

**STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES**

Rhode Island 2019 Annual Monitoring Network Plan



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Acronyms and Abbreviations

AIRS-AQS	Aerometric Information Retrieval System - Air Quality System
AQI	Air Quality Index
BAM	Beta Attenuation Monitor
CAA	Clean Air Act
CFR	Code of Federal Regulations
CO	Carbon Monoxide
DEM	Department of Environmental Management (RI)
DOH	Department of Health (RI)
EIS	Emissions Inventory System
EMP	Enhanced Monitoring Plan
EPA	Environmental Protection Agency
FEM	Federal equivalent method
FRM	Federal reference method
GC	Gas chromatograph
HAPs	Hazardous air pollutants
MADEP	Massachusetts Department of Environmental Protection
MDL	Method detection limit
MSA	Metropolitan statistical area
NAAQS	National Ambient Air Quality Standards
NAMS	National Air Monitoring Station
NATTS	National Air Toxics Trends Station
NCORE	National Core Multi-pollutant Monitoring Station
NO ₂	Nitrogen dioxide
NO _x	Nitrogen oxides
OAQPS	Office of Air Quality Planning and Standards
ORD	Office of Research and Development
OTR	Ozone Transport Region
PAMS	Photochemical Assessment Monitoring Stations
PAH	Polycyclic Aromatic Hydrocarbon
PM ₁₀	Particulate matter < 10 microns
PM _{2.5}	Particulate matter < 2.5 microns
QAPP	Quality assurance project plan
O ₃	Ozone
SIPs	State implementation plans
SLAMS	State and Local Air Monitoring Station
SOP	Standard operating procedure
SO ₂	Sulfur dioxide
STN	Speciation Trends Network
SVOC	Semi-Volatile Compound
TSA	Technical system audit
TSP	Total suspended particulate
VOC	Volatile organic compound

Introduction and Regulatory Background

This document will serve as Rhode Island's 2019 Annual Monitoring Network Plan, prepared by the Rhode Island Department of Environmental Management, in accordance with Section 58.10 (a) of Title 40 of the Code of Federal Regulations (40 CFR 58.10(a)), which requires states to submit a monitoring network plan to the United States Environmental Protection Agency (EPA) in July of each year. The plan provides a description of the state's current monitoring network, demonstrates that the network conforms to EPA requirements, and discusses any plans to remove or move a monitoring station in the 18 months following the plan submittal.

In addition, the recently revised monitoring rule (80 FR 65292; October 26, 2015) requires PAMS measurements June 1 through August 31 at NCORE sites that are in Core-Based Statistical Areas (CBSAs) with populations of 1,000,000 or more. The Providence, New Bedford, Fall River, RI-MA Statistical Area qualifies as one of those sites. RIDEM is required to develop an implementation plan for this monitoring rule. That implementation plan is detailed within this monitoring plan. The Annual Monitoring Network Plan must be posted for public comment 30 days prior to submittal to the EPA. Additionally, RIDEM was required to develop and implement Enhanced Monitoring Plans (EMPs) as required by 40 CFR Part 58, Appendix D, 5.(h), as the state is within the Ozone Transport Region (OTR). This original plan was submitted as part of the 2018 ANP and is updated in the 2019 ANP to reflect changes.

Rhode Island Monitoring Network

The Rhode Island Department of Environmental Management (RIDEM), in conjunction with the Rhode Island Department of Health (RIDOH), operates a network of air monitoring stations to measure ambient concentrations of pollutants for which the EPA has established a National Ambient Air Quality Standard (NAAQS). Those pollutants, which are known as criteria pollutants, include ozone (O₃), particulate matter smaller than 10 microns (PM₁₀), particulate matter smaller than 2.5 microns (PM_{2.5}), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), carbon monoxide (CO) and lead. The criteria pollutant monitoring sites are part of the EPA's State or Local Air Monitoring Stations network (SLAMS).

In addition, RI DEM and RI DOH monitor ambient levels of toxic air pollutants and of ozone precursors, which are compounds that react in the atmosphere to form ground-level ozone. The State operates one monitoring site that is part of the National Air Toxics Trends Sites (NATTS) network, one that is part of the Photochemical Assessment Monitoring Stations (PAMS) network, one that is part of the PM_{2.5} Speciation Trends Network (STN) and one that is part of the network of core multipollutant monitoring stations (NCORE).

Table 1 summarizes the NAAQS and Table 2 lists the locations of the six air monitoring stations that operated in the State in 2018 or are currently operating, along with the parameters monitored and monitoring methods used at each of the sites. Table 3 lists the sites as well as the methods used. The locations of those sites are shown in Figures 1-4. These sites have been approved by EPA Region 1 as meeting applicable siting criteria, as specified in Subpart B of 40 CFR Part 58. All criteria pollutants are monitored, as required in the CFR, using Federal Reference Methods (FRMs) or Federal Equivalent Methods (FEMs) and monitors are operated according to the procedures specified in Quality Assurance Project Plans (QAPPs)¹ that have been approved by EPA. Sites are located in the Providence-New Bedford-Fall River, RI-MA Metropolitan Statistical Area (MSA), which encompasses all of Rhode Island as well as Bristol County in Massachusetts.

Summary of Proposed Changes in the Rhode Island Monitoring Network

In summary, RI DEM plans to modify the current monitoring network as follows:

- RIDEM has completed the move of the PM_{2.5} FEM monitor and NATTS monitoring activities from the Urban League building to the Community College of Rhode Island (CCRI) location.
- When necessitated by the progression of highway construction activity to the northbound side of I-95, RIDEM will discontinue monitoring at the current Near-Road site at the corner of Park and Hayes and will seek EPA's approval for a future Near-Road monitoring site. Per RIDOT, work on the north side of the highway is tentatively scheduled to begin 2020 or later.
- The FRM PM_{2.5} sampling at Urban was discontinued in December 2018. Following the move from Urban, the continuous FEM PM_{2.5} is the only monitor at CCRI.
- At CCRI, RIDEM is monitoring meteorological parameters with equipment mounted on the shelter, not from a 10-meter tower. Installing a new tower at CCRI was not economically feasible. The data will not meet AQS or EPA siting standards at CCRI but will be important for the legacy of the site and tracking wind flows during times of high measurements of NATTS parameters.
- The continuous GC deployed in 2017 is operational going into the 2019 PAMS season at East Providence for measuring one-hour speciated VOCs. The data will be uploaded to AQS.
- RIDEM has deployed a new carbonyl sampler at East Providence to measure three 8-hr cartridges (4AM, 12PM, 8PM) every 3 days and a 1 in 6 day as outlined in the revised PAMS requirement in the final ozone NAAQS. This data will be uploaded to AQS.
- As part of the EMP, RIDEM has deployed the EPA 2B Ozone monitor at East Matunuck on 4/29/2019. The unit will not meet AQS siting criteria (yet) but will serve to gather exploratory ozone data as was done during the 2017 and 2018 seasons. More details can be found in the EMP section of this plan.
- The Vernon Street, Pawtucket site is adjacent to I-95N and characterizes the highest PM₁₀ concentrations in RI. Although Vernon Street experiences one of the highest PM₁₀ values in the state, at no point has the site approached the standard. As RIDEM seeks options for cost and workload savings, RIDEM will discontinue monitoring at Vernon Street at the end 2019 and start reporting PM₁₀ mass measured at the East Providence site.
- RIDEM has installed the Vaisala CL51 Ceilometer and Direct/True NO₂ at the NCORE/PAMS site in East Providence as required by the PAMs program.

RI DEM understands that all network modifications that involve discontinuation or moving of any sites are subject to EPA approval, even if the remaining network meets EPA's minimum requirements.

¹RI DEM and RI DOH, "QAPP for Criteria Pollutants Including Particulates and NCORE Parameters, Revision 1.0," approved by EPA October 2017 and "QAPP: Air Toxics and PAMS Monitoring Programs, Revision 6.1," approved by EPA October 2017.

Table 1 National Ambient Air Quality Standards (NAAQS)

POLLUTANT (links to historical tables of NAAQS reviews)	AVERAGING TIME	PRIMARY STANDARD	SECONDARY STANDARD
Sulfur Dioxide (SO₂)	3-Hour ^A	None	0.5 ppm (1300 µg/m ³)
	1-Hour ^B	0.075 ppm (75 ppb)	None
Carbon Monoxide (CO)	8-Hour ^A	9 ppm	None
	1-Hour ^A	35 ppm	None
Ozone (O₃)	8-Hour ^C	0.070 ppm (70 ppb)	Same as Primary Standard
Nitrogen Dioxide (NO₂)	Annual Arithmetic Mean	0.053 ppm (53 ppb)	Same as Primary Standard
	1-Hour ^D	100 ppb	None
Particulate Matter (PM₁₀)	24-Hour ^E	150 µg/m ³	Same as Primary Standard
Particulate Matter (PM_{2.5})	Annual Arithmetic Mean ^F	12.0 µg/m ³	15.0 µg/m ³
	24-Hour ^G	35 µg/m ³	Same as Primary Standard
Lead (Pb)	Rolling 3-Month Average ^H	0.15 µg/m ³	Same as Primary Standard

Primary standards protect against adverse health effects.

Secondary standards protect against welfare effects such as damage to crops, vegetation, and buildings.

^A Not to be exceeded more than once a year.

^B A rule revoking the annual and 24-hour SO₂ NAAQS and promulgating a new 1-hour SO₂ NAAQS was signed on June 2, 2010. To attain the 1-hour NAAQS, the 3-year average of the 99th percentile of the daily maximum 1-hour average SO₂ level at each monitor must not exceed 75 ppb.

^C The ozone NAAQS is violated when the average of the 4th highest daily eight-hour concentration measured in 3 consecutive years exceeds 0.070 ppm (70 ppb). The 0.070 ppm NAAQS became effective December 28, 2015.

^D To attain the 1-hour NO₂ NAAQS, effective January 22, 2010, the 3-year average of the 98th percentile of the daily maximum 1-hour average NO₂ concentration at each monitor must not exceed 100 ppb.

^E To attain the PM₁₀ standard, the 24-hour concentration at each site must not exceed 150 µg/m³ more than once per year, on average over 3 years.

^F The primary annual average PM_{2.5} NAAQS was revised on December 10, 2012. The secondary NAAQS was not changed. To attain the PM_{2.5} annual standard, the 3-year average of the weighted annual means of the 24-hour concentrations must not exceed the NAAQS value.

^g To attain the PM_{2.5} 24-hour standard, the 3-year average of the 98th percentile of 24-hour concentrations must not exceed 35 µg/m³.

^h On October 15, 2008, the Pb NAAQS was changed to 0.15 µg/m³ as a rolling 3-month average, not to be exceeded in a 3-year period.

µg/m³ = micrograms per cubic meter

mg/m³ = milligrams per cubic meter

ppb = parts per billion

ppm = parts per million

Table 2 - Monitoring Site Information

The ambient air monitoring sites currently operated by RIDEM and RIDOH are listed in the Table 2 below. Detailed information for each monitoring site is provided in a later section of this plan.

Town	Site	PM2.5 (FRM), 1:3	PM2.5 (FRM, Collocated), 1:6	PM2.5 (Continuous - FEM)	PM10/PM- (Hi Vol), 1:6	PM10/PM- (Hi Vol), Collocated, 1:6	PM10/PM-Coarse(lo-Vol), 1:3	Polycyclic aromatic hydrocarbons (PAH), 1:6 Speciation, PM2.5, SASS (CSN), 1:3	PM2.5 Carbon (URG) (CSN), 1:3	Ozone	SO2	CO	Direct NO ₂	NO/NO ₂ /NOx	NO/NOy	VOCs 24-HR Canister (NATTS, State)	VOCs Hourly PAMS	Black Carbon	Black Carbon, Collocated	Carbonyls, 1:6, Collocated 1:12	Carbonyls, PAMS 8-hr	Particle Counter	Wind Speed and Direction	Ceilometer	Temperature	Dew Point / Rel. Humidity	Barometric Pressure	Solar Radiation	UV Radiation	Precipitation
Pawtucket	Vernon Street	X	X	X												X														
Narragansett	USEPA Lab			X					S													X		X						
East Providence	Myron Francis School	X	X			X	X	X	X	X	X	X	X	X	X	X	S	X	X	X	S	X	X	X	X	X	X	S	S	S
Providence	CCRI	T	X	X*	X**	X										X		X	X		X	X		X	X	X				
West Greenwich	Alton Jones		X						S							X						X		X	S	X	S			
Providence	Near-Road Site		X									X		X				X				X								

X = Existing

T = Terminated in 2018

S = Seasonal (June 1-August 31)

S = Seasonal (March 1 – September 30)

* Includes metals

** Includes collocated metals 1:12

Table 3: Monitoring Sites

Site	AQS ID	Latitude Longitude	Parameter Measured	Method Of Sampling	EPA Method Designation
Vernon Vernon Street Pawtucket	440070026	41.874675 -71.379953	PM _{2.5}	Lo Vol	Reference
			PM ₁₀	Hi Vol	Reference
			VOC	Canisters, GC/FID/MS	Reference
USEPA Laboratory 27 Tarzwell Drive Narragansett	440090007	41.4950779 -71.4236587	Ozone	U.V. Photometric	Reference
			PM _{2.5}	Beta Attenuation/Cont	Equivalent
			Wind Speed	Anemometer	N/A
			Wind Direction	Wind Vane	N/A
			Temperature	Spot Reading	N/A
Myron Francis School 64 Bourne Avenue E. Providence	440071010	41.840920 -71.36094	Oxides of Nitrogen	Chemiluminescence (low range)	Reference
			Nitrogen Dioxide		
			NO/NO _y	Chemiluminescence (low range)	Reference
			Carbon Monoxide	Gas Filter Correlation (low range)	Equivalent
			Sulfur dioxide	Pulsed Fluorescence (low range)	Equivalent
			Ozone	U.V. Photometric	Reference
			PM _{2.5}	Lo Vol	Reference
			PM _{2.5}	Beta Attenuation/Cont	Equivalent
			Speciated PM _{2.5}	Speciation Monitor	N/A
			Coarse PM (PM _{10-2.5})	Lo Vols (PM ₁₀ & PM _{2.5})	Reference
			Black Carbon	Aethalometer	N/A
			VOC	Canisters, GC/FID/MS	Reference
			VOC	Continuous GC	Reference
			Carbonyls	HPLC Cartridges	Reference
			Wind Speed	Anemometer	N/A
			Wind Direction	Wind Vane	N/A
			Barometric Pressure	Barometer	N/A
			Temperature	Spot Reading	N/A
			Relative Humidity	Plastic Film	N/A
			Solar Radiation	Pyranometric	N/A
			UV Radiation	UV Photometric	N/A
			Precipitation	Bucket/Continuous	N/A
Direct NO ₂	Cavity Attenuated Phase Shift (CAPS)	Equivalent			
Ceilometer	LIDAR	N/A			

Site	AQS ID	Latitude Longitude	Parameter Measured	Method Of Sampling	EPA Method Designation
CCRI Liston Campus 1 Hilton Street Providence	TBD	41.807523 -71.413920	PM _{2.5}	Beta Attenuation/Cont	Equivalent
			PM ₁₀ /Metals	Hi Vol	Reference
			VOC	Canisters, GC/FID/MS	Reference
			Carbonyls	HPLC Cartridges	Reference
			Black Carbon	Aethalometer	N/A
			Semi-volatiles	PUF/XAD, GC/MS	N/A
			Wind Speed	Anemometer	N/A
			Wind Direction	Wind Vane	N/A
			Temperature	Spot Reading	N/A
			Relative Humidity	Plastic Film	N/A
			Particle Count	Water Based Condensation	N/A
Alton Jones Campus Victory Highway West Greenwich	440030002	41.615600 -71.719900	Ozone	U.V. Photometric	Reference
			VOC	Canisters, GC/FID/MS	Reference
			PM _{2.5}	Beta Attenuation/Cont	Equivalent
			Wind Speed	Anemometer	N/A
			Wind Direction	Wind Vane	N/A
			Barometric Pressure	Barometer	N/A
			Temperature	Spot Reading	N/A
			Relative Humidity	Plastic Film	N/A
			Solar Radiation	Pyranometric	N/A
Near-Road Site Hayes and Park Streets Providence	440070030	41.829495 -71.417457	Oxides of Nitrogen	Chemiluminescence (low range)	Reference
			Nitrogen Dioxide		
			Carbon Monoxide	Gas Filter Correlation (low range)	Equivalent
			PM _{2.5}	Beta Attenuation/Cont	Equivalent
			Black Carbon	Aethalometer	N/A
			Particle Count	Water Based Condensation	N/A

Network Evaluation

Following is a discussion, by pollutant, of:

- The current monitoring network,
- The NAAQS and a comparison of recent measurements with the NAAQS,
- Whether that network meets EPA's monitoring criteria,
- Whether new sites are needed,
- Whether any existing sites are no longer needed, and
- Plans for modification of the network in the next 18 months.

Ozone (O₃)

The sites in the current ozone monitoring network are listed in Table 4 and Figure 1:

Table 4: Rhode Island Ozone Monitoring Sites

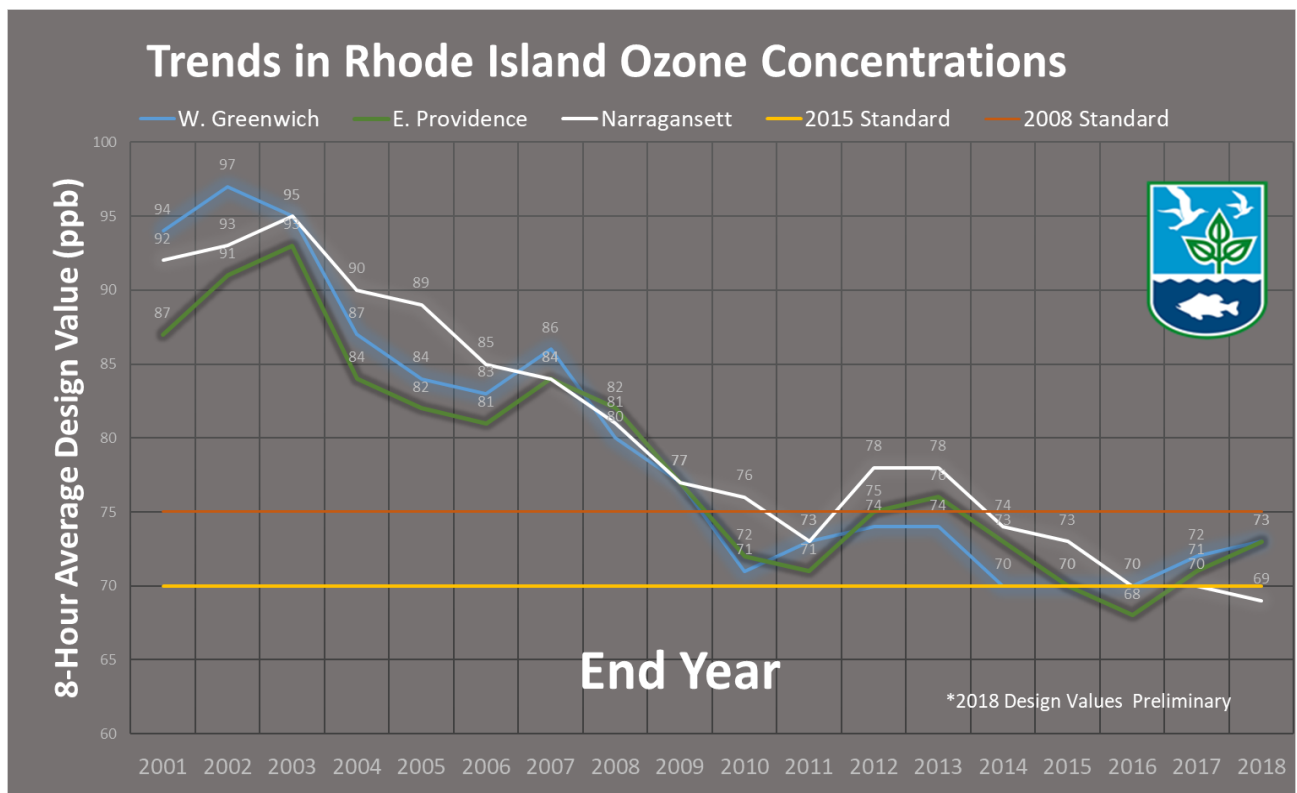
SITE	MEASUREMENT SCALE	MONITORING OBJECTIVE	SCHEDULE
Alton Jones Campus Victory Highway West Greenwich	Regional	Upwind background Population exposure	Continuous Ozone Season March-September
USEPA Laboratory 27 Tarzwell Drive Narragansett	Regional	Population exposure	Continuous Ozone Season March-September
Myron Francis School 64 Bourne Avenue E. Providence	Neighborhood (PAMS, NCORE)	Maximum precursor emissions impact Population exposure	Continuous Year-Round

The 2015 ozone NAAQS is 70 ppb over an 8-hour average. A site is in violation of that NAAQS when the average of the 4th highest daily eight-hour ozone concentration measured in 3 consecutive years (the design value) at that site exceeds 70 ppb.

Ozone design values for Rhode Island sites have generally decreased over time, but values have fluctuated both slightly above and slightly below the 2015 NAAQS of 70 ppb. Based on the 2014-2016 design values, all counties in Rhode Island have been classified as Attainment/Unclassifiable for the 2015 standard. However, Rhode Island's 2015-2017 design values have increased slightly for all three monitors. The 2018 design values show an increase for both West Greenwich and East Providence, with a decrease in design value for the Narragansett monitor.

Table 5: Ozone Design Values (ppb)

	W. Greenwich	Narragansett	E. Providence
2002 - 2004	87	90	84
2003 - 2005	84	89	82
2004 - 2006	83	85	81
2005 - 2007	86	84	84
2006 - 2008	80	81	82
2007 - 2009	77	77	77
2008 - 2010	71	76	72
2009 - 2011	73	73	71
2010 - 2012	74	78	75
2011 - 2013	74	78	76
2012 - 2014	70	74	73
2013 - 2015	70	73	70
2014- 2016	70	70	68
2015- 2017	72	71	70
2016- 2018	73	69	73



Since EPA’s rules require Rhode Island to operate at least two ozone monitors, the State has one more monitor than the minimum number required. Continued operation of all existing monitors is important for the following reasons:

- Ozone concentrations continue to reach unhealthy levels several days each summer, with moderate levels on many days. In 2018, there were 12 exceedance days of the 8-hour ozone standard, and 38 days where ozone levels were in the moderate range (8-hour average between 55-70 ppb). In 2017, there were 6 exceedance days and 35 days in the moderate range. In 2016, there were 13 exceedance days and 42 days in the moderate range.
- The three sites represent three distinct geographical and micro climates that are affected by different localized weather patterns and can experience very different ozone levels on some days.
- The availability of real-time ozone data from the three ozone sites enables RIDEM to issue area-specific health advisories as appropriate and to provide residents with real-time information about ozone concentrations and associated health risks in their region of the state.

As part of RIDEM’s EMP, additional ozone monitoring will again be conducted during 2019 as described in the EMP section of this plan.

Carbon Monoxide (CO)

The current CO monitoring network is as shown in Table 6 and on Figure 1. All figures are at the end of the document.

Table 6: Carbon Monoxide Monitoring Network

SITE	MEASUREMENT SCALE	MONITORING OBJECTIVE	SCHEDULE
Myron Francis School 64 Bourne Avenue E. Providence	Neighborhood	Maximum precursor emissions impact Population exposure	Continuous Year-Round
Near-Road Site Hayes and Park Streets Providence	Microscale	Maximum emissions Near-road	Continuous Year-Round

The NAAQS for CO are:

- 35 ppm as a 1-hour average, not to be exceeded more than once per year (design value is the highest annual 2nd maximum 1-hour concentration) and
- 9 ppm as an 8-hour average, not to be exceeded more than once per year (design value is the highest annual 2nd maximum non-overlapping 8-hour concentration)

The CO design values for Rhode Island are:

Near Road 2017:

- 2.6 ppm – 1-hour average, 7.4 % of NAAQS
- 1.6 ppm – 8-hour average, 17 % of NAAQS

Near Road 2018

- 2.3 ppm – 1-hour average, 6.3 % of NAAQS
- 1.5 ppm – 8-hour average, 16.7 % of NAAQS

East Providence 2017:

- 1.3 ppm – 1-hour average, 3.7 % of NAAQS
- 0.9 ppm – 8-hour average, 10 % of NAAQS

East Providence 2018

- 1.3 ppm – 1-hour average, 3.4 % of NAAQS
- 0.7 ppm – 8-hour average, 7.8 % of NAAQS

The CO NAAQS has not been exceeded in Rhode Island since 1984. Since 2001, all CO levels recorded in Rhode Island have been in the “Good” category of the EPA’s Air Quality Index (AQI).

EPA’s regulations do not specify a minimum number of CO monitors that must be operated in a state, except that CO monitoring is required at NCORE sites (40 CFR 58, Appendix D 3(b)) and EPA regulations require a certain number of CO monitors to be operating near road based upon population. Since the East Providence site is both a PAMS site and the State’s NCORE site, carbon monoxide monitoring will continue at that site using a low range monitor, consistent with NCORE requirements.

On August 21, 2011, EPA issued a decision retaining the CO NAAQS at the current levels². The decision requires the operation of CO monitors at sites established to comply with the near-road monitoring requirements specified in the 2010 NO₂ NAAQS. Near-road sites are required in all urban areas which, like the Providence-New Bedford-Fall River, RI-MA MSA, have a population of 1,000,000 or more. Near-road CO monitoring was not required until January 1, 2017; however, Rhode Island began operating a low-range CO monitor at a site adjacent to Interstate Route 95 that meets the above near-road specifications in April 2014.

No changes to the CO monitoring network are planned in the next 18 months.

Sulfur Dioxide (SO₂)

With the discontinuation of the Brown University site, the remaining SO₂ monitor is as shown in Table 7 and on Figure 1:

Table 7: Sulfur Dioxide Monitoring Network

SITE	MEASUREMENT SCALE	MONITORING OBJECTIVE	SCHEDULE
Myron Francis School 64 Bourne Avenue E. Providence	Neighborhood	NCORE	Continuous Year-Round

The NAAQS for SO₂ are:

- 75 ppb, 1-hour average (primary standard effective June 2, 2010). The design value is the average of the 99th percentile maximum daily hour measured in 3 consecutive years.
- 0.5 ppm (500 ppb), 3-hour average (secondary standard) not to be exceeded more than once per year.

The 2017 SO₂ design values (2015 – 2017) in Rhode Island are:

- 6 ppb -- 1-hour average, 8 % of primary NAAQS - Brown monitor (discontinued on 12/31/2017)
- 4 ppb -- 1-hour average 5 % of primary NAAQS – East Providence monitor

The SO₂ design value (2016 – 2018) in Rhode Island is as follows:

- 3 ppb -- 1-hour average 4 % of primary NAAQS – East Providence monitor

²US EPA, “Review of National Ambient Air Quality Standards of Carbon Monoxide: Final Rule,” Federal Register 76 (169):54294, August 31, 2011. <http://www.gpo.gov/fdsys/pkg/FR-2011-08-31/pdf/2011-21359.pdf> **Sulfur Dioxide (SO₂)**

The SO₂ NAAQS has never been exceeded in the State. One-hour design values for SO₂ have been below 75 ppb, the one-hour NAAQS promulgated in 2010³, since 1994. All measurements have been in the “Good” range of the AQI since 2007. SO₂ levels measured at the Brown University monitor in Providence declined dramatically in 2013, probably due to the increased use of natural gas rather than fuel oil by nearby sources.

EPA’s 2006 amended monitoring regulation requires SO₂ monitoring only at NCORE sites. However, the 2010 SO₂ NAAQS rule requires at least one SO₂ monitor in the Providence-New Bedford-Fall River RI, MA MSA, which includes all of Rhode Island and Bristol County, Massachusetts. That SO₂ monitor must be sited to meet one or more of the following objectives: (1) characterizing concentrations around emissions sources, (2) measuring the highest concentrations in an area, (3) determining population exposure, (4) establishing general background levels and (5) evaluating regional transport.

The State of Massachusetts operates a SO₂ monitor in the Providence Warwick RI-MA MSA, in Fall River. In prior years, the Fall River monitor was determined to be most appropriate for characterizing maximum SO₂ concentrations in the MSA, as it is situated 2 miles southeast of the Brayton Point coal fired power plant, which was the highest SO₂ emission source in the MSA. Emissions historically were substantially higher than Central Landfill, Rhode Island’s highest emitter. Brayton Point was permanently closed in May of 2017. With this closure, East Providence is positioned to represent the maximum concentrations in the MSA, as it is located downwind of the City of Providence.

Nitrogen Dioxide (NO₂)

The current NO₂ monitoring network is shown in Table 8 and on Figure 1:

Table 8: Nitrogen Dioxide Monitoring Network

SITE	MEASUREMENT SCALE	MONITORING OBJECTIVE	SCHEDULE
Myron Francis School 64 Bourne Avenue E. Providence	Neighborhood (PAMS)	Population exposure	Continuous Year-Round
Near-Road Site Hayes and Park Streets Providence	Microscale	Maximum emissions Near-road	Continuous Year-Round

³An EPA rule amending the SO₂ NAAQS was signed on June 2, 2010. The rule revokes the previous annual and 24-hour NAAQS and sets a new one-hour average NAAQS at 0.075 ppm (75 ppb). Revisions of monitoring networks consistent with the requirements in the rule must be in place by January 1, 2013.

The NO₂ NAAQS are:

- 100 ppb – 1-hour average (effective January 22, 2010). The design value is the average of the 98th percentile maximum daily hour measured in 3 consecutive years.
- 0.053 ppm (53 ppb) - annual average

The design values for 2015-2017 are:

- 58 ppb – 1-hour average, 58 % of NAAQS – Near Road
- 44 ppb – 1-hour average, 44 % of NAAQS – Brown (discontinued on 12/31/2017)
- 39 ppb – 1-hour average, 39 % - East Providence
- 9 ppb – 1-hour average, 9 % - West Greenwich (discontinued on 12/31/2017)

The annual averages for 2017 are:

- 18 ppb annual average, 33 % of NAAQS – Near Road
- 9 ppb annual average, 16 % of NAAQS – Brown
- 7 ppb annual average, 13 % of NAAQS – East Providence
- 1 ppb annual average, 1 % of NAAQS – West Greenwich (did not meet minimum data capture)

The design values for 2016-2018 are:

- 52 ppb – 1-hour average, 51 % of NAAQS – Near Road
- 37 ppb – 1-hour average, 37 % - East Providence

The annual averages for 2018 are:

- 17 ppb annual average, 32 % of NAAQS – Near Road
- 6 ppb annual average, 11 % of NAAQS – East Providence

The NO₂ NAAQS have never been exceeded in Rhode Island. Since there was no short-term NAAQS for NO₂ until the standard was amended in 2010, this pollutant was not used for the Air Quality Index (AQI) before that date. The amended NO₂ NAAQS rule, which was published on February 9, 2010, establishes hourly concentrations of 54 -100 ppb as the range for a “Moderate” AQI⁴.

The 2010 amended NO₂ NAAQS requires Rhode Island to operate two NO₂ monitoring sites, one at “a location of expected highest NO₂ concentrations representing the neighborhood or larger spatial scales” and a second monitor at a near-road location where maximum microscale-representative concentrations are expected.

⁴USEPA, “Primary National Ambient Air Quality Standards for Nitrogen Dioxide: Final Rule, “FR 75(26):6474, 9 February 2010. <http://www.epa.gov/ttn/naqs/standards/nox/fr/20100209.pdf>

The East Providence location fulfills the neighborhood monitoring scale for NO₂. To fulfill PAMS requirements, Direct/True NO₂ is monitored at East Providence June 1 to August 31. A low-range monitor that measures NO and NO_y (total reactive nitrogen oxides) has been operated at the East Providence site since January 2011, consistent with the NCORE requirements.

In April 2014, RIDEM began operating a near-road site on the east side of the Interstate Route 95 near downtown Providence, monitoring for NO₂/NO_x, CO, PM_{2.5} and black carbon to characterize those pollutants from the highway, downwind of the climatological prevailing wind direction. Construction of the northbound highway and bridge, next to where the monitoring shelter is located, is estimated to begin sometime late in 2019, at which time the monitoring site will need to be relocated or discontinued. However, per RIDOT, the funding for the project is delayed and the future schedule is still very uncertain.

Particulate Matter

Particles smaller than 10 microns (PM₁₀) The current PM₁₀ monitoring network is as shown in Table 9 and Figure 2:

Table 9: PM₁₀ Monitoring Network

SITE	MEASUREMENT SCALE	MONITORING OBJECTIVE	SCHEDULE
Vernon Trailer Vernon Street Pawtucket	Middle	Population exposure	24-hour 1 in 6 day
CCRI Liston Campus 1 Hilton Street Providence	Neighborhood (NATTS)	Population exposure Highest concentration	24-hour 1 in 6 day Co-located 1 in 6 day
Myron Francis School 64 Bourne Avenue E. Providence	Neighborhood (NCORE)	Population exposure (Lead discontinued 6/30/16) and PM _{10-2.5})	24-hour 1 in 3 (PM _{10-2.5})

The PM₁₀ NAAQS is:

- 150 µg/m³ – 24-hour average, not to be exceeded more than once per year on average over 3 years (design value is 4th high value in a 3-year period)

The highest value for PM₁₀ recorded at a Rhode Island site for the past 2 years is:

2017 38 µg/m³ – 24-hour average, 25 % of NAAQS, recorded at Vernon St.
 2018 79 µg/m³ – 24-hour average, 53 % of NAAQS, recorded at Vernon St.

The PM₁₀ NAAQS has never been exceeded in Rhode Island. Since PM₁₀ is measured using a filter-based method, results are not immediately available and cannot be used for Air Quality Index calculations. Levels tend to be highest at the Vernon Street site, which is adjacent to I-95, and higher than the two Providence sites. PM₁₀ levels appear to have slightly decreased over the past decade.

PM₁₀ is measured at the East Providence N CORE site every sixth day using a lo-vol sampler. The PM₁₀ measurements are used, in conjunction with PM_{2.5} measurements at that site, for calculating PM_{10-2.5} levels. EPA’s monitoring regulations require areas like the Providence-New Bedford-Fall River, RI-MA Metropolitan Statistical Area (MSA), which has a population greater than 1,000,000 and measured PM₁₀ concentrations below 80% of the NAAQS, to operate a minimum of 2 - 4 PM₁₀ monitoring sites.

As discussed, PM₁₀ measurements at the East Providence site are used for calculating PM_{10-2.5} levels and, since this measurement is required at N CORE sites, PM₁₀ sampling cannot be discontinued at that site. Similarly, PM₁₀ samples collected at the CCRI Providence are analyzed for metals to fulfill NATTS requirements, so PM₁₀ sampling at that location cannot be discontinued. The rural West Greenwich monitor, which previously provided information about background concentrations of PM₁₀ in Rhode Island, ceased operations on December 31, 2017.

The Vernon St., Pawtucket site, adjacent to I-95, characterizes the highest PM₁₀ concentrations in the RI. Although Vernon experiences the highest PM₁₀ values, at no point has the site approached the standard. As RIDEM seeks options for cost and workload savings, RIDEM plans to discontinue Vernon Street at the end of 2019. The 2 remaining PM₁₀ monitors will adequately characterize exposure of the sensitive populations in urban areas to PM₁₀ and fulfill the minimum monitoring requirement of the MSA.

Fine Particulate Matter (PM_{2.5}) The current Federal Reference Method/Federal Equivalent Method (FRM/FEM) PM_{2.5} monitoring network is shown in Table 10 and in Figure 3:

Table 10: PM_{2.5} Monitoring Network

SITE	MEASUREMENT SCALE	MONITORING OBJECTIVE	SCHEDULE
Vernon Trailer Vernon Street Pawtucket	Middle	Population exposure	24-hour, 1 in 3 day FRM Co-located FRM
CCRI Liston Campus 1 Hilton Street Providence	Neighborhood	Population exposure Highest concentration	24-hour, daily Continuous FEM
Myron Francis School 64 Bourne Avenue E. Providence	Urban	Population exposure Highest concentration	24-hour, daily Continuous FEM 1 in 3 day FRM
Alton Jones Campus Victory Highway West Greenwich	Regional	Population exposure General/Background Regional Transport	Continuous FEM
USEPA Laboratory 27 Tarzwell Drive Narragansett	Regional	Population exposure	Continuous FEM
Near Road Site Corner of Hayes and Park Providence	Microscale	Near-road	Continuous FEM

A filter-based FRM PM_{2.5} unit is the primary sampler at the Vernon site. FEM continuous PM_{2.5} monitors are used as the primary samplers at West Greenwich, Narragansett, East Providence, CCRI, and the Near-Road site in Providence. Co-located filter-based FRM samplers are operated at the Vernon and East Providence sites for quality assurance purposes.

The PM_{2.5} NAAQS are:

- 35 µg/m³ - 24-hour average (design value is the 3-year average of the 98th percentile 24-hour concentration)
- 12 µg/m³ - annual average (design value is calculated by averaging the daily concentrations from each quarter, averaging these quarterly averages to obtain an annual average, and then averaging the annual averages for three consecutive years)

The highest PM_{2.5} values for 2018 are:

- 24.7 µg/m³ – 24-hour average, 70.6 % of NAAQS, recorded at Near Road.
- 8.3 µg/m³ – annual average, 69.2 % of NAAQS, recorded at Near Road.

Design values for PM_{2.5} for the past 3 years, both annual and 24-hour are as follows:

* Near Road monitoring began in April 2014. First year of full data capture was 2015

** Design values are for the monitors formerly located at Urban League

SITE	24 hour DV 2014-2016	24 hour DV 2015-2017	24 hour DV 2016-2018	Annual DV 2014-2016	Annual DV 2015-2017	Annual DV 2016-2018
Vernon Trailer Vernon Street Pawtucket	18	18	16	7.6	7.1	6.7
CCRI Liston Campus** 1 Hilton Street Providence	16	15	16	6.7	6.4	6.3
Myron Francis School 64 Bourne Avenue E. Providence	18	17	17	6.9	6.7	6.7
Alton Jones Campus Victory Highway West Greenwich	13	13	14	4.5	4.8	5.0
USEPA Laboratory 27 Tarzwell Drive Narragansett	14	15	15	5.0	5.7	5.1
Near Road Site Hayes and Park Streets Providence	N/A*	20	19	N/A*	9.1	8.8

Historically, annual average levels have been consistently highest at the Vernon Street site, which is adjacent to I-95, and higher at the East Providence and Urban League sites than at the rural West Greenwich site. PM_{2.5} levels have slowly decreased over the past decade. The 2017 and 2018 (preliminary) design values of PM_{2.5} data at Near Road are the highest in the monitoring network.

EPA regulations requires a minimum of two PM_{2.5} Rhode Island monitoring sites to characterize the following:

- Community-wide air quality;
- Background PM_{2.5} levels in the State; and
- Regional transport of PM_{2.5}

Although Rhode Island operates more PM_{2.5} sites than required, each site fulfills a specific information need or EPA requirement. The West Greenwich site fulfills EPA's requirements for measurement of background and regional transport concentrations of PM_{2.5} into the state. The 24-hour and annual PM_{2.5} design values for the Vernon Street, Pawtucket site, which is immediately adjacent to Interstate Rte. 95, tend to be higher than those at the other sites besides Near Road. The East Providence monitor cannot be removed because PM_{2.5} monitoring is required at NCORE sites, and the Urban League and Narragansett monitors fulfill the need for air quality data for urban and coastal areas of the State, respectively.

As discussed above, near road PM_{2.5} monitoring began in April 2014 and will continue until such time that the site is no longer available, due to scheduled construction of the 95N viaduct. Monitoring for Near Road will be evaluated with EPA when the timeline for relocation of this site is determined. RIDEM continues working towards a move from Urban League to the approved location at the Community College of Rhode Island, Liston Campus, with initial construction beginning in April of 2019 for an anticipated move during summer. Since CCRI cannot accommodate all the equipment from the Urban League site, the PM_{2.5} from that location was moved to Vernon Street for co-locating with the existing FRM on April 1, 2017.

RIDEM has assigned the FEM PM_{2.5} monitor at East Providence to be the primary monitor and uses the FEM and FRM data from that site to evaluate FEM-FRM comparability at Rhode Island sites. The advantages of using the East Providence, rather than the West Greenwich site for this purpose include:

- PM_{2.5} levels at the East Providence site, although still substantially below the NAAQS, tend to be higher than those at the West Greenwich site.
- Since the East Providence FRM runs 1 in 3 days, it generates more comparative data than West Greenwich.

Historical data has demonstrated that the East Providence FEM and FRM measurements have better correlation and less bias than is observed at the W. Greenwich site.

In preparation for the move from Urban League to its new NATTS location at CCRI, the FRM sampler at Urban League was discontinued on December 31, 2018. There are no other changes to the PM_{2.5} network anticipated in the next 18 months.

Speciation Monitoring

The EPA's PM_{2.5} Speciation Trends Network (STN) is designed to characterize metal, ion and carbon constituents of PM_{2.5}. In November 2008, the speciation equipment at Urban League was replaced by a SASS speciation unit and, in March 2009, a URG carbon sampler began operation at that location as part of the speciation program. To conform to NCORE requirements, the speciation equipment, including the carbon sampler, was moved to the East Providence NCORE site in January 2011 and is now being operated there on a 1-in-3 schedule. Speciation filters are analyzed by an EPA contractor.

Lead (Pb)

As specified in the lead NAAQS rule, sampling of lead was previously conducted on a one-in-six-day schedule. EPA deleted the requirement to monitor for non-source Pb at NCORE sites from Appendix D of 40 CFR part 58.16 and to allow monitoring agencies to request permission to discontinue non-source monitoring following the collection of at least 3 years of data at urban NCORE sites. Since ambient lead monitoring was conducted in the State for more than 3 years and the lead levels were consistently considerably lower than the NAAQS since the inception of monitoring, RI DEM was granted permission to discontinue monitoring as of June 30, 2016.

Ozone Precursor and Air Toxics Measurements

Photochemical Assessment Monitoring Stations (PAMS)

The Clean Air Act Amendments of 1990 (CAAA) required serious, severe and extreme ozone nonattainment areas to establish enhanced monitoring networks to measure ozone and ozone precursors. In response to that mandate, the US EPA promulgated rules in 1993 that required the establishment of a network of Photochemical Assessment Monitoring Stations (PAMS) to measure ozone, NO_x, volatile organic compounds (VOCs), carbonyls, and meteorological parameters in serious and above nonattainment areas. This network was designed to provide comprehensive data on trends in ambient concentrations of ozone and ozone precursors and to evaluate the spatial and diurnal variability of those pollutants to track the formation and transport of ozone across large areas and to evaluate the effectiveness of strategies implemented to reduce levels of that pollutant.

The EPA rule identified four types of PAMS sites:

- Type 1 sites, located on the upwind side of the nonattainment area and used to characterize background and transported concentrations of ozone, NO_x and VOC;
- Type 2 sites, sited to measure the maximum impact of VOC and NO_x emitted in the area;
- Type 3 sites, sited to measure maximum ozone concentrations occurring downwind of the area, and
- Type 4 sites, sited to measure the concentration of ozone, NO_x and VOC exiting the area.

Two PAMS sites, including a Type 2 site, were required in each serious and above nonattainment area. At that time, Rhode Island was designated a serious nonattainment area for the one-hour average ozone standard, therefore requiring enhanced monitoring and a PAMS network. The Alton Jones monitoring site in West Greenwich was designated as the State's Type 1 PAMS site and the East Providence site as

the Type 2 PAMS site. In addition, the Massachusetts Department of Environmental Protection (MA DEP) operated a site at the Blue Hills Observatory in Milton, Massachusetts (Site ID 25-021-3003) that served as the Type 1 (upwind) site for the Boston area and as the Type 3 (downwind) site for the Providence area.

The following PAMS pollutants have been monitored in the Rhode Island network:

- 24-hour speciated VOC samples have been collected every sixth day year-round at the Alton Jones and East Providence sites, VOC samples were collected daily during June, July and August at the East Providence site. As of June, July and August of 2017, VOC samples were collected hourly at East Providence using an Auto-GC. Hourly VOC sampling will again continue June-August for 2019 at East Providence.
- 24-hour carbonyl samples have been collected every sixth day year-round at the East Providence site. Three 8-hour carbonyl samples per day will be collected every third day during June, July and August for 2019.
- In 2017, NO_x was measured continuously March through October at Alton Jones, year-round at East Providence, and year-round at the MA DEP site in Milton, MA.
- Rhode Island has measured reactive nitrogen oxides (NO and NO_y) at East Providence since January 2011 to fulfill NCORE requirements. The new EPA regulations require NO, NO_y, true NO₂ and mixing height measurements at required PAMS sites during the ozone season. True NO₂ and mixing heights are being measured for 2019.
- Ozone was measured March through October at the West Greenwich and Narragansett sites since 2011, and monitored March through September beginning in 2017. Ozone is measured year-round at East Providence to fulfill NCORE requirements.
- Surface meteorological parameters are measured at all three Rhode Island sites year-round.
- West Greenwich is no longer designated a PAMS site, and NO_x monitoring ceased operations as of December 31, 2017 as a cost savings measure.

PAMS recently revised monitoring rule (80 FR 65292; October 26, 2015) requirements

The recently revised monitoring rule (80 FR 65292; October 26, 2015) requires PAMS measurements June 1 through August 31 at NCORE sites that are located in Core-Based Statistical Areas with populations of 1,000,000 or more. The Providence, New Bedford, Fall River, RI-MA Statistical Area qualifies as one of those sites. RIDEM is required to develop an implementation plan for this monitoring rule.

PAMS Monitoring Implementation Network Plan

RIDEM operated two Photochemical Assessment Monitoring Stations (PAMS) sites in the air monitoring network in 2017, at the West Greenwich and East Providence sites. West Greenwich is no longer designated a PAMS site.

Network Decision

The NCore site located at Francis School in East Providence will serve as the location of the required PAMS site and will measure the following parameters described below. An inventory of equipment used at the site is provided in Table 12.

Auto GC Decision

Volatile organic compounds (VOCs) – A complete list of the targeted compounds are found in Table 11. For 2019, hourly speciated VOC measurement are measured with an auto-gas chromatograph (GC) using Chromatotec GC 866 Airmo VOC.

Meteorology Measurements Decision

RIDEM will continue to measure wind direction, wind speed, temperature, humidity, atmospheric pressure, precipitation, solar radiation, and ultraviolet radiation. For measuring mixing height, a Vaisala CL51 ceilometer was purchased in August 2018 and has been installed at East Providence. The following instrumentation has been in operation to measure the parameters described above:

Wind speed- Met One 014A

Wind direction – Met One 6929

Temperature and Humidity all in one – Met One 083D

Atmospheric pressure – Met One 091

Precipitation - Met One 370C

Solar radiation – LI-COR LI-200SZ pyranometer sensor

Ultraviolet radiation – EPLAB model TUVR

Other Required Measurements

Carbonyls - Carbonyl sampling at a frequency of three 8-hour samples on a 1 in 3 day basis (~90 samples per PAMS sampling season) with an ATEC 8000 sampler.

A complete list of the target carbonyl compounds may be found in Table 11. The TO-11A test method, as used in the National Air Toxics Trends (NATTS)⁶ program will be used.

Nitrogen Oxides – Will monitor for NO and NO_y (total oxides of nitrogen) to fulfill NCore requirements. True NO₂ will be measured June, July, and August as required by PAMS. True NO₂ is being measured by cavity attenuated phase shift (CAPS) spectroscopy with a Teledyne API T500U. NO and NO_y will be measured using a Thermo 42iY.

⁶ See NATTS Technical Assistance Document for TO-11A method

Table 11: PAMS Target Compound List

Priority Chemical Parameters (Required)	AQS Parameter Code	Compound Class	Optional Chemical Parameters	AQS Parameter Code	Compound Class
1,2,3-trimethylbenzene	45225	aromatic	1,3,5-trimethylbenzene	45207	aromatic
1,2,4-trimethylbenzene	45208	aromatic	1-pentene	43224	olefin
1-butene	43280	olefin	2,2-dimethylbutane	43244	paraffin
2,2,4-trimethylpentane	43250	paraffin	2,3,4-trimethylpentane	43252	paraffin
acetaldehyde	43503	carbonyl	2,3-dimethylbutane	43284	paraffin
benzene	45201	aromatic	2,3-dimethylpentane	43291	paraffin
cis-2-butene	43217	olefin	2,4-dimethylpentane	43247	paraffin
ethane	43202	paraffin	2-methylheptane	43960	paraffin
ethylbenzene	45203	aromatic	2-methylhexane	43263	paraffin
ethylene	43203	olefin	2-methylpentane	43285	paraffin
formaldehyde	43502	carbonyl	3-methylheptane	43253	paraffin
isobutane	43214	paraffin	3-methylhexane	43249	paraffin
isopentane	43221	paraffin	3-methylpentane	43230	paraffin
isoprene	43243	olefin	Acetone	43551	carbonyl
m&p-xylenes	45109	aromatic	Acetylene	43206	alkyne
m-ethyltoluene	45212	aromatic	cis-2-pentene	43227	olefin
n-butane	43212	paraffin	Cyclohexane	43248	paraffin
n-hexane	43231	paraffin	cyclopentane	43242	paraffin
n-pentane	43220	paraffin	isopropylbenzene	45210	aromatic
o-ethyltoluene	45211	aromatic	m-diethylbenzene	45218	aromatic
o-xylene	45204	aromatic	methylcyclohexane	43261	paraffin
p-ethyltoluene	45213	aromatic	methylcyclopentane	43262	paraffin

propane	43204	paraffin	n-decane	43238	paraffin
propylene	43205	olefin	n-heptane	43232	paraffin
styrene	45220	aromatic	n-nonane	43235	paraffin
toluene	45202	aromatic	n-octane	43233	paraffin
trans-2-butene	43216	olefin	n-propylbenzene	45209	aromatic
ozone	44201	criteria pollutant	n-undecane	43954	paraffin
true NO ₂	42602	criteria pollutant	p-diethylbenzene	45219	aromatic
total non-methane organic carbon	43102	total VOCs, non-methane	trans-2-pentene	43226	olefin
			α-pinene	43256	monoterpene olefin
			β-pinene	43257	monoterpene olefin
			1,3 butadiene	43218	olefin
			benzaldehyde	45501	carbonyl
			carbon tetrachloride	43804	halogenated
			Ethanol	43302	alcohol
			tetrachloroethylene	43817	halogenated

Table 12: Equipment Inventory at East Providence Site

NAME	Manufacturer	Model
Black Carbon-Aethalometer	Teldyne	M633
Black Carbon-Aethalometer	Magee	AE16-ER
Carbonyl sampler	Atec	2200
Carbonyl sampler	Atec	2200
Wind direction sensor	MetOne	590S (6929)
Pure air generator	aadco	737-R-12A
Chemiluminescence NO-NO ₂ -NO _x Analyzer	Thermo	42ITL
Sulphur Dioxide analyzer	Thermo	43ITL
Carbon Monoxide analyzer	Thermo	TE48i
Data logger	Agilaire	8832
Hydrogen generator	Packard	H2PD-150NA
Translator module	MetOne	126

Translator module	MetOne	2270
Barometric pressure sensor	MetOne	091
Rain sensor	MetOne	370-8"
Relative Humidity/temp sensor	MetOne	083D-1-35
Met Station Tower	MetOne	
Ultraviolet radiation sensor	EPLAB	TUVR
Wind Speed sensor	MetOne	014A
Solar Radiation pyranometer sensor	LI-COR	LI-200SZ
Chemiluminescence NO-DIF-NO _y Analyzer	Thermo	TE42iY
Ozone analyzer	Thermo	TE49i
PM2.5 Sampler	MetOne	1020
PM2.5 Speciation	MetOne	SASS
PM2.5 Partisol-Plus	R&P	2025
PM2.5 Partisol-Plus	R&P	2025
Standard Calibrator,	API	M700E
Standard Calibrator	EnviroNics	6103
Standard-Zero Air	Teledyne	701
VOC sampler	Xontech	910A
VOC sampler	Xontech	910A
Compac II AC units	Marvair	
Compac II AC units	Marvair	
GC custom	Agilent	7890A
Mass Spec	Agilent	5973N
Auto GC	Chromatotec	866
Ceilometer	Vaisala	CL51
Carbonyl Sampler	Atec	8000
True NO ₂	Teledyne API	T500U

The EPA promulgated a new NAAQS for ozone effective December 28, 2015. As a result, the following changes to the PAMS program have occurred because of the new regulations.

- The network design change involved EPA requiring PAMS measurements minimally during the PAMS season from June 1 through August 31, at all NCORE sites in CBSAs with a population of 1,000,000 people or more. Since the East Providence site is also the State's NCORE site, this requirement would not necessitate a relocation of that site. The second part of the network design requires states with moderate or above non-attainment areas or states in the Ozone Transport Region to develop and implement Enhanced Monitoring Plans. The EMP is intended to provide monitoring organizations with flexibility to implement additional monitoring to suit the needs of their area.
- As EPA strongly suggested that all required PAMS sites take hourly speciated VOC measurements with auto-gas chromatographs (GCs), RI DEM has purchased and has begun using a continuous GC at the East Providence PAMS site as of the summer of 2017 and is currently in operation for 2019.
- All required PAMS sites must monitor for NO and NO_y (total oxides of nitrogen) in addition to true NO₂ where the latter must be measured with a direct reading NO₂ analyzer, cavity attenuated phase shift (CAPS) spectroscopy analyzer, or photolytic-converter NO_x analyzer. Rhode Island installed a FRM low-range NO₂/NO_x analyzer at the East Providence site in 2013 and operates that analyzer year-

round. True NO₂ is being monitored with Teledyne API T500U CAPS.

- All required PAMS sites must measure wind direction, wind speed, temperature, humidity, atmospheric pressure, precipitation, solar radiation, ultraviolet radiation and mixing height. A ceilometer has been acquired to measure mixing height, with installation on the East Providence trailer roof in process. However, RIDEM would still like to extend the waiver to leave open the option of deploying the ceilometer at the Vernon Street location if logistical or infrastructure issues arise with East Providence.

Enhanced Monitoring Plan Update and Changes

RIDEM has developed an Enhanced Monitoring Plan (EMP) for implementing additional applicable PAMS requirements. Details on the siting for the initial EMP can be reviewed in the 2018 ANP.

Because of the immediate coastal location of the East Matunuck monitor, RIDEM feels this position may uniquely capture ozone plumes migrating over water along Long Island Sound as they come ashore. These measurements will enhance the existing network of Rhode Island ozone monitors to complement transport movement into the state from inland, and now, the immediate coastline.

Parameters

The original EMP was submitted as part of the 2018 ANP detailed RIDEM's plan for enhanced monitoring. In a letter to Peter Kahn, dated April 2, 2019, RIDEM provided an update on the proposed changes to the EMP. In summary, federal land use restrictions, infrastructure concerns, cost, and logistical problems prevented RIDEM from implement the EMP as outlined in the 2018 ANP.

On April 29, 2019 RIDEM again deployed the EPA 2B Ozone Analyzer in the lifeguard tower similarly as to 2017 and 2018 seasons. The ozone analyzer will not meet EPA siting criteria and the data will not meet EPA AQS criteria. The data will once again be considered for research and exploratory purposes. Calibration checks and maintenance will again be performed as often staffing and travel permits. However, RIDEM will be exploring siting the 2B Analyzer in 2020 to meet regulatory grade monitoring by tracking operating temperature, frequent calibration checks, and ensuring proper inlet configuration outside the lifeguard tower.

Location Address	Latitude/ Longitude	Parameter Measured	Instrument Info	EPA Method Designation
950 Succotash Road, South Kingstown, RI 02879	41.377451 -71.524852	Ozone	2B Model – 202	Equivalent

Following a successful 2019 season of data capture, RIDEM will be able to calculate a tentative design value for ozone for this location. At completion of the 2019 PAMS season, it will be determined if a more robust monitoring schedule be implemented.

Air Toxics

Rhode Island operates one site that is part of the National Air Toxics Trends Stations (NATTS) network. The primary purposes of the NATTS network are to track trends in ambient air toxics levels, to characterize exposures, and to measure progress toward emission and risk reduction goals.

The Rhode Island NATTS site was previously located on the roof of the Urban League building in an urban residential neighborhood on the south side of Providence, approximately ½ mile west of I-95. This site was chosen as the State's NATTS site because it is not dominated by local sources and because levels of air toxics at this site appear to be representative of those in urban areas in the State.

At the beginning of July, 2019 relocation to the CCRI Liston Campus was completed. This new location is approximately 315 feet (0.06 miles) to the south and east Urban League. There are some final logistical items to complete, but monitoring activities began shortly after completion of the move.

In keeping with EPA requirements, the following pollutants, at a minimum, are measured at the Rhode Island NATTS site:

Volatile Organic Compounds (VOC)

- Acrolein
- Perchloroethylene (tetrachloroethylene)
- Benzene
- Carbon tetrachloride
- Chloroform
- Trichloroethylene
- 1,3-butadiene
- Vinyl Chloride

Carbonyls

- Formaldehyde
- Acetaldehyde

Metals

- Nickel compounds (PM₁₀)
- Arsenic compounds (PM₁₀)
- Cadmium compounds (PM₁₀)
- Manganese compounds (PM₁₀)
- Beryllium (PM₁₀)

Semi-Volatile Organic Compounds (SVOC)

- Benzo(a)pyrene
- Naphthalene

VOCs, carbonyls and PM₁₀ metal samples are analyzed by RIDOH. Semi-Volatile Organic Compounds (SVOC) samples are analyzed by an EPA contractor. Sampling at the NATTS site is conducted for the above parameters for 24-hour periods every sixth day. 24-hour VOC samples are also collected every sixth day at the West Greenwich site, East Providence site, and at the Vernon Street site, which is adjacent to I-95 in Pawtucket. 24-hour carbonyl samples are collected at the East Providence site on the same schedule.

In addition, RIDEM operates aethalometers, which measure black carbon, an indicator of diesel exhaust, at the Urban League NATTS site, the East Providence PAMS/NCORE site and, as of April 2014, at the Near Road site in Providence.

No other changes are planned for the ozone precursor or air toxics monitoring sites in the next 18 months.

National Core Multi-Pollutant Monitoring Stations Network

As required in an October 17, 2006 Federal Register notice (FR 71:61236), Rhode Island began operating a site that is part of EPA’s network of core multipollutant monitoring (NCORE) stations in January 2011. This network is designed to address the following monitoring objectives:

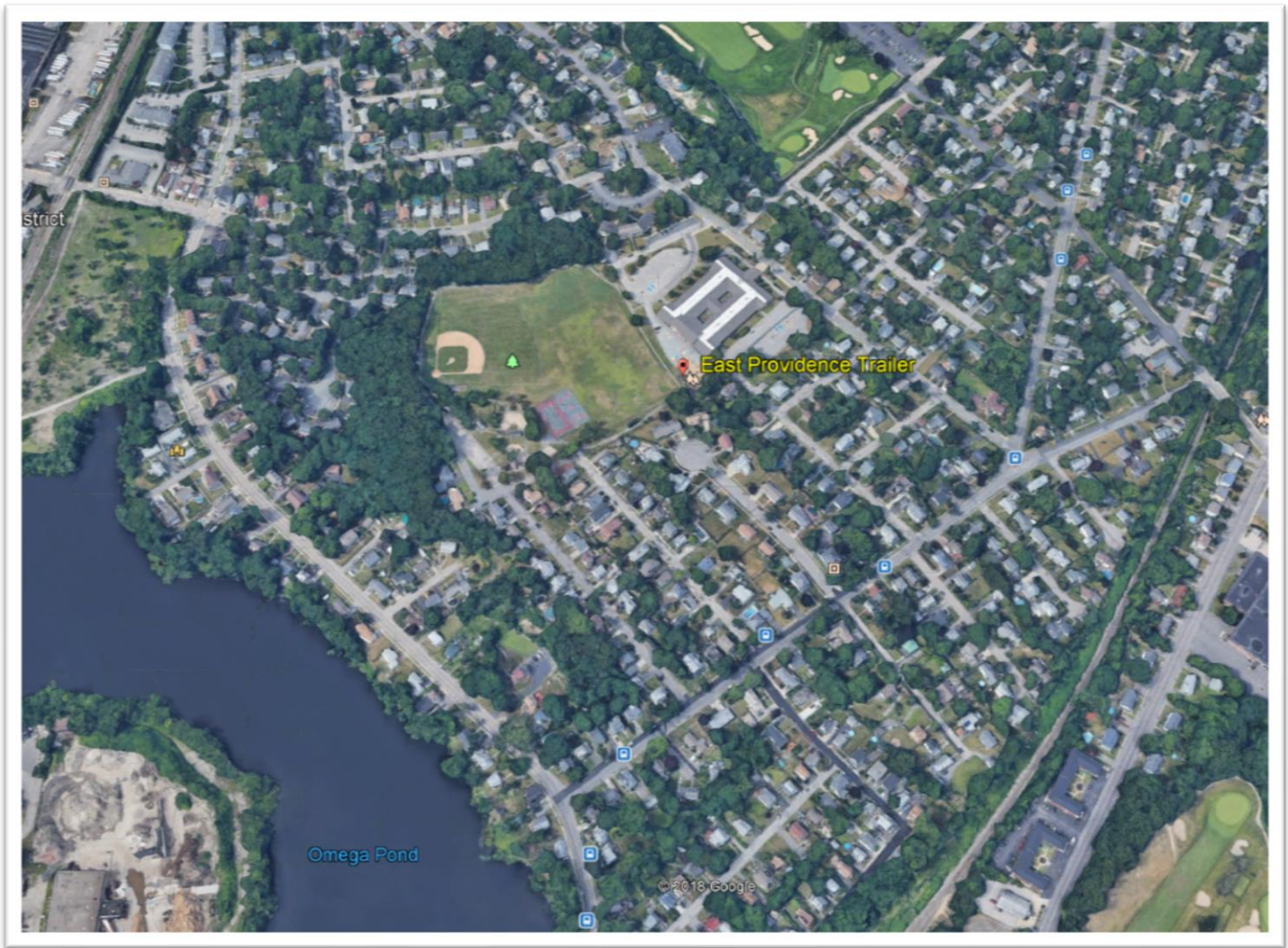
- Timely reporting of data to the public through AIRNow, air quality forecasting, and other public reporting mechanisms
- Supporting development of emission strategies through air quality model evaluation and other observational methods
- Assessing accountability of emission strategy progress through tracking long-term trends of criteria and non-criteria pollutants and their precursors
- Supporting long-term health assessments that contribute to ongoing reviews of the NAAQS
- Establishing nonattainment/attainment areas by comparison with the NAAQS
- Supporting disciplines of scientific research, including; public health, atmospheric and ecological.

The East Providence site is operating as the State’s NCORE site. Ozone, low-range NO₂/NO_x, reactive oxides of nitrogen (NO and NO_y), low-range CO, low range SO₂, PM_{2.5} (FRM, continuous and speciated), coarse PM (PM_{10-2.5}), VOCs, carbonyls, black carbon, and meteorological parameters are monitored at that site. PM_{10-2.5} is measured as the difference between lo-vol PM₁₀ and lo-vol PM_{2.5} concentrations. The conventional NO₂/NO_x monitor at this site was replaced by a low-range NO₂/NO_x monitor in January 2013 and is being operated year-round. True NO₂ is being measured by cavity attenuated phase shift (CAPS) spectroscopy with a Teledyne API T500U CAPS.

Detailed Site Information:

The following section presents detailed information for each monitoring site, such as: identification code, location, history, monitored parameters, monitoring objectives, history and descriptive information.

Myron Francis School – East Providence			
County	Providence	Latitude	41.840954°
Address	64 Bourne Street	Longitude	-71.360976°
AQS Site ID	440071010	Elevation	62 feet
Spatial Scale	Neighborhood/Urban	Year Established	1993
Statistical Area	Providence, New Bedford, Fall River, RI-MA Metropolitan Statistical Area		
<p>Site Description: The Myron Francis school is a neighborhood scale site located in a residential suburban area in East Providence in northeastern Rhode Island on city property. The site is operated by RIDEM as part of the NCORE and PAMS program. South of the site is residential neighborhoods, west is sports fields and recreation space, immediately northeast is a playground and school building, with additional residential neighborhoods due east. Interstate I-195 is approximately 2 miles due south. The trailer is approximately 12’X23’.</p>			
<p>Monitoring Objectives: To collect long term measurements to assess trends as part of the national NCORE and PAMS Networks.</p>			
<p>Planned changes for 2019-2020: None</p>			



View of East Providence Trailer
Facing West

West Greenwich – W. Alton Jones Campus			
County	Kent	Latitude	41.615316°
Address	401 Victory Highway	Longitude	-71.720032°
AQS Site ID	440030002	Elevation	210 feet
Spatial Scale	Regional/Background	Year Established	1976
Statistical Area	Providence, New Bedford, Fall River, RI-MA Metropolitan Statistical Area		
<p>Site Description: : The Alton Jones site is a regional scale site located in a meadow surrounded by trees in Rhode Island in the town of West Greenwich. This site is operated by RIDEM as part of the SLAMS State Toxics network. Land use type: Forest and recreation field. It is located near RT 102 approximately 2.5 miles east, and Interstate I-95, 5 miles south. The trailer approximately 12'X12', with a pressure treated deck off to the east side of the trailer. A meteorological tower sits on the west side of the trailer. As the photo below reveals, the shelter is in a very rural region of the state miles from any public roads or neighborhood residences.</p>			
<p>Monitoring Objectives: To collect long term measurements to assess transport into the Rhode Island as part of the SLAMS and State Toxics networks.</p>			
<p>Planned changes for 2019-2020: None</p>			





View of West Greenwich shelter and meteorological tower facing west

Narragansett – US EPA Lab			
County	Washington	Latitude	41.495060°
Address	27 Tarzwell Drive	Longitude	-71.423713°
AQS Site ID	440090007	Elevation	106 feet
Spatial Scale	Regional	Year Established	1997
Statistical Area	Providence, New Bedford, Fall River, RI-MA Metropolitan Statistical Area		
<p>Site Description: The Narragansett USEPA laboratory site is a regional scale site located 650 feet west of Narragansett Bay in the town of Narragansett. Route 1 is 1.75 miles to the west. This site is operated by RIDEM as part of SLAMS network. The ozone monitor, datalogger and other equipment is in a small office on the south side of the EPA building. A staircase on the north side of the building leads to the roof where the continuous PM2.5 sampler is placed. A meteorological tower sits on the east side of the building.</p>			
<p>Monitoring Objectives: To collect long term measurements to assess trends in Rhode Island as part of the national SLAMS network.</p>			
<p>Planned changes for 2019-2020: None</p>			



View of Narragansett BAM shelter facing to the northwest



Providence – CCRI Liston Campus			
County	Providence	Latitude	41.807523°
Address	1 Hilton Street	Longitude	-71.413920°
AQS Site ID	TBD	Elevation	75 feet
Spatial Scale	Neighborhood	Year Established	1999 (Urban) 2019 (CCRI)
Statistical Area	Providence, New Bedford, Fall River, RI-MA Metropolitan Statistical Area		
<p>Site Description: The newly established CCRI Liston Campus site is a neighborhood scale in an urban community in South Providence. This site is operated by RIDEM as part of the SLAMS and NATTS air toxics network. This rooftop site is on the main campus building approximately 30 feet off the ground. North of the building is parking, an open lot, and some commercial buildings. To the south is parking and residential homes. To the east is parking and the former monitoring site at Urban League. To the west is parking and eventually some mixed commercial and residential properties. The campus is not on a main road. I-95 is 0.45 miles east.</p>			
<p>Monitoring Objectives The CCRI monitoring site objective is to collect air quality measurements to assess long-term trends as part of the SLAMS and NATTS network.</p>			
<p>Planned changes for 2019-2020: The site is nearly fully operational. However, remaining items to complete include installing meteorological equipment, internet connectivity, and walkways. See satellite image below detailing both the new CCRI location and the former Urban League location.</p>			



Pawtucket – Vernon Street			
County	Providence	Latitude	41.874683°
Address	Vernon Street	Longitude	-71.379936°
AQS Site ID	440070026	Elevation	75 feet
Spatial Scale	Middle	Year Established	2001
Statistical Area	Providence, New Bedford, Fall River, RI-MA Metropolitan Statistical Area		
<p>Site Description: The Vernon Street site is a middle scale site located in a suburban area in north-eastern Rhode Island in the City of Pawtucket. This site is operated by RIDEM as part of the SLAMS and State Toxics networks. Land use type: Highway/ Residential. It is located at grass level adjacent to Interstate RT I-95 and sits midway on a hill near the on-ramp with houses on the east-south sides. This site is a small grassy median situated 22 meters from I-95 North and 7.6 meters to the ramp leading to the highway. The samplers are placed on a cement platform and pressure treated deck. The area is surrounded by a chain link fence.</p>			
<p>Monitoring Objectives: to collect air quality measurements to assess long-terms trends as part of the national SLAMS and Toxics network.</p>			
<p>Planned changes for 2019-2020: As RIDEM seeks options for cost and workload savings, RIDEM plans to discontinue PM₁₀ monitoring at Vernon and start reporting PM₁₀ mass measured at the East Providence site at the end of 2019.</p>			



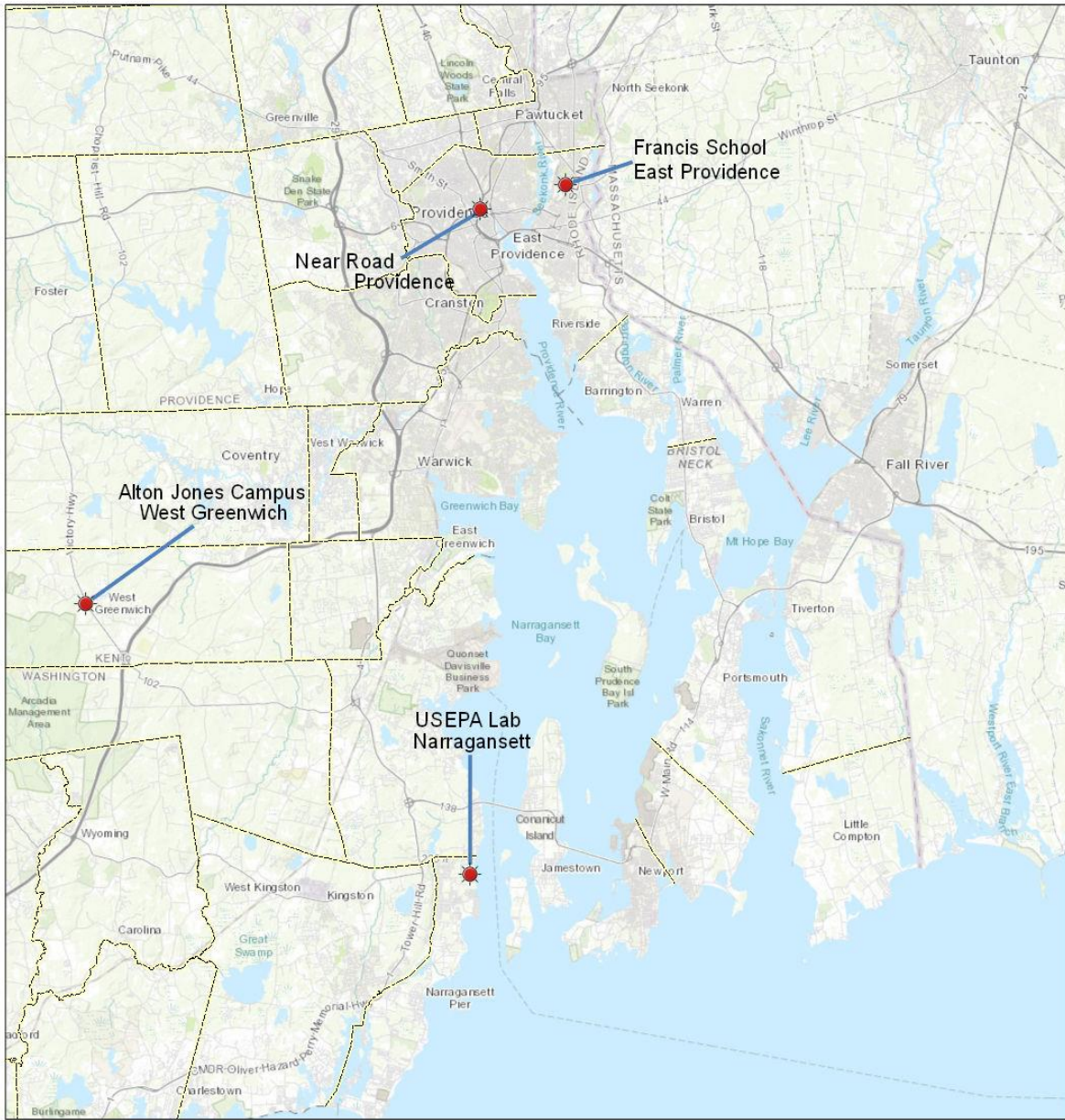
Providence – Near Road			
County	Providence	Latitude	41.829523°
Address	Hayes and Park St	Longitude	-71.417584°
AQS Site ID	440070030	Elevation	75 feet
Spatial Scale	Microscale	Year Established	2014
Statistical Area	Providence, New Bedford, Fall River, RI-MA Metropolitan Statistical Area		
<p>Site Description: The Near Road site is microscale situated in an urban, commercial area 4 meters from the I-95 North roadway near the corner of Park/Hayes Streets near the Route-10 and Route-146 connectors. It is the busiest trafficked street of highway in the state. The trailer is 20'x8' and sits level with the highway with a slight incline on Park Street to the east. Veterans Memorial Auditorium sits to the north and east on Park Street, the Foundry Complex is across the highway to the west, and the Providence Place Mall parking garage is to the south.</p>			
<p>Monitoring Objectives: To collect near road air quality measurements to assess long-terms trends as part of the Near Road Network.</p>			
<p>Planned changes for 2019-2020: Depending upon RIDOT I-95N viaduct construction plans, the site may have to be relocated or discontinued.</p>			



View from roof of Near Road shelter facing south

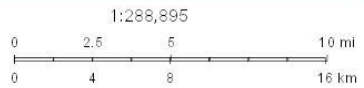


Figure 1 Air Quality Monitoring Network Continuous Gas Monitors



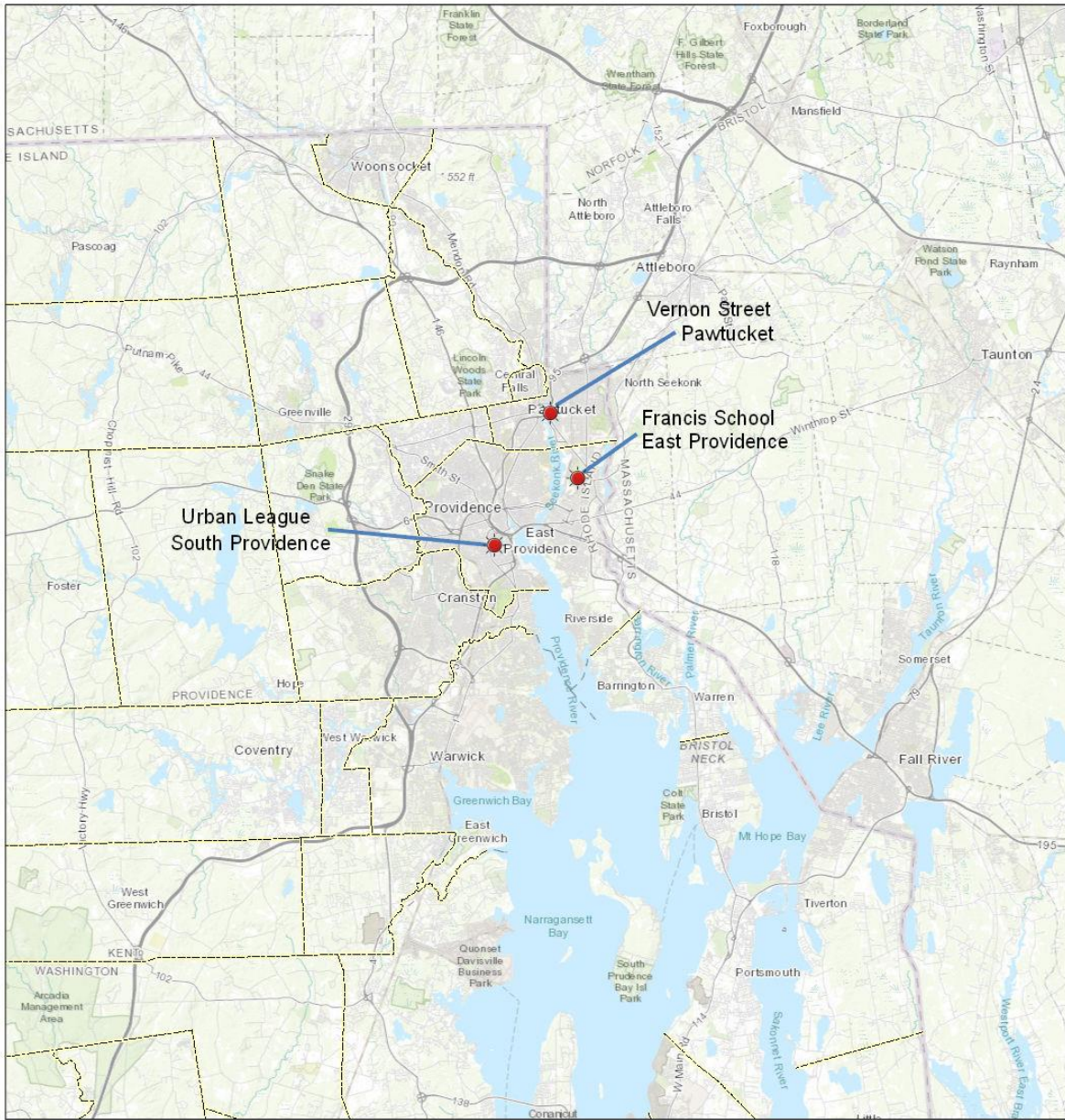
8/3/2018, 11:56:12 AM

- Continuous Gas Monitors
- Town Line



MassGIS, Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS

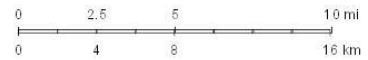
Figure 2 - PM-10 Air Pollution Monitoring Network Sites



8/3/2018, 12:16:25 PM

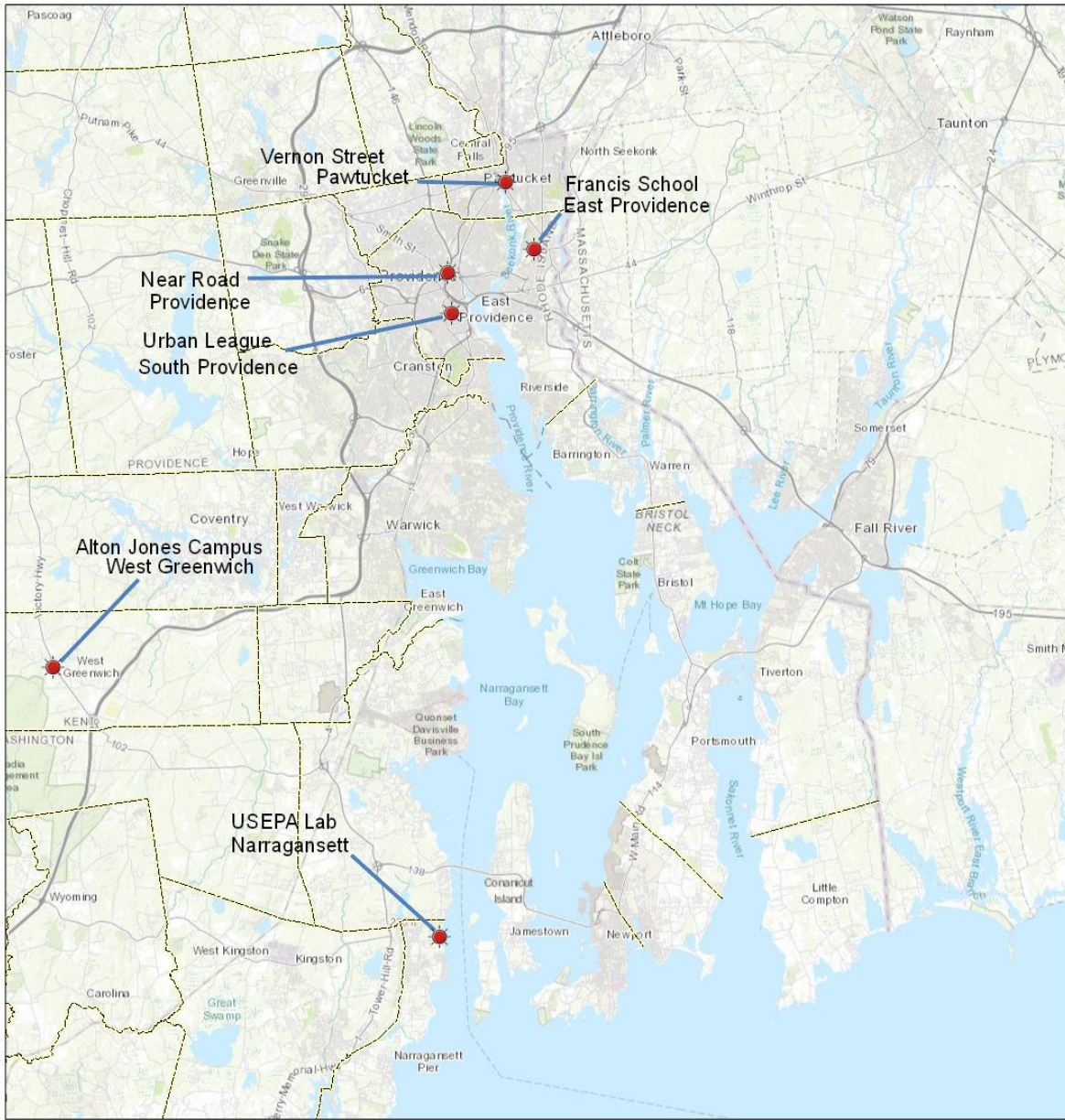
- PM-10 Site Locations
- Town Line

1:288,895



City of East Providence, City of Providence, MassGIS, Esri Canada, Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS

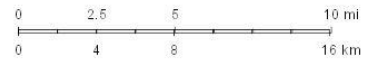
Figure 3 - PM-2.5 Air Quality Monitoring Network Sites



8/3/2018, 12:43:51 PM

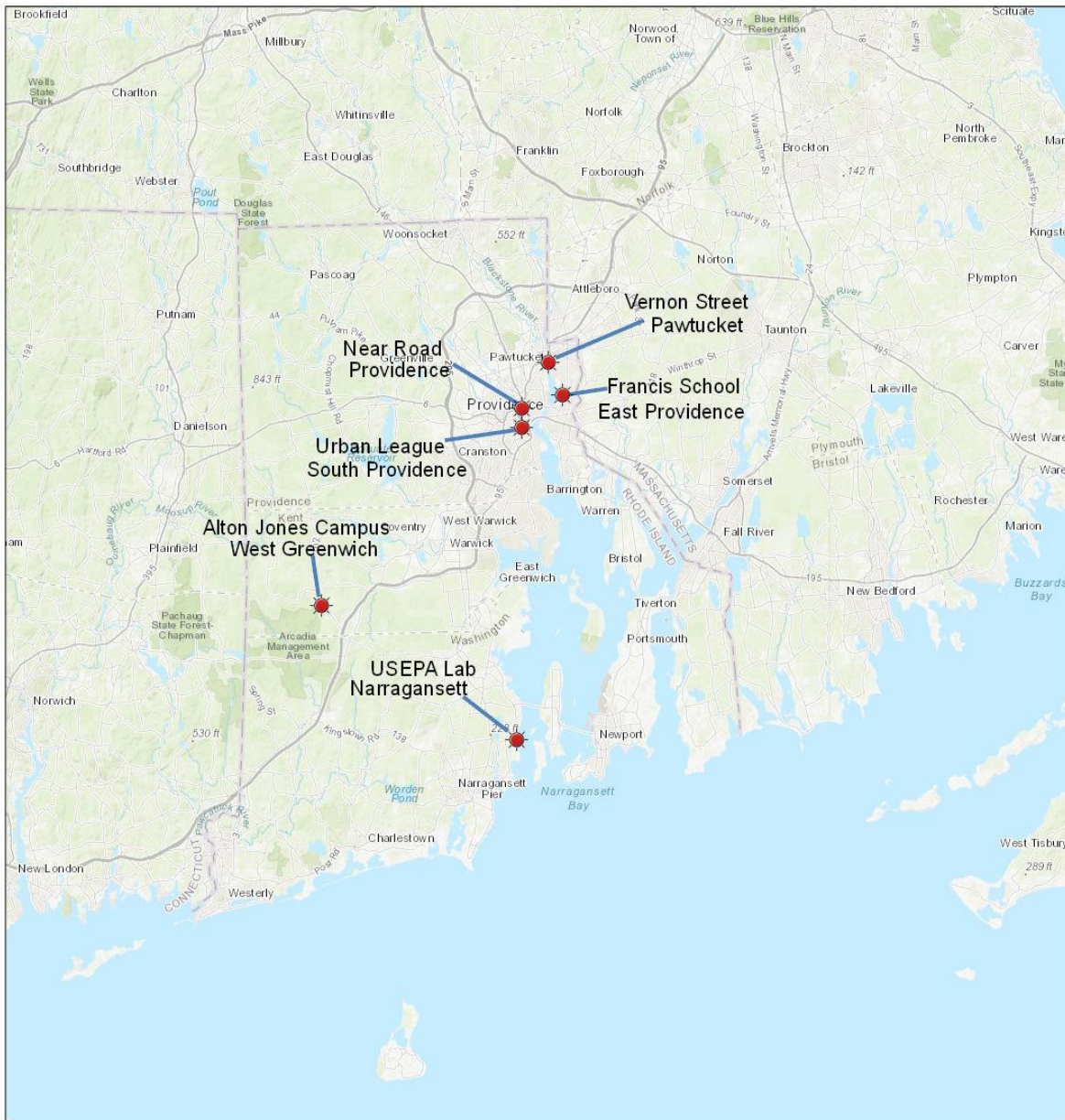
- PM-2
- Town Line

1:288,895



MassGIS, Esri Canada, Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS

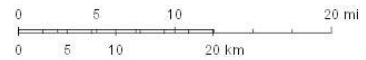
Figure 4 - RI Air Quality Monitoring Network



8/3/2018, 1:05:35 PM

● Rhode Island Air Quality Monitoring Network Sites

1:577,791



Eri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS

a Center (URI/EDC), Rhode Island Department of Environmental Management (RIDEM) | RIGIS, University of Rhode Island Environmental Data Center | RIEMA | Eri, HERE | Eri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS |