

# *PM ADVANCE*

## *PATH FORWARD UPDATE*

for RUTLAND, VERMONT  
(AND OTHER MOUNTAIN VALLEY AREAS)

September 2021



DEPARTMENT OF  
ENVIRONMENTAL CONSERVATION  
AIR QUALITY AND CLIMATE  
DIVISION

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## 1.0 INTRODUCTION

The Vermont Department of Environmental Conservation Air Quality and Climate Division (AQCD) submitted a PM Advance Path Forward to the U.S. Environmental Protection Agency in April 2018. The Path Forward identified Rutland, Vermont as a primary area of focus due to its location in a mountain valley, its relatively high population density, and the presence of a permanent air quality monitoring station which has observed the occurrence of periodic air quality issues (e.g. particulate matter, or PM<sub>2.5</sub>). The Path Forward also proposed to utilize resources such as EPA's Valley Identification Tool, in conjunction with the Valley Profile Tool, portable air monitoring equipment and other resources to identify additional mountain valley population centers that are likely to experience an elevated concentration of particulate matter air pollution, e.g. wood smoke emissions.

This report presents updated trends in Rutland for particulate matter concentration and a status update of Path Forward activities and planned activities for the winter seasons of 2018/19, 2019/20 and 2020/21. Please refer to the April 2018 Path Forward for more discussion of the program background and objectives.

## 2.0 RUTLAND AIR QUALITY UPDATED TRENDS

Since the initial Path Forward, data for 2016, 2017, 2018 and 2019 has been obtained; Rutland experienced more total "good" Air Quality Index (AQI) days than in any of the preceding years (2008-2015) (Figure 1). The average number of "good" days per year for the last four years has improved, compared to the entire 2008-2015 period. PM<sub>2.5</sub> was the criteria pollutant that contributed to the majority of the air pollution on moderate days, when they occurred. While fewer days had concerning PM<sub>2.5</sub> pollution in the last several years on average, there were still days where levels of pollution posed a concern for especially sensitive individuals.

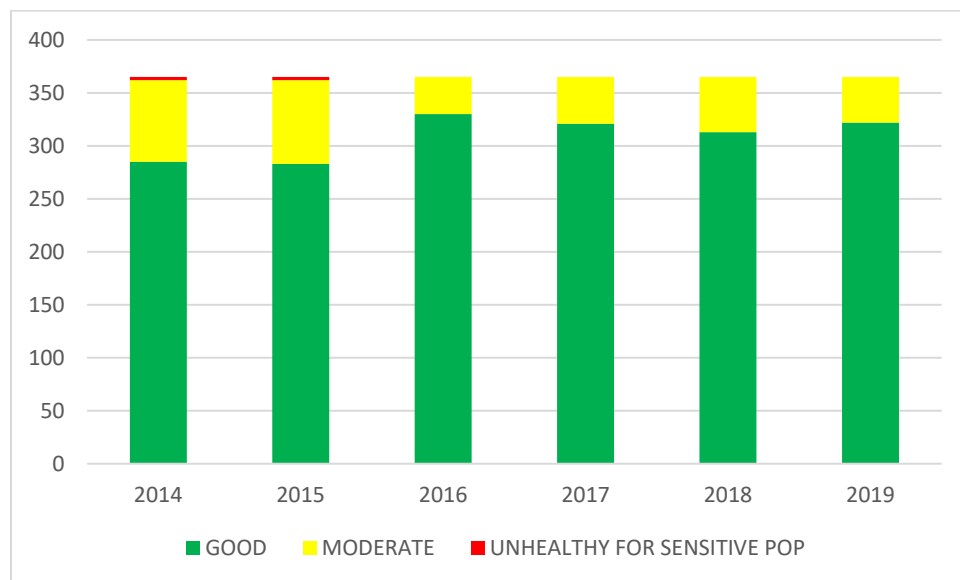


Figure 1. Rutland AQI days by category, 2008-2018.

### 3.0 SUMMARY AND STATUS OF VERMONT PM ADVANCE PLAN FORWARD ACTIVITIES

Following are the activities proposed in the April 2018 Path Forward and their current status:

**1. *Submit initial PM Advance Path Forward to EPA.***

The AQCD submitted a PM Advance Path Forward to EPA in April 2018.

**2. *Utilize available tools and data to identify and prioritize additional PM Advance Focus areas.***

AQCD staff developed a spreadsheet ranking geographical focus areas based on the population living in the valley. The top 12 municipalities with greatest population (and their related population density) within the valley-area defined by the EPA Valley Tool are shown in Table 1. Many small valleys with low population may have greater cumulative exposure to unhealthy levels of woodsmoke, if the density of older or poorly performing wood appliances is higher; while they are of concern, it is currently unknown if this is true. Consequently, ranking by population and population density was used to prioritize the initial selection of communities for potential short-term monitoring, to ascertain if PM<sub>2.5</sub> from woodsmoke is of concern in these valley communities.

**Table 1.** A selection of PM Advance focus areas in Vermont, including the top 12 with the greatest populations within GIS-defined valley areas. Ordered in decreasing population.

<b>Town name</b>	<b># of people in the valley</b>	<b>Pop density in the valley (persons/mi<sup>2</sup>)</b>
RUTLAND CITY	15940	3771
BENNINGTON	14249	1937
BRATTLEBORO	10170	3065
BARRE CITY	8171	5618
HARTFORD	6190	1207
MONTPELIER	5615	2667
ST. JOHNSBURY	5496	2169
SPRINGFIELD	5324	1695
NORTHFIELD	4795	1493
WATERBURY	4184	1066
ROCKINGHAM	3700	1177
BRISTOL	2848	1179

**3. *Conduct focused short-term portable PM monitoring studies to begin to determine the spatial and temporal extent of elevated PM concentrations using portable PM monitors.***

This work was done for the 2017/2018 winter monitoring season. AQCD staff acquired a portable particulate monitoring kit from the Maine Department of Environmental Protection via the Northeast States for Coordinated Air Use Management (NESCAUM) in 2017. The monitoring kit included a particulate monitor/data logger (Thermo pDR 1500),

a meteorological sensor (Gill WindObserver II), a Windows 7 mini PC and a wireless router enclosed in a heated weatherproof case.

The portable PM monitor was first deployed collocated with the AQCD permanent monitoring station in Rutland and in four other communities (Barre, Northfield, Waterbury and Montpelier) from December 2017 through February 2018. In two communities (Waterbury and Montpelier) there were sequential in-valley and out-of-valley deployment in adjacent weeks to explore differences in these locations, and the differences observed were in alignment with the valley effect.

**4. *Acquire an additional portable PM monitor.***

This work was done for the 2018/2019 winter monitoring season. Based on the design of the portable PM monitor kit acquired from Maine and with surplus parts from the New York Department of Environmental Conservation, AQCD staff assembled a second portable monitoring kit in 2018. The kit components included a particulate monitor/data logger (Thermo pDR 1500), a meteorological sensor (Lufft WS-500 UMB), a Windows 10 mini PC and a wireless router enclosed in a heated weatherproof case.

This second portable PM monitor (Thermo pDR 2) was deployed along with the first one (Thermo pDR 1) to four communities from December 2018 through April 2019. Most of these communities were those that had the highest population density in their valleys.

**5. *Develop a prioritized plan for deploying all portable monitoring equipment.***

As mentioned above, AQCD staff developed and executed a monitoring plan for the 2018-2019 heating season. The plan included a 12-day colocation at the Rutland monitoring station in late November/early December 2018 and multiple week monitoring events at state owned properties in Barre, Montpelier, Bennington, and Brattleboro. Results and analysis are presented in the Monitoring Results Summary (see Section 4 and Figure 3) of this report.

**6. *Begin outreach to and coordination with interested stakeholders in Rutland, VT and other valley locations as identified.***

Stakeholder engagement was initially envisioned to identify possible monitoring locations and to develop a plan for sharing the results of the monitoring events. Due to access to power and equipment security issues, the 2018-2019 monitoring plan limited locations for consideration to State office buildings in the communities of interest. Community stakeholder engagement will be pursued once sufficient portable monitors without the same siting limitations are available to be deployed, following a detailed study proposal.

**7. *Anticipated implementation of a woodstove change-out program in the Rutland area.***

In late 2016 the Vermont Department of Public Service and the Department of Environmental Conservation implemented a wood stove change out program. See Table 2 for the number of woodstove change-outs in the PM Advance focus areas. Due to the variability of the types of stoves, the amount of wood burned in them, and other factors

it is not possible to estimate the actual emission reduction due to the upgrades in wood-burning equipment. However, information from EPA's Burn Wise website estimates 75% reduction of PM emitted per residence. The program offered rebates of up to \$1,500 for the replacement of an in-use wood stove with a new EPA certified appliance. For the period December 2016 through March 2017, the program provided rebates for replacement of 267 wood stoves around the state totaling \$331,750. The departments implemented a subsequent change-out grant program in November 2018. The program provided incentives for replacement of in-use non-EPA certified stoves with a new EPA-qualified cord wood (\$800 incentive) or pellet (\$1,000 incentive) stove. An incentive of \$100 was also offered for replacement of catalytic stove catalysts. For the period October 2018 through June 2019 the program provided incentive payments for installation of 97 EPA-qualified cord wood stoves and 30 pellet stoves totaling \$107,600. In addition, 11 catalysts were replaced with incentives totaling \$1,100. In our communities of interest identified in Table 1, a total of 39 units were replaced with EPA certified appliances over this two-year period.

**Table 2.** Number of woodstove change-outs in PM Advance focus areas.

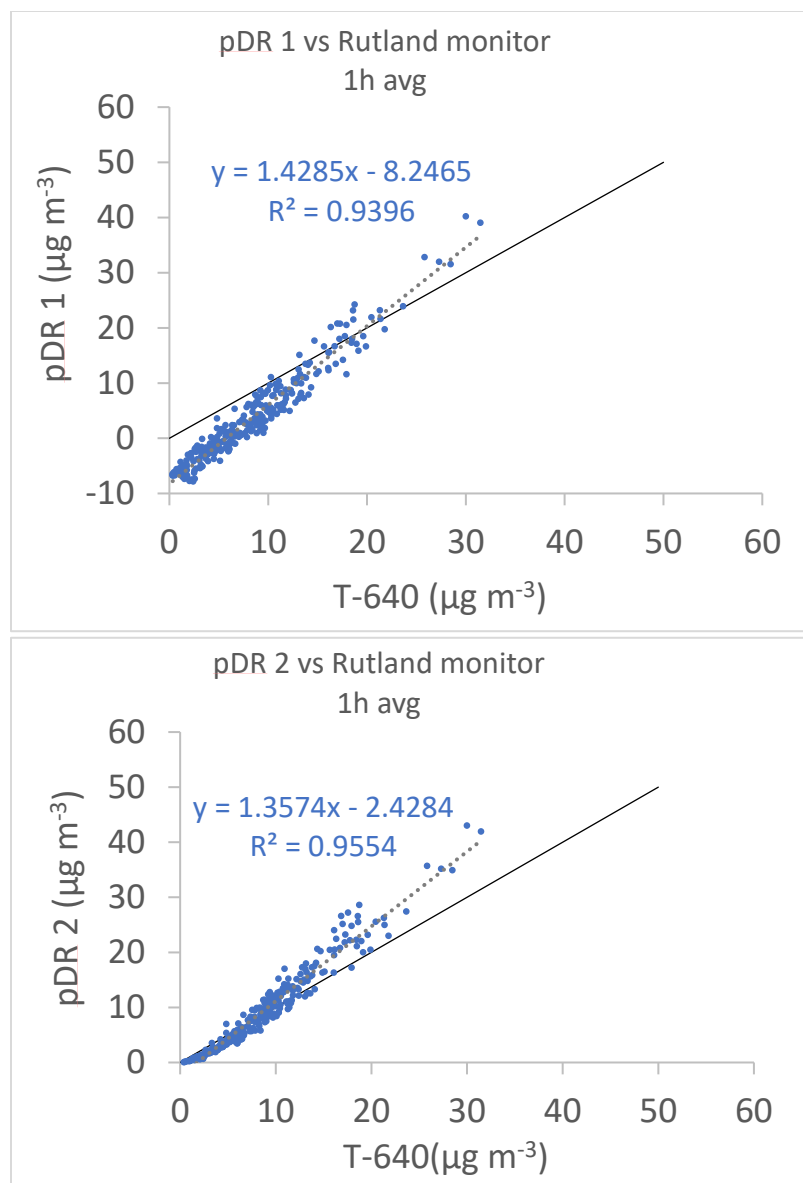
<b>Town name</b>	<b>Dec 2016 – Mar 2017</b>	<b>Oct 2018 – Jun 2019</b>
RUTLAND CITY	3	0
BENNINGTON	3	1
BRATTLEBORO	3	0
BARRE CITY	2	2
HARTFORD	0	0
MONTPELIER	5	0
ST. JOHNSBURY	2	1
SPRINGFIELD	0	3
NORTHFIELD	3	1
WATERBURY	1	4
ROCKINGHAM	0	0
BRISTOL	4	1

**8. Investigate spatial and temporal distribution of PM concentrations and emissions source categories during months outside of the heating season using portable PM monitoring equipment.**

The portable PM monitoring kits mount the kit components inside a fully enclosed weatherproof case. The case is heated for wintertime operation but is not sufficiently vented for warm weather deployment. Therefore, portable PM kit deployment outside of the heating season was cancelled. Additional work is needed to determine what modifications to the kits would be required to deploy them outside of heating season, or if other portable PM monitors would be more useful for warm seasons.

## 4.0 MONITORING RESULTS SUMMARY FOR 2018/2019

First, we determined how closely the portable PM monitors compared with the permanent PM monitor in Rutland. Results from a colocation study between the two portable PM monitors and the TSI T-640 (Federal Equivalent Method) monitor at the AQCD permanent monitoring station in Rutland showed good agreement between the different instruments (Figure 2). All three instruments responded similarly to variations in PM<sub>2.5</sub> concentration, both in terms of timing and magnitude. The 1-h average concentrations measured by the Thermo pDR 1 and pDR 2 showed an excellent correlation with concentration measured by the permanent monitor ( $R^2$  of 0.94 and 0.96, respectively – see charts below). The two pDR units showed a linear response ( $R^2 = 0.99$ ), but with a systematic bias that was corrected by subtracting the intercept ( $-0.0526 \mu\text{g m}^{-3}$ ) from all pDR 1 measurements. For more details about the methods used for data correction, see “Rutland Colocation\_2018” (Appendix A).





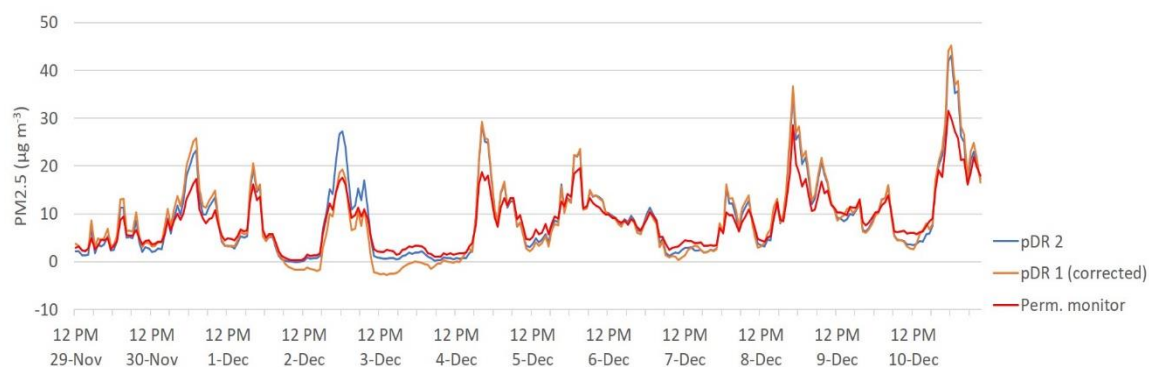


Figure 2. One-hour average ambient concentration of PM<sub>2.5</sub> measured during the colocation of two portable PM monitors (Thermo pDR-1500, in orange and blue) with the Federal Equivalent Method instrument (TSI T-640, in red) in Rutland, VT from November 29 to December 11, 2018.

Once it was established that good agreement existed among both portable and permanent PM monitors, analysis of the data from the five valleys could be evaluated. The PM<sub>2.5</sub> concentration measured with the portable monitors in four valleys (Barre, Montpelier, Brattleboro, and Bennington) was similar to the levels measured at the Rutland permanent monitoring station during the same time period (Figure 3), with similar PM<sub>2.5</sub> variations over time, both in terms of pattern and magnitude. These results indicate that Rutland is representative of other populated valleys in Vermont and suggest that most valleys in the state also experience high PM<sub>2.5</sub> levels during cold, clear, and calm weather conditions.

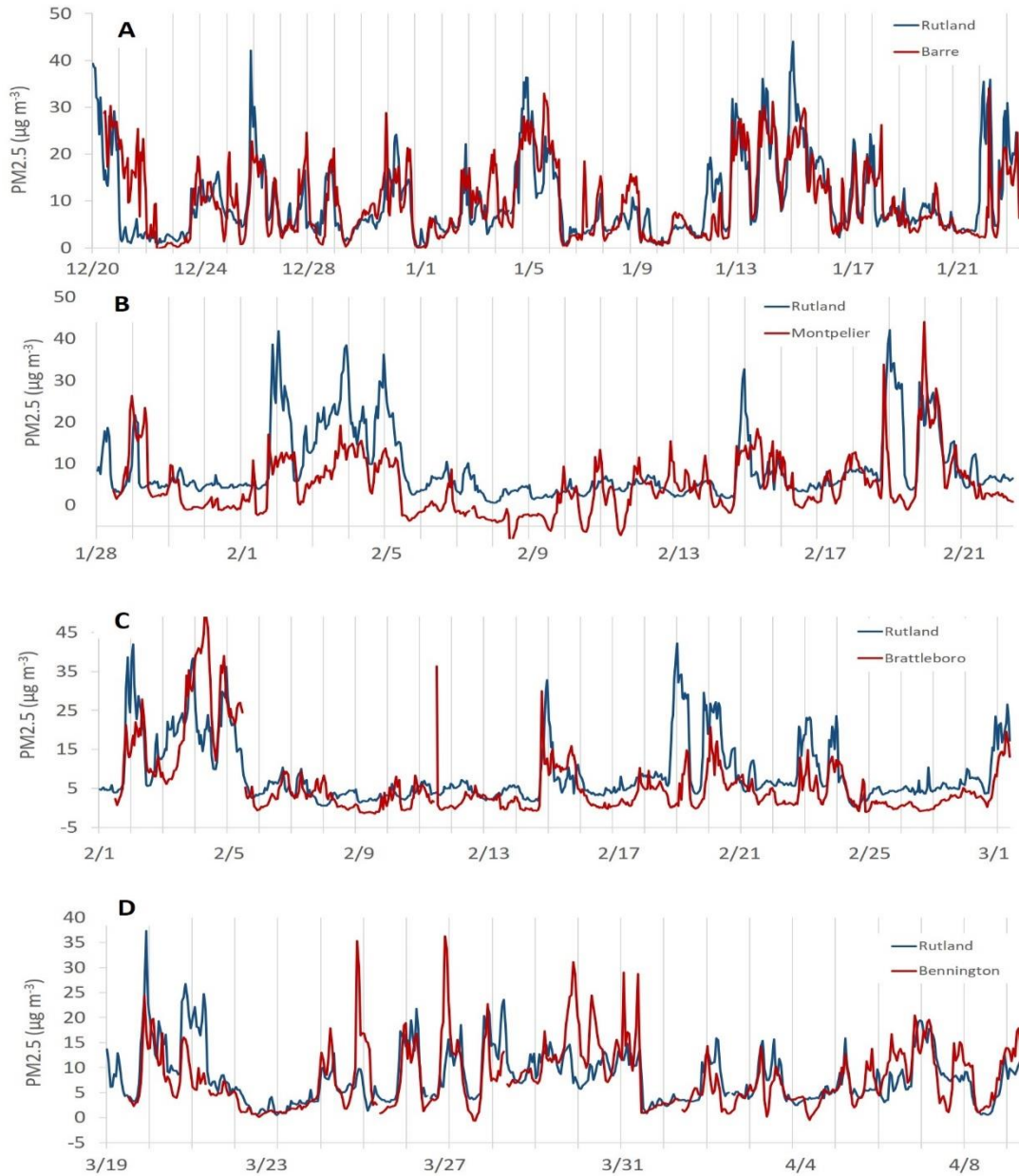


Figure 3. Comparison between ambient PM<sub>2.5</sub> concentrations measured by the TSI T-640 instrument at the permanent monitoring station in Rutland (in blue) and by one of the two portable Thermo pDR-1500 monitors deployed at different valley locations (in red) during the same time period.

A) pDR 2 located in downtown Barre, on the roof of the 3-story Washington County Courthouse at 255 North Main Street from Dec 20 through Jan 23, 2019.

B) pDR 1 located in downtown Montpelier, on the rooftop of a one-story state-owned building at 10 Taylor Street from Jan 28 to Feb 22, 2019.

C) pDR 2 in Brattleboro on the roof of a 2-story state-owned building at 232 Main Street from Feb 1 to March 1, 2019.

D) pDR 1 in downtown Bennington on the second-floor roof of a state-owned building at 234 Main Street from March 19 to April 9, 2019.

## 5.0 ACTIVITIES 2019-2020

These activities were performed in the heating season of 2019/2020:

- With the assistance of EPA Region 1, Vermont DEC received ten Arisense monitoring units developed for the EPA Office of Research and Development (ORD) as part of the RESES Sensor Loan Project. Nine were deployed on the AQCD monitoring trailer in Rutland for a two-week collocation period. For the remainder of the season, two were deployed at different elevations in Montpelier; one was placed at street level at City Hall and the other at the second floor level at the Pavilion Building. More sensors were planned for deployment on streetlamp poles around the Montpelier valley area, however it became known late in the planning process that power was supplied through a photocell activated switch that would limit monitoring to the nighttime hours, therefore those deployments were cancelled.
- Performed Thermo pDR-1500 monitoring kit maintenance and upgrades for deployment to the Rutland Courthouse.
- Acquired and distributed moisture meters to public libraries in our focus communities for loan to the public, along with supplemental information regarding best practices for wood burning (provided on request from the EPA Burn Wise program). A press release in late September 2020 gave details to the public for obtaining the moisture meters from the libraries.

## 6.0 ACTIVITIES 2020-2021

These activities occurred for the heating season of 2020/2021:

- Performed necessary Thermo pDR-1500 monitoring kit maintenance and upgrades in preparation for the monitoring season. One of the kits was found to need a complete overhaul.
- Analyze elevational differences in PM, comparing Rutland permanent monitor with Courthouse data.
- Deployed the functioning portable Thermo pDR-1500 monitor in Northfield, for the entire heating season. Northfield was on the list of priority communities for which we have limited or no data.
- Continue working with the libraries to loan moisture meters to the public along with supplemental information regarding best practices (from Burn Wise program) and evaluate effectiveness of the program by collecting a count of meter check-outs or time in circulation from libraries.
- Prepare for Montpelier study in winter 2021/22, using Purple Air sensors.
- Finish analyzing data from the Arisense monitors deployed during the 2019/2020 season.

## 7.0 ACTIVITIES 2021-2022

These activities are planned for the heating season of 2021/2022:

- Implement Montpelier study fall 2021-spring 2022.