THE NEW HAMPSHIRE AMBIENT AIR MONITORING PROGRAM 2019/2020 ANNUAL NETWORK REVIEW and PLAN

New Hampshire Department of Environmental Services

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

R-ARD-19-02

THE NEW HAMPSHIRE AMBIENT AIR MONITORING PROGRAM 2019/2020 ANNUAL NETWORK REVIEW and PLAN

prepared by the
Air Monitoring Program

Robert R. Scott, Commissioner
Clark Freise, Assistant Commissioner
Craig Wright, Air Resources Division Director

State of New Hampshire Department of Environmental Services
Air Resources Division
29 Hazen Drive, PO Box 95,
Concord, NH 03302-0095
(603) 271-3503
www.des.nh.gov

Table of Contents

Table of Contents..... 3
List of Tables..... 4
List of Figures 4
Introduction 5

Part 1: 2019/2020 Annual Network Review and Plan 5
Monitoring Objectives..... 5
Network Summary 7
$PM_{2.5}$ Beta Attenuation Federal Equivalency Method (FEM) Monitoring..... 10
Network Modifications..... 12
Future Plans 12
Purchasing/Expenses 13
Personnel 17
Cooperative Air Monitoring Initiatives..... 17
Monitoring Trends 18

Part 2: Individual Station Information..... 29
Camp Dodge, Green's Grant..... 30
Mt. Washington Summit 31
Hubbard Brook, Woodstock..... 32
Lebanon Airport, Lebanon..... 33
Green Street, Laconia..... 34
Hazen Station, Concord..... 35
Exchange Street, Pembroke 36
Peirce Island, Portsmouth 37
Seacoast Science Center, Rye..... 38
Water Street, Keene..... 39
Moose Hill, Londonderry..... 40
Pack Monadnock Mountain 41
Gilson Road, Nashua 42

Appendix A: $PM_{2.5}$ Comparability Assessment 43

List of Tables

Table 1.0: Equipment – (Method) 14
Table 1.1: New Hampshire State and Local Air Monitoring Stations Network – 2018/2019 15
Table 1.2: New Hampshire Particulate Matter Network – 2018/2019 16
Table 1.3: New Hampshire PAMS Network – 2018/2019 16
Table 1.4: New Hampshire NCore Network – 2018/2019 16
Table 1.5: National Ambient Air Quality Standards 20
Table 1.6: NAAQS Exceedances in New Hampshire (2013-2018) 21
Table 1.7: Ozone Design Values 22
Table 1.8: Carbon Monoxide Design Values 22
Table 1.9: Sulfur Dioxide Design Values 22
Table 1.10: Nitrogen Dioxide Design Values 22
Table 1.11: Fine Particle Matter Design Values 22
Table 1.12: Seasonal Maximum 24-hour Averages at Londonderry for Toxic PAMS Species vs Ambient Allowable Limit (AAL), 2015-2018 25
Table 1.13: Seasonal Maximum 24-hour Averages at Pack Monadnock in Miller State Park for Toxic PAMS Species Compared to the Ambient Allowable Limit (AAL), 2006-2018 26

List of Figures

Figure 1.1: Current Air Monitoring Program Organizational Chart 17
Figure 1.2: Ozone trends for the 8-Hour NAAQS 23
Figure 1.3: Ozone trends for the 8-Hour NAAQS 23
Figure 1.4: Carbon Monoxide trends for the 1-hour NAAQS 23
Figure 1.5: Carbon Monoxide trends for the 8-hour NAAQS 23
Figure 1.6: $PM_{2.5}$ trends for the 24-Hour NAAQS 24
Figure 1.7: $PM_{2.5}$ trends for the 24-Hour NAAQS 24
Figure 1.8: $PM_{2.5}$ trends for the annual NAAQS 24
Figure 1.9: $PM_{2.5}$ trends for the annual NAAQS 24
Figure 1.10: Nitrogen Dioxide trends for the 1-hour NAAQS 25
Figure 1.11: Lead trends for the primary NAAQS 25
Figure 1.12: Sulfur Dioxide trends for the 1-hour NAAQS 25
Figure 1.13: Sulfur Dioxide trends for the 3-hour NAAQS 25
Figure 1.14: PM_{10} trends for the 24-hour NAAQS 26
Figure 1.15: PM_{10} trends for the 24-hour NAAQS 26

Introduction

The New Hampshire Department of Environmental Services (NHDES) is pleased to submit this 2019/2020 Ambient Air Monitoring Program Annual Network Review and Plan in accordance with the *Code of Federal Regulations Title 40, PART 58.* Part 1 of this Plan reviews structure, objectives, history and data trends associated with NHDES' Air Monitoring Program (AMP). Part 2 of this Plan details individual air monitoring station information.

PART 1 – 2019/2020 Annual Network Review and Plan

NHDES continually revisits basic air monitoring fundamentals and efficiency initiatives to allow for reliable, high quality data capture and analysis within a tight budget. Key objectives remain to provide quality ambient air data in order to:

- Determine attainment status with the National Ambient Air Quality Standards (NAAQS, see Table 1.1).
- Guide future air quality policy decisions at the state and national level.
- Protect public health through forecasting and real-time mapping and air pollution alert initiatives.

Tables 1.8 through 1.11, presented later in this section, summarize the current status of the New Hampshire ambient air monitoring network – July 2017 through June 2018.

Monitoring Objectives

In accordance with the NHDES mission "to help sustain a high quality of life for all citizens by protecting and restoring the environment and public health in New Hampshire," NHDES operates a network of air monitoring sites throughout the state. These sites facilitate monitoring of ambient ozone (O_3), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), volatile and semi-volatile organic compounds (VOCs), carbon monoxide (CO), lead (Pb) and particulate matter chemistry (PM, $PM_{2.5}$, PM_{10}). Air monitoring data from NHDES' network helps assess air quality within New Hampshire, evaluate the status of air quality coming from areas upwind and also helps assess our contribution to downwind areas. These data combined with similar data collected in other states allow NHDES to predict air pollution episodes, enact protective actions and warnings, develop and assess effectiveness of emission reduction strategies and support health assessments and NAAQS reviews.

Ambient air pollution monitoring began in New Hampshire in the 1970s at a few locations. Over subsequent years, it grew to the point where each of the state's 10 counties hosted monitoring stations for air pollutants known to exist in the area. Over time, local industrial facilities either established pollution controls or shut down, resulting in improvements in air quality in those counties. For example, paper mills in Coos County emitted fairly high levels of sulfur dioxide and particles, resulting in periodic unhealthy air quality. Many of these facilities have since shut down and the air quality has improved to the point that there is no longer the need for monitoring in the area. Accordingly, NHDES has reallocated monitoring resources. However, NHDES continues to track emission inventories and reports of health concerns in these areas in order to assess any potential need to reestablish air monitoring infrastructure. In recent years, NHDES has coordinated with USEPA to streamline the

monitoring network in order to meet demands for ever increasing efficiency with limited resources. NHDES has given careful consideration to how the need for efficiency would affect network consolidation while maintaining adequate public protection and the ability to track progress.

The current New Hampshire ambient air monitoring network is carefully configured based on air pollution emission patterns to provide air quality data in populated areas which are potentially at risk for unhealthy air quality of one or more pollutants. Most populated areas are represented by an air monitoring station unless previous monitoring has demonstrated that either the community is not considered to be at risk or can be adequately represented by a nearby monitor. NHDES also considered topography, geographic coverage and air pollution modeling in the current network design.

Now, in 2019, most of the major pollution sources that are in operation in New Hampshire are generally well controlled. Areas of continued concern are mobile and area sources where population density and highway networks are dense enough to multiply the emissions of relatively small individual sources hundreds of thousands of times over. The cumulative emissions are greatest in the southeastern portion of the state where population and highway densities are greatest. This region is generally bounded by the Massachusetts state line to the south, Nashua and Manchester to the west, Concord to the north, and Rochester and Portsmouth to the east. This same region is also the most exposed portion of the state to air pollution transport, which generally crosses the southeastern part of the state from southwest to the northeast and along the New Hampshire coastline. Populated valley communities where wood burning is commonly used for residential heating are also being closely watched for $PM_{2.5}$ during cold weather seasons.

Pollutants of most concern in these areas in 2019 include ozone, ozone precursors (nitrogen oxides (NOx) and VOCs), $PM_{2.5}$ and SO_2. The New Hampshire monitoring network is densest in the southern portion of the state to reflect potential air quality concerns in heavily populated regions with diverse geography. While the greatest risk of unhealthy air quality occurs in these portions of New Hampshire, unhealthy air quality events can occur anywhere in the state for ozone and small particles. Accordingly, the monitoring network for these pollutants extends into all portions of the state. Small particles also lead to visibility impairment, and there are federal regulations to track visibility progress with a special kind of speciation monitoring (IMPROVE) near the Class I airsheds (Great Gulf Wilderness and Presidential Dry-River Wilderness) located adjacent to Mt. Washington in northern New Hampshire. Additional IMPROVE network monitors have been added at the NHDES NCORE locations (Londonderry and Miller State Park in Peterborough).

As part of the 2015 8-hour O_3 NAAQS implementation, USEPA requires states located within the Ozone Transport Region (OTR) to submit an Enhanced Monitoring Plan (EMP) by October 2019. This plan was submitted with NHDES' previous Network Review and was approved by EPA in October, 2018. States within the OTR are continuing to collaborate on a plan that addresses the scope of the ozone problem within the region.

Network Summary

Below is a brief summary of the New Hampshire Air Monitoring network as of May 2019 and the role each station plays for public protection. The list is presented alphabetically by community.

Concord

The Concord monitoring site is primarily intended to track ozone, the only criteria pollutant for which recent air monitoring and modeling has indicated possible population exposure to unhealthy levels. A previous Concord monitoring station was located in the valley near Interstate 93, but was moved to reduce the risks of NOx scavenging caused by nearby freeway traffic emissions and effectively lowering the measured ozone levels in the immediate area. The Hazen Drive site has the advantage of being in close proximity to the NHDES main office, for both outreach opportunities and ease of maintenance. It is also in the proximity of residential neighborhoods, retirement communities and schools. NHDES initiated SO_2 monitoring at this station in October 2010 to help quantify local SO_2 levels relative to the new SO_2 NAAQS. This monitoring was then discontinued at the end of 2016 due to low concentrations measured. The Concord Hazen Drive station represents population on a neighborhood scale.

Greens Grant – Mt. Washington base

The Greens Grant, Camp Dodge ozone monitor at the base of Mt. Washington is now the primary monitor representing the northern portion of New Hampshire. NHDES contracts with the Appalachian Mountain Club for general support and operation of the ozone monitoring at this station. This monitoring location is also important since it represents two federally recognized Class I airsheds, which also require IMPROVE visibility monitoring. Personnel from the US Forest Service's White Mountain National Forest operate the IMPROVE sampler. NHDES tracks $PM_{2.5}$ levels measured by the IMPROVE monitor for the purpose of estimating current exposures and the demand for more comprehensive $PM_{2.5}$ monitoring. NHDES consolidated previous monitoring in the North Country (Pittsburg and Conway) at Camp Dodge due to the high correlation between sites, low population densities, and low risk of exposure to unhealthy air quality. This station represents population exposure on a regional scale. On the other hand, Mt. Washington summit is a research oriented station and is not representative of general public exposure in communities located in New Hampshire's northern counties. Any attempt to apply Mt. Washington summit data in that way can result in misleading conclusions.

Keene

The monitoring station in the city of Keene tracks ozone and $PM_{2.5}$ on a continuous basis. The southwest portion of the state can experience a few days per year when ozone and $PM_{2.5}$ concentrations have the potential to reach unhealthy levels. NHDES installed a continuous $PM_{2.5}$ monitor at this station in September 2007 to better track the risks of wintertime wood smoke accumulation which is a product of residential heating in the community. Keene is a prime example of a city distinguished by the factors, such as population density, woodstove use, and valley topography that are necessary for these winter events. Other nearby communities may be similarly affected. The continuous $PM_{2.5}$ equipment has been invaluable in better understanding the winter $PM_{2.5}$ events and improving air pollution forecasts for the area. The data measured for ozone and non-winter $PM_{2.5}$ are considered valuable on a

regional basis, and the data for winter $PM_{2.5}$ is considered non-regional. This station represents population exposure on a neighborhood scale.

Laconia

The Laconia monitor tracks ozone and $PM_{2.5}$ in the "Lakes Region" of the state. The population of this area swells during the summer months with tourists. The monitor represents the very northern edge of the Boston CMSA (combined metropolitan statistical area) and periodically experiences elevated ozone and $PM_{2.5}$ concentrations. This station represents population exposure on a regional scale for ozone and non-winter $PM_{2.5}$, and on a neighborhood scale for winter $PM_{2.5}$. As part of a special study, a temporary monitoring station was operated at Wyatt Park from October 2016 through April 2017 and at Memorial Park from October 2017 to April 2018 to assess wood smoke concentrations in the community. Additional $PM_{2.5}$ measurements were made in and nearby Laconia with mobile monitoring technology during winter 2018-2019.

Lebanon

The Lebanon monitoring station is sited to provide population and regional based monitoring for the Lebanon/White River Junction (VT) metropolitan area with information on regional ozone and $PM_{2.5}$. This site is also important since it represents the consolidation of the closed Claremont (ozone) and Haverhill (ozone and $PM_{2.5}$) monitoring stations. The station is located on a ridge at the Lebanon airport, just above the river valley. The site was chosen primarily to represent the regional exposure, and the station is important to the New Hampshire network for its geographic coverage. This station represents population exposure on a regional scale.

Londonderry

The Londonderry station came online January 1, 2011, as an NCore superstation measuring a wide selection of pollutants. NHDES worked closely with USEPA to carefully select this site for its central proximity to the highly populated southeastern suburban portion of New Hampshire. The site has no nearby emission sources of significance, but lies in the air pollution transport corridor that crosses the southern portion of the state. The site is expected to track a number of potentially unhealthy ozone events each year. NHDES relocated photochemical assessment monitoring (PAMS) from Nashua to this station in April 2015 and is the required PAMS site for NH. PAMS measures important precursors to the development of ozone. These precursors include a wide variety of volatile organic compounds and nitrogen oxides. Changes to the site are documented in the Network Modifications section in accordance with the new PAMS site requirements taking place for the 2019 PAMS season. Being a multi-parameter station located in an area representative of a large population living in the northern suburbs of Boston, as well as between the major population centers of Nashua and Manchester, the data collected at this site will be ideal for future research and health-related analysis. This station also pairs with the Pack Monadnock NCore station to give the low elevation perspective as compared to Pack Monadnock's high elevation data for similar air masses transported into the area. This station represents population exposure on a regional scale.

Mt. Washington – Summit

The Mt. Washington summit monitoring site is of special value for scientific research for tracking ozone transport. The summit is located at 6,288 feet above sea level and is far away from any significant pollution sources; thus it is ideal for picking up long-range pollution transport into the northern portion of the state. The data are often compared to the data collected at Greens Grant (Camp Dodge) located at the base of the mountain, just a few miles to the east, to give a vertical gradient perspective. Ozone levels measured at the summit are normally higher than measured at the base and occasionally reach unhealthy levels. This station provides valuable high elevation data on a regional scale, but should not be considered representative of population exposure in nearby communities at lower elevation. Based on potential funding, trace level carbon monoxide measurements will be added at this location in 2019 under the Enhanced Monitoring Plan (EMP) to help differentiate ozone originating by manmade air pollution sources from ozone of natural (stratospheric) origin.

Nashua – Gilson Road

In past years, the Nashua area often saw the highest ozone concentrations in the state and thus there is an ongoing need to continue tracking ozone in this area. While this station is on the upwind side of the city of Nashua, it is critical to the network for tracking transport into the state and into the city of Nashua from the southwest. This station represents population exposure on a regional scale.

Peterborough, Pack Monadnock Mountain – Summit (Miller State Park)

NHDES has monitored several parameters at the Pack Monadnock station since 2002 and it became the state's second NCore site in 2011. The site's true value lies in the fact that it is located on a rural mountain top in the south-central portion of the state. At 2,288 feet above sea level, the station is ideally located to pick up the transport airflow from the heavily populated northeast urban corridor (Washington, D.C. to Boston) and is at the northern terminus of the low-level jet that begins near the middle of Virginia. This non-population-based monitor does not have nearby sources of significance. This site measures a wide variety of pollutants, including PAMS ozone precursors, IMPROVE, ozone, and $PM_{2.5}$. Due to its location and elevation, NHDES considers this station to be of high scientific value for transport measurements on a regional scale. When paired with data collected at Londonderry, Peterborough PAMS and $PM_{2.5}$ data provide a critical high-low cross section for regional photochemical models. Due to these unique characteristics, NHDES included continued PAMS operations at this location under the EMP.

Pembroke

The Pembroke monitoring station is located along the Merrimack River, just to the south of Merrimack Station power plant. The power plant is a large coal burning source which until recently caused relatively high levels of SO_2 at this monitor. While the power plant recently completed pollution control upgrades for SO_2, this station tracks progress in reducing emissions and measures exposure to SO_2 in a nearby community. This station represents population exposure to SO_2 on a local scale.

Portsmouth

The Portsmouth monitoring station is located on Peirce Island on the Piscataqua River just to the east of downtown Portsmouth. NHDES has been successful in establishing a long-term agreement for siting at its current location and has found the location to be suitable for tracking emissions from around the Portsmouth and Kittery (ME) areas. The station also picks up some sea breeze ozone events that work their way up the river. This station represents population exposure on a limited regional scale.

Rye

The Rye Monitoring station is located at Odiorne State Park. Its purpose is primarily to track summertime ozone events brought ashore by sea breezes. Past experience monitoring ozone in Rye found that these events sometimes result in measurements of ozone among the highest in the state. These events affect the coastline area and rarely penetrate more than a few miles inland. The data from this site are of scientific interest for air pollution flow dynamics when compared with data from Portsmouth station. This station represents a specific and limited population along the New Hampshire coastline for these periodic high ozone events.

$PM_{2.5}$ Beta Attenuation and API640 Federal Equivalency Method (FEM) Monitoring

NHDES operates several Met One 1020 BAMs (Beta Attenuation Monitors) and one API 640 (light scattering particle monitor) covering a total of six permanent stations. The API 640 is operated in Portsmouth, and the Met One 1020 BAMs (BAM) are operated at Keene, Laconia, Lebanon, Londonderry and Peterborough. The BAMs and API640 are classified as Federal Equivalent Methods (FEM) for PM monitoring. NHDES also operates Federal Reference Method (FRM) filter based samplers at Londonderry, Keene, Peterborough and Portsmouth in order to flesh out data comparison assessments between the continuous and filter based methodologies.

There are a number of factors that work against good correlation between FRM and FEM data. Some of these factors can be controlled by a monitoring organization and some cannot. NHDES continually strives to get better correlations through process control and limiting variables that we can control. However, there are basic uncontrollable differences between the FRM and FEM methods that work against good correlations. One key uncontrollable factor relates to volatiles and semi-volatile components in the air mass. Key differences between these two methodologies are based on the time between sample collection and sample analysis. The FEM BAM collects and analyzes each sample over discrete one hour time periods, whereas the FRM collects the sample over an integrated 24 hour period, with analysis performed several weeks later. This extended time period between sampling and analysis for the FRM likely allows volatile and/or semi-volatile compounds (when present) to leave the sample media prior to analysis – creating a negative bias when compared to the BAM. Please note information below relative to these data comparability assessments (FEM vs FRM) and declaration of primary sampler type for each station. For more information, see data Comparability Assessments in Appendix A and at: https://www.epa.gov/outdoor-air-quality-data/pm25-continuous-monitor-comparability-assessments.

Keene - The Met One 1020 BAM data at Keene remains primary toward the NAAQS. Any FRM data generated at Keene is considered secondary when BAM data are available. The 3-year data comparability assessment between FRM and FEM data is incomplete as NHDES discontinued FRM sampling in Keene during the 3rd and 4th quarters of 2017. Based on available data, individual seasonal data comparisons are outside acceptability limits. However all FRM and FEM data for the past three years (2016 – 2018) and 2018 data are within comparable acceptability limits. The three-year data set correlates with an overall R^2 = 0.77 and has an intercept of -1.45 micrograms per cubic meter (µg/m^3). The 2018 data set shows a progressive trend from the previous 2 years.

Lebanon - The Met One 1020 BAM data at Lebanon remains primary toward the NAAQS. Any FRM data generated at Lebanon is considered secondary when BAM data are available. The 3-year data comparability assessment between FRM and FEM data is incomplete as NHDES discontinued FRM sampling in Lebanon during the 3rd and 4th quarters of. Based on available data, the FRM and FEM data for the past three years falls within the additive vs. multiplicative bias acceptability limits for FEM testing. These data correlate with an overall R^2 = 0.83 and have an intercept of 0.08 µg/m^3. NHDES has not operated FRM samplers at this station since the 4th quarter of 2017 and does not plan on running FRM samplers routinely in the foreseeable future.

Laconia - The Met One 1020 BAM data at Laconia is primary toward the NAAQS. NHDES initiated continuous FEM monitoring at Laconia during the 4th quarter of 2018 with a BAM. There are no FRM vs FEM comparison data for the comparability assessment. NHDES does not plan to run FRM filters at this station in the foreseeable future.

Londonderry – The Met One 1020 BAM data at Londonderry remains primary toward the NAAQS. Any FRM data generated at Lebanon is considered secondary when BAM data are available. However, the FRM and FEM data for the past three years seems to be trending away from acceptability criteria. These data correlate with an overall R^2 = 0.58 and have an intercept of 1.46 µg/m^3. A number of laboratory filter weighing issues may have contributed to the poor correlations. Additionally, the BAMs in the network are getting aged and are beginning to show signs of instability. NHDES is seeking funding for more reliable continuous monitoring equipment for this station and the PM network as a whole. NHDES believes that the BAM data generated at Londonderry should remain primary towards the NAAQS, however, one should view these data with some uncertainty based on a number of factors including low concentration data, aged equipment, laboratory uncertainty and method differences.

Peterborough, Pack Monadnock Mountain – Summit (Miller State Park) - The Met One 1020 BAM at Peterborough remains primary toward the NAAQS. Any FRM data generated at Peterborough is considered secondary when BAM data are available. The FRM and FEM data from Peterborough are not within additive vs. multiplicative bias acceptability limits for FEM testing. This 3-year data set correlates with an overall R^2 = 0.50 and has an intercept of 0.95 µg/m^3. NHDES believes that the BAM data generated at Peterborough should remain

primary towards the NAAQS, however, one should view these data with some uncertainty based on a number of factors including low concentration data, aged equipment, laboratory uncertainty and method differences.

Portsmouth - The continuous FEM PM monitor in Portsmouth, Teledyne Model 602, started experiencing a number of operational issues during the 3rd and 4th quarter of 2018. For this reason, NHDES set-up and operated a demonstration (loaner) Teledyne Model 640 at Portsmouth starting in November 2018. During the 1st quarter of 2019, NHDES removed the Model 602 and has ordered a Model 640 to operate in Portsmouth; meanwhile, NHDES is reporting data generated by the loaner Model 640. Three-year data comparability assessment information between FRM and FEM data is incomplete at this station but NHDES is running FRM filter based samples every 12 days. API 640 data at Portsmouth will be primary toward the NAAQS. Any FRM data generated at this station is considered secondary when API 640 data are available.

Network Modifications

NHDES made the following modifications to the air monitoring network between July 1, 2018 and June 30, 2019.

PAMS – Starting in June, 2019 the PAMS required site in Londonderry will be in compliance with the monitoring requirements cited in in 40 CFR part 58. New instrumentation was purchased in 2018 with funds obtained from being an early adopter. The Markes Agilent system was operational for the 2018 PAMS season and will be used to monitor for VOC's in the future. The True NO_2 sampler was also purchased and installed in 2018. New for 2019, a ceilometer and carbonyl sampler were installed and started collecting and reporting data June 1, 2019.

Camp Dodge, Greens Grant – During October 2018, NHDES moved into a new air station structure located directly adjacent to the old one at Camp Dodge in Greens Grant. This relocation was completed in coordination with NHDES' Dam Bureau and our partners at Camp Dodge – the US Forest Service (USFS) and the Appalachian Mountain Club (AMC). The new structure is expected to produce savings in heating and cooling costs. Minimal downtime occurred and the sampling equipment was protected from the construction area.

Laconia, Green Street – As part of a continual effort to quantify and qualify wood smoke pollution in New Hampshire, NHDES conducted one mobile monitoring study during February 2019 that included monitoring for PM with a Thermo PDR1500 while driving through selected populated areas during a predicted inversion event. The driving loop included a number of areas within the city of Laconia and the towns of Northfield and Belmont.

Future Plans

In support of continuous efforts to improve performance and maximize network efficiency under a constrained budget, NHDES continues to seek efficiencies where possible within the network. NHDES presents the following future plans.

Enhanced Monitoring Plan (EMP) – NHDES' EMP was approved by EPA in October, 2019. As part of this plan, NHDES will continue to report VOCs at the Miller State Park NCORE site, as

well as install a trace-level CO monitor on top of Mt. Washington. NASA plans to install a Pandora Spectrometer at the Londonderry NCORE site in 2019. Additional sampling using borrowed ozone sonde equipment was outlined in the EMP but will not take place in 2019 and until financial resources and staffing are designated.

Mt Washington Summit, Sargents Purchase – NHDES is planning an overhaul of the ozone inlet during the summer of 2019. The unique environment at this site presents a number of challenges for this task. Additionally, and based on potential funding, NHDES is planning to add trace level carbon monoxide measurements at this location in 2019 under the PAMS EMP

Laconia, Green Street – NHDES is considering relocating Laconia monitoring to better capture winter wood smoke within the city neighborhoods.

Purchasing/Expenses

NHDES' budget cycle runs from July 1 through June 30 each year. With very limited equipment funding, the Air Monitoring Program attempted to update the antiquated air monitoring equipment by procuring one ozone analyzer, two ozone calibrators, one continuous PM monitor and one dilution calibrator.

NHDES utilized almost all federal funding for air monitoring for personnel, consumables, parts and supplies to operate the air monitoring network. Additionally, NHDES maintains fleet vehicles, updates maintenance and station contracts, pays utilities for existing facilities, and enhances air monitoring stations as needed throughout the network. Other key expenses include calibrating, repairing and maintaining equipment to meet USEPA and safety standards. NHDES procured a Teledyne NO_y analyzer back in 2017. This analyzer arrived from the factory and could not be installed due to electric code issues. The manufacturer was made aware and has took the instrument back for modification and has since returned it to NHDES. It has yet to be installed and operated due to further electrical concerns expressed by NHDES electricians. NHDES is working through a list of issues and hope to have it installed and operational in a safe manner soon.

Please note that a number of analyzers and samplers in NHDES' network are old and require frequent maintenance in order to assure adequate data capture. Of note, a majority of NHDES' filter-based particle samplers are near the end of their lifetime. Table 1.0 presents equipment, analyzer and sampler types that NHDES currently uses for ambient air quality monitoring.

Table 1.0 : Equipment – (Method)
SO_2
Teledyne – API 100A and EU – (Automated Equivalent Method EQSA-0495-100)
Teco 43A – (Automated Equivalent Method EQSA-0486-060)
Teco 43C – (Automated Equivalent Method EQSA-0486-060)
Thermo 43i – (Automated Equivalent Method EQSA-0486-060)
CO
Teco 48C - (Automated Reference Method RFCA-0981-054)
Thermo 48i – (Automated Reference Method RFCA-0981-054)
Teledyne – API 300 EU – (Automated Equivalent Method RFCA-1093-093)
O_3
Teledyne – API 400E - (Automated Equivalent Method EQOA-0992-087)
Teco 49 - (Automated Equivalent Method EQOA-0880-047)
Teco 49C - (Automated Equivalent Method EQOA-0880-047)
Thermo 49i - (Automated Equivalent Method EQOA-0880-047)
Teco 49C PS – (Lab Standard EQOA-0880-047)
NO_2
Teledyne – API 200E – (Automated Reference Method RFNA-0691-082)
Teledyne – Model T500U CAPS – (Automated Equivalent Method EQNA-0514-212)
Teco 42C – (Automated Reference Method: RFNA-1289-074)
Thermo 42i – (Automated Reference Method RFNA-1289-074)
NOy
Ecotech Model 9843 NOy
Particulate Matter
R&P Partisol Model 2025 (filter based)
BGI Model PQ200 (filter based)
Met One BAM Model 1020
API 640x
IMPROVE Visibility Speciation Monitor
Calibrator (multiple parameter)
TECO 165 Multi Gas Calibrator
Teledyne – API Model 700, 700E and 700U Gas Calibrators
Environics Series 6103 Multi Gas Calibrator
2B Technology Model 306 Ozone Calibrator
Data Acquisition System
Environmental Systems Corporation (ESC and Agilaire) Data Loggers Models 8816, 8832 and 8872
PAMS
Perkin Elmer Ozone Precursor System- Clarus 500 Gas Chromatograph, TurboMatrix 100 Thermal Desorber / TM50
Agilent/Markes Ozone Precursor System 7890 GC, Markes CIA Advantage (4 channel UNITY-xr)…, Kori-xr Moisture Removal system
Agilent Open Labs CDS, version 2.2, Chemstation Edition
Perkin Elmer Total Chrome Software- version 6.2.1
Parker Balston TOC Gas Generator
Parker Balston Hydrogen Generator

Table 1.1: New Hampshire State and Local Air Monitoring Stations Network – 2018/2019					
SO_2					
Town	**Name**	**AIRS #**	**Frequency**	**Scale**	**Objective**
Londonderry	Moose Hill School	33 015 0018	Continuous	Regional	Population
Pembroke	Pembroke Highway Dept.	33 013 1006	Continuous	Neighborhood	High Concentration
Peterborough	Pack Monadnock	33 011 5001	Continuous	Regional	Research
Portsmouth	Peirce Island	33 015 0014	Continuous	Neighborhood	Population
CO					
Town	**Name**	**AIRS #**	**Frequency**	**Scale**	**Objective**
Londonderry	Moose Hill School	33 015 0018	Continuous	Regional	Population
Peterborough	Pack Monadnock	33 011 5001	Continuous	Regional	Research
O_3					
Town	**Name**	**AIRS #**	**Frequency**	**Scale**	**Objective**
Concord	Hazen Drive	33 013 1007	April - Sept	Neighborhood	Population
Greens Grant	Camp Dodge	33 007 4002	April - Sept	Regional	Research
Keene	Water Street	33 005 0007	Continuous	Neighborhood	Population
Laconia	Lakes Region	33 001 2004	April - Sept	Regional	Population
Lebanon	Lebanon	33 009 0010	Continuous	Regional	Population
Londonderry	Moose Hill School	33 015 0018	Continuous	Regional	Population
Mount Washington	Mt. Washington Summit	33 007 4001	Continuous	Regional	Research
Nashua	Gilson Road	33 011 1011	April - Sept	Regional	Population
Peterborough	Pack Monadnock	33 011 5001	Continuous	Regional	Research
Portsmouth	Peirce Island	33 015 0014	Continuous	Neighborhood	Population
Rye, Odiorne	Seacoast Science Center	33 015 0016	April - Sept	Neighborhood	High Concentration
NO_2/NO_y					
Town	**Name**	**AIRS #**	**Frequency**	**Scale**	**Objective**
Londonderry NOy	Moose Hill School	33 015 0018	Continuous	Regional	Population
Londonderry NO_2	Moose Hill School	33 015 0018	Continuous	Regional	Population
Peterborough NOy	Pack Monadnock	33 011 5001	Not Operational	Regional	Research

Table 1.2: New Hampshire Particulate Matter Network – 2018/2019					
$PM_{2.5}$					
Town	**Name**	**AIRS #**	**Frequency**	**Scale**	**Objective**
Keene	Water Street	33 005 0007	1 in 6 filter *	Neighborhood	Colocation
Keene	Water Street	33 005 0007	Continuous - BAM	Neighborhood	Population
Laconia	Green Street	33 001 2004	Continuous - BAM	Regional	Population
Laconia	Green Street	33 001 2004	1 in 6 filter **	Regional	Colocation
Lebanon	Lebanon Airport	33 009 0010	Continuous - BAM	Regional	Population
Londonderry	Moose Hill School	33 015 0018	1 in 3 filter	Regional	Colocation
Londonderry	Moose Hill School	33 015 0018	Continuous - BAM	Regional	Population
Peterborough	Pack Monadnock	33 011 5001	Continuous - BAM	Regional	Research
Peterborough	Pack Monadnock	33 011 5001	1 in 3 filter	Regional	Research
Portsmouth	Peirce Island	33 015 0014	1 in 12 filter	Regional	Colocation
Portsmouth	Peirce Island	33 015 0014	Continuous – API 640x	Regional	Population
$PM_{2.5}$ Speciation					
Peterborough	Pack Monadnock	33 011 5001	1 in 3 IMPROVE	Regional	Research
Londonderry	Moose Hill School	33 015 0018	1 in 3 IMPROVE	Regional	Population
PM_{10}					
Londonderry	Moose Hill School	33 015 0018	Continuous - BAM	Regional	Population
Peterborough	Pack Monadnock	33 011 5001	Continuous - BAM	Regional	Research
Portsmouth	Peirce Island	33 015 0014	Continuous – API 640x	Neighborhood	Audit

* Changed from every 12 day schedule to every 6 day schedule in January 2019
** Discontinued January 2019

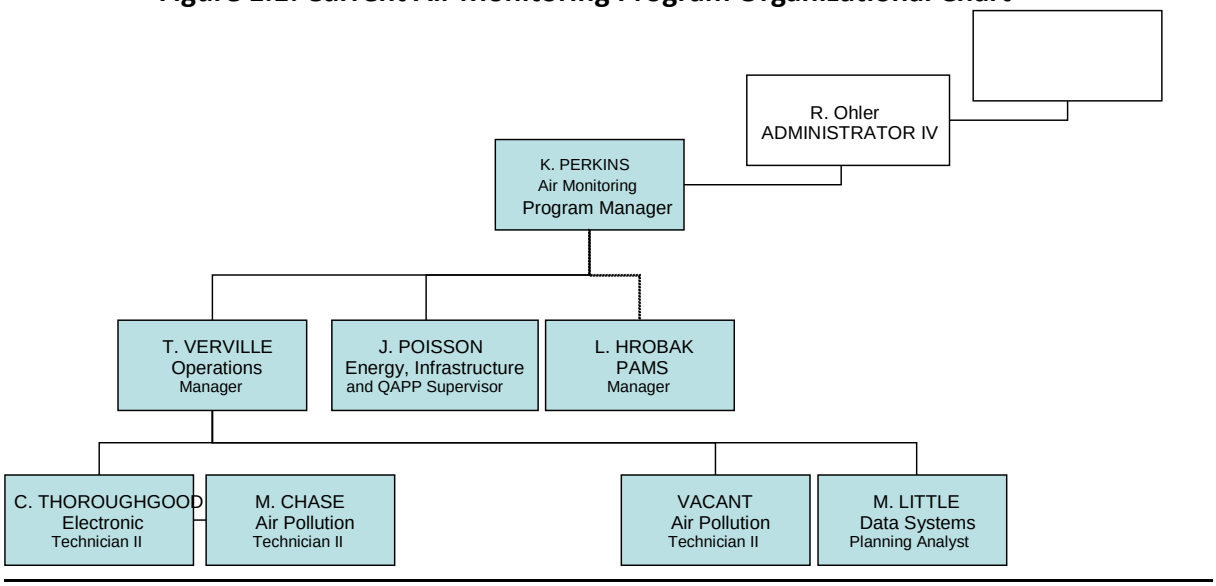
Table 1.3: New Hampshire PAMS Network – 2018/2019					
Town	**Name**	**AIRS #**	**Frequency**	**Scale**	**Objective**
Londonderry	Moose Hill School	33 015 0018	Starting 2015 June - Sept	Regional	Population
Peterborough	Pack Monadnock	33 011 5001	June - Sept	Regional	Research

Table 1.4: New Hampshire NCore Network – 2018/2019					
Town	**Name**	**AIRS #**	**Status**	**Scale**	**Objective**
Londonderry	Moose Hill School	33 015 0018	Operational on Jan 1, 2011	Regional	Population
Peterborough	Pack Monadnock	33 011 5001	Operational on Jan 1, 2011	Regional	Research

Personnel

The AMP continues to operate with one full-time technical position vacant as well as one technical position previously eliminated. In order to fulfill requirements, NHDES assigns some technical support duties to individuals outside the official AMP organizational structure, including PAMS management duties. See Figure 1.1. Atmospheric Science and Analysis section staff (of the Air Resources Division of NHDES) typically support the AMP program.

Figure 1.1: Current Air Monitoring Program Organizational Chart



Cooperative Air Monitoring Initiatives

NHDES is involved in numerous cooperative air monitoring initiatives with local, state and private entities.

For over 27 years now, the Appalachian Mountain Club (AMC) and NHDES have been joining resources to conduct ozone monitoring in Coos County. Since 1990, AMC and NHDES have been cooperatively monitoring ozone on the summit of Mount Washington to determine the exposure of hikers and other visitors to this pollutant and to quantify ozone transport from upwind areas. Significant levels of ozone have been measured on the summit during the summer months throughout this time. Also, AMC and NHDES began cooperatively managing a second monitoring station near the base of Mount Washington (Camp Dodge) in 1996, a White Mountain National Forest Class I Wilderness visibility monitoring station. AMC's involvement in air monitoring activities saves NHDES significant resources.

NHDES also partners with the US Department of Agriculture (Forest Service) in a Challenge Cost Share Agreement relative to air monitoring activities at Camp Dodge in Greens Grant. This agreement provides a framework of cooperation for station work such as upgrades, tree trimming and routine costs. The Forest Service operates an IMPROVE (Interagency Monitoring of Protected Visual Environments) sampler at this station. NHDES and AMC currently maintain ozone sampling, upkeep and routine site inspections at this station.

NHDES provides critical real-time rainfall data from the Laconia station for the protection of public health. When rainfall at the Laconia station exceeds a specific amount over a specific time period, an automated notification system operated by NHDES facilitates closing of a public beach and alerts of possible bacterial dangers. Similar notification systems incorporating our real-time meteorology data have been used to enact erosion control inspections at various New Hampshire Department of Transportation road construction projects.

NHDES maintains a near real-time air quality and forecasting website at: http://www2.des.state.nh.us/airdata/default.asp and contributes to a regional air quality website maintained by USEPA (https://www3.epa.gov/region1/airquality/aqi.html). These sites provide forecast information on New Hampshire's air quality that can be used by media, medical professionals, schools and athletic coaches, and individuals, to help plan daily activities and protect public health. The air quality forecast for New Hampshire is also available on the NHDES' Air Quality Information Line at (800) 935-SMOG. The forecast is made for ground-level ozone and particle pollution.

Monitoring Trends

Each year, NHDES reviews its monitoring data and calculates design values for comparison to the National Ambient Air Quality Standards (NAAQS) – Table 1.5. USEPA establishes these standards to protect public health and welfare. In general, design values consider the three most recent years for an averaging period in the form of the NAAQS, such as looking at the three-year average of the annual fourth highest ozone 8-hour value.

New Hampshire air quality data trends reveal the important progress that has been made in improving air quality in New Hampshire. Cleaner vehicles, fuels, power plants, industry and small engines located throughout the region have all contributed to much-improved air quality since the 1980s. More recent trends show that additional progress is still being made, but the task becomes more difficult as there are becoming fewer pollution sources that remain uncontrolled. It is also important to note that while progress has been made, the NAAQS have been strengthened in some cases to be more protective, thus we have more progress to make.

Figures 1.2 through 1.15 present monitoring trends for the key criteria pollutants for the period 2000 through 2018. In all cases, air quality is significantly improved from the 1970s and 1980s. Currently monitored levels of nitrogen dioxide (NO_2), PM_{10}, lead (Pb) and carbon monoxide (CO) are safely below the current levels of the NAAQS. However, the NAAQS for ozone and $PM_{2.5}$ have recently been tightened (lowered) to levels near what is currently being measured in New Hampshire. These two have drawn significant attention by NHDES as a focus for network monitoring and SIP planning. Ozone in New Hampshire has been substantially reduced from concentrations measured in the state in the 1980s and 1990s, but has become stable at levels just below the current NAAQS since 2013.

Monitoring trends for SO_2 indicate that all areas of New Hampshire meet the 3-hour SO_2 secondary NAAQS and for the 1-hour primary SO_2 NAAQS. Current data shows significantly lower SO_2 concentrations since 2011. Table 1.6 summarizes exceedances of NAAQS

thresholds during recent years.

Tables 1.7 through 1.11 provide the maximum of the five most recent design values and most recent (2016-18) design values for each criteria pollutant. These are also expressed as percentages of the current NAAQS. CO, NO_2, and 1- and 3-hour SO_2 design values are all under 30% of the NAAQS during the 2016-18 design value period. The highest SO_2 site, Pembroke, last exceeded the 1-hour NAAQS for the period of 2011 to 2013, but now meets the standard. With the lower ozone standard of 0.070 ppm, Londonderry, Rye, Mt. Washington Summit and Pack Monadnock summit all meet the NAAQS by a slim margin and must continue to be watched over the next few years.

In 2018, New Hampshire operated two Photochemical Assessment Monitoring Stations (PAMS): Pack Monadnock and Londonderry. Tables 1.11 and 1.12 show that none of the toxic PAMS parameters are near their Ambient Allowable Limits (AAL) at either site. Benzene has the lowest AAL, 5.7 $\mu g/m^3$. At Londonderry and Pack Monadnock, the maximum 24-hour averages for benzene over the full period were about 0.2 and 1.1 $\mu g/m^3$, respectively, or about 4%-20% of the AAL. Maximum values for all the other parameters for both sites are consistently less than 1% of their AAL.

Table 1.5: National Ambient Air Quality Standards

Pollutant [links to historical tables of NAAQS reviews]		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide (CO)		primary	8 hours	9 ppm	Not to be exceeded more than once per year
			1 hour	35 ppm	
Lead (Pb)		primary and secondary	Rolling 3 month average	0.15 µg/m^3 (1)	Not to be exceeded
Nitrogen Dioxide (NO_2)		primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		primary and secondary	1 year	53 ppb (2)	Annual Mean
Ozone (O_3)		primary and secondary	8 hours	0.070 ppm (3)	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particle Pollution (PM)	$PM_{2.5}$	primary	1 year	12.0 µg/m^3	annual mean, averaged over 3 years
		secondary	1 year	15.0 µg/m^3	annual mean, averaged over 3 years
		primary and secondary	24 hours	35 µg/m^3	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24 hours	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (SO_2)		primary	1 hour	75 ppb (4)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

(1) In areas designated nonattainment for the Pb standards prior to the promulgation of the current (2008) standards, and for which implementation plans to attain or maintain the current (2008) standards have not been submitted and approved, the previous standards (1.5 µg/m3 as a calendar quarter average) also remain in effect.
(2) The level of the annual NO_2 standard is 0.053 ppm. It is shown here in terms of ppb for the purposes of clearer comparison to the 1-hour standard level.
(3) Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) O3 standards additionally remain in effect in some areas. Revocation of the previous (2008) O3 standards and transitioning to the current (2015) standards will be addressed in the implementation rule for the current standards.
(4) The previous SO_2 standards (0.14 ppm 24-hour and 0.03 ppm annual) will additionally remain in effect in certain areas: (1) any area for which it is not yet 1 year since the effective date of designation under the current (2010) standards, and (2)any area for which implementation plans providing for attainment of the current (2010) standard have not been submitted and approved and which is designated nonattainment under the previous SO_2 standards or is not meeting the requirements of a SIP call under the previous SO_2 standards (40 CFR 50.4(3)), A SIP call is an EPA action requiring a state to resubmit all or part of its State Implementation Plan to demonstrate attainment of the require NAAQS.

Table 1.6: NAAQS Exceedances (Days) in New Hampshire (2013-2018)

Parameter/Location/Standard	Number of Exceedances						Most Recent (Relative to NAAQS from Each Year)
	2013	2014	2015	2016	2017	2018	
CO							
1-Hour (1971 standard)	0	0	0	0	0	0	1978
8-Hour (1971 standard)	0	0	0	0	0	0	1996
Lead							
Quarterly (2008 standard)	0	0	0	--	--	--	None
NO_2							
1-Hour (2010 standard)	0	0	0	0	0	0	None
Ozone							
8-Hour (2008 standard 2011-14; 2015 standard 2015-18)							
Camp Dodge	0	0	0	0	0	0	2004
Concord	0	0	1	0	0	0	2015
Keene	0	0	0	1	0	0	2016
Laconia	0	0	0	0	0	0	2010
Lebanon	0	0	0	0	0	0	2008
Londonderry	0	0	1	1	1	1	2018
Miller	0	1	2	3	1	0	2017
Mt. Washington[1]	2	0	5	2	3	2	2018
Nashua	0	0	1	1	0	0	2016
Portsmouth	1	0	1	0	0	0	2015
Rye	0	0	1	1	1	2	2018
Woodstock[2]	0	0	0	0	0	0	None
PM_{10}							
24-Hour (2006 standard)	0	0	0	0	0	0	1989
$PM_{2.5}$							
Annual (2012 standard)	0	0	0	0	0	0	None
24-Hour (2012 standard)							
Keene	3*	0*	0*	0*	0*	0*	2013
Laconia	0	0	0	0*	0*	0*	None
Lebanon	0*	0*	0*	0*	0*	0*	None
Miller	0*	0*	0*	0*	0*	0*	2002(Exceptional Event)
Nashua	0	0	--	--	--	--	2002 (Exceptional Event)
Pembroke	0	0	--	--	--	--	None
Portsmouth	0*	0*	0*	0*	0*	0*	None
SO_2							
Annual (1971 standard)	0	0	0	0	0	0	None
1-Hour (2010 standard)							
Concord	0	0	0	0	0	0	2011
Londonderry	0	0	0	0	0	0	None
Miller	0	0	0	0	0	0	None
Pembroke	0	0	0	0	0	0	2012
Portsmouth	0	0	0	0	0	0	None

* - Denotes measured by FEM equipment; otherwise measured by FRM method. ^ - Denotes exceptional event.

Station startups/closures: Nashua ($PM_{2.5}$) and Pembroke ($PM_{2.5}$) shut down in 2015; Concord station discontinued SO_2 monitoring in 2016; lead monitoring was discontinued at end of 2nd quarter 2016.

[1] Mt. Washington ozone exceedances exclude the second of overlapping 8-hour periods (i.e. those beginning hours 00:00-06:00) per the 2015 standard final rule; the 2015 count also includes an exceedance in October, outside the ozone season.

[2] Woodstock is part of EPA's Clean Air Status and Trends Network (CASTNET) as further discussed in the Individual Station Information in Part II.

Table 1.7: 2016 – 2018 Ozone Design Values (ppb)

Ozone	Design Value (DV) Description	NAAQS	5-Year Max DV	% of NAAQS	Location	2016-18 Max DV	% of NAAQS	Location
8-Hour	3-year average of 4th- highest daily maximum 8-hour averages	70 (2015-present); 75 (2008-14)	69	92*	Peterborough (2012-14)	67	96*	Rye, Mt. Washington Summit

* The five-year maximum design value is presented as a percentage of 75ppb, the NAAQS in place during the design value period in which the maximum occurred; the 2016-18 maximum design value is relative to 70ppb, the NAAQS in place during the most recent design value period.

Table 1.8: 2018 Carbon Monoxide Design Values (ppm)

CO	Design Value (DV) Description	NAAQS	5-Year Max DV	% of NAAQS	Location	2018 Max DV	% of NAAQS	Location
1-Hour	2nd maximum	35	0.6	2	Londonderry (2014)	0.5	1	Londonderry
8-Hour	2nd maximum	9	0.5	6	Londonderry (2014)	0.4	4	Londonderry

Table 1.9: 2016 – 2018 Sulfur Dioxide Design Values (ppb)

SO_2	Design Value (DV) Description	NAAQS	5-Year Max DV	% of NAAQS	Location	2016-18 Max DV	% of NAAQS	Location
1-Hour	3-year average of 99th percentile of daily maximum 1-hour averages	75	29	39	Portsmouth (2013-15)	14	19	Pembroke
3-Hour	2nd maximum	500	27	5	Portsmouth (2014)	12	2	Pembroke, Portsmouth

Table 1.10: 2016 – 2018 Nitrogen Dioxide Design Values (ppb)

NO_2	Design Value (DV) Description	NAAQS	5-Year Max DV	% of NAAQS	Location	2016-18 Max DV	% of NAAQS	Location
1-Hour	3-year average of 98th percentile of daily maximum 1-hour averages	100	23	23	Londonderry (2015-17)	22	22	Londonderry
Annual	Annual average	53	3	6	Londonderry (2014-18)	3	6	Londonderry

Table 1.11: 2016 – 2018 Fine Particulate Matter Design Values ($\mu g/m^3$)

$PM_{2.5}$	Design Value (DV) Description	NAAQS	5-Year Max DV	% of NAAQS	Location	2016-18 Max DV	% of NAAQS	Location
24-Hour	3-year average of 98th percentile of midnight- midnight 24-hour averages	35	27	77	Keene (2012-14)	18	51	Keene
Annual	Annual average over 3 years	12	8.8	73	Keene (2012-14, 2013-15)	5.7	48	Lebanon

Figures 1.2 and 1.3 show how ozone concentrations in the state have stabilized just under the NAAQS after years of steady decline.

Figure 1.2: Ozone trends for the 8-hour NAAQS (2000-2018)

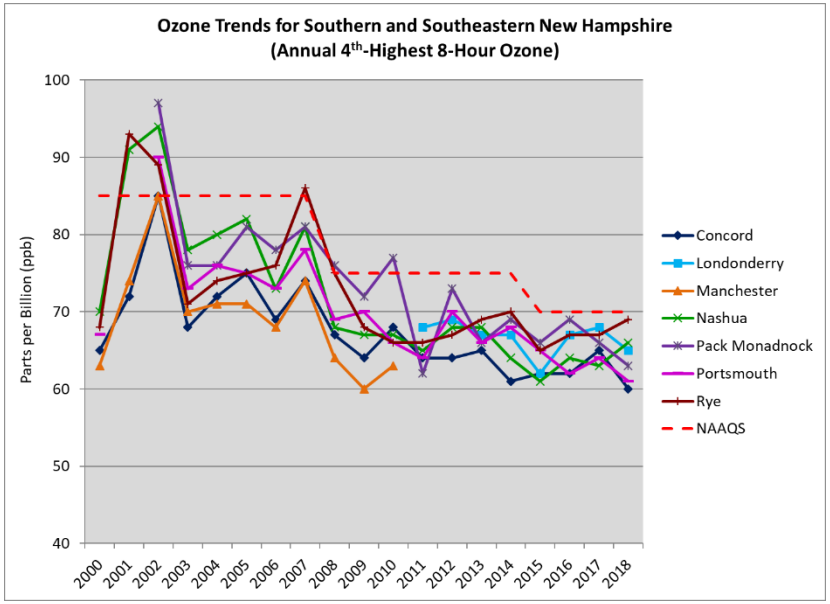
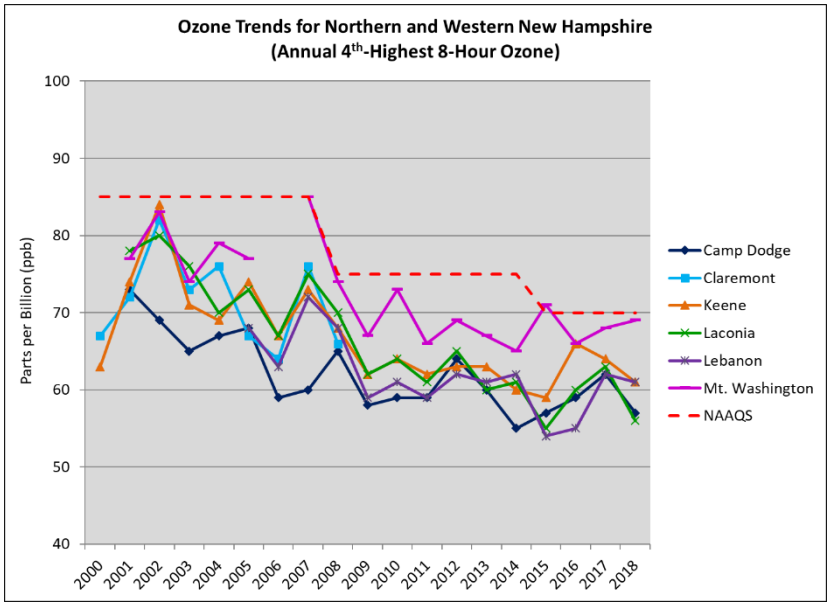


Figure 1.3: Ozone trends for the 8-hour NAAQS (2000-2018)



Figures 1.4 and 1.5 show very low carbon monoxide concentrations in the state, well below the NAAQS.

Figure 1.4: Carbon Monoxide trends for the 1-hour NAAQS (2000-2018)

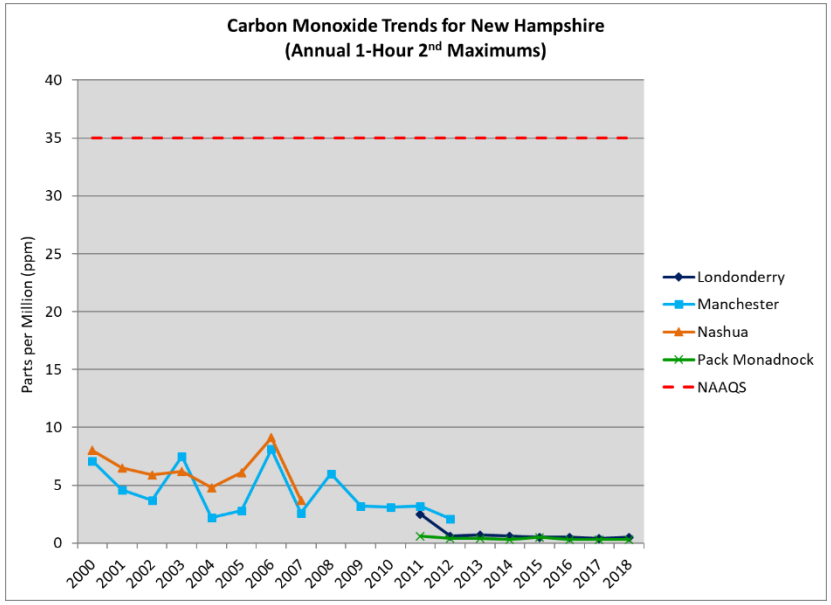
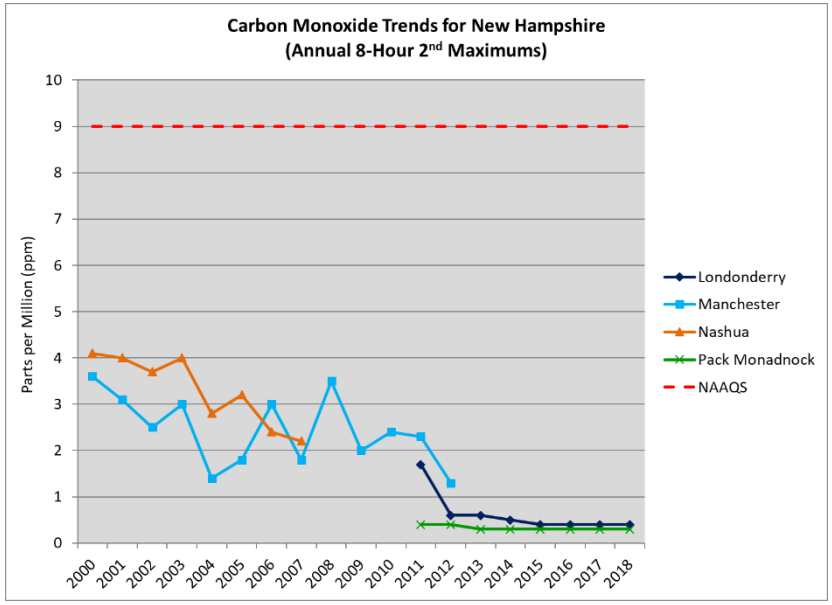


Figure 1.5: Carbon Monoxide trends for the 8-hour NAAQS (2000-2018)



Figures 1.6 and 1.7 show declining 24-hour $PM_{2.5}$ concentrations in the state with only Keene being recently near the NAAQS.

Figure 1.6: $PM_{2.5}$ trends for the 24-hour NAAQS (2000-2018)

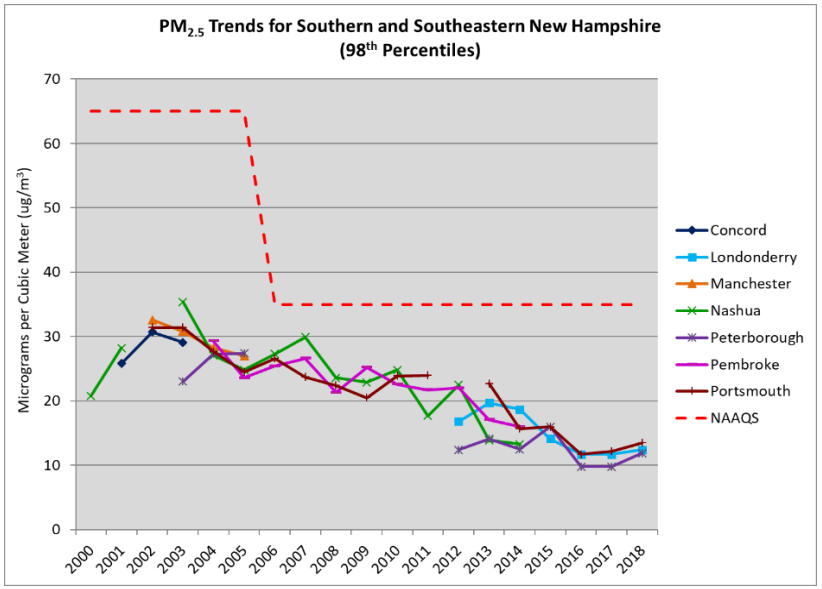
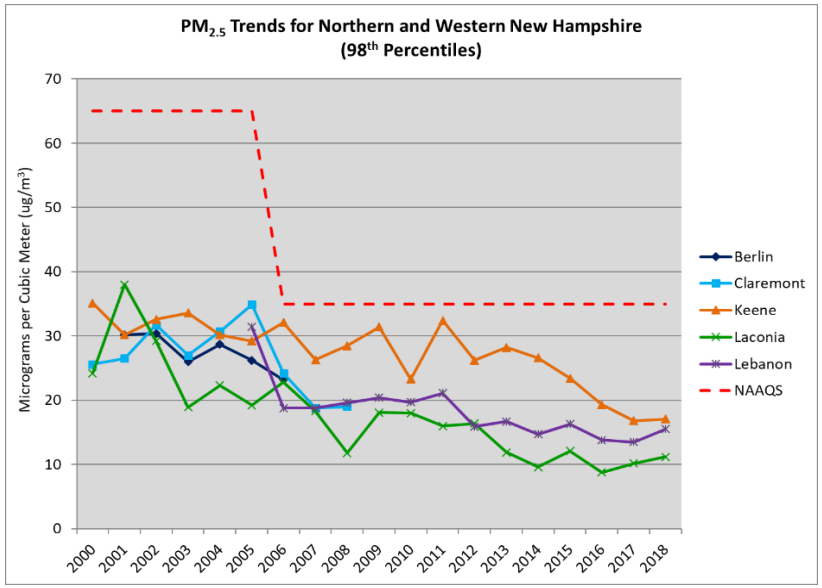


Figure 1.7: $PM_{2.5}$ trends for the 24-hour NAAQS (2000-2018)



Figures 1.8 and 1.9 show declining annual $PM_{2.5}$ concentrations, all well below the NAAQS.

Figure 1.8: $PM_{2.5}$ trends for the annual NAAQS (2000-2018)

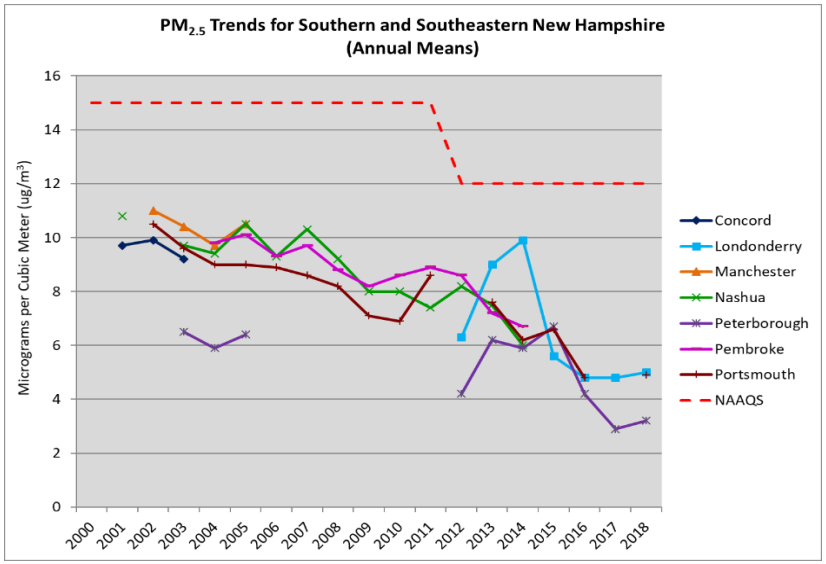
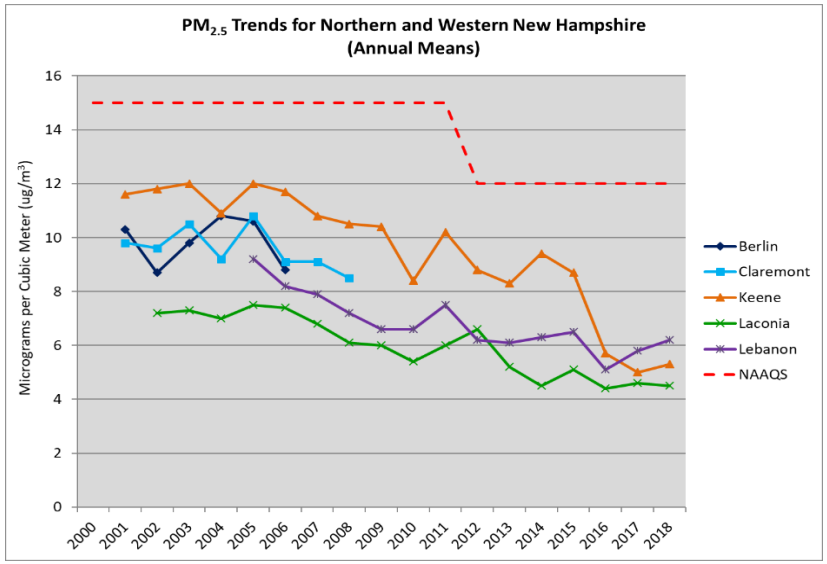


Figure 1.9: $PM_{2.5}$ trends for the annual NAAQS (2000-2018)



Figures 1.10 and 1.11 show very low nitrogen dioxide and lead concentrations in the state, well below the NAAQS.

Figure 1.10: Nitrogen Dioxide trends for the 1-hour NAAQS (2000-2018)

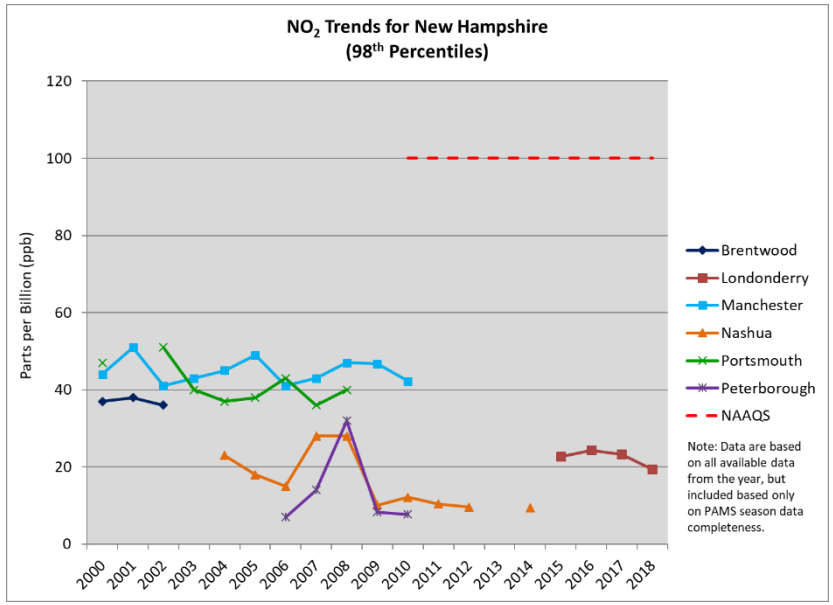
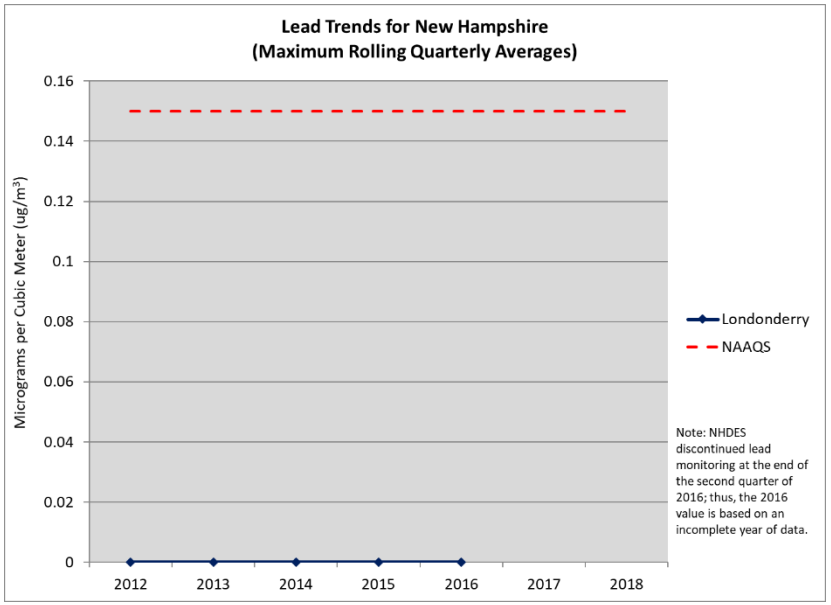


Figure 1.11: Lead trends for the annual NAAQS (2012-2018)



Figures 1.12 and 1.13 show low and declining sulfur dioxide concentrations in the state, currently well below the NAAQS.

Figure 1.12: Sulfur Dioxide trends for the 1-hour NAAQS (2000-2018)

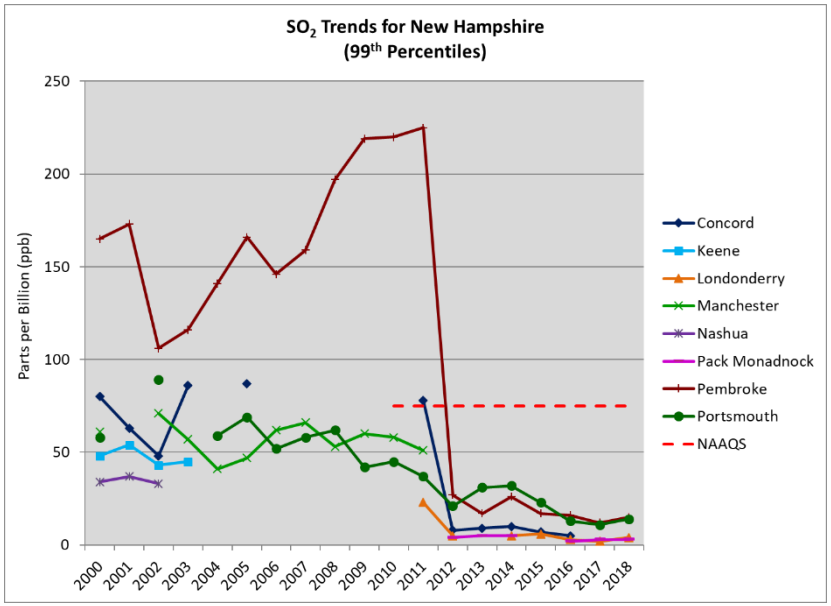
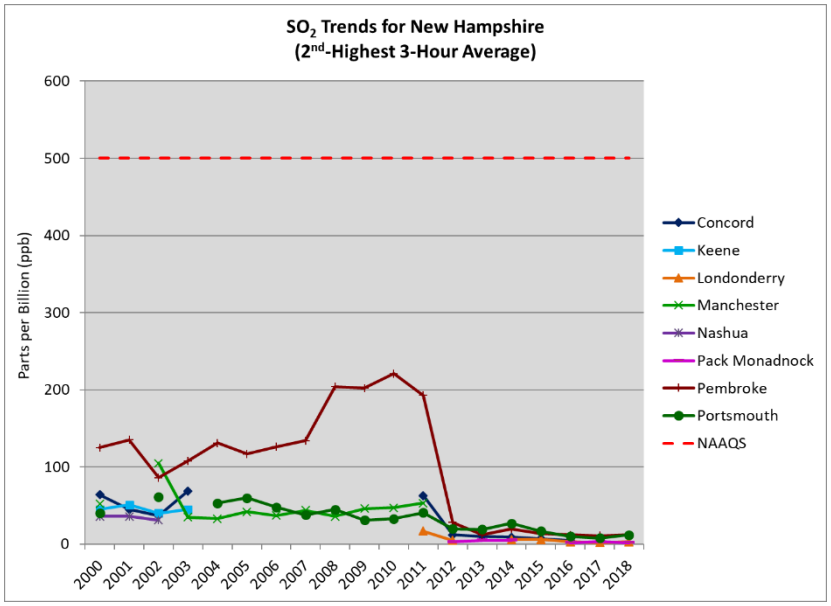


Figure 1.13: Sulfur Dioxide trends for 3-hour secondary NAAQS (2000-2018)



Figures 1.14 and 1.15 show very low and stable PM_{10} concentrations in the state, well below the NAAQS.

Figure 1.14: PM_{10} trends for the 24-hour NAAQS (2000-2018)

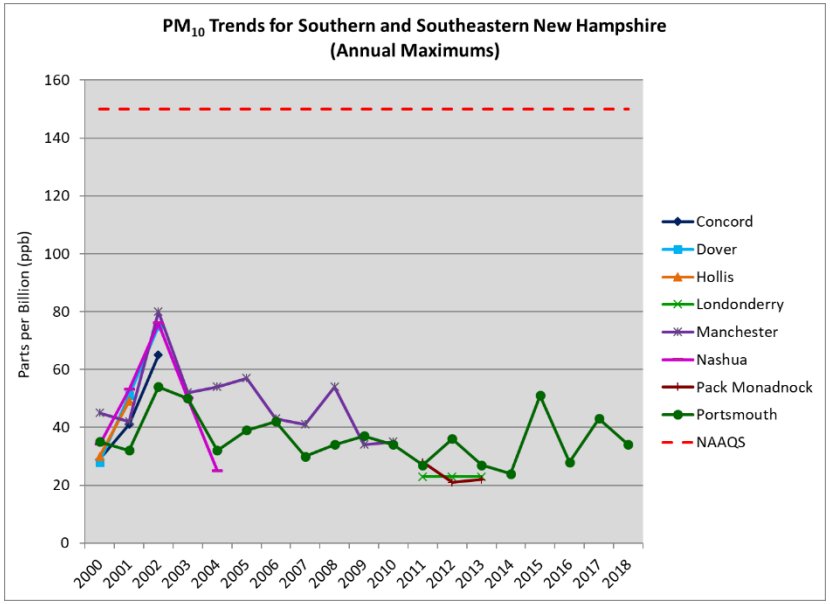


Figure 1.15: PM_{10} trends for the 24-hour NAAQS (2000-2018)

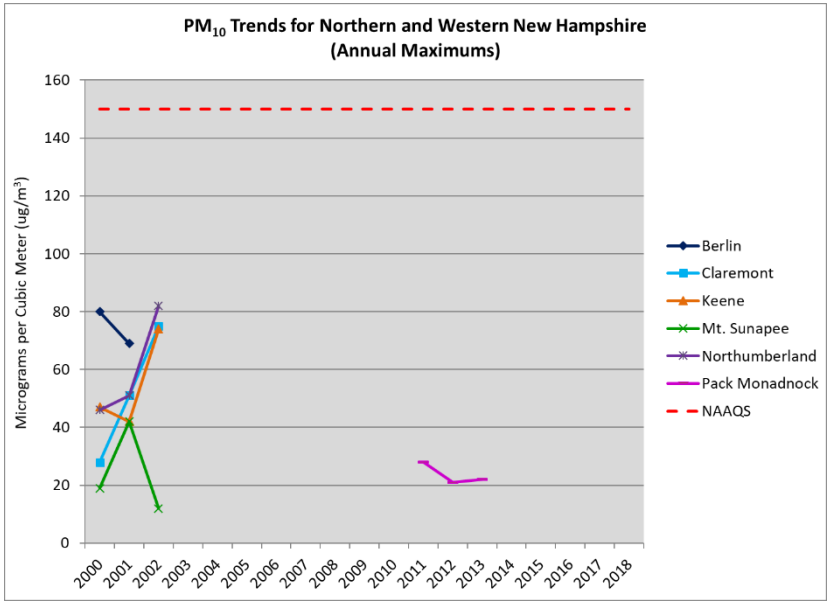


Table 1.8: Seasonal Maximum 24-hour Averages at Londonderry for Toxic PAMS Species Compared to the Ambient Allowable Limit (AAL), 2015-2018

PAMS Parameter	AAL ug/m3	Max 24 Hr. Avg. (ug/m3)				Max as % of AAL	2018 Change
		2015	2016	2017	2018		
PROPYLENE (43205)	35,833	0.37	0.21	0.28	0.85	0.00%	↑
CYCLOPENTANE (43242)	25,595	0.11	0.15	0.07	0.24	0.00%	↑
ISOPENTANE (43221)	36,875	1.17	1.73	1.27	1.90	0.01%	↑
PENTANE (43220)	36,875	0.59	0.73	0.73	1.44	0.00%	↑
2-METHYLPENTANE (43285)	36,875	0.16	0.25	0.13	0.76	0.00%	↑
3-METHYLPENTANE (43230)	36,875	0.16	0.29	0.11	0.60	0.00%	↑
HEXANE (43231)	885	0.44	0.64	0.5	0.97	0.11%	↑
BENZENE (45201)	6	0.53	0.27	0.33	1.28	21.34%	↑
CYCLOHEXANE (43248)	6,000	0.12	0.18	0.1	0.45	0.01%	↑
HEPTANE (43232)	8,249	0.18	0.44	0.11	0.52	0.01%	↑
METHYLCYCLOHEXANE (43261)	23,958	0.12	0.24	0.07	0.37	0.00%	↑
TOLUENE (45202)	5,000	1.11	1.65	1.17	2.06	0.04%	↑
OCTANE (43233)	7,000	0.11	0.15	0.04	0.27	0.00%	↑
ETHYLBENZENE (45203)	1,000	0.18	0.22	0.16	0.45	0.05%	↑
M & P-XYLENES (45109)	1,550	0.51	0.61	0.53	0.94	0.06%	↑
STYRENE (45220)	1,000	0.17	0.07	0.07	1.01	0.10%	↑
O-XYLENE (45204)	1,550	0.2	0.21	0.21	0.49	0.03%	↑
NONANE (43235)	15,625	0.13	0.11	0.12	0.25	0.00%	↑
1,3,5-TRIMETHYLBENZENE (45207)	619	0.1	0.12	0.07	0.13	0.02%	↑
1,2,4-TRIMETHYLBENZENE (45208)	619	0.21	0.27	0.19	0.65	0.10%	↑

* All data in $\mu g/m^3$

Table 1.9: Seasonal Maximum 24-hour Averages at Pack Monadnock in Miller State Park for Toxic PAMS Species Compared to the Ambient Allowable Limit (AAL), 2006-2018

PAMS Parameter	AAL ug/m3	Max 24 Hour Avg. (ug/m3)													Max as % of AAL	2018 Change
		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018		
PROPYLENE (43205)	35,833	0.28	0.25	0.46	0.15	0.20	0.59	0.38	0.17	0.16	0.28	0.29	0.23	0.61	0.00%	↑
CYCLOPENTANE (43242)	25,595	0.42	0.53	1.63	0.29	0.09	0.17	0.21	0.13	0.13	0.23	0.11	0.11	0.09	0.01%	↓
ISOPENTANE (43221)	36,875	1.03	1.09	0.70	0.89	0.75	1.84	2.32	0.95	0.73	0.96	0.68	1.34	0.74	0.01%	↓
PENTANE (43220)	36,875	45.41	7.63	0.55	0.45	0.38	0.86	0.76	0.48	0.40	0.51	0.38	0.69	0.55	0.12%	↓
2-METHYLPENTANE (43285)	36,875	0.19	0.27	0.04	0.06	0.04	0.30	0.25	0.06	0.07	0.12	0.07	0.09	0.07	0.00%	↓
3-METHYLPENTANE (43230)	36,875	0.13	0.17	0.01	0.04	0.03	0.21	0.19	0.03	0.02	0.05	0.03	0.02	0.02	0.00%	-
HEXANE (43231)	885	0.21	0.27	0.19	0.32	1.36	1.01	0.48	0.28	0.24	0.40	0.16	0.18	0.29	0.15%	↑
BENZENE (45201)	6	0.31	0.33	0.32	0.41	0.73	1.09	0.45	0.38	0.41	0.64	0.18	0.45	0.32	19.18%	↓
CYCLOHEXANE (43248)	6,000	0.14	0.05	0.02	0.08	0.04	0.48	0.15	0.06	0.04	0.09	0.01	0.06	0.03	0.01%	↓
HEPTANE (43232)	8,249	0.71	0.16	0.15	0.17	0.13	0.79	0.21	0.14	0.11	0.14	0.04	0.04	0.03	0.01%	↓
METHYLCYCLOHEXANE (43261)	23,958	1.23	0.15	0.15	0.11	0.16	0.49	0.14	0.07	0.06	0.10	0.04	0.03	0.02	0.01%	↓
TOLUENE (45202)	5,000	1.00	1.05	1.11	1.01	0.77	2.48	1.36	0.80	0.56	0.67	0.53	0.54	0.54	0.05%	-
OCTANE (43233)	7,000	0.91	0.17	0.27	0.11	0.06	0.40	0.23	0.07	0.04	0.02	0.02	0.02	0.01	0.01%	↓
ETHYLBENZENE (45203)	1,000	0.35	0.20	0.59	0.21	0.15	0.42	0.18	0.13	0.07	0.08	0.05	0.09	0.04	0.06%	↓
M & P-XYLENES (45109)	1,550	1.88	0.37	2.38	0.46	0.23	1.22	0.42	0.42	0.19	0.25	0.13	0.12	0.20	0.15%	↑
STYRENE (45220)	1,000	1.03	1.13	1.80	0.40	0.08	0.18	0.14	0.05	0.18	0.04	0.03	0.02	0.02	0.18%	-
O-XYLENE (45204)	1,550	0.60	0.13	0.67	0.15	0.08	0.45	0.20	0.16	0.08	0.06	0.04	0.04	0.06	0.04%	↑
NONANE (43235)	15,625	8.83	1.33	0.57	0.23	0.08	0.16	0.20	0.36	0.05	0.09	0.06	0.03	0.03	0.06%	-
1,3,5-TRIMETHYLBENZENE (45207)	619	1.75	0.08	0.29	0.13	0.04	0.10	0.12	0.08	0.01	0.09	0.01	0.02	0.04	0.28%	↑
1,2,4-TRIMETHYLBENZENE (45208)	619	3.91	1.34	0.79	0.53	0.14	0.38	0.26	0.08	0.09	0.15	0.04	0.04	0.06	0.63%	↑

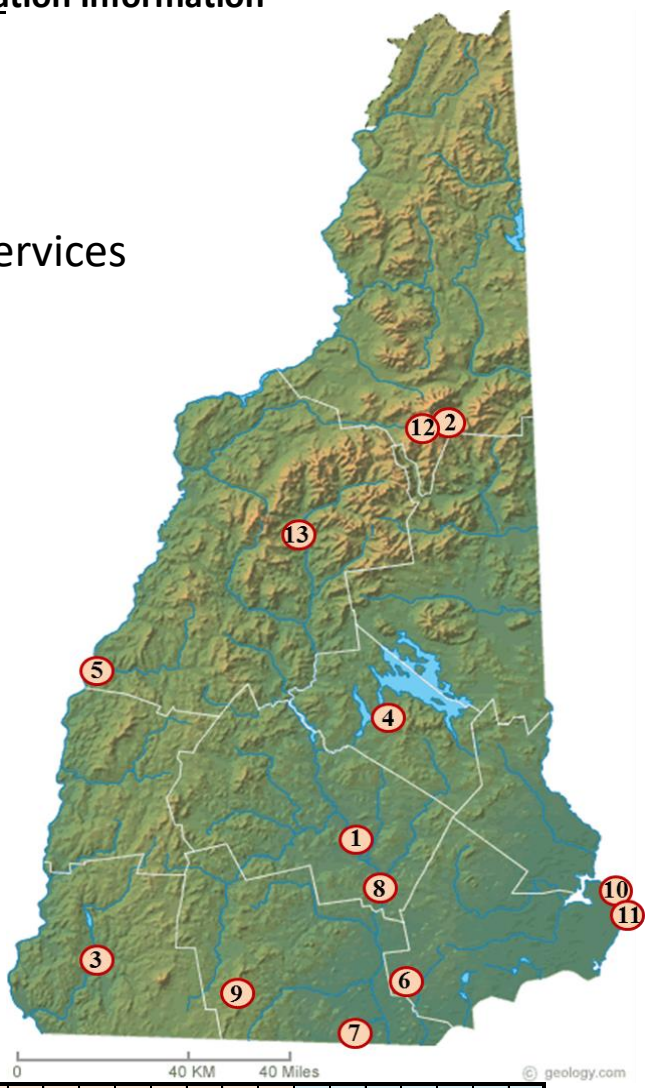
* All data in $\mu g/m^3$

PART 2: Individual Station Information

New Hampshire
Department of Environmental Services

Air Resources Division

Air Quality Monitoring Stations



NHDES Air Monitoring Station Locations and Parameter Details

Summer 2019	Ncore	IMPROVE	CASTNET	NADP	PAMS	Laboratory	Carbon Monoxide (CO)	Nitrogen Dioxide (NO2)	Nitrogen Oxides (NOy)	Ozone (O3)	PM2.5	PM2.5 co-location	PM10	PM10 co-location	PM Coarse	Sulfur Dioxide (SO2)	Wind Direction (WD)	Wind Speed (WS)	External Temperature (ETP)	Barometric Pressure (BP)	Relative Humidity (RH)	Precipitation (PT)	Solar Rediation (SolRad)
1. Concord						●				●							●	●	●				
2. Greens Grant - Camp Dodge		●								●									●				
3. Keene										●	●						●	●	●				
4. Laconia										●	●	●					●	●	●			●	
5. Lebanon										●	●						●	●	●				
6. Londonderry	●	●			●		●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●
7. Nashua										●							●	●	●				
8. Pembroke																●	●	●	●				
9. Peterborough - Pack Monadnock	●	●			●		●		●	●	●		●		●	●	●	●	●	●	●	●	
10. Portsmouth										●	●	●	●			●	●	●	●				
11. Rye										●							●	●	●				
12. Sargents Purchase - Mt Washington Summit										●													
13. Woodstock - Hubbard Brook			●	●						●									●				

● Frequency changed from 1/12 to 1/6 in January 2018

Camp Dodge, Greens Grant

General Information			
AQS ID:	33-007-4002	Latitude:	44.308132
Town:	Greens Grant	Longitude:	-71.217639
Address:	Route 16	Elevation (m):	449
County:	Coos	Year Est.:	1995
Spatial Scale:	Regional		

Site Description

This air monitoring station is located in a rural forested area off Route 16 in Greens Grant. This wood-clad, stick-built shelter is approximately 7' wide by 10' long. This station is representative of a Class 1 Type Airshed. NHDES operates this station in cooperation with the Appalachian Mountain Club and the US Forest Service.

Pollutants/Parameters

Ozone – Temperature – IMPROVE. The US Forest Service operates the IMPROVE sampler.

Recent Changes

NHDES relocated this station during the Fall of 2018. In coordination with the USFS and AMC, NHDES placed an efficient climate-controlled structure adjacent (approximately 10 ft. away) to the current structure and relocated all monitoring equipment into and on the new structure.

Proposed/Planned Changes

NHDES is not planning any significant changes to this station into the foreseeable future.

On the left, an image of the monitoring station and on the right a Google Earth map pinpointing the station's location.

Mt. Washington Summit

General Information			
AQS ID:	33-007-4001	Latitude:	44.270093
Town:	Sargent's Purchase	Longitude:	-71.303821
		Elevation (m):	1,910
Address:	Yankee Bld.	Year Est.:	1990
County:	Coos		
Spatial Scale:	Regional		

Site Description

This air monitoring station is located at the top of Mt. Washington in the Yankee Building.

Pollutants/Parameters

Ozone – Temperature

Recent Changes

NHDES did not make any significant changes to this station during this review period.

Proposed/Planned Changes

NHDES will, based on funding, add trace level CO in 2019 as part of the PAMS EMP. NHDES is also planning on working on the inlet manifold during the summer of 2019.

On the left, an image of the building housing the monitoring station and on the right a Google Earth map pinpointing the station's location.

Hubbard Brook, Woodstock

General Information			
AQS ID:	33-009-8001	Latitude:	43.944544
Town:	Woodstock	Longitude:	-71.700772
Address:	Mirror Lake Rd.	Elevation (m):	250
County:	Grafton	Year Est.:	1989
Spatial Scale:	Regional		

Site Description

This air monitoring station is located in a rural area in the White Mountain National Forest. This pre-fabricated structure is specifically designed for climate-controlled scientific operations. It measures approximately 8' wide by 10' long. NHDES is not involved in monitoring or data acquisition at this site. A USEPA Contractor operates this site.

Pollutants/Parameters

Ozone – Temperature – CASTNET

Recent Changes

NHDES did not make any significant changes to this station during this review period.

Proposed/Planned Changes

NHDES is not planning any significant changes to this station into the foreseeable future.

On the left, an image of the monitoring station and on the right a Google Earth map pinpointing the station's location.

Lebanon Airport, Lebanon

General Information			
AQS ID:	33-009-0010	Latitude:	43.629605
Town:	Lebanon	Longitude:	-72.309499
Address:	Airport Road	Elevation (m):	171
County:	Grafton	Year Est.:	2005
Spatial Scale:	Neighborhood		

Site Description

This 8' wide by 10' long insulated trailer is located at the northeast edge of the Lebanon Municipal Airport in a commercial area. The filter based $PM_{2.5}$ sampler is located on a deck on top of the trailer.

Pollutants/Parameters

Ozone - Continuous $PM_{2.5}$ (BAM) – Wind Speed - Wind Direction - Temperature

Recent Changes

NHDES did not make any significant changes to this station during this review period.

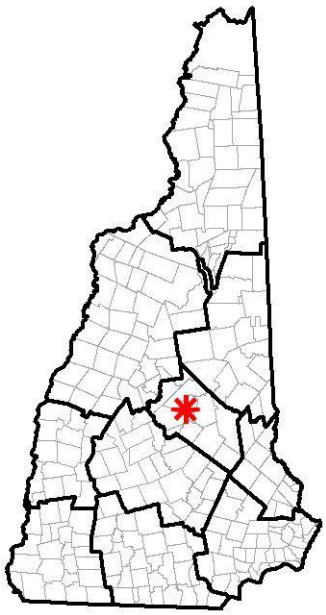
Proposed/Planned Changes

NHDES is not planning any significant changes to this station into the foreseeable future.

On the left, an image of the monitoring station and on the right a Google Earth map pinpointing the station's location.

Green Street, Laconia

General Information			
AQS ID:	33-001-2004	Latitude:	43.566122
Town:	Laconia	Longitude:	-71.496335
Address:	Green Street	Elevation (m):	216
County:	Belknap	Year Est.:	2001
Spatial Scale:	Regional		



Site Description

This 10' wide by 12' long cedar-clad, stick-built air monitoring station is located in an open field in a rural residential area. The filter-based $PM_{2.5}$ sampler is located on a platform approximately 30m from the structure.

Pollutants/Parameters

Ozone – filter based $PM_{2.5}$ (1 every 6 days) – Co-located filter based $PM_{2.5}$ (1 every 12 days) –Wind Speed – Wind Direction – Temperature - Precipitation

Recent Changes

NHDES installed a $PM_{2.5}$ Met One BAM at this station during November 2018 and removed the filter based samplers.

Proposed/Planned Changes

NHDES is considering relocating Laconia monitoring to better capture winter wood smoke within the city neighborhoods.

On the left, an image of the monitoring station and on the right a Google Earth map pinpointing the station's location.

Hazen Station, Concord

General Information			
AQS ID: Town: Address: County: Spatial Scale:	33-013-1007 Concord 27 Hazen Dr. Merrimack Neighborhood	Latitude: Longitude: Elevation (m): Year Est.:	43.218470 -71.514525 107 2004
Site Description This site has the advantage of being in close proximity to the NHDES main office, for both outreach opportunities and ease of maintenance. It is also in the proximity of residential neighborhoods, retirement communities and schools. The Station measures 8' wide by 18' long. Its insulated, box-type structure is specifically designed for climate-controlled scientific functions.			
Pollutants/Parameters			
Ozone – Temperature – Wind Speed – Wind Direction. NHDES also uses this station as an air monitoring laboratory and a staging area for field-ready equipment.			
Recent Changes			
NHDES did not make any significant changes to this station during this review period.			
Proposed/Planned Changes			
NHDES is not planning any significant changes to this station into the foreseeable future.			

On the left, an image of the monitoring station and on the right a Google Earth map pinpointing the station's location.

Exchange Street, Pembroke

General Information			
AQS ID:	33-013-1006	Latitude:	43.132460
Town:	Pembroke	Longitude:	-71.458246
Address:	Pleasant St.	Elevation (m):	74
County:	Merrimack	Year Est.:	2002
Spatial Scale:	Neighborhood		

Site Description
This station is located in a suburban residential area southeast of the coal burning Merrimack station power plant. It is the ideal location for improving our understanding of near-field emissions from the Merrimack Station power plant. This insulated, box-type structure is specifically designed for climate-controlled scientific functions and measures approximately 8' wide by 10' long.

Pollutants/Parameters

Sulfur Dioxide – Temperature – Wind Speed – Wind Direction.

Recent Changes

NHDES did not make any significant changes to this station during this review period.

Proposed/Planned Changes

NHDES is not planning any significant changes to this station into the foreseeable future.

On the left, an image of the monitoring station and on the right a Google Earth map pinpointing the station's location.

Peirce Island, Portsmouth

General Information			
AQS ID:	33-015-0014	Latitude:	43.075371
Town:	Portsmouth	Longitude:	-70.748017
Address:	Peirce Island	Elevation (m):	10
County:	Rockingham	Year Est.:	2001
Spatial Scale:	Neighborhood		

Site Description

This station is located in an urban commercial/residential area. It is strategically position to capture air quality data from the Portsmouth Shipyard (northeast), the urban center of Portsmouth (southwest), the industrialized Piscataqua River (northwest) and ocean fetch-type events (southeast) depending on wind direction. The cedar-clad, stick-built shelter is approximately 10' wide by 12' long. Filter-based samplers are located on platforms approximately 8m from the shelter.

Pollutants/Parameters

Ozone – $PM_{2.5}$ Continuous (light scattering) – filter based $PM_{2.5}$ (1 every 12 days) – PM_{10} Continuous (BAM) – Sulfur Dioxide – Temperature – Wind Speed – Wind Direction

Recent Changes

NHDES removed the API602 particle sampler from this station and installed an API640x particle sampler in January 2019.

Proposed/Planned Changes

NHDES is not planning any significant changes to this station into the foreseeable future.

On the left, an image of the monitoring station and on the right a Google Earth map pinpointing the station's location.

Seacoast Science Center, Rye

General Information			
AQS ID:	33-015-0016	Latitude:	43.045269
Town:	Rye	Longitude:	-70.713958
Address:	Seacoast Science Ctr.	Elevation (m):	10
		Year Est.:	2003
County:	Rockingham		
Spatial Scale:	Neighborhood		

Site Description
This station is located in a rural neighborhood on the seacoast in direct exposure to the Atlantic Ocean. The station is located inside a modified corner of the main facility building at the Seacoast Science Center. NHDES established this station to measure coastal ozone episodes as well as to promote public understanding of air pollution and monitoring.

Pollutants/Parameters

Ozone - Temperature – Wind Speed – Wind Direction.

Recent Changes

NHDES did not make any significant changes to this station during this review period.

Proposed/Planned Changes

NHDES is not planning any significant changes to this station into the foreseeable future.

On the left, an image of the building housing the monitoring station and on the right a Google Earth map pinpointing the station's location.

Water Street, Keene

General Information			
AQS ID:	33-005-0007	Latitude:	42.930521
Town:	Keene	Longitude:	-72.272332
Address:	Water Street	Elevation (m):	145
County:	Cheshire	Year Est.:	1989
Spatial Scale:	Neighborhood		

Site Description

This 8' wide by 10' long air monitoring station is situated in a commercial area, close to the center of the city of Keene. The filter-based $PM_{2.5}$ sampler is located on the rooftop deck.

Pollutants/Parameters

Ozone - $PM_{2.5}$ Continuous (BAM) – filter based $PM_{2.5}$ (1 every 6 days) – Wind Speed - Wind Direction - Temperature

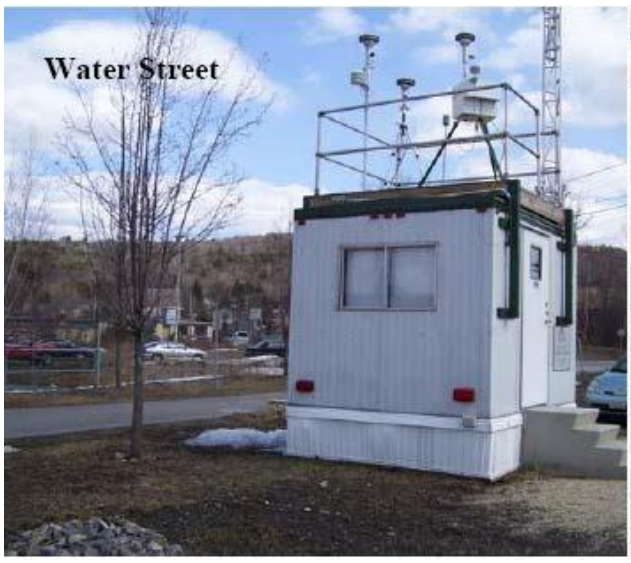
Recent Changes

NHDES discontinued filter based $PM_{2.5}$ sampling at this station from August 2017 through December 2017. NHDES resumed this sampling starting in January 2018 on 1 in 6 day schedule.

Proposed/Planned Changes

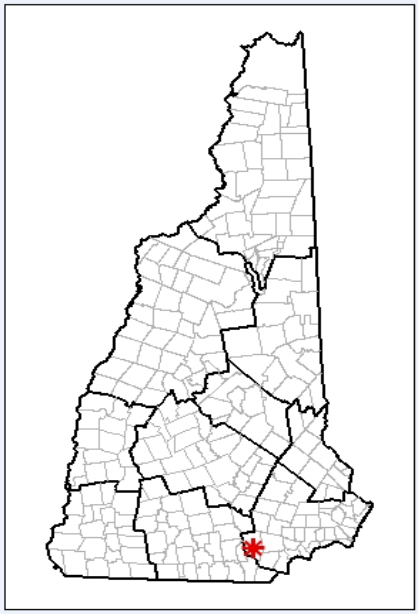
NHDES is not planning any significant changes to this station into the foreseeable future.

On the left, an image of the monitoring station and on the right a Google Earth map pinpointing the station's location.



Moose Hill, Londonderry

General Information			
AQS ID:	33-015-0018	Latitude:	42.862522
Town:	Londonderry	Longitude:	-71.380153
Address:	Moose Hill Sch.	Elevation (m):	104
County:	Rockingham	Year Est.:	2009
Spatial Scale:	Neighborhood		



Site Description

Proposed:

This 12' wide by 16' long wood clad, stick-built air monitoring station is located in a very open field in the heart of suburban New Hampshire, approximately halfway between the state's two largest cities (Manchester and Nashua). It has virtually zero local interferences from nearby pollution sources or obstructions, making it an ideal location to measure regional air quality. Filter-based $PM_{2.5}$ samplers are located on platforms approximately 15m from the structure.

Pollutants/Parameters

NCORE: $PM_{2.5}$ Continuous (BAM) – PM_{10} Continuous (BAM) - filter based $PM_{2.5}$ (1 every 3 days) – IMPROVE – PM Coarse (Continuous) – Oxides of Nitrogen (NOy) – Nitrogen Dioxide (NO_2) – Ozone – Sulfur Dioxide (trace) – Carbon Monoxide (trace) – Temperature – Wind Speed – Wind Direction – Relative Humidity – Precipitation – Barometric Pressure – Photochemical Precursors.

Recent Changes

NHDES did not make any significant changes to this station during this review period.

Proposed/Planned Changes

NHDES is not planning any significant changes to this station into the foreseeable future, except in accordance with Part 3 of this document (PAMS Implementation Plan).

On the left, an image of the monitoring station and on the right a Google Earth map pinpointing the station's location.

Pack Monadnock Mountain, Peterborough

General Information			
AQS ID:	33-011-5001	Latitude:	42.861830
Town:	Peterborough	Longitude:	-71.878626
Address:	Miller State Park	Elevation (m):	694
County:	Hillsborough	Year Est.:	2002
Spatial Scale:	Regional		

Site Description

This station is located in an elevated forest environment on the summit of Pack Monadnock Mountain. NHDES recently renovated this 27' by 10' structure to include many efficiency initiatives. The location of this station is scientifically significant because it is the highest accessible peak that lies directly within the primary air pollution transport corridor into the central part of the state. This allows this site to be the ideal location for improving our understanding of air pollution transport into the heavily populated Merrimack Valley and beyond. The filter-based $PM_{2.5}$ sampler is located on a deck on top of the structure.

Pollutants/Parameters

NCORE: $PM_{2.5}$ Continuous (BAM) – PM_{10} Continuous (BAM) - filter based $PM_{2.5}$ (1 every 3 days) – IMPROVE – PM Coarse (Continuous) – Oxides of Nitrogen (NOy) – Ozone – Sulfur Dioxide (trace) – Carbon Monoxide (trace) – Temperature – Wind Speed – Wind Direction – Relative Humidity – Precipitation – Barometric Pressure – Solar Radiation – Photochemical Precursors.

Recent Changes

NHDES did not make any significant changes to this station during this review period.

Proposed/Planned Changes

NHDES is not planning any significant changes to this station into the foreseeable future, except in accordance with Part 3 of this document (PAMS Implementation Plan).

On the left, an image of the monitoring station and on the right a Google Earth map pinpointing the station's location.

Gilson Road, Nashua

General Information			
AQS ID:	33-011-1011	Latitude:	42.718656
Town:	Nashua	Longitude:	-71.522428
Address:	57 Gilson Rd.	Elevation (m):	59
County:	Hillsborough	Year Est.:	2003
Spatial Scale:	Neighborhood		

Site Description

This air monitoring station is located in a suburban residential neighborhood near a Superfund site. NHDES requires two 8' wide by 16' long trailers to accommodate the equipment needed to measure ambient air parameters, including PAMS. NHDES collects meteorological data from a tower located on an adjacent building. Photochemical Assessment Monitoring (PAMS) was previously conducted at this station. NHDES moved PAMS to Londonderry in 2014. PAMS canister preparation still takes place at this station.

Pollutants/Parameters

Ozone – Temperature – Wind Speed – Wind Direction.

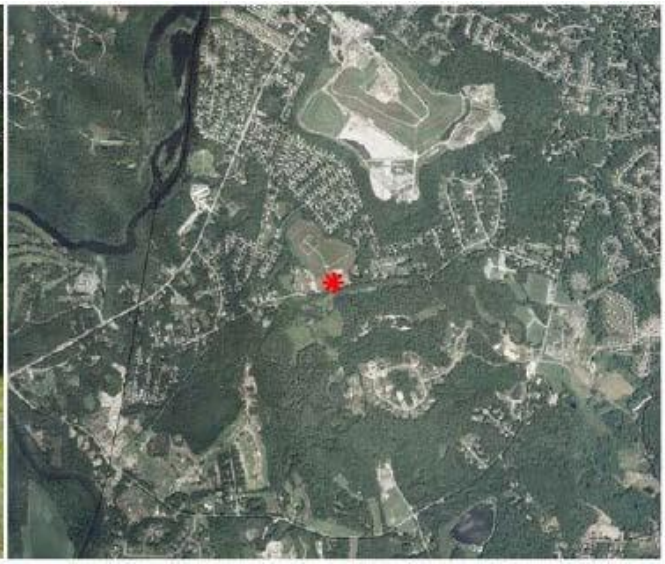
Recent Changes

NHDES did not make any significant changes to this station during this review period.

Proposed/Planned Changes

NHDES is not planning any significant changes to this station into the foreseeable future.

On the left, an image of the monitoring station and on the right a Google Earth map pinpointing the station's location.



APPENDIX A:
$PM_{2.5}$ Comparability Assessments

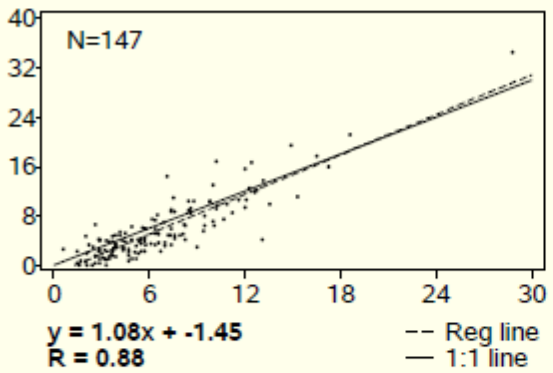
The image below compares FRM vs. FEM $PM_{2.5}$ sampling at the Keene Station

$PM_{2.5}$ Continuous Monitor Comparability Assessment

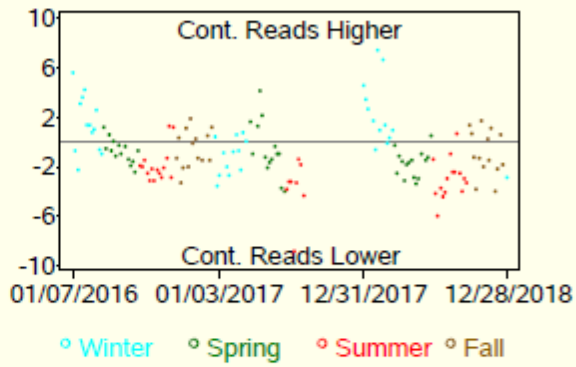
Site 33-005-0007: Keene, NH

FRM: BGI Models PQ200-VSCC or PQ200A-VSCC - Gravimetric (116,142), PM2.5 - Local Conditions (88101), POC=1
Cont: Met One BAM-1020 Mass Monitor w/VSCC - Beta Attenuation (170), PM2.5 - Local Conditions (88101), POC=3

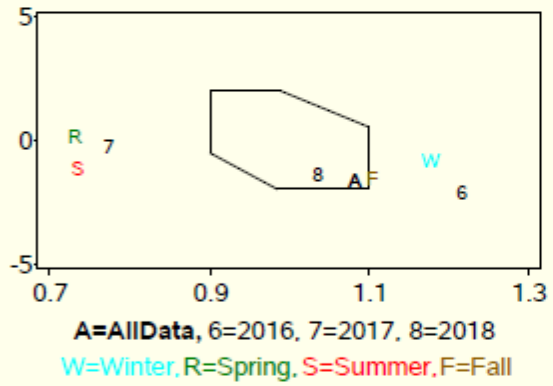
Cont. (y) vs. FRM (x) ($\mu g/m^3$)



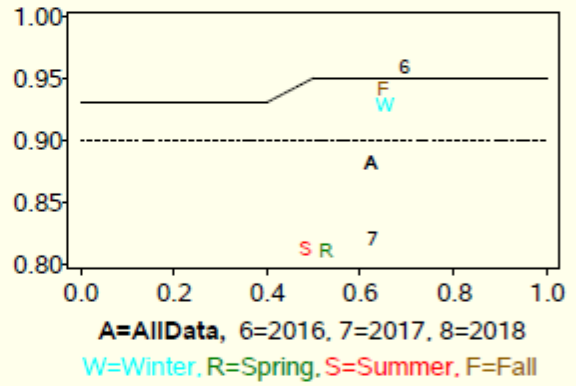
Cont. minus FRM ($\mu g/m^3$)



Additive (y) vs. Multiplicative (x) Bias



R (y) vs. FRM CCV (x)



Mean Concentration ($\mu g/m^3$)

Dataset	N	FRM	Cont	Ratio (Cont/FRM)
AllData	**147**	**6.5**	**5.6**	**0.86**
Winter	38	8.2	9.1	1.10
Spring	43	5.1	4.0	0.80
Summer	38	6.4	3.7	0.58
Fall	28	6.5	5.8	0.89
2016	57	6.9	6.4	0.93
2017	33	6.4	4.8	0.75
2018	57	6.2	5.2	0.84

Appendix A Statistics

Dataset	N (all observations)	Bias (all observations)	N (only >= 3 ug/m^3)	Bias (only >= 3 ug/m^3)
AllData	**147**	**-18**	**93**	**-8.0**
Winter	38	8.1	30	13.1
Spring	43	-12	24	-20
Summer	38	-46	20	-32
Fall	28	-25	19	-0.4
2016	57	-16	40	-3.9
2017	33	-17	18	-23
2018	57	-22	35	-5.0

Data Source: EPA AQS Data Mart

Generated on: May 28, 2019

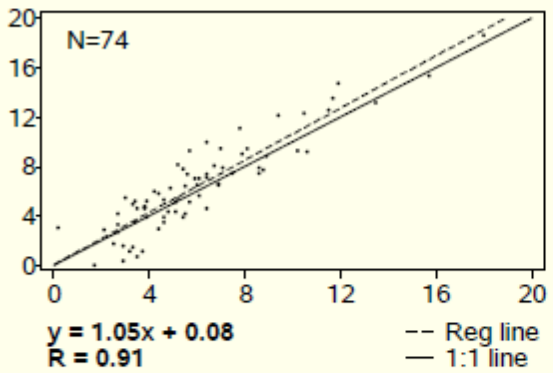
The image below compares FRM vs. FEM $PM_{2.5}$ sampling at the Lebanon Station

$PM_{2.5}$ Continuous Monitor Comparability Assessment

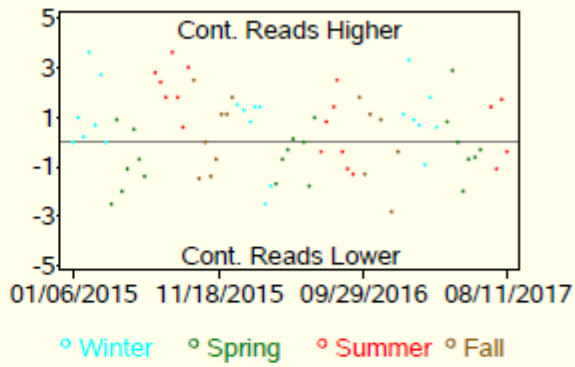
Site 33-009-0010: Lebanon, NH

FRM: BGI Models PQ200-VSCC or PQ200A-VSCC - Gravimetric (116,142), PM2.5 - Local Conditions (88101), POC=1
Cont: Met One BAM-1020 Mass Monitor w/VSCC - Beta Attenuation (170), PM2.5 - Local Conditions (88101), POC=3

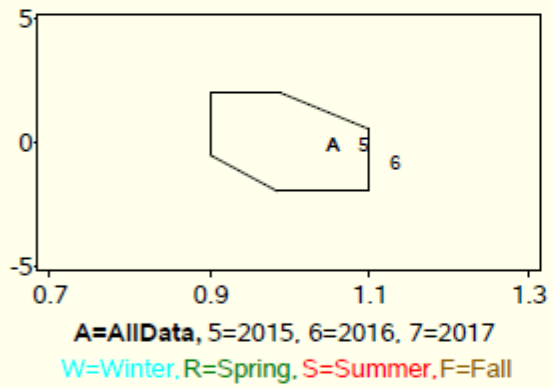
Cont. (y) vs. FRM (x) ($\mu g/m^3$)



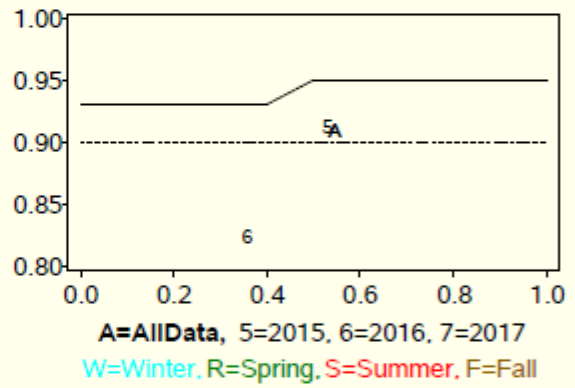
Cont. minus FRM ($\mu g/m^3$)



Additive (y) vs. Multiplicative (x) Bias



R (y) vs. FRM CCV (x)



Mean Concentration ($\mu g/m^3$)

Dataset	N	FRM	Cont	Ratio (Cont/FRM)
AllData	**74**	**6.0**	**6.4**	**1.07**
Winter	21	5.7	6.6	1.15
Spring	21	5.1	4.6	0.91
Summer	18	7.9	8.9	1.13
Fall	14	5.2	5.4	1.03
2015	29	6.6	7.3	1.11
2016	28	5.1	5.1	1.00
2017	17	6.4	6.9	1.07

Appendix A Statistics

Dataset	N (all observations)	Bias	N (only >= 3 ug/m^3)	Bias
AllData	**74**	**23.0**	**60**	**12.8**
Winter	21	13.1	16	20.0
Spring	21	51.2	15	-3.9
Summer	18	17.9	18	17.9
Fall	14	2.1	11	16.6
2015	29	9.2	25	17.8
2016	28	-2.9	22	9.6
2017	17	89.2	13	8.5

Data Source: EPA AQS Data Mart

Generated on: May 28, 2019

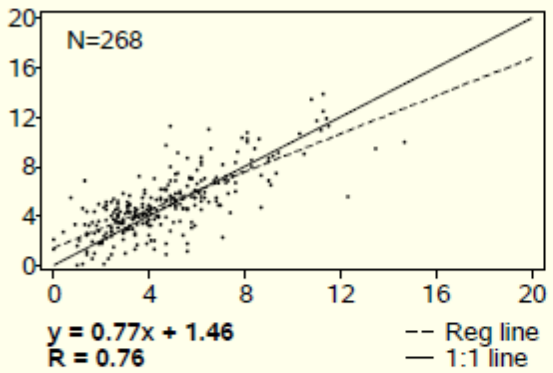
The image below compares FRM vs. FEM $PM_{2.5}$ sampling at the Londonderry Station

$PM_{2.5}$ Continuous Monitor Comparability Assessment

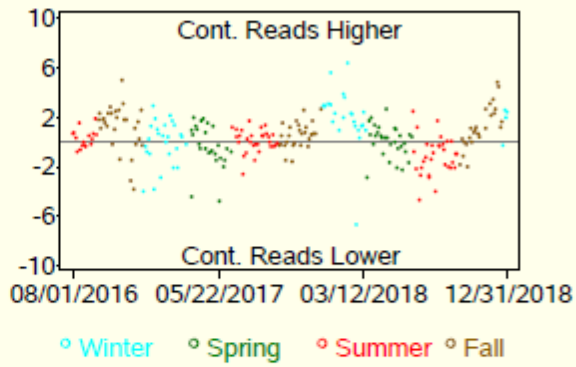
Site 33-015-0018: Londonderry, NH

FRM: R & P Model 2025 PM-2.5 Sequential Air Sampler w/VSCC - Gravimetric (118,142,145), PM2.5 - Local Conditions (88101), POC=1,2,4
Cont: Met One BAM-1020 Mass Monitor w/VSCC - Beta Attenuation (170), PM2.5 - Local Conditions (88101), POC=3

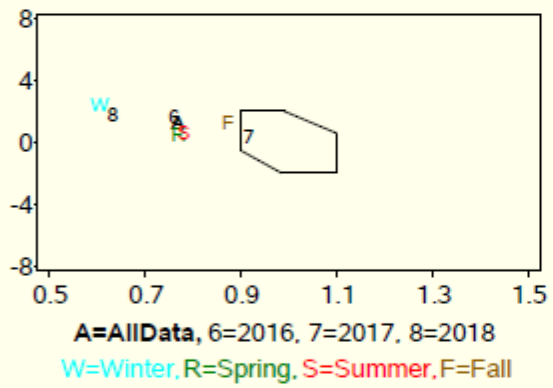
Cont. (y) vs. FRM (x) ($\mu g/m^3$)



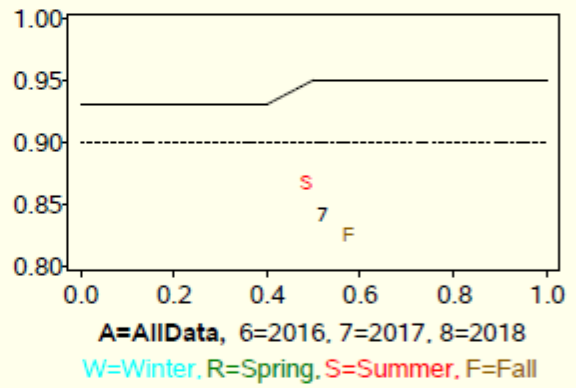
Cont. minus FRM ($\mu g/m^3$)



Additive (y) vs. Multiplicative (x) Bias



R (y) vs. FRM CCV (x)



Mean Concentration ($\mu g/m^3$)

Dataset	N	FRM	Cont	Ratio (Cont/FRM)
AllData	**268**	**4.7**	**5.0**	**1.08**
Winter	54	4.1	5.1	1.24
Spring	56	4.0	3.9	0.97
Summer	77	5.6	5.2	0.94
Fall	81	4.6	5.6	1.21
2016	48	5.2	5.9	1.13
2017	109	4.7	4.9	1.04
2018	111	4.4	4.8	1.09

Appendix A Statistics

Dataset	N (all observations)	Bias	N (only >= 3 ug/m^3)	Bias
AllData	**268**	**21.9**	**177**	**9.9**
Winter	54	42.8	31	23.1
Spring	56	4.1	30	2.3
Summer	77	-2.6	61	-3.1
Fall	81	43.6	55	21.0
2016	48	23.1	39	16.7
2017	109	8.9	72	9.0
2018	111	34.2	66	6.9

Data Source: EPA AQS Data Mart

Generated on: May 28, 2019

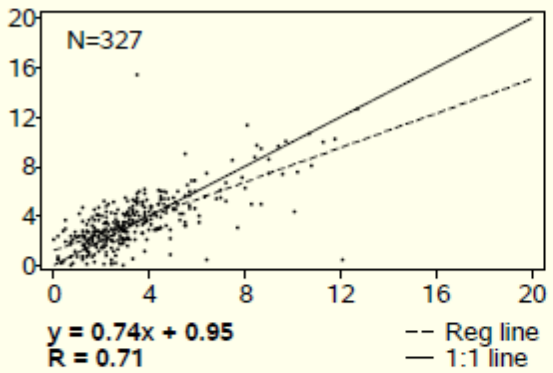
The image below compares FRM vs. FEM $PM_{2.5}$ sampling at the Peterborough Station

$PM_{2.5}$ Continuous Monitor Comparability Assessment

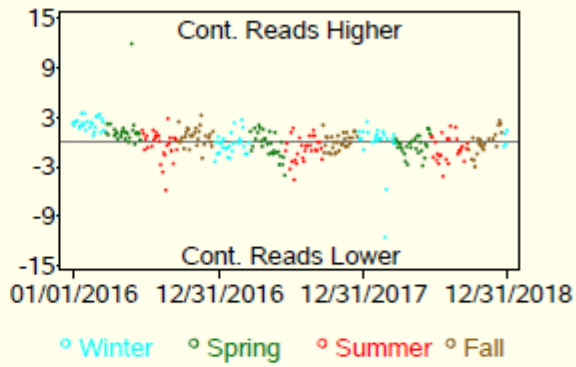
Site 33-011-5001: Peterborough (Peterboro), NH

FRM: R & P Model 2025 PM-2.5 Sequential Air Sampler w/VSCC - Gravimetric (116,118,145), PM2.5 - Local Conditions (88101), POC=1
Cont: Met One BAM-1020 Mass Monitor w/VSCC - Beta Attenuation (170), PM2.5 - Local Conditions (88101), POC=3

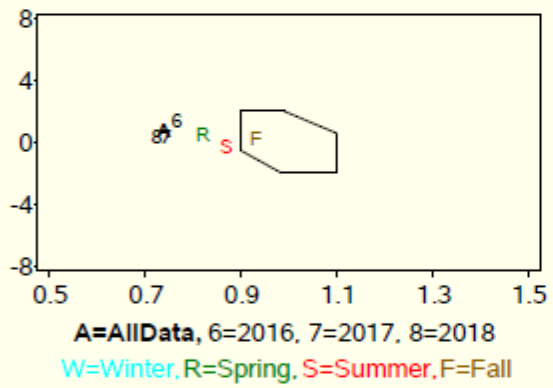
Cont. (y) vs. FRM (x) ($\mu g/m^3$)



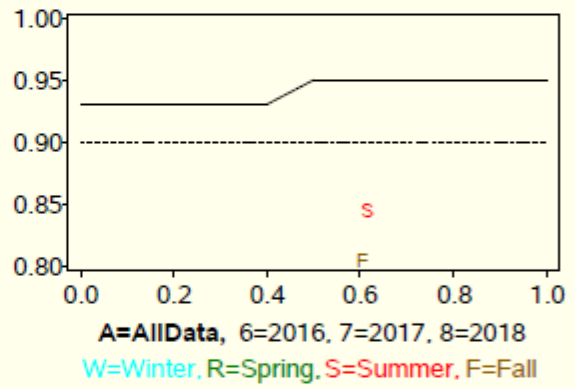
Cont. minus FRM ($\mu g/m^3$)



Additive (y) vs. Multiplicative (x) Bias



R (y) vs. FRM CCV (x)



Mean Concentration ($\mu g/m^3$)

Dataset	N	FRM	Cont	Ratio (Cont/FRM)
AllData	**327**	**3.3**	**3.4**	**1.02**
Winter	80	2.9	3.5	1.20
Spring	86	3.0	3.2	1.06
Summer	83	4.6	3.9	0.86
Fall	78	2.9	3.1	1.07
2016	113	3.3	4.2	1.27
2017	114	3.2	2.9	0.91
2018	100	3.5	3.1	0.88

Appendix A Statistics

Dataset	N (all observations)	Bias	N (only >= 3 ug/m^3)	Bias
AllData	**327**	**16.5**	**131**	**9.3**
Winter	80	50.8	26	20.9
Spring	86	28.4	28	23.3
Summer	83	-24	45	-6.8
Fall	78	11.6	32	10.0
2016	113	53.5	55	24.6
2017	114	-4.1	43	-1.1
2018	100	-1.9	33	-2.9

Data Source: EPA AQS Data Mart

Generated on: May 28, 2019

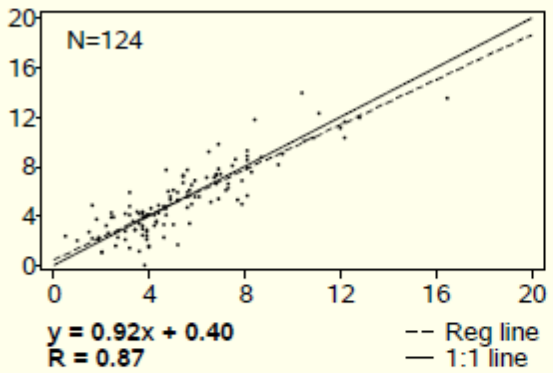
The image below compares FRM vs. FEM $PM_{2.5}$ sampling at the Portsmouth Station

$PM_{2.5}$ Continuous Monitor Comparability Assessment

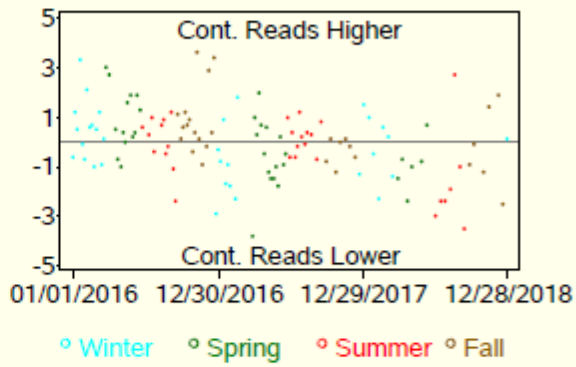
Site 33-015-0014: Portsmouth, NH

FRM: BGI Models PQ200-VSCC or PQ200A-VSCC - Gravimetric (116,118,142), PM2.5 - Local Conditions (88101), POC=1
Cont: Teledyne Model 602 Beta plus w/VSCC - Beta Attenuation (204), PM2.5 - Local Conditions (88101), POC=6

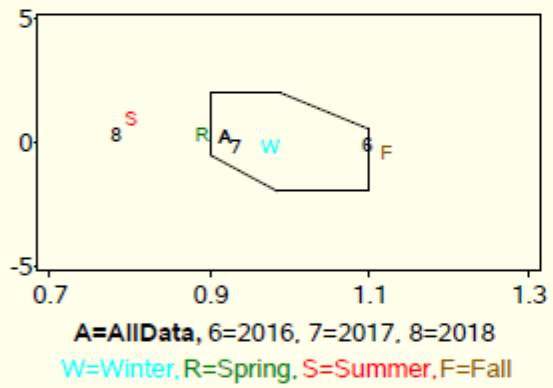
Cont. (y) vs. FRM (x) ($\mu g/m^3$)



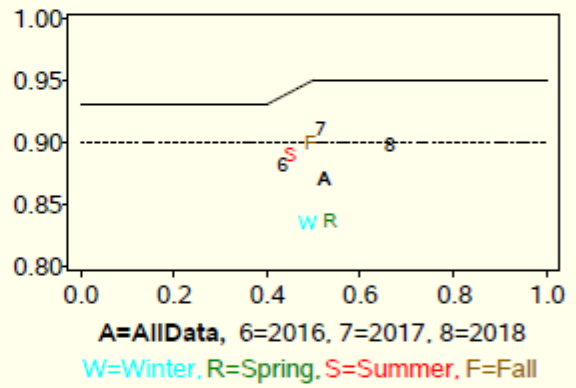
Cont. minus FRM ($\mu g/m^3$)



Additive (y) vs. Multiplicative (x) Bias



R (y) vs. FRM CCV (x)



Mean Concentration ($\mu g/m^3$)

Dataset	N	FRM	Cont	Ratio (Cont/FRM)
AllData	**124**	**5.3**	**5.3**	**0.99**
Winter	32	4.5	4.4	0.98
Spring	34	4.7	4.7	0.99
Summer	30	7.0	6.7	0.96
Fall	28	5.1	5.5	1.07
2016	54	5.2	5.8	1.11
2017	43	5.2	4.9	0.93
2018	27	5.6	4.9	0.87

Appendix A Statistics

Dataset	N (all observations)	Bias	N (only >= 3 ug/m^3)	Bias
AllData	**124**	**5.0**	**89**	**4.3**
Winter	32	-0.5	21	-0.3
Spring	34	5.2	21	6.4
Summer	30	-0.3	26	2.3
Fall	28	16.8	21	9.2
2016	54	12.1	43	13.0
2017	43	-2.6	29	-1.6
2018	27	3.1	17	-7.8

Data Source: EPA AQS Data Mart

Generated on: May 28, 2019