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

Rhode Island 2020 Annual Monitoring Network Plan and 5-Year Network Assessment

RIDEM

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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
NO2	Nitrogen dioxide
NOx	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
PM10	Particulate matter < 10 microns
PM2.5	Particulate matter < 2.5 microns
QAPP	Quality assurance project plan
O3	Ozone
SIPs	State implementation plans
SLAMS	State and Local Air Monitoring Station
SOP	Standard operating procedure
SO2	Sulfur dioxide
STN	Speciation Trends Network
SVOC	Semi-Volatile Compound
VOC	Volatile Organic Compound

Introduction and Regulatory Background

This document will serve as Rhode Island's 2020 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. The Annual Monitoring Network Plan must be posted for public comment 30 days prior to submittal to the EPA.

In addition, 40 CFR 58.10(d) requires each state to prepare an assessment of its monitoring network once every five years beginning in 2010. The second 5-year assessment was submitted to EPA on August 11, 2015. The 3rd 5-year assessment must be submitted to EPA by July 1, 2020. In its 5-year assessment, the state must determine whether its existing network meets required monitoring objectives, whether new sites are needed, whether any existing sites are no longer needed, and whether new technologies are available that should be incorporated into the network. The assessment must also consider "the ability of existing and proposed sites to support air quality characterization for areas with relatively high populations of susceptible individuals, (e.g. children with asthma)" and must identify shifts in the distribution of the population within the state which may necessitate changing the location of population-oriented monitoring sites.

This document will serve as both Rhode Island's 2020 Annual Monitoring Network Plan and Rhode Island's 5- Year Network Assessment.

Network Assessment

As required in 40 CFR Part 58.10(d), state air quality monitoring agencies must conduct a network assessment once every five years. The goals of this assessment are as follows:

- Determine if the network meets the monitoring objectives of 40 CFR 58 Appendix D.
- Determine whether new sites are needed.
- Determine whether existing sites are no longer needed and can be terminated.
- Determine whether new technologies are appropriate for incorporation into the ambient air monitoring network.

For the 2020 Network Assessment these criteria are evaluated below.

Does the Network meet the monitoring objectives of 40 CFR 58 Appendix D?

40 C.F.R. Part 58, Appendix D, requires that the ambient air monitoring network be designed to meet three basic monitoring objectives (in no specific order):

- Provide air pollution data to the general public in a timely manner. Data can be presented to the public in a number of attractive ways including through air quality maps, newspapers, Internet sites, and as part of weather forecasts and public advisories.

- Support compliance with ambient air quality standards and emissions strategy development. Data from [Federal Reference Method (FRM), Federal Equivalency Method (FEM), and Automated Reference Method (ARM) monitors] for NAAQS pollutants will be used for comparing an area's air pollution levels against the NAAQS. Data from monitors of various types can be used in the development of attainment and maintenance plans. SLAMS, and especially NCORE station data, will be used to evaluate the regional air quality models used in developing emission strategies, and to track trends in air pollution abatement control measures' impact on improving air quality. In monitoring locations near major air pollution sources, source-oriented monitoring data can provide insight into how all industrial sources are controlling their pollutant emissions.

- Support for air pollution research studies. Air pollution data from the NCORE network can be used to supplement data collected by researchers working on health effects assessments and atmospheric processes, or for monitoring methods development work.

The network described in this plan meets all the monitoring requirements in 40 CFR Part 58.

Are New Sites Needed?

The population in Rhode Island has been quite stable over the past 10 years. Annual estimates of county data performed by The United States Census Bureau from April 1, 2010 through July 1, 2019 indicate very minor shifts in population. The projected overall population of Rhode Island has increased by 0.65%. Several counties experienced a projected loss in population (Bristol, Kent, Newport, and Washington). Providence County was the only county with an estimated increase in population (1.96%) as compared to the 2010 census (see Table 1 below).

Table 1: Census Data

Annual Estimates of the Resident Population for Counties in Rhode Island: April 1, 2010 to July 1, 2019													
County	April 1, 2010		Population Estimate (as of July 1)										
	Census	Estimates Base	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Change
Rhode Island	**1,052,567**	**1,052,964**	**1,053,959**	**1,053,649**	**1,054,621**	**1,055,081**	**1,055,936**	**1,056,065**	**1,056,770**	**1,055,673**	**1,058,287**	**1,059,361**	**0.65%**
Bristol County	49,875	49,844	49,818	49,233	49,268	49,247	49,074	49,127	48,844	48,734	48,637	48,479	**-2.80%**
Kent County	166,158	166,109	166,030	165,278	164,627	164,358	164,490	163,747	163,711	163,543	164,053	164,292	**-1.12%**
Newport County	82,888	83,141	83,176	83,212	83,206	83,459	83,351	83,259	83,164	82,952	82,547	82,082	**-0.97%**
Providence County	626,667	626,781	627,838	629,393	631,229	631,584	632,668	633,747	634,922	634,130	636,953	638,931	**1.96%**
Washington County	126,979	127,089	127,097	126,533	126,291	126,433	126,353	126,185	126,129	126,314	126,097	125,577	**-1.10%**
Note: The estimates are based on the 2010 Census and reflect changes to the April 1, 2010 population due to the Count Question Resolution program and geographic program revisions. All geographic boundaries for the 2019 population estimates are as of January 1, 2019. For population estimates methodology statements, see http://www.census.gov/programs-surveys/popest/technical-documentation/methodology.html.													
Suggested Citation:													
Annual Estimates of the Resident Population for Counties in Rhode Island: April 1, 2010 to July 1, 2019 (CO-EST2019-ANNRES-44)													
Source: U.S. Census Bureau, Population Division													
Release Date: March 2020													

Note that 59% of the entire Rhode Island population resides in Providence County. Within Providence county, the cities of Providence, Pawtucket, and East Providence, all contain monitoring sites. Therefore, since there have been no major population shifts and the monitoring network is focused in the most populated area of the State, a change in the location of population-oriented monitoring sites is not warranted.

EPA Network Assessment Tool

In July 2019, EPA released a Network Assessment Tool to assist with the 5-year monitoring network evaluations, https://sti-r-shiny.shinyapps.io/EPA_Network_Assessment/.
The exceedance probability tool (Figure 1) mapped the probability of areas experiencing exceedances for Rhode Island using data from 2014-2016. Note the lobe of warm values and higher probabilities in Westerly (70-80%), with higher probabilities along coastal portions upwards in Narragansett Bay (40% or more, circled red), with lower probabilities in northern portions of the state (20%) and interior portions (30%). The higher coastal probabilities may not be adequately captured by the Narragansett monitor located approximately 10 miles up the Bay. This was part of the reasoning to expand ozone monitoring to East Matunuck as part of the Enhanced Monitoring Plan described later in this document.

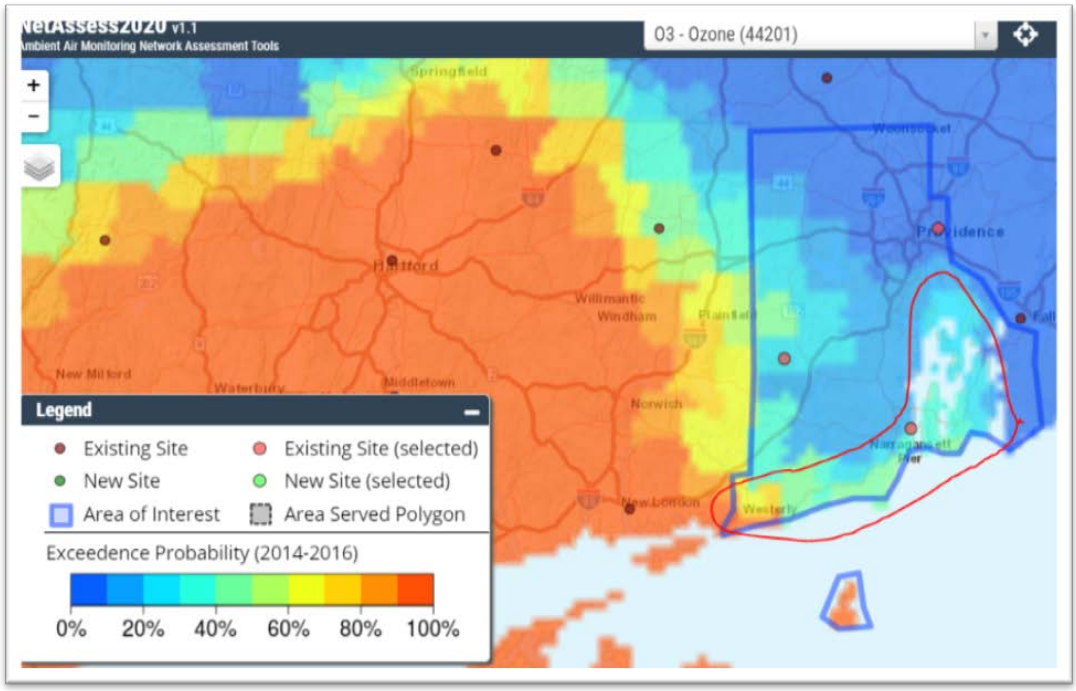


Figure 1: Exceedance Probability

The strategy for ozone monitoring in the remainder of Rhode Island has not changed. West Greenwich continuous to serve as the background monitor for transport, East Providence is downwind of the most densely populated urban environment in the state, Narragansett serves as a coastal monitor for southern portions of the state, and East Matunuck serves as an immediate coastal monitor. The EPA Network Bias Assessment tool was used to evaluate each monitor and the area served. Once again, this tool was used to evaluate for ozone, as Rhode Island continues to experience Design Values above the 2015 Standard. Regardless of the either positive or negative removal biases indicated by the EPA Network Assessment Tool, RIDEM does not intend to remove any of the existing sites, as they each serve a specific function to our monitoring objective.

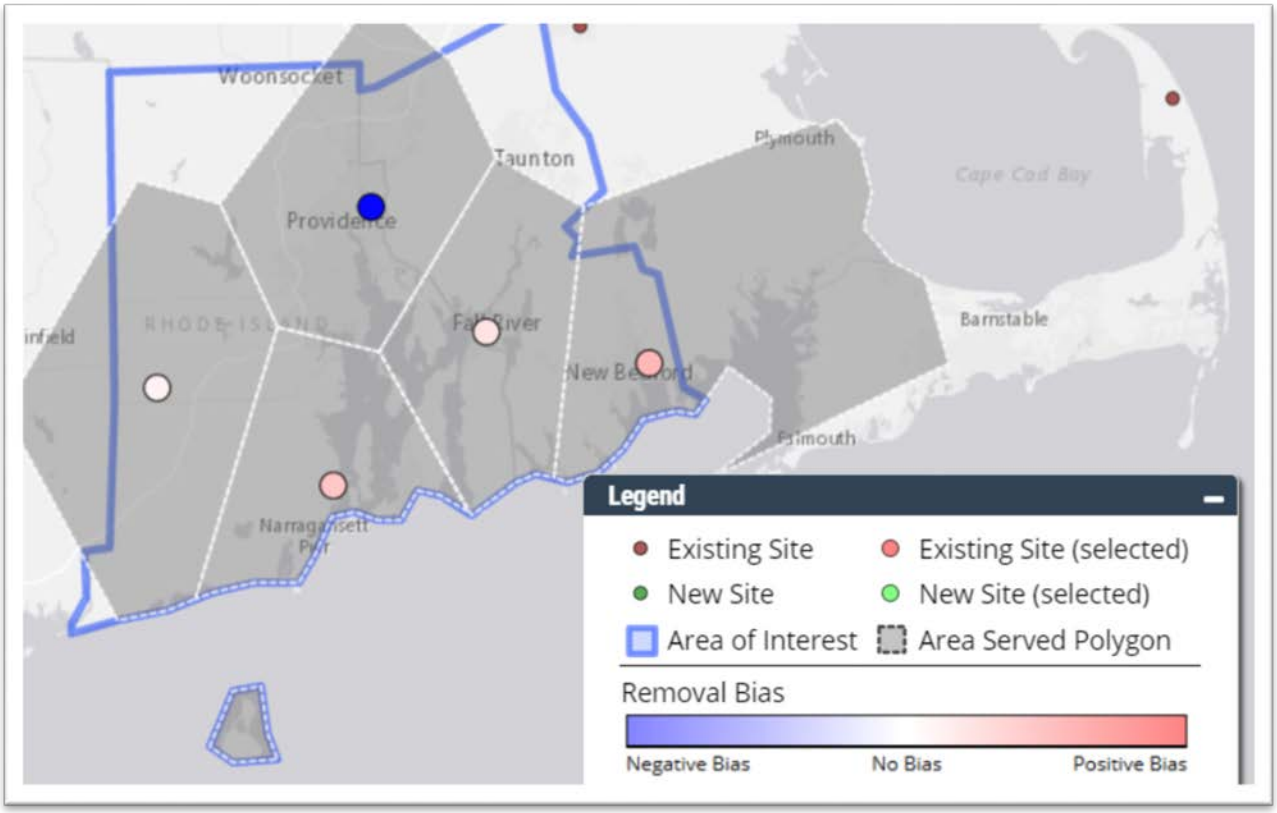


Figure 2: Removal Bias

Does the Network Adequately Characterize High Populations or Areas of Sensitive Groups?

40 CFR Part 58.10(d), requires 5-year assessments to evaluate whether the state's monitoring network adequately characterizes air quality in areas with high populations of susceptible people, such as children with asthma. The rate of emergency room visits for childhood asthma is considerably higher in Rhode Island's core cities; Providence, Pawtucket, Central Falls and Woonsocket, than in the State as a whole. The rate of pediatric asthma hospitalizations was also elevated in the core cities, as compared to the State average. Per RIDOH data, 10.9% of Rhode Island children have asthma, compared to 8.4% nationally, which is the 9th highest ranked in terms of states.

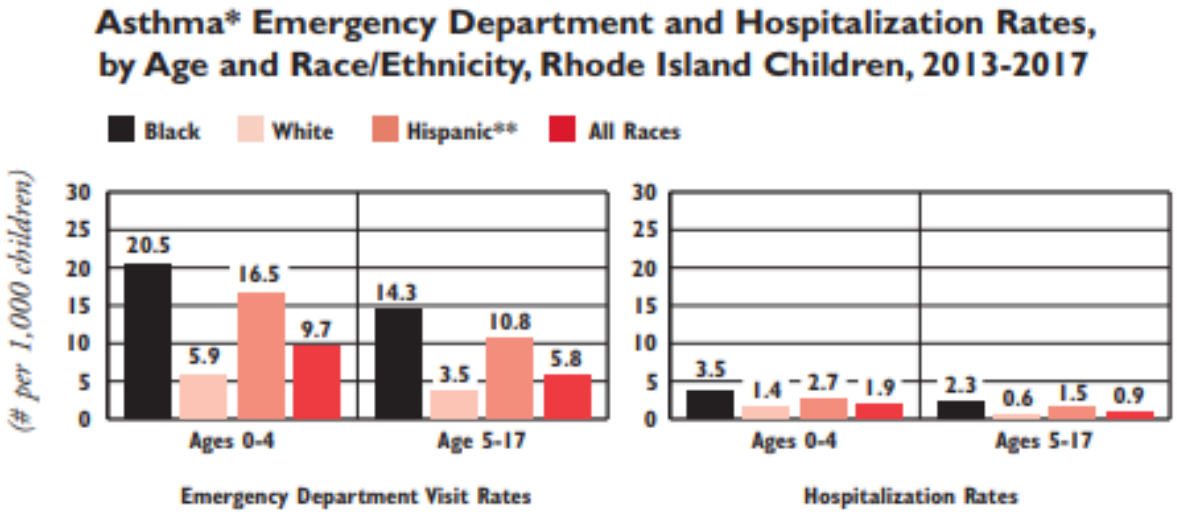
Asthma Emergency Department (ED) rates: Providence rate is 92% higher than statewide rate, and 3 times higher than noNCORE cities (outside Providence, Pawtucket, Central Falls, Woonsocket)

- Providence asthma ED rate: 13.3 per 1,000 children
- Statewide asthma ED rate: 6.8 per 1,000 children
- Remainder of state outside the four core cities: 4.3 per 1,000 children

Asthma Hospitalization rates: Providence rate is 75% higher than statewide rate, and 2.6 times higher than noNCORE cities (outside Providence, Pawtucket, Central Falls, Woonsocket)

- Providence asthma hospitalization rate: 2.1 per 1,000 children
- Statewide asthma hospitalization rate: 1.2 per 1,000 children
- Remainder of state outside the four core cities: 0.8 per 1,000 children
-

RIDOH reports asthma-related ED and hospitalization rates to RI KIDSCOUNT for the annual asthma indicator page. There are persistent racial and ethnic disparities in both ED and hospitalization rates for asthma. Depending on the age range, the ED visit rate for black children is 3.5 to 4 times higher, and for Latino children is 2.8 to 3 times higher than the ED visit rate for white children in Rhode Island.



Source: Rhode Island Department of Health, Hospital Discharge Database, 2013-2017; U.S. Census Bureau, Census 2010.
*Rates are for primary diagnosis of asthma. **Hispanic children can be of any race.

Figure 3: Asthma Hospital Rates

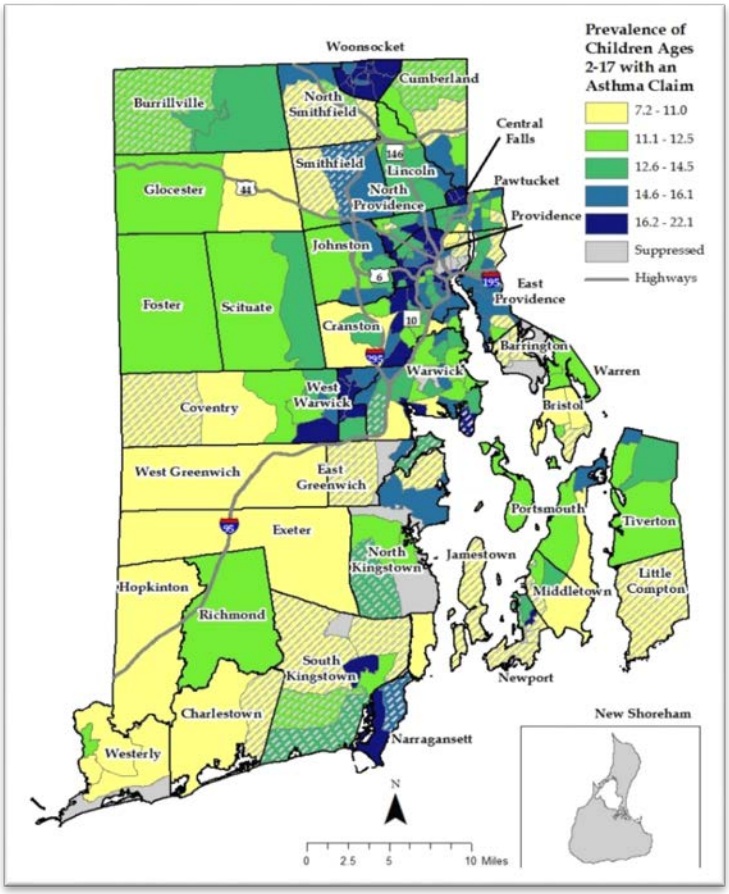


Figure 4: Asthma Rates

When looking at asthma prevalence rates in Medicaid data in children, the mapping reveals a clear burden centered around Providence. Some of the hot spots from the census data are also focused in communities with the highest population of persons of color.

Three of the core cities; Providence, Pawtucket, and Central Falls are contiguous. Those cities comprise 2.7% of the State's land area and 29% of the State's population. Providence County comprises of 59% of the overall state population. The rates of pediatric asthma emergency room visits and hospitalizations in those cities are elevated and the demographic profile of children in those cities is consistent with an increased asthma risk. Therefore, it is appropriate that much of the State's monitoring network is concentrated in that area. However, health data indicates an opportunity for higher resolution monitoring, i.e. the Port of Providence, as discussed in the next section.

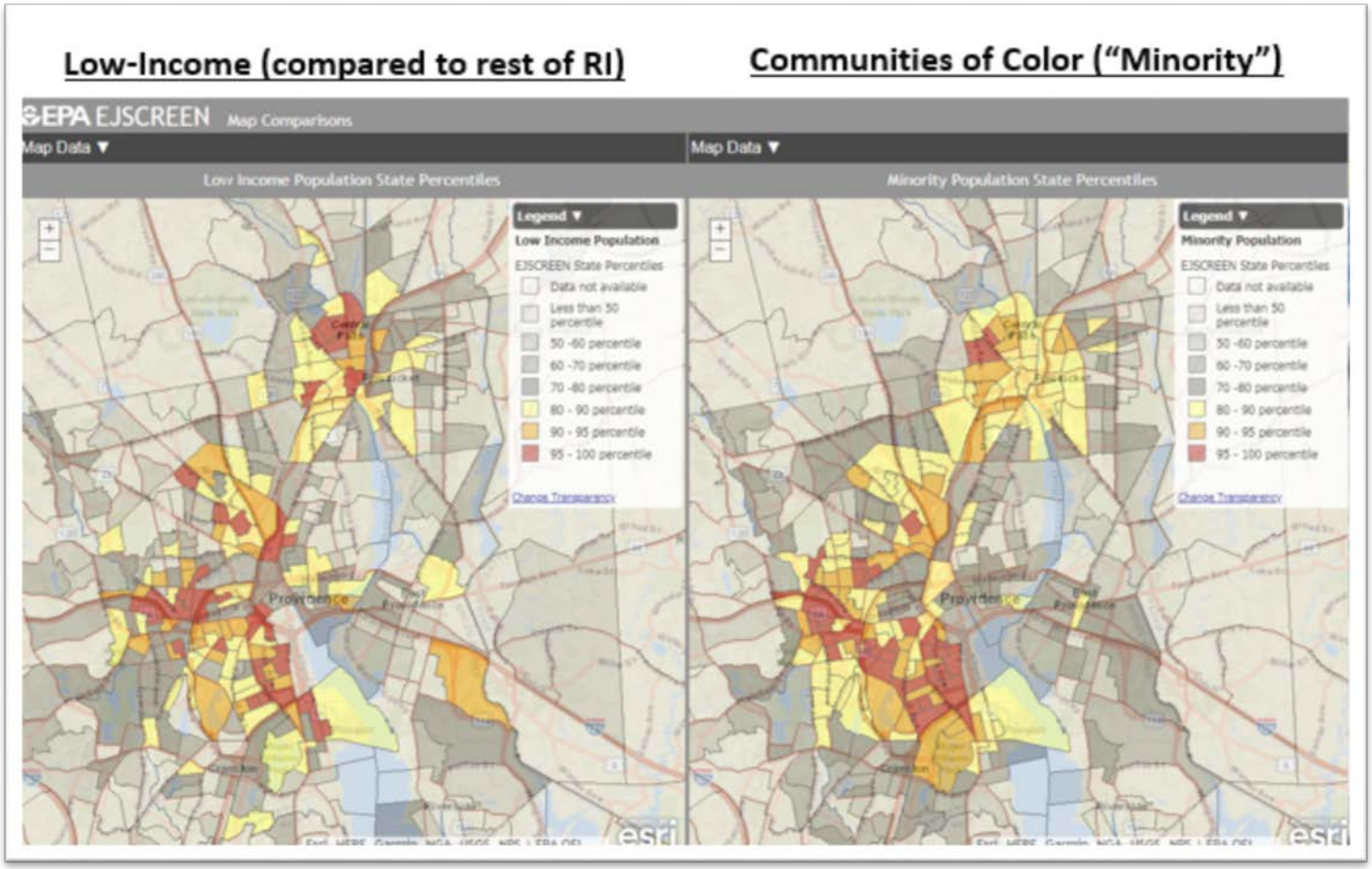


Figure 5: EJ Screen Tool Low-Income Population

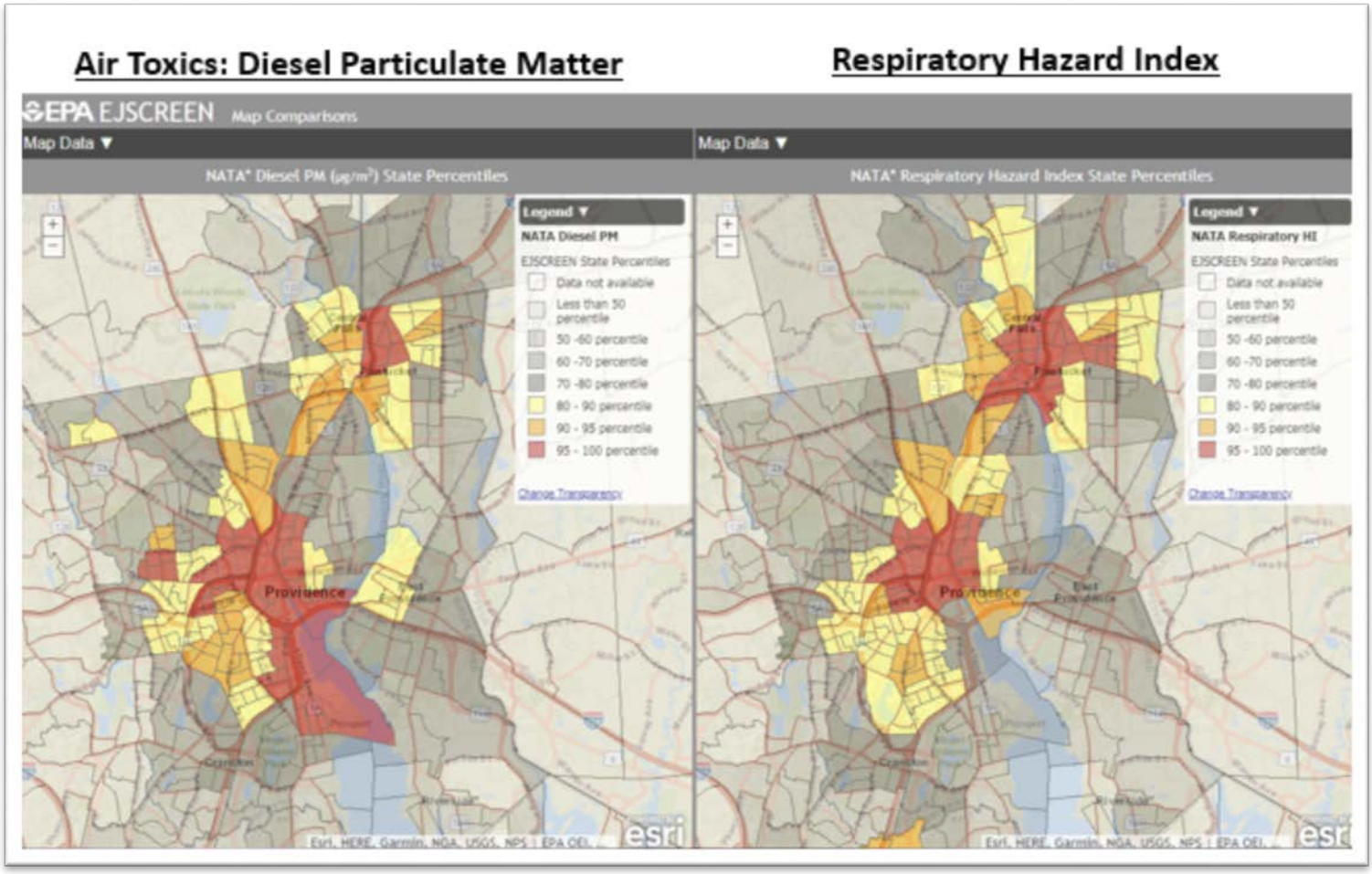


Figure 6: EJ Screen Diesel Particulate

Port of Providence

RIDEM has recently submitted a grant application for a 2020 Community-Scale Air Toxics Monitoring Grant (EPA-OAR-OAQPS-20-05). The proposed project would characterize air toxic emissions near the Port of Providence to characterize risk to the most highly impacted populations including surrounding environmental justice areas, residences, schools, and hospitals. Air quality near the Port is impacted by air pollution generated from diesel trucks, marine vessels, oil and gas storage and distribution, asphalt and cement processing, metals recycling, natural gas and utility service, and large heating plants. If awarded, the study will focus on volatile organic compounds, benzene and 1,3 butadiene found in diesel exhaust and petroleum products. *While funding for this study is not guaranteed, it is important to note that RIDEM is continuously seeking strategies to evaluate air quality in this Environmental Justice Area.*

If RIDEM is not awarded this grant, the intention is to conduct fine particle monitoring using low-cost sensors as part of a sampling plan around the Port of Providence. RIDEM has purchased 5 low cost Clarity Node sensors with intensions of monitoring in and around the Port of Providence

beginning late 2020, for a minimum of 1-year. *Exploratory monitoring data may reveal the need for full time intensive monitoring as part of the full Rhode Island monitoring network.*

Any Existing Sites No Longer Needed or Can Be Terminated?

As part of an effort to trim infrastructure cost and labor, EPA and RIDEM/RIDOH have been continuously working together for the past 3 years to discontinue equipment deemed no longer of value, no longer required, or redundant in the network. Please refer to prior years ANP summary pages for full information on discontinued monitoring equipment with reasoning behind each decision. Currently, there are no monitoring activities that RIDEM is seeking to discontinue.

Are There New Technologies to Incorporate into the Network?

RIDEM explores new technologies as part of specific monitoring objectives. Monitoring activities are exploratory as part of a broader assessment, but the equipment remains available for regular field use. While some of the equipment below is not part of the Network or FRM/FEM status, the equipment does provide valuable screening level data to assist in making decisions for Network changes.

Recent New Technologies Evaluated

The 2015 Rhode Island Community-Scale study was designed to definitively characterize air pollutant levels at sensitive receptors near I-95 in the Providence area, as well as the factors that influence those levels.

Both instruments below are handheld and were used to measure spatial variability of particle count and black carbon at receptors at set points away from the highway and are available for field use.

- Hand-held TSI 3007 Particle Counter
- MicroAeth portable aethalometers to measure Black Carbon

Sampling for PM2.5 at facilities has utilized newer citizen science technology.

- Met One Neighborhood Monitor – easily deployed and mounted nephelometer to measure PM 2.5 species with a cellular modem to push 15-minute data to a server with online access.

Recent New Technologies Deployed into the Network

In conjunction with EPA guidance, RIDEM and RIDOH are early adopters of newly required parameters and technologies. Below are some recent Network additions incorporating newer methods of monitoring.

- New continuous Gas Chromatograph for hourly VOCs deployed in 2017
- Vaisala CL51 Ceilometer deployed at the NCORE/PAMS site in East Providence in 2018
- True NO_2 at the NCORE/PAMS site in East Providence in 2018

Rhode Island Annual Monitoring Network

The Rhode Island Department of Environmental Management (RIDEM), in conjunction with the Rhode Island Department of Health (RIDOH), operate 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 (PM2.5), 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, RIDEM and RIDOH 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 PM2.5 Speciation Trends Network (STN), and one that is part of the network of core multipollutant monitoring stations (NCORE).

Table 2 summarizes the NAAQS and Table 3 lists the locations of the six air monitoring stations that operated in the State in 2019 and operate currently, along with the parameters monitored and methods. The locations of those sites are shown in Figure 27. 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:

[1] RI DEM and RI DOH, "QAPP for Criteria Pollutants Including Particulates and NCORE Parameters, Revision 1.0," approved by EPA October 2018, revised November 2019 and "QAPP: Air Toxics and PAMS Monitoring Programs, Revision 6.1," approved by EPA October 2018, revised November 2019.

- RIDEM has completed the move of the PM2.5 FEM monitor and NATTS monitoring activities from the Urban League building to the Community College of Rhode Island (CCRI) location.

- Per RIDOT, the highway construction activity to the northbound side of I-95 is tentatively expected to begin late 2020. RIDEM will discontinue monitoring at the current Near-Road site at the corner of Park and Hayes and relocate to the approved Near-Road monitoring site. Details on the newly approved Near-Road location are contained later in this report.

- 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 once again deployed a 2B Ozone monitor, on loan from EPA, at East Matunuck with the goal of meeting AQS siting criteria.

- The Vernon Street, Pawtucket PM_{10} monitor adjacent to I-95N was discontinued at the end 2019 and relocated to the East Providence site

- RIDEM has installed the Vaisala CL51 Ceilometer and Direct/True NO_2 at the NCORE/PAMS site in East Providence as required by the PAMs program.

- RIDEM intends to establish communication with University Maryland Baltimore County (UMBC) to push ceilometer data to their server, which houses a national network of publicly available ceilometer data.

RIDEM 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.

Table 2: National Ambient Air Quality Standards (NAAQS)

POLLUTANT (links to historical tables of NAAQS reviews)	AVERAGING TIME	PRIMARY STANDARD	SECONDARY STANDARD
Sulfur Dioxide (SO_2)	3-Hour[A]	None	0.5 ppm (1300 µg/m³)
	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 (O_3)	8-Hour[C]	0.070 ppm (70 ppb)	Same as Primary Standard
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean	0.053 ppm (53 ppb)	Same as Primary Standard
	1-Hour[D]	100 ppb	None
Particulate Matter (PM_{10})	24-Hour[E]	150 µg/m³	Same as Primary Standard
Particulate Matter ($PM_{2.5}$)	Annual Arithmetic Mean[F]	12.0 µg/m³	15.0 µg/m³
	24-Hour[G]	35 µg/m³	Same as Primary Standard
Lead (Pb)	Rolling 3-Month Average[H]	0.15 µg/m³	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 SO_2 NAAQS and promulgating a new 1-hour SO_2 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 SO_2 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 NO_2 NAAQS, effective January 22, 2010, the 3-year average of the 98th percentile of the daily maximum 1-hour average NO_2 concentration at each monitor must not exceed 100 ppb.

[E] To attain the PM_{10} 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 PM2.5 NAAQS was revised on December 10, 2012. The secondary NAAQS was not changed. To attain the PM2.5 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 PM2.5 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 3: Monitoring Site Information

The ambient air monitoring sites currently operated by RIDEM and RIDOH are listed in the Table 3 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													
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	S	X	X	X	X	X	S	S	S
Providence	CCRI			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								

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
South Kingston	East Matunuck										S																			

X = Existing
S= Seasonal (June 1-August 31)
S= Seasonal (March 1 – September 30)
* Includes metals
** Includes collocated metals 1:12

Table 3: (Continued) Monitoring Site Information

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
			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

Site	AQS ID	Latitude Longitude	Parameter Measured	Method Of Sampling	EPA Method Designation
			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
CCRI Liston Campus 1 Hilton Street Providence	440070022	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

Site	AQS ID	Latitude Longitude	Parameter Measured	Method Of Sampling	EPA Method Designation
			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
East Matunuck State Beach Pavilion 950 Succotash Road South Kingston	440090008	41.377451 -71.524852	Ozone	U.V. Photometric	Equivalent

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 shown on Figure 24 which includes all gaseous monitors.

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
East Matunuck State Beach Pavillion 950 Succotash Road, South Kingstown	Regional	Upwind background Population exposure	Continuous Ozone Season March-September

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. The final 2019 design values did not change for East Providence and Narragansett but dropped 2 ppb for West Greenwich.

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
2017- 2019	71	69	73

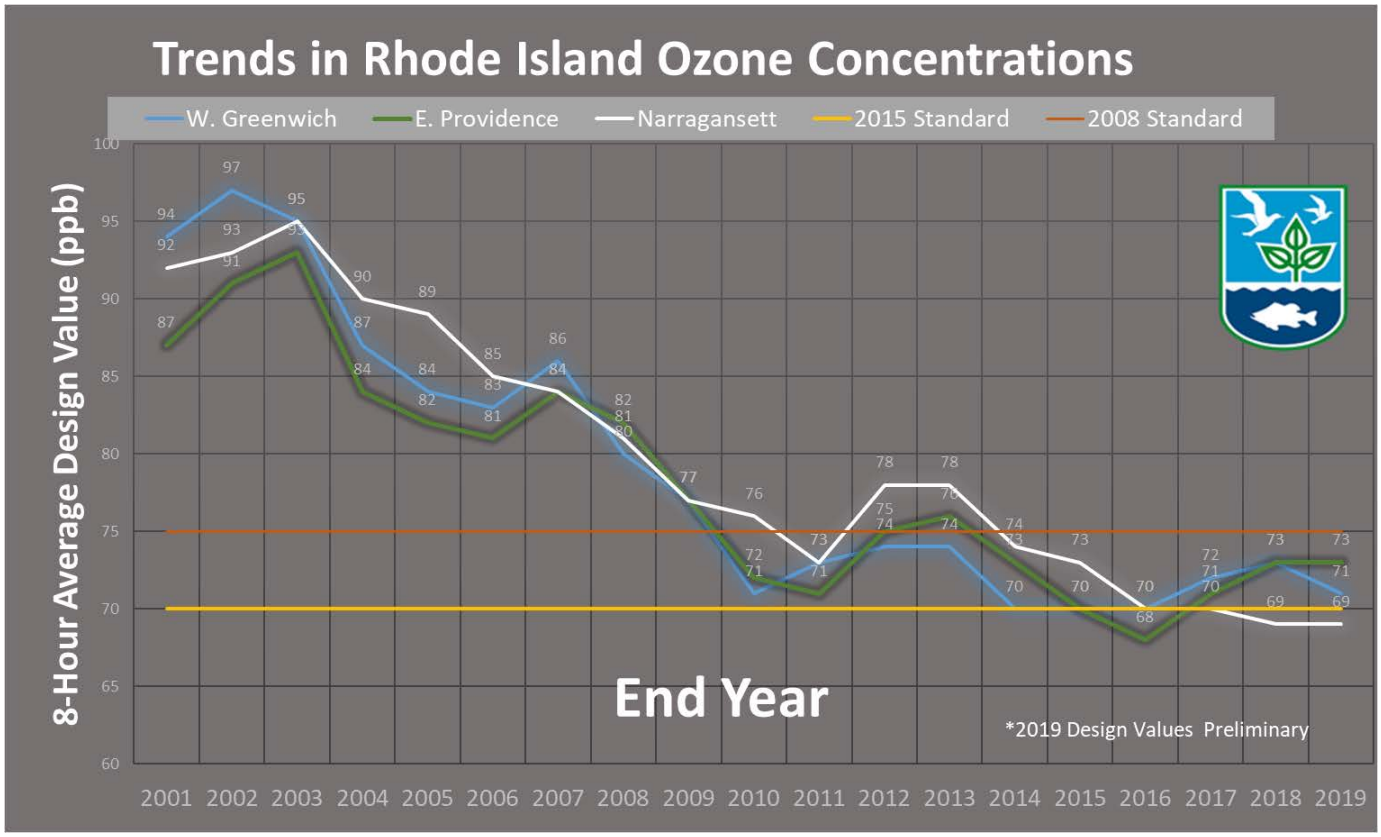


Figure 7: Ozone Trends 2001-2019

Since EPA's rules require Rhode Island to operate at least two ozone monitors, the State has two more monitors 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.
- The four 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 four 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.
- The newly deployed East Matunuck site may provide critical information on transport of ozone along Long Island Sound corridor and the immediate coastline.

As part of RIDEM's EMP, additional ozone monitoring will again be conducted during 2020 as described in the EMP section of this plan.

Carbon Monoxide (CO)

The current CO monitoring network is listed in Table 6 and shown on Figures 8 and 12.

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 2018

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

Near Road 2019:

- 2.3 ppm – 1-hour average, 6.3 % of NAAQS
- 1.7 ppm – 8-hour average, 18.9 % 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

East Providence 2019:

- 1.6 ppm – 1-hour average, 4.5% % of NAAQS
- 0.8 ppm – 8-hour average, 8.9 % 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 levels[2]. 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.

[2] US 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 (SO_2)

The current SO_2 monitoring network is listed in in Table 7 and shown on Figure 8.

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 SO_2 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 SO_2 design value (2016 – 2018) in Rhode Island is as follows:

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

The 2019 SO_2 design values (2017 – 2019) in Rhode Island are:

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

The SO_2 NAAQS has never been exceeded in the State. One-hour design values for SO_2 have been below 75 ppb, the one-hour NAAQS promulgated in 2010[3], since 1994. All measurements have been in the "Good" range of the AQI since 2007. SO_2 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 SO_2 monitoring only at NCORE sites. However, the 2010 SO_2 NAAQS rule requires at least one SO_2 monitor in the Providence-New

[3] An EPA rule amending the SO_2 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.

Bedford-Fall River RI, MA MSA, which includes all of Rhode Island and Bristol County, Massachusetts. That SO_2 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 SO_2 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 SO_2 concentrations in the MSA, as it is situated 2 miles southeast of the Brayton Point coal fired power plant, which was the highest SO_2 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 (NO_2)

The current NO_2 monitoring network is listed in Table 8 and shown on Figures 8 and 16.:

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

The NO_2 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 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 design values for 2017-2019 are:

- 50 ppb – 1-hour average, 50 % of NAAQS – Near Road
- 39 ppb – 1-hour average, 39 % - East Providence

The annual averages for 2019 are:

- 17 ppb annual average, 32 % of NAAQS – Near Road
- 7 ppb annual average, 13 % of NAAQS – East Providence

The NO_2 NAAQS have never been exceeded in Rhode Island. Since there was no short-term NAAQS for NO_2 until the standard was amended in 2010, this pollutant was not used for the Air Quality Index (AQI) before that date. The amended NO_2 NAAQS rule, which was published on February 9, 2010, establishes hourly concentrations of 54 -100 ppb as the range for a "Moderate" AQI[4].

The 2010 amended NO_2 NAAQS requires Rhode Island to operate two NO_2 monitoring sites, one at "a location of expected highest NO_2 concentrations representing the neighborhood or larger spatial scales" and a second monitor at a near-road location where maximum microscale-representative concentrations are expected.

The East Providence location fulfills the neighborhood monitoring scale for NO_2 and operates year round to fulfill the neighborhood or larger spatial scale requirements. To fulfill PAMS requirements, Direct/True NO_2 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 NO_2/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 2020, at which time the monitoring site will be relocated to a site approved by EPA, located along Route 95 south of the existing site.

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

Particles smaller than 10 microns (PM10)

The current PM_{10} monitoring network is listed in Table 9 and shown in Figure 26:

Table 9: PM_{10} 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 PM_{10} NAAQS is:

- 150 µg/m^3 – 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 24-hour average value for PM_{10} recorded at a Rhode Island site for the past 3 years is:

2017 38 µg/m^3 – 24-hour average, 25 % of NAAQS, recorded at Vernon St.
2018 79 µg/m^3 – 24-hour average, 53 % of NAAQS, recorded at Vernon St.
2019 41 µg/m^3 – 24-hour average, 27 % of NAAQS, recorded at Vernon St.

The PM_{10} NAAQS has never been exceeded in Rhode Island. Since PM_{10} 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. PM_{10} levels appear to have slightly decreased over the past decade.

PM_{10} is measured at the East Providence NCORE site every sixth day using a lo-vol sampler. The PM_{10} 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 PM_{10} concentrations below 80% of the NAAQS, to operate a minimum of 2 - 4 PM_{10} monitoring sites.

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

The Vernon St., Pawtucket site, adjacent to I-95, characterizes the highest PM_{10} concentrations in the RI. Although Vernon experiences the highest PM_{10} values, at no point has the site approached the standard. As RIDEM continually seeks options for cost and workload savings, RIDEM discontinued PM_{10} monitoring at Vernon Street at the end of 2019. The two remaining PM_{10} monitors will adequately characterize exposure of the sensitive populations in urban areas to PM_{10} and fulfill the minimum monitoring requirement of the MSA.

Fine Particulate Matter (PM2.5)

The current Federal Reference Method/Federal Equivalent Method (FRM/FEM) $PM_{2.5}$ monitoring network is listed in Table 10 and shown on Figure 25:

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

SITE	MEASUREMENT SCALE	MONITORING OBJECTIVE	SCHEDULE
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/m^3 - 24-hour average (design value is the 3-year average of the 98th percentile 24-hour concentration)
- 12 µg/m^3 - 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 2019 are:

- 28 µg/m3 – 24-hour average, 80 % of NAAQS, recorded at Near Road.
- 8.5 µg/m3 – annual average, 71 % of NAAQS, recorded at Near Road.

Table 11: Design values for $PM_{2.5}$

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

SITE	24 hour DV 2015-2017	24 hour DV 2016-2018	24 hour DV 2017-2019	Annual DV 2015-2017	Annual DV 2016-2018	Annual DV 2017-2019
Vernon Vernon Street Pawtucket	18	16	15	7.1	6.7	6.4
CCRI Liston Campus** 1 Hilton Street Providence	15	16	16	6.4	6.3	5.9
Myron Francis School 64 Bourne Avenue E. Providence	17	17	16	6.7	6.7	6.3
Alton Jones Victory Highway West Greenwich	13	14	13	4.8	5.0	4.9
USEPA Laboratory 27 Tarzwell Drive Narragansett	15	15	14	5.7	5.1	4.8
Near Road Site Hayes and Park Streets Providence	20	19	18	9.1	8.8	8.5

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 (now CCRI) 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. As discussed previously it is anticipated that the Near -road site will be relocated to a new EPA approved site in late 2020. RIDEM relocated the Urban League monitor to the Community College of Rhode Island, Liston Campus in June 2019. 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. 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.

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 $PM_{2.5}$. Per NCORE requirements, the speciation equipment, including the carbon sampler, has been in operation at 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.

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. The NCORE site located at Francis School in East Providence continues to 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 13.

The following PAMS pollutant will be monitored for the upcoming 2020 PAMs season:

- The NCORE site located at Francis School in East Providence serves as the PAMS site and will measure parameters described below.

- 24-hour speciated VOC samples are collected every sixth day year-round at the Alton Jones and East Providence sites, VOC samples are 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 2020 at East Providence. A complete list of the targeted compounds are found in Table 12. For 2020, hourly speciated VOC measurement continue to be measured with an auto-gas chromatograph (GC) using Chromatotec GC 866 Airmo VOC.

- 24-hour carbonyl samples are collected every sixth day year-round at the East Providence site using an ATEC 8000 Sampler. Three 8-hour carbonyl samples per day are collected every third day during June, July and August for 2020. A complete list of the target carbonyl compounds may be found in Table 12. The TO-11A test method, as used in the National Air Toxics Trends (NATTS)[5] program will be used.
- Rhode Island has measured reactive nitrogen oxides (NO and NO_y) at East Providence since January 2011 to fulfill NCORE requirements. NO_x is also measured year-round at the MA DEP site in Milton, MA. New EPA regulations required NO, NO_y, true NO_2 and mixing height measurements at required PAMS sites during the ozone season. True NO_2 and mixing heights were measured for 2019 and will continue for 2020. True NO_2 is measured by cavity attenuated phase shift (CAPS) spectroscopy with a Teledyne API T500U. NO and NO_y is measured using a Thermo 42iY.
- Ozone is 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 West Greenwich, Narragansett, and East Providence year-round.

- RIDEM continues 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 was installed at East Providence in 2019.

[5] See NATTS Technical Assistance Document for TO-11A method

Table 12: 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

Priority Chemical Parameters (Required)	AQS Parameter Code	Compound Class	Optional Chemical Parameters	AQS Parameter Code	Compound Class
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-diethlybenzene	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

Priority Chemical Parameters (Required)	AQS Parameter Code	Compound Class	Optional Chemical Parameters	AQS Parameter Code	Compound Class
			carbon tetrachloride	43804	halogenated
			Ethanol	43302	alcohol
			Tetrachloroethylene	43817	halogenated

Table 13: 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-NO2-NOx Analyzer	Thermo	42ITL
Sulphur Dioxide analyzer	Thermo	43ITLE
Caron 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-NOy 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

NAME	Manufacturer	Model
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

Enhanced Monitoring Plan Update

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.

During prior PAMs seasons, the ozone analyzer did not meet EPA siting criteria and the data did not meet EPA AQS criteria. For the 2020 season, RIDEM is attempting to have the 2B Analyzer meet regulatory grade monitoring by tracking operating temperature, performing required calibration checks, and having established proper inlet configuration outside the lifeguard tower.

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.

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 (PM_{10})
- Arsenic compounds (PM_{10})
- Cadmium compounds (PM_{10})
- Manganese compounds (PM_{10})
- Beryllium (PM_{10})

Semi-Volatile Organic Compounds (SVOC)

- Benzo(a)pyrene
- Napthalene

VOCs, carbonyls and PM_{10} 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.

As part of an EPA initiative to characterize Ethylene Oxide (EtO) concentrations as part of a national network for sites away from known sources of EtO, measurement of this toxic and

known carcinogen began at the CCRI NATTS site in January 2020. Previous national monitoring efforts in 2018-2019 showed measurable EtO readings away from known sources. The goals of this effort are to increase national analytical capacity of EtO, to support analysis of local monitoring programs, to determine seasonal variability and sources of EtO, and to determine persistence in the atmosphere. 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
- Accessing 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 NO_2/NO_x, reactive oxides of nitrogen (NO and NO_y), low-range CO, low range SO_2, $PM_{2.5}$ (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 PM_{10} and lo-vol $PM_{2.5}$ concentrations. True NO_2 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.

Table 14: Myron Francis School – East Providence

Myron Francis School – East Providence			
County	Providence	Latitude	41.840954°
Address	64 Bourne Avenue	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		
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'.			
Monitoring Objectives: To collect long term measurements to assess trends as part of the national NCORE and PAMS Networks.			
Planned changes for 2020-2021: None			

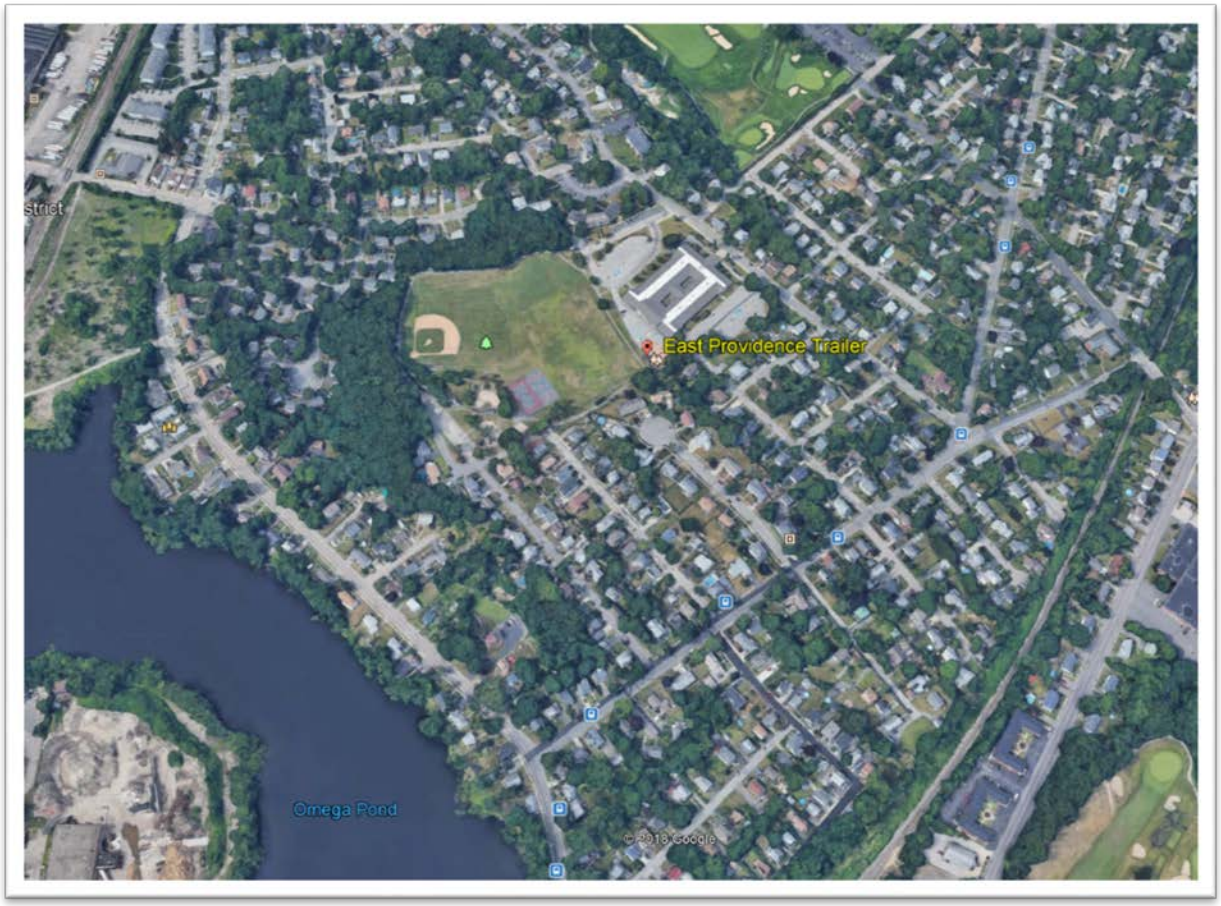


Figure 8: East Providence Location

Figure 9: East Providence Monitoring Trailer

Table 15: W. Alton Jones Campus – West Greenwich

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		
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.			
Monitoring Objectives: To collect long term measurements to assess transport into the Rhode Island as part of the SLAMS and State Toxics networks.			
Planned changes for 2020-2021: The future for this property of the University of Rhode Island has some uncertainty, as portions of the campus has been closed. If RIDEM must relocate this monitoring site, considerations will be made for moving to East Matunuck or Misquamicut State Beach in Westerly.			

Figure 10: W. Alton Jones Monitoring Location

Figure 11: W. Alton Jones Monitoring Site

Table 16: US EPA Lab - Narragansett

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		
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.			
Monitoring Objectives: To collect long term measurements to assess trends in Rhode Island as part of the national SLAMS network.			

Figure 12: Narragansett Monitoring Location

Figure 13: Narragansett Monitoring Shelter

Table 17: CCRI Liston Campus - Providence

Providence – CCRI Liston Campus			
County	Providence	Latitude	41.807523°
Address	1 Hilton Street	Longitude	-71.413920°
AQS Site ID	440070022	Elevation	75 feet
Spatial Scale	Neighborhood	Year Established	1999 (Urban) 2019 (CCRI)
Statistical Area	Providence, New Bedford, Fall River, RI-MA Metropolitan Statistical Area		
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.			
Monitoring Objectives: The CCRI monitoring site objective is to collect air quality measurements to assess long-terms trends as part of the SLAMS and NATTS network.			

Figure 14: Providence- CCRI Monitoring Location

Table 18: Vernon St - Pawtucket

Pawtucket – Vernon Street			
County	Providence	Latitude	41.874683°
Address	Vernon Street	Longitude	-71.379936°
AQS Site ID	440070026	Elevation	82 feet
Spatial Scale	Middle	Year Established	2001
Statistical Area	Providence, New Bedford, Fall River, RI-MA Metropolitan Statistical Area		
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.			
Monitoring Objectives: to collect air quality measurements to assess long-terms trends as part of the national SLAMS and Toxics network.			

Figure 15: Pawtucket Monitoring Location

Table 19: Providence – Near -Road

Providence – Near Road			
County	Providence	Latitude	41.829523°
Address	Hayes and Park St	Longitude	-71.417584°
AQS Site ID	440070030	Elevation	50 feet
Spatial Scale	Microscale	Year Established	2014
Statistical Area	Providence, New Bedford, Fall River, RI-MA Metropolitan Statistical Area		
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.			
Monitoring Objectives: To collect near road air quality measurements to assess long-terms trends as part of the Near Road Network.			
Planned changes for 2020-2021: RIDEM is actively in communication with RIDOT for the anticipated beginning of the I-95N viaduct construction. A tentative location has been established.			

Figure 16: Providence Near-Road Monitoring Location

Figure 17: Providence Near-Road Site

The current RIDEM/RIDOH Near Road monitoring station began operating in April 2014. The site is positioned along a segment of I-95 with the highest AADT traffic counts. Monitoring began in April of 2014. Additionally, RIDOT speed profile data from 2012 indicated the current segment experienced some of the highest congestion profiles in the state.

It was known at the time of construction of the current Near Road location, that once the I-95 South viaduct bridge was completed, at some point the northbound bridge construction would take place and force the relocation of this Near Road location. We are now required to move the Near Road monitoring site as noted below.

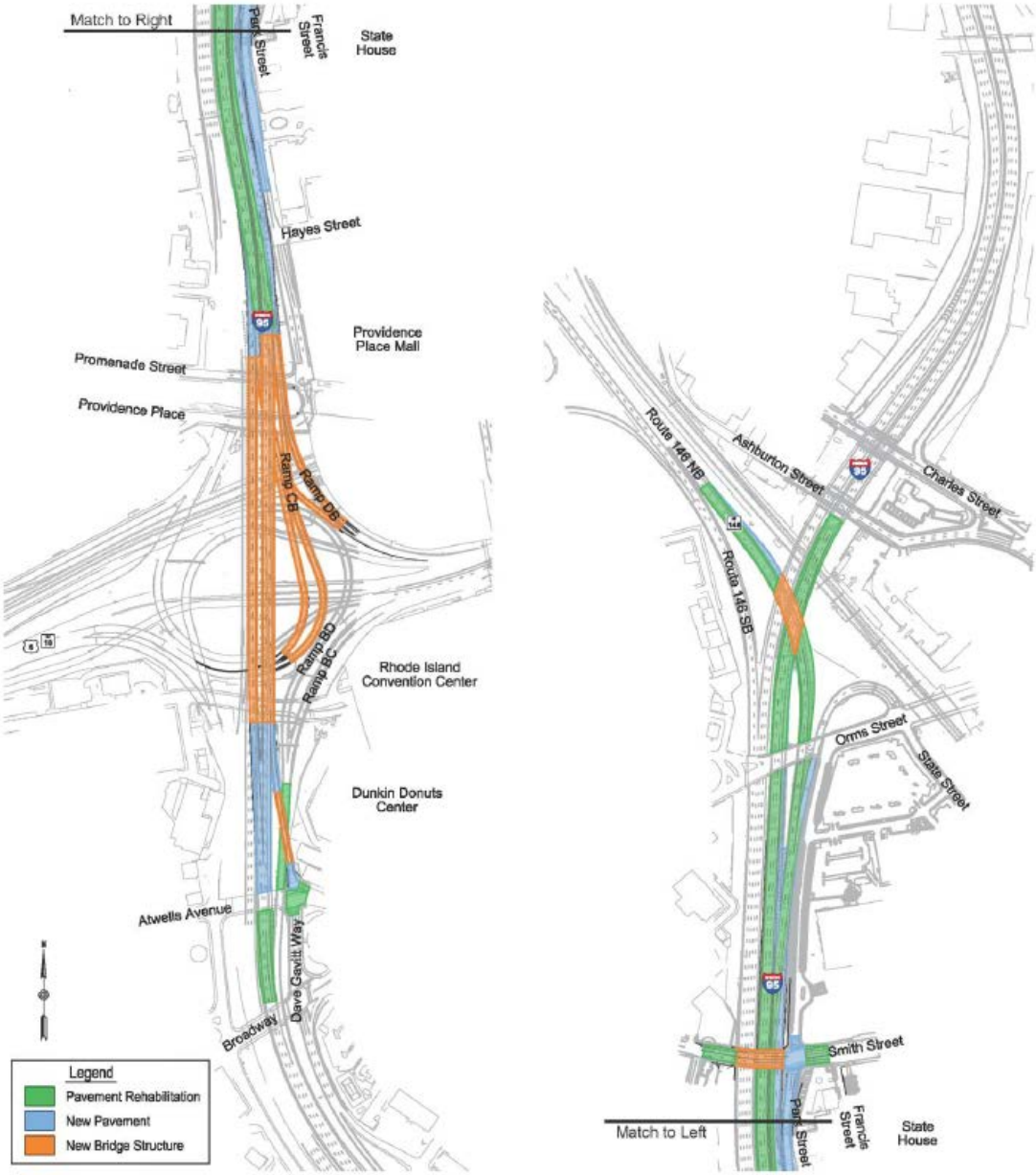
Per RI Department of Transportation (RIDOT):

The Providence Viaduct Northbound Project will include integral access facility improvements that will serve to remedy critical deficiencies in the existing freeway network. The following elements of the project design will, upon completion, significantly reduce congestion, travel times, and the frequency (and severity) of vehicle collisions throughout the system:

A new collector-distributor (C-D) road will be constructed along the easterly, right side the new Viaduct Northbound structure, effectively eliminating the weaving conflicts and congestion that presently afflict the segment of I-95 Northbound from the 6/10 Connector (and Downtown) on-ramp at Exit 22 to the State Route 146 (and Orms Street / State Offices) offramp at Exit 23. The construction of this C-D road and reconfiguration of ramp facilities will effectively disentangle these conflicting movements, improving motorist safety and comfort, reducing congestion and delay, and providing new, efficient connections between the arterial freeway facilities of I-95, the 6-10 Connector, and State Route 146.

In summary, a new collector/distributor road will be constructed over the top of the current Near Road location, as indicated in Figure 18. The Near Road site is just north of Hayes Street and will be paved over (see blue road labeled “New Pavement”). Per the current agreement for property usage, RIDEM/RIDOH is required to vacate the property within 60 days of notice. Per Anthony Pompei, P.E., PMP, Project Manager for the I-95 N Viaduct project, RIDOT expects a notice to proceed sometime late 2020. However, RIDEM would like to have the new Near Road station relocated by that time. RIDOT has preliminarily stated they will be providing some assistance for that move.

http://www.dot.ri.gov/accountability/docs/2017-2018_INFRA_Providence_Viaduct_North.pdf



Design concept for Viaduct replacement, new C-D road, and I-95 Northbound ramp modifications.

Figure 18: Highway Considerations

Near Road Providence – Future Site

Traffic Volume

The Rhode Island Division of Statewide Planning provided 2015 AADT (Annual Average Daily Traffic) data by ranked segment. In Table 20 below, the segments are ranked by traffic count. The ID's indicate the stretch of highway as labeled on the map in Figure 19. The number 1 ranked site is where our current Near Road site is located.

The 2nd highest and 3rd highest traffic count segments are the stretch between Route 37, Jefferson Boulevard, and Route 10, where the Near Road site is proposed to be situated. See the red segments #12 and #13 (Figure 19). Per Benjamin Jacobs, Principal Research Technician at RI Division of Planning, segments #12 and #13 are divided because they cross town lines but are the same segment. Of the remaining top 10 segments (4-10), only the 4th ranked segment is located at highway level with open space (ID #5). However, that stretch of I-95 is heavily forested with no access points, RIDOT properties, or siting options. The remaining segments (5-10) have a variety of flaws including both elevated or sunken highway, are along bridges, private land, or are inaccessible.

Table 20: 2015 AADT HPMS DATA

Rank	Beginning	End	Segment Length	Traffic Count	ID	I-95 Description
1	36.970	37.200	0.230	184616	19	Route 6 to 146
2	31.520	31.938	0.418	174938	12	Route 37 to Route 10 Warwick
3	31.938	33.570	1.632	174938	13	Route 37 to Route 10 Cranston
4	26.987	27.767	0.780	174731	5	117 to I-295 Split
5	37.200	37.400	0.200	171707	20	6/10 Merge
6	1.030	1.280	0.250	170767	40	I-195 Bridge 1
7	35.805	36.690	0.885	167639	17	I-195 and I-95 merge
8	36.690	36.970	0.280	167639	18	I-95/I-195 merge to exit 22
9	0.810	1.030	0.220	165030	39	I-195 Bridge 2
10	35.340	35.805	0.465	163411	16	Eddy Street exit to I-195 split

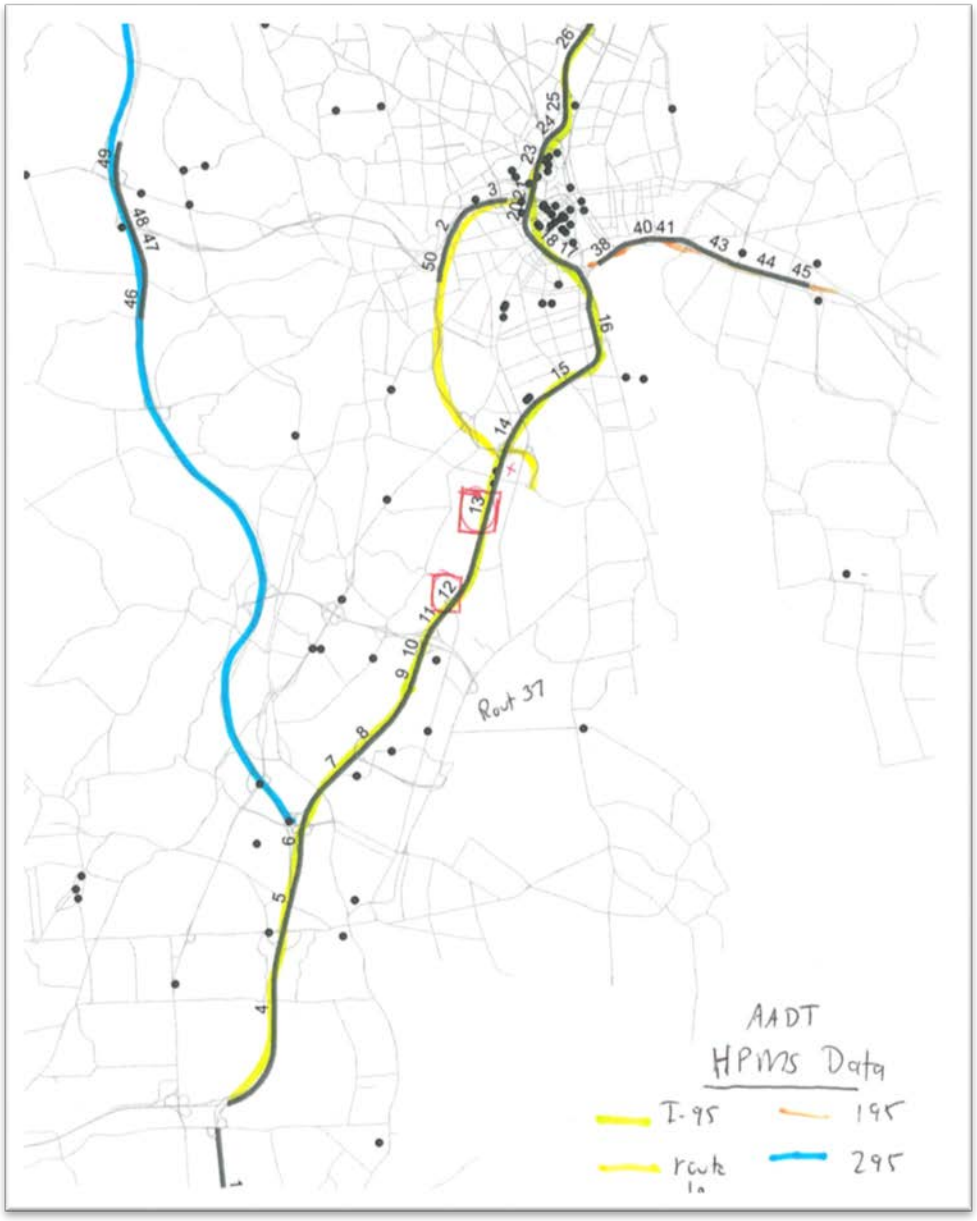


Figure 19: Traffic Count Data

Roadway Congestion and Fleet Mix

Congestions maps were provided by Benjamin Jacobs in Planning. The maps were uploaded to the EPA SharePoint site located in the Rhode Island/Public Folder/5-Year Network Assessment folder. Please refer to those maps in reference to the following paragraph.

The congestion maps on the SharePoint site show the stretch between Route 37 (road colored white connecting I-95 to I-295) and Route 10 (Cranston) experience significant congestion both during morning rush hour (8AM) and afternoon/evening rush hour (4PM), as indicated by the

color-coded travel time index (red). Four months of the year were chosen and indicate slow-down during weekdays when traffic patterns are the busiest and most predictable.

According to Rhode Island Motor Vehicle System (RIMS) at the beginning of June 2019 there were roughly 766,000 light duty vehicles, and 39,000 heavy duty diesel vehicles (5% of overall fleet) registered in Rhode Island. This however does not give an accurate count of how many vehicles pass through RI highways daily. RI has a series of permanent traffic counting stations that record and count the daily traffic traveling on the highways that record much higher numbers than what is registered in the state. A study was done in cooperation with the US DOT and FHA in 2016 that recorded as high as 1.48 million daily vehicles traveling on a section of I-95 in the Cranston area. This shows that I-95 is a heavily used route for more than just Rhode Island residents and includes a large percentage of diesel vehicles traveling in the state.

Near Road Site Physical Considerations

The EPA Technical Assistance Document (TAD) for near road site selection indicates the site should be level with the roadway. This restriction greatly limits possible sites in the Providence area. Much of I-95 segments with high AADT counts is elevated or is below grade with steep embankments and complex terrain. Land use and safety restrictions also discounts many possibilities, as other locations are not accessible, are developed, forested, or do not have high enough traffic counts.

RIDEM was granted tentative approval for the selected location during November 2019. The proposed site is a RIDOT property near the gantry in Cranston that meets the physical criteria. The open grassy area sits at highway grade along an approximately 0.25 miles stretch of highway that is level to the surrounding terrain. The shelter would ideally sit within 5-10 meters from the outside edge of traffic lanes. There are no roadside barriers, high structures, thick vegetation, sound walls, or complex terrain. The east side of the highway is very open, while the west side has very slight elevation and some larger trees. Additionally, Doric Park, a City of Cranston park that is very heavily used for recreation is directly across from the proposed site on the west side of the highway. The basketball courts are less than 100 feet from I-95 S and the soccer field and track are approximately 200 feet from the highway. Collecting data at this site would be valuable for studying potential impacts in this community.

Per RIDOT, there is no construction planned in this area.

The photo below (Figure 20) is facing west from Wellington Avenue on the I-95N side of the freeway. Across the highway is Doric Park. The grassy area is where RIDEM will be placing the shelter.

Figure 20: Preliminary location of new Near-Road site

A playground is situated about 300 feet from the highway. To the north and south of the park are residential neighborhoods. The east side of the highway is commercial use, with the closest businesses a roofing supply company and moving/storage facility. There are no large structures (all about 1 to 1.5 stories) across Wellington Avenue, which is a 2-way, 2 lane road.

Meteorology

The location is oriented very similarly to the current Near Road site, with a SSW to NNE orientation. The current site is just very slightly more northerly oriented. Therefore, the newly proposed site is down wind of the target road segment. It is known that the predominant flows in that region have a westerly component year-round as can be seen from 5-year wind rose for TF Green for 2013-2018 in Figure 21. TF Green Airport is approximately 3 miles due south of the proposed location.

Unlike the current site, there are no tall buildings (like the Promenade, Providence Place Mall, or Veterans Memorial Auditorium) to obstruct air flow significantly from any direction. This site is 2 miles west of Narragansett Bay and would seldomly be impacted by bay or sea breezes. As mentioned, there is very little grade in this area.

Infrastructure and Safety

All public land options along I-95 were explored, including city, state, and RIDOT. Land options are VERY limited. There are 2 private land options that have not been explored yet, as both are inferior to the current prospective site already mentioned, have no infrastructure, are further from the highway, and not located along the heaviest traffic segments, per AADT data.

The proposed site has excellent access off Wellington Avenue in Cranston. There is safe street parking. Electricity is already available and minimum infrastructure would be needed to become operational. The property is owned by RIDOT and RIDEM has already received approval with some assistance from RIDOT for this location.

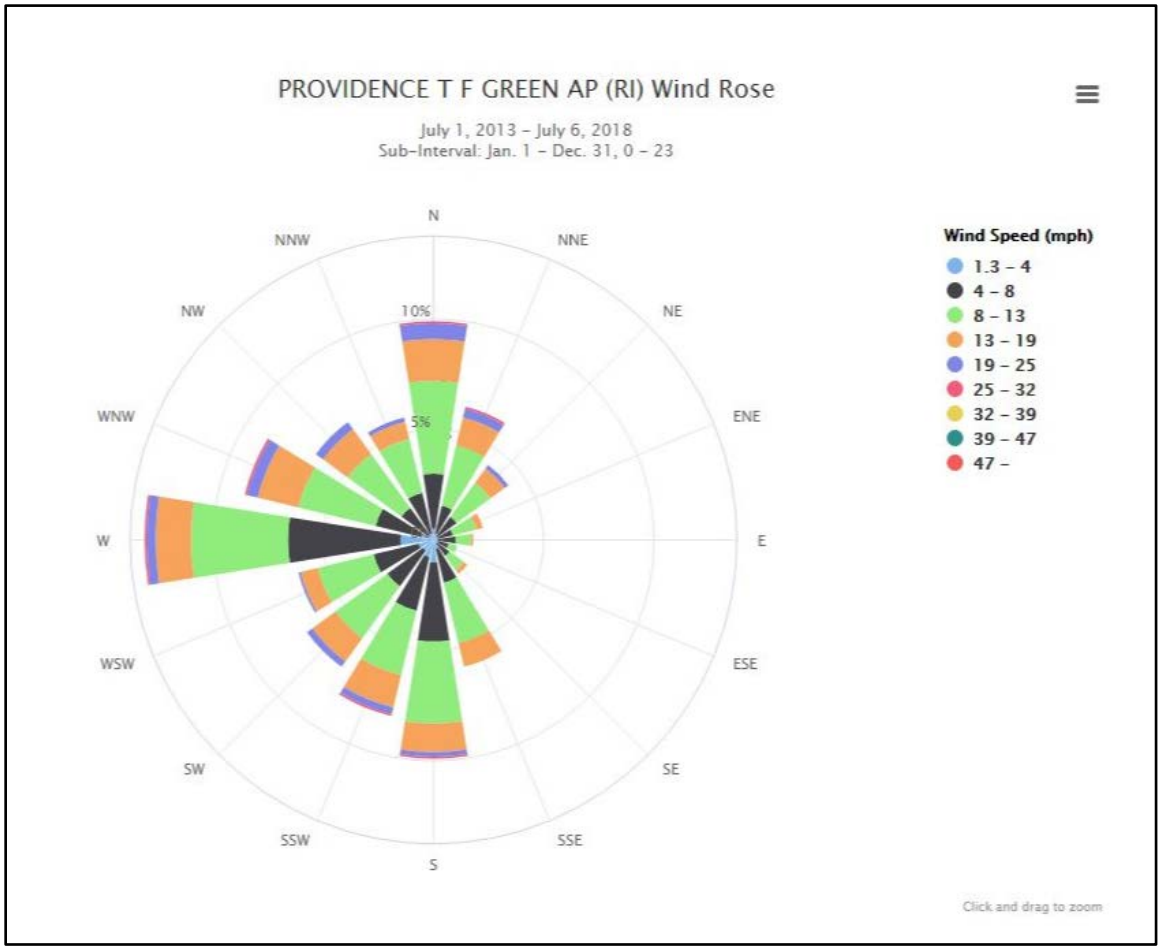


Figure 21: Wind Rose Data

In conclusion, the proposed location for a new Near Road monitoring site is ideal for all the reasons listed. Unfortunately, there isn't even an obvious second option with enough traffic counts, congestion, at highway level with adequate space and infrastructure for shelter.

Table 21: State Beach Pavilion - East Matunuck

East Matunuck – State Beach Pavilion			
County	Washington	Latitude	41.377451°
Address	950 Succotash Road	Longitude	-71.52485°
AQS Site ID	440090008	Elevation	8 feet
Spatial Scale	Regional	Year Established	2020
Statistical Area	Providence, New Bedford, Fall River, RI-MA Metropolitan Statistical Area		
Site Description: The East Matunuck site is a regional scale site established to capture ozone concentrations on the coast.			
Monitoring Objectives: Because of its immediate coastal location, this monitor will 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 arriving inland, and now, the immediate coastline. Additionally, in summertime, the open ocean beaches along the Southern Rhode Island coastline are highly populated and it is important to understand the ground-based ozone health risk in a region where hundreds of thousands of people visit and recreate. RIDEM aims to meet AQS level data for 2020.			
Planned changes for 2020-2021: RIDEM may temperature control the shelter for 2021 if unable to maintain stable room temperatures for analyzer, zero air box, and calibrator performance. Additionally, there is consideration to relocate this site to Misquamicut State Beach in Westerly, as there may be even more potential to capture coastal ozone plumes with a more southerly exposed location.			

Figure 22: East Matunuck Site Location

Figure 23: *East Matunuck Monitoring Site*

Table 22: Continuous Gaseous Monitoring Sites

	Site	Address	Latitude	Longitude
1	Alton Jones Campus	Victory Highway, West Greenwich RI	41.615316	-71.720032
2	USEPA Laboratory	27 Tarzwell Drive, Narragansett RI	41.495060	-71.423713
3	Myron Francis School	64 Bourne Avenue, East Providence RI	41.840954	-71.360976
4	Near Road	Hayes and Park Street, Providence RI	41.829495	-71.417457
5	East Matunuck	950 Succotash Road, South Kingstown RI	41.377451	-71.524850

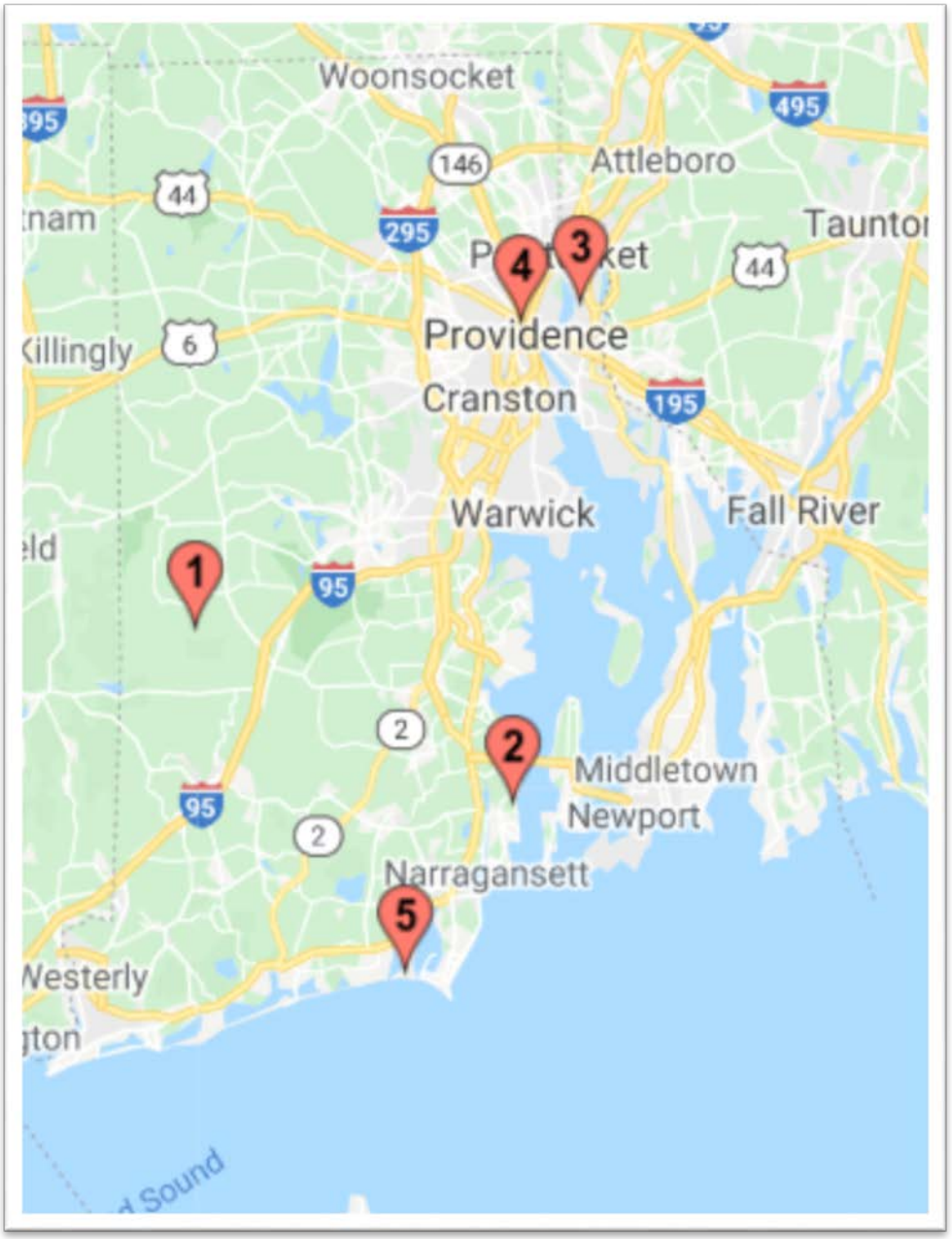


Figure 24: Continuous Gas Monitoring Sites

Table 23: PM 2.5 Monitoring Sites

	Site	Address	Latitude	Longitude
1	Near Road	Hayes and Park Street, Providence RI	41.829495	-71.417457
2	CCRI Liston Campus	1 Hilton Street, Providence RI	41.807523	-71.41392
3	Vernon Street	Vernon Street, Pawtucket RI	41.874675	-71.379953
4	Myron Francis School	64 Bourne Avenue, East Providence RI	41.84092	-71.423659
5	Alton Jones Campus	Victory Highway, West Greenwich RI	41.6156	-71.7199
6	USEPA Laboratory	27 Tarzwell Drive, Narragansett RI	41.4950779	-71.423659

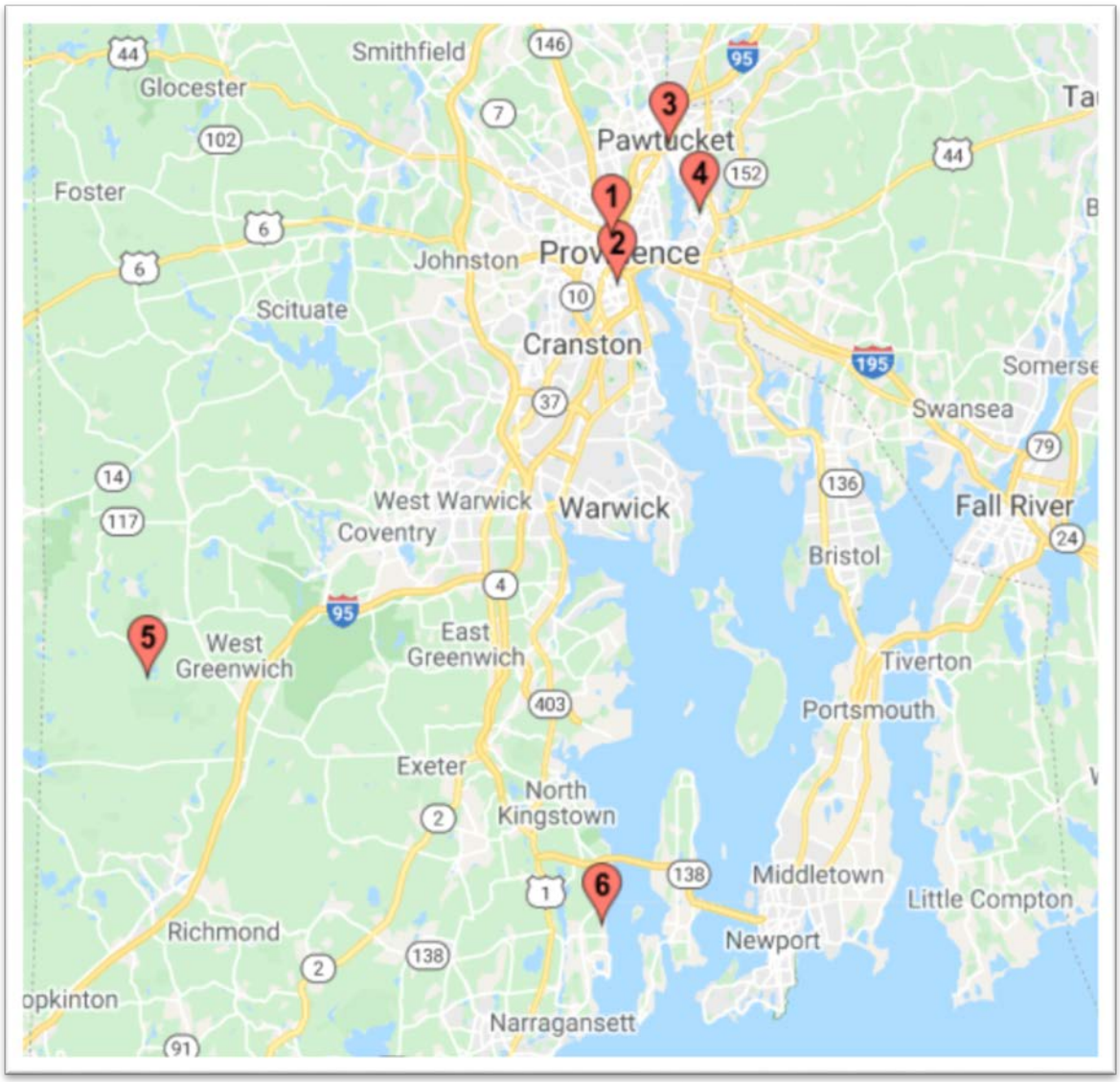


Figure 25: PM 2.5 Monitoring Sites

PM 10 Monitoring Sites

	Site	Address	Lattitude	Longitude
1	CCRI Liston Campus	1 Hilton Street, Providence RI	41.807523	-71.413920
2	Myron Francis School	64 Bourne Avenue, East Providence RI	41.840954	-71.360976

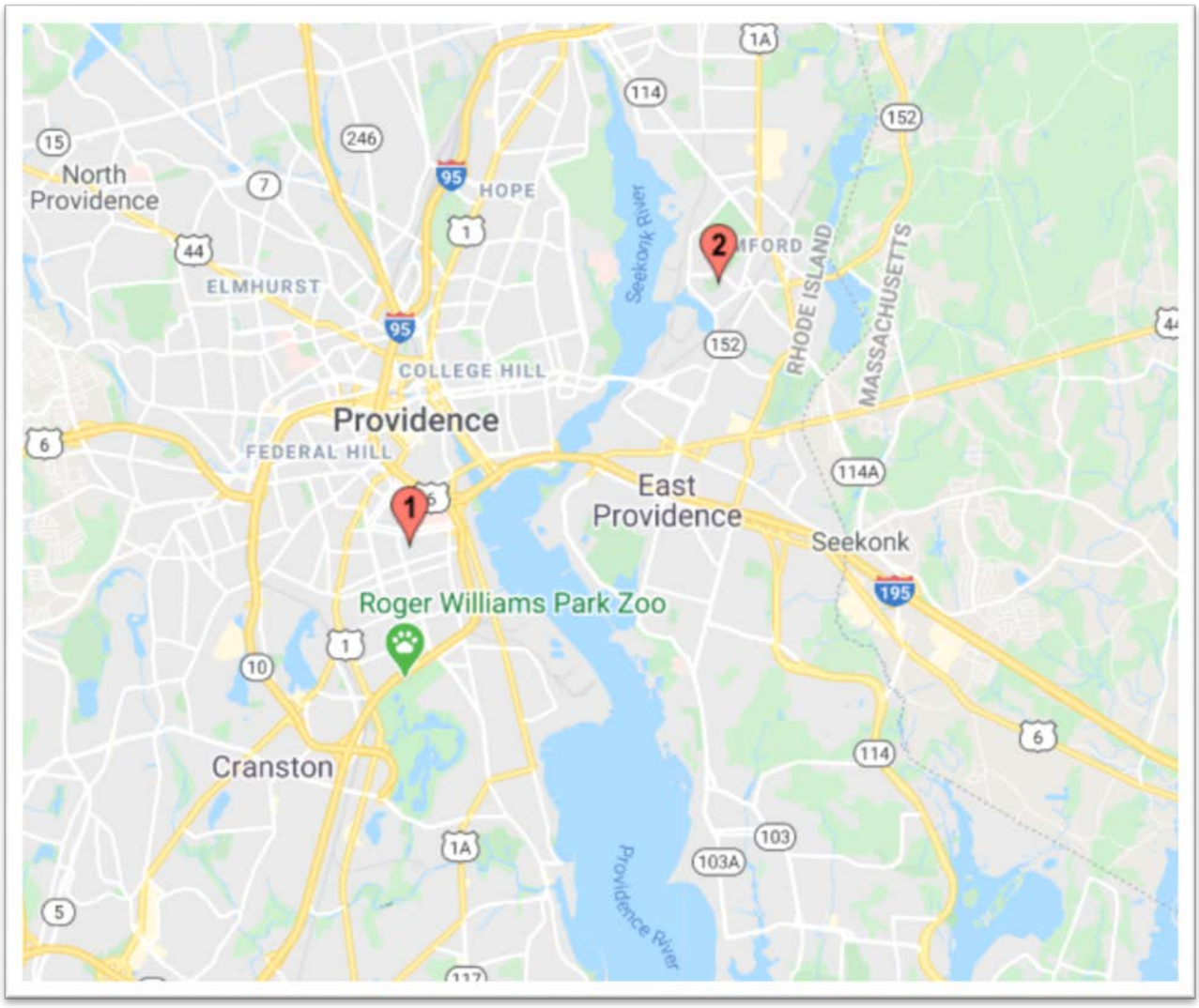


Figure 26: *PM-10 Monitoring locations*

All Rhode Island Monitoring Sites

	Site	Address	Latitude	Longitude
1	Near Road	Hayes and Park Street, Providence RI	41.829495	-71.417457
2	CCRI Liston Campus	1 Hilton Street, Providence RI	41.807523	-71.413920
3	Vernon Street	Vernon Street, Pawtucket RI	41.874683	-71.379936
4	Myron Francis School	64 Bourne Avenue, East Providence RI	41.840954	-71.360976
5	Alton Jones Campus	Victory Highway, West Greenwich RI	41.615316	-71.720032
6	USEPA Laboratory	27 Tarzwell Drive, Narragansett RI	41.495060	-71.423713
7	East Matunuck	950 Succotash Road, South Kingstown RI	41.377451	-71.524850

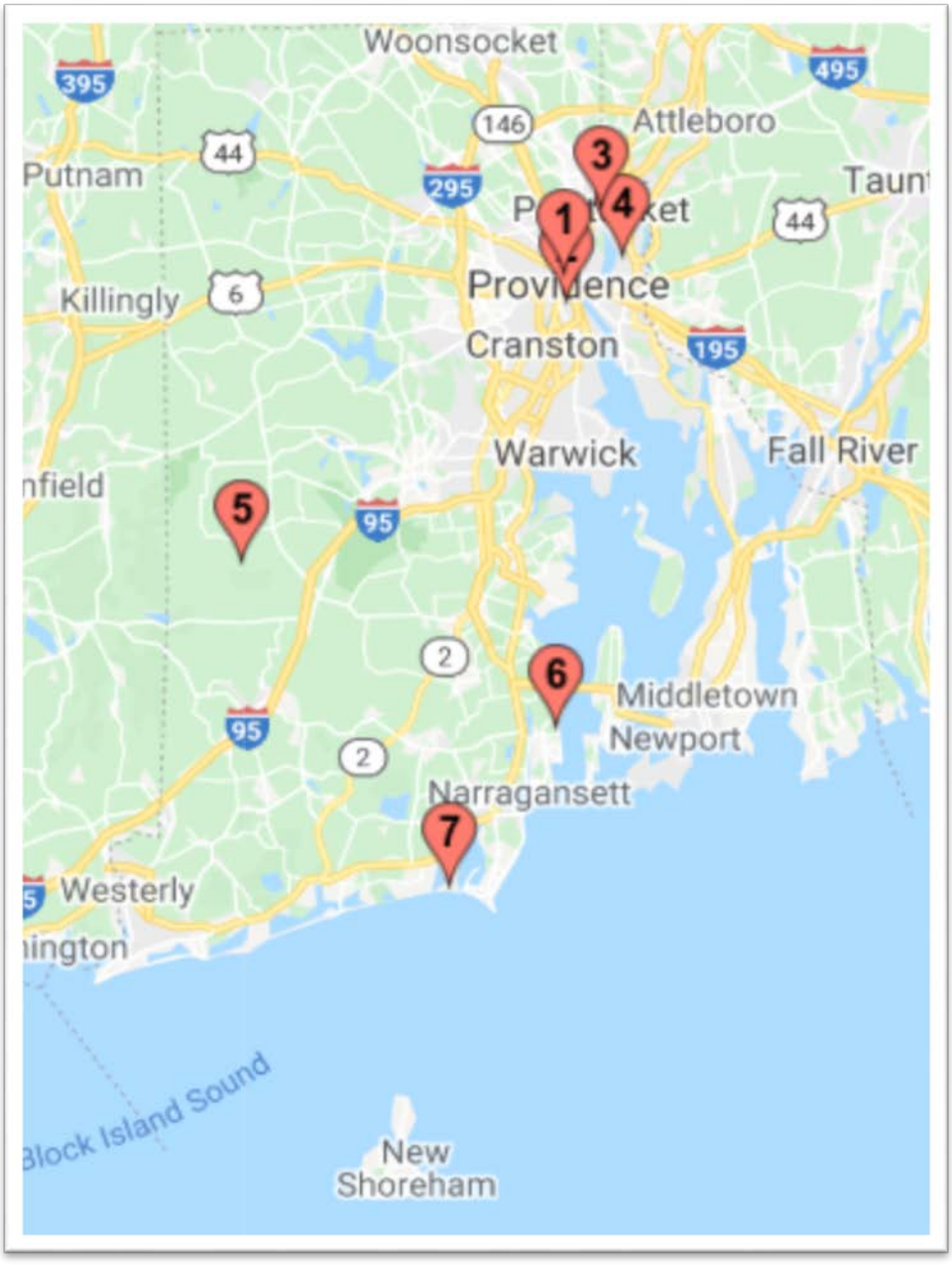


Figure 27: *RI Monitoring Network*