THE NEW HAMPSHIRE AMBIENT AIR MONITORING PROGRAM 2018/2019 ANNUAL NETWORK REVIEW and PLAN

New Hampshire Department of Environmental Services

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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THE NEW HAMPSHIRE AMBIENT AIR MONITORING PROGRAM 2018/2019 ANNUAL NETWORK REVIEW and PLAN

prepared by the
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Introduction

The New Hampshire Department of Environmental Services (NHDES) is pleased to submit this 2018/2019 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 3 of this Plan details our Photochemical Assessment Monitoring Station (PAMS) Enhanced Monitoring Plan (EMP) for organizations in the Ozone Transport Region as per United States Environmental Protection Agency (USEPA) monitoring rule (80 FR 65292; October 26, 2015)

PART 1 – 2018/2019 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 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. Most 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 2018, 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 2018 include ozone, ozone precursors (nitrogen oxides (NOx) and VOCs), $PM_{2.5}$ and SO_2. The New Hampshire monitoring network is most dense 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.

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). This plan is due by October 2019 and is to include instrumentation, proposed measurements, and analysis plans for advancing scientific understanding of the nature of the ozone problem and transport within the OTR, in order to develop solutions for states to reach attainment. States within the OTR are working together collaboratively to develop a comprehensive plan that reduces redundancies and capitalizes on state expertise. Each state will then submit an EMP for their portion of the comprehensive plan.

Network Summary

Below is a brief summary of the New Hampshire Air Monitoring network as of June 2018 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 research oriented station also represents population exposure on a regional scale. On the other hand, Mt. Washington summit is not representative of general public exposure in communities located in New Hampshire's northern counties and any attempt to apply this 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 buildup 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 levels. This station represents population exposure on a regional scale. 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.

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. Trace level carbon monoxide measurements are proposed for this location 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 is including 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 Federal Equivalency Method (FEM) Monitoring
NHDES operates several Met One 1020 BAMs and one API 602 BAM covering a total of five permanent stations. NHDES operates BAMs at Keene, Lebanon, Londonderry, Peterborough and Portsmouth. NHDES also operates Federal Reference Method (FRM) filter based samplers at all of these stations except for Lebanon in order to flesh out data comparison assessments between the beta and filter based methodologies. Please note below information 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 the following link: https://www.epa.gov/outdoor-air-quality-data/pm25-continuous-monitor-comparability-assessments.

Keene - The Met One 1020 BAM data at Keene remains primary data 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 curtailed FRM sampling in Keene during the 3rd and 4th quarters of 2017 due to limited resources. Based on available data, individual seasonal data comparisons are outside acceptability limits and all FRM and FEM data for the past three years (2015 – 1017). These data sets do correlate with an overall $R^2 = 0.62$ and have an intercept of +1.8 micrograms per cubic meter ($\mu g/m^3$). These statistics show a progressive trend from the previous year. And, these data are significantly skewed based on one FRM outlier collected on 1/12/15. NHDES flagged this data point as an outlier, but AQS is still using the point to generate these statistics. Due to the outlier's negative influence and the overall positive trends with the FRM to FEM correlations, NHDES believes that the BAM data should remain primary towards the NAAQS at Keene.

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 curtailed FRM sampling in Lebanon during the 3rd and 4th quarters of 2017 due to limited resources. 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 R2 = 0.83 and have an intercept of 0.08.

Londonderry – The Met One 1020 BAM data at Londonderry remains primary toward the NAAQS. The FRM and FEM data for the past three years is moving closer to being within the additive vs. multiplicative bias acceptability limits for FEM testing. On a positive trend, the 2017 data is within these acceptability limits. These data correlate with an overall R2 = 0.67 and have an intercept of 0.91.

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 within additive vs. multiplicative bias acceptability limits for FEM testing. This 3-year data set correlates with an overall R^2 = 0.58 and have an intercept of 1.15. The 2016 and 2017 data, however, are outside these acceptability limits (see Comparability Assessments in Appendix A). These data should be viewed with some uncertainty based on a number of factors. Outliers, low data and method differences are key factors in this uncertainty.

Portsmouth - API 602 BAM data at Portsmouth remains primary toward the NAAQS. Any FRM data generated at this station is considered secondary when BAM data are available. The API 602 BAM has correlated quite well with the FRM when operational. All valid FRM and API 602 FEM data sets from Portsmouth for the past three years are within or very close to additive vs. multiplicative bias acceptability limits for FEM testing. This three-year data set correlates with an overall R^2 = 0.86 and have an intercept of -0.17.

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.

Network Modifications

NHDES made the following modifications to the air monitoring network between July 1, 2017 and June 30, 2018.

PAMS – As per NHDES' PAMS Implementation Plan both New Hampshire PAMS sites, Londonderry and Miller State Park, discontinued 24 hour can sampling during the 2017 monitoring season. These sites no longer collect and analyze a 24 hour can on the one and six day sampling schedule. NHDES does still collect one can on a monthly frequency, and run in duplicate at each site for precision data.

Laconia $PM_{2.5}$ – As part of a special study, NHDES again established a temporary winter $PM_{2.5}$ monitoring platform near downtown Laconia (Memorial Park) during the 2017-2018 winter season. A

report will be generated based on final quality assured $PM_{2.5}$ BAM and Aetholometer data generated during this study. It has not yet been determined if NHDES will continue monitoring at this location or choose another within the city for Winter 2018-19.

Filter Based PM Sampling – Due to severe personnel resource deficits, NHDES requested – and received – permission from EPA to reduce some PM co-location sampling. These modifications did not affect NHDES' ability to comply with air quality monitoring regulations. Please note the following modifications in this regard:

- NHDES Stopped all $PM_{2.5}$ co-location sampling in Keene during 3rd and 4th quarter 2017.
- NHDES Stopped all $PM_{2.5}$ co-location sampling in Lebanon starting in the 3rd quarter 2017.
- NHDES reduced frequency of $PM_{2.5}$ co-location sampling in Portsmouth from 1/6 to 1/12 days starting in the 3rd quarter 2017.
- NHDES reduced frequency of $PM_{2.5}$ co-location sampling in Laconia from 1/6 to 1/12 days starting in the 3rd quarter 2017.
- NHDES stopped all PM_{10} co-location in Portsmouth starting in the 3rd quarter 2017.

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) – Part 3 of this document details the NHDES Enhanced Monitoring Plan for the 2015 Ozone NAAQS Implementation. New Hampshire, being part of the Ozone Transport Region (OTR), is required to submit this EMP by October 2019. NHDES has been working in coordination with other states in OTR and takes into consideration interregional transport of pollutants of concern. The NH EMP presents only the relevant portion of the regionally coordinated plan that falls within the state boundary.

In addition, to upgrade the Londonderry NCORE/PAMS station, the solar and UV radiation sensors currently located at Peterborough will be relocated to Londonderry in the spring of 2018. The NOx instrument in Londonderry has also been replaced with a True NO_2 CAPS 500 analyzer, and a ceilometer will be installed to meet the mixing height requirement as part of the modifications to 40 CFR Part 58. Further, carbonyl sampling will commence in Londonderry every three days starting in 2019.

Camp Dodge, Green's Grant – NHDES is planning a minor relocation of this station during the Fall of 2018. In coordination with the USFS and AMC, NHDES plans to place an efficient climate controlled structure adjacent (approximately 10 ft away) to the current structure and relocate all monitoring equipment into and on the new structure. Once all monitoring activities are associated with the new structure, NHDES will remove the current one.

Purchasing/Expenses

NHDES' budget cycle runs from July 1 through June 30 each year. The Air Monitoring Program received some limited funding through the New Hampshire Capital Budget for equipment procurement during this previous budget cycle. With those funds NHDES chose to update our antiquated air monitoring equipment by procuring one ozone analyzer, one sulfur dioxide analyzer, one carbon monoxide analyzer and two dilution calibrators. NHDES also received some early PAMS adoption funding during this budget cycle. With that, NHDES has procured, or is in the process of procuring, an NO_2 CAPS analyzer, a Markes Agilent gas chromatograph system, a ceiliometer and a carbonyl sampler.

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 with the limited federal equipment funding we received. This analyzer arrived from the factory and could not be installed due to electric code issues with the analyzer. The manufacturer was made aware and has taken the instrument back for modification.

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 602 BAM
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

Table 1.0 : Equipment – (Method)
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 – 2017/2018					
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	Continuous	Regional	Research

Table 1.2: New Hampshire Particulate Matter Network – 2017/2018					
$PM_{2.5}$					
Town	**Name**	**AIRS #**	**Frequency**	**Scale**	**Objective**
Keene	Water Street	33 005 0007	1 in 12 filter	Neighborhood	Population
Keene	Water Street	33 005 0007	Continuous - BAM	Neighborhood	Population
Laconia	Green Street	33 001 2004	1 in 6 filter	Regional	Population
Laconia	Green Street	33 001 2004	1 in 6 filter *	Regional	Colocate Audit
Lebanon	Lebanon Airport	33 009 0010	1 in 12 filter **	Neighborhood	Population
Lebanon	Lebanon Airport	33 009 0010	Continuous - BAM	Regional	Population
Londonderry	Moose Hill School	33 015 0018	1 in 3 filter	Regional	Population
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 6 filter *	Regional	Population
Portsmouth	Peirce Island	33 015 0014	Continuous - BAM	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	1 in 6 filter **	Neighborhood	Audit
Portsmouth	Peirce Island	33 015 0014	Continuous - BAM	Neighborhood	Audit

* Changed to "1 in 12" Aug 2017
** Discontinued Aug 2017

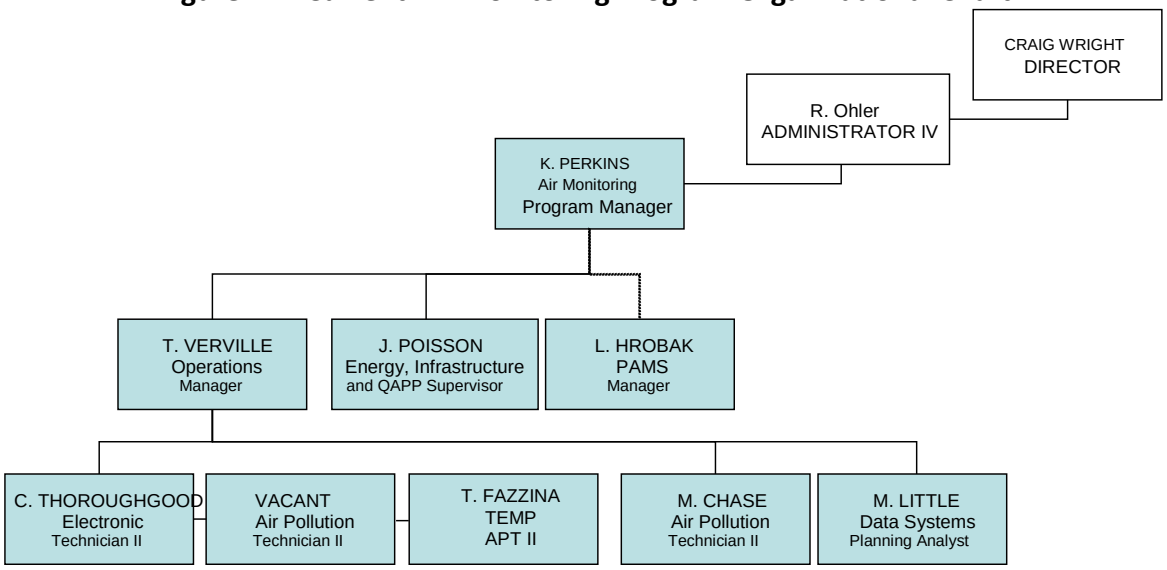
Table 1.3: New Hampshire PAMS Network – 2016/2017					
Town	**Name**	**AIRS #**	**Frequency**	**Scale**	**Objective**
Londonderry	Moose Hill School	33 015 0018	Starting 2015 June - Sept	Regional	Population
Peterborough	Pack Monadnock	33 011 5001	June - Sept	Regional	Research

Table 1.4: New Hampshire NCore Network – 2016/2017					
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. Due to limited budget, NHDES is unable to fill the vacant position during the next year. 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 26 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 2017. 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, $PM_{2.5}$, and SO_2 have all recently been tightened (lowered) to levels near what is currently being measured in New Hampshire. Two of these pollutants (ozone and $PM_{2.5}$) 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 (2015-17) 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 2015-17 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 be watched over the next few years.

In 2016, 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		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 (2012-2017)

Parameter/Location/Standard	Number of Exceedances						Most Recent (Relative to NAAQS from Each Year)
	2012	2013	2014	2015	2016	2017	
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	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 2015-16)							
Camp Dodge	0	0	0	0	0	0	2004
Concord	0	0	0	1	0	0	2015
Keene	0	0	0	0	1	0	2016
Laconia	0	0	0	0	0	0	2010
Lebanon	0	0	0	0	0	0	2008
Londonderry	2	0	0	1	1	1	2017
Miller	2	0	1	2	3	1	2017
Mt. Washington[1]	0	2	0	5	2	3	2017
Nashua	2	0	0	1	1	0	2016
Portsmouth	1	1	0	1	0	0	2015
Rye	1	0	0	1	1	1	2017
Woodstock	0	0	0	0	0	0	None
PM_{10}							
24-Hour (1987 standard)	0	0	0	0	0	0	1989
$PM_{2.5}$							
Annual (2012 standard)	0	0	0	0	0	0	None
24-Hour (2006 standard)							
Keene	1*	3*	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	0	--	--	--	2002 (Exceptional Event)
Pembroke	0	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	1	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: Manchester closed in 2011; Nashua ($PM_{2.5}$) and Pembroke ($PM_{2.5}$) shut down in 2015; Londonderry opened January 1, 2011; Concord station began SO_2 monitoring in 2011; lead monitoring was discontinued at end of 2nd quarter 2016.

[1] Mt. Washington ozone exceedances exclude the second of overlapping 8-hour periods (ie. 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.

Table 1.7: 2015 – 2017 Ozone Design Values (ppb)

Ozone	Design Value (DV) Description	NAAQS	5-Year Max DV	% of NAAQS	Location	2015-17 Max DV	% of NAAQS	Location
8-Hour	3-year average of 4th- highest daily maximum 8-hour averages	70 (2015-16); 75 (2008-14)	69	92*	Peterborough (2012-14)	68	97*	Mt. Washington

* 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 2015-17 maximum design value is relative to 70ppb, the NAAQS in place during the most recent design value period.

Table 1.8: 2017 Carbon Monoxide Design Values (ppm)

CO	Design Value (DV) Description	NAAQS	5-Year Max DV	% of NAAQS	Location	2017 Max DV	% of NAAQS	Location
1-Hour	2nd maximum	35	1.4	4	Keene (2013)	0.4	1	Londonderry
8-Hour	2nd maximum	9	1.1	14	Keene (2013)	0.4	4	Londonderry

Table 1.9: 2015 – 2017 Sulfur Dioxide Design Values (ppb)

SO_2	Design Value (DV) Description	NAAQS	5-Year Max DV	% of NAAQS	Location	2015-17 Max DV	% of NAAQS	Location
1-Hour	3-year average of 99th percentile of daily maximum 1-hour averages	75	89	119	Pembroke (2011-13)	16	21	Portsmouth
3-Hour	2nd maximum	500	27	5	Pembroke (2014)	11	2	Pembroke

Table 1.10: 2015 – 2017 Nitrogen Dioxide Design Values (ppb)

NO_2	Design Value (DV) Description	NAAQS	5-Year Max DV	% of NAAQS	Location	2015-17 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)	23	23	Londonderry
Annual	Annual average	53	3	6	Londonderry (2013-15, 2014-16, 2015-17)	3	6	Londonderry

Table 1.11: 2015 – 2017 Fine Particulate Matter Design Values ($\mu g/m^3$)

$PM_{2.5}$	Design Value (DV) Description	NAAQS	5-Year Max DV	% of NAAQS	Location	2015-17 Max DV	% of NAAQS	Location
24-Hour	3-year average of 98th percentile of midnight- midnight 24-hour averages	35	29	83	Keene (2011-13)	20	57	Keene
Annual	Annual average over 3 years	12	9.1	76	Keene (2011-13)	6.5	54	Keene

Figure 1.2: Ozone trends for the 8-hour NAAQS (2000-2017)

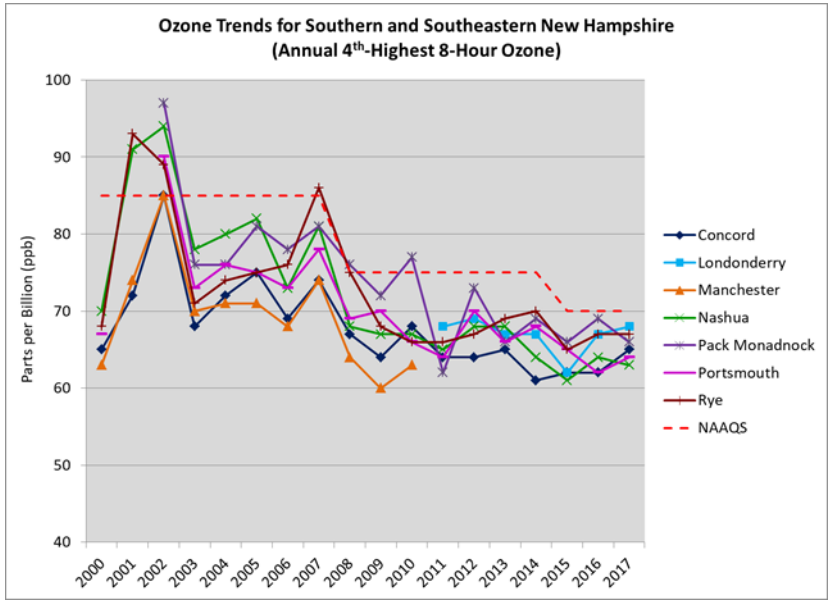


Figure 1.3: Ozone trends for the 8-hour NAAQS (2000-2017)

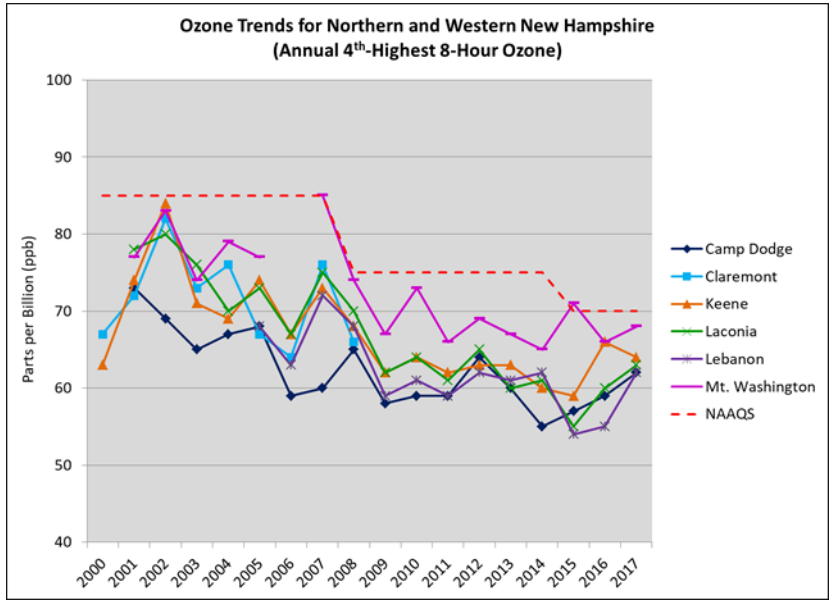


Figure 1.4: Carbon Monoxide trends for the 1-hour NAAQS (2000-2017)

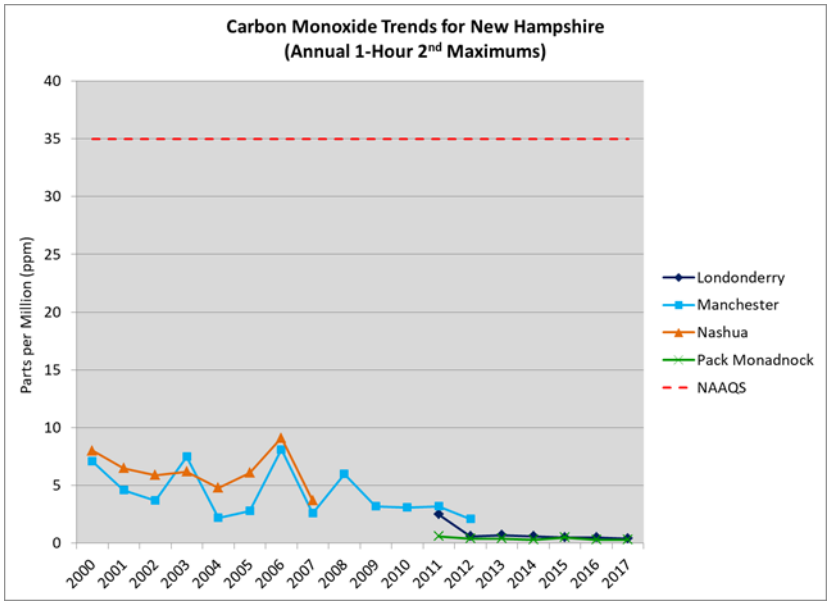


Figure 1.5: Carbon Monoxide trends for the 8-hour NAAQS (2000-2017)

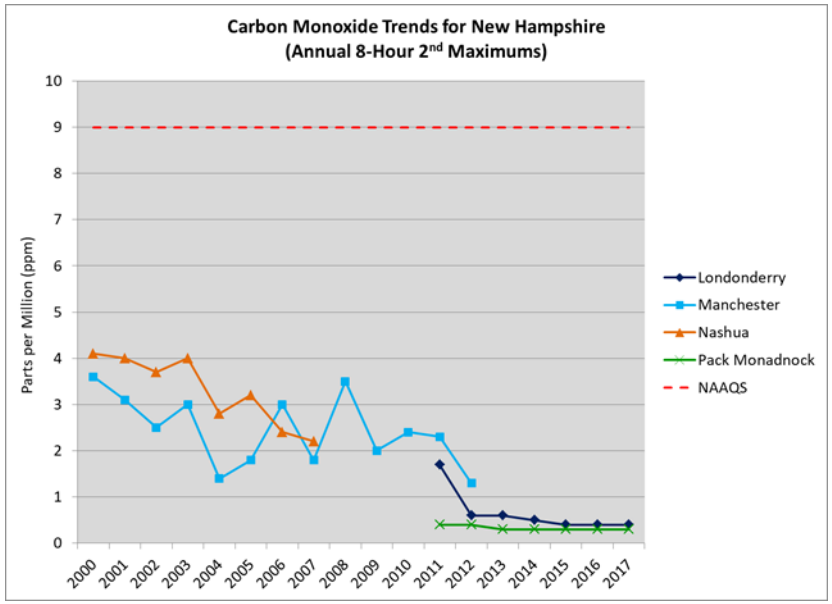


Figure 1.6: $PM_{2.5}$ trends for the 24-hour NAAQS (2000-2017)

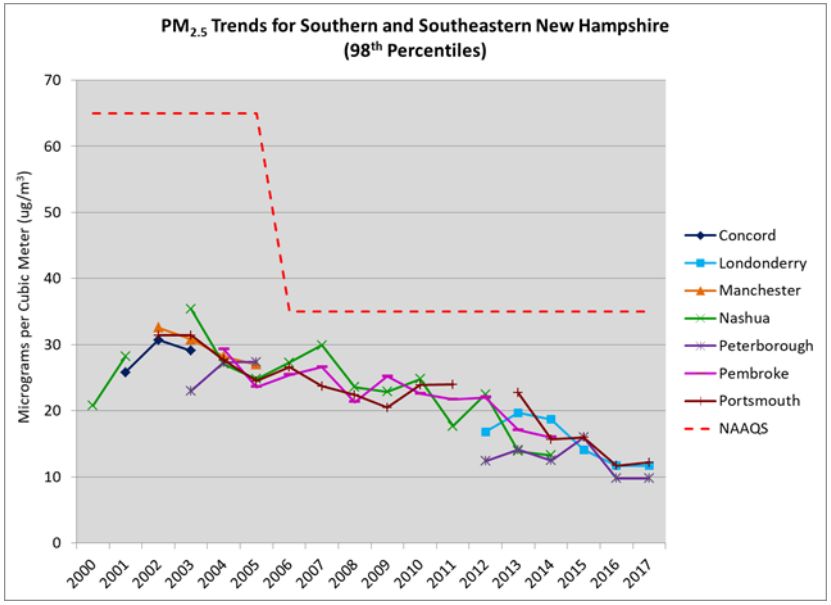


Figure 1.7: $PM_{2.5}$ trends for the 24-hour NAAQS (2000-2017)

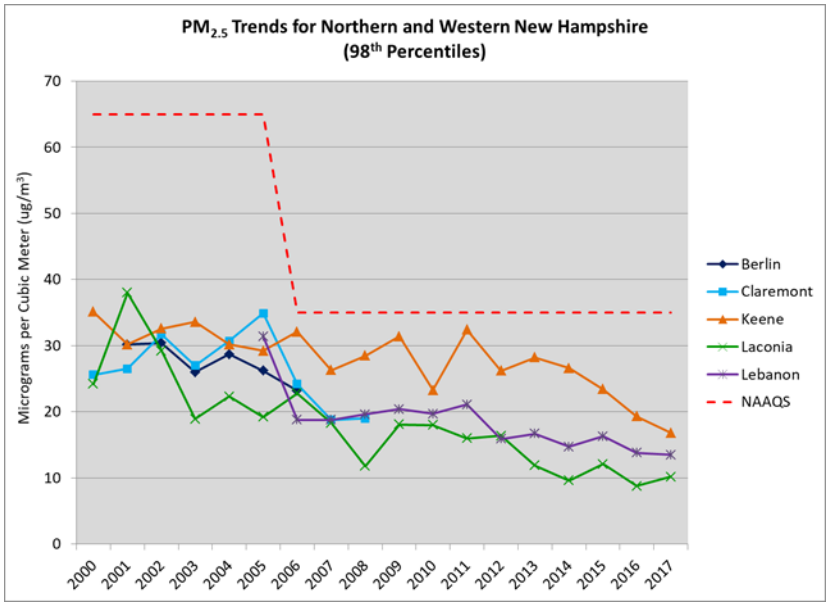


Figure 1.8: $PM_{2.5}$ trends for the annual NAAQS (2000-2017)

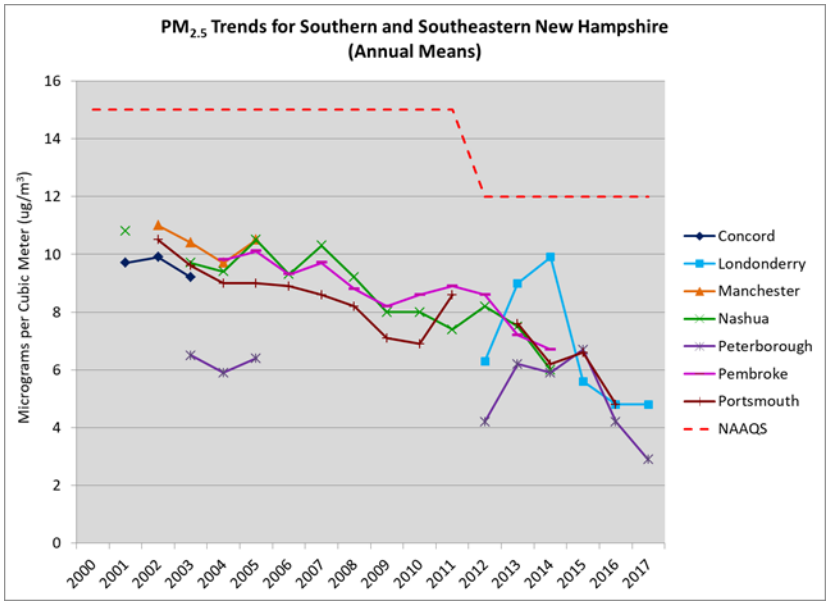


Figure 1.9: $PM_{2.5}$ trends for the annual NAAQS (2000-2017)

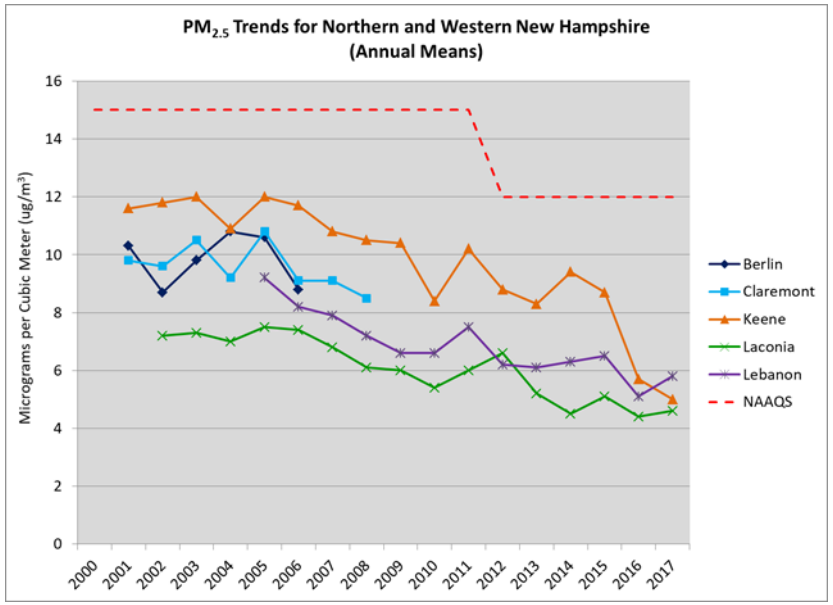


Figure 1.10: Nitrogen Dioxide trends for the 1-hour NAAQS (2000-2017)

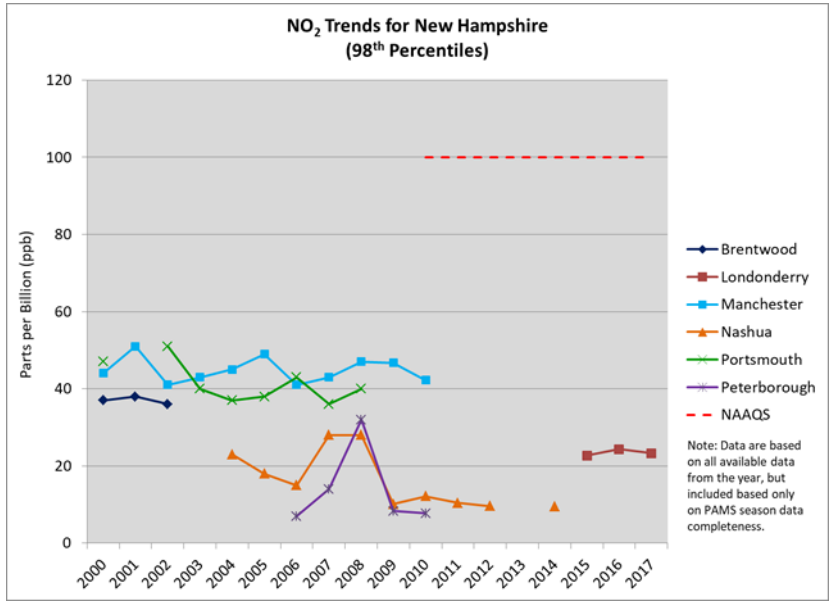


Figure 1.11: Lead trends for the annual NAAQS (2012-2017)

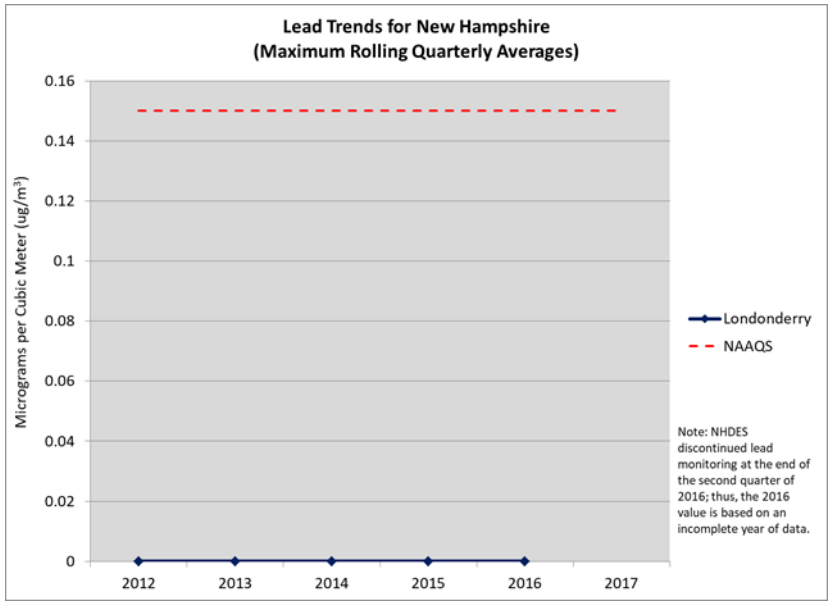


Figure 1.12: Sulfur Dioxide trends for the 1-hour NAAQS (2000-2017)

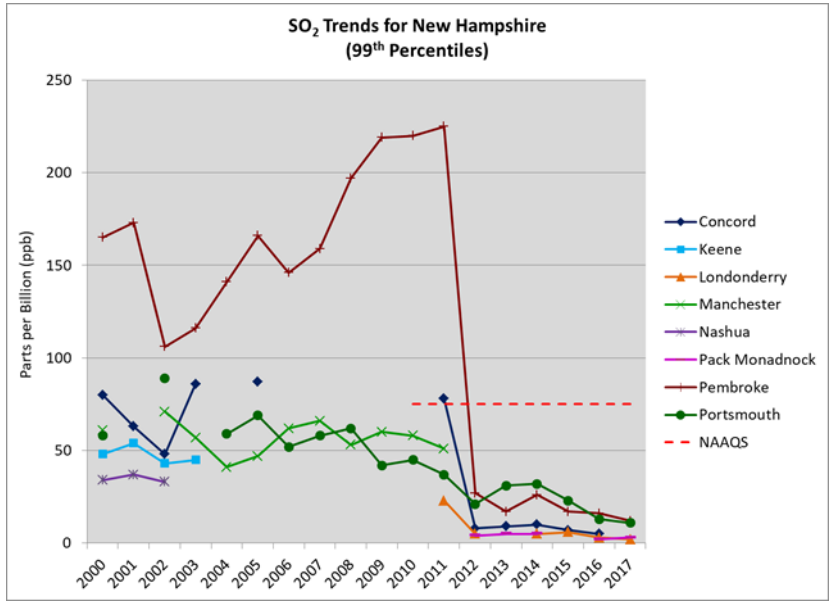


Figure 1.13: Sulfur Dioxide trends for the 3-hour NAAQS (2000-2017)

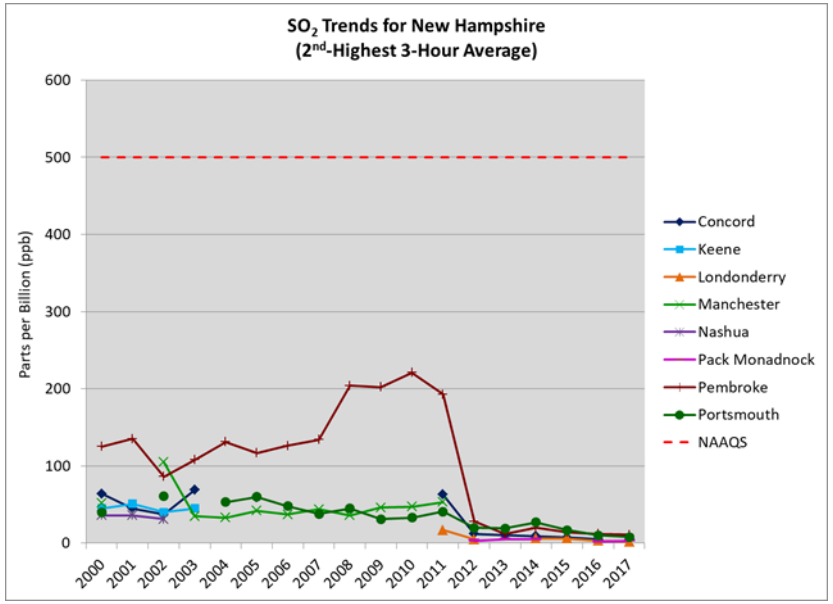


Figure 1.14: PM_{10} trends for the 24-hour NAAQS (2000-2017)

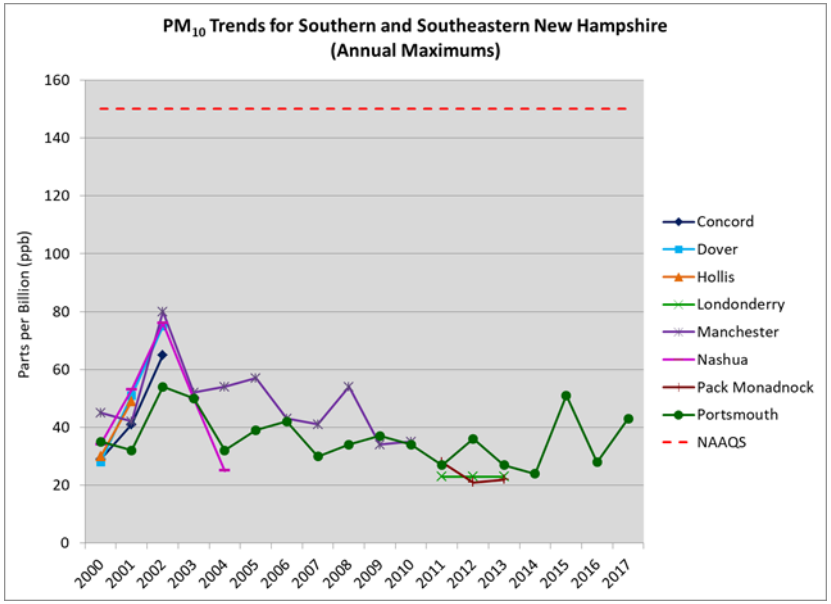


Figure 1.15: PM_{10} trends for the 24-hour NAAQS (2000-2017)

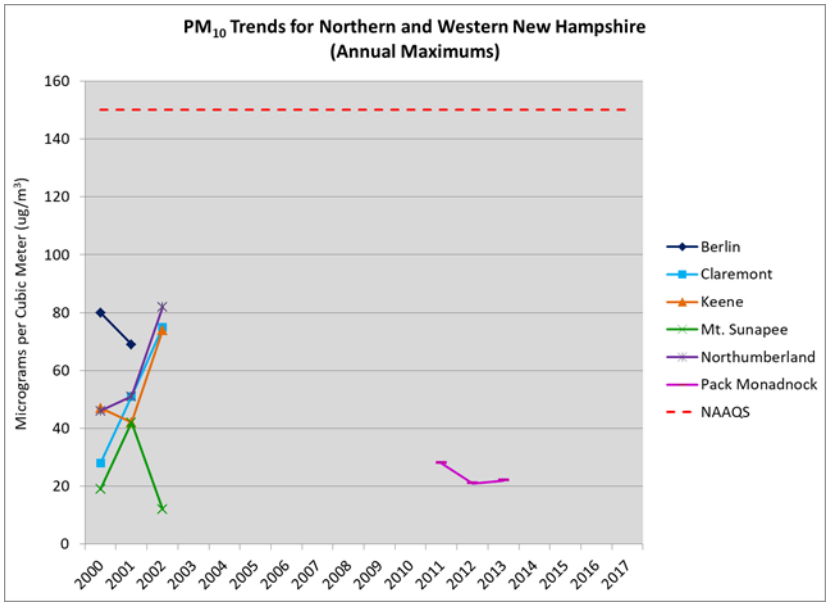


Table 1.8: Seasonal Maximum 24-hour Averages at Londonderry for Toxic PAMS Species Compared to the Ambient Allowable Limit (AAL), 2015-2017

PAMS Parameter	AAL ug/m3	Max 24 Hr. Avg. (ug/m3)			Max as % of AAL
		2015	2016	2017	
PROPYLENE (43205)	35,833	0.37	0.21	0.28	0.00%
CYCLOPENTANE (43242)	25,595	0.11	0.15	0.07	0.00%
ISOPENTANE (43221)	36,875	1.17	1.73	1.27	0.00%
PENTANE (43220)	36,875	0.59	0.73	0.73	0.00%
2-METHYLPENTANE (43285)	36,875	0.16	0.25	0.13	0.00%
3-METHYLPENTANE (43230)	36,875	0.16	0.29	0.11	0.00%
HEXANE (43231)	885	0.44	0.64	0.50	0.07%
BENZENE (45201)	6	0.53	0.27	0.33	9.26%
CYCLOHEXANE (43248)	6,000	0.12	0.18	0.10	0.00%
HEPTANE (43232)	8,249	0.18	0.44	0.11	0.01%
METHYLCYCLOHEXANE (43261)	23,958	0.12	0.24	0.07	0.00%
TOLUENE (45202)	5,000	1.11	1.65	1.17	0.03%
OCTANE (43233)	7,000	0.11	0.15	0.04	0.00%
ETHYLBENZENE (45203)	1,000	0.18	0.22	0.16	0.02%
M & P-XYLENES (45109)	1,550	0.51	0.61	0.53	0.04%
STYRENE (45220)	1,000	0.17	0.07	0.07	0.02%
O-XYLENE (45204)	1,550	0.20	0.21	0.21	0.01%
NONANE (43235)	15,625	0.13	0.11	0.12	0.00%
1,3,5-TRIMETHYLBENZENE (45207)	619	0.10	0.12	0.07	0.02%
1,2,4-TRIMETHYLBENZENE (45208)	619	0.21	0.27	0.19	0.04%

* 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), 2006-2017

PAMS Parameter	AAL ug/m3	Max 24 Hour Avg. (ug/m3)												Max as % of AAL
		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
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	0.00%
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	0.01%
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	0.01%
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	0.12%
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	0.00%
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	0.00%
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	0.15%
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	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	0.01%
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	0.01%
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	0.01%
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	0.05%
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%
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	0.06%
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	0.15%
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	0.18%
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	0.04%
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	0.06%
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	0.28%
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	0.63%

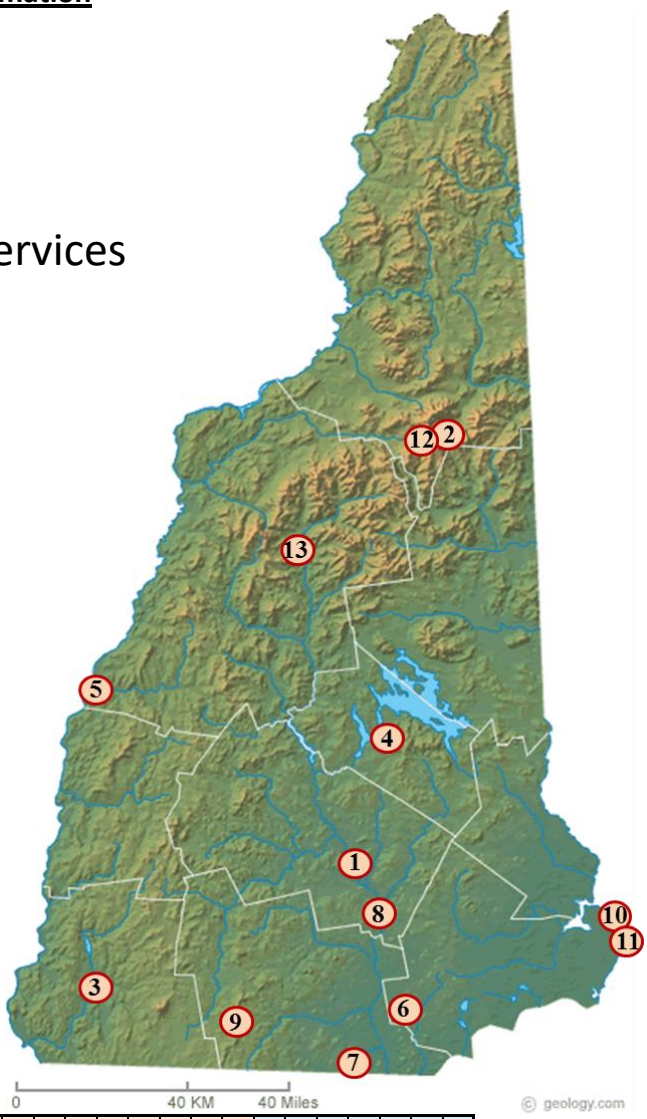
* All data in $\mu g/m^3$

PART 2: Individual Station Information

New Hampshire
Department of Environmental Services

Air Resources Division

Air Quality Monitoring Stations



Summer 2017	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			●	●						●									●				

● discontinued in August 2017 ● Frequency changed from 1/6 to 1/12 in August 2017

Camp Dodge, Greens Grant

General Information			
AQS ID:	33-007-4002	Latitude:	44.308132
Town:	Green's 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 did not make any significant changes to this station during this review period.

Proposed/Planned Changes

NHDES is planning a minor relocation of this station during the Fall of 2018. In coordination with the USFS and AMC, NHDES plans to place an efficient climate-controlled structure adjacent (approximately 10 ft. away) to the current structure and relocate all monitoring equipment into and on the new structure. Once all monitoring activities are associated with the new structure, NHDES will remove the current one.

Mt. Washington Summit

General Information			
AQS ID:	33-007-4001	Latitude:	44.270093
Town:	Sargents 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 is proposing to add trace level CO as part of the PAMS EMP.

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.

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) – filter based $PM_{2.5}$ (1 every 12 days) - Wind Speed - Wind Direction - Temperature

Recent Changes

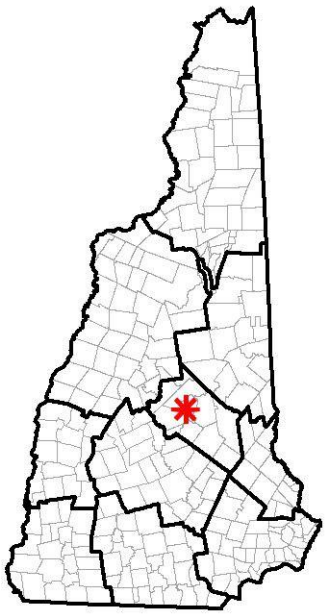
NHDES Discontinued Filter Based PM2.5 sampling in August 2017

Proposed/Planned Changes

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

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 changed the frequency of filter-based PM2.5 sampling at this station from 1/6 to 1/12 days in August 2017.

Proposed/Planned Changes

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

Hazen Station, Concord

General Information			
AQS ID:	33-013-1007	Latitude:	43.218470
Town:	Concord	Longitude:	-71.514525
Address:	27 Hazen Dr.	Elevation (m):	107
County:	Merrimack	Year Est.:	2004
Spatial Scale:	Neighborhood		

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.

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

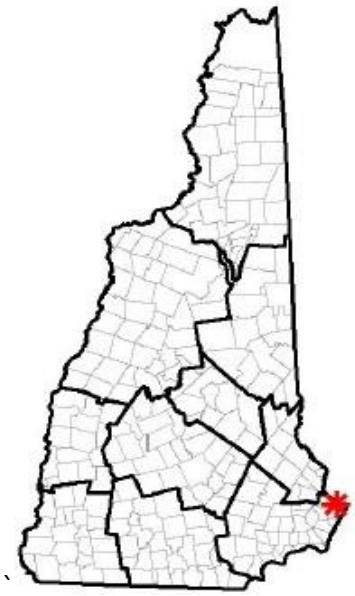
NHDES did not make any significant changes to this station during this review period.

Proposed/Planned Changes

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

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 $PM_{2.5}$ samplers are located on platforms approximately 8m from the shelter.

Pollutants/Parameters

Ozone – $PM_{2.5}$ Continuous (BAM) – filter based $PM_{2.5}$ (1 every 12 days) – PM_{10} Continuous (BAM) – filter based PM_{10} (1 every 6 days) – filter based PM_{10} Colocation (1 every 6 days) – Sulfur Dioxide – Temperature – Wind Speed – Wind Direction

Recent Changes

NHDES Discontinued filter based PM10 sampling at this station in August 2017.

Proposed/Planned Changes

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

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.

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

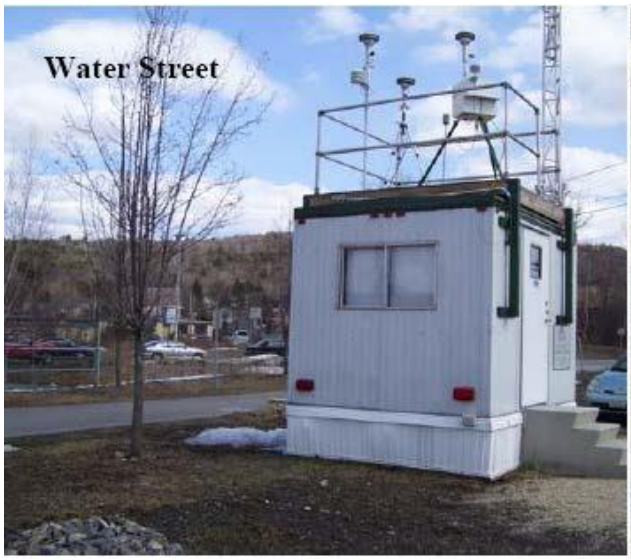
Ozone - $PM_{2.5}$ Continuous (BAM) – filter based $PM_{2.5}$ (1 every 12 days) – Wind Speed - Wind Direction - Temperature

Recent Changes

NHDES discontinued filter based PM2.5 sampling at this station from August 2017 through December 2017. NHDES resumed this sampling starting in January 2018.

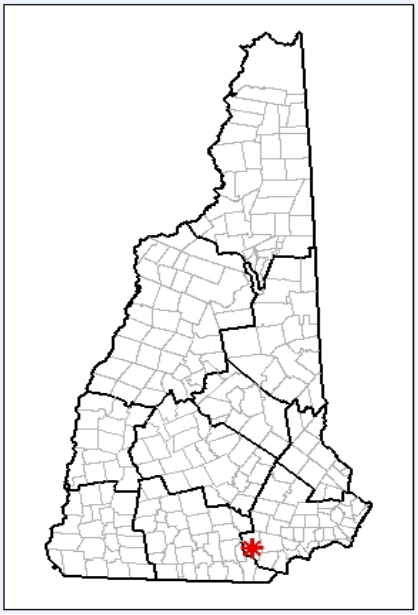
Proposed/Planned Changes

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



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).

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) - 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 planning to move Solar Radiation from this station to Londonderry by June 2018.

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

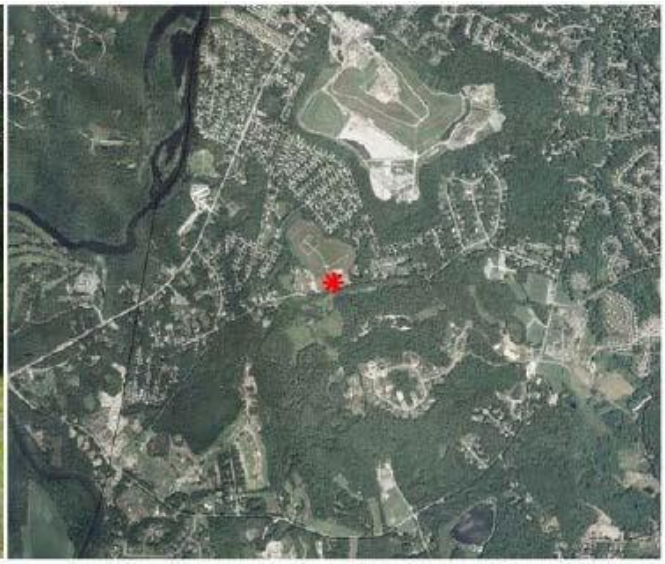
Ozone – Temperature – Wind Speed – Wind Direction.

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.



PART 3: Enhanced Monitoring Plan

The 2015 revision to the ozone National Ambient Air Quality Standard for ozone in October 2015 by the USEPA) included changes to the monitoring requirements in 40 CFR part 58, Appendix D Section 5, "Network Design for Photochemical Assessment Monitoring Station (PAMS) and Enhanced Ozone Monitoring." The PAMS network consists of multi-pollutant monitoring sites that are designed to measure ozone, the pollutants that form ozone, and meteorology in order to better understand ozone formation and to evaluate national and local ozone-reduction options.

States located in the Ozone Transport Region (OTR) are also required to develop and implement Enhanced Monitoring Plans (EMPs). These EMPs are intended to provide monitoring organizations with flexibility to implement additional monitoring to suite needs including:

- Additional ozone measurements,
- Ozone precursor measurements, and/or
- Meteorological monitoring.

This part first addresses PAMs requirements and then further discusses the EMP further below.

3.1 Photochemical Assessment Monitoring Station (PAMS)

In the past, ozone nonattainment areas classified as serious, severe, or extreme were required to operate between two and four PAMS monitoring sites. During the past 30 years, however, both monitoring technology and priorities have changed. EPA updated the PAMS monitoring requirements to modernize and streamline the network, based on a 2011 evaluation of the PAMS network, along with consultation with EPA's independent science advisers (the Clean Air Scientific Advisory Committee) and state air agencies. The changes include:

- Requiring PAMS monitoring at existing NCore monitoring site in large urban areas with a population of 1,000,000 or more. (NCore is a multi-pollutant monitoring network for particles, gases and meteorology.) This change reduces the required number of PAMS sites while improving geographic distribution and reducing redundancy in the network.
- Requiring states that operate PAMS sites to measure nitrogen dioxide, hourly speciated VOCs, eight-hour averaged carbonyls on every third day and hourly averaged mixing height, in addition to a number of other meteorological parameters (e.g. wind speed and direction). There is a waiver option that will allow the use of less frequent, longer-averaged VOC measurements in limited situations.

NHDES currently operates two Photochemical Assessment Monitoring Stations (PAMS) sites in its air monitoring network – at Miller State Park in Peterborough NH (330115001) and at Moose Hill School in Londonderry, NH (330150018). The recent revised ozone NAAQS rule requires PAMS measurements at NCore sites that are located in Core-Based Statistical Areas (CBSAs) with populations of 1,000,000 or more. NHDES proposes the following initial changes to operations at the required New Hampshire PAMS location at Londonderry:

1. The NCore site located at Londonderry will serve as the location of the required PAMS site and will measure the parameters described below (Table 2). Carbonyl compounds will be collected on DNPH-Silica Cartridges and subcontracted to Eastern Research Group, Inc. for analysis; a true NO_2 analyzer has been added to this site. Mixing height measurements will be made by a ceilometer that was added to the site.

3.2 Enhanced Monitoring Plan

States with moderate or above ozone non-attainment areas and states within the Ozone Transport Region (OTR) are required to develop and implement EMPs. In developing this plan, NHDES collaborated with other

States (and DC) in the OTR and EPA Regions 1, 2, and 3 to discuss and develop a regional approach for enhanced measurements where each state would submit an EMP for monitoring activities proposed in their portion of the study domain. A coordinated plan for a spatial distribution of enhanced monitoring locations has been developed, including the type and frequency of measurements as detailed below. As a result, this EMP reflects local needs within the context of interstate, interregional transport of ozone and ozone precursors.

In an effort to understand how ozone is generated in the OTR and how states may collectively and effectively mitigate it, in a collaborative effort, OTR states discussed goals for the EMP. At the core of this work, collecting measurements of transport of pollution at both the surface and aloft from sources outside and within the OTR is critical to better understanding regional ozone formation, and by extension, its mitigation. Understanding the main sources and mechanisms of ozone formation and transport is the main focus of a regionally coordinated monitoring plan.

The main goal of the collective EMP approach is to collect information to better understand the scientific nature of ozone violations of the 2008 and 2015 NAAQS in the OTR. This includes:

1. Collecting information to better identify relative emission magnitude and location of major emission sources or sectors contributing to the violations,
2. Improving knowledge of air circulation patterns connected to the violations, and
3. Better understanding the atmospheric chemistry so that effectiveness of emission reduction strategies can be estimated.

Two main focus areas were discussed; the greater New York City/Connecticut/Long Island Sound area, and the Baltimore/Chesapeake Bay area. Monitoring intensive studies have been proposed for both locations beginning as early as summer 2018. Ongoing measurements are to supplement these monitoring intensives within the target regions and up and downwind of these areas. This EMP focuses on the New Hampshire portion which deals with measurements in the downwind portions of the OTR as well as transported ozone that still creates high ozone concentrations in the higher elevations of the state. New Hampshire has specific interests in better understanding land-water ozone interactions, which study is proposed in the two OTR EMP focus areas, to provide insight as to how ozone moves along the New Hampshire coast line; and for better understanding the existence and transport of the aloft ozone reservoir.

NHDES proposes the following EMP monitoring activities:

2. **Additional PAMS** – Continue PAMS monitoring at the Peterborough site (33-011-5001) using the current PerkinElmer VOC system. The rationale for retaining this PAMS site on Pack Monadnock include:

    a. The site is currently operational and has historical data.
    b. Because it is at a high elevation, measurements are made at traditional transport altitudes.
    c. It provides elevation observations for photochemical modeling assessments.
    d. When paired with the nearby Londonderry PAMS site, gives a view of pollutants at two elevations.

3. **PANDORA Spectrometer** – NHDES has requested from the National Aeronautics and Space Administration (NASA) that a PANDORA spectrometer be added to their network at the PAMS site in Londonderry. NASA estimates that the PANDORA unit will be installed and operational by summer 2019. The PANDORA spectrometer is an operational research instrument developed by NASA-Goddard to make total column measurements of O_3, SO_2, formaldehyde (HCHO), BrO, NO_2 and H_2O,

4. **Carbon Monoxide (CO)** – Trace CO gas measurements will be made on Mount Washington (33-007-4001), to better differentiate anthropogenic ozone transport from stratospheric ozone (i.e., Manmade vs. natural), and

5. **Ozonesonde –** Ten ozonesonde launches are proposed to cover five days with morning and evening ozone measurements. Ideally ozonesonde measurements will be coordinated with measurements taken in other OTR states to form a more complete picture of the aloft ozone reservoir. Ozonesondes would likely be taken in the vicinity of the Londonderry NCore/PAMS station within permission of the Federal Aviation Administration.

Table 1. Proposed Changes to New Hampshire Monitoring Network (only affected stations are listed)

Site ID	Location	CO	O3	Direct NO_2	NOx	NO/ NOy	PM2.5 Continuous	Total Column	PAMS		PM Speciation	Meteorology			
									VOC	Carbonyl		Mixing Height	Wind Profiler	Solar Rad UV Rad	Surface
33-007-4001	Mount Washington-Mt. Washington Summit	X **(P)**	X												Temp
33-011-5001	Peterborough - Pack Monadnock	X	X			X	BAM		GC		IMPROVE				WS,WD, Temp, RH, BP, Precip
33-015-0018	Londonderry - Moose Hill School (RP)	X	X **(OS)**	X	X	X	BAM	**(Pa)**	GC	8-3hr-1/3 **(P)**	IMPROVE	X **(P)**		X **(P)**	WS, WD, Temp, RH, BP, Precip

(P) Proposed
(Pa) Pandora ozone measurements
(OS) Ozonesonde

Table 2. PAMS Target Compound List

Priority Compounds				Optional Compounds			
1	1,2,3-trimethylbenzene [a]	19	n-hexane [b]	1	1,3,5-trimethylbenzene	19	m-diethylbenzene
2	1,2,4-trimethylbenzene [a]	20	n-pentane	2	1-pentene	20	methylcyclohexane
3	1-butene	21	o-ethyltoluene [a]	3	2,2-dimethylbutane	21	methylcyclopentane
4	2,2,4-trimethylpentane [b]	22	o-xylene [a,b]	4	2,3,4-trimethylpentane	22	n-decane
5	acetaldehyde [b,c]	23	p-ethyltoluene [a]	5	2,3-dimethylbutane	23	n-heptane
6	acetone [c,d]	24	Propane	6	2,3-dimethylpentane	24	n-nonane
7	benzene [a,b]	25	Propylene	7	2,4-dimethylpentane	25	n-octane
8	c-2-butene	26	styrene [a,b]	8	2-methylheptane	26	n-propylbenzene [a]
9	ethane [d]	27	toluene [a,b]	9	2-methylhexane	27	n-undecane
10	ethylbenzene [a,b]	28	t-2-butene	10	2-methylpentane	28	p-diethylbenzene
11	Ethylene			11	3-methylheptane	29	t-2-pentene
12	formaldehyde [b,c]			12	3-methylhexane	30	α/β-pinene
13	Isobutane			13	3-methylpentane	31	1,3 butadiene [b]
14	Isopentane			14	Acetylene	32	benzaldehyde [c]
15	Isoprene			15	c-2-pentene	33	carbon tetrachloride [b]
16	m&p-xylenes [a,b]			16	cyclohexane	34	Ethanol
17	m-ethyltoluene [a]			17	cyclopentane	35	Tetrachloroethylene [b]
18	n-butane			18	isopropylbenzene [b]		

[a] Important SOAP (Secondary Organic Aerosols Precursor) Compounds
[b] HAP (Hazardous Air Pollutant) Compounds
[c] Carbonyl compounds
[d] Non-reactive compounds, not considered to be VOC for regulatory purposes

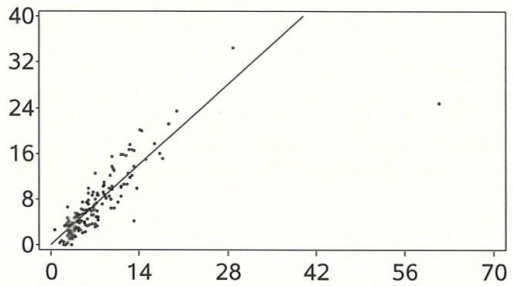
APPENDIX A:
$PM_{2.5}$ Comparability Assessments

PM 2.5 Continuous Monitor Comparability Assessment

Site 33-005-0007: Keene, NH

FRM: BGI Models PQ200-VSCC or PQ200A-VSCC - Gravimetric (142,116), 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

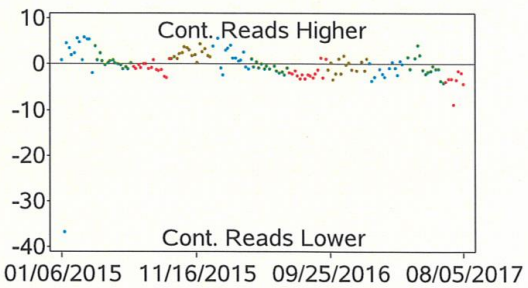
Cont. (y) vs. FRM (x) PM 2.5 ($\mu g/m^3$)



y = 0.72x + 1.84
R = 0.79

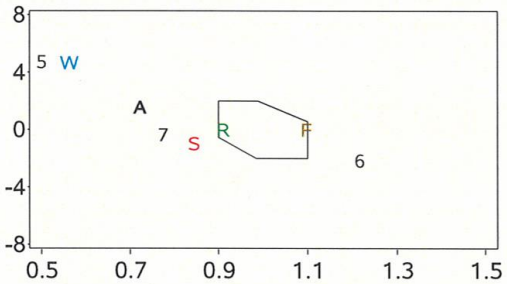
— 1:1 line

Cont. minus FRM PM 2.5 ($\mu g/m^3$)



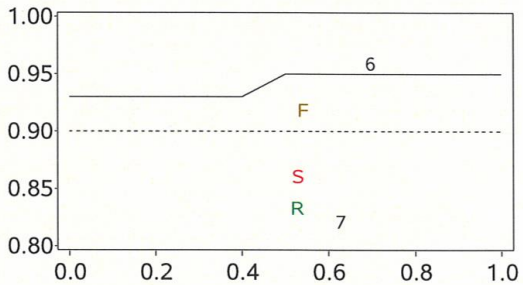
° Winter ° Spring ° Summer ° Fall

Additive (y) vs. Multiplicate (x) Bias



A=AllData, 5=2015, 6=2016, 7=2017
W=Winter, R=Spring, S=Summer, F=Fall

R (y) vs. FRM CCV (x)



A=AllData, 5=2015, 6=2016, 7=2017
W=Winter, R=Spring, S=Summer, F=Fall

Mean PM 2.5 ($\mu g/m^3$)

Dataset	N	FRM	Cont	Ratio (Cont/FRM)
AllData	**150**	**7.5**	**7.2**	**0.97**
Winter	39	10.6	10.9	1.03
Spring	43	5.2	4.9	0.95
Summer	38	6.8	4.9	0.73
Fall	30	7.6	8.6	1.13
2015	60	8.6	9.3	1.08
2016	57	6.9	6.4	0.93
2017	33	6.4	4.8	0.75

Appendix A Statistics

Dataset	N (all observations)	Bias	N (only >= 3 ug/m^3)	Bias
AllData	**150**	**-3.7**	**112**	**2.9**
Winter	39	4.6	33	15.8
Spring	43	1.7	28	-4.9
Summer	38	-30	26	-20
Fall	30	11.6	25	17.9
2015	60	14.7	54	16.6
2016	57	-16	40	-3.9
2017	33	-17	18	-23

Data Source: EPA AQS Data Mart

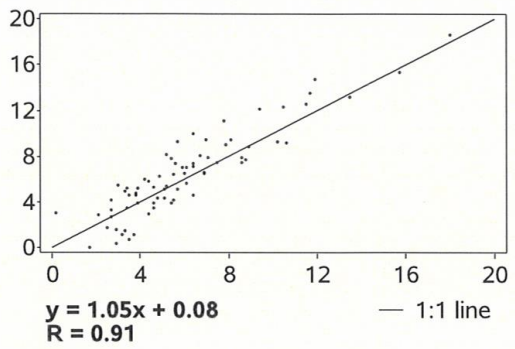
Generated on: April 26, 2018

PM 2.5 Continuous Monitor Comparability Assessment

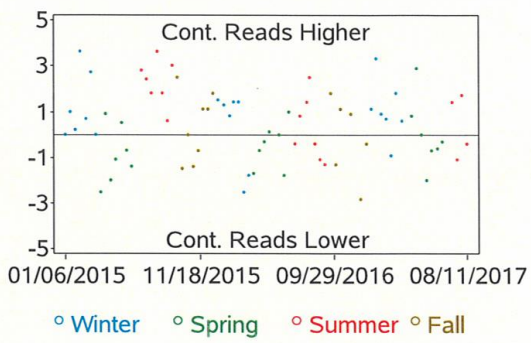
Site 33-009-0010: Lebanon, NH

FRM: BGI Models PQ200-VSCC or PQ200A-VSCC - Gravimetric (142,116), 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

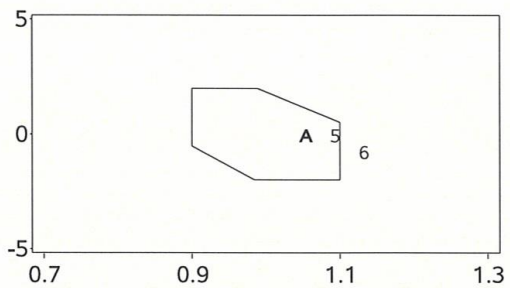
Cont. (y) vs. FRM (x) PM 2.5 ($\mu g/m^3$)



Cont. minus FRM PM 2.5 ($\mu g/m^3$)

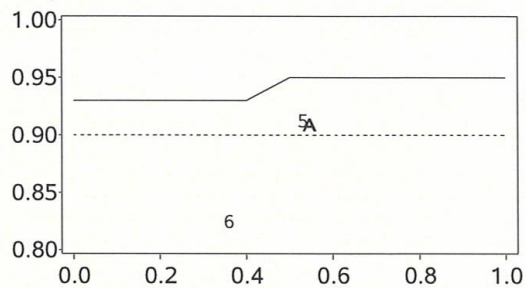


Additive (y) vs. Multiplicate (x) Bias



A=AllData, 5=2015, 6=2016, 7=2017
W=Winter, R=Spring, S=Summer, F=Fall

R (y) vs. FRM CCV (x)



A=AllData, 5=2015, 6=2016, 7=2017
W=Winter, R=Spring, S=Summer, F=Fall

Mean PM 2.5 ($\mu g/m^3$)

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

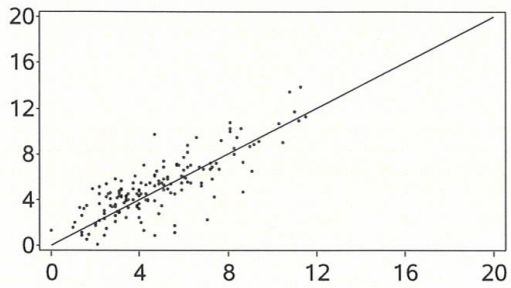
Generated on: April 26, 2018

PM 2.5 Continuous Monitor Comparability Assessment

Site 33-015-0018: Londonderry, NH

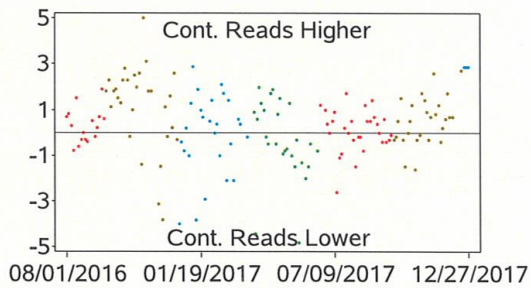
FRM: R & P Model 2025 PM-2.5 Sequential Air Sampler w/VSCC - Gravimetric (145,142,), PM2.5 - Local Conditions (88101), POC=1
Cont: Met One BAM-1020 Mass Monitor w/VSCC - Beta Attenuation (170), PM2.5 - Local Conditions (88101), POC=3

Cont. (y) vs. FRM (x) PM 2.5 ($\mu g/m^3$)



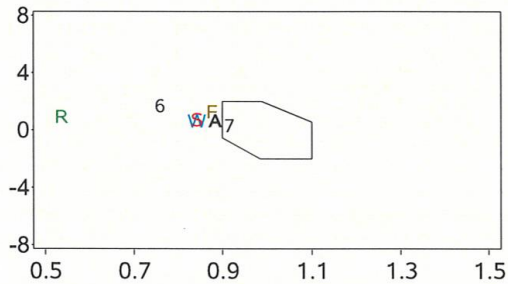
y = 0.88x + 0.91
R = 0.82
— 1:1 line

Cont. minus FRM PM 2.5 ($\mu g/m^3$)



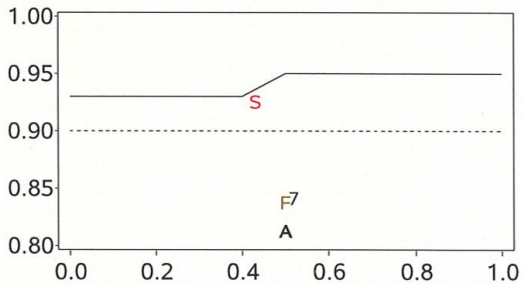
° Winter ° Spring ° Summer ° Fall

Additive (y) vs. Multiplicate (x) Bias



A=AllData, 5=2015, 6=2016, 7=2017
W=Winter, R=Spring, S=Summer, F=Fall

R (y) vs. FRM CCV (x)



A=AllData, 5=2015, 6=2016, 7=2017
W=Winter, R=Spring, S=Summer, F=Fall

Mean PM 2.5 ($\mu g/m^3$)

Dataset	N	FRM	Cont	Ratio (Cont/FRM)
AllData	**157**	**4.8**	**5.2**	**1.07**
Winter	29	4.5	4.7	1.05
Spring	26	3.3	2.9	0.90
Summer	46	5.3	5.5	1.03
Fall	56	5.3	6.2	1.16
2015	0	.	.	.
2016	48	5.2	5.9	1.13
2017	109	4.7	4.9	1.04

Appendix A Statistics

Dataset	N (all observations)	Bias	N (only >= 3 ug/m^3)	Bias
AllData	**157**	**13.2**	**111**	**11.7**
Winter	29	9.1	19	8.2
Spring	26	-0.1	8	3.9
Summer	46	8.7	39	4.0
Fall	56	25.1	45	21.2
2015	0	.	.	.
2016	48	23.1	39	16.7
2017	109	8.9	72	9.0

Data Source: EPA AQS Data Mart

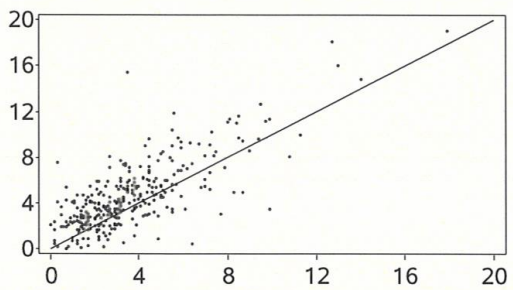
Generated on: April 26, 2018

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 (145,118,), 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

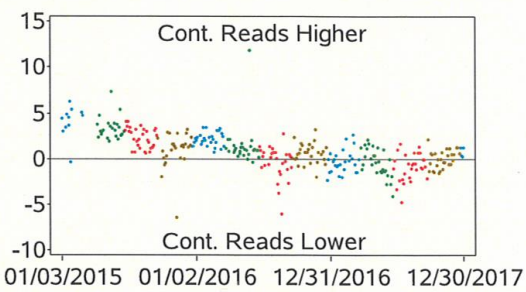
Cont. (y) vs. FRM (x) PM 2.5 ($\mu g/m^3$)



y = 0.93x + 1.15
R = 0.76

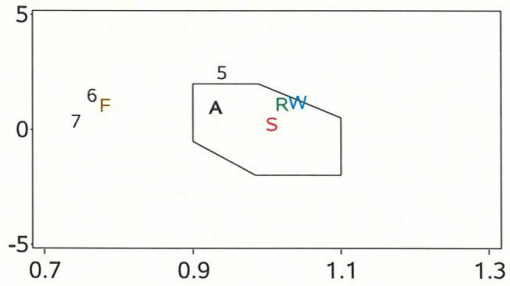
— 1:1 line

Cont. minus FRM PM 2.5 ($\mu g/m^3$)



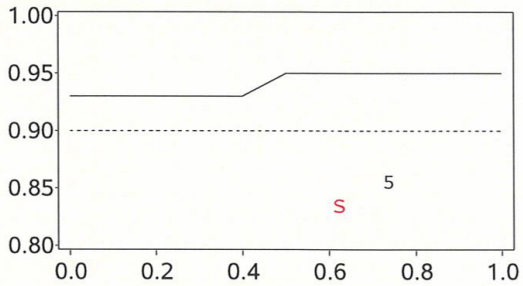
° Winter ° Spring ° Summer ° Fall

Additive (y) vs. Multiplicate (x) Bias



A=AllData, 5=2015, 6=2016, 7=2017
W=Winter, R=Spring, S=Summer, F=Fall

R (y) vs. FRM CCV (x)



A=AllData, 5=2015, 6=2016, 7=2017
W=Winter, R=Spring, S=Summer, F=Fall

Mean PM 2.5 ($\mu g/m^3$)

Dataset	N	FRM	Cont	Ratio (Cont/FRM)
AllData	**321**	**3.6**	**4.5**	**1.25**
Winter	70	2.9	4.4	1.49
Spring	80	3.1	4.4	1.43
Summer	87	4.9	5.4	1.08
Fall	84	3.1	3.7	1.17
2015	94	4.3	6.7	1.55
2016	113	3.3	4.2	1.27
2017	114	3.2	2.9	0.91

Appendix A Statistics

Dataset	N	Bias (all observations)	N (only >= 3 ug/m^3)	Bias
AllData	**321**	**54.3**	**156**	**27.0**
Winter	70	67.3	27	45.0
Spring	80	115	34	46.3
Summer	87	5.7	56	17.1
Fall	84	36.9	39	11.7
2015	94	125	58	50.0
2016	113	53.5	55	24.6
2017	114	-4.1	43	-1.1

Data Source: EPA AQS Data Mart

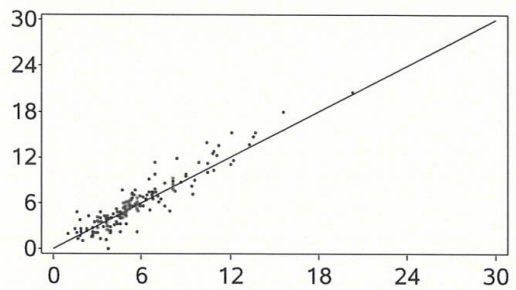
Generated on: April 26, 2018

PM 2.5 Continuous Monitor Comparability Assessment

Site 33-015-0014: Portsmouth, NH

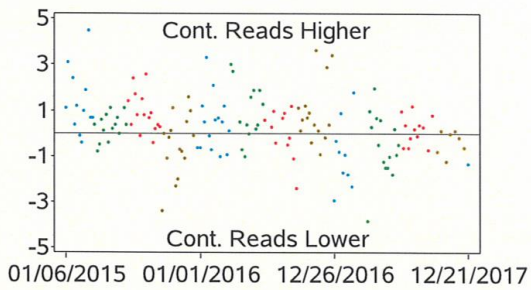
FRM: BGI Models PQ200-VSCC or PQ200A-VSCC - Gravimetric (142,116,), PM2.5 - Local Conditions (88101), POC=1
Cont: Teledyne Model 602 Beta plus w/VSCC - Beta Attenuation (204), PM2.5 - Local Conditions (88101), POC=6

Cont. (y) vs. FRM (x) PM 2.5 ($\mu g/m^3$)



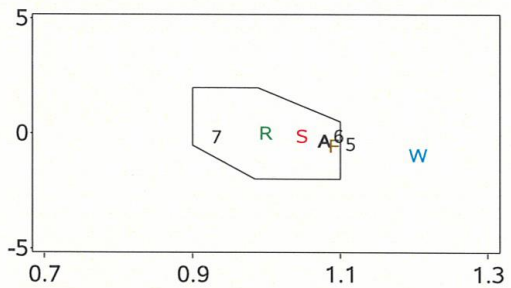
y = 1.08x + -0.17
R = 0.93
— 1:1 line

Cont. minus FRM PM 2.5 ($\mu g/m^3$)



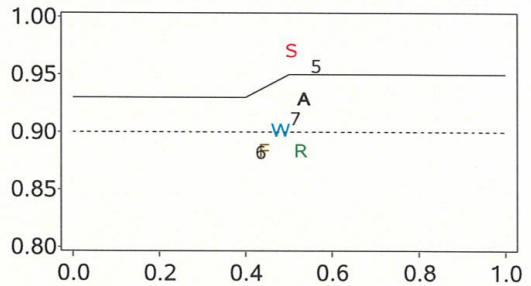
° Winter ° Spring ° Summer ° Fall

Additive (y) vs. Multiplicate (x) Bias



A=AllData, 5=2015, 6=2016, 7=2017
W=Winter, R=Spring, S=Summer, F=Fall

R (y) vs. FRM CCV (x)



A=AllData, 5=2015, 6=2016, 7=2017
W=Winter, R=Spring, S=Summer, F=Fall

Mean PM 2.5 ($\mu g/m^3$)

Dataset	N	FRM	Cont	Ratio (Cont/FRM)
AllData	**154**	**5.8**	**6.0**	**1.05**
Winter	37	5.4	5.8	1.07
Spring	42	4.6	4.8	1.04
Summer	38	7.6	8.0	1.05
Fall	37	5.5	5.6	1.02
2015	57	6.6	7.1	1.07
2016	54	5.2	5.8	1.11
2017	43	5.2	4.9	0.93

Appendix A Statistics

Dataset	N (all observations)	Bias	N (only >= 3 ug/m^3)	Bias
AllData	**154**	**5.4**	**120**	**7.6**
Winter	37	6.6	29	7.9
Spring	42	8.3	27	9.4
Summer	38	6.2	35	6.8
Fall	37	-0.2	29	6.6
2015	57	5.0	48	8.4
2016	54	12.1	43	13.0
2017	43	-2.6	29	-1.6

Data Source: EPA AQS Data Mart

Generated on: April 26, 2018