Vermont Annual Air Monitoring Network Plan 2022

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
FEM – Federal Equivalent Method
FEMC – Forest Ecosystem Monitoring Cooperative
FRM – Federal Reference Method
GIS – Geographical Information Systems
HAAS – Hazardous Ambient Air Standard
HAP – Hazardous Air Pollutants
LC – Local Conditions of Temperature and Pressure
MDL – Method Detection Limit
MQO – Measurement Quality Objectives
MSA – Metropolitan Statistical Area
NAAQS – National Ambient Air Quality Standards
NAMS – National Air Monitoring Station
NATTS – National Air Toxic Trends Stations Network
NCore – National Core Monitoring Sites
NO_2 – Nitrogen Dioxide
NOx – Oxides of Nitrogen
NOy – Reactive Nitrogen Compounds
O_3 – Ozone
OAQPS – Office of Air Quality Planning and Standards
PAH – Polycyclic Aromatic Hydrocarbon
PM_{10} – Particulate matter less than 10 micron aerodynamic particle size
$PM_{2.5}$ – Particulate matter less than 2.5 micron aerodynamic particle size
PMc – Coarse Particulate between 10 and 2.5 micron aerodynamic particle size (PM10-2.5)
QA/QC – Quality Assurance/Quality Control
QAPP – Quality Assurance Project Plan

SLAMS – State and Local Monitoring Stations
SO_2 – Sulfur Dioxide
SOP – Standard Operating Procedure
SPMS – Special Purpose Monitoring Stations
STP – Standard Conditions of Temperature and Pressure
TAPI – Teledyne Advanced Pollution Instruments
TEI – Thermo Environmental Instruments
TL – Trace Level
TSP – Total Suspended Particulate
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, the Vermont Air Quality & Climate Division is required to submit an air monitoring network plan for the State of Vermont to EPA by July 1, 2022. 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 current Vermont Annual Air Monitoring Network Plan was made available to the public on the "Public Notice" section of the AQCD website for a 30-day comment period. During this time the VT AQCD received comments from EPA Region 1 in a letter dated June 17, 2022, included at the end of this document. Minor revisions were made to address EPA's comments.

Please send all comments regarding Vermont Air Monitoring Network Plan:

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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 10 V.S.A. § 575. The collected data is utilized to determine compliance with the Environmental Protection Agency's (EPA) National Ambient Air Quality Standards (NAAQS), and Vermont's Hazardous Air Contaminants Standards (Vermont Regulations Appendix C). 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 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 (SO_2), and nitrogen dioxide (NO_2) 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 NO_2, CO and volatile organic compounds (VOCs). Through other regional, national, and global control strategies, concentration of pollutants such as ozone and particulate matter 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.

During the 1970s, monitoring methods improved to allow for higher quality particulate sampling and continuous monitoring of gaseous criteria pollutants such as CO, SO_2, NO_2, and ozone (O_3). During the late 70s and early 80s rapid development of computerized data acquisition systems allowed for collection of air quality data on a near real-time basis. During the 1980s, 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 newer technologies allow for real-time monitoring of toxic compounds.

Ambient air monitoring is essential for state and federal environmental planning, enforcement efforts, air pollutant trends analysis, and providing timely air quality health advisories. Vermont began air monitoring in the 1960s with a focus on total suspended particulate (TSP). Vermont established an air monitoring network for criteria pollutants in the 1970s and a network for monitoring toxic air pollutants in 1985. The Vermont AQCD currently operates and maintains five permanent air monitoring stations to measures six EPA criteria air pollutants and 96 air toxic pollutants as well as 53 separate $PM_{2.5}$ mass and chemical speciation parameters at the CSN/IMPROVE sites. The Burlington Main Street, Rutland, and Bennington sites are designated as SLAMS, the Underhill site is NCORE, CSN is operated at Burlington Zampieri and IMPROVE is operated at the Underhill site. The operation of the SLAMS, NCore and CSN air monitors in the network all meet 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). The AQCD QAPPs and associated SOPs for the Criteria Gases, Particulate Matter, Air Toxics and National Air Toxics Trend Sites (NATTS) and Meteorology have received EPA approval. These documents are reviewed, and a summary update report submitted to EPA annually by November 1st. The current versions are available on the AQCD website (AQCD QAPPs).

The Federal EPA National Ambient Air Quality Standards

The Clean Air Act of 1990 requires EPA to set NAAQS (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. 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 for six principal pollutants, which are called "criteria" pollutants. The current table of NAAQS is in Appendix B of this document and on the EPA website (epa.gov/criteria-air-pollutants/naaqs-table). 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 ($\mu g/m^3$).

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.

On December 16, 2006, the EPA reduced the daily $PM_{2.5}$ NAAQS from 65 $\mu g/m^3$ to 35 $\mu g/m^3$. The annual $PM_{2.5}$ NAAQS remained 15$\mu g/m^3$. On January 15, 2013, EPA adopted an updated primary $PM_{2.5}$ annual standard of 12 ug/m^3 and a secondary standard of 15 ug/m^3. This annual $PM_{2.5}$ average will be computed as the average of the last three years. 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). Vermont operates a small network of FRM filter-based samplers as well as FEM for continuous $PM_{2.5}$ to assess air quality for $PM_{2.5}$.

On November 12, 2008, the NAAQS for lead (Pb) was strengthened to 0.15 $\mu g/m^3$ 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 because 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 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. VT AQCD collects low-volume PM_{10} FRM with subsequent multi-metals analysis (Pb included) as part of the National Air Toxics Trends Site (NATTS) in Underhill (since 2010), Rutland and Burlington (since 2017 and 2018 respectively). A review of the lead NAAQS began in December 2014, and on October 18, 2016, the EPA retained the existing lead NAAQS.

The final rule for NO_2 NAAQS was adopted on January 22, 2010. The new 1-hour average NO_2 NAAQS is 100 ppb, based on the 3-year average of the 98th percentile of the 1-hour daily maximum. EPA, in cooperation with State/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 a

"near roadway" site other than what is currently being operated in Burlington and Rutland or elsewhere in the state of Vermont.

A new 1-hour SO_2 NAAQS was adopted on June 2, 2010. EPA strengthened the primary NAAQS for SO_2 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 SO_2 summary data. Vermont is not currently required under the new rule to set up additional SO_2 monitors in the network, beyond what is currently in Rutland. EPA finalized its Data Requirements Rule for the 1-hour SO_2 primary NAAQS on August 21, 2015 (80 FR 51052) and provided detailed monitoring and modeling guidance for implementing the SO_2 standard.

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.

Changes July 2021 to June 2022 Air Monitoring Network

The Vermont AQCD network changes, additions, and deletions that were performed during the previous 12-month period were:

1. The Rutland Agilaire 8832 datalogger was replaced with an Agilaire 8872 datalogger in August 2021.

2. MetOne AIO (all-in-one) meteorological sensor was installed at the Rutland site to replace the older sensors for sonic wind speed/wind direction, ambient temperature, relative humidity and barometric.

3. A new Teledyne API T640 FEM Continuous $PM_{2.5}$ monitor was purchased an installed at the Underhill site following an unexpected instrument failure. This purchase allows us to have one on the shelf for future emergencies.

4. Continuous reporting of CO and NO_2 was discontinued at the Burlington Main Street site on December 31, 2021.

5. VAEL completed method development for adding ethylene oxide to the target list for EPA Method TO-15 to meet a new EPA NATTS Grant requirement, and reporting to AQS began in April 2021.

6. The Synspec Continuous BTEX method at the Burlington Main Street site has been suspended until resources are available to properly operate the analyzer and review data.

Proposed Changes July 2022 to June 2023 Air Monitoring Network

The Vermont AQCD network changes, additions and deletions that are planned for the next 12-month period are:

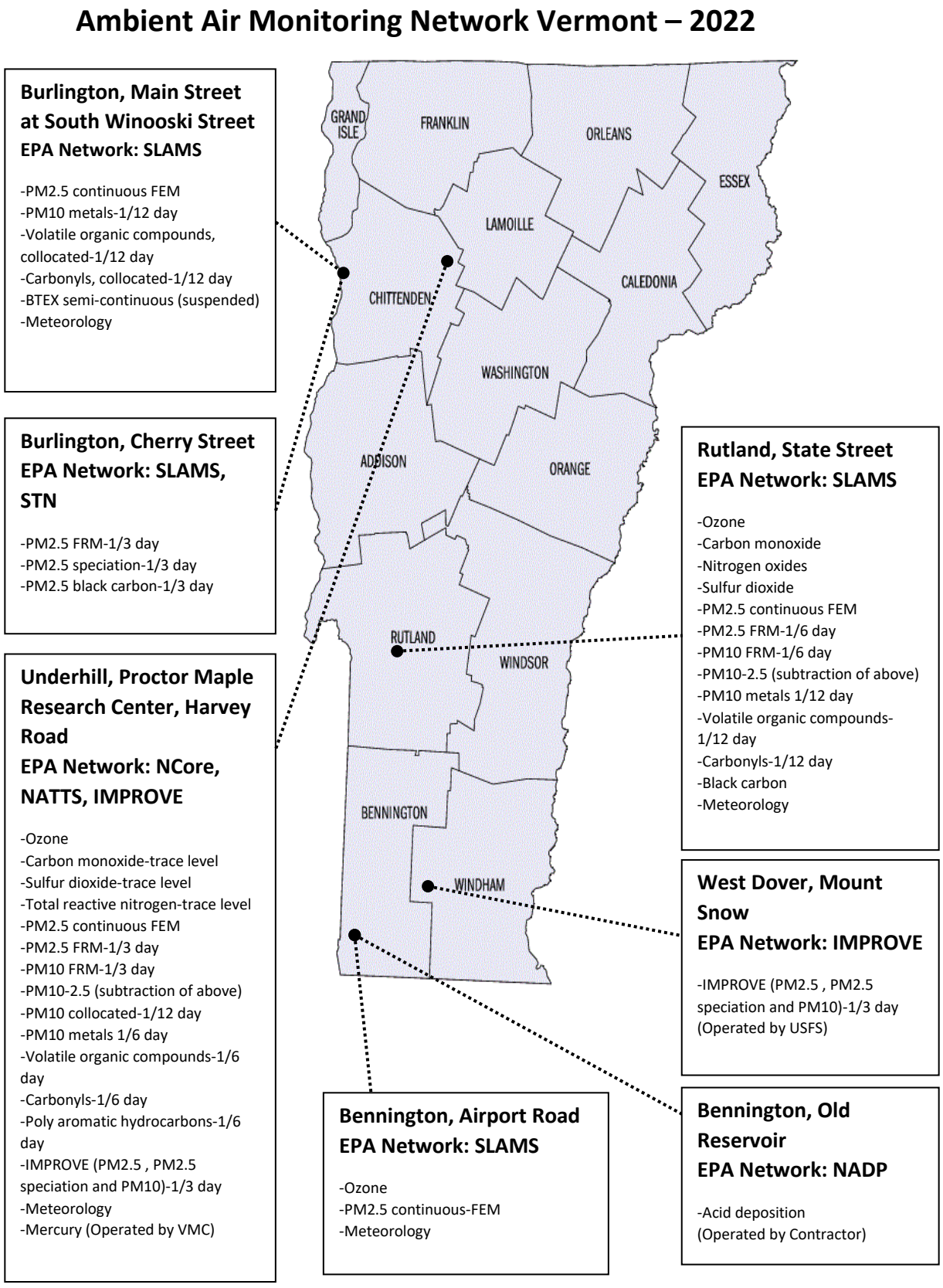
1. Continue to evaluate procedures for processing, evaluating and validating AE33 data, and upload to the EPA AQS database.

2. Continue working with the Burlington Planning Department and others to develop a plan for relocating 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. Depending on the new location selected for this site, the AQCD will consider proposing to EPA that the STN site (currently located at the Burlington Cherry Street site) be relocated to this new location, thus combining the two sites, and will consider resuming $PM_{2.5}$ FRM measurements to support the STN measurements.

3. 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.

4. Resume sampling $PM_{2.5}$ FRM on a 1-in-3 day schedule at the Burlington Cherry Street site to collocate with STN. Sampling was suspended at the end of 2016 and is scheduled to resume on July 1, 2022.

Figure 1 – Vermont Air Monitoring Network Plan Map



Network Pollutant Monitoring Descriptions

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

Ozone Monitoring Network

The Vermont AQCD operates three 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 (Table 1).

Table 1 – Ozone Monitoring Method

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

Ozone Design Value

"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.

Ozone design values are calculated by taking the 3-year average of the annual fourth-highest 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 2 – Ozone 8-Hour Design Values (2021)

Site	Design Value (PPM)
Bennington	0.057
Underhill	0.057
Rutland	0.053

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 October 25, 2018. 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 3 – Vermont AQCD EMP. These activities along with existing continuous NO_2 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 3 – 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

Carbon Monoxide Monitoring Network

The Vermont AQCD operates two carbon monoxide (CO) analyzers in the air monitoring network, located at the Rutland and Underhill sites. The CO analyzers are operated year-round. CO concentrations are determined by a continuous infra-red method (Table 4).

The current primary NAAQS for CO are 9 ppm for an 8-hour average concentration and 35 ppm for a 1-hour average concentration, both not to be exceeded more than once per year. Design values are based on the 2nd maximum 1-hour and 8-hour averages and are listed in Table 5.

Table 4 – Carbon Monoxide Monitoring Method

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

Table 5 – Carbon Monoxide Design Values (2021)

Site	1-Hour Design Value	8-Hour Design Value
Underhill	0.5	0.4
Burlington	0.9	0.6
Rutland	2.9	0.8

Oxides of Nitrogen (NO/NO2/NOx) and Total Reactive Oxides of Nitrogen (NOy) Monitoring Network

The Vermont AQCD operates one nitrogen oxide ($NO/NO_2/NOx$) analyzer located at the Rutland monitoring site. Ambient concentrations of both nitrogen dioxide and nitric oxide are determined by the continuous chemiluminescence method (Table 6). The AQCD operates a total reactive nitrogen (NOy) trace level analyzer at the Underhill NCore monitoring site. The NOx and NOy samplers are operated year-round.

Table 6 – 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/NOy (trace)	Teledyne-API T200U RFNA-1194-099	Continuous	Chemiluminescence	1 Hour

Nitrogen Dioxide Design Value

Below are the current calculated 1-hour and annual design values for nitrogen dioxide. (Table 7). 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 NO_2 NAAQS standard is 100 ppb. The current annual NAAQS NO_2 standard is 53 ppb. 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 NO_2.

Table 7 – Nitrogen Dioxide Design Values (2021)

Site	1-Hour Design Value (PPB)	Annual Average (PPB)
Burlington Main Street	29	5
Rutland	32	6

Sulfur Dioxide Monitoring Network

The Vermont AQCD operates two sulfur dioxide (SO_2) analyzers in the air monitoring network, located at the Rutland and Underhill sites. The SO_2 analyzers are operated year-round. SO_2 concentrations are determined by a continuous pulsed florescence method (Table 8).

The level of the national primary 1-hour annual ambient air quality standard for oxides of sulfur is 0.075 ppm, measured in the ambient air as sulfur dioxide (SO_2). The secondary standard is 0.500 ppm.

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 SO_2 design values are presented in Table 9.

Table 8 – Sulfur Dioxide Monitoring Method

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

Table 9 – Sulfur Dioxide Design Values (2021)

Site	Design Values (SO_2 PPB)
Underhill – 1 Hour	1
Rutland – 1 Hour	2

$PM_{2.5}$ Monitoring Network

Continuous: The Vermont AQCD operates four continuous $PM_{2.5}$ monitoring sites in the air monitoring network, located in Burlington (Main Street), Underhill, Rutland and Bennington (see Table 10). The TAPI T640 continuous PM monitor (non-X version) has Federal Equivalency Method (FEM) designation for $PM_{2.5}$ from EPA (EQPM-0516-236). It uses 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/m^3. Continuous $PM_{2.5}$ µg/m^3 data is reported as 1-hour averages.

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. All continuous $PM_{2.5}$ FEM monitoring data from VT sites has been reported as $PM_{2.5}$ LC (88101) since 2014. Vermont is not requesting that any sites be excluded from comparison to the NAAQS in this annual network plan.

All T640 $PM_{2.5}$ monitors are operated year-round. The collocated monitor for QA purposes is located at Rutland. It is 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.

FRM: The Vermont AQCD operates two $PM_{2.5}$ TEI 2025i FRM samplers (Table 10), 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. A third FRM sampler will operate at the Burlington Zampieri site beginning with sample date 7/1/2022.

The EPA approved FRM sampling method collects an integrated 24-hour particulate sample on a 47mm Teflon® filter disc (Table 11). 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 10 – $PM_{2.5}$ Network Sampling

Site	Continuous FEM (Primary)	FRM (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
Burlington Zampieri	N/A	TEI 2025i (1-in-3 day)	STN collocated
Bennington	Teledyne API T640	N/A	N/A

Table 11 – $PM_{2.5}$ 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	Continuous Direct Measurement	Continuous.Broadband Spectroscopy	1-Hour

$PM_{2.5}$ Design Values

"Design values" for $PM_{2.5}$ must be calculated every year for 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.

$PM_{2.5}$ annual design values are calculated using the 3-year average of $PM_{2.5}$ annual mean mass concentrations. The current annual $PM_{2.5}$ NAAQS is 12 $\mu g/m^3$. Currently, all Vermont monitors are in attainment of the annual $PM_{2.5}$ NAAQS.

$PM_{2.5}$ 24-hour design values are calculated using the 3-year average of the annual 98th percentile 24-hour averages. The 24-hour average $PM_{2.5}$ NAAQS is 35 $\mu g/m^3$. Currently, all Vermont monitors are in attainment for the daily $PM_{2.5}$ NAAQS. $PM_{2.5}$ design values are presented in Table 12.

Table 12 – $PM_{2.5}$ Design Values (2021)

Site	24-Hour Design Value ($\mu g/m^3$)	Annual Design Value ($\mu g/m^3$)
Bennington	16	5.8
Underhill	12	4.7
Burlington Main Street	18	6.9
Rutland	21	7.6

$PM_{2.5}$ Speciation Monitoring Network

The Vermont AQCD operates two $PM_{2.5}$ speciation sites in the air monitoring network at the Burlington-Cherry Street (Zampieri) and Underhill sites (Table 13). The samplers operate on a 1-in-3 day schedule and produce a 24-hour integrated filter-based sample. A third site in Dover, VT, not officially part of the AQCD network, is operated and maintained by the U.S. Forest Service (USFS). 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 $\mu g/m^3$ concentration results for 53 parameters on chemical makeup of $PM_{2.5}$ (see Table 22 in Appendix A). 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 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 same 1-in-3 day schedule and is collocated with the current Met One SUPERSASS sampler at the Burlington Cherry St. site.

Table 13 – Speciation Sample/Analysis Method

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

PM_{10} Monitoring Network

FRM: The Vermont AQCD currently operates two FRM PM_{10} monitoring sites in the air monitoring network, located at the Underhill and Rutland sites. The Underhill site is a NCore site and operates on a 1-in-3 day sampling schedule, with collocated PM_{10} sample collection performed on 1-in-12 day schedule. The Rutland site operates on a 1-in-6 day sampling schedule. A FRM PM_{10} sampler is also operated at the Burlington Main Street site, but these PM_{10} filters are collected for metals analysis only, on a 1-in-12 day sampling schedule to support the AQCD's air toxics monitoring program. The Burlington PM_{10} mass concentration is no longer reported to EPA. The Underhill samplers are TEI 2025i sequential samplers. The Burlington and Rutland samplers are TEI 2000i non-sequential samplers.

The sampling method utilized for FRM sample collection is 24-hour low volume sample collection, on a 47mm Teflon® filter. 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 PM_{10} is completed by Wood LLC through the EPA National Contract.

Filter samples from all four samplers are subsequently submitted to the VAEL laboratory for metals analysis. The metals analysis performed includes 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 PM_{10} lead code for Non-FRM/FEM methods (85128).

Continuous: The Vermont AQCD operates four continuous PM_{10} monitoring sites in the air monitoring network, located in Burlington (Main Street), Underhill, Rutland and Bennington. The TAPI T640 continuous PM monitor used for reporting $PM_{2.5}$ also reports non-FEM PM_{10}. The Underhill and Rutland T640 PM_{10} monitors are collocated with a TEI FRM samplers and provide strictly unofficial method comparisons for informational purposes.

The TAPI T640 continuous PM monitor design is described above in the $PM_{2.5}$ section. Continuous PM_{10} $\mu g/m^3$ data is reported as 1-hour averages. All continuous PM_{10} monitoring data from VT sites have been reported as non-FEM PM_{10} LC (85101) since August 2017.

Table 14 – PM_{10} Sample/Analysis Method

Sampler	Duration; Collection	Analytical Method/Lab	Location
TEI 2025i Manual Reference Method: RFPS-1298-127	24-hr; Low Volume 47 mm Teflon® Filter	Gravimetric/ Wood LLC	Underhill
TEI 2000i Manual Reference Method: RFPS-1298-126	24-hr; Low Volume 47 mm Teflon® Filter	Gravimetric/ Wood LLC	Rutland and Burlington Main Street*
TAPI T640 (non-FEM)	1-hr; Direct Measurement	Continuous Broadband Spectroscopy	Bennington, Burlington, Rutland, Underhill

* Burlington PM_{10} is collected for metals only and not weighed for total mass.

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 15 – Black Carbon Monitoring Method

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

Ambient Air Toxics Monitoring Network

The Vermont AQCD operates three 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 PM_{10} metals at all sites (PM_{10} 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 PM_{10} metals samples are collected on 47 mm Teflon® filters using FRM samplers operated for the PM_{10} network (see Table 16 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 4/22/2021 sample date, the VAEL added Ethylene Oxide to the TO-15A 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.

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). This method is currently suspended due to staffing shortage.

See Table 16 below for the list of sampling methods and analytical methods. The list of target analytes and associated MDLs for analytical air toxics methods are listed in tables in Appendix A.

Table 16 – Ambient Air Toxic Sampling/Analysis Methods

Pollutant	Sampler	Collection	Analytical Method	Analytes/Lab
VOC	ATEC 2200 (combined sampler)	6 L Silco-coated SS Canister; 24-hour (sub-atmospheric)	TO-15 (GC/MS)	56 VOC Compounds; VAEL[1]
Carbonyl	ATEC 2200 (combined sampler)	DNPH Cartridge; 24-hour	TO-11A (HPLC)	13 Carbonyl Compounds; VAEL[2]
Metals (Lead Included)	TEI 2025i/2000i PM10 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[3] (EPA National Contract Lab)
BTEX[4]	Synspec GC955 Series 600	Semi- Continuous; 15 Minute	GC-PID	5 VOC Compounds; direct measurement

1: Beginning with 4/22/2021 samples, VAEL added ethylene oxide to the TO-15 target compound list
2: 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.
3: Beginning with 4/1/19 samples, ERG no longer reports 9-fluorenone, cyclopenta(c,d)pyrene and retene
4: Method suspended in early 2020.

Monitoring Site Parameter Information

Table 17 contains a list of all the monitoring sites and parameters currently operated by the State of Vermont or National Forest Service.

Table 17 – Network Ambient Air Pollutant Monitoring By Location

Site	Address	Ozone	Carbon Monoxide	Nitrogen Dioxide / NOy	Sulfur Dioxide	$PM_{2.5}$ FRM	$PM_{2.5}$ Continuous (FEM)	PM_{10} FRM	PM_{10} metals	$PM_{10-2.5}$ Difference	PM_{10} Continuous (non-FEM)	Speciation (STN / IMPROVE)	Black Carbon	BTEX	VOC	Carbonyl	PAH	Wind Speed/Wind Direction	Temperature	Relative Humidity	Solar Radiation	Precipitation	Barometric Pressure
Bennington	Airport Road	✓					✓				✓							✓	✓	✓	✓	✓	✓
Burlington	150 So Winooski Ave						✓	*	✓		✓			✓†	✓C	✓C		✓	✓	✓	✓	✓	✓
Rutland	Merchants Row	✓	✓	✓	✓	✓C	✓C	✓	✓	✓	✓		✓		✓	✓		✓	✓	✓	✓	✓	✓
Underhill	Harvey Road	✓	✓T	✓T	✓T	✓	✓	✓C	✓C	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓
Burlington	108 Cherry Street					✓						✓											
Dover	Mount Snow											✓1											

T=Trace Level; C=Collocation; 1=Operated by U. S. Forest Service; *=Metals only, no µg/m^3 total mass after 4/1/19; †=Suspended in 2020

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		

Ozone	Carbon Monoxide	Nitrogen Dioxide / NOy	Sulfur Dioxide	$PM_{2.5}$ FRM	$PM_{2.5}$ Continuous (FEM)	PM_{10} FRM	PM_{10} metals	$PM_{10-2.5}$ Difference	PM_{10} Continuous (non-FEM)	Speciation	Black Carbon	BTEX	VOC	Carbonyl	PAH	Wind Speed/Direction	Temperature	Relative Humidity	Solar Radiation	Precipitation	Barometric Pressure
✓					✓				✓							✓	✓	✓	✓	✓	✓

Site Description:
This site is located in a field at the rural western end of Bennington, 0.25 km southwest 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 O_3 and $PM_{2.5}$ continuous FEM is compliance and trends analysis. The site represents a background/transport site with regional scale of exposure. The O_3 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. Continuous $PM_{2.5}$ collected since January 2015. TAPI T640 FEM continuous $PM_{2.5}$ installed 7/27/17.

Figure 2 – Aerial View Bennington

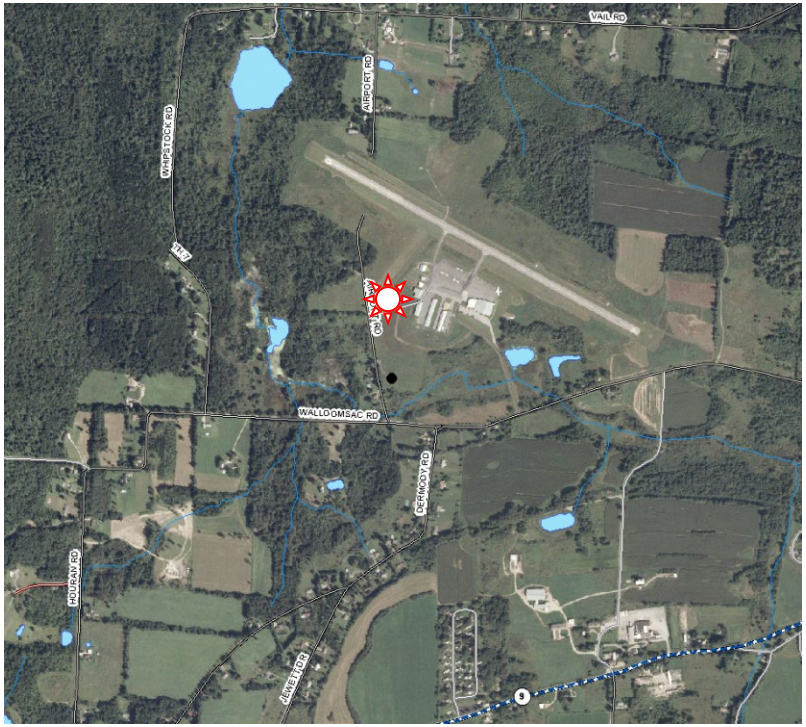


Figure 3 – Bennington Trailer

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		

Ozone	Carbon Monoxide	Nitrogen Dioxide	Sulfur Dioxide	$PM_{2.5}$ FRM	$PM_{2.5}$ Continuous (FEM)	PM_{10} FRM	PM_{10} metals	$PM_{10-2.5}$ Difference	PM_{10} Continuous (non-FEM)	Speciation	Black Carbon	BTEX	VOC (collocated)	Carbonyl (collocated)	PAH	Wind Speed/Direction	Temperature	Relative Humidity	Solar Radiation	Precipitation	Barometric Pressure
	†	†			✓	*	✓		✓			**	✓	✓		✓	✓	✓	✓	✓	✓

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 southwest 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 monitoring objective for PM_{10} metals, VOC and Carbonyl sampling and 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 PM_{10}. Installed TEI 2000i on May 10, 2017, configured for $PM_{2.5}$. Configured for PM_{10} and submitted for metals analysis added in 2018. PM_{10} $\mu g/m^3$ total mass discontinued beginning on 4/1/19, collected for metals analysis only.
Continuous $PM_{2.5}$ collected since January 2014. TAPI T640 FEM continuous $PM_{2.5}$ installed on 8/22/17.
**BTEX suspended in 2020.
† CO and NO_2 discontinued on 12/31/2021.

Figure 4 – Burlington Aerial Photo

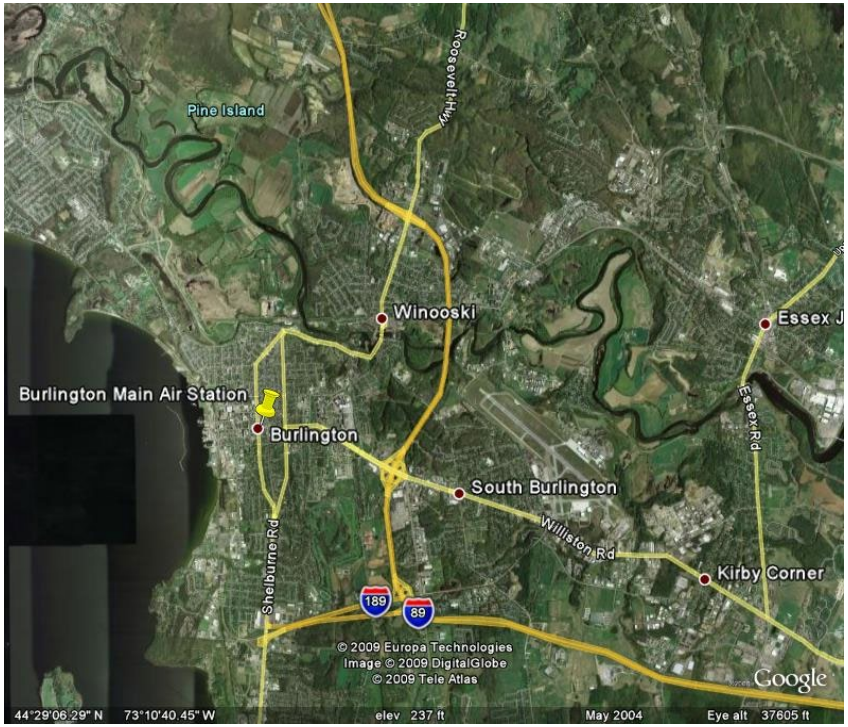


Figure 5 – Burlington Monitoring Shelter

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		

Ozone	Carbon Monoxide	Nitrogen Dioxide	Sulfur Dioxide	$PM_{2.5}$ FRM	$PM_{2.5}$ Continuous (FEM)	PM_{10} FRM	PM_{10} metals	$PM_{10-2.5}$ Difference	PM_{10} Continuous (non-FEM)	Speciation (STN)	Black Carbon	BTEX	VOC (collocated)	Carbonyl (collocated)	PAH	Wind Speed/Direction	Temperature	Relative Humidity	Solar Radiation	Precipitation	Barometric Pressure
				✓						✓											

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 southwest 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; Plan to resume on 7/1/2022.
Discontinued Meteorological parameters 12/31/17.

Figure 6 – Burlington Aerial Photo

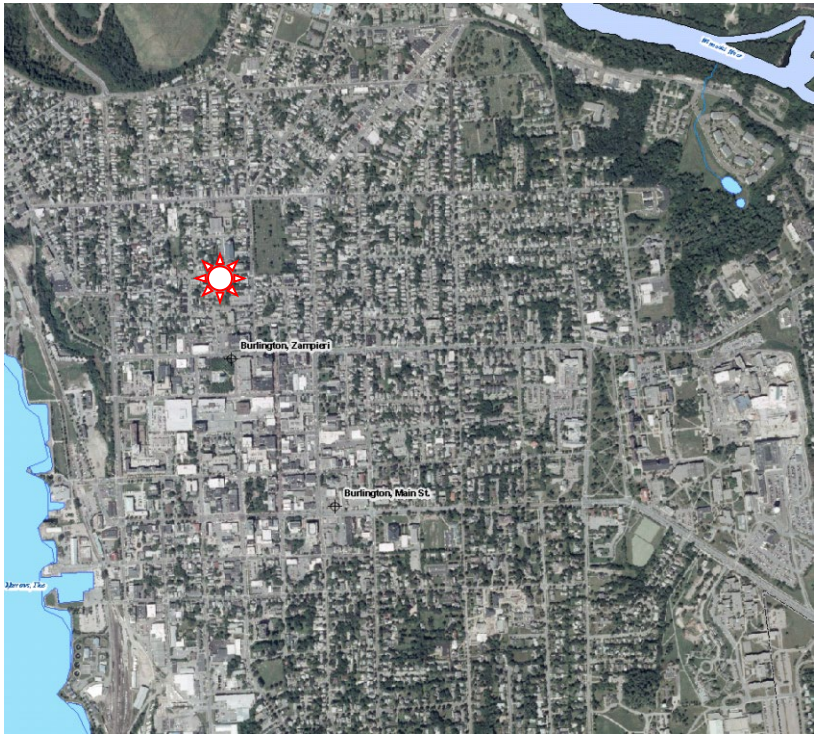


Figure 7 – Zampieri Building Sampling Platform

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		

Ozone	Carbon Monoxide	Nitrogen Dioxide	Sulfur Dioxide	$PM_{2.5}$ FRM	$PM_{2.5}$ Continuous (FEM)	PM_{10} FRM	PM_{10} metals	$PM_{10-2.5}$ Difference	PM_{10} Continuous (non-FEM)	Speciation	Black Carbon	BTEX	VOC	Carbonyl	PAH	Wind Speed/Direction	Temperature	Relative Humidity	Solar Radiation	Precipitation	Barometric Pressure
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓		✓	✓	✓	✓	✓	✓

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, NOx, $PM_{2.5}$, PM_{10} and SO_2 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 PM_{10} 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 PM_{10} FRM added
Continuous $PM_{2.5}$ collected since January 2014. TAPI T640 FEM continuous PM2.5 installed on 7/27/17.
PM_{10} metals analysis added in 2017
Magee AE33 Aethalometer installed in June 2018

Figure 8 – Aerial View Rutland

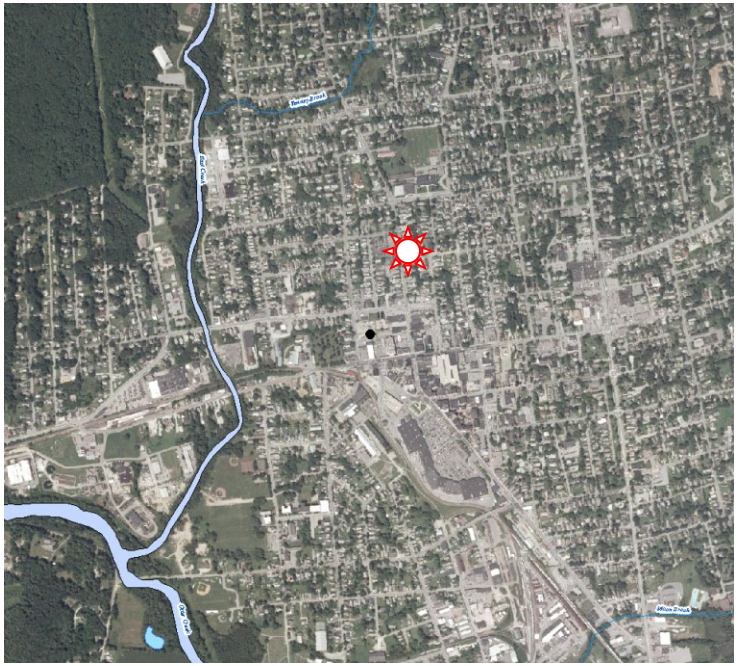


Figure 9 – Rutland Trailer

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		

Ozone	Carbon Monoxide (Trace)	Total Reactive Oxides of Nitrogen (trace)	Sulfur Dioxide (Trace)	$PM_{2.5}$ FRM	$PM_{2.5}$ Continuous (FEM)	PM_{10} FRM (Collocated)	PM_{10} metals (Collocated)	$PM_{10-2.5}$ Difference	PM_{10} Continuous (non-FEM)	Speciation (IMPROVE)	Black Carbon	BTEX	VOC	Carbonyl	PAH	Wind Speed/Direction	Temperature	Relative Humidity	Solar Radiation	Precipitation	Barometric Pressure
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓

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, $PM_{2.5}$, PM_{10}, PM speciation and trace-level CO, SO_2 and NO_y monitoring is regional scale background levels. The monitoring objectives for the VOC, Carbonyl, PAH, and metals sample collection and analysis are 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, NOy, and SO_2 continuous monitoring started 4th Quarter 2010. Trace level TAPI CO (T300U) and SO_2 (T100U) analyzers installed March 2017.
Continuous $PM_{2.5}$ collected since January 2014. TAPI T640 FEM continuous $PM_{2.5}$ installed 8/22/17
Collocated PM_{10} sample frequency reduced to 1-in-12 day schedule beginning on 4/1/19
TAPI T200U NO/NOy analyzer and T700U station dilution calibrator installed in Fall 2019

Figure 10 – Aerial View Underhill

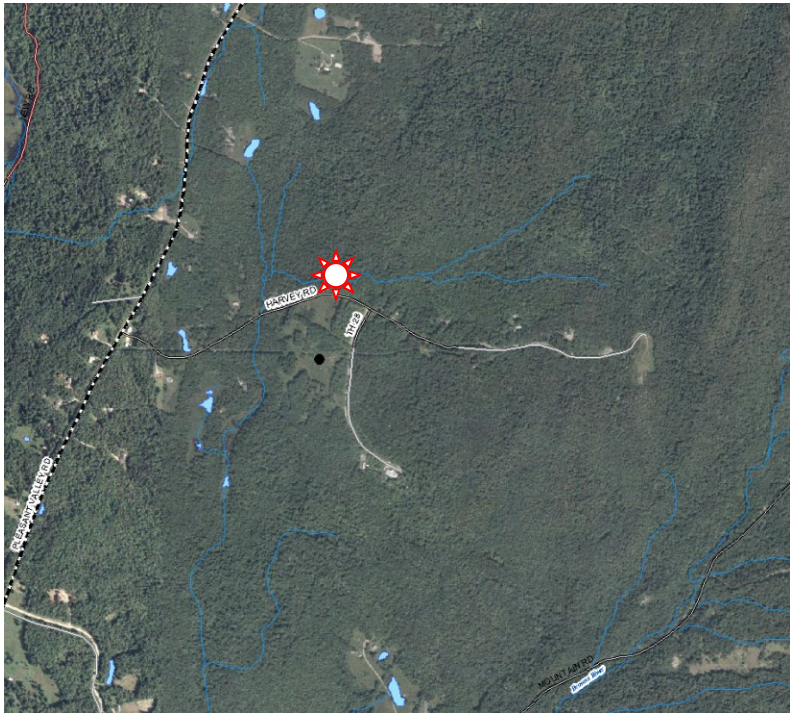
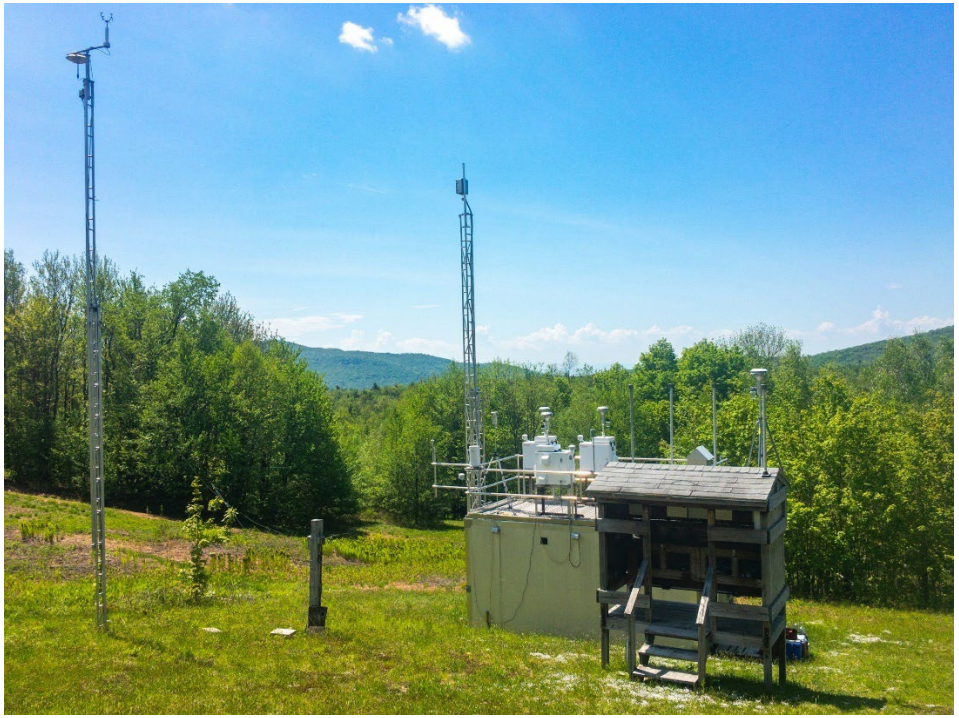


Figure 11 – Underhill IMROVE Shelter & Trailer



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		

Ozone	Carbon Monoxide	Nitrogen Dioxide / NOy	Sulfur Dioxide	$PM_{2.5}$ FRM	$PM_{2.5}$ Continuous (FEM)	PM_{10} FRM	PM_{10} metals	$PM_{10-2.5}$ Difference	PM_{10} Continuous (non-FEM)	Speciation (IMPROVE)	Black Carbon	BTEX	VOC	Carbonyl	PAH	Wind Speed/Direction	Temperature	Relative Humidity	Solar Radiation	Precipitation	Barometric Pressure
										✓											

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.(http://vista.cira.colostate.edu/Improve/improve-program/) 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 12 – Aerial View Mount Snow

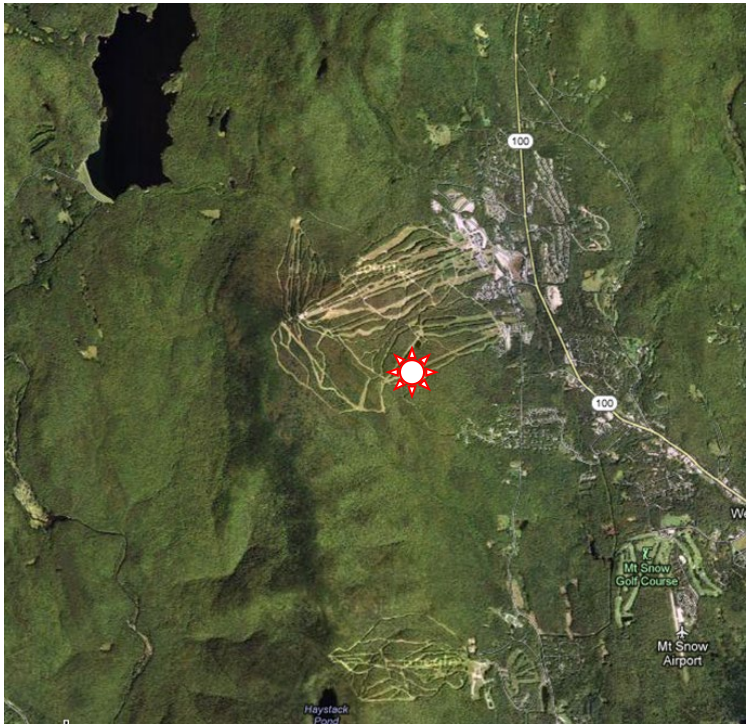


Figure 13 – Mount Snow Monitor Shelter

Appendix A. Lists of Analytes and MDL for Methods

Table 18 – PM_{10} Elemental Metals Analytes and MDL (VAEL 2020, 47 mm Teflon)

Metal	MDL (ng/m^3)*
Antimony	0.127
Arsenic	0.045
Barium	0.104
Beryllium	0.023
Cadmium	0.021
Chromium	11.358
Cobalt	0.025
Lead	0.067
Manganese	0.301
Molybdenum	0.050
Nickel	0.319
Selenium	0.121
Silver	0.027
Strontium	0.133
Vanadium	0.023

* assumes 24.0 m^3 total sample volume

Table 19 – Carbonyl Analytes and MDL (VAEL, 2020)

Carbonyl Compound	VT DEC MDL (µg/m^3)*
2,5-Dimethylbenzaldehyde[1]	0.008
Acetaldehyde	0.008
Acetone	0.006
Benzaldehyde[1]	0.002
Butyraldehyde[1]	0.033
Formaldehyde	0.013
Hexanaldehyde[1]	0.008
Isovaleraldehyde[1]	0.004
m-Tolualdehyde[2]	0.011
o-Tolualdehyde[2]	0.011
Propionaldehyde	0.004
p-Tolualdehyde[2]	0.009
Valeraldehyde[1]	0.003

*: assumes 1.30 m^3 total sample volume

1: new target list compounds January 2019

2: new target list compounds in July 2019

MDLs for Carbonyls are calculated for each cartridge lot. Vermont AQCD uses about three lots per year. The values in this table are used for cartridges sampled between 8/31/20 and 1/28/21.

Table 20 – VOC Analytes and MDL (VAEL, 2021)

VOC Compound	MDL (ppb)
1,1,1-Trichloroethane	0.004
1,1,2,2-Tetrachloroethane	0.008
1,1,2-Trichloroethane	0.009
1,1-Dichloroethane	0.006
1,1-Dichloroethene	0.007
1,2,4-Trichlorobenzene	0.015
1,2,4-Trimethylbenzene	0.012
1,2-Dibromoethane	0.005
1,2-Dichloroethane	0.005
1,2-Dichloropropane	0.007
1,3,5-Trimethylbenzene	0.014
1,3-Butadiene	0.007
3-Chloropropene	0.009
Acrolein*	0.029
Acrylonitrile	0.014
Benzene	0.007
Bromochloromethane	0.007
Bromodichloromethane	0.008
Bromoform	0.010
Bromomethane	0.004
Carbon Tetrachloride	0.007
Chlorobenzene	0.009
Chloroethane	0.007
Chloroform	0.006
Chloromethane	0.008
Chloroprene	0.024
cis-1,2-Dichloroethylene	0.006
cis-1,3-Dichloropropene	0.006
Dibromochloromethane	0.011
Dichlorodifluoromethane	0.006
Dichlorotetrafluoroethane	0.007
Ethyl Acrylate	0.009
Ethyl tert-Butyl Ether	0.009
Ethylbenzene	0.009
Hexachloro-1,3-butadiene	0.012
m,p-Xylene	0.015
m-Dichlorobenzene	0.013
Methyl Isobutyl Ketone	0.010
Methyl Methacrylate	0.011
Methyl tert-Butyl Ether	0.028
Methylene Chloride	0.011
n-Octane	0.006
o-Dichlorobenzene	0.012
o-Xylene	0.008
p-Dichlorobenzene	0.012
Styrene	0.011
tert-Amyl Methyl Ether	0.010
Tetrachloroethylene	0.006
Toluene	0.007
trans-1,2-Dichloroethylene	0.023
trans-1,3-Dichloropropene	0.007
Trichloroethylene	0.008
Trichlorofluoromethane	0.005
Trichlorotrifluoroethane	0.006
Vinyl Chloride	0.008

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

Table 21 – PAH Analytes and MDL (ERG, 2020)

PAH Compounds	MDL (ng/m^3)
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.

Table 22 – CSN Analytes and MDL (EPA, 2017)

Parameter	Average MDL (µg/m3)
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

Parameter	Average MDL (µg/m3)
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 B. National Ambient Air Quality Standards

Pollutant		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 (NO_2)		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 (O_3)		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 (SO_2)		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/m^3 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 are not revoked and remain in effect for designated areas. Additionally, some areas may have certain continuing implementation obligations under the prior revoked 1-hour (1979) and 8-hour (1997) O3 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 an implementation plan providing for attainment of the current (2010) standard has 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 required NAAQS.

References

1. Code of Federal Regulation, (e-CFR) 40 CFR Part 50, Protection of Environment.

2. Code of Federal Regulation, (e-CFR) 40 CFR Part 53, Protection of Environment.

3. Code of Federal Regulation, (e-CFR) 40 CFR Part 58, Protection of Environment.

4. State of Vermont, Agency of Natural Resources, Air Pollution Control Regulation; Appendix C. July 1, 2018.

5. United States Environmental Protection Agency, Ambient Monitoring Technology Information Center – List of Designated EPA Reference and Equivalent Methods. 2021. epa.gov/amtic/air-monitoring-methods.

6. United States Environmental Protection Agency, National Ambient Air Quality Standards (NAAQS), epa.gov/criteria-air-pollutants/naaqs-table.

7. US EPA Design Value Reports, epa.gov/air-trends/air-quality-design-values#report.

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

June 17, 2022

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

Dear Ms. Berschling:

Thank you for providing EPA with a draft of the Vermont 2022 Air Monitoring Network Plan, which was posted for public review on June 1, 2022. 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. 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 12, we note these changes below which occurred between July 2021 and June 2022.

Changes July 2021 to June 2022 Air Monitoring Network

The Vermont AQCD network changes, additions, and deletions that were performed during the previous 12-month period were:

- The Rutland Agilaire 8832 datalogger was replaced with an Agilaire 8872 datalogger in August 2021.
- MetOne AIO (all-in-one) meteorological sensor was installed at the Rutland site to replace the older sensors for sonic wind speed/wind direction, ambient temperature, relative humidity and barometric.
- A new Teledyne API T640 FEM Continuous PM2.5 monitor was purchased an installed at the Underhill site following an unexpected instrument failure. This purchase allows us to have one on the shelf for future emergencies.
- Continuous reporting of CO and NO2 was discontinued at the Burlington Main Street site on December 31, 2022.
- VAEL completed method development for adding ethylene oxide to the target list for EPA Method TO-15 to meet a new EPA NATTS Grant requirement, and reporting to AQS began in April 2021.

- The Synspec Continuous BTEX method at the Burlington Main Street site has been suspended until resources are available to properly operate the analyzer and review data.

Note: The date for when the continuous NO2 and CO monitors were shut down at Burlington is listed as December 31, 2022. EPA believes that this date is a typo and should be 2021

2. Page 13: We note the listed network changes between July 2022 and June 2023

Proposed Changes July 2022 to June 2023 Air Monitoring Network

The Vermont AQCD network changes, additions and deletions that are planned for the next 12-month period are:

- Continue to evaluate procedures for processing, evaluating and validating AE33 data, and upload to the EPA AQS database.
- Continue working with the Burlington Planning Department and others to develop a plan for relocating 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. Depending on the new location selected for this site, the AQCD will consider proposing to EPA that the STN site (currently located at the Burlington Cherry Street site) be relocated to this new location, thus combining the two sites, and will consider resuming $PM_{2.5}$ FRM measurements to support the STN measurements.
- 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.
- Resume sampling $PM_{2.5}$ FRM on a 1-in-3 day schedule at the Burlington Zampieri site to collocate with STN. Sampling was suspended at the end of 2016 and is scheduled to resume on July 1, 2022.

3. On page 15, 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.

4. On page 16, under Carbon Monoxide Monitoring Network, the plan states a CO monitor is operated at Burlington Main Street. According to the changes in the plan, this monitor was discontinued on December 31, 2021. The plan should be changed to reflect this.

5. On page 17, Table 4- Carbon Monoxide Monitoring Method, a CO monitor is listed for Burlington Main Street. Please change the table to reflect the fact that this monitor was discontinued.

6. On Page 17, Oxides of Nitrogen (NO/NO2/NOx) and Total Reactive Oxides of Nitrogen (NOy) Monitoring Network, the plan states an NO_2 monitor is operated at Burlington Main street. According to the changes in the plan, this monitor was discontinued on December 31, 2021. The plan should be changed to reflect this.

7. Per the discussion on page 19 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.

8. Pages 15, 17, 18, and 20. EPA has released design values (DV) for all criteria pollutants in May, 2022 which includes 2021 data for the entire country. We have reviewed the design values and we will work with you to ensure the design values represented here are consistent with those values.

9. On page 24, Monitoring Site Parameter Information, a CO and NO_2 monitor is checked off within the table for Burlington Main Street. According to the changes in the plan, these monitors were discontinued December 31, 2021. The table should be updated to reflect this.

In addition, on page 22, 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 AQCD in early 2020 where the pods were deployed to Montpelier to help determine potential wood smoke issues. Also utilized by the planning group were nine PurpleAir sensors deployed in Montpelier from October 2021 to March 2022.

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) 918-8392, or Alysha Murphy at (617) 918-8381.

Sincerely,

Tyler Kotsifas
Vermont State Coordinator
Laboratory Services and Applied Science Division
EPA-New England