Ambient Monitoring and Analytical Modeling of Air Toxics in New Jersey

April 19, 2023

New Jersey Department of Environmental Protection

How Does NJ DEP Monitor Air Toxics in NJ?

- **Ambient Monitoring**
  - Physical measurement certain air toxics at four locations

- **Analytical Modeling**
  - Use computer numerical models to analyze multiple air toxics over the entire state

Ambient Monitoring Of Air Toxics

- What pollutants are monitored
- Where are these monitored
- How has monitoring advanced in 20 years
- Measured pollutant trends
- Opportunities to enhance monitoring

Monitoring of Air Toxics (VOC)

- 24-hour canister samples
- 68 compounds analyzed
- About 9 are usually non-detectable
- 43 are Hazardous Air Pollutants (HAPs)
- 36 have cancer endpoints
- 15 have noncancer endpoints

Monitoring of Air Toxics (Metals & Particles)

- 24-hour filter samples
- 41 metals & elements analyzed
- 5 or 6 are almost always non-detectable, including arsenic & cobalt
- 11 are HAPs:

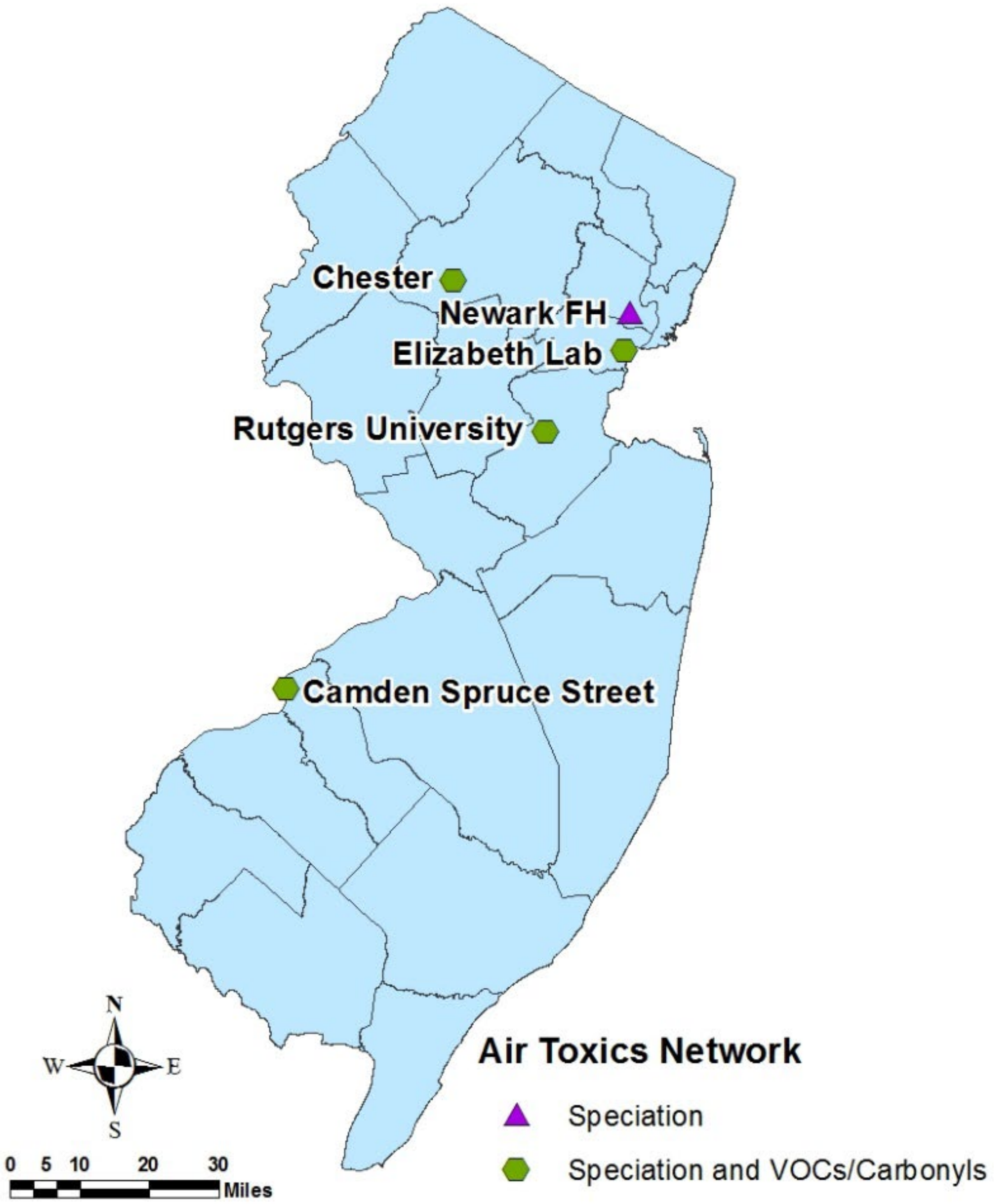
Antimony	Chromium	Nickel
Arsenic	Cobalt	Phosphorus
Cadmium	Lead	Selenium
Chlorine	Manganese	

NJ Toxics Monitoring Locations

SITE	VOCs		Metals/Elements		
	Start	End	Start	End	Freq.*
Camden 1 (Copewood & Davis Sts)	1989	2008	2001	2008	---
Camden 2 (Spruce St)	2013		2013		1/6
Chester	2001		2001		1/6
Elizabeth (Lab)	2000		2001		1/3
Newark (Firehouse)			2010	2022	1/3
New Brunswick	2001	2015	2001	2015	---
Rutgers	2016		2016		1/3

*Freq. = frequency of sampling for metals/elements is either every 3rd day or every 6th day.

VOCs are sampled every 6 days at all sites.



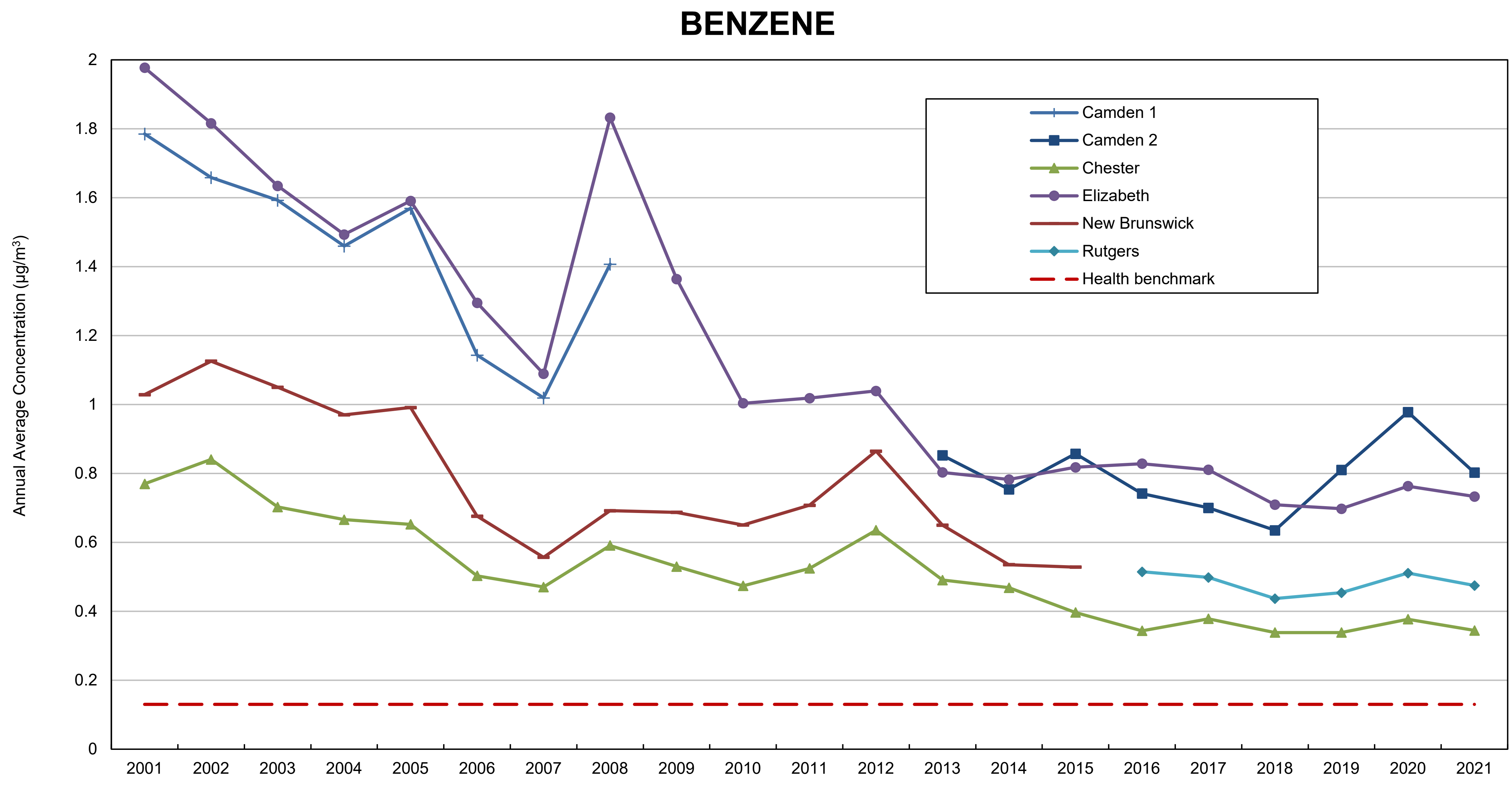
Advancements in Monitoring Technology

Continuous measurement:

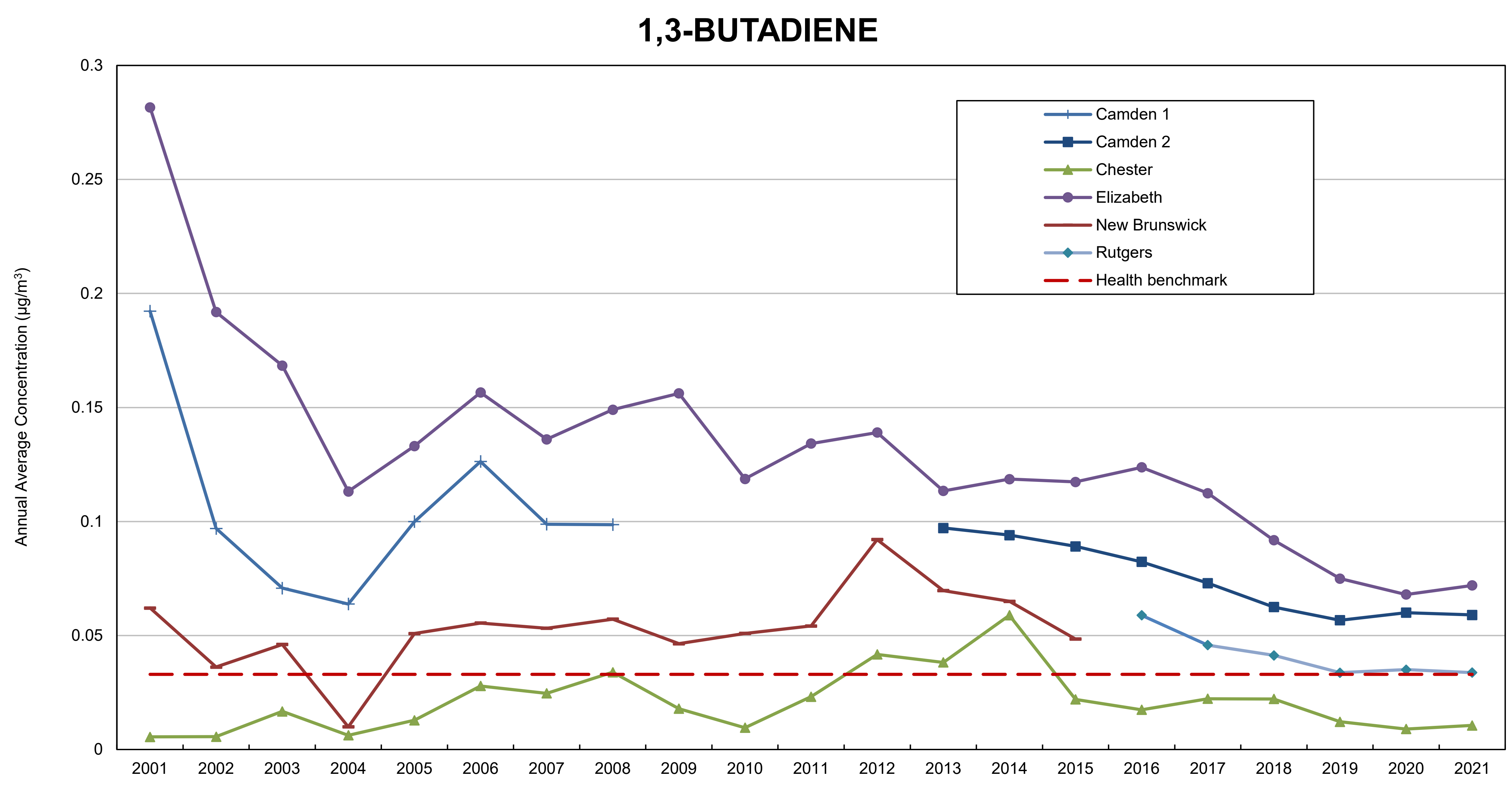
- BTEX (benzene, toluene, ethylbenzene & xylenes)
- Black carbon

Better analysis:

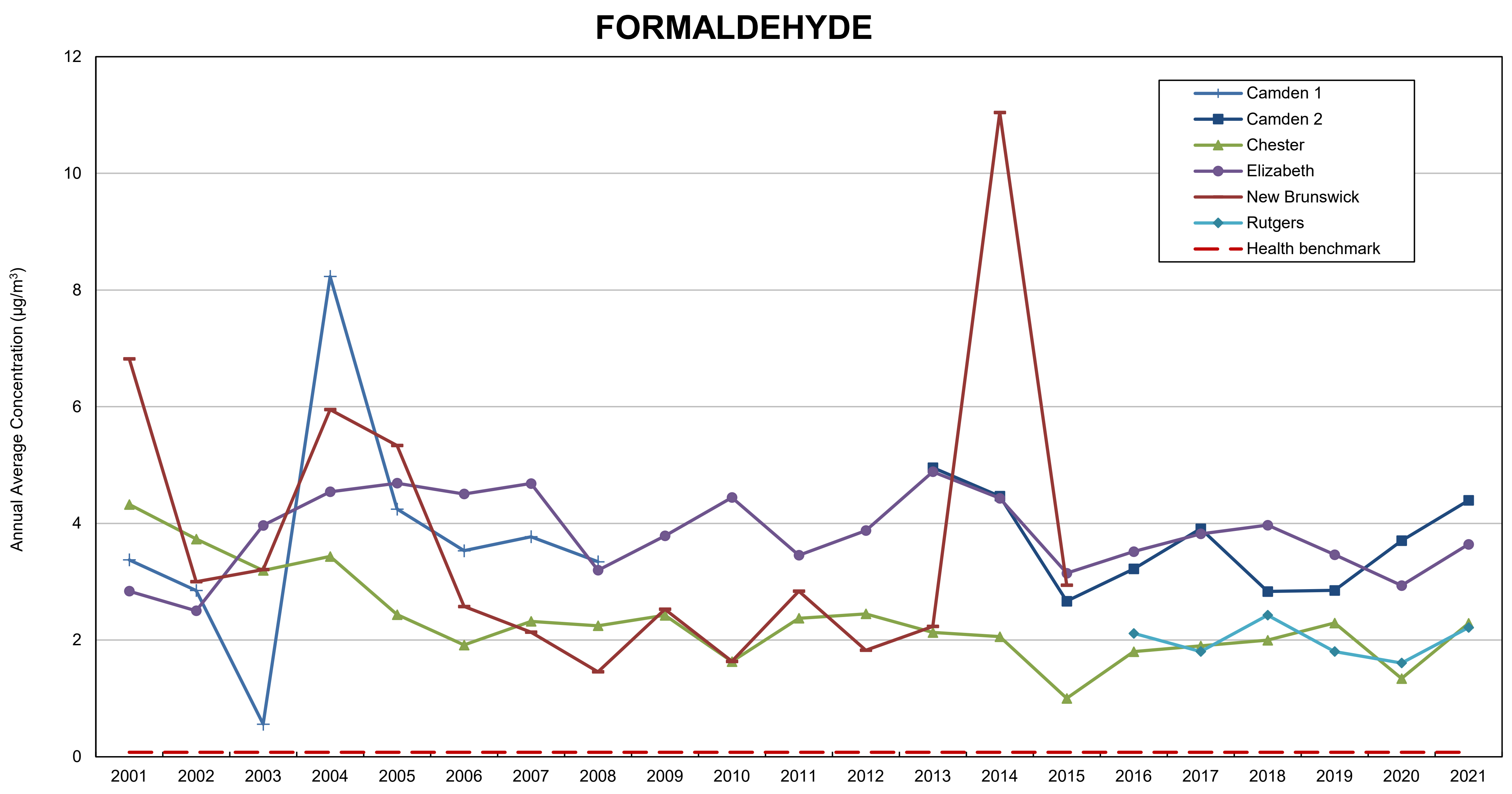
- Ethylene oxide, acrolein
- Lower detection limits



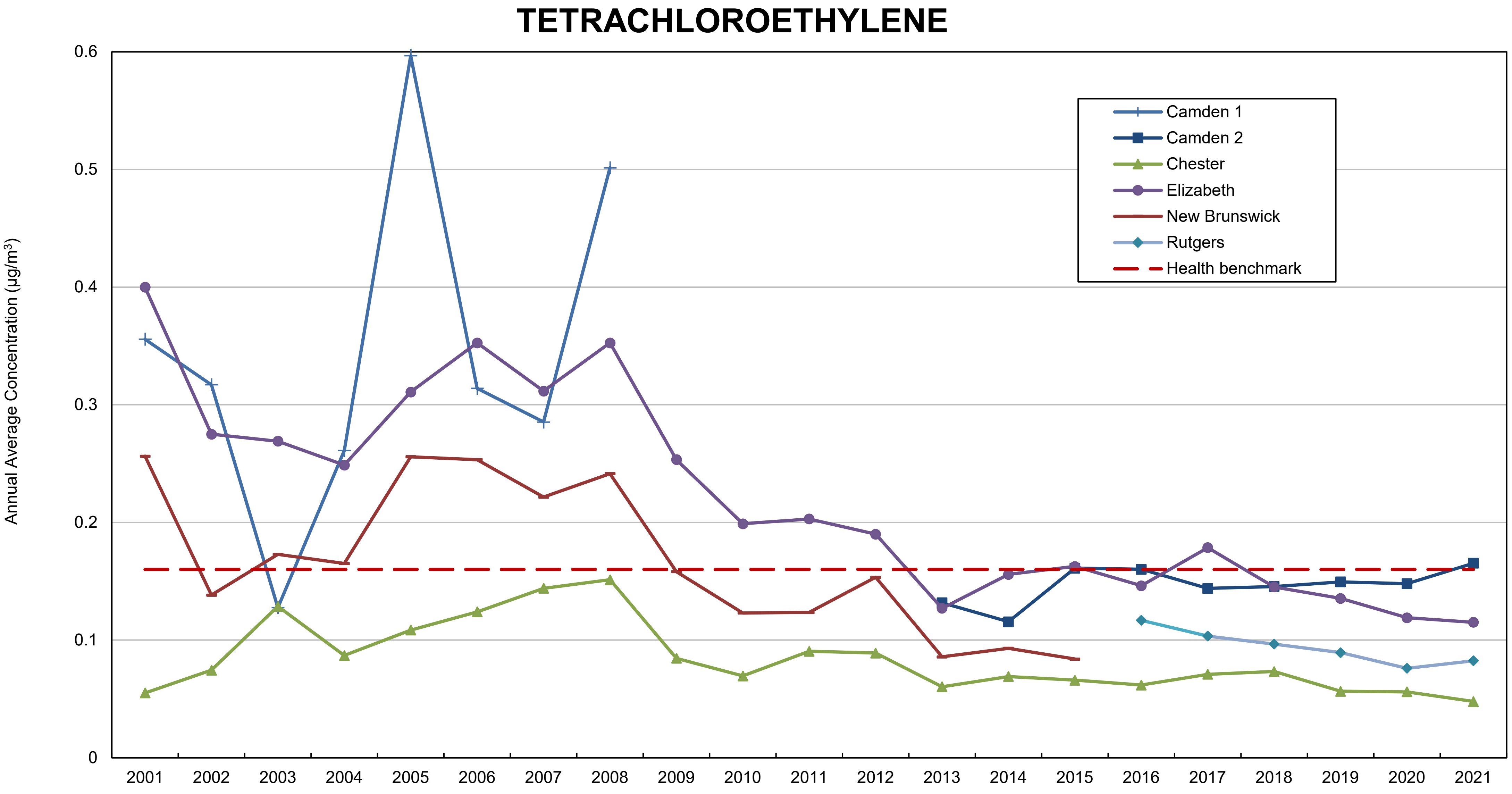
BENZENE
Annual Average Concentration (µg/m³)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Camden 1
Camden 2
Chester
Elizabeth
New Brunswick
Rutgers
Health benchmark



1,3-BUTADIENE
Annual Average Concentration (µg/m³)
0.3
0.25
0.2
0.15
0.1
0.05
0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Camden 1
Camden 2
Chester
Elizabeth
New Brunswick
Rutgers
Health benchmark



FORMALDEHYDE
Annual Average Concentration (µg/m³)
0
2
4
6
8
10
12
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Camden 1
Camden 2
Chester
Elizabeth
New Brunswick
Rutgers
Health benchmark



TETRACHLOROETHYLENE
Annual Average Concentration (µg/m³)
0.6
0.5
0.4
0.3
0.2
0.1
0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Camden 1
Camden 2
Chester
Elizabeth
New Brunswick
Rutgers
Health benchmark

Analytical Modeling of Air Toxics

- Supplementing the physical monitoring stations is the use of computer numerical models to analyze multiple air toxics over the entire state
  - **Identification** of locations of interest for further study
  - **Prioritization** of pollutants and emission sources
  - **Informing** the air monitoring program
  - Trends analysis
- Currently NJ DEP is primarily using EPA's **AirToxScreen** for planning an evaluation of state-wide Air Toxics impacts and **Environmental Justice Mapping, Assessment and Protection Tool**
- Regulatory Decisions (Permits) use other tools computer numerical models (AERMOD, etc.)

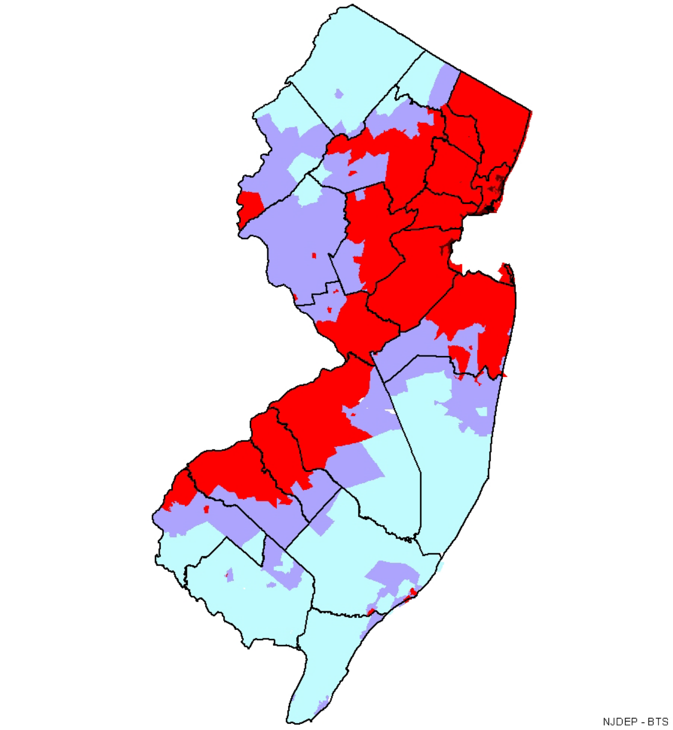
New Jersey Analysis of AirToxScreen

- EPA tool formally known as the National Air Toxics Assessment (NATA)
- AirToxScreen is a screening-level characterization of air toxics across the U.S. with ***census tract*** resolution
- Ambient air concentration estimates for 180 Clean Air Act HAPs plus Diesel PM
- Cancer and noncancer risk estimates for about 140 HAPs with health data based on chronic exposures
- Uses computer numerical models and emissions from the National Emissions Inventory (NEI) (Clean Air Act Hazardous Air Pollutants (HAP) and Diesel Particulate Matter (DPM))

Three additional Air Toxics Trends

- Diesel Particulate Matter
- Formaldehyde
- Benzene

2005 Estimated Diesel Particulate Risk in New Jersey from Mobile Sources



Diesel Particulate Risk

- Under 10 times benchmark
- 10 - 50 times benchmark
- 50 - 100 times benchmark
- 100 - 1000 times benchmark
- 1000 - 2400 times benchmark

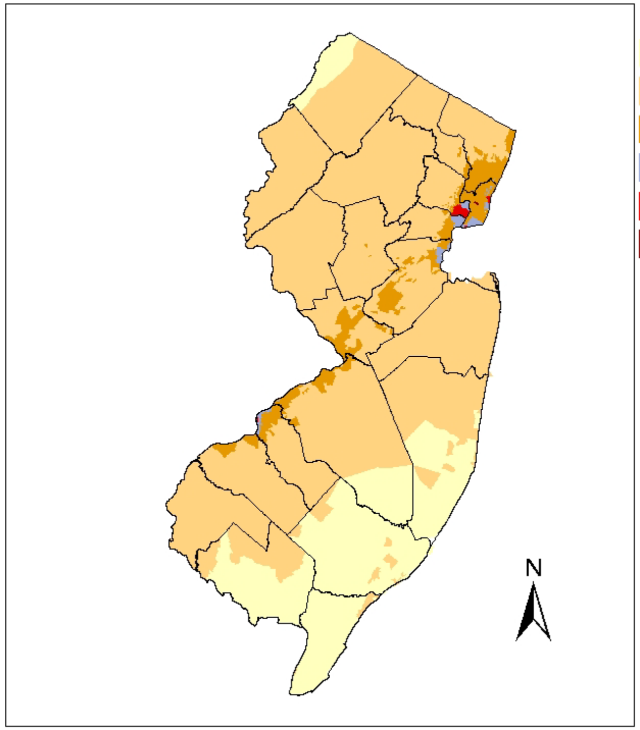
Maximum average census tract concentration is 7.9 ug/m^3, or 2379 times the health benchmark
Health Benchmark = 0.0033 ug/m^3

Source Contribution

On-Road - 47%
Nonroad - 53%

Based on 2005 NATA concentrations and California cancer risk factor.

2002 NATA Predicted Concentrations in New Jersey



Diesel Particulate Matter Risk

- Under 250 times benchmark
- 250 - 500 times benchmark
- 500 - 1000 times benchmark
- 1000 - 1500 times benchmark
- 1500 - 2000 times benchmark
- 2000 - 2300 times benchmark

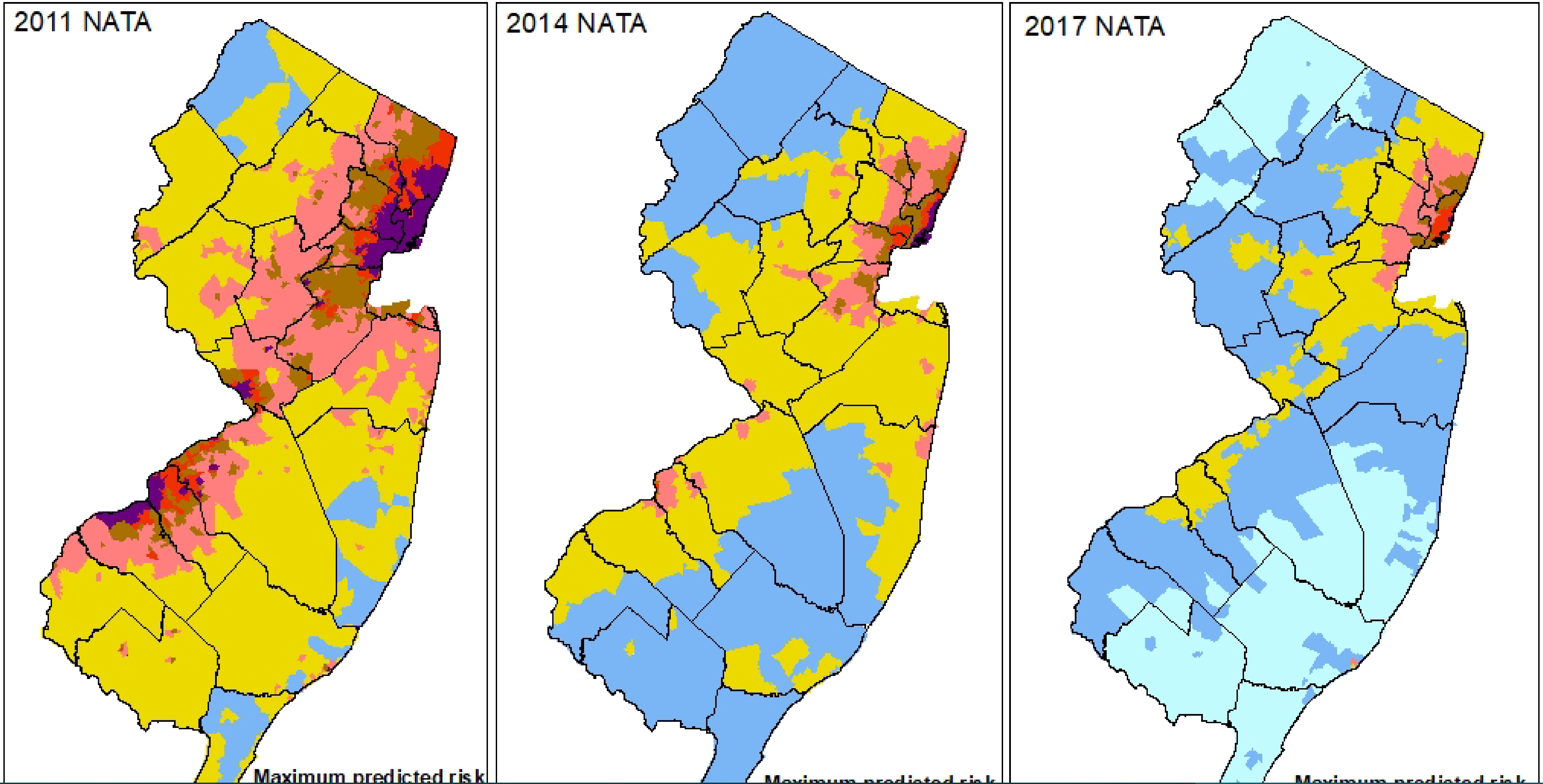
Maximum average census tract concentration is 7.66 ug/m^3, or 2300 times the health benchmark.

Health Benchmark = 0.0033 ug/m^3

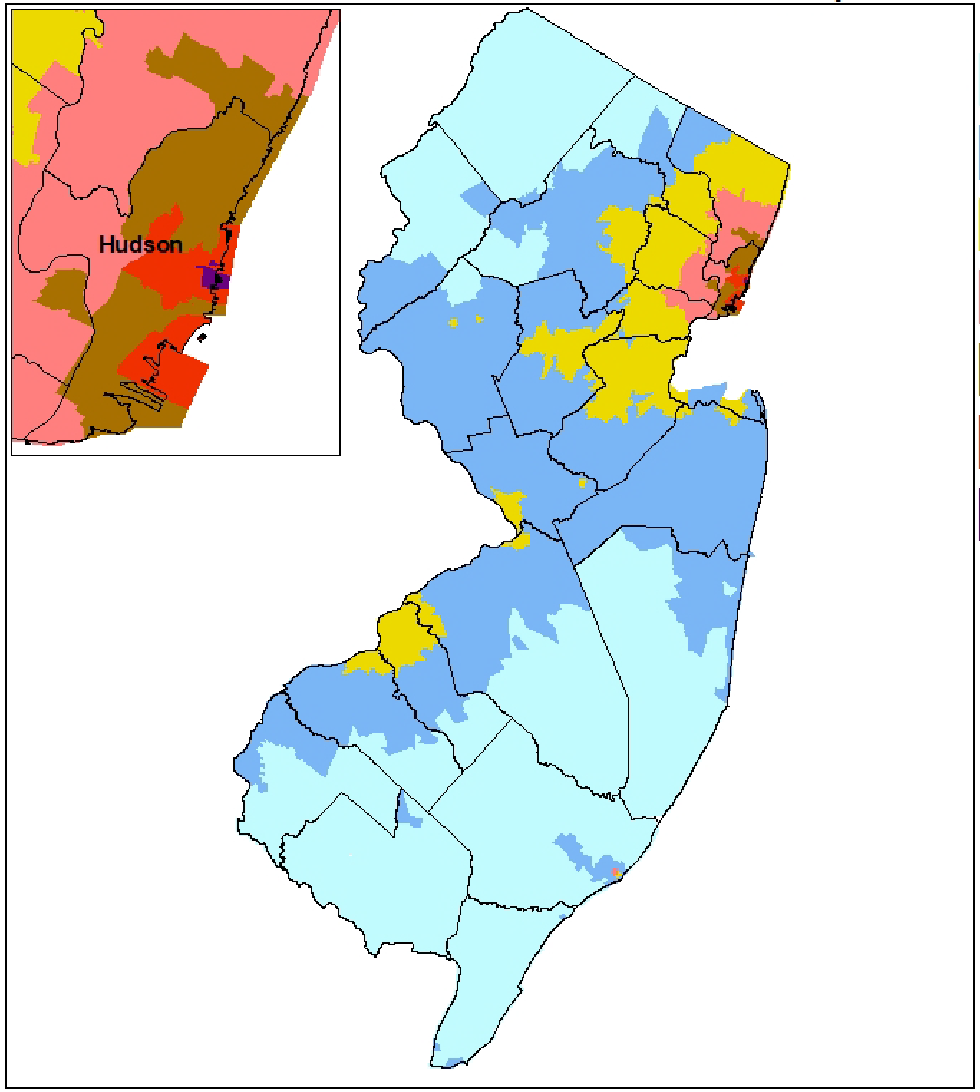
Source Contribution

Major - 0%
Area - 0%
On-Road Mobile - 28%
Nonroad Mobile - 72%
Background - 0%

Diesel Particulate Risk



2018 AirToxScreen Predicted Concentrations in New Jersey



Diesel Particulate Risk

- Under 50 in a million
- 50 - 100 in a million
- 100 - 200 in a million
- 200 - 300 in a million
- 300 - 400 in a million
- 400 - 500 in a million
- Over 500 in a million

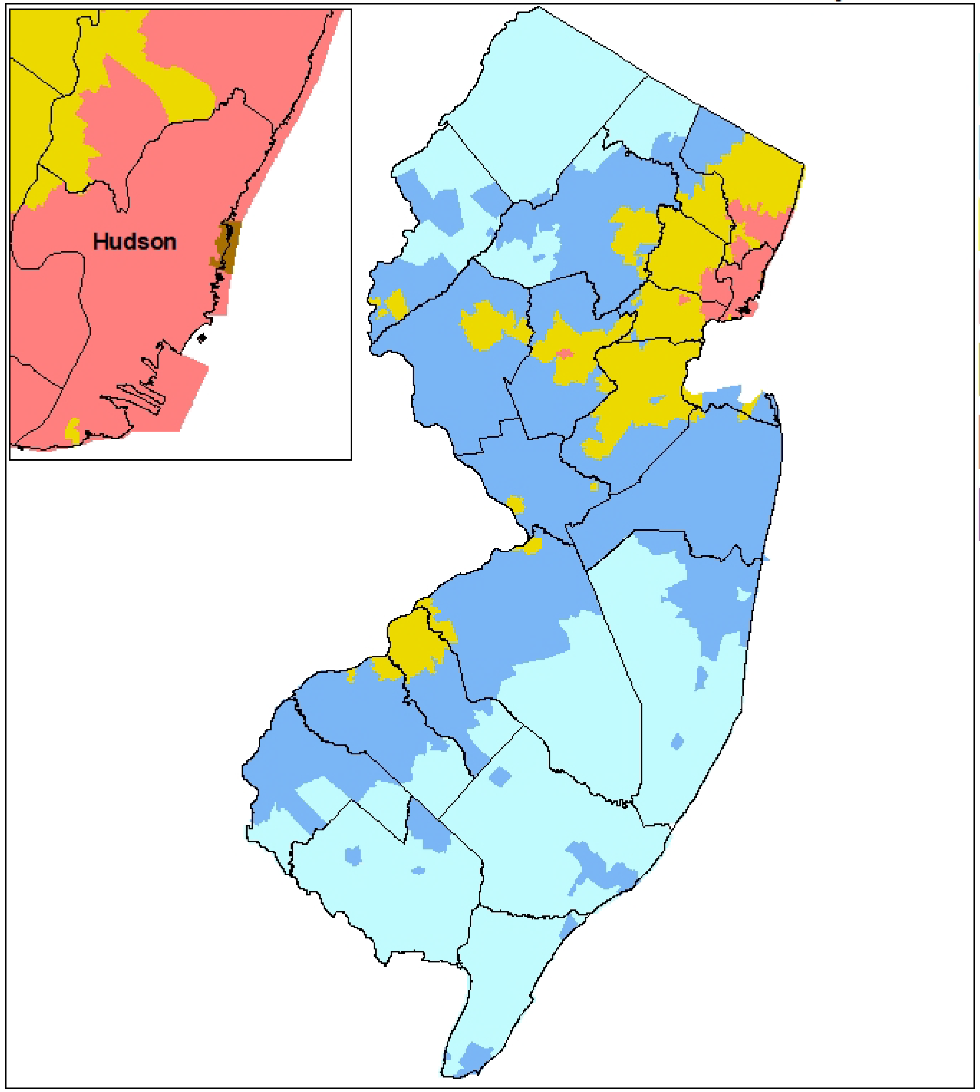
Maximum predicted risk is 516 in a million

Source Contribution

On-road - 43%
Nonroad - 57%

*Based on EPA's 2018 AirToxScreen Ambient Concentrations & California Cancer Risk Factor

2019 AirToxScreen Predicted Concentrations in New Jersey



Diesel Particulate Risk

- Under 50 in a million
- 50 - 100 in a million
- 100 - 200 in a million
- 200 - 300 in a million
- 300 - 400 in a million
- 400 - 500 in a million
- Over 500 in a million

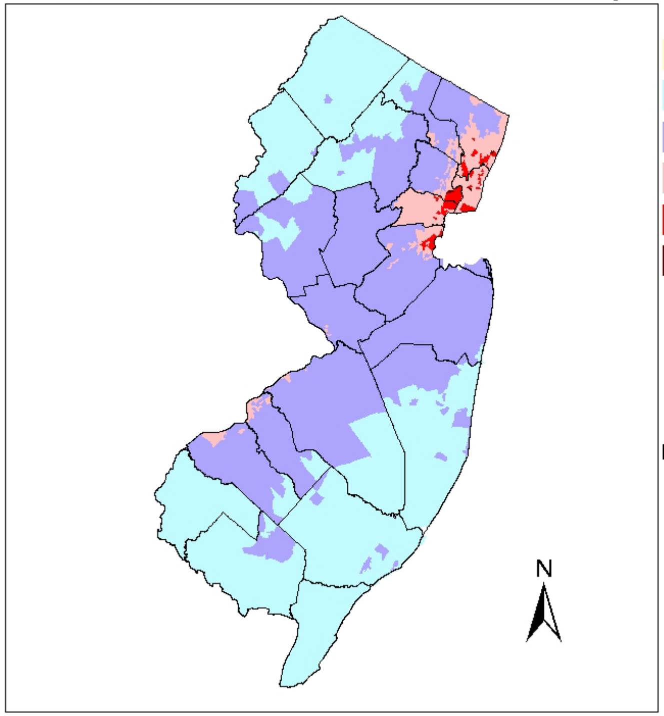
Maximum predicted risk is 339 in a million

Source Contribution

On-road - 49%
Nonroad - 51%

*Based on EPA's 2019 AirToxScreen Ambient Concentrations & California Cancer Risk Factor

2002 NATA Predicted Concentrations in New Jersey



Formaldehyde Risk

- Under 10 times benchmark
- 10 - 20 times benchmark
- 20 - 30 times benchmark
- 30 - 40 times benchmark
- 40 - 50 times benchmark
- 50 - 60 times benchmark

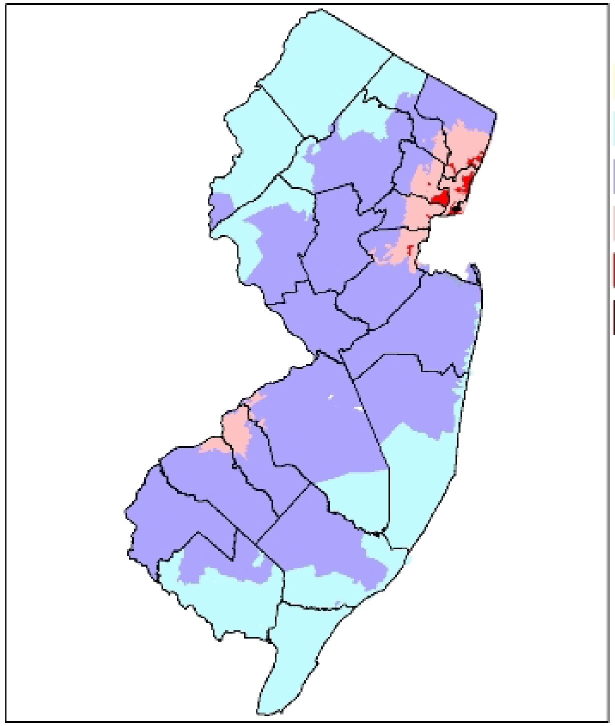
Maximum average census tract concentration is 4.66 ug/m^3, or 61 times the health benchmark

Health Benchmark = 0.077 ug/m^3

Source Contribution

Major - 0.3%
Area - 3%
On-Road Mobile - 25%
Nonroad Mobile - 13%
Background - 59%

2005 NATA Predicted Concentrations in New Jersey



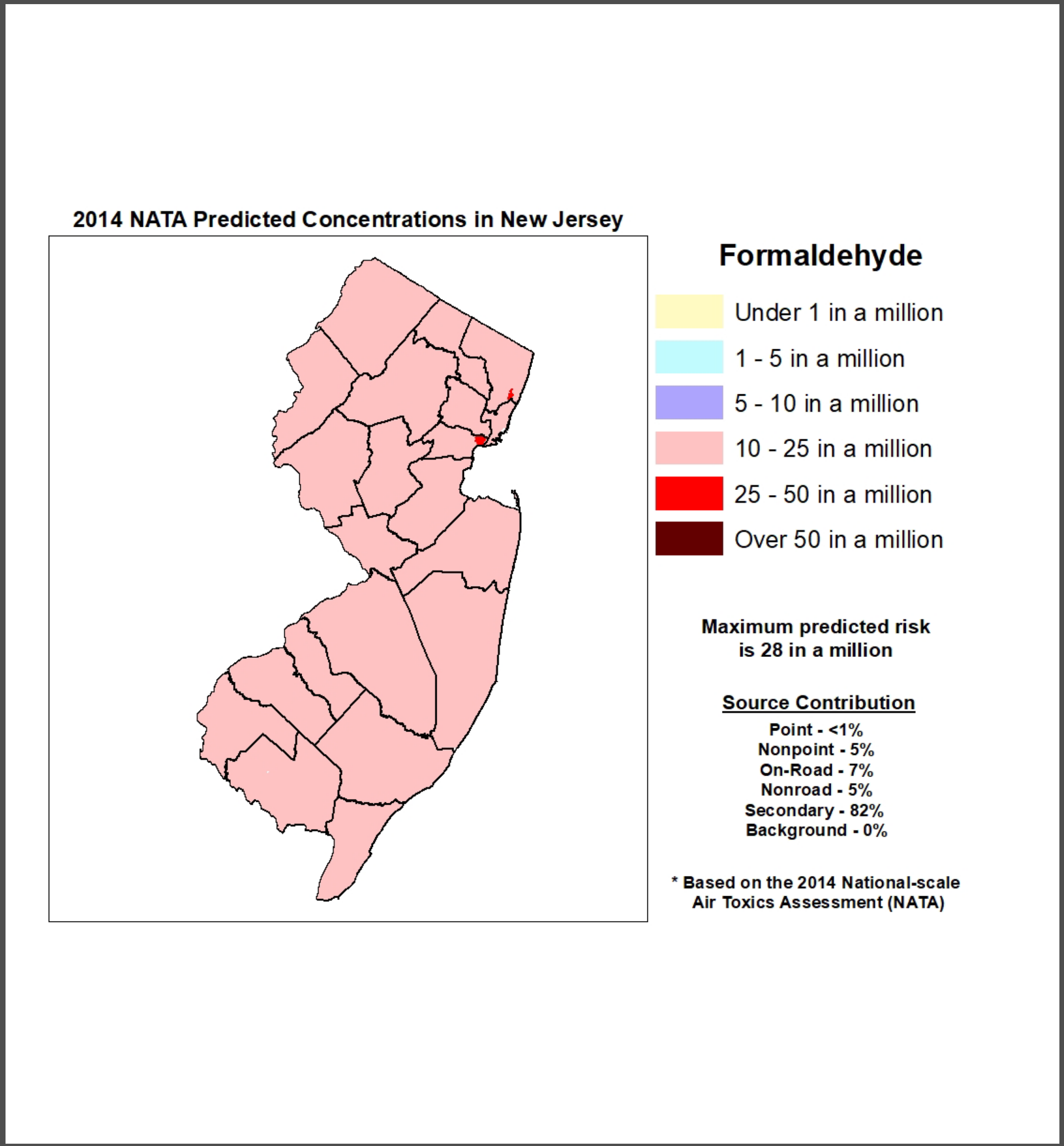
Formaldehyde Risk

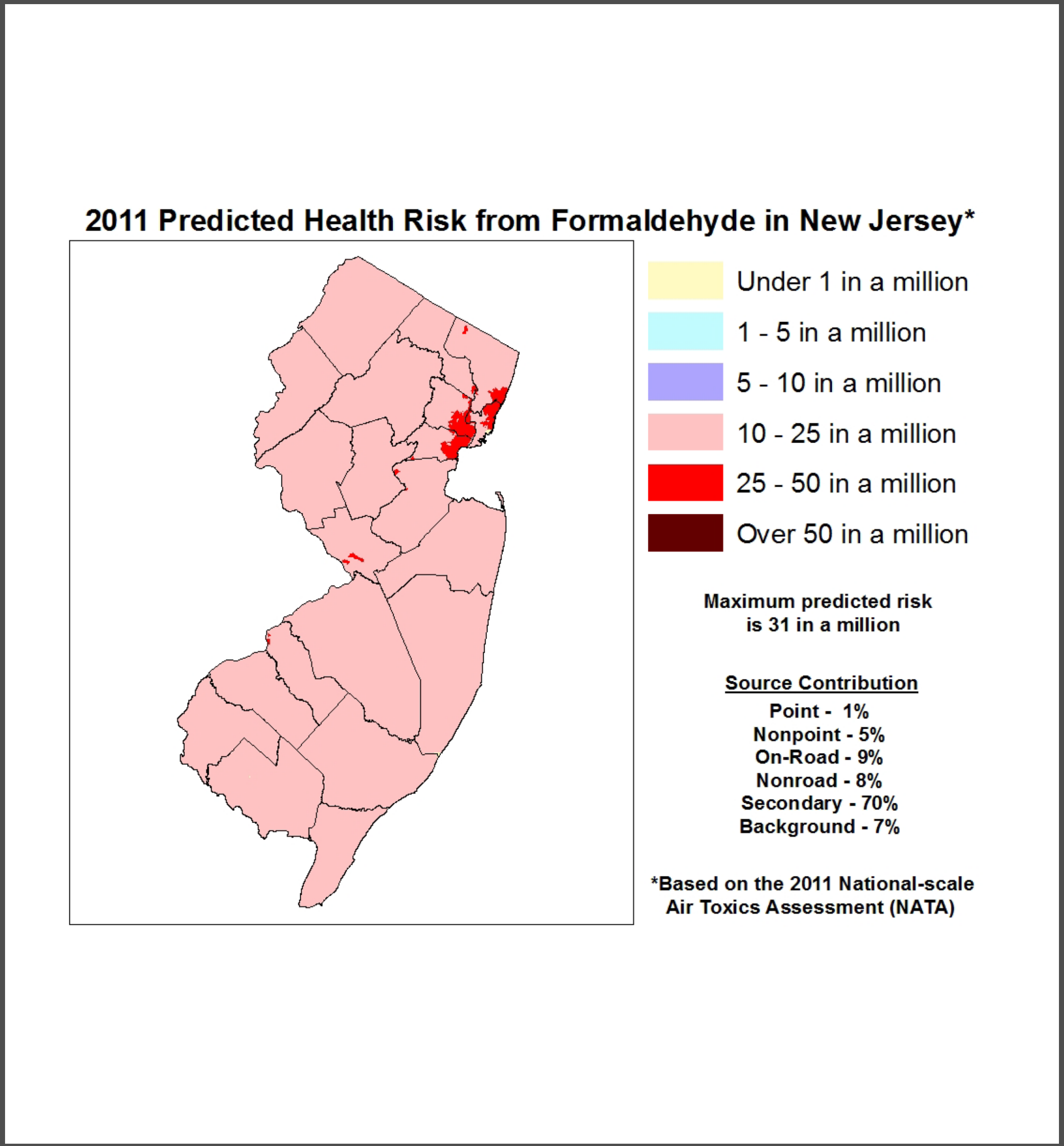
- Under 10 times benchmark
- 10 - 20 times benchmark
- 20 - 30 times benchmark
- 30 - 40 times benchmark
- 40 - 50 times benchmark
- 50 - 60 times benchmark

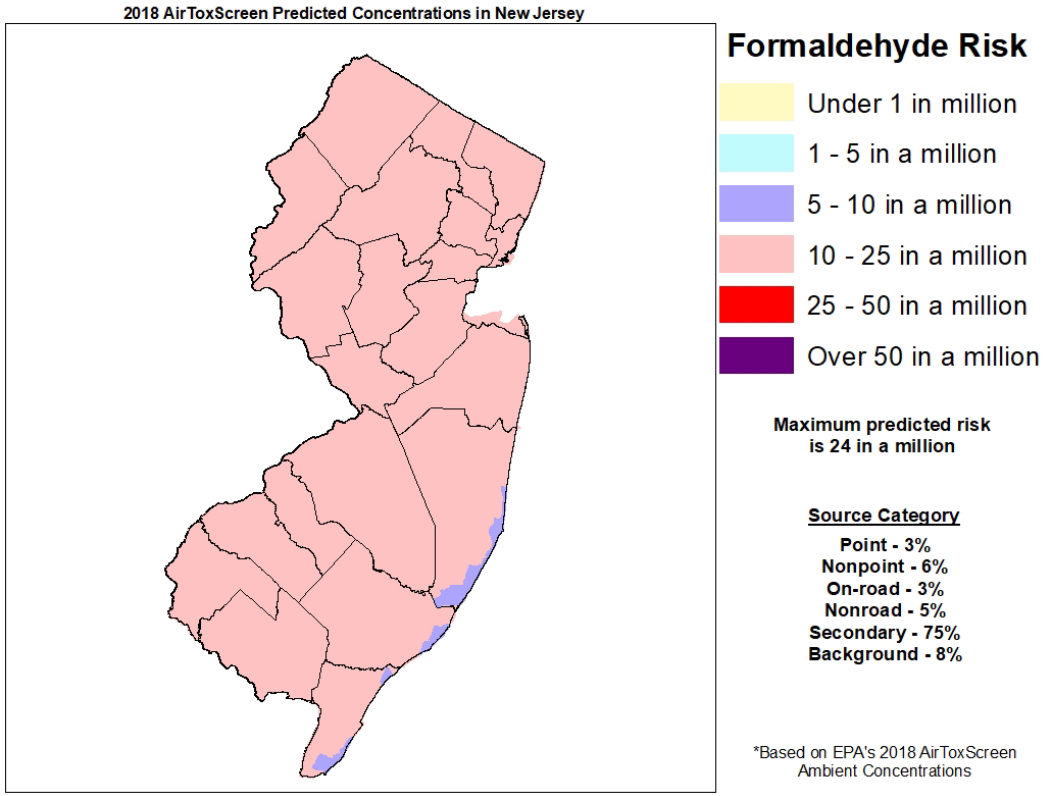
Maximum average census tract concentration is 3.9 ug/m^3, or 50 times the health benchmark
Health benchmark = 0.077 ug/m^3

Source Contribution

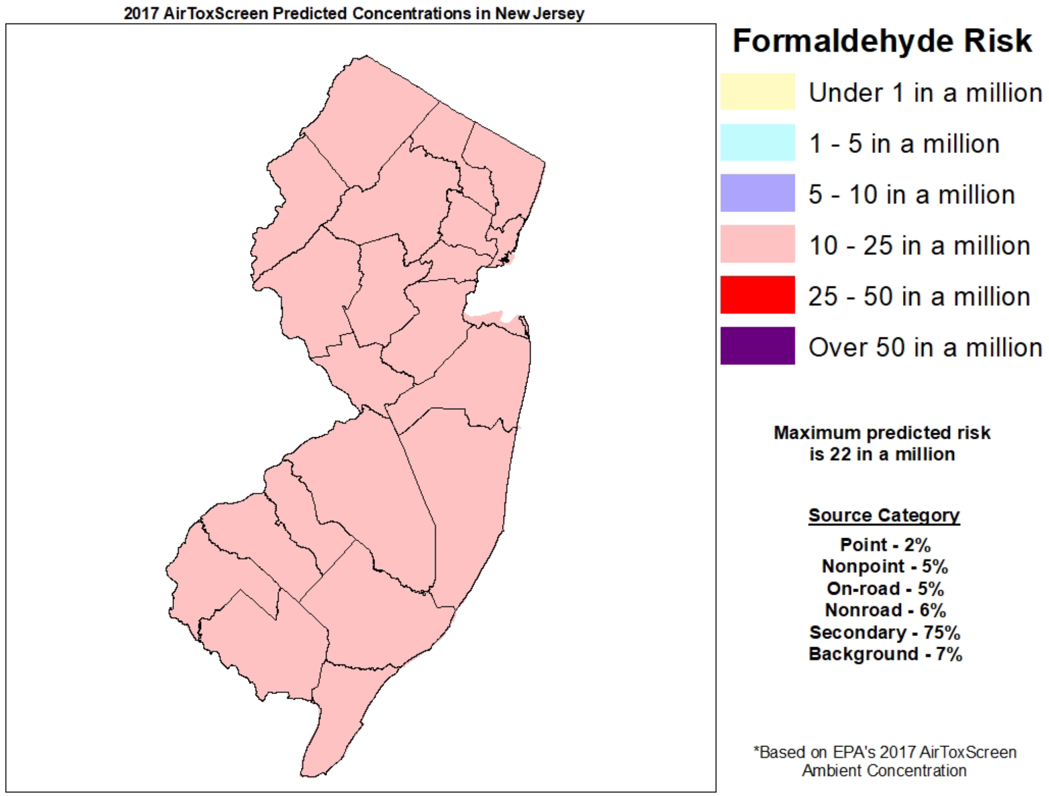
Point - <1%
Nonpoint - 3%
On-Road - 9%
Nonroad - 6%
Background - 0%
Secondary - 82%


2014 NATA Predicted Concentrations in New Jersey
Formaldehyde
Under 1 in a million
1 - 5 in a million
5 - 10 in a million
10 - 25 in a million
25 - 50 in a million
Over 50 in a million
Maximum predicted risk is 28 in a million
Source Contribution
Point - <1%
Nonpoint - 5%
On-Road - 7%
Nonroad - 5%
Secondary - 82%
Background - 0%
* Based on the 2014 National-scale Air Toxics Assessment (NATA)


2011 Predicted Health Risk from Formaldehyde in New Jersey*
Under 1 in a million
1 - 5 in a million
5 - 10 in a million
10 - 25 in a million
25 - 50 in a million
Over 50 in a million
Maximum predicted risk is 31 in a million
Source Contribution
Point - 1%
Nonpoint - 5%
On-Road - 9%
Nonroad - 8%
Secondary - 70%
Background - 7%
*Based on the 2011 National-scale Air Toxics Assessment (NATA)

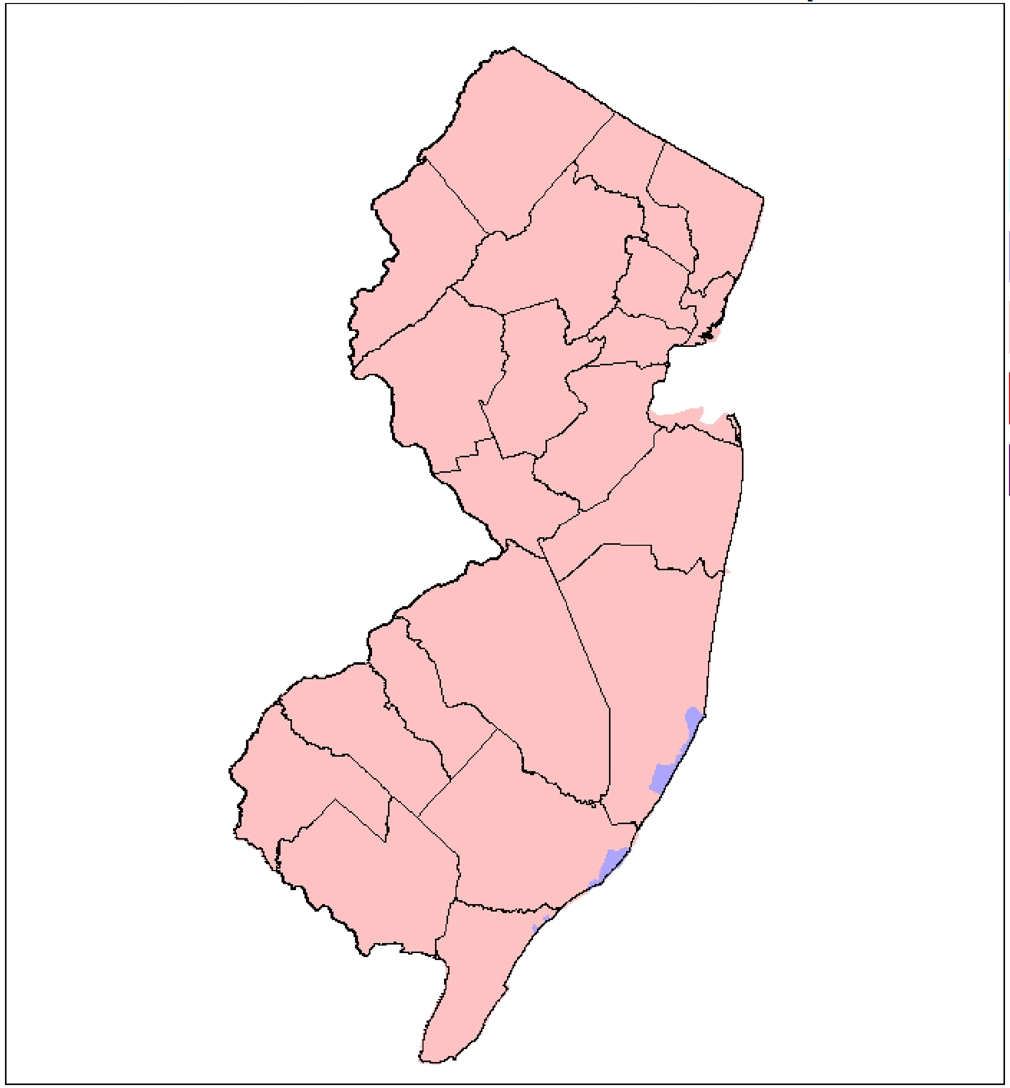


2018 AirToxScreen Predicted Concentrations in New Jersey
Formaldehyde Risk
Under 1 in million
1 - 5 in a million
5 - 10 in a million
10 - 25 in a million
25 - 50 in a million
Over 50 in a million
Maximum predicted risk is 24 in a million
Source Category
Point - 3%
Nonpoint - 6%
On-road - 3%
Nonroad - 5%
Secondary - 75%
Background - 8%
*Based on EPA's 2018 AirToxScreen Ambient Concentrations



2017 AirToxScreen Predicted Concentrations in New Jersey
Formaldehyde Risk
Under 1 in a million
1 - 5 in a million
5 - 10 in a million
10 - 25 in a million
25 - 50 in a million
Over 50 in a million
Maximum predicted risk is 22 in a million
Source Category
Point - 2%
Nonpoint - 5%
On-road - 5%
Nonroad - 6%
Secondary - 75%
Background - 7%
*Based on EPA's 2017 AirToxScreen Ambient Concentration

2019 AirToxScreen Predicted Concentrations in New Jersey



Formaldehyde Risk

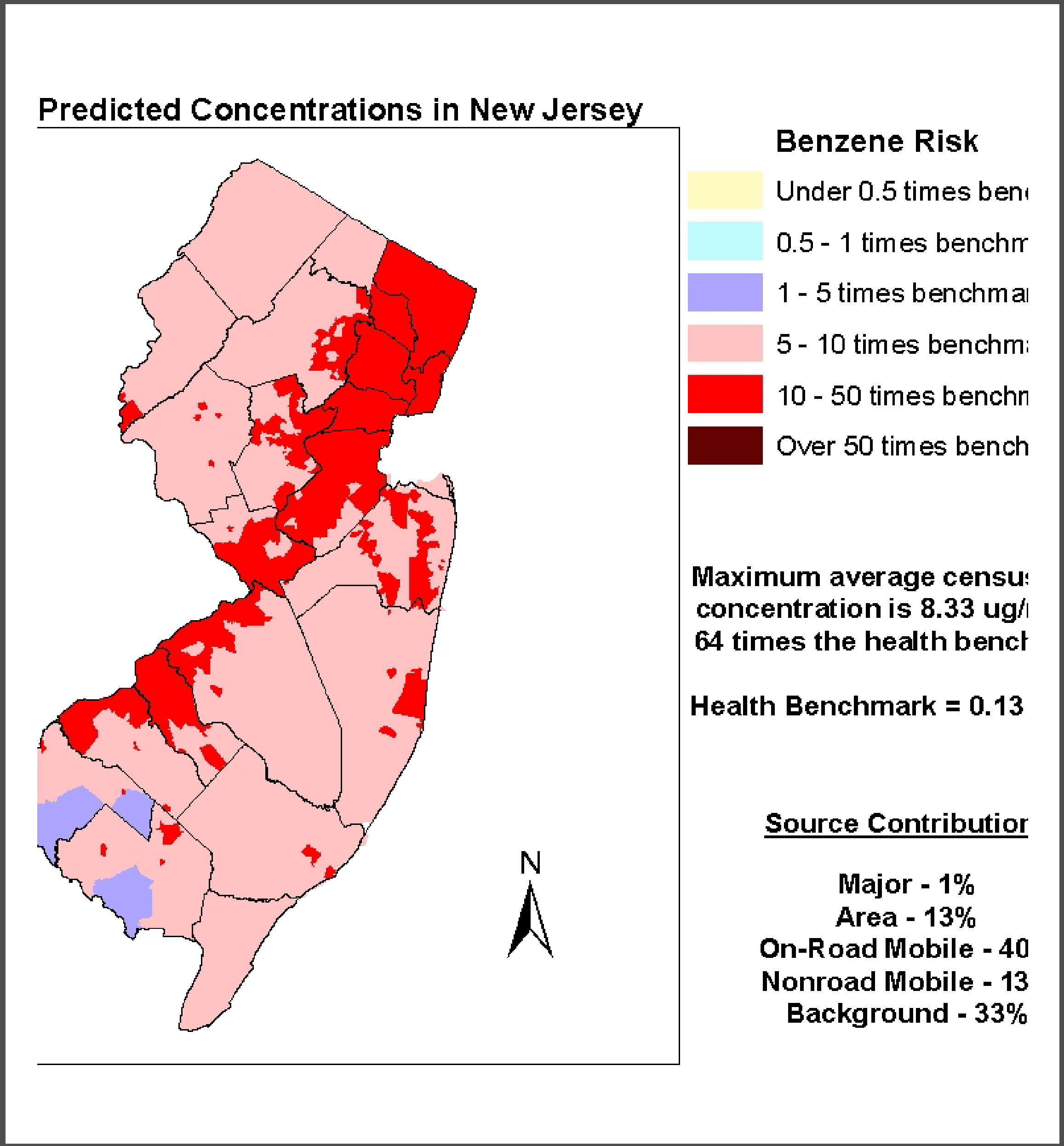
- Under 1 in million
- 1 - 5 in a million
- 5 - 10 in a million
- 10 - 25 in a million
- 25 - 50 in a million
- Over 50 in a million

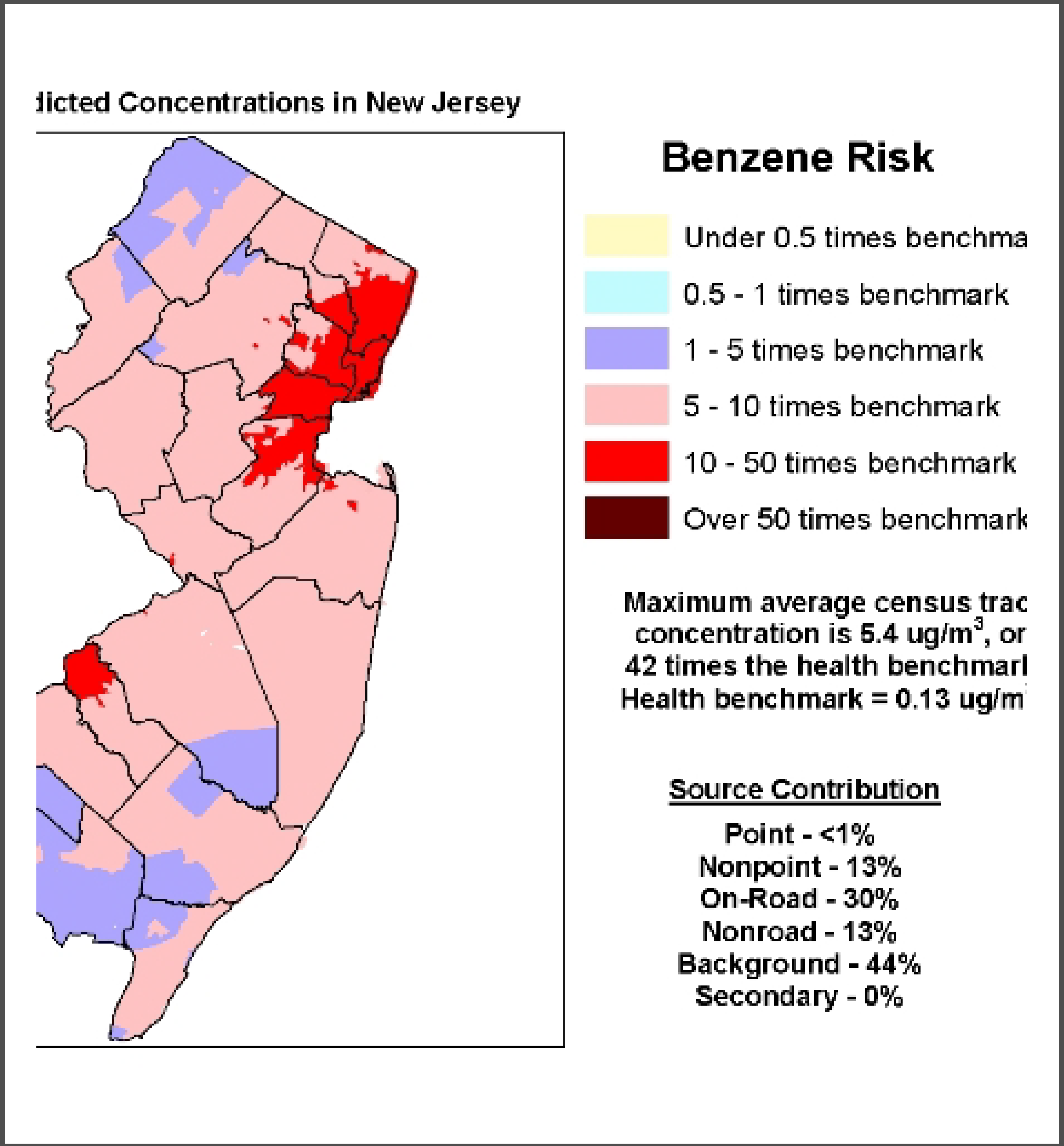
Maximum predicted risk is 23 in a million

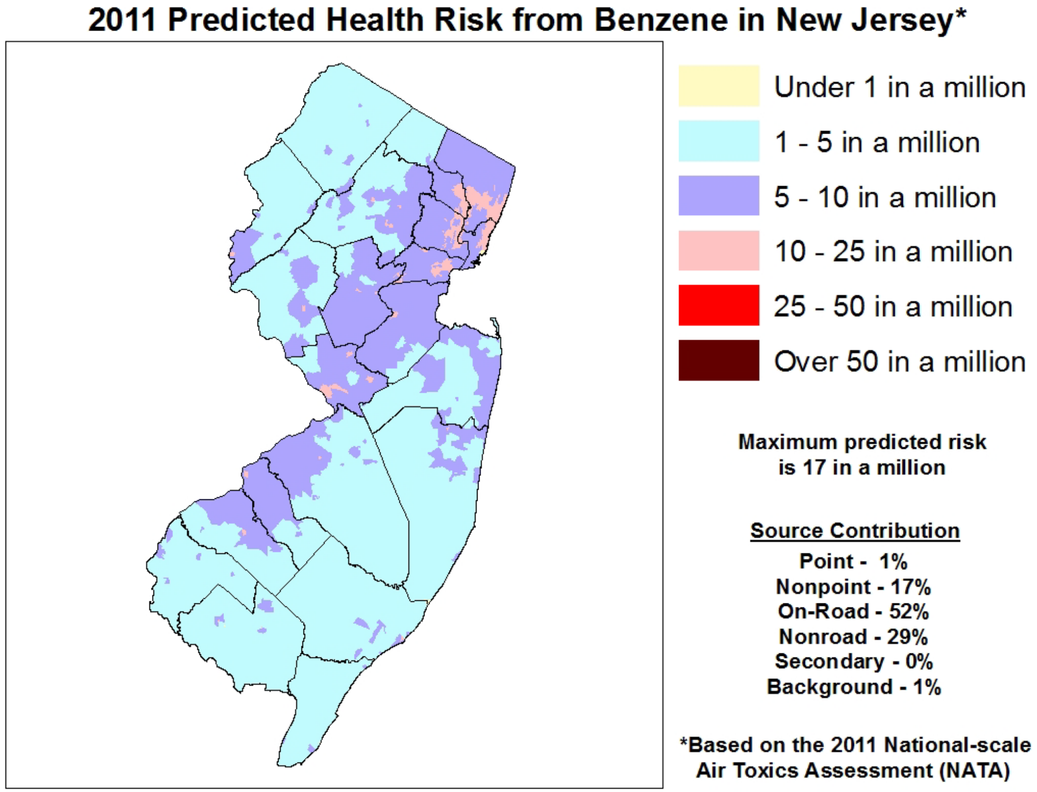
<u>Source Category</u>

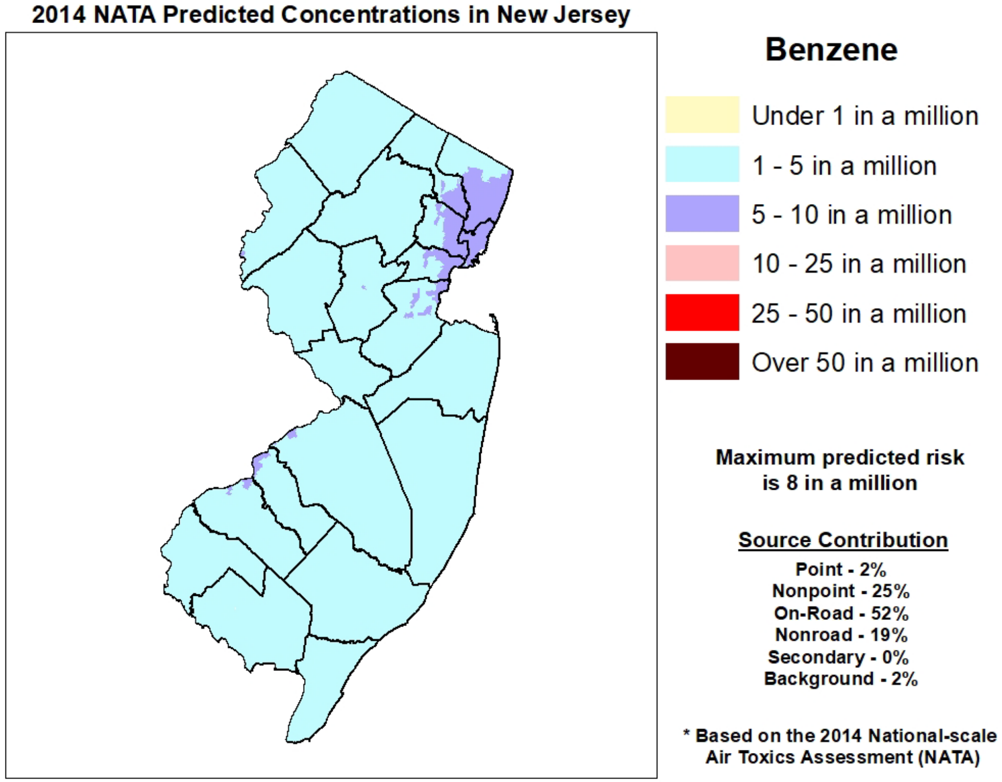
Point - 2%
Nonpoint - 6%
On-road - 3%
Nonroad - 5%
Secondary - 76%
Background - 8%

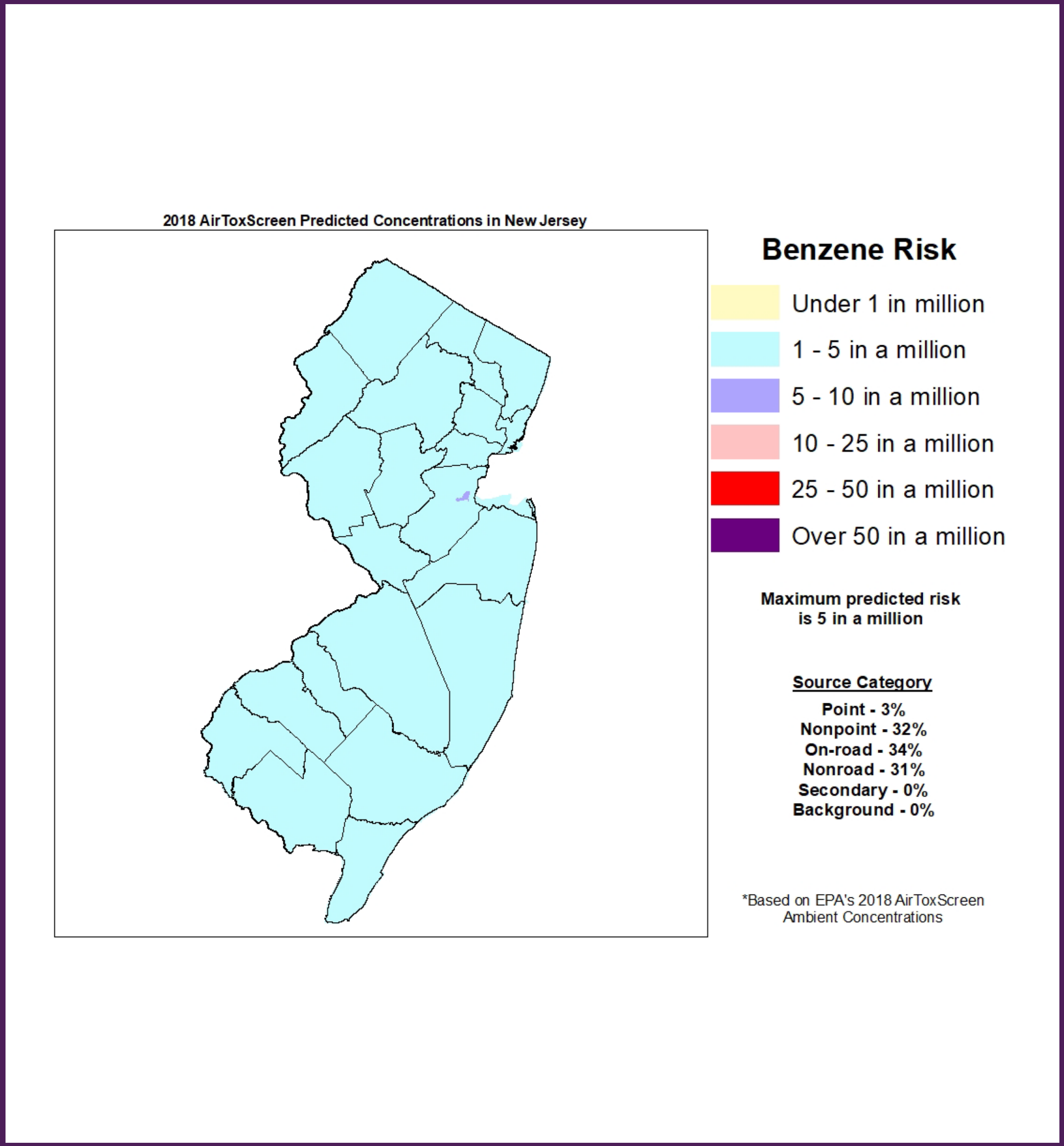
*Based on EPA's 2019 AirToxScreen Ambient Concentrations

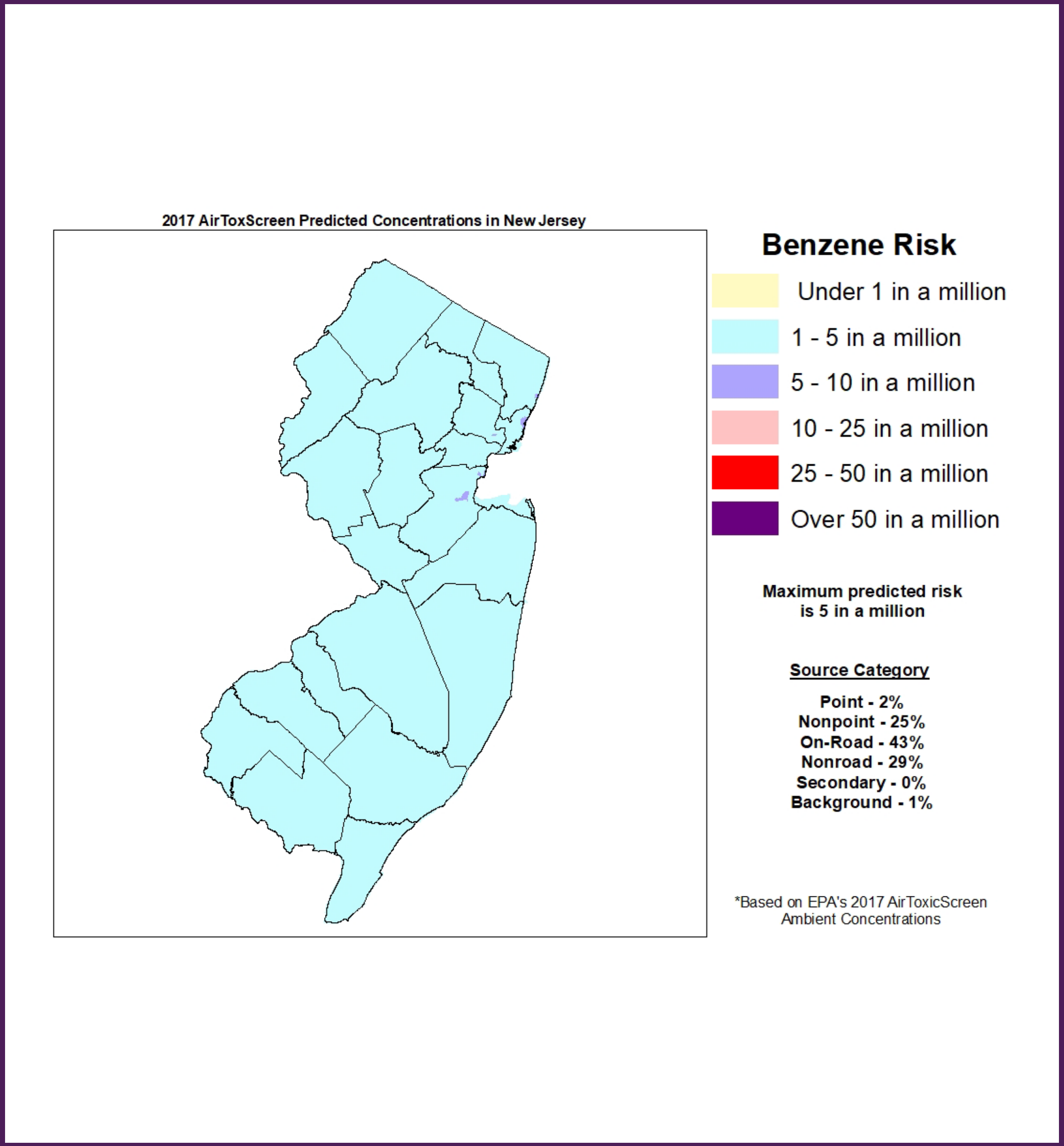

Predicted Concentrations in New Jersey
Benzene Risk
Under 0.5 times ben
0.5 - 1 times benchm
1 - 5 times benchma
5 - 10 times benchm
10 - 50 times benchm
Over 50 times bench
Maximum average census
concentration is 8.33 ug/
64 times the health bench
Health Benchmark = 0.13
Source Contributior
Major - 1%
Area - 13%
On-Road Mobile - 40
Nonroad Mobile - 13
Background - 33%
N


licted Concentrations in New Jersey
Benzene Risk
Under 0.5 times benchma
0.5 - 1 times benchmark
1 - 5 times benchmark
5 - 10 times benchmark
10 - 50 times benchmark
Over 50 times benchmark
Maximum average census trac
concentration is 5.4 ug/m3, or
42 times the health benchmarl
Health benchmark = 0.13 ug/m
Source Contribution
Point - <1%
Nonpoint - 13%
On-Road - 30%
Nonroad - 13%
Background - 44%
Secondary - 0%

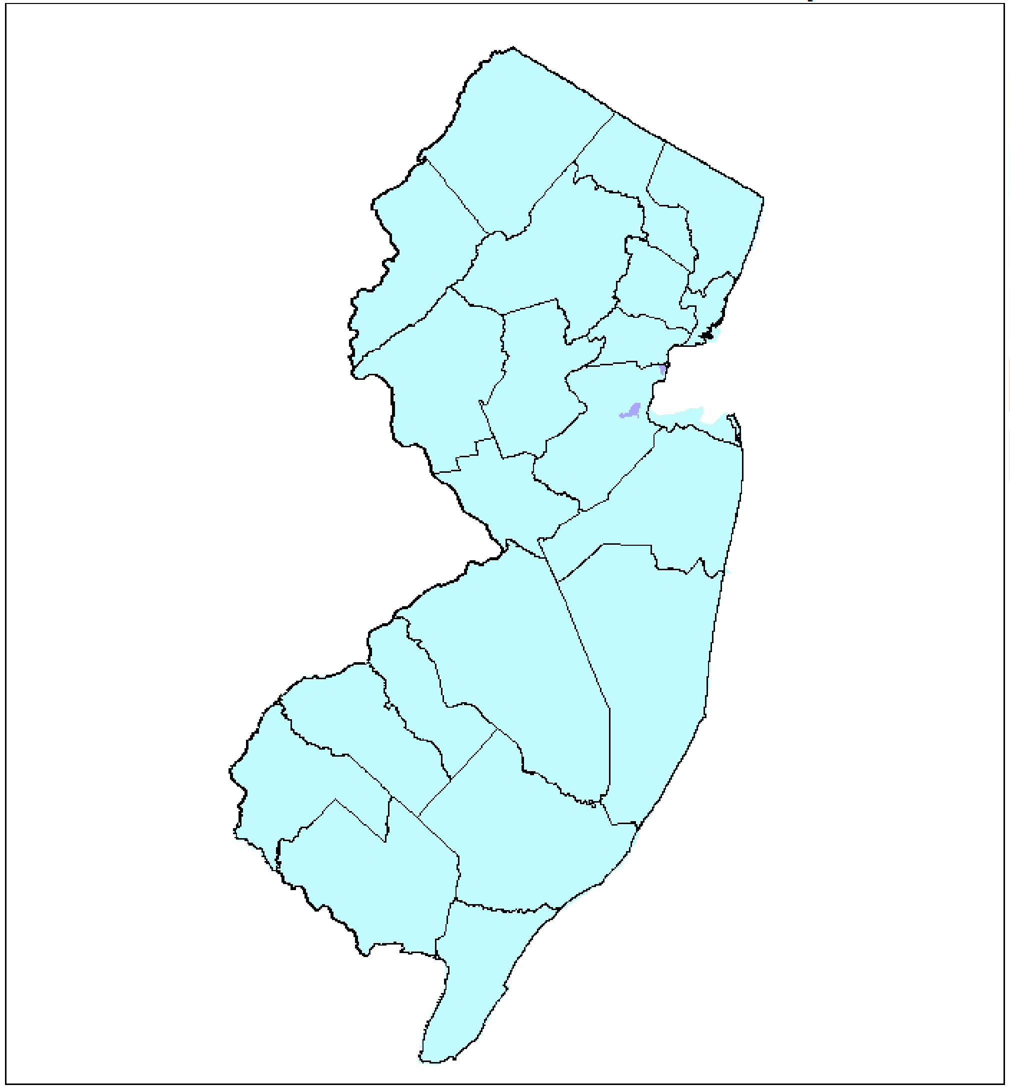

2011 Predicted Health Risk from Benzene in New Jersey*
Under 1 in a million
1 - 5 in a million
5 - 10 in a million
10 - 25 in a million
25 - 50 in a million
Over 50 in a million
Maximum predicted risk is 17 in a million
Source Contribution
Point - 1%
Nonpoint - 17%
On-Road - 52%
Nonroad - 29%
Secondary - 0%
Background - 1%
*Based on the 2011 National-scale Air Toxics Assessment (NATA)


2014 NATA Predicted Concentrations in New Jersey
Benzene
Under 1 in a million
1 - 5 in a million
5 - 10 in a million
10 - 25 in a million
25 - 50 in a million
Over 50 in a million
Maximum predicted risk is 8 in a million
Source Contribution
Point - 2%
Nonpoint - 25%
On-Road - 52%
Nonroad - 19%
Secondary - 0%
Background - 2%
* Based on the 2014 National-scale Air Toxics Assessment (NATA)


2018 AirToxScreen Predicted Concentrations in New Jersey
Benzene Risk
Under 1 in million
1 - 5 in a million
5 - 10 in a million
10 - 25 in a million
25 - 50 in a million
Over 50 in a million
Maximum predicted risk is 5 in a million
Source Category
Point - 3%
Nonpoint - 32%
On-road - 34%
Nonroad - 31%
Secondary - 0%
Background - 0%
*Based on EPA's 2018 AirToxScreen Ambient Concentrations


2017 AirToxScreen Predicted Concentrations in New Jersey
Benzene Risk
Under 1 in a million
1 - 5 in a million
5 - 10 in a million
10 - 25 in a million
25 - 50 in a million
Over 50 in a million
Maximum predicted risk is 5 in a million
Source Category
Point - 2%
Nonpoint - 25%
On-Road - 43%
Nonroad - 29%
Secondary - 0%
Background - 1%
*Based on EPA's 2017 AirToxicScreen Ambient Concentrations

2019 AirToxScreen Predicted Concentrations in New Jersey



Benzene Risk

- Under 1 in million
- 1 - 5 in a million
- 5 - 10 in a million
- 10 - 25 in a million
- 25 - 50 in a million
- Over 50 in a million

Maximum predicted risk is 5 in a million

<u>Source Category</u>

Point - 3%
Nonpoint - 32%
On-road - 34%
Nonroad - 31%
Secondary - 0%
Background - 0%

*Based on EPA's 2019 AirToxScreen Ambient Concentrations

2017 Permitting Rule Amendments

2017 Rule Amendments changed the threshold levels for reporting air toxics on permit applications

- 126 Hazardous Air Pollutant (HAP) reporting thresholds were lowered
- 17 HAP thresholds were raised
- 49 HAP thresholds did not change

Recommendations for Consideration

- Environmental Justice
  - How can air toxics monitoring help overburdened communities?
  - How can cumulative risk be evaluated in overburdened communities?
- Air Monitoring
  - Are the number and locations of the air toxics monitoring stations sufficient?
  - What additional air toxics should be monitored?
  - Should the DEP consider less expensive but less accurate monitoring technology?
- Air Quality Regulation & Evaluation
  - Should the Emission Statement program be expanded?
    - Sources types required to report Air Toxic Emissions
    - List of substances reported
    - Reporting level reported (facility level vs stack level)

More Information

- **NJ DEP Air Monitoring - https://www.nj.gov/dep/airmon/**
- **EPA's AirToxScreen - https://www.epa.gov/AirToxScreen**
- **NJDEP's Stop the Soot - https://dep.nj.gov/stopthesoot/**
- **NJDEP's Air Toxics website - https://dep.nj.gov/airplanning/airtoxics/**

Extra Materials

2012 Vinyl Chloride Release in Paulsboro, NJ

- A train carrying vinyl chloride derailed in Paulsboro NJ on November 30, 2012.
- Recovery operations for the derailed train cars ended on December 17, 2012.
- Approximately 24000 gallons were released.
- Although locally people experienced symptoms of exposure, NJ’s monitoring stations measured no detectable levels.

2012 Vinyl Chloride Monitoring in NJ

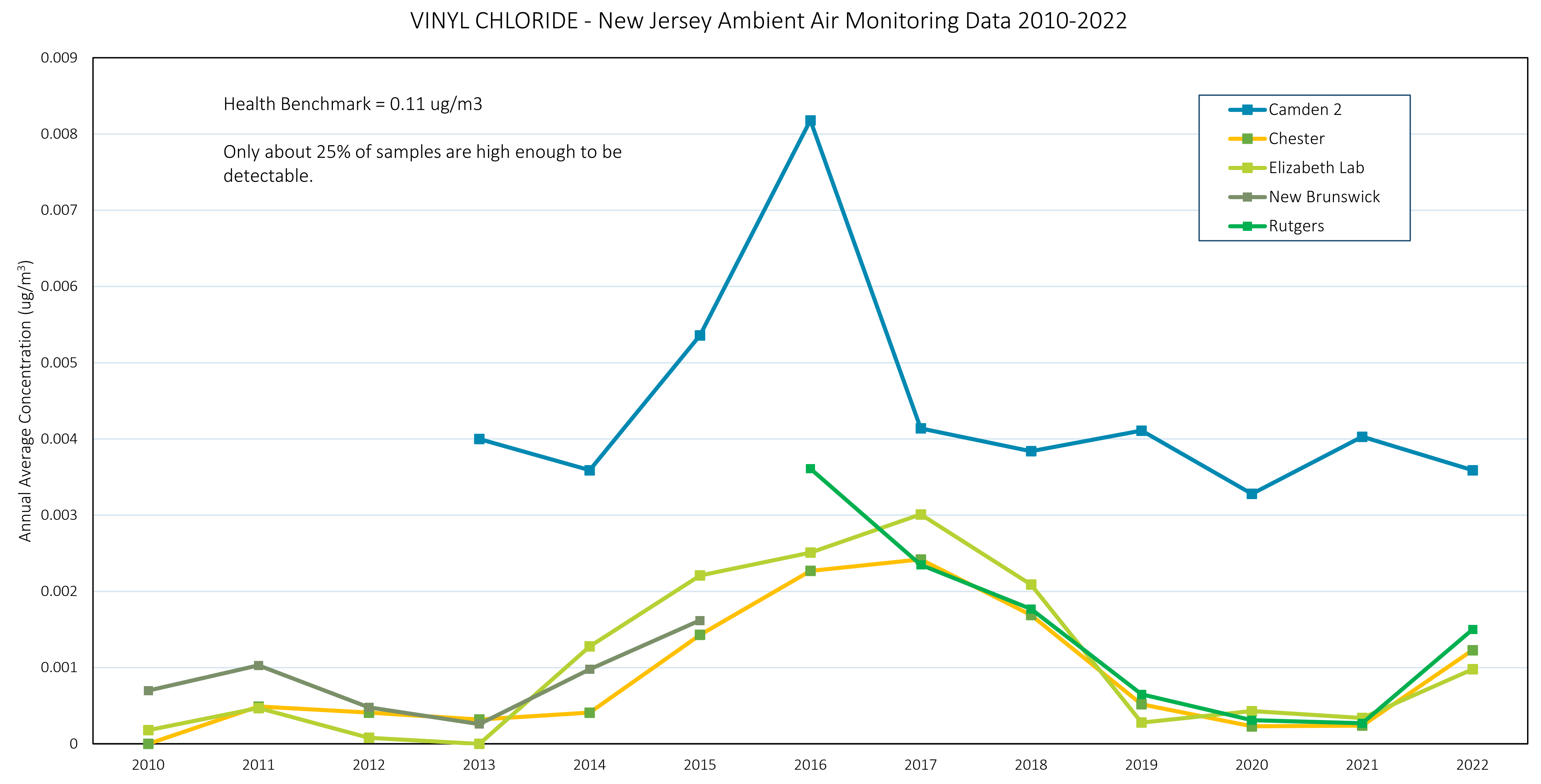
- Monitoring stations were located in Chester (Morris County), Elizabeth (Union County) & New Brunswick (Middlesex County).
- Camden had no monitoring station from 2009-2012.
- In 2012, less than 10% of VC samples were measurable.
- October-December 2012 VC levels were non-detectable at the NJ monitoring stations.

2023 Vinyl Chloride Release in Ohio

- A train carrying vinyl chloride derailed in East Palestine, Ohio on February 3, 2023. Vinyl chloride was the chemical of concern that was released from the derailed train cars
- Over 100000 gallons of “hazardous materials” were released, including vinyl chloride
- After the initial derailment and release, there was a fire, and a deliberate release where the contents of the tanker cars were burned off over 3 days to prevent a possible explosion
- EPA and Ohio authorities reported Vinyl Chloride measurements taken outside exclusion zone were below levels of concern

2023 Vinyl Chloride Monitoring in NJ

- Monitoring stations are located in Camden (Camden County), Chester (Morris County), Elizabeth (Union County) & Rutgers (Middlesex County).
- Vinyl chloride, was detected in samples collected on February 5 at three of the sites (Chester, Elizabeth, and Rutgers) but was not detected at the Camden site.
- The levels ranged between 0.004 micrograms per cubic meter (ug/m^3) at Rutgers and 0.007 ug/m^3 at Elizabeth
- Measured levels are comparable to historical levels, which are typically very low in the range of 0.005 ug/m^3 to 0.010 ug/m^3 when detected.


VINYL CHLORIDE - New Jersey Ambient Air Monitoring Data 2010-2022
Health Benchmark = 0.11 ug/m3
Only about 25% of samples are high enough to be detectable.
Annual Average Concentration (ug/m3)
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Camden 2
Chester
Elizabeth Lab
New Brunswick
Rutgers

Vinyl Chloride Health Impacts

Comparison of historical levels (0.005 ug/m^3 to 0.010 ug/m^3)

- Significantly below the level at which there are acute (short term exposure) health impacts (180,000 ug/m^3 in any hour of exposure)
- Well below the level at which there are chronic (long term exposure) health impacts (100 ug/m^3 averaged over one year of exposure).
- If an individual was exposed to the historical levels for their entire lifetime, the increased cancer risk would be around 0.05 in a million which is more than ten times below the long-term cancer health benchmark.