

Vermont Annual Air Monitoring Network Plan 2020



Vermont Department of Environmental Conservation
Air Quality & Climate Division
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Acronyms and Abbreviations

AMTIC – Ambient Monitoring Technical Information Center
AQCD – (Vermont) Air Quality & Climate Division
AQI – Air Quality Index
BTEX – Benzene, Toluene, Ethylbenzene, Xylene
CAA – Clean Air Act
CARB – California Air Resources Board
CBSA – Core Based Statistical Area
CFR – Code of Federal Regulations
CO – Carbon Monoxide
CSA – Combined Statistical Area
CT DEEP – Connecticut Department of Energy & Environmental Protection
EPA – Environmental Protection Agency
FEMC – Forest Ecosystem Monitoring Cooperative
FEM – Federal Equivalent Method
FRM – Federal Reference Method
GIS – Geographical Information Systems
HAAS – Hazardous Ambient Air Standard
HAP – Hazardous Air Pollutants
IO – Inorganic
LC – Local Conditions of Temperature and Pressure
MDL – Method Detection Limit
MQO – Measurement Quality Objectives
NAAQS – National Ambient Air Quality Standards
NAMS – National Air Monitoring Station
NATTS – National Air Toxic Trends Stations Network
NCore – National Core Monitoring Sites
NECMSA – New England County Metropolitan Statistical Area
NO₂ – Nitrogen Dioxide
NO_x – Oxides of Nitrogen
NO_y – Reactive Nitrogen Compounds
O₃ – Ozone
OAQPS – Office of Air Quality Planning and Standards
PAH – Polycyclic Aromatic Hydrocarbon
PM₁₀ – Particulate matter less than 10 micron aerodynamic particle size
PM_{2.5} – Particulate matter less than 2.5 micron aerodynamic particle size
PM_c – Coarse Particulate between 10 and 2.5 micron aerodynamic particle size (PM_{10-2.5})
PMSA – Primary Metropolitan Statistical Area
QA/QC – Quality Assurance/Quality Control
QAPP – Quality Assurance Project Plan
SLAMS – State and Local Monitoring Stations
SO₂ – Sulfur Dioxide
SOP – Standard Operating Procedure
SPMS – Special Purpose Monitoring Stations
STP – Standard Temperature and Pressure
TAPI – Teledyne API (Advanced Pollution Instruments)
TEI – Thermo Environmental Instruments
TL – Trace Level
TOR – Total Organic Reduction
TSP – Total Suspended Particulate
TSS – Technical Services Section (Monitoring Section) of the AQCD
VAEL – Vermont Agriculture and Environmental Lab
VOC – Volatile Organic Compound
XRF – X-Ray Fluorescence

Introduction

In accordance with adopted federal EPA regulation, 40 CFR Part 58, Subpart B §58.10⁽¹⁾, the Vermont Air Quality & Climate Division is required to submit to EPA by July 1, 2020 an air monitoring network plan for the State of Vermont. The regulation requires that the network plan be posted on the AQCD website or other form of notification for public comment 30 days prior to submission to the EPA Region 1 Office.

The 2020 Vermont Annual Air Monitoring Network Plan was posted on the “public notice” section of the AQCD website <http://dec.vermont.gov/air-quality/monitoring>, for the 30-day comment period from 5/28/20 to 6/26/20. During this period, the VT AQCD received no public comments. VT AQCD did receive comments from EPA-Region 1 in a letter dated 6/12/20, which is included at the end of this document. VT AQCD made minor revisions to address EPA comments.

Please send all comments regarding Vermont Air Monitoring Network Plan:

Robert Lacaillade
State of Vermont AQCD
Davis Building 4th Floor
One National Life Drive
Montpelier, VT 05620-3802

E-mail: robert.lacaillade@vermont.gov

Vermont Air Monitoring Network Plan Overview

The Vermont Air Quality & Climate Division (AQCD) is a division within the Vermont Department of Environmental Conservation (DEC), which is one of three departments in the Vermont Agency of Natural Resources. The mission of the AQCD is to implement the Clean Air Act and Vermont State Statutes related to air quality. The AQCD regulates air quality to protect public health and the environment. As part of that effort, air monitoring data is required to be collected by federal regulations as put forth in the federal Clean Air Act, 40 CFR Parts [50](#), [53](#), [58](#), and the [Vermont Statutes Title 10, Part 1, Chapter 23, § 575](#). The collected data is utilized to determine compliance with the Environmental Protection Agency's (EPA) National Ambient Air Quality Standards ([NAAQS](#))⁽²⁾, and Vermont's Hazardous Ambient Air Standards ([HAAS](#))⁽³⁾. Other important uses of the of air monitoring data includes production of a daily Air Quality Index (AQI) report, daily air quality forecast report, support of short and long-term health risk assessments, and tracking long-term environmental trends in air quality.

This document provides general information and overview of the Vermont AQCD's air monitoring operational network. It also provides a brief annual summary of the Vermont "[NAAQS Design Values](#)" where applicable, and some of the major activities and changes scheduled for the upcoming year.

VT AQCD Air Monitoring Program Overview

Air pollution is created by many anthropogenic sources such as cars, trucks, buses, factories, and power plants, as well as natural sources such as forest fires, volcanoes, and windstorms. The air pollution emanating from these sources can be local or transported from great distances. The amount of particulate matter (PM), carbon monoxide (CO), sulfur dioxide (SO₂), and nitrogen dioxide (NO₂) emitted into the ambient air has been greatly reduced by control strategies and equipment applied to industrial sources. The phase-out of leaded gasoline produced reductions in ambient air lead concentrations. New automobiles are now equipped with emission controls and catalytic converters which greatly reduced ambient air concentrations of NO₂, CO and volatile organic compounds (VOCs). Through other regional, national, and global control strategies, pollutants such as ozone and particulate matter concentrations in Vermont are continuing to be reduced. New air pollution control technologies and strategies on various emission sources are expected to provide further reductions of air pollutants in the future.

Ambient air monitoring is a valuable service, which is essential for state and federal environmental planning, enforcement efforts, air pollutant trends analysis, and more recently providing timely air quality health advisories. Air monitoring began in Vermont in the 1960's, with a focus on total suspended particulate (TSP). During the 1970's, monitoring methods improved to allow for better quality particulate sampling and continuous monitoring of gaseous criteria pollutants such as CO, SO₂, NO₂, and ozone (O₃). During the late 70's and early 80's rapid development of computerized data acquisition systems allowed for collection of air quality data on a near real-time basis. Also, during the 1980's, monitoring methods and analytical techniques were developed to assay classes of toxic compounds such as VOCs, PCBs, PAHs, Carbonyls, and Metals. As technology improves, so does the ability to identify and quantify pollutants in both a spatial and temporal manner. Some of the newer technologies allow for real-time monitoring of toxic compounds.

The Vermont AQCD currently operates and maintains five permanent air monitoring stations and will be evaluating potential sites during 2020 for relocation of the Burlington Main Street shelter, as requested a few years ago by the Burlington Department of Planning and Zoning. Burlington's plans for renovation of this location has been put on hold while they re-evaluate potential options and funding sources. Vermont originally established an air monitoring network for criteria pollutants in the 1970's and a network for monitoring toxic air pollutants in 1985. Currently, the AQCD measures six EPA Criteria air pollutants and 96 air toxic pollutants (see Appendix A) as well as 53 separate PM_{2.5} mass and chemical speciation parameters at the CSN/IMPROVE sites (see Appendix B). The operation of all the SLAMS, NCore and CSN air monitors in the network meets the requirements in *40 CFR Part 58, Appendices A, C, D and E*. The EPA Criteria pollutant monitoring methods utilized by the VT AQCD are EPA federal reference method (FRM) or equivalent method (FEM) designated instruments.

All EPA CAA §105 & §103 grant agreements with VT AQCD require a Quality Assurance Project Plan (QAPP), an annual Work Plan, and Standard Operating Procedures (SOPs). These are reviewed annually and a summary update report is submitted to EPA annually by November 1st. The AQCD QAPPs and key associated SOPs for the Criteria Gases, Particulate Matter, Air Toxics and National Air Toxics Trend Sites (NATTS) and Meteorology have received EPA approval. All QAPPs originally approved by EPA are updated annually. The current versions are available on the AQCD website ([VT Air Quality & Climate Division](#)).

The Federal EPA National Ambient Air Quality Standards

The [Clean Air Act](#) of 1990 requires EPA to set [NAAQS's](#) (40 CFR part 50) for pollutants that are deemed harmful to public health and the environment. The Clean Air Act presents two types of NAAQS's: primary standards provide public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly; secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

EPA identified NAAQS's for six principal pollutants, which are called "criteria" pollutants. They are listed in Appendix B of this document. Units of measure for the standards are parts per million (ppm) by volume, parts per billion (ppb) by volume, or micrograms per cubic meter of air ($\mu\text{g}/\text{m}^3$).

On December 16, 2006, the EPA reduced the daily $\text{PM}_{2.5}$ NAAQS from $65 \mu\text{g}/\text{m}^3$ to $35 \mu\text{g}/\text{m}^3$. The annual $\text{PM}_{2.5}$ NAAQS remained $15 \mu\text{g}/\text{m}^3$. Vermont operates a small network of FRM filter based samplers as well as FEM for continuous $\text{PM}_{2.5}$ to assess air quality for $\text{PM}_{2.5}$.

On December 16, 2006, a regulation update addressed the creation of a multi-pollutant National Core (NCore) site network throughout the country. EPA's Office of Air Quality Planning and Standards (OAQPS) approved Vermont's NCore station at Underhill, VT on October 30, 2009. The Underhill site is one of 20 rural sites within the NCore network. The upgrades to the existing site required the addition of "trace level" monitoring for carbon monoxide, nitrogen oxides, and sulfur dioxide.

On November 12, 2008, the NAAQS for lead was strengthened to 0.15 micrograms per cubic meter for both the primary and secondary standard. In April 2012, the EPA issued the final NAAQS lead monitoring requirements for the required monitoring sites. Vermont was not required to set up any NAAQS lead monitors at that time. The reason for this designation is that the State of Vermont does not meet the regulation requirements regarding population thresholds for the Core Based Statistical Area (CBSA). Vermont airports do not meet "take off" & "landing" thresholds, and stationary emission source "tons per year" do not meet required thresholds. The 2009 Vermont lead (Pb) NAAQS Monitoring Plan provided the current plan and approach that was pursued by the State of Vermont regarding the ambient air lead monitoring network prior to the 2010-2012 monitoring requirement updates. As of January 2010, VT AQCD, as part of the National Air Toxics Trends Site (NATTS) in Underhill, has conducted low-volume PM_{10} sampling with subsequent multi-metals analysis (Pb included). Beginning in 2017 and 2018, low-volume PM_{10} sampling with subsequent multi-metals analysis (Pb included) is being performed at Rutland and Burlington Main Street sites, accordingly. On October 18, 2016, the EPA opted to retain the existing lead (Pb) NAAQS after a review that began in December 2014.

The final rule for NO_2 NAAQS was adopted on January 22, 2010. The new 1-hour average NO_2 NAAQS is based on the 3-year average of the 98th percentile of the 1-hour daily maximum. The 1-hour NAAQS value was set at 100 ppb. EPA, in cooperation with States/Local/Tribal agencies, will set up 40 NO_2 monitors nationwide to help protect communities that are susceptible to NO_2 health effects. Vermont is not currently required by EPA under this rule to set up any additional NO_2 monitors or require consideration of a "near roadway" site in the network other than what is currently being operated in Burlington and Rutland or elsewhere in the state of Vermont.

A new 1-Hour SO₂ NAAQS was adopted on June 2, 2010. EPA strengthened the primary NAAQS for SO₂ by establishing a 1-hour standard level of 0.075 ppm. The new design value is a three-year average of the 99th percentile of the annual distribution of the daily maximum 1-hour average concentration for that year. The rule revokes the previous 24-hour standard (140 ppb) and annual standard (30 ppb). The Vermont recommended design value uses 2015, 2016, and 2017 SO₂ summary data. Vermont is not currently required under the new rule to set up additional SO₂ monitors in the network, beyond what is currently in Rutland. EPA finalized its Data Requirements Rule for the 1-hour Sulfur Dioxide Primary NAAQS on August 21, 2015 (80 FR 51052) and provided detailed monitoring and modeling guidance for implementing the SO₂ standard.

On January 15, 2013, EPA adopted an updated PM_{2.5} primary annual PM_{2.5} standard of 12 ug/m³ and the secondary standard of 15 ug/m³. This annual PM_{2.5} average will be computed as the average of the last three years. As an example: The average for 2012 would be the annual averages from 2010, 2011 and 2012. In addition, EPA established that all continuous PM_{2.5} FEM monitors operating for more than 24 months be used for comparison to the NAAQS unless the state specifically requests that the data be excluded as is provided under 40 CFR Part 58.11(e).

The ozone primary and secondary NAAQS for 8-hour average of 0.070 ppm was adopted on December 28, 2015. At this time, Vermont is in compliance with the current NAAQS ozone standard.

Changes July 2019 to June 2020 Air Monitoring Network

The Vermont AQCD network changes, additions, and deletions that were performed during the 12-month period between July 2019-June 2020 were:

1. A new TAPI T200U trace NO/NO_y analyzer was installed at the Underhill NCore site in October 2019, replacing an Ecotech 9843.
2. A new TAPI T700U dynamic dilution calibrator was installed at the Underhill NCore site in December 2019, replacing a TAPI 700EU.
3. VAEL installed new Agilent GC/MS and ENTECH pre-concentrator, autosampler and canister cleaner for TO-15 in January 2020.
4. VAEL installed new Waters HPLC for TO-11A in March 2020 and added m-tolualdehyde, o-tolualdehyde and p-tolualdehyde to the TO-11A target compound list in July 2019
5. VAEL staff began method development procedures during the first quarter of 2020 to add ethylene oxide to the EPA Method TO-15 target list to meet a new EPA NATTS Grant requirement.
6. A Meteorological QAPP (and associated SOPs) were submitted to EPA Region 1 in July 2019 which includes meteorological parameter measurements required at the Underhill NCore site as well as meteorological systems at the other SLAMS sites in the network. EPA approved the Meteorological QAPP on January 2, 2020.
7. Based on the new Meteorological QAPP, onsite annual collocated transfer system (CTS) audits, using a certified standalone MetOne Automet system, were initially performed at the Underhill NCore site in August 2019 and the other network SLAMS sites during the fall of 2019.

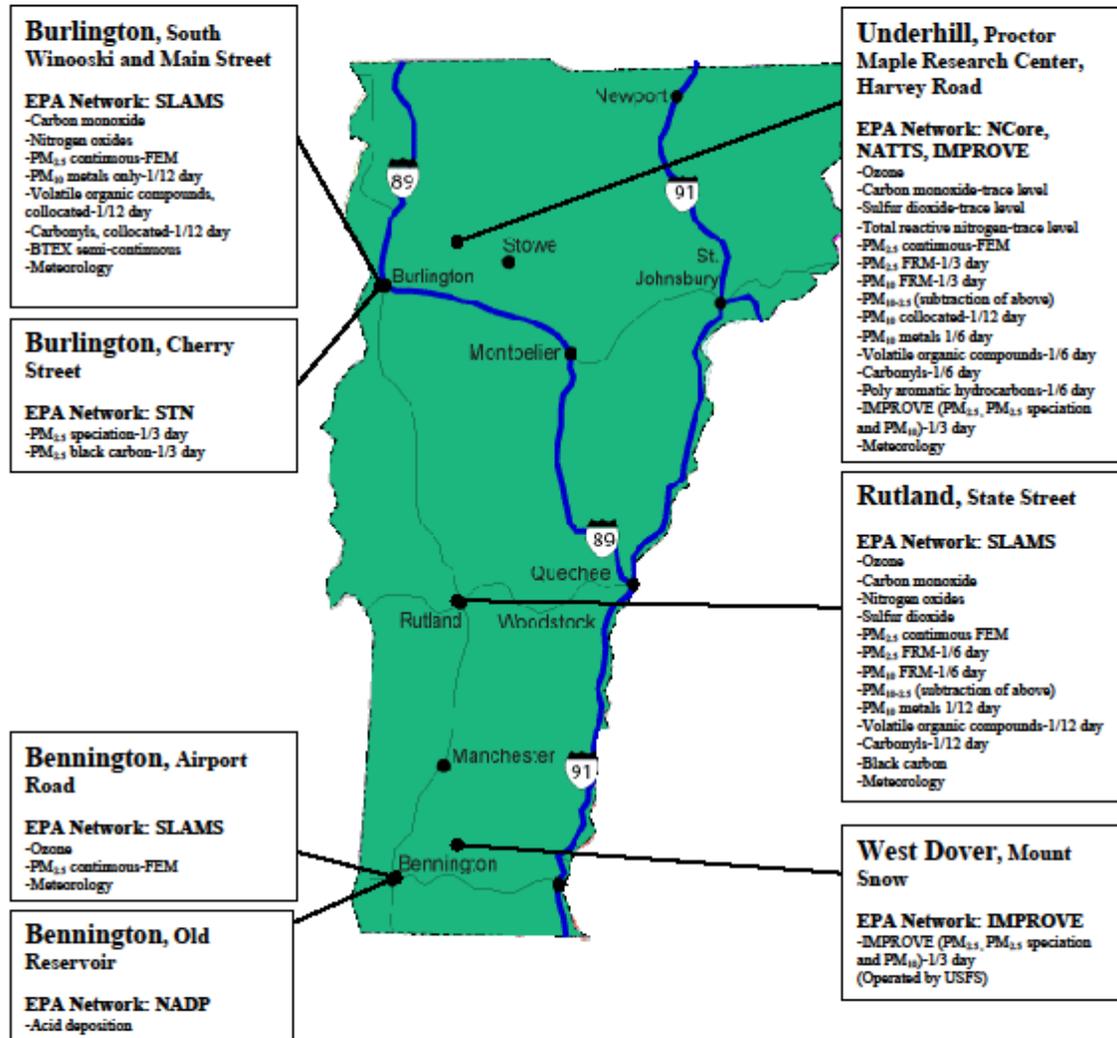
Proposed Changes July 2020 to June 2021 Air Monitoring Network

The Vermont AQCD network changes, additions and deletions that are planned for the next 12 months of July 2020-June 2021 are:

1. Procure an Agilaire 8872 datalogger for the Rutland site which will update storage capacity and replace the current Agilaire 8832.
2. Continue to evaluate procedures for processing, evaluating and validating AE33 data and possible upload to the EPA AQS database.
3. Continue working with the Burlington Planning Department and others on the development of a plan for the relocation of the Burlington Main Street monitoring site. The Burlington Planning Department has not updated the status of the redevelopment project for the current monitoring site location which continues to be in transition with no firm schedule or funding. Based on the new location for Burlington Main Street site, the AQCD will consider proposing to EPA that the STN site (which is currently located at the Burlington Cherry Street site) be relocated to this new location as well, thus combining the two sites.
4. VAEL is planning to complete method development requirements for adding ethylene oxide to the target list for EPA Method TO-15 to meet a new EPA NATTS Grant requirement.
5. The AQCD and VAEL will continue to evaluate the logistics and method development requirements necessary for VAEL to add EPA Method TO-13A to its air toxics analytical capabilities for possible future semi-volatile sample support of the VT AQCD's NATTS and state air toxics program.

Figure 1 – Vermont Air Monitoring Network Plan Map

2020 Vermont Ambient Air Monitoring Network



Network Pollutant Monitoring Descriptions

Below is the list of network pollutant monitoring descriptions with number of sites, the sampling frequency, and specific network information.

PM_{2.5} Monitoring Network

Continuous: The Vermont AQCD operates four (4) continuous PM_{2.5} monitoring sites in the air monitoring network, located in Burlington (Main Street), Underhill, Rutland and Bennington (see Table 1). The TAPI T640 continuous PM_{2.5} monitor (non-X version) is operated at all four sites and has Federal Equivalency Method (FEM) designation from EPA (EQPM-0516-236). All T640 PM_{2.5} monitors are operated year-round. The Rutland T640 PM_{2.5} monitor is collocated with a PM_{2.5} TEI 2025i FRM sampler on a 1-in-6 day schedule for official determination of network precision, QA assessment and comparative analysis for this method. The Underhill T640 PM_{2.5} monitor is also collocated with a TEI 2025i FRM on a 1-in-3 day schedule for NCore requirements and provides unofficial method precision for informational purposes.

The TAPI T640 continuous PM_{2.5} monitor design is a direct ambient air measurement method (no in-line filter) using optical broadband spectrometry which converts 90° scattered polychromatic LED light from suspended aerosol particles into a mass concentration in µg/m³. Continuous PM_{2.5} µg/m³ data is reported as 1-hour averages. The TAPI T640 FEMs at all four AQCD sites are designated in AQS as the primary monitor for PM_{2.5} LC (AQS code: 88101). The network primary and collocated monitors are deemed suitable for the applicable NAAQS comparison. Vermont AQCD is not requesting that any site's continuous PM_{2.5} FEM be excluded from comparison to the NAAQS. As of 2014, all continuous PM_{2.5} FEM monitoring data from VT sites have been reported as PM_{2.5} LC (88101).

FRM: The Vermont AQCD currently operates two (2) PM_{2.5} TEI 2025i FRM samplers (see Table 1) in the air monitoring network, located at the Rutland and Underhill sites. The Underhill NCore sampler operates on a 1-in-3 day sampling schedule, while the Rutland sampler operates on a 1-in-6 day sampling schedule as the designated network collocated sampling site for assessing precision for TAPI T640 FEM used throughout the network.

The EPA approved FRM sampling method collects an integrated 24-hour particulate sample on a 47mm Teflon[®] filter disc (See Table 2). The particulate collected on the filter has an aerodynamic particle size of ≤ 2.5 microns. The filter and associated sampling data are post processed using gravimetric assessment, performed by Wood, LLC (begun 4/27/19), to determine the mass concentration for the 24-hour sampling period.

Table 1 – PM_{2.5} Network Sampling

Site	Continuous FEM (Primary)	FRM	FRM Collection frequency	Collocated Precision Site
Underhill	Teledyne API T640	TEI 2025i	1-in-3 day	NCore/Informational
Rutland	Teledyne API T640	TEI 2025i	1-in-6 day	Yes (network)
Burlington Main Street	Teledyne API T640	N/A	N/A	N/A
Bennington	Teledyne API T640	N/A	N/A	N/A

Table 2 – PM_{2.5} Methods

Sampler	Collection	Analytical Method/Lab	Reported Data Interval
TEI 2025i Manual Equivalent Method: EQPM-0202-145	Low Volume 47 mm Teflon® Filter - 24-hour	Gravimetric/ Wood LLC	24-hour
TAPI T640 EQPM-0516-236	Direct Measurement	Continuous Broadband Spectroscopy	1-Hour

“Design values” for PM_{2.5} must be calculated every year for operational sites operating FRM or FEM PM_{2.5} monitors/samplers. The site must meet the design value statistical definition for a design value to be calculated. See below for further information.

PM_{2.5} Annual Design Value (2019)

PM_{2.5} annual design values are presented in Table 3 below and are calculated using the 3-year average of the respective annual averages from 2017-2019. The current annual PM_{2.5} NAAQS is 12 µg/m³. Currently, all Vermont monitors are in attainment of the annual PM_{2.5} NAAQS.

Table 3 – PM_{2.5} 2019 Annual Design Value

Site	Design Value (µg/m ³) Years 2017-2019
Bennington	5.6
Burlington Main St	6.1
Rutland	7.4
Underhill	4.3

Source: <https://www.epa.gov/air-trends/air-quality-design-values#report>

PM_{2.5} 24-Hour Design Value (2019)

The PM_{2.5} 24-hour design values are presented in Table 4 below and are calculated using the 3-year average of the annual 98th percentile 24-hour averages from 2017-2019. The 24-hour average PM_{2.5} NAAQS is 35 µg/m³. Currently, all Vermont monitors are in attainment for the daily PM_{2.5} NAAQS.

Table 4 – PM_{2.5} 2019 24-Hour Design Value

Site	Design Value (µg/m ³) Years 2017-2019
Bennington	14
Burlington Main Street	15
Rutland	19
Underhill	12

Source: <https://www.epa.gov/air-trends/air-quality-design-values#report>

PM_{2.5} Speciation Monitoring Network

The Vermont AQCD operates two (2) PM_{2.5} speciation sites in the air monitoring network at the Burlington-Cherry Street (Zampieri) and Underhill sites (See Table 5). The samplers operate on a 1-in-3 day schedule and produce a 24-hour integrated filter-based sample. A third Vermont site not officially part of the AQCD network, which is operated and maintained by the U.S. Forest Service (USFS), is located in Dover, VT. Both the Underhill and Dover, VT (Mt. Snow-Lye Brook) are part of the IMPROVE (Interagency Monitoring of Protected Visual Environments) network. The Burlington Cherry Street site is part of the EPA Speciation Trends Network (STN).

The analysis of the filters generates $\mu\text{g}/\text{m}^3$ concentration results for 53 parameters on chemical makeup of PM_{2.5} (see Appendix B). The parameters include levels of sulfate, nitrate, ammonium, and trace elements including metals, elemental carbon, and organic carbon. The STN is designed to complement the PM FEM/FRM network. The IMPROVE network monitors are mostly located in rural areas and provide measurements of regional and background levels of PM_{2.5} concentrations on a 1-in-3 day sampling schedule. The same chemical components are measured by IMPROVE as are measured by the STN, although differences exist between the methods employed to collect and analyze the collected sample.

In 2009, the STN network deployed the URG carbon sampler to enhance the carbon speciation measurement. The sampler operates on the 1-in-3 day schedule and is collocated with the current Met One SUPERSASS sampler at the Burlington Cherry St. site.

Table 5 – Speciation Sample/Analysis Method

Pollutant	Site	Sampler	Collection	Analytical Method	Analytes /Lab
PM Speciation (STN)	Burlington Cherry St.	Met One - SUPERSASS	Low Volume Multi Filter sequential - 24-hour	STN	See Appendix B/UCDavis
PM Carbon (STN)	Burlington Cherry St.	URG 3000-N	Low Volume Multi Filter - 24-hour	Carbon Analysis	See Appendix B/UCDavis
PM Speciation (IMPROVE)	Underhill and West Dover	UCDavis – IMPROVE Sampler	Low Volume Multi Filter - 24-hour	IMPROVE	See Appendix B/UCDavis

Black Carbon

The AQCD currently operates a Magee AE33 Aethalometer at the Rutland site which was installed in 2018. This instrument measures the optical absorption of carbon particles at seven wavelengths: 370, 470, 520, 590, 660, 880, and 950 nm. The data obtained from channel 6 (measurement at 880 nm) is the defining standard used for reporting ‘black’ or elemental carbon concentration. These results provide PM_{2.5} concentration levels of aromatic organic compounds found in wood smoke, biomass-burning smoke, and tobacco smoke. Utilizing 7 wavelength measurement allows for the determination of the multiple potential sources of airborne black carbon particles (i.e. diesel exhaust vs. wood smoke combustion). Data is stored at 1-minute, 5-minute, and 1-hour intervals.

Table 6 – Black Carbon Monitoring Method

Pollutant	Sampler	Collection	Analytical Method	Reported Data Interval
Black Carbon	Magee AE33	Quartz Filter Tape	Continuous Optical Measurement	1 Hour

Ozone Monitoring Network

The Vermont AQCD operates three (3) ozone sites in the air monitoring network, located at the Bennington, Underhill and Rutland sites. Currently, all ozone analyzers are operated year-round. Data is collected continuously and recorded as 1-hour averages. Ozone measurements are utilized to determine compliance with the 1-hour and 8-hour NAAQS, atmospheric transport modeling, and ozone precursor studies. Data is transferred hourly to the EPA AIRNOW website for AQI mapping and air quality forecasting. The AQCD operates TAPI Model T400 ozone analyzers at all sites (see Table 7).

“Design values” for ozone must be calculated every year for sites operating FEM instruments. The site must meet the design value statistical definition for a design value to be calculated. See below for further information.

Table 7 – Ozone Monitoring Method

Pollutant	Sampler	Collection	Analytical Method	Reported Data Interval
Ozone	TAPI T400 Automated Equivalent Method: EQOA-0992-087	Continuous	Ultraviolet Photometry	1 Hour

Ozone Design Value (2019)

Below are the current design values for ozone determined from data for 2017-2019 (See Table 8). Ozone design values are calculated by taking the 3-year average of the annual 4th maximum daily maximum 8-hour ozone averages. The applicable NAAQS 8-hour ozone standard is 0.070 ppm (effective 12/28/15). Currently, all Vermont monitors are in attainment for ozone NAAQS.

Table 8 – Ozone 8-Hour 2019 Design Values

Site	Design Value (PPM) Years 2017-2019
Bennington	0.062
Underhill	0.058
Rutland	0.059

Source: <https://www.epa.gov/air-trends/air-quality-design-values#report>

Enhanced Monitoring Plan

Vermont is located in the Ozone Transport Region (OTR) as defined in 40 CFR 51.900 making it subject to developing an Enhanced Monitoring Plan (EMP) detailing enhanced ozone and ozone precursor monitoring per 40 CFR Part 58, Appendix D, 5. (h). For OTR states, the EMP was required to be submitted to the EPA Regional Administrator no later than 10/1/19. Vermont AQCD's EMP was originally submitted as part of the 2018 Annual Air Monitoring Network Plan as required by 40 CFR 58.10 and approved by EPA New England in a letter dated 10/25/18. The original EMP noted here has not been modified from 2018.

Vermont AQCD understands that EPA has encouraged OTR states to work towards a comprehensive effort to understanding and eventually solving the ozone problem in this Region. Vermont is designated by EPA as Attainment/Unclassifiable and the Underhill NCore site is not in a Core-Based Statistical Area (CSBA) with a population of 1,000,000 or more. Consequently, the AQCD is not, nor has ever been, required to operate a PAMS site and does not receive any EPA PAMS funding. Consequently, Vermont AQCD's ability to contribute to the OTR ozone issue is limited and based on available resources. Nevertheless, Vermont AQCD has determined its EMP includes additional monitoring activities it performs that exceed EPA requirements in Sections 4.1 and 4.3 of 40 CFR Part 58, Appendix D, which are listed in Table 9 – Vermont AQCD EMP. These activities along with existing continuous NO₂ and NO_y monitoring at AQCD network sites, can be considered important in helping to understand the ozone problem in Vermont, the northeast and the OTR.

The EMP activities include the operation of an additional network ozone monitor at the Rutland site which is operated year-round, operating the existing Bennington SLAMS site ozone monitor year-round and the 24-hour sample collection and analysis of a subset of the PAMS target list compounds, including carbonyls and speciated VOCs, at three (3) AQCD network sites (including 2 of 3 network ozone monitoring sites) on a 1-in-6 day or 1-in-12 day schedule.

Table 9 – Vermont AQCD EMP

Parameter	Site	Measurement Frequency/Avg./Units	EMP Qualification	Comments
Ozone	Rutland	Continuous/1-hr avg./ppm	Additional Site exceeds Part 58 App. D 4.1/operated year-round	SLAMS
Ozone	Bennington	Continuous/1-hr avg./ppm	Operated year-round	SLAMS
Carbonyl	Underhill (NATTS) Burlington Main St. Rutland	1-in-6/24 hr avg./µg/m ³ 1-in-12/24 hr avg./µg/m ³ 1-in-12/24 hr avg./µg/m ³	Non-PAMS TO-11A monitoring	formaldehyde acetaldehyde acetone
VOCs	Underhill (NATTS) Burlington Main St. Rutland	1-in-6/24 hr avg./ppb 1-in-12/24 hr avg./ppb 1-in-12/24 hr avg./ppb	Non-PAMS TO-15 monitoring	styrene, 1,3-butadiene, benzene, toluene, ethylbenzene, m/p/o- xylene, octane, 1,2,4- trimethylbenzene, 1,3,5- trimethylbenzene

Ambient Air Toxics Monitoring Network

The Vermont AQCD operates three (3) ambient air toxics monitoring sites in the air monitoring network, located at the Burlington Main Street, Rutland and Underhill sites. The Underhill site is part of the EPA NATTS network and the Burlington and Rutland air toxics monitoring sites are part of the Vermont AQCD Air Toxics Monitoring Network.

The air toxic sample collection and analysis program includes volatile organic compounds (VOC), carbonyl compounds and PM₁₀ metals at all sites (PM₁₀ metals were added at Burlington Main Street site in 2018). VOC and carbonyl compound samples are collected with a combined VOC/carbonyl air toxics sampler and the PM₁₀ metals samples are collected on 47 mm Teflon® filters using FRM samplers operated for the PM₁₀ network (see Table 11 – PM₁₀ Sample/Analysis Method below). VOC, carbonyl and metals samples are collected on a 1-in-12 day schedule at the Burlington Main Street and Rutland sites and a 1-in-6 day schedule at the Underhill site. Beginning with the 1/3/19 sample date, the VAEL added 7 compounds to the TO-11A target list. The Underhill site also includes sampling and analysis of polyaromatic hydrocarbons (PAH) compounds on a 1-in-6 day schedule to meet NATTS requirements. Beginning with the 4/1/19 sample date, ERG (EPA’s contract lab) will no longer report concentrations of 9-fluorenone, cyclopenta(c,d)pyrene and retene.

In addition to the VOC samples collected at all 3 sites, a Synspec GC955 semi-continuous analyzer using gas chromatography with photo ionization detector (GC/PID) is operated at the Burlington Main Street site to determine 15-minute average concentrations of benzene, toluene, ethylbenzene and xylenes (BTEX). See Table 10 below for the list of sampling methods and analytical methods. The list of target analytes and associated MDLs for the all analytical air toxics methods are listed in [Appendix A](#).

Table 10 – Ambient Air Toxic Sampling/Analysis Methods

Pollutant	Sampler	Collection	Analytical Method	Analytes/Lab
VOC	ATEC 2200 (combined sampler)	6 Liter Silco-coated SS Canister- 24-hour (sub-atmospheric)	TO-15 (GC/MS)	56* VOC Compounds/ VAEL
Carbonyl	ATEC 2200 (combined sampler)	DNPH Cartridge- 24-hour	TO-11A (HPLC)	13** Carbonyl Compounds/ VAEL
Metals (Lead Included)	TEI 2025i/2000i PM ₁₀ Low-Volume	Teflon® Filter- 24-hour	IO-3.5 (ICP/MS)	15 Elements/ VAEL
PAH	Tisch PUF +	PUF/XAD- 24-hour	TO-13A (GC/MS)	19*** PAH Compounds/ ERG (EPA National Contract Lab)
BTEX	Synspec GC955 Series 600	Semi- Continuous 15 Minute	GC-PID	5 VOC Compounds/direct measurement

*: VAEL is completing method development work in 2020 to add ethylene oxide to the TO-15 target compound list

**Beginning with 1/3/19 samples, VAEL added 7 new TO-11A compounds (butyraldehyde, benzaldehyde isovaleraldehyde, valeraldehyde, tolualdehydes, hexanaldehyde, 2,5-dimethylbenzaldehyde) and beginning in 7/1/19 replaced tolualdehydes with o-tolualdehyde, m-tolualdehyde and p-tolualdehyde.

***: Beginning with 4/1/19 samples, ERG no longer reports 9-fluorenone, cyclopenta(c,d)pyrene and retene

PM₁₀ Monitoring Network

The Vermont AQCD currently operates three (3) PM₁₀ monitoring sites in air monitoring network, located at the Burlington Main Street, Rutland and Underhill sites. Beginning on 4/1/19, the Burlington Main Street PM₁₀ filters are no longer tare or final weighed and thus reporting of PM₁₀ total mass (µg/m³) to EPA’s AQS database was discontinued. Burlington Main Street PM₁₀ filter samples continue to be collected on a 1-in-12 day sampling schedule and submitted to VAEL for metals analysis to support the AQCD’s air toxics monitoring program. The Underhill site is a NCore site and operates on a 1-in-3 day sampling schedule, with collocated PM₁₀ sample collection performed on 1-in-12 day schedule (beginning 4/1/19). The Rutland site operates on a 1-in-6 day sampling schedule.

The sampling method utilized for sample collection is 24-hour low volume sample collection, on a 47mm Teflon[®] filter (See Table 11 – PM₁₀ Sample/Analysis Method). The particulate collected on the filter has an aerodynamic particle size of less than 10 microns. The filter and associated sampling data are post processed using gravimetric analysis to determine the mass concentration for the 24-hour sampling period. Beginning with the 4/27/19 sample date, the gravimetric determination for concentration of PM₁₀ is completed by Wood LLC through the EPA National Contract.

At the Underhill NCore site, the PM₁₀ collocated sampling is performed with TEI 2025i samplers on the 1-in-12 day schedule (beginning 4/1/19). These Underhill PM₁₀ samples as well as the Burlington Main Street and Rutland 1-in-12 day PM₁₀ samples are subsequently submitted for metals analysis to the VAEL laboratory. The metals analysis performed does include the element lead (Pb). The ICP/MS analytical method performed by VAEL is not designated by EPA as a FEM for lead (Pb) NAAQS determination, so Pb analytical results for all 3 sites will be submitted to AQS using PM₁₀ lead code for Non-FRM/FEM methods (85128).

Table 11 – PM₁₀ Sample/Analysis Method

Pollutant	Sampler	Collection	Analytical Method/Lab	Location
PM ₁₀	TEI 2025i Manual Reference Method: RFPS-1298-127	Low Volume 47 mm Teflon [®] Filter	Gravimetric/ Wood LLC	Underhill
PM ₁₀	TEI 2000i Manual Reference Method: RFPS-1298-126	Low Volume 47 mm Teflon [®] Filter	Gravimetric/ Wood LLC	Rutland and Burlington Main Street*

* Burlington PM₁₀ is collected for metals only and not weighed for total mass.

Oxides of Nitrogen (NO/NO₂/NO_x) and Total Reactive Oxides of Nitrogen (NO_y) Monitoring Network

The Vermont AQCD operates two (2) nitrogen oxide (NO/NO₂/NO_x) analyzers located at the Burlington and Rutland monitoring sites. Ambient concentrations of both nitrogen dioxide and nitric oxide are determined by the continuous chemiluminescence method (See Table 12). The AQCD also operates a total reactive nitrogen (NO_y) trace level analyzer at the Underhill NCore monitoring site. The NO_x and NO_y samplers are operated year-round.

Table 12 – Nitrogen Dioxide and Total Reactive Nitrogen Monitoring Method

Pollutant	Sampler	Collection	Analytical Method	Reported Data Interval
Nitrogen Dioxide/Nitric Oxide	Teledyne-API T200 Automated Reference Method: RFNA-1194-099	Continuous	Chemiluminescence	1 Hour
Total Reactive Nitrogen Compounds-NO/NO _y (trace)	Teledyne-API T200U RFNA-1194-099	Continuous	Chemiluminescence	1 Hour

Nitrogen Dioxide Design Value (2019)

Below are the current calculated 1-hour and annual design values for nitrogen dioxide from 2017-2019 (See Table 13 & Table 14). Nitrogen dioxide design values are calculated by taking the 3-year average of the 98th percentile daily maximum 1-hour nitrogen dioxide averages. The current 1-hour NO₂ NAAQS standard is 100 parts per billion. The current annual NAAQS NO₂ standard is 53 parts per billion. The annual average is simply the average of all valid 1-hour averages for the calendar year. Currently, all Vermont monitors are in attainment for nitrogen dioxide.

Table 13 – Nitrogen Dioxide 2019 1-Hour Design Values

Site	Design Value (PPB) Years 2017-2019
Burlington Main Street	29
Rutland	35

Source: <https://www.epa.gov/air-trends/air-quality-design-values#report>

Table 14 – Nitrogen Dioxide 2019 Annual Average

Site	2019 Annual Average (PPB)
Burlington Main Street	6
Rutland	7

Source: <https://www.epa.gov/air-trends/air-quality-design-values#report>

Carbon Monoxide Monitoring Network

The Vermont AQCD operates three (3) carbon monoxide (CO) analyzers in air monitoring network, located at the Burlington Main Street, Rutland and Underhill sites. The CO analyzers are operated year-round. CO concentrations are determined by a continuous infra-red method (See Table 15 – Carbon Monoxide Monitoring Method).

The current national primary ambient air quality standards for carbon monoxide are as follows:

9 parts per million for an 8-hour average concentration not to be exceeded more than once per year and 35 parts per million for a 1-hour average concentration not to be exceeded more than once per year.

Table 15 – Carbon Monoxide Monitoring Method

Pollutant	Sampler	Collection	Analytical Method	Location/Reported Data Interval
Carbon Monoxide	Teledyne-API Model T300 Automated Reference Method: RFCA-1093-093	Continuous	Infra-red (Gas filter correlation)	Burlington & Rutland/1 Hour
Carbon Monoxide (trace)	Teledyne-API Model T300U Automated Reference Method: RFCA-1093-093	Continuous	Infra-red (Gas filter correlation)	Underhill/1 Hour

Table 16 – Carbon Monoxide Design Value 2018-2019

Site	2018-2019 Design Value*
Burlington CO -1 Hour	1.1
Burlington CO -8 Hour	0.6
Rutland CO -1 Hour	2.5
Rutland CO -8 Hour	1.0
Underhill CO -1 Hour	0.3
Underhill CO -8 Hour	0.3

Source: <https://www.epa.gov/air-trends/air-quality-design-values#report>

*value based on 2nd maximum 1-hour and 8-hour averages

Sulfur Dioxide Monitoring Network

The Vermont AQCD operates two (2) sulfur dioxide (SO₂) analyzers in the air monitoring network, located at the Rutland and Underhill sites. The SO₂ analyzers are operated year-round. SO₂ concentrations are determined by a continuous pulsed fluorescence method (Table 17).

The level of the national primary 1-hour annual ambient air quality standard for oxides of sulfur is 0.075 parts per million, measured in the ambient air as sulfur dioxide (SO₂). The secondary standard is 0.500 parts per million.

The 1-hour primary standard is met at an ambient air quality monitoring site when the three-year average of the annual (99th percentile) of the daily maximum 1-hour average concentrations is less than or equal to 75 ppb, as determined in accordance with 40 CFR Part 50 Appendix T. The SO₂ design values are presented in Table 18.

Table 17 – Sulfur Dioxide Monitoring Method

Pollutant	Sampler	Collection	Analytical Method	Location/Reported Data Interval
Sulfur Dioxide (trace)	Teledyne-API T100U Automated Equivalent Method: EQSA-0495-100	Continuous sampling	Pulsed Fluorescence	Underhill/1 Hour
Sulfur Dioxide	Teledyne-API T100 Automated Equivalent Method: EQSA-0495-100	Continuous sampling	Pulsed Fluorescence	Rutland/1 Hour

Table 18 – Sulfur Dioxide Design Values 2019

Site	Design Values (SO ₂ PPB) Average of Years 2017-2019 1 Hour 99 th Percentile Daily Max
Rutland – 1 Hour	2
Underhill – 1 Hour	1

Source: <https://www.epa.gov/air-trends/air-quality-design-values#report>

Monitoring Site Parameter Information

Below in Table 19 is a list of all the monitoring sites and parameters currently operated by the State of Vermont or National Forest Service. The monitoring sites are listed in alphabetical order by site name.

Table 19 – Network Ambient Air Pollutant Monitoring By Location

		Carbon Monoxide	Nitrogen Dioxide / or NO _y	Ozone	Sulfur Dioxide	Speciation (STN /or IMPROVE)	BTEX	PM _{2.5} FRM	PM _{2.5} FEM (Continuous)	PM ₁₀ FRM	PM _{10-2.5} Difference	PM ₁₀ metals	VOC	Carbonyl	Black Carbon	Wind Speed	Wind Direction	Temperature	Relative Humidity	Solar Radiation	Precipitation	Pressure	PAH
Bennington	Airport Road			✓					✓							✓	✓	✓	✓	✓	✓	✓	
Burlington	150 So Winooski Ave	✓	✓				✓		✓	*		✓	✓ ^C	✓ ^C		✓	✓	✓	✓	✓	✓	✓	
Burlington	108 Cherry Street					✓																	
Dover	Mount Snow					✓ ¹																	
Rutland	Merchants Row	✓	✓	✓	✓			✓ ^C	✓ ^C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Underhill	Harvey Road	✓ ^T	✓ ^T	✓	✓ ^T	✓		✓	✓	✓ ^C	✓	✓ ^C	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓

T=Trace Level; C=Collocation; 1=Operated by U. S. Forest Service; *=Metals only, no µg/m³ total mass after 4/1/19

Site Description: Bennington – Airport Road

Town – Site: **Bennington – Airport Rd.**
 County: **Bennington** Latitude: **+42.887590**
 Address: **Airport Rd.** Longitude: **-73.249840**
 AQS Site ID: **50-003-0004** Elevation: **241 m**
 Spatial Scale: **Rural** Year Established: **1986**
 Statistical Area: **Bennington, VT Micropolitan NECTA**

Location	Site	Carbon Monoxide	Nitrogen Dioxide	Ozone	Sulfur Dioxide	Speciation (STN)	Speciation (IMPROVE)		PM _{2.5} FEM Continuous	PM ₁₀ FRM	PM ₁₀ Low Volume	VOC	Carbonyl	Black Carbon	Wind Speed	Wind Direction	Temperature	Relative Humidity	Solar Radiation	Precipitation	Pressure
Bennington	Airport Road			✓					✓						✓	✓	✓	✓	✓	✓	✓

Site Description:
 This site is located in a field at the rural western end of Bennington, 0.25 km south west of the Morse Airport, 4.5 km west of the center of Bennington, 1 km north of Route 9, 4 km west of Route 7, 50 km east of Albany, NY. This monitoring location meets all siting requirements and criteria and has been approved by VTAQCD and EPA Region 1.

General Monitoring Description & Objectives:
 This monitoring objective for O₃ and PM_{2.5} continuous FEM is compliance and trends analysis. The site represents a background/transport site with regional scale of exposure. The O₃ and continuous PM_{2.5} data are utilized for AQI and air quality forecasting. WS/WD & Temp/RH data is collected from a 10.0 meter tower.

- Plans/History:**
- Site Established 1986
 - TEI 2025 FRM discontinued April 11, 2016
 - TAPI T640 FEM continuous PM2.5 installed 7/27/17

Figure 2 – Aerial View Bennington

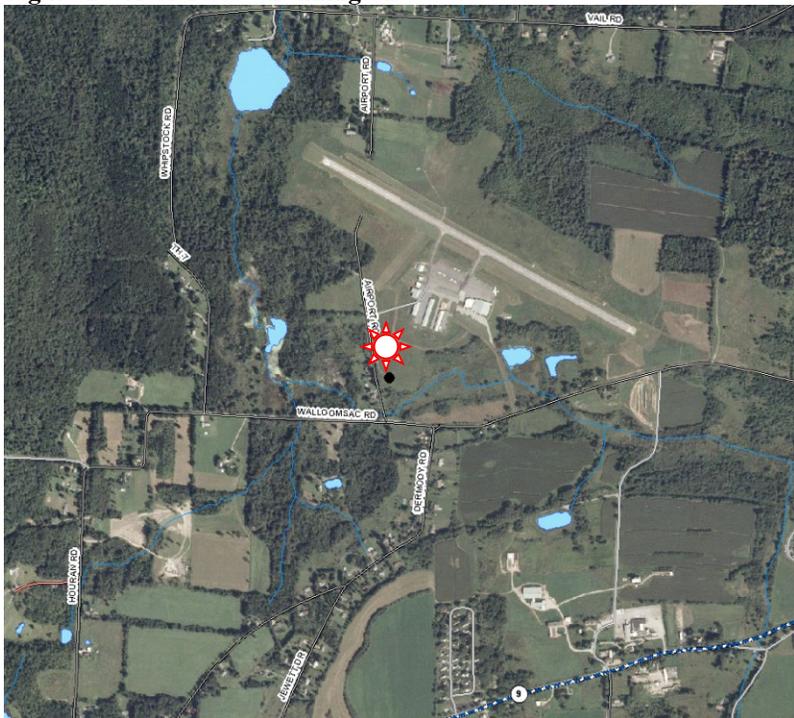


Figure 3 – Bennington Trailer



Site Description: Burlington – 150 South Winooski Ave.

Town – Site: **Burlington – South Winooski Ave**
 County: **Chittenden** Latitude: **+44.476200**
 Address: **150 S. Winooski Ave.** Longitude: **-73.210600**
 AQS Site ID: **50-007-0014** Elevation: **63.1 m**
 Spatial Scale: **Urban and City Center** Year Established: **2003**
 Statistical Area: **Burlington-South Burlington, VT Metropolitan NECTA**

Location	Site	Carbon Monoxide	Nitrogen Dioxide	Ozone	Sulfur Dioxide	BTEX	PM _{2.5} FEM Continuous	PM ₁₀ FRM	PM ₁₀ metals	VOC (collocated)	Carbonyl (collocated)	Black Carbon	Wind Speed	Wind Direction	Temperature	Relative Humidity	Solar Radiation	Precipitation	Pressure
Burlington	150 S. Winooski	✓	✓			✓	✓	*	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓

Site Description:

This site is located in a municipal parking lot of downtown Burlington, VT, located 1 km east of Lake Champlain, 1.5 km south west of McNeil Generating Station, 2 km west of I-89, and 8 km west of the Essex Global Foundries plant. This site is designated to represent middle and neighborhood-scale. The monitoring location meets all siting requirements and criteria and has been approved by VTAQCD and EPA Region 1.

General Monitoring Description & Objectives:

The Burlington monitoring site objective for the CO & NO₂ measurements is compliance and trends purposes. Historically, CO and NO₂ measurements at this site are well below the NAAQS. Monitoring for CO and NO₂ is primarily for trends analysis and modeling. The PM₁₀ monitoring objective is for subsequent metals analysis. That and the monitoring objectives for the VOC and Carbonyl sampling/analysis is to assess long-term population exposure on a neighborhood scale, comparison to applicable state standards and trend assessment. Continuous PM_{2.5} is used for NAAQS compliance, AQI and forecasting. WS/WD/Temp/RH s collected from a 3.0 meter tripod on the roof.

Plans/History:

- Site established in 2003
- Discontinued TEI 2025iD dichotomous sampler on December 31, 2016 and installed TAPI 2025i FRM configured for PM₁₀,
- Installed TEI 2000i on May 10, 2017, configured for PM_{2.5}
- TAPI T640 FEM continuous PM_{2.5} installed on 8/22/17
- TEI 2000i configured for PM₁₀ and submitted for metals analysis added in 2018
- PM₁₀ μg/m³ total mass discontinued beginning on 4/1/19, collected for metals analysis only.

Figure 4 – Burlington Aerial Photo

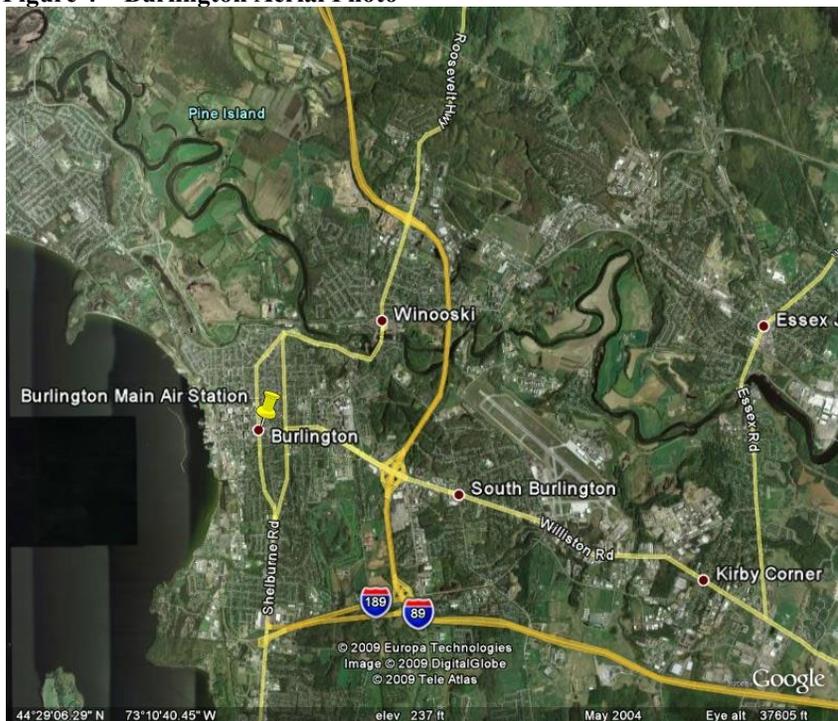


Figure 5 – Burlington Monitoring Shelter



Site Description: Burlington – 108 Cherry Street.

Town – Site: **Burlington – Zampieri State Office Building**
 County: **Chittenden** Latitude: **+44.480278**
 Address: **108 Cherry St.** Longitude: **-73.214444**
 AQS Site ID: **50-007-0012** Elevation: **81.4 m**
 Spatial Scale: **Urban & Center City** Year Established: **1999**
 Statistical Area: **Burlington-South Burlington, VT Metropolitan NECTA**

Location	Site	Carbon Monoxide	Nitrogen Dioxide	Ozone	Sulfur Dioxide	Speciation (STN)	Speciation (IMPROVE)	PM _{2.5} FRM	PM _{2.5} FEM Continuous	PM ₁₀ FRM	PM ₁₀ Low Volume	VOC	Carbonyl	Black Carbon	Wind Speed	Wind Direction	Temperature	Relative Humidity	Solar Radiation	Precipitation	Pressure	
Burlington	108 Cherry St.					✓																

Site Description:
 This site is located on the roof of the Zampieri State Office Building in Burlington. The monitoring site is located 15 meters above street level, 0.25 km from Lake Champlain, 1.2 km south west of McNeil Generating Station, 2.5 km west of I-89, and 8.5 km west of the Essex Global Foundries plant. The site represents a neighborhood scale. This monitoring location meets all siting requirements and criteria and has been approved by VTAQCD and EPA Region 1

General Monitoring Description & Objectives:
 The speciation monitoring objective is PM_{2.5} trends analysis and complimentary data for PM_{2.5} FEM data at the Burlington Main Street Site. The speciation sampling is conducted as part of the EPA Speciation Trends Network (STN).

- Plans/History:**
- Site established 1999
 - Discontinued collocated PM_{2.5} FRM samplers on 12/31/16
 - Discontinued Meteorological parameters 12/31/17

Figure 6 – Burlington Aerial Photo

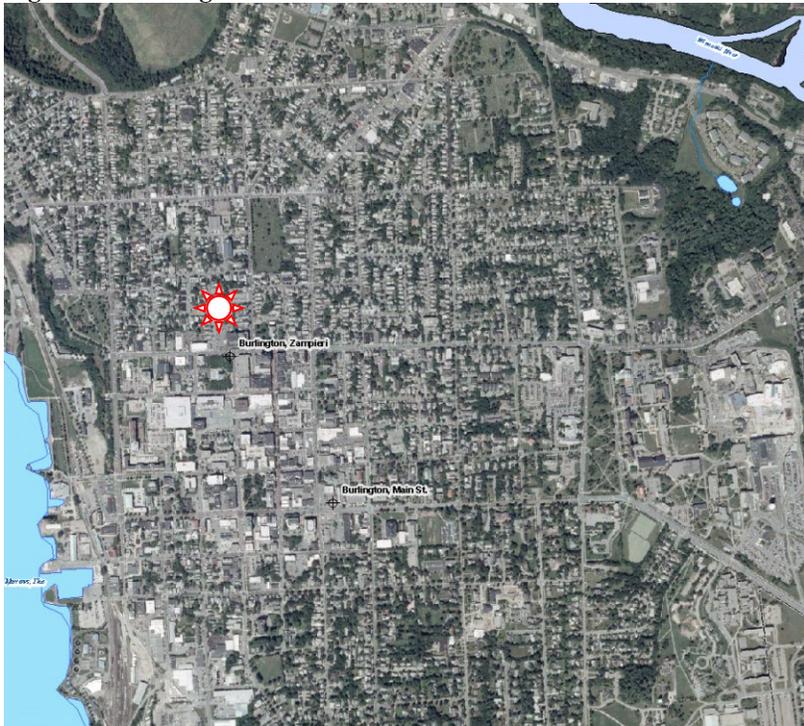


Figure 7 – Zampieri Building Sampling Platform



Site Description: Lye Brook – West Dover – Mount Snow

Town – Site: **West Dover – Mount Snow – Near Lye Brook Class 1 Area**
 County: **Bennington** Latitude: **+ 42°57'11.41 N**
 Address: **Mount Snow** Longitude: **- 72° 54' 36.72 W**
 Site ID: **LYEB1** Elevation: **1093 m**
 Spatial Scale: **Rural** Year Established: **2012**
 Statistical Area: **Bennington, VT Micropolitan Area**

Location	Site	Carbon Monoxide	Nitrogen Dioxide	Ozone	Sulfur Dioxide	Speciation (STN)	Speciation (IMPROVE)	PM _{2.5} FRM	PM _{2.5} FEM Continuous	PM ₁₀ FRM	PM ₁₀ Low Volume	VOC	Carbonyl	Black Carbon	Wind Speed	Wind Direction	Temperature	Relative Humidity	Solar Radiation	Precipitation	Pressure	
West Dove	Mount Snow						✓															

Site Description:
This monitoring location is not part of the Vermont AQCD monitoring network. The USFS site participates in the IMPROVE network and is included here because it represents a permanent monitoring station within Vermont.
 This site is located on the northern slope of Mount Snow. It is operated and maintained by the U.S. Forest Service. For further information go to the [IMPROVE program website](#). The current data from this site is not accessible from the EPA AQS system.

General Monitoring Description & Objectives:
 This site was established to monitor pollutants that contribute to regional haze impact on the visual environment within the Class 1 Area - Lye Brook Wilderness.

Plans/History:

- Site established 2012

Figure 8 – Aerial View Mount Snow

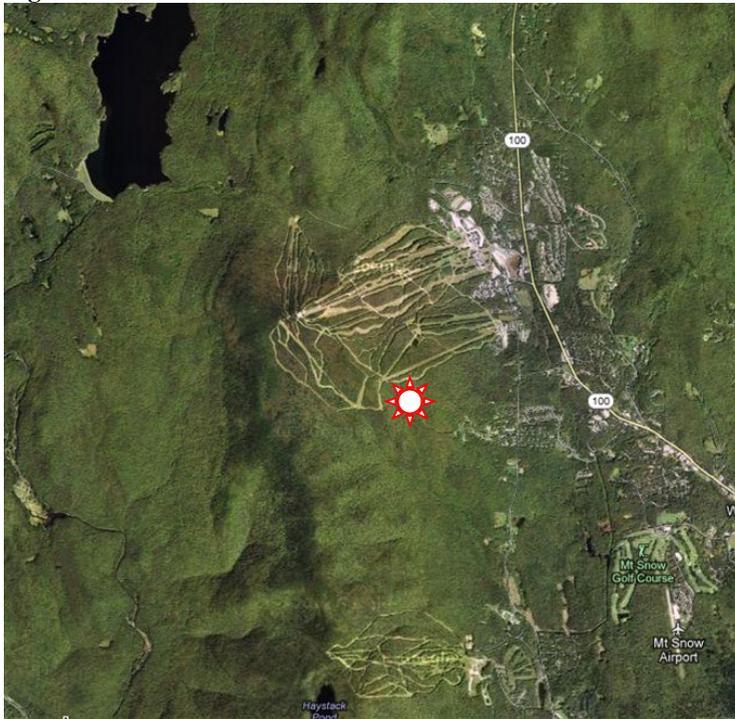


Figure 9 – Mount Snow Monitor Shelter



Site Description: Rutland – 96 State Street

Town – Site: **Rutland – State St.**
 County: **Rutland** Latitude: **+43.608056**
 Address: **96 State St.** Longitude: **-72.982778**
 AQS Site ID: **50-021-0002** Elevation: **165 m**
 Spatial Scale: **Urban and Center City** Year Established: **1971**
 Statistical Area: **Rutland, VT Micropolitan NECTA**

Location	Site	Carbon Monoxide	Nitrogen Dioxide	Ozone	Sulfur Dioxide	Speciation (STN)	Speciation (IMPROVE)	PM _{2.5} FEM Continuous (collocated w/FRM)	PM _{2.5} FRM	PM ₁₀ FRM	PM _{10-2.5} Difference	PM ₁₀ /Metals	VOC	Carbonyl	Black Carbon	Wind Speed	Wind Direction	Temperature	Relative Humidity	Solar Radiation	Precipitation	Pressure
Rutland	96 State Street	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Site Description:
 This site is located in a courthouse parking lot in the downtown area of Rutland, 1 km from north junction of Route 7 & Route 4, 3.5 km from south junction of Route 7 & Route 4, 4 km NW of GE plant. The site is adjacent to a postal center distribution center which serves as the parking area for USPS vehicles. This monitoring location meets all siting requirements and criteria and has been approved by VTAQCD and EPA Region 1.

General Monitoring Description & Objectives:
 The monitoring objective for CO, NO_x, PM_{2.5}, PM₁₀ and SO₂ is for compliance purposes and trends analysis. The monitoring objective for the VOC and Carbonyl sample collection and analysis is to assess long-term population exposure on a neighborhood scale, comparison to applicable state standards and trend assessment. WS/WD & Temp/RH data is collected from a 10.0 meter tower.

- Plans/History:**
- Site Established 1971
 - Fall 2012 replaced Wedding PM₁₀ with TEI 2025i Dichotomous (PM_{2.5} & PM_{10-2.5}) unit.
 - April 2016 TEI 2025iD Dichotomous discontinued
 - April 2016 TAPI T400 Ozone and TEI 2025i PM₁₀ FRM added
 - TAPI T640 FEM continuous PM_{2.5} installed on 7/27/17
 - PM₁₀ metals analysis added in 2017
 - Magee AE33 Aethalometer installed in June 2018

Figure 10 – Aerial View Rutland

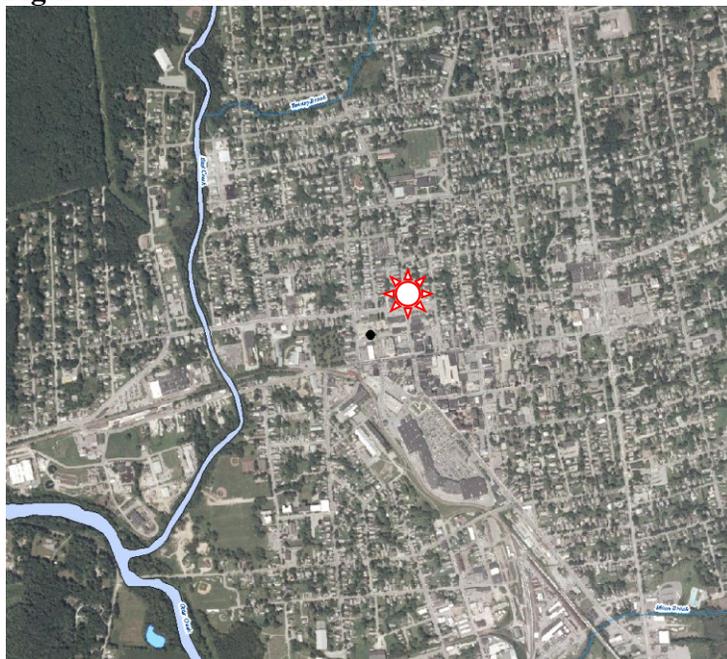


Figure 11 – Rutland Trailer



Site Description: Underhill – 58 Harvey Road

Town – Site: **Underhill – Proctor Maple Research Center**
 County: **Chittenden** Latitude: **+44.528390**
 Address: **58 Harvey Rd.** Longitude: **-72.868840**
 AQS Site ID: **50-007-0007** Elevation: **392 m**
 Spatial Scale: **Rural** Year Established: **1988**
 Statistical Area: **Burlington-South Burlington, VT Metropolitan NECTA**

Location	Site	Carbon Monoxide (trace)	Total Reactive Oxides of Nitrogen (trace)	Ozone	Sulfur Dioxide (trace)	Speciation (IMPROVE)	PM _{2.5} FRM	PM _{2.5} FEM Continuous	PM ₁₀ FRM (collocated)	PM ₁₀ /Metals (collocated)	PM _{10+2.5} Difference	VOC	Carbonyl	PAH	Wind Speed	Wind Direction	Temperature	Relative Humidity	Solar Radiation	Precipitation	Pressure
Underhill	56 Harvey Rd.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Site Description:

This site is located at the western slope of Mount Mansfield at the north end Underhill, VT. The site is rural in nature and located 5 km south west of the summit of Mount Mansfield, 6 km south of Route 15, and 26 km east of Burlington. This monitoring location meets all siting requirements and criteria and has been approved by VTAQCD and EPA Region 1.

General Monitoring Description & Objectives:

The monitoring objective for ozone, PM_{2.5}, PM₁₀, PM speciation and trace-level CO, SO₂ and NO_y monitoring is regional scale background levels. The monitoring objectives for the VOC, Carbonyl, PAH, and metals sample collection and analysis is to assess background levels on a regional scale for short and long-term trends, comparison to applicable state standards and federal guidelines and assessment of contribution of transported pollutants. WS/WD & Temp/RH data is collected from a 10.0 meter tower.

Plans/History:

- Site Established 1988
- Began participation in EPA NATTS in 2004
- EPA NCore trace level CO, NO_y, and SO₂ continuous monitoring started 4th Quarter 2010.
- Trace level TAPI CO (T300U) and SO₂ (T100U) analyzers installed March 2017
- TAPI T640 FEM continuous PM_{2.5} installed 8/22/17
- Collocated PM₁₀ sample frequency reduced to 1-in-12 day schedule beginning on 4/1/19
- TAPI T200U NO/NO_y analyzer and T700U station dilution calibrator installed in Fall 2019

Figure 12 – Aerial View Underhill

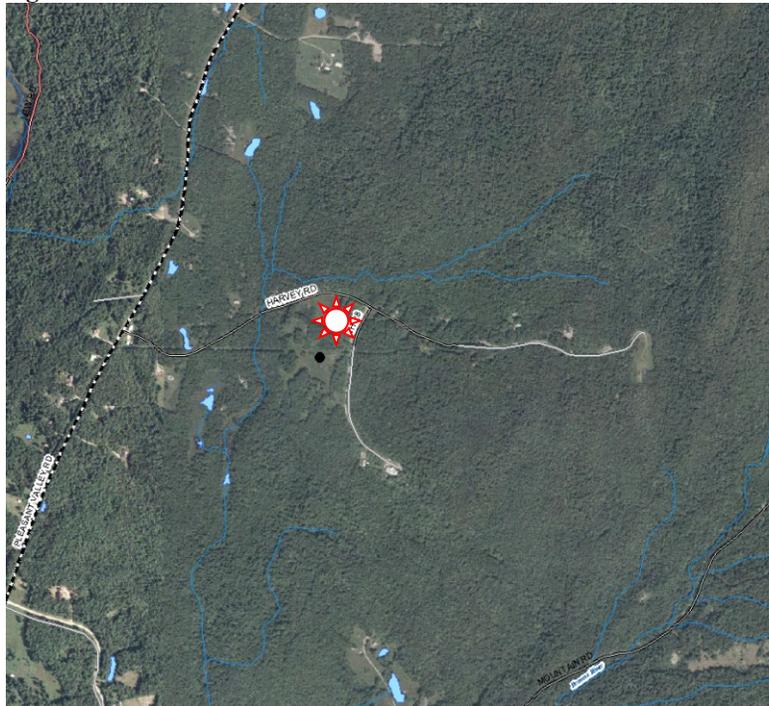
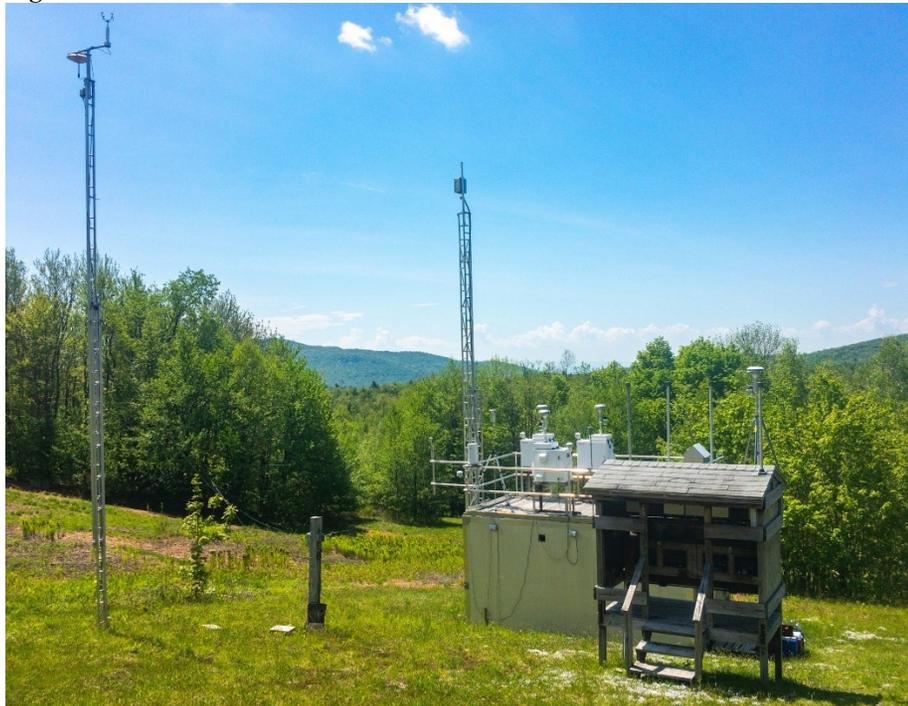


Figure 13 – Underhill IMROVE Shelter & Trailer



Appendix A. List of Analytes for Analytical Methods

Table 20 – Elemental Metals Analytes for PM10 (VAEL 2020, 47 mm Teflon)

Metal	MDL (ng/m³)*	Metal	MDL (ng/m³)*
Antimony	0.127	Manganese	0.301
Arsenic	0.045	Molybdenum	0.050
Barium	0.104	Nickel	0.319
Beryllium	0.023	Selenium	0.121
Cadmium	0.021	Silver	0.027
Chromium	11.358	Strontium	0.133
Cobalt	0.025	Vanadium	0.023
Lead	0.067		

* assumes 24.0 m³ total sample volume

Table 21 – List of Carbonyl Analytes (VAEL, 2020)

Carbonyl Compound	VT DEC MDL (µg/m³)*
Formaldehyde	0.036
Acetaldehyde	0.006
Acetone	0.015
Propionaldehyde	0.008
Butyraldehyde ¹	0.016
Benzaldehyde ¹	0.004
Isovaleraldehyde ¹	0.005
Valeraldehyde ¹	0.008
o-Tolualdehyde ²	0.005
m-Tolualdehyde ²	0.004
p-Tolualdehyde ²	0.004
Hexanaldehyde ¹	0.007
2,5-Dimethylbenzaldehyde ¹	0.005

*: assumes 1.30 m³ total sample volume 1: new target list compound in Jan 2019

1: new target list compounds January 2019

2: new target list compounds in July 2019

Table 22 – Analyte List for VOC Analysis (VAEL, 2019)

VOC Compound	MDL (ppb)
1,1,1-Trichloroethane	0.009
1,1,2,2-Tetrachloroethane	0.025
1,1,2-Trichloroethane	0.012
1,1-Dichloroethane	0.007
1,1-Dichloroethene	0.007
1,2,4-Trichlorobenzene	0.047
1,2,4-Trimethylbenzene	0.015
1,2-Dibromoethane	0.012
1,2-Dichloroethane	0.010
1,2-Dichloropropane	0.009
1,3,5-Trimethylbenzene	0.015
1,3-Butadiene	0.008
3-Chloropropene	0.010
Acrolein*	0.012
Acrylonitrile	0.005
Benzene	0.009
Bromochloromethane	0.004
Bromodichloromethane	0.009
Bromoform	0.024
Bromomethane	0.005
Carbon Tetrachloride	0.012
Chlorobenzene	0.015
Chloroethane	0.007
Chloroform	0.006
Chloromethane	0.010
Chloroprene	0.013
cis-1,2-Dichloroethylene	0.010
cis-1,3-Dichloropropene	0.007

VOC Compound	MDL (ppb)
Dibromochloromethane	0.018
Dichlorodifluoromethane	0.007
Dichlorotetrafluoroethane	0.002
Ethyl Acrylate	0.006
Ethyl tert-Butyl Ether	0.014
Ethylbenzene	0.022
Hexachloro-1,3-butadiene	0.073
m,p-Xylene	0.028
m-Dichlorobenzene	0.030
Methyl Isobutyl Ketone	0.015
Methyl Methacrylate	0.011
Methyl tert-Butyl Ether	0.010
Methylene Chloride	0.007
n-Octane	0.012
o-Dichlorobenzene	0.031
o-Xylene	0.015
p- Dichlorobenzene	0.028
Styrene	0.014
tert-Amyl Methyl Ether	0.010
Tetrachloroethylene	0.016
Toluene	0.015
trans-1,2-Dichloroethylene	0.007
trans-1,3-Dichloropropene	0.007
Trichloroethylene	0.012
Trichlorofluoromethane	0.009
Trichlorotrifluoroethane	0.006
Vinyl Chloride	0.007

*EPA is continuing to evaluate analytical method for the compound - Acrolein.

Table 23 – Analyte List for PAH Analysis (ERG, 2020)

PAH Compounds	MDL (ng/m³)
Acenaphthene	0.219
Acenaphthylene	0.0113
Anthracene	0.0289
Benzo (a) anthracene	0.0154
Benzo (a) pyrene	0.0187
Benzo (b) fluoranthene	0.0093
Benzo (e) pyrene	0.00776
Benzo (g,h,i) perylene	0.00746
Benzo (k) fluoranthene	0.0165
Chrysene	0.01
Coronene	0.00481
Dibenz (a,h)anthracene	0.018
Fluoranthene	0.0548
Fluorene	0.11
Indeno(1,2,3-cd)pyrene	0.015
Naphthalene	1.33
Perylene	0.0204
Phenanthrene	0.23
Pyrene	0.039

Beginning with 4/1/19 samples, ERG stopped reporting concentrations for 9-fluorenone, cyclopenta(c,d)pyrene and retene.

Appendix B. CSN Analytes/MDLs (EPA, 2017)

Parameter	Average MDL ($\mu\text{g}/\text{m}^3$)
Ag	0.018
Al	0.035
As	0.002
Ba	0.082
Br	0.004
Ca	0.029
Cd	0.023
Ce	0.122
Cl	0.004
Co	0.003
Cr	0.004
Cs	0.077
Cu	0.008
Fe	0.022
In	0.029
K	0.016
Mg	0.056
Mn	0.006
Na	0.068
Ni	0.002
P	0.002
Pb	0.015
Rb	0.008
S	0.009
Sb	0.045
Se	0.006
Si	0.017
Sn	0.046
Sr	0.006
Ti	0.004
V	0.002
Zn	0.004
Zr	0.036
EC1	0.014
EC2	0.012
EC3	0.002
ECTR	0.018
ECTT	0.014
OC1	0.024
OC2	0.059

OC3	0.196
OC4	0.051
OCTR	0.297
OCTT	0.299
OPTR	0.014
OPTT	0.017
TCTC	0.063
Ammonium	0.015
Chloride	0.132
Nitrate	0.072
Potassium Ion	0.006
Sodium Ion	0.048
Sulfate	0.117

Source: EPA QAPP; Lab Analysis and Data Processing/Validation for Chemical Speciation of PM_{2.5} Filter Samples, Rev 1, 10/16/17

Appendix C. National Ambient Air Quality Standards

Pollutant [links to historical tables of NAAQS reviews]		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide (CO)		primary	8 hours	9 ppm	Not to be exceeded more than once per year
			1 hour	35 ppm	
Lead (Pb)		primary and secondary	Rolling 3 month average	0.15 µg/m ³ ⁽¹⁾	Not to be exceeded
Nitrogen Dioxide (NO₂)		primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		primary and secondary	1 year	53 ppb ⁽²⁾	Annual Mean
Ozone (O₃)		primary and secondary	8 hours	0.070 ppm ⁽³⁾	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particle Pollution (PM)	PM _{2.5}	primary	1 year	12.0 µg/m ³	annual mean, averaged over 3 years
		secondary	1 year	15.0 µg/m ³	annual mean, averaged over 3 years
		primary and secondary	24 hours	35 µg/m ³	98th percentile, averaged over 3 years
	PM ₁₀	primary and secondary	24 hours	150 µg/m ³	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (SO₂)		primary	1 hour	75 ppb ⁽⁴⁾	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

(1) In areas designated nonattainment for the Pb standards prior to the promulgation of the current (2008) standards, and for which implementation plans to attain or maintain the current (2008) standards have not been submitted and approved, the previous standards (1.5 µg/m³ as a calendar quarter average) also remain in effect.

(2) The level of the annual NO₂ standard is 0.053 ppm. It is shown here in terms of ppb for the purposes of clearer comparison to the 1-hour standard level.

(3) Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) O₃ standards additionally remain in effect in some areas. Revocation of the previous (2008) O₃ standards and transitioning to the current (2015) standards will be addressed in the implementation rule for the current standards.

(4) The previous SO₂ standards (0.14 ppm 24-hour and 0.03 ppm annual) will additionally remain in effect in certain areas: (1) any area for which it is not yet 1 year since the effective date of designation under the current (2010) standards, and (2) any area for which implementation plans providing for attainment of the current (2010) standard have not been submitted and approved and which is designated nonattainment under the previous SO₂ standards or is not meeting the requirements of a SIP call under the previous SO₂ standards (40 CFR 50.4(3)), A SIP call is an EPA action requiring a state to resubmit all or part of its State Implementation Plan to demonstrate attainment of the require NAAQS.

*For current changes that may not be reflected in the above NAAQS table please visit <https://www.epa.gov/criteria-air-pollutants/naaqs-table>

References

1. [Code of Federal Regulation, \(e-CFR\) 40 CFR Part 58, Protection of Environment, May 26, 2020.](#)
2. United States Environmental Protection Agency Air and Radiation - [National Ambient Air Quality Standards \(NAAQS\)](#). May 2020
3. State of Vermont, Agency of Natural Resources, [Air Pollution Control Regulation; Appendix C](#). November 30, 2016
4. United States Environmental Protection Agency, Technology Transfer Network, Ambient Monitoring Technology Information Center – [List of Designated EPA Reference and Equivalent Methods](#). June 17, 2017
5. [Code of Federal Regulation, \(e-CFR\) 40 CFR Part 50, Protection of Environment, May 26, 2020.](#)
6. [Code of Federal Regulation, \(e-CFR\) 40 CFR Part 53, Protection of Environment, May 26, 2020.](#)



**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 1
LABORATORY SERVICES AND APPLIED SCIENCE DIVISION
11 Technology Drive
North Chelmsford, MA 01863**

June 12, 2020

Robert Lacaillade
State of Vermont
Air Quality and Climate Division
Davis Building 2nd Floor
One National Life Drive
Montpelier, VT 05620-0802

Dear Mr. Lacaillade:

Thank you for providing EPA with a draft of the Vermont 2020 Air Monitoring Network Plan, which was posted for public review on May 29, 2020. EPA-New England has reviewed your draft plan with respect to meeting the requirements of 40 CFR Part 58. Upon final submission of this document, we will move forward regarding approval of the Annual Network Plan. This year, we also look forward to reviewing the 5-year Network Assessment as required under 40 CFR 58.10(d). In addition, upon final submission of this document, we will work with our Headquarters offices to address the portions of the plan which require their attention, most notably monitoring associated with NCore, STN and NATTS.

The following are our comments:

1. On page 11, we note these changes below which occurred between July 2019 and June 2020.

Changes July 2019 to June 2020 Air Monitoring Network

The Vermont AQCD network changes, additions, and deletions that were performed during the 12-month period between July 2019-June 2020 were:

- A new TAPI T200U trace NO/NO_y analyzer was installed at the Underhill NCore site in October 2019, replacing an Ecotech 9843.
- A new TAPI T700U dynamic dilution calibrator was installed at the Underhill NCore site in December 2019, replacing a TAPI 700EU.
- VAEL installed new Agilent GC/MS and ENTECH pre-concentrator, autosampler and canister cleaner for TO-15 in January 2020.
- VAEL installed new Waters HPLC for TO-11A in March 2020 and added m-tolualdehyde, o-tolualdehyde and p-tolualdehyde to the TO-11A target compound list in July 2019
- VAEL staff began method development procedures during the first quarter of 2020 to add ethylene oxide to the EPA Method TO-15 target list to meet a new EPA NATTS Grant requirement.
- A Meteorological QAPP (and associated SOPs) were submitted to EPA Region 1 in June 2019 which includes meteorological parameter measurements required at the Underhill NCore site as well as meteorological systems at the other SLAMS sites in the network. (*EPA approved the Meteorological QAPP that was submitted on July 15th, 2019 on January 2, 2020.*)

- Based on the new Meteorological QAPP, onsite annual collocated transfer system (CTS) audits, using a certified standalone MetOne Automet system, were initially performed at the Underhill NCore site in August 2019 and the other network SLAMS sites during the fall of 2019.

2. Page 12: We note the listed network changes between July 2020 and June 2021,

Proposed Changes July 2020 to June 2021 Air Monitoring Network

The Vermont AQCD network changes, additions and deletions that are planned for the next 12 months of July 2020-June 2021 are:

- Procure an Agilair 8872 datalogger for the Rutland site which will update storage capacity and replace the current Agilair 8832.
 - Continue to evaluate procedures for processing, evaluating and validating AE33 data and possible upload to the EPA AQS database.
 - Continue working with the Burlington Planning Department and others on the development of a plan for the relocation of the Burlington Main Street monitoring site. The Burlington Planning Department has not updated the status of the redevelopment project for the current monitoring site location which continues to be in transition with no firm schedule or funding. Based on the new location for Burlington Main Street site, the AQCD will consider proposing to EPA that the STN site (which is currently located at the Burlington Cherry Street site) be relocated to this new location as well, thus combining the two sites.
 - VAEL is planning to complete method development requirements for adding ethylene oxide to the target list for EPA Method TO-15 to meet a new EPA NATTS Grant requirement.
 - The AQCD and VAEL will continue to evaluate the logistics and method development requirements necessary for VAEL to add EPA Method TO-13A to its air toxics analytical capabilities for possible future semi-volatile sample support of the VT AQCD's NATTS and state air toxics program.
3. Per the discussion on page 14 relative to continuous PM_{2.5} FEMs, PM_{2.5} Network – on January 15, 2013, EPA revised the PM_{2.5} standard. In that rule, EPA also established that all continuous PM_{2.5} FEM monitors operating for more than 24 months should be used for comparison to the NAAQS unless a State specifically requests that the data be excluded under 40 CFR Part 58.11(e) and EPA approves that request. Vermont is not requesting that any sites be excluded from comparison to the NAAQS in this annual network plan. We note that the collocated monitor for QA purposes is located at Rutland.
4. Pages 15, 16, 19, 24, 25, and 26. EPA has released design values (DV) for all criteria pollutants in May, 2020 which includes 2019 data for the entire country. We have reviewed to design values and note the State's annual DV for nitrogen dioxide should be truncated to match. Also, we note that the DV at Underhill for carbon monoxide for the 1- hour and 8-hour NAAQS differ from those EPA has posted. <https://www.epa.gov/air-trends/air-quality-design-values#report>
5. On page 20, we acknowledge the Enhanced Monitoring Plan (EMP) that it is included as part of this Annual Network Plan. That plan was approved on October 25, 2018 by EPA. Vermont EMP activities include the operation of an additional network ozone monitor at the Rutland site which is operated year-round, operating the existing Bennington SLAMS

site ozone monitor year-round and the 24-hour sample collection and analysis of a subset of the PAMS target list compounds, including carbonyls and speciated VOCs, at three (3) AQCD network sites (including 2 of 3 network ozone monitoring sites) on a 1-in 6 day or 1-in-12 day schedule.

In addition, on page 18, you note your measurements for black carbon as it relates to wood smoke. As you are aware, EPA Region 1 has developed a GIS tool which identifies valley locations across the Region which may be impacted by wood smoke. See the link: <https://epa.maps.arcgis.com/apps/webappviewer/index.html?id=646ebe715800410d9e5c02aa3653546d>. We are looking forward to working with Vermont to identify areas, such as Rutland, which may be impacted by wood smoke emissions. There may also be other areas in the State that might have higher wood smoke concentrations, but fewer permanent residents. Our “sensor pod loan program” was utilized by the planning group of VTDEC in early 2020 where the pods were deployed to Montpelier to help determine potential wood smoke issues. We are awaiting the results of that study.

Finally, as part of the Region 1 monitoring collaborative, EPA has identified several resource saving opportunities that Vermont may wish to consider. If Vermont feels that monitors that EPA identified as being of lower value are worth keeping, then we would suggest monitors capable of measuring the concentrations that are being recorded should be used (i.e. trace instruments at sites with low concentrations).

EPA- New England appreciates your partnership in conducting ambient air monitoring, and we look forward to working with you to continuously improve the quality of ambient air in Vermont. We also look forward to the submission of the final Annual Network Plan as soon as possible. If you have any questions or comments regarding these comments, please contact me at (617) 918-8387, or Alysha Thompson at (617) 918-8381.

Sincerely,

Robert C Judge /s/

Robert C. Judge
Air Monitoring Coordinator
Laboratory Services and Applied Science Division
EPA-New England