PM ADVANCE

PATH FORWARD

for RUTLAND, VERMONT
(AND OTHER VALLEY AREAS
TO BE DETERMINED)

April 2018

VERMONT

DEPARTMENT OF
ENVIRONMENTAL CONSERVATION
AIR QUALITY AND CLIMATE
DIVISION

- This page intentionally left blank -

CONTENTS

LIST of FIGURES

LIST of TABLES

Report contact: Jeff Merrell (jeff.merrell@vermont.gov), Vermont Air Quality & Climate Division.

Cover photo: Rutland valley temperature inversion, from Killington Peak. Courtesy of Richard D. Mercier

1. PM ADVANCE: BACKGROUND & PURPOSE

1.1. PM Advance Program Description

Since 2013, the U.S. Environmental Protection Agency (EPA) has sponsored the PM Advance program as a voluntary, collaborative program to engage states, tribes, and local governments in proactively reducing emissions in attainment areas, and helping to ensure that local air quality continues to meet the National Ambient Air Quality Standards (NAAQS) for fine particulate matter ($PM_{2.5}$).[1] This adaptable partnership enables participants to set their own goals, and design an appropriate path forward in order to reach these goals. The Vermont Department of Environmental Conservation (DEC) Air Quality and Climate Division (AQCD) entered into a PM Advance partnership with EPA on March 31, 2016. This report is intended to initiate a path forward to improving air quality in areas of the state that have been prone to periodic elevated $PM_{2.5}$ concentrations. The areas for initial focus will include Rutland, Vermont (City and Town), and other appropriate valley locations as they are identified. The criteria used to select these priority areas are described later in this report.

1.2. Importance of Reducing Air Emissions and Ambient $PM_{2.5}$ Concentrations

Fine particulate matter, also known as $PM_{2.5,}$ is made up of tiny inhalable solid particles or liquid droplets having diameters 2.5 micrometers and smaller. By comparison, the diameter of a human hair is about 30 times larger than the largest fine particles. These small particles are produced and emitted as smoke or soot directly from burning materials such as wood and other fuels, or they may be resuspended into the air in the form of road, construction, or agricultural dust. Particulate matter is also formed secondarily in the atmosphere through complex chemical reactions involving other precursor air pollutants such as nitrogen dioxide (NO_2) and sulfur dioxide (SO_2) emitted from sources such as power plants, industrial facilities, mobile sources, and other combustion sources. These $PM_{2.5}$ precursor pollutants also react in the atmosphere to form nitric (HNO_3) and sulfuric (H_2SO_4) acids that form the acid precipitation, better known as acid rain, that has negatively impacted many of Vermont's aquatic and terrestrial ecosystems.[2]

Under the Clean Air Act, EPA is required to set health-based National Ambient Air Quality Standards (NAAQS) for particulate matter ($PM_{2.5}$ and PM_{10}), as well as for the other "criteria" air pollutants, which include ground-level ozone (O_3), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), and lead (Pb).[3] The NAAQS are reviewed periodically and updated to

[1] U.S. EPA PM Advance website: https://www.epa.gov/advance
[2] Acid Rain in the 21st Century: http://dec.vermont.gov/sites/dec/files/wsm/mapp/docs/AcidRainFactSheetTemplateC.pdf
[3] U.S. EPA Criteria Air Pollutants website: https://www.epa.gov/criteria-air-pollutants

make sure they incorporate the latest available scientific information, and adequately protect public health and welfare, with an adequate margin of safety. The serious negative health and environmental impacts caused by $PM_{2.5}$ emissions underscore the importance of ensuring that Vermont's air quality continues to improve and attain the NAAQS set by EPA.

Children, older adults, and people already suffering from lung or heart disease are the most likely to be negatively impacted by inhalation exposure to fine particles. Abundant scientific studies[4] point to the strong link between particle pollution and premature death, heart attacks or other cardiac impairments, worsened asthma, lung cancer, decreased lung function, irritation of the air passages, etc. In addition, a growing amount of scientific evidence suggest that fine particles may also enter the nose and travel through the olfactory bulb directly to the brain, resulting in plaque formation and other adverse impacts to the brain.[5] Even otherwise healthy people may experience temporary symptoms from fine particle exposure, such as irritation of the eyes, nose, and throat, shortness of breath, etc.

Fine particles in the atmosphere also cause increased scattering and absorption of light which can result in noticeably reduced visibility for distant objects, known as haze, when particle concentrations in the outdoor air become elevated.[6] These tiny particles can travel long distances on the wind, so hazy skies can be attributable to both local and distant pollution sources. Although progress in reducing haze has been made through various Clean Air Act programs, there still is more that can be done locally to help reduce the number days when Vermont's beautiful scenic vistas are shrouded in haze (Figure 1).[7]

Figure 1. Illustrated Spectrum of Visibility Impairment Conditions at Lye Brook Wilderness, VT (visibility of 150 miles on a clear day, left vs. visibility of approx. 6 miles on a hazy day, right).

[4] U.S. EPA Health and Environmental Effects of PM website: https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm

[5] The Polluted Brain. Underwood, Emily. January 27, 2017. Science 344 (6323). 342-345. http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia

[6] VERMONT STATE IMPLEMENTATION PLAN (SIP) REVISION REGIONAL HAZE, June 2009: http://dec.vermont.gov/sites/dec/files/documents/Vermont%20Haze%20SIP.pdf

[7] How Air Pollution Affects the View. U.S. EPA brochure: https://www.epa.gov/sites/production/files/2015-05/documents/haze_brochure_20060426.pdf

2. IDENTIFYING AREAS WITH ELEVATED $PM_{2.5}$

2.1. Vermont's PM Monitoring Efforts

The Vermont DEC Air Quality and Climate Division (AQCD) operates a statewide ambient air monitoring network for the measurement of the six common "criteria" pollutants, including particulate matter ($PM_{2.5}$ and PM_{10}), as well as for numerous air toxics compounds such as benzene, 1,3-butadiene, formaldehyde, acetaldehyde, toxic metals, etc. Meteorological parameters such as wind speed and wind direction, temperature, barometric pressure, precipitation, and solar radiation are also recorded. Monitoring sites within the network are part of EPA National Networks such as SLAMS (State and Local Air Monitoring Stations), NCORE (National Core Monitoring Stations) and NATTS (National Air Toxics Trends Stations).

The AQCD has maintained an air quality monitoring station in Rutland since 1971. Other stations in the AQCD monitoring network include Burlington, Bennington, and Underhill. These stations collect continuous $PM_{2.5}$ data on an hourly basis; and Underhill and Rutland also collect filter-based 24-hour $PM_{2.5}$ samples every three to six days, respectively. Network-wide monitoring for particulate matter having a diameter of 10 micrometers or less (PM_{10}) began in 1985, and $PM_{2.5}$ monitoring began in 1999. Average annual fine particulate matter concentrations monitored across Vermont have been below the 2012 $PM_{2.5}$ NAAQS for at least the past fifteen years. Design values for three population centers (Bennington, Burlington, and Rutland) and a rural area (Underhill) show an overall declining trend that is below the annual and twenty-four-hour average NAAQS for $PM_{2.5}$ (Figure 2).

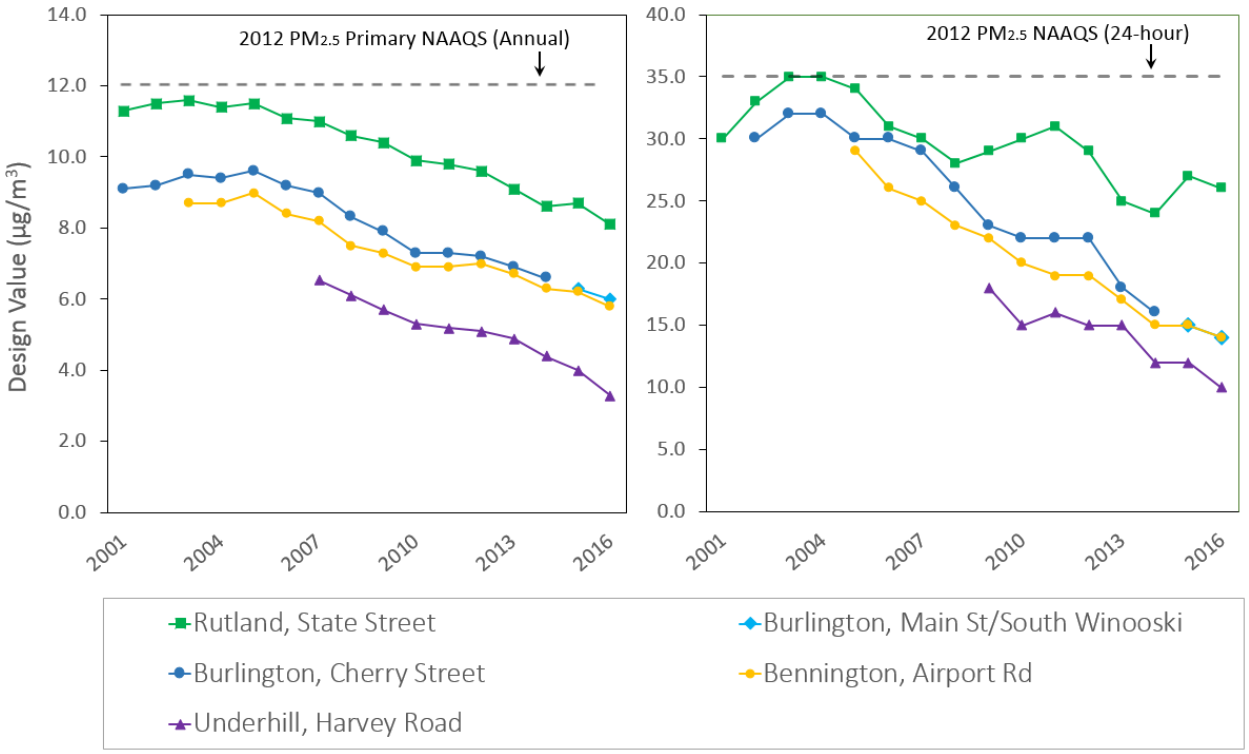

Figure 2. Design value trends for the primary annual 2012 $PM_{2.5}$ NAAQS at monitoring locations in Vermont (left panel), and for the twenty-four-hour $PM_{2.5}$ NAAQS at monitoring locations in Vermont (right panel).

These data from Vermont's monitoring network indicate that all areas of Vermont have air quality that attains the current $PM_{2.5}$ NAAQS, which is one key requirement for enrolling in the PM Advance program. Even though all Vermont's sites are in attainment, annual average measurements of ambient fine particle measurements historically have been, and currently remain higher in Rutland than at the other population centers (i.e., Bennington and Burlington) having monitors. Also, despite not exceeding the federal standard, monitor data show that fine particle pollution concentrations periodically still reach unhealthy levels at certain times of day, and during certain seasons (especially in winter) for people who are most sensitive (e.g., the elderly, children, and people with lung or heart conditions). Further, short-term (over several hours) concentrations of $PM_{2.5}$ are typically high (e.g., greater than 60 µg/m^3) during winter inversion invents.

2.2. PM Advance Focus Area

Description of PM Advance Focus Area

According to the U.S. Census Bureau, the combined population of Rutland City and Rutland Town in 2015 was approximately 19,841 people, ranking it as one of the largest population centers in Vermont. Rutland is located in south-central Vermont (43.6106° N, 72.9726° W) (Figure 3), in a broad valley defined by the Green Mountains to the east, and the Taconic Mountains to the west, with an elevation of approximately 600 feet above sea level, and a differential elevation of about 2000 feet from valley floor to the Green Mountains.

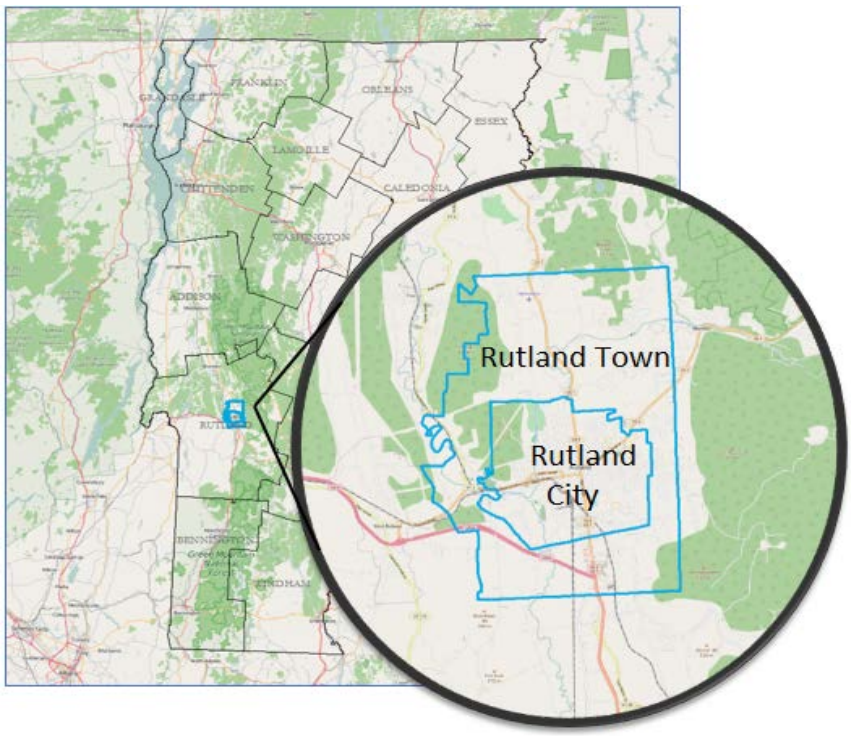

Figure 3. Map of Vermont, and location of Rutland City and Town (inset).

In addition to being one of Vermont's larger residential population centers, this area encompasses a wide-variety of economic activities including commercial, agriculture, industrial manufacturing, tourism, institutions of higher education, rail, and air transportation, etc.[8,9] Air

[8] Rutland County Development Corp.; Jobs in Our Sites: http://www.rutlandeconomy.com/~rutlande/wp-content/uploads/2015/01/Business-Case-REDC.pdf.

[9] 2012 Census of Agriculture – County Profile, USDA: https://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/Vermont/cp50021.pdf

pollutant emissions from these and other activities can build to unhealthy levels under the right atmospheric conditions. Rutland is prone to experiencing elevated PM levels since it is a valley population center surrounded by elevated rural terrain and can be subjected to strong winter morning temperature inversions. An inversion is an atmospheric phenomenon in which temperature becomes warmer with increasing elevation (in contrast to the typical tendency of temperature to cool with increasing elevation), creating a layer of warmer air that acts like a lid for trapping the underlying cooler air. This greatly enhances the possibility of building up unhealthy concentrations of air pollutants near the ground that might otherwise be dispersed. Inversions typically occurs during cold, calm days experienced during the heating season. A study focusing on PM concentrations in Rutland (Allen et al, 2004)[10] confirmed that wood smoke is a substantial contributor to the elevated levels of $PM_{2.5}$, and that its relative contribution increased as temperature decreased. The authors of the study noted anecdotally that winter $PM_{2.5}$ sample filters from this site often exhibited a distinct "wood smoke odor." Monitoring data that illustrate these periods of elevated PM concentrations will be discussed further in the next section of this report.

The EPA indicates that numerous valleys throughout New England are impacted periodically by relatively high concentrations of $PM_{2.5}$ from wood combustion and other sources during events such as wintertime inversions. To help address this problem, the EPA has created a set of screening tools for use by state and local governments.[11] Graphics produced from both the EPA *Valley Identification Tool* and *EPA Valley Profile Tool* illustrate that Rutland, VT has a relatively high population density living within a geographical area that is clearly designated as a deep valley location (Figures 4 and 5). Rutland was selected as the initial area of focus for this PM Advance "path forward" due to these physical characteristics, and because the VT AQCD maintains a long-term PM monitor at this location which demonstrates the occurrence of periodic air quality issues. Unfortunately, at this time, it is far too cost-prohibitive and resource-intensive to establish PM monitors at additional locations around the state. However, in the next phase of this PM Advance "path forward", the VT AQCD will utilize the EPA Valley Identification Tool, EPA Valley Profile Tool, portable monitoring equipment, and other available resources to identify additional deep mountain valley population centers that lack a long-term monitoring site, but are likely to experience similar air quality issues to Rutland, VT. Identifying these locations will help prioritize the use of limited resources for developing strategies and actions that reduce $PM_{2.5}$ emissions and ambient concentrations, and lead to improved air quality and better protection of public health.

[10] Allen, G. A., P. Babich, and R. L. Poirot (2004), Evaluation of a new approach for real time assessment of wood smoke pm, paper presented at Regional and Global Perspectives on Haze: Causes, Consequences and Controversies—Visibility Specialty Conference, Am. Waste Manage. Assoc., Asheville, N. C., 25 – 29 Oct.
[11] EPA Advance Program – Advance Resources website: https://www.epa.gov/advance/advance-resources

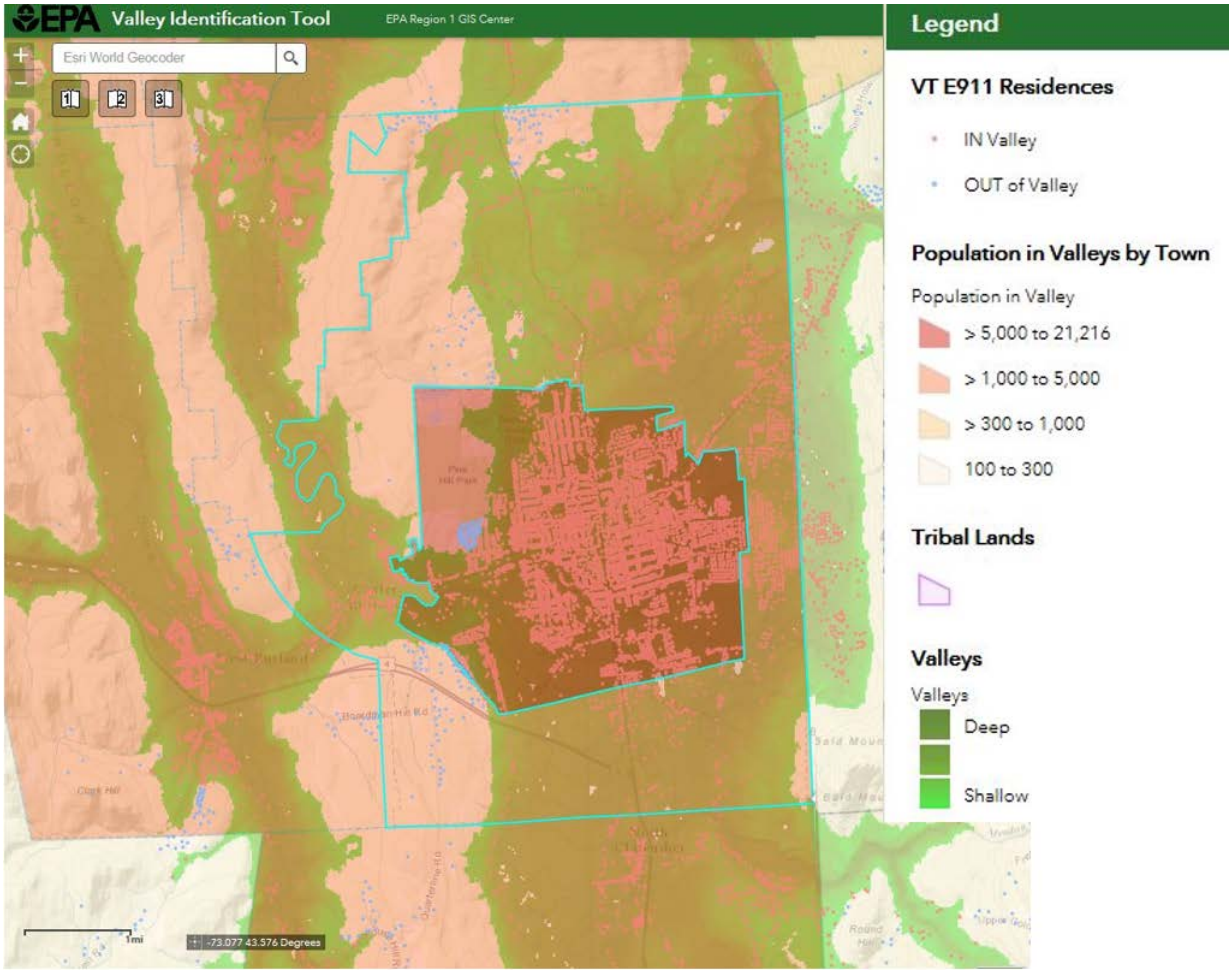

Figure 4. EPA Valley ID Tool visualization showing the geographical overlap between the deep valley and the relatively high population density of Rutland City and Rutland Town, VT.

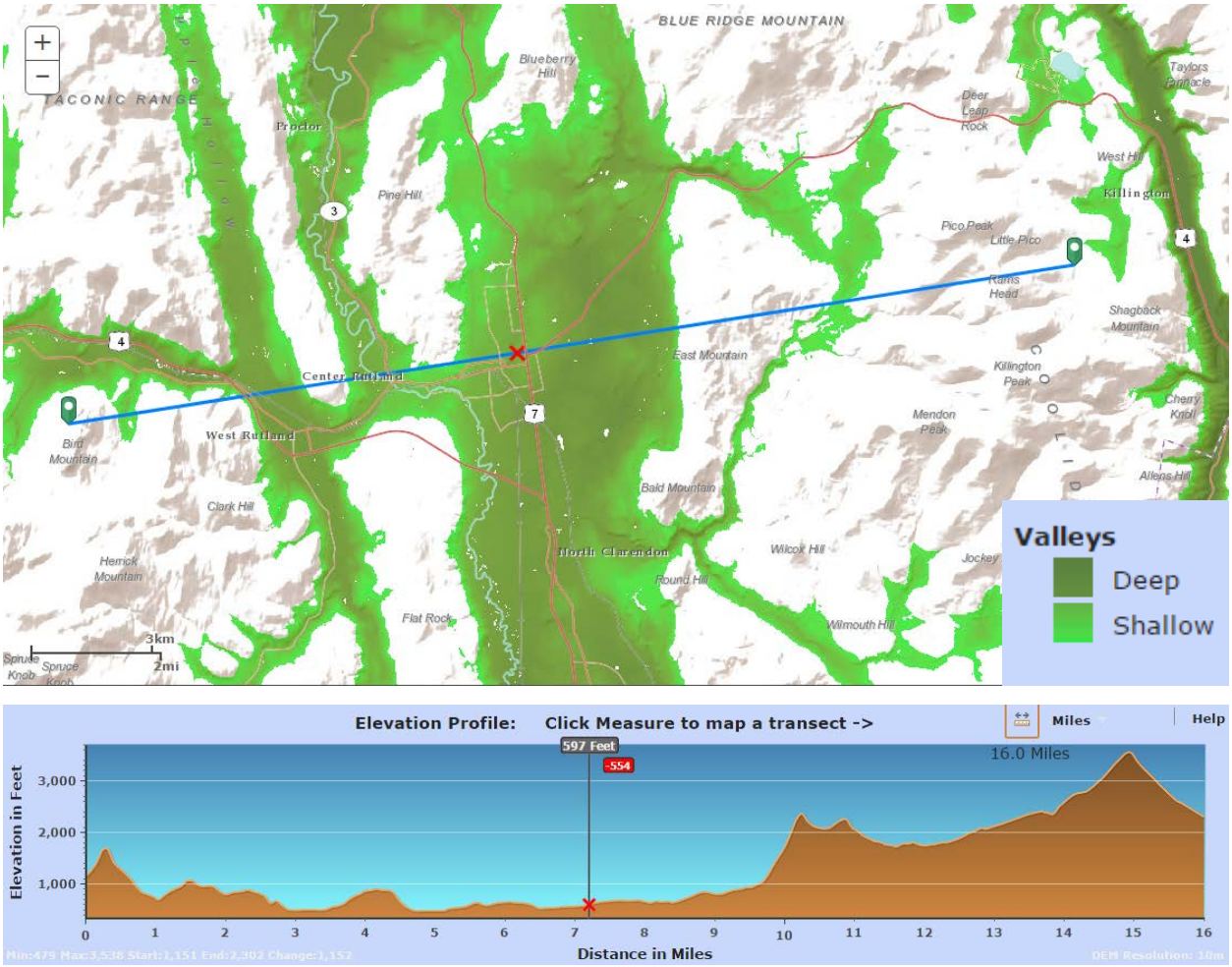

Figure 5. EPA Valley Profile Tool aerial view (upper panel) showing the deep valley location of Rutland City and Rutland Town, VT with a blue line drawn to represent a transect from the Taconic Mountains in the west to the Green Mountains in the east. The blue line transect is shown as an elevation cross-section (lower panel) to illustrate the topography of the region.

Air Quality in the PM Advance Focus Area

The Rutland monitoring station is located in the downtown Rutland area, west of Route 7, between two parking lots in a commercial block which includes a postal distribution center (Figure 6). In addition to $PM_{2.5,}$ the station monitors for ozone, carbon monoxide, sulfur dioxide, nitrogen oxides, carbonyls, volatile organic compounds, air toxics, and black carbon.

Figure 6. Aerial view of the Rutland area illustrating the location of AQCD Rutland Air Quality Monitoring Station (inset photo).

As shown previously (Figure 2), the ambient monitor located in Rutland, VT has consistently measured higher annual and 24-hour average $PM_{2.5}$ values than all other monitors in the VT AQCD network. This section of the report more closely examines $PM_{2.5}$ daily and hourly data collected at the Rutland monitoring site.

The EPA Air Quality Index (AQI)[12] provides an index for evaluating air quality impacts attributable to $PM_{2.5}$, ozone, sulfur dioxide (SO_2), nitrogen dioxide (NO_2) and carbon monoxide (CO). Lower AQI scores indicate better air quality (Table 1).

[12] EPA AirNow website: https://airnow.gov/index.cfm?action=aqibasics.aqi

Table 1. The U.S. EPA Air Quality Index (AQI).

AQI	Numerical Value	Meaning
Good	0 to 50	Air quality is considered satisfactory, and air pollution poses little or no risk.
Moderate	51 to 100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups (USG)	101 to 150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	151 to 200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	201 to 300	Health alert: everyone may experience more serious health effects.
Hazardous	301 to 500	Health warnings of emergency conditions. The entire population is more likely to be affected.

For the period 2008-2015, the average number of days that air quality was classified in Rutland as "Good" using the AQI was just over 265. This compares with over 310 days in two other population centers of the state, and 332 days at the rural station in Underhill (Figure 7).

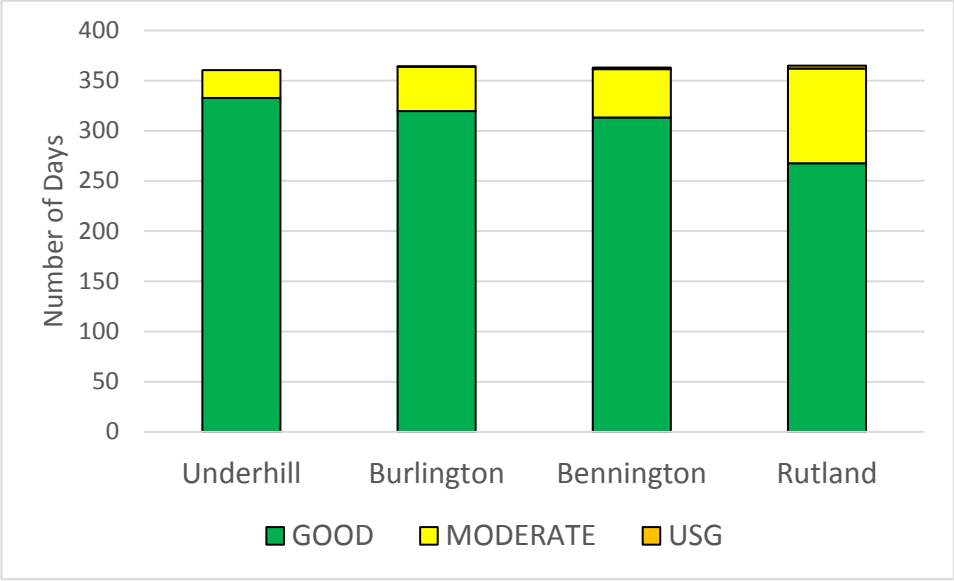

Figure 7. Vermont monitoring station average number of Air Quality Index (AQI) days by category 2008-2015.

On a year-to-year basis, the number of "Good" AQI days in Rutland increased from 264 to over 280 from 2008-2010, declined to 231 in 2011, and rebounded again the following year to 258 days (Figure 8). The 2012-2015 average number of “Good” days was 270. Of the 756 “Moderate” AQI days that occurred between 2008 to 2015, $PM_{2.5}$ was the critical pollutant in all but two days. On those two days sulfur dioxide, a $PM_{2.5}$ precursor, was the critical pollutant.

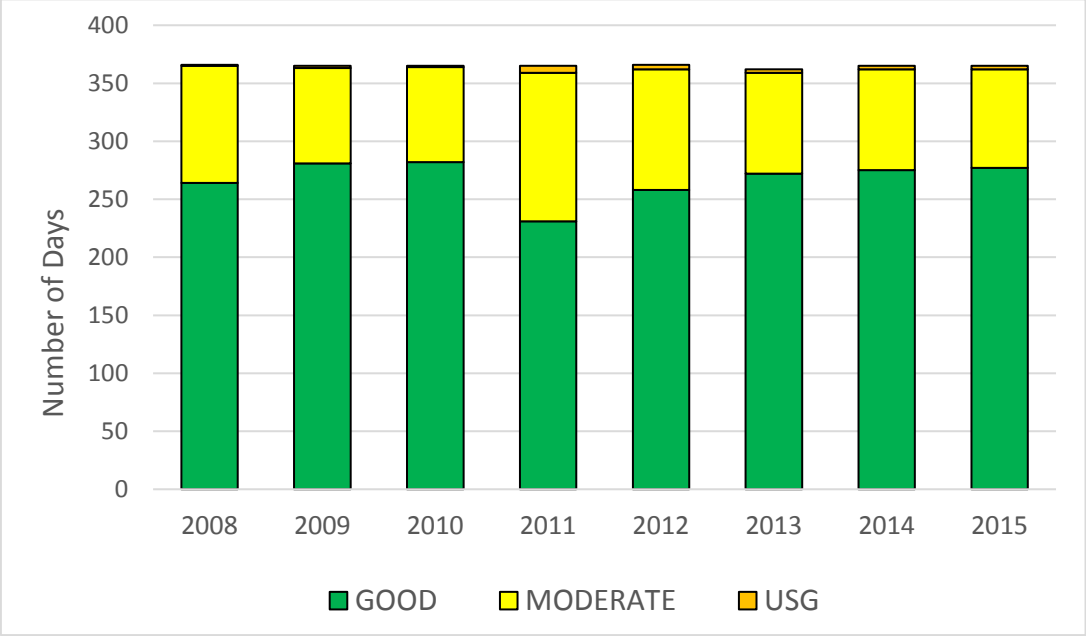

Figure 8. Rutland AQI days by category 2008-2015.

The 2012 primary National Ambient Air Quality Standard (NAAQS) established by the EPA for average annual $PM_{2.5}$ is 12 µg/m^3 (annual arithmetic mean, averaged over three years). Annual average $PM_{2.5}$ concentrations at the Rutland site between 2008 and 2015 ranged from a low of 8.9 µg/m^3 in 2014 to high of 11.8 µg/m^3 in 2011. Although the 2011 annual average was close to the annual standard, the 3-year mean for 2009-2011 was 10.1 µg/m^3, which was 1.9 µg/m^3 below the 2012 NAAQS. The most recent annual means for 2014 and 2015 were 8.9 and 9.0 µg/m^3, respectively (Figure 9).

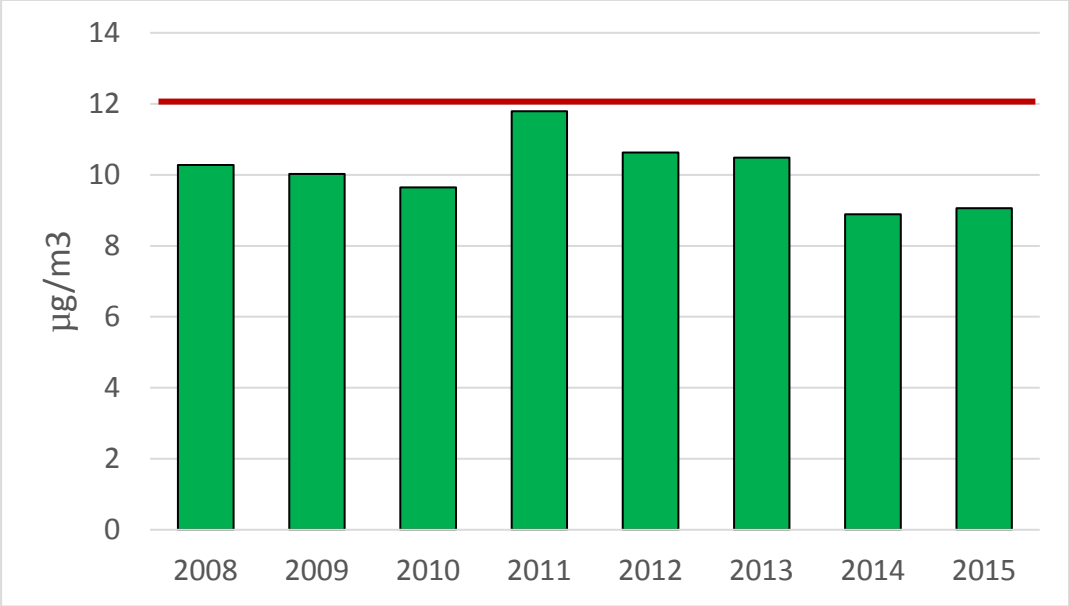

Figure 9. Rutland annual average $PM_{2.5}$ concentration 2008-2015.

The NAAQS established by EPA for 24-hour $PM_{2.5}$ is 35 µg/m^3 (98th percentile, averaged over three years). The average and maximum 24-hour $PM_{2.5}$ concentrations in Rutland for the years 2008-2015, plotted against the day of the year (1-365, or 366 on leap years) depicts the seasonal variation associated with $PM_{2.5}$, with elevated concentrations observed primarily in the first two (January – February) and last two months (November – December) of the year (Figure 10). The eight-year average indicates air quality falls primarily into the AQI "Good" category for the summer months, but maximum concentration data indicate that elevated PM occurs during this time of year as well, often due to long-range interstate transport of fine particles and precursor pollutants.[13]

[13] Air Pollution Transport and How It Affects New Hampshire. NH DES, May 2004: https://www.des.nh.gov/organization/commissioner/pip/publications/ard/documents/r-ard-04-1.pdf

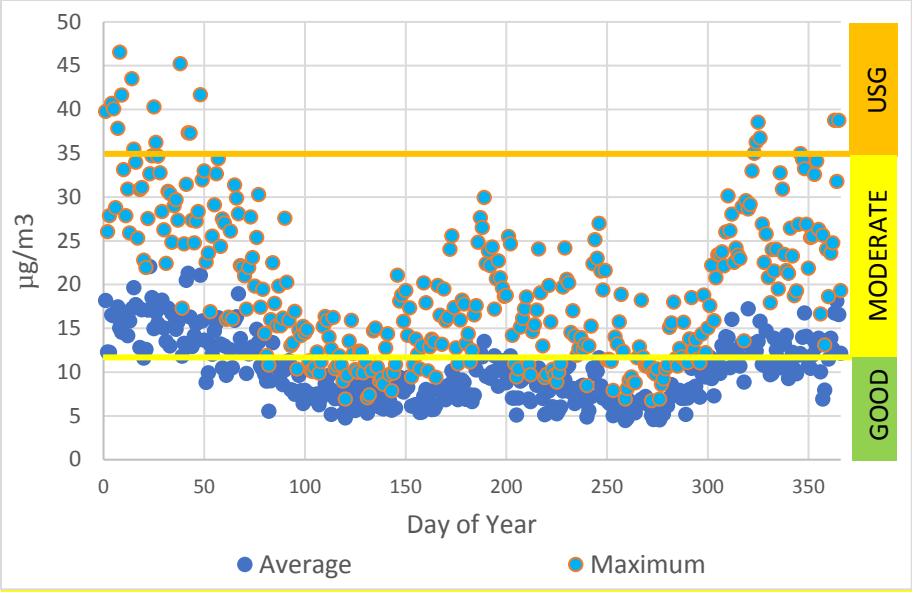

Figure 10. Rutland 24-Hour $PM_{2.5}$ concentrations (average and maximum) by day of year during 2008-2015.

An example of the effects of local meteorological conditions on $PM_{2.5}$ concentrations occurred in Rutland during early January 2014. The Rutland 24-hour average $PM_{2.5}$ concentration for January 1st through 7th, 2014 ranged from 5 µg/m^3 to 41 µg/m^3 (Figure 11). This concentration of 41 µg/m^3 was above the level of the standard (i.e., 35 µg/m^3), indicating that air pollutant concentrations were higher than the EPA-designated level for protection of public health on that day, and again the following day when 24-hour average $PM_{2.5}$ concentrations were only slightly reduced.

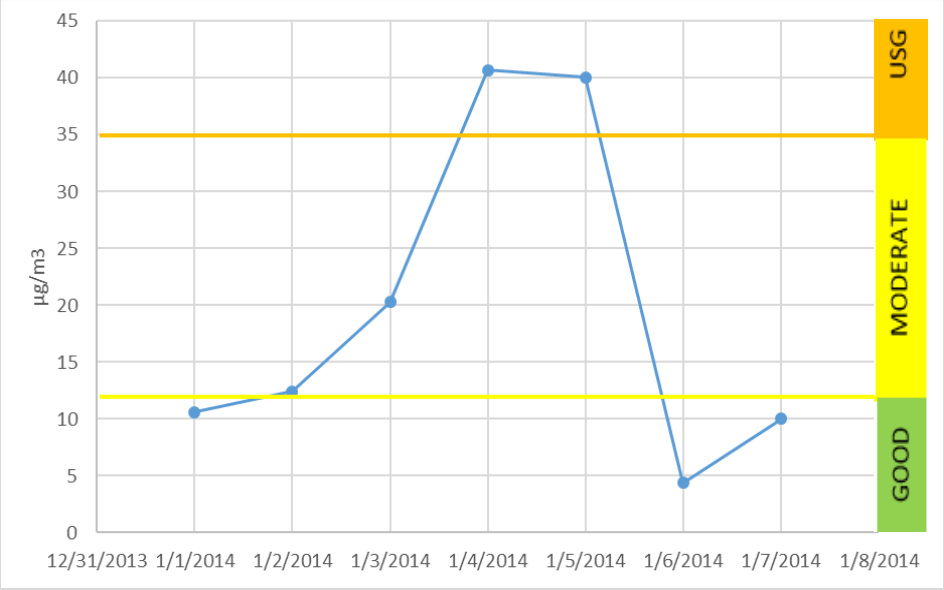

Figure 11. Rutland 24-hour $PM_{2.5}$ concentrations, January 1-7, 2014.

The 1-hour data for the same period provides a detailed look at the $PM_{2.5}$ concentrations and the local meteorological factors that may be contributing to elevated levels (Figure 12). During this period, hourly average $PM_{2.5}$ concentrations began to rise at 1600h local time on January 3, and climbed from 7.1 µg/m^3 to a maximum concentration of 62.6 µg/m^3 by 2200h. Concentrations varied but remained above 40 µg/m^3 throughout the evening of January 3 and morning of January 4, climbed to greater than 80 µg/m^3 in the early morning hours of January 5 and remained above 35 µg/m^3 until 1100h when concentrations decreased to below 12 µg/m^3.

Meteorological data collected simultaneously with the $PM_{2.5}$ data provide some insight regarding this pattern. The month began with an extended period of cold weather. However, light winds kept surface air mixed and $PM_{2.5}$ concentrations in the 10 µg/m^3 range. On the evening of January 3, the wind speed calmed to less than 1 meter per second and the surface temperature dropped from minus 18°C to minus 27°C from 1300h to 0200h on January 4. Temperature climbed from minus 27°C to minus 4.5°C by 1400h, with a concurrent drop in $PM_{2.5}$ as described above. Winds were still light and variable, and the temperature fell again the afternoon and evening of January 4, dropping to a low of minus 15°C at 0200h January 5. There was a concurrent rebound in PM concentration to a peak of 66 µg/m^3. As winds increased in speed, and the temperature climbed to 2°C by 1200h on January 5, the $PM_{2.5}$ concentrations fell back to the 10 µg/m^3 range by 2000h.

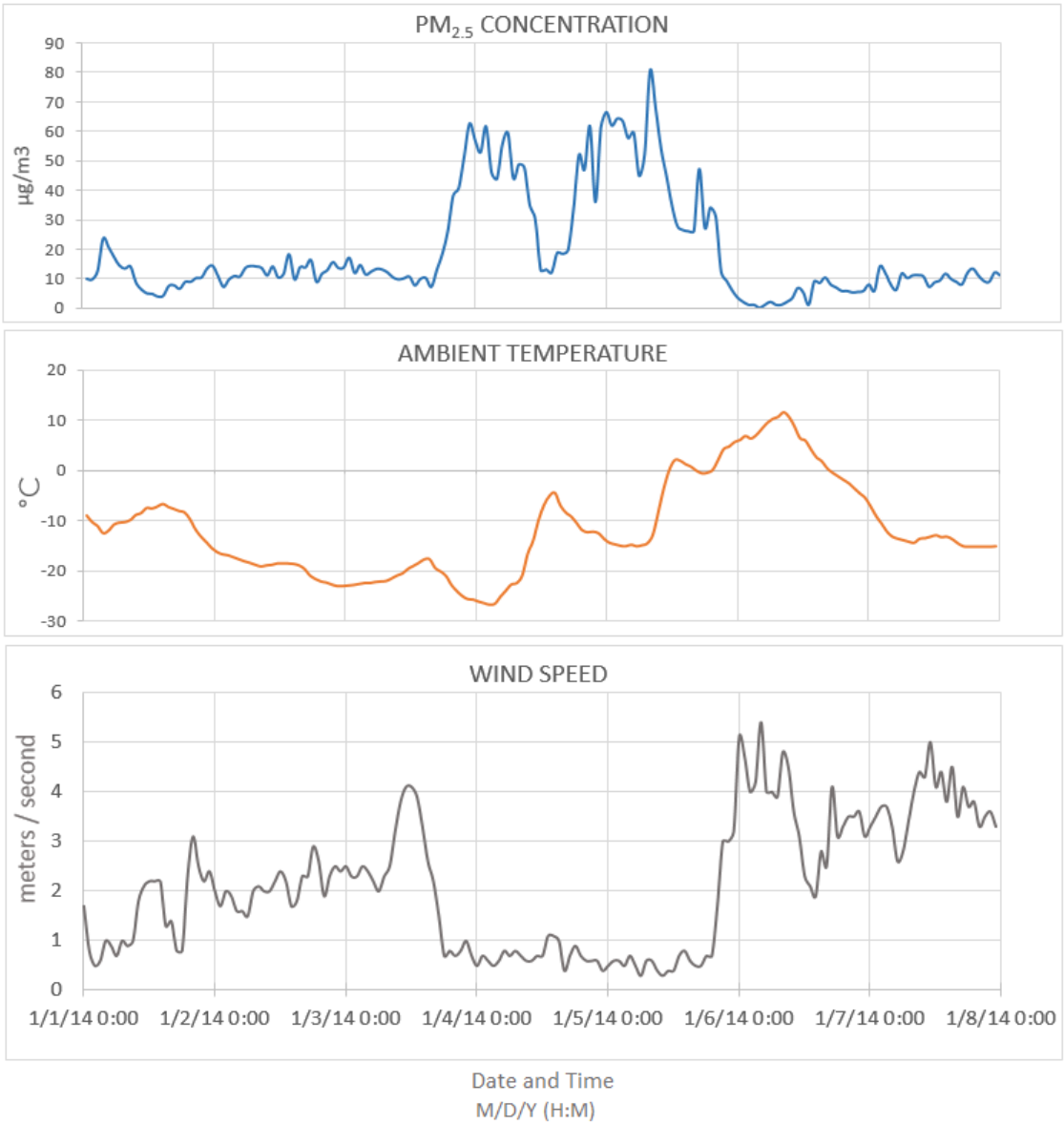

Figure 12. Rutland $PM_{2.5}$ ambient air concentrations, ambient air temperature, and wind speed during January 1-7, 2014.

Relationships between $PM_{2.5}$ concentration and two meteorological variables were explored using daily (24-hour) average values plotted against ambient temperature and wind speed. Days having the highest daily average $PM_{2.5}$ concentrations in this dataset would be categorized on the AQI as "unhealthy for sensitive groups" (USG) for $PM_{2.5}$, and only occurred at temperatures below 5.4 °C (42 °F) (Figure 13). These most polluted (USG) days also only occurred when daily average wind speeds were less than 1.5 m/s (approximately 3.4 miles per hour) (Figure 14).

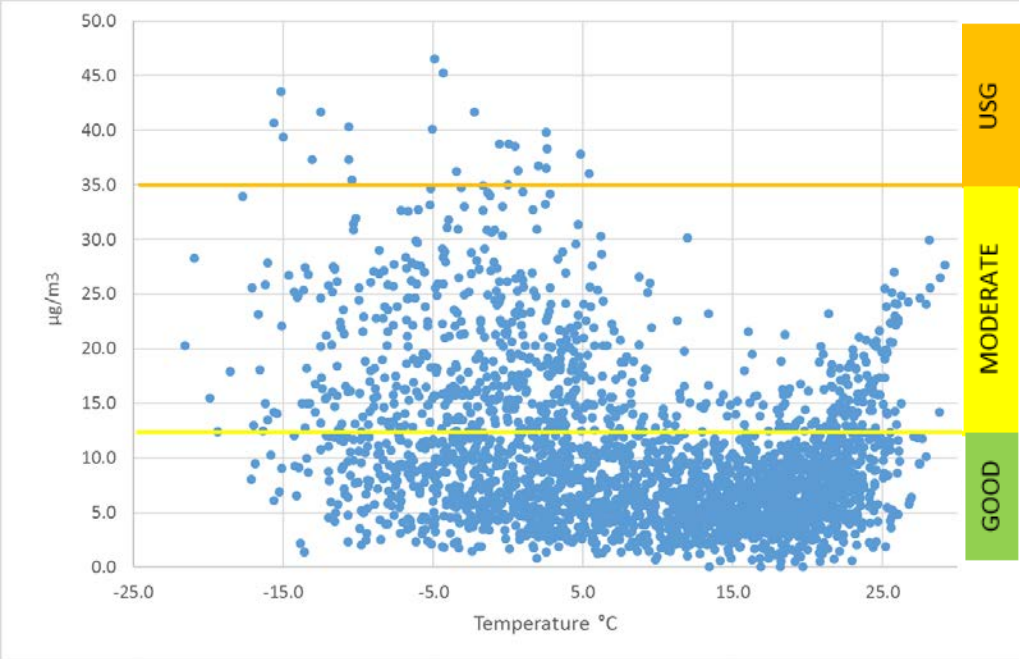

Figure 13. $PM_{2.5}$ concentrations versus 24-hour average temperature during 2008-2015.

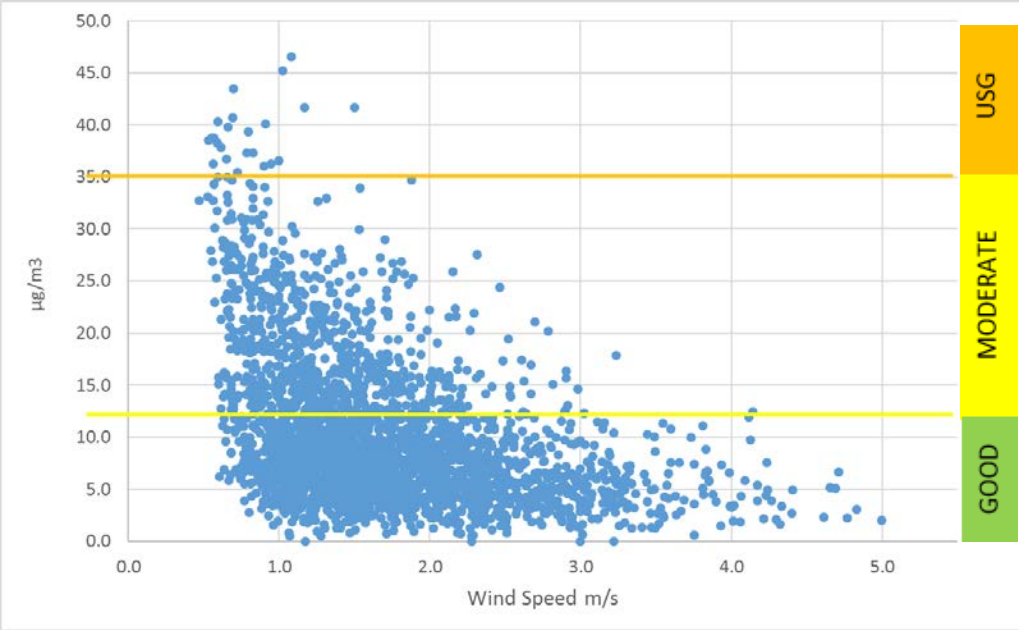

Figure 14. $PM_{2.5}$ concentrations versus 24-hour average wind speed during 2008-2015.

2.3. Emissions Inventory

Direct anthropogenic emissions sources of $PM_{2.5}$, as well as emissions of fine particulate precursor pollutants such as NOx, SO_2, VOC, and NH_3 from version 2 of the 2014 U.S. EPA National Emissions Inventory (NEI)[14] are summarized below for Rutland County, VT (Figure 15). These annual emissions data for calendar year 2014 are based on a compilation of State and EPA data used to produce a comprehensive estimate of emissions from various point, nonpoint, onroad, and nonroad sources for each county in Vermont, and across the U.S. It is important to note that these emissions inventory estimates represent countywide emissions in Rutland County, and not solely emissions from within Rutland City or Rutland Town.

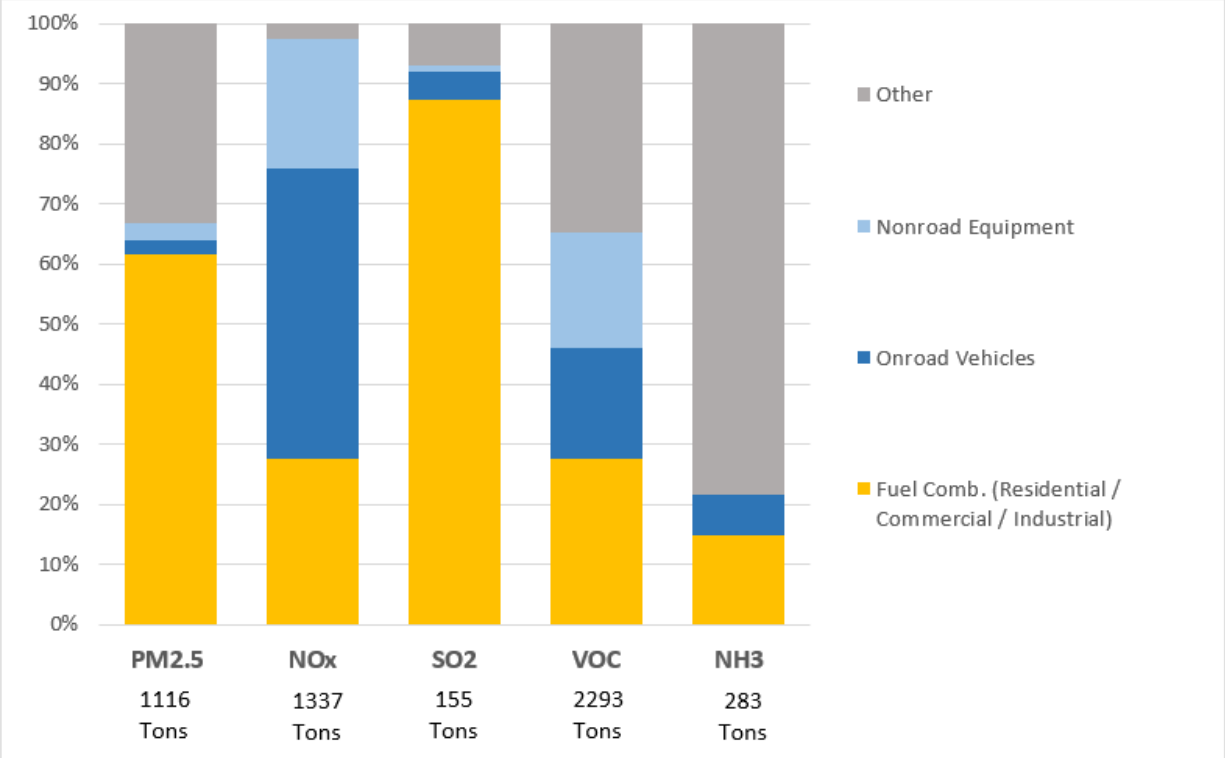

Figure 15. National Emissions Inventory (NEI) 2014 v.2 anthropogenic $PM_{2.5}$, and fine PM precursor pollutant emissions summarized by emissions source category for Rutland, VT.

For direct emissions of $PM_{2.5}$, the category contributing the most to the Rutland countywide total was residential wood combustion (645 tons or approx. 59% of the total combustion and non-combustion emissions). Another large contributor to $PM_{2.5}$ emissions was the "Other" category, which was dominated by dust from unpaved roads, paved roads, and agricultural operations (179 tons or 16% of the total). Much smaller contributions to direct fine PM emissions can be

[14] U.S. EPA National Emissions Inventory webpage: https://www.epa.gov/air-emissions-inventories/national-emissions-inventory-nei (data queried on 3/08/18)

attributed to nonroad (31 tons or 3% of the total) and onroad (27.1 tons or 2.5% of the total) mobile sources.

Because emissions of other precursor pollutants (i.e., NOx, SO_2, VOC, NH_3) are key contributors to the secondary formation of $PM_{2.5}$, it also is important to identify the prominent emissions source types of these pollutants within the PM Advance focus area (Table 2).

Table 2. National Emissions Inventory 2014 v.2 source categories having the highest emissions of anthropogenic fine PM precursor pollutants in Rutland, VT.

NOx	SO2	VOC	NH3
Onroad Vehicles (645.2 tons)	Residential Fuel Oil Combustion (76.3 tons)	Residential Wood Combustion (621.3 tons)	Agriculture – Livestock Waste (176.7 tons)
Nonroad Equipment (290.7 tons)	Residential Wood Combustion (24.3 tons)	Solvent Use (557.1 tons)	Agriculture – Fertilizer Application (36.8 tons)
Residential Wood Combustion (102 tons)	Commercial /Institutional Oil Combustion (19.1 tons)	Nonroad Gasoline Equipment (446.2 tons)	Residential Wood Combustion (34.2 tons)
Residential Fuel Oil Combustion (101.7 tons)	Industrial Boilers and Internal Combustion Engines – Oil (13.7 tons)	Onroad Vehicles (411.7 tons)	Onroad Vehicles (19.2 tons)

The NEI emissions estimates make it clear that residential wood combustion is one of the key sources of concern, given that it is the largest, or one of the largest contributors to both direct $PM_{2.5}$ emissions as well as $PM_{2.5}$ precursor pollutant emissions. In addition to residential wood use, many industrial facilities in Vermont burn wood for space or process heat. Vermont also has two electricity-generating plants fired by wood, plus several large-scale heating plants, over forty public schools, four college campuses, two state office complexes, and five other state facilities that burn wood chips. Additionally, wood pellet fuel is burned at ten schools, fourteen multi-family housing complexes, and two state buildings statewide.[15]

Estimating emissions associated with the combustion of wood for residential heating is complicated because wood is not a "metered" fuel like fuel oil, propane, or natural gas; and many Vermonters harvest firewood from their own woodlots. This makes tracking annual wood usage trends very difficult. Periodic statewide telephone surveys that have been conducted by the Vermont Department of Forest, Parks and Recreation and the Department of Public Service have

[15] Vermont Department of Forests, Parks, and Recreation – Wood Energy webpage http://fpr.vermont.gov/forest/wood_biomass_energy

been invaluable tools to help assess in-state residential heating fuel and firewood demand. The most recent of these surveys was performed in 2015 (Frederick & Jaramillo, 2016).[16] Real world emissions of $PM_{2.5}$ also depend on various factors such as the wood fuel quality, moisture content, how the heating appliance is operated, and the specific heating appliance technology / design.

The results of the fuel survey were used to estimate the total amount of wood fuel used for space heating in each Vermont county. The Rutland County estimate was that over 30,000 cords of wood and over 28,000 tons of wood pellets were used for heat in 2014-2015 heating season. This was approximately 9% of the estimated statewide residential wood total. The 30,000 cords of wood burned was more than double the amount estimated from the prior 2007-2008 survey. Almost half of Rutland County households were estimated to have at least one wood or wood pellet burning appliance. Statewide, the estimated number of households that burn wood increased from 32% in 2007-2008 to 42% in 2014-2015. While the number of EPA-certified appliances in use doubled over that period (to 48,600 in the 2014-2015 heating season), there were still an estimated 61,000 older, uncertified wood burning appliances operating statewide in 2014-2015. The substantial number of old, high-emitting wood burning appliances still in use in Vermont represents a significant opportunity to achieve air quality improvements through appliance change outs or other actions.

Efforts to encourage early replacement of these old, uncertified units with cleaner, advanced wood heating or other low or non-emitting appliances is especially important given that the State of Vermont has established goals through the statewide 2016 Comprehensive Energy Plan (CEP) to substantially increase reliance on wood energy. According to the CEP, *"One fifth of the energy used to heat Vermont's buildings and to provide process heat in industrial applications comes today from renewable sources, primarily wood. The CEP establishes a goal of increasing that portion to 30% by 2025, through both efficiency and increased use of renewable fuels. One sample pathway involves increasing the use of solid and liquid biofuels by 20% by 2025, on the way to doubling wood's share of building heat by 2035."*[17]

[16] Vermont Residential Fuel Assessment for the 2014-2015 Heating Season. Frederick, Paul and Diana Jaramillo. March 2016.: http://fpr.vermont.gov/sites/fpr/files/About_the_Department/Library/Library/FINAL_2015%20Residential%20Fuel%20Assessment%20Report.pdf

[17] Vermont Department of Public Service, Vermont Comprehensive Energy Plan 2016 - https://outside.vermont.gov/sov/webservices/Shared%20Documents/2016CEP_Final.pdf

3. HISTORICAL & EXISTING PROGRAMS & ACTIVITIES

The State of Vermont has established a regulatory framework to address emissions of $PM_{2.5}$ in compliance with the Federal Clean Air Act (CAA) Section 110(a)(1) and (2) for the 2012 $PM_{2.5}$ National Ambient Air Quality Standards (NAAQS). Listed below are a few of the most relevant programs. A complete list of Vermont requirements can be found in the 2012 $PM_{2.5}$ Infrastructure SIP.[18]

- The sections of the **Vermont Air Pollution Control Regulations (VT APCR)**[19] that specify or are used to establish emission limits related to the control of $PM_{2.5}$ and its precursors include:

  § 5-201 Open Burning Prohibited
  § 5-203 Procedures for Local Authorities to Burn Natural Wood
  § 5-204 Outdoor Wood Fired Boilers
  § 5-211 Prohibition of Visible Air Contaminants
  § 5-221 Prohibition of Potentially Polluting Materials in Fuel
  § 5-231 Prohibition of Particulate Matter
  § 5-241 Prohibition of Nuisance and Odor
  § 5-251 Control of Nitrogen Oxides Emissions
  § 5-252 Control of Sulfur Dioxide Emissions
  § 5-261 Control of Hazardous Air Contaminants
  § 5-271 Control of Air Contaminants from Stationary Reciprocating Internal Combustion Engines
  § 5-302 Sulfur Oxides (Sulfur Dioxide)
  § 5-304 Particulate Matter $PM_{2.5}$
  § 5-306 Particulate Matter PM_{10}
  § 5-309 Nitrogen Dioxide
  § 5-501 Review of Construction or Modification of Air Contaminant Sources
  § 5-502 Major Stationary Sources and Major Modifications
  § 5-701 Maintenance and Removal of Control Devices
  § 5-702 Excessive Smoke Emissions from Motor Vehicles
  Subchapter IV. Operations and Procedures
  Subchapter VIII. (§ 5-801 - § 5-806) Registration of Air Contaminant Sources

[18] CERTIFICATION OF VERMONT STATE IMPLEMENTATION PLAN (SIP)
ADEQUACY REGARDING CLEAN AIR ACT SECTIONS 110(a)(1) AND (2) FOR THE 2012 FINE PARTICULATE MATTER ($PM_{2.5}$) NATIONAL AMBIENT AIR QUALITY STANDARD (NAAQS)
http://dec.vermont.gov/sites/dec/files/documents/Vermont_2012_PM2_5_ISIP_proposed_0.pdf
[19] Vermont Air Pollution Control Laws and Regulations: http://dec.vermont.gov/air-quality/laws

- **Sulfur Content in Heating Fuel Requirements**[20] - As part of a regional air pollution control strategy, Vermont has adopted regulations to lower the allowed sulfur content of fuel oils used, purchased, or sold for use for heating and power generation. On July 1, 2014, the sulfur content of No.2 heating oil purchased, sold, or used in Vermont shall not exceed 500 ppm (0.05%). Additional sulfur limits go into effect on July 1, 2018.

- **Vermont Anti-Idling Laws** - In Vermont, mobile sources are the largest source of greenhouse gases and numerous other air pollutants that threaten human health and our environment. Unnecessary idling harms human health, pollutes the air, wastes fuel and money, and causes excess engine wear. And it's against the law. The VT AQCD estimates that if every car and truck in Vermont reduced unnecessary idling by just one minute per day, over the course of a year Vermonters would save over 1 million gallons of fuel and over $2 million in fuel costs, and we would reduce CO_2 emissions by more than 10,000 metric tons.
  - Motor Vehicle Idling Law (V.S.A. Title 23 Chapter 013 Section 01110). Act 57 was signed into law in May 2013 and includes a provision that, effective May 1, 2014, limits all motor vehicle idling to five minutes in any 60-minute period with some exceptions.[21]
  - School Bus Idling Rule on School Property. School buses shall not idle while picking up and dropping off children on school property.[22]

- **Vermont Wood Stove Change Out Programs** –

  - March 2009-August 2009 - The AQCD undertook a statewide wood stove change-out program in 2009, supported by an EPA grant. The proposal originally included a phase which targeted low-income households in the Rutland area, but due to the difficulty of identifying low-income households utilizing wood for heat, this phase was not implemented. The program consisted of two components:
    - A wood stove change-out program, providing a $450 voucher for purchase of a replacement certified wood stove ($87,000 originally allocated); and
    - A catalyst change-out program, providing a $75 voucher for purchase of a replacement catalyst ($10,000 originally allocated).

    The wood stove change-out program received over 338 applications within the application period. A total of 316 rebate vouchers were issued during the program period, and 213 vouchers were redeemed for purchase and installation of a replacement wood stove. Voucher redeemers were required to surrender their existing stove for destruction. Four participants were located in the Rutland area, and 21 replacements were in Rutland County. The catalyst change-out program received 32 applications. A total of 32 vouchers were issued, and 21 vouchers were redeemed for a replacement catalyst.

[20] Vermont DEC Sulfur Content in Heating Oil – Fact Sheet: http://dec.vermont.gov/sites/dec/files/documents/2014-05-02%20SulfurContent%20Fact_EOG_BRM_042514%20R.pdf

[21] Vermont Motor Vehicle Idling Law: http://legislature.vermont.gov/statutes/section/23/013/01110

[22] Vermont Department of Education School Bus Idling Rule: http://dec.vermont.gov/sites/dec/files/aqc/mobile-sources/documents/FINAL-RULE-BUS-IDLING-Mar08.pdf

- November 2016 - the Vermont Department of Public Service (PSD), in cooperation with the VTDEC AQCD, launched a new round of residential wood stove change-out incentives. The program, administered by the state's Clean Energy Development Fund and funded by the Vermont AQCD and the Vermont PSD, made $325,000 available to residential wood stove owners to change out in-use uncertified residential wood stoves with an EPA certified unit. Incentives were offered only through participating dealers and were available at four levels (from $500 to $1,500) depending on the particulate emissions limit rating of the new stove. The program was statewide, and incentives were awarded on a first-come, first served basis. There are two participating dealers in the Rutland area. As of May 2017, the program had resulted in 244 wood stove replacements in communities across the state, with 3 replacements receiving the highest incentive level occurring in Rutland City or Town. All allocated incentive funding has either been spent or has been reserved.

- Current wood stove change-out program with PSD in Rutland.

- **Vermont Outdoor Wood Boiler Change-Out Program** - From 2011 through 2016, this change out program was implemented in accordance with Act 94, effective May 7, 2010 and codified at 10 V.S.A. § 584. This legislation mandated that in implementing this program the Air Quality and Climate Division (AQCD) "give priority to replacing eligible OWBs that have resulted in complaints regarding emissions, including particulate matter or smoke, that the agency has determined are valid, and have the highest emission rates, cause nuisance, or are within 200 feet of a residence, school, or health care facility". In addition, the legislation also required that such OWBs be retired by December 31, 2012. The program successfully removed 85 uncertified OWBs from service during its run. The majority of participants changed out to certified cordwood OWBs. There were four participants that moved to certified pellet OWBs and two that moved to gas units. The OWB Change Out Program was ended on September 30, 2015 due to a lack of remaining funding.[23]

- **Wood heater standards** - Until 1997, Vermont had no state regulations that applied to wood burning devices; the only requirements were from a federal regulation (40 CFR Part 60, Subpart AAA), adopted in 1988, that set emission limits for most woodstoves and some wood pellet stoves. This regulation did not cover wood-fired central heaters. Due to numerous complaints about excessive smoke from outdoor hydronic heaters during the early and mid-1990's, the Air Quality & Climate Division adopted the first regulation addressing outdoor hydronic heaters in 1997 to require setbacks from neighboring residences and taller smoke stacks. As these requirements failed to resolve the complaints being received, the regulation was amended in 2007 to require new outdoor hydronic heaters to meet an emission standard to be sold in Vermont. The emission standard was amended to be more stringent in 2009. The most recent development to promote cleaner wood burning technology came with the update of the existing federal regulation for residential wood heaters in 2015. The new

[23] Vermont Outdoor Wood Boiler Change-out Program website: http://dec.vermont.gov/air-quality/compliance/owb/change-out-program

regulation made several significant changes to the original requirements in Subpart AAA for woodstoves and wood pellet stoves including removal of some loopholes in the original regulation that excluded certain woodstoves and wood pellet stoves from having to meet the emission standard; and more stringent emission limits are applied to woodstoves and wood pellet stoves in two phases with the first applying to those manufactured after May 15, 2015 and the second as of May 15, 2020. Significantly, the new federal regulation also added a new Subpart (QQQQ) that established the first nationwide emission standards for wood-fired central heaters. Both cordwood and wood pellet units are covered by the regulation. Effective on December 15, 2016, Vermont adopted amendments to the existing regulation for outdoor hydronic heaters to update the requirements for outdoor hydronic heaters and include other wood-fired central heaters, woodstoves and wood pellet stoves. Any wood-fired central heater, woodstove or wood pellet stove that is certified for sale under the federal regulations is also allowed to be sold in Vermont.[24]

- The Vermont AQCD also has implemented multiple projects to help reduce emissions of fine PM locally in Rutland, VT under the **Diesel Emissions Reduction Act (DERA)**[25] state grant program. The AQCD has awarded numerous grants providing both financial and technical assistance to entities in and around Rutland. Below is a summary of some of the relevant awards:

    - Electrically powered "kiosks" have been installed at three Vermont hospitals, including Rutland Regional Medical Center. The kiosks power onboard equipment and provide cabin climate control for an ambulance without the need to run the vehicle's engine. Vermont was the first in the nation to deploy this type of idle reduction technology, successfully serving as a demonstration for other hospitals in improving local air quality, reducing potential exhaust infiltration of hospital buildings, reducing greenhouse gas emissions, and increasing the energy efficiency of emergency services. Additionally, this idle reduction project increases community awareness about diesel pollution and hospital stewardship of public health and the environment.

    - A grant $37,500 was awarded to The Belden Company, Inc. (of Rutland, VT) in March 2017 for the early replacement of an older, dirtier Class 8, heavy-duty dump truck with a new truck equipped with state-of-the-art emissions control systems.

    - A grant of $29,046 was awarded to the Casella Waste Management, Inc. in February 2016. The project included the purchase and installation of verified exhaust control technology, Diesel Oxidation Catalysts, on 11 refuse haulers to reduce diesel emissions and health impacts associated with diesel exhaust. Several of these trucks are operated in and around Rutland.

[24] Vermont AQCD Wood Stoves and Wood-Fired Central Heaters web page: http://dec.vermont.gov/air-quality/compliance/owb

[25] Vermont Clean Diesel Grant Projects website: http://dec.vermont.gov/air-quality/mobile-sources/diesel-emissions/clean-diesel-projects

- In 2013 and 2014, the AQCD collaborated with Vermont Railway, Inc. to complete another idle reduction project. Under the Vermont Clean Diesel Grant Program, auxiliary power units (APUs) were installed on six locomotives. The APUs provide auxiliary power for battery charging and maintain engine coolant and oil temperatures, essentially eliminating the need to idle. Typically, a locomotive uses about five gallons of diesel fuel per hour of idling. Operating an APU in place of idling the locomotive engine, results in fuel savings of more than 90%. These locomotives operate at least part of the time in Rutland.

- In 2012, a grant was awarded to the Rutland South Supervisory Union for the early replacement of an older, dirtier school bus with a new bus equipped with state-of-the-art emissions control systems.

- In 2010, a grant was awarded to the Rutland Northeast Supervisory Union (RNESU) for the early replacement of two older, dirtier school buses with new buses equipped with state-of-the-art emissions control systems.

- Additional projects completed using other funding sources, include:

  - In 2011, with funding from the American **Recovery and Reinvestment Act (ARRA)**, Gagnon Lumber of Pittsford, VT was awarded a grant to replace the sawmill's diesel-powered generator sets. Financial and technical assistance was provided to repower the diesel-powered generators with lower-emitting diesel engines that has resulted in emissions reductions of up to 80%. This project is located just north of the Rutland Town boundary.

  - In 2008, with funding from **EPA's Clean School Bus USA program**, AQCD provided technical and financial assistance to RNESU for the installation of idle reduction technologies on three school buses.

4. PATH FORWARD

Efforts to further reduce emissions and ambient air concentrations of $PM_{2.5}$ and its precursor pollutants under the PM Advance Path Forward will require utilization of a wide array of available tools. The toolbox likely will include a mixture of community engagement and outreach efforts, technological advancements, voluntary and incentivized programs, and regulatory mechanisms. All the identified options likely will have both near term and long-term components. Below is a preliminary list of anticipated actions and opportunities that the VT AQCD plans to utilize to help reduce emissions of $PM_{2.5}$ and associated precursor pollutants. Some of these actions and opportunities can be geotargeted and tailored for the area(s) covered by this PM Advance partnership. Other actions and opportunities will fall into the category of tools having equal availability statewide, but still can result in meaningful emissions reductions and air quality improvements for the PM Advance focus area(s).

4.1. Community Engagement and Outreach

- **Stakeholder Engagement** - Reach out to and collaborate with hospitals, health associations, schools, municipal governments, and others in the PM Advance area(s) to raise awareness about the specific local air quality concerns and develop effective partnerships and approaches to reduce $PM_{2.5}$ and precursor pollutant emissions and protect human health. It will also be important to work with public and private sector partners to:
  - Promote selection of the cleanest and most efficient wood burning appliances for those households choosing to heat with wood.
  - Raise awareness about proper wood fuel storage and drying, stacking, proper wood fuel moisture content, and proper wood burning. This can be achieved by:
    - Conducting targeted outreach to make users of wood burning appliances aware of the EPA Burn-Wise program and the Wood Smoke Awareness Kit.
    - Actively increasing awareness and online access to do-it-yourself woodshed construction plans.
    - The VT AQCD will also evaluate the ability to secure potential funding sources to purchase and provide wood moisture meters to the public.

- **AirNow / AQI / EnviroFlash** - Raise overall air quality awareness through promotion of EnviroFlash, AQ Forecasts, and recent availability of real-time air quality data.[26] The VT AQCD will work to make enhanced materials available online for moderate and USG air quality events that explain the causes of the elevated air pollutant concentrations, reminders about good practices and actions that the public can take to protect their health and minimize their own contribution to worsened air quality, etc.

[26] Vermont Air Quality Data: http://dec.vermont.gov/air-quality/Air-Quality-Data

- **Vermont Idle-Free Fleets** - Under a grant from the Vermont Department of Environmental Conservation, the American Lung Association has partnered with the University of Vermont Certification for Sustainable Transportation, to launch Vermont Idle-Free Fleets[27], a free online training for Vermont diesel truck drivers and fleet managers about the benefits of idling reduction. This program can have a powerful impact resulting in cost savings, increased vehicle efficiency, reduced number of employee sick days, and reduced environmental impacts. The VT AQCD will work with stakeholders in the PM Advance focus area to raise awareness and enhance participation in this free program.

4.2. Voluntary and Incentivized Emissions Reduction Programs

- **Vermont Clean Diesel Grant Program** - The U.S. Environmental Protection Agency awards grants under the Diesel Emissions Reduction Act (DERA) to assist States in their efforts to develop diesel emission reduction programs. The Vermont AQCD developed the Vermont Clean Diesel Grant Program to provide technical assistance and incentive funding for projects that reduce diesel emissions from engines, vehicles, and equipment in the state with the goals of reducing public exposure to emissions from diesel-powered engines and the associated risks to public health and the environment.[28] With the aid of the DERA funds, the VT AQCD has funded more than a dozen successful diesel reduction projects since 2013, with several in the Rutland area. Continued allocation of DERA funds from EPA to Vermont will make it likely to achieve further diesel-related PM and precursor emissions reductions for projects statewide, and potentially in the PM Advance focus area(s).

- **Volkswagen (VW) Environmental Mitigation Trust** - On June 28, 2016, the U.S. Department of Justice filed with the U.S. District Court, Northern District of California, a Partial Consent Decree that resolves claims against Volkswagen (VW) for violating the Clean Air Act by selling approximately 500,000 vehicles containing 2.0-liter diesel engines equipped with devices designed to defeat emission controls. These defeat devices caused increased emissions of nitrogen oxides (NOx), resulting in adverse impacts to air quality and increased risk of associated health impacts such as impairment of lung function and cardiovascular health. On October 25, 2016, the Court approved the Partial Consent Decree that requires VW to (among other obligations) establish and fund a $2.7 billion environmental mitigation trust. Vermont's allocation of this trust amounts to $18.7 million. The purpose of the environmental mitigation trust is to fund eligible mitigation actions that replace mobile diesel

[27] Vermont Idle-Free Fleets website: http://dec.vermont.gov/air-quality/mobile-sources/be-idle-free
[28] Vermont Clean Diesel Grant Program website: http://dec.vermont.gov/air-quality/mobile-sources/diesel-emissions/vt-clean-diesel-grant

emission sources with cleaner technology to mitigate the harm caused by the excess NOx (a $PM_{2.5}$ precursor) emitted by the affected VW vehicles. Since the funded projects will be mobile sources, the resulting reduction in $PM_{2.5}$ and precursor emissions would be experienced wherever the vehicle / equipment operated, potentially including PM Advance area(s).

- **Additional Wood Stove Change-Outs –** There is broad support for implementing additional voluntary change-out programs to accelerate retirement of higher-emitting, uncertified wood heating appliances. In addition, such programs will be a key component of managing potential air quality impacts that may arise due to anticipated substantial increases in new installations of advanced wood heating appliances in accordance with the aggressive goals of the statewide 2016 Comprehensive Energy Plan.

  The Vermont Agency of Natural Resources has supplied the Clean Energy Development Fund of the Vermont Public Service Department with $100,000 for a limited-income change out program to occur in Rutland County and surrounding area. The funding will be added to an existing fund of $500,000 for a program that also includes weatherization. The Vermont AQCD assisted the Public Service Department with the design of the project which incentivizes EPA-certified pellet and cordwood stoves with certified emissions ratings of ≤ 2.0 grams/hour of particulate matter and have an efficiency rating of at least 70%. The program began in 2018. Additionally, the Vermont Legislature has earmarked $200,000 in the 2019 budget to be used for wood stove change outs. The AQCD will play a large role in the design and potentially the implementation of the future program.

  The Vermont AQCD also will be conducting additional outreach and education efforts in conjunction with any future change out programs. This effort will not only ensure that high-emitting heating units are removed from service, but also that those individuals receiving certified units are aware of the proper operating procedures as well as the importance of a dry, clean fuel supply.

4.3. Targeted Compliance / Enforcement

- **Increased Wood Heater Compliance and Enforcement** - On December 15, 2016 the Vermont AQCD adopted and amended the Vermont Air Pollution Control Regulations at §5-204 for Wood Stoves and Central Heaters. The state regulations were adopted to reflect the amendments to the federal Standards of Performance for New Residential Wood Heaters, New Residential Hydronic Heaters, and Forced-Air Furnaces (NSPS) at 40 CFR part 60, subparts AAA and QQQQ. On October 27, 2017 Vermont became one of the first states in

the nation to receive partial delegation to implement and enforce specific provisions of the NSPS including; improper installation/ operation, advertisement, or sale of uncertified heaters, as well as several labeling requirements.

- **New Source Performance Standards (NSPS) Factsheets** - As part of this effort the AQCD drafted several NSPS related factsheets specific to each type of wood heater, as well as wood pellet manufacturing. Additionally, the AQCD performed extensive outreach to all of Vermont's manufacturers and dealers of wood heaters and wood pellet producers to ensure that the requirements of the NSPS were understood. The AQCD now has an active inspection program for dealers of wood heaters to ensure that no uncertified heaters are sold in Vermont and all proper labeling requirements are fulfilled.

4.4. Monitoring & Measurement

- **Prioritization of Other PM Advance Areas** - The Path Forward includes identification of other valley areas where periodic elevated ambient particulate concentrations may occur. Identification of additional areas is hampered by the absence of monitoring infrastructure in most areas of the state. However, the AQCD plans to explore whether other currently available or easily acquired information can be used to identify other areas of the state at risk of elevated particulate concentrations. Resources currently under evaluation include:

  - EPA Valley ID and Valley Profile Tool
  - The EPA National Emissions Inventory (NEI)
  - VT Residential Fuel Assessment Surveys
  - PM data from neighboring areas outside of Vermont
  - U.S. Census data regarding households that rely on wood heat
  - Satellite and other remote sensing data
  - Use of portable PM monitors

  The EPA Valley ID Tool provides a useful base of information to undertake this identification effort. The AQCD is exploring utilizing additional information regarding emissions and fuel use at the county (from the National Emissions Inventory and the VT Residential Fuel Assessment Report) and census tract level (from the U.S. Census Bureau) to further refine the list of possible areas to investigate. For example, the number of wood-burning households in a valley area is likely to impact the fine particulate matter concentrations in that area. U.S. Census data are available to identify communities with a higher reported use of wood as heating fuel. In addition to the Vermont ambient air quality monitoring network, there are monitoring stations in Lebanon (adjacent to White River Junction, Vermont) and Keene, New Hampshire that may be useful in strengthening

our understanding of the relationship between meteorological conditions, emissions, and $PM_{2.5}$ concentrations.

The VT AQCD also has begun to conduct short-term deployments of a portable particulate and meteorological monitoring device (a.k.a. "the wood smoke kit") and has plans to acquire a second portable monitoring setup during 2018. Temporary deployments of these portable units will facilitate a better understanding of temporal and spatial distribution of PM in additional priority locations that lack more comprehensive fixed monitoring stations. Simultaneous short-term deployments of portable monitors in a deep valley location, and at a nearby location outside of the valley will be one way to gather important information about the types of locations prone to elevated PM events, as well as the degree of spatial variability in PM concentrations. Deployments may result in identification and characterization of additional important local PM emissions sources (e.g., dust from roads / construction / agricultural activities, commercial cooking, on-road and nonroad fuel combustion, etc.) and development of associated effective strategies to reduce PM emissions from these sources.

Finally, satellite remote sensing data describing aerosol optical depth may provide an additional source of data in unmonitored areas. The VT AQCD will continue to examine these and other data sources to develop methods to identify additional areas that may be impacted by elevated levels of fine particle pollution.

- **Document Relevant Actions and Estimate Emissions Reductions** - The VT AQCD will work to develop ongoing estimates of expected emissions reductions of $PM_{2.5}$ and precursor emissions from relevant newly-implemented programs and actions (e.g., wood stove changeouts, diesel emissions reduction projects, etc.). As part of Vermont's 5-year PM Advance Plan, the AQCD will report annually to EPA on the relevant programs and actions implemented and associated expected emissions reductions. The annual update will also include any newly available information regarding PM and precursor emissions inventory and ambient air quality data in the Advance focus area(s).

4.5. Timeline

As part of Vermont's commitment, the PM Advance Path Forward, the following draft activities and timeline are proposed. It is important to note that efforts are likely to evolve over time to reflect discussions with stakeholders, readiness of new technologies, availability of funding, changes to regulatory / legal frameworks, etc.

2018

- Spring 2018

- Submit initial PM Advance Path Forward to EPA.
- Utilize available tools and data to identify and prioritize additional PM Advance Focus areas.
- Conduct focused short-term portable PM monitoring studies to begin to determine the spatial and temporal extent of elevated PM concentrations using the portable "wood smoke kit".
- Acquire an additional portable PM monitor, and develop a prioritized plan for deploying all portable monitoring equipment.

- Summer / Fall 2018

  - Begin outreach to and coordination with interested stakeholders in Rutland, VT, and other valley locations as identified.
  - Anticipated implementation of woodstove change-out program in the Rutland area.
  - Investigate spatial and temporal distribution of PM concentrations and emissions source categories during months outside of the heating season using portable PM monitoring equipment.

2019

- Winter 2018-19

  - Continue conducting short-term deployments of the portable PM monitor at locations of interest to expand our understanding of the spatial and temporal extent of elevated PM concentrations, as well as key emissions sources.
  - Analyze data collected with the portable monitors and summarize key findings.
  - Estimate PM and PM precursor emissions reductions achieved in the PM Advance area(s) as a result of relevant actions and projects implemented during 2018.

- Spring 2019

  - Submit PM Advance Path Forward Update to EPA.