



**U.S. Department of Energy
National Nuclear Security Administration**

Livermore Field Office, Livermore, California 94551

Lawrence Livermore National Laboratory

Lawrence Livermore National Security, LLC, Livermore, California 94551



LLNL-AR-855267

**Building 511
Air Sample Results
July 11 to July 18, 2023
Lawrence Livermore National Laboratory
Livermore Site**

October 2023



Environmental Restoration Department

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Acronyms and Abbreviations

1,1,1-TCA	1,1,1-trichloroethane
BAAQMD	Bay Area Air Quality Management District
CFORM	chloroform
<i>cis</i> -1,2-DCE	<i>cis</i> -1,2-dichloroethene
DOE	U.S. Department of Energy
DTSC	California Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
ft	feet
HS	Hotspot
LFO	Livermore Field Office
LLNL	Lawrence Livermore National Laboratory
PCE	perchloroethene or tetrachloroethene
PPM(V/V)	parts per million on a volume-to-volume basis
PZ	Perched Zone
RPM	remedial project managers
RWQCB	California Regional Water Quality Control Board
<i>trans</i> -1,2-DCE	<i>trans</i> -1,2-dichloroethene
TCE	trichloroethene
µg/L	micrograms per liter
µg/m ³	micrograms per cubic meter
VI	vapor intrusion
VOC	volatile organic compound
VTF	soil vapor treatment facility (used for specific facility names, e.g., VTF511)

1. Introduction

From July 11 to July 18, 2023, indoor air was sampled in Building 511 at Lawrence Livermore National Laboratory (LLNL) Livermore Site as part of a long-term indoor air monitoring program that evaluates the potential risk of vapor intrusion (VI) from residual subsurface contamination to indoor air. This report was prepared for the communication of indoor air screening level exceedances of tetrachloroethene (PCE) in (b) (7)(F) and chloroform (CFORM) in (b) (7)(F) that occurred during this sample event. During this event, PCE and CFORM were the only volatile organic compounds (VOC) that exceeded their respective indoor air screening levels.

The following sections of this report present an overview of LLNL and the U.S. Department of Energy's (DOE) indoor air sampling activities at Building 511; this building's use and occupancy; indoor air screening level exceedances and detections that occurred previously and during the sample event from July 11 to July 18, 2023; historical and current subsurface VOC concentrations; and next steps.

These discussions are supplemented by three tables:

- **Table 1:** Air sample results for the sample event in parts per million on a volume-to-volume basis (PPM[V/V]).
- **Table 2:** Air sample results for the sample event in micrograms per cubic meter ($\mu\text{g}/\text{m}^3$).
- **Table 3:** Historical and current maximum concentrations of VOCs in groundwater and soil vapor samples from wells within 100 feet (ft) of Building 511's footprint.

Note that, while Tables 1 and 2 present the indoor air sample results for all sampling locations in Building 511, this report focuses on (b) (7)(F) and (b) (7)(F), the only locations with indoor air screening level exceedances during the sample event. Additionally, Table 3 includes all VOCs detected in air samples collected as part of the long-term indoor air monitoring program to evaluate potential VI from residual subsurface contamination to indoor air at the building. In Table 3, all groundwater concentrations are provided in units of micrograms per liter ($\mu\text{g}/\text{L}$), and all soil vapor concentrations are provided in units of PPM(V/V) and $\mu\text{g}/\text{m}^3$.

2. Building 511

Since 2018, DOE/LLNL has been monitoring indoor air in Building 511 for potential VI from subsurface contamination during the winter and summer months. Per the *Addendum to the Fifth Five-Year Review for the Lawrence Livermore National Laboratory Livermore Site* (Demir, McKereghan, and Porubcan 2021), this building is included in the long-term indoor air monitoring program, given that it had a PCE and/or trichloroethene (TCE) detection during sample events in 2018 and/or 2019.

2.1. Building Use and Occupancy

Located in the southeastern corner of the Livermore Site, Building 511 is a two-story, industrial building on a concrete slab. The building consists primarily of manufacturing workshops but also has offices, conference rooms, breakrooms, kitchens, restrooms, a control room, and a shower.

With alternate and flexible work schedules, personnel occupy the building for various amounts of time. (b) (7)(F)

2.2. Indoor Air Sampling

During the sample event from July 11 to July 18, 2023 at Building 511, twenty locations were sampled to evaluate indoor air and areas of preferential pathways. Outdoor ambient air samples were also collected. All locations sampled were selected based on guidance provided by the U.S. Environmental Protection Agency (EPA) and California Department of Toxic Substances Control (DTSC) during a Livermore Site visit in May 2018 and key elements discussed in working group meetings with Livermore Site remedial project managers (RPMs), including DOE Livermore Field Office (LFO), EPA, DTSC, and the California Regional Water Quality Control Board (RWQCB), as well as regulatory support staff and contractors.

Since indoor air monitoring began in 2018 at Building 511, the building has been sampled eight times and all VOCs have been below their respective indoor air screening levels with the exception of PCE and CFORM. During the sample event from July 11 to July 18, 2023, PCE exceeded the indoor air screening level in (b) (7)(F) and chloroform exceeded the indoor air screening level in (b) (7)(F), as shown in Tables 1 and 2.

During this sample event, 1,1,1-trichloroethane (1,1,1-TCA), CFORM, and *trans*-1,2-dichloroethene (*trans*-1,2-DCE) were also detected in (b) (7)(F) though at concentrations below their respective indoor air screening levels. In (b) (7)(F), TCE and *trans*-1,2-DCE were detected at concentrations below their respective indoor air screening levels. Similarly, PCE, TCE, 1,1,1-TCA, CFORM, *cis*-1,2-dichloroethene (*cis*-1,2-DCE), and *trans*-1,2-DCE were detected at concentrations below their respective indoor air screening levels.

CTET was ubiquitously detected at nearly identical concentrations at every outdoor ambient air location as well as at every indoor air and area of preferential pathway sample location. These concentrations detected were also similar to levels observed in multiple ambient air studies, including the Bay Area Air Quality Management District's (BAAQMD) *Summary and Analysis of Cupertino Air Monitoring Results* (2014) and the EPA's *2013 National Monitoring Programs Annual Report (UATMP, NATTS, CSATAM)* (2015). As such, CTET concentrations detected in air samples collected during the sample event from July 11 to July 18, 2023, at Building 511 are likely representative of background levels, and therefore, are not discussed further in this report.

2.2.1. PCE Indoor Air Screening Level Exceedances

Previously, in (b) (7)(F) in June 2018 PCE was detected at 0.00045 PPM(V/V) ($3.1 \mu\text{g}/\text{m}^3$), thus exceeding the long-term cancer indoor air screening level of 0.000295 PPM(V/V) ($2.0 \mu\text{g}/\text{m}^3$). This room has been sampled eight times since then, including from July 11 to July 18, 2023, and PCE has not been detected above the indoor air screening level.

Likewise, previously in (b) (7)(F) in July and September 2022, PCE was detected at 0.0014 PPM(V/V) ($9.5 \mu\text{g}/\text{m}^3$) and 0.0020 PPM(V/V) ($14 \mu\text{g}/\text{m}^3$), respectively, thus exceeding the long-term cancer indoor air screening level of 0.000295 PPM(V/V) ($2.0 \mu\text{g}/\text{m}^3$). This room contains an active sheet metal shop where chemicals that contain VOCs are used. Prior to these two PCE exceedances,

this room was sampled five times between 2018 and 2022, during which PCE was not detected above the analytical laboratory reporting limit. In late December 2022, DOE/LLNL minimized activity in the sheet metal shop and removed additional chemicals from the room to minimize potential indoor air sources of VOCs. Following this mitigative action, (b) (7)(F) has been sampled three times, including from July 11 to July 18, 2023, and PCE has not been detected above the analytical laboratory reporting limit of 0.000025 PPM(V/V) ($0.17 \mu\text{g}/\text{m}^3$). Therefore, the PCE indoor air screening level exceedances in (b) (7)(F) are likely due to potential VOC sources located in the room.

During the sample event from July 11 to July 18, 2023, PCE was detected at 0.00066 PPM(V/V) ($4.5 \mu\text{g}/\text{m}^3$) in (b) (7)(F) thus exceeding the long-term cancer indoor air screening level of 0.000295 PPM(V/V) ($2.0 \mu\text{g}/\text{m}^3$). This high-bay contains an active shop where various items are fabricated and chemicals that contain VOCs are used. These chemicals were removed from the high-bay as much as practicable prior to resampling. The room was resampled from August 22 to August 29, 2023, and PCE was detected at 0.00016 PPM(V/V) ($1.1 \mu\text{g}/\text{m}^3$), which is below the indoor air screening level. Many of the same chemicals identified and used in (b) (7)(F) where there were prior PCE indoor air screening level exceedances, were also noted to be in the vicinity of the sample location in (b) (7)(F). Therefore, the PCE indoor air screening level exceedance in (b) (7)(F) is likely due to potential VOC sources located in the room.

2.2.2. CFORM Indoor Air Screening Level Exceedances

During the sample event from July 11 to July 18, 2023, CFORM was detected at 0.00033 PPM(V/V) ($1.6 \mu\text{g}/\text{m}^3$) in Room 144A, thus exceeding the long-term cancer indoor air screening level of 0.000109 PPM(V/V) ($0.53 \mu\text{g}/\text{m}^3$). Since regulatory agencies requested that DOE/LLNL focus resampling on PCE or TCE exceedances and this exceedance was for CFORM, (b) (7)(F) was not resampled.

2.3. Subsurface Volatile Organic Compound Concentrations

A total of 24 wells are located within 100 ft of Building 511's footprint, of which 15 are completed in the first water-bearing zone. Groundwater VOC data is available from 9 of these wells completed in the first water-bearing zone while soil vapor VOC data is available from 13 of the wells completed within 100 ft of the building.

Table 3 summarizes the historical and current maximum concentrations of PCE, TCE, 1,1,1-TCA, CFORM, *cis*-1,2-DCE, and *trans*-1,2-DCE in groundwater and soil vapor samples collected from these wells. All five of these VOCs were detected in air samples collected as part of the long-term indoor air monitoring program to evaluate potential VI from residual subsurface contamination to indoor at Building 511 during this sample event.

Table 3. Historical and current maximum concentrations of PCE and TCE and maximum concentrations of other pertinent VOCs in groundwater and soil vapor samples collected from wells completed within 100 ft of Building 511's footprint.

VOC	Historical maximum			Maximum since January 1, 2018		
	Groundwater µg/L	Soil vapor PPM(V/V)	Soil vapor µg/m ³	Groundwater µg/L	Soil vapor PPM(V/V)	Soil vapor µg/m ³
PCE	1,400	16	110,000	69	9.4	64,000
TCE	13,000	1,700	9,100,000	2,900	5.6	30,000
1,1,1-TCA	9	0.16	870	< 0.5	0.04	220
CFORM	53	1.2	5,900	6.1	0.35	1,700
<i>cis</i> -1,2-DCE	170	2.5	9,900	132	2.2	8,700
<i>trans</i> -1,2-DCE	0.96	0.014	56	0.89	< 0.0044	< 17

As shown, concentrations have significantly declined from historical levels as a result of continued remediation efforts. Groundwater remediation at the Livermore Site began in 1989, and vadose zone remediation began in 1995. Nearby former soil vapor treatment facility VTF518 began operation in 1995 and was replaced by VTF518 Perched Zone (VTF518-PZ) in 2004. Soil vapor treatment facilities VTF406 Hotspot (VTF406-HS) and VTF511 are also nearby and began operation in 2005 and 2006, respectively. All three facilities were operational during the sample event from July 11 to July 18, 2023.

2.4. Conclusion

Concentrations of TCE in groundwater samples collected from wells within the first water bearing zone and 100 ft of Building 511's footprint are at least an order of magnitude higher than any of the other VOCs (PCE, 1,1,1-TCA, CFORM, *cis*-1,2-DCE, and *trans*-1,2-DCE) detected in indoor air samples collected at Building 511 during this sample event. Similarly, TCE in soil vapor samples collected from wells within 100 ft of Building 511's footprint is about the same concentration as PCE and an order of magnitude higher than the other VOCs detected in indoor air samples during this event. As such, proportionate TCE concentrations in indoor air samples would be anticipated if there was significant vapor intrusion. Since chemicals that contain VOCs are used in (b) (7)(F) and TCE was not detected above the reporting limit of 0.000027 PPM(V/V) (0.15 µg/m³), the PCE indoor air screening level exceedance is likely due to potential VOC sources located in the room. Additionally, given that CFORM concentrations in the sub surface are an order of magnitude lower the PCE and TCE concentration the CFORM exceedance is also likely due to indoor VOC sources.

DOE/LLNL believes that VI from subsurface contamination to indoor air does not pose an indoor air inhalation risk to occupants in Building 511 while the soil vapor treatment facilities around Building 511 (e.g., VTF406-HS, VTF511, and VTF518-PZ) are operating. Since regulatory agencies requested that DOE/LLNL focus resampling on PCE or TCE exceedances, (b) (7)(F) was resampled from August 22 to 29, 2023, and PCE was below the long-term cancer indoor air screening level. All results of analytical samples collected as part of the long-term indoor air monitoring program are included in the Livermore Site annual reports.

3. References

- BAAQMD (Bay Area Air Quality Management District). 2014. *Summary and Analysis of Cupertino Air Monitoring Results*. San Francisco, CA: BAAQMD. https://www.baaqmd.gov/~/_media/files/technical-services/summary_and_analysis_of_cupertino_air_monitoring_revised_20140708_final.pdf?la=en.
- Demir, Zafer, Peter McKereghan, and Alexis Porubcan. 2021. *Addendum to the Fifth Five-Year Review for the Lawrence Livermore National Laboratory Livermore Site*. Livermore, CA: LLNL. LLNL-AR-809279.
- U.S. EPA (U.S. Environmental Protection Agency). 2015. *U.S. EPA's 2013 National Monitoring Programs Annual Report (UATMP, NATTS, CSATAM)*. Research Triangle Park, NC: EPA. <https://www.epa.gov/sites/default/files/2021-03/documents/2013nmpreport.pdf>.

Building 511 Air Sample Results
July 11 to July 18, 2023
LLNL Livermore Site

Table 1. Building 511 air sample results from July 11 to July 18, 2023. All results are in parts per million on a volume-to-volume basis [PPM(V/V)].

Screening levels [PPM(V/V)]			1,1,1-Trichloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	Carbon tetrachloride	Chloroform	Tetrachloroethene	Trichloroethene	Trichlorofluoromethane	Trichlorotrifluoroethane	Vinyl chloride	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene
Urgent response											0.00391 ^c					
Accelerated response											0.00130 ^c					
Hazardous non-cancer target (THQ = 1)			0.806 ^a	0.000161 ^b	0.865 ^a	0.0782 ^a	0.00766 ^b	0.0286 ^a	0.0881 ^b	0.0265 ^b	0.00164 ^b	0.943 ^a	2.87 ^b	0.137 ^b	0.00883 ^a	0.0454 ^b
Long-term cancer target (TCR = 1E-06)				0.000141 ^b	0.00190 ^b		0.000116 ^b	0.000318 ^b	0.000109 ^b	0.000295 ^a	0.000558 ^b			0.000626 ^a		
Description of sampling location	Sample location	Date	1,1,1-Trichloroethane PPM(V/V)	1,1,2-Trichloroethane PPM(V/V)	1,1-Dichloroethane PPM(V/V)	1,1-Dichloroethene PPM(V/V)	1,2-Dichloroethane PPM(V/V)	Carbon tetrachloride PPM(V/V)	Chloroform PPM(V/V)	Tetrachloroethene PPM(V/V)	Trichloroethene PPM(V/V)	Trichlorofluoromethane ^d PPM(V/V)	Trichlorotrifluoroethane ^d PPM(V/V)	Vinyl chloride ^d PPM(V/V)	cis-1,2-Dichloroethene PPM(V/V)	trans-1,2-Dichloroethene PPM(V/V)
Outdoor																
Outdoor sample northeast of Building 511.	VI-LS-OUT-002	7/11/23	< 0.000029	< 0.000028	< 0.000039	< 0.00013	< 0.000032 E	0.000043	< 0.000027 E	< 0.000025 E	< 0.000027				< 0.000040	< 0.000084
Outdoor sample northeast of Building 511.	VI-LS-OUT-002	7/11/23 DUP	< 0.000029	< 0.000028	< 0.000039	< 0.00013	< 0.000032 E	0.000039	< 0.000027 E	< 0.000025 E	< 0.000027				< 0.000040	< 0.000083
Outdoor sample northwest of Building 511.	VI-LS-OUT-003	7/11/23	< 0.000029	< 0.000028	< 0.000039	< 0.00013	< 0.000032 E	0.000044	< 0.000027 E	< 0.000025 E	< 0.000027				< 0.000040	< 0.000084
Indoor																
Building 511 (b) (7)(F) sample on the kitchen counter.	VI-B511-(b) (7)(F) 01	7/11/23	< 0.000029	< 0.000028	< 0.000039	< 0.00013	< 0.000032 E	0.000030	< 0.000027 E	< 0.000025 E	< 0.000027				< 0.000040	< 0.000083 E
Building 511 (b) (7)(F) sample on a table near the middle of the room.	VI-B511-(b) (7)(F) 01	7/11/23	< 0.000029 E	< 0.000027	< 0.000039	< 0.00013	< 0.000032 E	0.000037	< 0.000027 E	< 0.000025 E	< 0.000027 E				< 0.000040	< 0.000083 E
Building 511 (b) (7)(F) sample on the desk in the office.	VI-B511-(b) (7)(F) 01	7/11/23 DUP	< 0.000029	< 0.000027	< 0.000038	< 0.00013	< 0.000032 E	0.000041	< 0.000027 E	0.000036	0.000098				< 0.000040	< 0.000082 E
Building 511 (b) (7)(F) sample on the desk in the office.	VI-B511 (b) (7)(F) 01	7/11/23	< 0.000029	< 0.000028	< 0.000039	< 0.00013	< 0.000032 E	0.000038	< 0.000027 E	0.000034	0.000092				< 0.000040	< 0.000083 E
Building 511 (b) (7)(F) sample on the desk in the office.	VI-B511 (b) (7)(F) 02	7/11/23	< 0.000029	< 0.000028	< 0.000039	< 0.00013	< 0.000032 E	0.000035	< 0.000027 E	< 0.000025 E	< 0.000027				< 0.000040	< 0.000083 E
Building 511 (b) (7)(F) sample in the breathing space of the clean room.	VI-B511 (b) (7)(F) 02	7/11/23	< 0.000029 E	< 0.000028 E	< 0.000039	< 0.00013	< 0.000032 E	0.000031	0.000029	< 0.000025 E	< 0.000027 E				< 0.000040	0.00024
Building 511 (b) (7)(F) sample near the shower.	VI-B511 (b) (7)(F) 01	7/11/23	< 0.000029 E	< 0.000028 E	< 0.000039	< 0.00013	< 0.000032 E	0.000034	0.000034	< 0.000025 E	< 0.000027 E				< 0.000040	0.00048
Building 511 (b) (7)(F) sample on the table near the middle of the breakroom.	VI-B511-(b) (7)(F) 01	7/11/23	< 0.000029	< 0.000028	< 0.000039	< 0.00013	< 0.000032 E	0.000040	0.000051	< 0.000025 E	< 0.000027				< 0.000040	< 0.000084 E
Building 511 (b) (7)(F) sample on the countertop in the shop.	VI-B511 (b) (7)(F) 01	7/11/23	0.00042	< 0.000028	< 0.000039	< 0.00013	< 0.000032 E	0.000033	< 0.000027 E	< 0.000025	0.00013				< 0.000040 E	0.0016
Building 511 (b) (7)(F) sample on the desk near the utilities that run along the eastern wall in the control room.	VI-B511-(b) (7)(F) 01	7/11/23	0.000029	< 0.000028 E	< 0.000039	< 0.00013	< 0.000032 E	0.000024	< 0.000027	< 0.000025 E	< 0.000027 E				< 0.000040	0.000084
Building 511 (b) (7)(F) sample on the table in the breakroom with the door open to Room 110A.	VI-B511 (b) (7)(F) 01	7/11/23	0.000032	< 0.000028 E	< 0.000039	< 0.00013	< 0.000032 E	0.000030	0.000030	< 0.000025 E	< 0.000027 E				< 0.000040	0.00098
Building 511 (b) (7)(F) sample on the conference table near the middle of the room.	VI-B511-(b) (7)(F) 01	7/11/23 DUP	0.000040	< 0.000028	< 0.000039	< 0.00013	< 0.000032 E	0.000035	0.000030	0.000026	< 0.000027 E				0.000055	0.0099
Building 511 (b) (7)(F) sample on the conference table near the middle of the room.	VI-B511 (b) (7)(F) 01	7/11/23	0.000046	< 0.000028	< 0.000039	< 0.00013	< 0.000032 E	0.000040	0.000032	0.000027	< 0.000027 E				0.000083	0.011
Building 511 (b) (7)(F) sample on the countertop in the shop.	VI-B511 (b) (7)(F) 01	7/11/23	0.000054	< 0.000028	< 0.000039	< 0.00013	< 0.000032 E	0.000028	0.000028	0.000025	< 0.000027 E				0.000042	0.012
Building 511 (b) (7)(F) sample in the breathing space near the northwest corner of the room where there is a building footing in the interior space of the shop.	VI-B511-(b) (7)(F) 01	7/11/23	< 0.000030 E	< 0.000028	< 0.000040	< 0.00013	< 0.000032	0.000036	< 0.000028 E	< 0.000025 E	< 0.000027				< 0.000041	< 0.000085
Building 511 (b) (7)(F) sample on the desk in the office.	VI-B511 (b) (7)(F) 01	7/11/23	< 0.000029 E	< 0.000028	< 0.000039	< 0.00013	< 0.000032 E	0.000037	0.00033	< 0.000025 E	0.000030				< 0.000040	0.00028
Building 511 (b) (7)(F) sample on the table in the breakroom.	VI-B511 (b) (7)(F) 01	7/11/23	< 0.000029 E	< 0.000028	< 0.000039	< 0.00013	< 0.000032 E	0.000035	< 0.000027 E	< 0.000025 E	< 0.000027 E				< 0.000040	0.00038
Building 511 (b) (7)(F) sample on the conference table near the middle of the room.	VI-B511 (b) (7)(F) 01	7/11/23	< 0.000029 E	< 0.000028	< 0.000039	< 0.00013	< 0.000032 E	0.000033	< 0.000027 E	< 0.000025 E	< 0.000027 E				< 0.000040	0.00011
Building 511 (b) (7)(F) sample in the office.	VI-B511 (b) (7)(F) 01	7/11/23	< 0.000030 E	< 0.000028	< 0.000039	< 0.00013	< 0.000032 E	0.000029	< 0.000027	0.000053	< 0.000027 E				< 0.000041	0.00033
Building 511 (b) (7)(F) sample on a workbench near the middle of the high bay and shop area.	VI-B511 (b) (7)(F) 01	7/11/23	0.000094	< 0.000028 E	< 0.000039	< 0.00013	< 0.000032 E	0.000041	0.000027	0.00066	< 0.000027 E				< 0.000040	0.00052
Crawl space, confined space, or pathway																
Building 511 (b) (7)(F) sample by the wooden planks in the storage area.	VI-B511 (b) (7)(F) PTH-01	7/11/23	0.000034	< 0.000028	< 0.000039 E	< 0.00013	< 0.000032 E	0.000032	< 0.000027 E	< 0.000025 E	0.000069				< 0.000040 E	0.00015
Building 511 (b) (7)(F) sample on the second floor next to the elevator shaft on the southwest side of the building.	VI-B511 (b) (7)(F) PTH-01	7/11/23	< 0.000030	< 0.000028	< 0.000039	< 0.00013	< 0.000032 E	0.000049	< 0.000027	< 0.000025 E	< 0.000027				< 0.000040	< 0.000084 E

Notes:
^a DTSC SL: California Department of Toxic Substances Control Human Health Risk Assessment Note 3–Modified Screening Levels (DTSC SLs), June 2020 (revised May 2022).
^b VISL: U.S. Environmental Protection Agency (https://epa-visl.ornl.gov/cgi-bin/visl_search), vapor intrusion screening level (VISL) calculator (accessed March 12, 2023).
^c Urgent and accelerated response action levels, as defined in the U.S. EPA Region IX memorandum *Response Action Levels and Recommendations to Address Near-Term Inhalation Exposures to TCE in Air from Subsurface Vapor Intrusion* (July 2014), are also evaluated.
^d Volatile organic compound does not have an uptake rate available for Radiello 130® passive diffusive samplers, thus, no analytical results are provided.

DUP = duplicate sample; PPM(V/V) = parts per million on a volume-to-volume basis.
< Indicates the measured value is less than the reporting limit.
Data in bold font indicates a result above the reporting limit.
Data in bold and italic font indicates a result at or above an indoor air screening level.
Data qualifier flags
B = Analyte found in method blank; sample results should be evaluated.
D = Analysis performed at a secondary dilution or concentration.
E = The analyte was detected below the LLNL reporting limit, but above the analytical laboratory minimum detection limit or activity.
F = Analyte found in field blank, trip blank, or equipment blank; sample results should be evaluated.
H = Sample analyzed outside of holding time; sample results should be evaluated.
I = Surrogate or tracer yield recoveries were outside of QC limits; sample results should be evaluated.
J = The analyte was positively identified; however, the associated numerical value is the approximate concentration or activity of the analyte in the sample.
L = Matrix spike recoveries not within control limits.
O = Matrix spike duplicate relative percent difference (RPD), sample duplicate RPD, or relative error ratio (RER) not within control limits.
This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

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July 11 to July 18, 2023
LLNL Livermore Site

Table 2. Building 511 air sample results from July 11 to July 18, 2023. All results are in micrograms per cubic meter (µg/m³).

Screening levels (µg/m ³)			1,1,1-Trichloroethane		1,1,2-Trichloroethane		1,1-Dichloroethane		1,1-Dichloroethene		1,2-Dichloroethane		Carbon tetrachloride		Chloroform		Tetrachloroethene		Trichloroethene		Trichlorofluoromethane		Trichlorotrifluoroethane		Vinyl chloride		cis-1,2-Dichloroethene		trans-1,2-Dichloroethene					
Urgent response																			21 ^c															
Accelerated response																			7.0 ^c															
Hazardous non-cancer target (THQ = 1)			4,400 ^a		0.88 ^b		3,500 ^a		310 ^a		31 ^b		180 ^a		430 ^b		180 ^b		8.8 ^b		5,300 ^a		22,000 ^b		350 ^b		35 ^a		180 ^b					
Long-term cancer target (TCR = 1E-06)			0.77 ^b		7.7 ^b						0.47 ^b		2.0 ^b		0.53 ^b		2.0 ^a		3.0 ^b						0.16 ^a									
Description of sampling location			Sample location		Date		1,1,1-Trichloroethane		1,1,2-Trichloroethane		1,1-Dichloroethane		1,1-Dichloroethene		1,2-Dichloroethane		Carbon tetrachloride		Chloroform		Tetrachloroethene		Trichloroethene		Trichlorofluoromethane ^d		Trichlorotrifluoroethane ^d		Vinyl chloride ^d		cis-1,2-Dichloroethene		trans-1,2-Dichloroethene	
							µg/m ³		µg/m ³		µg/m ³		µg/m ³		µg/m ³		µg/m ³		µg/m ³		µg/m ³		µg/m ³		µg/m ³		µg/m ³		µg/m ³		µg/m ³			
Outdoor																																		
Outdoor sample northeast of Building 511.			VI-LS-OUT-002		7/11/23		<	0.16	<	0.15	<	0.16	<	0.52	<	0.13	E	0.27	<	0.13	E	<	0.17	E	<	0.15			<	0.16	<	0.33		
Outdoor sample northeast of Building 511.			VI-LS-OUT-002		7/11/23		DUP	<	0.16	<	0.15	<	0.16	<	0.52	<	0.13	E	0.25	<	0.13	E	<	0.17	E	<	0.15			<	0.16	<	0.33	
Outdoor sample northwest of Building 511.			VI-LS-OUT-003		7/11/23		<	0.16	<	0.15	<	0.16	<	0.52	<	0.13	E	0.28	<	0.13	E	<	0.17	E	<	0.15			<	0.16	<	0.33		
Indoor																																		
Building 511 (b) (7)(F) sample on the kitchen counter.			VI-B511 (b) (7)(F) 01		7/11/23		<	0.16	<	0.15	<	0.16	<	0.52	<	0.13	E	0.19	<	0.13	E	<	0.17	E	<	0.15			<	0.16	<	0.33	E	
Building 511 (b) (7)(F) sample on a table near the middle of the room.			VI-B511 (b) (7)(F) 01		7/11/23		<	0.16	E	<	0.15	<	0.16	<	0.52	<	0.13	E	0.23	<	0.13	E	<	0.17	E	<	0.15	E		<	0.16	<	0.33	E
Building 511 (b) (7)(F) sample on the desk in the office.			VI-B511 (b) (7)(F) 01		7/11/23		DUP	<	0.16	<	0.15	<	0.15	<	0.52	<	0.13	E	0.26	<	0.13	E	0.24	0.53			<	0.16	<	0.33	E			
Building 511 (b) (7)(F) sample on the desk in the office.			VI-B511 (b) (7)(F) 01		7/11/23		<	0.16	<	0.15	<	0.16	<	0.52	<	0.13	E	0.24	<	0.13	E	0.23	0.49			<	0.16	<	0.33	E				
Building 511 (b) (7)(F) sample on the desk in the office.			VI-B511 (b) (7)(F) 02		7/11/23		<	0.16	<	0.15	<	0.16	<	0.52	<	0.13	E	0.22	<	0.13	E	<	0.17	E	<	0.15		<	0.16	<	0.33	E		
Building 511 (b) (7)(F) sample in the breathing space of the clean room.			VI-B511 (b) (7)(F) 02		7/11/23		<	0.16	E	<	0.15	E	<	0.16	<	0.52	<	0.13	E	0.2	0.14	<	0.17	E	<	0.15	E		<	0.16	0.95			
Building 511 (b) (7)(F) sample near the shower.			VI-B511 (b) (7)(F) 01		7/11/23		<	0.16	E	<	0.15	E	<	0.16	<	0.52	<	0.13	E	0.21	0.17	<	0.17	E	<	0.15	E		<	0.16	1.9			
Building 511 (b) (7)(F) sample on the table near the middle of the breakroom.			VI-B511 (b) (7)(F) 01		7/11/23		<	0.16	<	0.15	<	0.16	<	0.52	<	0.13	E	0.25	0.25	<	0.17	E	<	0.15		<	0.16	<	0.33	E				
Building 511 (b) (7)(F) sample on the countertop in the shop.			VI-B511 (b) (7)(F) 01		7/11/23			2.3	<	0.15	<	0.16	<	0.52	<	0.13	E	0.21	<	0.13	E	<	0.17	0.70		<	0.16	E		6.3				
Building 511 Room 118A sample on the desk near the utilities that run along the eastern wall in the control room.			VI-B511 (b) (7)(F) 01		7/11/23			0.16	<	0.15	E	<	0.16	<	0.52	<	0.13	E	0.15	<	0.13	<	0.17	E	<	0.15	E		<	0.16	0.33			
Building 511 (b) (7)(F) sample on the table in the breakroom with the door open to Room 110A.			VI-B511 (b) (7)(F) 01		7/11/23			0.17	<	0.15	E	<	0.16	<	0.52	<	0.13	E	0.19	0.15	<	0.17	E	<	0.15	E		<	0.16	3.9				
Building 511 (b) (7)(F) sample on the conference table near the middle of the room.			VI-B511 (b) (7)(F) 01		7/11/23		DUP	0.22	<	0.15	<	0.16	<	0.52	<	0.13	E	0.22	0.15	0.18	<	0.15	E			<	0.16	0.22	39					
Building 511 (b) (7)(F) sample on the conference table near the middle of the room.			VI-B511 (b) (7)(F) 01		7/11/23			0.25	<	0.15	<	0.16	<	0.52	<	0.13	E	0.25	0.16	0.18	<	0.15	E			<	0.16	0.33	44					
Building 511 (b) (7)(F) sample on the countertop in the shop.			VI-B511 (b) (7)(F) 01		7/11/23			0.29	<	0.15	<	0.16	<	0.52	<	0.13	E	0.18	0.14	0.17	<	0.15	E			<	0.16	0.17	48					
Building 511 (b) (7)(F) sample in the breathing space near the northwest corner of the room where there is a building footing in the interior space of the shop.			VI-B511 (b) (7)(F) 01		7/11/23		<	0.16	E	<	0.15	<	0.16	<	0.52	<	0.13		0.23	<	0.14	E	<	0.17	E	<	0.15		<	0.16	<	0.34		
Building 511 (b) (7)(F) sample on the desk in the office.			VI-B511 (b) (7)(F) 01		7/11/23		<	0.16	E	<	0.15	<	0.16	<	0.52	<	0.13	E	0.23	1.6	<	0.17	E	0.16		<	0.16		1.1					
Building 511 (b) (7)(F) sample on the table in the breakroom.			VI-B511 (b) (7)(F) 01		7/11/23		<	0.16	E	<	0.15	<	0.16	<	0.52	<	0.13	E	0.22	<	0.13	E	<	0.17	E	<	0.15	E		<	0.16	1.5		
Building 511 (b) (7)(F) sample on the conference table near the middle of the room.			VI-B511 (b) (7)(F) 01		7/11/23		<	0.16	E	<	0.15	<	0.16	<	0.52	<	0.13	E	0.21	<	0.13	E	<	0.17	E	<	0.15	E		<	0.16	0.44		
Building 511 (b) (7)(F) sample in the office.			VI-B511 (b) (7)(F) 01		7/11/23		<	0.16	E	<	0.15	<	0.16	<	0.52	<	0.13	E	0.18	<	0.13	0.36	<	0.15	E		<	0.16	1.3					
Building 511 (b) (7)(F) sample on a workbench near the middle of the high bay and shop area.			VI-B511 (b) (7)(F) 01		7/11/23			0.51	<	0.15	E	<	0.16	<	0.52	<	0.13	E	0.26	0.13	4.5	<	0.15	E		<	0.16	2.1						
Crawl space, confined space, or pathway																																		
Building 511 (b) (7)(F) sample by the wooden planks in the storage area.			VI-B511 (b) (7)(F) PTH-01		7/11/23			0.19	<	0.15	<	0.16	E	<	0.52	<	0.13	E	0.20	<	0.13	E	<	0.17	E	0.37		<	0.16	E	0.59			
Building 511 (b) (7)(F) sample on the second floor next to the elevator shaft on the southwest side of the building.			VI-B511 (b) (7)(F) PTH-01		7/11/23		<	0.16	<	0.15	<	0.16	<	0.52	<	0.13	E	0.31	<	0.13	<	0.17	E	<	0.15		<	0.16	<	0.33	E			

Notes:
^a DTSC SL: California Department of Toxic Substances Control Human Health Risk Assessment Note 3–Modified Screening Levels (DTSC SLs), June 2020 (revised May 2022).
^b VISL: U.S. Environmental Protection Agency (https://epa-visl.com/cgi-bin/visl_search), vapor intrusion screening level (VISL) calculator (accessed March 12, 2023).
^c Urgent and accelerated response action levels, as defined in the U.S. EPA Region IX memorandum *Response Action Levels and Recommendations to Address Near-Term Inhalation Exposures to TCE in Air from Subsurface Vapor Intrusion* (July 2014), are also evaluated.
^d Volatile organic compound does not have an uptake rate available for Radiello 130® passive diffusive samplers, thus, no analytical results are provided.

DUP = duplicate sample; µg/m³ = micrograms per cubic meter.
< Indicates the measured value is less than the reporting limit.
Data in bold font indicates a result above the reporting limit.
Data in bold and italic font indicates a result at or above an indoor air screening level.
Data qualifier flags:
B = Analyte found in method blank; sample results should be evaluated.
D = Analysis performed at a secondary dilution or concentration.
E = The analyte was detected below the LLNL reporting limit, but above the analytical laboratory minimum detection limit or activity.
F = Analyte found in field blank, trip blank, or equipment blank; sample results should be evaluated.
H = Sample analyzed outside of holding time; sample results should be evaluated.
I = Surrogate or tracer yield recoveries were outside of QC limits; sample results should be evaluated.
J = The analyte was positively identified; however, the associated numerical value is the approximate concentration or activity of the analyte in the sample.
L = Matrix spike recoveries not within control limits.
O = Matrix spike duplicate relative percent difference (RPD), sample duplicate RPD, or relative error ratio (RER) not within control limits.
This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.



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