

Vermont Annual Air Monitoring Network Plan 2017



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
EPA – Environmental Protection Agency
FDMS – Filter Dynamic Measurement System
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
IC – Ion Chromatography
IO – Inorganic
LC – Local Conditions of Temperature and Pressure
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 Oxides of Nitrogen
O₃ – Ozone
OAQPS – Office of Air Quality Planning and Standards
PAH – Polycyclic Aromatic Hydrocarbon
PIXE – Proton Induced X-ray Emission
PM₁₀ – Particulate ≤10 micron aerodynamic particle size
PM_{2.5} – Particulate ≤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
TEOM – Tapered Element Oscillating Microbalance
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, 2017 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.

Please send all comments regarding Vermont Air Monitoring Network Plan:

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The 2017 Network Plan was posted on the “public notice” section of the AQCD website listed above from 5/26/17 through 6/27/17. During this period, the VT AQCD received no public comments. VT AQCD did receive comments from EPA-New England in a letter dated 6/26/17, which is included at the end of this document. VT AQCD revised the report as necessary to address EPA’s comments.

Vermont Air Monitoring Network Plan Overview

The Vermont 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 Air Quality & Climate Division'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 wind storms. The air pollution emanating from these sources can be local or transported from great distances. The amount of particulate matter, 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 VOC's, PCB's, PAH's, 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 2017 for relocation of the Burlington Main Street shelter, as requested by the Burlington Department of Planning and Zoning. Vermont established a monitoring network for criteria pollutants in the 1970's and a network for toxic air pollutants in 1985. Currently, the AQCD monitors for six criteria pollutants and 96 toxic pollutants. 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 criteria pollutant monitoring methods utilized by the VT AQCD are EPA federal reference method (FRM) or federal 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 most associated SOPs for the Criteria Gases, Particulate Matter, Air Toxics and National Air Toxics Trend Sites (NATTS) have received initial EPA approval. The annual updates for the Air Toxics and NATTS QAPP was submitted in December, 2016. The QAPP For Criteria Gas & Particulate Matter Pollutant Monitoring, Revision 1 was approved by EPA on 10/14/16. A subset of SOPs and the Meteorological QAPP is pending and will be finalized and submitted to EPA in 2017.

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. 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 Dec 12, 2012, the EPA set the $\text{PM}_{2.5}$ primary annual $\text{PM}_{2.5}$ standard to $12 \mu\text{g}/\text{m}^3$ and the secondary standard was set to $15 \mu\text{g}/\text{m}^3$. This annual $\text{PM}_{2.5}$ 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. On January 15, 2013, EPA established that all continuous $\text{PM}_{2.5}$ 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).

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 with regard to 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 with regard to 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). On December 19, 2014, the EPA reviewed the standard requirements and opted to retain the existing standards.

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.

The final rule for NO₂ NAAQS was adopted on January 22, 2010. The new 1-hour average NO₂ 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 NO₂ monitors nationwide to help protect communities that are susceptible to NO₂ health effects. Vermont is not currently required by EPA under this rule to set up any additional NO₂ 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 2010 Vermont state recommended design value uses 2008, 2009, and 2010 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.

Changes July 2016 to June 2017 Air Monitoring Network

The Vermont AQCD network changes, additions, and deletions that were performed during the 12-month period between July 2016-June 2017 were:

1. On March 17, 2017, the existing trace level Ecotech 9830T CO and Thermo 43CTL SO₂ analyzers at the Underhill NCore site were replaced with API T300U CO and T100U SO₂ analyzers.
2. In August 2016, the frequency of collocated FRM filter-based sample collection was reduced from 1-in-3 day to 1-in-6 day for the Rutland and Burlington Main Street PM_{2.5} samplers and Underhill PM₁₀ collocated sampler. The frequency of PM₁₀ FRM filter-based sample collection in Rutland and Burlington was also reduced from 1-in-3 day to 1-in-6 day.
3. On December 31, 2016, PM_{2.5} FRM primary and collocated sample collection was terminated at the Burlington Cherry Street site.
4. The Underhill NCore site legacy TEI 2025 FRM primary and collocated PM₁₀ samplers were replaced with TEI 2025i FRM's on January 17 and May 10, 2017, respectively.
5. The following PM filter collection changes were made at the Burlington Main Street site:
 - On November 14, 2016, the TEI 2025iD Dichotomous sampler at the Burlington Main Street site was terminated. PM_{10-2.5} collection was terminated at this time.
 - In January 2017, a TEI 2025i FRM was installed at the Burlington Main Street site for PM₁₀ and operated from January 19 through April 13, 2017.
 - On April 13, 2017 the TEI 2025i FRM was configured for PM_{2.5} for collocation with the TEOM continuous PM_{2.5}.
 - On May 10, 2017 the TEI 2025i FRM was replaced with a TEI 2000i FRM.
6. On May 24, 2017, the legacy TEI 2025 for PM₁₀ at the Rutland site was replaced with a TEI 2000i FRM.
7. On December 23, 2016, the MetOne SASS was replaced with a MetOne SUPERSASS.
8. On September 15, 2016, the T700U dilution calibrator used for QA was installed at the Rutland site as the new station ozone standard/dilution calibrator.
9. In September 2016, began using a new TAPI 751H (Zero Air System) and T750U (dilution calibrator) for performing annual QA audits of continuous gas analyzers.

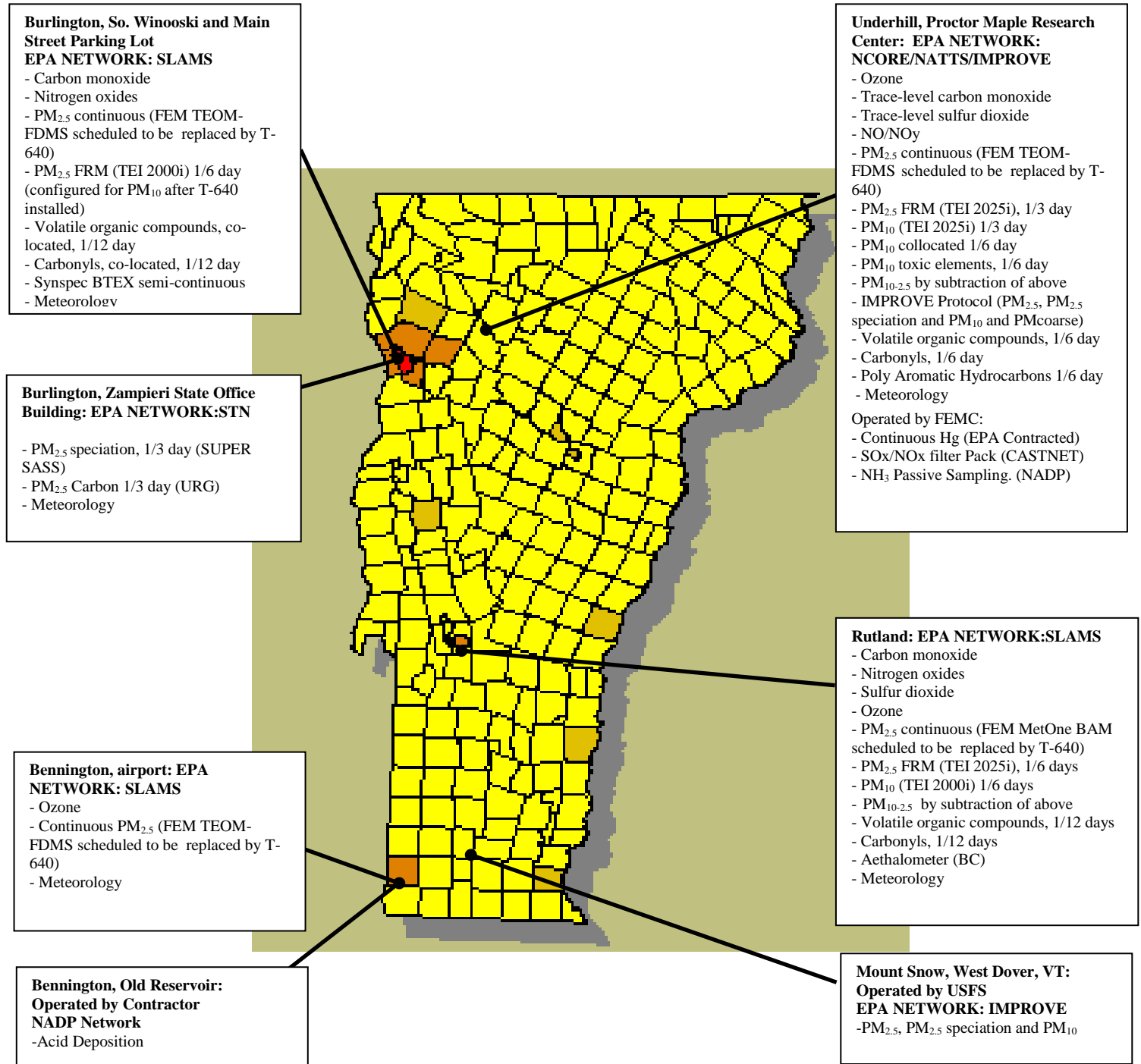
Proposed Changes July 2017 to June 2018 Air Monitoring Network

The Vermont AQCD network changes, additions and deletions that are planned for the next 12 months of July 2017-June 2018 are:

1. Procure four (4) TAPI T-640 Continuous PM_{2.5} FEM monitors to replace the TEOMs at the Bennington, Burlington Main Street, and Underhill sites, and the BAM at the Rutland site. (Purchase Order submitted to vendor June 2, 2017)
2. Once TAPI-640 monitors are installed at all network sites, Burlington Main Street TEI 2025i will be configured from PM_{2.5} to PM₁₀ (Summer 2017).
3. Install new Agilaire 8872 data logger at the Underhill NCore site (Summer 2017).
4. Install new TAPI T703 as the ozone primary standard at the Berlin Field Operations Center (Summer 2017, Purchase Requisition completed/approved April, 2017).
5. Install existing ozone primary standard (TAPI M703E) as the new ozone station standard at the Bennington Site. (Summer 2017).
6. Procure a new ozone analyzer for the Underhill NCore site (Date TBD-Included in current EPA Grant Budget).
7. Procure a new aethalometer (Black Carbon-EC/OC) for Rutland site (Date TBD-Included in current EPA Grant Budget).
8. Procure the Agilaire AgileWeb module for new public outreach AQCD website to present realtime AQCD monitoring data (Purchase Request completed/approved on May 22, 2017.)
9. Begin developing a plan for an alternative space for the AQCD field operations center in the Central Vermont area.
10. Continue developing a plan for relocation of the Burlington monitoring site. The Burlington Department of Planning and Zoning has provided notification that the current shelter will need to be relocated within 18-24 months due to a redevelopment project.

Figure 1 – Vermont Air Monitoring Network Plan Map

2017 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 FEM: The Vermont AQCD operates four (4) continuous PM_{2.5} sites (See Table 1). This currently includes two Thermo Scientific TEOM® 1400a Ambient Particulate Monitor with Series 8500C FDMS®, one Thermo Scientific TEOM® 1405-F Ambient Particulate Monitor, and one MetOne BAM 1020. All four network samplers have Federal Equivalency Method (FEM) designation from EPA. The Thermo Scientific Model 8500C FDMS TEOM is operated at the Burlington, and Underhill sites. The Thermo Scientific 1405-F is operated in Bennington. The MetOne BAM 1020 FEM is operated at the Rutland site. All continuous PM_{2.5} samplers are operated year-round and each method (TEOM or BAM) is collocated with a PM_{2.5} FRM sampler at one site in the network for precision QA assessment (operated on a 1-in-6 day schedule) and comparative analysis. Data from all monitors is reported as 1-hour averages. The FEMs at all four sites are designated in AQS as the primary monitor for PM_{2.5} LC (AQS code: 88101) as of September, 2015. The primary monitor and collocated monitors are all 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 are reported as PM_{2.5} LC (88101).

During summer of 2017, the AQCD is scheduled to complete procurement of four (4) TAPI T640 Continuous PM_{2.5} FEM monitors (EQPM-0516-236) to replace the TEOM and BAM monitors at the respective four monitoring sites. The purchase order was submitted to the vendor on June 2, 2017.

FRM: The Vermont AQCD currently operates three (3) PM_{2.5} FRM sites utilizing TEI 2025i's and TEI 2000i (See Table 1). The monitoring locations are in Burlington, Rutland and Underhill. The Underhill sampler operates on a 1-in-3 day sampling schedule for NCore, while the Burlington and Rutland samplers operate on a 1-in-6 day sampling schedule (implemented in Rutland on 8/1/16 and Burlington on 4/13/17) as designated collocated sampling for assessing precision for TEOM and BAM methods, accordingly.

The Vermont AQCD discontinued the operation of the two (2) PM_{2.5} FRM TEI 2025i samplers (collocated) at the Burlington Cherry Street site on 12/31/16. These two samplers were relocated to Underhill NCore site for primary and collocated PM₁₀ only (see page 22-PM₁₀ Monitoring Network).

Once the TAPI T-640 monitors are installed at all network sites, the Rutland FRM will be designated as the network collocated site for this method and the operation of the Burlington TEI 2000i sampler will be suspended for PM_{2.5} and reconfigured for PM₁₀.

The EPA approved 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 CT DEEP) to determine the mass concentration for the 24-hour sampling period.

Table 1 – PM_{2.5} Sample/Analysis Method

Current:				
Site	Continuous FEM (Primary)	FRM	FRM Collection frequency	Collocated Precision Site
Rutland	MetOne BAM 1020	TEI 2025i	1-in-6 day	Yes
Burlington	Thermo Scientific Model 8500 FDMS TEOM	TEI 2000i	1-in-6 day	Yes (beginning 4/13/17)
Underhill	Thermo Scientific Model 8500 FDMS TEOM	TEI 2025i	1-in-3 day	No
Bennington	Thermo Scientific Model 1405F FDMS TEOM	N/A	N/A	N/A
Planned for Summer 2017:				
Site	Continuous FEM (Primary)	FRM	FRM Collection frequency	Collocated Precision Site
Rutland	Teledyne API T640	TEI 2025i	1-in-6 day	Yes
Burlington	Teledyne API T640	N/A	N/A	N/A
Underhill	Teledyne API T640	TEI 2025i	1-in-3 day	No
Bennington	Teledyne API T640	N/A	N/A	N/A

Table 2 – PM_{2.5} Methods

Sampler	Collection	Analytical Method	Reported Data Interval / Location
TEI 2025i/2000i Manual Equivalent Method: EQPM-0202-145/143	Low Volume 47 mm Teflon® Filter - 24 Hour	Gravimetric/ CT DEEP	Site dependent (see Table 1)
Thermo Scientific Model 8500 FDMS TEOM EQPM-0609-181	Tapered Element Oscillating Microbalance	Continuous gravimetric	1 Hour Burlington Underhill
Thermo Scientific Model 1405F FDMS TEOM EQPM-0609-181	Tapered Element Oscillating Microbalance	Continuous gravimetric	1 Hour Bennington (as of 12/1/14)
MetOne BAM1020 EQPM-0308-170	Standard glass fiber filter tape	Continuous Beta Ray Attenuation	1 Hour Rutland
TAPI T640* EQPM-0516-236	Direct Measurement	Continuous Broadband Spectroscopy	1 Hour All Sites (as of Summer 2017)

***: Proposed; procurement completed in summer/fall 2017**

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

PM_{2.5} Annual Design Value (2016)

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. The current annual PM_{2.5} NAAQS is 12µg/m³. Currently, all Vermont monitors are in attainment of the annual PM_{2.5} NAAQS .

Table 3 – PM_{2.5} 2016 Annual Design Value

Site	Design Value (µg/m³) Years 2014-2016
Bennington	5.8
Burlington (Main St)*	6.0
Rutland	8.1
Underhill	3.3

Source: EPA AQS AMP480 *: Burlington Cherry Street Site is not included as it does not meet completeness criteria for 2015. FRMs at this site discontinued on 12/31/16.

PM_{2.5} 24-Hour Design Value (2016)

The current 24-Hour (daily) design values from PM_{2.5} for 2016 are presented in Table 4 below. PM_{2.5} daily design values are calculated using the 3-year average of the annual 98th percentile values. The 24-hour average PM_{2.5} standard is 35 µg/m³. PM_{2.5} design values relative to the PM_{2.5} daily standard were compiled based upon measured PM_{2.5} data from 2014-2016. Currently, all Vermont monitors are in attainment for the daily PM_{2.5} NAAQS .

Table 4 – PM_{2.5} 2016 24-Hour Design Value

Site	Design Value (µg/m ³) Years 2014-2016
Bennington	14
Burlington (Main Street)*	14
Rutland	26
Underhill	10

Source: EPA AQS AMP480 *: Burlington Cherry Street Site is not included as it does not meet completeness criteria for 2015. FRMs at this site discontinued on 12/31/16.

PM_{2.5} Speciation Monitoring Network

The Vermont AQCD operates two (2) PM_{2.5} speciation sites (See Table 5). These sites are located at Burlington-Cherry Street (Zampieri) and Underhill. 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 at 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 site is part of the EPA Speciation Trends Network (STN).

The analysis of the filters generates data on chemical makeup of PM_{2.5}. The method is capable of measuring concentration levels of sulfate, nitrate, ammonium, and trace elements including metals, elemental carbon, and organic carbon. The STN is designed to complement the 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 new 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.

Table 5 – Speciation Sample/Analysis Method

Pollutant	Sampler	Collection	Analytical Method	Analytes /Lab
PM Speciation (STN)	Met One - SUPERSASS	Low Volume Multi Filter sequential 24 Hour	STN	See Appendix A/AMEC FosterWheeler
PM Carbon (STN)	URG 3000-N	Low Volume Multi Filter 24 Hour	Carbon Analysis	See Appendix A/ AMEC FosterWheeler
PM Speciation (IMPROVE)	UCDavis – IMPROVE Sampler	Low Volume Multi Filter - 24 Hour	IMPROVE	See Appendix A/UCDavis

Black Carbon

The Magee AE22 Aethalometer measures the optical absorption of carbon particles at two wavelengths: 880 nm (IR), quantitative for the mass of ‘black’ or elemental carbon; and 370 nm (UV). With data processing aromatic organic compounds such as are found in wood smoke, biomass-burning smoke, and tobacco smoke may be identified. Utilizing dual wavelength measurement allows for the determination of the sources of airborne black carbon particles (ie. diesel exhaust vs. wood smoke combustion). Data is store at 1 hour intervals. The Magee unit is currently located in Rutland and has been operational since February 2009.

The AQCD has budgeted current EPA Grant funds for the procurement of a new Aethalometer for the Rutland site sometime during 2017.

Table 6 – Aethalometer Monitoring Method

Pollutant	Sampler	Collection	Analytical Method	Reported Data Interval
Black Carbon	Magee AE22	Quartz Filter Tape	Continuous Optical Measurement	1 Hour

Ozone Monitoring Network

The Vermont AQCD operates three (3) ozone sites in the air monitoring network, Bennington, Underhill and Rutland. Currently, all ozone analyzers are operated year-round. Data is collected continuously and recorded as hourly 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 has budgeted current EPA Grant funds for the procurement of a new ozone analyzer for the Underhill NCore site sometime during 2017.

“Design values” for ozone must be calculated every year for sites operating FEM instruments. The site must meet the design value statistical definition in order 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	API 400 Automated Equivalent Method: EQOA-0992-087	Continuous	Ultraviolet Photometry	1 Hour

Ozone Design Value (2016)

Below are the current design values for ozone determined from data for 2014-2016 (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.

Table 8 – Ozone 8-Hour 2016 Design Values

Site	Design Value (PPM) Years 2014-2016
Bennington	0.063
Underhill	0.061
Rutland	0.063*

Source: EPA AQS AMP480 *: Ozone monitoring began 4/1/16, design value criteria not met: value reported is 4th max for 2016 only.

Ambient Air Toxics Monitoring Network

The Vermont AQCD operates three (3) ambient air toxics monitoring sites. The three monitoring sites are located in Burlington, Rutland and Underhill. Samplers at the Burlington and Rutland sites are operated on a 1-in-12 day and the samplers at the Underhill site are operated on a 1-in-6 day sample schedule. The Underhill site is part of the EPA NATTS network. The Burlington and Rutland air toxics monitoring sites are part of the VT AQCD air toxics network.

The air toxic sample collection and analysis program includes volatile organic compounds (VOC) and carbonyl compounds at all sites. The NATTS - Underhill site includes additional sampling and analysis for PM₁₀ metals and polyaromatic hydrocarbons (PAH) compounds. In addition to the VOC samples collected at all 3 sites, a Synspec GC955 semi-continuous GC/PID analyzer is operated at the Burlington site to determine 15-minute average concentrations of benzene, toluene, ethylbenzene and xylenes (BTEX). See Table 9 below for the list of sampling methods and analytical methods. The list of target analytes for the analytical air toxics methods and associated MDLs are listed in [Appendix A](#).

Table 9 – Ambient Air Toxic Sampling/Analysis Methods

Pollutant	Sampler	Collection	Analytical Method	Analytes/Lab
VOC	ATEC 2200	6 Liter Silco-coated SS Canister- 24 Hour (sub-atmospheric)	TO-15 (GC/MS)	55 VOC Compounds VAEL Lab
Carbonyl	ATEC 2200	DNPH Cartridge- 24 Hour	TO-11A (HPLC)	4 Carbonyl Compounds VAEL Lab
Metals (Lead Included)	TEI 2025i PM ₁₀ Low- Volume	Teflon Filter- 24 Hour	IO-3.5 (ICP/MS)	15 Elements VAEL Lab
PAH	Tisch PUF +	PUF/XAD- 24 Hour	TO-13A (GC/MS)	22 PAH Compounds ERG (EPA National Contract Lab)
BTEX	Synspec GC955 Series 600	Semi- Continuous 15 Minute	GC-PID	5 VOC Compounds/direct measurement

PM₁₀ Monitoring Network

The Vermont AQCD currently operates two (2) PM₁₀ monitoring sites. The monitoring locations are Rutland and Underhill. The Underhill NCore site operates on a 1-in-3 day sampling schedule, with collocated PM₁₀ sample collection performed on 1-in-6 day schedule (beginning 8/1/16). The Rutland site operates on a 1-in-6 day schedule. Once the TAPI T-640 PM_{2.5} monitors are installed at all network sites during the summer of 2017, operation of the Burlington TEI 2000i sampler will be suspended for PM_{2.5} and reconfigured at that point for PM₁₀ and operated on a 1-in-6 day schedule (see section on Continuous PM_{2.5} Monitoring Network Page 14).

The sampling method utilized for sample collection is 24-hour low volume sample collection, on a 47mm Telfon[®] filter (See Table 10 – PM₁₀ Sample/Analysis Method). The particulate collected on the filter has an aerodynamic particle size of ≤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. The gravimetric determination for concentration of PM₁₀ is completed by CT DEEP.

The TEI 2025iD samplers at Rutland and Burlington were discontinued on April 11, 2016 and December 31, 2016, respectively. They were both subsequently replaced with a TEI 2025 and 2025i which were in turn replaced with TEI 2000i's in May, 2017, configured for PM₁₀ at Rutland and PM_{2.5} at Burlington.

In Underhill, the two collocated low-volume R&P 2025 samplers configured to collect PM₁₀ were replaced with TEI 2025i samplers in on January 17 and May 10, 2017. The PM₁₀ sample is collected on a 47mm Teflon[®] filter. Subsequent gravimetric analysis is performed by Conneticutt DEEP and is used to determine the mass concentration. The Underhill filter samples collected on the 1-in-6 day schedule are subsequently submitted for metals analysis to the VAEL laboratory. The metals analysis performed does include the element lead (Pb). This ICP/MS analytical method performed by VAEL is not designated by EPA as a FEM for lead (Pb) NAAQS determination, so Underhill lead results for NATTS will be submitted to AQS using code for lead in PM₁₀ for Non-FRM/FEM methods (85128).

Table 10 – PM₁₀ Sample/Analysis Method

Pollutant	Sampler	Collection	Analytical Method	Location /Lab
PM ₁₀	TEI 2025i Manual Reference Method: RFPS-1298-127	Low Volume 47 mm Teflon [®] Filter	Gravimetric	Underhill CT DEEP
PM ₁₀	TEI 2000i Manual Reference Method: RFPS-1298-126	Low Volume 47 mm Teflon [®] Filter	Gravimetric	Rutland (and Burlington beginning Summer-2017) CT DEEP

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 which are presently 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 11– Nitrogen Dioxide and Total Reactive Nitrogen Monitoring Method). The NO_x samplers are operated year-round. The AQCD also operates a total reactive nitrogen (NO_y) trace level analyzer at the Underhill NCore monitoring site.

Table 11 – 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
NO _y (TL)	Ecotech EC9843 Automated Reference Method: RFNA-1292-090	Continuous	Chemiluminescence	1 Hour

Nitrogen Dioxide Design Value (2016)

Below are the current calculated 1-hour & annual design values for nitrogen dioxide from 2014-2016 (See Table 12 & Table 13). 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 nitrogen 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 annual 1 hr averages. Currently, all Vermont monitors are in attainment for nitrogen dioxide.

Table 12 – Nitrogen Dioxide 2016 1-Hour Design Values

Site	Design Value (PPB) Years 2014-2016
Burlington	33
Rutland	36

Source: EPA AQS AMP480

Table 13 – Nitrogen Dioxide 2016 Annual Average

Site	2016 Annual Average(PPB)
Burlington	5.7
Rutland	6.6

Source: EPA AQS AMP450

Carbon Monoxide Monitoring Network

The Vermont AQCD operates three (3) carbon monoxide (CO) analyzers located at the Burlington, Rutland and Underhill NCore monitoring sites. The CO analyzers are operated year-round. CO concentrations are determined by a continuous infra-red method (See Table 14 – 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 14 – 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 (TL)	Teledyne-API Model T300U Automated Reference Method: RFCA-1093-093	Continuous	Infra-red(Gas filter correlation)	Underhill/1 Hour

Table 15 – Carbon Monoxide Design Value 2016 (Preliminary-based on 2nd max 1-hour and 8-hour values

Site	2016 Design Value-(2 nd maximum PPM)
Burlington CO -1 Hour	0.9
Burlington CO -8 Hour	0.7
Rutland CO -1 Hour	1.5
Rutland CO -8 Hour	0.7
Underhill CO -1 Hour	0.367
Underhill CO -8 Hour	0.2

Source: EPA AQS AMP450

Sulfur Dioxide Monitoring Network

The Vermont AQCD operates two (2) sulfur dioxide (SO₂) analyzers, located in Rutland and Underhill monitoring sites. The SO₂ analyzers are operated year-round. SO₂ concentrations are determined by a continuous pulsed fluorescence method (Table 16 – Sulfur Dioxide Monitoring Method)

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 17.

Table 16 – Sulfur Dioxide Monitoring Method

Pollutant	Sampler	Collection	Analytical Method	Location/Reported Data Interval
Sulfur Dioxide (TL)	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 17 – Sulfur Dioxide Design Values 2016

Site	Design Values (SO ₂ PPB) Average of Years 2014-2016 1 Hour 99 th Percentile Daily Max
Rutland – 1 Hour	6
Underhill – 1 Hour	2*

Source: EPA AQS AMP480 *: Underhill data completeness for 2014 does not meet the EPA criteria.

Monitoring Site Parameter Information

Below in Table 18 is a list of all of the monitoring sites and parameters currently operated by the State of Vermont (or recently discontinued) or National Forest Service. The monitoring sites are listed in alphabetical order by site name.

Table 18 – Network 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 _{2.5} /PM ₁₀ FEM (Dicot)	PM _{10-2.5} Difference	PM ₁₀ Low Volume/(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	✓	✓				✓	✓*	✓		D			✓ ^c	✓ ^c		✓	✓	✓	✓	✓	✓	✓	
Burlington	108 Cherry Street					✓		D									✓	✓	✓	✓	✓	✓	✓	
Dover	Mount Snow					✓ ¹																		
Rutland	Merchants Row	✓	✓	✓	✓			✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Underhill	Harvey Road	✓ ^T	✓ ^T	✓	✓ ^T	✓		✓	✓	✓ ^c		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓

T=Trace Level C=Collocation D=Discontinued *=New 4/2017 1= Operated by U. S. Forest Service

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	PM _{2.5} FRM	BTEX	PM _{2.5} PM ₁₀ FEM Dicot	PM _{2.5} FEM TEOM Continuous			VOC (collocated)	Carbonyl (collocated)	Black Carbon	Wind Speed	Wind Direction	Temperature	Relative Humidity	Solar Radiation	Precipitation	Pressure
Burlington	150 S. Winooski	✓	✓			✓	✓	D	✓			✓	✓		✓	✓	✓	✓	✓	✓	✓

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 IBM 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 at this site continues to be operated into the future primarily for trends analysis. The objective of the PM₁₀ monitoring is for trends analysis and subsequent metals analysis if feasible. 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. Continuous PM_{2.5} is used for NAAQS compliance, AQI determination and air quality forecasting. WS/WD & Temp/RH data is collected from a 3.0 meter tower.

Plans/History:

- Site established in 2003
- December 31, 2016 suspended 2025i Dichotomous sampler.
- January, 2017 installed 2025i configured for PM₁₀, then replaced that with 2000i on May 10, 2017, configured for PM_{2.5}
- Scheduled for relocation in 2018, based on City of Burlington Planning Redevelopment Project

Figure 2 – Burlington Aerial Photo

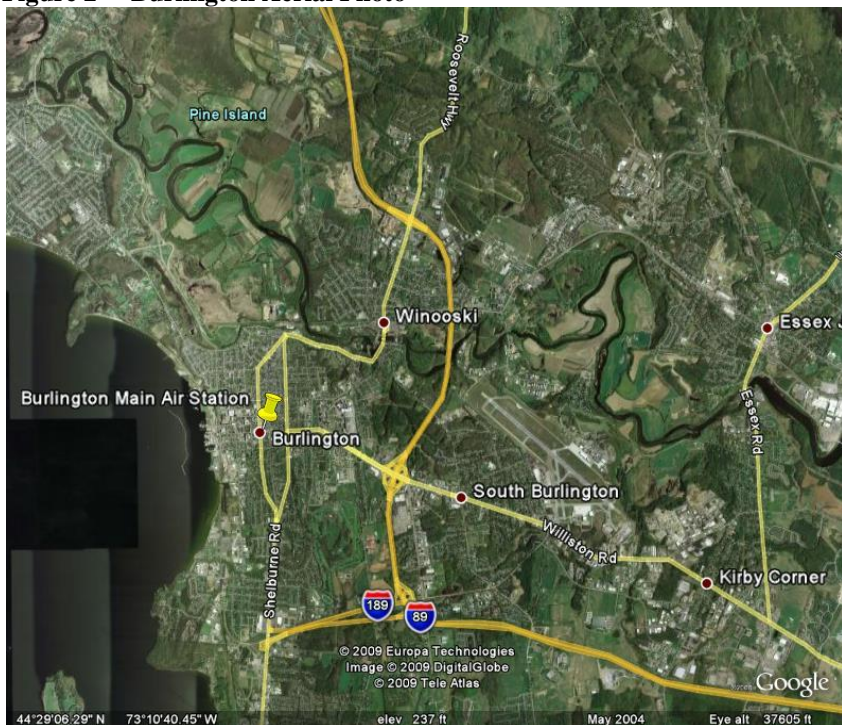


Figure 3 – Burlington Monitoring Shelter



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} TEOM	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.					✓		D							✓	✓	✓	✓	✓	✓	✓
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, .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 IBM 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 monitoring objective for PM _{2.5} , is for compliance and trends analysis. Speciation monitoring objective is PM _{2.5} trends analysis and complimentary data for PM _{2.5} FRM data. The speciation sampling is conducted as part of the EPA Speciation Trends Network (STN). WS/WD & Temp/RH data is collected from a 3.0 meter tower.																					
Plans/History: <ul style="list-style-type: none"> Site established 1999 Discontinued collocated PM_{2.5} FRM samplers on 12/31/16; samplers relocated to Underhill for PM₁₀ 																					

Figure 4 – Burlington Aerial Photo

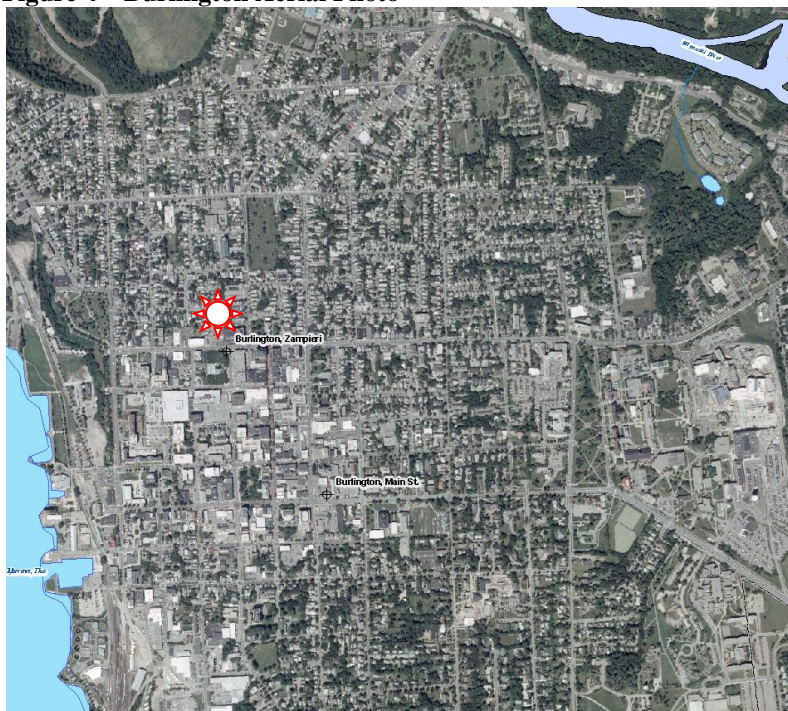
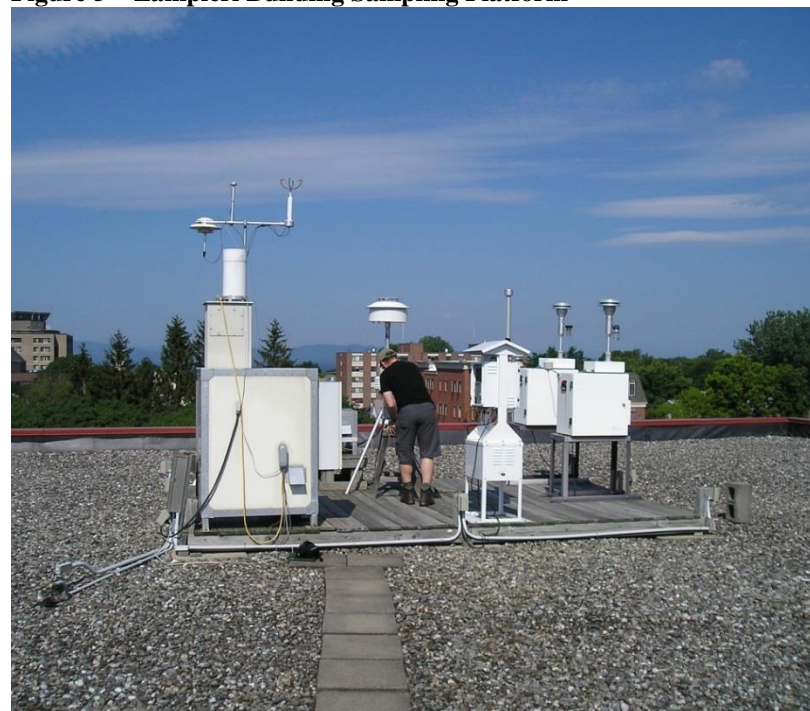


Figure 5 – Zampieri Building Sampling Platform



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} TEOM	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						✓														
<p>Site Description: <i>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.</i> This site is located on the northern slope of Mount Snow. This site is operated and maintained by the U.S. Forest Service. Further information about the Lye Brook site can be seen at http://vista.cira.colostate.edu/views/Web/SiteBrowser/SiteBrowser.aspx . The site is identified in the data search as LYEB1. The current data from this site is not accessible from the EPA AQS system.</p>																					
<p>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.</p>																					
<p>Plans/History:</p> <ul style="list-style-type: none"> Site established 2012 																					

Figure 6 – Aerial View Mount Snow

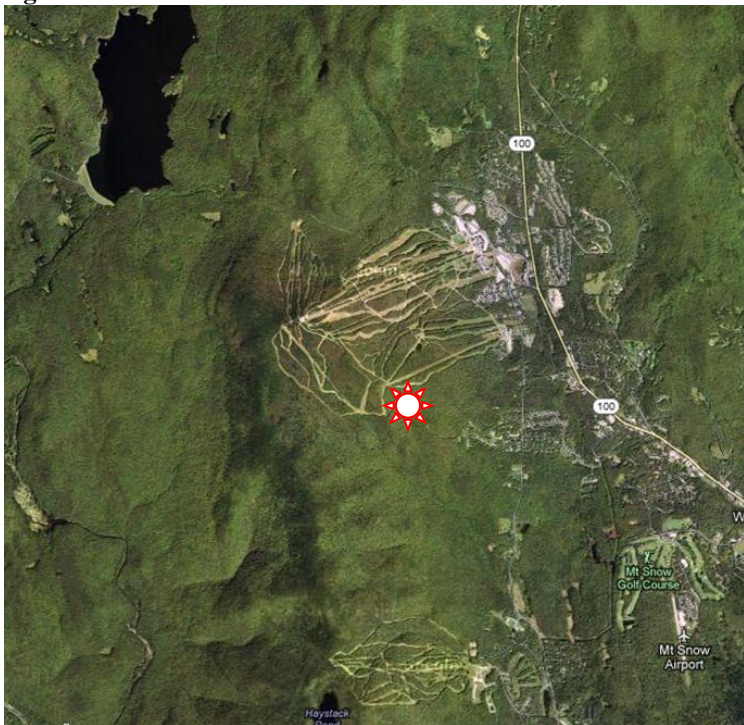


Figure 7 – View of Monitor Location



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			✓					✓						✓	✓	✓	✓	✓	✓	✓

This site is located in a field at rural western end of Bennington, .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

This monitoring objective for O₃ and PM_{2.5} FRM 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.

- Site Established 1986
- 2025 FRM discontinued April 11, 2016

Figure 8 – Aerial View Bennington

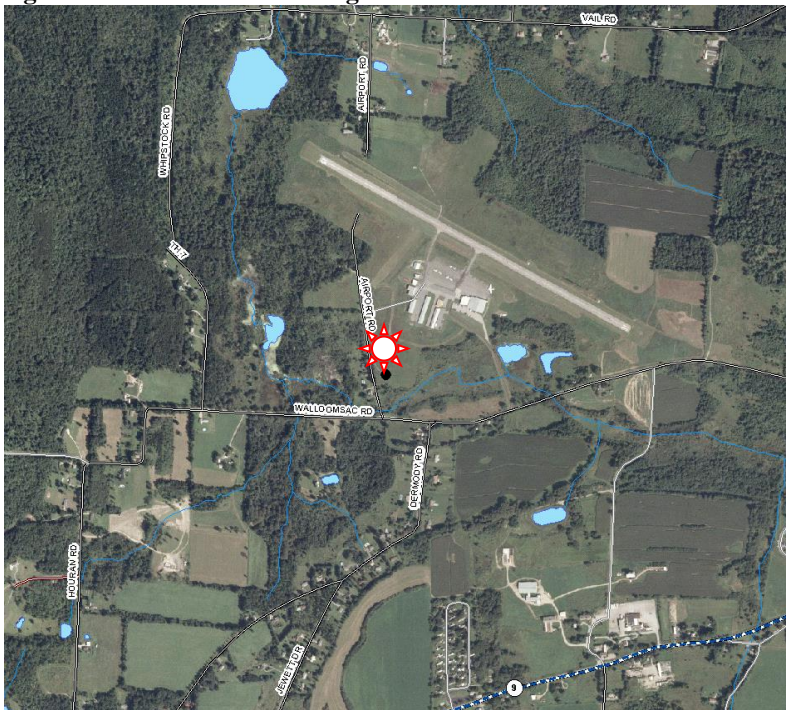


Figure 9 – Bennington Trailer



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	Nitrogen Dioxide	Ozone	Sulfur Dioxide	Speciation (STN)	Speciation (IMPROVE)	PM _{2.5} FRM	PM _{2.5} FEM Continuous	PM ₁₀ FRM (collocated)	PM ₁₀ /Metals	VOC	PM _{10/2.5} Difference	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} , PM ₁₀ , PM speciation and future trace-level 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: <ul style="list-style-type: none"> • Site Established 1988 • Began participation in NATTS 2004 • NCore trace level CO, NOy, and SO₂ continuous monitoring started 4th Quarter 2010. • Trace level CO and SO₂ analyzers replaced March, 2017 																					

Figure 10 – Aerial View Underhill

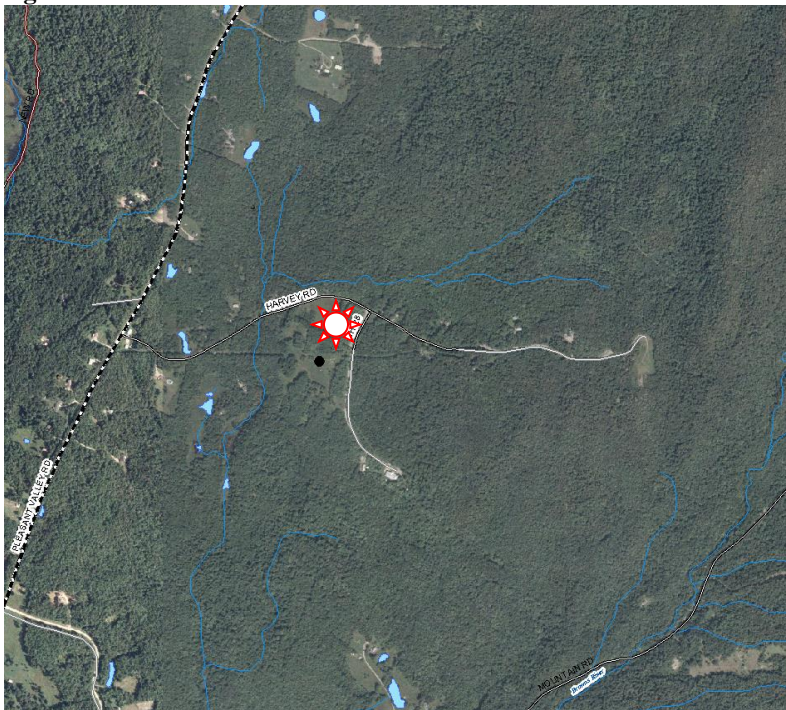


Figure 11 – Underhill IMROVE Shelter & Trailer



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	Video Camera	PM _{2.5} FRM	PM ₁₀ FRM	PM _{10-2.5} Difference	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 court house 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} , 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: <ul style="list-style-type: none"> • 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 Ozone and PM₁₀ FRM added 																					

Figure 12 – Aerial View Rutland

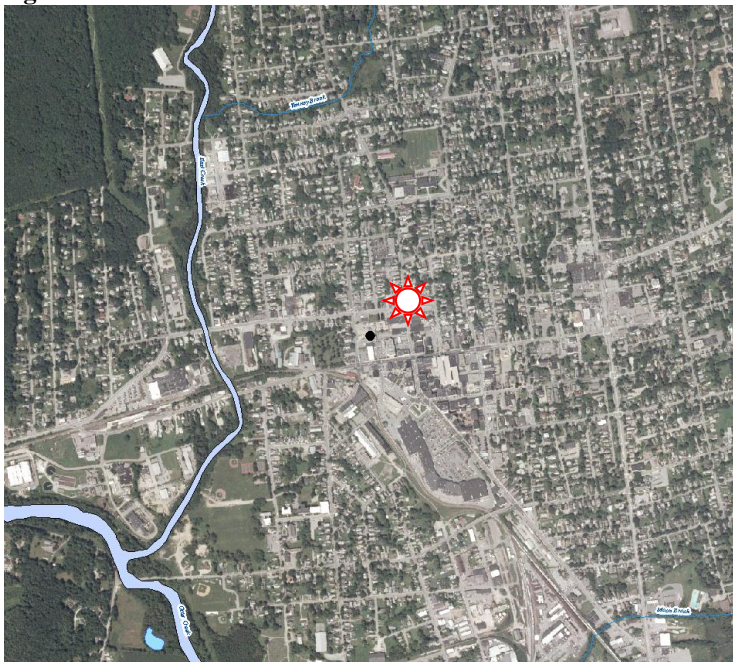


Figure 13 – Rutland Trailer



Appendix A – List of Analytes for Analytical Methods

Table 19 – Elemental Metals Analytes for PM10 (2016, 47 mm Teflon)

Metal	MDL (ng/m³)*	Metal	MDL (ng/m³)*
Antimony	0.061	Manganese	0.326
Arsenic	0.162	Molybdenum	0.043
Barium	0.056	Nickel	0.293
Beryllium	0.017	Selenium	0.289
Cadmium	0.024	Silver	0.024
Chromium	4.217	Strontium	0.351
Cobalt	0.038	Vanadium	0.028
Lead	0.128		

* assumes 24.0 m³

Table 20 – List of Analytes for Speciation Sampling

Analysis	Analytes	MDL
Gravimetric	Mass	300 ng/m³
HIPS	Optical Absorption	0.2 Mm⁻¹
XRF	Elements Fe to Pb	0.05 - 0.18 ng/m³
PIXE	Elements S to Mn	1 - 4 ng/m³
	Element Na	20 ng/m³
PESA	Elemental H	4 ng/m³
IC	NO₃, SO₄, NH₄	10 - 30 ng/m³
	NO₂, Cl	60 - 100 ng/m³
TOR	Organic Carbon	250 ng/m³
	Elemental Carbon	100 ng/m³

Table 21 – List of Carbonyl Analytes (2016)

Carbonyl Compound	VT DEC MDL (µg/m³)*
Formaldehyde	0.013
Acetaldehyde	0.008
Acetone	0.005
Propionaldehyde	0.005

*: assumes 1.30 m³ total sample volume

Table 22 – Analyte List for VOC Analysis (2016)

VOC Compound	MDL (ppb)
1,1,1-Trichloroethane	0.001
1,1,2,2-Tetrachloroethane	0.012
1,1,2-Trichloroethane	0.002
1,1-Dichloroethane	0.002
1,1-Dichloroethene	0.002
1,2,4-Trichlorobenzene	0.059
1,2,4-Trimethylbenzene	0.018
1,2-Dibromoethane	0.002
1,2-Dichloroethane	0.002
1,2-Dichloropropane	0.002
1,3,5-Trimethylbenzene	0.014
1,3-Butadiene	0.003
3-Chloropropene	0.002
Acrolein*	0.065
Acrylonitrile	0.003
Benzene	0.010
Bromochloromethane	0.001
Bromodichloromethane	0.001
Bromoform	0.004
Bromomethane	0.001
Carbon Tetrachloride	0.001
Chlorobenzene	0.002
Chloroethane	0.003
Chloroform	0.001
Chloromethane	0.008
Chloroprene	0.003
cis-1,2-Dichloroethylene	0.002
cis-1,3-Dichloropropene	0.002

VOC Compound	MDL (ppb)
Dibromochloromethane	0.002
Dichlorodifluoromethane	0.005
Dichlorotetrafluoroethane	0.001
Ethyl Acrylate	0.002
Ethyl tert-Butyl Ether	0.003
Ethylbenzene	0.003
Hexachloro-1,3-butadiene	0.070
m,p-Xylene	0.004
m-Dichlorobenzene	0.021
Methyl Isobutyl Ketone	0.005
Methyl Methacrylate	0.002
Methyl tert-Butyl Ether	0.002
Methylene Chloride	0.003
n-Octane	0.003
o-Dichlorobenzene	0.026
o-Xylene	0.005
p- Dichlorobenzene	0.021
Styrene	0.005
tert-Amyl Methyl Ether	0.002
Tetrachloroethylene	0.001
Toluene	0.004
trans-1,2-Dichloroethylene	0.002
trans-1,3-Dichloropropene	0.002
Trichloroethylene	0.003
Trichlorofluoromethane	0.002
Trichlorotrifluoroethane	0.002
Vinyl Chloride	0.002

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

Table 23 – Analyte List for PAH Analysis (ERG: 2016)

PAH Compounds	ng/m³
9-Fluorenone	0.0318
Acenaphthene	0.0599
Acenaphthylene	0.0191
Anthracene	0.0968
Benzo (a) anthracene	0.0764
Benzo (a) pyrene	0.0802
Benzo (b) fluoranthene	0.0943
Benzo (e) pyrene	0.0586
Benzo (g,h,i) perylene	0.0535
Benzo (k) fluoranthene	0.0751
Chrysene	0.0943
Coronene	0.0102
Cyclopenta[cd]pyrene	0.0076
Dibenz (a,h)anthracene	0.0217
Fluoranthene	0.1450
Fluorene	0.1440
Indeno(1,2,3-cd)pyrene	0.0573
Naphthalene	1.0100
Perylene	0.0166
Phenanthrene	0.0841
Pyrene	0.1200
Retene	0.1060

Appendix B – 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 24, 2017.](#)
2. United States Environmental Protection Agency Air and Radiation - National Ambient Air Quality Standards (NAAQS) May, 2017 <https://www.epa.gov/criteria-air-pollutants/naaqs-table>
3. State of Vermont, Agency of Natural Resources, *Air Pollution Control Regulation; Appendix C*, November 30, 2016 <http://dec.vermont.gov/air-quality/laws>
4. United States Environmental Protection Agency, Technology Transfer Network, Ambient Monitoring Technology Information Center – *List of Designated EPA Reference and Equivalent Methods* Dec 17, 2016 <http://www.epa.gov/ttn/amtic/criteria.html>
5. [Code of Federal Regulation, \(e-CFR\) 40 CFR Part 50, Protection of Environment, May 24, 2017.](#)
6. [Code of Federal Regulation, \(e-CFR\) 40 CFR Part 53, Protection of Environment, May 24, 2017.](#)



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 1
OFFICE OF ENVIRONMENTAL MEASUREMENT AND EVALUATION
11 Technology Drive
North Chelmsford, MA 01863

June 26, 2017

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

Dear Mr. Lacaille:

Thank you for providing EPA with a draft of the Vermont 2017 Air Monitoring Network Plan, which was posted for public review on May 26, 2017. 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. Page 8. Paragraph four discusses the status of QAPP updates/ documents. We are awaiting the Meteorological QAPP and a subset of SOP documents.
2. Page 10. SO₂ monitoring. Based on your current network, Vermont is not currently obligated to site any additional SO₂ monitors under the final SO₂ NAAQS rule.

EPA has finalized its **Data Requirements Rule for the 1-Hour Sulfur Dioxide Primary National Ambient Air Quality Standard (NAAQS)** on August 21, 2015 (80 FR 51052), and provided detailed monitoring and modelling guidance for implementing the SO₂ standard.

3. On page 11, we note and explicitly agree and acknowledge these changes below which occurred between July 2016 and June 2017.
 - On March 17, 2017, the existing trace level Ecotech 9830T CO and Thermo 43CTL SO₂ analyzers at the Underhill NCore site were replaced with API T300U CO and T100U SO₂ analyzers.
 - In August 2016, the frequency of collocated FRM filter-based sample collection was reduced from 1-in-3 day to 1-in-6 day for the Rutland and Burlington Main Street PM_{2.5} samplers and Underhill PM₁₀ collocated sampler. The frequency of PM₁₀ FRM filter-based sample collection in Rutland and Burlington was also reduced from 1-in-3 day to 1-in-6 day.

- On December 31, 2016, PM 2.5 FRM primary and collocated sample collection was terminated at the Burlington Cherry Street site.
- The Underhill NCore site legacy TEI 2025 FRM primary and collocated PM10 samplers were replaced with TEI 2025i FRM's on January 17 and May 10, 2017, respectively.
- The following PM filter collection changes were made at the Burlington Main Street site:
 - On November 14, 2016, the TEI 2025iD Dichotomous sampler at the Burlington Main Street site was terminated. PM10-2.5 collection was terminated at this time.
 - In January 2017, a TEI 2025i FRM was installed at the Burlington Main Street site for PM10 and operated from January 19 through April 13, 2017.
 - On April 19, 2017 the TEI 2025i FRM was configured for PM2.5 for collocation with the TEOM continuous PM2.5.
 - On May 10, 2017 the TEI 2025i FRM was replaced with a TEI 2000i FRM.
- On May 24, 2017, the legacy TEI 2025 for PM10 at the Rutland site was replaced with a TEI 2000i FRM.
- On December 23, 2016, the MetOne SASS was replaced with a MetOne SUPERSASS.
- On September 15, 2016, the T700U dilution calibrator used for QA was installed at the Rutland site as the new station ozone standard/dilution calibrator.
- In September 2016, began using a new TAPI 751H (Zero Air System) and T750U (dilution calibrator) for performing annual QA audits of continuous gas analyzers.

4. Page 12: We note the listed network changes between July, 2017 and June, 2018 (in italics below),

Proposed Changes July 2017 to June 2018 Air Monitoring Network

The Vermont AQCD network changes, additions and deletions that are planned for the next 12 months of July 2017-June 2018 are:

- 1. Procure four (4) TAPI T-640 Continuous PM2.5 FEM monitors to replace the TEOMs at the Bennington, Burlington Main Street, and Underhill sites, and the BAM at the Rutland site. (Purchase Requisition completed/approved on May 22, 2017)*
- 2. Once TAPI-640 monitors are installed at all network sites, Burlington Main Street TEI 2025i will be configured from PM2.5 to PM10 (Summer 2017).*
- 3. Install new Agilair 8872 data logger at the Underhill NCore site (Summer 2017).*
- 4. Install new TAPI T703 as the ozone primary standard at the Berlin Field Operations Center (Summer 2017, Purchase Requisition completed/approved April, 2017).*
- 5. Install existing ozone primary standard (TAPI M703E) as the new ozone station standard at the Bennington Site. (Summer 2017).*
- 6. Procure a new ozone analyzer for the Underhill NCore site (Date TBD-Included in current EPA Grant Budget).*
- 7. Procure a new aethalometer (Black Carbon-EC/OC) for Rutland site (Date TBD-Included in current EPA Grant Budget).*
- 8. Procure the Agilair AgileWeb module for new public outreach AQCD website to present realtime AQCD monitoring data (Purchase Request completed/approved on May 22, 2017.)*
- 9. Begin developing a plan for an alternative space for the AQCD field operations center in the Central Vermont area.*

10. Continue developing a plan for relocation of the Burlington monitoring site. The Burlington Department of Planning and Zoning has provided notification that the current shelter will need to be relocated within 18-24 months due to a redevelopment project.

5. 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. VT AQCD is not requesting that any sites be excluded from comparison to the NAAQS in this annual network plan.

In light of the many planned changes to the PM_{2.5} network, we believe it would be beneficial to identify which monitors will be “primary,” and which will be utilized for quality assurance colocation purposes.

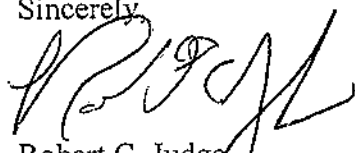
6. Page 21: PM₁₀ Monitoring Network, what will be the PM₁₀ sampling schedule for Burlington once the TAPI T-640 is installed? Also, relative to the discussion of lead by PM₁₀, be aware that ICP/MS methods have been approved for NAAQS compliance purposes.
<https://www3.epa.gov/ttn/amtic/files/ambient/criteria/AMTIC%20List%20Dec%202016-2.pdf>

7. Pages 14, 15, 19, 23, 24, and 25. EPA expects to release design values for all criteria pollutants in July, 2017 which includes 2016 data for the entire country. We will work with you to ensure the design values represented here are consistent with those values.

Finally, 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. In addition, as part of the Region 1 monitoring collaborative, EPA has identified several cost saving opportunities that Vermont may wish to consider.

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
Air Monitoring Coordinator
Office of Environmental Measurement and Evaluation
EPA-New England