Vermont Annual Air Monitoring Network Plan
2014

Vermont Department of Environmental Conservation
Air Quality & Climate Division
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Table of Contents

Section	Page Number
Table of Contents	2
List of Figures	3
List of Tables	4
Acronyms and Abbreviations	5
Introduction	6
Vermont Air Monitoring Network Plan Overview	6
VT AQCD Air Monitoring Program Overview	7
The Federal EPA National Ambient Air Quality Standards	8
Network Changes July 2013 to July 2014 Air Monitoring Network Changes	10
Proposed Changes July 2014 to July 2015 Air Monitoring Network	10
Site Description: Burlington - 150 South Winooski Ave.	28
Site Description: Burlington – 108 Cherry Street	30
Site Description: Lye Brook - West Dover – Mount Snow	32
Site Description: Bennington – Airport Road	34
Site Description: Underhill – 58 Harvey Road	36
Site Description: Rutland – 96 State Street	38
Appendix A – List of Analytes for Analytical Methods	40
Appendix B – National Ambient Air Quality Standards	44
References	45

List of Figures

Figure ID **Page Number**

Figure 1 - Vermont Air Monitoring Network Plan Map 11
Figure 2 2011 - 2013 Bennington Comparative Assessment 16
Figure 3 2012 -2013 Rutland Comparative Assessment 17
Figure 4 2013 Burlington Comparative Assessment 18
Figure 5 Underhill 2011-2013 Comparative Assessment 19
Figure 6 - Burlington Aerial Photo 29
Figure 7 - Burlington Monitoring Shelter 29
Figure 8 - Burlington Aerial Photo 31
Figure 9 - Zampieri Building Sampling Platform 31
Figure 10 - Aerial View Mount Snow 33
Figure 11 - View of Monitor Location 33
Figure 12 - Aerial View Bennington 35
Figure 13 - Bennington Trailer 35
Figure 14 - Aerial View Underhill 37
Figure 15 - Underhill Sampling Deck & Trailer 37
Figure 16 - Aerial View Rutland 39
Figure 17 - Rutland Trailer 39

List of Tables

Table ID **Page Number**

Table 1 - $PM_{2.5}$ Sample/Analysis Method 12
Table 2- $PM_{2.5}$ Annual Design Value 12
Table 3 - $PM_{2.5}$ 2013 Daily Design Value 13
Table 4– Speciation Sample/Analysis Method 14
Table 5 - Continuous $PM_{2.5}$ Method 20
Table 6 – Aethalometer Monitoring Method 20
Table 7 – Ozone Monitoring Method 21
Table 8 - Ozone 8 Hour 2013 Design Values 21
Table 9- Ambient Air Toxic Sampling/Analysis Methods 22
Table 10 – PM_{10} Sample/Analysis Method 23
Table 11– Nitrogen Dioxide Monitoring Method 24
Table 12 – Nitrogen Dioxide 2013 1- Hr Design Values 24
Table 13 – Nitrogen Dioxide 2013 Annual Average 24
Table 14– Carbon Monoxide Monitoring Method 25
Table 15 – Carbon Monoxide Design Value 2013 25
Table 16– Sulfur Dioxide Monitoring Method 26
Table 17 – Sulfur Dioxide Design Values 2013 26
Table 18 - Network Pollutant Monitoring By Location 27
Table 19 – Elemental Metals Analytes for PM_{10} (47 mm Teflon;ERG:2014) 41
Table 20 – List of Analytes for Speciation Sampling 41
Table 21- List of Carbonyl Analytes (2014) 41
Table 22 - Analyte List for VOC Analysis (VT DEC:2014) 42
Table 23 - Analyte List for PAH Analysis (ERG: 2014) 43

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
ESC - Environmental Systems Corporation
FDMS – Filter Dynamic Measurement System
FEM - Federal Equivalent Method
FRM - Federal Reference Method
GIS - geographical information systems
HAP - hazardous air pollutants
HAAS – Hazardous Ambient Air Standard
IC – Ion Chromatography
IO - inorganic
MQOs - measurement quality objectives
MPA - monitoring planning area
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
NECMSA - New England county metropolitan statistical area
NOX – Oxides of Nitrogen
NOy - sum of the individual reactive nitrogen oxide species
NO2 – Nitrogen Dioxide
O3 - Ozone
OAQPS - Office of Air Quality Planning and Standards
PIXE- Proton Induced X-ray Emission
PMSA - primary metropolitan statistical area
PM_{10} – Particulate ≤10 micron aerodynamic particle size
$PM_{2.5}$ - Particulate ≤2.5 micron aerodynamic particle size
PAH – Polycyclic Aromatic Hydrocarbon
QA - quality assurance
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
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
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, 2014 an air monitoring network plan for the State of Vermont. The regulation requires that the plan be posted for public comment 30 days prior to submission to the EPA Region 1 Office.

The current air monitoring network plan will be made available to the public on the AQCD's website, http://www.anr.state.vt.us/air/index.htm for the 30-day comment period.

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 Department of Environmental Conservation (DEC), which is one of three departments within the Vermont Agency of Natural Resources. The mission of the AQCD implements Clean Air Acts 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 and 40 CFR Parts 50, 53, 58, and State of Vermont Statute 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, the 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 brief annual Vermont "NAAQS Design Values" summary data where applicable, and what some of the major activities and changes are 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, 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. Control strategies and equipment applied to industry greatly reduced the particulate, CO, SO_2, and NO_2 emitted into the ambient air. 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 nitrogen dioxide (NO_2), carbon monoxide (CO) and volatile organic compounds (VOC's). 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 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 carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and ozone (O_3). 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 operates and maintains five permanent air monitoring stations. 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 6 criteria pollutants and 92 toxic pollutants. All current air monitoring sites meet the federal requirements for site development. The criteria pollutant monitoring methods utilized by the VT AQCD are EPA compliant as federal reference methods (FRM), or federal equivalent methods (FEM) designated instruments.

All EPA CAA §105 & §103 grants agreements that VT AQCD enters into for ambient air monitoring efforts, require a Quality Assurance Project Plans (QAPP), an annual Work Plan, and Standard Operating Procedures (SOP's). These documents are reviewed annually, and a review summary and document updates are submitted to EPA by November 1st each year. The AQCD QAPP and SOP for Criteria Pollutants, Air Toxics (NATTS), and $PM_{2.5}$ monitoring programs have received initial EPA approval. The annual QAPP updates and SOP updates for a number of monitoring program elements are still pending and need EPA approval. The Meteorological QAPP must still be finalized, submitted, and approved by EPA.

The Federal EPA National Ambient Air Quality Standards

The Clean Air Act, of 1990, requires EPA to set National Ambient Air Quality Standards (40 CFR part 50) for pollutants that are deemed harmful to public health and the environment. The Clean Air Act presents two types of national ambient air quality standards. 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 National Ambient Air Quality Standards for six principal pollutants, which are called "criteria" pollutants. They are also 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, and micrograms per cubic meter of air (µg/m3).

On December 16, 2006, the EPA reduced the daily $PM_{2.5}$ (NAAQS) from 65 µg/m^3 to 35 µg/m^3. The annual $PM_{2.5}$ NAAQS remained 15µg/m^3. Vermont operates a small network of Federal Reference Monitors (FRM) as well as Federal Equivalent Monitors (FEM) for continuous $PM_{2.5}$ to assess air quality for $PM_{2.5}$.

On Dec 12, 2012, the EPA set the PM2.5 "Primary" Annual $PM_{2.5}$ standard to 12 ug/m3 with the "Secondary set at 15 ug/m3. This annual $PM_{2.5}$ average will be computed as the average of the last of a three year period. As an example: The average for 2012 would be the annual averages from 2010, 2011, and 2012. On January 15, 2013 EPA revised the $PM_{2.5}$ standard EPA established that all continuous PM2.5 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, regulation update, addressed the creation of multi-pollutant National Core Sites (NCore) sites 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 the 20 rural sites within the NCore network. The upgrades to the site required the addition of "trace level" monitoring for Carbon Monoxide (CO), Nitrogen Oxides (NOy), and Sulfur Dioxide (SO2).

On November 12, 2008, the new national ambient air quality standard (NAAQS) for lead was strengthened to 0.15 micrograms per cubic meter. The primary standard and secondary standard are set at the same level. 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 the State of Vermont does not meet the regulation requirements with regard to the population thresholds for the CBSA's, 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 ambient lead air 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 (Pb included) analysis. EPA will propose action on the Lead NAAQS in 2014 with final promulgation in 2015.

The March 27, 2008 8-Hour Ozone NAAQS of 8 hour primary standard of 0.075 parts per million was adopted. Vermont currently is in compliance with this NAAQS standard. EPA Region 1 has recommended that Vermont consider a new ozone monitoring station in the central part of Vermont to better define ozone spatial and temporal occurrence. The new proposed Ozone NAAQS should be reviewed and re-promulgated by Oct 1, 2015

On January 22, 2010, the final rule for Nitrogen Dioxide (NO2) NAAQS for was adopted. The new NO_2 NAAQS for 1-hour is based on the 3 year average, of the 98th percentile, of the 1-hr daily maximum. The 1- hr NAAQS value was set at 100 parts per billion. EPA in cooperation with States/Local/Tribe agencies will set up 40 NO_2 monitors nationwide to help protect communities that are susceptible to NO_2 health effects. EPA does not anticipate any requires affecting Vermont. Vermont currently is not be required by EPA under this rule to set up any additional NO_2 monitors or require consideration of a "near roadway" site in the network other than what is currently being operated in Burlington and Rutland or elsewhere in the state of Vermont.

On June 2, 2010 the Sulfur Dioxide NAAQS was updated and the new 1 Hour Sulfur Dioxide (SO_2 **)** NAAQS was adopted. EPA strengthened the primary NAAQS for sulfur dioxide by establishing a new 1 hour standard level set at 0.075 ppm. The new design value form 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 the annual standard (30 ppb). The 2010 State recommended designation design value for Vermont NAAQS SO_2 uses 2008, 2009, and 2010 SO_2 summary data. Vermont currently is not required under the new rule to set up additional SO_2 monitors in the network above and beyond what is currently being operated in Rutland. EPA has initiated a stakeholder process to refine the implementation the SO2 monitoring and modeling requirements. On April 17, 2014, EPA proposed the Data Requirements Rule for the 1-Hour Sulfur Dioxide Primary National Ambient Air Quality Standard (NAAQS) detailing modeling and monitoring guidance for implementing the SO2 standard. The outcome of this process may require greater reliance on new or existing SO2 monitoring.

Network Changes July 2013 to July 2014 Air Monitoring Network Changes

The Vermont AQCD network changes, additions, and deletions that were planned for the 12 month period of July 2012-June 2013 were:

1. Switch data acquisition to new AirVision August 2013
2. Install new Rutland Trailer – August 2013
3. Provide EPA with assessment of FEM continuous versus FRM historical $PM_{2.5}$ comparison data. Decision of use for FEM continuous $PM_{2.5}$ samplers for NAAQS determinations will be provided.
4. Terminate Hexavalent Chromium sampling in Underhill – NATTS July 2013
5. Re-establish $PM_{2.5}$ weighing services August 2013
6. Rebuild Underhill platform – Sept 2013
7. Reestablish TO-11A analytical work with DEC Laboratory in Burlington, VT
8. Reestablish TO-15 analytical work with DEC Laboratory in Burlington, VT
9. Develop IO 3.5 analytical plan for low-volume PM10 (Underhill, Burlington, Rutland).
10. Work with DEC laboratory advisory group to formulate long term plan for DEC laboratory services.
11. New roof on Burlington Zampieri building and samplers must shut down for 3-6 days in July or August. Flagging of samples during 6 week period of project.
12. Development of new AQCD real-time website to accommodate new data format of Air Vision.
13. Improve Air Quality alert system on AQCD website.

Proposed Changes July 2014 to July 2015 Air Monitoring Network

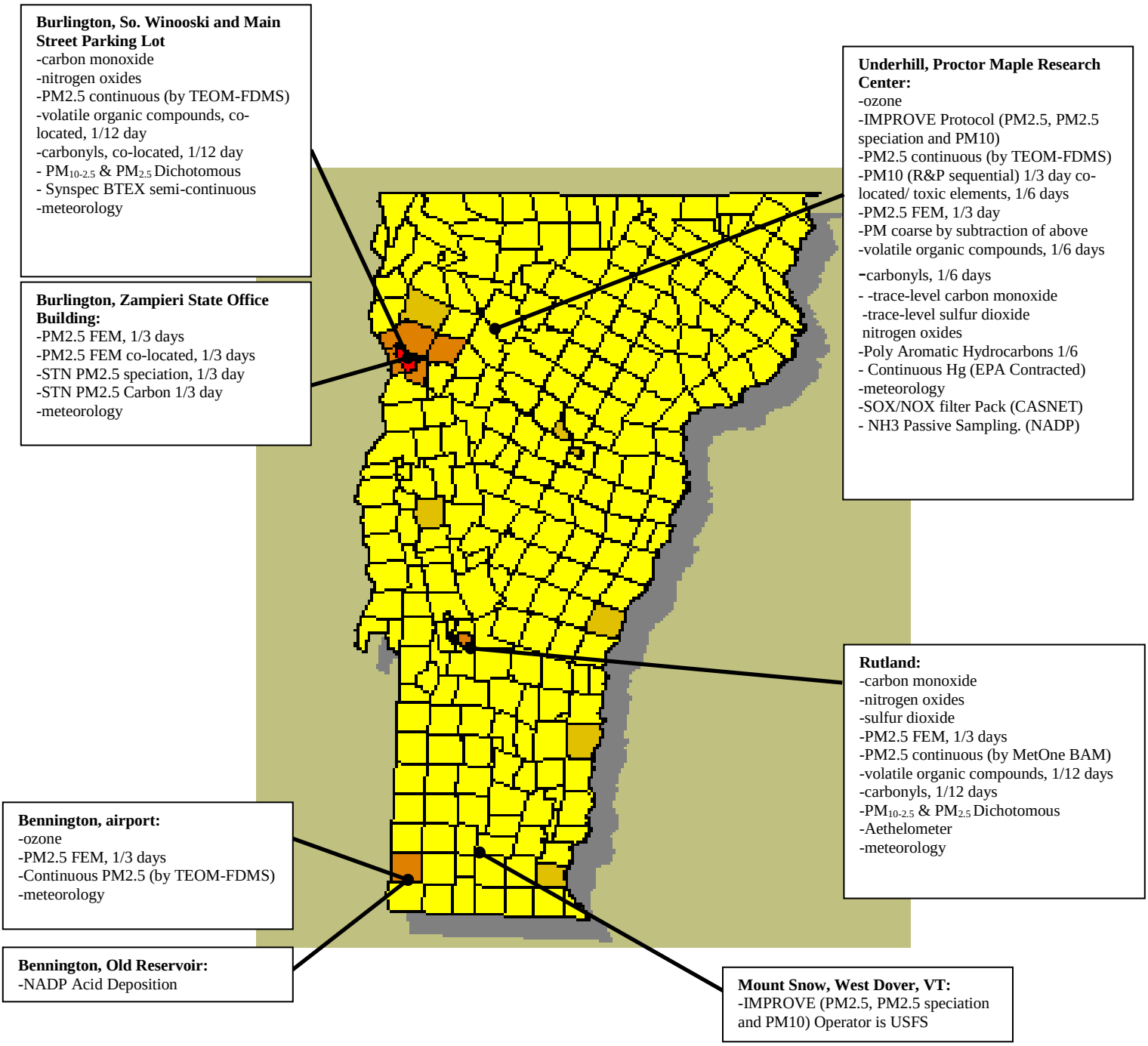
The Vermont AQCD network additions that are planned for the next 12 months of July 2014-June 2015 are:

1. Commence weighing PM2.5 and PM10 filters at Berlin Operations Facility.
2. Replacement of Underhill Air Monitoring Trailer.
3. Replacement of Bennington TEOM 1400/8500 with TEI 1405-F
4. Restart DEC Metals Air Monitoring Program in Burlington & Rutland.
5. All analytical analysis for VOC, Carbonyl compounds for NATTS and State Air Toxics performed by DEC Laboratory.
6. Remove sampling deck from Underhill. Current samplers on deck will be placed on the new trailer roof.
7. Procure backup trace level instrumentation.
8. Continue scheduled replacement of 2025i units.
9. Develop lab space design for new AGR/ANR laboratory.
10. Update site computes with AVTrend and retire Windows XP platforms.

2014 - Monitoring Site Network Map

Figure 1 - Vermont Air Monitoring Network Plan Map

2014 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.

$PM_{2.5}$ FRM Monitoring Network

The Vermont AQCD operates four $PM_{2.5}$ FRM sites. The monitoring locations are in Burlington, Bennington, Rutland and Underhill. The network samplers operate on a 1-in-3 day sampling schedule. The sampling method is an EPA approved method, collecting an integrated 24 hour particulate sample on a 47mm Teflon® filter disc (See Table 1). The particulate collected on the filter has an aerodynamic particle size of ≤2.5 microns. The filter and associated sampling data are post processed through gravimetric analysis to determine the mass concentration for the 24 hour sampling period.

Table 1 - $PM_{2.5}$ Sample/Analysis Method

Pollutant	Sampler	Collection	Analytical Method	Analytes /Lab
$PM_{2.5}$	R&P 2025 Manual Reference Method: EQPM–0202–145	Low Volume 47 mm Teflon® Filter - 24 Hour	Gravimetric	$PM_{2.5}$ VT DEC

"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 (2013)

$PM_{2.5}$ annual design values are calculated using the 3-year average of the respective annual averages (See Table 2). The current annual $PM_{2.5}$ NAAQS is 15µg/m^3.

Table 2- $PM_{2.5}$ Annual Design Value

Site	Design Value (µg/m^3) Years 2011-2013
Bennington	6.7*
Burlington	6.9*
Rutland	9.1*
Underhill	4.9*

**In August 2011, due to the flood destruction of the DEC Laboratory PM sampling was suspended for a month until Massachusetts DEP was online to accept VT filters for weighing. The 2011 data completeness rates were not met by rule and summaries reflect this condition.*

$PM_{2.5}$ Daily Design Value (2013)

Below are the current daily design values from $PM_{2.5}$ for 2013. $PM_{2.5}$ daily design values are calculated using the 3-year average of the annual 98th percentile values. As of 2006, the new more stringent daily $PM_{2.5}$ standard is 35 µg/m^3. Area $PM_{2.5}$ designations relative to the $PM_{2.5}$ daily standard were compiled based upon measured $PM_{2.5}$ data from 2011-2013. Currently, under the 2006 $PM_{2.5}$ NAAQS, all Vermont monitors are in attainment for both the annual and daily $PM_{2.5}$ standards.

Table 3 - $PM_{2.5}$ 2013 Daily Design Value

Site	Design Value (µg/m^3) Years 2011-2013
Bennington	19*
Burlington	22*
Rutland	29*
Underhill	15*

**In August 2011, due to the flood destruction of the DEC Laboratory PM sampling was suspended for a month until Massachusetts DEP was online to accept VT filters for weighing. The 2011 data completeness rates were not met by rule and summaries reflect this condition.*

$PM_{2.5}$ Speciation Monitoring Network

The Vermont AQCD operates two $PM_{2.5}$ speciation sites (See Table 4). These sites are located at Burlington-Zampiere and Underhill. The samplers operate on a 1-in-3 day schedule and produce a 24 hour integrated filter based sample. Both Underhill and Dover, VT - Mt. Snow-Lye Brook are part of the IMPROVE (Interagency Monitoring of Protected Visual Environments) network. The Dover, VT, Mt Snow - monitoring site listed in this document is operated and maintained by the National Forest Service (NFS) and is not part of the Vermont AQCD network plan. 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. 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 1/3 day schedule and is collocated with the current Met One SASS sampler.

Table 4– Speciation Sample/Analysis Method

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

Continuous $PM_{2.5}$ Monitoring Network

The Vermont AQCD operates four continuous $PM_{2.5}$ sites (See Table 5). At this time, the VT AQCD operates three Thermo Scientific TEOM® 1400a Ambient Particular Monitor with Series 8500C FDMS® and one MetOne BAM 1020. All four network samplers have received their Federal Equivalency Method (FEM) certification by EPA. The R&P Model 8500C FDMS TEOM is operated at the Bennington, Burlington, and Underhill sites. The MetOne 1020 FEM is operated at the Rutland site and was install in July of 2012. All continuous $PM_{2.5}$ samplers are operated year-round and have a collocated $PM_{2.5}$ FRM or FEM sampler for comparative analysis. Data is reported to 1-hour averaging periods. The data is currently used for $PM_{2.5}$ AQI determination and trends analysis.

40 CFR Part 58.11(e) provides that if the State agency operates continuous monitors with FEM certification in the network greater than 24 months, they must be report as regular $PM_{2.5}$ parameter AQS method code designation $PM_{2.5}$ LC 88101. VT AQCD must formally notify Region 1 EPA NE that the continuous $PM_{2.5}$ monitors will not be reported as NAAQS determination monitors (AQS Code 88101 $PM_{2.5}$ LC) until the annual and seasonal collocated datasets comply with the with the assessment show CFR Part 53 – Subpart C, Table C-4 designated control parameters.

The Bennington continuous $PM_{2.5}$ FEM monitors has been operated for over 24 months, however the monitor does not fall consistently within the assessment specifications, demonstrating proper correlation to FRM filter based samples. This fact alone has will prevent the State of Vermont AQCD from reporting continuous $PM_{2.5}$ results as $PM_{2.5}$ LC (88101) for NAAQS determination at the Bennington location. VT AQCD will switch out the monitor in September and replace with a TEI 1405-F $PM_{2.5}$ unit which has FEM certification. Starting in 2015 Vermont will report Bennington continuous monitor data as $PM_{2.5}$ LC (88101) in the EPA AQS system.

The Underhill $PM_{2.5}$ continuous monitor's overall performance has been acceptable, however the reported concentrations are very low due to the background nature of the site. AQCD agrees with EPA that the relatively low concentration contribute to the comparative assessment that is

less than acceptable however looking at the general comparisons of FRM and FEM data there is good agreement even at the low levels. Therefore starting in 2015 Vermont will report the continuous monitor data as $PM_{2.5}$ LC (88101) in the EPA AQS system.
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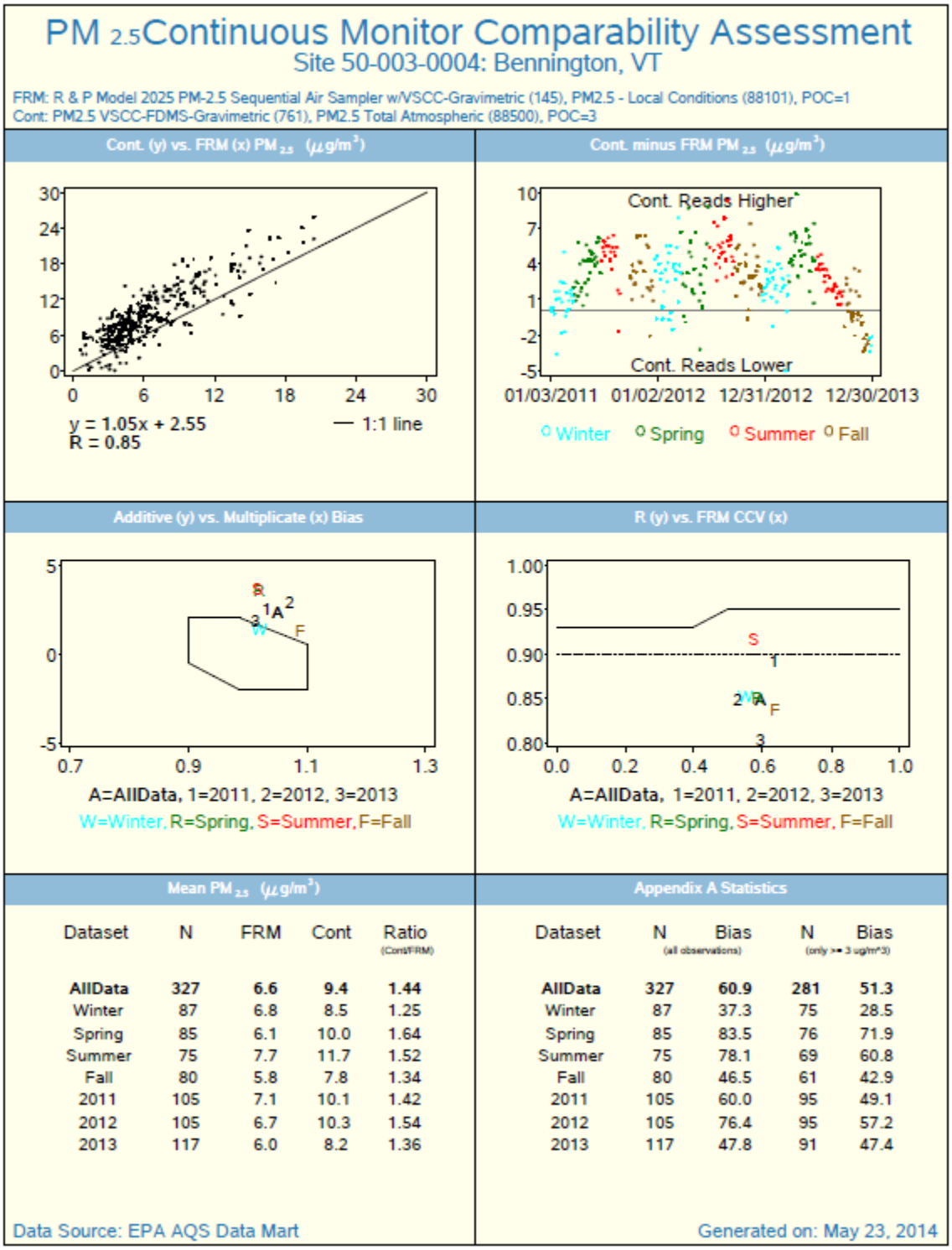
The Rutland continuous $PM_{2.5}$ monitor has been in operation greater than 24 months of operation. The monitor falls marginally within the assessment specifications, demonstrating proper correlation to FRM filter based samples. Therefore starting in 2014 the data will be reported as $PM_{2.5}$ LC 88101.

The Burlington continuous $PM_{2.5}$ FEM monitor now has a collocated FEM 2025iD dichot sampler on-site, as of Jan 1 2013. The data from this instrument will be reported as $PM_{2.5}$ LC 88101 in 2014. While the FEM 2025iD dichot is not an FRM, the current EPA tool does allow assessment to be completed and represents a similar assessment. 40 CFR 58.11 (e) does not recognize this comparison however is included here to provide the current comparative precision.

Vermont AQCD is required to provide EPA with an assessment (see Figures 2-5 below) of the FEM continuous data results compared to the collocated FRM data. The VT AQCD also evaluates continuous $PM_{2.5}$ sampling methods utilizing internal assessment method quarterly at all four current SLAMS and NCORE sites. All maintenance and QA/QC procedures, audits and sample handling have been performed as required.

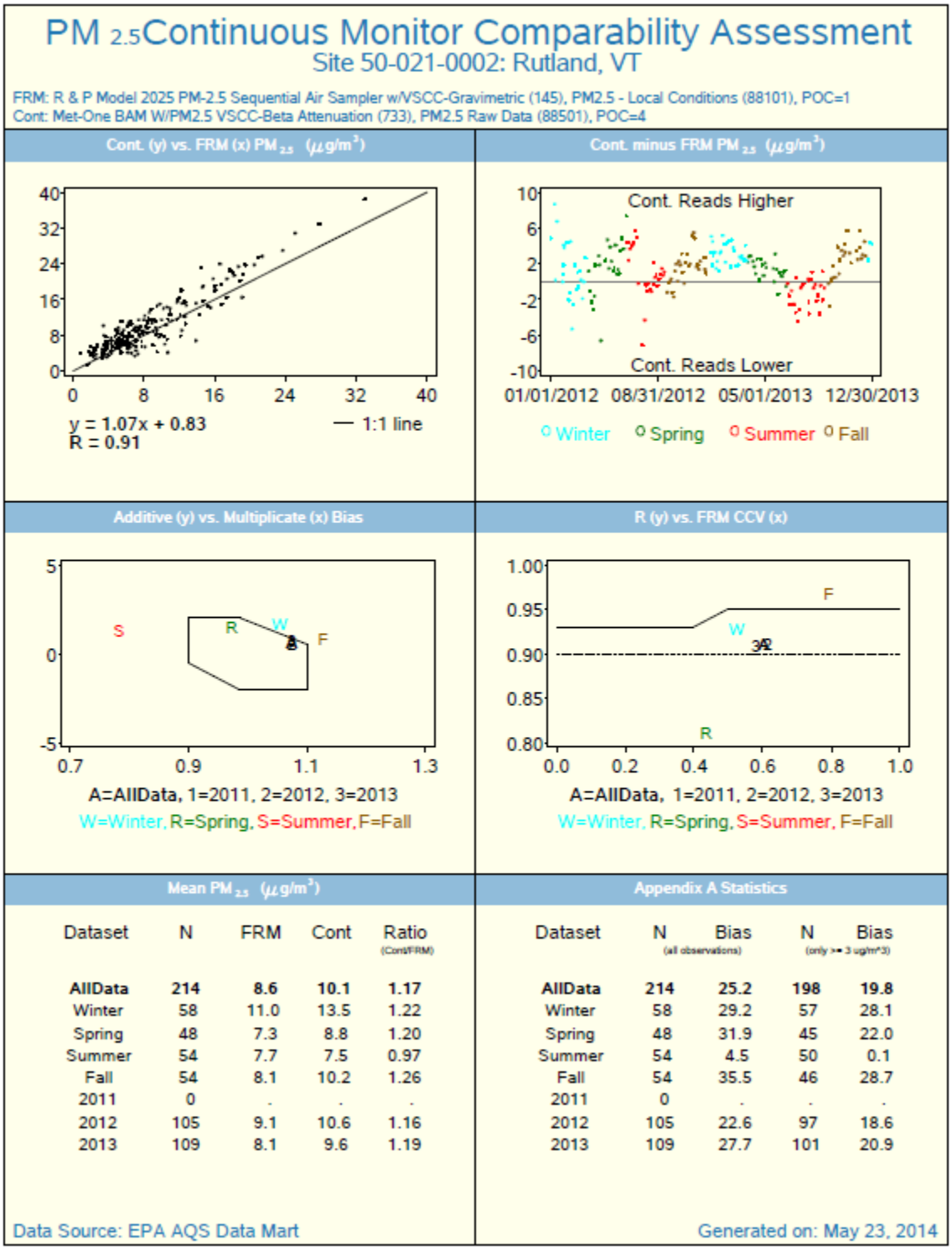
Figure 2 2011 - 2013 Bennington Comparative Assessment



Dataset	N	FRM	Cont	Ratio (Cont/FRM)
AllData	**327**	**6.6**	**9.4**	**1.44**
Winter	87	6.8	8.5	1.25
Spring	85	6.1	10.0	1.64
Summer	75	7.7	11.7	1.52
Fall	80	5.8	7.8	1.34
2011	105	7.1	10.1	1.42
2012	105	6.7	10.3	1.54
2013	117	6.0	8.2	1.36

Dataset	N (all observations)	Bias	N (only >= 3 ug/m^3)	Bias
AllData	**327**	**60.9**	**281**	**51.3**
Winter	87	37.3	75	28.5
Spring	85	83.5	76	71.9
Summer	75	78.1	69	60.8
Fall	80	46.5	61	42.9
2011	105	60.0	95	49.1
2012	105	76.4	95	57.2
2013	117	47.8	91	47.4

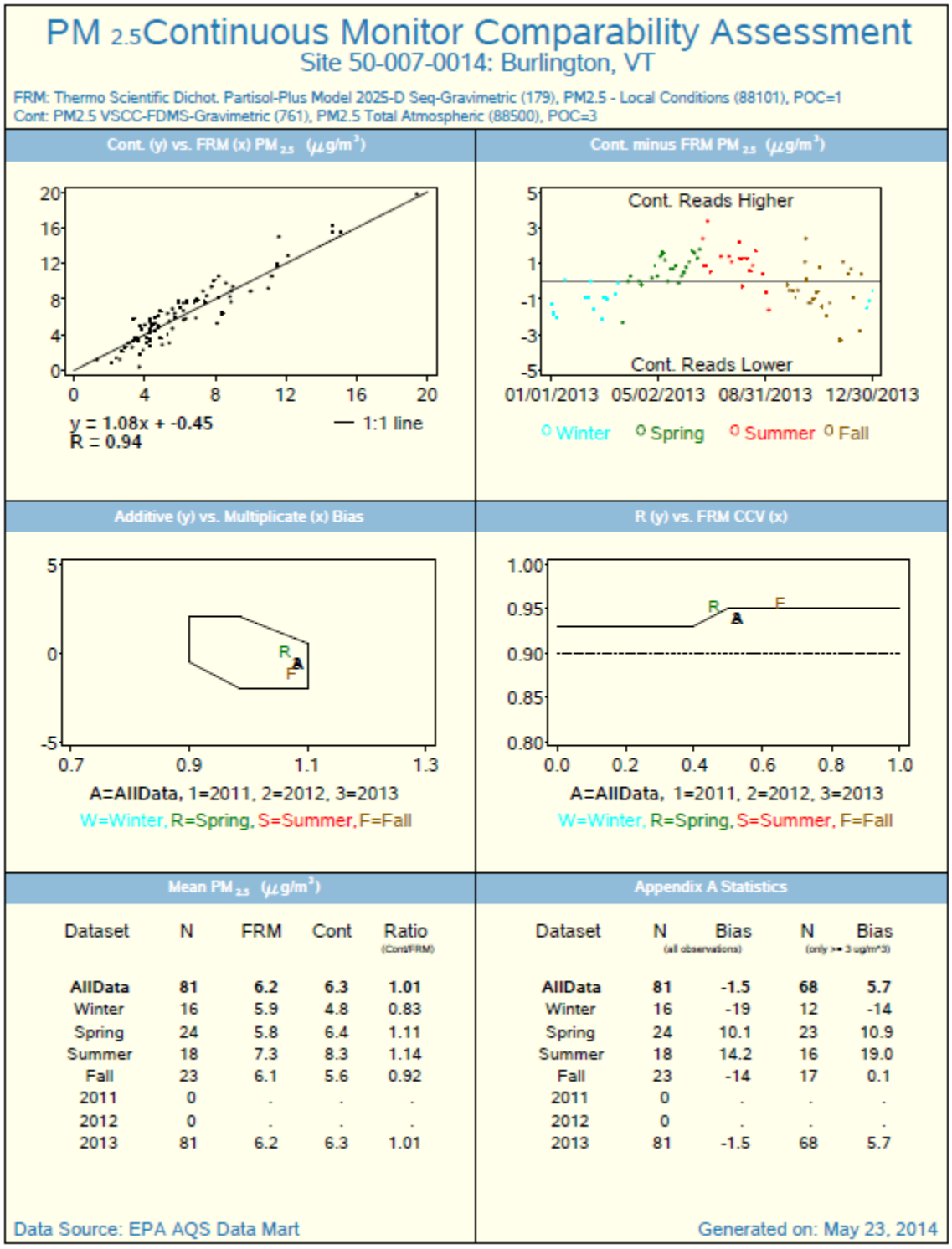
Figure 3 2012 -2013 Rutland Comparative Assessment



Dataset	N	FRM	Cont	Ratio (Cont/FRM)
AllData	**214**	**8.6**	**10.1**	**1.17**
Winter	58	11.0	13.5	1.22
Spring	48	7.3	8.8	1.20
Summer	54	7.7	7.5	0.97
Fall	54	8.1	10.2	1.26
2011	0	.	.	.
2012	105	9.1	10.6	1.16
2013	109	8.1	9.6	1.19

Dataset	N (all observations)	Bias	N (only >= 3 ug/m^3)	Bias
AllData	**214**	**25.2**	**198**	**19.8**
Winter	58	29.2	57	28.1
Spring	48	31.9	45	22.0
Summer	54	4.5	50	0.1
Fall	54	35.5	46	28.7
2011	0	.	.	.
2012	105	22.6	97	18.6
2013	109	27.7	101	20.9

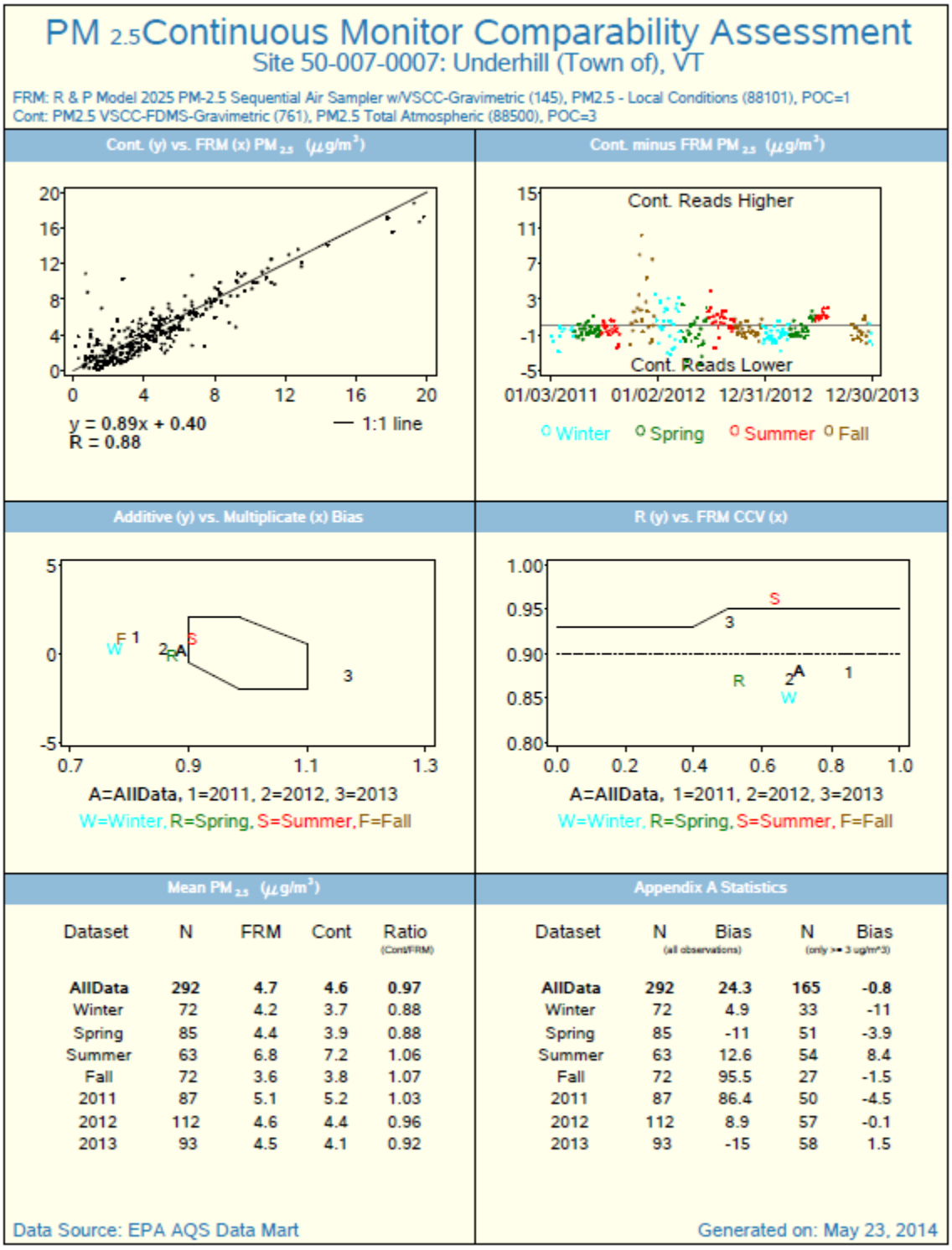
Figure 4 2013 Burlington Comparative Assessment



Dataset	N	FRM	Cont	Ratio (Cont/FRM)
AllData	**81**	**6.2**	**6.3**	**1.01**
Winter	16	5.9	4.8	0.83
Spring	24	5.8	6.4	1.11
Summer	18	7.3	8.3	1.14
Fall	23	6.1	5.6	0.92
2011	0	.	.	.
2012	0	.	.	.
2013	81	6.2	6.3	1.01

Dataset	N (all observations)	Bias	N (only >= 3 ug/m^3)	Bias
AllData	**81**	**-1.5**	**68**	**5.7**
Winter	16	-19	12	-14
Spring	24	10.1	23	10.9
Summer	18	14.2	16	19.0
Fall	23	-14	17	0.1
2011	0	.	.	.
2012	0	.	.	.
2013	81	-1.5	68	5.7

Figure 5 Underhill 2011-2013 Comparative Assessment



Dataset	N	FRM	Cont	Ratio (Cont/FRM)
AllData	**292**	**4.7**	**4.6**	**0.97**
Winter	72	4.2	3.7	0.88
Spring	85	4.4	3.9	0.88
Summer	63	6.8	7.2	1.06
Fall	72	3.6	3.8	1.07
2011	87	5.1	5.2	1.03
2012	112	4.6	4.4	0.96
2013	93	4.5	4.1	0.92

Dataset	N (all observations)	Bias	N (only >= 3 ug/m^3)	Bias
AllData	**292**	**24.3**	**165**	**-0.8**
Winter	72	4.9	33	-11
Spring	85	-11	51	-3.9
Summer	63	12.6	54	8.4
Fall	72	95.5	27	-1.5
2011	87	86.4	50	-4.5
2012	112	8.9	57	-0.1
2013	93	-15	58	1.5

Table 5 - Continuous $PM_{2.5}$ Method

Pollutant	Sampler	Collection	Analytical Method	Reported Data Interval / Location
$PM_{2.5}$	Thermo Scientific Model 8500 FDMS TEOM **EQPM-0609-181**	Low Volume Filter/ microbalance	Continuous gravimetric	1 Hour Bennington Burlington Underhill
$PM_{2.5}$	Thermo Scientific Model 1405F FDMS TEOM **EQPM-0609-181**	Low Volume Filter/ microbalance	Continuous gravimetric	1 Hour Not in Use
$PM_{2.5}$	MetOne BAM1020 **EQPM-0308-170**	Low Volume Filter/ microbalance	Continuous gravimetric	1 Hour Rutland

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 unit is currently located in Rutland and has been operational as of February 2009.

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 two ozone sites in the air monitoring network. Both ozone analyzers are operated year-round. Data is collected on an hourly basis. Ozone measurements are utilized to determine compliance with the 8-hour NAAQS. Data is transferred hourly to the EPA AIRNOW website for AQI mapping and air quality forecasting.

"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 sampling	Ultraviolet	1 Hour

Ozone Design Value (2011-2013)

Below are the current design values for ozone from 2011-2013 (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 current NAAQS 8-hour ozone standard is 0.075 ppm. Currently, all Vermont monitors are in attainment for ozone.

Table 8 - Ozone 8 Hour 2013 Design Values

Site	Design Value (PPM) Years 2011-2013
Bennington	.062
Underhill	.061

Ambient Air Toxics Monitoring Network

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

The air toxic sample collection and analysis program includes volatile organic compounds (VOC), carbonyl compounds, and elemental metals at all sites. In addition, the NATTS - Underhill site includes sampling for 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 BTEX compounds. See Table 9 below for the list of sampling methods and analytical methods. The list of target analytes for the sampling methods 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 SS Canister- 24 Hour (sub atmospheric)	TO-15 (GC/MS)	54 VOC Compounds ERG and/or VT DEC
Carbonyl	ATEC 2200	DNPH Cartridge- 24 Hour	TO-11A (HPLC)	4 Carbonyl Compounds VTDEC
Metals (Lead Included)	R&P 2025 PM10 Low-Volume	Teflon Filter- 24 Hour	IO-3.5 (ICP/MS)	11 Elements ERG and/or VT DEC
PAH	Tisch TE-1000	PUF/XAD- 24 Hour	TO-13 (GC/MS)	22 PAH Compounds ERG
Hexavalent Chromium (Terminated 6/27/13)	VT AQCD Cr+6 Sampler (based on ERG design)	Cellulose Filter- 24 Hour	Modified CARB 039 (Ion Chromatography)	1 Element ERG
BTEX	Synspec GC955 Series 600	Semi-Continuous 15 Minute	GC-PID	5 VOC Compounds

PM_{10} Monitoring Network

The Vermont AQCD operates three PM_{10} monitoring sites. The monitoring locations of these sites are Burlington, Rutland and Underhill. The network operates on a 1-in-3 day sampling schedule. The sampling method utilized for sample collection is 24 hour low volume sample collection, on a 47mm Telfon® filter (See Table 10 – PM_{10} 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 through gravimetric analysis to determine the mass concentration for the 24 hour sampling period. The gravimetric determination for concentration of PM_{10} is completed.

In Rutland and Burlington the AQCD has deployed the TEI 2025iD (dichotomous sampler) which provides $PM_{2.5}$ and PM_{coarse} , as well as PM_{10} concentration measurements. Data from these units was uploaded to AQS starting first quarter 2013. Due to various manufacturer firmware design issues the data capture was not acceptable for 2013. With the help from the vendor it is hoped that 2014 performance will improve.

In Underhill, two collocated low-volume R&P 2025 samplers are configured to collect PM_{10}. The sample is collected on a 47mm Teflon® filter. Subsequent gravimetric analysis is performed to determine the mass concentration. These filters are subsequently submitted for metals analysis to either EPA's contract laboratory ERG or the VT DEC laboratory. The metals analysis performed does include the element lead (Pb). This ICP/MS analytical method has received FEM approval for Lead NAAQS determination by EPA.

Table 10 – PM_{10} Sample/Analysis Method

Pollutant	Sampler	Collection	Analytical Method	Analytes /Lab
PM_{10}	TEI 2025iD **Manual Equivalent Method: EQPS-0311-198**	Low Volume 47 mm Teflon® Filter	Gravimetric	PM_{10} VT DEC
PM_{10}	R&P 2025 Manual Reference Method: **RFPS-1298-127**	Low Volume 47 mm Teflon® Filter	Gravimetric	PM_{10} VT DEC

Nitrogen Dioxide Monitoring Network

The Vermont AQCD operates two nitrogen oxide (NOx) analyzers which are presently located at the Burlington and Rutland monitoring sites. Ambient concentrations of both nitrogen dioxide and nitric oxide are determined by this continuous chemiluminescence method (See Table 11 – Nitrogen Dioxide Monitoring Method) The NOx samplers are operated year-round. Underhill NCore monitoring commenced fall of 2010 which includes NO_y trace level monitoring.

Table 11– Nitrogen Dioxide Monitoring Method

Pollutant	Sampler	Collection	Analytical Method	Reported Data Interval
Nitrogen Dioxide/Nitric Oxide	TEI 42C Automated Reference Method: RFNA-1289-074	Continuous sampling	Chemiluminescence	1 Hour
Nitrogen Dioxide/Nitric Oxide	Teledyne-API T200 Automated Reference Method: RFNA-1194-099	Continuous sampling	Chemiluminescence	1 Hour
NOy (TL)	Ecotech EC9841T Automated Reference Method: RFNA-1292-090	Continuous sampling	Chemiluminescence	1 Hour

Nitrogen Dioxide Design Value (2013)

Below are the current calculated 1-Hr & Annual design values for Nitrogen Dioxide from 2011-2013 (See Table 12 & 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 NO_2 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 2013 1- Hr Design Values

Site	Design Value (PPB) Years 2011-2013
Burlington	35
Rutland	37

Table 13 – Nitrogen Dioxide 2013 Annual Average

Site	2013 Design Value (PPB)
Burlington	6.5
Rutland	7.4

Carbon Monoxide Monitoring Network

The Vermont AQCD operates two CO analyzers located at the Burlington and Rutland monitoring sites. The CO samplers 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	Reported Data Interval
Carbon Monoxide	Teledyne-API Model T300 Automated Reference Method: RFCA-1093-093	Continuous sampling	Infra-red	1 Hour
Carbon Monoxide	TEI 48C Automated Reference Method: RFCA-0981-054	Continuous sampling	Infra-red	1 Hour
Carbon Monoxide (TL)	Ecotech EC9830 Automated Reference Method: RFCA-0992-088	Continuous sampling	Infra-red	1 Hour

Table 15 – Carbon Monoxide Design Value 2013

Site	2013 Design Value (CO PPM)
Burlington CO -1 Hour	1.6
Burlington CO -8 Hour	0.9
Rutland CO -1 Hour	2.9
Rutland CO -8 Hour	1.3
Underhill CO -1 Hour	0.54
Underhill CO -8 Hour	0.50

Sulfur Dioxide Monitoring Network

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

Table 16– Sulfur Dioxide Monitoring Method

Pollutant	Sampler	Collection	Analytical Method	Reported Data Interval
Sulfur Dioxide	TEI 43C Automated Equivalent Method: EQSA-0486-060	Continuous sampling	Pulsed Florescence	1 Hour
Sulfur Dioxide (TL)	TEI 43C – TL Automated Equivalent Method: EQSA-0486-060	Continuous sampling	Pulsed Florescence	1 Hour
Sulfur Dioxide	Teleydyne-API T100 Automated Equivalent Method: EQSA-0193-092	Continuous sampling	Pulsed Florescence	1 Hour

Table 17 – Sulfur Dioxide Design Values 2013

Site	Design Values (SO_2 PPB) Average of Years 2011-2013 1 Hour 99th Percentile Daily Max
Rutland – 1 Hour	18
Underhill – 1 Hour	4*

- **Design value for Underhill does not have full three years as required for proper calculation.**

Monitoring Site Parameter Information

Below in Table 16 is a list of all of the monitoring sites and parameters currently or proposed to be operated by the State of Vermont 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	Ozone	Sulfur Dioxide	Speciation (STN / IMPROVE)	BTEX	$PM_{2.5}$ FRM	$PM_{2.5}$ TEOM	PM_{10} FRM	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	✓	✓				✓		✓	x	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	
Burlington	108 Cherry Street					✓		✓							✓	✓	✓	✓	✓	✓	✓	
Dover	Mount Snow					✓																
Rutland	Merchants Row	✓	✓		✓			✓	✓	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Underhill	Harvey Road	✓	✓	✓	✓	✓		✓	✓	x	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓

P=Proposed T=Trace Level

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**		
	Burlington-South Burlington, VT Metropolitan NECTA		

Location	Site	Carbon Monoxide	Nitrogen Dioxide	Ozone	Sulfur Dioxide	Speciation (STN)	BTEX	$PM_{2.5}$ FEM	$PM_{2.5}$ TEOM	PM_{10} FRM (collo)	$PM_{10\text{-}2.5}$ Low Volume FEM	VOC (collocated)	Carbonyl (collocated)	Black Carbon	Wind Speed	Wind Direction	Temperature	Relative Humidity	Solar Radiation	Precipitation	Pressure
Burlington	**150 S. Winooski**	✓	✓				✓	✓	✓	**x**	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓

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 & NO_2 measurements is compliance and trends purposes. Historically, CO and NO_2 measurements at this site are well below the NAAQS. Monitoring for CO and NO_2 at this site continues to be operated into the future primarily for trends analysis. The objective of the PM_{10} monitoring is collect PM_{10} for 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. Continuous $PM_{2.5}$ is used for 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
- Fall 2012 replaced Wedding PM10 collocated samplers with 2025i Dichotomous sampler.

Figure 6 - Burlington Aerial Photo

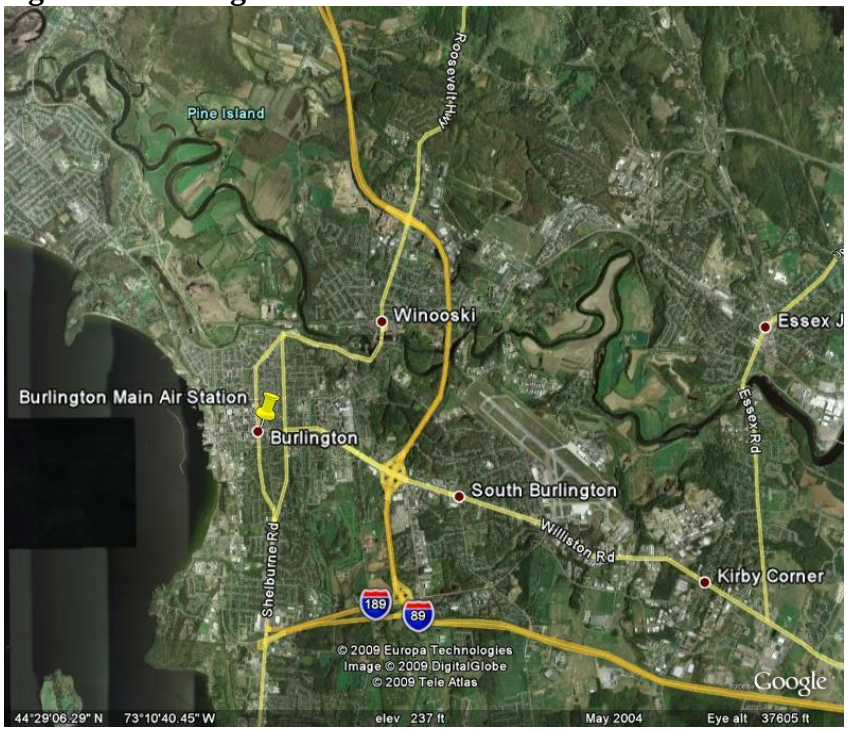


Figure 7 - Burlington Monitoring Shelter

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** **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.**					✓		✓							✓	✓	✓	✓	✓	✓	✓

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:

- Site established 1999

Figure 8 - Burlington Aerial Photo

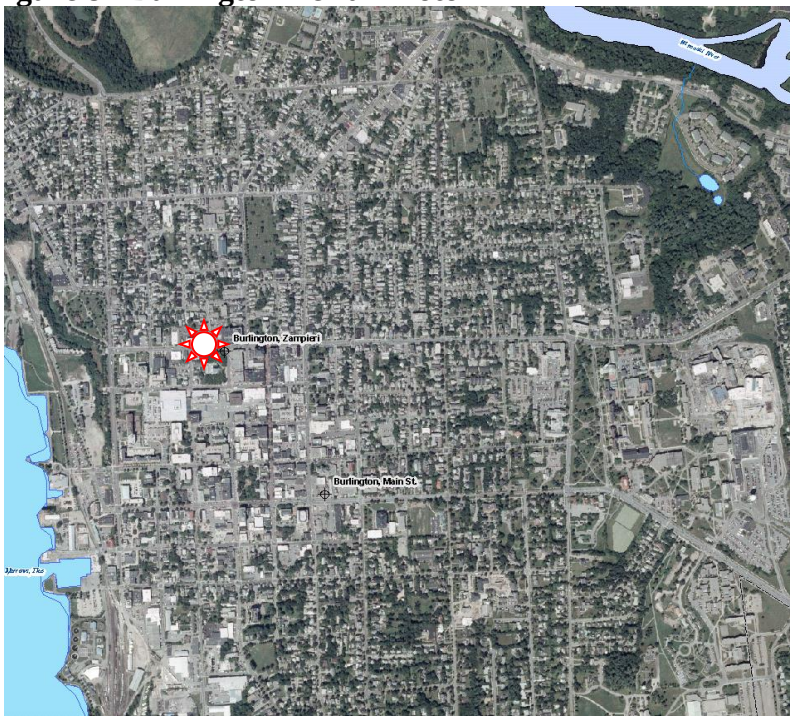
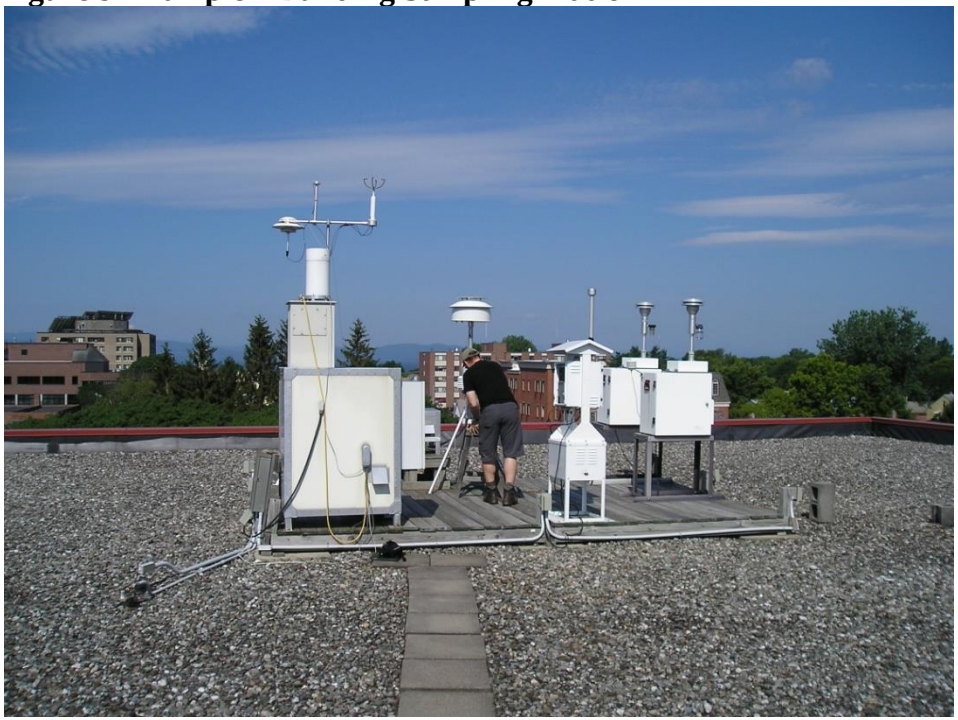


Figure 9 - Zampieri Building Sampling Platform



Site Description: Lye Brook - West Dover – Mount Snow

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

Location	**Site**	Carbon Monoxide	Nitrogen Dioxide	Ozone	Sulfur Dioxide	Speciation (STN)	Speciation (IMPROVE)	$PM_{2.5}$ FRM	$PM_{2.5}$ 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**						✓														

Site Description:

This monitoring location is not part of the Vermont AQCD monitoring network. The NFS 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. This site is operated and maintained by the National 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.

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 10 - Aerial View Mount Snow

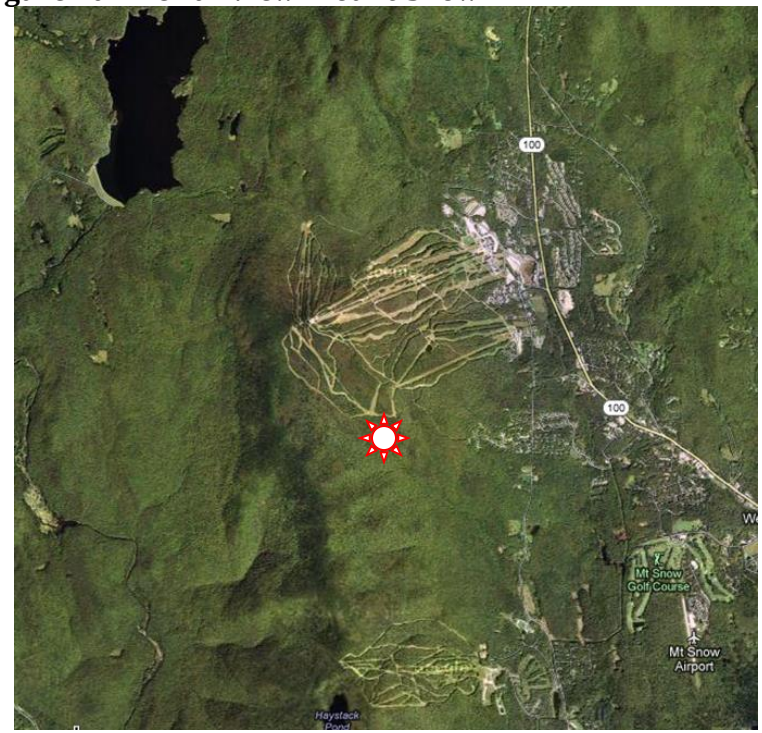


Figure 11 - View of Monitor Location

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 Area**		
	Bennington, VT Micropolitan 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
Bennington	**Airport Road**			✓				✓	✓						✓	✓	✓	✓	✓	✓	✓

Site Description:
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

General Monitoring Description & Objectives:
This monitoring objective for O_3 and $PM_{2.5}$ FRM 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

Figure 12 - Aerial View Bennington

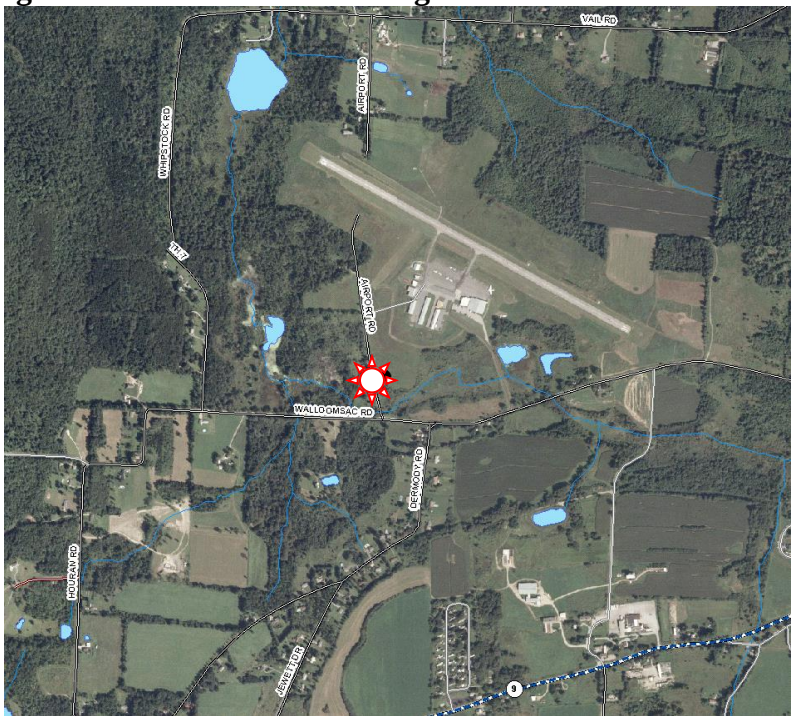


Figure 13 - Bennington Trailer

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 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} LV/Metals	VOC	TSP Cr^{+6} (terminated 6/27/13)	Carbonyl	PAH	Wind Speed	Wind Direction	Temperature	Relative Humidity	Solar Radiation	Precipitation	Pressure
Underhill	**56 Harvey Rd.**	✓	✓	✓	✓		✓	✓	✓	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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, metals, and CR^{+6} 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
- NCore upgrade CO, NOy, and SO2 continuous monitoring started 4th Quarter 2010.

Figure 14 - Aerial View Underhill

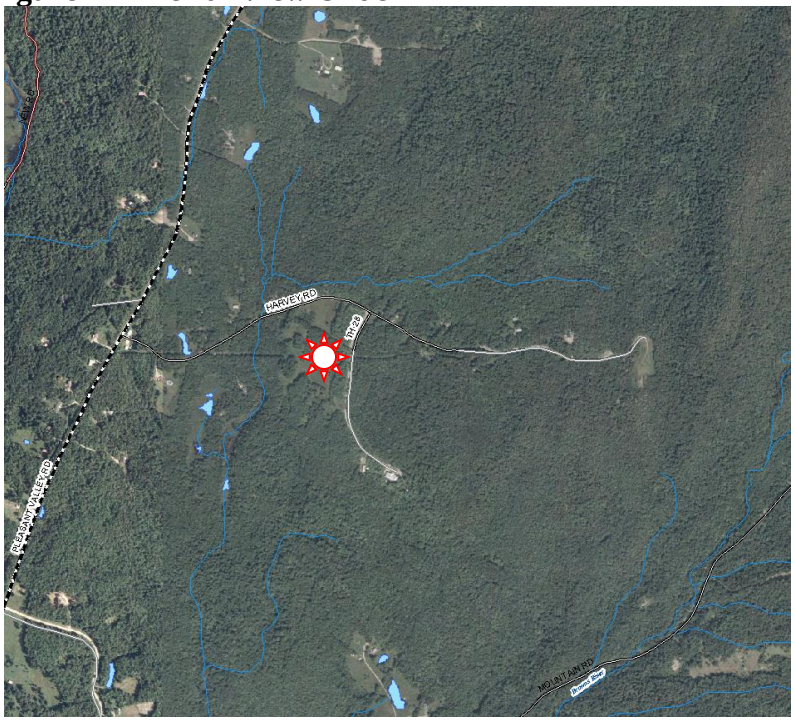


Figure 15 - Underhill Sampling Deck & Trailer

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 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	$PM_{10-2.5}$ Low Volume	VOC	Carbonyl	Black Carbon	Wind Speed	Wind Direction	Temperature	Relative Humidty	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 mail service 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 ($PM_{10-2.5}$ & $PM_{2.5}$) unit.

Figure 16 - Aerial View Rutland

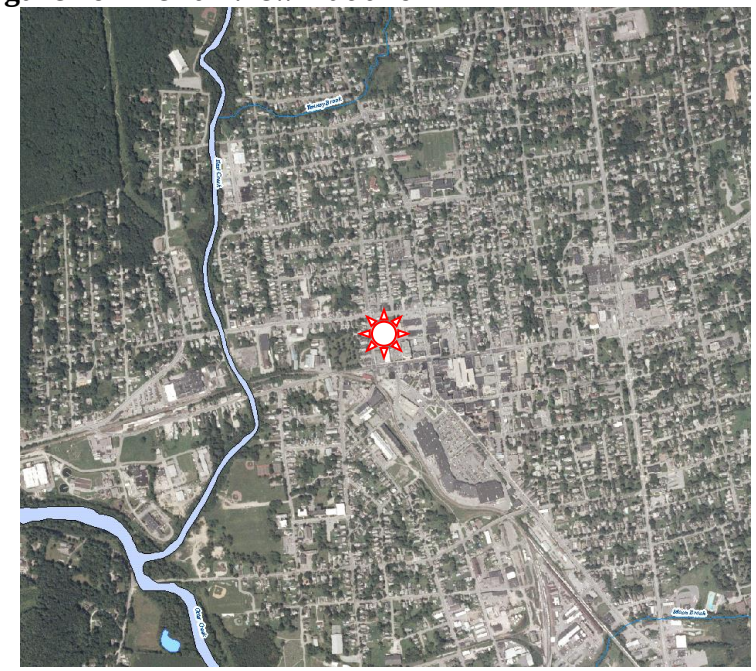


Figure 17 - Rutland Trailer

Appendix A – List of Analytes for Analytical Methods

Table 19 – Elemental Metals Analytes for PM_{10} (47 mm Teflon;ERG:2014)

Metal	MDL (ng/m^3)*	Metal	MDL (ng/m^3)*
Antimony	0.047	**Lead**	0.10
Arsenic	0.20	**Manganese**	0..14
Beryllium	0.016	**Mercury**	0.025
Cadmium	0.014	**Nickel**	0.25
Chromium	17	**Selenium**	0.30
Cobalt	0.023	**Chromium^{+6}****	0.0038

*ERG analysis; assumes 24.04 m^3 except for ** Cr^{+6} suspended on 6/27/13

Table 20 – List of Analytes for Speciation Sampling

Analysis	Analytes	MDL
Gravimetric	**Mass**	**300 ng/m^3**
HIPS	**Optical Absorption**	**0.2 Mm^{-1}**
XRF	**Elements Fe to Pb**	**0.05 - 0.18 ng/m^3**
PIXE	**Elements S to Mn**	**1 - 4 ng/m^3**
	Element Na	**20 ng/m^3**
PESA	**Elemental H**	**4 ng/m^3**
IC	**NO_3, SO_4, NH_4**	**10 - 30 ng/m^3**
	NO_2, Cl	**60 - 100 ng/m^3**
TOR	**Organic Carbon**	**250 ng/m^3**
	Elemental Carbon	**100 ng/m^3**

Table 21- List of Carbonyl Analytes (2014)

Carbonyl Compound	VT DEC MDL ($\mu g/m^3$)*	ERG MDL ($\mu g/m^3$)**
Formaldehyde	**0.017**	**0.014**
Acetaldehyde	**0.002**	**0.013**
Acetone	**0.008**	**0.036**
Propionaldehyde	**0.006**	**0.008**

*: assumes 1.294m^3 total sample volume **: assumes 1000 L total sample volume

Table 22 - Analyte List for VOC Analysis (VT DEC:2014)

VOC Compound	MDL (µg/m^3)
1,1,1-Trichloroethane	0.091
1,1,2,2-Tetrachloroethane	0.246
1,1,2-Trichloroethane	0.057
1,1-Dichloroethane	0.054
1,1-Dichloroethene	0.043
1,2,4-Trichlorobenzene	0.082
1,2,4-Trimethylbenzene	0.054
1,2-Dibromoethane	0.085
1,2-Dichloroethane	0.046
1,2-Dichloropropane	0.142
1,3,5-Trimethylbenzene	0.232
1,3-Butadiene	0.027
Acrolein*	0.032
Acrylonitrile	0.024
Benzene	0.04
Bromochloromethane	0.061
Bromodichloromethane	0.099
Bromoform	0.123
Bromomethane	0.048
Carbon Tetrachloride	0.100
Chlorobenzene	0.071
Chloroethane	0.036
Chloroform	0.076
Chloromethane	0.031
Chloroprene	0.069
cis-1,2-Dichloroethylene	0.064
cis-1,3-Dichloropropene	0.060
Dibromochloromethane	0.143
Dichlorodifluoromethane	0.075
Dichlorotetrafluoroethane	0..132
Ethyl Acrylate	0.064
Ethyl tert-Butyl Ether	0.056
Ethylbenzene	0.062
Hexachloro-1,3-butadiene	0.187
m,p-Xylene	0.071
m-Dichlorobenzene	0.113
Methyl Isobutyl Ketone	0.063
Methyl Methacrylate	0.072
Methyl tert-Butyl Ether	0.060
Methylene Chloride	0.042
n-Octane	0.065
o-Dichlorobenzene	0.107
o-Xylene	0.075
p- Dichlorobenzene	0.172
Styrene	0.076
tert-Amyl Methyl Ether	0.108
Tetrachloroethylene	0.108
Toluene	0.072
trans-1,2-Dichloroethy...	0.072
trans-1,3-Dichloropropene	0.106
Trichloroethylene	0.125
Trichlorofluoromethane	0.132
Trichlorotrifluoroethane	0.184
Vinyl Chloride	0.073

Note: 3-chloropropene, chloromethylbenzene and methyl ethyl ketone have been removed from this table as they are not on ERG's VOC target list

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

Table 23 - Analyte List for PAH Analysis (ERG: 2014)

PAH Compounds	ng/m^3
Naphthalene	0.207
Acenaphthylene	0.039
Acenaphthene	0.038
Fluorene	0.052
9-Fluorenone	0.054
Fluoranthene	0.044
Pyrene	0.047
Phenanthrene	0.040
Anthracene	0.027
Retene	0.095
Benz(a)anthracene	0.076
Cyclopenta(c,d)pyrene	0.038
Chrysene	0.023
Benzo(b)fluoranthene	0.040
Benzo(k)fluoranthene	0.050
Benzo(e)pyrene	0.051
Benzo(a)pyrene	0.051
Perylene	0.036
Indeno(1,2,3-cd)pyrene	0.033
Dibenz(a,h)anthracene	0.037
Benzo(g,h,i)perylene	0.036
Coronene	0.049

Appendix B – National Ambient Air Quality Standards

As of December 2014

Pollutant [final rule cite]		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide [76 FR 54294, Aug 31, 2011]		primary	8-hour	9 ppm	Not to be exceeded more than once per year
			1-hour	35 ppm	
Lead [73 FR 66964, Nov 12, 2008]		primary and secondary	Rolling 3 month average	0.15 μg/m^3 (1)	Not to be exceeded
Nitrogen Dioxide [75 FR 6474, Feb 9, 2010] [61 FR 52852, Oct 8, 1996]		primary	1-hour	100 ppb	98th percentile, averaged over 3 years
		primary and secondary	Annual	53 ppb (2)	Annual Mean
Ozone [73 FR 16436, Mar 27, 2008]		primary and secondary	8-hour	0.075 ppm (3)	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particle Pollution Dec 14, 2012	$PM_{2.5}$	primary	Annual	12 μg/m^3	annual mean, averaged over 3 years
		secondary	Annual	15 μg/m^3	annual mean, averaged over 3 years
		primary and secondary	24-hour	35 μg/m^3	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24-hour	150 μg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide [75 FR 35520, Jun 22, 2010] [38 FR 25678, Sept 14, 1973]		primary	1-hour	75 ppb (4)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

(1) Final rule signed October 15, 2008. The 1978 lead standard (1.5 μg/m3 as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

(2) The official level of the annual NO2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.

(3) Final rule signed March 12, 2008. The 1997 ozone standard (0.08 ppm, annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years) and related implementation rules remain in place. In 1997, EPA revoked the 1-hour ozone standard (0.12 ppm, not to be exceeded more than once per year) in all areas, although some areas have continued obligations under that standard ("anti-backsliding"). The 1-hour ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is less than or equal to 1.

(4) Final rule signed June 2, 2010. The 1971 annual and 24-hour SO2 standards were revoked in that same rulemaking. However, these standards remain in effect until one year after an area is designated for the 2010 standard, except in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.

*For current changes that may not be reflect tin the above NAAQS table please visit http://epa.gov/air/criteria.html

References

1. United States Environmental Protection Agency Air and Radiation - National Ambient Air Quality Standards (NAAQS) October 1, 2011 http://epa.gov/air/criteria.html

2. State of Vermont, Agency of Natural Resources, *Air Pollution Control Regulation; Appendix C*, July 5, 2014 http://www.anr.state.vt.us/air/docs/regs2014/AQCD Regulations 2014.pdf

3. United States Environmental Protection Agency, Technology Transfer Network, Ambient Monitoring Technology Information Center – *List of Designated EPA Reference and Equivalent Methods* Dec 18, 2014 http://www.epa.gov/ttn/amtic/criteria.html

4. Code of Federal Regulation, (e-CFR) 40 CFR Part 50, Protection of Environment, December 29, 2014.

5. Code of Federal Regulation, (e-CFR) 40 CFR Part 53, Protection of Environment, December 29, 2014.

6. Code of Federal Regulation, (e-CFR) 40 CFR Part 58, Protection of Environment, December 29, 2014.