

2023

Annual Site Environmental Report

***Department of Energy Operations at the
Energy Technology Engineering Center
– Area IV***

Santa Susana Field Laboratory



September 2024

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2023 Annual Site Environmental Report

Department of Energy Operations at the Energy Technology Engineering Center – Area IV Santa Susana Field Laboratory

September 2024

Contract No. DE-EM0000837-DT0007583

**Prepared for:
U.S. Department of Energy**

**Prepared by:
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CERTIFICATE OF ACCURACY

I certify that I have personally examined, and am familiar with, the information submitted herein and, based on inquiry of those individuals immediately responsible for preparing this report, believe that the submitted information is true, accurate, and complete.



Jeff Scott
Program Manager
North Wind Portage, Inc.
Santa Susana Field Laboratory

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September 2024

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DOE CERTIFICATION LETTER

TBD



U. S. Department of Energy
Energy Technology Engineering Center
4100 Guardian Street, Suite 160
Simi Valley, CA 93063

September 25, 2024

SUBJECT: DOE Certification for the 2023 Annual Site Environmental Report for the Energy Technology Engineering Center (ETEC)

North Wind, Inc. has prepared the subject report for the U.S. Department of Energy (DOE). It is a comprehensive summary of the Department's environmental protection activities at ETEC located in Area IV of the Santa Susana Field Laboratory (SSFL) facility in Ventura County, California for Calendar Year 2023. Site Environmental reports are prepared annually for all DOE sites with significant environmental activities.

To the best of my knowledge, this report accurately summarizes the results of the 2023 environmental monitoring and restoration program at ETEC for DOE. This statement is based on reviews conducted by DOE-ETEC staff and by the staff of North Wind, Inc.

Sincerely,

JOSHUA
MENGERS

Dr. Josh Mengers
ETEC Director, Site Manager

Digitally signed by JOSHUA
MENGERS
Date: 2024.09.25 15:17:25 -07'00'

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Acronyms

%D	percent difference or percent drift
%R	percent recovery
AOC	Administrative Order on Consent
ASL	above sea level
ASME	American Society of Mechanical Engineers
BCG	biota concentration guide
bgs	below ground surface
CAA	Clean Air Act
Cal-EPA	California Environmental Protection Agency
CDM	Camp Dresser & McKee
CDIR	California Department of Industrial Relations
CDPH	California Department of Public Health
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLIN	contract line item number
CMS	Corrective Measures Study
Co-60	cobalt-60
CoC	chain of custody
Cs-137	cesium-137
CSWRCB	California State Water Resources Control Board
D&D	decontamination and decommissioning
DCS	derived concentration standard
DPH/RHB	Department of Public Health/Radiological Health Branch
DMR	discharge monitoring report
DOE	Department of Energy
DQI	data quality indicator
DRO	diesel-range organic
DTSC	Department of Toxic Substances Control
EA	environmental assessment
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency

ETEC	Energy Technology Engineering Center
Eu-152	europium-152
FESOP	Federally Enforceable State Operating Permit
FFCA	Federal Facilities Compliance Act
FONSI	Finding of No Significant Impact
FR	Federal Register
FSDF	Former Sodium Disposal Facility
GWIM	groundwater interim measure
H-3	tritium
HMSA	Hazardous Materials Storage Area
HWMF	Hazardous Waste Management Facility
ICP	inductively coupled plasma
ID	identification
ISMS	Integrated Safety Management System
LARWQCB	Los Angeles Regional Water Quality Control Board
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LLRW	low-level radioactive waste
LUT	look-up table
MCL	maximum contaminant level
MDL	method detection limit
MEI	maximally exposed individual
MLLW	mixed low-level waste
MRL	method reporting limit
MS	matrix spike
MSD	matrix spike duplicate
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
North Wind	North Wind Portage, Inc.

NOA	Notice of Availability
NOI	Notice of Intent
NOT	Notice of Termination
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity units
OCY	Old Conservation Yard
OSLD	optically stimulated luminescent detector
PARCCS	precision, accuracy, representativeness, comparability, completeness, and sensitivity
PCE	tetrachloroethylene
PFAS	per- and polyfluoroalkyl substances
QA	quality assurance
QAPjP	Quality Assurance Project Plan
QAPP	Quality Assurance Program Plan
QC	quality control
R&D	research and development
Ra-226	radium-226
Ra-228	radium-228
RAD	radiochemical
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RHB	Radiologic Health Branch
RMHF	Radioactive Materials Handling Facility
RPD	relative percent difference
RL	reporting limit
SDG	sample delivery group
SIM	selective ion monitoring
SIP	State Implementation Plan
SNAP	Systems for Nuclear Auxiliary Power
SPCC	spill prevention, control and countermeasure
SPTF/CHCF	Sodium Pump Test Facility / Component Handling & Cleaning Facility
Sr-90	strontium-90

SRE	Sodium Reactor Experiment
SSFL	Santa Susana Field Laboratory
STP	Site Treatment Plan
SWPPP	Storm Water Pollution Prevention Plan
TCA	trichloroethane
TCE	trichloroethene
TLD	thermoluminescent dosimeter
U	uranium
USFWS	U.S. Fish and Wildlife Service
VCAPCD	Ventura County Air Pollution Control District
VOC	volatile organic compound
WDID	waste discharger identification
WMP	Waste Management Plan
WQSAP	Water Quality Sampling and Analysis Plan

1. EXECUTIVE SUMMARY

This Annual Site Environmental Report for 2023 describes the environmental conditions related to work performed for the Department of Energy (DOE) at Area IV of the Santa Susana Field Laboratory (SSFL) as required by DOE Order (O) 231.1B, Admin Chg. 1, “Environment, Safety and Health Reporting” (DOE 2011a). This report is used to communicate internally to DOE, and externally to the public, the environmental monitoring results and the state of environmental conditions related to DOE activities at Area IV at SSFL. The report summarizes:

- Environmental management performance for DOE activities (e.g., environmental monitoring of effluents and estimated radiological doses to the public from releases of radioactive materials)
- Environmental occurrences and responses reported during the calendar year
- Compliance with environmental standards and requirements
- Significant programs and efforts related to environmental management.

Based on this monitoring data, no activities occurred in Area IV in 2023 that would have released effluents into the atmosphere. Therefore, the potential radiation dose to the general public through airborne release was zero. Similarly, the radiation dose to an off-site member of the public (maximally-exposed individual) due to direct radiation from SSFL is indistinguishable from background.

Results of the radiological monitoring program continue to indicate that there were no significant releases of radioactive material from Area IV of SSFL. All potential exposure pathways were sampled and/or monitored, including air, soil, surface water, groundwater, direct radiation, transfer of property (i.e., land, structures, and/or waste), and recycling. No radioactive wastes were processed for disposal during 2023. No liquid radioactive wastes were released into the environment.

During 2023, four regulatory agency visits were conducted related to DOE operations in Area IV. These visits were carried out by the California Department of Public Health (CDPH). A historical records search pertaining to the use of per- and polyfluoroalkyl substances (PFAS) within Area IV was conducted during 2021 and 2022. The initial review performed in 2021 focused on fire suppression, chemical spills, and accidents that could have involved PFAS chemicals. There was no fire training or petroleum-related fires within Area IV. Fire suppression was primarily accomplished by smothering small laboratory fires. There was no documentation of PFAS chemical use related to spills or accidents in Area IV.

In 2022, a more extensive review of historic reports and documents for the identification of potential use of PFAS chemicals by DOE within the Energy Technology Engineering Center’s (ETEC’s) portion of Area IV was conducted. The report remains within internal DOE review; however, the extensive records research did not identify use of PFAS chemicals by DOE in Area IV. Currently, CDM Smith is addressing DOE comments on a PFAS sampling work plan that will be submitted to the Department of Toxic Substances Control (DTSC) in the future.

The following sections in this report provide information related to ensuring protection of human health and the environment for DOE's operations at Area IV:

- Section 3, Compliance Summary. Identifies and provides the status of applicable permits and other regulatory requirements for DOE's closure mission.
- Section 4, Environmental Management System. Summarizes the programs in place to characterize, monitor, and respond to known or potential releases to the environment that may pose a threat to human health and the environment.
- Section 5, Environmental Radiological Protection Program and Dose Assessment. Summarizes the data collection activities and associated results for radiological contaminants.
- Section 6, Environmental Non-Radiological Program Information. Summarizes the data collection activities and associated results for non-radiological contaminants.
- Section 7, Groundwater Protection and Monitoring Program. Addresses collection and analysis of groundwater samples and measurement of the water levels at SSFL.
- Section 8, Soil Investigation Program. Summarizes soil investigation with the objectives of determining the nature and extent of chemicals in soil and the potential threat to groundwater.
- Section 9, Quality Assurance Program. Summarizes the quality assurance/quality control (QA/QC) elements incorporated into the data analysis program.

2. INTRODUCTION

This annual report describes the environmental monitoring program related to DOE activities conducted at Area IV of the SSFL facility located in Ventura County, California, during 2023. Area IV was used for DOE activities since the 1950s. A broad range of energy-related research and development (R&D) projects, including nuclear technology projects, were conducted at the site. All nuclear R&D operations in Area IV ceased in 1988 and efforts were directed toward environmental restoration and decontamination and decommissioning (D&D). By 2007, D&D remained for two former nuclear facilities, two liquid metal facilities, and various support facilities. In May 2007, the D&D operations in Area IV ceased while DOE completed the SSFL Area IV Environmental Impact Statement (EIS). The Draft EIS was released by DOE in January 2017 (DOE 2017), and the EIS was finalized in November 2018.

Environmental monitoring and characterization programs were continued throughout 2023. ETEC, a government-owned, company-operated test facility, was located in Area IV. The operations in Area IV included development, fabrication, operation and disassembly of nuclear reactors, reactor fuel, and other radioactive materials. Other activities in the area involved the operation of large-scale liquid metal facilities that were used for testing non-nuclear liquid metal fast breeder reactor components. All nuclear work was terminated in 1988, and all subsequent radiological work has been directed toward environmental restoration and D&D of the former nuclear facilities and their associated sites. Liquid metal R&D ended in 2002.

North Wind, Inc. officially assumed responsibilities for the ETEC closure activities on October 1, 2014, under contract DE-EM0000837-DT0007583. The contract is now executed by North Wind Portage, Inc. (North Wind). Boeing was previously responsible for the management of the site from 1996–2014.

2.1 Site Location and Setting

The SSFL site occupies 2,850 acres located in the Simi Hills of Ventura County, California, approximately 48 kilometers (km) (30 miles) northwest of downtown Los Angeles. SSFL is situated on rugged terrain with elevations at the site varying from 500 to 700 meters (m) (1,640 to 2,250 feet [ft]) above sea level (ASL). The location of the SSFL site in relation to nearby communities is shown in Figure 2-1. No significant agricultural land use exists within 30 km (19 miles) of the SSFL site. Undeveloped land surrounds most of the SSFL site.

Boeing owns the majority of the site, which is divided into four administrative areas (Areas I through IV) and undeveloped land (Table 2-1). Figure 2-2 illustrates the arrangement of the site. Area IV consists of approximately 290 acres, of which DOE leases 90 acres. Boeing and DOE-operated facilities (Figures 2-3 and 2-4) share the Area IV portion of this site. While the land immediately surrounding Area IV is undeveloped, suburban residential areas are at greater distances from Area IV. The community of Santa Susana Knolls lies 4.8 km (3.0 miles) to the northeast, the Bell Canyon area begins approximately 2.3 km (1.4 miles) to the southeast, and the American Jewish University is adjacent to the north. Except for the Pacific Ocean, which is approximately 20 km (12 miles) south, no recreational body of water of noteworthy size is located in the surrounding area. Four major reservoirs providing domestic water to the greater

Los Angeles area are located within 50 km (30 miles) of SSFL; the closest to SSFL (Bard Reservoir, near the west end of Simi Valley) is more than 10 km (6 miles) from Area IV.



Figure 2-1. Map Showing Location of SSFL

Table 2-1. Owners and Size of Administrative Areas at SSFL

Subdivisions			
Owner	Jurisdiction	Acres	Subtotals
Boeing	Boeing—Area IV	289.9	2,399.3
	Boeing—Areas I and III	784.8	
	Boeing (Undeveloped land)	1,324.6	
U.S. Government	NASA (former AFP 57)	409.5	451.2
	NASA (former AFP 64)	41.7	
Total Acres			2,850.5

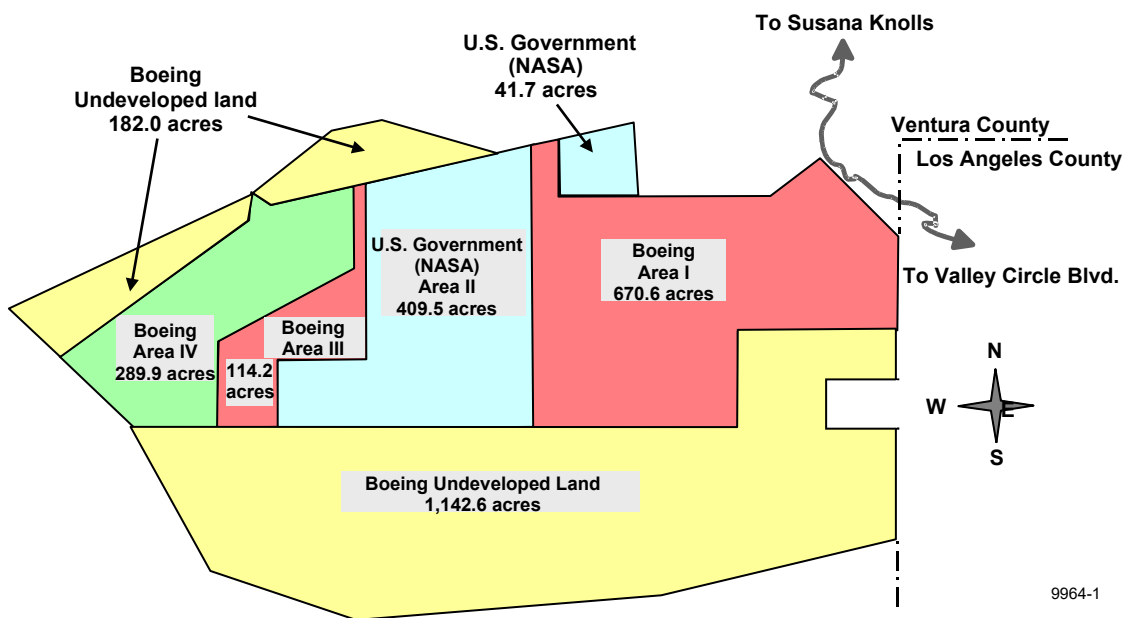


Figure 2-2. Santa Susana Field Laboratory Site Arrangement



Figure 2-3. Santa Susana Field Laboratory Site, Area IV (2022)

2.2 Operational History

SSFL has been used for various research, development, and test projects funded by several U.S. Government agencies, including DOE, Department of Defense, and the National Aeronautics and Space Administration (NASA). Since 1956, various R&D projects had been conducted in Area IV, including small tests and demonstrations of reactors and critical assemblies, fabrication of reactor fuel elements, and disassembly and de-cladding of irradiated fuel elements. These projects were completed and terminated during the next 30 years. Details for these projects can be found at the DOE website devoted to the ETEC closure (<http://www.etc.energy.gov>).

All nuclear R&D operations in Area IV ceased in 1988. The only work related to nuclear operations after 1988 has been the cleanup and decontamination of the remaining inactive radiological facilities and off-site disposal of radioactive waste. In 1998, DOE awarded Boeing a contract for the closure of all DOE facilities in Area IV. Environmental remediation and restoration activities at SSFL are conducted as directed by DOE.



2.3 Facility Descriptions

2.3.1 Radiological Facilities

Radioactive Materials Handling Facility

The RMHF complex consisted of Buildings 4021, 4022, 4034, 4044, 4075, 4563, 4621, 4658, 4663, 4665, and 4688, with the above-grade portions of the buildings demolished in 2020. Sump 4614 was a holdup pond located at the base of the drainage channel west of the RMHF complex. The use of the pond was discontinued, and the pond was excavated in 2006. The drainage channel and pond have been replaced with an above-ground storage tank that receives storm water runoff from the RMHF via a drainage pipe.

Historical operations at RMHF included processing, packaging, and temporary storage of radioactive waste materials for off-site disposal at DOE-approved facilities. The radioactive waste included uranium, plutonium, mixed fission products such as cesium-137 (Cs-137), strontium-90 (Sr-90), and activation products, including cobalt-60 (Co-60), europium-152 (Eu-152), and tritium (H-3).

Historically, no effluents were released into the atmosphere through the stack at the RMHF, and no radioactive liquid effluents were released from the facility. DOE developed a Resource Conservation and Recovery Act (RCRA) closure plan for Buildings 4021, 4022, and 4621 of the RMHF complex, collectively permitted as an Interim Status (Part A) facility, which DTSC approved on August 14, 2020. Demolition of the RMHF structures was completed in November 2020. The Phase 1 Closure Plan, which addresses the demolition of all above-grade building structures, was completed, and accepted by DTSC, in 2021.

Building 4024

Building 4024, Systems for Nuclear Auxiliary Power (SNAP) Environmental Test Facility, housed four experimental reactor systems in the 1960s. Following termination of the experimental projects, all equipment and fuel were removed from the facility. The shielding concrete in the vaults has low-level activation products, including Co-60 and Eu-152. Building remediation began in 2004, and portions of the building used to support the office space and the mechanical ventilation systems were demolished.

The ventilation stack was removed and a geophysical study supporting final building demolition was completed. In 2007, final demolition of the building was put on hold by DOE pending completion of the EIS. The Final EIS was issued in November 2018, asbestos abatement was performed in 2020, and demolition of above-grade structures was completed in May 2021.

Figure 2-5 shows the aboveground structures that have been demolished to date and the four buildings, owned by Boeing, that still exist.

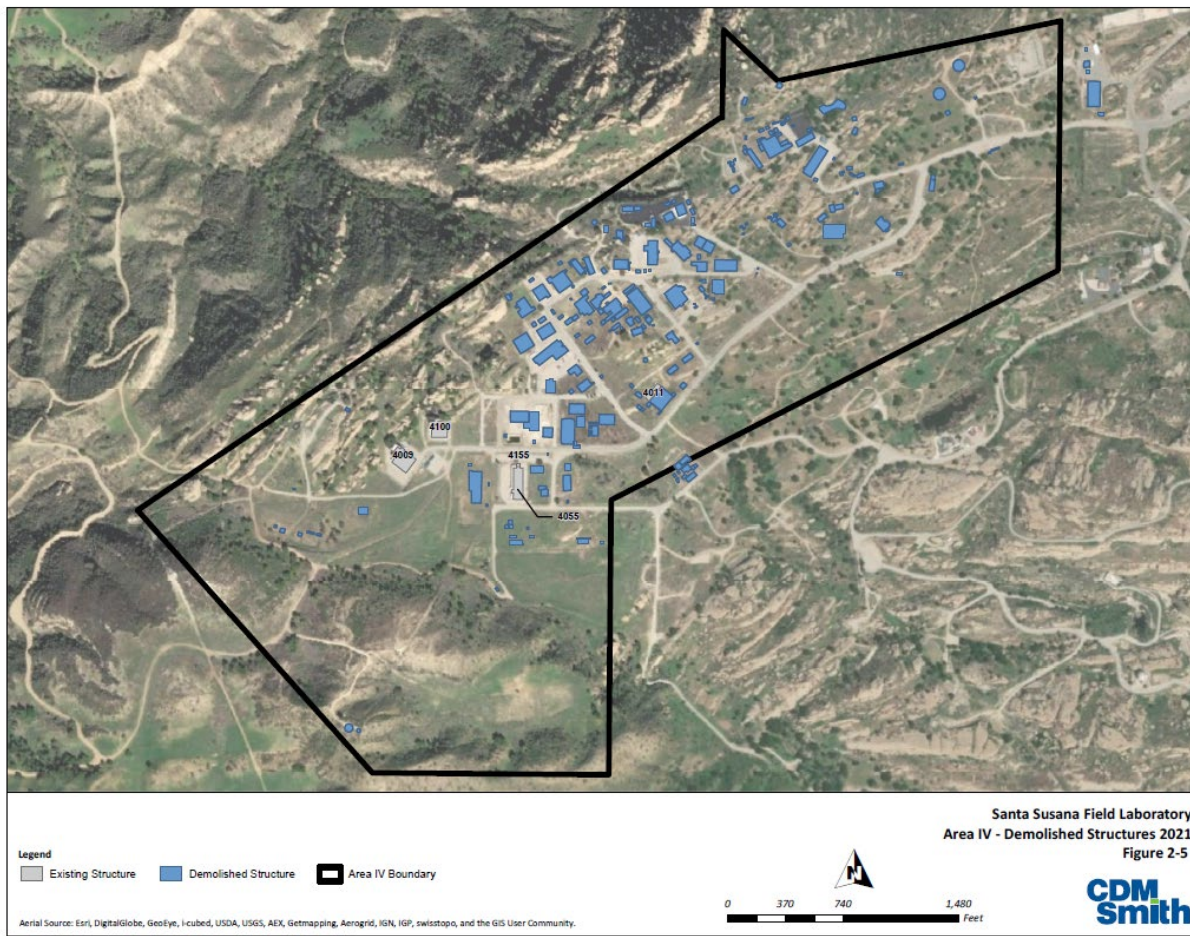


Figure 2-5. Area IV – Demolished Structures 2021

2.3.2 Former Sodium Facilities

Sodium Pump Test Facility / Component Handling & Cleaning Facility

All utility connections to the SPTF/CHCF buildings were severed in 2007. Demolition of Building 4461 was completed in early 2007. In May 2007, DOE halted demolition and the remaining buildings (4462 and 4463) were placed into a safe shutdown condition. Asbestos abatement started in 2020, and demolition was completed in October 2021.

Hazardous Waste Management Facility

The HWMF, a DTSC RCRA-permitted facility consisting of Buildings 4133 and 4029, was approved for closure and demolition by the DTSC in 2006. In May 2007, DOE halted plans for demolition pending completion of the EIS. The EIS was finalized in November 2018. DOE developed a RCRA closure plan for the HWMF, which DTSC approved on November 9, 2020. Phase 1 of the closure plan, which addresses the demolition of all above-grade building structures, was initiated in 2020. Both buildings were demolished in November/December 2020.

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3. COMPLIANCE SUMMARY

3.1 Compliance Status

During 2023, the CDPH, California Department of Industrial Relations (CDIR), and Ventura County Air Pollution Control District (VCAPCD) made four regulatory agency visits to Area IV.

A list of site visits in 2023 by the CDPH agency overseeing the ETEC site is provided in Table 3-1.

Table 3-1. 2023 Agency Inspections, Audits, and Visits Related to DOE Operations

Date	Agency	Subject Area	Results
January 3, 2023	CDPH	Quarterly Environmental TLD Exchange	Compliant
April 26, 2023	CDPH	Quarterly Environmental TLD Exchange	Compliant
June 28, 2023	CDPH	Quarterly Environmental TLD Exchange	Compliant
October 26, 20223	CDPH	Quarterly Environmental TLD Exchange	Compliant
TLD = thermoluminescent dosimeter			

3.1.1 Radiological

The radiological monitoring programs at SSFL comply with applicable federal, state, and local environmental regulations. The monitoring results (Section 5) indicate that SSFL does not pose any significant radiological impact to the health and safety of the general public. All potential pathways to the public or the environment, as illustrated in Figure 3-1, are monitored. These include air, soil, surface water, groundwater, direct radiation, transfer of property (i.e., land, structures, and/or waste), and recycling.

Airborne Activity

All above-grade structures within the RMHF, and Buildings 4133 and 4029, were demolished during 2020. Buildings 4019, 4024, 4038, 4057, 4462, and 4463 were demolished in 2021. During the demolition efforts, multiple controls were emplaced to minimize airborne contamination by managing dust. The controls included maximum wind speed, pre-wetting the materials, water mist sprays, and using best management practices for slow-pace demolition to minimize dust generation. Consequently, neither nearby air monitors emplaced specifically for the demolition nor the perimeter air monitors found any increase of airborne concentrations above background. As a result, the potential radiation exposure dose from the airborne pathway was zero during 2020 and 2021 demolition activities.

No soil excavation or building demolition with the potential to release airborne contaminants was conducted by DOE in Area IV in 2023. Annual National Emission Standards for Hazardous Air Pollutants (NESHAP) reports submitted by DOE to the U.S. Environmental Protection Agency (EPA) are provided at:

<https://www.energy.gov/etec/national-emission-standards-hazardous-air-pollutants-radionuclides-neshaps>

Groundwater

Annual Groundwater Sampling

In accordance with the Water Quality Sampling and Analysis Plan (WQSAP; Haley & Aldrich 2010a), which requires that groundwater sampling be performed on an annual basis, groundwater samples were collected from 40 monitoring wells located in Area IV during the Q1 2023 annual sampling event completed in February and March 2023. The Q1 2023 sampling event was conducted during a period of higher-than-normal rainfall across the region. Based on results in the Q1 2023 report, stakeholders agreed to an off-normal round of groundwater sample collection in Q3 2023. A total of 38 monitoring wells located in Area IV were sampled in Q3 2023.

Data review and validation were completed, and first quarter results were reported in the 2023 First Quarter Groundwater Sampling Report (North Wind 2023a). The third quarter results were reported in the 2023 Third Quarter Groundwater Sampling Report (North Wind 2023b). The 2023 Report on Annual Groundwater Monitoring (North Wind 2024) summarizes the Q1 and Q3 2023 Area IV Groundwater Sampling reports.

In 2023, 10 shallow near-surface wells (less than 35 ft below groundwater surface) were installed at a groundwater seep location in the Northern Buffer Zone. Depending on water availability, samples were collected for tritium, metals, and volatile organic compounds (VOCs). The sampling was performed as part of the monitoring of tritium degradation trends from a source near bedrock wells RD-90 and RD-95. Results of this sampling effort are reported in the technical memorandum *2023 Sampling Results for Near-Surface Monitoring Wells, Santa Susana Field Laboratory (SSFL) Area IV* (CDM Smith 2024a).

Groundwater reports are provided online under the *RCRA Facility Investigation – Groundwater* tab in the SSFL Document Library at the following link: <https://www.dtsc-ssfl.com>

Surface Water

Surface water is regulated under the Los Angeles Regional Water Quality Control Board (LARWQCB) National Pollutant Discharge Elimination System (NPDES). The existing NPDES Permit (CA0001309) for SSFL is held by Boeing and requires monitoring of storm water runoff, treated groundwater, and fire suppression water into Bell Creek, a tributary to the Los Angeles River. The permit also regulates the discharge of storm water runoff from Area IV northwest slope locations into the Arroyo Simi, a tributary of Calleguas Creek. Storm water is collected at the five northwest outfalls (RMHF: Outfall 003; Sodium Reactor Experiment (SRE): Outfall 004; Former Sodium Disposal Facility (FSDF) #1: Outfall 005; FSDF #2: Outfall 006; and Building 4100: Outfall 007), pumped to a centralized storage and treatment center at Silvernale Pond in Area III, and subsequently discharges into Bell Creek. The permit applies the numerical limits for radioactivity established for drinking water suppliers to these discharges. The permit requires radiological measurements of gross alpha, gross beta, tritium, Sr-90, total combined radium-226 (Ra-226) and radium-228 (Ra-228), potassium-40, Cs-137, and uranium isotopes.

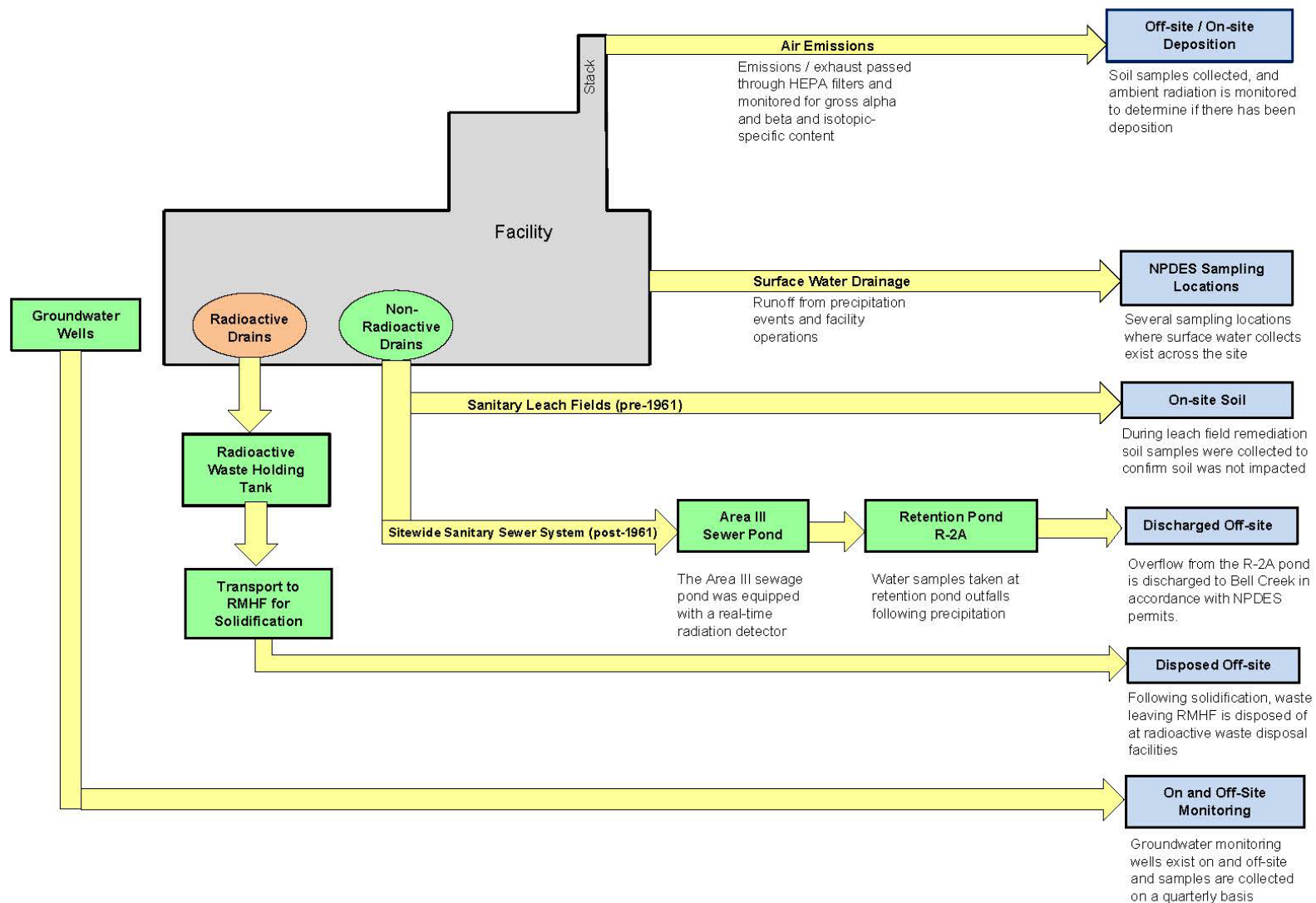


Figure 3-1. Conceptual Model of Potential Pathways

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Detailed monitoring results are provided in the quarterly and annual NPDES discharge monitoring reports (DMRs), which may be viewed under the *California Regional Water Quality Control Board* tab in the SSFL Document library at the following link:

<http://www.boeing.com/principles/environment/santa-susana/monitoring-reports.page>

Direct Radiation

The northern property boundary, the closest property boundary to the RMHF, is approximately 300 m from the RMHF and is separated by a sandstone ridge, effectively shielding the boundary from any direct radiation from the RMHF. Readings from dosimeters placed on the RMHF side of this sandstone ridge, approximately 150 m from the RMHF, were no different than natural background.

Protection of Biota

There is no aquatic system in Area IV of SSFL. Storm water discharge from the site is monitored in accordance with the Boeing NPDES permit (see surface water discussion above).

Terrestrial biota (i.e., vegetation and small wild animals) are abundant at SSFL. They are subject to potential exposure to the radioactivity in soil. Screening analysis indicates that the potential radiation exposure is less than the dose limit recommended by DOE. Section 5.4 provides detailed information on biota protection.

3.1.2 Chemical

RCRA

RCRA allows the EPA broad authority to regulate the handling, treatment, storage, and disposal of hazardous wastes. This authority has been delegated to the Cal-EPA and DTSC. DOE owns and co-operated two RCRA-permitted treatment and storage facilities within ETEC: the RMHF and the HWMF. There are no active operations ongoing at either facility. Permit numbers are listed in Section 3.1.4.

- **RMHF** – In 2021, Buildings 4021, 4022, and 4621 of the RMHF Complex continued to be permitted collectively as an Interim Status (Part A) facility. This facility was previously used primarily for the handling and packaging of low-level radioactive and mixed wastes. Interim status was required for the storage and treatment of the small quantities of mixed waste (i.e., waste containing both hazardous and radioactive constituents) resulting from D&D activities at ETEC. The final disposition of mixed waste was addressed under the DOE and DTSC-approved Site Treatment Plan (STP), which was authorized by the Federal Facilities Compliance Act (FFCA). All mixed waste was dispositioned in accordance with the STP prior to the RMHF Complex being placed in a safe shutdown mode in May 2007. DOE developed a RCRA closure plan for these buildings, which DTSC approved on August 14, 2020. Phase 1 of the closure plan, which addresses the demolition of all above-grade building structures, was successfully executed and completed prior to the end of 2020. The RMHF permitted buildings were demolished in 2020, and the site has been inactive and awaiting final closure.

- **HWMF** – The HWMF includes an inactive storage facility (4029) and an inactive treatment facility (4133) that were utilized for reactive metal waste (i.e., sodium). DOE developed a RCRA closure plan for the HWMF, which DTSC approved on November 9, 2020. Phase 1 of the closure plan, which addresses the demolition of all above-grade building structures, was initiated and the buildings were demolished during November and December of 2020.
- **RCRA Facility Investigation (RFI)** – Under the Hazardous and Solid Waste Amendments of 1984, RCRA facilities can be brought into the corrective action process when an agency is considering any RCRA permit action for the facility. SSFL was initially made subject to the corrective action process in 1989 by the EPA, Region IX. The EPA has completed the Preliminary Assessment Report and the Visual Site Inspection portions of the RCRA Facility Assessment process. ETEC has transitioned from the RFI phase to the Corrective Measures Study (CMS) phase. A CMS report has been provided to DTSC for review, and DOE is actively addressing comment issues (CDM Smith 2020).
- **Administrative Order on Consent** – In December 2010, DOE and DTSC signed an Administrative Order on Consent (AOC), which outlines a specific soil investigation and remediation program for all of Area IV. Groundwater investigation and remediation are still being conducted under RCRA corrective action requirements specified in the 2007 Consent Order among DTSC, DOE, NASA, and Boeing. Samples collected and analyses performed to date at DOE locations are summarized in Section 6.

Groundwater

Characterization of the groundwater at the site continues. The Groundwater RFI Report (CDM Smith 2018a), identified five distinct areas of trichloroethene (TCE)-impacted groundwater in Area IV. From the groundwater samples collected in 2023, concentrations of TCE exceeding maximum contaminant levels (MCLs) were present in all five areas. Detailed analytical results are discussed in Section 7, and the time series plots of analytical data are included in Appendix A.

Federal Facilities Compliance Act

Historically, any mixed wastes were managed in accordance with the FFCA-mandated STP, approved in October 1995. All mixed wastes that required extended on-site storage were managed within the framework of the STP. Characterization, treatment, and disposal plans for each of several different waste streams are defined in the STP with enforceable milestones. Previous management of the mixed waste has been in full compliance with the STP. In 2022, mixed wastes were newly generated in association with the building demolition on the ETEC project and were transported to a licensed or permitted facility outside of the State of California. Because demolition is complete, there were no mixed wastes that needed to be managed or shipped from the ETEC site in 2023.

3.1.3 National Environmental Policy Act

The National Environmental Policy Act (NEPA) establishes a national policy to ensure that consideration is given to environmental factors in federal planning and decision-making. For those projects or actions with a potential to affect human health or the environment, DOE

requires that appropriate NEPA actions (e.g., Categorical Exclusion, Environmental Assessment [EA], Finding of No Significant Impact [FONSI], or Notice of Intent [NOI], draft EIS, final EIS, and/or Record of Decision) be incorporated into project planning documents.

DOE issued a FONSI and the final EA report on March 31, 2003. Subsequently, the Natural Resources Defense Council, City of Los Angeles, and the Committee to Bridge the Gap filed a lawsuit in federal court claiming DOE had violated NEPA, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and the Endangered Species Act. Pursuant to a court order, DOE released the *Draft EIS for Remediation of Area IV and the Northern Buffer Zone of the SSFL* (DOE 2017) on January 6, 2017, with EPA publishing a Notice of Availability (NOA) in the Federal Register (FR) on January 13, 2017, opening the 60-day public comment period. A subsequent notice was issued on March 17, 2017, extending the comment period for an additional 30 days. DOE considered all comments received in preparation of the final EIS document, with the NOA for the *Final EIS for the Remediation of Area IV and the Northern Buffer Zone of the SSFL* (DOE 2018) published in the FR on December 28, 2018.

The Final EIS analyzes the potential environmental and community impacts of remediation alternatives for soil, buildings, and groundwater associated with Area IV and the Northern Buffer Zone and presents the preferred remediation alternatives, which are consistent with the site's end use as open space and are protective of human health and the environment. Based on the analysis presented in the Final EIS (<http://www.ssflareaiveis.com/>), in September of 2020, DOE issued the Records of Decision detailing the path forward for achieving remediation objectives established for environmental media and the building structures in these areas.

Clean Air Act (CAA)

The 1970 CAA (amended in 1977 and 1990) authorized the EPA to establish National Ambient Air Quality Standards (NAAQS) to limit the concentrations of pollutants in ambient (i.e., outdoor) air. The EPA has promulgated NAAQS for six “criteria” pollutants: ozone (O₃), nitrogen dioxide (NO₂), carbon monoxide (CO), sulfur dioxide (SO₂), 10-micron and 2.5-micron particulate matter (PM₁₀ and PM_{2.5}), and lead (Pb). All areas of the United States must maintain ambient levels of these pollutants below the ceilings established by the NAAQS; any area that does not meet the standards is considered a NAAQS “nonattainment” area. Under the CAA, states are required to develop State Implementation Plans (SIPs) that define how each state will carry out its responsibilities under the CAA, mainly through promulgation and enforcement of air pollution control rules and regulations. However, the EPA must approve each SIP, and it can enforce the CAA itself under a Federal Implementation Plan if it deems a state's SIP unacceptable and the state or region is unwilling or unable to develop an acceptable SIP. Other requirements, including NESHAP, New Source Performance Standards, and ambient air monitoring programs, were established to ensure that ambient air quality is acceptable for public health and environmental protection.

Area IV is regulated by the VCAPCD and must comply with all applicable rules, regulations, and permit conditions. DOE previously operated under Permit to Operate No. 00271. In 2008, this permit was consolidated with the existing Federally Enforceable State Operating Permit (FESOP) No. 00232 for SSFL, which presently covers Areas I, III, and IV. The NASA property

– Area II and the former LOX Plant site located in Area I – was removed from the permit in January 2014. On December 15, 2014, VCAPCD issued administrative changes to the permit, relieving Boeing from responsibility for Area IV, except for activities and contractors under Boeing’s direct control. DOE activities currently being performed in Area IV are not subject to air permitting. DOE conducts air monitoring, as described in Section 5.2.1, and the data are published in quarterly reports submitted to DTSC.

Clean Water Act

The Clean Water Act is the primary authority for water pollution control programs, including the NPDES permit program. The NPDES program regulates point source discharges of surface water and the discharge of storm water runoff associated with industrial activities.

Surface water discharges from SSFL are regulated under the California Water Code (Division 7), as administered by the LARWQCB. The existing Boeing NPDES Permit (CA0001309) for SSFL, which was renewed and became effective April 1, 2015, includes the requirements for a site-wide Storm Water Pollution Prevention Plan (SWPPP). The SWPPP is revised, as needed, and includes by reference many existing pollution prevention plans, policies, and procedures implemented at the SSFL site.

Dischargers whose projects disturb ≥ 1 acre of soil or whose projects disturb < 1 acre but are part of a larger common plan of development that in total disturbs ≥ 1 acre, are required to obtain coverage under the General Permit for Discharges of Storm Water Associated with Construction Activity ([Construction General Permit Order 2009-0009-DWQ](#)). Construction activity subject to this permit includes clearing, grading, and disturbances to the ground (i.e., stockpiling and/or excavation). In anticipation of D&D activities associated with contract line item number (CLIN) 0008, CLIN 0010, and RMHF that fall into one or more of these categories, North Wind applied for and was granted coverage (Waste Discharger Identification [WDID] 4 56C388835) by the California State Water Resources Control Board (CSWRCB) to operate and discharge in accordance with the state’s Construction General Permit. The permit requires the development and submittal of a site-specific SWPPP as part of the permitting process. The CLIN 0008, CLIN 0010, and RMHF SWPPPs were revised, as needed, to address changing site conditions during D&D activities. The final SWPPP Notice of Termination (NOT) was submitted to, and accepted by, the CSWRCB in the spring of 2022.

A spill prevention, control and countermeasure (SPCC) plan identifies specific procedures for handling oil and hazardous substances to prevent uncontrolled discharge into or upon the navigable waters of the State of California or the United States. The EPA requires the preparation of an SPCC plan by those facilities that, because of their locations, could reasonably be expected to discharge oil in harmful quantities into or upon navigable waters. The SSFL Facility Spill Prevention and Response Plan, which serves as the site SPCC plan, was submitted by Boeing in January 2015 as a part of the 2014 Hazardous Materials Release Response Business Plan to the County of Ventura Environmental Health Division.

3.1.4 Permits and Licenses (Area IV)

Table 3-2 lists the permits applicable to activities in Area IV.

Table 3-2. SSFL Permits

Permit/License	Facility	Valid
Air (VCAPCD)		
Permit 00232	Combined permit renewed	Current
Treatment/Storage (EPA)		
CAD000629972 (93-3-TS-002)	HWMF (Bldg. 4133 and Bldg. 4029)	<u>Inactive</u> . A permit modification was approved by DTSC on January 22, 2015, to change the owner/operator from Boeing to DOE/North Wind, Inc. A closure plan was approved on December 22, 2006; however, demolition did not occur since DOE first had to complete an EIS (Draft EIS was released by DOE in January 2017 [DOE 2017]). The Final EIS was released in November 2018 (DOE 2018), with DTSC requesting revision and submittal of an updated closure plan. Subsequent revisions were made to the closure plan, with final approval from DTSC received on November 9, 2020. Phase 1 of the plan, which addressed demolition of above-grade building structures, was initiated prior to the end of 2020. The above-grade portions of Buildings 4133 and 4029 were demolished in November/December 2020.
CA3890090001	RMHF	<u>Inactive</u> . A permit modification was approved by DTSC on January 22, 2015, to change the owner/operator from Boeing to DOE/North Wind, Inc. A draft closure plan was submitted in 2007, with DTSC requesting revision and submittal of an updated closure plan upon issuance of the Final EIS (DOE 2018). Subsequent revisions were made to the closure plan, with final approval from DTSC received on August 14, 2020. Phase 1 of the plan, which addressed demolition of above-grade building structures, was successfully completed prior to the end of 2020.
NPDES (LARWQCB)		
CA0001309	SSFL	Current
State of California		
WDID 4 56C388835 (2009-0009-DWQ)	DOE CLIN0008 Demo	NOT Effective Date 03/28/2022

3.2 Current Issues and Actions

3.2.1 Area IV Environmental Impact Statement

Pursuant to a federal court order issued in May 2007, DOE submitted a Draft EIS for Area IV; the Final EIS was approved in November 2018:

<http://www.ssflareaiveis.com/>

Activities conducted in support of this EIS are described below.

- DOE, in partnership with the State of California, completed the remaining “go-back” phase, including stepping down and any remaining data gap sampling, as identified as Phase 3 in the 2010 AOC.
- DOE conducted extensive analysis of previous groundwater sampling and developed groundwater sampling plans to complete groundwater characterization to understand the nature and extent of groundwater contamination.
- As both the groundwater and soil characterizations were nearing an end, DOE began to focus more completely on the EIS. In February 2014, DOE issued an Amended NOI to prepare the EIS.
- DOE conducted monthly community site visits and bi-monthly community meetings in conjunction with DTSC. The tours included inspection of ongoing field activities and areas of interest to stakeholders involved in the site investigation. Stakeholders also provided input to planning for co-located soil sampling described above.

3.2.2 Radiological

All demolition and waste disposal activities were completed on January 26, 2022.

Radioactive Materials Handling Facility

During 2023, the RMHF remained in a safe shutdown mode with operations limited to routine inspections and surveys. The demolition of all above-grade structures within the RMHF was completed in November 2020.

SNAP Environmental Test Facility

During 2023, the SNAP Environmental Test Facility (Building 4024) remained in a safe shutdown mode with operations limited to routine inspections and surveys. Demolition of the above-grade portion of Building 4024 was completed in May 2021.

Groundwater that infiltrates into the cells and French drain of Building 4024 has historically been pumped into frac tanks and sampled for radionuclides and chemicals prior to being shipped off-site as non-hazardous waste water. During 2023, approximately 89,303 gallons of water were pumped out of the Building 4024 sump into frac tanks and shipped to the Crosby and Overton, Inc., waste water treatment facility in Long Beach, CA.

3.2.3 Disposal of Non-Radiological Waste and License-exempt Radioactive Material

Non-radiological waste disposal information is provided in Table 3-3.

Table 3-3. Non-Radiological Wastes Disposal

Type of Waste	Quantity	Hauler	Disposal Facility
Non-hazardous Building 4024 water	89,303 gal	American Integrated Services Phone: (805) 639-0884	Crosby and Overton, Inc. 1610 W. 17th Street Long Beach, CA 90813 Facility Phone (562) 432-5445

3.2.4 Administrative Order of Consent

In December 2010, DTSC and DOE signed an AOC for Remedial Action that defined the process for characterization of the soil and the cleanup end-state for Area IV of the SSFL, including regional “background” for chemicals that currently have a background value, and method reporting limits (MRLs) for those chemicals that have no background value. Background values and MRLs have been incorporated into a look-up table (LUT), per the AOC, by DTSC. The LUT provides the cleanup standards, per the AOC, for Area IV.

In November 2012, EPA made recommendations to DTSC regarding how the AOC LUT values for radionuclides should be calculated based on background soil data (EPA 2012). Subsequently, in January 2013, DTSC issued draft provisional LUTs for 16 radionuclides (DTSC 2013a). In May 2013, DTSC issued a “Chemical LUT Technical Memorandum” for more than 130 chemicals (DTSC 2013b).

The AOC addresses two requirements regarding anthropogenic materials. The first is that the materials be characterized as to waste type and that waste classified as low-level radioactive waste (LLRW) be disposed of at a facility authorized to receive the waste. In accordance with the Order on Consent for Interim Response Action at the RMHF Complex (May 2020), all building debris generated as part of the HWMF building decommissioning and demolition was classified mixed low-level waste (MLLW) irrespective of the presence of radioactivity above background) and was transported and disposed of at a facility authorized to receive MLLW waste outside of the State of California. The second criterion is the complete removal of all anthropogenic material. DOE removed above-grade building debris and disposed of it as MLLW at a licensed facility outside of the State of California.

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4. ENVIRONMENTAL MANAGEMENT SYSTEM

At SSFL, the ETEC Site Closure Program Office has programmatic responsibility for the former radiological facilities, former sodium test facilities, and related cleanup operations, including environmental restoration and waste management. Past environmental restoration activities have included D&D of radioactively contaminated facilities, building demolition, treatment of sodium, assessment and remediation of soil and groundwater, surveillance and maintenance of work areas, and environmental monitoring. Waste management activities include waste characterization and certification, storage, treatment, and off-site disposal. Waste management activities in the past were performed at the RMHF for radioactive and mixed waste. The HWMF was used to handle alkali metal waste; however, it is now inactive and awaiting closure.

4.1 Environmental Monitoring Program

The purpose of the environmental monitoring program is to detect and measure the presence of hazardous and radioactive materials; maintain compliance with federal, state, and local laws and regulations; and identify other undesirable impacts on the environment. It includes remediation efforts to correct or improve contaminated conditions at the site and prevent off-site impact. For this purpose, the environment is sampled and monitored, and effluents are analyzed. Goals of this program include demonstrating compliance with applicable regulations and protecting human health and the environment. Environmental restoration activities at SSFL include a thorough review of past programs and historical practices to identify, characterize, and correct all areas of potential concern. The key requirements governing the monitoring program are DOE Order 231.1B (DOE 2011a) and DOE Order 458.1 (DOE 2013). Additional guidance is drawn from California regulations and licenses, and appropriate standards.

The basic policy for control of radiological and chemical materials requires that adequate containment of such materials be provided through engineering controls, that facility effluent releases be controlled to federal and state standards, and that external radiation levels be reduced to as low as reasonably achievable through rigid operational controls. The environmental monitoring program provides a measure of the effectiveness of these operational procedures and of the engineering safeguards incorporated into facility designs.

4.1.1 Historical Radiological Monitoring

Monitoring the environment for potential impacts from past nuclear operations has been a primary focus of DOE since the inception of operations in the mid-1950s.

In the mid-1950s, the Atomic Energy Commission, in concert with its contractor, Atomics International (then a Division of North American Aviation), began initial plans for nuclear research at its facilities in the west San Fernando Valley. In 1955, prior to initial operations, a comprehensive monitoring program was initiated to sample and monitor environmental levels of radioactivity in and around its facilities.

During the 60-year history of nuclear research and later environmental restoration, on-site and off-site environmental monitoring and media sampling have been extensive. In the early years, soil/vegetation sampling was conducted monthly. Sampling locations extended to the Moorpark freeway to the west, to the Ronald Reagan freeway to the north, to Reseda Avenue to the east, and to the Ventura freeway to the south. Samples were also taken around the Canoga and De Soto facilities, as well as around the Chatsworth Reservoir. This extensive off-site sampling program was terminated in 1989 when all nuclear research and operations (except remediation) came to an end.

During the 1990s, extensive media sampling programs were conducted in the surrounding areas, including the Brandeis-Bardin Institute (now known as the American Jewish University) and the Santa Monica Mountains Conservancy to the north, Bell Canyon to the south, the Rocketdyne Recreation Center in West Hills to the east, and various private homes in Chatsworth and West Hills. Samples were also taken from such distant areas as Wildwood Park and Tapia Park. In addition, monitoring of off-site radiation, groundwater, and storm water runoff from the site was routinely performed during this time.

Ongoing radiological environmental sampling and monitoring ensures that DOE operations at SSFL, including cleanup, do not adversely affect either on-site personnel or the surrounding community.

Additional details about on-site and off-site monitoring are available at:

http://www.etec.energy.gov/Environmental_and_Health/Enviro_Monitoring.php

From 2009 through 2012, the EPA conducted extensive radiological sampling in off-site locations (Background Study) and on-site locations (Area IV Radiological Study). Results are available at:

http://www.etec.energy.gov/Char_Cleanup/EPA_Soil_Char.php

4.1.2 Non-radiological Monitoring

Extensive monitoring programs for chemical contaminants in soils, surface water, and groundwater are in effect to ensure that the existing environmental conditions and restoration activities do not pose a threat to human health or the environment. Extensive soil sampling has been performed under the RFI and other site-specific remedial programs.

Groundwater beneath Area IV is extensively monitored for chemical groundwater conditions. Groundwater sampling and analysis is conducted using a DTSC-approved sampling and analysis plan and EPA-approved analytical methods and laboratories.

Surface storm water is contained, treated, and monitored in compliance with Boeing's NPDES permit, which was most recently renewed on February 12, 2015, and became effective on April 1, 2015. All sources of air emissions were monitored as required by the VCAPCD.

4.2 Integrated Safety Management System

The “ETEC Closure Contract, ISMS Description” details how the Integrated Safety Management System (ISMS) guiding principles and the core functions are met by utilizing North Wind guides and Santa Susana site procedures contained in ETEC Closure Program documents. General ISMS guidelines are tailored specifically for ETEC closure work. The tailored ISMS integrates safety, health, and environmental protection into management and work practices at all levels so that the ETEC Closure Contract work is accomplished while protecting the worker, the public, and the environment. The Annual ISMS Declaration reviews performance, accomplishments, and improvements to the site ISMS. The Fiscal Years 2023 and 2024 Biannual ISMS Report was submitted in August 2024.

The site ISMS self-assessment plan incorporates quarterly program assessments, site audits, and the review and distribution of DOE lessons learned, occurrence reports, and operating experience reports.

To ensure that the ISMS continues to reflect current policies, procedures, processes, and business organization within the context of the ISMS principles, related program documents continue to be regularly reviewed and updated. No program updates were required during 2023, and no program changes to North Wind’s approved ISMS are anticipated for 2024.

4.3 Environmental Training

North Wind conducts training and development programs as an investment in human resources to meet both organizational and individual goals. These programs are designed to improve employee performance, ensure employee proficiency, prevent obsolescence in employee capability, and prepare employees for changing technology requirements and possible advancement.

All training is administered through North Wind University. The Program Manager is responsible for individual employee development through formal training, work assignments, coaching, counseling, and performance evaluation. Managers and employees are jointly responsible for defining and implementing individual training development goals and plans, including on-the-job training.

North Wind currently maintains a list of more than 110 courses for North Wind Santa Susana personnel and contractors. Classes are available as both computer-based training and instructor-led training. Specialized training programs on new technological developments and changes in regulations are provided, as needed, to ensure effective environmental protection and worker health and safety. Additional off-site courses are also encouraged.

4.4 Waste Minimization and Pollution Prevention

A Waste Minimization and Pollution Prevention Awareness Program is in place and serves as a guidance document for all waste generators at ETEC. The plan emphasizes management’s proactive policy of waste minimization and pollution prevention, and also outlines goals,

processes, and waste minimization techniques to be considered for all waste streams generated at ETEC. The plan requires that waste minimization opportunities for all major restoration projects be identified and that all cost-effective waste reduction options be implemented.

Wastes generated at ETEC result from environmental characterization. The typical environmental characterization wastes generated at ETEC during 2023 included:

- Investigation-derived waste
- Groundwater sampling disposable equipment, personal protective equipment, rinse water, and purge water
- Well purge water, including the purge water from wells containing low levels of tritium
- Basement water pumped to frac tanks (disposal discussed in Section 3.2.3).

4.5 Public Participation

Throughout 2023, DOE interacted with community members at DTSC Community Update meetings to inform them of plans and progress. Also in 2023, DOE continued its participation in meetings with NASA, Boeing, DTSC, and the staff to coordinate public outreach efforts.

5. ENVIRONMENTAL RADIOLOGICAL PROTECTION PROGRAM AND DOSE ASSESSMENT

The environmental radiological monitoring program at SSFL started before the first radiological facility was established in 1956. The program has continued with modifications to suit the changing operations. The selection of monitoring locations was based on several site-specific criteria (i.e., topography, meteorology, hydrology, and the locations of the nuclear facilities). The prevailing wind direction for the SSFL site is generally from the northwest, with some seasonal diurnal shifting to the southeast quadrant.

Multiple air samples are continuously collected to determine if there was any airborne radioactive material. Ambient air samples are measured for gross alpha and gross beta for screening purposes. These screening measurements can quickly identify an unusual release and provide long-term historical records of radioactivity in the environment. Air sampling at ETEC during 2023 was performed by North Wind. The individual air samples are screened for gross alpha and gross beta activity. Following screening, the air samples are stored until the end of each quarter, combined into composite samples, and analyzed for specific radionuclides.

Direct radiation is monitored by optically stimulated luminescent dosimeters (OSLDs). The OSLDs used to monitor direct radiation at ETEC were placed and analyzed by North Wind. These OSLDs are complemented by TLDs installed by the State of California Department of Public Health/Radiological Health Branch (DPH/RHB) for independent surveillance.

Surface water samples collected by Boeing at ETEC are analyzed for radioactivity (as well as chemical constituents) and the results compared with NPDES limits intended to protect aquatic organisms.

Groundwater was sampled by North Wind in the first quarter (Q1) (February/March) and third quarter (Q3) of 2023 in accordance with the monitoring programs in place at the site. Samples were analyzed for chemical constituents, and some were also analyzed for radioactivity. The results were compared to the screening values listed in the various groundwater reports. The analytical data suite used for laboratory analysis is updated annually after review of the previous year's data.

5.1 Air Effluent Monitoring

The only historical emission source from DOE facilities in Area IV was the exhaust stack at the RMHF, which was demolished in 2020.

The EPA limit for emissions of radionuclides to ambient air from a DOE site was established to prevent an effective dose equivalent from exceeding 10 millirems per year (mrem/y), as specified in 40 CFR 61, Subpart H. The regulation also specifies that radiation exposure dose to the maximally exposed individual (MEI) be calculated using the EPA's CAP88-PC computer model (EPA 2014). Since no effluents were released to the atmosphere from the DOE facility at SSFL, the potential airborne radiation exposure dose to the MEI was zero.

5.2 Environmental Sampling

5.2.1 Ambient Air

Air particulates are collected on filters at six locations. The number of environmental stations was temporarily reduced to two locations in 2009 due to the temporary suspension of D&D operations at SSFL. These two locations (ETEC samplers) are within the confines of the ETEC site and are shown in Figure 5-1.

Until July 1, 2020, the samples were being used to establish a baseline prior to work being performed. Starting July 1, 2020 (Quarter 10), demolition activities of the CLIN 10 and 12 facilities were being performed within Area IV. Air samples collected after this date were then compared to the baseline readings to verify that the demolition activities are not responsible for an increase in airborne particulates.

Four more sampling stations were installed at the ETEC site perimeter (DOE samplers) and became operational on April 9, 2018 (Figure 5-1). All six sampling locations are listed in Table 5-1.

The two original ETEC samplers operate on 7-day sampling cycles. The sample volume of a typical weekly ambient air sample is approximately 50.4 cubic meters (m^3). The four DOE sampler filters are changed twice each week. The cycle is 3 days and then 4 days. The volume of air sampled is approximately 32 m^3 and 57 m^3 , depending on whether the sample interval is 3 or 4 days.

Airborne particulate radioactivity is collected on glass fiber (Type A/E) filters. The samples are analyzed for gross alpha and beta radiation following a minimum 120-hour decay period to allow the decay of short-lived radon progeny (background radioactivity).

During 2023, 402 air sample filters were collected. Each was analyzed individually. The individual measurements were then reviewed to determine if any events required investigation. No events required investigation in 2023.

Quarterly, the filters from each sampler were aggregated and then sent to an off-site laboratory for radiochemical analysis. The filters were analyzed for all expected background and possibly site-released material. Analyses of all air samples indicate that there have been no airborne releases at the site distinguishable from background.

The results are compared to the derived concentration standards (DCSs) specified in DOE-STD-1196-2011 (DOE 2011b). The conservative guideline for alpha activity is 8.1×10^{-14} microcuries per milliliter ($\mu\text{Ci/mL}$) (assuming plutonium-239), and the guideline for beta activity is 1.0×10^{-10} $\mu\text{Ci/mL}$ (assuming Sr-90). The values found on the air samples are less than 1% of the DCS, before correcting for background, and most radionuclides are indistinguishable from background.

The radionuclides tested for included actinium-228, beryllium-7, Cs-137, Co-60, potassium-40, polonium-210, thorium-228, thorium-230, thorium-232, uranium-234, uranium-235, uranium-238, plutonium-238, plutonium-239, americium-241, Sr-90, Ra-226, Ra-228, and plutonium-241. None of the analytes were more than 1% of the most restrictive limits.

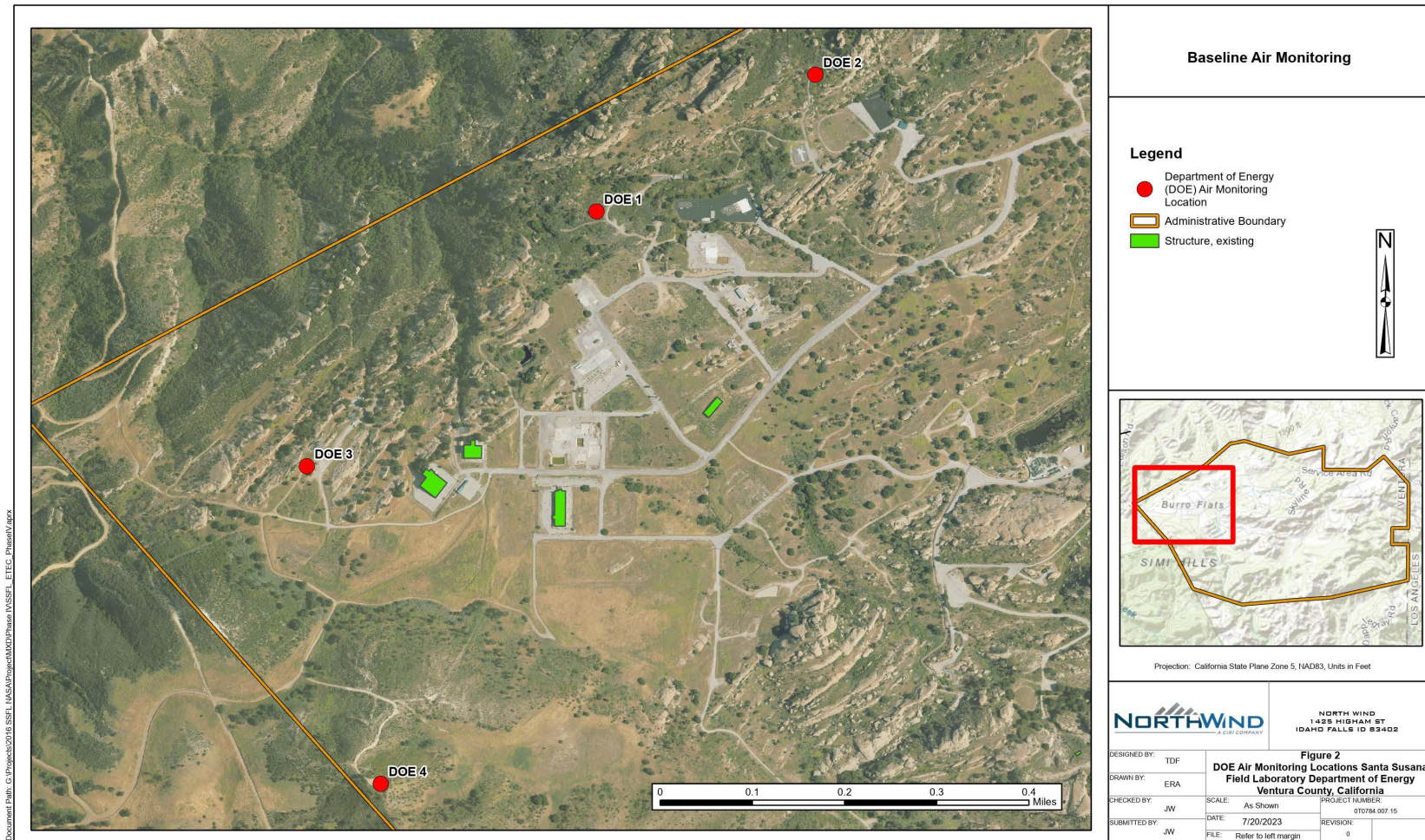


Figure 5-1. DOE Perimeter and ETEC Air Sampler Locations

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Table 5-1. Sampling Location Description

Station	Location	Sampling Frequency
Ambient Air Sampler Locations		
ETEC-1	SSFL Site, Building 4020, northeast of former 4020 site	W
ETEC-2	SSFL Site, RMHF Facility, next to main gate	W
DOE-1	North perimeter near RMHF	BW (3 or 4 days)
DOE-2	Northeast perimeter	BW (3 or 4 days)
DOE-3	Northwest perimeter	BW (3 or 4 days)
DOE-4	West-Southwest perimeter	BW (3 or 4 days)
Codes		Locations
BW	Twice Each Week	SSFL Santa Susana Field Laboratory
W	Weekly Sample	

Air monitoring data are published in quarterly reports submitted to DTSC.

5.2.2 Groundwater

Wells installed in both the Chatsworth Formation and the shallow subsurface are sampled annually to monitor groundwater conditions in Area IV in accordance with the WQSAP (Haley & Aldrich 2010a). Well locations are shown in Figure 7-1. The purpose of these wells is to monitor concentrations of chemicals and/or radioactivity released by historical DOE operations. Groundwater samples are analyzed for a suite of chemical constituents, while some are selected and analyzed for radioactivity, including gross alpha, gross beta, gamma-emitter radionuclides, Ra-226, Ra-228, Sr-90, H-3, and isotopic uranium. Complete sampling schedules and analytical results are presented in the Quarterly and Annual Groundwater Reports, which can be found under the *RCRA Facility Investigation – Groundwater* tab in the SSFL Document library located at the following link:

<https://www.dtsc-ssfl.com>

The 2023 Annual Groundwater Report was submitted in March 2024 (North Wind 2024).

Groundwater Investigation and Remediation Activities

The DOE groundwater investigation and remediation activities that were completed during 2023 are summarized below.

Groundwater Elevation Monitoring and Sampling

Water level measurements were collected weekly through Area IV throughout 2023.

The measurements were made to identify the effects of winter rainfall recharge to near-surface groundwater and the decline in water levels following the rains.

Static water level measurements in Q1 2021, Q1 2022, Q1 2023, Q2 2023, Q3 2023, and Q4 2023 show a generally consistent increase in water levels from Q1 2021 through Q2 2023. With some exceptions, water levels generally stabilized or decreased between Q2 2023 and Q4 2023.

The data show that the static water level increases due to the heavy rains during Q1 2023 occurred primarily between Q1 2023 and Q2 2023. The range of static water level changes across the site are indicative of the various types of recharge mechanisms and geologic conditions present, including topographic (surface terrain), stratigraphic (bedding orientation and grain size), and structural (faults, fractures, and lineaments) (North Wind 2024).

New Well Installations

CDM Smith installed six new monitoring wells at the HMSA in Q4 2023. This work was performed under the *Final Area IV Groundwater Data Gap Well Installation Work Plan Addendum 2 for the Hazardous Materials Storage Area*, dated October 2023 (CDM Smith 2023). The new and existing HMSA wells will be sampled in Q1 2024. HMSA investigation data will be presented in the HMSA Data Gap Well Installation activities report.

Former Sodium Disposal Facility Groundwater Interim Measure

In November 2017, DOE initiated a groundwater interim measure (GWIM) at the FSDF using near-surface well RS-54 as the pumping well. The well exhibited TCE and 1,1,1-trichloroethane (1,1,1-TCA) concentrations greater than 1,000 micrograms per liter ($\mu\text{g/L}$), the target concentration for initiating the GWIM. In June 2018, eight near-surface coreholes (to 63 ft bgs) were drilled at the FSDF. New corehole C-21 exhibited elevated VOC concentrations and was added to the GWIM pumping.

The FSDF Groundwater Interim Measure (GWIM) continued in calendar year 2023. Four wells (RS-54, C-21, C-24, and C-25) exhibiting elevated volatile organic chemical (VOC) groundwater concentrations were pumped on a routine basis. RS-54 was pumped 39 times with 1,533 gallons extracted. C-21 was pumped 45 times with 3,632 gallons extracted. C-24 was pumped 39 times with 1,501 gallons extracted. C-25 was pumped 19 times with 494 gallons extracted. A total of 7,160 gallons were extracted from these wells in 2023.

During the course of the 2023 GWIM operation, water samples from extraction wells were collected and analyzed for VOCs and periodically for metals. The FSDF GWIM will continue in 2024 because 2023 sample results showed that groundwater VOC concentrations remained above the 1,000 micrograms per liter ($\mu\text{g/L}$) VOC threshold in several samples. Data for the FSDF GWIM will be presented in the *Former Sodium Disposal Facility Groundwater Interim Measure Status Report* (CDM Smith 2024b).

5.2.3 Surface Water

The most significant areas of Area IV (FSDF, RMHF, and SRE) drain to the north, while the remaining areas drain to the southeast. Runoff to the north is captured in five catch basins (two at the FSDF, one at Building 4100, one at the RMHF, and one at the SRE). Collected water from Area IV is pumped for treatment/filtration and sampling under the Boeing NPDES Permit. Precipitation in Area IV is collected by a series of drainage channels.

Boeing is the land owner, as listed in its NPDES Permit No. CA0001309, which mandates the collection of surface water samples each year as well as the presentation of the information in DMRs for SSFL published quarterly and annually. The DMR provides information and data, including summary tables of surface water sample analytical results, rainfall summaries, liquid waste shipment summaries, and analytical laboratory QA/QC procedures and certifications. Quarterly and Annual NPDES DMRs are found under the *CA RWQCB* tab in the SSFL Document library located at the following link:

<https://www.dtsc-ssfl.com>

5.2.4 Soil

The last radiological soil sampling in Area IV was conducted by the EPA in 2012. No radiological soil sampling was conducted in Area IV on behalf of DOE during 2023.

5.2.5 Vegetation

Under the oversight of the U.S. Fish and Wildlife Service (USFWS), DOE collected seeds of the federally endangered Brauton's milkvetch, which inhabits the southern portion of Area IV. The seeds, which were collected in August 2022, were provided to the California Botanic Garden facility in Claremont California for preservation and long-term storage. The seeds will be available for restoration of any disturbance of milkvetch habitat.

5.2.6 Wildlife

In accordance with the USFWS Biological Opinion, DOE initiated biweekly surveys for the presence of the federally endangered California coastal gnatcatcher within the area of the FSDF. The bird species was not observed during the surveys.

5.2.7 Ambient Radiation

Both North Wind and the state RHB deployed external radiation dosimeters to measure radiation that could leave the site, and also determine if there were any changes in background that would require investigation. No results were detected to indicate changes in background or radiation leaving the site.

Previous reports noted an agreement between the North Wind measurements and the state measurements; any variance between the two sets of data are within the statistical range of both data sets.

The locations of the North Wind OSLDs and the state TLD are shown on Figure 5-2. Locations marked with an “S” have North Wind dosimeters, and all other locations have state dosimeters. There is also a dosimeter at the SSFL front gate.



Figure 5-2. Locations of External Ambient Radiation Dosimeters

All dosimeters are exchanged quarterly. The quarterly results are summed to obtain the annual ambient gamma radiation exposure in milli-Roentgens/year (mR/y). Note that an mR is very similar to an mrem in terms of impact; however, the unit mrem cannot be properly applied to an environmental measurement. The annual ambient exposure data obtained during 2023 from these dosimeters are shown in Table 5-2.

Table 5-2. 2023 SSFL Ambient Radiation Dosimetry Data

Location Identifier	OSLD (mR/y) (North Wind)	TLD (mR/y) (California)	Comment
SS-1/017	135	128	OSLD and TLD collocated at SSFL front gate. Away from ETEC, not included in average.
SS-3/001	132	129	OSLD and TLD collocated at electric substation boundary fence (Substation 719).
SS-4/002	143	134	OSLD and TLD collocated W of former sodium disposal facility (H Street West Boundary).

Table 5-2. (continued)

Location Identifier	OSLD (mR/y) (North Wind)	TLD (mR/y) (California)	Comment
SS-6/003	137	130	OSLD and TLD collocated at NE corner Building 4353 former location.
006	NA	134	Near sodium disposal facility, NE site boundary at Building 4133.
SS-11/007	132	141	OSLD and TLD collocated at Building 4036, east side.
SS-12/008	132	141	OSLD and TLD collocated at RMHF NW property line boundary.
009	NA	142	RMHF N boundary fence, middle. Close to elevated radiation sources from Building 4021. Excluded from annual average.
SS-14/010	132	130	RMHF NW property line boundary (W of Bldg 4614).
013	NA	134	RMHF, NE fence line. Close to elevated radiation sources from Building 4021. Excluded from annual ambient average.
014	NA	135	RMHF, N central fence line. Close to elevated radiation sources from Building 4021. Excluded from annual ambient average.
015	NA	142	RMHF, NW fence line. Close to elevated radiation sources from Building 4021. Excluded from annual average.
016	NA	156	RMHF, Building 4075, N fence line. Near fixed contamination area, excluded from annual ambient average.
018	NA	149	RMHF north boundary west.
Average	135	133	Only data in both sets compared.
019	NA	136	Offsite, Indian Falls Estates.

Location identifiers shown in bold font are most representative of ambient background conditions near the ETEC site. These dosimeters were used to calculate the annual average exposure. The monitoring results from the state TLDs are comparable to, but slightly lower than, the OSLDs deployed by North Wind. This is attributed to differences in the dosimeters themselves. Note that the off-site TLD location at Indian Falls Estates is 136 mR/y and the average of the ETEC ambient OSLDs dosimeters is 135 mR/y, as measured by the OSLDs, and 133 mR/y, as measured by the TLDs. Ambient conditions at ETEC may reasonably be considered representative of natural background.

The state TLD location 008 measured is 141 mR/y. This location is farthest away from the RMHF and is likely measuring natural background radioactivity from the sandstone rock formation and not elevated radiation levels within the RMHF.

Four of the state's TLDs were deployed inside the RMHF fence near fixed subsurface elevated radiation sources at ETEC. Although no member of the public spends any significant time, if any time at all, near these four locations, the dosimeters measure radiation at all times.

When natural background of 136 mR/y is subtracted from the highest measurement of 156 mR/y, the result of 20 mR/y is below the DOE public dose limit of 100 mrem/y. This satisfies the requirements specified in DOE O 458.1 (DOE 2013). These dosimeter results demonstrate that the potential external exposure at the site boundary is below the DOE's dose limit.

For comparison, a worker exposed to the average of these measurements (133 mR/y) for 2,000 working hours per year would receive approximately 29 mrem/y. When background is subtracted, the dose for the hypothetical worker is reduced to approximately <1 mrem/y.

5.3 Estimation of Radiation Dose

5.3.1 Individual Dose

Monitoring the airborne and external radiation dose is performed to ensure that no individual is exposed to radiation above the limits. The monitoring conducted in 2023 demonstrated that no individual was exposed near the DOE or EPA limits. The population radiation dose was estimated to be 0 mrem/y, well below the most restrictive limit of 10 mrem/y, as stated in DOE O 458.1, "Radiation Protection of the Public and the Environment" (DOE 2013).

In accordance with regulations, the total effective dose equivalent to any member of the public from all pathways (combining internal and external dose) shall not exceed 100 mrem/y (above background) for any DOE facility. The four TLDs deployed along the RMHF fence line near elevated sources of radiation at ETEC have an annual average exposure of 127 mrem/y. Even if a person spent the entire year at this fence line, the hypothetical external dose with background subtracted would be 3 mR/y (135 mR minus 132 mR at the background location). This is less than the 100 mrem dose limit (note that for gamma rays, 1 mR is the same as 1 mrem). In reality, because no member of the public spends any appreciable time near the RMHF fence line, the external dose to a member of the public is zero.

For DOE operations, the air pathway standard is 10 mrem/y committed effective dose equivalent, as established by the EPA.

Public exposure to radiation and radioactivity is shown in Table 5-3. The table presents the estimated exposures in comparison to the regulatory standards. Dose values in the table represent both internal and external exposures.

Table 5-3. Public Exposure to Radiation from DOE Operations at SSFL

All pathways	
1. Maximum estimated external dose to an individual from direct radiation	0 mrem/y
2. Maximum estimated internal dose to an individual	0 mrem/y
Limit (“Radiation Protection of the Public and the Environment,” DOE Order 458.1)	100 mrem/y
2. Air pathway (reported in NESHAP report)	0 mrem/y
Limit (40 CFR 61, Subpart H)	10 mrem/y

5.3.2 Population Dose

Since no effluents were released to the atmosphere during 2023, the potential collective dose to the general population was zero person-rem.

5.4 Protection of Biota

Radiation protection of the biota is also required, and is estimated by using standardized processes using actual soil contamination concentrations. As shown below, the total estimated biota radiation dose is approximately 1.2% of the limit.

DOE O 458.1, “Radiation Protection of the Public and the Environment,” (DOE 2013) requires that populations of aquatic organisms be protected using a dose limit of 1 rad/day. While there is no formal DOE dose limit for terrestrial biota, DOE strongly recommends that its site activities meet the internationally recommended dose limits for terrestrial biota, which are:

- The absorbed dose to aquatic animals will not exceed 1 rad/day (10 mGy/day) from exposure to radiation or radioactive material
- The absorbed dose to terrestrial plants will not exceed 1 rad/day (10 mGy/day) from exposure to radiation or radioactive material
- The absorbed dose to terrestrial animals will not exceed 0.1 rad/day (1 mGy/day) from exposure to radiation or radioactive material.

There is no aquatic system in Area IV of SSFL. Therefore, the protection of aquatic organisms on-site is not an issue.

Terrestrial biota (i.e., vegetation and small wild animals) are abundant at SSFL. They are subject to potential exposure from radioactivity in the soil. The DOE Technical Standard, “A Graded Approach for Evaluating Doses to Aquatic and Terrestrial Biota” (DOE 2002), provides a methodology for demonstrating compliance with the requirement for protection of biota. RESRAD-BIOTA, a computer program developed by DOE, implements the graded approach for biota dose evaluation. There are three levels of dose evaluations in RESRAD-BIOTA. The first level is a conservative screening tool for compliance demonstration. Once the screening test in Level 1 is met, no further evaluation is necessary. In the Level 1 dose evaluation, measured radionuclide concentrations in environmental media are compared with the biota concentration

guides (BCGs). Each radionuclide-specific BCG represents the limiting concentration in environmental media that would not cause the biota dose limits to be exceeded.

EPA soil concentrations in Area IV, taken in 2011 and 2012, are used for the Level 1 dose evaluation. Table 5-4 summarizes the comparison results. The total BCG fraction in Area IV, as shown in Table 5-4, is less than 1, indicating that the potential exposure is less than the dose limit recommended by DOE.

Table 5-4. Terrestrial Biota Radiation Exposure as a Fraction of Dose Limit

Isotope	Soil			
	Draft LUT (pCi/g)	BCG Limit (pCi/g)	Avg. Soil Concentration above	Avg. Site Isotopic Partial Fraction
Am-241	3.86E-02	3.89E+03	1.50E-05	3.966E-09
Cm-243/244	3.96E-02	4.06E+03	9.00E-06	2.223E-09
Co-60	3.63E-02	6.92E+02	4.00E-06	6.080E-09
Cs-137	2.25E-01	2.08E+01	2.11E-01	1.012E-02
Eu-152	7.39E-02	1.52E+03	3.40E-05	2.252E-08
Pu-238	2.54E-02	5.27E+03	9.00E-06	1.624E-09
Pu-239/240	2.30E-02	6.11E+03	1.65E-04	2.705E-08
Sr-90	1.17E-01	2.25E+01	4.68E-02	2.082E-03
Th-230	2.38E+00	9.98E+03	9.85E-04	9.872E-08
Th-232	3.44E+00	1.51E+03	0.00E+00	0.00E+00
Th-234	3.54E+00	2.16E+03	1.30E-03	6.026E-07
U-233/234	2.18E+00	5.13E+03	2.56E-03	4.991E-07
U-235/236	1.52E-01	2.77E+03	1.47E-04	5.322E-08
U-238	1.96E+00	1.58E+03	1.49E-03	9.445E-07
Sum of Partial Fraction				0.012

6. ENVIRONMENTAL NON-RADIOLOGICAL PROGRAM INFORMATION

SSFL maintains a comprehensive environmental program to ensure compliance with all applicable regulations, to prevent adverse environmental impacts, and to restore the quality of the environment from past operations.

The LARWQCB regulates discharges through Boeing's NPDES permit. Surface water runoff is collected in the water reclamation/pond system, with discharges from this system being subject to effluent limitations and monitoring requirements, as specified in Boeing's NPDES permit. The significant areas of Area IV discharge storm water runoff to five northern catchment basins (Figure 6-1), where water is contained and pumped to the central treatment system at Silvernale Pond in Area III.

The VCAPCD regulates the air program and must comply with all permit conditions contained in FESOP No. 00232, which implement applicable VCAPCD rules and regulations. In 2008, the former Permit to Operate No. 00271 for DOE was consolidated into FESOP No. 00232.

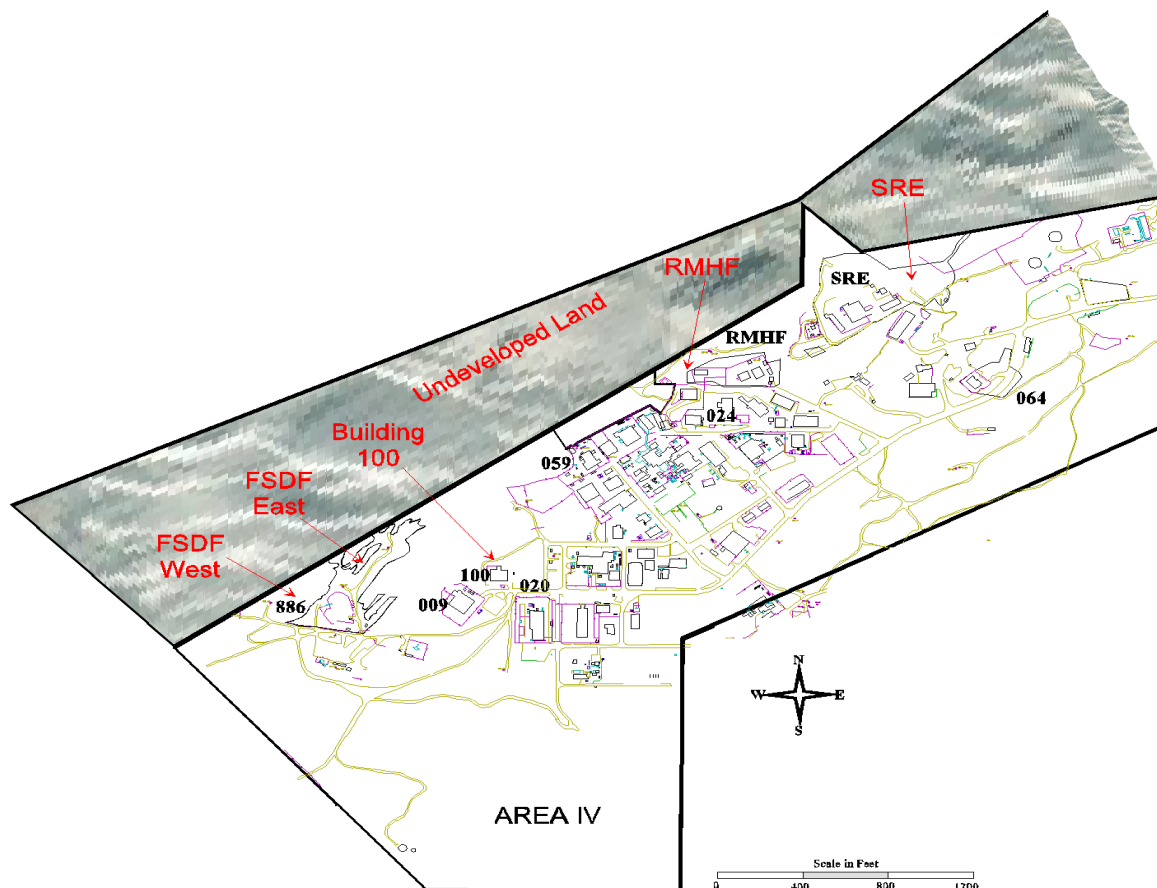


Figure 6-1. Locations of Surface Water Runoff Collectors

6.1 Surface Water Discharge

The LARWQCB granted Boeing a discharge permit pursuant to the NPDES and Section 402 of the Federal Water Pollution Control Act. NPDES Permit No. CA0001309 initially became effective on September 27, 1976, was most recently renewed on February 12, 2015, and became effective April 1, 2015.

The NPDES permit allows the discharge of storm water runoff from retention ponds into Bell Creek, a tributary of the Los Angeles River. Storm water from the southeastern portion of Area I is permitted to discharge to Dayton Creek and from the northeastern locations of Area II into the Arroyo Simi, a tributary of Calleguas Creek. The permit also allows for the discharge of storm water runoff from the northwest slope (Area IV) locations into the Arroyo Simi. Since 2012, storm water from the northwest slope (RMHF: Outfall 003; SRE: Outfall 004; FSDF #1: Outfall 005; FSDF #2: Outfall 006; and T100: Outfall 007) is pumped to a retention pond in Area III (Silvernale Pond). Discharge from these outfalls occurs only if the pumps fail or the systems get overwhelmed by heavy rainfall.

Of the two retention ponds (R1 and Silvernale) at SSFL that have approved discharge points in the NPDES permit (i.e., Outfalls 011 and 018), only one, Silvernale Pond (Outfall 018), receives influent (i.e., storm water) from Area IV. When there is discharge from either the R-1 or Silvernale pond, grab and composite samples are collected by Boeing and sent to a California State-certified testing laboratory for analysis. Analyses include chemical constituents such as heavy metals, volatile organics, base/neutral and acid extractables, general chemistry, E. coli and fecal coliform, and specified radionuclides. Toxicity testing is also conducted in the form of acute and chronic toxicity bioassays. There is no sanitary sewer connection to a publicly owned treatment works from SSFL. Portable toilet facilities are currently in use in Area IV and have been for the prior 4 years.

Details on the NPDES discharge from SSFL for the period of January 1, 2023, through December 31, 2023, are available in the 2023 quarterly DMRs. These reports provide information and data, including summary tables of surface water sample analytical results, rainfall summaries, liquid waste shipment summaries, and analytical laboratory QA/QC procedures and certifications.

6.2 Air

SSFL is regulated by the VCAPCD and must comply with all permit conditions contained in FESOP No. 00232, which implement applicable VCAPCD rules and regulations. In 2008, the former Permit to Operate No. 00271 for DOE was consolidated into FESOP No. 00232. No substantive changes or modifications (i.e., an Administrative Change) from the previous permit were made as a result of the permit consolidation. However, as permitted equipment is removed from the site, it is removed from the permit, along with any conditions applicable to the equipment. Per FESOP monitoring, recordkeeping, reporting requirements, and calculated emissions of criteria air pollutants and precursors were under the mass limits defined in the permit conditions. As a present-day remediation site, SSFL is not a major source of air pollutants under CAA Title V (i.e., Synthetic Minor source per FESOP conditions) and is not subject to 40 CFR 63, Subpart GG, “National Emission Standards for Aerospace Manufacturing and Rework Facilities.”

7. GROUNDWATER PROTECTION AND MONITORING PROGRAM

A site-wide groundwater monitoring program has been in place at SSFL since 1984. Area IV contains 121 shallow and deep wells and 12 seep wells. Routine chemical and radiological monitoring of the wells and seep wells is conducted according to the monitoring plan submitted to DTSC for the Site-Wide Groundwater Monitoring Program and the RFI Program.

The overall groundwater monitoring program at SSFL addresses collection and analysis of groundwater samples and measurement of the water levels. The locations of the wells and piezometers within and around DOE areas in Area IV are shown in Figure 7-1. Groundwater quality parameters and sampling frequency have been determined on the basis of historical water quality data, location of known or potential sources of groundwater contamination, operational requirements of groundwater extraction and treatment systems, and regulatory direction. Wells are gauged quarterly for groundwater levels and sampled annually. The specific analysis dictated for each well is modified annually by DOE and is determined by review of existing data and conditions. Ongoing coordination with DOE and state and federal regulators ensures that all applicable analyses are being performed, and that the analysis for each location (including emerging contaminants) is carefully considered and addressed. The groundwater monitoring program for Area IV includes the analysis of the following parameters, which are analyzed using the appropriate EPA methods:

- VOCs (including 1,4-dioxane)
- Metals (including sodium)
- Fluoride
- Perchlorate
- 1,2,3-Trichloropropane
- Radionuclides (gross alpha, gross beta, tritium, Sr-90, total combined Ra-226 and Ra-228, potassium-40, Cs-137, and uranium isotopes).

Groundwater reports are submitted to the regulatory agencies following each sampling event. Summaries of groundwater monitoring activities and sampling results for Area IV during 2023 are presented in Table 7-1. Historical time series plots are located in Appendix A.

Groundwater wells are screened in alluvium, weathered bedrock, and unweathered bedrock (Figure 7-1). For regulatory purposes, “near-surface groundwater” is defined to occur perched or vertically continuous with deeper groundwater within the site’s unconsolidated deposits (e.g., alluvium) and shallow weathered bedrock, whereas deep groundwater, referred to as “Chatsworth Formation groundwater,” occurs in unweathered bedrock. The alluvium is indicated to generally consist of unconsolidated sand, silt, and clay. Groundwater is ephemeral in some portions of the alluvium and upper weathered Chatsworth Formation. The principal water-bearing system at SSFL is the fractured Chatsworth Formation, predominantly composed of weak- to well-cemented sandstone with interbeds of siltstone and claystone. Several hydraulically significant features (i.e., fault zones and shale beds) are present at SSFL and may act as aquitards or otherwise influence the groundwater flow system.

Table 7-1. Ranges of Detected Non-Radiological Analytes in 2023 Groundwater Samples

Analytes	Ranges of Results for Positive Detections	Screening Values
Fluoride (mg/L)	0.235J to 1	0.800 ¹
Perchlorate (µg/L)	0.793 to 2.42	6 ²
1,1-Dichloroethane (µg/L)	0.35 J/J to 4.18	5 ²
1,1-Dichloroethene (µg/L)	0.4 J/J to 26.8	6 ²
1,4-Dioxane (µg/L)	0.112J/J to 5.69	1 ³
cis-1,2-Dichloroethene (cis-1,2-DCE) (µg/L)	0.43 J/J to 36.3	6 ²
trans-1,2-Dichloroethene (µg/L)	0.79J/J to 21.2	10 ²
Tetrachloroethene (PCE) (µg/L)	0.63 J/J to 29.7	5 ⁴
Toluene (µg/L)	no detections	150 ²
1,1,1-TCA (µg/L)	0.34 J/J to 0.84 J/J	200 ⁴
TCE (µg/L)	0.4 J/J to 354	5 ⁴

1 = SSFL Comparison (site-specific values developed by DTSC)

2 = California Maximum Contaminant Level

3 = Notification Level (site-specific values developed by DTSC)

4 = Primary Maximum Contaminant Level

J = Estimated value

Qualifiers presented as laboratory qualifier / data validation qualifier.

Figures 7-2 and 7-3 show areas that have historically been impacted by TCE and tritium, respectively. There is one location (DOE Landfill 2) between SNAP and the RMHF that has been impacted by tritium. During 2020, tritium concentrations were above the MCL of 20,000 picocuries per liter (pCi/L) in wells RD-90 and RD-95 at concentrations of 26,000 and 23,300 pCi/L, respectively. These concentrations are similar to, but less than, the 2019 detections. Tritium samples were not collected during the 2021 sampling event. Tritium samples collected from RD-90 and RD-95 during the 2022 sampling event showed concentrations of 27,100 pCi/L and 14,700 pCi/L, respectively. There were no reported detections of tritium above the MCL in 2023. Tritium concentration vs. time graphs (see Appendix A) illustrate overall decreasing trends for these wells. The graphs include trendlines generated from both actual tritium detections and projected tritium half-life decay from the highest historical detection. Based on the detection trendlines, tritium is expected to decrease to below the MCL by 2026 in RD-90 and by 2023 in RD-95. The decay trendlines indicate a much longer timeframe with tritium decaying below the MCL by 2032 in RD-90 and by 2040 in RD-95. The Groundwater RFI Report notes that the rate of diminishing tritium concentrations is faster than the half-life decay due to dispersion and dilution factors (CDM Smith 2018a).

The Groundwater RFI Report (CDM Smith 2018a) identified five distinct areas in Area IV roughly defined by monitoring well locations with historical TCE results equal to or above the MCL of 5 µg/L. These areas include the FSDF, Building 4100/Building 56 Landfill, Metals Clarifier/DOE Leach Field 3 (DOE LF3), the HMSA, and the RMHF (Figure 7-2). The 2023 TCE results for these areas are discussed below. In general, sample results were consistent with

historical results, and any increases in concentrations were likely influenced by high seasonal rains and movement of groundwater caused by pumping of wells in the FSDF area for the GWIM and pumping of wells in the HMSA area as part of the CMS. TCE detections are reported as a concentration followed by the laboratory qualifier and the data validation qualifier. The qualifiers are defined in Appendix B. Concentrations with a J qualifier are considered estimated due to uncertainty in the reported value. This uncertainty is due to not meeting accuracy criteria (Section 9.1.6) and/or the reported value was above the method detection limit (MDL) (i.e., lowest concentration that can be detected) but below the quantitation limit (i.e., lowest concentration that can be quantitatively detected with accuracy and precision).

7.1 FSDF Area

The following wells had TCE concentrations detected above the MCL of 5 µg/L for this area in 2023:

- RD-54A showed an increasing trend from 2018 (2.3 µg/L), 2019 (9.4 µg/L), and 2020 (23.7 µg/L). The Q1 2021 result decreased to 7.59 µg/L, and further decreased in Q1 2022 to 3.3 µg/L. The TCE concentration increased in Q1 2023 to 4.9 µg/L and above the screening criteria in Q3 2023 to 47.8 µg/L. The 2023 increasing results in this well are influenced by shallow impacted groundwater migrating downward from near-surface bedrock fractures. Data from future sampling rounds will be used to evaluate the current increasing trend.
- RD-21 at 63.9 µg/L and RD-65 at 276 µg/L were above the screening criteria in Q1 2023. RD-21 was not sampled in Q3 2023. RD-65 showed a continued increase to 354 µg/L in Q3 2023. While the RD-21 detection in Q1 2023 decreased from the Q1 2022 result (97.6 µg/L), the RD-65 detection increased in Q1 2023 and Q3 2023 from Q1 2022 detection (5.38 µg/L). The increases in TCE concentration in 2023 are influenced by high seasonal rainfall recharging near-surface bedrock fractures. Data from future sampling rounds will be used to evaluate potential trends.
- RD-64 at 76.8 µg/L (Q3 2023) is increased from the previous reported detection of 15.6 µg/L in 2020. Data from future sampling rounds will be used to evaluate potential trends.

7.2 Building 4100 / Building 56 Landfill Area

The following wells had TCE concentrations detected above the MCL of 5 µg/L for this area in 2023:

- RD-07 at 43.7 µg/L in Q1 2023 and 55.3 µg/L in Q3 2023 is increased and decreased, respectively, from 2021 (45.1 µg/L) and both are decreased from 2021 (60.2 µg/L). The results remain above the result detected in 2019 (22.2 µg/L). TCE concentrations are influenced by seasonal rainfall recharging near-surface fractures. Data from future sampling rounds will be used to evaluate potential trends.
- RD-91 at 87.8 µg/L in Q1 2023 is decreased from the 2022 result (91.4 µg/L). RD-91 was not sampled in Q3 2023. This well supports extent and trend analysis in the area, particularly near well RD-07, and may be evaluated in future sampling rounds for confirmation of extent and trend analysis.

7.3 Metals Clarifier / DOE Leach Field 3 Area

The following well had TCE concentrations detected above the MCL of 5 µg/L for this area in 2023:

- PZ-105 at 6.37 µg/L in Q1 2023 and 6.87 µg/L in Q3 2023 is increased from 2022 (5.5 µg/L) and decreased from 2020 (8.34 µg/L). PZ-105 was not sampled in 2021. Fluctuating TCE concentrations are influenced by seasonal rainfall recharging near-surface fractures. Data from future sampling rounds will be used to evaluate potential trends.

7.4 HMSA Area

The following wells had TCE concentrations detected above the MCL of 5 µg/L for this area in 2023:

- DD-157 at 9.96 µg/L (Q1); DS-48 at 41.4 µg/L (Q1) and 41.7 µg/L (Q3). Neither of these wells was sampled in Q1 2022. Both of the results are increased from the 2021 results (DD-157 non-detect and DS-48 at 4.89 µg/L), which was the first year these two wells were sampled after installation.
- PZ-108 at 119 µg/L in Q1 2023 and 130 µg/L in Q3 2023 are decreased from the Q1 2022 result of 141 µg/L.
- PZ-162 at 12.8 µg/L in Q1 2023 and 5.61 µg/L in Q3 2023 are increased and decreased, respectively, from the Q1 2022 result of 9.56 µg/L.
- PZ-163 at 77.2 µg/L in Q1 2023 and 129 µg/L in Q3 2023 are decreased and increased, respectively, from the Q1 2022 result of 78.4 µg/L.
- DD-144 at 108 µg/L in Q1 2023 and 79 µg/L in Q3 2023 are both increased from the 2022 result (14.3 µg/L) and decreased from the 2020 result (168 µg/L).

The fluctuations in TCE concentrations are influenced by seasonal rainfall impacting near-surface conditions. Data from future sampling rounds will be used to evaluate potential trends.

7.5 RMHF Area

The following wells had TCE concentrations detected above the MCL of 5 µg/L for this area in 2023:

- RD-63 at 3.95 µg/L in Q1 2023 and 3.19 µg/L in Q3 2023 are decreased from the 2022 result (4.84 µg/L) and the 2021 result (5.72 µg/L). The 2023 results are consistent with historical concentration fluctuations.
- RS-28 at 7.01 µg/L in Q1 2023 and 1.53 µg/L in Q3 2023. RD-28 was not sampled in 2022 or 2021.

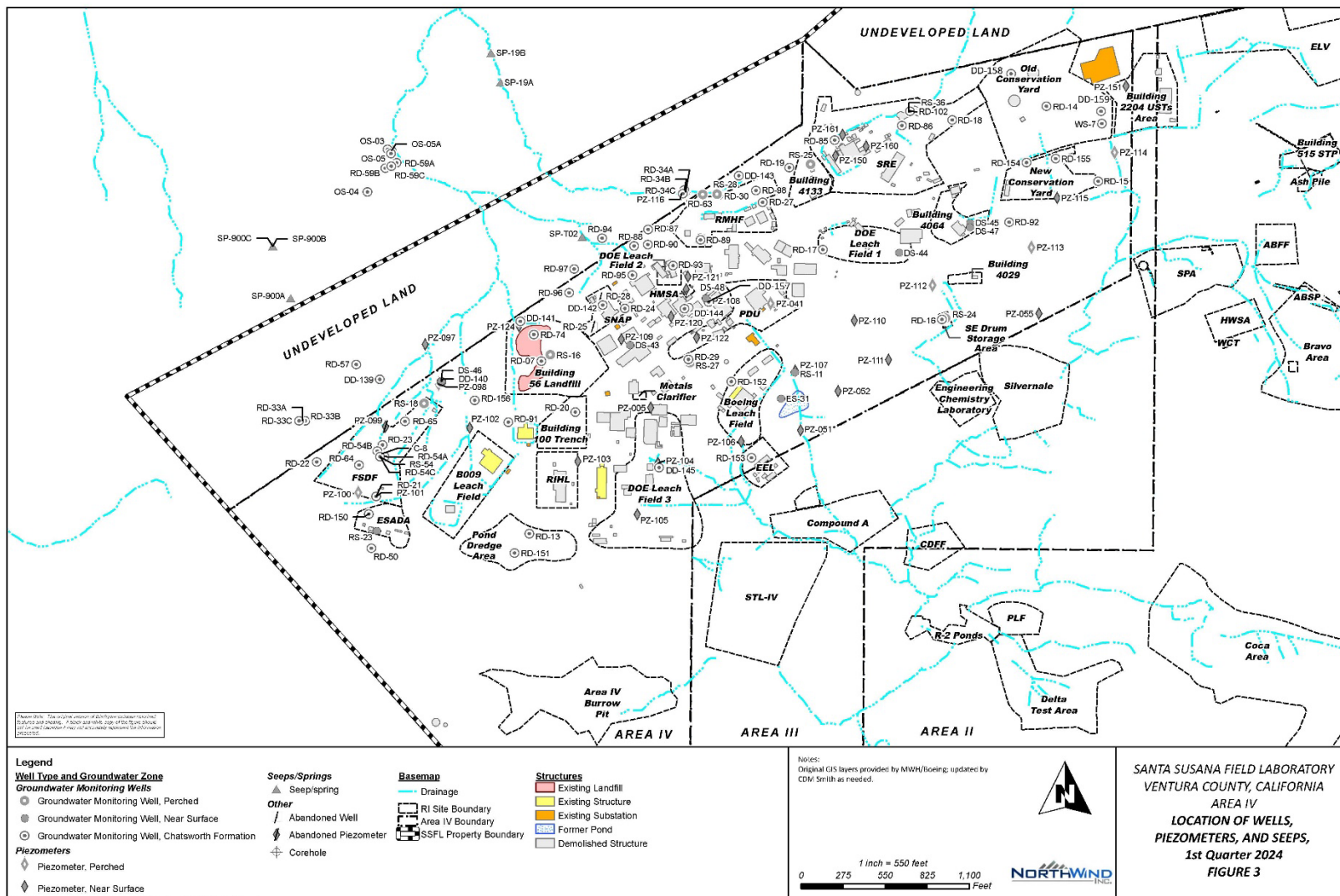


Figure 7-1. Area IV Well, Piezometer, and Seeps Locations

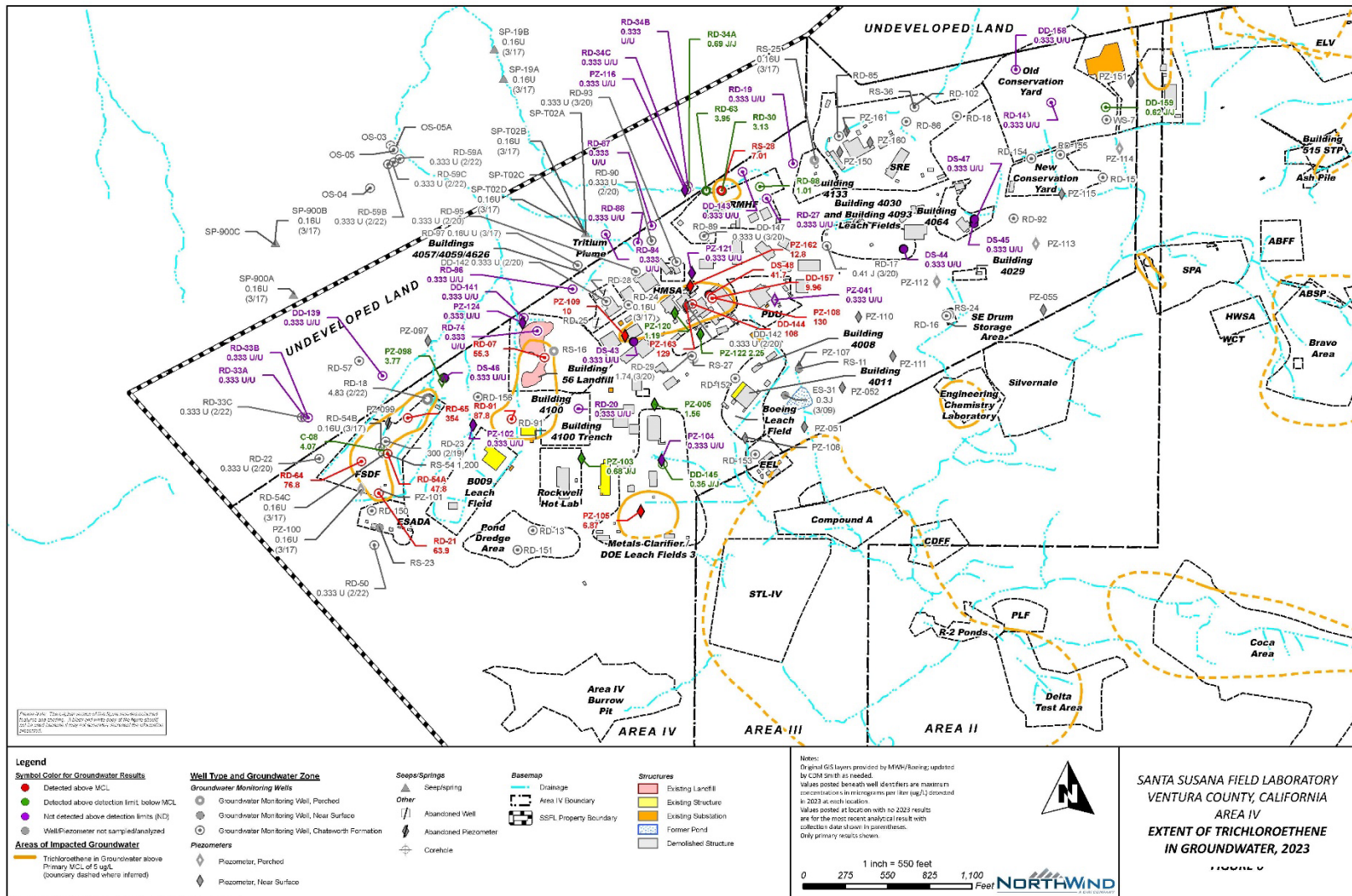


Figure 7-2. 2023 TCE Occurrences in Groundwater at SSFL, Area IV

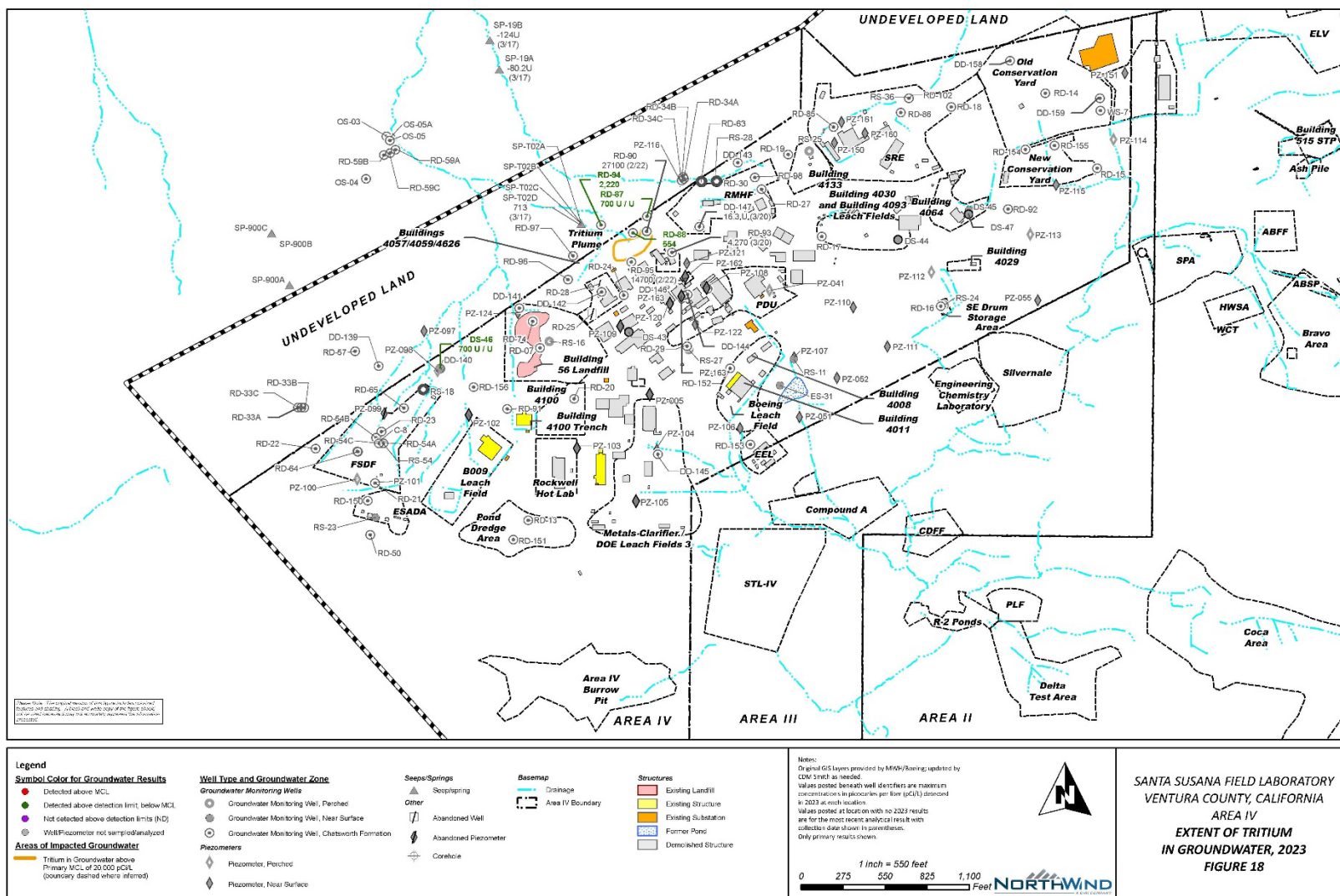


Figure 7-3. 2023 Tritium Occurrences in Groundwater at SSFL, Area IV

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8. SOIL INVESTIGATION PROGRAM

The soils investigation program started at the SSFL site in 1996 and was completed in late 2014. Future remedial actions are being planned for impacted soils at the site. From 2010 to 2014, potential chemically contaminated soils in Area IV were evaluated under the DTSC/DOE AOC sampling program. The agreement between the DOE and DTSC outlines an approach to investigate and clean up soil contamination in Area IV to specified cleanup levels (LUT) under DTSC oversight, with the objectives of determining the nature and extent of chemicals in soil and assessing the potential threat to groundwater quality in Area IV, the adjacent undeveloped land in the Northern Buffer Zone (NBZ), and in contiguous areas where soil contamination has migrated. Prior to the signing of the AOC on December 6, 2010, investigation of chemical contamination in soil was performed as part of the RFI program under DTSC oversight. Per the AOC and as described above, investigation and cleanup of groundwater are continuing under the RCRA corrective action program under DTSC oversight.

The Phase 3 Chemical Data Gap Sampling Investigation was completed in 2015; however, a VOC source investigation was conducted at the FSDF during 2018 to locate the VOC source to groundwater observed in well RS-54. The results indicated that the primary bedrock VOC source is in the vicinity of well RS-54 (CDM Smith 2018b). Recent information regarding the Phase 3 chemical data sampling investigation may be found at:

[Chemical Co-Located Sampling | Department of Energy](#)

The Draft Chemical Data Summary Report, which summarizes the data from all soil samples collected to date, was prepared in 2016 and released by DOE in January 2017 for DTSC review and approval. The Draft Chemical Data Summary Report may be found at:

[Chemical Data Summary Report | Department of Energy](#)

Additionally, DOE will continue evaluation of Area IV sampling data and results of the soils treatability studies for soil cleanup remedial alternatives. The Final EIS was released by DOE during November 2018. Recent information regarding the Final EIS may be found at:

https://www.ssflareaiveis.com/final_documentation.aspx

Information regarding the 2010 AOC requirements and AOC soil sampling efforts may be found at:

[Consent Orders | Department of Energy](#)

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9. QUALITY ASSURANCE PROGRAM

QA/QC practices encompass all aspects of the SSFL environmental monitoring and surveillance activities. SSFL contractors, subcontractors, and multiple DOE organizations are involved in and conduct environmental monitoring and surveillance activities independently, each driven by different missions and regulatory requirements but with the same goal in mind. The Environmental Surveillance program includes environmental surveillance and monitoring across multiple media types both on and off the SSFL site. The program conducts multimedia environmental monitoring to assess SSFL and off-site human health exposures to radionuclides and chemicals and evaluate the potential impact of site operations on the environment.

The QAPP (North Wind 2017) and field Quality Assurance Project Plan for Groundwater Monitoring (QAPjP; North Wind 2015) reflect how quality requirements are fulfilled in support of the environmental monitoring activities at SSFL, including EM-QA-001, *Office of Environmental Management Quality Assurance Program* (DOE 2012). The QAPP and QAPjP present the QA/QC procedures associated with tracking, reviewing, and auditing to ensure that the data collected in the field and in the off-site laboratory are of sufficient quality, as well as to ensure that the project work meets the outlined QA requirements for intended data use. The QAPP and QAPjP are formatted to provide a direct correlation to the management/performance/assessment criteria specified in 10 CFR and DOE O 414.1D, with references to the applicable requirements of American Society of Mechanical Engineers (ASME) NQA-1.

Together, EM-QA-001 (Rev. 1); the criteria of 10 CFR 830, Subpart A, “Quality Assurance Requirements”; and DOE O 414.1D, “Quality Assurance,” are achieved through the application of ASME NQA-1-2008 with the NQA-1a-2009 addenda, *Quality Assurance Requirements for Nuclear Facility Applications*, as the basis for the QA Program described in the plan.

The primary goal of an Environmental Surveillance program is to provide high-quality data so that the necessary assessments and decisions based on the data can be made. This section presents information on measures taken by the groundwater environmental monitoring program in 2023 to ensure the high quality of data collected and presented in this annual report.

9.1 Quality Control Results for 2023

9.1.1 Background

The following summarizes the inorganic, metals, organic, and radiochemical data validation completed for 28 EPA Level IV data packages containing results from the SSFL Area IV in Ventura County, California. The data for this effort were acquired from sampling efforts completed from February 13, 2023, through March 6, 2023, for the Spring 2023 sampling event and August 14, 2023, through August 25, 2023, for the Fall 2023 sampling event. All of the data for this summary were generated by GEL Laboratories, LLC.

The data were validated using the requirements and protocols outlined in the following documents and analytical methods:

- *Statement of Work Data Validation Services Santa Susana Field Laboratory Area IV, Ventura County, California* (North Wind 2016).
- *Site-Wide Water Quality Sampling and Analysis Plan, Revision 1, Santa Susana Field Laboratory, Ventura County, California, Appendix A, December* (Haley & Aldrich 2010a).
- *Groundwater Monitoring, Quality Assurance Project Plan, Revision 1, Santa Susana Field Laboratory, Ventura County, California, Appendix B, December* (Haley & Aldrich 2010b).
- *U.S. EPA National Functional Guidelines for Organic Superfund Methods Data Review*, OLEM 9355.0-136 EPA-540-R-2017-002, January (EPA 2017a).
- *U.S. EPA National Functional Guidelines for Inorganic Superfund Methods Data Review*, OLEM 9355.0-135 EPA-540-R-2017-001, January (EPA 2017b).
- *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, EPA publication SW-846, Third Edition, Final Updates I (1993), II (1995), IIA (1994), IIB (1995), III (1997), IIIA (1999), IIIB (2005), IV (2008), and V (2015).
- *Multi Agency Radiological Laboratory Analytical Protocols Manual (MARLAP)*, EPA 402-B-04-001A, July 2004 (EPA et al. 2004).
- *Evaluation of Radiochemical Data Usability, ES/ER-MS-5*, April 1997 (Paar and Porterfield 1997).

The following provides an overview of the data set and findings of the data package validation effort.

9.1.2 Groundwater Sampling Summary

The SSFL data set consists of 28 EPA Level IV sample delivery groups (SDGs) with a total of 200 water samples. SDGs 612262, 613112, 613617, 613573, 633824, and 634992 underwent a Level IV EPA validation and comprised more than 20% of the overall data per an analysis for this sampling effort. The remaining SDGs underwent an EPA Level III validation.

The samples were analyzed for VOCs, 1,4-dioxane, and dissolved and total metals, including mercury, perchlorate, fluoride, tritium, and dissolved and total radiochemical (RAD) analyses. Tables 9-1 and 9-4 identify the requested analyses, analytical methods, and number of samples analyzed for each analysis compiled from the CoC forms for the Spring 2023 and Fall 2023 sampling efforts, respectively.

Table 9-1. Summary of Analyses for SSFL Area IV Groundwater Sampling, Spring 2023

Analysis	Method		Number of Samples Analyzed
Volatile Organic Compounds	USEPA SW-846 8260B		71
1,4-Dioxane	USEPA SW-846 8270D Selective Ion Monitoring (SIM)		55
DRO	USEPA SW-846 8015D		9
GRO	USEPA SW-846 8015D		13
Perchlorate	USEPA SW-846 6850 Modified		11
Fluoride and Nitrate	EPA 300.0		7
Metals (Total & Dissolved)	USEPA SW-846 6020B USEPA SW-846 7470A		45 Total Metals 45 Dissolved Metals
Radiochemical Analyses (Total & Dissolved)	Isotopic U	DOE EML HASL-300, U-02-RC Modified	37 Total Isotopic U 37 Dissolved Isotopic U
	Gamma Spectroscopy	EPA 901.1	37 Total Gamma Spectroscopy 37 Dissolved Gamma Spectroscopy
	Gross Alpha/Beta	EPA 900.0/SW846 9310	37 Total Gross Alpha/Gross Beta 37 Dissolved Gross Alpha/Beta
	Strontium-90 (Sr-90)	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	37 Total Sr-90 37 Dissolved Sr-90
	Radium-226 (Ra-226)	EPA 903.1 Modified	37 Total Ra-226 37 Dissolved Ra-226
	Radium-228 (Ra-228)	EPA 904.0/SW846 9320 Modified	37 Total Ra-228 37 Dissolved Ra-228
Radiochemical Analysis	Tritium	EPA 906 Modified	4 Tritium

Spring 2023:

Fluoride by EPA Method 300.0:

The SSFL anions data set consists of 7 water samples analyzed for fluoride/nitrate, which resulted in 16 data points. All 24 data points are considered usable for evaluating site conditions and indicated that:

- 10 data points (62.5% of the total) were either non-detect and identified as “U” or were evaluated and remain unqualified. These results can be considered qualitative data and have been considered usable for evaluating site conditions.
- 6 data points (37.5% of the total) were qualified with a “J” or “UJ” validation flag and can be considered as quantitative data.

Perchlorate by USEPA SW-846 Method 6860:

The SSFL perchlorate data set consists of 11 water samples. All 14 data points are considered usable for evaluating site conditions. The 14 data points for perchlorate (100% of the total) were either non-detect and identified as “U” or were evaluated and remain unqualified. These results can be considered qualitative data.

Total and Dissolved Metals by USEPA SW-846 Methods 6020B and 7470A:

The SSFL metals data set consists of 45 water samples analyzed for total and dissolved metals including mercury, and resulted in 2,726 data points. All 2,726 data points are considered usable for evaluating site conditions and indicated that:

- 2,572 total and dissolved metals data points (94.3% of the total) were qualified with a “U” validation flag due to blank detections, were non-detect, or were detected in the samples and can be considered as qualitative data.
- 154 total and dissolved metals data points (5.7% of the total) were qualified with a “J” or “UJ” validation flag and can be considered as quantitative data.

1,4-Dioxane by USEPA SW-846 Method 8270D SIM:

The SSFL 1,4-dioxane data set consists of 55 water samples. All 61 data points are considered usable for evaluating site conditions and indicated that:

- 44 data points for 1,4-dioxane (72.1% of the total) were either non-detect and identified as “U” or were evaluated and remain unqualified. These results can be considered qualitative data.
- 17 data points for 1,4-dioxane results (27.9% of the total) were qualified with a “J” validation flag and can be considered as quantitative data.

Volatile Organic Compounds by USEPA SW-846 Method 8260B:

The SSFL VOC data set consists of 71 water samples, which resulted in 4,240 data points. Seventy-seven (77) data points were rejected and are considered as unusable for evaluating site conditions, and 4,163 data points are considered usable for evaluating site conditions and indicated that:

- 3,929 data points (92.7% of the total) were non-detect, qualified “U” due to method, trip, or field blank detections, or were detections above the quantitation limit and can be considered qualitative data.
- 234 data points (5.5% of the total) were qualified “UJ” or “J” and can be considered quantitative data.
- 77 data points (1.8% of the total) were qualified ‘R,’ rejected, due to exceeded instrument calibration criteria and should not be used in evaluating site conditions.

Radiochemical Analyses:

The SSFL radiochemical data set consists of 4 water samples for tritium and 37 water samples for total and dissolved isotopic uranium, strontium-90 (Sr-90), gamma spectroscopy, gross alpha/gross beta, radium-226 (Ra-226), and radium-228 (Ra-228), which resulted in 1,706 data points. All 1,706 data points are considered usable for evaluating site conditions and indicated that:

- 1,621 data points (95.0% of the total) were statistical non-detects or were considered as truly present in the samples and can be considered qualitative data.
- 85 data points (5.0% of the total) were qualified with a “UJ” or “J” validation flag and can be considered as quantitative data.

Trip Blanks and Field Blanks:

Fourteen trip blank samples were collected for the SSFL Area IV groundwater 2023 sampling effort and are listed in in Table 9-2.

Table 9-2. Trip/Field Blanks for SSFL Area IV Groundwater Sampling, Spring 2023

Sample Delivery Group (SDG)	Sample ID	Analysis	Quality Control (QC) Type
611006	RD-07_021323_78_L	VOC	Trip Blank
611152	DS-43_021423_78_L	VOC	Trip Blank
611338	RD-14_021523_78_L	VOC	Trip Blank
611477	RD-19_021723_78_L	VOC	Trip Blank
611842	DD-159_022023_78_L	VOC	Trip Blank
611922	RD-30_022123_78_L	VOC	Trip Blank
612050	RS-28_022223_78_L	VOC	Trip Blank
612262	RD-98_022323_78_L	VOC	Trip Blank
612640	DS-45_022723_78_L	VOC	Trip Blank
612703	DD-158_022823_78_L	VOC	Trip Blank
613112	RD-65_030123_78_L	VOC	Trip Blank
613112	PZ-163_030223_78_L	VOC	Trip Blank
613062	C-08_030323_78_L	VOC	Trip Blank
613171	DS-46_030623_78_L	VOC	Trip Blank

Field Duplicates:

Eight pairs of field duplicates were collected during the SSFL Area IV groundwater 2023 sampling effort and are listed in Table 9-3.

Table 9-3. Field Duplicates for SSFL Area IV Groundwater Sampling, Spring 2023

SDG#	Parent ID	Field Duplicate ID	Analysis
611006	DS-43_021423_01_L	DS-43_021423_36_L	VOC
	DS-43_021423_01_L	DS-43_021423_36_L	T&D Metals
	PZ-098_021423_01_L	PZ-098_021423_36_L	Perchlorate
	DS-43_021423_01_L	DS-43_021423_36_L	1,4-Dioxane
611477	RD-19_021723_01_L	RD-19_021723_36_L	VOC
	RD-19_021723_01_L	RD-19_021723_36_L	Fluoride
611338	PZ-162_021623_01_L	PZ-162_021623_36_L	T&D Radiochem
611842	RD-63_022023_01_L	RD-63_022023_36_L	1,4-Dioxane
612050	RS-28_022223_01_L	RS-28_022223_36_L	T&D Radiochem
612262	RD-94_022323_01_L	RD-94_022323_36_L	Tritium
612703	DD-157_022823_01_L	DD-157_022823_36_L	VOC
	DD-157_022823_01_L	DD-157_022823_36_L	T&D Metals
	DD-157_022823_01_L	DD-157_022823_36_L	1,4-Dioxane
613112	PZ-005_030223_01_L	PZ-005_030223_36_L	VOC
	PZ-005_030223_01_L	PZ-005_030223_36_L	T&D Metals
	PZ-102_030223_01_L	PZ-102_030223_36_L	1,4-Dioxane
	PZ-105_030223_01_L	PZ-105_030223_36_L	DRO/GRO
	PZ-005_030223_01_L	PZ-005_030223_36_L	Nitrate

Table 9-4. Summary of Analyses for SSFL Area IV Groundwater Sampling, Fall 2023

Analysis	Method		Number of Samples Analyzed
Volatile Organic Compounds	USEPA SW-846 8260B		68
1,4-Dioxane	USEPA SW-846 8270D Selective Ion Monitoring (SIM)		59
DRO	USEPA SW-846 8015D		32
GRO	USEPA SW-846 8015D		38
Perchlorate	USEPA SW-846 6850 Modified		7
Metals (Total & Dissolved)	USEPA SW-846 6020B USEPA SW-846 7470A		53 Total Metals 53 Dissolved Metals
Radiochemical Analyses (Total & Dissolved)	Strontium-90 (Sr-90)	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	14 Total Sr-90 14 Dissolved Sr-90
Radiochemical Analysis	Tritium	EPA 906 Modified	5 Tritium

Fall 2023:

Perchlorate by USEPA SW-846 Method 6860:

The SSFL perchlorate data set consists of 7 water samples. All 7 data points are considered usable for evaluating site conditions. The 7 data points for perchlorate (100% of the total) were either non-detect and identified as “U” or were evaluated and remain unqualified. These results can be considered qualitative data.

Total and Dissolved Metals by USEPA SW-846 Methods 6020B and 7470A:

The SSFL metals data set consists of 53 water samples analyzed for total and dissolved metals including mercury, and resulted in 2,862 data points. All 2,862 data points are considered usable for evaluating site conditions and indicated that:

- 2,419 total and dissolved metals data points (84.5% of the total) were qualified with a “U” validation flag due to blank detections, were non-detect, or were detected in the samples and can be considered as qualitative data.
- 443 total and dissolved metals data points (15.5% of the total) were qualified with a “J” or “UJ” validation flag and can be considered as quantitative data.

1,4-Dioxane by USEPA SW-846 Method 8270D SIM:

The SSFL 1,4-dioxane data set consists of 59 water samples. All 59 data points are considered usable for evaluating site conditions and indicated that:

- 41 data points for 1,4-dioxane (69.5% of the total) were either non-detect and identified as “U” or were evaluated and remain unqualified. These results can be considered qualitative data.
- 18 data points for 1,4-dioxane results (30.5% of the total) were qualified with a “J” validation flag and can be considered as quantitative data.

Volatile Organic Compounds by USEPA SW-846 Method 8260B:

The SSFL VOC data set consists of 68 water samples, which resulted in 1,423 data points. All 1,423 data points are considered usable for evaluating site conditions and indicated that:

- 1,381 data points (97.0% of the total) were non-detect, qualified “U” due to method, trip, or field blank detections, or were detections above the quantitation limit and can be considered qualitative data.
- 42 data points (3.0% of the total) were qualified “UJ” or “J” and can be considered quantitative data.

Radiochemical Analyses:

The SSFL radiochemical data set consists of 5 water samples for tritium and 14 water samples for total and dissolved isotopic strontium-90 (Sr-90) which resulted in 33 data points. All 19 data points are considered usable for evaluating site conditions and indicated that:

- 33 data points (100% of the total) were statistical non-detects or were considered as truly present in the samples and can be considered qualitative data.

Trip Blanks and Field Blanks:

Nine trip blank samples and one field blank sample were collected for the SSFL Area IV groundwater Fall 2023 sampling effort and are listed in Table 9-5.

Table 9-5. Trip/Field Blanks for SSFL Area IV Groundwater Sampling, Fall 2023

Sample Delivery Group (SDG)	Sample ID	Analysis	Quality Control (QC) Type
633523	DS-48_081423_78_L	VOC & GRO	TB
633653	PZ-041_081523_78_L	VOC & GRO	TB
633824	PZ-104_081623_78_L	VOC & GRO	TB
634055	DD-139_081823_78_L	GRO	TB
634056	DD-143_081723_78_L	GRO	TB
634410	DS-43_082123_78_L	VOC	TB
634540	DS-46_082223_78_L	VOC & GRO	TB
634764	PZ-124_082323_78_L	VOC	TB
634992	RD-64_082423_78_L	VOC & GRO	TB
634992	PZ-005_082523_19F_L	Metals, SVOC, VOC, GRO, DRO, Perchlorate, Sr-90, Tritium	FB

- All trip blank results were non-detect and no data qualification was warranted.

Field Duplicates:

Eleven pairs of field duplicates were collected during the SSFL Area IV groundwater Fall 2023 sampling effort and are listed in Table 9-6.

Table 9-6. Field Duplicates for SSFL Area IV Groundwater Sampling, Fall 2023

SDG#	Parent ID	Field Duplicate ID	Analysis
633523	DS-48 081423 01 L	DS-48 081423 36 L	DRO & GRO
633523	PZ-103 081423 01 L	PZ-103 081423 36 L	T&D Metals
633523	PZ-105 081423 01 L	PZ-105 081423 36 L	V-D
634056	RD-88 081723 01 L	RD-88 081723 36 L	V,D,T
634316	DS-45 081823 01 L	DS-45 081823 36 L	T&D Metals
634316	RD-98 081823 01 L	RD-98 081823 36 L	Sr-90
634540	RD-34A 082223 01 L	RD-34A 082223 36 L	V-D
634540	PZ-098 082223 01 L	PZ-098 082223 36 L	Perchlorate & DRO
634764	DD-141 082323 01 L	DD-141 082323 36 L	T&D Metals
634992	RD-65 082423 01 L	RD-65 082423 36 L	GRO
634992	PZ-005 082523 01 L	PZ-005 082523 36 L	VOC

All field duplicate precision results were within the $\pm 35\%$ RPD percent difference criterion. No qualifications were warranted.

9.1.3 Data Validation Qualifications

Qualifications were assigned in accordance with the *U.S. EPA Contract Laboratory Program National Functional Guidelines* (EPA 2017a and 2017b) and resulted from:

- Preparation and CoC issues
- Exceeded holding times
- Poor initial and continuing calibration criteria
- Positive blank detections
- Poor laboratory control sample (LCS), laboratory control sample duplicate (LCSD), MS, MSD, and serial dilution sample performance
- Results reported below the quantitation limits.

Tables 9-7 and 9-8 summarize the findings and data qualifications assigned to SSFL Area IV groundwater data results for the Spring 2023 and Fall 2023 sampling efforts, respectively. Definitions of the data validation qualifiers are provided in Appendix B.

Table 9-7. Summary of Data Validation Qualifications for SSFL Area IV Groundwater Sampling, Spring 2023

Analyte	Total # of Data Points	Number of Validation flags	Qualification Flags
Fluoride/Nitrate	16	10	“U” or No Qualification
Perchlorate	18	1	UJ
		5	J
		12	“U” or No Qualification
Metals	2,726	2,572	“U” or No Qualification
		11	UJ
		143	J
1,4-Dioxane	61	44	“U” or No Qualification
		17	J
VOCs	4,240	3,929	“U” or No Qualification
		200	UJ
		34	J
		77	R
Radiochemical Data	1,706	1,621	“U” or Positively Detected in the Sample
		44	UJ
		17	J
DRO/GRO	24	19	“U” or No Qualification
		3	UJ
		2	J

Table 9-8. Summary of Data Validation Qualifications for SSFL Area IV Groundwater Sampling, Fall 2023

Analyte	Total # of Data Points	Number of Validation flags	Qualification Flags
Perchlorate	7	7	“U” or No Qualification
Metals	2,862	2,419	“U” or No Qualification
		441	J
		2	UJ
1,4-Dioxane	59	41	“U” or No Qualification
		18	J
VOCs	1,423	1,381	“U” or No Qualification
		39	UJ
		3	J
Radiochemical Data	33	33	“U” or Positively Detected in the Sample
DRO/GRO	71	40	“U” or No Qualification
		31	J

9.1.4 Data Review Process

Data produced by the analytical laboratories were subject to multiple review steps to coincide with the start of distinct tasks. These steps were performed in a timely manner to ensure appropriate feedback and correction of errors. These steps included:

- Cross-reference check of sample CoC documents against the laboratory acknowledgement of sample receipt form. The laboratory acknowledgement of sample receipt was typically transmitted to the data manager via e-mail 2 to 3 days after sample receipt and log-in and included a summary of the requested analyses to be performed per sample. Sample log-in errors were identified and corrected at this step.
- Tracking of sample collection, receipt, and laboratory SDG numbers on a sample tracking spreadsheet. This spreadsheet also included field QC sample information and well sample location coordinates.
- Laboratory consultation with the project chemists on data quality issues during sample analyses (missed holding times, poor spike recoveries, etc.). These issues were discussed between the project chemists and the laboratory and were resolved based on technical merit and determined if usable in the evaluation.

Upon receipt of the laboratory report (delivered via e-mail), a preliminary review of the data was performed. This review consisted of:

- Reconciliation of the reported analyses against the analyses that were requested on the CoC documents.
- Review of the laboratory case narratives. The case narrative identified and explained quality issues encountered during the analysis of the samples. Quality issues may include (but not be limited to) expired holding times, poor spike recoveries in matrix or batch-specific QC samples, instrument calibration exceedances, and blank contamination.
- Review of the laboratory-specific QC data. These data were provided by the laboratory in summary form. Any unanticipated deviations from the project or method-specific criteria were reconciled with the laboratory at this stage.

9.1.5 Data Quality Indicators

This section summarizes the validation performed.

Achievement of the data quality objectives was determined in part by the use of data quality indicators (DQIs). The DQIs for measurement data are expressed in terms of what are collectively referred to as the precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS) parameters. The DQIs provide a mechanism for ongoing control to evaluate and measure data quality throughout the project. These criteria are defined in the sections below.

I. Precision

Precision is the measurement of the ability to obtain the same value on re-analysis of a sample through the entire analytical process. The closer the measurement results, the greater the precision. Precision has nothing to do with accuracy or true values of the sample. Instead, it is focused on random errors inherent in the analysis that stem from the measurement process and are compounded by the non-homogeneous nature of some samples. Precision is measured by analyzing two portions of the sample (sample and duplicate) and then comparing the results. This comparison can be expressed in terms of RPD. The RPD is calculated as the absolute difference between the two measurements divided by the average of the two measurements.

$$\text{RPD} = \frac{|(A-B)/A+B| \times 100}{2}$$

A condition with this formula is that it depends on the average of the two measurements, and the magnitude of the calculated RPD is intimately linked to the magnitude of the results. When sample results are close to the reporting limit (RL), the RPD is greater but does not necessarily indicate that the precision is out of control limits, just that the sample concentrations are low.

RPD as a measure of precision works very well in those cases where the same level of analyte is present in all samples; however, it does not work well as a quantitative tool when varying levels are present. Another option that is used for evaluating the differences between sample results that

are close to the RL is calculating the absolute difference between the results. In this situation, the difference between the sample results is compared to the RL and if the difference is greater, the sample results are qualified as estimated “J/UJ.” Sample results are also qualified as estimated “J/UJ” if the RPD is outside of criteria.

Because of the limitations with the use of RPDs for field duplicate precision evaluation, precision is also calculated on spike samples, either on an MS and MSD or on an LCS/LCSD. For spike samples, a known concentration of analyte has been added to each sample and evaluations of RPD can be made that are more applicable to variations in environmental measurements. The drawback is that the precision measurement is applicable only to the particular spike level used.

For the groundwater samples, precision was evaluated by reviewing RPD results for MS/MSDs, LCS/LCSDs, laboratory duplicates, and field duplicates.

Laboratory RPD control limits are presented in the WQSAP (Haley & Aldrich 2010a) or are laboratory specific. For laboratory duplicates, if one or both of the sample results were less than five times the RL, a control limit of the absolute difference value equal to the RL was used for comparison. The field duplicate RPD criterion is 35%.

Based on laboratory and/or field duplicate precision criteria during the validation process, qualifiers were applied to applicable sample results.

II. Accuracy

Accuracy is a concept from quantitative analysis that attempts to address the question of how close the analytical result is to the true value of the analyte in the sample. Accuracy is determined through a spike procedure, where a known amount of the target analyte is added to a portion of the sample and then the sample and the spiked sample are analyzed. The quantitative measure of accuracy is percent recovery (%R), calculated as follows:

$$\%R = \frac{(\text{Total Analyte Found} - \text{Analyte Originally Present}) \times 100}{\text{Analyte Added}}$$

Each measurement performed on a sample is subject to random and systematic error. Accuracy is related to the systematic error. Attempts to assess systematic error are always complicated by the inherent random error of the measurement.

Analytical accuracy for the entire data collection activity is difficult to assess because several sources of error exist. Errors can be introduced by any of the following:

- Sampling procedure
- Field contamination
- Sample preservation and handling
- Sample matrix
- Sample preparation

- Analytical techniques.

Accuracy is maintained to the extent possible by adhering to the EPA method and approved field and analytical standard operating procedures.

The following QC samples are used to assess laboratory accuracy:

- Matrix Spikes: These are samples with a known amount of a target analyte added to them. Analysis of the sample that has been spiked and comparison with the results from the unspiked sample (i.e., background) gives information about the ability of the test procedure to generate a correct result from the sample.
- Post-Digestion Spikes: Post-digestion spikes are performed after the sample has been prepared and is ready for analysis. These are also termed “analytical spikes.” The technique is used in conjunction with an MS to provide data that can separate interferences produced as part of the sample preparation from interferences that are innate qualities of the sample.
- Laboratory Control Samples: LCSs consist of a portion of analyte-free water spiked with target analytes at a known concentration.
- Surrogates: Surrogate recovery is a QC measure limited to use in organics analysis. Surrogates are compounds added to every sample at the beginning of the sample preparation to monitor the success of the sample preparation and analytical procedures on an individual sample basis. Individual compounds used as surrogates are selected based on their ability to mimic the behavior of specific target analytes held to be particularly sensitive to the sample preparation manipulations.
- Interference Check Samples: Interference check sample analysis is a QC measure unique to metals analysis using inductively coupled plasma (ICP) atomic emission spectrometry. This QC sample verifies the analytical instrument’s ability to overcome interferences typical of those found in samples.
- Calibrations: Method requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative data for metals. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical run. Continuing calibrations demonstrate that the initial calibration is still valid by checking the performance of the instrument on a continuing basis.
- Internal Standards: Internal standards measure the gas chromatograph/mass spectrometer sensitivity and response stability during each analysis.
- Serial Dilution: Serial dilutions are performed on at least one sample from every batch of analyses for metals to determine if physical or chemical interferences exist in the analyte determinations.

For the groundwater samples, accuracy was evaluated by reviewing the %R values and relative response factors of initial and continuing calibration (percent difference or percent drift [%D] for organic analyses), the initial and continuing calibration recoveries for inorganic analyses, internal standards, surrogate spikes (organic analyses only), MS/MSD, LCS/LCSD, ICP

interferences, and by performing serial dilution checks during metals analyses, in conjunction with method blank, calibration blank, equipment rinsate blank, and trip blank results.

These QC results assist in identifying the type and magnitude of effects that may have contributed to system error introduced from field and/or laboratory procedures.

Qualifiers were applied to applicable sample results during the validation process based on laboratory accuracy results. Results were qualified based on calibrations, surrogates, internal standards, ICP serial dilutions, LCS/LCSD recoveries, and MS/MSD recoveries.

Sample preservation, handling, and holding times are additional measures of accuracy of the data. Holding times are defined as the amount of time that elapses from collection of the sample in the field to the start of the analysis. Preservation is defined as techniques used to maintain the target analytes at concentrations representative of the source sampled.

In summary, sample results that have been qualified as estimated “J, J-, or UJ” due to accuracy criteria, are usable for project decisions. Seventy-seven (77) sample data points (0.9% of the total) were qualified ‘R,’ rejected, and are unusable for project decisions. The remaining sample results are usable for project decisions.

Blank Contamination

Blanks are used to determine the level of laboratory and field contamination introduced into the samples, independent of the level of target analytes found in the sample source. Sources of sample contamination can include the containers and equipment used to collect the sample; preservatives added to the sample; cross contamination from other samples in transport coolers and laboratory sample storage refrigerators; standards used to calibrate instruments; glassware and reagents used to prepare samples for analysis; airborne contamination in the laboratory preparation area; and the analytical instrument sample introduction equipment. Each analyte group has its own particular suite of common laboratory contaminants. Active measures must be performed to continually measure the ambient contamination level and steps taken to discover the source of the contamination and to eliminate or minimize the levels. Random spot contamination can also occur from analytes that are not common laboratory problems but that can arise as a problem for a specific project or over a short period of time. Field blanks, equipment blanks, trip blanks, and laboratory method blanks are analyzed to identify possible sources of contamination.

The data validation reports discuss the specific results that were qualified as non-detect “U” based on field and laboratory blank contamination.

Representativeness, Comparability, and Sensitivity

Representativeness, comparability, and sensitivity are achieved by using EPA-approved sampling procedures and analytical methodologies. By following the procedures described in the WQSAP and Groundwater Monitoring QAPP (Haley & Aldrich 2010a, 2010b) for this sampling event and future sampling events, sample analysis should yield results representative of environmental conditions at the time of sampling. Similarly, reasonable comparability of

analytical results for this and future sampling events can be achieved if approved EPA analytical methods and standardized reporting units are employed.

III. Representativeness

Representativeness is a qualitative term that expresses the degree to which the sample data accurately and precisely represent the environmental conditions corresponding to the location and depth interval of sample collection. Requirements and procedures for sample collection are designed to maximize sample representativeness.

Representativeness also can be monitored by reviewing field documentation and/or performing field audits. For this report, a detailed review was performed on the CoC forms, laboratory sample confirmation logs, and data validation packages.

The most significant measure of representativeness is the accuracy of the sampling network and selection of appropriate locations and depths. Field sampling accuracy was attained through adherence to the approved WQSAP and Groundwater Monitoring QAPP (Haley & Aldrich 2010a, 2010b) for sample location and collection and by using approved standard operating procedures for field data collection. The data should represent, as near as possible, the actual field conditions at the time of sampling.

Representativeness has been achieved by the performed field work and laboratory analyses. The analytical data generated are viewed to be a representative characterization of the project area. Seventy-seven (77) sample data points (0.9% of the total) were qualified 'R,' rejected, and are unusable for project decisions. The remaining sample results are usable for project decisions.

IV. Comparability

Comparability is a qualitative term that expresses the confidence with which a data set can be compared with another. Strict adherence to standard sample collection procedures, analytical detection limits, reporting units, and analytical methods ensures that data from like samples and sample conditions are comparable. This comparability is independent of laboratory personnel, data reviewers, or sampling personnel. Comparability criteria are met for the project if, based on data review, the sample collection and analytical procedures are determined to have been followed or defined to show that variations did not affect the values reported.

To ensure comparability of data generated for the site, standard sample collection procedures were utilized by North Wind. DTSC-approved analytical methods were performed by Test America Laboratories. Similar methods and concentration levels to those used for previous sampling events also allow for comparable data. Utilizing such procedures and methods enables the current data to be comparable with previous and future data sets generated.

V. Completeness

Completeness is a measure of the amount of valid data collected compared to the amount planned. Measurements are considered to be valid if they are unqualified or qualified as estimated data during validation. Field completeness is a measure of the number of samples

collected versus the number of samples planned. Laboratory completeness is a measure of the number of valid measurements compared to the total number of measurements planned.

Completeness has been achieved by the performed field work and laboratory analyses. The analytical data generated are viewed for the project area. Seventy-seven (77) sample data points (0.9% of the total) were qualified 'R,' rejected, and are unusable for project decisions. The remaining sample results (99.1% of the total) are usable for project decisions, and 99.1% completeness was achieved from the analytical data.

VI. Sensitivity

Sensitivity is related to the ability to compare analytical results with project-specific levels of interest (i.e., risk-based screening levels or action levels). Analytical detection limits for the various sample analytes should be below the level of interest to allow for an effective comparison.

Detection Limits

The MDL study attempts to answer the question, "What is the lowest level of analyte in a sample that will result in a signal different than zero?" The study is based upon repetitive analysis of an interference-free sample spiked with a known amount of the target analyte. The MDL is a measure of the ability of the test procedure to generate a positive response for the target analyte in the absence of any other interferences from the sample.

The RL is generally defined as the lowest concentration at which an analyte can be detected in a sample and its concentration reported with a reasonable degree of accuracy and precision. For samples that do not pose a particular matrix problem, the RL is typically about three to five times higher than the MDL.

Laboratory results are reported according to rules that provide an established certainty of detection and RLs. The result for an analyte is flagged with a "U" if that analyte was not detected, or qualified with a "J" flag if associated QC results fall outside the appropriate tolerance limits. Also, if an analyte is present at a concentration between the MDL and the RL, the analytical result is flagged with a "J," indicating an estimated quantity. Qualifying the result as an estimated concentration reflects increased uncertainty in the reported value.

Qualifiers were applied to applicable sample results by the laboratory and during the validation process based on sample results being reported as detected below the RL/MDL. Details of the validation and specific sample analytes qualified are discussed in the data validation reports.

In summary, for the collected groundwater samples, results for some of the analytes were qualified as estimated due to RL criteria. For the data validated in the 2023 groundwater sampling, RLs for a majority of the sample results were low enough to compare to the RL objectives stated in the WQSAP and Groundwater Monitoring QAPP (Haley & Aldrich 2010a, 2010b). RLs above those stated in these documents are considered usable for project purposes.

Data Completeness

Completeness of the data collection program is defined as the percentage of samples planned for collection, as listed in the WQSAP and Groundwater Monitoring QAPP (Haley & Aldrich 2010a, 2010b) versus the actual number of samples collected during the field program (see Equation A).

$$\% \text{Completeness} = C \times \frac{100}{n}$$

Equation A

Where:

C = actual number of samples collected
n = total number of samples planned

Completeness for acceptable data is defined as the percentage of acceptable data obtained judged to be valid versus the total quantity of data generated (see Equation B). Acceptable data include both data that pass all the QC criteria (i.e., unqualified data) and data that may not pass all the QC criteria but had appropriate corrective actions taken (i.e., qualified but usable data).

$$\% \text{Completeness} = V \times \frac{100}{n'}$$

Equation B

Where:

V = number of measurements judged valid
n' = total number of measurements made

The overall completeness goal, as defined in the WQSAP and Groundwater Monitoring QAPP (Haley & Aldrich 2010a, 2010b) for this sampling event, is 90% for each analytical test for all project data.

The completeness goal achieved for acceptable data was 99.1% of the groundwater sample results for the number of measurements judged to be valid versus the total number of measurements made for all samples analyzed. Seventy-two (72) sample data points (0.9% of the total) were qualified 'R,' rejected, and are unusable for project decisions.

The completeness goal for the number of measurements judged to be valid was met for 2023 groundwater monitoring sampling. The data reported and not rejected are suitable for their intended use for characterization of groundwater in Area IV of SSFL.

9.1.6 Assessment of Data Usability and Reconciliation with the Site-Wide WQSAP Goals

For the Spring and Fall 2023 groundwater sampling, 99.8% of the data validated and reported in this QA summary are suitable for their intended use for site characterization. Seventy-seven (77) sample results (0.9%) were rejected and are not suitable for site characterization.

The RLs reported generally met the expected limits proposed by the analytical laboratories in their subcontract agreements with North Wind except for the analytes identified previously.

Sample results that were qualified as estimated are usable for project decisions. Decisions based on results close to the RL should be made with a degree of caution.

The field duplicate precision criteria were met and all radiological field duplicate error ratio (DER)<2 criterion was met.

The achievement of the completeness goal for the number of samples collected was met. The completeness goal for the number of sample results acceptable for use provides sufficient quality data to support project decisions for the wells that were sampled during this sampling event.

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