2020 Annual Site Environmental Report

Department of Energy

Energy Technology Engineering Center – Area IV

Santa Susana Field Laboratory

September 2021

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2020 Annual Site Environmental Report

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

September 2021

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.

Adobe Acrobat Sign Transaction Number: CBJCHBCAABAA9A_bxGbdT6G0FBXm1pHpMbsNa4GIAgkp

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

September 2021

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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

June 26, 2024

SUBJECT: DOE Certification for the 2020 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 in Canoga Park, California for Calendar Year 2020. 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 2020 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,

Josh Mengers
Josh Mengers (Jul 3, 2024 10:54 PDT)

Dr. Josh Mengers
Site Director, DOE/ETEC

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ACKNOWLEDGEMENTS

Preparation of this report has been a collaborative effort of members of DOE Environmental Management Consolidated Business Center, North Wind Portage, Inc., and our subcontractors.

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The staff of North Wind Portage, CDM Federal Services (CDM), and the Department of Energy provided technical contributions to this report.

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Acronyms

%D	percent difference or percent drift
%R	percent recovery
AOC	Administrative Order on Consent
ASL	above sea level
BCG	biota concentration guide
CAA	Clean Air Act
Cal-EPA	California Environmental Protection Agency
CDM	Camp Dresser & McKee
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLIN	contract line item number
D&D	decontamination and decommissioning
DCS	derived concentration standard
DPH	Department of Public Health
DPH/RHB	Department of Public Health/Radiologic 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	Environmental Protection Agency
ETEC	Energy Technology Engineering Center
FESOP	Federally Enforceable State Operating Permit
FFCA	Federal Facilities Compliance Act
FONSI	Finding of No Significant Impact
FSDF	Former Sodium Disposal Facility
GRO	gasoline-range organic
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
LUT	look-up table
MCL	maximum contaminant level
MEI	maximally exposed individual
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
ND	non-detect
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
NPDES	National Pollutant Discharge Elimination System
ORISE	Oak Ridge Institute for Science and Education
OSLD	optical stimulated luminescence detector
PARCCS	precision, accuracy, representativeness, comparability, completeness, and sensitivity
PCE	tetrachloroethylene
QA	quality assurance
QA/QC	quality assurance/quality control
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
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
TCE	trichloroethene
TCP	trichloropropane
TLD	thermoluminescent dosimeter
U	uranium
USEPA	U.S. Environmental Protection Agency
VCAPCD	Ventura County Air Pollution Control District
VOC	volatile organic compound
WDID	waste discharger identification
WQSAP	Water Quality Sampling and Analysis Plan

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1. EXECUTIVE SUMMARY

This Annual Site Environmental Report for 2020 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 O 231.1B Admin Chg. 1, "Environment, Safety and Health Reporting." 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 2020 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 (land, structures, waste), and recycling.

No radioactive wastes were processed for disposal during 2020. No liquid radioactive wastes were released into the environment.

During 2020, four regulatory agency inspections and/or visits were conducted related to DOE operations in Area IV. These inspections and visits were carried out by the California Department of Public Health (DPH). In addition, the California Environmental Protection Agency (Cal-EPA) Department of Toxic Substances Control (DTSC) visited the site for meetings and to observe field activities.

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 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 the DOE activities at Area IV of the SSFL facility located in Ventura County, California, during 2020. 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 2020. The Energy Technology Engineering Center (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 Portage, Inc., (North Wind) officially assumed responsibilities for the ETEC Closure activities October 1, 2014, under contract DE-EM0000837-DT0007583. 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 km (30 miles) northwest of downtown Los Angeles. The SSFL is situated on rugged terrain with elevations at the site varying from 500 to 700 m (1,640 to 2,250 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 and undeveloped land. 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.

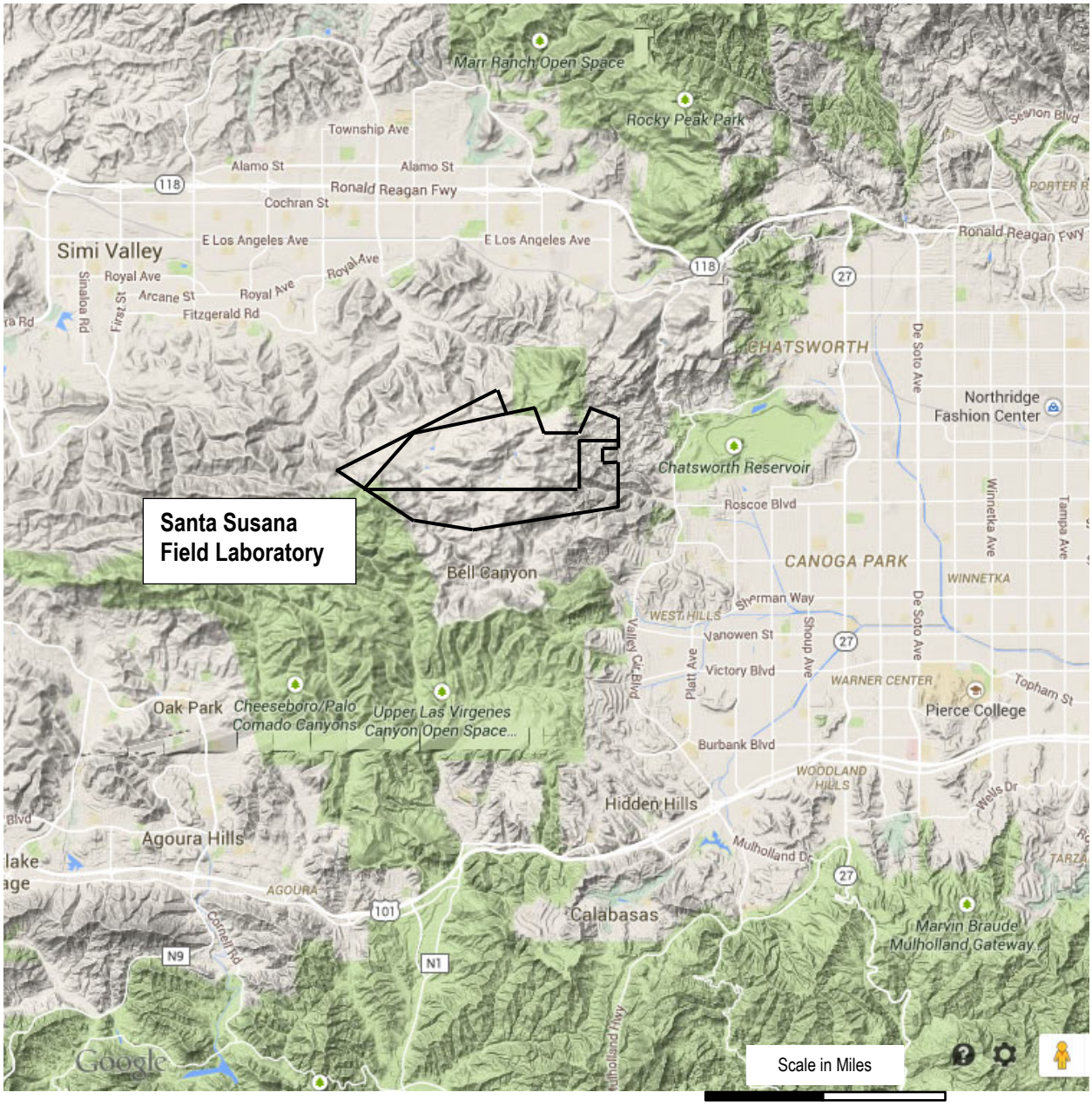

Figure 2-1. Map Showing Location of SSFL

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

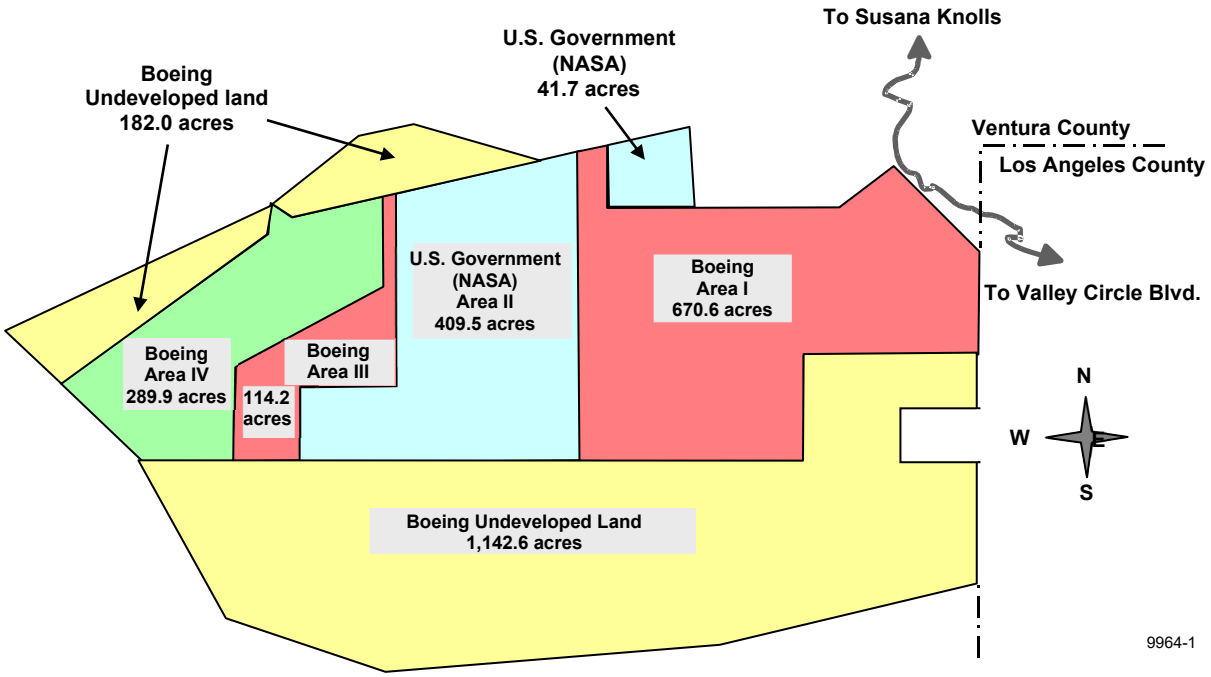

Figure 2-2. Santa Susana Field Laboratory Site Arrangement

Figure 2-3. Santa Susana Field Laboratory Site, Area IV (2021)

Figure 2-4. Map of Former and Current Radiological Facilities in Area IV

2.2 Operational History

The SSFL has been used for various research, development, and test projects funded by several U.S. government agencies, including DOE, Department of Defense, and 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.etec.energy.gov).

All nuclear R&D operations in Area IV ceased in 1988. The only work related to the 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

There were 27 radiological facilities that operated in Area IV (see Figure 2-4). As of the end of 2014, 20 had been released for unrestricted use and four had been declared suitable for unrestricted release by DOE. Demolition is pending for Building 4024. The Radioactive Materials Handling Facility (RMHF) above-grade building structures were demolished in 2020. Six former radiological facilities in Area IV have been declared free of contamination: 4009 (Boeing), 4011 (Boeing), 4019 (DOE), 4029 (DOE), 4055 (Boeing), and 4100 (Boeing). Building 4019 is scheduled for demolition in 2021.

In addition to radiological facilities, two inactive sodium and related liquid metal test facilities remain in Area IV, as well as various support facilities. They are the Sodium Pump Test Facility/ Component Handling & Cleaning Facility (SPTF/CHCF) and the Hazardous Waste Management Facility (HWMF). These were constructed at SSFL to support development testing of components for liquid metal electrical power production systems. With the completion of the EIS, the facilities will undergo closure and demolition in 2021.

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.

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).

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 RCRA closure plan for Buildings 4021, 4022 and 4621 of RMHF complex, collectively permitted as an Interim Status (Part A) facility, which DTSC approved on August 14, 2020. Phase 1 of the closure plan, which addresses the demolition of all above-grade building structures, was completed 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 the 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 is scheduled for 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 was started in 2020 and demolition is scheduled to be completed in 2021.

Hazardous Waste Management Facility

The HWMF, a DTSC Resource Conservation and Recovery Act (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 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.

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3. COMPLIANCE SUMMARY

3.1 Compliance Status

During 2020, four regulatory agency inspections, audits, and visits were conducted in Area IV. These inspections and visits were carried out by the California DPH. In addition, DTSC was frequently on-site for meetings and to observe field activities.

A list of inspections, audits, and site visits in 2020 by the various agencies overseeing the SSFL sites is provided in Table 3-1. California DPH quarterly Environmental TLD exchanges did not occur in quarters 2 and 3; due to COVID-19 travel restrictions.

Table 3-1. 2020 Agency Inspections, Audits, and Visits Related to DOE Operations

Date	Agency	Subject Area	Results
January 8, 2020	State of CA, DPH	Quarterly Environmental TLD Exchange	Compliant
October 1, 2020	State of CA, DPH	Quarterly Environmental TLD Exchange	Compliant

3.1.1 Radiological

The radiological monitoring programs at the SSFL comply with applicable federal, state, and local environmental regulations. The monitoring results (Section 5) indicate that the 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 (land, structures, waste), and recycling.

3.1.1.1 Airborne Activity

For potential airborne releases from the RMHF exhaust stack, the maximum radiation exposure dose to an off-site individual is limited to 10 mrem/y or less, as specified in 40 Code of Federal Regulations (CFR) 61, the National Emission Standards for Hazardous Air Pollutants (NESHAP), Subpart H (DOE facilities). Since operations at SSFL did not occur in 2020, no effluents from the RMHF stack were released into the atmosphere. As a result, the potential radiation exposure dose from the airborne pathway was zero.

The RMHF exhaust stack, and other RHMF structures, were demolished during 2020. During the demolition efforts, multiple controls were emplaced to minimize airborne contamination of any find (including 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. In consequence, neither nearby air monitors emplaced specifically for the demolition, nor the perimeter air monitors, found any increase of airborne concentration above background.

No soil excavation or building demolition with the potential to release airborne contaminants was conducted by DOE in Area IV in 2020. Annual NESHAP reports submitted by DOE to the U.S. Environmental Protection Agency (EPA) are provided at:

https://www.etec.energy.gov/Environmental_and_Health/NESHAPs.php

3.1.1.2 Groundwater

Annual Groundwater Sampling

In accordance with the Water Quality Sampling and Analysis Plan (WQSAP; Haley & Aldrich 2010), which requires that groundwater sampling be performed on an annual basis, groundwater samples were collected from 41 monitoring wells located in the DOE portion of Area IV during the annual sampling event completed in February and March 2020.

Data review and validation were completed, and first quarter results were reported in the 2020 First Quarter Groundwater Sampling Report (North Wind 2020) and the 2020 Report on Annual Groundwater Monitoring (North Wind 2021).

Due to Ventura County COVID-19 restrictions established in the spring of 2020, the sampling of the four clusters of seep wells was cancelled. This activity is scheduled to continue in 2021.

Groundwater reports are provided online under the RCRA Facility Investigation – Groundwater tab in the SSFL Document Library at the following link:

https://dtsc.ca.gov/sitecleanup/Santa_Susana_Field_Lab/ssfl_document_library

3.1.1.3 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; FSDF #1: Outfall 005; FSDF #2: Outfall 006; and Bldg. 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, strontium-90, total combined radium-226 and radium-228, potassium-40, cesium-137, and uranium isotopes. 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 (RWQCB) tab in the SSFL Document library at the following link:

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

3.1.1.4 Direct Radiation

The northern property boundary, the closest property boundary to the RMHF, is approximately 300 meters from the RMHF and 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 meters from the RMHF, were no different than natural background.

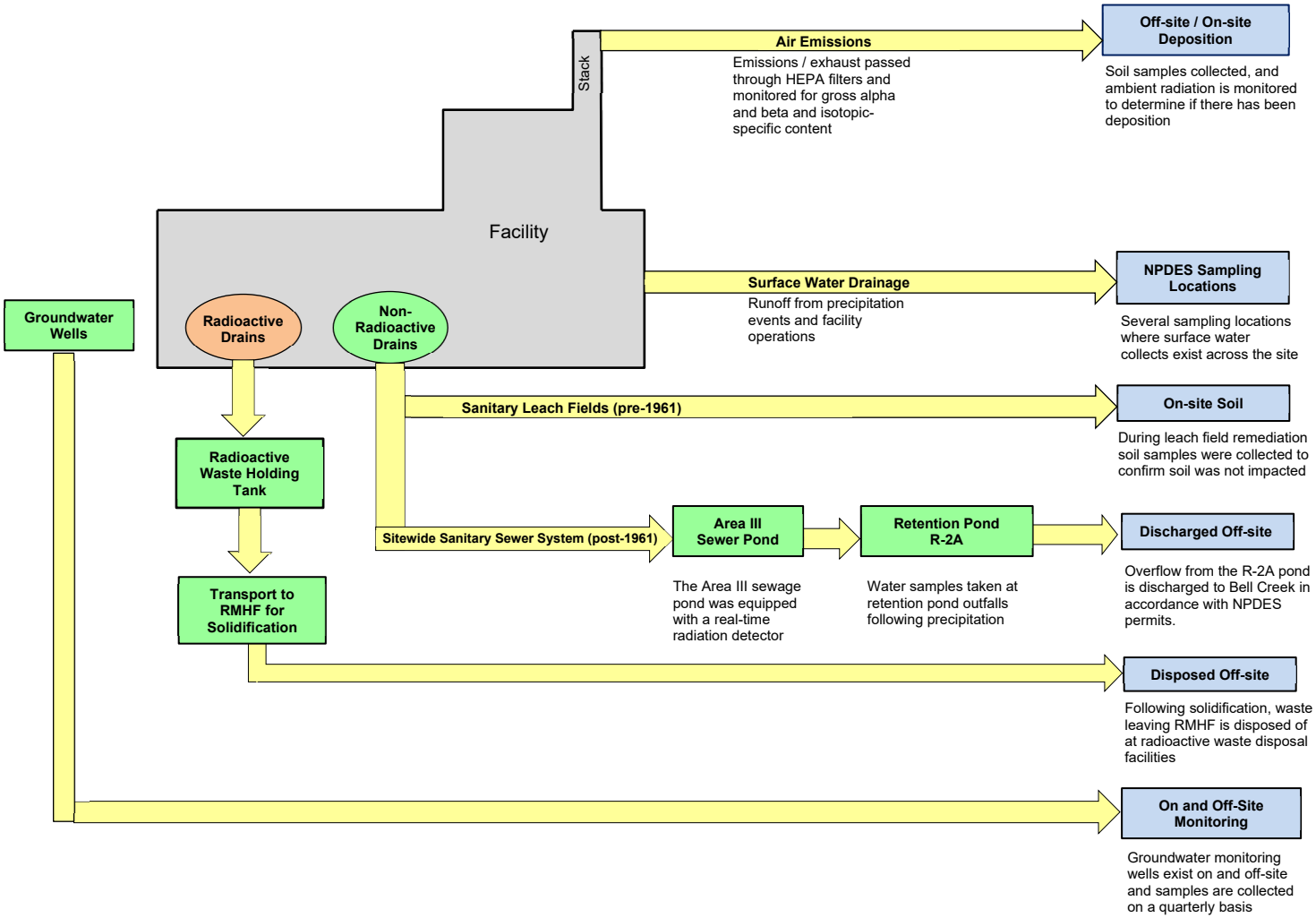

Figure 3-1. Conceptual Model of Potential Pathways

3.1.1.5 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 Section 3.1.1.3 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 the DOE. Section 5.4 provides detailed information on biota protection.

3.1.2 Chemical

3.1.2.1 Resource Conservation and Recovery Act

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.

Radioactive Materials Handling Facility (RMHF) – In 2020, 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 (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. The RMHF permitted buildings have been inactive and awaiting final closure since the complex was placed in this shutdown mode. 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 the year.

Hazardous Waste Management Facility (HWMF) – The HWMF includes an inactive storage facility (4029) and an inactive treatment facility (4133) that were utilized for reactive metal waste such as sodium. The HWMF is no longer in operation and is awaiting final closure. 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 prior to the end of the year.

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. The SSFL was initially made subject to the corrective action process in 1989 by EPA, Region IX. The EPA has completed the Preliminary Assessment Report and the Visual Site Inspection portions of the RCRA Facility Assessment

process. ETEC is now within the RFI stage of the RCRA corrective action process under DTSC oversight for investigation of groundwater.

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 is 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 identified five distinct areas of trichloroethene (TCE)-impacted groundwater in Area IV. From the groundwater samples collected in 2020, 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

In 2020, newly generated mixed wastes were generated in association with the building demolition on the ETEC project, protocols were in accordance with the WMP-10784, *Waste Management Plan* and were transported to licensed or permitted facility, outside of the State of California. 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.

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), have been incorporated into project planning documents.

The 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, the DOE released the *Draft EIS for Remediation of Area IV and the Northern Buffer Zone (NBZ) of the SSFL* 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. The DOE considered all comments received in the 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* 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, in September of 2020 the 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.

http://www.ssflareaiveis.com/

3.1.3.1 Clean Air Act

The 1970 Clean Air Act (CAA, amended 1977 and 1990) authorized the U.S. 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 (O_3), nitrogen dioxide (NO_2), carbon monoxide (CO), sulfur dioxide (SO_2), 10-micron and 2.5-micron particulate matter (PM_{10} 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 Ventura County Air Pollution Control District (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 is published in quarterly reports submitted to DTSC.

3.1.3.2 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. The Storm Water Pollution Prevention Plan 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 one or more acres of soil or whose projects disturb less than one acre, but are part of a larger common plan of development that in total disturbs one or more acres, 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 such as 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 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 will be revised as needed to address changing site conditions as D&D activities progress.

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 U.S. 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)	Inactive. A closure plan was approved on 12/22/06, but 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 addressing demolition of above-grade building structures was initiated prior to the end of 2020. A permit Modification was approved by DTSC on January 22, 2015, to change the owner/operator from Boeing to DOE/North Wind, Inc.
CA3890090001	RMHF	Inactive. 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 addressing demolition of above-grade building structures was successfully completed prior to the end of 2020. A permit Modification was approved by DTSC on January 22, 2015, to change the owner/operator from Boeing to DOE/North Wind, Inc.
NPDES (LARWQCB)		
CA0001309	SSFL	Current
State of California		
WDID 4 56C388835 (2009-0009-DWQ)	DOE CLIN0008 Demo	Current
WDID 4 56C391724 (2009-0009-DWQ)	DOE HWMF Phase 1 D&D	NOT Effective Date 01/28/2021
WDID 4 56C389264 (2009-0009-DWQ)	DOE RMHF Phase 1 D&D	NOT Submitted on 06/02/2021

3.2 Current Issues and Actions

3.2.1 Area IV Environmental Impact Statement

Pursuant to a federal court order issued in May 2007, the DOE submitted a Draft EIS for Area IV; the Final EIS was approved 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 conducted 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 D&D

For the first time since May 24, 2007, demolition of radiological facilities in Area IV commenced in 2020.

3.2.2.1 Radioactive Materials Handling Facility

During 2020, the RMHF remained in a safe shutdown mode with operations limited to routine inspections and surveys until plans were approved to allow the demolition of above-grade building structures. The 10 remaining RMHF structures were demolished in 2020.

The status of the D&D at the RMHF may be found at:

http://www.etec.energy.gov/Operations/Support_Ops/RMHF.php

http://www.etec.energy.gov/Library/RMHFDocRecord.php

3.2.2.2 SNAP Environmental Test Facility

During 2020, the SNAP Environmental Test Facility (Building 4024) remained in a safe shutdown mode with operations limited to routine inspections and surveys. Demolition of Building 4024 is scheduled to be completed in 2021.

The status of the D&D of Building 4024 may be found at:

http://www.etec.energy.gov/Operations/Major_Operations/SNAP.php

http://www.etec.energy.gov/Library/Building24DocRecord.php

Groundwater that infiltrates into the cells and french drain of Building 4024 has historically been pumped into Baker tanks and sampled for radionuclides, and periodically for chemicals, prior to being shipped off-site as non-hazardous waste water. During 2020, approximately 74,530 gallons of water were pumped out of the Building 4024 sump into Baker tanks and shipped to the Cosby and Overton, Inc., waste water treatment facility in Long Beach, CA.

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

Table 3-3. Non-Radiological Wastes Disposal

Type of Waste	Quantity	Hauler	Disposal Facility
Non-hazardous Bldg. 4024 water	74,530 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
Non-hazardous purge water from groundwater monitoring wells	9,834 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, the DTSC and DOE signed an AOC for Remedial Action that defines 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, the 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 LLRW be disposed of at a facility authorized to receive the waste. In accordance with the May 2020, Order on Consent for Interim Response Action at the RMHF Complex, all building debris generated as part of the HWMF building decommissioning and demolition will be classified mixed low-level waste (MLLW) irrespective of the presence of radioactivity above background) and will be 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 will remove above grade building debris and dispose of it as MLLW at a licensed facility outside of the state of California.

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, but 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. A goal of this program is to demonstrate compliance with applicable regulations and protection of human health and the environment. Environmental restoration activities at the 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 impact 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 has 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 the 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, 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 assure 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 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 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 FY 2019 and 2020 Biannual ISMS Report was submitted in December of 2020.

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. All safety observations noted during quarterly program assessments during this term were addressed in a timely fashion.

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 2020 and no program changes to North Wind's approved ISMS are anticipated for 2021.

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.

North Wind's Quality organization is responsible for the development and administration of formal training and development programs. 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 over 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

4.4.1 Program Planning and Development

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.

In addition to waste generated from demolition, wastes generated at ETEC result from environmental characterization. The typical environmental characterization wastes generated at ETEC during 2020 were:

- Investigation-derived waste
- Groundwater and soil 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.

4.4.2 Waste Management and Pollution Prevention Activities

Demolition and construction debris as well as secondary materials (e.g., materials used for contamination control) generated during demolition activities were appropriately characterized for waste disposal. During demolition, identified contaminated building materials required size reduction in place for immediate packaging as radioactive waste. Procedures for waste segregation, downsizing, and loading were detailed in the Waste Management Plan.

The following are routine activities related to waste minimization and pollution prevention:

- Hazardous waste containers in acceptable condition are reused to the maximum extent possible.
- Empty product drums are returned to the vendor for reuse when practical.

4.4.3 Waste Characterization

Waste generated by demolition activities was characterized LLRW or MLLW as applicable, in accordance with procedures outlined in U.S. Environmental Protection Agency (EPA) SW-846, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods"; Title 40 of the Code of Federal Regulations; Title 22 of the CCR; and Chapter 6.5 of Division 20 of the California Health and Safety Code. DOE provided DTSC with the waste characterization data for DTSC's review and records. DOE responded to DTSC comments relative to the characterization data.

4.4.4 Characterization of Containerized Wastes

Demolition wastes that were contained in drums, cubic-yard boxes, or roll-off bins were characterized based on definitive, documented generator process knowledge. The WMP outlined the requirements that were necessary for managing hazardous waste (labeling, container storage, spill prevention measures, etc.). Using the waste profiling and manifesting procedures discussed in the WMP, wastes were characterized so that waste profiles could be completed before they were transported to the approved off-site disposal facilities.

4.4.5 Radioactive Waste Management

The waste management activities at the site consisted of size reduction, use of historical characterization data, certification, preparation for off-site disposal, and shipment. The purpose of this section is to describe the process for the generation, characterization, storage, and disposal of LLRW and MLLW associated with demolition activities. Onsite management of all radioactive waste was performed to comply with the DOE Order 435.1, Chg. 1, "Radioactive Waste Management." The purpose of this DOE order is to "ensure that all DOE radioactive waste is managed in a manner that is protective of worker and public health and safety, and the environment." The requirements of this Order were monitored for applicable updates and/or modifications throughout the duration of Phase 1 which ensured compliance with the most current requirements.

The principal radioactive waste materials generated were contaminated metals, principally steel with small amounts of office furniture, brass, copper, and aluminum; wood; filters (HEPA, pre and bag filters); and soft trash. The radioactive trash was predominantly plastic sheeting used for contamination control, plastic shoe covers, latex rubber gloves, duct tape, and paper wipes. In addition, waste included large pieces of equipment and/or machinery, such as compressors, motor generators, and transformers.

Waste was generated, characterized, and packaged per specific waste handling procedures presented in the WMP that specified the requirements for loading the waste into containers, recording its description, and completing the waste inventory documentation. All operations were performed by trained personnel and in full accordance with the processes and requirements contained in the approved project HASP and QAPP. Containers were stored at the job site or placed in storage at a limited access storage area, pending shipment. The WMP included detailed procedures for waste generation, characterization, packaging and shipping, and quality assurance verification. These procedures complied with DOE, DOT, EPA, State of California, and the disposal sites' Waste Acceptance Criteria and the following requirements as appropriate:

1. DOE Order 435.1, Chg. 1, "Radioactive Waste Management"
2. CFR Title 49, "Transportation"
3. CFR Title 40, "Protection of Environment"
4. CCR, Title 22, Division 4.5 (all "appropriate" requirements)
5. The waste acceptance criteria of the disposal facilities receiving the waste.

There was no on-site disposal of radioactive waste. All radioactive waste was shipped to the Energy Solution's licensed LLRW/MLLW disposal facility in Utah, outside the State of California.

4.4.6 Mixed Low-Level Waste Management

Management of any generated MLLW (includes hazardous materials/waste) included all the requirements for LLRW and in addition complied with the following:

- MLLW was managed in accordance with Title 40 of the CFR, Title 22, Division 4.5 of the CCR, and Division 20, Chapter 6.5 of the California Health and Safety Code. Waste was accumulated in closed containers (including lined roll-off bins), tanks, or lined trucks/trailers

that prevented the release of any material. Wastes that were hazardous or potentially hazardous were not managed using practices such as stockpiling, where the wastes are accumulated outside of lined and closed containers.

- Whenever there was the possibility that wastes were hazardous, even if the hazardous nature of the wastes had not been verified, the wastes were managed as though they were hazardous, until they were verified through characterization to be non-hazardous.
- If it was necessary to combine compatible non-hazardous wastes with hazardous or unverified potentially hazardous wastes, the resulting mixture was managed as hazardous waste regardless of the properties of the waste resulting from the mixture.
- Segregation, waste compatibility, container labeling, accumulation times, and all other management requirements for hazardous wastes stated in local, state, and federal regulations identified above were observed for all wastes as applicable.
- Containers were kept securely closed, except when wastes were being transferred into or out of them.

4.4.7 Recycling of Demolition Materials

There was no recycling of materials generated as part of the demolition of the RMHF facilities.

4.4.8 Volume of Waste Generated during Closure

Volumes of waste and demolition debris that were generated during closure of Buildings 4021, 4022, and 4621 of the RMHF are presented below. All materials generated during Phase 1 and 2 activities were shipped to Energy Solution's licensed LLRW/MLLW facility in Utah, outside the State of California.

No soil waste was generated during Phase 1 demolition activities. All activities associated with soil removal will be addressed under the Soil Remedial Action Program being completed by DOE as cleanup actions are being conducted under the requirements of Chapter 6.8 of the California Health and Safety Code, which identifies cleanup actions as "remedial actions".

Table 4-1. Volume of Waste Generated

Activity	Waste	Waste Classification	Waste Volume	Disposal Facility
Radiological Waste	Metal & debris	MLLW and LLRW	*1970 cubic yards	Energy Solutions, licensed MLLW and LLRW disposal facility, outside the State of California.

* Waste volume allows for void space when packaged for disposal.

4.4.9 Designated Disposal Facilities

All materials generated during Phase 1 activities were shipped to Energy Solutions, Clive, Utah. Energy Solutions is a licensed LLRW/MLLW facility, located outside the State of California. The

designated Phase 2 disposal facility will be described in the Phase 2 Standard Operating Procedure and decommissioning and demolition plan, subject to DTSC review.

4.4.10 Waste Transportation

All RMHF waste was disposed of as LLRW or MLLW. Due to the sensitive nature of transporting the waste through the residential areas, and in and out of SSFL, the specific procedures and relevant details for waste transportation were defined in the WMP. Waste Management and Transportation personnel were trained to these requirements prior to transporting any waste off-site. Waste disposition was controlled to cooperate with local homeowners adjacent to the site and along Woolsey Canyon Road. These requirements included, but were not limited to, the following:

- The number of loads leaving the site was staggered and limited to 16 round-trip truckloads per day to limit disruption to the local community. Permit loads were coordinated with the assigned Boeing Field Coordinator 48 hours in advance of arrival.
- It was possible that Boeing and NASA also had trucks leaving the site; therefore, DOE coordinated with the Boeing Field Coordinator to stagger loads to cause the least amount of disruption to the residents along Woolsey Canyon Road. Drivers used the turnouts along Woolsey Canyon Road to allow motorists to pass.
- Truck drivers departing SSFL followed the direction of the Boeing Field Coordinator to ensure that the waste transportation requirements for the SSFL outlined in the WMP were met. In general, drivers did not depart earlier than 7:00 a.m. and not later than 4:00 p.m.
- All out-bound waste containers were covered prior to leaving the site. Visual inspections of the surfaces of the trucks, including tires, were performed. If caked mud/soil was observed, it was removed prior to the vehicle departure.
- To minimize noise impacts, drivers did not use “jake-brakes,” unless it was necessary. Drivers used the area outside the gate to check their brakes as needed but did not wait for other drivers.
- Drivers did not convoy through, or spend the night in, the adjacent neighborhoods.

4.5 Public Participation

Throughout 2020, DOE interacted with community members at DTSC Community Update meetings to inform them of plans and progress. Also in 2020, 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 such as 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 2020 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 thermoluminescent dosimeters (TLDs) installed by the State of California 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 Q1 (February/March) of 2020 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 are compared to the screening values as 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. No effluents were released to the atmosphere through the stack during 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 mrem/year, 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 in April 9, 2018 (Figure 5-2). 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 m^3. The four DOE sampler filters are changed twice each week. The cycle is 3 days, 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 2020, 525 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 2020.

Quarterly, the filters from each sampler were aggregated, then sent to an off-site lab 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} µCi/mL (assuming plutonium-239), and the guideline for beta activity is 1.0×10^{-10} µCi/mL (assuming strontium-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 were: actinium-228, beryllium-7, cesium-137, cobalt-60, manganese-54, potassium-40, polonium-210, thorium-228, thorium-230, thorium-232, uranium-234, uranium-235, uranium-238, plutonium-238, plutonium-239, americium-241, strontium-90,

radium-228, plutonium-241, and radium-226. None of the analytes were more than 1% of the most restrictive limits.

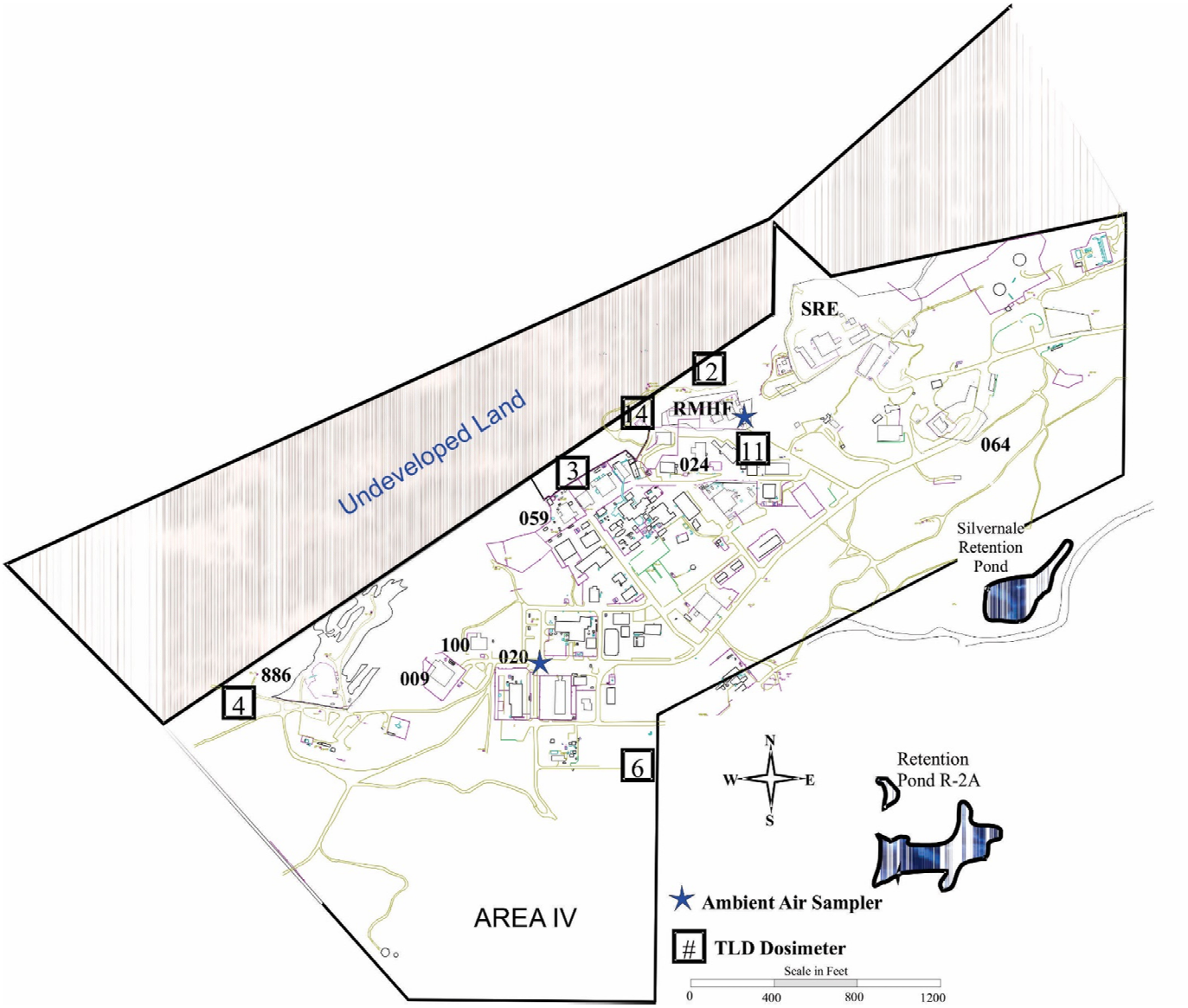

Figure 5-1. Map of Santa Susana Field Laboratory Area IV Sampling Stations

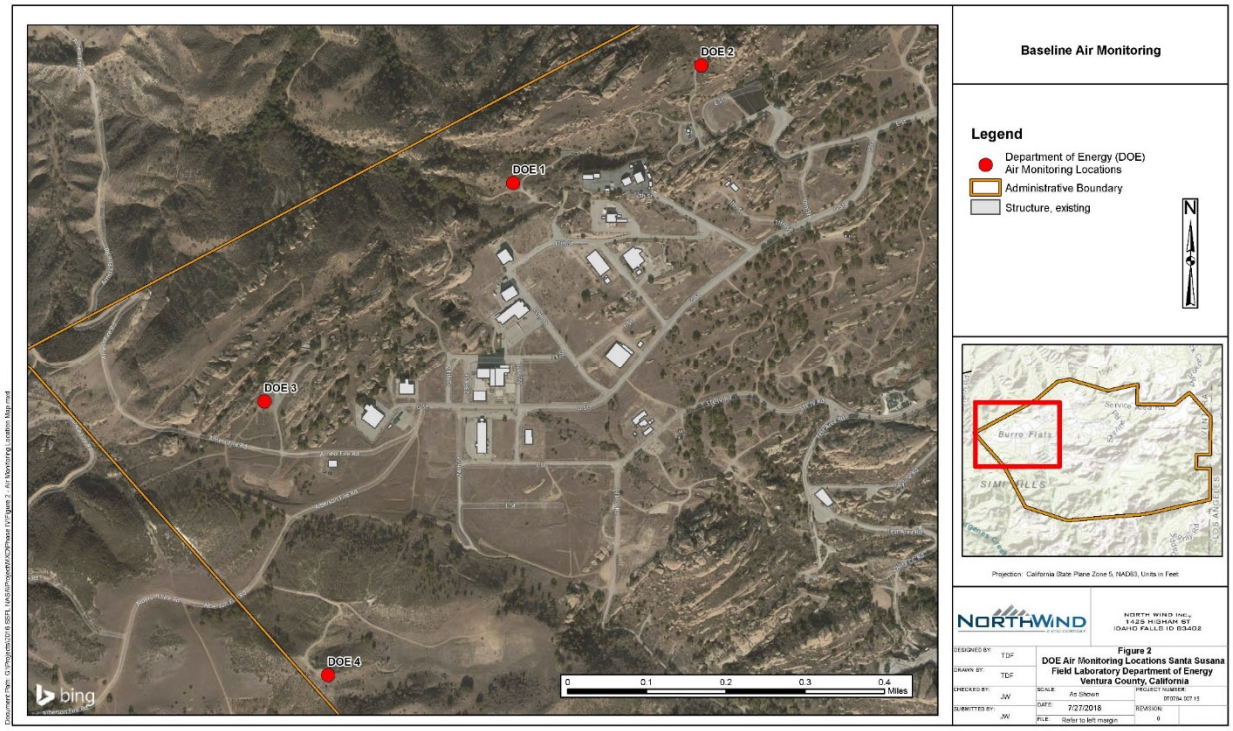

Figure 5-2. Perimeter Sampling Locations

Table 5-1. Sampling Location Description

Station	Location	Sampling Frequency
Ambient Air Sampler Locations		
ETEC-1	SSFL Site, 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	
ETEC	Energy Technology Engineering Center	SSFL	Santa Susana Field Laboratory
DOE	Department of Energy		
BW	Twice Each Week		
W	Weekly Sample		

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 2010). 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 First Quarter Groundwater Report as well as the 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://dtsc.ca.gov/sitecleanup/Santa_Susana_Field_Lab/ssfl_document_library/

The 2020 Annual Groundwater Report was submitted in January 2021 (North Wind 2021).

5.2.2.1 Groundwater Investigation and Remediation Activities

The below paragraphs summarize DOE groundwater investigation and remediation activities that were completed during 2020.

5.2.2.2 Groundwater Elevation Monitoring and Sampling

Weekly water level measurements at the Former Sodium Disposal Facility (FSDF) and Hazardous Materials Storage Area (HMSA), which were started in 2019, continued throughout 2020.

The weekly measurements were made to identify the effects of winter rainfall recharge to near-surface groundwater, and the decline in water levels following the rains. At the FSDF, rising water levels were observed in mid-March and continued to early May, followed by observations

of receding water levels. The water level changes were observed only in the near-surface FSDF corehole wells drilled to approximately 60 feet below ground surface (bgs). There was no significant change in water levels for the Chatsworth Formation bedrock wells at the FSDF. The data are provided in the *Summary of FSDF 2020 Groundwater Investigations* Technical Memorandum (CDM Smith 2021a).

Water levels were also observed to rise at the HMSA, but not to the same degree as were observed at the FSDF. From mid-March to mid-April the water elevations rose approximately 5 feet for near-surface and Chatsworth Formation bedrock wells. The data are provided in *Summary of HMSA 2020 Investigations* (CDM Smith 2021b).

5.2.2.3 New Well Installations

To address data gaps identified in the DOE *Area IV Groundwater Corrective Measures Study* (CDM Smith 2020), new wells were installed and subsequently sampled at the HMSA and Old Conservation Yard (OCY). Well installation initiated in March 2020 was halted soon after starting due to Ventura County COVID-19 restrictions, and resumed in June 2020. At the FSDF, five coreholes were drilled and used as wells to investigate near-bedrock fractures impacted by TCE. Descriptions of wells and sampling data are provided in *Summary of FSDF 2020 Groundwater Investigations* (CDM Smith 2021a).

At the HMSA, two wells (DS-48 and DD-157) were installed at the eastern edge of the TCE plume to define the lateral and vertical extent of contamination. Descriptions of the wells and sampling data are provided in the *Summary of HMSA 2020 Investigations* Technical Memorandum (CDM Smith 2021b).

Two bedrock wells (DD-158 and DD-159) were installed at the OCY to expand the groundwater network and to evaluate for the presence of metals. Descriptions of the wells and sampling data are provided in *Summary of OCY 2020 Investigations* (CDM Smith 2021c).

5.2.2.4 Former Sodium Disposal Facility Groundwater Interim Measure (GWIM)

In November 2017, DOE initiated a groundwater interim measure (GWIM) at the FSDF using near-surface well RS-54 as the pumping well. In June 2018, eight near-surface coreholes (to 63 feet bgs) were drilled at the FSDF. New corehole C-21 exhibited elevated VOC concentrations and was added to the GWIM pumping. In July 2018, RS-54 stopped producing sufficient water for pumping, and C-21 was used as the sole pumping well for the remainder of the year. The winter rains of 2018–2019 recharged the near-surface fractures at the FSDF, and water levels in the coreholes rose. Water level in RS-54 rose 28 feet in March 2019 and pumping volume increased from 10 gallons per event prior to the rains to more than 50 gallons per event.

During 2020, the water elevation in RS-54 remained relatively stable (in comparison with 2019) and RS-54 was pumped 50 times with 2,036 gallons removed, averaging 40 gallons per pumping event. Corehole C-21 was pumped 54 times with 1,830 gallons removed, averaging 34 gallons per pumping event. The water level in C-21 rose 20 feet in mid-March 2020, and the corehole temporarily produced over 100 gallons per pumping event. The C-21 groundwater elevation receded in late June and the pumping rate dropped to an average of 10 gallons per pumping

event. C-21 exhibited the highest TCE concentrations in 2020, with greater than 1,000 micrograms per liter (µg/L) detected.

Monitoring well RS-18 is located in the drainage downgradient from the former FSDF ponds, and groundwater presence at this location is highly dependent on winter rainfall. The well was dry prior to December 2019 but exhibited a rising water level in December. The water level elevation slowly receded starting in May 2020, and RS-18 was dry again by September. RS-18 was pumped 27 times in 2020 with 805 gallons removed.

Near-surface corehole C-28 was installed in the summer of 2020, but did not produce sufficient water to sample until the fall of 2020. This well exhibited TCE at a concentration greater than 1,000 µg/L and was pumped when it had sufficient water. Only 20 gallons of water could be removed from the well. The data for the FSDF GWIM are presented in the *FSDF GWIM 2020 Annual Report* (CDM Smith 2021d).

5.2.3 Surface Water

The most significant areas of Area IV (FSDF, RMHF, and SRE) drain to the north, while the remainder drains 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 the 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.ca.gov/SiteCleanup/Santa_Susana_Field_Lab/ssfl_document_library.cfm

5.2.4 Soil

The last radiological soil sampling in Area IV was conducted by EPA in 2012. No radiological soil sampling was conducted in Area IV on behalf of DOE during 2020.

5.2.5 Vegetation

No vegetation samples were collected or analyzed in 2020.

5.2.6 Wildlife

No animal samples were collected or analyzed during 2020.

5.2.7 Ambient Radiation

Both North Wind and the State Radiological Health Branch (RHB) deploy 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 unusual results were noted in 2020.

Previous reports noted an agreement between the North Wind measurements and the State measurements. The State measurements are often slightly higher, due to using two different suppliers. Due to a problem with the North Wind background dosimeters, the results for 2020 are invalid, and this report will use the State results.

The locations of the North Wind OSLDs and the State TLD are shown on Figure 5-3. 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 5-3. 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, but the unit mrem cannot be properly applied to an

environmental measurement. The annual ambient exposure data obtained during 2020 from these dosimeters are shown in Table 5-2.

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 higher 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 80 mR/y and the average of the ETEC ambient TLDs dosimeters is 85 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 81 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 TLDs were deployed near elevated radiation sources at ETEC. Three were near Building 4021, which is posted as a Contamination Area and Radiation Area. One was near an area of fixed contamination near the northwestern RMHF boundary fence. No member of the public spends any significant time, if any time at all, near these four locations, but the dosimeters measure radiation at all times.

When natural background of 80 mR/y is subtracted from the highest measurement of 133 mR/y, the result of 53 mR/y is below the DOE public dose limit of 100 mrem/y. This satisfies the requirements specified in DOE Order 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 for 2,000 working hours per year would receive approximately 19 mrem/y. When background is subtracted, the dose for the hypothetical worker is reduced to approximately 1 mrem/y.

Table 5-2. 2020 SSFL Ambient Radiation Dosimetry Data

Location Identifier	TLD (mR/y)	Comment
017	69	SSFL front gate. Away from ETEC, **not included in average**.
001	78	Electric substation boundary fence.
002	60*	W of former sodium disposal facility. *first quarter badge not included
003	71	NE corner Bldg 4353 former location.
006	66	Near sodium disposal facility, NE site boundary at Bldg 4133.
007	85	BLDG 4036, east side.
008	81	RMHF NW property line boundary.
009	84	RMHF N boundary fence, middle. Close to elevated radiation sources from Bldg 4021.
010	79	RMHF NW property line boundary.
013	87	RMHF, NE fence line. Close to elevated radiation sources from Bldg 4021.
014	117	RMHF, N central fence line. Close to elevated radiation sources from Bldg 4021.
015	133	RMHF, NW fence line. Close to elevated radiation sources from Bldg 4021.
016	81	RMHF, Bldg 4075, N fence line. Near fixed contamination area.
018	80	RMHF north boundary west
Average	**85**	
019	80	Off-site, Indian Falls Estates

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 in 2020 demonstrated that no individual was exposed near the limits, either DOE or EPA. The population radiation dose was estimated be zero mrem/y, well below the most restrictive limit of 10 mrem/y.

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/year (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 113 mrem/y. Even if a person spent the entire year at this fence line the hypothetical external dose with background subtracted would be 7 mrem (87 mR minus 80 mR at the background location). This is less than the 100 mrem dose limit. 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/year committed effective dose equivalent, as established by 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.

5.3.2 Population Dose

Since no effluents were released to the atmosphere during 2020, the potential collective dose to the general population was zero person-rem.

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

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

5.4 Protection of Biota

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

DOE Order 458.1, "Radiation Protection of the Public and the Environment," 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 the 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 the 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 LUT (pCi/g)	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 impact, 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.

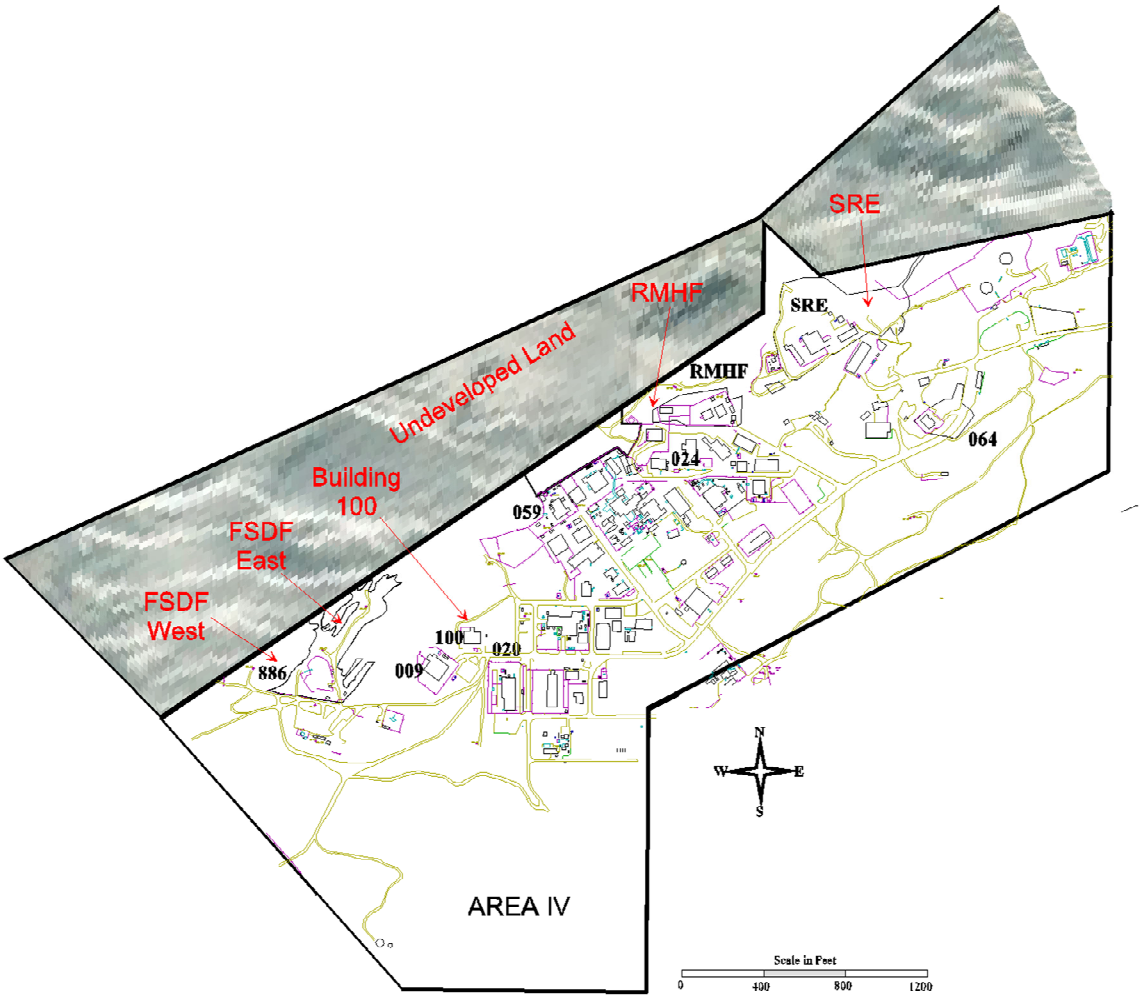

Figure 6-1. Locations of Surface Water Runoff Collectors

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 (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 the SSFL for the period of January 1, 2020, through December 31, 2020, are available in the 2020 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

The 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 from the previous permit were made as a result of the permit consolidation (i.e., an Administrative Change). 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, calculated emissions of criteria air pollutants and precursors were under the mass limits defined in the permit conditions. As a present-day remediation site, the 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 the SSFL site 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 the DOE and state and federal regulators ensures that all applicable analysis is 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 following parameters, which are analyzed using the appropriate EPA methods:

- Volatile organic compounds (including 1,4-dioxane)
- Metals (including sodium)
- Fluoride
- Perchlorate
- Nitrate
- Petroleum hydrocarbons
- 1,2,3-Trichloropropane (TCP)
- Radionuclides (gross alpha, gross beta, tritium, strontium-90, total combined radium-226 and radium-228, potassium-40, cesium-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 2020 are presented in Tables 7-1 and 7-2. Historical Time Series Plots are located in Appendix A.

Table 7-1. Ranges of Detected Non-Radiological Analytes in 2020 Groundwater Samples

Analytes	Ranges of Results for Positive Detections
Fluoride (mg/L)	0.264 to 0.805
Perchlorate (µg/L)	4.33 (one detection)
1,1-Dichloroethane (µg/L)	0.36 J/J to 3.09
1,1-Dichloroethene (µg/L)	0.43J/J to 6.56
1,4-Dioxane (µg/L)	0.157J h/J to 3.7
cis-1,2-Dichloroethene (cis-1,2-DCE) (µg/L)	0.36 J/J to 12.6
trans-1,2-Dichloroethene (µg/L)	0.62 J/J to 19.9
Tetrachloroethene (PCE) (µg/L)	0.45 J/J to 45.1
Toluene (µg/L)	no detections
1,1,1-Trichloroethane (µg/L)	1.82 (one detection)
Trichloroethene (TCE) (µg/L)	0.37 J/J to 168
Diesel-Range Organics (µg/L)	301 h/J (one detection)
Gasoline-Range Organics (µg/L)	19 J/J (one detection)

J = Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the MDL.
Qualifiers presented as laboratory qualifier / data validation qualifier.

h = Sample preparation or preservation holding time exceeded.

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 the Facility is the fractured Chatsworth Formation, predominantly composed of weak- to well-cemented sandstone with interbeds of siltstone and claystone. Several hydraulically significant features such as fault zones and shale beds are present at SSFL and may act as aquitards or otherwise influence the groundwater flow system.

Figures 7-2 and 7-3 show areas that have historically been impacted by TCE and tritium, respectively. There is one location between SNAP, DOE Landfill 2, and the RMHF that has been impacted by tritium. During 2020, tritium was 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 concentration vs. time graphs illustrate overall decreasing trends for these wells (Appendix A). 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). All other wells sampled during 2020 for tritium had results that were non-detect or below the MCL.

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 2020 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 Corrective Measures Study. 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 (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).

FSDF Area

TCE concentrations detected above the MCL of 5 µg/L for this area in 2020 include wells:

- RD-54A at 23.7 µg/L. The concentration increased from the result detected in 2019 (9.4*/µg/L). This concentration increase may be influenced by shallow impacted groundwater migrating downward from near-surface bedrock fractures.
- RD-64 at 15.6 µg/L. The estimated concentration increased from the result detected in 2019 (6.18/J µg/L), but is below the result detected in 2017 (25 µg/L). The fluctuation may be influenced by shallow impacted groundwater migrating downward from near-surface bedrock fractures.
- RS-18 at 57.5 µg/L. The concentration increased from the estimated result detected in 2019 (0.44J/J). The increase in TCE concentrations is likely influenced by seasonal rainfall recharging near-surface fractures.

The TCE concentration at well RD-65 (1.96 µg/L) decreased to below the MCL from the result detected in 2019 (16 µg/L).

Building 4100 / Building 56 Landfill Area

TCE concentration detected above the MCL of 5 µg/L for this area in 2020 includes well:

- RD-07 at 22.2 µg/L. The concentration is similar to the result detected in 2019 (23 µg/L).

It is notable that the highest TCE concentrations in the B4100 plume were historically detected at well RD-91 (200 µg/L in 2014).

Metals Clarifier / DOE Leach Field 3 Area

TCE concentration detected above the MCL of 5 µg/L for this area in 2020 includes well:

- PZ-105 at 8.34 µg/L. The concentration decreased from the result detected in 2019 (9.5 µg/L).

HMSA Area

TCE concentrations detected above the MCL of 5 µg/L for this area in 2020 include wells:

- DD-144 at 168 µg/L. The concentration is similar to the result detected in 2019 (170 µg/L).
- PZ-162 at 9.67 µg/L. The concentration decreased from the result detected in 2019 (15 µg/L). This well was first sampled during 2019 and sufficient information is not available to further evaluate trends.
- PZ-163 at 102 µg/L. The concentration decreased from the result detected in 2019 (150 µg/L). This well was first sampled during 2019 and sufficient information is not available to further evaluate trends.

The TCE concentration at PZ-109 (3.96 µg/L) decreased to below the MCL from the result detected in 2019 (5 µg/L).

RMHF Area

TCE concentrations detected above the MCL of 5 µg/L for this area in 2020 include wells:

- RD-63 at 5.41 µg/L. The concentration increased from the result detected in 2019 (4 µg/L), but is below the concentration detected during 2018 (6 µg/L) and consistent with historical concentration fluctuations.
- RD-30 at 5.49 µg/L. The concentration increased to above the MCL from the result detected in 2019 (2.2 µg/L); however, this detection is within the range of previous sampling events.

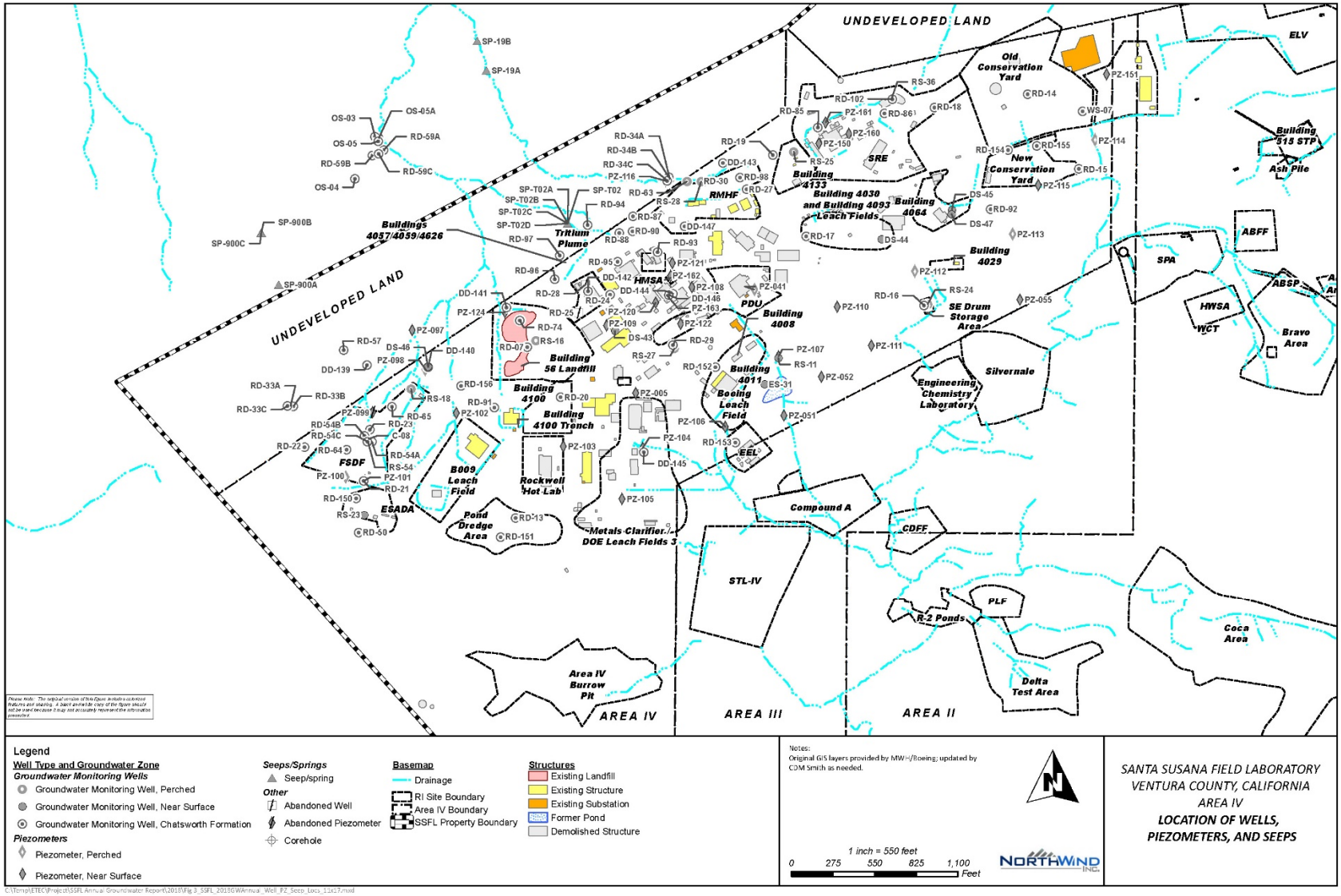

Figure 7-1. Area IV Well and Piezometer Locations

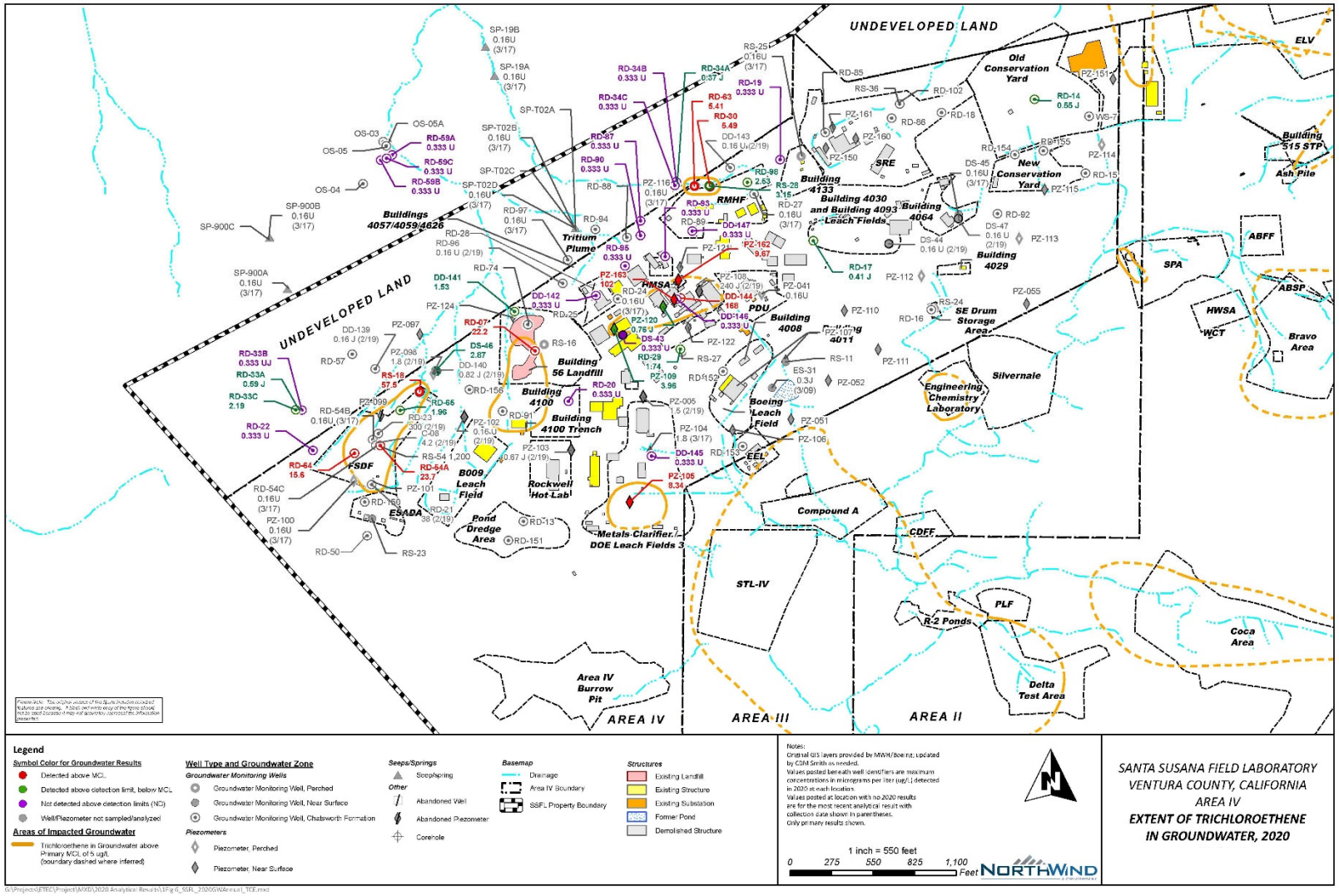

Figure 7-2. 2020 TCE Occurrences in Groundwater at SSFL, Area IV

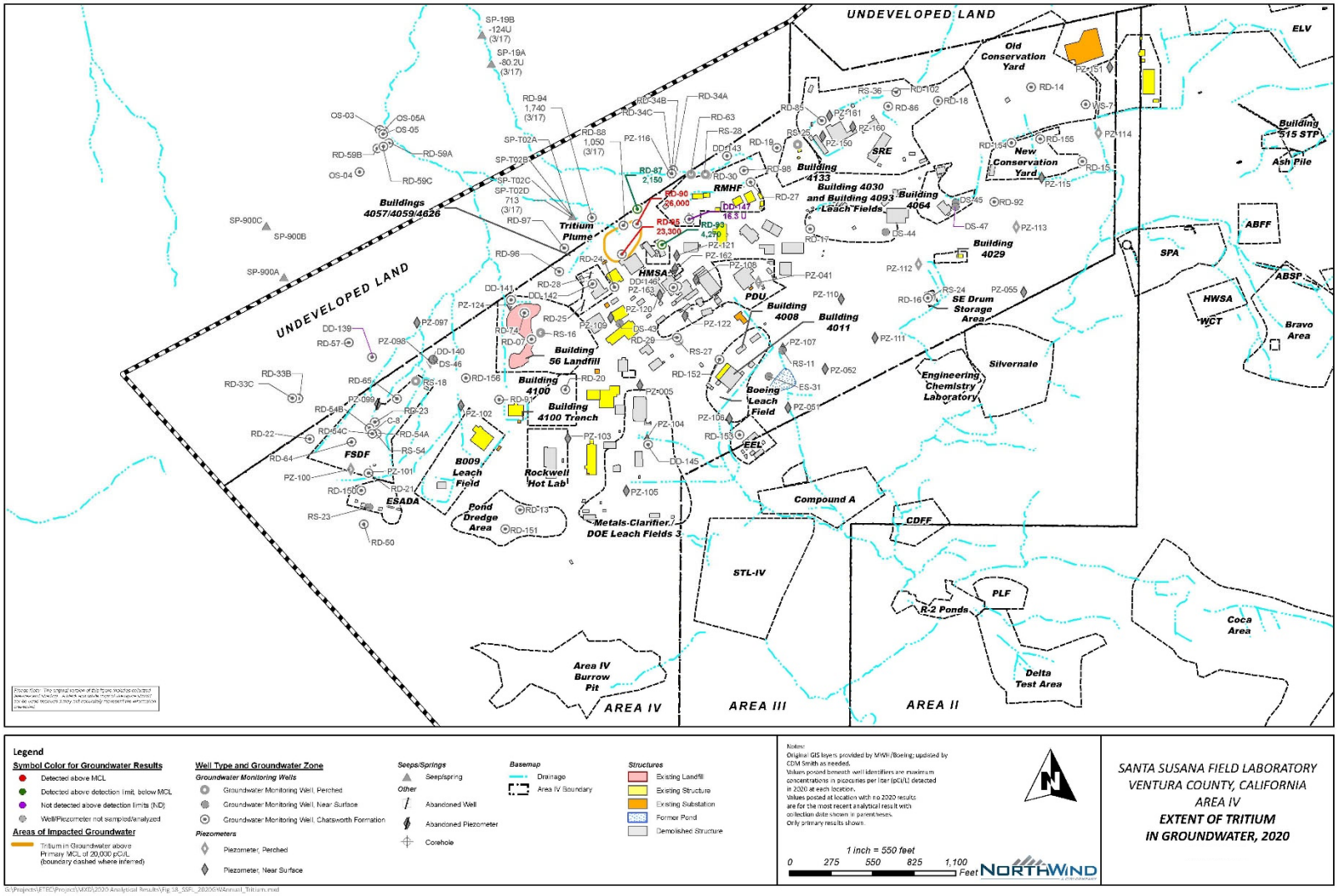

Figure 7-3. 2020 Tritium Occurrences in Groundwater at SSFL, Area IV

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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 action is 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 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 is 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:

http://www.etec.energy.gov/char_cleanup/Phase3.php

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:

http://www.etec.energy.gov/char_cleanup/Chemical_Data.php

Additionally, DOE will continue evaluation of Area IV sampling data and results of the soils treatability studies for soil cleanup remedial alternatives. DOE will continue to support soil treatability studies by university researchers and conduct Soil Treatability Investigation Group public meetings. The Final EIS was released by DOE during November 2018. Recent information regarding the Final EIS may be found at:

https://www.ssflareaiveis.com/

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

http://www.etec.energy.gov/char_cleanup/AOC.php

http://www.etec.energy.gov/char_cleanup/Co-located.php

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9. QUALITY ASSURANCE PROGRAM

Quality assurance (QA) and quality control (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. 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 Quality Assurance Program Plan (QAPP; North Wind 2017) and field Quality Assurance Plan for Groundwater Monitoring (QAPjP; North Wind 2015) reflect how quality requirements are fulfilled in support of the environmental monitoring activities at SSFL, including the EM-QA-001, EM 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 Title 10 of the CFR and DOE O 414.1D, with references to the applicable requirements of American Society of Mechanical Engineers (ASME) NQA-1.

Together, Rev. 1 of EM-QA-001, the criteria of 10 CFR 830 Subpart A, Quality Assurance Requirements, and DOE Order 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 2020 to ensure the high quality of data collected and presented in this annual report.

9.1 Quality Control Results for 2020

9.1.1 Background

The following summarizes the inorganic, metals, organic, and radiochemical data validation completed for 14 United States EPA Level IV data packages containing results from the SSFL Area IV. The data for this effort were acquired from sampling efforts completed from February 24, 2020, through March 6, 2020. The data for this summary were generated by GEL Laboratories.

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

- North Wind, 2016, *Statement of Work Data Validation Services Santa Susana Field Laboratory Area IV, Ventura County, California.*
- Haley & Aldrich, 2010, *Report on Annual Groundwater Monitoring, 2009, Santa Susana Field Laboratory, Simi Hills, Ventura County, California,* including the following appendixes:
  - Appendix A, Site-Wide Water Quality Sampling and Analysis Plan.
  - Appendix B, Groundwater Monitoring, Quality Assurance Project Plan.
- EPA et al., 2014, *Multi-Agency Radiological Laboratory Analytical Protocols, MARLAP, Manual*, EPA 402-B-04-001A, July.
- EPA, 2008, *U.S. EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review,* OSWER 9240.1-48 EPA 540/R-08/01, February.
- EPA, 2010, *U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,* OSWER 9240.1-45 EPA 540-R-04-004, October.
- EPA, 2015, *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).
- Paar and Porterfield, 1997, *Evaluation of Radiochemical Data Usability*, ES/ER-MS-5, April.

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

9.1.2 Summary

The SSFL data set consists of 14 EPA Level IV sample delivery groups (SDGs) with a total of 80 water samples. SDGs 505628, 506159, and 506292 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.

Table 9-1 shows the number and type of samples collected for the SSFL ETEC groundwater 2020 sampling effort.

Table 9-1. Samples Collected for SSFL ETEC Groundwater Sampling, 2020

Sample Type	Number of Samples
Field Samples	41 Samples (14 were designated on the chain-of-custody forms as MS/MSD)
Trip Blanks	11 Samples
Rinsates	15 Samples
Field Blank	1 Sample
Field Duplicates	12 Samples

The samples were analyzed for volatile organic compounds (VOCs); 1,4-dioxane; 1,2,3-trichloropropane; gasoline-range organics (GRO); diesel-range organics (DRO); dissolved and total metals including mercury, perchlorate, nitrate, and fluoride; and radiochemical (RAD) analyses (tritium and total/dissolved for the remaining RAD analyses). Table 9-2 shows the requested analyses, analytical methods, and number of samples analyzed for each analysis compiled from the chain-of-custody forms.

Table 9-2. Summary of Analyses for SSFL ETEC Groundwater Sampling

Analysis	Method	Number of Samples Analyzed
Volatile Organic Compounds	USEPA SW-846 8260B	73
1,4-Dioxane	USEPA SW-846 8270D Selective Ion Monitoring (SIM)	13
Gasoline-Range Organics	USEPA SW-846 8015B	20
Diesel-Range Organics	USEPA SW-846 8015B	14
Perchlorate	USEPA SW-846 6850 Modified	18
Nitrate as N	EPA 300.0	18
Fluoride	EPA 300.0	18
Metals (Total & Dissolved)	USEPA SW-846 6020B USEPA SW-846 7470A	41 Total Metals 41 Dissolved Metals

Analysis	Method		Number of Samples Analyzed
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/ 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
	Tritium	EPA 906.0 Modified	11 Tritium
	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

9.1.3 Data Quality Summary

Anions (Fluoride and Nitrate as N) by EPA Method 300.0:

The SSFL anions data set consists of 18 water samples analyzed for nitrate as N and fluoride, which resulted in 36 data points. All 36 data points are considered usable for evaluating site conditions and indicated that:

- 6 data points for nitrate as N and 18 data points for fluoride (24 data points, 66.6% of the total) were either non-detect and identified as "U" or were evaluated and remain unqualified. These results can be considered qualitative data.
- 12 data points for nitrate as N (33.3% 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 18 water samples. All 18 data points (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 and have been considered usable for evaluating site conditions.

Total and Dissolved Metals by USEPA SW-846 Methods 6010C, 6020A, and 7470A:

The SSFL metals data set consists of 41 water samples analyzed for total metals and dissolved metals and resulted in 2,214 data points. All 2,214 data points are considered usable for evaluating site conditions and indicated that:

- 1,985 total and dissolved metals data points (89.7% 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.
- 229 total and dissolved metals data points (10.3% of the total) were qualified with a "J+" or "J" validation flag and can be considered as quantitative data.

Gasoline-Range Organics (GRO) and Diesel-Range Organics (DRO) by USEPA SW-846 Method 8015B:

The SSFL GRO and DRO data set consists of 20 GRO samples and 14 DRO samples, which resulted in 34 data points for GRO and DRO. All 34 data points are considered usable for evaluating site conditions and indicated that:

- 19 GRO data points and 8 DRO data points (27 data points, 79.4% of the total) were non-detect and qualified with a "U" validation flag. These results can be considered as qualitative data.
- 1 GRO data point and 6 DRO data points (7 data points, 20.6% of the total) were qualified with a "UJ" or "J" 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 13 water samples. All 13 data points are considered usable for evaluating site conditions and indicated that:

- 2 data points for 1,4-dioxane (15.4% of the total) were either non-detect and identified as "U" or were evaluated and remain unqualified. These results can be considered qualitative data.
- 11 data points for 1,4-dioxane results (84.6% of the total) were qualified with a "J" or "UJ" and can be considered as quantitative data.

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

The SSFL VOC data set consists of 73 water samples, which resulted in 3,869 data points. Seventy-three (73) data points were rejected and are considered as unusable for evaluating site conditions, and 3,796 data points are considered usable for evaluating site conditions and indicated that:

- 3,692 data points (95.4% 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.
- 104 data points (2.7% of the total) were qualified "UJ" or "J" and can be considered quantitative data.
- 73 data points (1.9% 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 37 samples for total and dissolved isotopic uranium, strontium-90 (Sr-90), gamma spectroscopy, gross alpha/gross beta, radium-226 (Ra-226), radium-228 (Ra-228), and 11 samples for tritium, which resulted in 4,303 data points. All 4,303 data points are considered usable for evaluating site conditions and indicated that:

- 4,207 data points (97.8% of the total) were statistical non-detects or were considered as truly present in the samples and can be considered qualitative data.
- 96 data points (2.2% of the total) were qualified with a "UJ" or "J" validation flag and can be considered as quantitative data.

Trip Blanks and Field Blanks:

Eleven trip blank samples and one field blank sample were collected for the SSFL Area IV groundwater 2020 sampling effort and are listed in Table 9-3.

Table 9-3. Trip/Field Blanks for SSFL ETEC Groundwater Sampling, 2020

Sample Delivery Group (SDG)	Sample ID	Analysis	Quality Control (QC) Type
505203	PZ-105_022420_78_L	VOC, GRO	Trip Blank
505277	RD-20_022520_78_L	VOC	Trip Blank
505454	RD-33A_022520_78_L	VOC	Trip Blank
505628	RD-63_022620_78_L	VOC, GRO	Trip Blank
505709	DD-142_022720_78_L	VOC	Trip Blank
505710	PZ-162_022820_78_L	VOC, GRO	Trip Blank
505991	RD-34A_030220_78_L	VOC	Trip Blank
506159	RD-34B_030320_78_L	VOC	Trip Blank
506292	RD-14_030420_78_L	VOC, GRO	Trip Blank
506418	DD-141_030520_78_L	VOC, GRO	Trip Blank
506419	PZ-120_030620_78_L	VOC	Trip Blank
506502	RD-59B_030920_19F_L	VOC, Metals, Perchlorate, GRO, DRO, RAD Analyses, Anions, 1,4-Dioxane, & Tritium	Field Blank

Acetone, chloroform, 1,4-dioxane, total K-40, dissolved gross beta, and total and dissolved Ra-226 were detected in the field blank RD-59B_030920_19F_L. All trip blank results and the remaining field blank results were non-detect. No qualifications were warranted.

Field Duplicates:

Twelve pairs of field duplicates were collected during the SSFL Area IV groundwater 2020 sampling effort and are listed in Table 9-4.

Table 9-4. Field Duplicates for SSFL ETEC Groundwater Sampling, 2020

SDG#	Parent ID	Field Duplicate ID	Analysis
505628	RD-63_022620_01_L	RD-63_022620_36_L	GRO/DRO and 1,4-Dioxane
505628	RS-18_022620_01_L	RS-18_022620_36_L	Perchlorate
505709	DD-142_022720_01_L	DD-142_022720_36_L	Metals
505709	RD-95_022720_01_L	RD-95_022720_36_L	VOC
505709	RD-90_022720_01_L	RD-90_022720_36_L	Tritium
505991	RD-34A_030220_01_L	RD-34A_030220_36_L	VOC
506159	RD-34B_030320_01_L	RD-34B_030320_36_L	VOC
506292	RD-14_030420_01_L	RD-14_030420_36_L	GRO & VOC
506292	RD-98_030420_01_L	RD-98_030420_36_L	RAD
506292	DD-147_030520_01_L	DD-147_030520_36_L	Nitrate
506419	RD-59C_030620_01_L	RD-59C_030620_36_L	VOCs, Metals, & Fluoride
506419 (Perchlorate) & 506527 (RAD)	RD-59B_030620_01_L	RD-59B_030620_36_L	Perchlorate & RAD

The following field duplicate precision results exceeded the 35% relative percent difference (% RPD) criterion or the radiological field duplicate error ratio (DER)<2 criterion:

- Total copper (62.1% RPD) and dissolved copper (48.2% RPD), nickel (35.7% RPD), and zinc (35.4% RPD) in field duplicate pair DD-142_022720_01_L/DD-142_022720_36_L
- Acetone (200% RPD) in field duplicate pair RD-14_030420_01_L/RD-14_030420_36_L
- Dissolved Gross Alpha (DER = 7.86), gross beta (DER = 3.53), and Cs-136 (DER = 3.14) in field duplicate pair RD98_030420_01_L/RD98_030420_36_L-98_030420_36_L
- Total K-40 (DER = 3.19) in field duplicate pair RD-59B_030620_01_L/RD-59B_030620_36_L

The remaining field duplicate precision criteria were met.

9.1.4 Data Validation Qualifications

Qualifications were assigned in accordance with the *U.S. EPA Contract Laboratory Program National Functional Guidelines* and resulted from preparation and chain-of-custody issues; poor initial and continuing calibration criteria; positive blank detections; poor laboratory control sample (LCS), laboratory control sample duplicate (LCSD), matrix spike (MS), matrix spike duplicate (MSD), and serial dilution sample performance; and results reported below the quantitation limits. Table 9-5 summarizes the findings and data qualifications assigned to SSFL ETEC groundwater 2020 data results. Please refer to Appendix B for definitions of the data validation qualifiers.

Table 9-5. Summary of Data Validation Qualifications for SSFL ETEC Groundwater Sampling, 2020

Analyte	Total # of Data Points	Qualifier	Total number of Qualifiers
Nitrate as N	18	"U" or No Qualification	6
		UJ	6
		J-	6
Fluoride	18	"U" or No Qualification	18
Perchlorate	18	"U" or No Qualification	18
Metals	2,214	"U" or No Qualification	1,985
		J+	10
		J	219
GRO	20	"U"	19
		J	1
DRO	14	"U"	8
		UJ	5

Analyte	Total # of Data Points	Qualifier	Total number of Qualifiers
		J	1
1,4-Dioxane	13	"U" or No Qualification	2
		UJ	1
		J	10
VOCs	3,869	"U" or No Qualification	3,692
		UJ	56
		J	48
		R	73
Radiochemical Data (including Tritium)	4,303	"U" or Positively Detected in the Sample	4,207
		UJ	33
		J	63

9.1.5 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 chain-of-custody 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 such as 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 chain-of-custody 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.

9.1.6 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 PARCCS parameters (precision, accuracy, representativeness, comparability, completeness, and sensitivity). 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 relative percent difference (RPD). RPD is calculated as the absolute difference between the two measurements divided by the average of the two measurements.

$$\mathbf{RPD = [(A-B)/\frac{A+B}{2}] \times 100}$$

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 2010) 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:

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

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 (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 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, inductively coupled plasma (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+, J-, or UJ" due to accuracy criteria are usable for project decisions. Eight sample data points (0.1% of the total) were qualified "R," rejected, and are unusable for project decision. 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.

9.1.7 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, Quality Assurance Project Plan (Haley & Aldrich 2010) 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.

I. 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 chain-of-custody 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, etc. Field sampling accuracy was attained through adherence to the approved WQSAP, including its Appendix B, Groundwater Monitoring Quality Assurance Project Plan (Haley & Aldrich 2010), 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. Seven sample data points (0.1% of the total) were qualified "R," rejected, and are unusable for project decisions. The remaining sample results are usable for project decisions.

II. 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 assures 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. Department of Toxic Substances Control–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.

III. Sensitivity

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

Detection Limits

The method detection limit (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 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 2017 groundwater sampling, RLs for a majority of the sample results were low enough to compare to the RL objectives stated in the WQSAP, Appendix B, Groundwater Monitoring Quality Assurance Project Plan (Haley & Aldrich 2010). RLs above those stated in Haley & Aldrich (2010) are considered usable for project purposes.

9.1.8 Data Completeness

Completeness of the data collection program is defined as the percentage of samples planned for collection as listed in the WQSAP, including its Appendix B, Groundwater Monitoring Quality Assurance Project Plan (Haley & Aldrich 2010), versus the actual number of samples collected during the field program (see Equation A).

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 (unqualified data) and data that may not pass all the QC criteria but had appropriate corrective actions taken (qualified but usable data).

Equation A.

$$\%\text{Completeness} = C_x \frac{100}{n}$$

Where:

C = actual number of samples collected

n = total number of samples planned

Equation B.

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

Where:

V = number of measurements judged valid

n' = total number of measurements made

The overall completeness goal, as defined in the WQSAP, Appendix B, Groundwater Monitoring Quality Assurance Project Plan (Haley & Aldrich 2010), for this sampling event is 90% for each analytical test for all project data.

The completeness goal achieved for acceptable data was 99.9% 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. Seven sample data points (0.1% 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 2020 groundwater monitoring sampling. The data reported and not rejected are suitable for their intended use for characterization of groundwater in Area IV of SSFL.

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

For the 2020 groundwater sampling, 99.3% of the data validated and reported in this quality assurance summary are suitable for their intended use for site characterization. Seventy-three (73) sample results (0.7%) 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 following field duplicate precision results exceeded the 35% RPD criterion or the radiological field DER<2 criterion:

- Total copper (62.1% RPD) and dissolved copper (48.2% RPD), nickel (35.7% RPD), and zinc (35.4% RPD) in field duplicate pair DD-142_022720_01_L/DD-142_022720_36_L
- Acetone (200% RPD) in field duplicate pair RD-14_030420_01_L/RD-14_030420_36_L
- Dissolved Gross Alpha (DER = 7.86), gross beta (DER = 3.53), and Cs-136 (DER = 3.14) in field duplicate pair RD-98_030420_01_L/RD-98_030420_36_L
- Total K-40 (DER = 3.19) in field duplicate pair RD-59B_030620_01_L/RD-59B_030620_36_L

The remaining field duplicate precision criteria were met. 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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40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities."

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APPENDIX A. TIME SERIES PLOTS OF ANALYTICAL DATA

Time Series Plots of Analytical Data

Time series plots for trichlorothene (TCE), perchlorate, and tritium are presented in this Appendix. Only primary sample results for the following wells are presented in the plots.

TCE

FSDF/ESADA
RD-21
RD-33A
RD-33B
RD-33C
RD-54A
RD-54B
RD-54C
RD-64
RD-65
RS-18
RS-54

RMHF
RD-30
RD-34A
RD-34B
RD-34C
RD-63
RD-98
RS-28

Bldg 65 Metals Clarifier
PZ-005
PZ-104
PZ-105

TCE

Bldg 56 Landfill
RD-07

HMSA/PDU
PZ-108
PZ-120

B4057/59/626
PZ-109

OCY
RD-14

Bldg 4100 Trench
RD-20

Bldg 4133
RD-19

Offsite

RD-59A
RD-59B
RD-59C

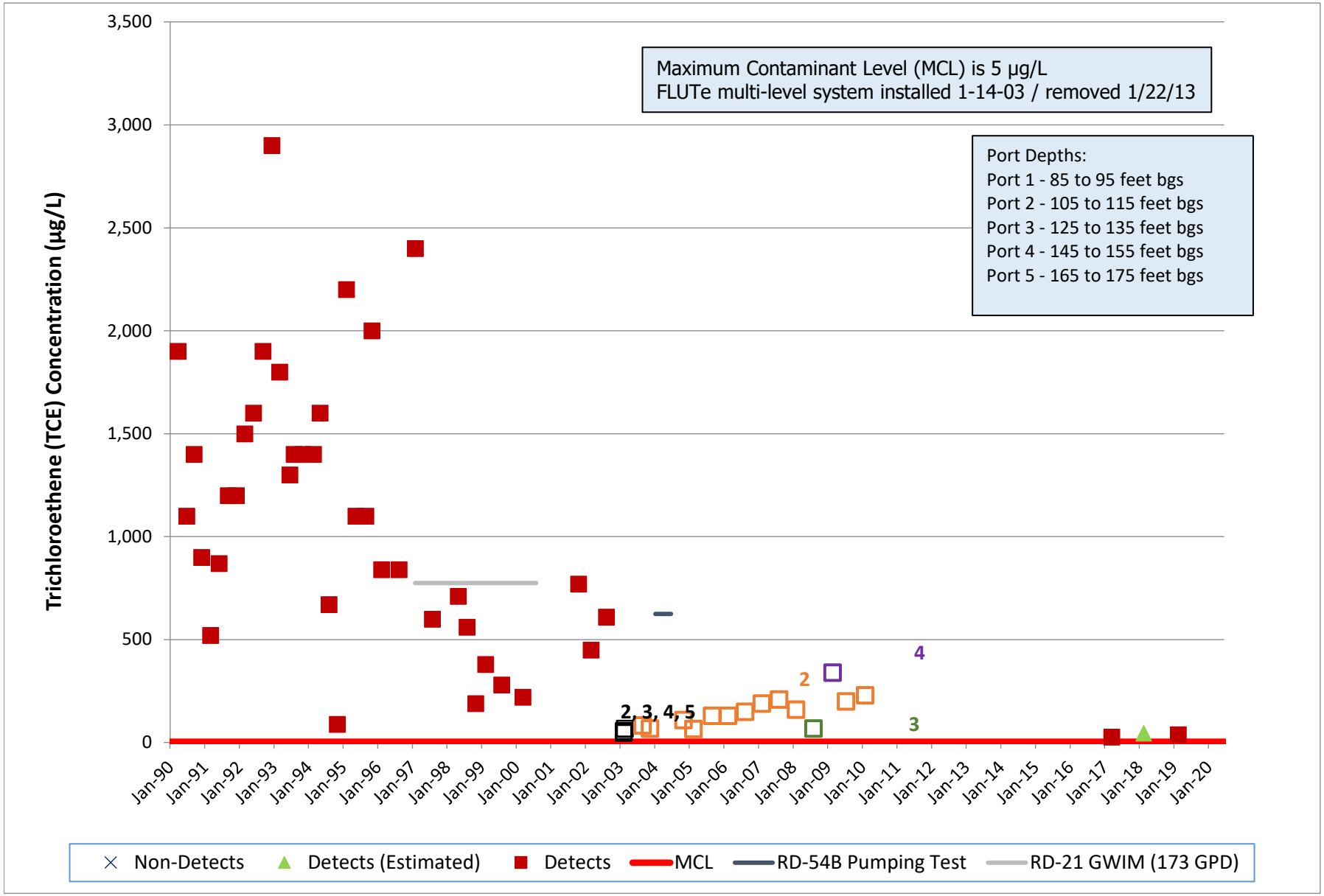
Perchlorate

FSDF/ESADA
RD-21
RD-54A
RS-18
RS-54

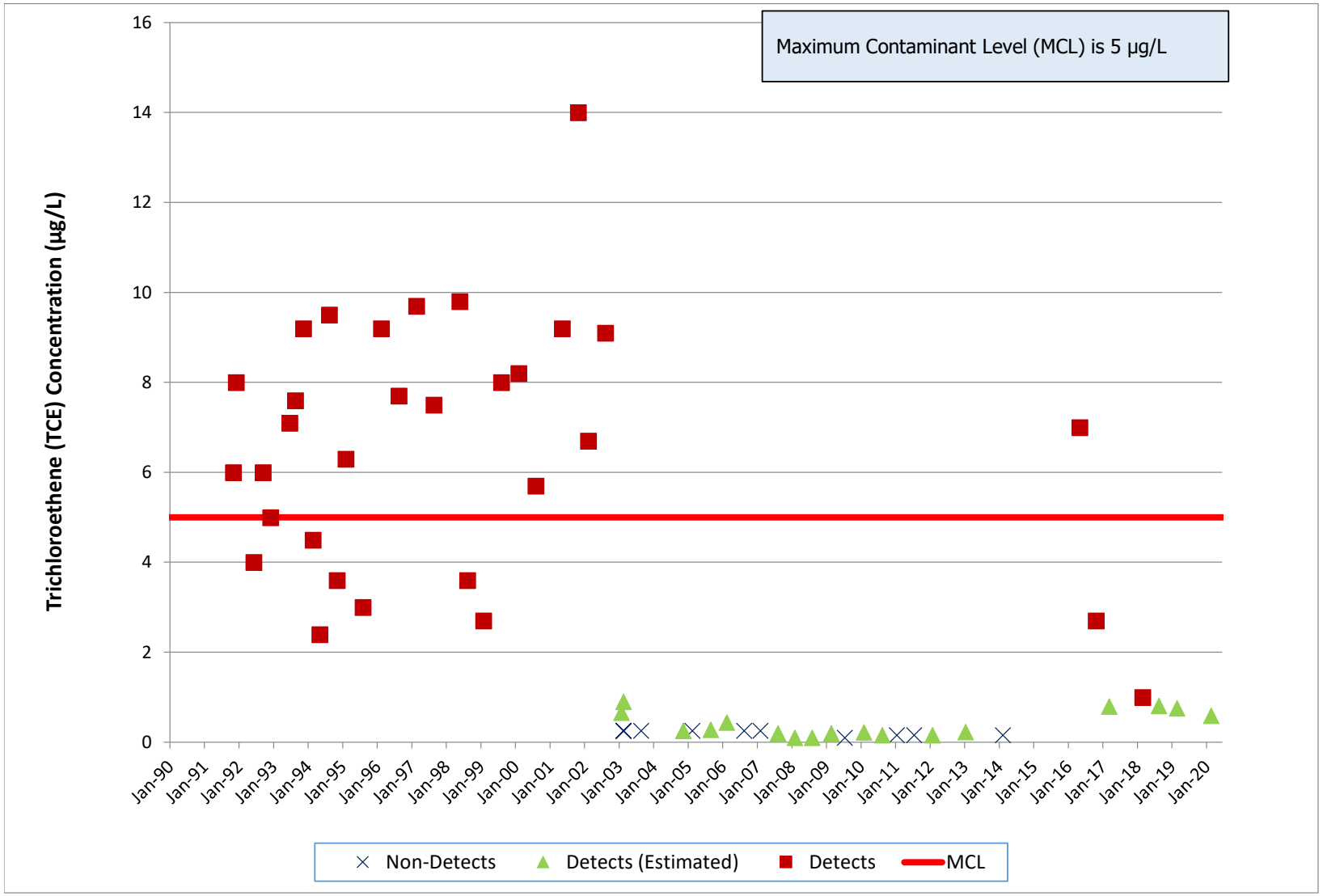
Tritium Plume

RD-34A
RD-88
RD-90
RD-93
RD-94
RD-95

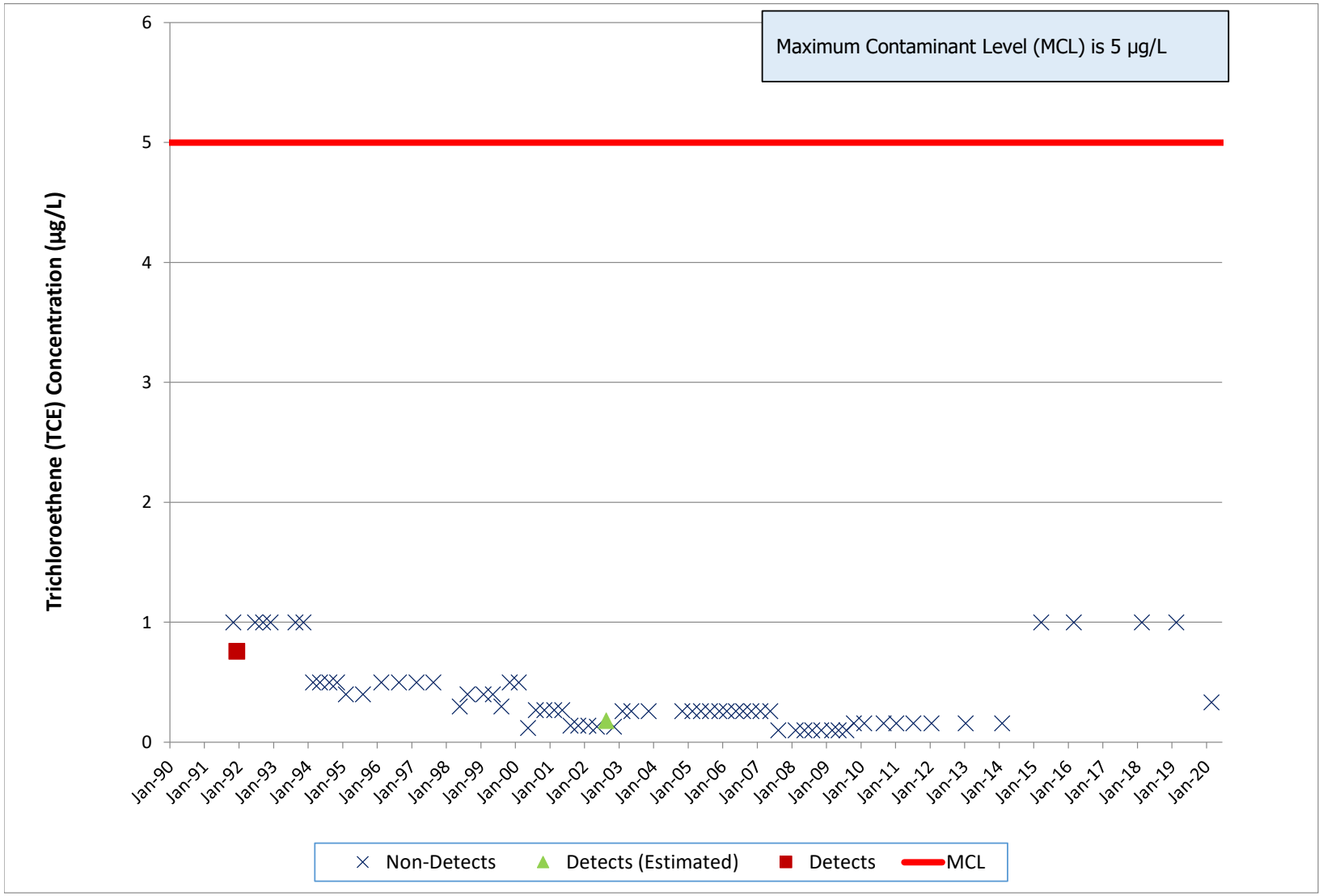
RD-21, FSDF/ESADA
Trichloroethene



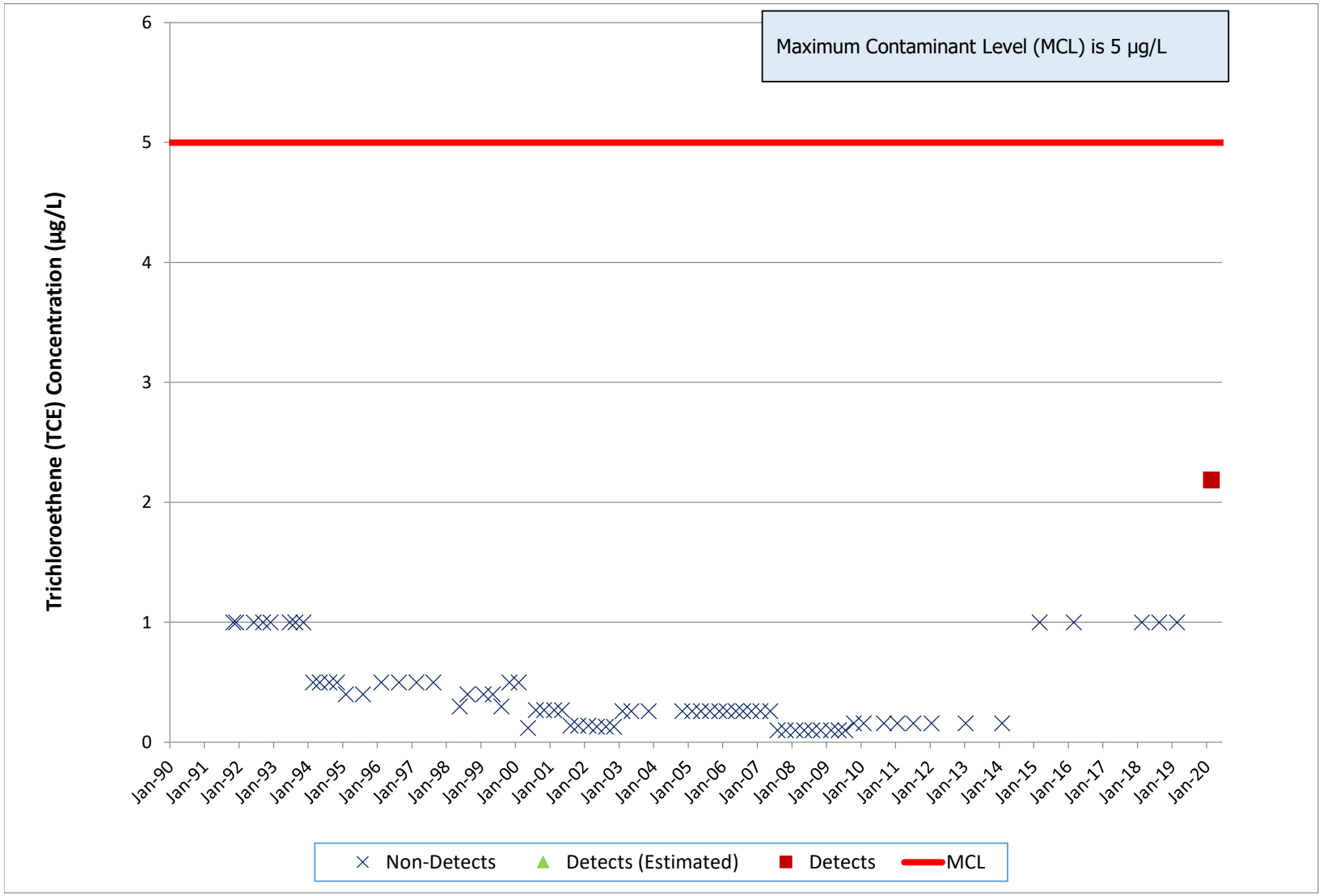
RD-33A, FSDF/ESADA
Trichloroethene



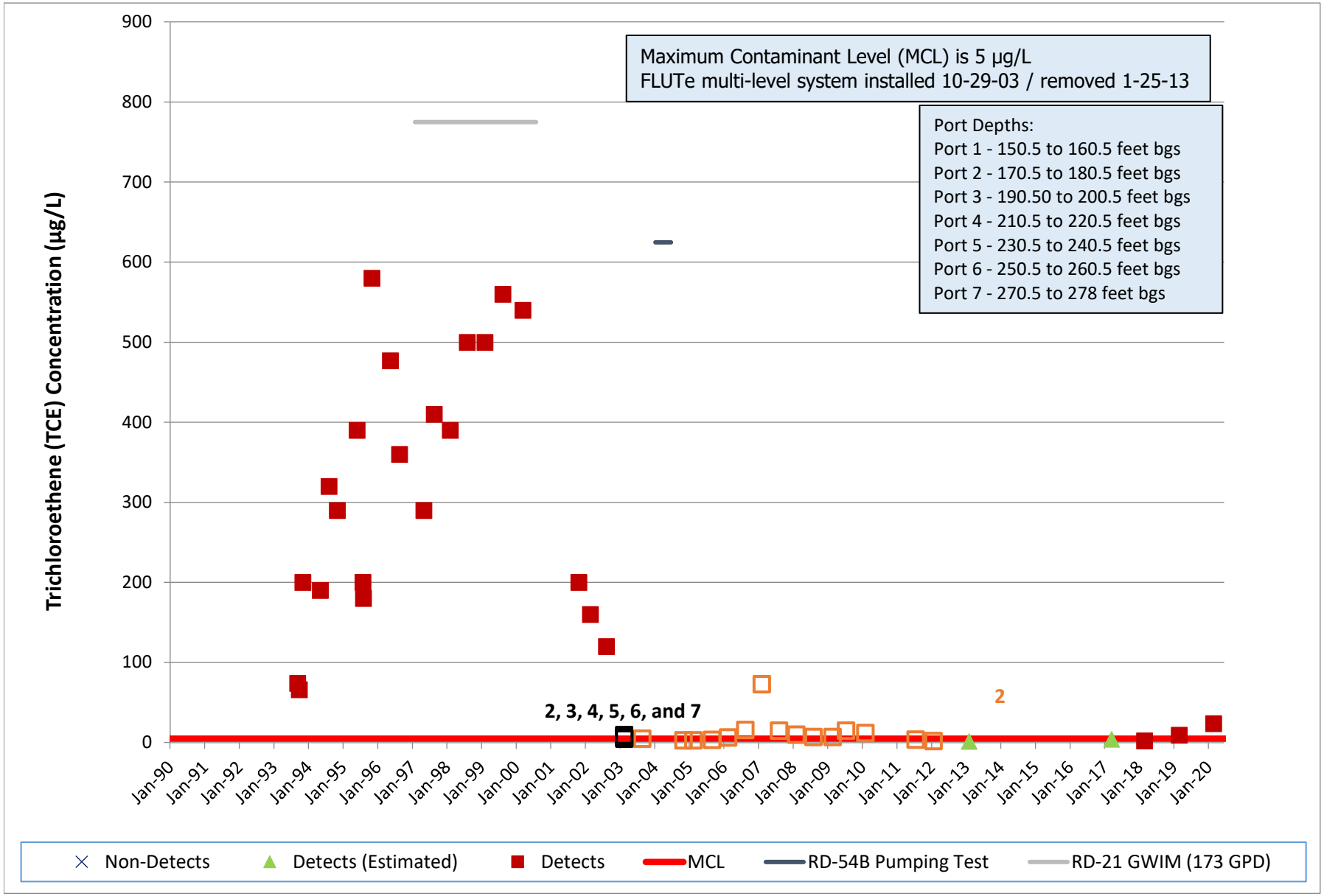
RD-33B, FSDF/ESADA
Trichloroethene



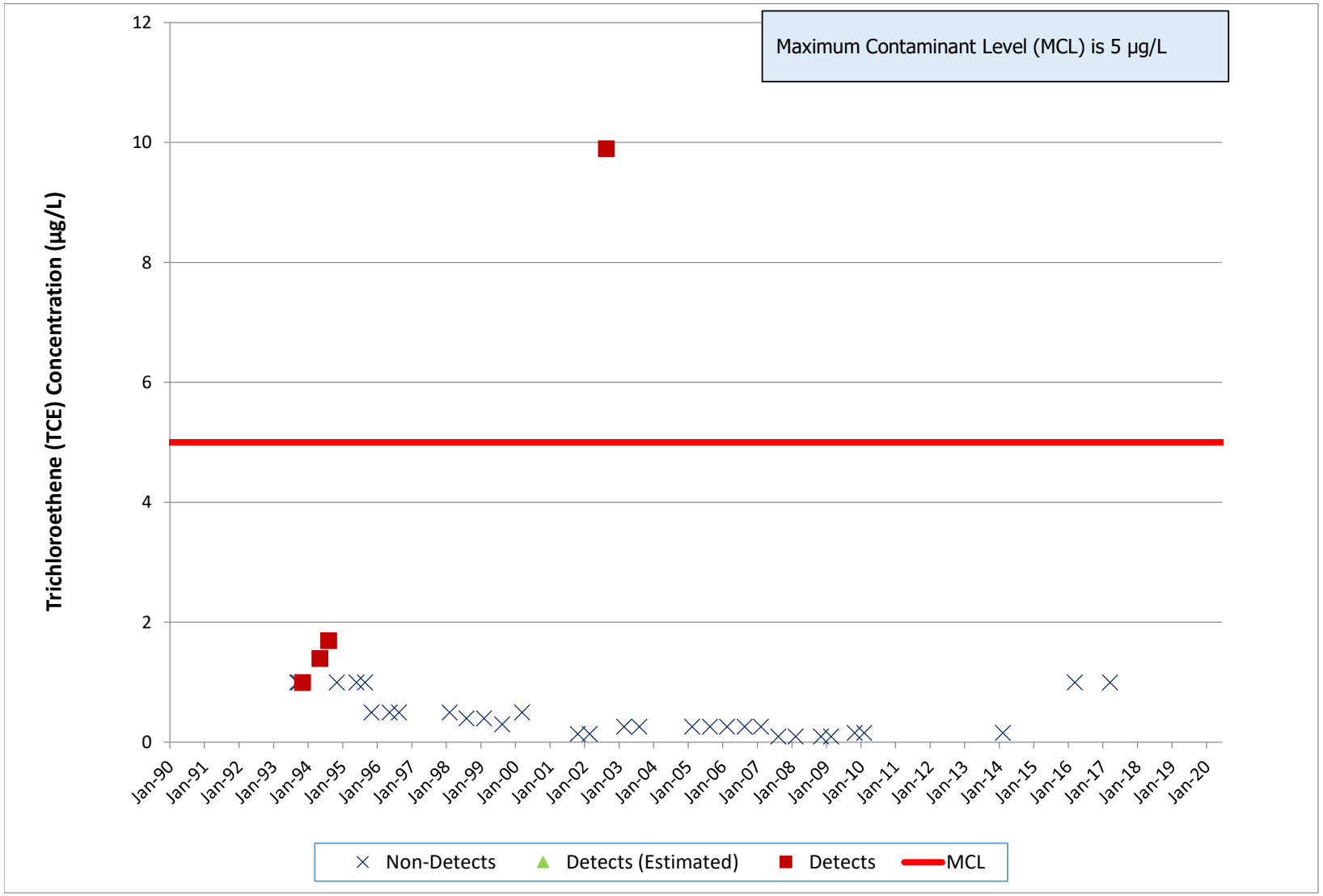
RD-33C, FSDF/ESADA
Trichloroethene



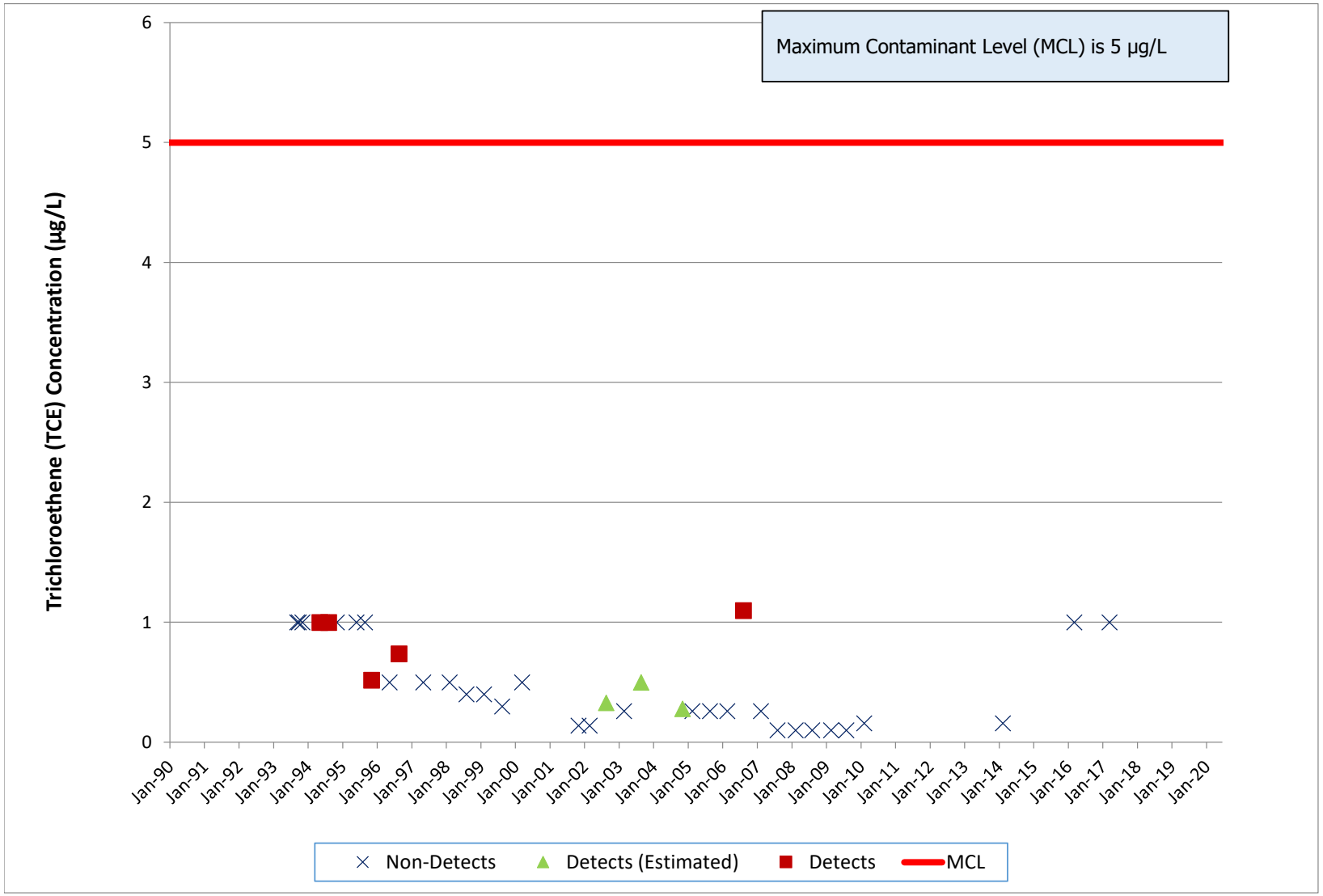
RD-54A FSDF/ESADA
Trichloroethene



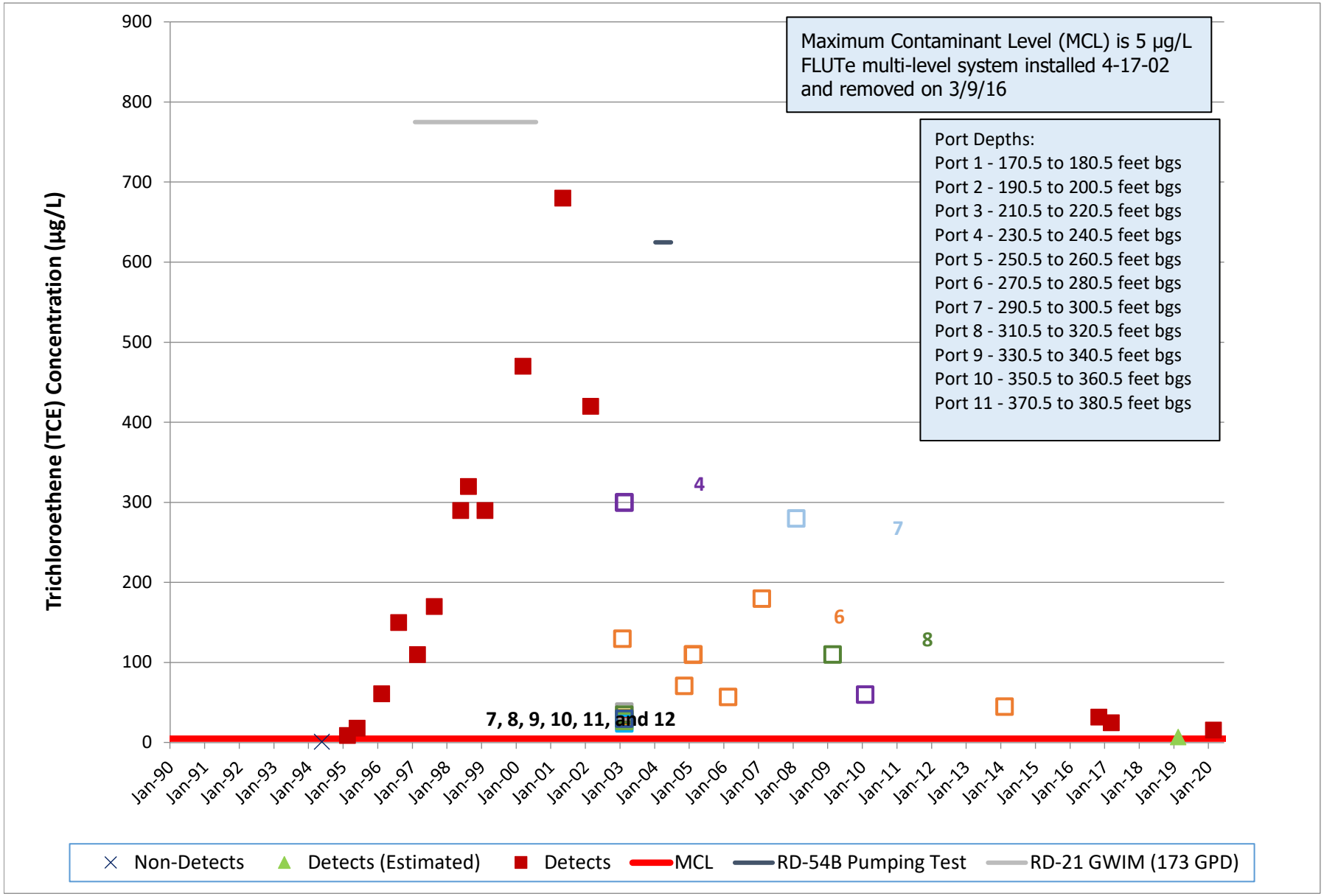
RD-54B, FSDF/ESADA
Trichloroethene



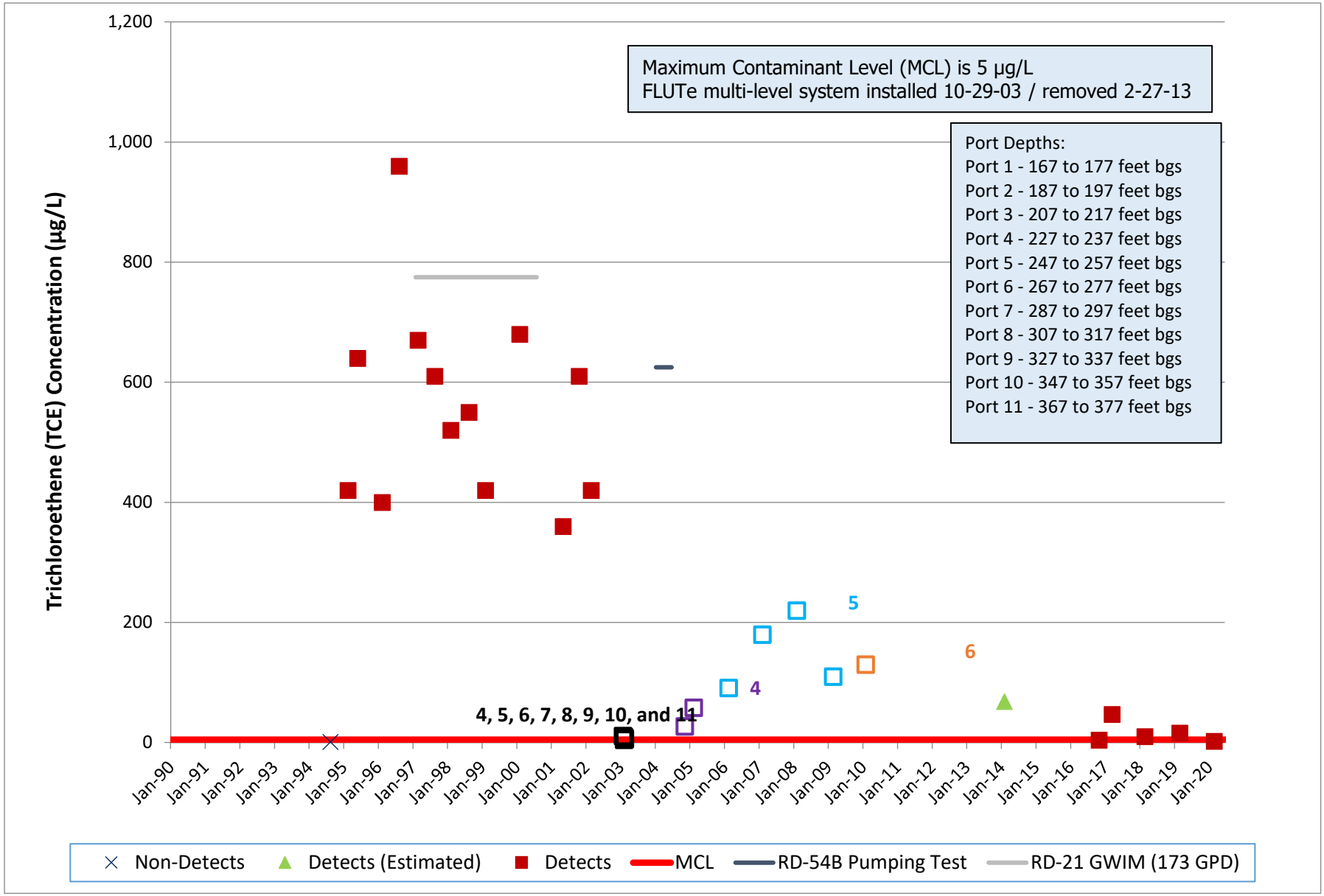
RD-54C, FSDF/ESADA
Trichloroethene



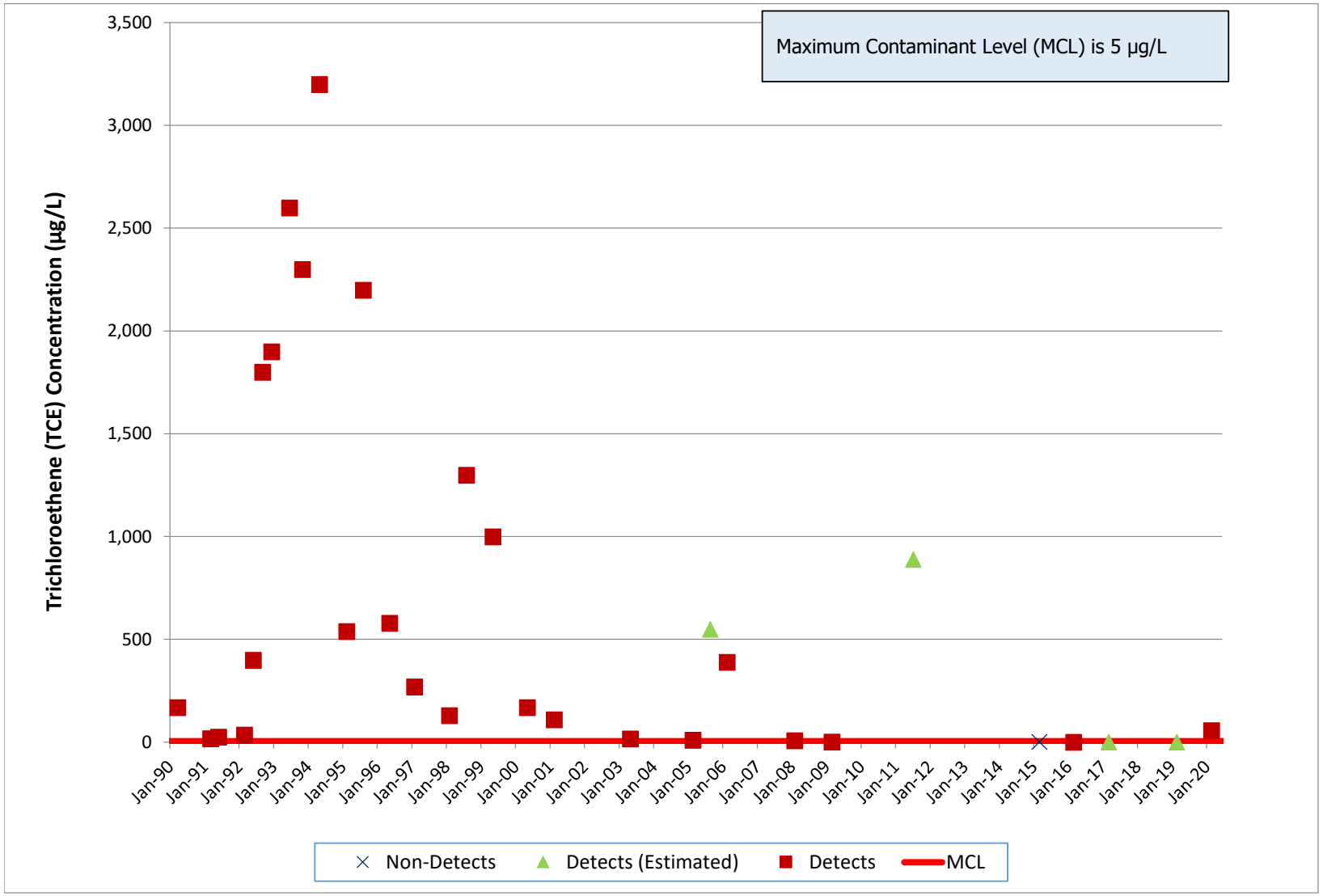
RD-64, FSDF/ESADA
Trichloroethene



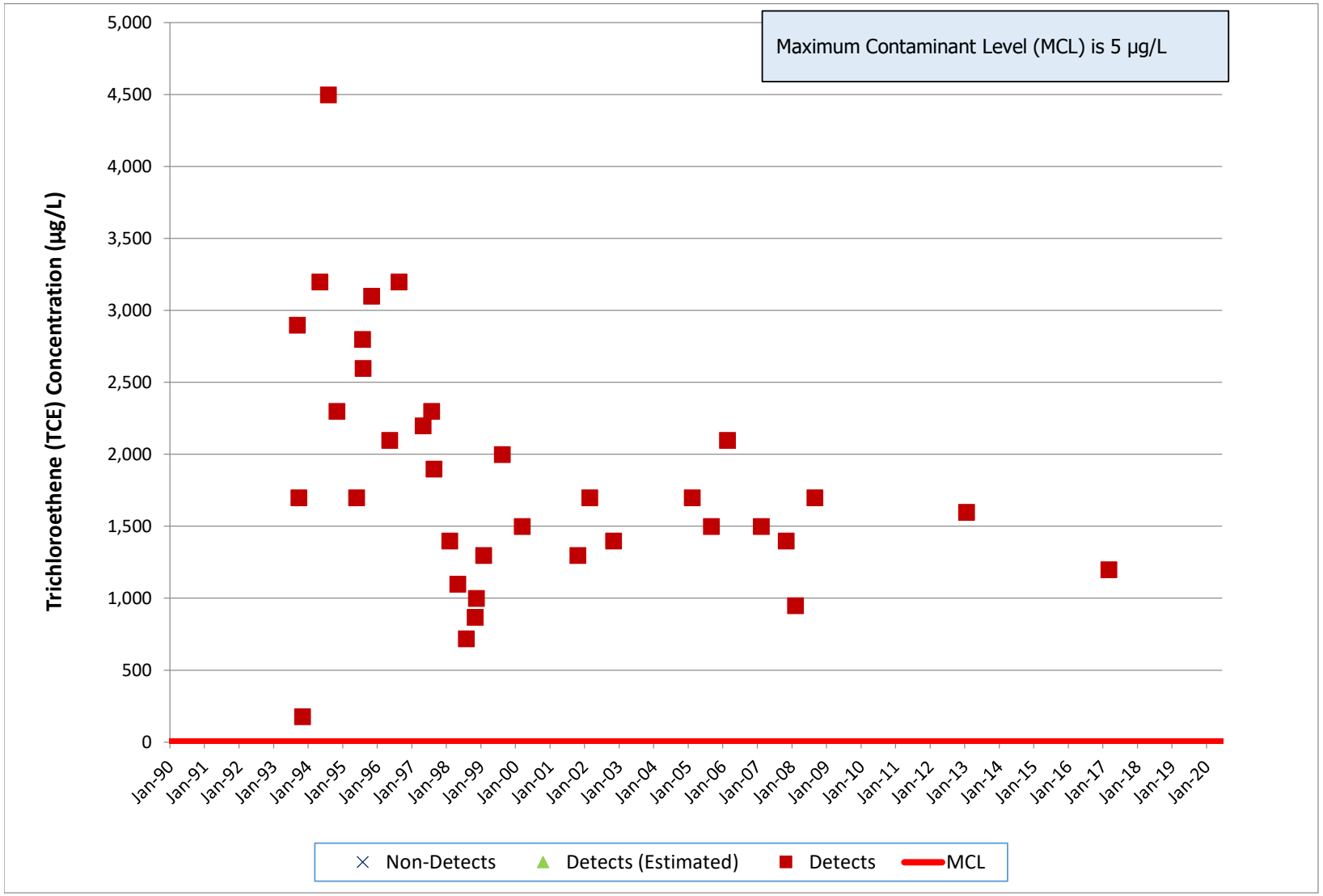
RD-65, FSDF/ESADA
Trichloroethene



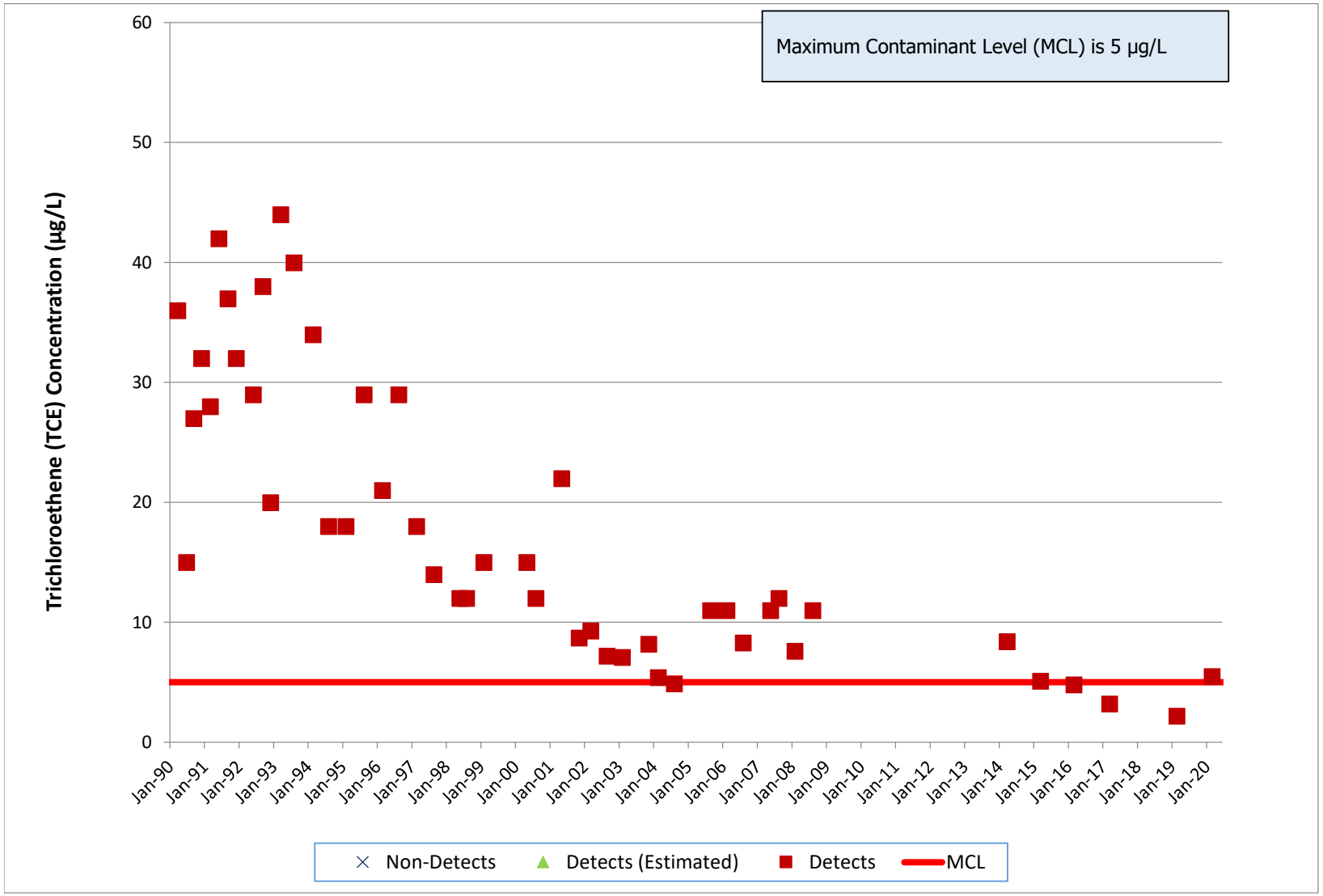
RS-18, FSDF/ESADA
Trichloroethene



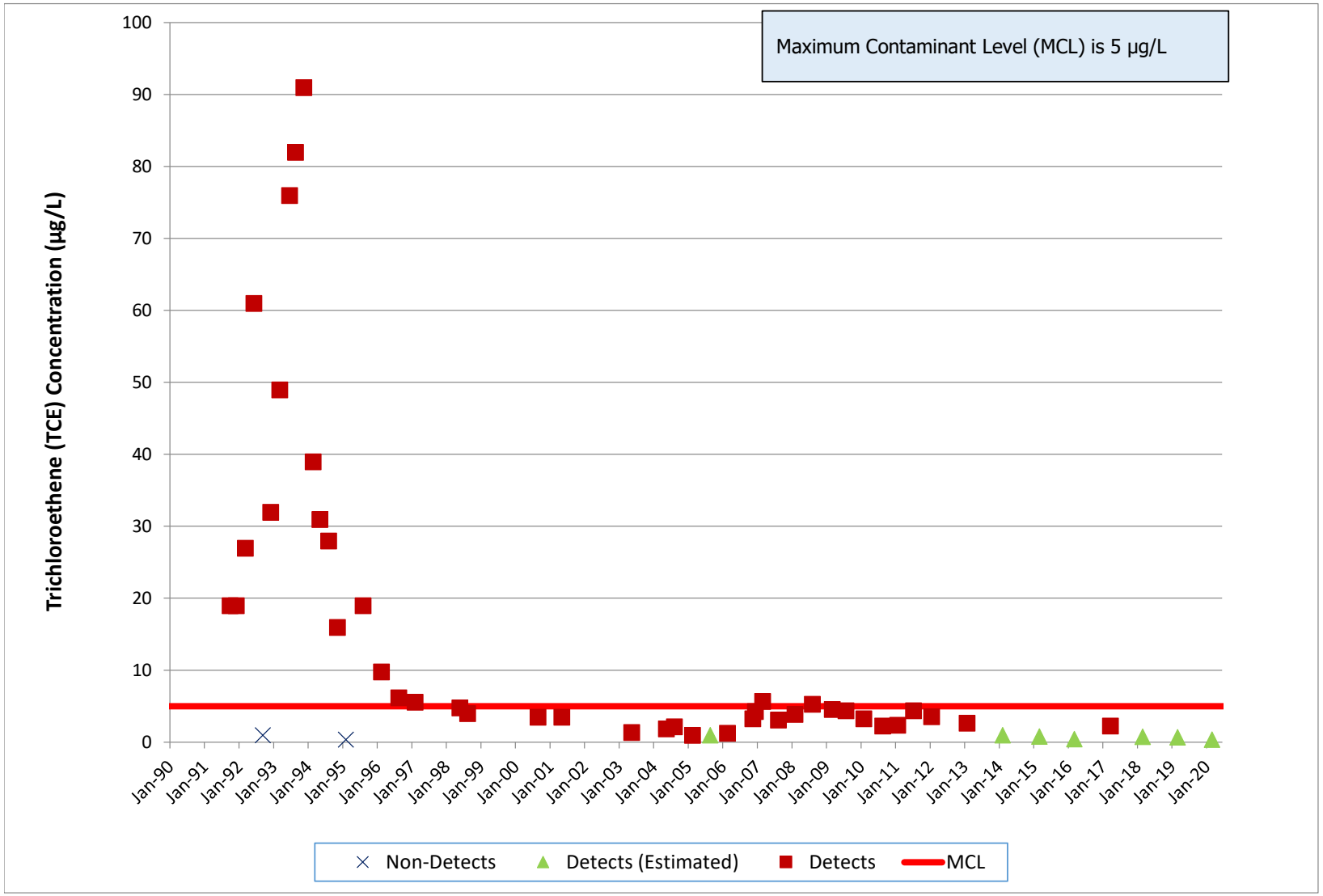
RS-54, FSDF/ESADA
Trichloroethene



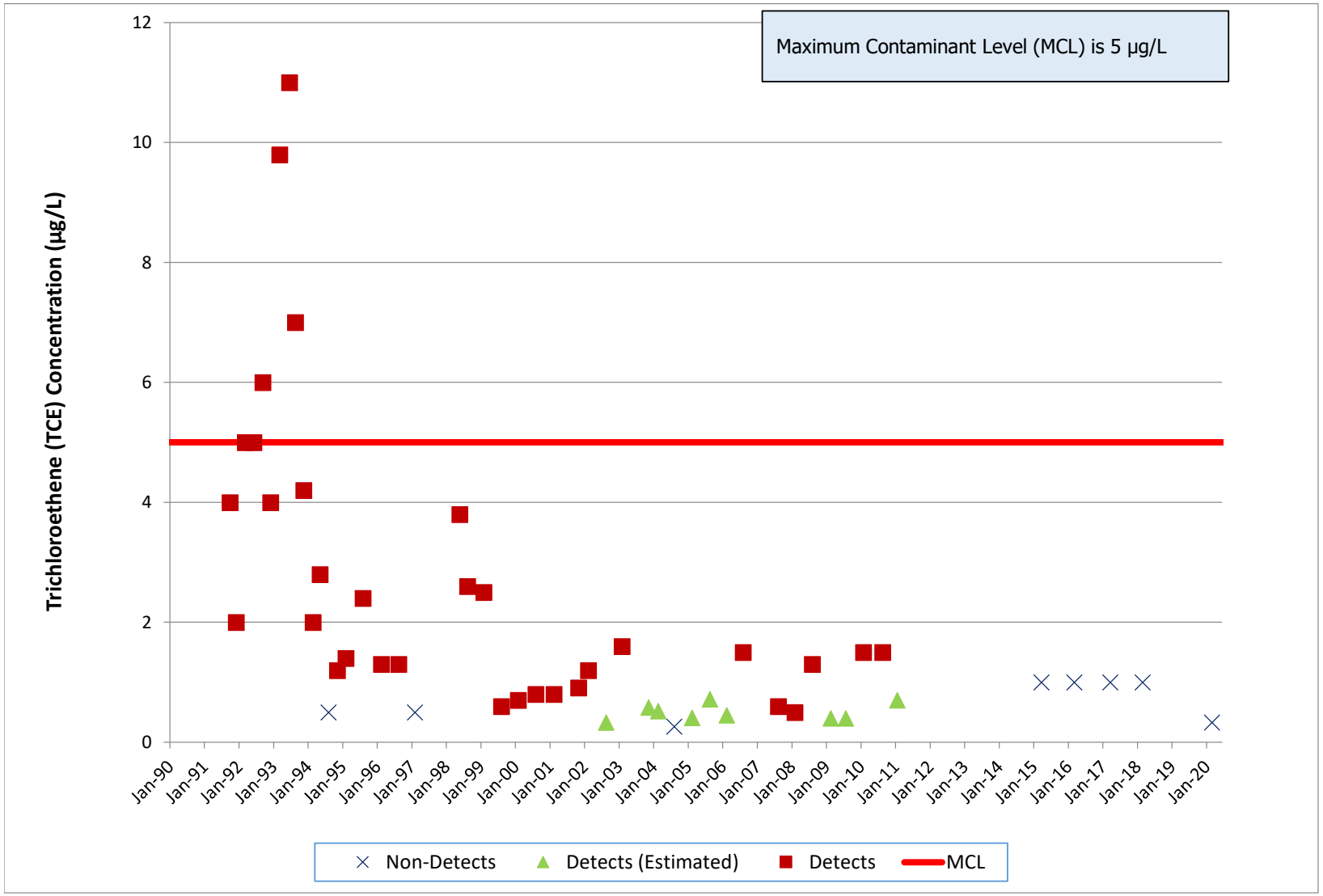
RD-30, RMHF
Trichloroethene



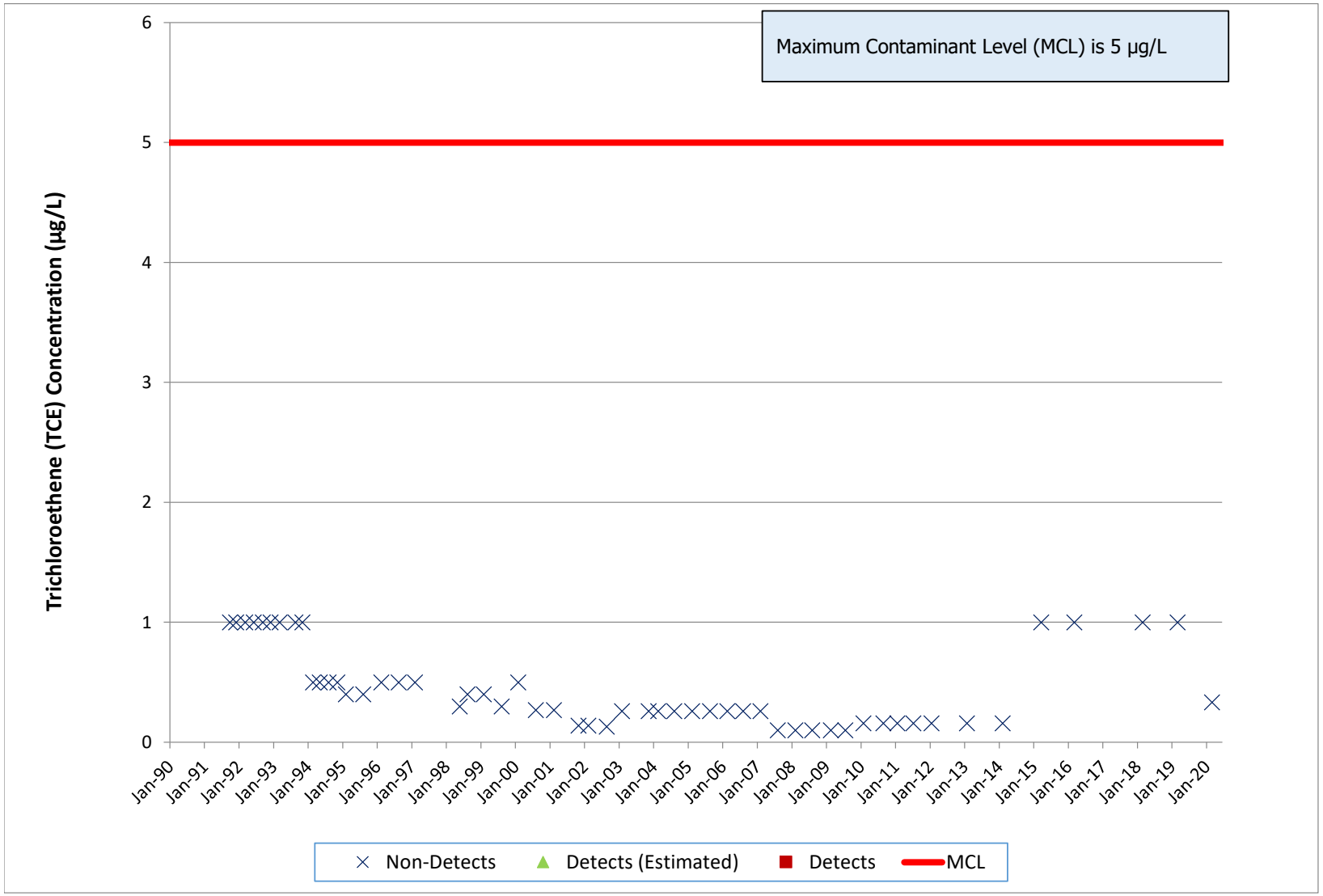
RD-34A, RMHF
Trichloroethene



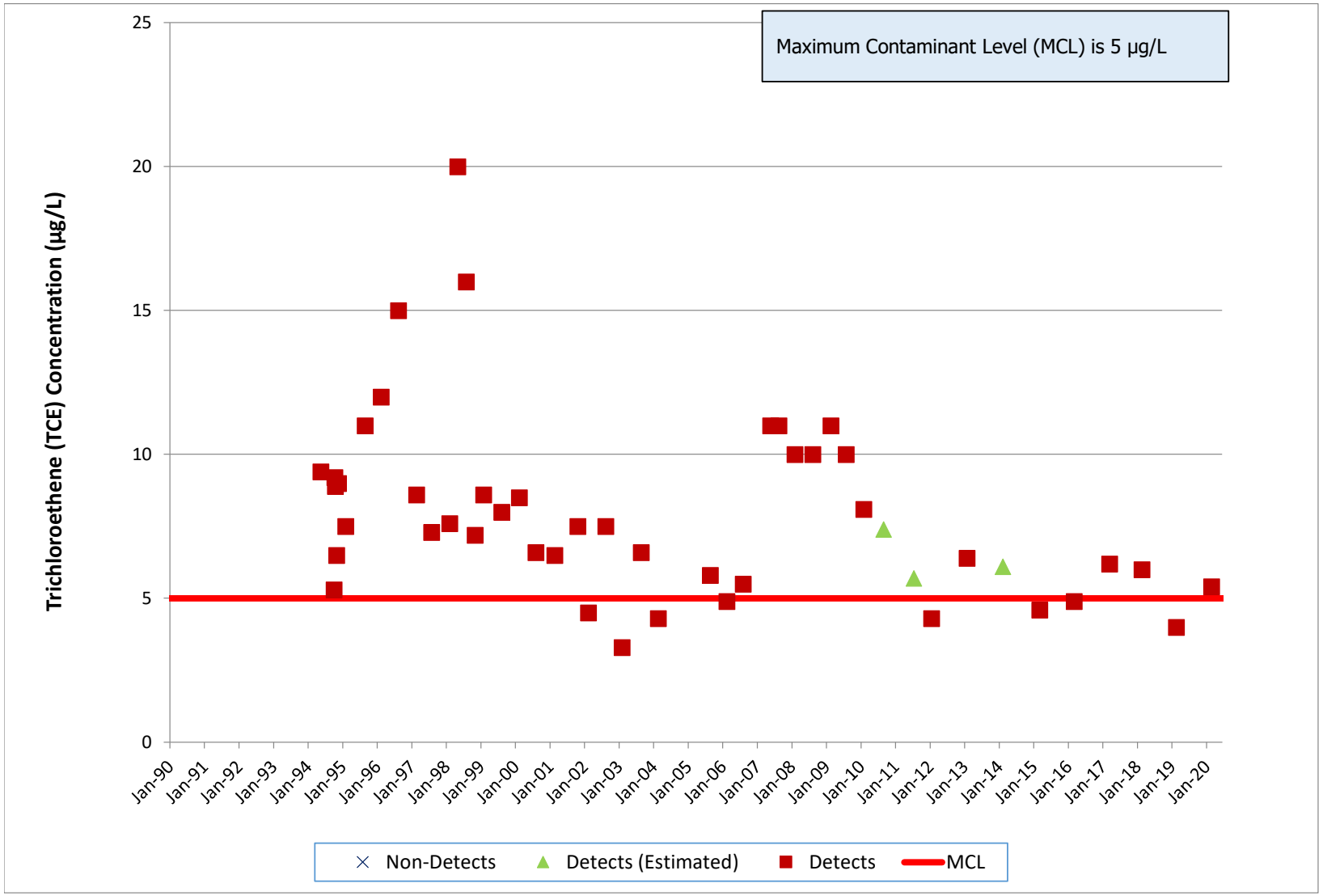
RD-34B, RMHF
Trichloroethene



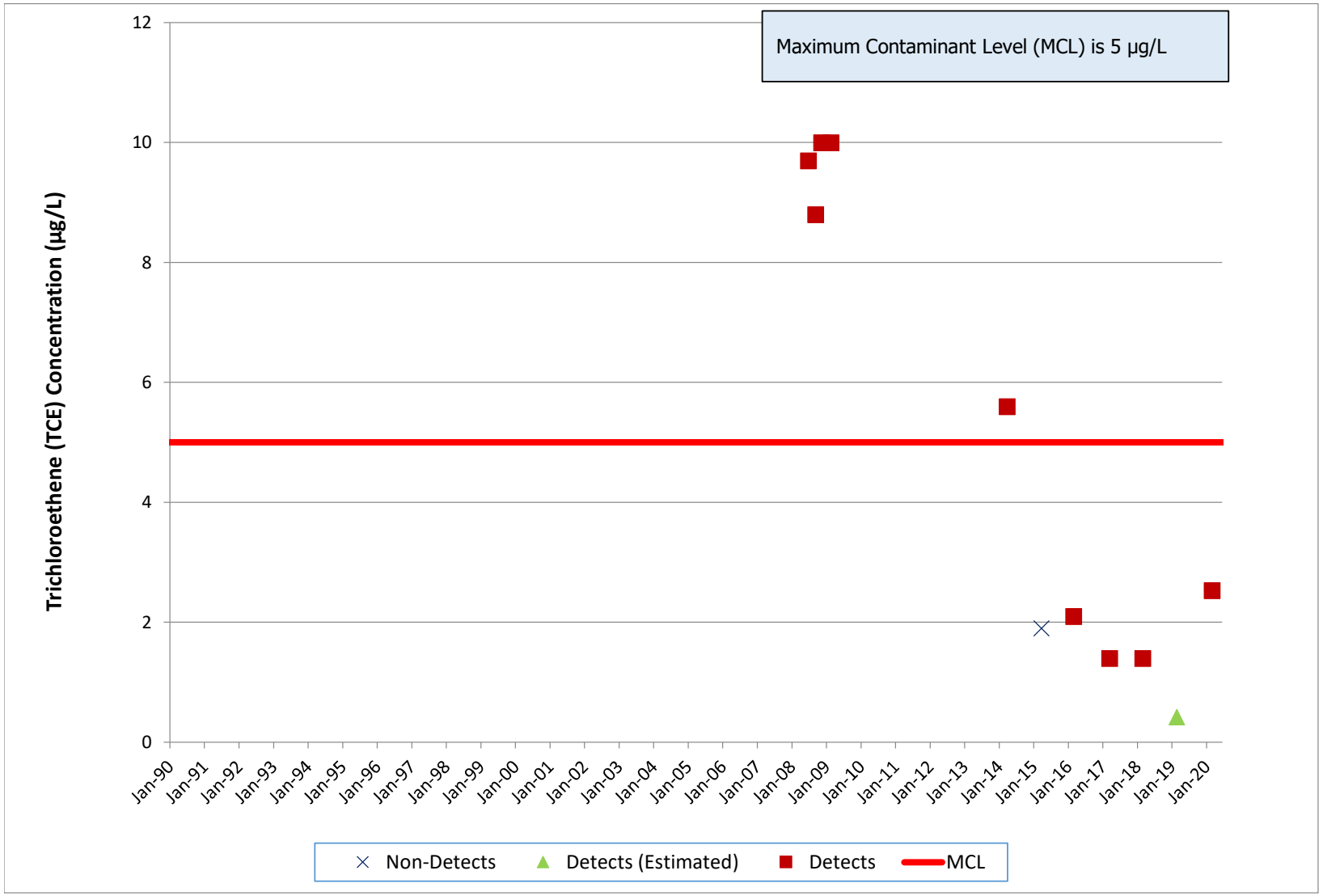
RD-34C, RMHF
Trichloroethene



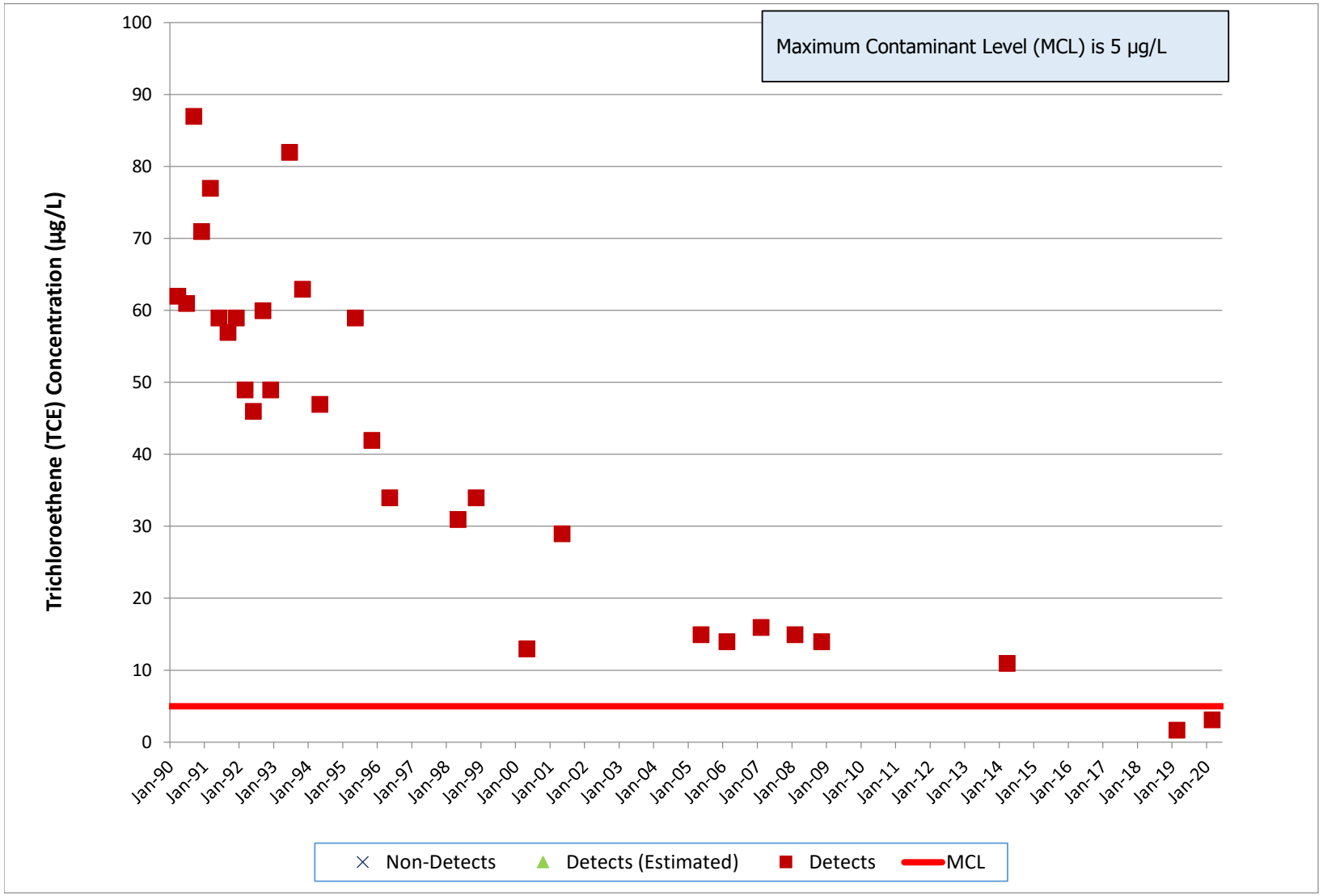
RD-63, RMHF
Trichloroethene



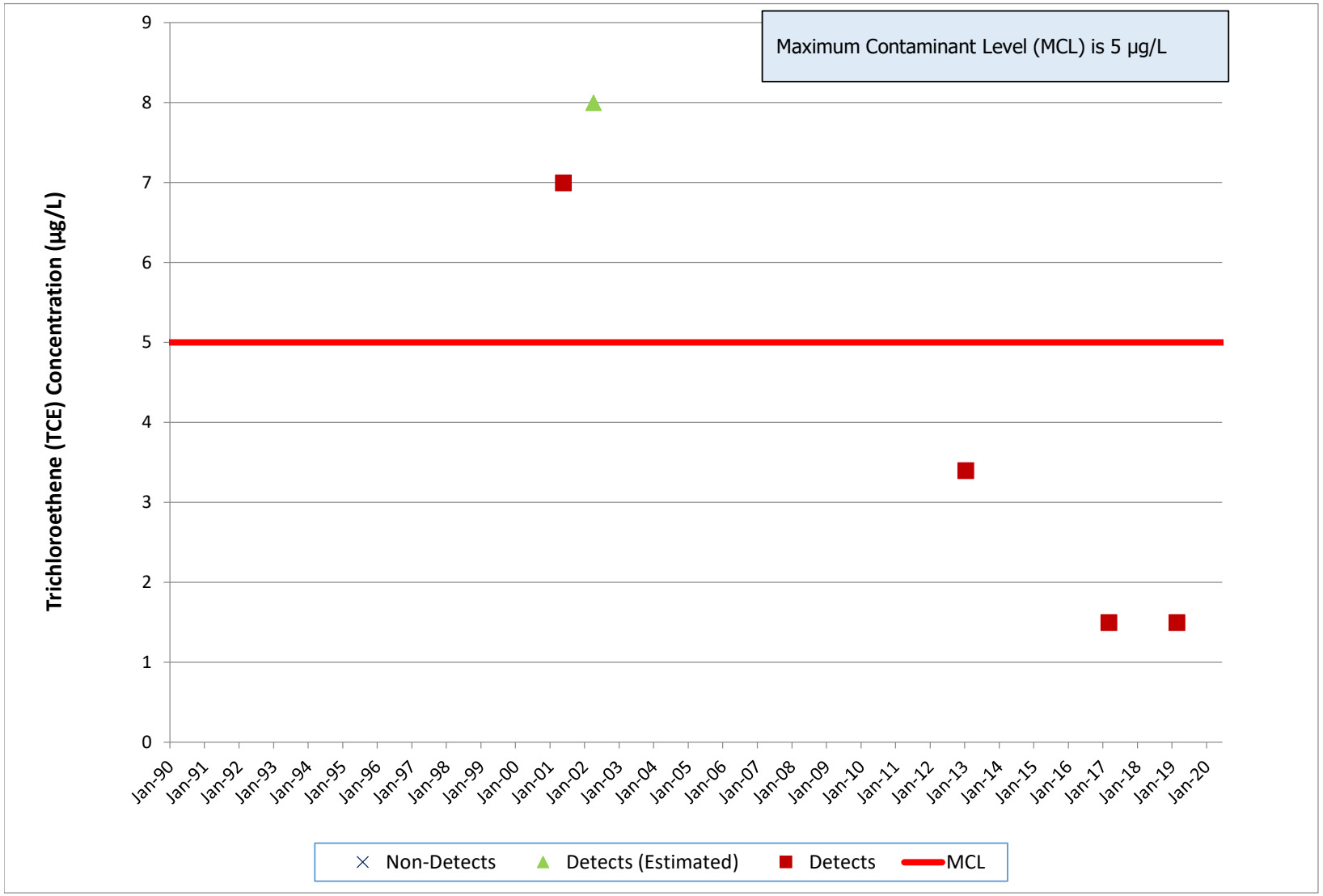
RD-98, RMHF
Trichloroethene



RS-28, RMHF
Trichloroethene



PZ-005, Bldg 65 Metals Clarifier
Trichloroethene



PZ-104, Bldg 65 Metals Clarifier
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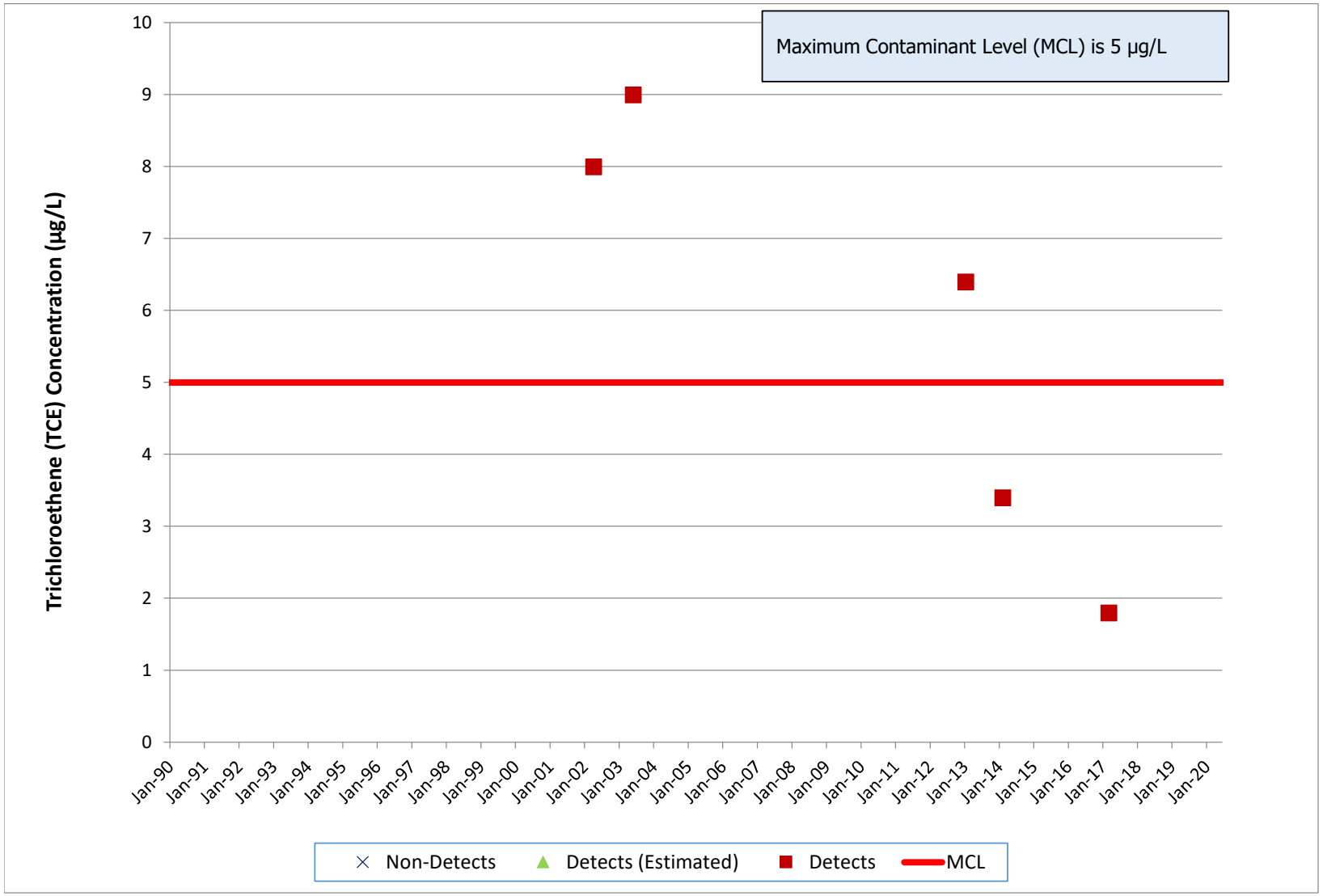

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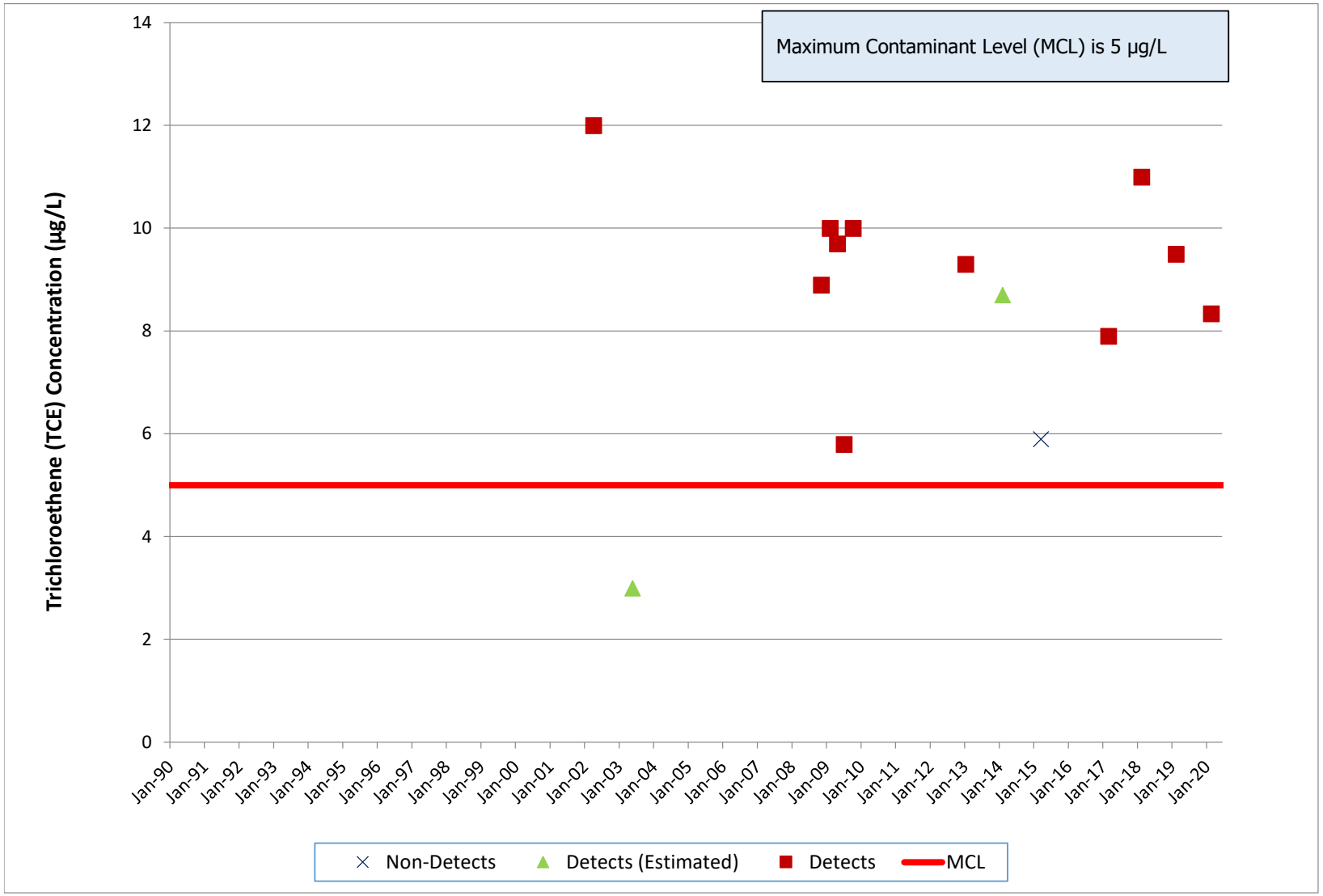
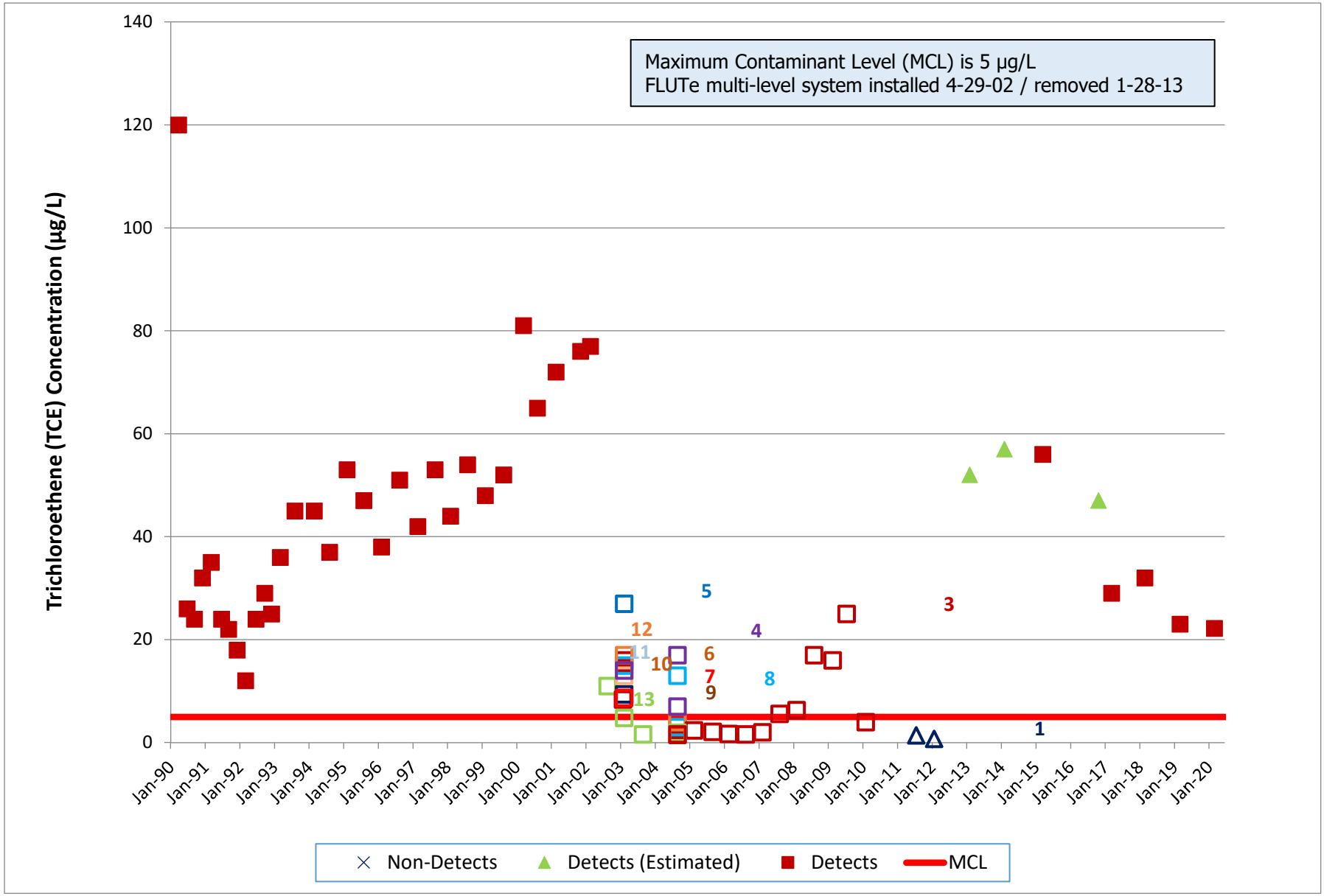
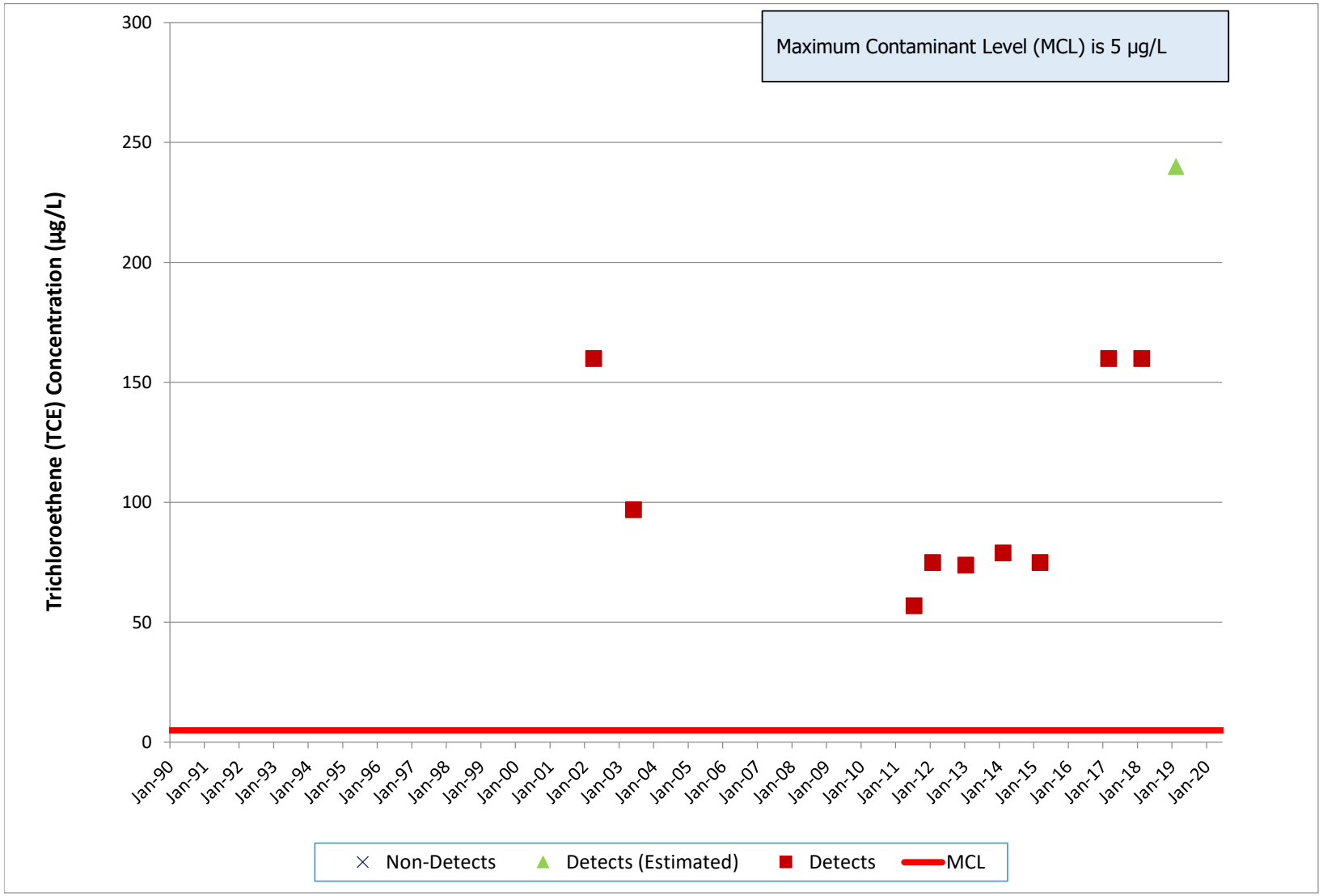


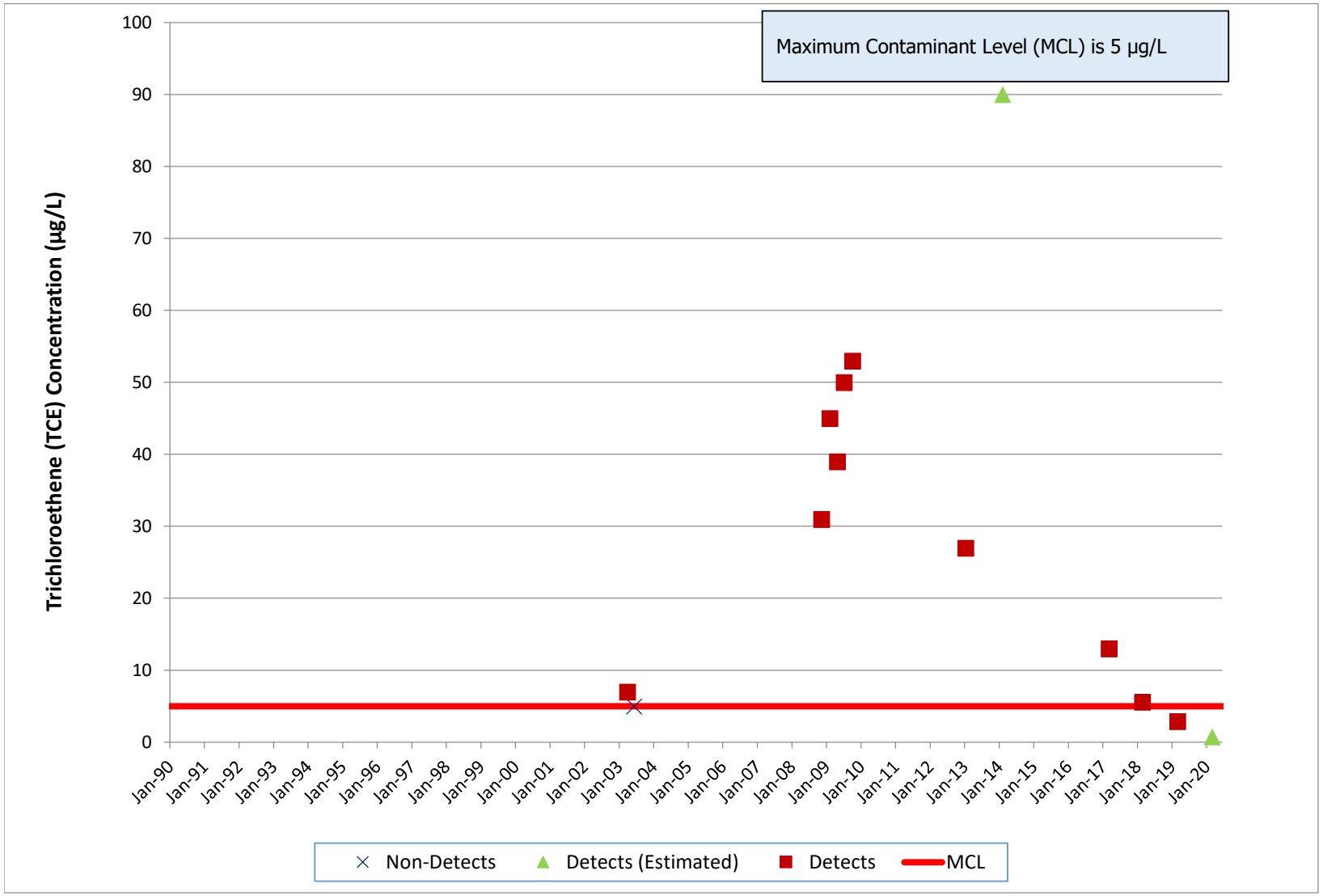
RD-07, Bldg 56 Landfill
Trichloroethene



PZ-108, HMSA/PDU
Trichloroethene



PZ-120, HMSA/PDU
Trichloroethene



PZ-109, B4057/4059/4626
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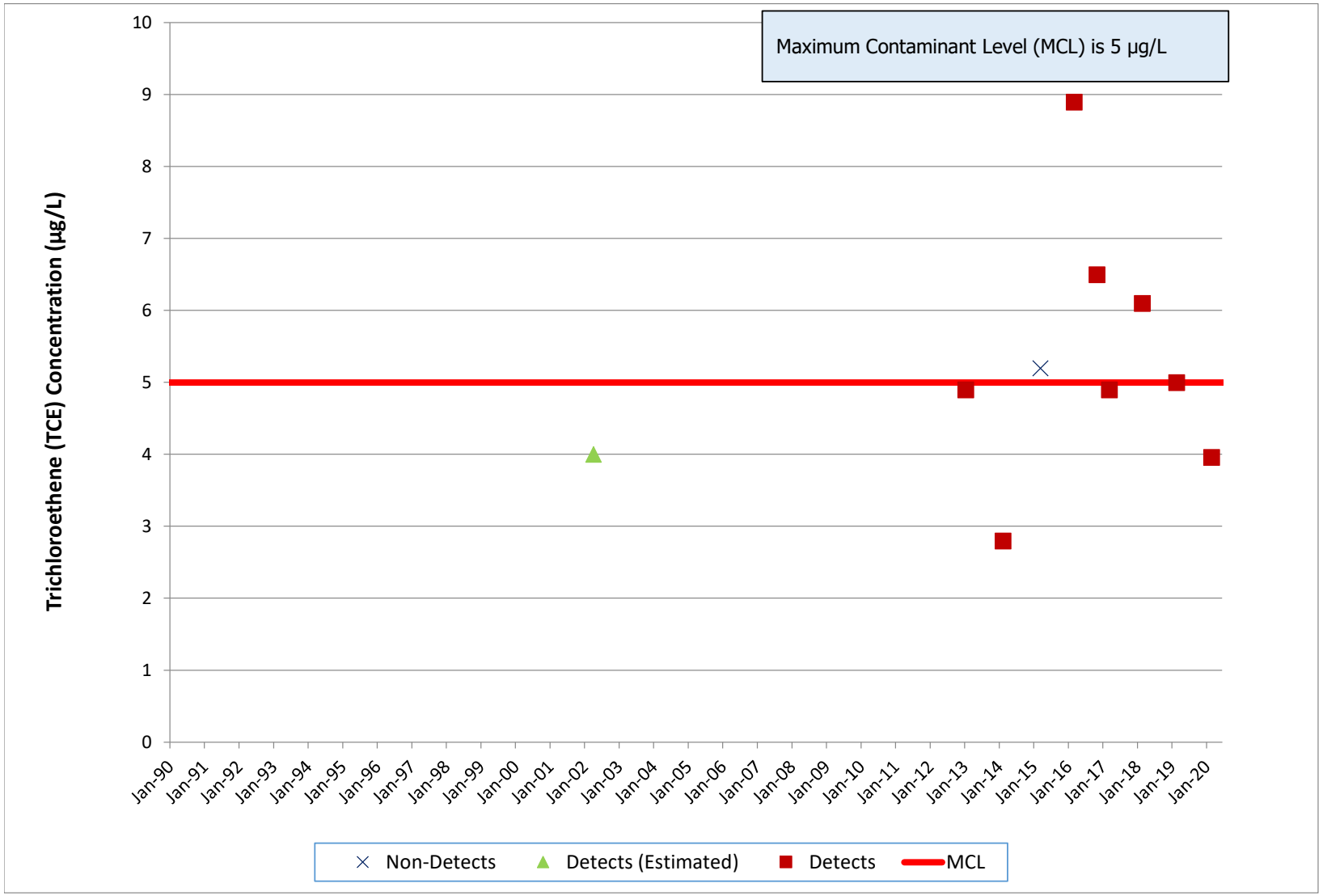
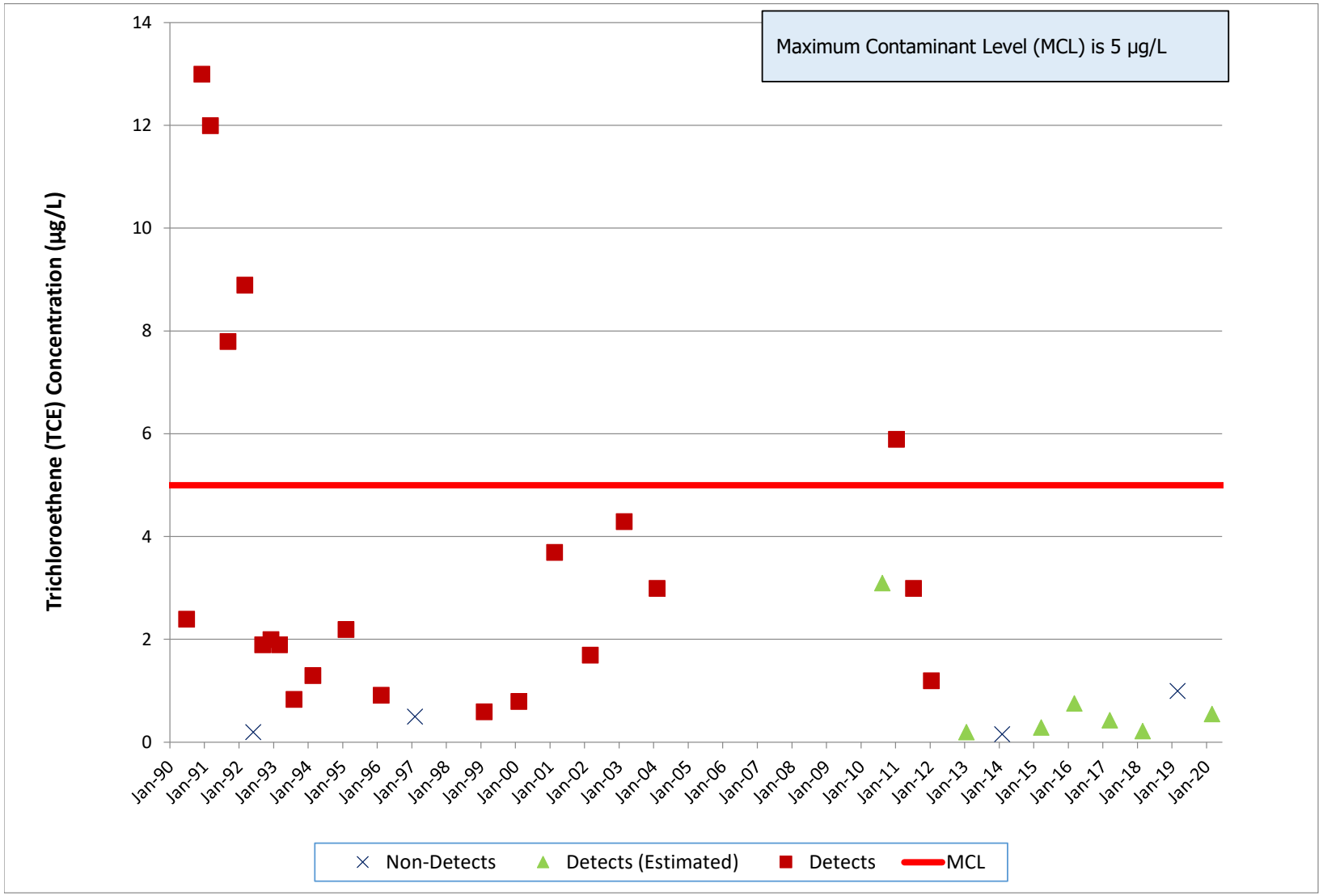
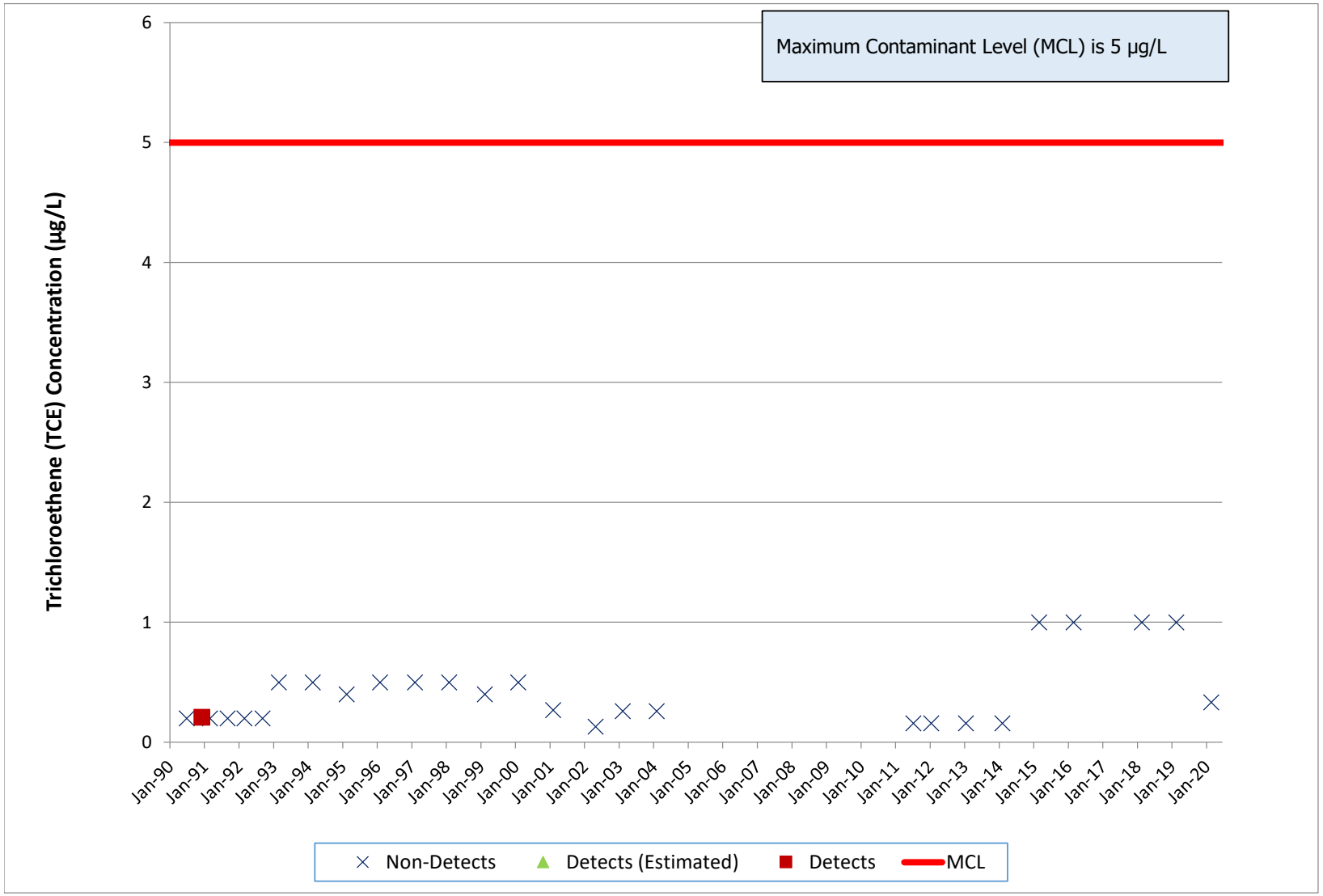


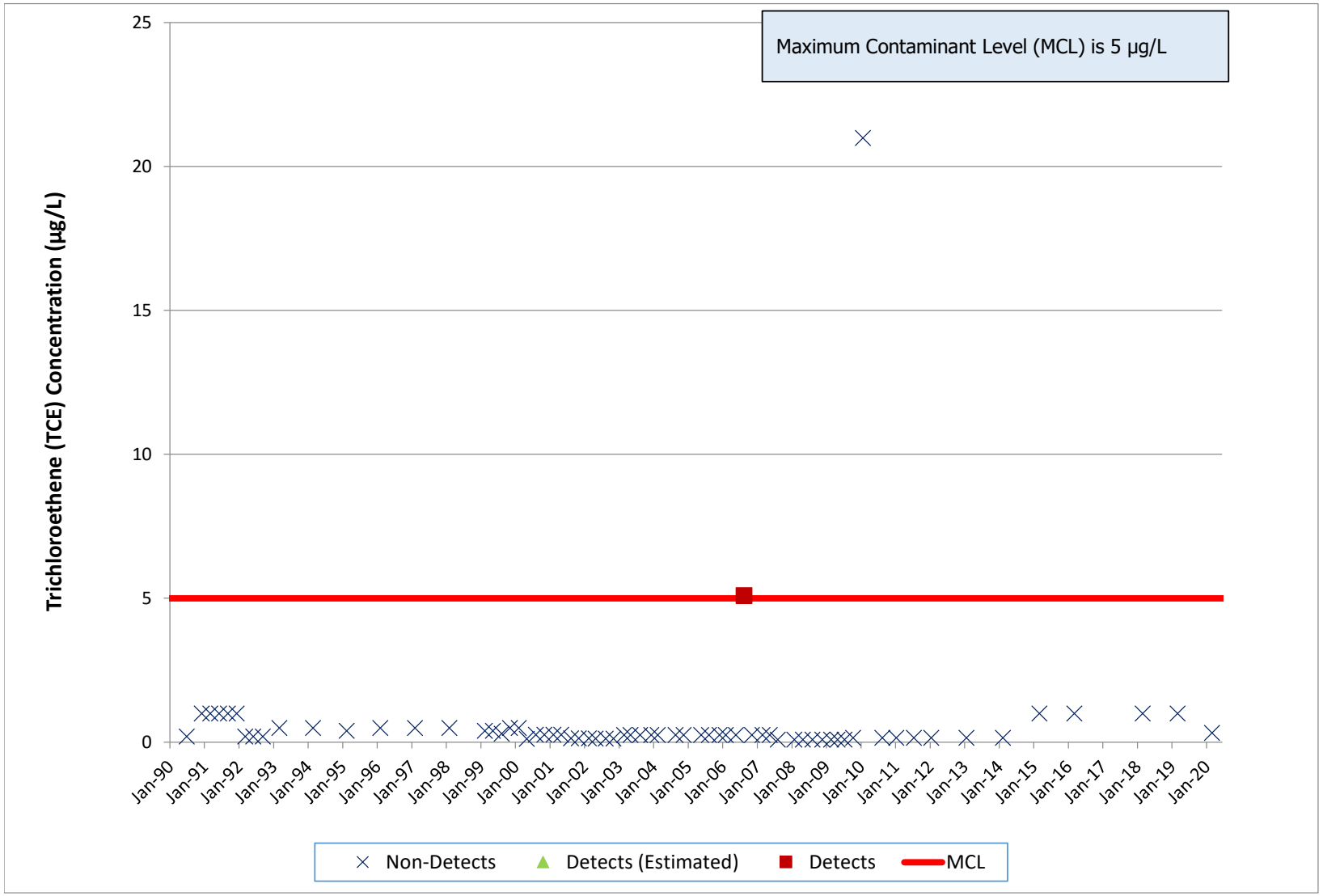
RD-14, OCY
Trichloroethene



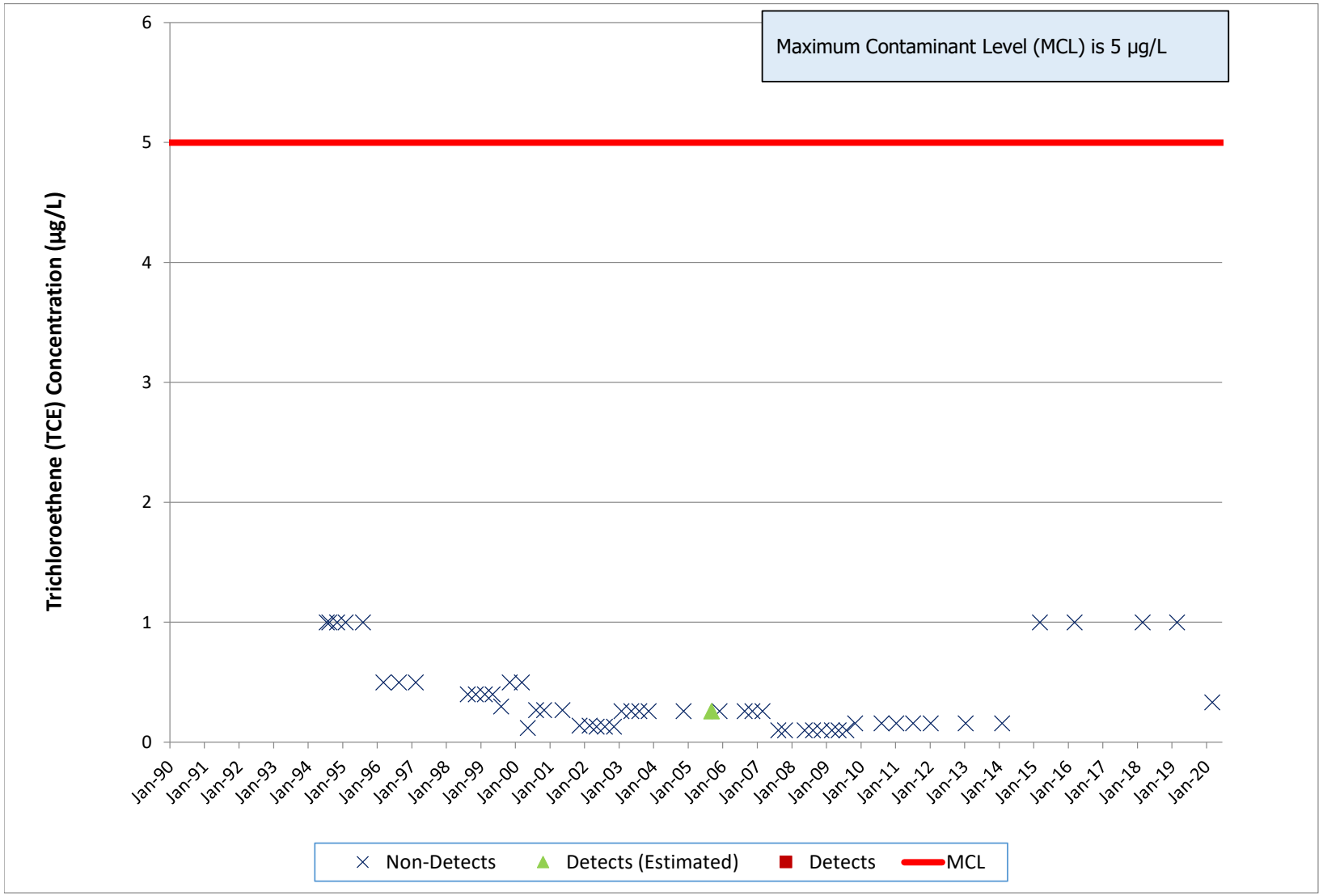
RD-20, Bldg 4100 Trench
Trichloroethene



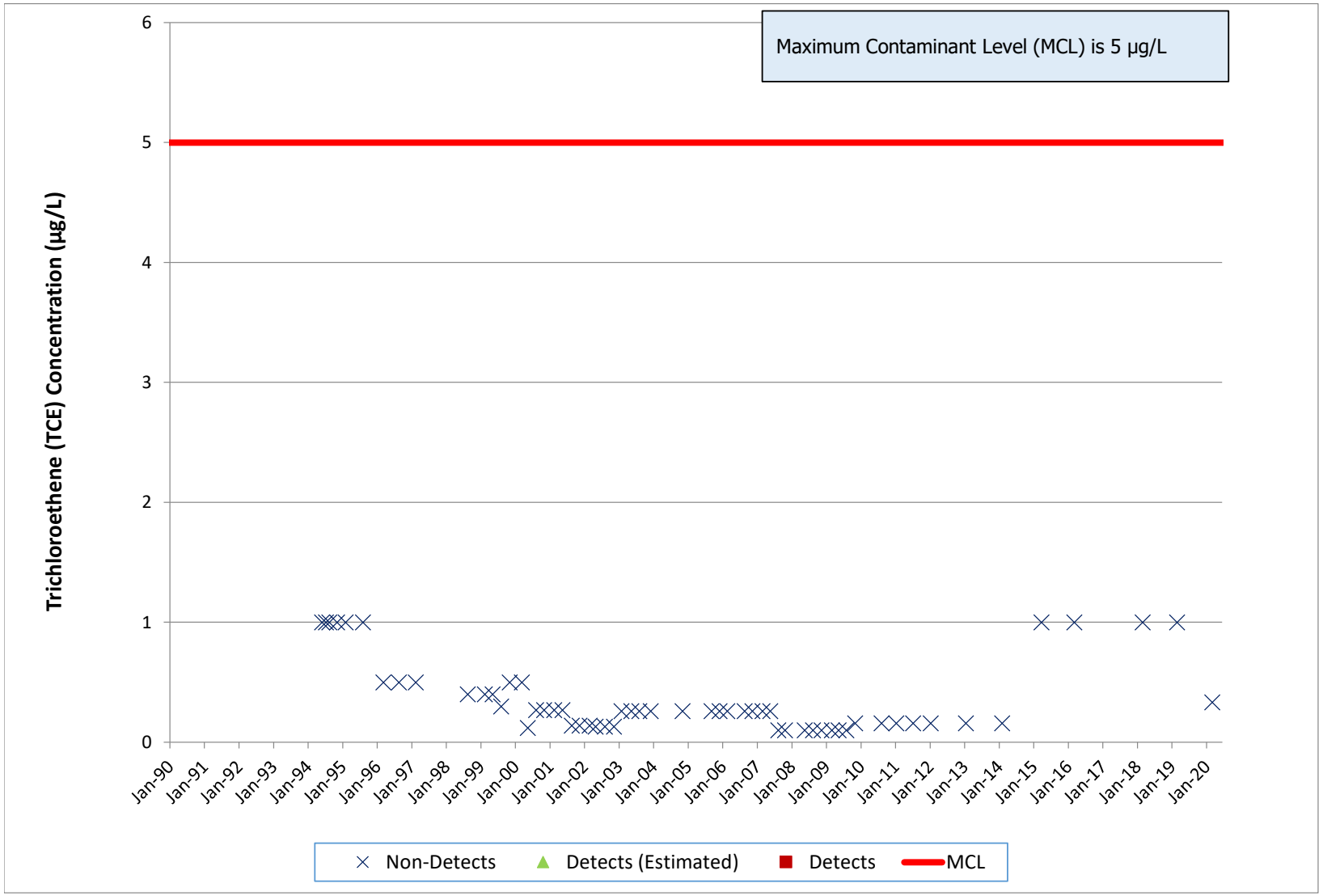
RD-19, B4133
Trichloroethene



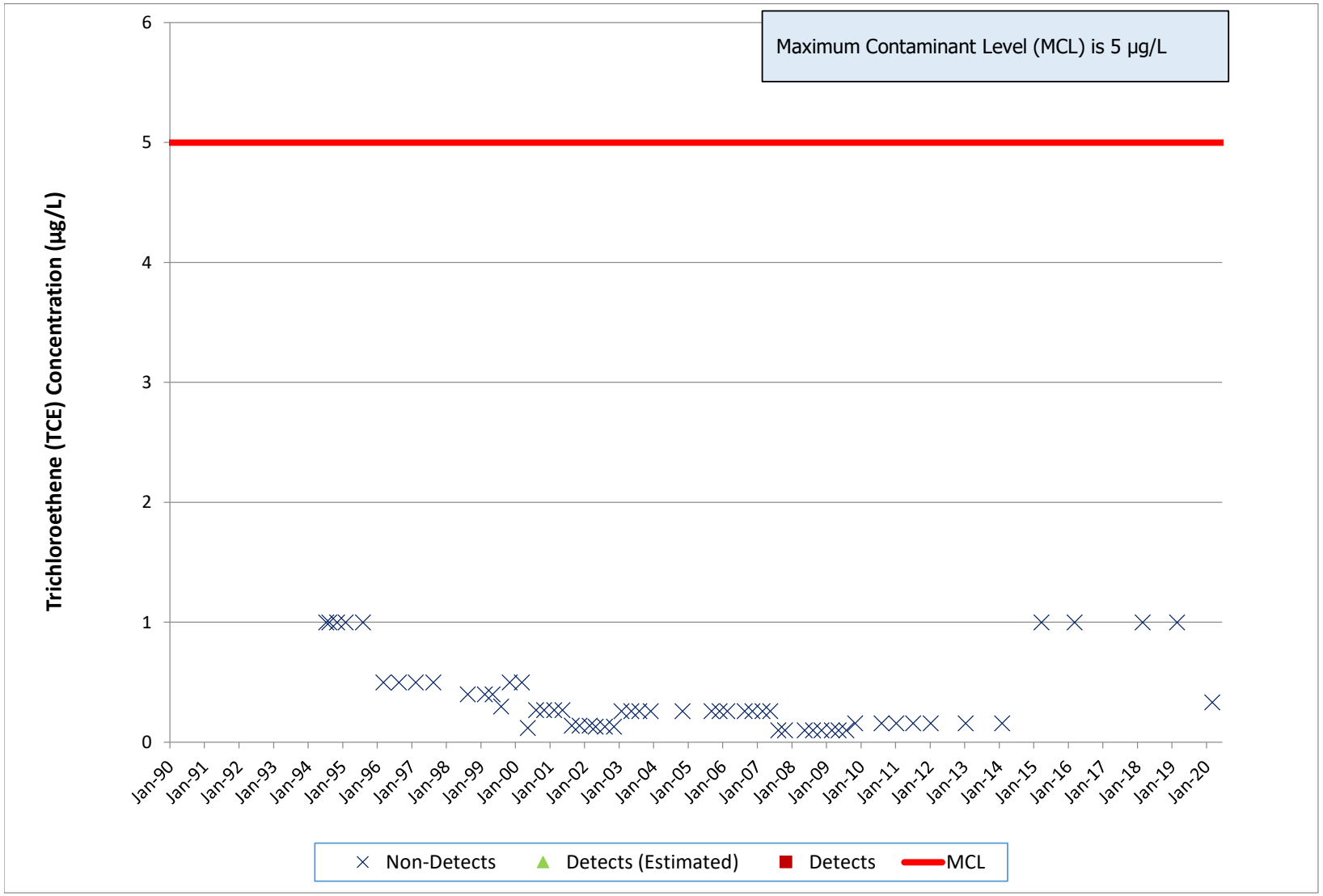
RD-59A, Offsite
Trichloroethene



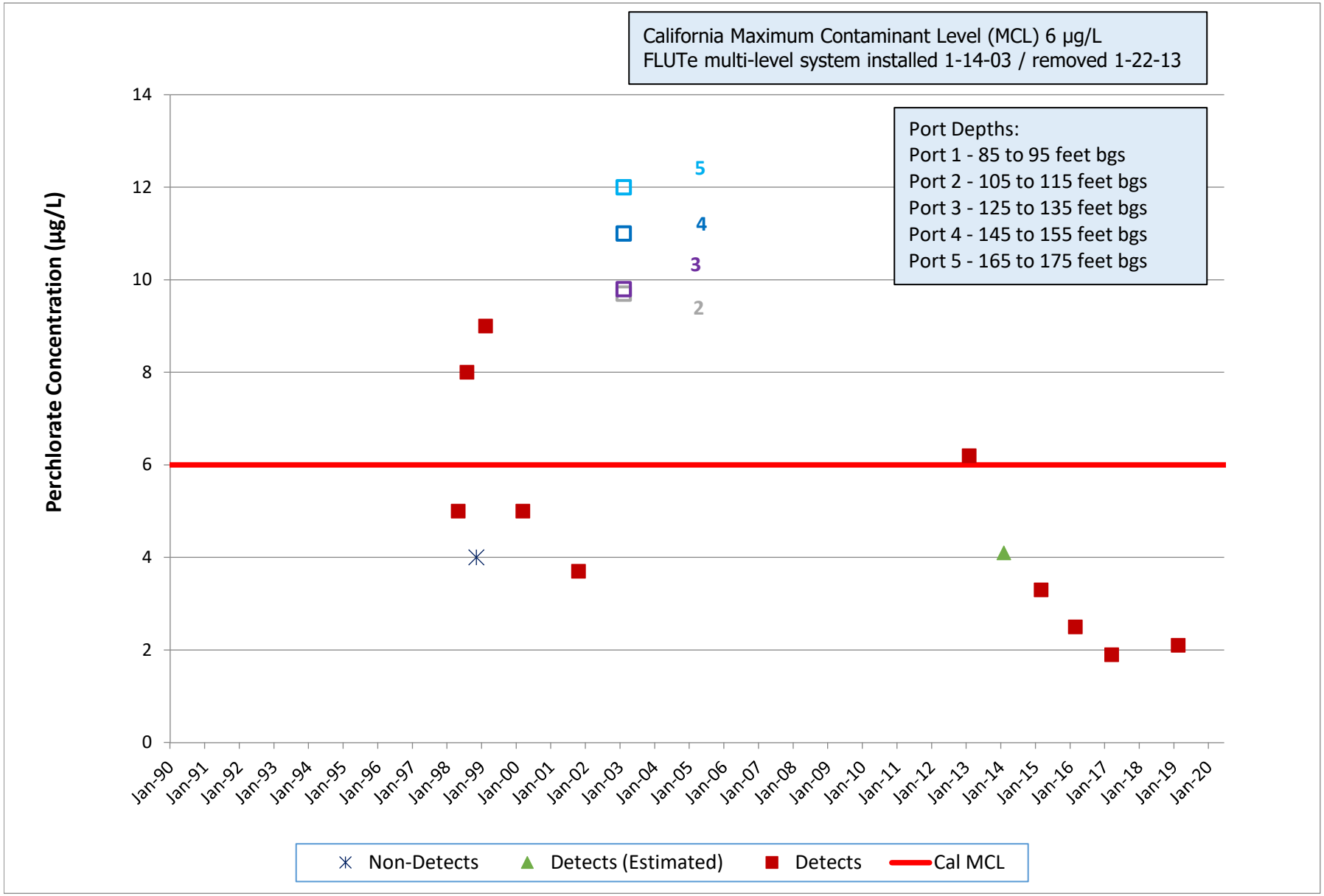
RD-59B, Offsite
Trichloroethene



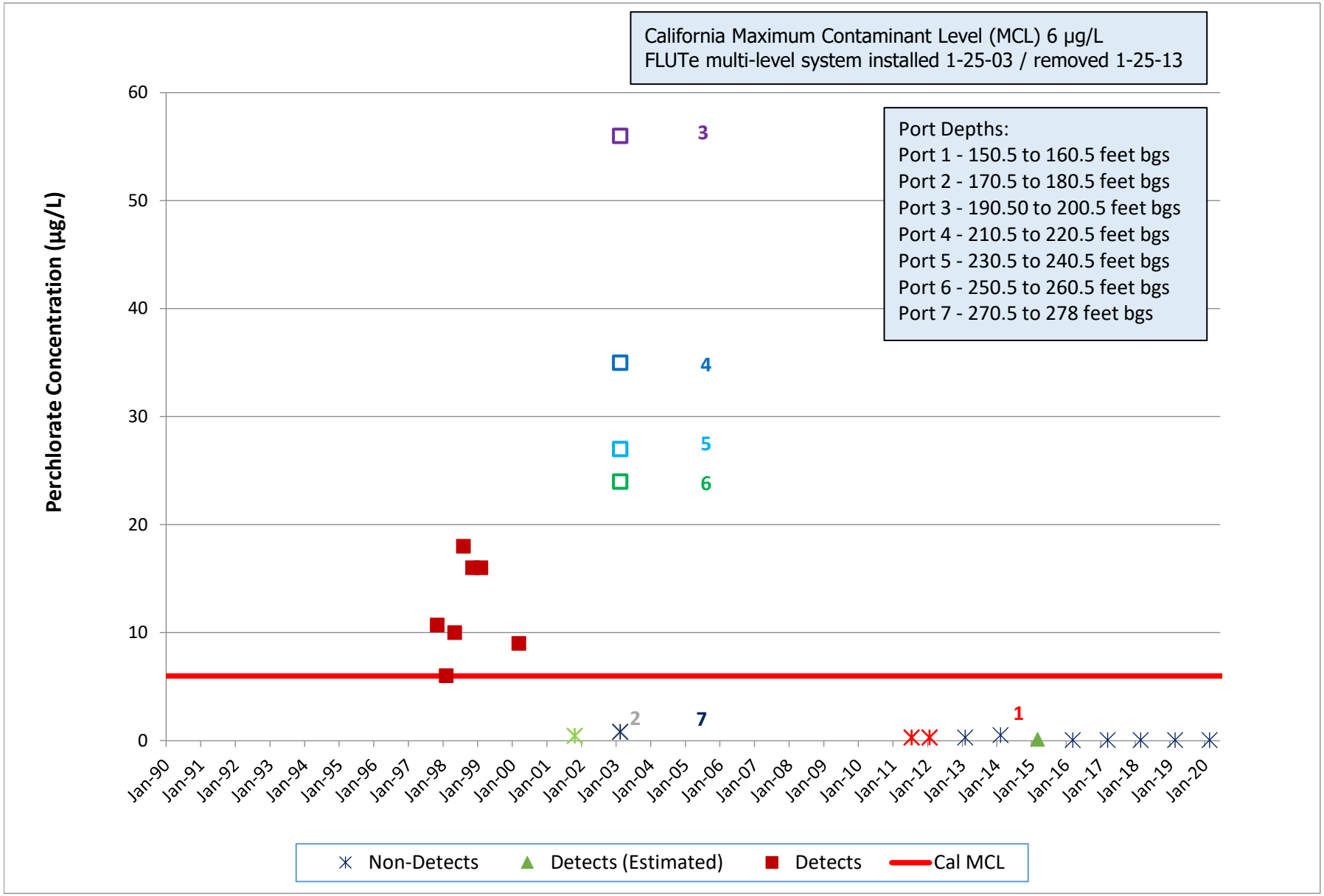
RD-59C, Offsite
Trichloroethene



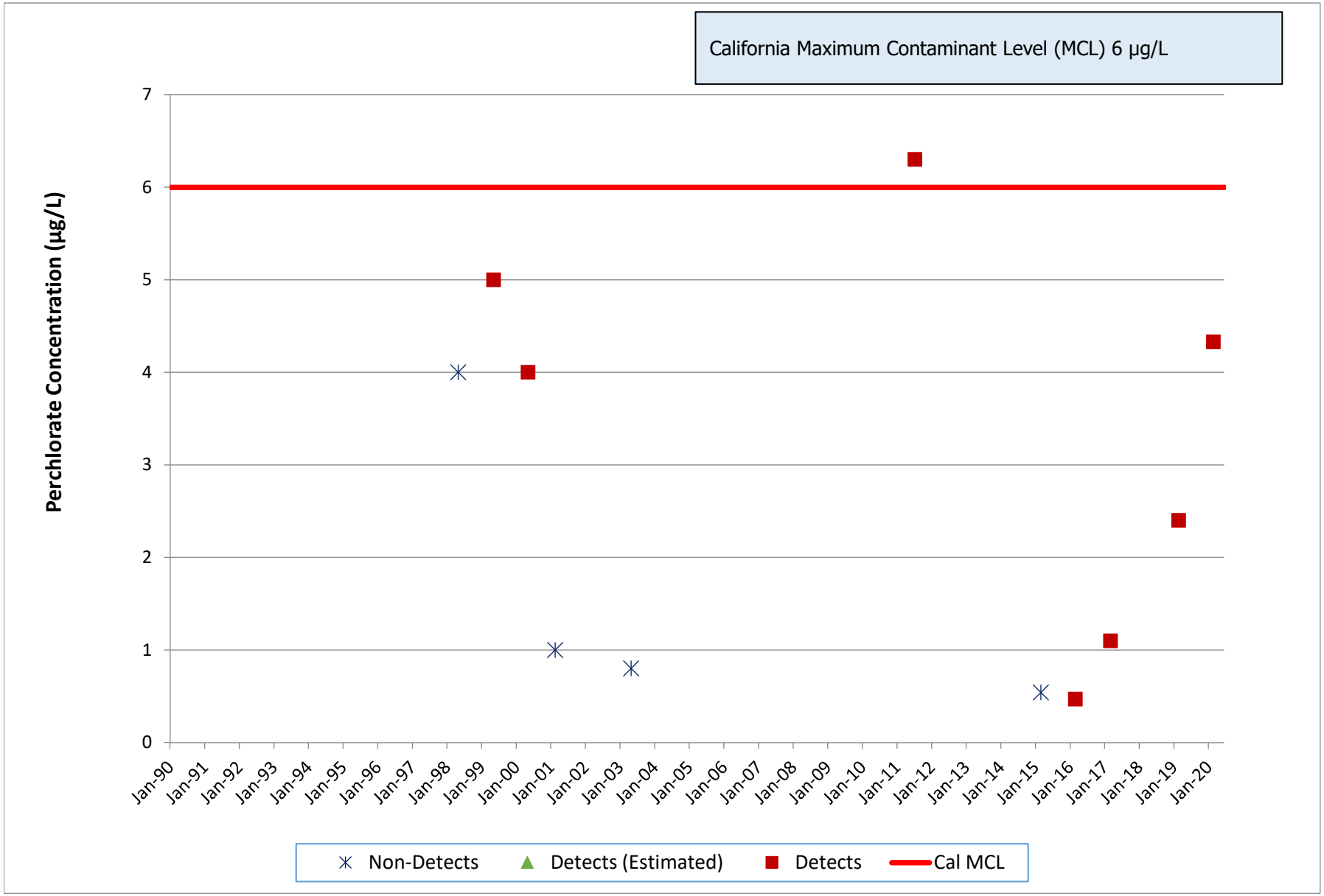
RD-21, FSDF/ESADA
Perchlorate



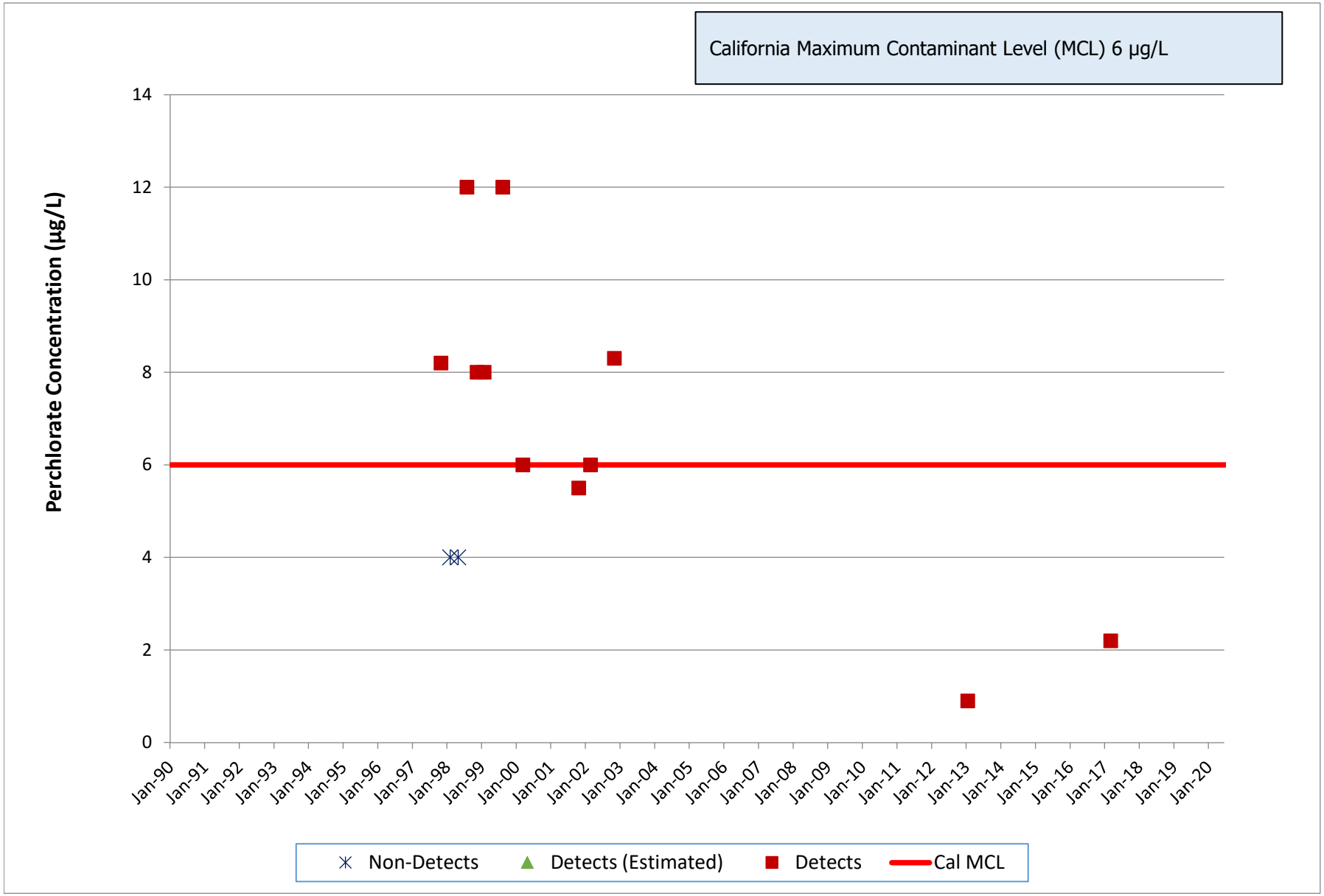
RD-54A, FSDF/ESADA
Perchlorate



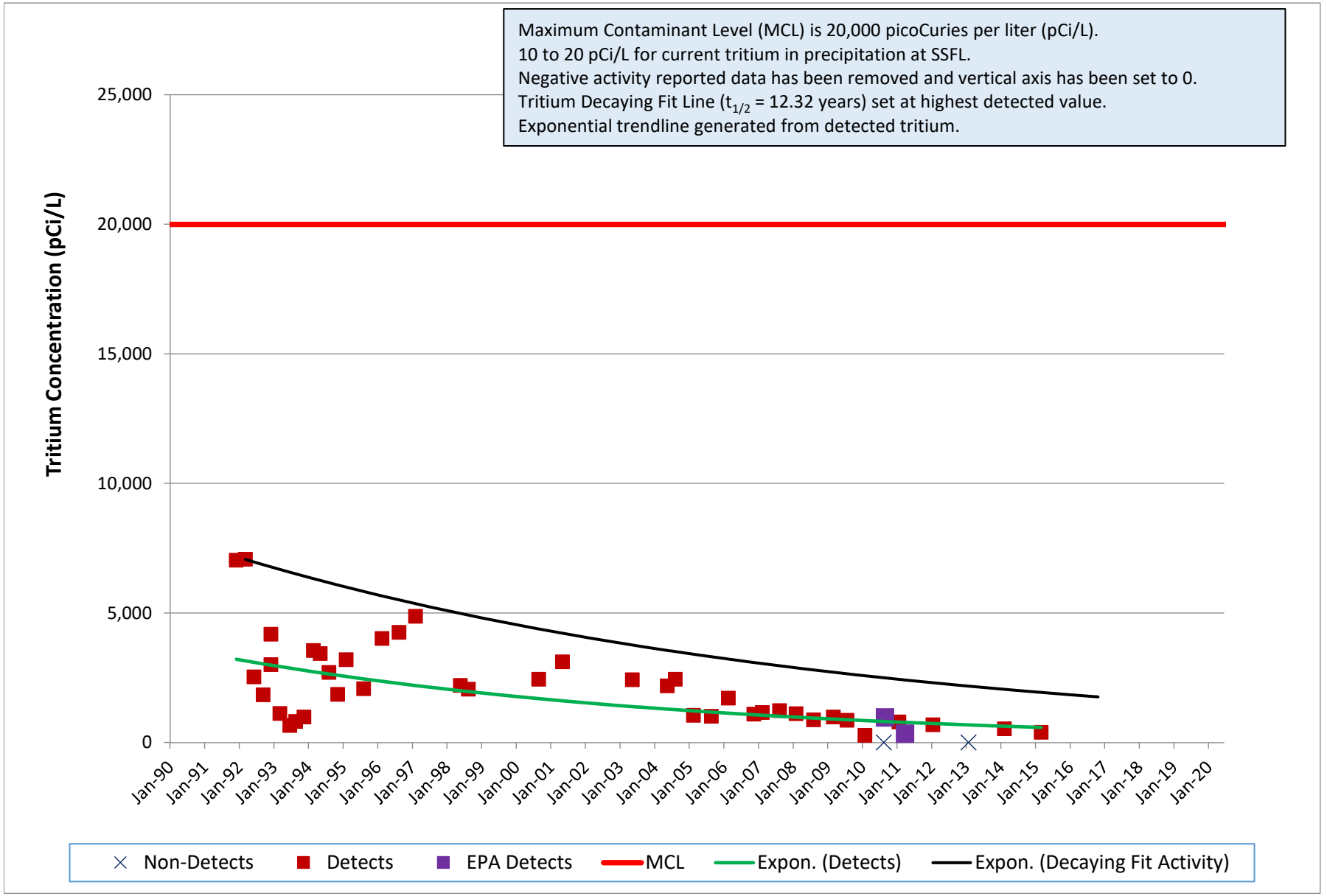
RS-18, FSDF/ESADA
Perchlorate



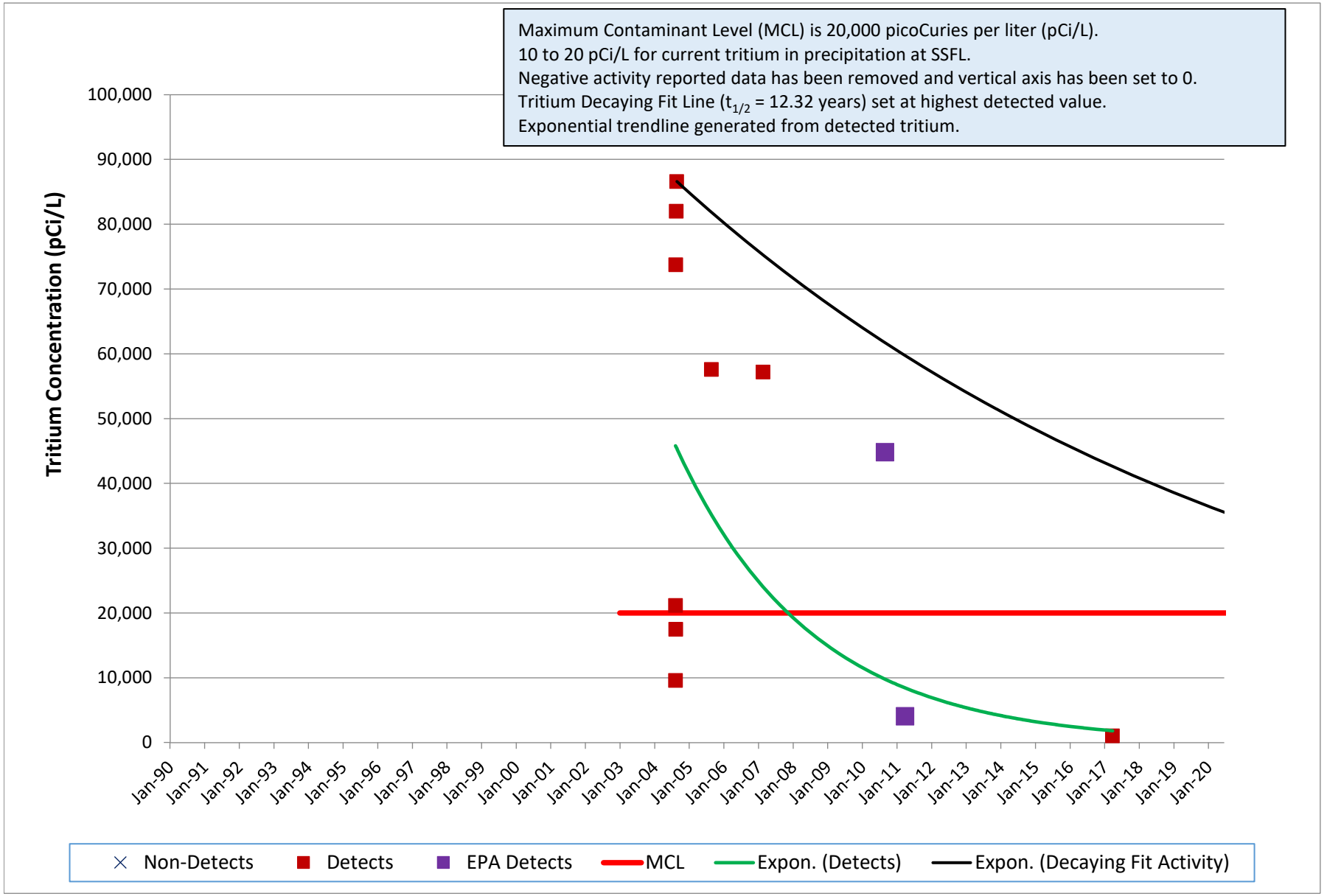
RS-54, FSDF/ESADA
Perchlorate



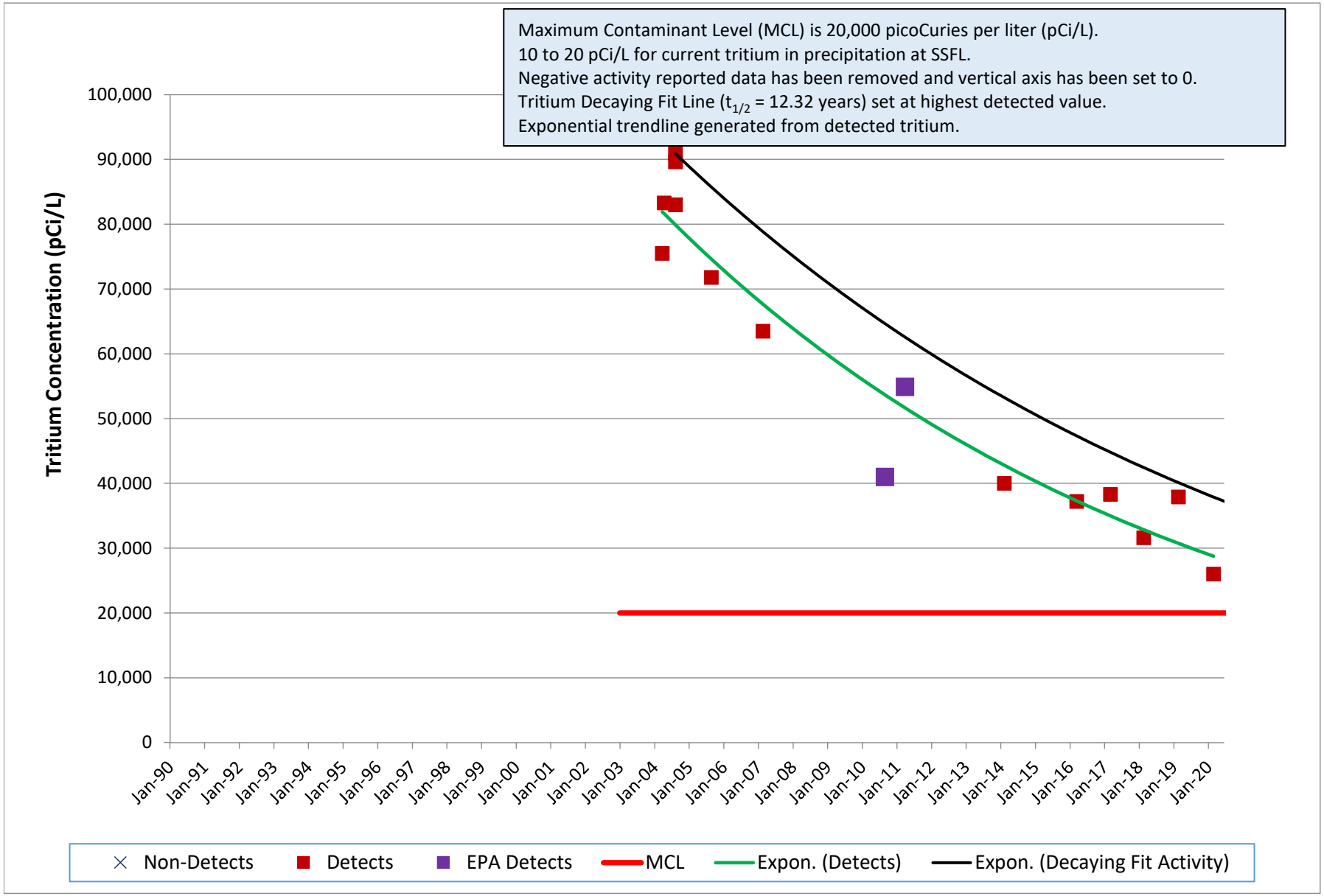
RD-34A, Tritium Plume
Tritium



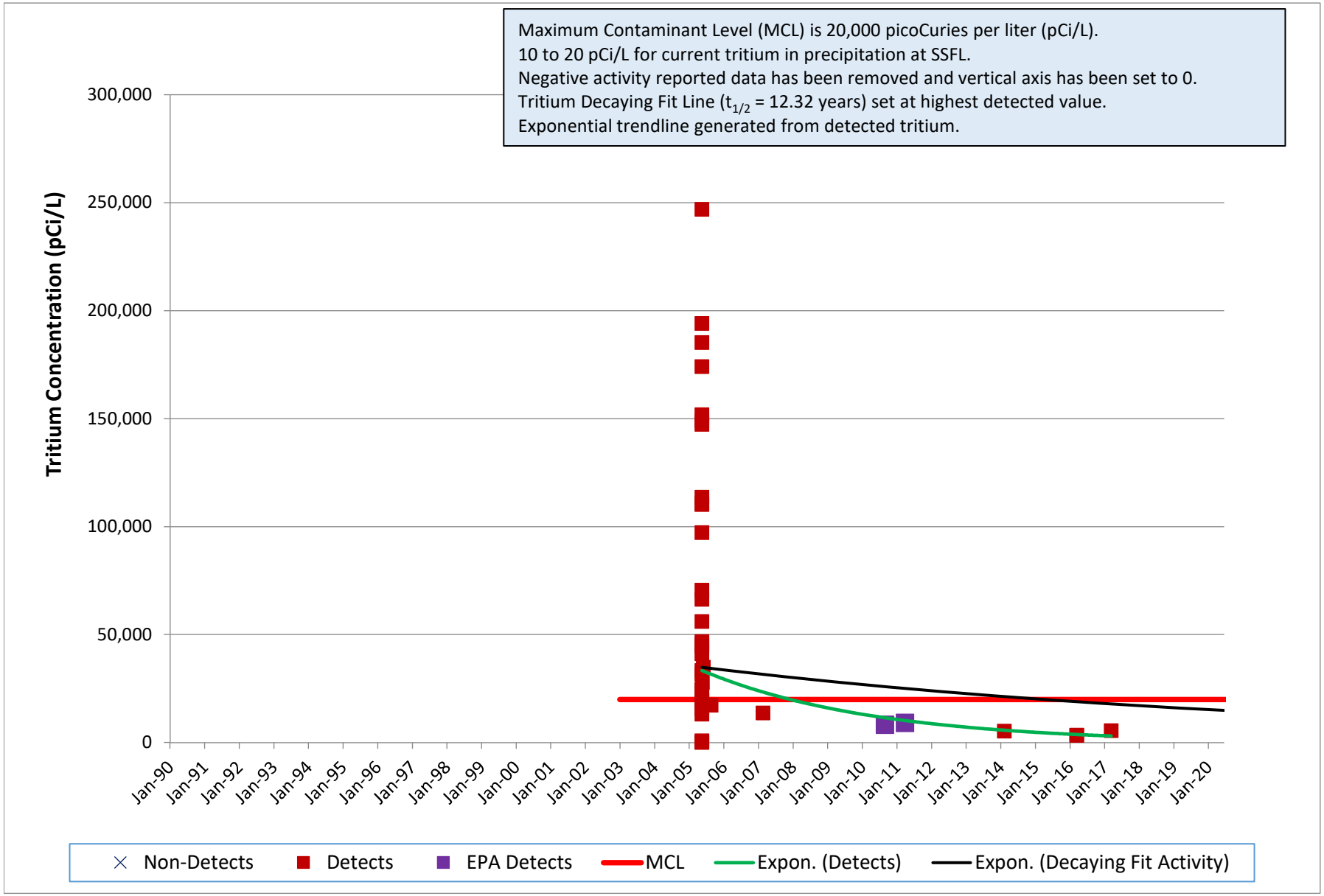
RD-88, Tritium Plume
Tritium



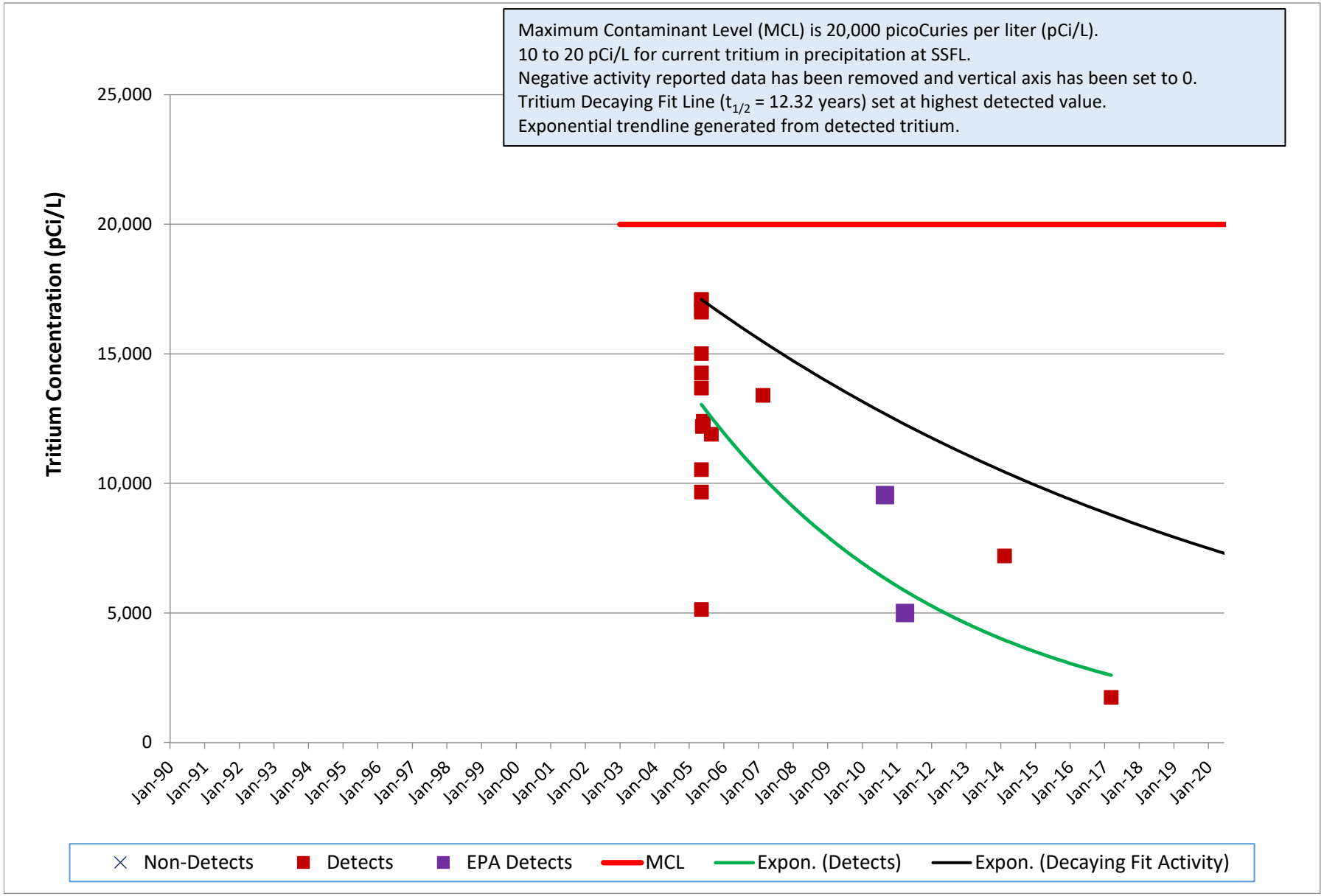
RD-90, Tritium Plume
Tritium



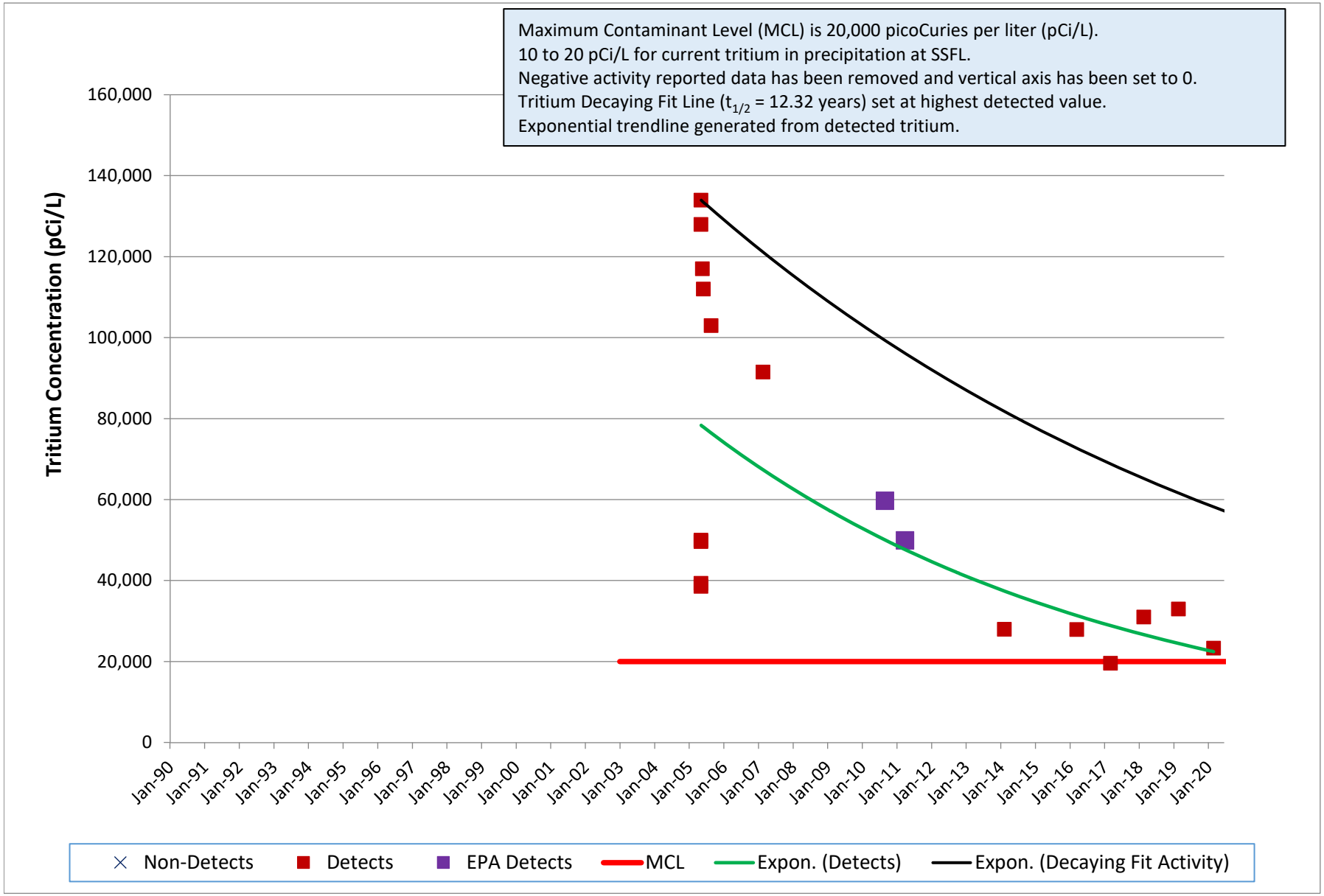
RD-93, Tritium Plume
Tritium



RD-94, Tritium Plume
Tritium



RD-95, Tritium Plume
Tritium



APPENDIX B. DATA VALIDATION QUALIFIER DEFINITIONS

Inorganic Data Validation Qualifiers

Flag	Definition
U	The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
J	The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
J+	The result is an estimated quantity, but the result may be biased high.
J-	The result is an estimated quantity, but the result may be biased low.
UJ	The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.
R	The data are unusable. The sample results are rejected due to serious deficiencies in meeting quality control criteria. The analyte may or may not be present in the sample.

Organic Data Validation Qualifiers

Flag	Definition
U	The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
J	The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
UJ	The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.
R	The data are unusable. The sample results are rejected due to serious deficiencies in meeting quality control criteria. The analyte may or may not be present in the sample.
NJ	Presumptively present at an estimated quantity (use with Tentatively Identified Compounds [TICs] only). A TIC is a compound not specified on the Target Compound List (TCL). A mass spectral library search is used to identify the compound.

Radiochemical Data Validation Qualifiers

Flag	Definition
	The analysis was performed, and radioactivity was detected (i.e., the radioanalytical result is statistically positive at the 95% confidence interval and is above its MDC). **NOTE:** *The radionuclide is considered to be present in the sample.*
U	The analysis was performed, but no radioactivity was detected (i.e., the radioanalytical result was not statistically positive at the 95% confidence interval and/or the result was below its MDC). The "U" qualifier flag is also applicable to any result reported as zero (0) (± an associated uncertainty). **NOTE:** *The radionuclide is not considered to be present in the sample.*
UJ	The analysis was performed, but the result is highly questionable due to analytical and/or laboratory quality control anomalies. The use of such a result is strongly discouraged. Analytical and quality control anomalies include such items as: significant blank contamination, known photopeak interferences and/or photopeak resolution problems, known matrix interferences, unacceptable laboratory control sample recoveries, serious instrument calibration problems, improper sample preservation, etc. The "UJ" qualifier flag could designate a possible false positive result in the case of a result that is statistically positive at the 95% confidence level. The "UJ" qualifier flag could indicate the result is considered an estimated non-detect (a non-detect that may be due to loss of analyte from lack of sample preservation, holding time exceedances, etc.). The specific use of the "UJ" flag is included by the validator in the text of the validation report. **NOTE:** *The radionuclide may or may not be present in the sample and the result is considered highly questionable.*
J	The analysis was performed, and radioactivity was detected (i.e., the radionuclide result is statistically positive at the 95% confidence interval and is above its MDC). However, the result is questionable due to analytical and/or laboratory quality control anomalies/ irregularities and should therefore be used only as an estimated (approximated) quantity. Analytical and/or quality control anomalies include such items as: laboratory duplicate imprecision, unsatisfactory analytical yields, insufficient laboratory control sample recoveries, unacceptable PE sample results, instrument calibration problems, improper sample preservation, etc. **NOTE:** *The radionuclide is considered to be present in the sample; however, the result may not be an accurate representation of the amount of activity actually present in the sample.*
R	The analysis result is unusable and was rejected due to severe analytical and/or quality control problems. **NOTE:** *The radionuclide may or may not be present, and the result is known to be inaccurate or imprecise.*