Underhill, VT NATTS Network Assessment Review

- Established 2004: Carbonyls, PM_{10} Metals, and VOCs
  - Chromium VI added in 2005; ended in in 2013
  - PAHs added in 2008
  - Ethylene Oxide added in 2021
- For the NATTS Network Assessment (2004-2022):
  - 17 of 17 Method Quality Objective (MQO) Core HAPs were included in the national trends
  - 301 of 313 pollutant datasets were suitable for trends analysis
  - Annual Average and 3-Year Rolling Average Concentrations were decreasing for acetaldehyde, arsenic (PM_{10}), benzene, cadmium (PM_{10}), lead (PM_{10}), and naphthalene.
  - 100% Reporting of Datasets
- Method Quality Objectives (MQO): 2004-2022
  - Completeness: Met 85% completeness in 304 of 313 pollutant datasets
  - Method Detection Limits: Met MDL Target Ratio of 1.00 in 300 of 315 pollutant datasets
  - Bias: Met ±25% for 272 of 283 pollutant datasets
  - Overall Method Precision: Met ≤15% CV for 47 of 67 pollutant datasets
  - Analytical Method Precision: Met ≤15% CV for 145 of 168 pollutant datasets
- Analytical Laboratories for 2022

VOC	Carbonyl	PM_{10} Metals	PAHs
VTDEC	VTDEC	VTDEC	ERG

- Equipment Year Deployed

Equipment Type	VOC	Carbonyl	PM_{10} Metals	PAHs
Sampler	2011	2011	2014	2008
Analytical	2020	2020	2017	2021
Preconcentrator	2020	NA	NA	NA
Standards Preparation	2018	NA	NA	NA
Canister Cleaning	2020	NA	NA	NA
Extraction	NA	NA	2011	2019

National Summary: NATTS data were collected at 27 locations across the United States, with sites beginning in 2003 or later (Figure 1) for 20 core HAPs. Over 670,000 concentrations (primary, secondary, and replicate) were generated and analyzed for this assessment. Pollutant datasets were scored to assess whether they were suitable for trends analysis. Each pollutant dataset was evaluated against four MQOs: Completeness; Sensitivity; Bias; and Precision. Datasets that were suitable (A- or B-rated) for six consecutive years were used for national trends analysis (Table 1).

National trends were determined by comparing the most recent 3-year blocked averages (e.g., 2017-2019 vs. 2020-2022) to determine if the NATTS Trends DQO was being met:

To be able to detect a 15 percent difference (trend) between the annual mean concentrations of successive 3-year periods within acceptable levels of decision error.

Of the 20 core HAPs. 17 were assessed for the NATTS Trends DQO. Due to sampling and analytical issues, acrolein and ethylene were not considered for trends analysis (Table 2). Additionally, hexavalent chromium was discontinued as a required pollutant . The assessment showed that across the network, 11 of those 17 pollutants were decreasing between the 3-year blocks, while four of those pollutants were increasing between the 3-year blocks. Two pollutants did not exhibit a noticeable trend.

Figure 1. NATTS Site and Year Established

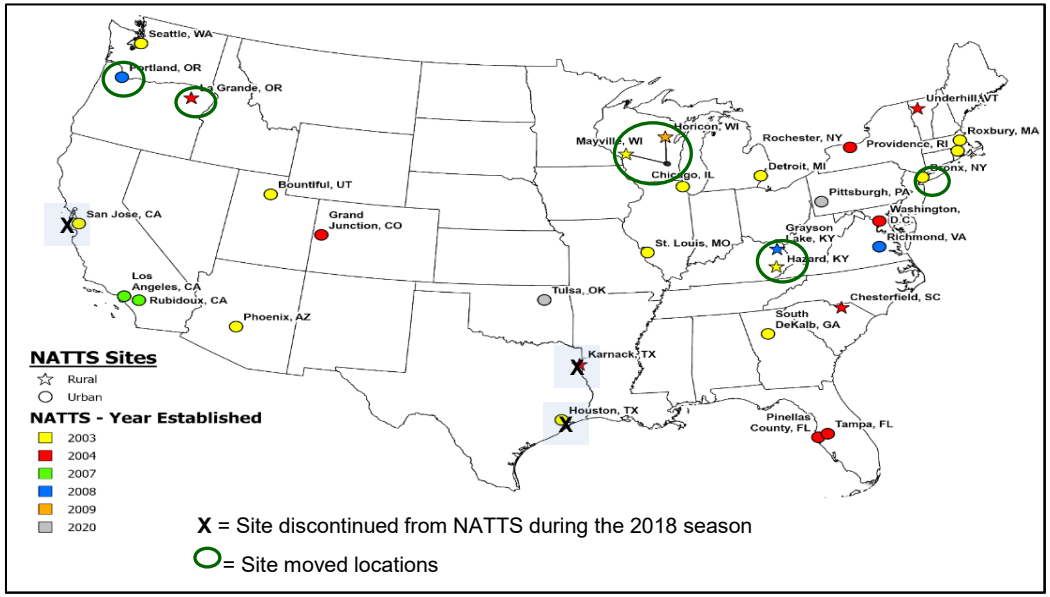


Table 1. NATTS Network Assessment: Count and Percentage of Suitable Datasets by Pollutant Group

Pollutant Group	A-rated		B-rated		Does Not Meet	
	#	%	#	%	#	%
VOCs	1,968	58%	864	25%	572	17%
Carbonyls	668	68%	231	24%	77	8%
PM_{10} Metals	1,906	66%	775	27%	217	7%
PAHs	571	77%	144	19%	29	4%
Total = 8,704	5,113	64%	2,014	25%	895	11%

Table 2. Three-Year Block Averages for National Trends

Pollutant[a,b]	Units	# Sites	Block 1	Block 2	% Difference
Acetaldehyde	$\mu g/m^3$	16	1.48	1.34	-9.2%
Arsenic (PM_{10})	ng/m^3	18	0.68	0.64	-6.6%
Benzene	$\mu g/m^3$	16	0.529	0.525	-0.8%
Benzo(a)pyrene	ng/m^3	18	0.086	0.072	-16.6%
Beryllium (PM_{10})	ng/m^3	18	0.008	0.010	15.0%
Butadiene, 1,3-	$\mu g/m^3$	15	0.057	0.054	-5.1%
Cadmium (PM_{10})	ng/m^3	20	0.087	0.090	3.7%
Carbon Tetrachloride	$\mu g/m^3$	15	0.53	0.50	-5.3%
Chloroform	$\mu g/m^3$	16	0.173	0.165	-4.8%
Formaldehyde	$\mu g/m^3$	15	2.809	2.482	-11.7%
Lead (PM_{10})	ng/m^3	20	2.44	2.43	-0.5%
Manganese (PM_{10})	ng/m^3	20	6.69	7.31	9.2%
Naphthalene	ng/m^3	17	42.00	35.10	-16.4%
Nickel (PM_{10})	ng/m^3	19	0.87	0.83	-3.7%
Tetrachloroethylene	$\mu g/m^3$	15	0.12	0.12	1.5%
Trichloroethylene	$\mu g/m^3$	14	0.019	0.022	16.3%
Vinyl Chloride	$\mu g/m^3$	16	0.004	0.001	-69.0%

[a] Acrolein and ethylene oxide were not assessed due to sampling and analytical issues

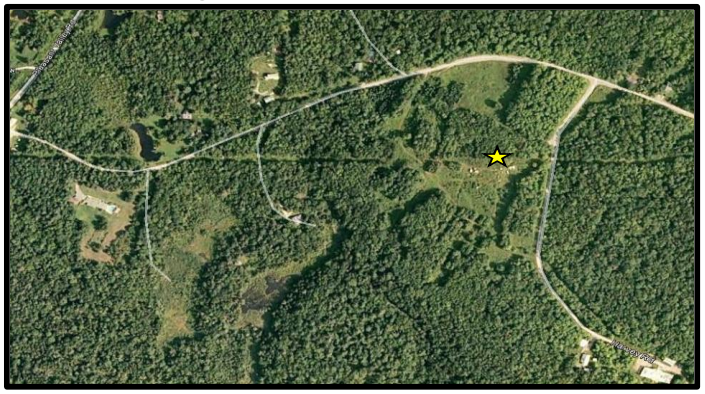
[b] Hexavalent chromium (not assessed) was discontinued in 2013

NATTS Monitoring Site Report: Underhill, VT

Site Information

Region	1
NATTS Site Type	Rural
County	Chittendon
AQS Site Code	50-007-0007
NATTS Operating Agency	VT Dept. of Env. Conservation
Latitude	44.52839
Longitude	-72.86884
AQS Land Use	Forest
AQS Location Setting	Rural
County Population (2023)	169,481

Figure 2. NATTS Site Location



Pollutant Datasets Evaluation: Suitable for Trends (Y=yes; Y(T)=yes, and used for DQO Trends; N=No; "--"=not rated)

Final Pollutant Name	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Acetaldehyde	N(a)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Arsenic (PM_{10})	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N(a)	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Benzene	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Benzo(a)pyrene	--	--	--	--	--	Y	Y	Y	Y	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Beryllium (PM_{10})	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N(a)	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Butadiene, 1,3-	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Cadmium (PM_{10})	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N(a)	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Carbon tetrachloride	Y	N(b)	N(b)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Chloroform	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Formaldehyde	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Lead (PM_{10})	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N(a)	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Manganese (PM_{10})	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N(a)	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Naphthalene	--	--	--	--	--	Y	Y	Y	Y	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Nickel (PM_{10})	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N(a)	N(c)	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Tetrachloroethylene	N(b)	Y	N(b)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Trichloroethylene	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)
Vinyl chloride	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N(b)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)	Y(T)

[a]: Completeness was less than 75% based on 1-in-6 day sampling.

[b]: Reported MDL to NATTS Target Ratio greater than 2.0.

[c]: Pollutant was expected, but were invalidated at this site for this year.

Table 3. NATTS Network Assessment Data (2003-2022) - National Distribution Statistics By Type[a]

Analyte	Units	Site Type	# Data Records	% Detections	Arithmetic Mean[b]	Percentile Value[c]						
						5th	10th	25th	50th	75th	90th	95th
Acetaldehyde	µg/m^3	Urban	22,000	100%	1.73 ± 0.02	0.50	0.65	0.95	1.42	2.15	3.19	3.96
	µg/m^3	Rural	6,392	100%	1.17 ± 0.03	0.36	0.45	0.65	0.92	1.35	1.98	2.67
	µg/m^3	All Sites	28,392	100%	1.61 ± 0.02	0.45	0.58	0.85	1.29	1.97	2.99	3.79
Arsenic (PM_{10})	ng/m^3	Urban	21,944	95%	0.87 ± 0.03	0.03	0.16	0.32	0.56	0.96	1.65	2.37
	ng/m^3	Rural	6,385	96%	0.49 ± 0.02	0.03	0.08	0.16	0.35	0.58	0.93	1.30
	ng/m^3	All Sites	28,329	96%	0.78 ± 0.02	0.03	0.13	0.27	0.51	0.87	1.51	2.16
Benzene	µg/m^3	Urban	22,246	99%	0.85 ± 0.01	0.23	0.29	0.42	0.64	1.02	1.62	2.20
	µg/m^3	Rural	5,932	90%	0.52 ± 0.01	ND	0.06	0.20	0.38	0.67	1.08	1.51
	µg/m^3	All Sites	28,178	97%	0.78 ± 0.01	0.16	0.23	0.36	0.58	0.95	1.52	2.07
Benzo(a)pyrene	ng/m^3	Urban	17,810	73%	0.10 ± 0.01	ND	ND	ND	0.04	0.10	0.23	0.35
	ng/m^3	Rural	4,735	37%	0.07 ± 0.01	ND	ND	ND	ND	0.02	0.19	0.38
	ng/m^3	All Sites	22,545	65%	0.09 ± 0.01	ND	ND	ND	0.03	0.09	0.22	0.35
Beryllium (PM_{10})	ng/m^3	Urban	21,786	77%	0.042 ± 0.004	ND	ND	0.0005	0.005	0.015	0.043	0.098
	ng/m^3	Rural	6,062	49%	0.018 ± 0.002	ND	ND	ND	ND	0.004	0.012	0.041
	ng/m^3	All Sites	27,848	71%	0.037 ± 0.003	ND	ND	ND	0.003	0.011	0.038	0.083
Butadiene, 1,3-	µg/m^3	Urban	22,220	78%	0.092 ± 0.002	ND	ND	0.018	0.051	0.110	0.215	0.317
	µg/m^3	Rural	5,940	29%	0.017 ± 0.001	ND	ND	ND	ND	0.011	0.054	0.104
	µg/m^3	All Sites	28,160	68%	0.076 ± 0.002	ND	ND	ND	0.039	0.092	0.190	0.283
Cadmium (PM_{10})	ng/m^3	Urban	21,954	93%	0.184 ± 0.014	ND	0.019	0.043	0.081	0.160	0.354	0.572
	ng/m^3	Rural	6,067	89%	0.092 ± 0.005	ND	ND	0.026	0.055	0.099	0.179	0.270
	ng/m^3	All Sites	28,021	92%	0.164 ± 0.011	ND	0.012	0.039	0.075	0.143	0.300	0.518
Carbon Tetrachloride	µg/m^3	Urban	22,202	98%	0.556 ± 0.002	0.336	0.423	0.486	0.550	0.638	0.725	0.784
	µg/m^3	Rural	5,909	84%	0.494 ± 0.010	ND	ND	0.342	0.533	0.629	0.728	0.807
	µg/m^3	All Sites	28,111	95%	0.543 ± 0.003	ND	0.363	0.475	0.547	0.636	0.726	0.788
Chloroform	µg/m^3	Urban	22,218	88%	0.243 ± 0.016	ND	ND	0.094	0.129	0.205	0.398	0.630
	µg/m^3	Rural	5,942	56%	0.062 ± 0.002	ND	ND	ND	0.049	0.098	0.134	0.228
	µg/m^3	All Sites	28,160	82%	0.205 ± 0.013	ND	ND	0.076	0.110	0.187	0.342	0.543
Formaldehyde	µg/m^3	Urban	22,024	100%	3.03 ± 0.04	0.69	1.00	1.57	2.42	3.72	5.47	6.95
	µg/m^3	Rural	6,432	100%	2.16 ± 0.04	0.49	0.64	1.03	1.67	2.69	4.12	5.34
	µg/m^3	All Sites	28,456	100%	2.83 ± 0.03	0.61	0.86	1.42	2.25	3.50	5.22	6.65

Table 3. NATTS Network Assessment Data (2003-2022) - National Distribution Statistics By Type[a]

Analyte	Units	Site Type	# Data Records	% Detections	Arithmetic Mean[b]	Percentile Value[c]						
						5th	10th	25th	50th	75th	90th	95th
Lead (PM_{10})	ng/m^3	Urban	21,955	100%	3.97 ± 0.10	0.70	0.95	1.46	2.49	4.34	7.87	11.16
	ng/m^3	Rural	6,066	99%	1.93 ± 0.14	0.34	0.45	0.75	1.27	2.14	3.59	4.96
	ng/m^3	All Sites	28,021	100%	3.53 ± 0.09	0.53	0.75	1.22	2.17	3.88	6.99	10.10
Manganese (PM_{10})	ng/m^3	Urban	21,906	100%	9.76 ± 0.25	1.06	1.49	2.53	4.96	10.43	20.40	30.79
	ng/m^3	Rural	6,067	99%	3.79 ± 0.12	0.48	0.74	1.34	2.48	4.49	8.08	11.64
	ng/m^3	All Sites	27,973	100%	8.47 ± 0.20	0.84	1.22	2.16	4.19	8.99	18.13	27.27
Naphthalene	ng/m^3	Urban	17,811	100%	67.25 ± 0.97	13.42	18.03	28.73	49.00	84.13	136.42	180.00
	ng/m^3	Rural	4,732	98%	21.76 ± 1.02	2.79	4.04	6.84	12.47	23.51	45.68	69.01
	ng/m^3	All Sites	22,543	100%	57.70 ± 0.83	5.92	9.77	20.41	40.15	74.11	124.40	167.26
Nickel (PM_{10})	ng/m^3	Urban	21,958	98%	1.76 ± 0.05	0.29	0.40	0.62	1.02	1.86	3.32	5.05
	ng/m^3	Rural	5,989	85%	0.56 ± 0.07	ND	ND	0.10	0.26	0.53	0.96	1.63
	ng/m^3	All Sites	27,947	95%	1.50 ± 0.04	0.00	0.17	0.45	0.84	1.59	2.92	4.47
Tetrachloroethylene	$\mu g/m^3$	Urban	22,209	84%	0.24 ± 0.05	ND	ND	0.05	0.12	0.22	0.43	0.68
	$\mu g/m^3$	Rural	5,936	38%	0.07 ± 0.02	ND	ND	ND	ND	0.04	0.12	0.31
	$\mu g/m^3$	All Sites	28,145	75%	0.21 ± 0.04	ND	ND	ND	0.08	0.20	0.38	0.61
Trichloroethylene	$\mu g/m^3$	Urban	22,204	43%	0.040 ± 0.008	ND	ND	ND	ND	0.043	0.096	0.152
	$\mu g/m^3$	Rural	5,922	19%	0.019 ± 0.003	ND	ND	ND	ND	ND	0.029	0.124
	$\mu g/m^3$	All Sites	28,126	38%	0.036 ± 0.006	ND	ND	ND	ND	0.033	0.085	0.148
Vinyl Chloride	$\mu g/m^3$	Urban	22,021	18%	0.0046 ± 0.0003	ND	ND	ND	ND	ND	0.0126	0.0251
	$\mu g/m^3$	Rural	5,940	13%	0.0070 ± 0.0008	ND	ND	ND	ND	ND	0.0125	0.0304
	$\mu g/m^3$	All Sites	27,961	17%	0.0051 ± 0.0003	ND	ND	ND	ND	ND	0.0126	0.0253

[a] Statistics presented are from pollutant datasets which were suitable for trends.

[b] The arithmetic mean is the average of all samples results which include actual measured values. If no chemical was registered, then a value of zero is used when calculating the mean.

[c] ND: No results of this chemical were registered by the laboratory analytical equipment.

Table 4. Summary Statistics for Underhill, VT

Analyte	Units	# Data Records	% Detection	Arithmetic Mean[a]	Percentile Value[b]						
					5th	10th	25th	50th	75th	90th	95th
Acetaldehyde	µg/m^3	1,104	100%	0.61 ± 0.02	0.28	0.32	0.41	0.55	0.75	0.95	1.15
Arsenic (PM_{10})	ng/m^3	1,115	98%	0.25 ± 0.01	0.03	0.06	0.12	0.21	0.32	0.46	0.57
Benzene	µg/m^3	1,107	100%	0.31 ± 0.01	0.09	0.12	0.17	0.27	0.42	0.55	0.66
Benzo(a)pyrene	ng/m^3	857	43%	0.021 ± 0.005	ND	ND	ND	ND	0.02	0.05	0.08
Beryllium (PM_{10})	ng/m^3	1,110	38%	0.0014 ± 0.0002	ND	ND	ND	ND	0.00	0.01	0.01
Butadiene, 1,3-	µg/m^3	1,111	29%	0.007 ± 0.001	ND	ND	ND	ND	0.00	0.02	0.04
Cadmium (PM_{10})	ng/m^3	1,113	100%	0.060 ± 0.003	0.02	0.02	0.03	0.05	0.07	0.10	0.13
Carbon Tetrachloride	µg/m^3	1,084	100%	0.57 ± 0.01	0.43	0.46	0.50	0.55	0.63	0.71	0.75
Chloroform	µg/m^3	1,111	85%	0.076 ± 0.002	ND	ND	0.06	0.09	0.10	0.11	0.12
Formaldehyde	µg/m^3	1,136	100%	1.07 ± 0.04	0.36	0.44	0.60	0.93	1.34	1.95	2.39
Lead (PM_{10})	ng/m^3	1,115	100%	1.19 ± 0.06	0.27	0.37	0.58	0.96	1.50	2.20	2.76
Manganese (PM_{10})	ng/m^3	1,112	100%	1.51 ± 0.07	0.29	0.40	0.67	1.18	2.00	3.01	3.93
Naphthalene	ng/m^3	858	100%	10.19 ± 0.77	2.46	2.87	4.13	6.70	13.07	21.06	27.28
Nickel (PM_{10})	ng/m^3	1,032	94%	0.26 ± 0.02	ND	0.04	0.10	0.18	0.32	0.53	0.80
Tetrachloroethylene	µg/m^3	1,111	62%	0.034 ± 0.002	ND	ND	ND	0.03	0.05	0.08	0.09
Trichloroethylene	µg/m^3	1,111	26%	0.005 ± 0.001	ND	ND	ND	ND	0.00	0.01	0.03
Vinyl Chloride	µg/m^3	1,111	16%	0.0019 ± 0.0004	ND	ND	ND	ND	ND	0.00	0.01

[a] :The arithmetic mean is the average of all samples results which included actual measured values. If no chemical was registered, then a value of zero is used.

[b] ND: No results of this chemical were registered by the laboratory analytical equipment.

Table 5. Analytical Labs Supporting this Site

Pollutant Group	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
VOCs	VTDEC	VTDEC	VTDEC	VTDEC	VTDEC	ERG	ERG	ERG	ERG	ERG	VTDEC	VTDEC	VTDEC	VTDEC	VTDEC
Carbonyls	VTDEC	VTDEC	VTDEC	VTDEC	VTDEC	VTDEC/ ERG	ERG/ VTDEC	VTDEC/ EPA R1	EPA R1/ ERG	ERG/ VTDEC	VTDEC	VTDEC	VTDEC	VTDEC	VTDEC
PM_{10} Metals	VTDEC	VTDEC	VTDEC	VTDEC	ERG	ERG	ERG	ERG	ERG	ERG	ERG	ERG	VTDEC	VTDEC	VTDEC
PAHs	--	--	--	--	ERG	ERG	ERG	ERG	ERG	ERG	ERG	ERG	ERG	ERG	ERG

Pollutant Group	2019	2020	2021	2022
VOCs	VTDEC	VTDEC	VTDEC	VTDEC
Carbonyls	VTDEC	VTDEC	VTDEC	VTDEC
PM_{10} Metals	VTDEC	VTDEC	VTDEC	VTDEC
PAHs	ERG	ERG	ERG	ERG

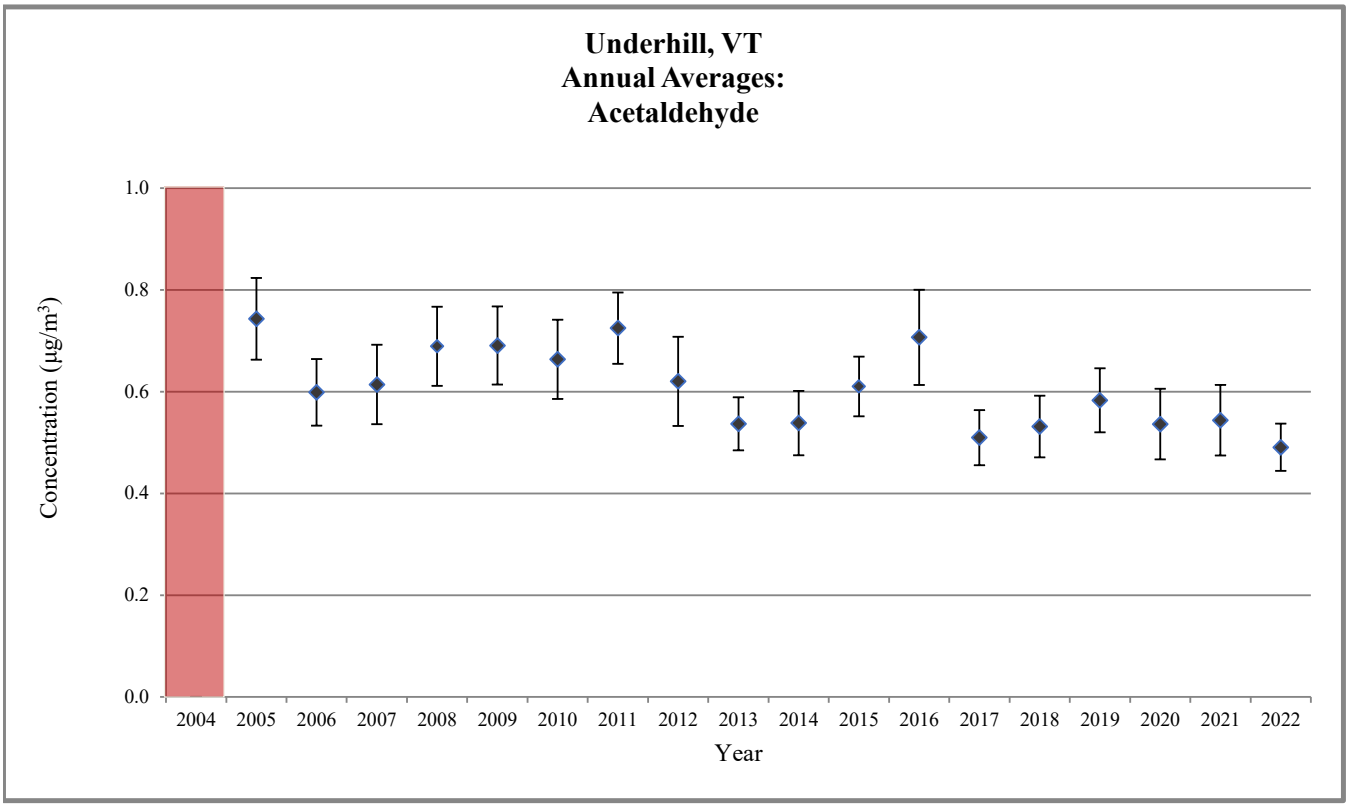
--: Not Applicable

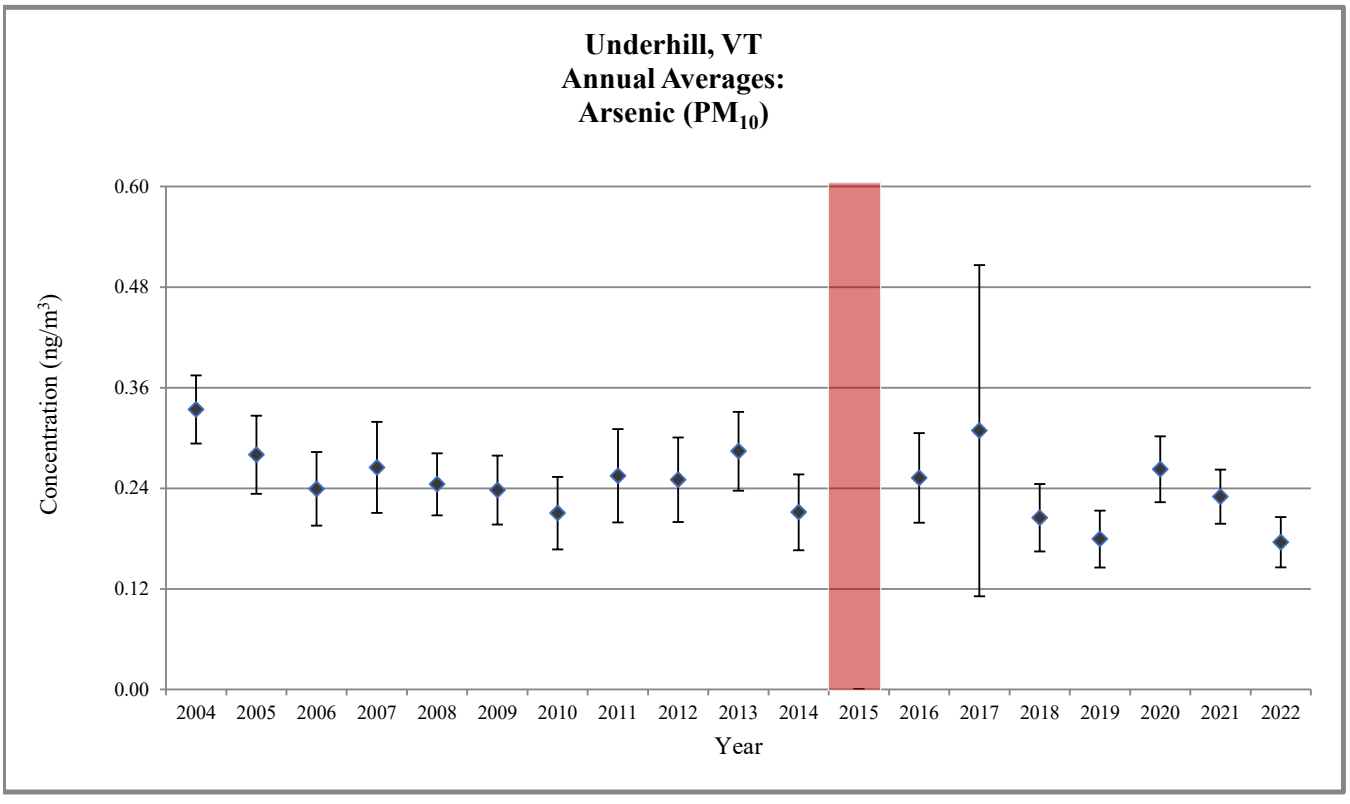
VTDEC: Vermont Department of Environmental Conservation

ERG: Eastern Research Group, Inc.

EPA R1: EPA Region 1 Laboratory

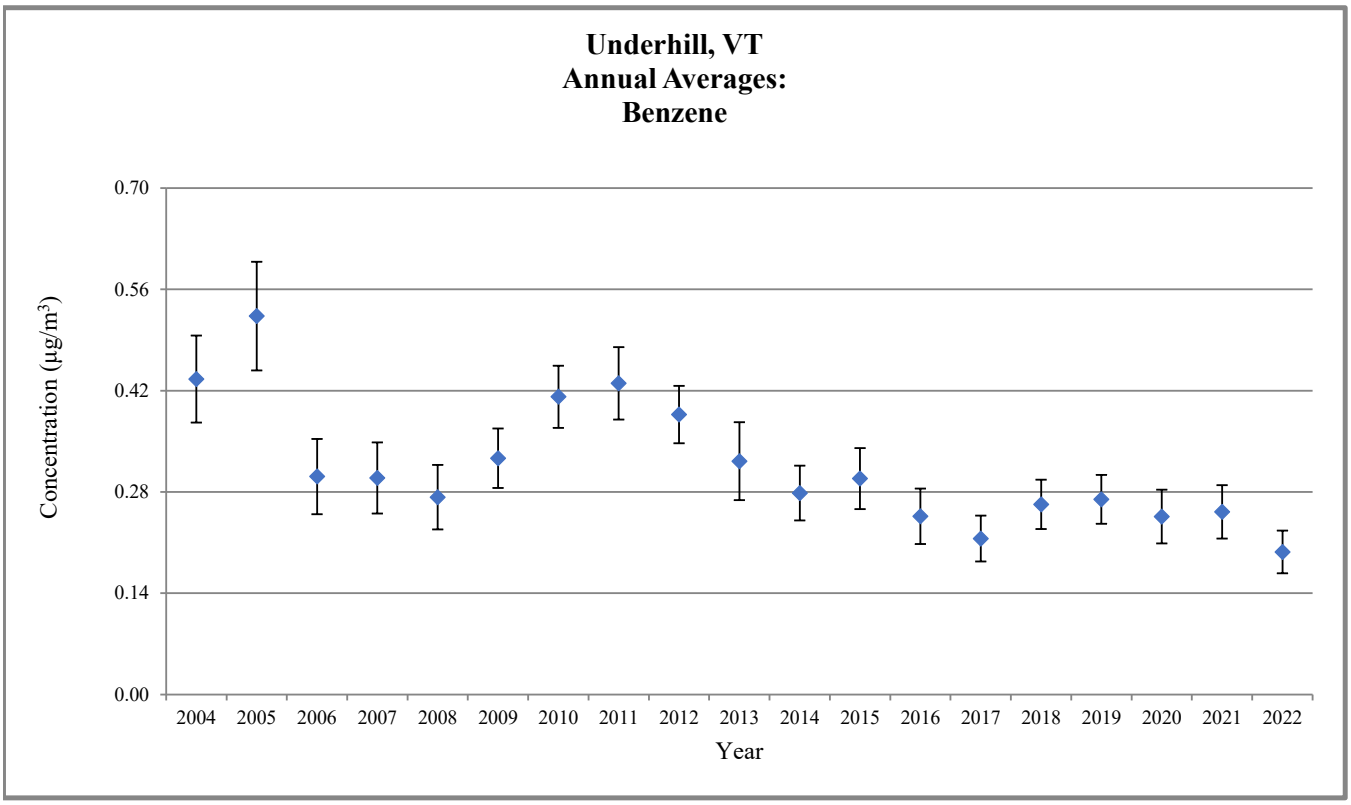
Figure 3. Underhill, VT Annual Average Concentrations

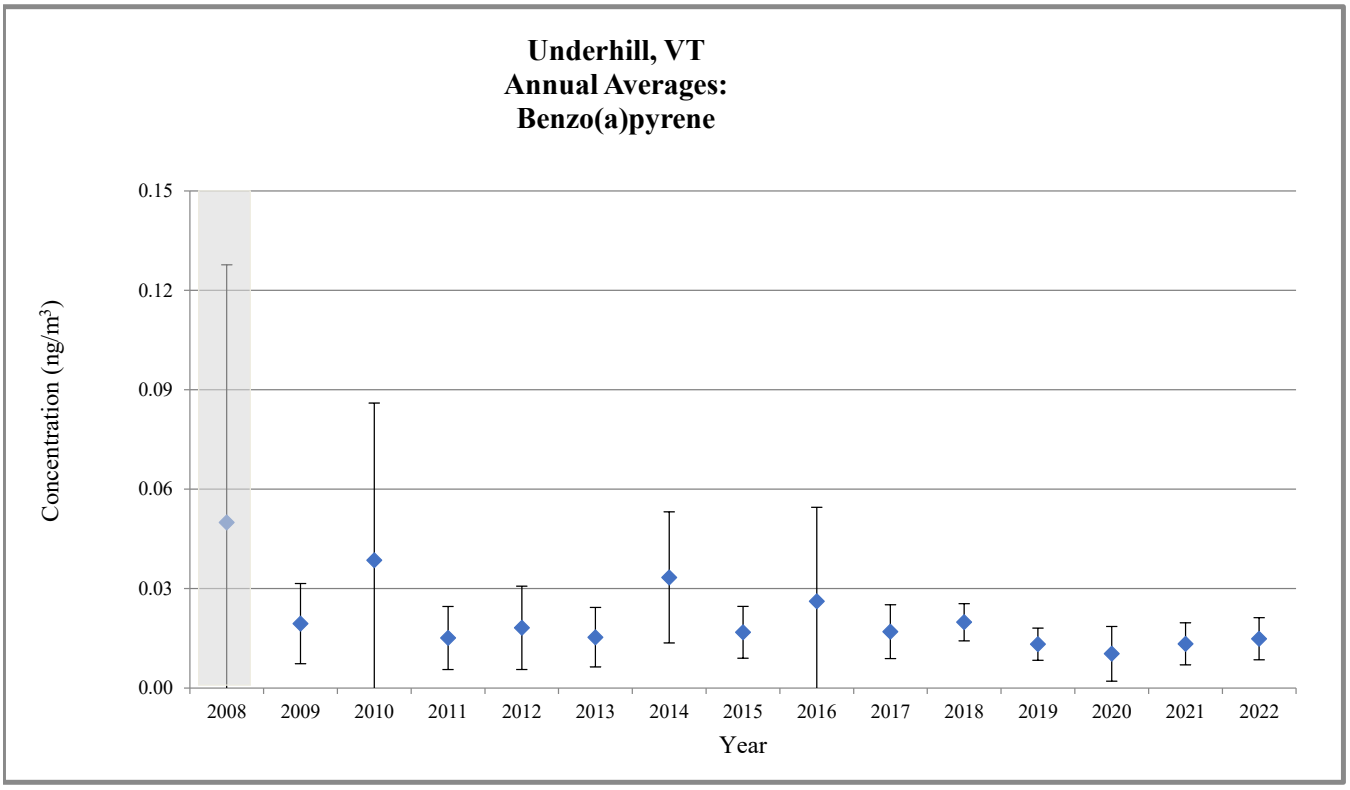




Sampling began midway through the year.
Does not meet MQO

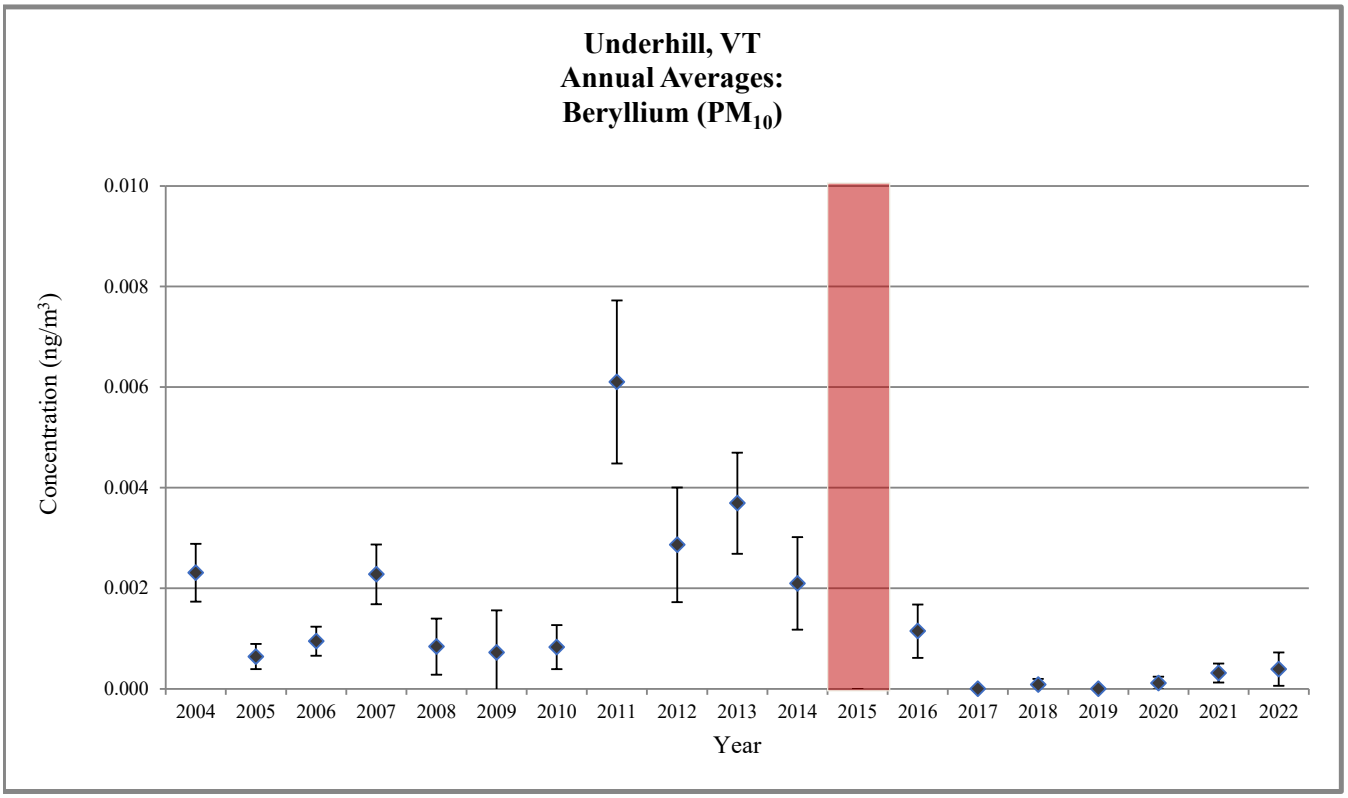
Figure 3. Underhill, VT Annual Average Concentrations

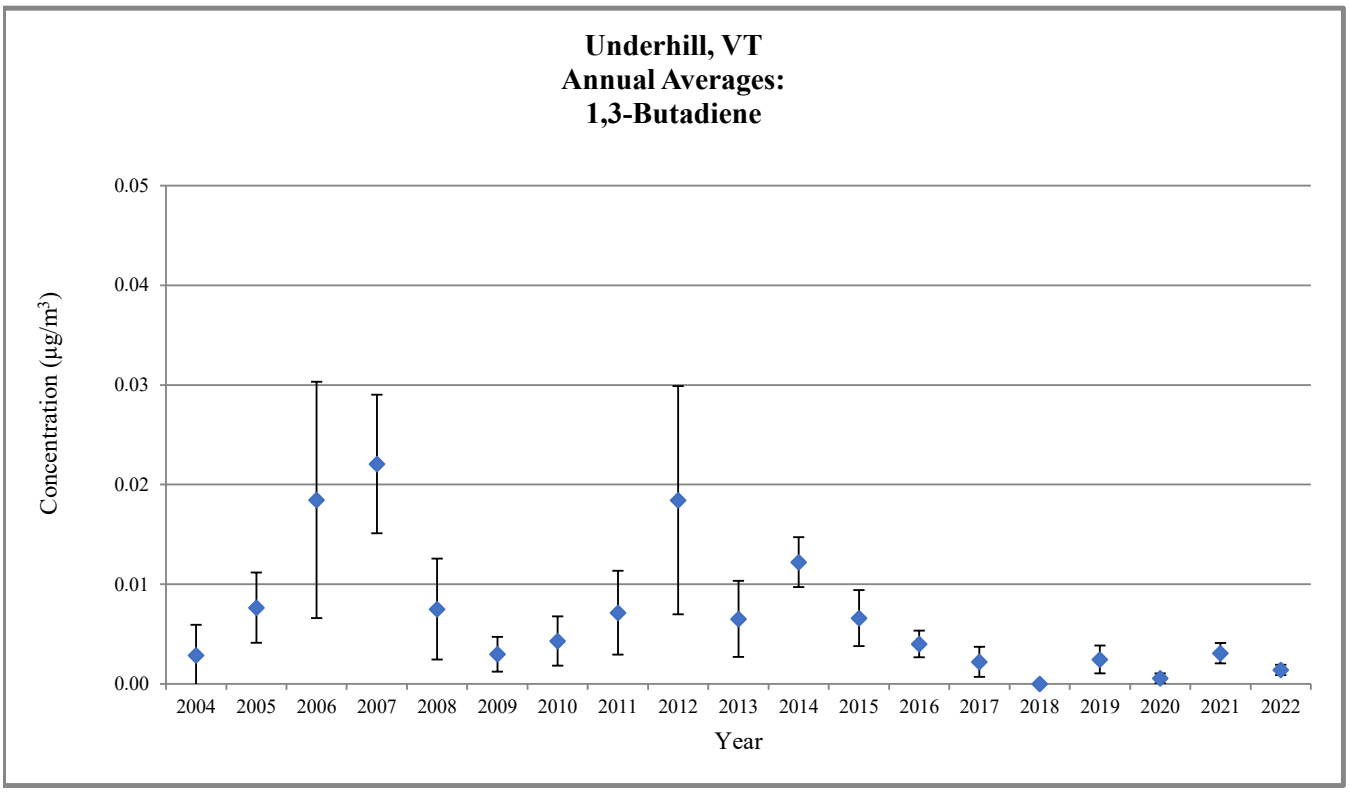




Sampling began midway through the year.
Does not meet MQO

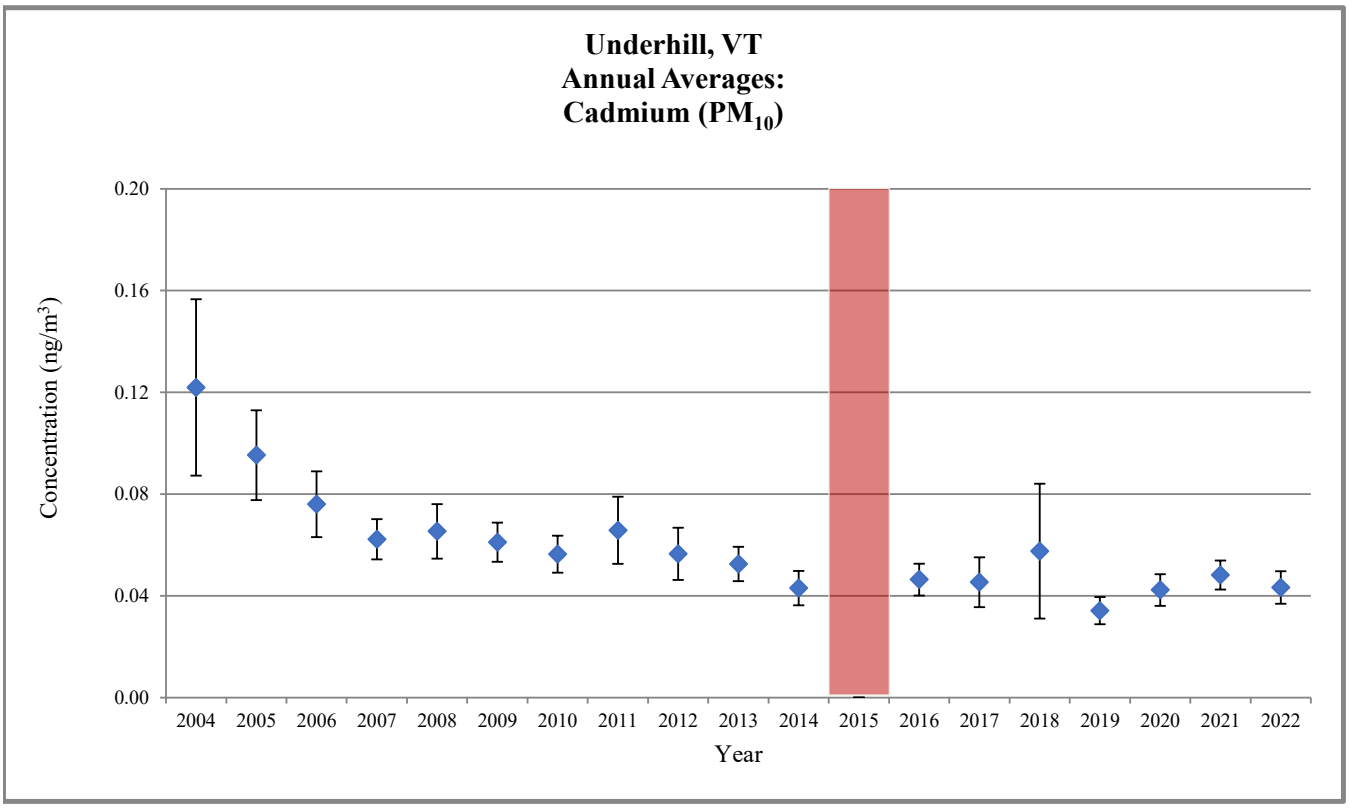
Figure 3. Underhill, VT Annual Average Concentrations

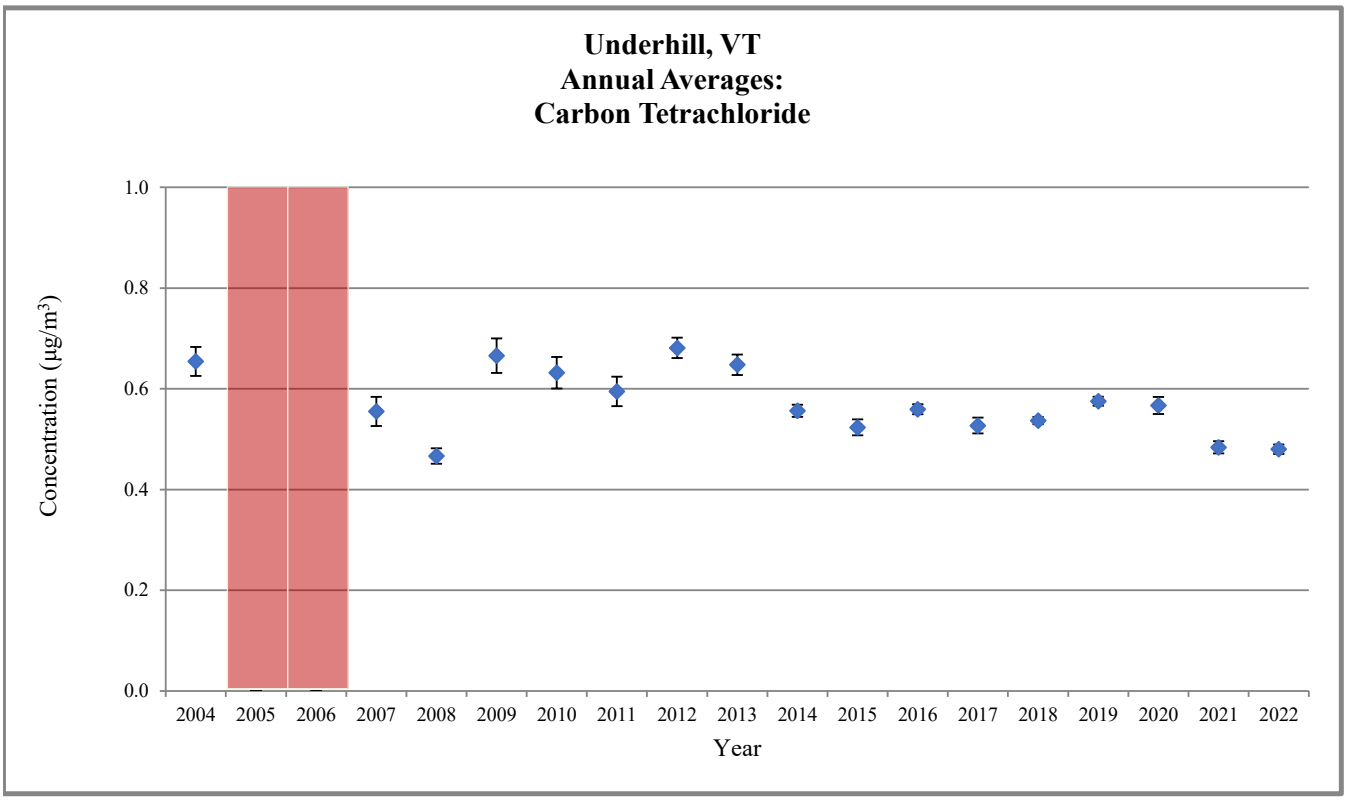




Sampling began midway through the year.
Does not meet MQO

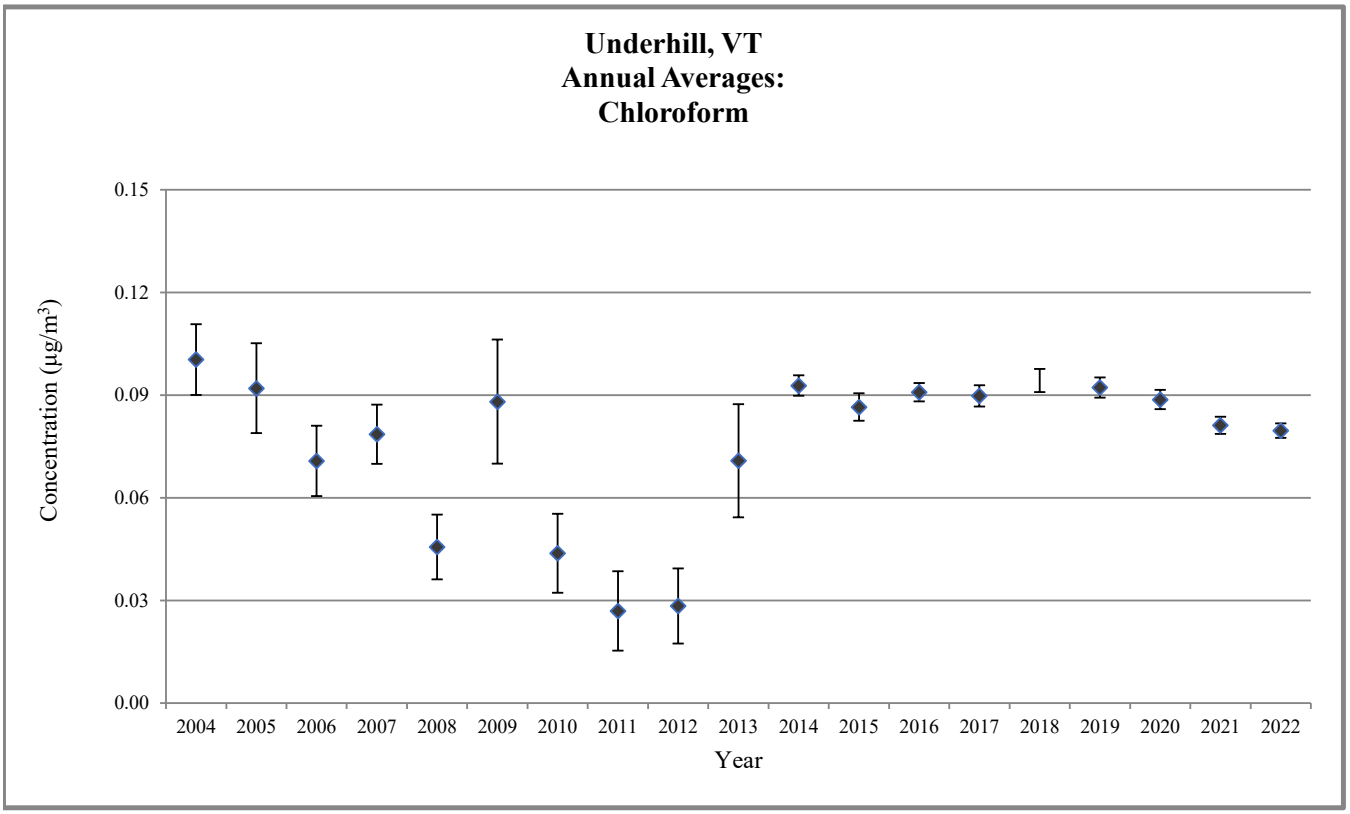
Figure 3. Underhill, VT Annual Average Concentrations

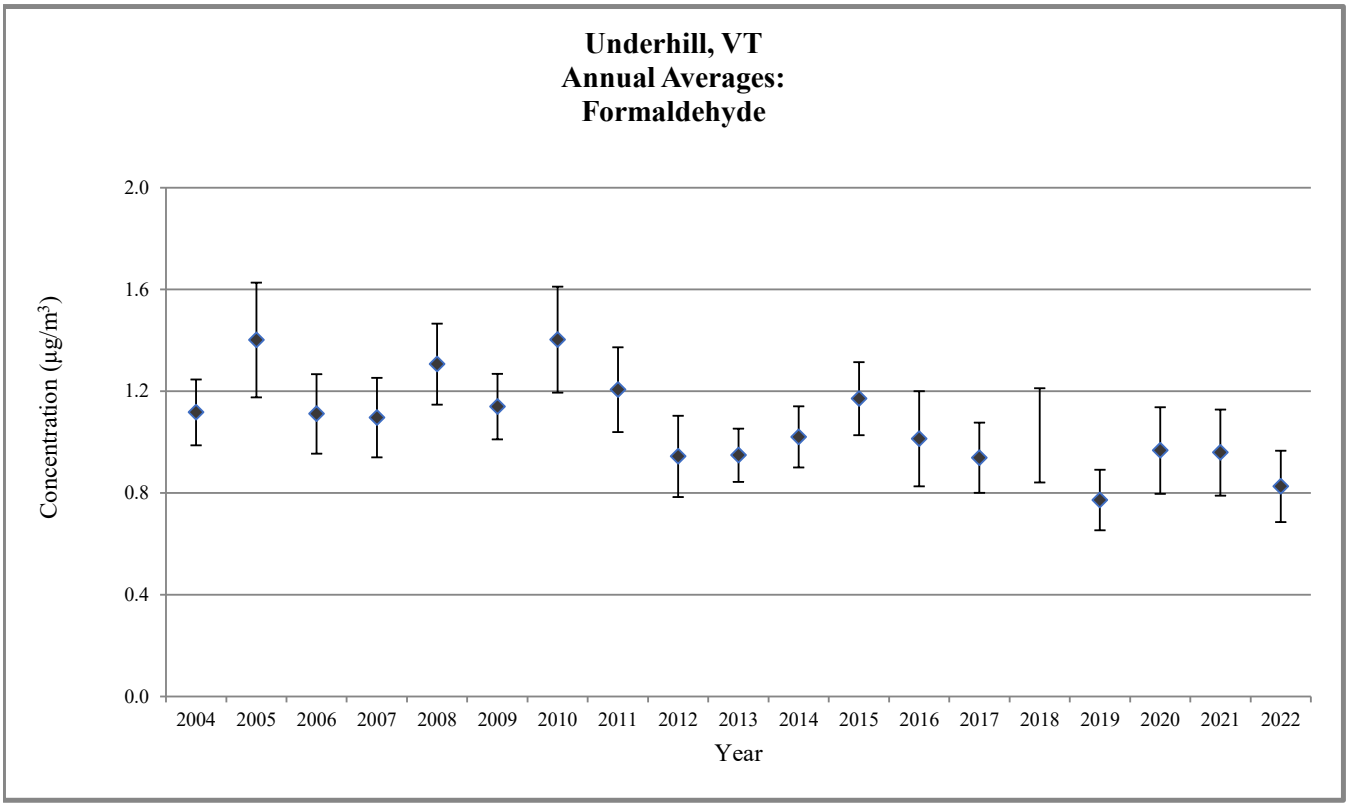




Sampling began midway through the year.
Does not meet MQO

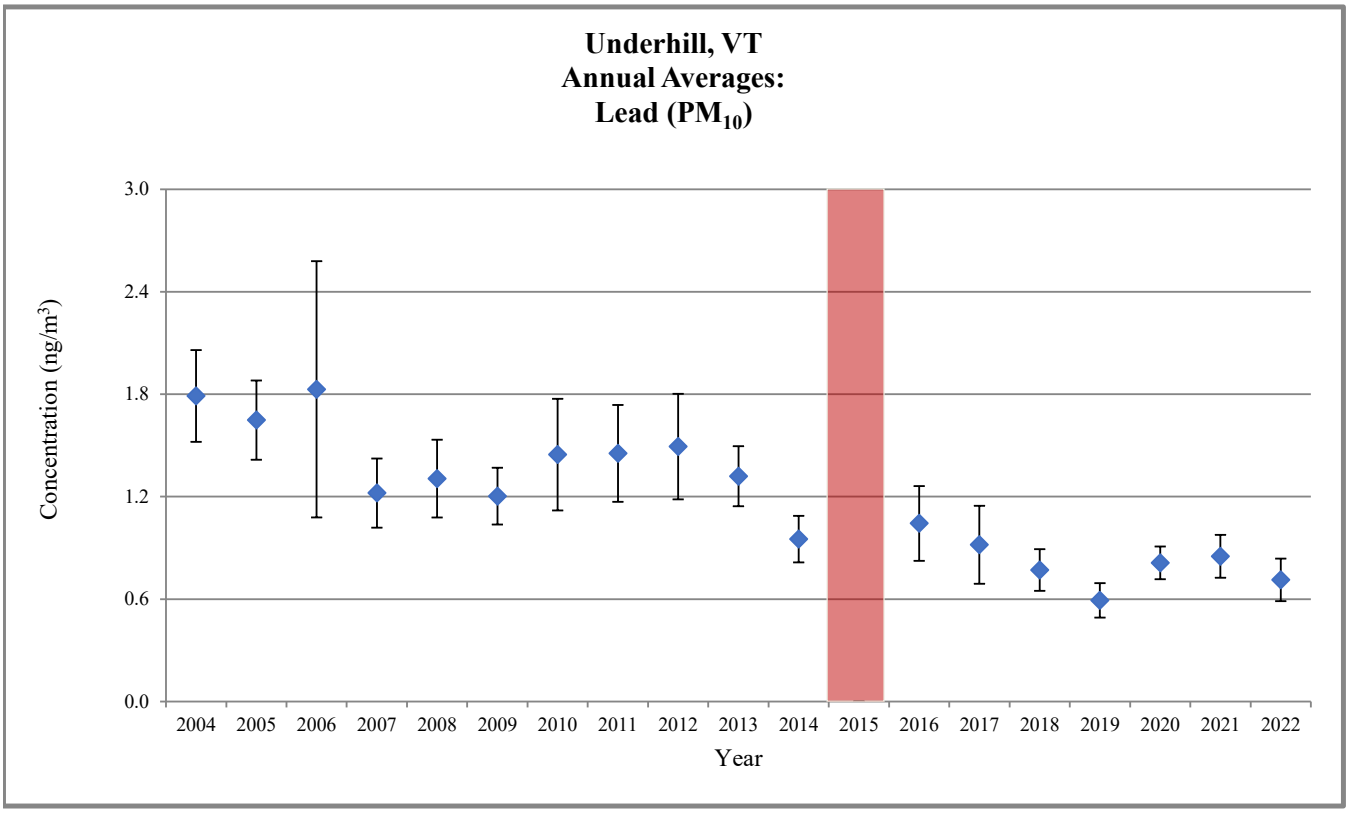
Figure 3. Underhill, VT Annual Average Concentrations

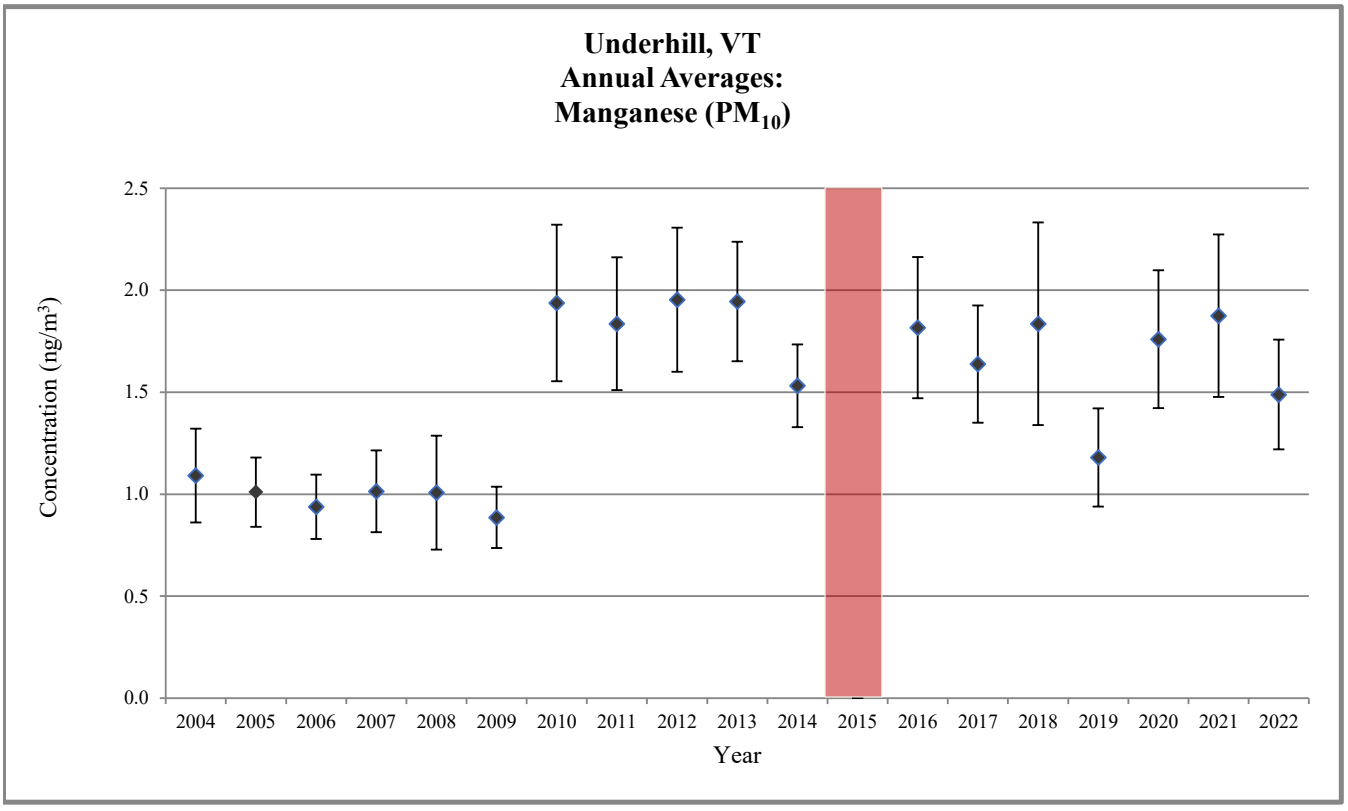




Sampling began midway through the year.
Does not meet MQO

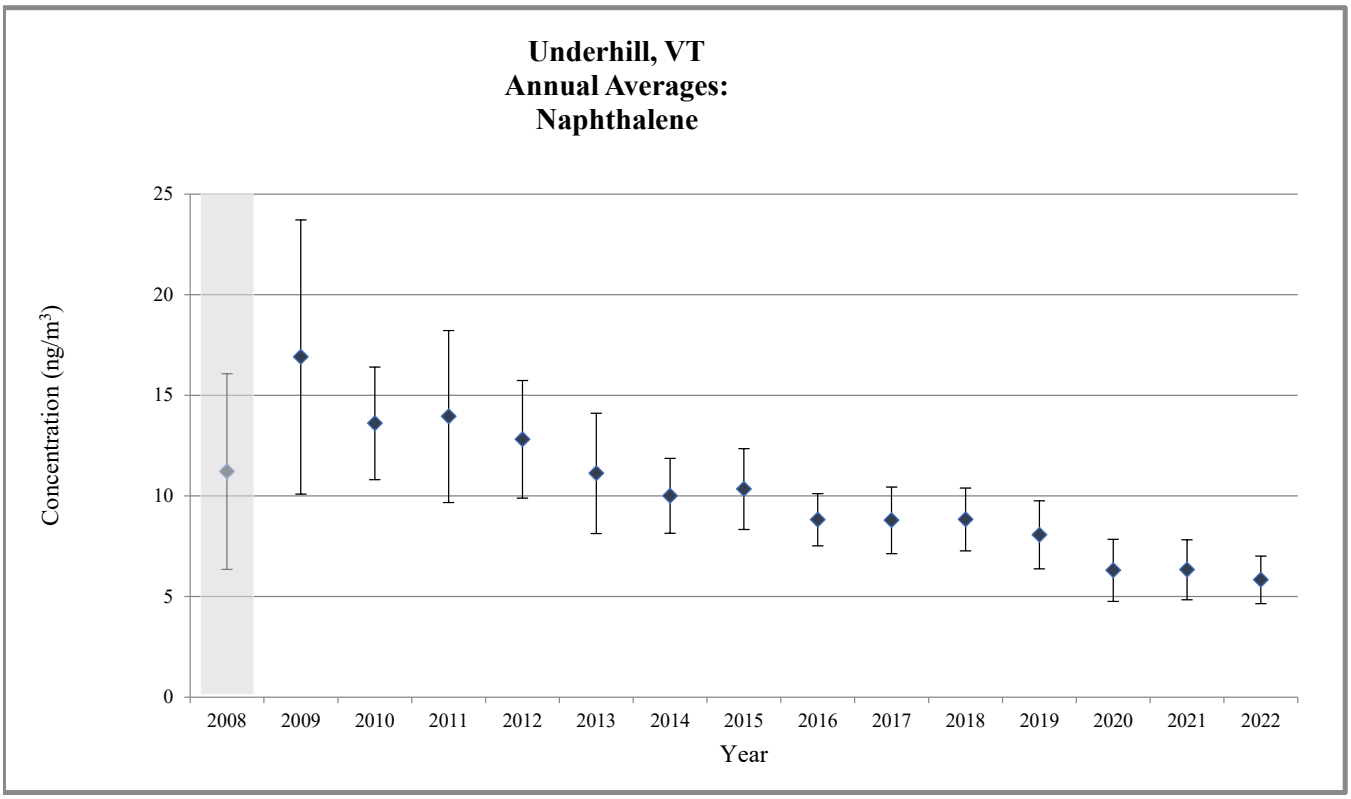
Figure 3. Underhill, VT Annual Average Concentrations

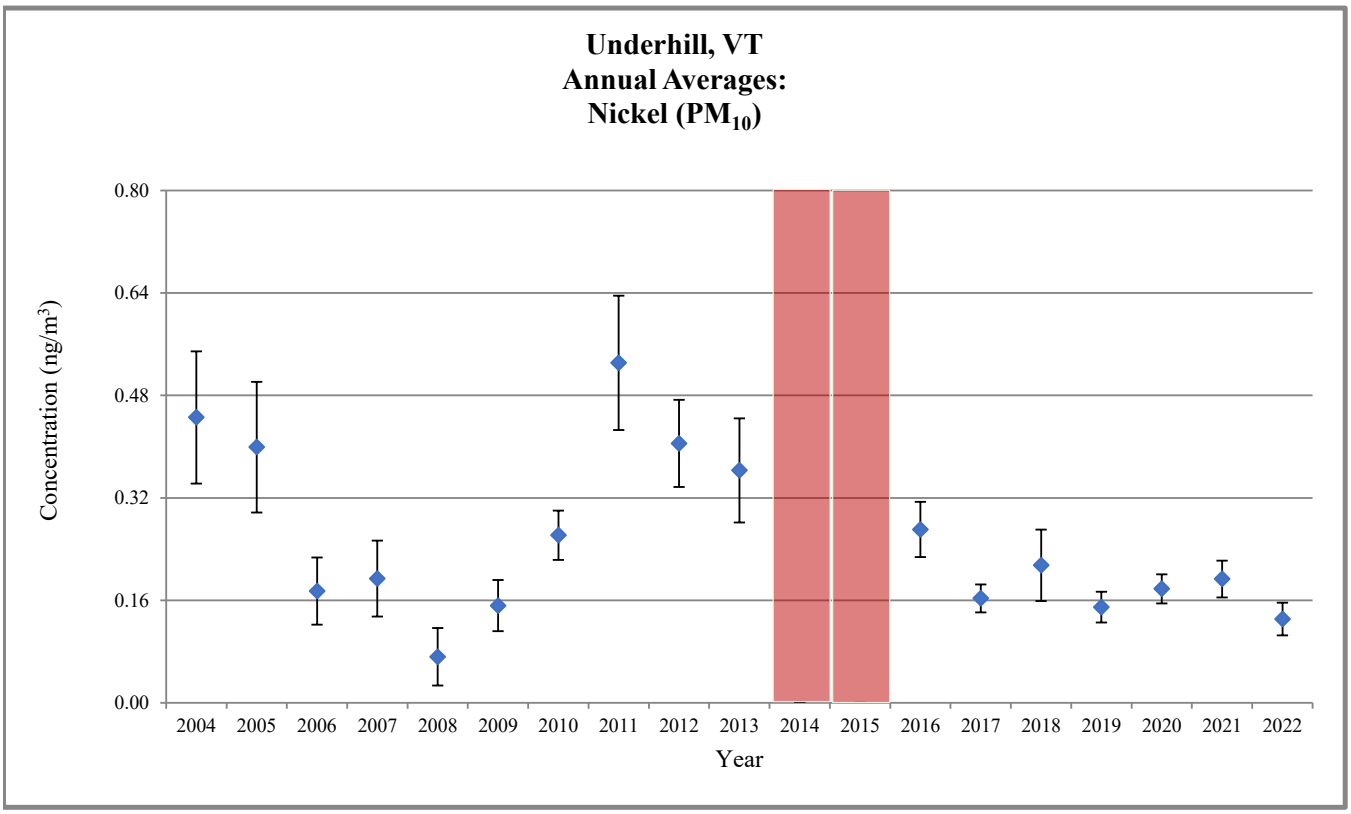




Sampling began midway through the year.
Does not meet MQO

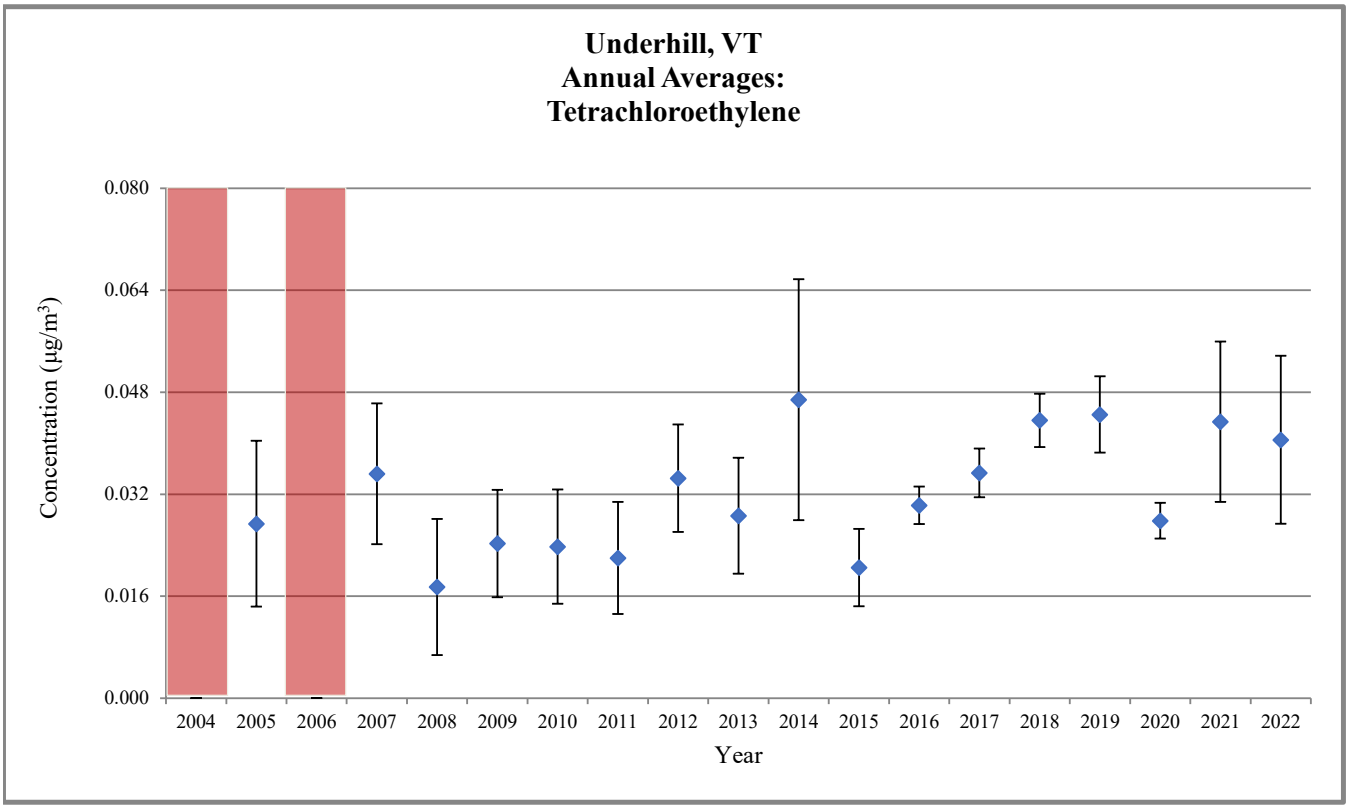
Figure 3. Underhill, VT Annual Average Concentrations

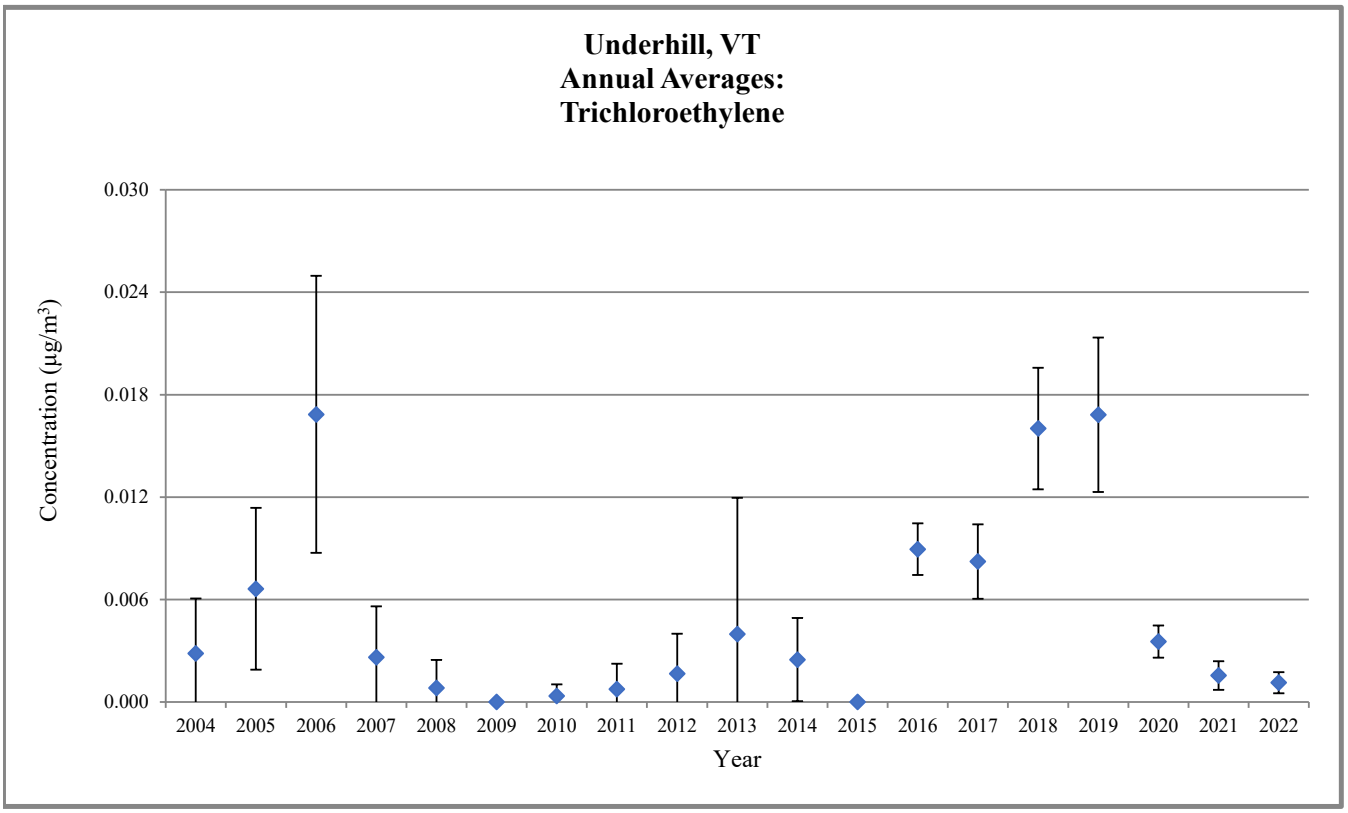




Sampling began midway through the year.
Does not meet MQO

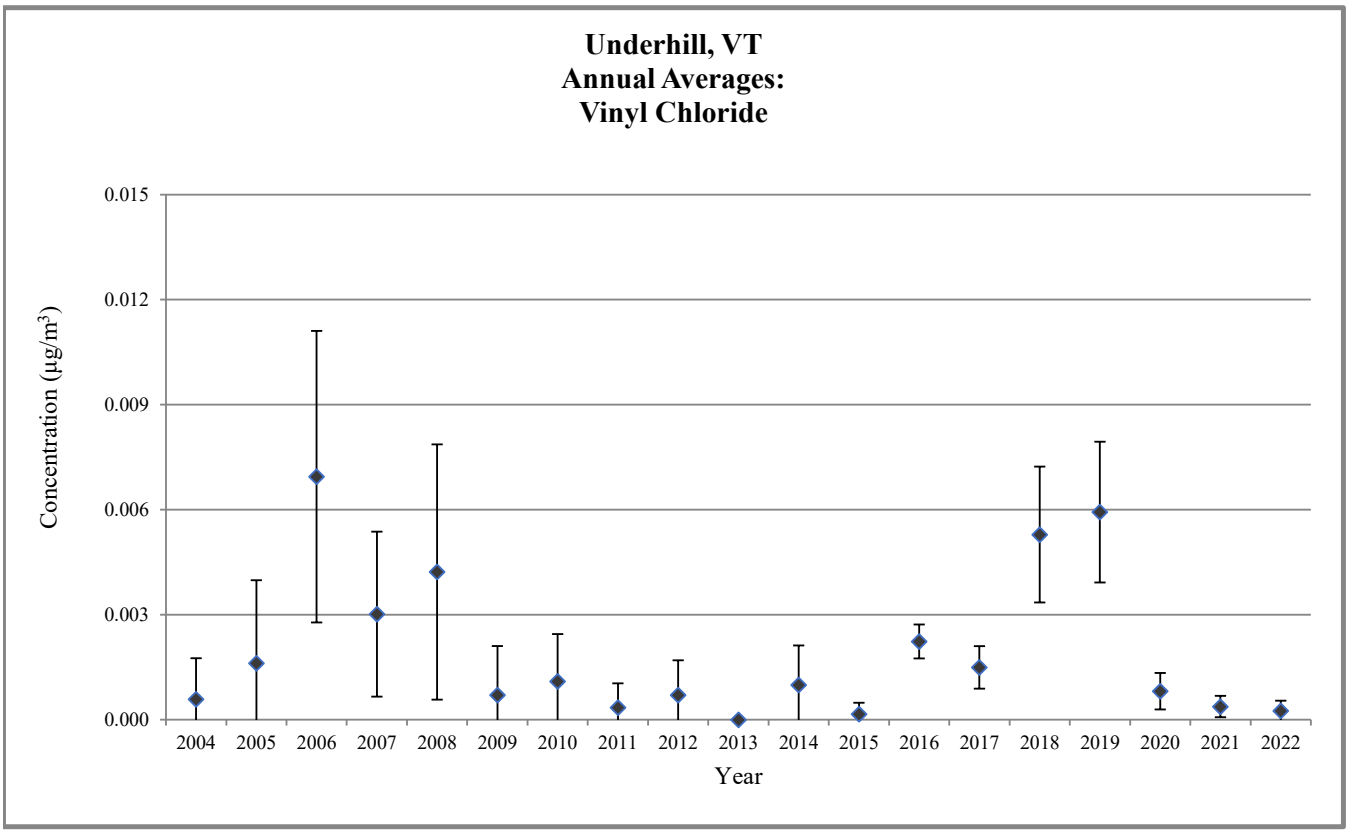
Figure 3. Underhill, VT Annual Average Concentrations





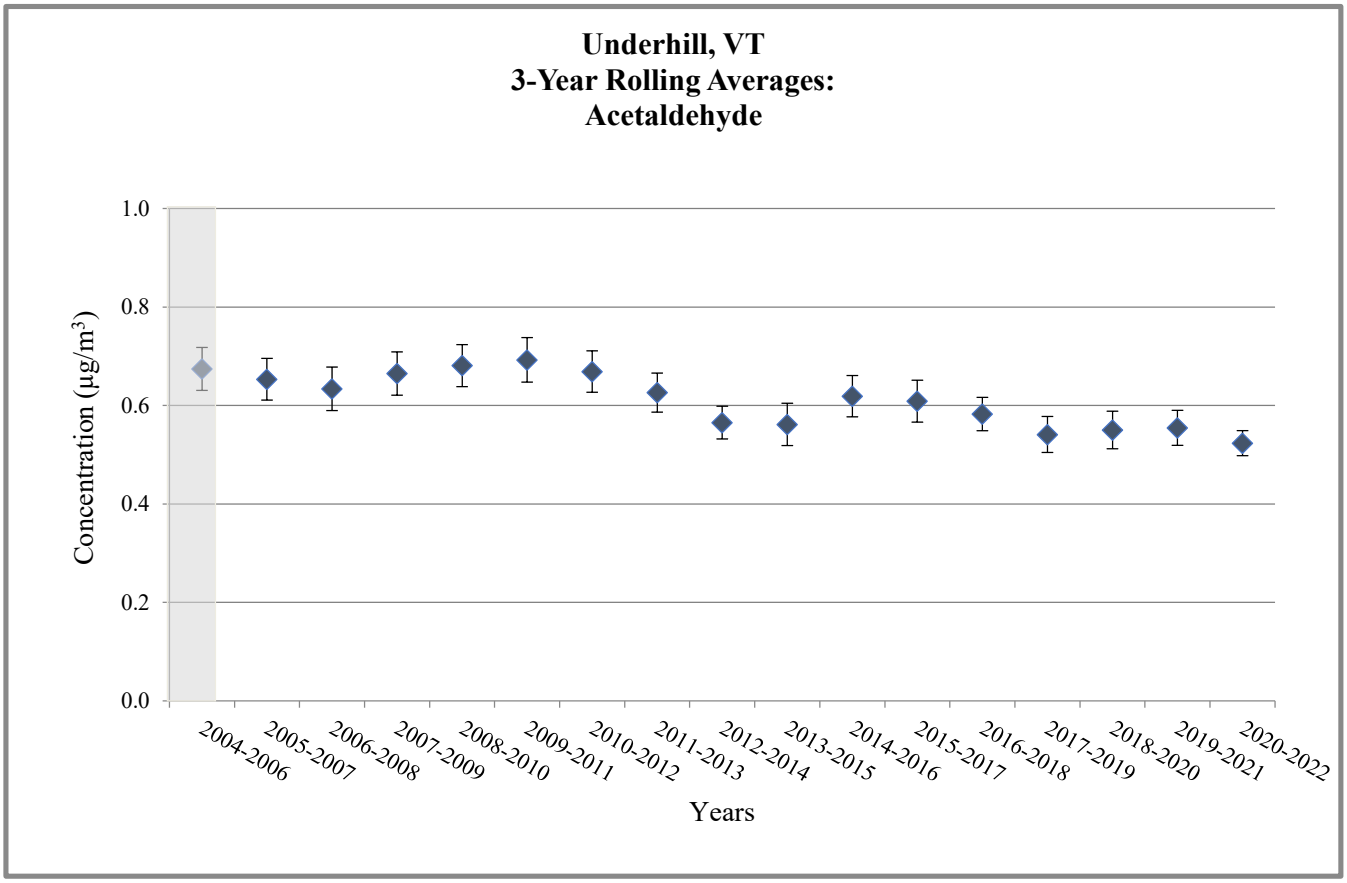
Sampling began midway through the year.
Does not meet MQO

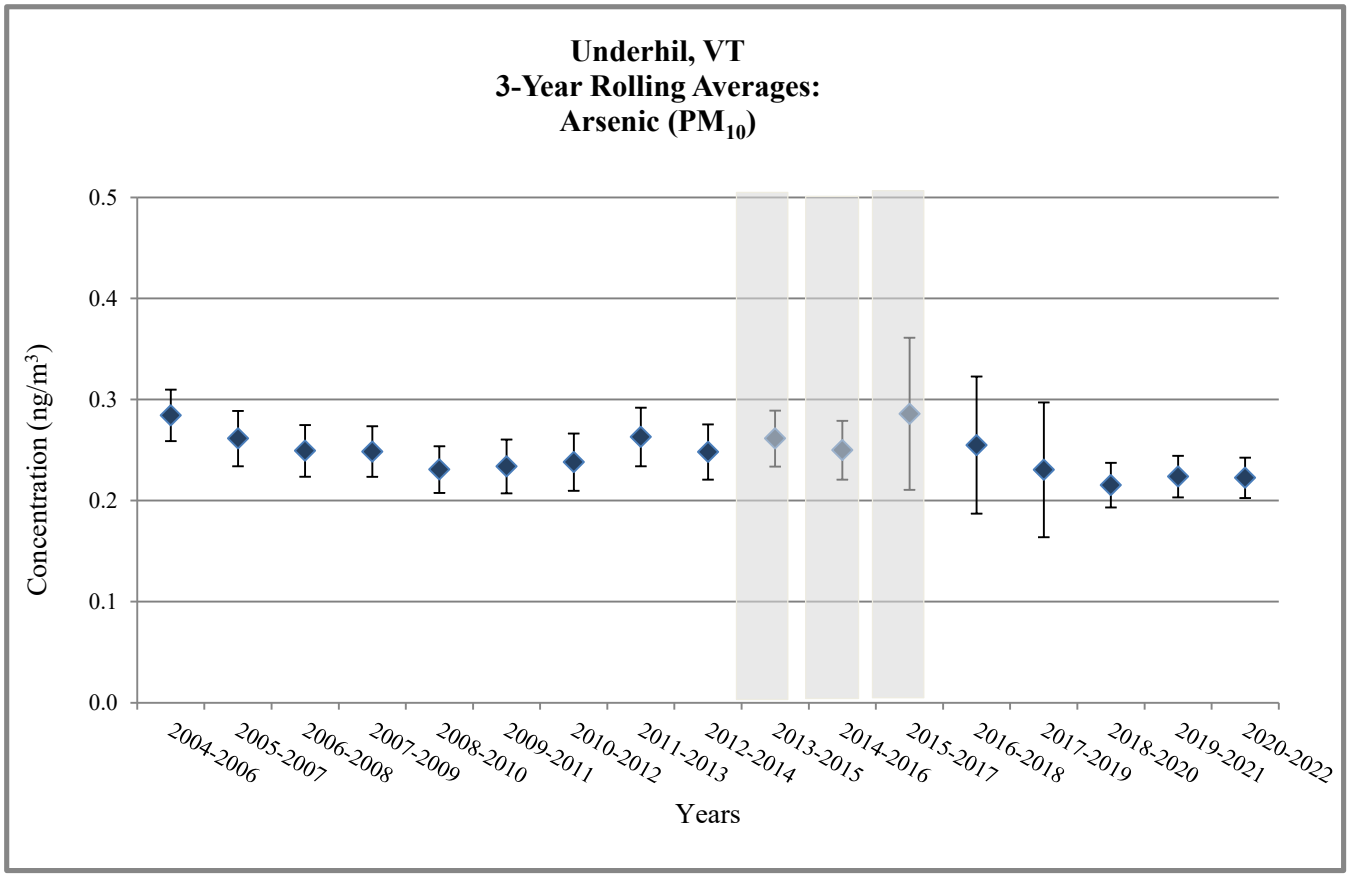
Figure 3. Underhill, VT Annual Average Concentrations



Sampling began midway through the year.
Does not meet MQO

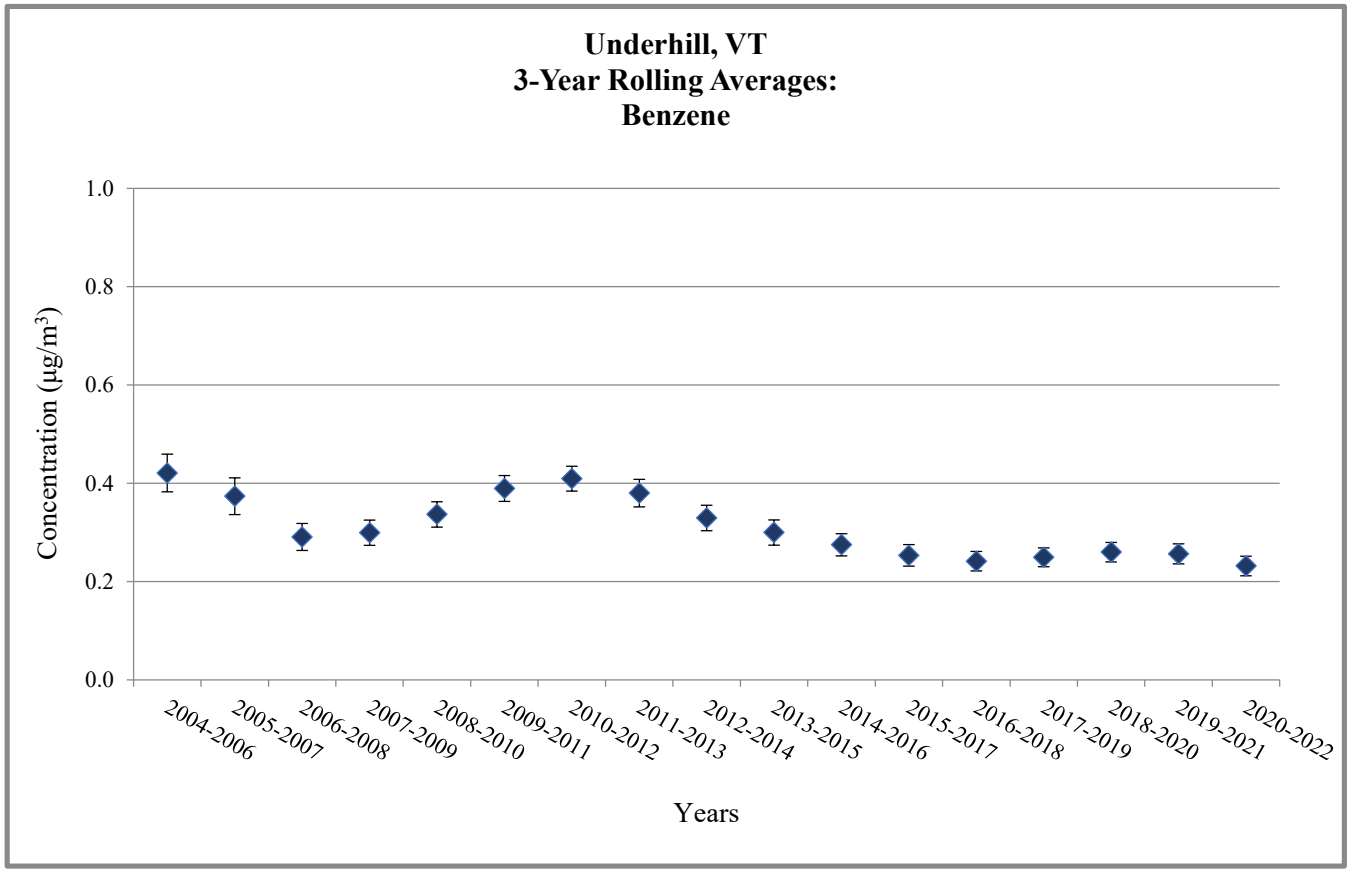
Figure 4. Underhill, VT - 3-Year Rolling Average Concentrations

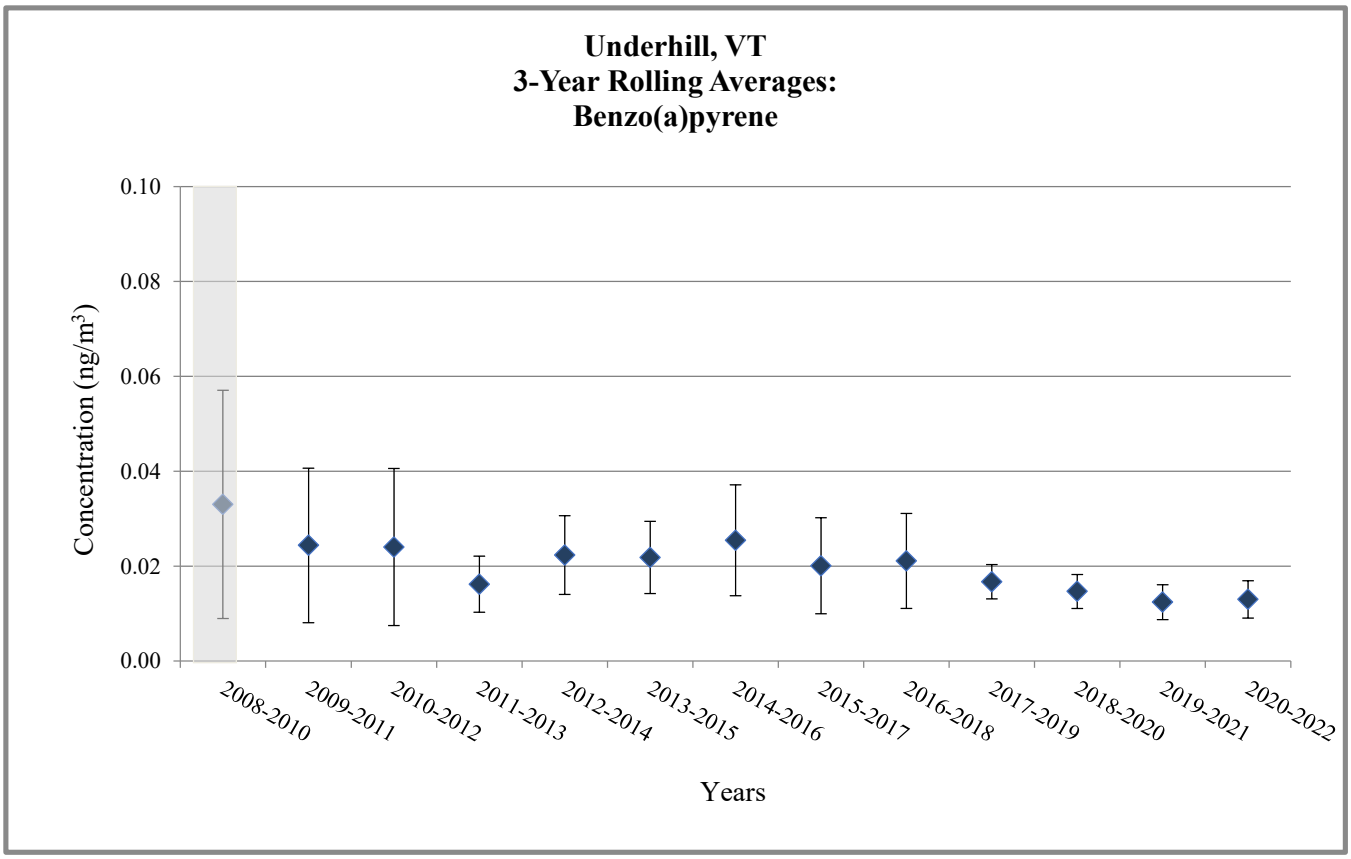




Does not meet MQO or wasn't able to collect enough samples

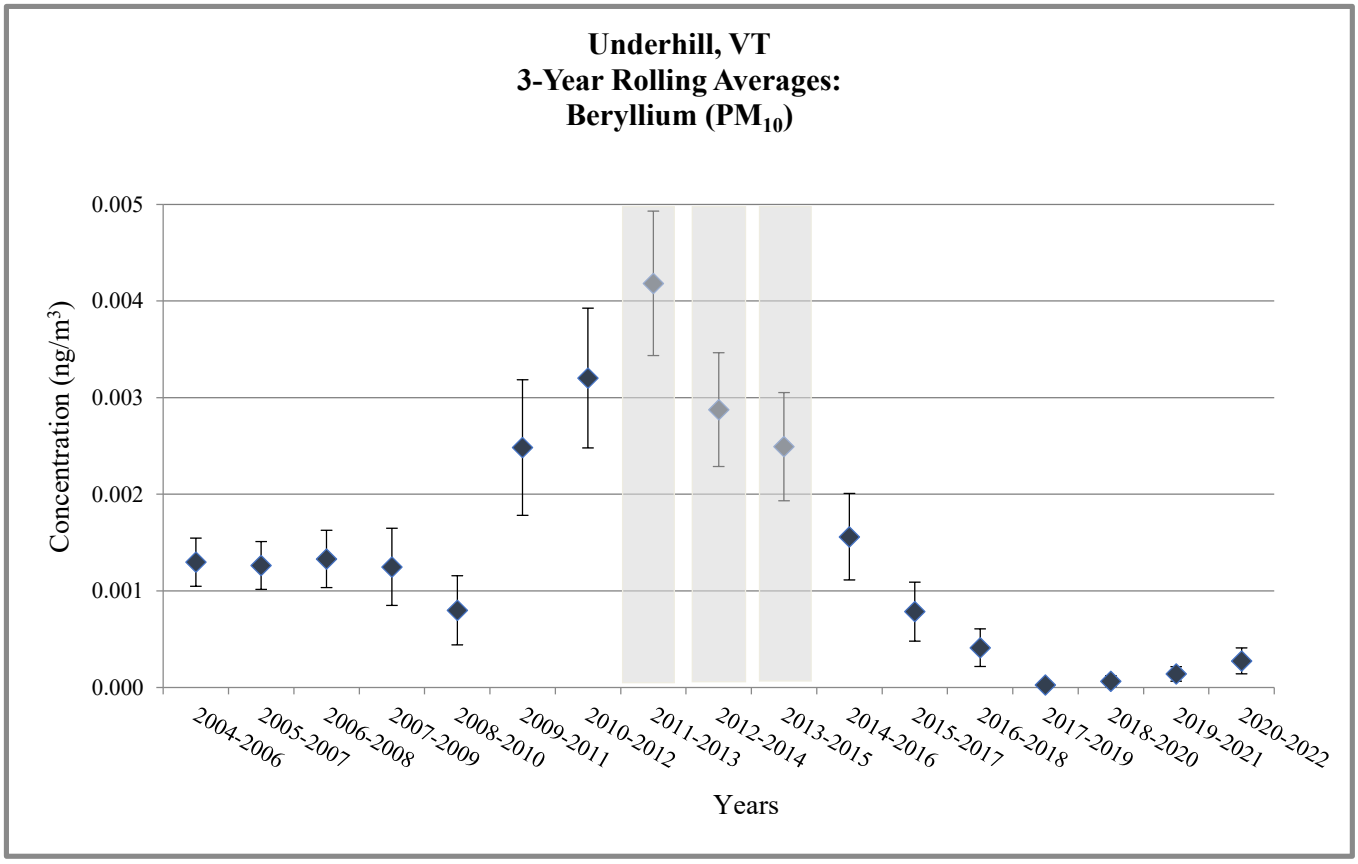
Figure 4. Underhill, VT - 3-Year Rolling Average Concentrations

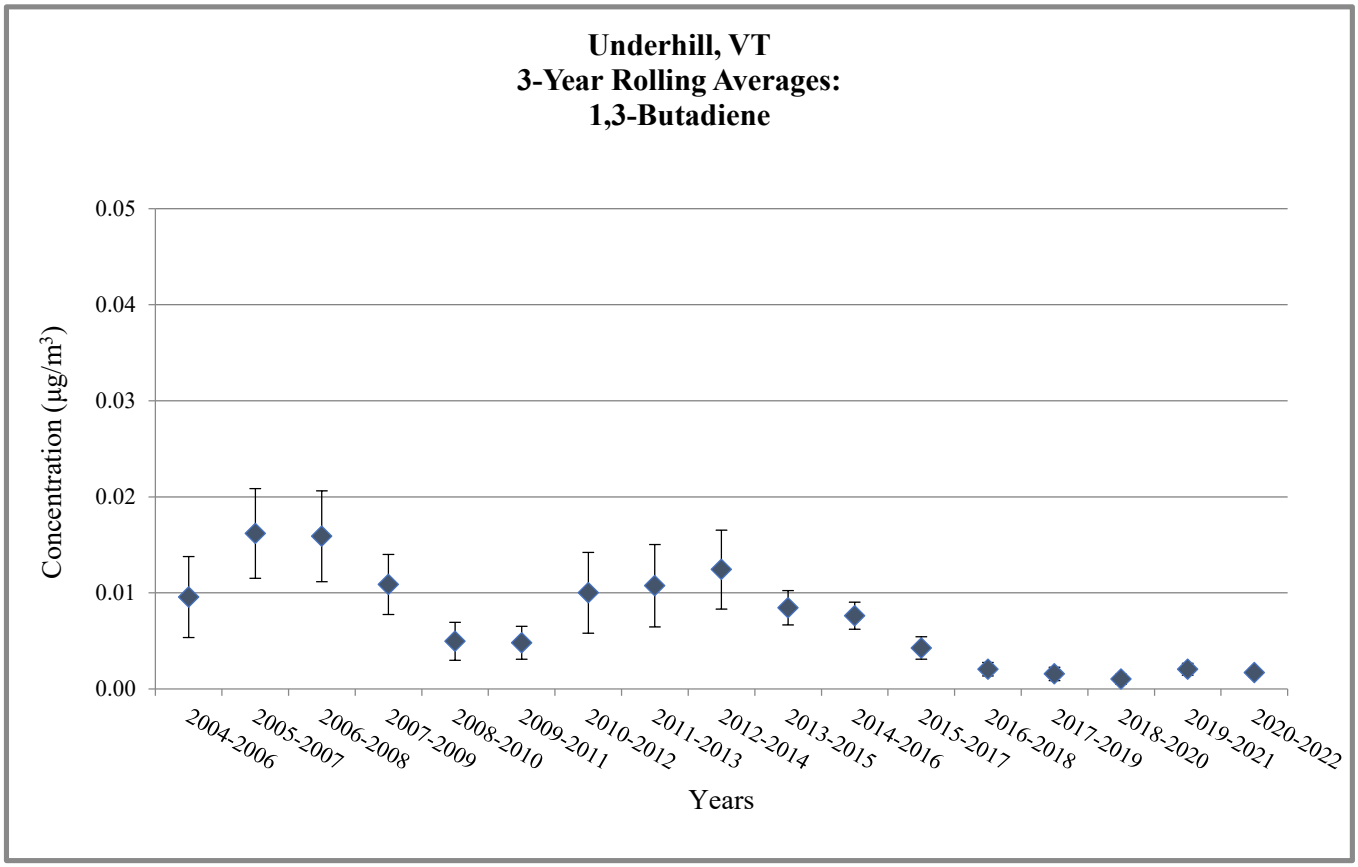




Does not meet MQO or wasn't able to collect enough samples

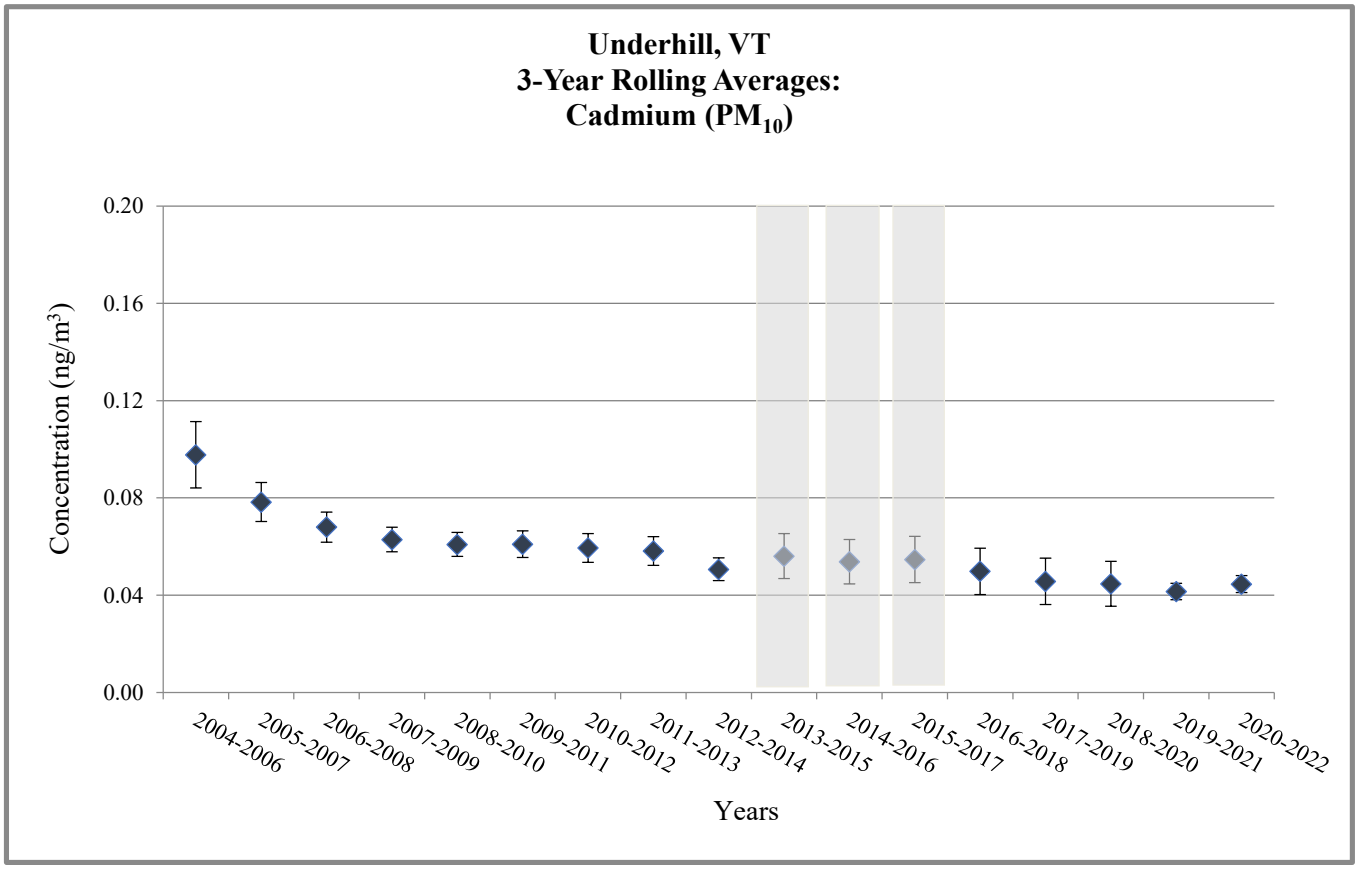
Figure 4. Underhill, VT - 3-Year Rolling Average Concentrations

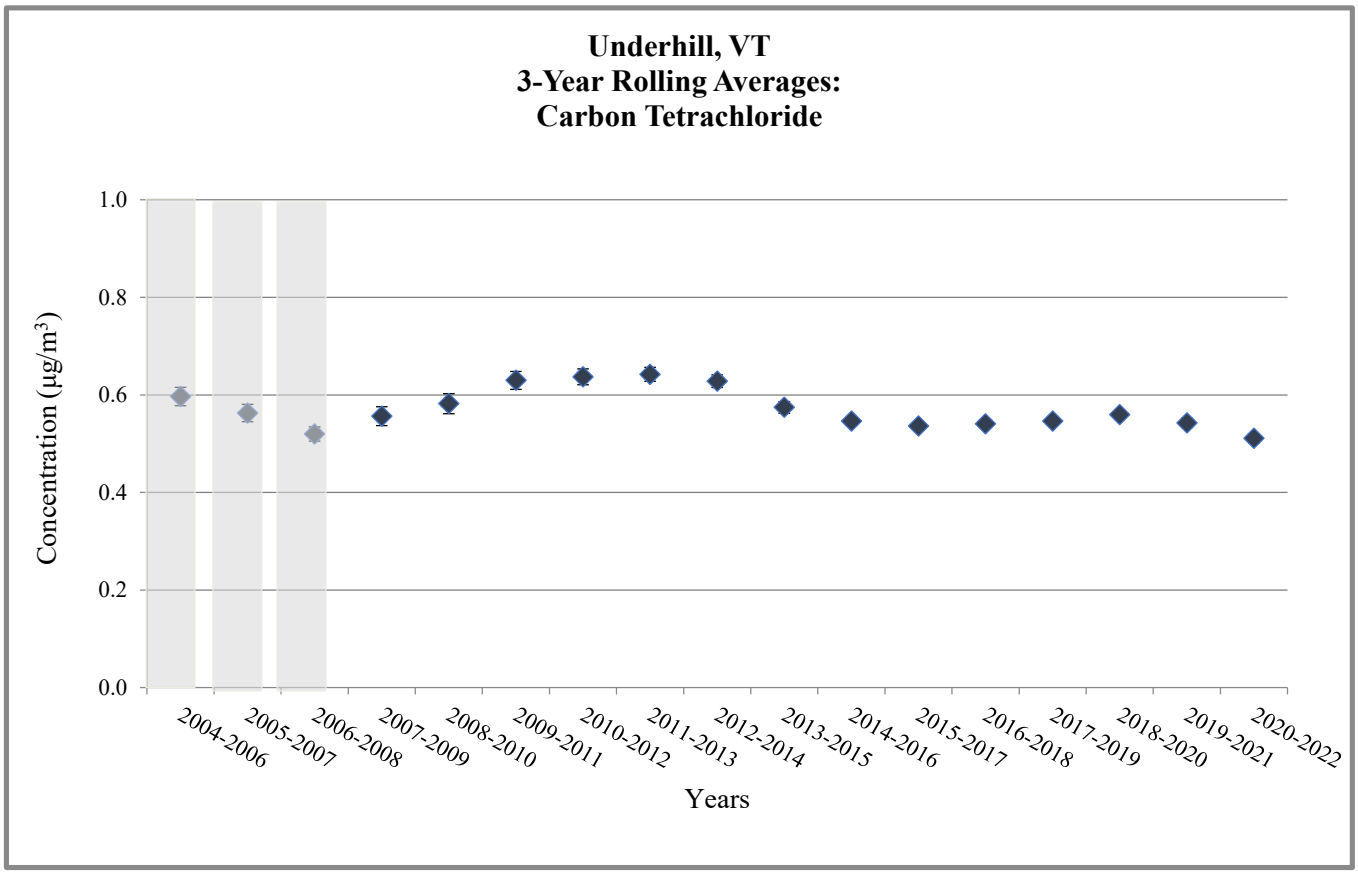




Does not meet MQO or wasn't able to collect enough samples

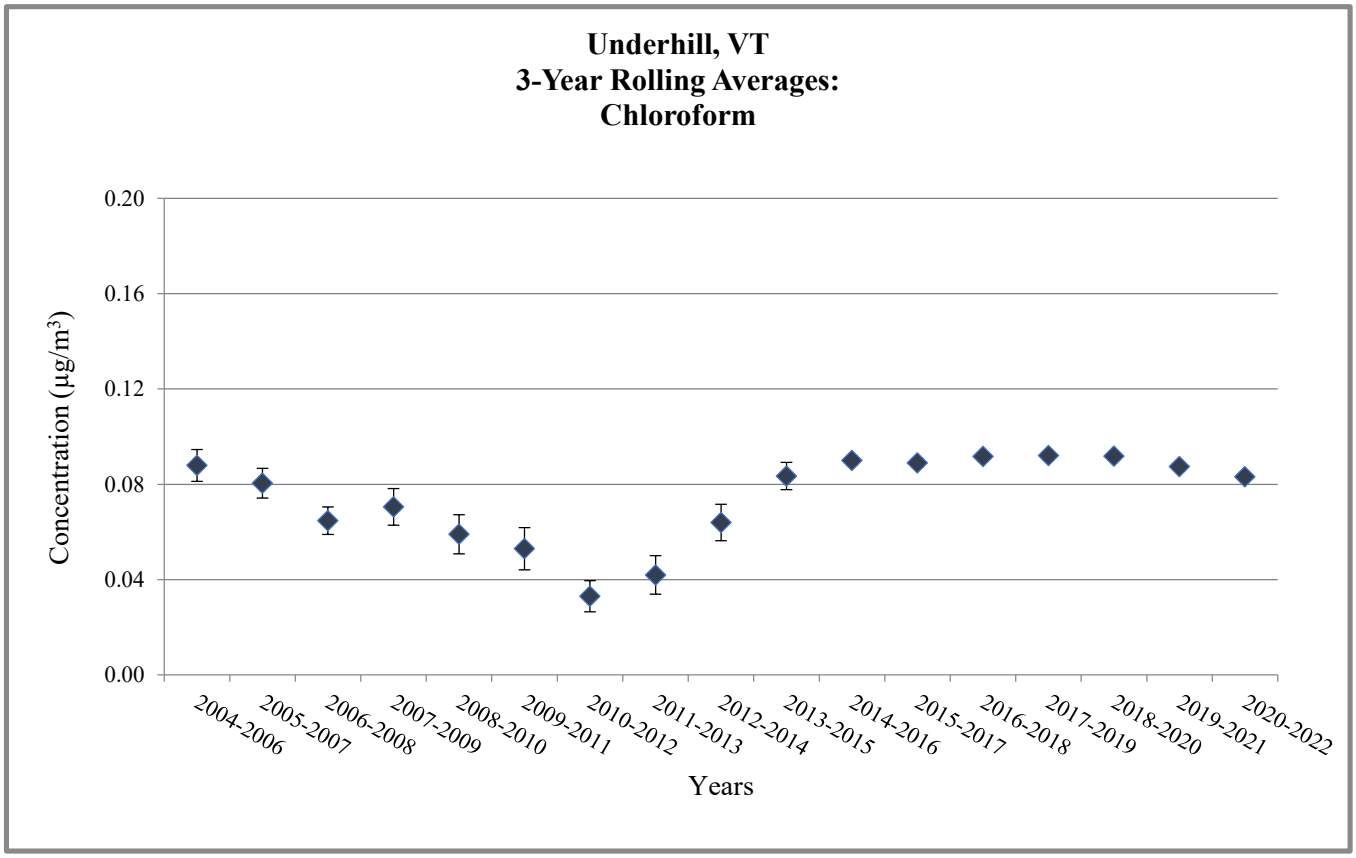
Figure 4. Underhill, VT - 3-Year Rolling Average Concentrations

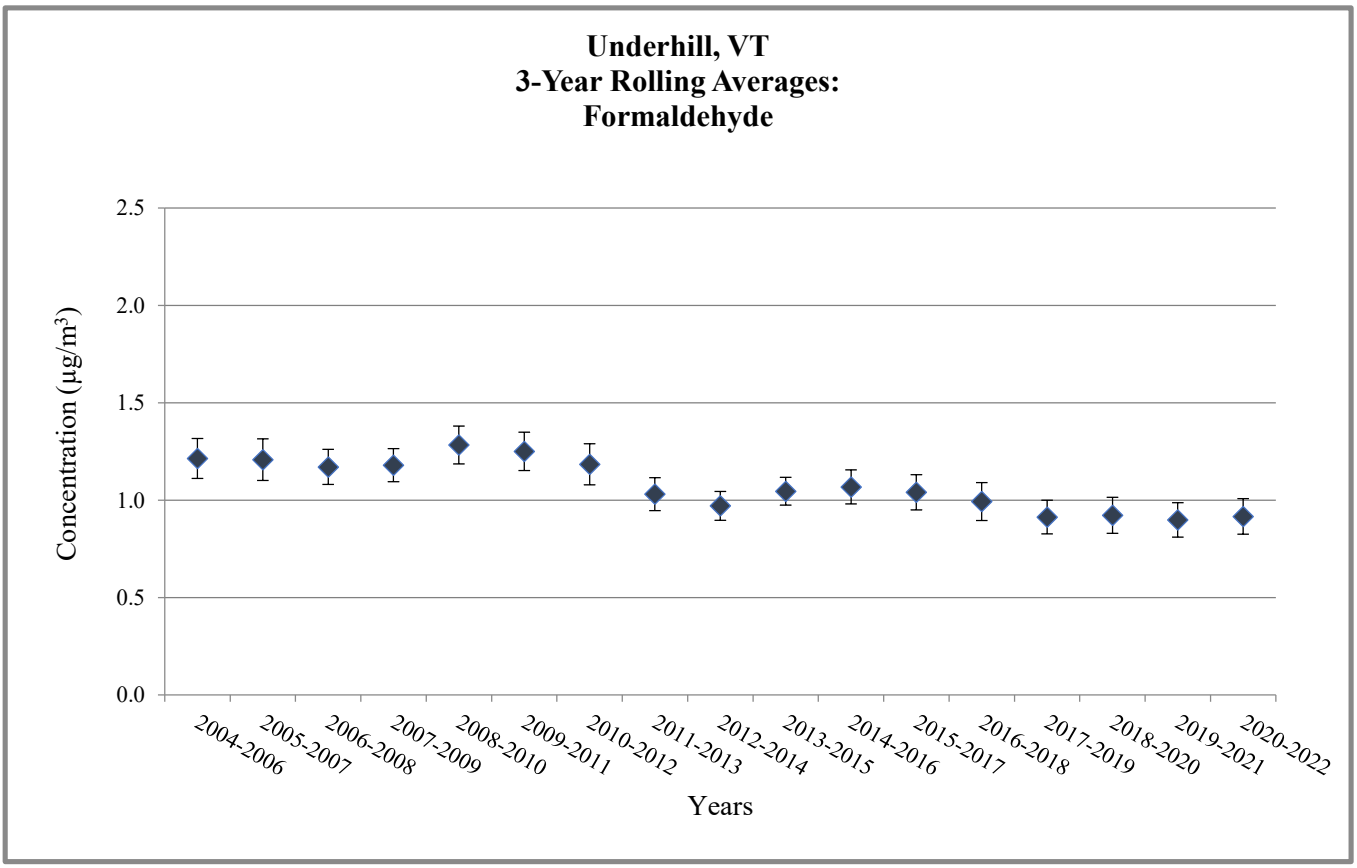




Does not meet MQO or wasn't able to collect enough samples

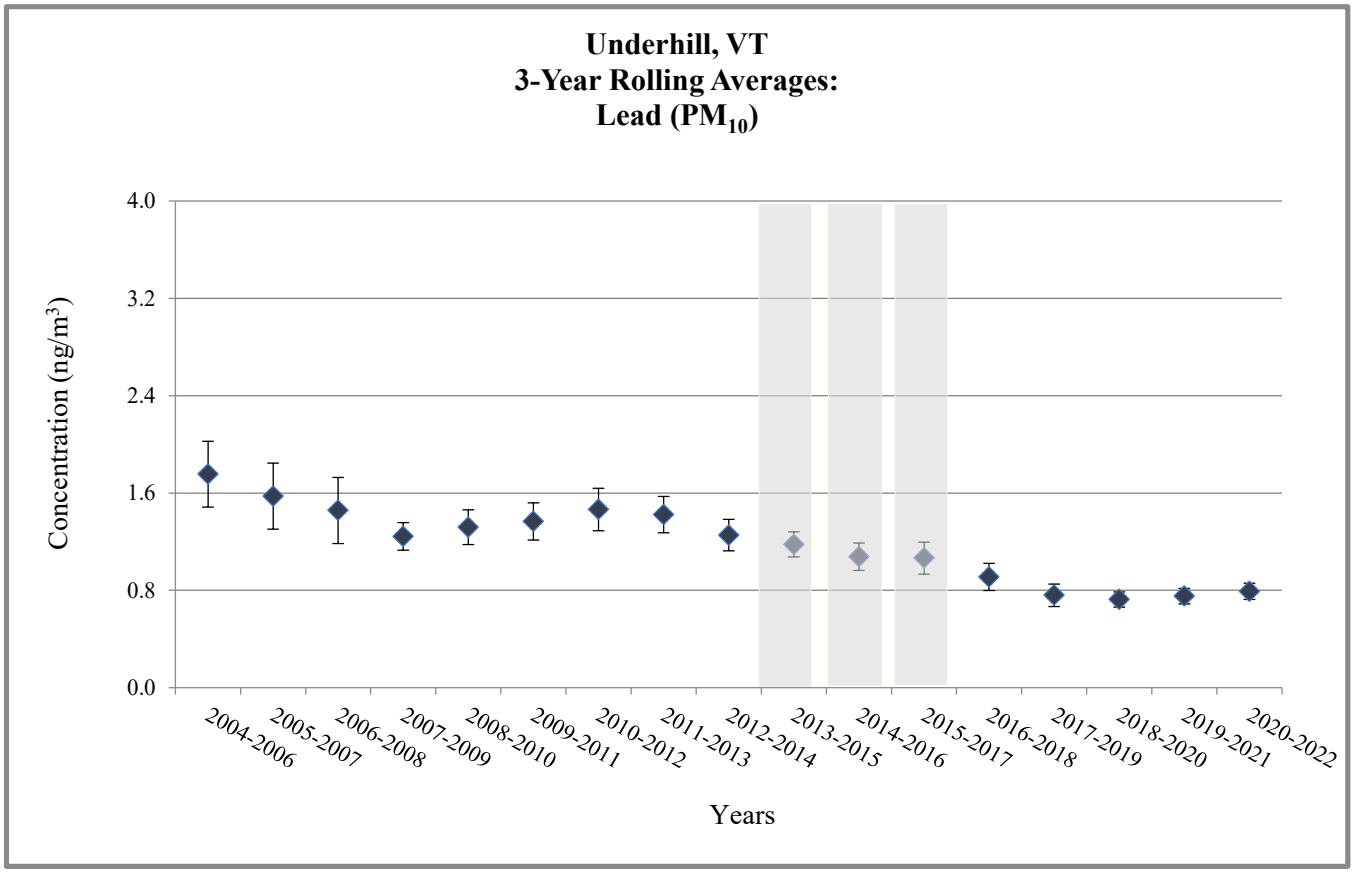
Figure 4. Underhill, VT - 3-Year Rolling Average Concentrations

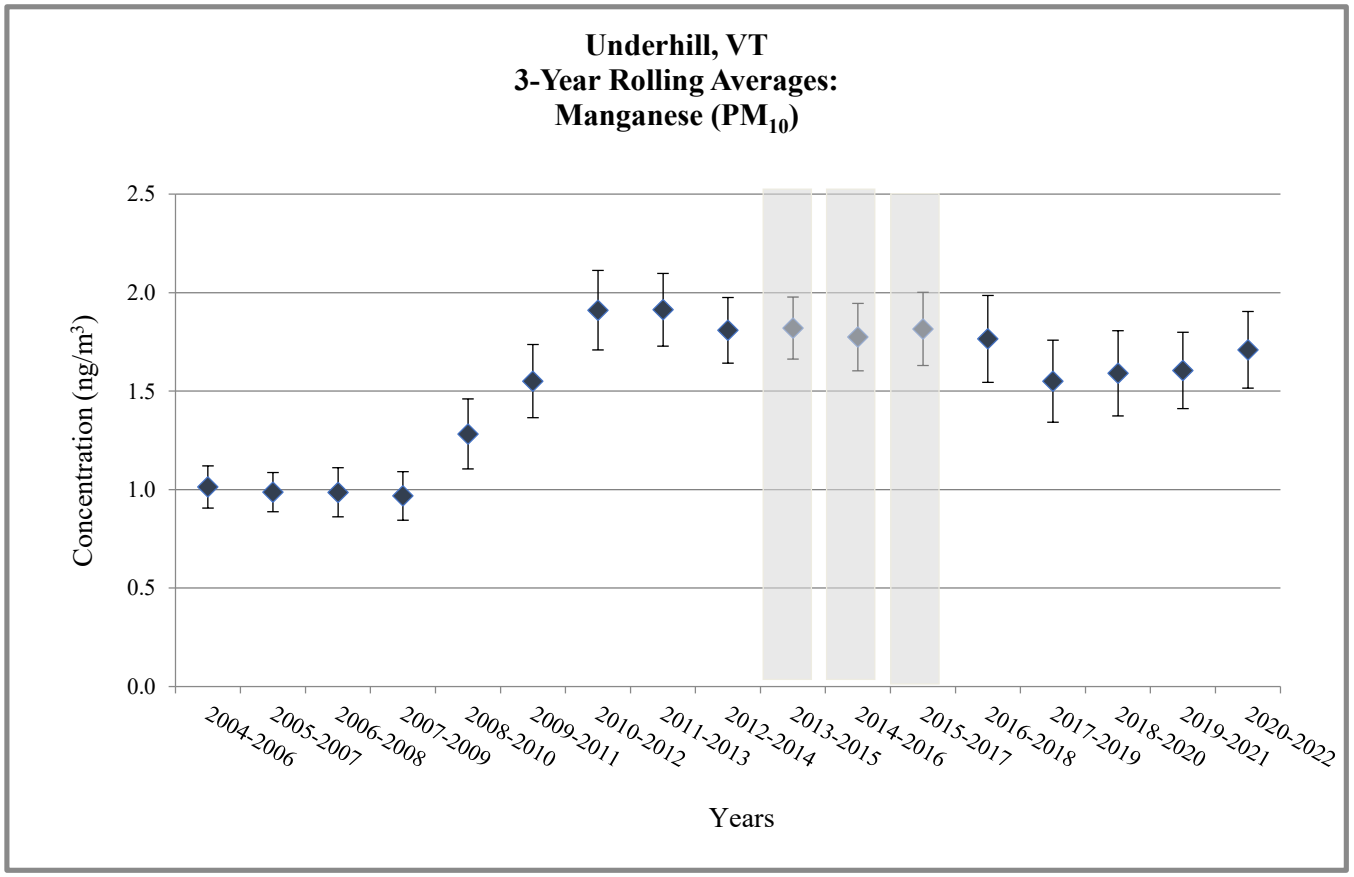




Does not meet MQO or wasn't able to collect enough samples

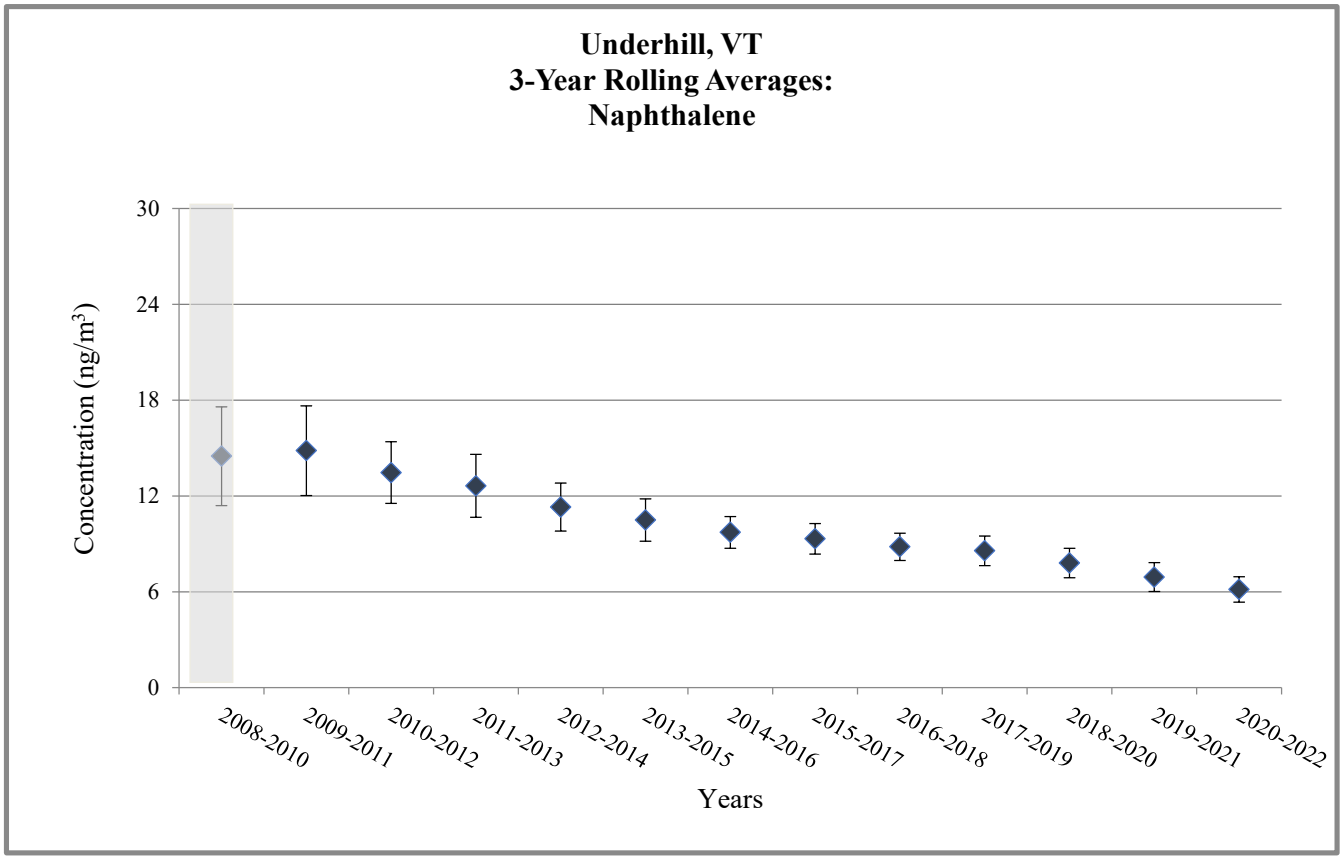
Figure 4. Underhill, VT - 3-Year Rolling Average Concentrations

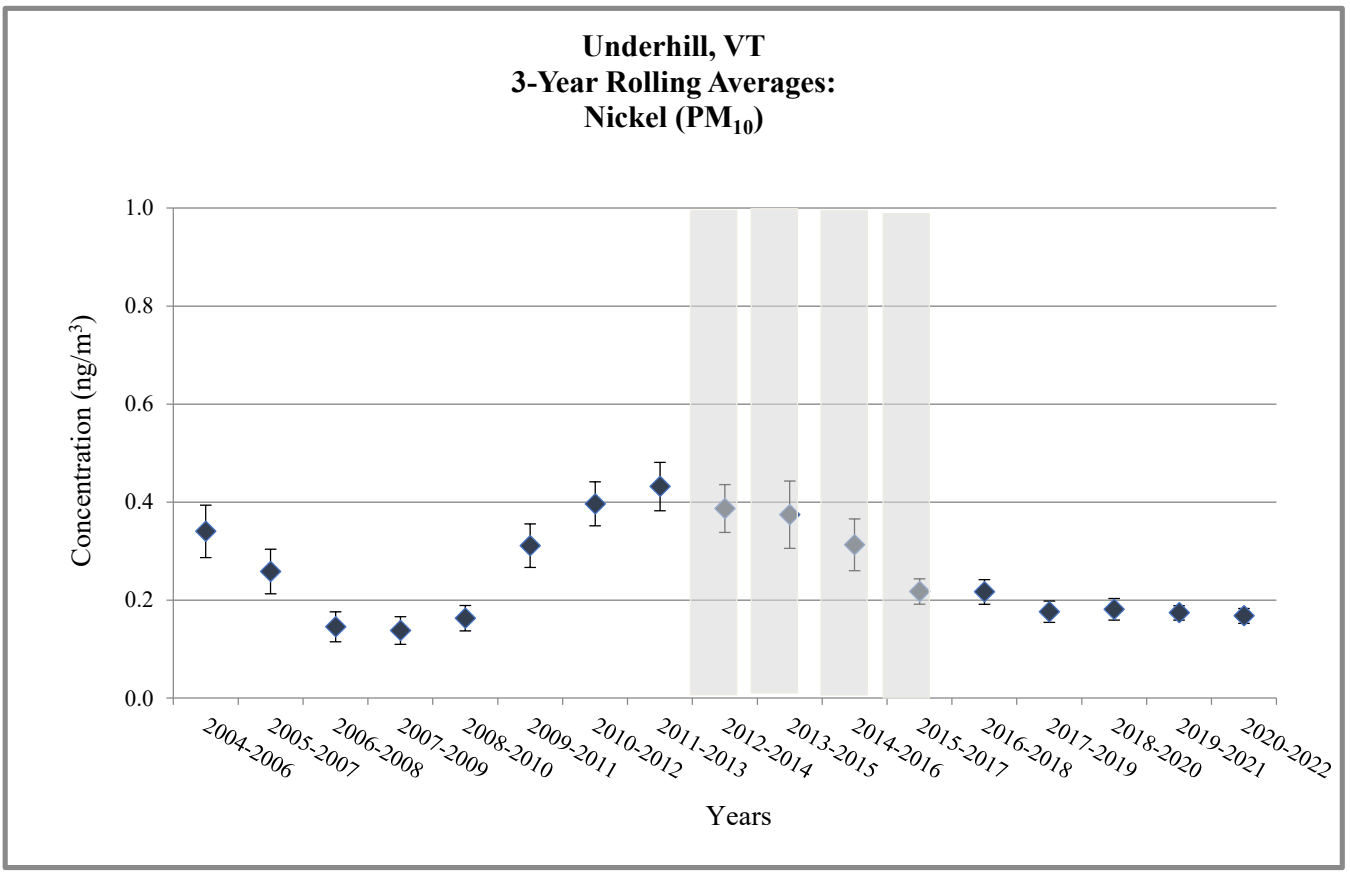




Does not meet MQO or wasn't able to collect enough samples

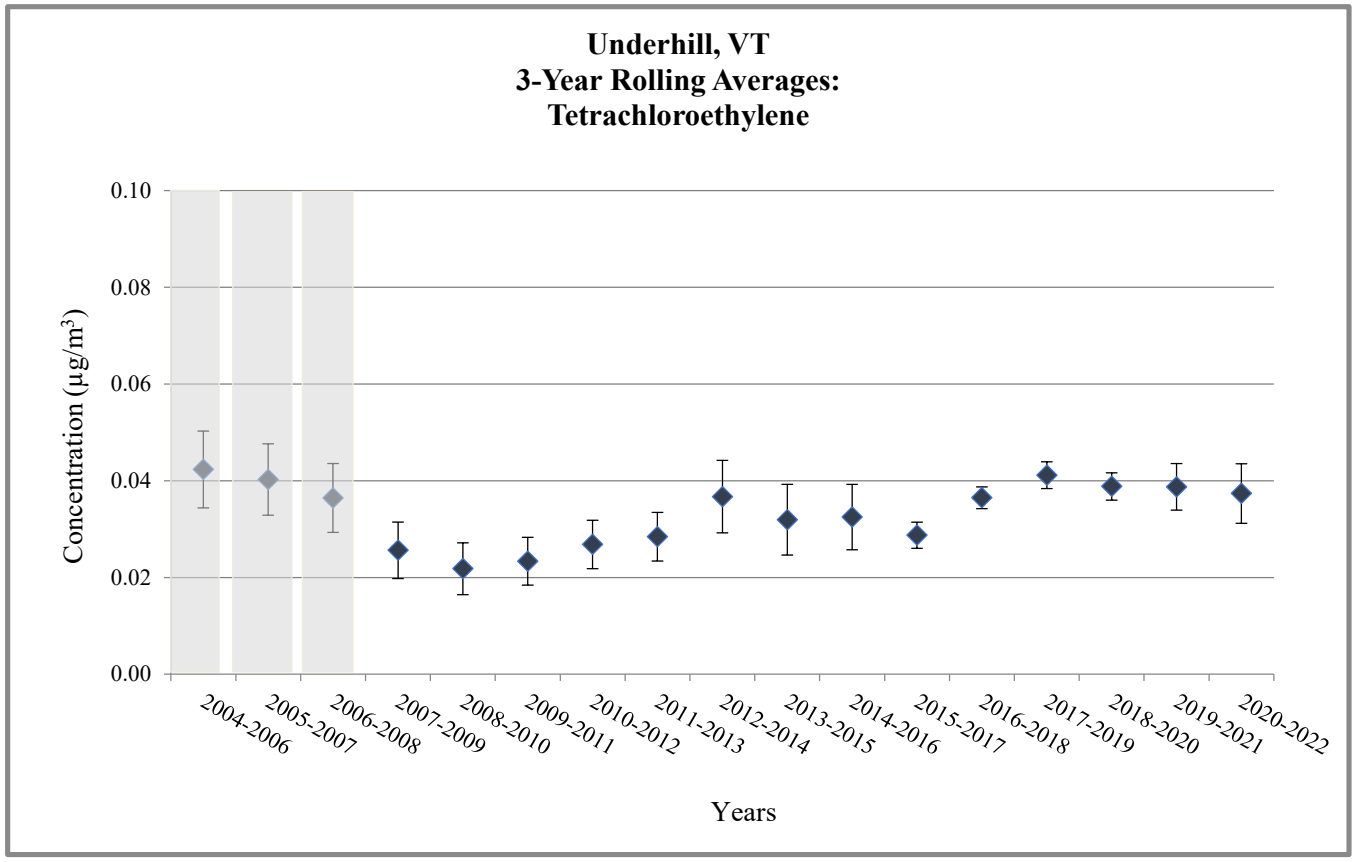
Figure 4. Underhill, VT - 3-Year Rolling Average Concentrations

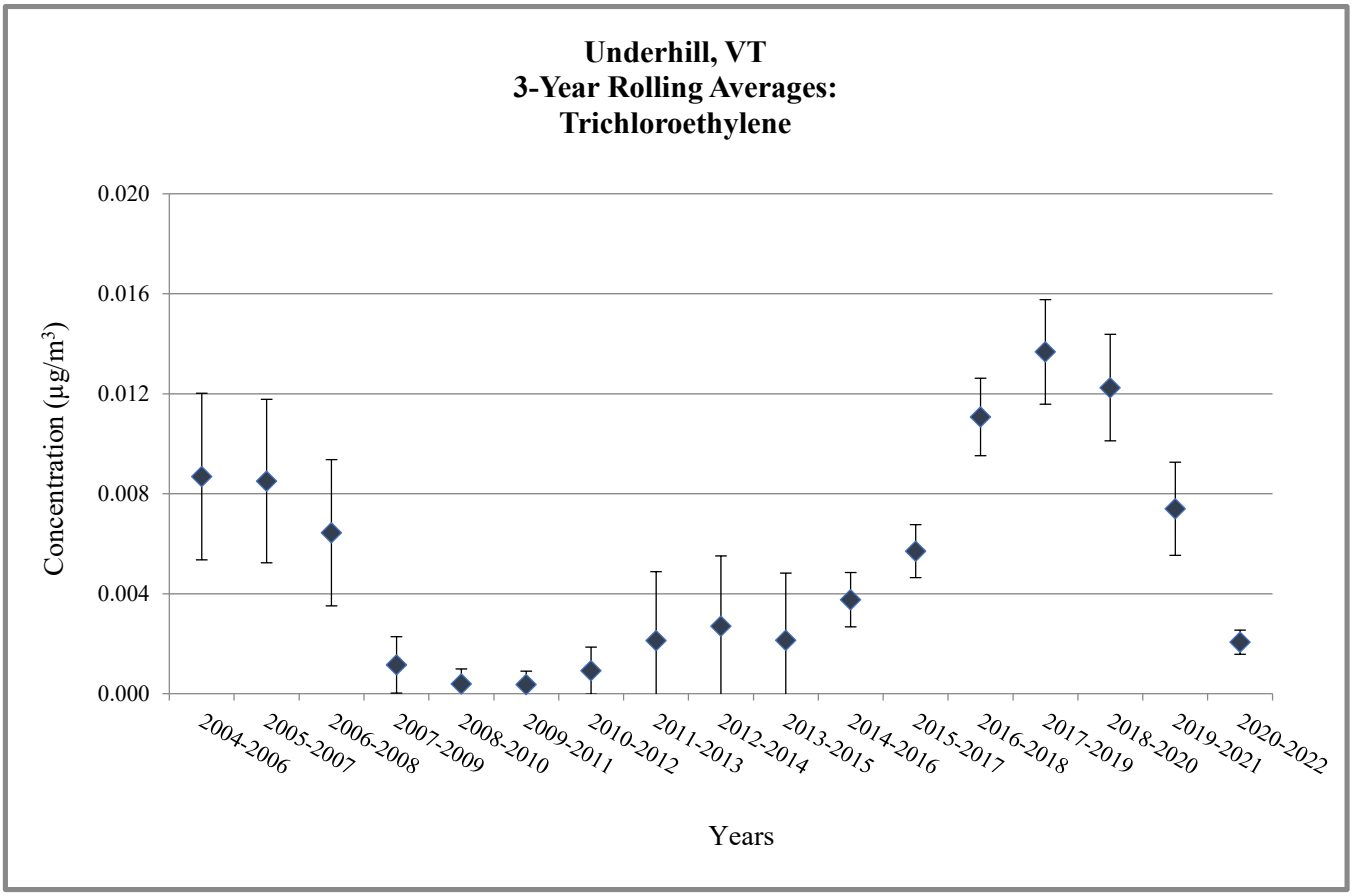




Does not meet MQO or wasn't able to collect enough samples

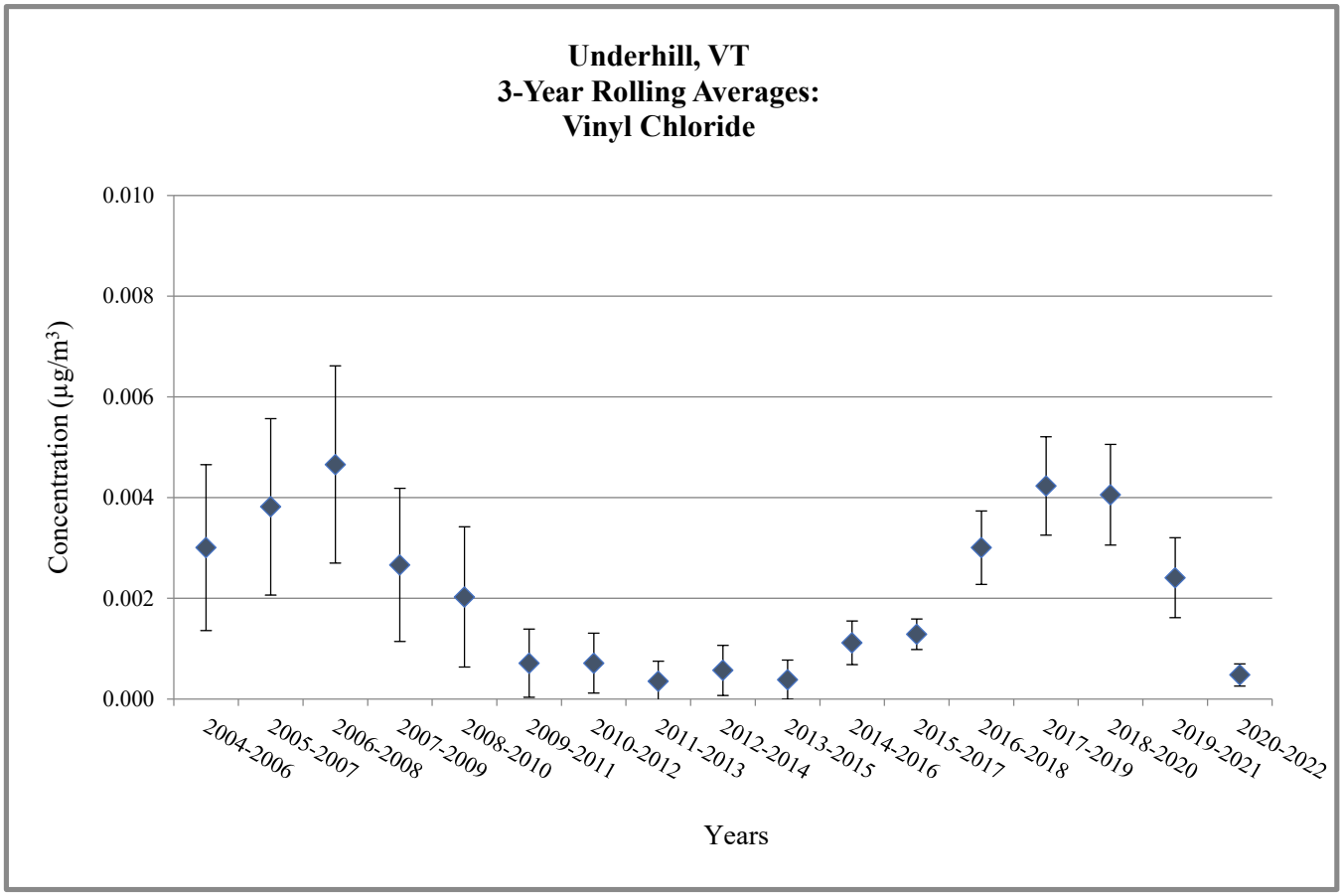
Figure 4. Underhill, VT - 3-Year Rolling Average Concentrations





Does not meet MQO or wasn't able to collect enough samples

Figure 4. Underhill, VT - 3-Year Rolling Average Concentrations



Does not meet MQO or wasn't able to collect enough samples

Table 6. NATTS Network Assessment: MQO#1 - Completeness Percentage at Underhill, VT

Year	Benzene	Butadiene, 1,3-	Carbon tetrachloride	Chloroform	Tetrachloroethylene	Trichloroethylene	Vinyl chloride	Acetaldehyde	Formaldehyde	Arsenic (PM10)	Beryllium (PM10)	Cadmium (PM10)	Lead (PM10)	Manganese (PM10)	Nickel (PM10)	Benzo(a)pyrene	Naphthalene
	VOCs							Carbonyls		PM10 Metals						PAHs	
Underhill, VT (AQS Site Code: 50-007-0007)																	
2004	92	92	92	92	92	92	92	48	97	95	95	95	95	95	95	--	--
2005	90	90	90	90	90	90	90	98	102	97	97	97	97	97	97	--	--
2006	89	89	89	89	89	89	89	93	93	95	95	95	95	95	95	--	--
2007	97	98	98	98	98	98	98	97	97	90	90	90	90	90	90	--	--
2008	97	98	98	98	98	98	98	93	93	97	97	97	97	97	97	--a	--a
2009	95	95	82	95	95	95	95	98	98	98	98	98	98	98	98	100	100
2010	95	95	90	95	95	95	95	100	100	100	100	100	100	100	100	98	98
2011	95	95	90	95	95	95	95	97	97	93	93	93	93	93	93	98	98
2012	97	97	97	97	97	97	97	100	100	100	100	100	100	100	100	95	95
2013	95	95	92	95	95	95	95	100	100	97	97	97	97	97	97	97	97
2014	97	97	97	97	97	97	97	98	98	100	100	100	100	100	49	97	97
2015	100	100	100	100	100	100	100	100	100	70	70	70	70	70	--b	100	100
2016	95	95	95	95	95	95	95	100	100	100	100	100	100	100	98	100	100
2017	100	100	100	100	100	100	100	100	100	98	98	98	98	97	97	97	97
2018	98	98	98	98	98	98	98	100	100	100	100	100	100	100	100	97	98
2019	100	100	98	100	100	100	100	98	98	100	100	100	100	100	97	97	97
2020	95	95	93	95	95	95	95	97	97	98	98	98	98	97	93	85	85
2021	95	98	93	98	98	98	98	97	97	102	93	98	102	102	100	98	98
2022	97	97	87	97	97	97	97	98	98	100	100	100	100	98	97	100	100

A-rated: ≥85%
B-rated: Between 75% to 85%
Does not meet: ≤75%
-- No data available

[a]: Scheduled sampling began midway through the year, thus, the site did not have the opportunity to collect enough samples to meet the 85% MQO.

[b]: Pollutant was expected, but were invalidated at this site for this year.

Table 7. NATTS Network Assessment: MQO#2 - Reported Method Detection Limits (MDLs) at Underhill, VT

Year	Benzene	Butadiene, 1,3-	Carbon tetrachloride	Chloroform	Tetrachloroethylene	Trichloroethylene	Vinyl chloride	Acetaldehyde	Formaldehyde	Arsenic (PM10)	Beryllium (PM10)	Cadmium (PM10)	Lead (PM10)	Manganese (PM10)	Nickel (PM10)	Benzo(a)pyrene	Naphthalene
	VOCs							Carbonyls		PM10 Metals						PAHs	
Underhill, VT (AQS Site Code: 50-007-0007)																	
2004	1.31	1.30	2.00	0.38	2.12	0.32	1.00	0.03	0.01	0.05	0.03	0.02	0.002	0.01	0.01	--	--
2005	1.23	1.30	2.24	0.40	2.00	0.54	0.91	0.03	0.01	0.05	0.03	0.02	0.002	0.01	0.01	--	--
2006	1.23	1.80	2.82	0.56	3.29	0.62	1.55	0.02	0.01	0.05	0.03	0.02	0.002	0.01	0.01	--	--
2007	0.31	0.40	0.35	0.16	0.41	0.20	0.36	0.02	0.01	0.05	0.03	0.02	0.002	0.02	0.01	--	--
2008	0.08	0.90	0.76	0.20	0.53	0.18	0.45	0.02	0.01	0.03	0.00	0.05	0.003	0.01	0.06	0.09	0.02
2009	0.08	0.10	0.06	0.02	0.12	0.02	0.09	0.02	0.01	0.05	0.00	0.06	0.004	0.01	0.07	0.07	0.01
2010	0.15	0.10	0.06	0.02	0.12	0.02	0.09	0.02	0.01	0.20	0.04	0.02	0.001	0.01	0.002	0.05	0.01
2011	0.69	0.20	0.88	0.08	0.71	0.26	0.18	0.02	0.01	0.40	0.02	0.02	0.001	0.04	0.13	0.05	0.004
2012	1.46	0.20	0.88	0.14	0.82	0.24	0.27	0.02	0.03	0.67	0.04	0.02	0.004	0.06	0.17	0.07	0.01
2013	0.46	0.20	0.59	0.14	0.53	0.45	0.27	0.01	0.21	0.79	0.04	0.02	0.006	0.03	0.11	0.07	0.01
2014	0.46	0.50	0.47	0.16	0.71	0.60	0.45	0.01	0.20	0.86	0.04	0.02	0.002	0.03	0.08	0.04	0.02
2015	0.15	0.20	0.18	0.06	0.24	0.20	0.18	0.01	0.18	0.23	0.07	0.02	0.006	0.05	--a	0.17	0.01
2016	0.15	0.02	0.06	0.01	0.06	0.05	0.03	0.01	0.10	0.62	0.04	0.04	0.007	0.06	0.12	0.09	0.04
2017	0.07	0.02	0.04	0.02	0.08	0.06	0.03	0.01	0.10	0.11	0.02	0.04	0.006	0.03	0.11	0.03	0.09
2018	0.07	0.04	0.12	0.02	0.12	0.07	0.05	0.01	0.09	0.08	0.03	0.05	0.003	0.02	0.13	0.02	0.08
2019	0.07	0.04	0.12	0.02	0.12	0.07	0.05	0.01	0.08	0.08	0.03	0.03	0.003	0.02	0.13	0.02	0.05
2020	0.18	0.17	0.26	0.05	0.25	0.23	0.17	0.01	0.16	0.16	0.05	0.02	0.002	0.04	0.07	0.02	0.04
2021	0.18	0.17	0.26	0.05	0.25	0.13	0.17	0.01	0.10	0.17	0.05	0.02	0.002	0.04	0.05	0.01	0.04
2022	0.46	0.30	0.32	0.10	0.25	0.13	0.27	0.01	0.06	0.27	0.10	0.10	0.01	0.04	0.05	0.01	0.04

A-rated: MDL to Target MDL ratio ≤ 1

B-rated" MDL to Target MDL ratio between 1 and 2

Does Not Meet MDL to Target MDL ratio>2

-- No data available

[a]: Pollutant was expected, but invalidated at this site for this year.

Table 8. NATTS Network Assessment: MQO#3 - Bias Percent Difference at Underhill, VT

Year	Benzene	Butadiene, 1,3-	Carbon tetrachloride	Chloroform	Tetrachloroethylene	Trichloroethylene	Vinyl chloride	Acetaldehyde	Formaldehyde	Arsenic (PM10)	Beryllium (PM10)	Cadmium (PM10)	Lead (PM10)	Manganese (PM10)	Nickel (PM10)	Benzo(a)pyrene	Naphthalene
	VOCs							Carbonyls		PM10 Metals						PAHs	
Underhill, VT (AQS Site Code: 50-007-0007)																	
2004	-1.3	-15.0	13.3	6.2	-6.7	-4.6	-11.9	-2.8	-2.7	--7.3a	--11.2a	--4.9a	---3.5a	--0.6a	--4.7a	--	--
2005	6.5	-6.3	23.7	6.8	-8.7	-5.7	-14.3	2.7	-0.7	--7.3a	--11.2a	--4.9a	---3.5a	--0.6a	--4.7a	--	--
2006	-13.5	-1.1	-9.6	-11.2	-23.6	-11.4	-14.1	-4.6	-14.2	--7.3a	--11.2a	--4.9a	---3.5a	--0.6a	--4.7a	--	--
2007	-9.5	-3.4	-2.9	5.5	-23.2	-12.9	-1.9	-3.5	-2.9	--7.3a	--11.2a	--4.9a	---3.5a	--0.6a	--4.7a	--	--
2008	-9.2	-7.2	-4.4	-20.3	-13.6	-9.5	-16.9	8.5	6.7	8.4	4.8	5.1	4.7	-25.3	8.6	--b	--b
2009	6.2	-0.5	1.9	5.4	1.1	2.7	-0.1	---17.8c	---15.8c	-14.8	-5.5	-16.2	-30.6	-37.7	-28.9	-1.7	-7.7
2010	-13.2	-3.7	31.6	1.0	-16.1	-6.4	-14.1	--2.4c	---0.1c	7.3	11.2	4.9	-3.5	0.6	4.7	-2.3	-17.1
2011	10.2	10.9	25.4	-9.7	0.8	-8.3	0.3	-1.4	1.3	1.4	-8.2	-5.7	-6.3	-3.8	-6.8	-2.1	-13.9
2012	--b	--b	--b	--b	--b	--b	--b	--b	--b	15.7	17.5	16.6	19.9	21.5	11.4	25.2	21.4
2013	-3.3	0.6	13.3	-2.4	-9.5	3.0	-8.1	-1.3	-2.5	-3.0	-2.0	1.4	0.1	-6.2	-1.2	-5.7	25.5
2014	10.8	0.8	7.2	0.9	7.4	4.4	7.6	1.5	3.3	1.9	--d	--d	2.2	13.2	--e	-16.3	0.7
2015	1.4	-1.3	9.4	-3.9	-13.5	-11.9	-8.1	--f	--f	--b	--b	--b	--b	--b	--b	-14.2	-11.4
2016	6.7	9.3	24.4	-3.3	-6.4	-5.8	0.4	-0.5	-10.2	9.9	-0.1	10.0	2.6	17.1	138.9	-10.5	-9.5
2017	2.6	0.0	-2.7	-7.5	-3.6	-4.9	-4.2	--f	--f	-2.6	-12.5	-3.6	-4.5	-4.2	-3.6	-22.4	-11.6
2018	-2.3	-8.3	-5.6	-12.7	-0.4	-5.3	-6.1	-9.6	-8.1	-21.9	-18.5	-20.8	-23.5	12.7	-21.0	-14.8	-20.7
2019	0.4	4.7	0.0	-9.4	-6.6	-1.4	3.5	0.5	12.9	-10.9	-0.9	-12.5	-34.9	-14.3	-10.1	29.3	18.5
2020	-3.8	-13.7	-2.3	1.1	-0.2	3.9	-4.0	0.7	-5.9	2.5	-1.4	-1.9	-1.4	-1.8	2.1	13.1	15.8
2021	0.6	1.9	-18.6	3.4	-6.2	-5.3	-0.1	-2.2	-2.9	-4.4	-3.3	3.4	-4.0	-1.9	-7.1	0.1	-2.0
2022	5.7	10.0	-1.1	4.0	-0.6	-6.2	-2.1	0.0	17.1	--b	--b	--b	--	--b	--b	--b	--b

A-rated:±25%

B-rated: Between 25% to 35% or between -25% to -35%

Does not meet:>35% or <35%

-- No data available

[a]: PM_{10} metals taken from 2004-2007 at this monitoring site were not analyzed until 2010 by Vermont DEC. Thus, the Proficiency Test data for 2010 data is applied to these.

[b]: No Proficiency Test samples were sent for this pollutant and year.

[c]: Bias data presented is an average of the ERG and Vermont DEC PT results.

[d]: The Proficiency Test sample for this pollutant was 0; the site reported a concentration as "< MDL", rather than 0. EPA accepted this result.is applied to these.

[e]: Although a Proficiency Test sample was sent to the lab supporting this site and year, the results were nullified by EPA due to QA issues.

[f]: Pollutant was sampled at this site and year, but no bias data were reported

Table 9. NATTS Network Assessment: MQO#4 - Overall Method Precision %CV at Underhill, VT

Year	Benzene	Butadiene, 1,3-	Carbon tetrachloride	Chloroform	Tetrachloroethylene	Trichloroethylene	Vinyl chloride	Acetaldehyde	Formaldehyde	Arsenic (PM10)	Beryllium (PM10)	Cadmium (PM10)	Lead (PM10)	Manganese (PM10)	Nickel (PM10)	Benzo(a)pyrene	Naphthalene
	VOCs							Carbonyls		PM10 Metals						PAHs	
Underhill, VT (AQS Site Code: 50-007-0007)																	
2004	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2006	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2007	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2008	--	--	--	--	--	--	--	--	--	0.7	--	3.1	1.1	1.1	--a	--	--
2009	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2010	--	--	--	--	--	--	--	--	--	9.5	--a	11.0	3.4	4.2	16.7	--	--
2011	--	--	--	--	--	--	--	--	--	23.2	--a	16.2	4.6	4.2	0.0	--	--
2012	--	--	--	--	--	--	--	--	--	33.9	--a	19.7	5.5	6.4	6.6	--	--
2013	--	--	--	--	--	--	--	--	--	5.5	--a	17.0	1.6	4.9	15.7	--	--
2014	--	--	--	--	--	--	--	--	--	5.8	--a	23.0	4.3	4.5	8.7	--	--
2015	--	--	--	--	--	--	--	--	--	11.3	--a	11.6	2.2	10.0	--	--	--
2016	--	--	--	--	--	--	--	--	--	5.9	--a	18.0	6.9	9.5	25.8	--	--
2017	--	--	--	--	--	--	--	--	--	9.3	--a	12.5	11.8	14.5	60.2	--	--
2018	--	--	--	--	--	--	--	--	--	5.7	--a	35.7	4.5	11.6	1.9	--	--
2019	--	--	--	--	--	--	--	--	--	12.7	--a	18.6	20.1	10.9	--a	--	--
2020	--	--	--	--	--	--	--	--	--	11.0	--a	14.7	16.3	11.9	15.4	--	--
2021	--	--	--	--	--	--	--	--	--	14.0	--a	13.5	17.8	17.3	31.8	--	--
2022	--	--	--	--	--	--	--	--	--	11.5	--a	5.5	10.7	7.5	29.8	--	--

Green = precision ≤ 15%

Yellow = precision > 15% to ≤ 25%

Red = precision > 25%

-- Gray = dataset was not rated

[a]: The primary and/or replicate value were less than the MDL, so no calculation could be made.

Table 10. NATTS Network Assessment: MQO#4 - Analytical Method Precision %CV at Underhill, VT

Year	Benzene	Butadiene, 1,3-	Carbon tetrachloride	Chloroform	Tetrachloroethylene	Trichloroethylene	Vinyl chloride	Acetaldehyde	Formaldehyde	Arsenic (PM10)	Beryllium (PM10)	Cadmium (PM10)	Lead (PM10)	Manganese (PM10)	Nickel (PM10)	Benzo(a)pyrene	Naphthalene
	VOCs							Carbonyls		PM10 Metals						PAHs	
Underhill, VT (AQS Site Code: 50-007-0007)																	
2004	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2006	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2007	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2008	--	--	--	--	--	--	--	--	--	1.0	--	0.8	8.2	1.2	--a	--	--
2009	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2010	--	--	--	--	--	--	--	--	--	9.0	--a	0.0	2.6	2.4	4.8	--	--
2011	--	--	--	--	--	--	--	1.7	0.7	4.2	--a	7.6	1.9	2.9	4.0	--	--
2012	6.1	60.6	4.2	14.7	--b	--b	--b	0.8	0.6	15.9	--a	19.5	2.5	0.9	1.2	--b	0.7
2013	9.8	--b	7.2	7.5	--a	--b	--b	--b	--b	25.4	--a	7.8	1.1	1.2	3.9	--a	2.1
2014	2.0	5.9	4.0	3.5	4.1	--a	--a	0.4	0.6	8.8	--a	12.4	1.3	1.2	3.7	9.1	2.4
2015	2.6	6.5	2.0	2.6	3.2	--a	--a	0.8	0.5	14.3	--a	7.4	3.8	6.4	--b	--a	1.2
2016	1.7	2.9	3.0	2.6	13.7	0.0	--a	0.6	0.8	4.9	--a	5.7	15.2	4.6	6.6	--a	0.7
2017	2.1	--a	2.9	2.9	10.7	8.8	23.1	2.6	2.6	3.5	--a	5.2	1.9	4.6	3.4	0.0	0.6
2018	3.0	--a	3.1	4.5	10.5	10.0	9.1	0.3	0.3	3.8	--a	12.6	3.0	2.4	2.5	4.6	1.1
2019	4.1	--a	4.2	--a	--a	--b	--a	0.5	0.5	12.2	--a	5.8	2.7	7.5	14.7	1.8	2.1
2020	2.6	--a	3.1	--a	--a	--b	--a	2.3	1.5	7.9	34.3	4.7	2.0	3.1	6.0	1.0	0.8
2021	2.0	--a	6.1	--a	--a	--b	--a	1.7	1.6	13.4	3.3	6.1	6.2	5.5	9.4	1.4	0.4
2022	2.2	--a	2.5	--a	--a	--b	--a	1.7	1.7	26.7	115.1	10.4	4.4	4.6	6.4	1.6	0.3

A-rated:≤ 15% CV

B-rated: Between 15%CV to25% CV

Does Not Meet: >25% CV or did not report Precision (required in the NATTS Workplan Template since 2012)

-- No data available

[a]: The primary and/or replicate value were less than the MDL, so no calculation could be made.

[b]: Per the NATTS Workplan template, analytical replicates were required to be reported to AQS for this sampling year.

Appendix A. Equipment Inventory

Pollutant Type	Year(s)	Manufacturer/Model, Extraction Type, and Year
Sampling Equipment		
Carbonyls	2004-2010	ATEC 300 Cartridge Sampler (Year Deployed: 2005)
	2011-2022	ATEC 2200 Canister/Cartridge Sampler (Year Deployed: 2011)
PAHs	2008-2022	Tisch Environmental PS-1 PUF Sampler (Year Deployed: 2008)
PM_{10} Metals	2004-2008	Wedding & Associates Hi-Volume PM10 Sampler (Year Deployed: 2004)
	2009-2013	Thermo R&P Parisol-Plus 2025 Sequential Air Sampler (Year Deployed: 1985)
	2014-2022	Thermo Parisol-Plus 2025i Sequential Air Sampler (2) (Year Deployed: 2014)
VOCs	2004-2010	ATEC 301 Canister Sampler (Year Deployed: 1999)
	2011-2022	ATEC 2200 Canister/Cartridge Sampler (Year Deployed: 2011)
Analytical Equipment		
Carbonyls	2004-2010	Waters Alliance 2695 HPLC /model 2487 Dual Absorbance (Year Deployed: 1999)
	2011-2013	HP/Agilent 1100 HPLC/Waters 2486 UV detection (Year Deployed: 2011)
	2014-2019	Waters Alliance 2695 HPLC /model 2487 Dual Absorbance (Year Deployed: 2003)
	2020-2022	Waters Alliance e2695 HPLC/Model 2998 PDA Detector (Year Deployed: 2020)
PAHs	2008-2014	HP/Agilent 5890/5971 GC/MS (Year Deployed: 2008)
	2015-2020	HP/Agilent 7890B/5975C GC/MS (Year Deployed: 2015)
	2021-2022	HP/Agilent 7890B/5975C GC/MS (Year Deployed: 2015); HP/Agilent 6890/5973 GC/MS (Year Deployed: 2021)
PM_{10} Metals	2004-2007	Thermo/VG Elemental X Series II ICP-MS (Year Deployed: 2003)
	2008-2014	PE ELAN 9000 ICP-MS (Year Deployed: 2003)
	2015-2016	Thermo X-Series II ICP-MS (Year Deployed: 2003)
	2017-2022	Thermo iCAP RQ ICP-MS (Year Deployed: 2017)
VOCs	2004-2008	HP/Agilent 6890/5973 GC/MS (Year Deployed: 1999)
	2009	HP/Agilent 6890/5973 GC/MS (Year Deployed: 2005)
	2010	HP/Agilent 5890/5971 GC/MS (Year Deployed: 2008)
	2011-2013	HP/Agilent 6890/5975 GC/MS (Year Deployed: 2010)
	2014-2019	HP/Agilent 6890/5973 GC/MS (Year Deployed: 1999)
	2020-2022	Entech 7200 (Year Depolyed: 2020)
Preconcentrator Equipment		
VOCs	2004-2008	Entech 7100 (1), Entech 7016A (2) (Year Deployed: 2001)
	2009-2012	Entech 7100A (Year Deployed: 2007)
	2013-2019	Entech 7100A (Year Deployed: 2003)
	2020-2022	Entech 7200 (Year Depolyed: 2020)
Standards Preparation Equipment		
VOCs	2004-2005	Environics S4040 (Dynamic Dilution) (Year Deployed: 1999)
	2006-2008	Entech 4600A (Dynamic Dilution) (Year Deployed: 2006)
	2009-2012	Custom-built (dynamic dilution) (Year Deployed: 2003)
	2013	Entech 4600A (Dynamic Dilution) (Year Deployed: 2003)
	2014-2017	Entech 4600A (Syringe dilution/static) (Year Deployed: 2006)
	2018-2022	Entech 4700 (Syringe dilution/static) (Year Deployed: 2018)
Canister Cleaning Equipment		
VOCs	2004-2005	Nutech 3650 (Hot) (Year Deployed: 1999)
	2006-2008	Entech 3100A (Hot) (Year Deployed: 2006)
	2009-2013	Custom-built (Cold) (Year Deployed: 2003)
	2014-2019	Entech 3100A (Hot) (Year Deployed: 2006)
	2020-2022	Entech 3100D (Hot)(Year Deployed: 2020)
PM_{10} Extraction Equipment		
PM_{10} Metals	2004-2007	Environmental Express (Hotblock) (Year Deployed: 2003)
	2008-2014	Branson 8510 (Sonicator) (Year Deployed: 2004)
	2015-2022	Environment Express (Hotblock) (Year Deployed: 2011)
PAHs Extraction Equipment		
PAHs	2008-2018	Dionex -300 (ASE) (Year Deployed: 2004)
	2019-2022	Dionex -350 (ASE) (Year Deployed: 2019)