY: IL
DATE: 9/12/2018

CHECKED BY: AIS
DATE CHECKED: 9/18/2018
WRKSHT NO.: Labor Hr

Labor Hours

	Percentage of Time On-Site for Mixed Location	20%	Cleanup to AOC LUT Values Alternative				Cleanup to Revised AOC LUT Values Alternative				Conservation of Natural Resources Alternative – Residential Scenario			
	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				5,746				1,768				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				32,448				9,984				2,496
	15 Job Site Personnel	On-Site				378,560				116,480				29,120
	20 Temp Facilities													
	05 Project Sign	On-Site	16				16							
	10 Staging Area and Fencing	On-Site	16				16							
	15 Temporary Facilities	On-Site	0				0							
	20 Removal of Temp. Construction Facilities	On-Site	120				120							
02	**Mob and Demob**													
	05 Site Mob	On-Site	317				317				317			
	10 Site Demob	On-Site												
	05 Equipment Demob	On-Site	285				285				285			
	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				2,496				768				192
	10 Temp. Erosion and Sediment Control													
	05 Silt Fence	On-Site	6,156				1,409				460			
	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	75				18				5			
	35 Inspection and Maintenance	On-Site	10,816				3,328				832			
	15 Existing Tree Protection													
	05 Arborist and Care for Existing Trees	On-Site				6,336				2,016				576
	10 Tree Protection Fencing	On-Site	225				79				79			
	20 Dust Control	On-Site	52,000				16,000				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	54,080				16,640				4,160			
	35 Street Sweeping	On-Site	27,040				8,320				2,080			
	40 Traffic Control													
	05 Preconstruction Video Survey	On-Site	32				32				32			
	10 Traffic Control Signs / Barricades	On-Site	2,512				784				208			
	15 Traffic Control	On-Site	416,000				128,000				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	1,310				148				94			
	10 Excavation	On-Site	40,157				4,073				2,559			
	15 Hauling	Mixed			397,759				40,345				25,345	
	20 Conf Sampling	On-Site	2,859				161				49			
	25 Sampling Analysis	Off-Site				0	0				0			
	10 Soil Cat 3													
	05 Construction Survey and Staking	On-Site	3				4				4			
	10 Excavation	On-Site	597				597				597			
	15 Hauling	Mixed			6,000				6,000				6,000	

K-B-16

CDM Smith

PROJECT: SSFL Area IV Soils CBA
JOB NO.: 94489.1204
CLIENT: DOE

COMPUTED BY: IL
DATE: 9/12/2018

CHECKED BY: AIS
DATE CHECKED: 9/18/2018
WRKSHT NO.: Labor Hr

Labor Hours

	Percentage of Time On-Site for Mixed Location	20%	Cleanup to AOC LUT Values Alternative				Cleanup to Revised AOC LUT Values Alternative				Conservation of Natural Resources Alternative – Residential Scenario			
	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	7				5				2			
	25 Sampling Analysis	Off-Site				0				0				0
	15 Soil Cat 4													
	05 Construction Survey and Staking	On-Site	187				208				2			
	10 Excavation	On-Site	12,022				12,022				109			
	15 Hauling	Mixed			150,000				150,000				1,364	
	20 Conf Sampling	On-Site	409				227				2			
	25 Sampling Analysis	Off-Site				0				0				0
05	**Disposal**													
	05 Soil Cat 1/2	Off-Site	0				0							
	10 Soil Cat 3	Off-Site	0				0							
	15 Soil Cat 4	Off-Site	0				0							
06	**Backfill**													
	05 Backfill from Onsite Sources													
	05 Rock Excavation	On-Site	0				0				0			
	10 Rock Crushing and Screening	On-Site	0				0				0			
	15 Fill	On-Site	0				0				0			
	10 Backfill from Offsite Sources													
	05 Import Fill Material	Mixed	139,841				27,143				7,429			
	10 Fill	On-Site	41,655				8,575				2,349			
	15 QC and Testing	On-Site	0				0				0			
07	**Restoration**													
	05 Seeding	On-Site	240				58				16			
	10 Allowance for Street/Pavement Repair	On-Site	1,006				1,006				1,006			

K-B-17

	Cleanup to AOC LUT Values Alternative				Cleanup to Revised LUT Values Alternative				Conservation of 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	670,562	0	0	387,392	202,679	0	0	119,264	51,631	0	0	29,888
Off-Site Total	0	0	0	40,854	0	0	0	14,412	0	0	0	5,598
Mixed Total (on-Site and off-site total)	139,841	0	553,759	0	27,143	0	196,345	0	7,429	0	32,708	0
Mixed Total (on-site only)	27,968	0	110,752	0	5,429	0	39,269	0	1,486	0	6,542	0
Total On-Site Hours	698,530	0	110,752	387,392	208,108	0	39,269	119,264	53,116	0	6,542	29,888

CDM Smith

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	AIS
JOB NO.:	94489.1204	DATE:	9/12/2018	DATE CHECKED:	9/18/2018
CLIENT:	DOE			WRKSHT NO.:	Othr Equip Hr

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 Resource 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	Cleanup to Revised LUT Values Alternative	Conservation of Resource Alternative - Residential Scenario
Excavator Small	3,317	1,027	278	MAP H25KM015 HYDRAULIC EXCAVATOR, CRAWLER, 133,160 LBS, 4.25 CY BUCKET, 27.83' MAX DIGGING DEPTH	433	12.037	39,926	12,365	3,352
Dozer	462	118	40	GEN T15Z6520 TRACTOR, CRAWLER (DOZER), 181-250 HP (135-186 KW), POWERSHIFT, LGP, W/UNIVERSAL BLADE	258	6.616	3,057	781	265
Excavator	0	0	0	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	0	0	0
Rock Hauler	0	0	0	EP T5SCA011 TRUCK, OFF-HIGHWAY, ARTICULATED FRAME, 22 CY, 30 TON, 6X6, REAR DUMP	260	6.616	0	0	0
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	2,82	2,826
Hauler	139,841	27,143	7,429	MAP T50XX033 DUMP TRUCK, HIGHWAY, 75,000 LBS GVW, 3 AXLE, 6X4 WITH REAR 16 - 20 CY DUMP BODY	400	12.037	1,683,269	326,7	89,418
Loader	0	0	0	GEN L35Z4250 LOADER, FRONT END, CRAWLER, 2.00 CY (1.5 M3) BUCKET	148	3.626	0	0	0
Flatbed Truck	11,068	3,299	947	GEN T50Z7360 TRUCK, HIGHWAY, 20,000 LBS (9,000 KG) GVW, 2 AXLE, 4X2 WITH FLATBED	210	6.616	73,226	21,826	6,268
Pickup	3,891	552	109	MAP T50XX001 TRUCK, HIGHWAY, CONVENTIONAL, 1/2 TON PICKUP, 4X2	130	3.626	14,108	2,002	393
Roller	13,496	2,939	811	MAP R50CA012 ROLLER, VIBRATORY, SELF-PROPELLED, SINGLE DRUM, PAD FOOT, 12.5 TON, 84" WIDE, 3X2, SOIL COMPACTOR	150	3.626	48,937	10,656	2,942
Sweeper	27,040	8,320	2,080	EP B15FS001 STREET SWEEPER, 12' BROOM PATH, 4.5 CY HOPPER, 350 GAL WATER TANK, SELF PROPELLED	230	6.616	178,897	55,045	13,761
Tractor	690	211	102	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	1,216	372	180
Water Truck	104,000	32,000	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	688,064	211,712	52,928
Total Fuel Consumption							**2,733,526**	**644,304**	**172,333**

K-B-18

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	Fuel Consumption
		(gal/yr)	(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.

CDM Smith

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	AIS
JOB NO.:	94489.1204	DATE:	9/12/2018	DATE CHECKED:	9/18/2018
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
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	384,896									
	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	100	USR USR-MB-LE-002 Mobilization or demobilization of medium equipment	Cab with Trailer	200	USR USR-MB-LE-003 Mobilization or demobilization of self-propelled equipment	Misc.	30	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	100	USR USR-MB-LE-002 Mobilization or demobilization of medium equipment	Cab with Trailer	200	USR USR-MB-LE-003 Mobilization or demobilization of self-propelled equipment	Misc.	30			
	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	2,052									
	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	150									
	35 Inspection and Maintenance	Other fueled Equipment	USR SP-ESC-LE-008 Inspection and maintenance of erosion and sediment control measures.	Flatbed Truck	7,571	USR SP-ESC-LE-008 Inspection and maintenance of erosion and sediment control measures.	Excavator Small	3244.8						
	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	104,000									
	25 Air Monitoring													
	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	27,040									
	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	1248						
	15 Traffic Control													

K-B-19

CDM Smith

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	AIS
JOB NO.:	94489.1204	DATE:	9/12/2018	DATE CHECKED:	9/18/2018
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
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	524									
	10 Excavation	Equipment Use - Earthwork	USR EW-EX-A5-100 Excavation - Non-Hazardous/Non-Radioactive Waste	Excavator	20,078									
	15 Hauling	Residue Disposal / Recycling	USR EW-HL-A5-100 Hauling - Non-Hazardous/Non-Radioactive Waste	Hauler	397,759									
	20 Conf Sampling	Other fueled Equipment	USR EW-CS-001 Confirmation sampling	Pickup	2,859									
	25 Sampling Analysis													
	10 Soil Cat 3													
	05 Construction Survey and Staking	Other fueled Equipment	USR SUR-02 Surveying Crew	Pickup	1									
	10 Excavation	Equipment Use - Earthwork	USR EW-EX-200 Excavation - RCRA Hazardous Waste	Excavator	299									
	15 Hauling	Residue Disposal / Recycling	USR EW-HL-200 Hauling - RCRA Hazardous Waste	Hauler	6,000									
	20 Conf Sampling	Other fueled Equipment	USR EW-CS-001 Confirmation sampling	Pickup	7									
	25 Sampling Analysis													
	15 Soil Cat 4													
	05 Construction Survey and Staking	Other fueled Equipment	USR SUR-02 Surveying Crew	Pickup	75									
	10 Excavation	Equipment Use - Earthwork	USR EW-EX-400 Excavation - Low-level Radioactive Waste (LLW)	Excavator	6,011									
	15 Hauling	Residue Disposal / Recycling	USR EW-HL-400 Hauling - Low-level Radioactive Waste (LLW)	Hauler	150,000									
	20 Conf Sampling	Other fueled Equipment	USR EW-CS-001 Confirmation sampling	Pickup	409									
	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													

K-B-20

CDM Smith

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	AIS
JOB NO.:	94489.1204	DATE:	9/12/2018	DATE CHECKED:	9/18/2018
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
06	**Backfill**													
	05 Backfill from Onsite Sources													
	05 Rock Excavation	Other fueled Equipment	USR EX-200 Rock Breaking	Excavator	0	USR EX-210 Rock Excavation	Excavator	0	USR EX-220 Rock Loading	Loader	0	USR EX-230 Rock Onsite Hauling	Hauler	0
	10 Rock Crushing and Screening	Equipment - Generator	USR 312316306120 Rock Crusher, 25 Tons/ HR operation	Rocker Crusher, Electricity Run	0									
	15 Fill (splitted to 2 entries)	Equipment Use - Earthwork	USR EW-BM-LE-200 Fill - Spreading	Loader	0									
	15 Fill (splitted to 2 entries)	Other fueled Equipment	USR EX-230 Rock Onsite Hauling	Rock Hauler	0	USR SD-SP-LE-004B Site Grading - Rough	Roller	0						
	10 Backfill from Offsite Sources													
	05 Import Fill Material	Other fueled Equipment	USR EW-HL-010 Haul Imported Soil	Hauler	139,841									
	10 Fill (splited to 2 entries)	Equipment Use - Earthwork	USR EW-BM-LE-200 Fill - Spreading	Loader	13,984									
	10 Fill (splited to 2 entries)	Other fueled Equipment	USR SD-SP-LE-004B Site Grading - Rough	Dozer	450	USR EW-BM-LE-202 Fill - Compaction	Roller	12586	USR SD-SP-LE-005 Site Grading - Finish	Roller	9(			
	15 QC and Testing													
07	**Restoration**													
	05 Seeding	Other fueled Equipment	USR SR-SD-LE-002 Seeding	Tractor	480									
	10 Allowance for Street/Pavement Repair (splitt	Other fueled Equipment	USR SR-PV-300 Hauling for asphalt cold milling and paving	Asphalt Hauler	235									
	10 Allowance for Street/Pavement Repair (splitt	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						

K-B-21

CDM Smith

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	AIS
JOB NO.:	94489.1204	DATE:	9/12/2018	DATE CHECKED:	9/18/2018
CLIENT:	DOE			WRKSHT NO.:	Rev LUT Equip Hr

Cleanup to Revised 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
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	118,496									
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	100	USR USR-MB-LE-002 Mobilization or demobilization of medium equipment	Cab with Trailer	200	USR USR-MB-LE-003 Mobilization or demobilization of self-propelled equipment	Misc.	30	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	100	USR USR-MB-LE-002 Mobilization or demobilization of medium equipment	Cab with Trailer	200	USR USR-MB-LE-003 Mobilization or demobilization of self-propelled equipment	Misc.	30			
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	470									
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	1	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	36									
35 Inspection and Maintenance	Other fueled Equipment	USR SP-ESC-LE-008 Inspection and maintenance of erosion and sediment control measures.	Flatbed Truck	2,330	USR SP-ESC-LE-008 Inspection and maintenance of erosion and sediment control measures.	Excavator Small	998.4						
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	32,000									
25 Air Monitoring													
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	8,320									
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	384						
15 Traffic Control													

K-B-22

CDM Smith

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	AIS
JOB NO.:	94489.1204	DATE:	9/12/2018	DATE CHECKED:	9/18/2018
CLIENT:	DOE			WRKSHT NO.:	Rev LUT Equip Hr

Cleanup to Revised 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
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	59									
	10 Excavation	Equipment Use - Earthwork	USR EW-EX-A5-100 Excavation - Non-Hazardous/Non-Radioactive Waste	Excavator	2,037									
	15 Hauling	Residue Disposal / Recycling	USR EW-HL-A5-100 Hauling - Non-Hazardous/Non-Radioactive Waste	Hauler	40,345									
	20 Conf Sampling	Other fueled Equipment	USR EW-CS-001 Confirmation sampling	Pickup	161									
	25 Sampling Analysis													
	10 Soil Cat 3													
	05 Construction Survey and Staking	Other fueled Equipment	USR SUR-02 Surveying Crew	Pickup	2									
	10 Excavation	Equipment Use - Earthwork	USR EW-EX-200 Excavation - RCRA Hazardous Waste	Excavator	299									
	15 Hauling	Residue Disposal / Recycling	USR EW-HL-200 Hauling - RCRA Hazardous Waste	Hauler	6,000									
	20 Conf Sampling	Other fueled Equipment	USR EW-CS-001 Confirmation sampling	Pickup	5									
	25 Sampling Analysis													
	15 Soil Cat 4													
	05 Construction Survey and Staking	Other fueled Equipment	USR SUR-02 Surveying Crew	Pickup	83									
	10 Excavation	Equipment Use - Earthwork	USR EW-EX-400 Excavation - Low-level Radioactive Waste (LLW)	Excavator	6,011									
	15 Hauling	Residue Disposal / Recycling	USR EW-HL-400 Hauling - Low-level Radioactive Waste (LLW)	Hauler	150,000									
	20 Conf Sampling	Other fueled Equipment	USR EW-CS-001 Confirmation sampling	Pickup	227									
	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													

K-B-23

CDM Smith

PROJECT:	SSFL Area IV Soils CBA	COMPUTED BY:	IL	CHECKED BY:	AIS
JOB NO.:	94489.1204	DATE:	9/12/2018	DATE CHECKED:	9/18/2018
CLIENT:	DOE			WRKSHT NO.:	Rev LUT Equip Hr

Cleanup to Revised 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
06	**Backfill**													
	05 Backfill from Onsite Sources													
	05 Rock Excavation	Other fueled Equipment	USR EX-200 Rock Breaking	Excavator	0	USR EX-210 Rock Excavation	Excavator	0	USR EX-220 Rock Loading	Loader	0	USR EX-230 Rock Onsite Hauling	Hauler	0
	10 Rock Crushing and Screening	Equipment - Generator	USR 312316306120 Rock Crusher, 25 Tons/ HR operation	Rocker Crusher, Electricity Run	0									
	15 Fill (splitted to 2 entries)	Equipment Use - Earthwork	USR EW-BM-LE-200 Fill - Spreading	Loader	0									
	15 Fill (splitted to 2 entries)	Other fueled Equipment	USR EX-230 Rock Onsite Hauling	Rock Hauler	0	USR SD-SP-LE-004B Site Grading - Rough	Roller	0						
	10 Backfill from Offsite Sources													
	05 Import Fill Material	Other fueled Equipment	USR EW-HL-010 Haul Imported Soil	Hauler	27,143									
	10 Fill (splited to 2 entries)	Equipment Use - Earthwork	USR EW-BM-LE-200 Fill - Spreading	Loader	2,714									
	10 Fill (splited to 2 entries)	Other fueled Equipment	USR SD-SP-LE-004B Site Grading - Rough	Dozer	108	USR EW-BM-LE-202 Fill - Compaction	Roller	2714	USR SD-SP-LE-005 Site Grading - Finish	Roller	2			
	15 QC and Testing													
07	**Restoration**													
	05 Seeding	Other fueled Equipment	USR SR-SD-LE-002 Seeding	Tractor	115									
	10 Allowance for Street/Pavement Repair (splitt	Other fueled Equipment	USR SR-PV-300 Hauling for asphalt cold milling and paving	Asphalt Hauler	235									
	10 Allowance for Street/Pavement Repair (splitt	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						

K-B-24

CDM Smith

PROJECT: SSFL Area IV Soils CBA
JOB NO.: 94489.1204
CLIENT: DOE

COMPUTED BY: IL
DATE: 9/12/2018

CHECKED BY: AIS
DATE CHECKED: 9/18/2018
WRKSHT NO.: Conserv. Resource Equip Hr

Conservation of Natural Resources Alternative – Residential Scenario

	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	100	USR USR-MB-LE-002 Mobilization or demobilization of medium equipment	Cab with Trailer	200	USR USR-MB-LE-003 Mobilization or demobilization of self-propelled equipment	Misc.	30	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	100	USR USR-MB-LE-002 Mobilization or demobilization of medium equipment	Cab with Trailer	200	USR USR-MB-LE-003 Mobilization or demobilization of self-propelled equipment	Misc.	30			
	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	153									
	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	1	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	10									
	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													
	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									

K-B-25

CDM Smith

PROJECT: SSFL Area IV Soils CBA
JOB NO.: 94489.1204
CLIENT: DOE

COMPUTED BY: IL
DATE: 9/12/2018

CHECKED BY: AIS
DATE CHECKED: 9/18/2018
WRKSHT NO.: Conserv. Resource Equip Hr

Conservation of Natural Resources Alternative – Residential Scenario

	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
	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 15 Traffic Control	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	96						
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	38									
	10 Excavation	Equipment Use - Earthwork	USR EW-EX-A5-100 Excavation - Non-Hazardous/Non-Radioactive Waste	Excavator	1,279									
	15 Hauling	Residue Disposal / Recycling	USR EW-HL-A5-100 Hauling - Non-Hazardous/Non-Radioactive Waste	Hauler	25,345									
	20 Conf Sampling 25 Sampling Analysis	Other fueled Equipment	USR EW-CS-001 Confirmation sampling	Pickup	49									
	10 Soil Cat 3													
	05 Construction Survey and Staking	Other fueled Equipment	USR SUR-02 Surveying Crew	Pickup	2									
	10 Excavation	Equipment Use - Earthwork	USR EW-EX-200 Excavation - RCRA Hazardous Waste	Excavator	299									
	15 Hauling	Residue Disposal / Recycling	USR EW-HL-200 Hauling - RCRA Hazardous Waste	Hauler	6,000									
	20 Conf Sampling 25 Sampling Analysis	Other fueled Equipment	USR EW-CS-001 Confirmation sampling	Pickup	2									
	15 Soil Cat 4													
	05 Construction Survey and Staking	Other fueled Equipment	USR SUR-02 Surveying Crew	Pickup	1									
	10 Excavation	Equipment Use - Earthwork	USR EW-EX-400 Excavation - Low-level Radioactive Waste (LLW)	Excavator	55									
	15 Hauling	Residue Disposal / Recycling	USR EW-HL-400 Hauling - Low-level Radioactive Waste (LLW)	Hauler	1,364									
	20 Conf Sampling 25 Sampling Analysis	Other fueled Equipment	USR EW-CS-001 Confirmation sampling	Pickup	2									

K-B-26

CDM Smith

PROJECT: SSFL Area IV Soils CBA
JOB NO.: 94489.1204
CLIENT: DOE

COMPUTED BY: IL
DATE: 9/12/2018

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DATE CHECKED: 9/18/2018
WRKSHT NO.: Conserv. Resource Equip Hr

Conservation of Natural Resources Alternative – Residential Scenario

	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
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													
06	**Backfill**													
	05 Backfill from Onsite Sources													
	05 Rock Excavation	Other fueled Equipment	USR EX-200 Rock Breaking	Excavator	0	USR EX-210 Rock Excavation	Excavator	0	USR EX-220 Rock Loading	Loader	0	USR EX-230 Rock Onsite Hauling	Hauler	0
	10 Rock Crushing and Screening	Equipment - Generator	USR 312316306120 Rock Crusher, 25 Tons/ HR operation	Rocker Crusher, Electricity Run	0									
	15 Fill (splitted to 2 entries)	Equipment Use - Earthwork	USR EW-BM-LE-200 Fill - Spreading	Loader	0									
	15 Fill (splitted to 2 entries)	Other fueled Equipment	USR EX-230 Rock Onsite Hauling	Rock Hauler	0	USR SD-SP-LE-004B Site Grading - Rough	Roller	0						
	10 Backfill from Offsite Sources													
	05 Import Fill Material	Other fueled Equipment	USR EW-HL-010 Haul Imported Soil	Hauler	7,429									
	10 Fill (splited to 2 entries)	Equipment Use - Earthwork	USR EW-BM-LE-200 Fill - Spreading	Loader	743									
	10 Fill (splited to 2 entries)	Other fueled Equipment	USR SD-SP-LE-004B Site Grading - Rough	Dozer	30	USR EW-BM-LE-202 Fill - Compaction	Roller	743	USR SD-SP-LE-005 Site Grading - Finish	Roller	60			
	15 QC and Testing													
07	**Restoration**													
	05 Seeding	Other fueled Equipment	USR SR-SD-LE-002 Seeding	Tractor	32									
	10 Allowance for Street/Pavement Repair (splitt	Other fueled Equipment	USR SR-PV-300 Hauling for asphalt cold milling and paving	Asphalt Hauler	235									
	10 Allowance for Street/Pavement Repair (splitt	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						

K-B-27

Appendix L
Sensitivity Evaluation

APPENDIX L
SENSITIVITY EVALUATION

L.1 Introduction

This appendix addresses three potentially significant sources of analysis uncertainty for this *Final Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory (Final SSFL Area IV EIS).* One area of uncertainty is the total volume of soil that would be remediated. A sensitivity evaluation was performed to determine the effect of remediating more area and a larger volume of soil than is addressed under the Cleanup to AOC LUT Values Alternative analyzed in Chapter 4, Environmental Consequences. This sensitivity evaluation is referred to as the Increased Soil Volume Scenario. This scenario addresses comments received on the *Draft SSFL Area IV EIS* concerned with uncertainty in the volume of contaminated soil and the consequence of under-estimating the volume of soil that would require removal. It also addresses comments concerned with excluding from the cleanup area and soil volumes those soils that were characterized as exceeding the 2010 *Administrative Order on Consent for Remedial Action* (AOC) Look-Up Table (LUT) value of only chemicals that are detected as total petroleum hydrocarbons (TPH) and areas designated for the protection of biological and cultural resources.

A second area of uncertainty is the speed with which cleanup would occur. Sensitivity analyses were performed to evaluate the effect of a slower soil cleanup than assumed for the Chapter 4 analyses. Cleanup could proceed at a slower rate for a number of reasons; for example, budgetary constraints, limitations caused by weather, or as a U.S. Department of Energy (DOE) response to concerns about the level of truck traffic associated with cleanup. For purposes of reference, these are referred to as Constrained Scenarios. A Constrained Scenario was evaluated for each soil remediation action alternatives.

The third area of uncertainty addresses the speed of remediation of the demolition and removal of buildings. A sensitivity evaluation was performed to determine the effects on environmental resources of accelerating the Building Removal Alternative, referred to as the Accelerated Building Removal Scenario.

Together with the alternatives analyses in Chapter 4 (the base case analyses against which the sensitivity analyses are compared), the sensitivity analyses provide a perspective on the changes in potential environmental impacts that could occur. Comparing the relevant parameters of the base case alternatives with those from the sensitivity scenarios identifies the resource areas that could be affected by a change and an evaluation of the magnitude of the change.

L.2 Increased Soil Volume Scenario

The Increased Soil Volume Scenario is a sensitivity evaluation relative to the base case Cleanup to AOC LUT Values Alternative analyzed in Chapter 4. Under the base case analysis, 90 acres would be remediated by removal of soil, including focused removal from 4 acres within the areas in which the exemption process would be applied for protection of biological and cultural resources. A total of 881,000 cubic yards of contaminated soil would be removed

Under the Increased Soil Volume Scenario, all of the soil that was identified as exceeding an AOC LUT value for chemicals or a provisional AOC LUT value for radionuclides would be excavated without regard for avoiding impacts on biological or cultural resources and without consideration of soil that exceeds only the AOC LUT value for TPH. Remediation would disturb 222 acres in Area IV and the Northern Buffer Zone (NBZ) and remove 1,616,000 cubic yards of soil. The rate at which

soil would be removed and backfill delivered would remain the same as that under the base case analysis, which is about 16 heavy-duty truck round trips per day. Because the rate at which work is accomplished is unchanged, the effect of the Increased Soil Volume Scenario would be an extension of the project duration from 26 years to 47 years.

Table L–1 presents a parameter summary for the Increased Soil Volume Scenario in comparison to the base analysis (Cleanup to AOC LUT Values Alternative), which is described in Chapter 2 and evaluated in detail in Chapter 4.

Table L–1 Parameter Summary for Increased Soil Volume Scenario Sensitivity Evaluation

Parameter	*Base Case (Cleanup to AOC LUT Values Alternative)*	*Increased Soil Volume Scenario*
Disturbed area (acres)	**90**	**222**
Total soil volume (cubic yards)	**881,000**	**1,616,000**
Nonhazardous material [a] (cubic yards)	**769,000**	**1,504,000**
Hazardous waste soil volume (cubic yards)	2,000	2,000
LLW/MLLW soil volume (cubic yards)	110,000	110,000
Total backfill volume (cubic yards)	**661,000**	**1,212,000**
Total number of soil removal shipments	**57,500**	**105,400**
Number of nonhazardous material shipments	**50,200**	**98,100**
Number of hazardous waste shipments	130	130
Number of LLW/MLLW shipments	7,200	7,200
Number of backfill shipments	**43,100**	**79,000**
Soil removal employment (workers)	25	25
Water use (gallons per day)	7,000	7,000
Total remediation period (years)	**26**	**47**

AOC = *Administrative Order on Consent for Remedial Action*; LLW = low-level radioactive waste; LUT = Look-Up Table; MLLW = mixed low-level radioactive waste.

[a] Includes moderate-risk soil, as well as non-waste soil, as described in Chapter 2.

Note: Values have been rounded.

Bolded and shaded entries identify parameters values that differ between the base case analysis and the sensitivity evaluation.

For both the base case analysis and the Increased Soil Volume Scenario, it was assumed that soil removal would occur using two soil excavation crews to load soil into containers or transport vehicles (e.g., end-dump trucks), for a total employment requirement of 25 workers.

For both the base case analysis and the Increased Soil Volume Scenario, the removal strategy would focus initially on removal of soil containing radiological constituents above AOC LUT values (low-level waste [LLW] and mixed LLW [MLLW]), as well as soil classified as hazardous waste. For purposes of analysis, it was assumed that these wastes would be removed during the first 4 years of the project.

The daily water use, equipment requirements, and employment for the base case analysis and the Increased Soil Volume Scenario were assumed to be the same, reflecting the assumption that the same soil removal operations would occur in each year of soil remediation, with essentially the same annual quantities of soil removed, but that the duration of soil remediation would be extended from 26 to 47 years under the Increased Soil Volume Scenario to remove an additional 735,000 cubic yards of soil.

DOE recognizes that the Increased Soil Volume Scenario may involve activities that are contrary to State or Federal (or both) laws and regulations. For example, DOE assumes for this scenario that all

areas exceeding an AOC LUT value would be removed without provisions for protecting species or habitat in accordance with the Federal and California endangered species acts. DOE has considered the scenario to evaluate the impacts that could result assuming a more extensive remediation than analyzed under the Cleanup to AOC LUT Values Alternative.

As noted above, the annual rate of removal would remain constant so the remediation time period would be extended by 21 years to address the larger soil volume. This results in the annual potential impacts for most of the resource areas being comparable under the Increased Soil Volume Scenario to those for the base case analysis, but extends the duration of these impacts. The following is a resource-by-resource assessment, with the resource areas grouped according to the potential for differences in impacts between the base case Cleanup to AOC LUT Values Alternative and the Increased Soil Volume Scenario.

No Change in Impacts—The groundwater, environmental justice, and sensitive-aged population resource areas are not expected to have annual or long-term impact changes compared to those for the Cleanup to AOC LUT Values Alternative.

Groundwater

Most contaminated soil in Area IV and the NBZ that had the potential to act as a source of contaminants to groundwater was removed during previous removal actions. Remaining soil contaminants are most likely adsorbed to the soil (and therefore unavailable to be flushed into groundwater by infiltrating precipitation). Although it is not expected, the extent to which soil contaminants act as a source of groundwater contamination in areas of higher concentration is currently under investigation. The additional soil that would be removed under this scenario is not in areas of higher concentrations and does not represent a meaningful source of contamination to groundwater. Therefore, removal of additional soil under the Increased Soil Volume Scenario would not result in a measurable change to groundwater quality because no measurable changes would be expected in the concentrations in groundwater of metals, dioxins, PCBs, or radionuclides. The removal of soil containing TPH would have little, if any, impact on overall groundwater quality. The removal of additional soil under the Increased Soil Volume Scenario would have no impact on the quantity of available groundwater because site groundwater would not be used as part of soil removal operations.

Environmental Justice

The annual level of activities (e.g., soil removal operations and truck shipments, traffic on Woolsey Canyon Road and other roads in the SSFL vicinity) would be the same under the Increased Soil Volume Scenario as that under the base case analysis but would last for an additional 21 years. After remediation is complete, potential impacts on an onsite receptor would be slightly less under the Increased Soil Volume Scenario than those under the base case analysis. As with the base case analysis, the Increased Soil Volume Scenario would not cause disproportionately high and adverse impacts on minority or low-income populations in the SSFL region of influence (ROI), including Native Americans. Similarly, the average daily truck traffic at the evaluated disposal facilities would be the same under the Increased Soil Volume Scenario as that for the base case analysis, and insufficient to cause noticeable increases in average daily traffic volumes in the facility vicinities. Thus, the Increased Soil Volume Scenario would not cause disproportionately high and adverse impacts on minority or low-income populations, including Native Americans, in the regional ROIs for the facilities.

Sensitive-aged Populations

Because the annual level of activities would be the same under the Increased Soil Volume Scenario as that under the base case the Increased Soil Volume Scenario would not result in larger annual impacts to sensitive-aged persons. Any impacts due to transport of waste, backfill, or equipment in the SSFL

area would be felt by persons of all ages, and no disparate impacts are expected on sensitive-aged populations in the SSFL ROI. In addition, waste shipments to any of the evaluated disposal facilities would be within the daily ranges normally experienced at these facilities, and the average daily shipments to the facilities would be insufficient to cause noticeable increases in average daily traffic volumes in the facility vicinities. Therefore, the Increased Soil Volume Scenario would not cause disparate impacts to sensitive-aged populations in the regional ROIs for the facilities.

No Change in Annual Impacts; Overall Impact Change due to Extended Duration—The air quality and climate change, noise, transportation and traffic, and socioeconomics resource areas are expected to have similar estimated potential annual impacts as the base case analysis because, annual remediation activities would be comparable. However, total potential impacts increase because soil removal would occur for 26 years rather than 47 years.

Air Quality and Climate Change

Under the Increased Soil Volume Scenario, the annual emissions of dioxide, carbon monoxide, nitrogen oxides, sulfur dioxide, volatile organic compounds, and particulates would be similar to those for the base case analysis because the annual rate of soil removal and offsite waste transport would remain relatively constant. However, this scenario would generate total emissions that are 61 to 97 percent greater than those under the base case analysis, depending on the pollutant, because cleanup activities would continue for an additional 21 years.

Noise

Onsite activities under the Increased Soil Volume Scenario would use the same types of equipment and would generate the same noise levels as the base case analysis. Because the average daily number of heavy-duty truck round trips) would remain the same noise impacts from DOE remediation activities along roads in the vicinity of SSFL would remain the same. For both the base case analysis and the Increased Soil Volume Scenario, noise levels at the closest residence to SSFL and along the haul roads used by trucks would be well below the threshold for potential adverse noise impacts established for this EIS. However, noise impacts under the Increased Soil Volume Scenario would continue for an additional 21 years.

Transportation

Transportation risks under the Increased Soil Volume Scenario would remain the same as those for the base case analysis except that there would be increased fatality accident[1] risks associated with the increased number of shipments of nonhazardous material. The transportation analysis evaluated a truck option and a truck/rail option. For the truck option, although the risk of a traffic fatality would almost double, no traffic fatalities would be expected among the populations along the transportation routes (calculated value: 0.49). For the truck/rail option, the calculated total number of traffic fatalities among the populations along the transportation routes would increase from 2.3 under the base case analysis to 4.4 under the Increased Soil Volume Scenario.

Traffic

Under the Increased Soil Volume Scenario, the annual rate of soil removal would remain the same as that for the base case analysis, with the same annual number of heavy-duty truck round trips and the same potential traffic impacts attributable to DOE remediation activities in the SSFL area. However, potential traffic impacts would continue for an additional 21 years (see "Land Resources"). The

[1] Accident fatality risks are those associated with the mechanical forces of a potential accident independent of the nature of the cargo.

additional traffic would cause increased damage to pavement on SSFL-are roads over a longer period of time than that for the base case analysis.

Socioeconomics

Not including truck drivers, soil removal under the Increased Soil Volume Scenario would annually employ 25 persons over the 47-year duration of soil removal. Remediation activities would have a minor beneficial impact on the economy in Los Angeles and Ventura Counties by providing employment for site workers and truck drivers and increasing sales for industries that provide equipment, supplies, and rentals, but because of the large existing local workforce, this employment would not generate substantial new spending or economic activity in these counties. Neither the base case analysis nor the Increased Soil Volume Scenario would impact the availability of local housing, require additional municipal services such as police or fire services, or result in increased traffic in the SSFL area sufficient to impact businesses along the haul routes.

The passage of heavy-duty trucks (in particular) on haul routes in the SSFL area could accelerate deterioration of affected roads, which may require resurfacing earlier than anticipated, resulting in economic impacts on local governments. Because the number of heavy-duty truck round trips for remediation of Area IV and the NBZ would increase under the Increased Soil Volume Scenario, more damage to SSFL-area road pavement would be expected. DOE may need to negotiate with local governments to contribute its portion of the cost for maintenance and repair of the affected roads.

The daily numbers of shipments of any type of waste to offsite facilities would be expected to cause no or minimal impacts to businesses on the routes to these facilities.

Annual and/or Overall Impact Change—The resource areas of land resources, geology and soils, surface water, biological resources, human health, waste management, and cultural resources are expected to have different annual or long-term potential impacts. Changes in impacts are not only attributable to the longer duration of the activities, but may result from the increased area disturbed in Area IV and the NBZ, the volume of soil removed, or the total inventories of chemical and radioactive constituents removed from the site.

Land Resources

Although the Increased Soil Volume Scenario would result in Area IV and the NBZ remaining as open space, the land is subject to conservation easements[2] and the existing open space and habitat could be adversely impacted without a benefit justified by a risk-based analysis. Such impacts would be larger under the Increased Soil Volume Scenario, which would disturb 222 acres as compared to 90 acres under the base case analysis.

Annual shipments of waste and backfill under the Increased Soil Volume Scenario would remain the same as those under the base case analysis, with an increase in average daily traffic on Woolsey Canyon Road of about 3.3 percent. This increased traffic could lead to the same traffic delays or perception of delays on Woolsey Canyon Road or its intersection with Valley Circle Boulevard, which could discourage weekday use of Sage Ranch Park and would last for 47 years rather than 26 years. Annual water use under the Increased Soil Volume Scenario would be the same as that under the base case analysis, but the total water use would increase from about 45.5 million gallons under the base case analysis to about 82 million gallons under the Increased Soil Volume Scenario. Visual impacts would

[2] In 2017, The Boeing Company (Boeing) and North American Land Trust recorded two Grant Deeds of Conservation Easement and Agreements (conservation easements) with Ventura County (Ventura County 2017a, 2017b) that permanently preserve as open space nearly 2,453 acres of land that Boeing owns at SSFL, including Area IV and the NBZ. The conservation easements are legally enforceable documents that, among other restrictions, forever prohibit residential, agricultural, or commercial development or uses of the site.

be the same on an annual basis under the Increased Soil Volume Scenario as that for the base case analysis but these impacts would continue for an additional 21 years.

Geology and Soils

Under the Increased Soil Volume Scenario, there could be more impacts on (loss of) paleontological resources because the fossil-bearing Santa Susana Formation coincides with areas subject to the AOC exemption process. Under the Increased Soil Volume Scenario an additional 132 acres of soil would be removed compared to the base case analysis, and much of this additional area is steeply-sloped where the velocity of surface water runoff is faster than on flatter areas. Hence, the potential for erosion of disturbed soil during both the period of excavation and after backfilling would be larger for the Increased Soil Volume Scenario than for the base case analysis. An additional 551,000 cubic yards of backfill would be required under the Increased Soil Volume Scenario compared to the base case analysis. This is considered to be significant because the potential for loss of soil function increases proportionally to the increase in soil volume removed if the backfill is not of equal quality including regenerative structures, organic carbon, seed bank and beneficial soil organisms. The potential risk to workers from seismic events would also increase under the Increased Soil Volume scenario because activity on steep slopes in seismic hazard zones within the exemption areas would not be limited.

Surface Water

During and immediately following remediation activities, soil disturbance and vegetation removal would create increased opportunities during rainstorms for soil erosion and sediment loading in runoff. Nonetheless, under the Increased Soil Volume Scenario, the total surface area exposed in any 1 year of remediation would be comparable to that for the base case analysis. The existing NPDES stormwater control and monitoring system and best management practices implemented during remediation would prevent the SSFL and regional stormwater control capacity from being overwhelmed except for extreme precipitation events. Extreme precipitation events could occur under either the Increased Soil Volume Scenario or the base case analysis but, are more likely to occur under the Increased Soil Volume Scenario because remediation activities would continue for 21 additional years.

Biological Resources

Under the Increased Soil Volume Scenario, the estimated increase in habitat disturbance (222 acres compared to 90 under the base case) could dramatically increase adverse effects on biological resources by removing soils and vegetation and potentially impacting habitat and causing individual mortality. The impacts to the Braunton's milk vetch could affect the species and not just individuals because of the unique nature of this population. The population on the SSFL site is one of the largest known populations and represents a significant percentage of the species and therefore this scenario could result in impacts that would affect a large portion of the species and could impact the species viability. Because of the difficulty of restoring the habitat and species populations following the profound and extensive disturbance caused by vegetation and soil removal under the Increased Soil Volume Scenario, the effects on biological resources would be longer-termed and adverse and therefore, much greater than those under the Cleanup to AOC LUT Values Alternative.

Human Health

Under the Increased Soil Volume Scenario, 222 (rather than 90) acres of soil would be remediated to meet AOC LUT values, resulting in a slightly lower risk, after remediation is complete, to an onsite receptor for any visitor to the site (onsite receptor) compared the that under the base case analysis. This is because under the base case analysis, areas subject to the exemption process would be cleaned up based on risk assessments, meaning some soil exceeding AOC LUT values would remain on site.

Removing that soil and the soil that exceeds the AOC LUT value for TPH would reduce risk slightly under the Increased Soil Volume Scenario. However, the risk to an offsite receptor would be essentially the same because the expected exposure duration would be the same.[3] The maximum annual radiation dose to an offsite receptor would be comparable under either the Increased Soil Volume Scenario or the base case analysis because the dose is dominated by the direct exposure pathway (inhalation and immersion) and radioactively impacted soil would be remediated during the same period of time under either cleanup. Because the assumed exposure period for a worker is approximately equal to the duration the base case Cleanup to AOC LUT Values Alternative,[4] the cancer risk to an individual worker would be the same because the duration of exposure is not expected to change.

Waste Management

There would be no change in waste management impacts regarding the disposal of LLW and MLLW and hazardous waste soils because the volumes and timing of their removal would be the same under the Increased Soil Volume Scenario as they would be under the base case analysis. The increased volume of nonhazardous material would not exceed the disposal capacity of any of the evaluated disposal facilities, even assuming all waste would be disposed of in a single facility authorized for that waste. The projected volume of nonhazardous material could represent a significant percentage (64 percent) of the disposal capacity of the McKittrick Waste Treatment Site. However, any impacts on the disposal capacity of any facility could be alleviated by distributing the soil to multiple facilities which have capacities that range from 0.02 to 30 percent of the total nonhazardous material to be disposed. Wastes in the projected quantities would not impact any daily or annual waste acceptance limits (if applicable) at any of the evaluated disposal facilities.

Cultural Resources

Under the Increased Soil Volume Scenario, cultural resources eligible for listing on the National Register of Historic Places (NRHP) (i.e., historic properties) would be disturbed in areas where chemicals or radionuclides exceed AOC LUT values. The Increased Soil Volume Scenario would disturb a larger surface area (222 acres compared to 90 acres) and remove more soil (1,616,000 cubic yards compared to 881,000 cubic yards) than that under the base case analysis. Because of this, soil removal would disturb at least 17 of the 26 known archaeological sites in the APE, which would result in adverse impacts. The larger effort under the Increased Soil Volume Scenario would also increase the potential to encounter an unanticipated archaeological resource and would cause more extensive changes to the general landscape (e.g., topography, soil color, vegetation) associated with traditional cultural resources at Area IV and the NBZ.

Table L–2 presents a summary for all resource areas for the Increased Soil Volume Scenario.

[3] The U.S. Environmental Protection Agency (EPA) parameter for a residential exposure period reflects the assumption that a resident is exposed for 26 years (EPA 2018). Using the EPA's assumption, under the Increased Soil Volume Scenario, an offsite resident would be exposed for 26 years, that same exposure duration as the base case Cleanup to AOC LUT Values Alternative.

[4] The EPA parameter for a worker's exposure period reflects an assumption that a worker is exposed for 25 years (EPA 2018). Using EPA's assumption, under either the Increased Soil Volume Scenario (47 years) or the Cleanup to AOC LUT Values Alternative (26 years), worker exposure would be the same, 25 years.

Table L–2 Summary of Changes in Potential Impacts of the Increased Soil Volume Scenario Compared to the Base Case Cleanup to AOC LUT Values Alternative

Resource Area	*No Change*	*No Annual Change/Overall Change Due to Extended Duration*	*Annual and/or Overall Change*
Land Resources			✓
Geology and Soils			✓
Surface Water			✓
Groundwater Resources	✓		
Biological Resources			✓
Air Quality and Climate Change		✓	
Noise		✓	
Transportation and Traffic		✓	
Human Health			✓
Waste Management			✓
Cultural Resources			✓
Socioeconomics		✓	
Environmental Justice	✓		
Sensitive-Aged Populations	✓		

L.3 Constrained Scenarios

The soil remediation action alternatives addressed in this EIS would each require several years to implement, depending on the alternative. Delays could occur during implementation of any of the action alternatives. These delays might occur for a variety of reasons with varying effects on remediation, but it is assumed for this appendix that the delay results in soil remediation occurring at half the rate assumed for the base case analyses for the Cleanup to AOC LUT Values Alternative, Cleanup to Revised LUT Values Alternative, and Conservation of Natural Resources Alternative (Residential and Open Space Scenarios). **Table L–3** compares the principal analysis parameters under the Constrained Scenarios for each of the soil remediation action alternatives with those for the base case analyses.

It is assumed for the Constrained Scenarios for any soil remediation action alternative that the daily number of waste and backfill heavy-duty trucks round trips would be reduced to an average of eight per day, or one-half the average 16 per day for the base case analysis for soil remediation as described in Chapter 2 of this EIS. This assumption essentially doubles the soil remediation durations for all alternatives. It was assumed that soil removal would occur using a single soil excavation crew of 20 workers rather than two crews totaling 25 workers. The strategy for the base case analyses and the Constrained Scenarios would focus initially on removal of soil containing radiological constituents as well as soil classified as hazardous waste. Daily water use under the Constrained Scenario was assumed to be reduced in proportion to the amount of soil excavated and truck movement, that is, reduced by one half compared to the base case analyses. Otherwise, most other parameters such as disturbed area, total soil volume removed, and total number of heavy-duty truck shipments are the same for the base case analyses and the Constrained Scenarios.

No Change in Impacts—The geology and soils, groundwater, cultural resources, environmental justice, and sensitive-aged population resource areas are not expected to have annual or long-term impact changes compared to those for the base case Cleanup to AOC LUT Values, Cleanup to Revised LUT, and Conservation of Natural Resources (Residential and Open Space Scenarios) Alternatives.

Table L–3 Parameter Summary for the Constrained Scenarios Sensitivity Evaluation

Parameter	Alternatives							
	Cleanup to AOC LUT Values		Cleanup to Revised LUT Values		Conservation of Natural Resources			
					Residential Scenario		Open Space Scenario	
	Base Case Analysis	Constrained Scenario	Base Case Analysis	Constrained Scenario	Base Case Analysis	Constrained Scenario	Base Case Analysis	Constrained Scenario
Disturbed area (acres)	90		38		10		9	
Total soil volume (cubic yards) [a]	881,000		190,000		52,000		38,200	
Total backfill volume (cubic yards)	661,000		143,000		39,000		28,700	
Total waste shipments [a]	57,500		12,400		3,400		2,500	
Total backfill shipments	43,100		9,300		2,500		1,900	
Employment (persons)	**25**	**20**	**25**	**20**	**25**	**20**	**25**	**20**
Water use (gallons per day)	**7,000**	**3,500**	**7,000**	**3,500**	**7,000**	**3,500**	**7,000**	**3,500**
Total remediation duration (years) [b]	**26**	**51**	**6**	**11**	**2**	**3**	**2**	**3**
Remediation period for LLW/MLLW (years) [c]	**4**	**8**	**4**	**8**	1	1	<1	<1
Remediation period for hazardous waste (years) [c]	1	1	1	1	1	1	1	1
Remediation period for nonhazardous waste (years) [c]	**26**	**51**	**6**	**11**	**2**	**3[d]**	**2**	**3[d]**

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 waste volumes and shipments for each type of waste (radioactive, hazardous, or nonhazardous) are the same as those listed for the base case analysis in Table L–1.

[b] Under all action alternatives, the final year of the project would require a lower level of effort (e.g., fewer truck trips) than the prior years. As a consequence, when the rate of remediation is reduced by half, the total durations do not exactly double.

[c] The soil removal strategy would focus initially on removal of soil containing radiological constituents as well as soil classified as hazardous waste.

[d] For the Constrained Scenarios, although soil removal under the Residential Scenario would require 3 years, it is expected that soil removal under the Open Space Scenario would actually require only a few months beyond 2 years.

Bolded and shaded entries identify parameters values that differ between the base case analyses and the sensitivity analyses.

Geology and Soils

Under the Constrained Scenarios and compared to the base case analyses there would be no differences in impacts to paleontological resources and neither increased nor decreased risk to workers from seismic events. For the base case analyses as well as the Constrained Scenarios, the areas potentially vulnerable to erosion would be largest under the Cleanup to AOC LUT Values Alternative and smallest under the Conservation of Natural Resources Alternative (Open Space Scenario).

Groundwater

Under the Constrained Scenarios, there would be no or minimal additional impacts to groundwater quality compared to the base case analyses. Much of the soil that had the potential to act as a source of contaminants to groundwater was removed in prior removal actions. As discussed in Section L.2, the remaining contaminants in soil are expected to be adsorbed to soil and unavailable to migrate to groundwater. Although the extent to which contaminated soil in areas with higher concentrations acts as a source of contaminants to groundwater is still under investigation, there would be no measurable differences to groundwater quality if the soil remains in place for an additional 1 year under both Constrained Conservation of Resource Alternative scenarios, an additional 5 years under the Constrained Cleanup to Revised LUT Values Alternative, or an additional 25 years under the Constrained Cleanup to AOC LUT Values Alternative. Implementing the Constrained Scenarios

would have no impact on the quantity of available groundwater because site groundwater would not be used as part of soil removal operations.

Cultural Resources

Under the Constrained Scenarios, the same areas of land would be disturbed for each action alternatives as those for the base case analyses. Because there would be no difference in the areas disturbed, no changes in impact on archaeological and architectural cultural resources are expected. Potential impacts on traditional cultural resources would be greater, due to the increased duration of cleanup activities and associated changes in setting (e.g., presence of human activity and equipment).

Environmental Justice

After remediation is complete, impacts on an onsite receptor would be the same for each soil remediation action alternative under the Constrained Scenarios as those under the base case analyses, and no disproportionately high and adverse impacts are expected on minority or low-income populations in the SSFL ROI, including Native Americans. Average daily traffic levels attributable to DOE remediation activities would be smaller under the Constrained Scenarios than under the base case analyses, and would not cause disproportionately high and adverse impacts on minority or low-income populations in the SSFL ROI, including Native Americans. Average daily traffic levels at the evaluated disposal facilities would also be reduced for the Constrained Scenarios compared to the base case analyses, and would not cause disproportionately high and adverse impacts on minority or low-income populations, including Native Americans, in the regional ROIs for the evaluated facilities.

Sensitive-aged Populations

Because the annual level of activities would be about half under the Constrained Scenarios as that under the base case analyses, the Constrained Scenarios would result in reduced potential annual impacts on SSFL-area individuals (e.g., pedestrians) compared to those for the base case analyses. Any impacts due to transport of waste, backfill, or equipment in the SSFL area would be felt by persons of all ages, and no disparate impacts are expected on sensitive-aged populations in the SSFL ROI. In addition, the average daily waste shipments to any of the offsite disposal facilities would be reduced for the Constrained Scenarios and insufficient to cause noticeable increases in average daily traffic levels in the facility vicinities. Therefore, the Constrained Scenarios would not cause disparate impacts on sensitive-aged populations in the regional ROIs for the evaluated facilities.

Reduced Annual Impacts; No Overall Change due to Extended Duration and Same Level of Remediation—The air quality and climate change, noise, transportation and traffic, waste management, and socioeconomics resource areas are expected to have reduced potential annual impacts compared to their corresponding base case analyses because the annual rate of soil removal under any of the action alternatives would be reduced. However, under the Constrained Scenarios, the total potential impacts would remain about the same for each soil remediation action alternative as those under the base case analyses.

Air Quality and Climate Change

Under the Constrained Scenarios, annual emissions of carbon dioxide, carbon monoxide, nitrogen oxides, sulfur dioxide, volatile organic compounds, and particulates would be about half of those for the base case analyses. However, the Constrained Scenarios would generate about the same total emissions for each soil removal action alternative as their corresponding base case analyses because the same quantities of soil would be removed.

Noise

Onsite activities under the Constrained Scenarios would involve the same types but somewhat reduced numbers of equipment compared to the base case analyses because the daily quantity of soil being

excavated and the number of heavy-duty trucks being loaded would be reduced for each soil remediation action alternative. Therefore, there would be a modest reduction in the noise levels caused by onsite activities, but this impact would occur for twice as many years. Reducing the daily and annual number of heavy-duty truck round trips by about half would reduce noise impacts along the transportation routes; however, these noise impacts would continue for about twice as many years relative to the respective base case analyses. Noise levels would not exceed the threshold for potential adverse noise impacts established for this EIS.

Transportation

The total radiological risks and traffic fatality risks associated with transporting material to and from SSFL would be the same for the Constrained Scenarios and the base case analyses because the total mileage traveled for transport of waste, backfill, and equipment would remain the same. The risks in any single year would be reduced, but the duration of those risks would be extended.

Traffic

Under the Constrained Scenarios, because soil would be removed from Area IV and the NBZ at about half the annual rate for each action alternative as that under the base case analyses, the average daily number of heavy-duty trucks hauling soil from and backfill to Area IV would also be halved. The reduced number of truck trips would lessen local traffic impacts attributable to DOE soil remediation activities (see "Land Resources"). Total impacts on SSFL-area pavement due to the passage of trucks and other vehicles would be the same under the Constrained Scenarios as those for the base case analyses, but would occur over longer durations, indicating that the need for pavement restoration could be less frequent for the Constrained Scenarios than for the base case analyses.

Waste Management

For any of the soil remediation action alternatives, the same volumes of soil would be disposed of at the evaluated facilities under the Constrained Scenarios as those for the base case analysis. Therefore, the impacts on disposal capacities for the evaluated facilities would be the same as those for the base case analyses, and no waste would lack disposal capacity. The projected quantities of waste under either the base case analyses or the Constrained Scenarios would not impact any daily or annual waste acceptance limit (if applicable) at any of the disposal facilities evaluated in this EIS.

Socioeconomics

Remediation activities would have a minor beneficial impact on the economy in Los Angeles and Ventura Counties by providing employment and increased sales for industries that provide equipment, supplies, and rentals, but because of the large local economy and existing local workforce, this employment would not generate substantial new spending or economic activity in these counties. Compared to the base case analyses, the Constrained Scenarios would generate less annual employment but greater total employment for site workers and truck drivers (e.g., 20 workers would be employed under the Constrained Scenarios for twice as long as 25 workers under the base case analyses) but, these differences would not cause noticeably different socioeconomic impacts. Neither the Constrained Scenarios nor the base case analyses for any of the soil remediation action alternatives would impact the availability of local housing, require additional municipal services such as police or fire services, or result in increased traffic in the SSFL area sufficient to impact businesses along the haul routes.

As discussed in Section L.2, the passage of heavy-duty trucks and other vehicles on the haul routes traffic could accelerate deterioration of the affected roads, which could require resurfacing earlier than anticipated, resulting in economic impacts on local governments. Because the number of heavy-duty truck round trips for remediation of Area IV and the NBZ would be the same under the Constrained Scenarios as those for the base case analyses, about the same damage to SSFL-area roads would be

expected under either the Constrained Scenarios or the base case analyses. DOE may need to negotiate with local governments to contribute its portion of the cost for maintenance and repair of the affected roads.

The average daily numbers of shipments of any type of waste to offsite disposal facilities would be reduced for the Constrained Scenarios compared to those for the base case analyses and would not be expected to impact businesses on the routes to these facilities.

Annual and/or Overall Impact Change—The resource areas of land resources, surface water, biological resources, and human health are expected to experience different annual or long-term potential impacts. Changes in impacts are attributable to the longer durations of the remediation activities.

Land Resources

For any of the soil remediation action alternatives under the Constrained Scenarios, remediation of Area IV and the NBZ would be consistent with existing conservation easements (see Section L.2). Heavy-duty truck traffic would be essentially halved for any of the Constrained Scenarios compared to the base case analyses, with increase in average daily traffic on Woolsey Canyon Road of 2.2 percent. There would be less potential for traffic delays or the perception of delays on Woolsey Canyon Road, or at its intersection with Valley Circle Boulevard, to discourage weekday use of Woolsey Canyon Road to access Sage Ranch Park. Annual water use under any of the Constrained Scenario action alternatives would be about half of that for the base case analyses, but the total water use would about the same (e.g., about 45.5 million gallons for the Cleanup to AOC LUT Values Alternative). Visual impacts for each soil removal action alternative would be about the same on an annual basis under the Constrained Scenarios as those for the base case analyses but would continue for approximately twice as long.

Surface Water

During and immediately following remediation activities, soil disturbance and vegetation removal would create increased opportunities during rainstorms for soil erosion and sediment loading in runoff. Under the Constrained Scenarios, the total surface area exposed in any year of remediation would generally be less than that under the base cases analyses. The existing NPDES stormwater control and monitoring system and best management practices implemented during remediation would prevent the SSFL and regional stormwater control capacity from being overwhelmed except for extreme precipitation events. Extreme precipitation events could occur under either the Constrained Scenarios or the base case analyses but, are more likely to occur under the Constrained Scenarios because of the longer duration of remediation activities.

Biological Resources

Under the Constrained Scenarios, although the same quantities of soil would be removed under each soil removal action alternative as those for the base case analyses, and therefore the same total amount of habitat disturbance would occur, the longer periods of disturbance under the Constrained Scenarios would have greater potentials for short- and long-term impacts on biological resources. Any increases in activity durations would mean ongoing disturbances to wildlife for longer periods, which could interfere with or preclude revegetation and habitat restoration activities. These impacts could be mitigated by phased implementation of restoration activities as remediation is completed in a given area. This would be most relevant for the Constrained Cleanup to AOC LUT Values Alternative because the duration of remediation would increase from 26 to 51 years. Compared to the respective base case analyses, the increased impact durations for the other Constrained Scenarios would have fewer impacts because the increases are not as substantial – i.e., from 6 to 11 years for the Cleanup to Revised LUT Values Alternative and from 2 to 3 years for the Conservation of Natural Resources

Alternative (Residential and Open Space Scenarios). Potential impacts on aquatic and wetland habitat and biota under the Constrained Scenarios would likely be the same as those under the base case analyses because the same quantities of soil would be removed under the Constrained Scenarios as under the base case analyses. Removal actions for areas where the exemption process would be applied would avoid direct impacts on aquatic and wetland habitats and biota.

Human Health

Under the Constrained Scenarios and after remediation is complete, potential impacts on an onsite receptor would be the same for each action alternative as those for the base case analyses because the final concentrations of radioactive and chemical constituents following cleanup would be the same. Under the Constrained Scenario of the Cleanup to AOC LUT Values Alternative, the cancer risk to a worker or an offsite resident would be less based on the average exposure durations for both workers and residents.[5] Although the exposure durations are assumed to be the same, the receptors would be exposed to about half the quantity of material as a result of the lower soil removal rate under the Constrained Scenario. For the Constrained Cleanup to Revised LUT Values and Conservation of Natural Resources Alternatives (both scenarios), worker and offsite cancer risks would be the same as those for the base case analyses. Although the rate of remediation (and therefore annual exposures) would be about half, the duration of the Constrained Scenarios are sufficiently short that the receptors would be exposed to the same total quantities as they would under the bases case analyses. Because soil would be removed at half the rate under the Constrained Scenarios, the maximum annual radiation doses and the annual non-cancer hazardous chemical exposures would be about half of those for the bases case analyses.

Table L–4 presents a summary for all of the resource areas for the Constrained Scenarios.

Table L–4 Summary of Changes in Potential Impacts of the Constrained Scenarios Compared to the Base Case Cleanup to AOC LUT Values, Cleanup to Revised LUT Values, and Conservation of Natural Resources Alternatives

Resource Area	*No Change*	*Reduced Annual and No Overall Change due to Extended Duration and Same Level of Remediation*	*Annual and/or Overall Change*
Land Resources			✓
Geology and Soils	✓		
Surface Water			✓
Groundwater Resources	✓		
Biological Resources			✓
Air Quality and Climate Change		✓	
Noise		✓	
Transportation and Traffic		✓	
Human Health			✓
Waste Management		✓	
Cultural Resources	✓		
Socioeconomics		✓	
Environmental Justice	✓		
Sensitive-aged Populations	✓		

AOC = *Administrative Order on Consent for Remedial Action*; LUT = Look-Up Table.

[5] The EPA parameter for a worker's exposure period reflects the assumption that a worker is exposed for 25 years. The EPA parameter for a residential exposure period reflects the assumption that a resident is exposed for 26 years (EPA 2018). Using EPA's parameters, under the Constrained Cleanup to AOC LUT Values Alternative (51 year duration) a worker would be exposed for 25 years and a resident would be exposed for 26 years. These exposure durations are approximately the same as the duration of the base case Cleanup to AOC LUT Values Alternative (26 years). However, under the Constrained Scenario, over a 25- or 26-year time period, the amount of soil remediated would be half of that remediated under the Cleanup to AOC LUT Values Alternative because remediation is proceeding at half the base case rate.

L.4 Accelerated Building Removal Scenario

The Accelerated Building Removal Scenario evaluates the change in potential environmental impacts from demolishing 18 DOE-owned buildings in Area IV, hauling the waste and debris to waste disposal or recycle facilities, and backfilling excavations in a shorter period of time than evaluated for the Building Removal Alternative as described in Chapter 2 of this EIS. Under the base case analysis, building removal would be accomplished in a little over 2 years and some additional time is assumed for hauling and emplacing backfill in the excavations associated with buildings with extensive below-grade construction. The total duration would be 2 to 3 years and demolition activities would require 60 workers. Under the Accelerated Building Removal Scenario, a larger crew of about 100 workers would be deployed so that multiple buildings could be demolished simultaneously, completing building demolition in about 1 year. A small amount of additional time could be required to haul and emplace backfill to bring the excavations up to grade.

No Change in Impacts—The geology and soils, groundwater, human health, cultural resources, environmental justice, and sensitive-aged population resource areas are not expected to have annual or long-term impact changes compared to those for the Building Removal Alternative.

Geology and Soils

Impacts to geology and soil from the base case Building Removal Alternative are minimal and would be neither increased nor decreased by accelerating the building removal schedule under the Building Removal Scenario.

Groundwater

The reduced duration of building removal activities under the Accelerated Building Removal Scenario would not have any potential impacts on groundwater quality and quantity.

Human Health

Under the Building Removal Alternative, potential offsite and worker exposures associated with removal of radioactively contaminated buildings were assumed to occur in single year. Therefore, the impacts estimated for the Accelerated Building Removal Scenario would be no different than those assessed for the base case analysis.

Cultural Resources

No impacts on cultural resources are expected from demolishing the remaining DOE structures within Area IV. Under the Accelerated Building Removal Scenario, therefore impacts would be the same as those for the base case analysis.

Environmental Justice

As with the base case analysis, following removal of the DOE-owned buildings under the Accelerated Building Removal Scenario, there would be no impacts attributable to the buildings to a receptor. Therefore, no disproportionately high and adverse impacts are expected on minority and low-income populations in the SSFL ROI, including Native Americans.

Under the Accelerated Building Removal Scenario, the weekday average daily traffic on Woolsey Canyon Road could increase as discussed under "Land Resources." However, although some traffic delays or perceived delays are possible, trucks and other vehicles associated with building removal activities would traverse minority and non-minority communities, as well as low-income and non-low-income communities, and would not pass through Native American lands. Therefore, any traffic impacts on minority or low-income populations, including Native Americans, would be the same as those experienced by the general population, and the Accelerated Building Removal Scenario would

not cause disproportionately high and adverse impacts on minority or low-income populations in the SSFL ROI, including Native Americans.

The Accelerated Building Removal Scenario would not result in noticeable increases in heavy-duty truck traffic in the vicinities of the evaluated disposal and recycle facilities; thus, no disproportionately high and adverse impacts are expected on minority or low-income populations, including Native Americans, in the regional ROIs for these facilities.

Sensitive-aged Populations

Assuming waste and backfill were shipped to or from Area IV during a single year of building removal, there could be increased annual impacts on pedestrians walking along or crossing Woolsey Canyon Road under the Accelerated Building Scenario as compared to the base case analysis, due to the increased traffic volumes on this road. Traffic volumes on other evaluated routes are also expected to be larger than those under the base case analysis (see "Environmental Justice"). Nonetheless, because these risks would be experienced by persons of all ages, no disparate impacts are expected on sensitive-aged populations in the SSFL ROI.

As discussed in "Environmental Justice, the Accelerated Building Removal Scenario would not result in a noticeable increase in heavy-duty truck traffic in the vicinities of the evaluated disposal or recycle facilities. Thus, no disparate impacts are expected on sensitive-aged populations in the regional ROIs for these facilities.

Increased Annual and No Overall Change due to Shortened Duration and Same Level of Remediation—The air quality and climate change, transportation and traffic, waste management, and socioeconomics resource areas are expected to have increased potential annual impacts compared to the base case analysis. These resource areas are affected by the rate of building removal activities. However, the total potential impacts are estimated to remain the same because the scope of building removal remains the same.

Air Quality and Climate Change

Under the Accelerated Building Removal Scenario, annual emissions of carbon dioxide, carbon monoxide, nitrogen oxides, sulfur dioxide, volatile organic compounds, and particulates would be approximately twice those under the base case analysis, because removal of buildings would occur during a single year rather than 2 to 3 years. Even though annual emissions would be higher, they are not expected to exceed indicator emissions thresholds The Accelerated Building Removal would generate the same total emissions as the base case analysis because the same building removal activities would take place but over a shorter period of time.

Transportation

Because the same number of shipments of waste, backfill, and equipment would occur for the Accelerated Building Removal Scenario and the base case analysis, the total transportation impacts would remain the same, although the impacts would occur during a single year rather than 2 to 3 years.

Traffic

The number of buildings to be removed would be the same under the Accelerated Building Removal Scenario as for the base case analysis, but building removal would require less time to complete. Under the Accelerated Building Removal Scenario, the weekday average daily traffic on roads in the SSFL vicinity would be larger during the single year of building removal than under the 2 to 3 years required for building removal under the base case analysis (see "Land Resources"). Weekday motorist delays or perceived delays could occur on Woolsey Canyon Road and at its intersection with Valley Circle Boulevard, and would be expected to be more likely for the Accelerated Building Removal Scenario than for the base case analysis. Potential damage to roads due to the passage of trucks and other

vehicles would be about the same under either the Accelerated Building Removal Scenario or the base case analysis.

Waste Management

Because the same volumes of building demolition waste would be disposed of at the evaluated facilities under the Accelerated Building Removal Scenario as that for the base case analysis, the impacts on disposal capacities for the evaluated facilities would be the same as those for the base case analysis. No waste would lack disposal or recycle capacity. The daily or annual quantities of waste or recycle material delivered to offsite facilities would be larger under the Accelerated Building Removal Scenario than that under the base case analysis, but would not impact any daily or annual waste acceptance limit (if applicable) at any of the evaluated facilities.

Socioeconomics

Remediation activities would have a minor beneficial impact on the economy in Los Angeles and Ventura Counties by providing employment and increasing sales for industries that provide equipment, supplies, and rentals, but because of the large local economy and existing local workforce, building demolition activities would not generate substantial new spending or economic activity in these counties. Compared to the base case analysis, the Accelerated Building Removal Scenario would provide different annual employment for site workers and truck drivers but comparable total employment (e.g., 100 workers would be employed for a year as opposed to 60 workers for 2 to 3 years), and any differences in annual or total employment would not cause noticeably different socioeconomic impacts. Neither the Accelerated Building Removal Scenario nor the base case analysis would impact the availability of local housing, require additional municipal services such as police or fire services, or result in increased traffic in the SSFL area sufficient to impact businesses along the haul routes.

As discussed in Section L.2, the passage of heavy-duty trucks and other vehicles on the haul routes traffic could accelerate deterioration of the affected roads, which may require resurfacing earlier than anticipated, resulting in an economic impact on local governments. Because the total number of heavy-duty truck round trips for remediation of Area IV and the NBZ would be the same under the Accelerated Building Removal Scenario as that for the base case analysis, about the same potential damage to SSFL-area roads would be expected. DOE may need to negotiate with local governments to contribute its portion of the cost for maintenance and repair of the affected roads.

The daily number of shipments to disposal or recycle facilities would be increased for the Accelerated Building Removal Scenario compared to that for the base case analysis but this increased traffic would not be expected to impact businesses on the routes to these facilities.

Annual and/or Overall Impact Change—The resource areas of land resources, surface water, biological resources, and noise could result in different annual or long-term potential impacts. Changes in impacts are attributable to the shorter duration of the activities.

Land Resources

Similar to the base case analysis, building removal under the Accelerated Building Removal Scenario would be consistent with existing conservation easements (see Section L.2).

The average daily traffic on Woolsey Canyon Road would increase over baseline conditions by about 8.8 percent during the single year of building removal (as compared to 5.2 percent under the base case analysis), mainly due to increased worker commutes. Motorists on Woolsey Canyon Road could experience or perceive delays compared to baseline conditions on weekdays during the hours when heavy-duty trucks would be traveling to and from SSFL; there could also be delays at the intersection of Woolsey Canyon Road with Valley Circle Boulevard. These delays or their perception could

discourage weekday use of Sage Ranch Park. Because the average daily traffic on other SSFL-area roads would also increase (by up to 4 percent) access to other recreational areas in the SSFL vicinity, such as the Chatsworth Nature Preserve, could also be somewhat affected.

About the same total quantity of water (about 630,000 gallons) would be required under the Accelerated Building Removal Scenario as that under the base case analysis, although this water use would occur during a single year rather than 2 to 3 years. Annual visual impacts would be about the same under the Accelerated Building Removal Scenario as those under the base case analysis but the duration of impacts would be shorter.

Surface Water

During and immediately following remediation activities, soil disturbance and vegetation removal would create increased opportunities during rainstorms for soil erosion and sediment loading in runoff. Under the Accelerated Building Removal Scenario, the total surface area exposed during removal would generally be higher than that under the base case analysis. The existing NPDES stormwater control and monitoring system and best management practices implemented during building removal would prevent the SSFL and regional stormwater control capacity from being overwhelmed except for extreme precipitation events. Extreme precipitation events could occur under either the Accelerated Building Removal Scenario or the base case analysis but, are less likely to occur under the Accelerated Building Removal Scenario because of the shorter duration of remediation activities.

Biological Resources

Under the Accelerated Building Removal Scenario, the amount of land disturbance associated with building removal would not change substantially; therefore the amount of habitat disturbance would remain the same as under the base case analysis. However, because the duration of demolition activities would be shorter, with corresponding less potential for habitat disturbance, the Accelerated Building Removal Scenario would have a lower potential than the base case analysis for short-term impacts on wildlife, including resident and transient species.

Noise

Onsite activities under the Accelerated Building Removal Scenario, would involve the same types of equipment as those under the base case analysis. Because multiple buildings could be demolished simultaneously, there could be an increase in noise generated on site; however due to the distance to the closest residence to SSFL, this potential increase in the house would remain below the threshold for potential adverse noise impacts established for this EIS. The daily average number of heavy-duty truck round trips would be higher because the rate of remediation activities would be increased, with a consequential increase in noise impacts along transportation routes. Nonetheless, noise levels along the haul routes would be the same or less than those associated with soil remediation activities, and noise level thresholds established in the EIS would not be exceeded.

Table L–5 presents a summary for all resource areas for the Accelerated Building Removal Scenario.

Table L–5 Summary of Changes in Potential Impacts of the Accelerated Building Removal Scenario Compared to the Base Case Building Removal Alternative

Resource Area	*No Change*	*Increased Annual and No Overall Change due to Shortened Duration of Same Level of Remediation*	*Annual and/or Overall Change*
Land Resources			✓
Geology and Soils	✓		
Surface Water			✓
Groundwater Resources	✓		
Biological Resources			✓
Air Quality and Climate Change		✓	
Noise			✓
Transportation and Traffic		✓	
Human Health	✓		
Waste Management		✓	
Cultural Resources	✓		
Socioeconomics		✓	
Environmental Justice	✓		
Sensitive-Aged Populations	✓		

APPENDIX M
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.

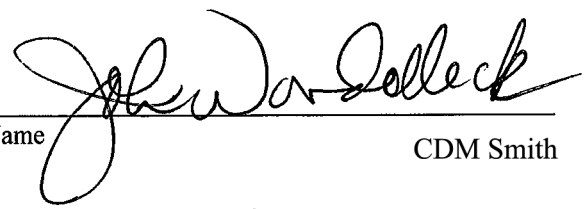
(b) _____ Offeror and any proposed subcontractor have the following financial or other interest in the outcome of the project and hereby agree to divest themselves of such interest prior to award of this contract.

Financial or Other Interests:

1.
2.
3.

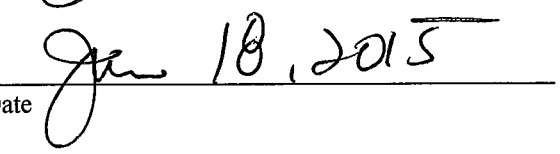
Certified by:

Signature



Name

CDM Smith



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:

Signature

Sheila B. Maglaque, Senior Contracts Representative

Name Leidos, Inc.

30 Mar 2015

Date