$PM_{2.5}$ Overview

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$PM_{2.5}$: Background, Current Status, and Implications

1. **PM SCIENCE:** What is Particulate Matter (“PM”)?
2. **REGULATIONS:** Rules & Historical Context
3. **MEASUREMENTS:** Current Air Quality Status
4. **IMPLICATIONS:** Why Nonattainment is a Problem
5. **GOING FORWARD:** What’s Next?

1. PM Science

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What is Particulate Matter?

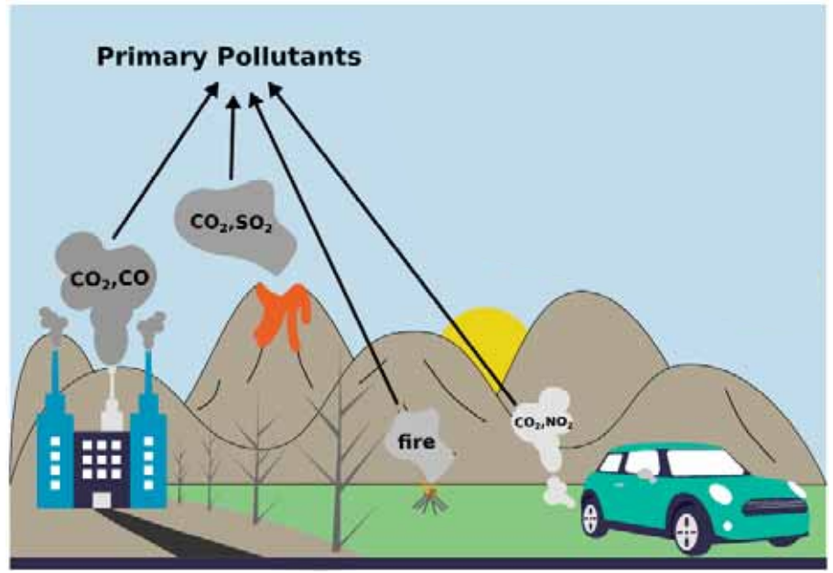
- PM is a suspension of a liquid or solid in the atmosphere
- All such matter is collectively considered PM
  - Examples: dust, sand, soot, fibers, paint overspray, metal shavings
- Why consider them collectively?
  - Affect health as they impact breathing
  - Affect the environment as they impact visibility

How Does PM Get Into the Air?

Primary Emissions – released directly into the atmosphere by some process

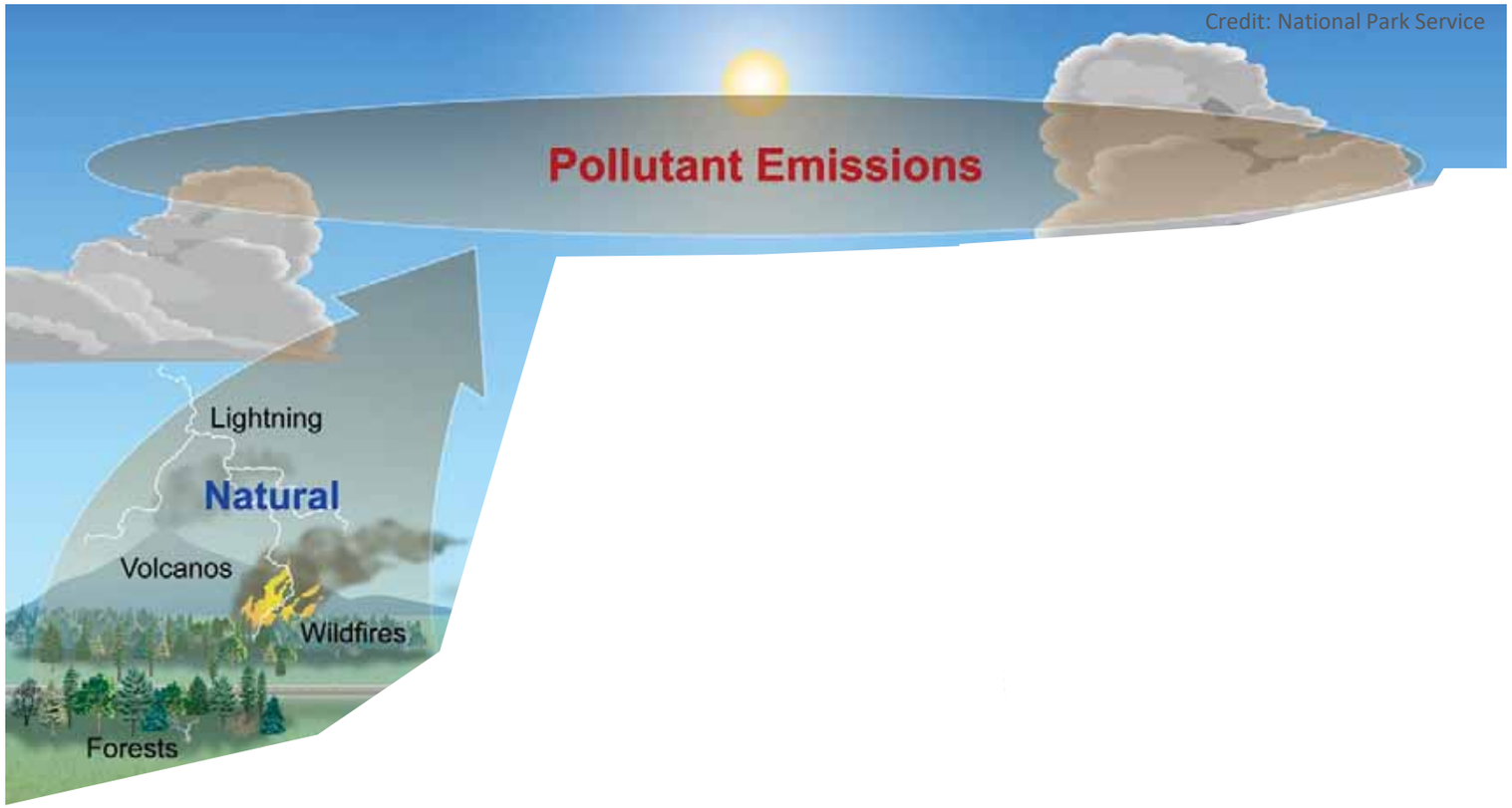
Secondary Emissions – formed in the atmosphere following reactions that occur among primary emissions

- Think ozone
- For example, coagulation of carbons



Credit: psiberg.com

What *Processes* Produce PM Emissions?

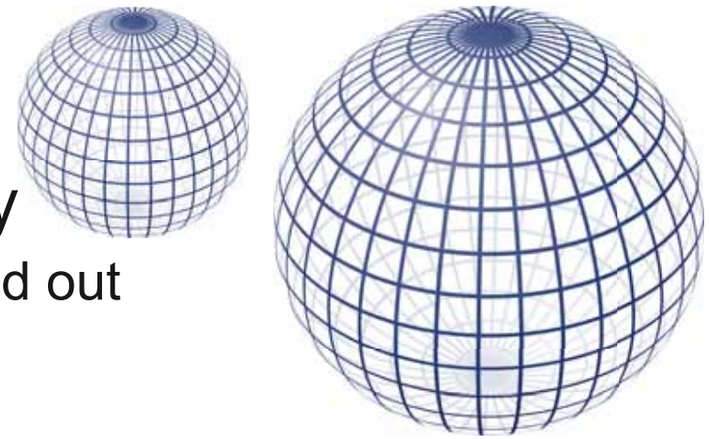


How Much Does Each of These Processes Contribute?

From the US EPA 2020 National Emissions Inventory for TX & LA (Total $PM_{2.5}$ Emissions: 417,201 tons)

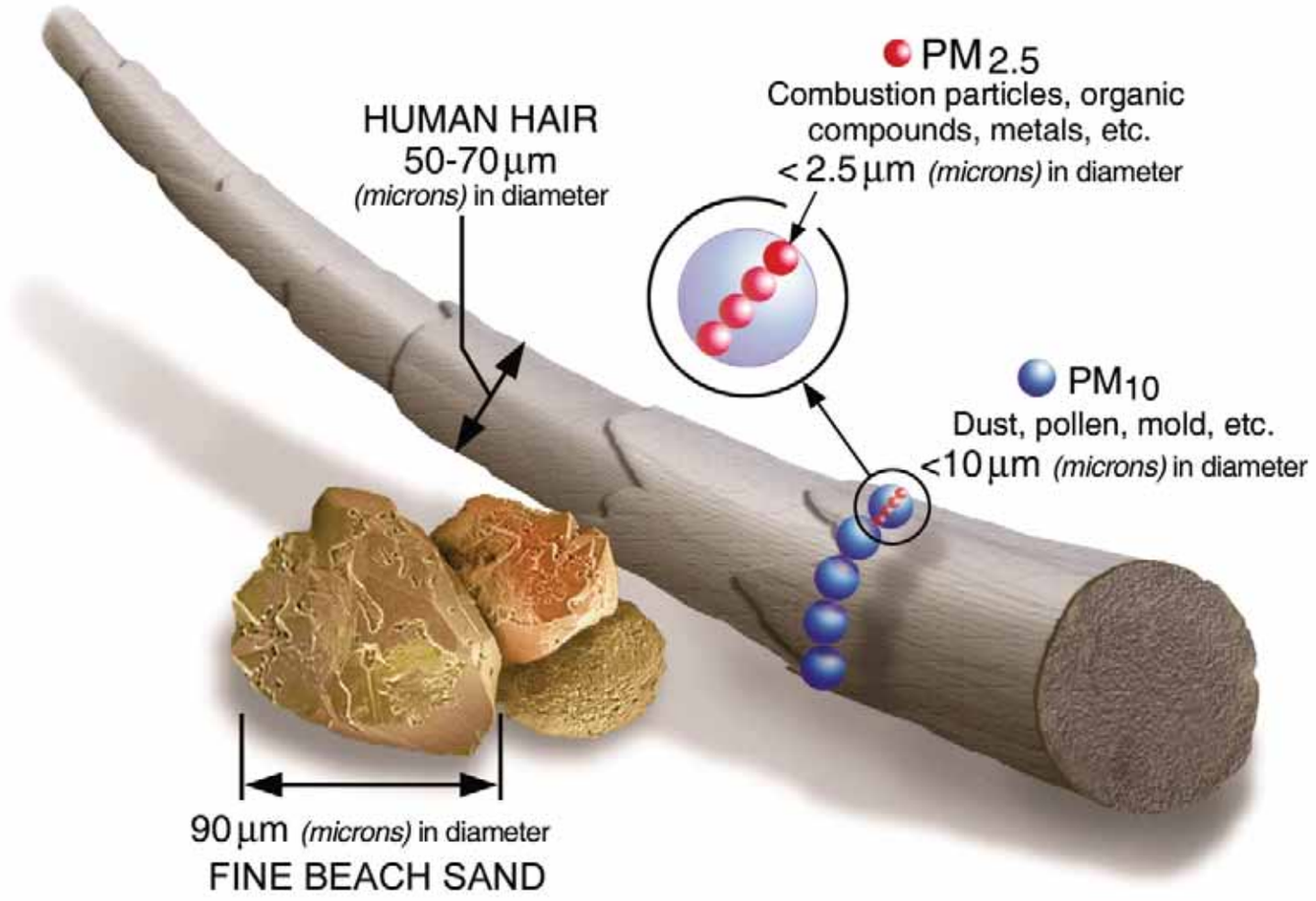
Rank	Sector	Source Type	$PM_{2.5}$ Emissions (tons)	% of Total $PM_{2.5}$	Cumulative %
1					
2					
3					
4					
5					

Size & Measurement



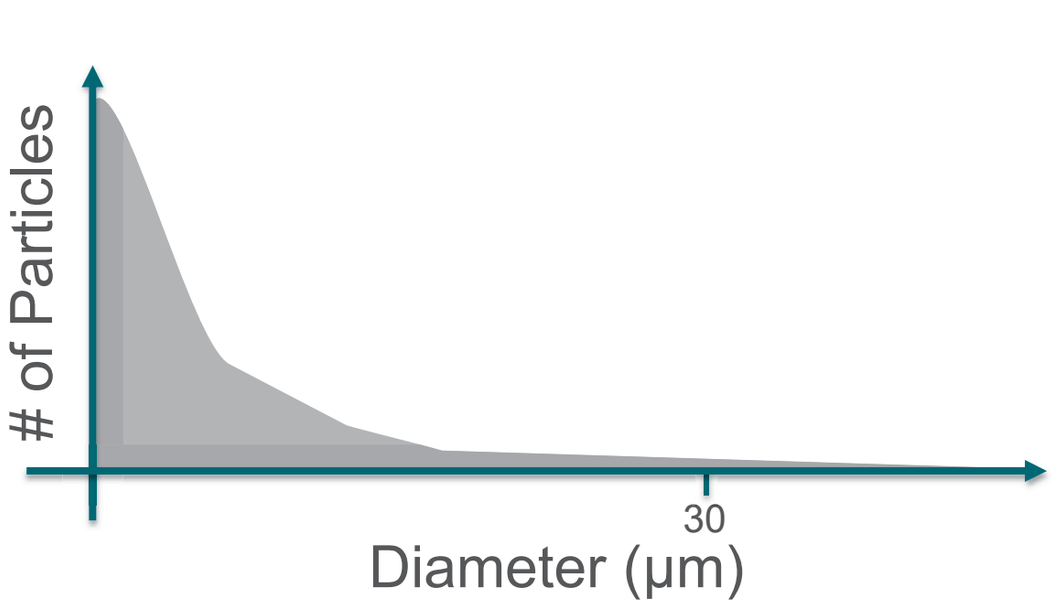
- The size of the particles matters tremendously
  - Smaller particles can reach lungs; larger ones get filtered out
  - Larger particles are heavier and fall out more quickly
- Particles are measured by their diameter
  - Usually in *microns*, short for *micrometer* and abbreviated “µm”
  - 1,000,000 µm = 1 meter
  - 1,000 µm = 1 mm
- Diameter is 2-dimensional, but we live in a 3-dimensional world
  - $Volume\ of\ a\ Sphere = \frac{4}{3}\pi r^3 = \frac{1}{6}\pi d^3$
  - Double the diameter, increase the volume (and therefore mass) by a factor of 8

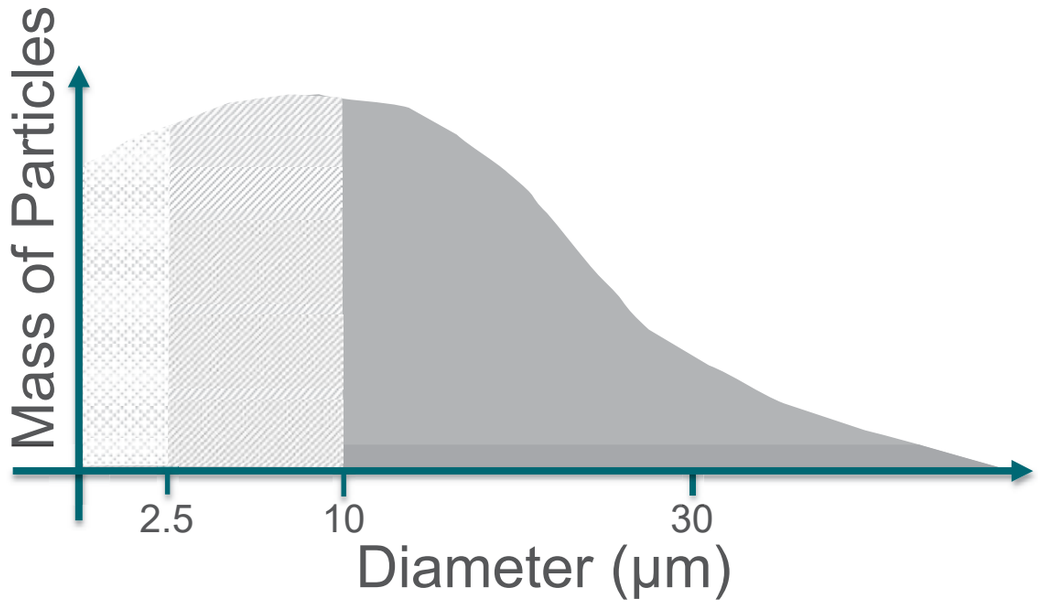
Putting Size into Perspective



Credit: US EPA

What are PM_{10} and $PM_{2.5}$?





- PM can be tracked by size in a Particle Size Distribution (not *that* PSD)
- PM_{10} is the combined mass of all PM with diameter 10 μm or less
- $PM_{2.5}$ is the combined mass of all PM with diameter 2.5 μm or less

2. Regulations & History

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What Are the Requirements?

EPA has established National Ambient Air Quality Standards ("NAAQS")

- **Primary** standards for health & **Secondary** standards for human welfare

Pollutant [links to historical tables of NAAQS reviews]		Primary/ Secondary	Averaging Time	Level	Form
Particle Pollution (PM)	$PM_{2.5}$	primary	1 year	12.0 µg/m^3	annual mean, averaged over 3 years
		secondary	1 year	15.0 µg/m^3	annual mean, averaged over 3 years
		primary and secondary	24 hours	35 µg/m^3	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24 hours	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years

How Have the $PM_{2.5}$ Standards Evolved?

24-Hour Average

- 1997: 65 µg/m³
- 2006: 35 µg/m³
- 2012: 35 µg/m³
- 2020: 35 µg/m³

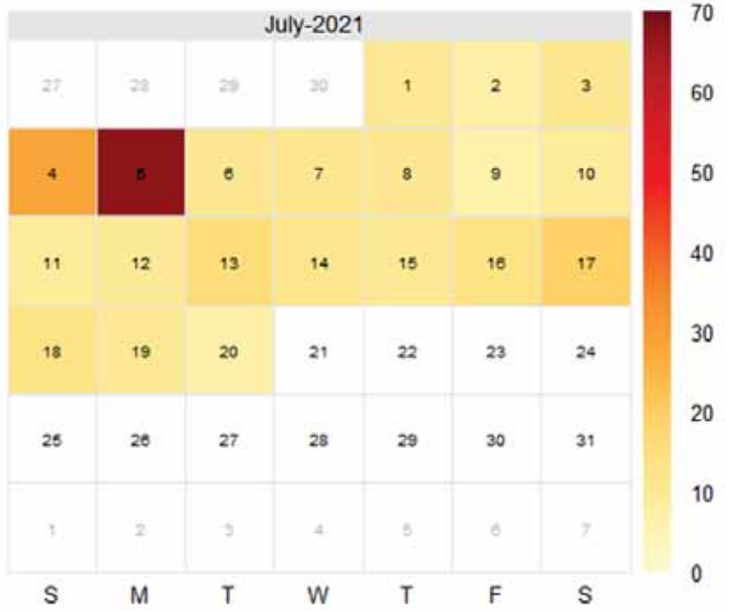
98th Percentile, averaged over 3 years

- 365 days/yr, so 2% = 7 days
- 98th percentile = 8th highest day
- Spikes are de-emphasized

Annual Average

- 1997: 15.0 µg/m³
- 2006: 15.0 µg/m³
- 2012: 12.0 µg/m³
- 2020: 12.0 µg/m³

3-year average of **all** data



3. Current Air Quality

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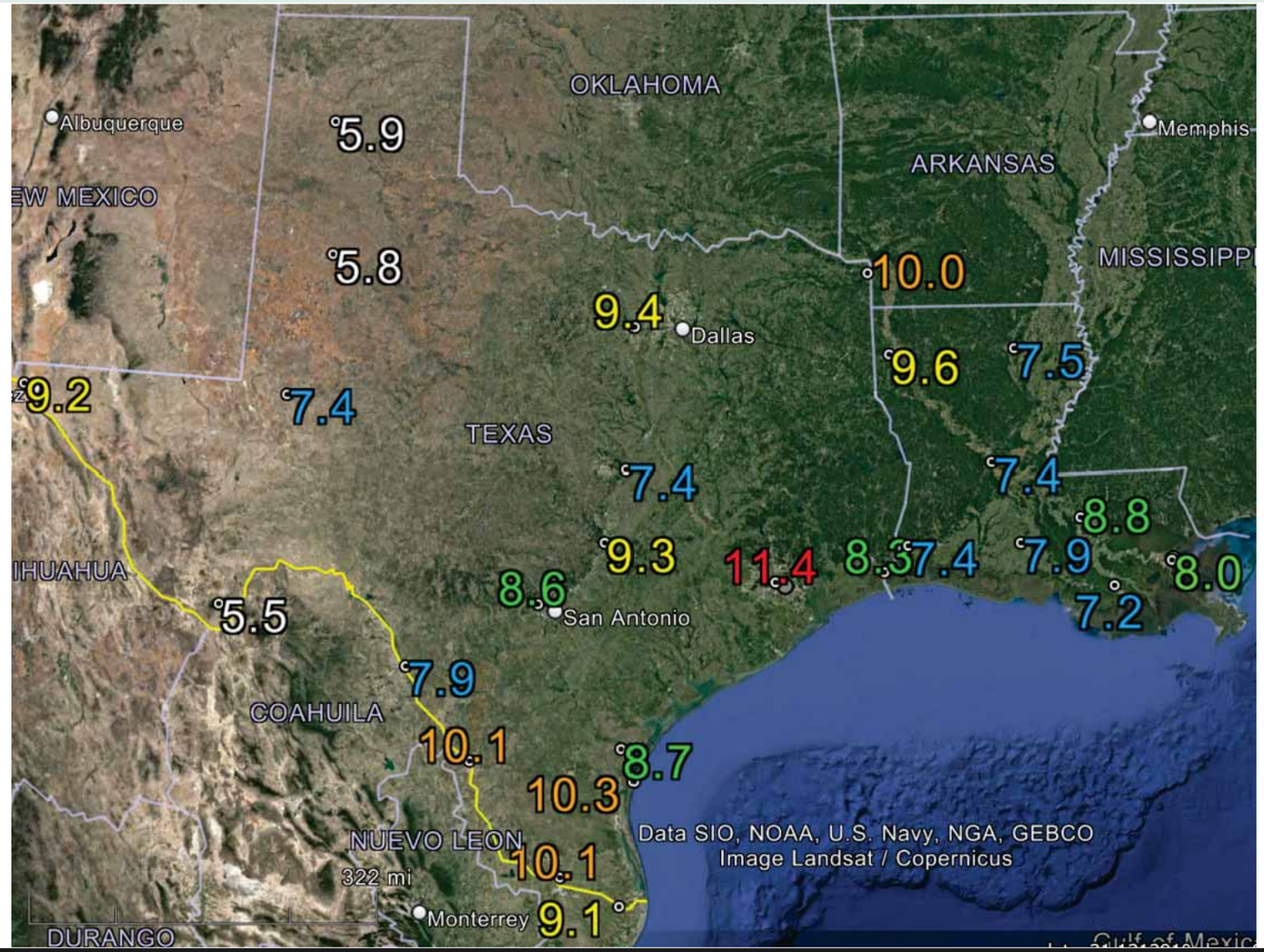
Texas & Louisiana

Annual $PM_{2.5}$ Design Values, 2020-2022

Official Monitoring Data

- Must be complete
- Must be validated



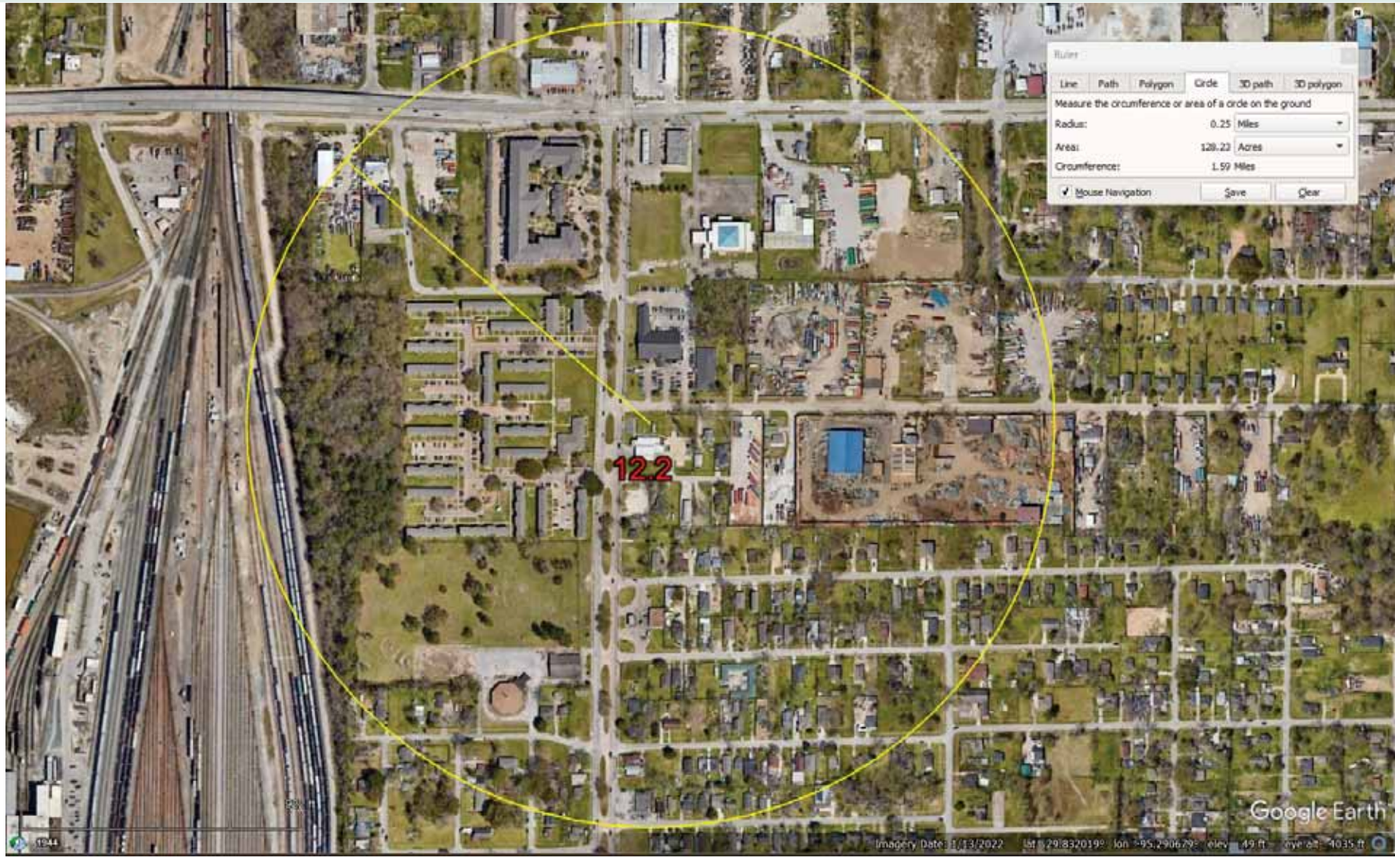
Why the Variability?

- What local sources influence monitoring data?
- We must look at the surrounding area
- Consider the scale of sources, evaluating their magnitude and proximity

Why Scale is Important

North Wayside Monitor

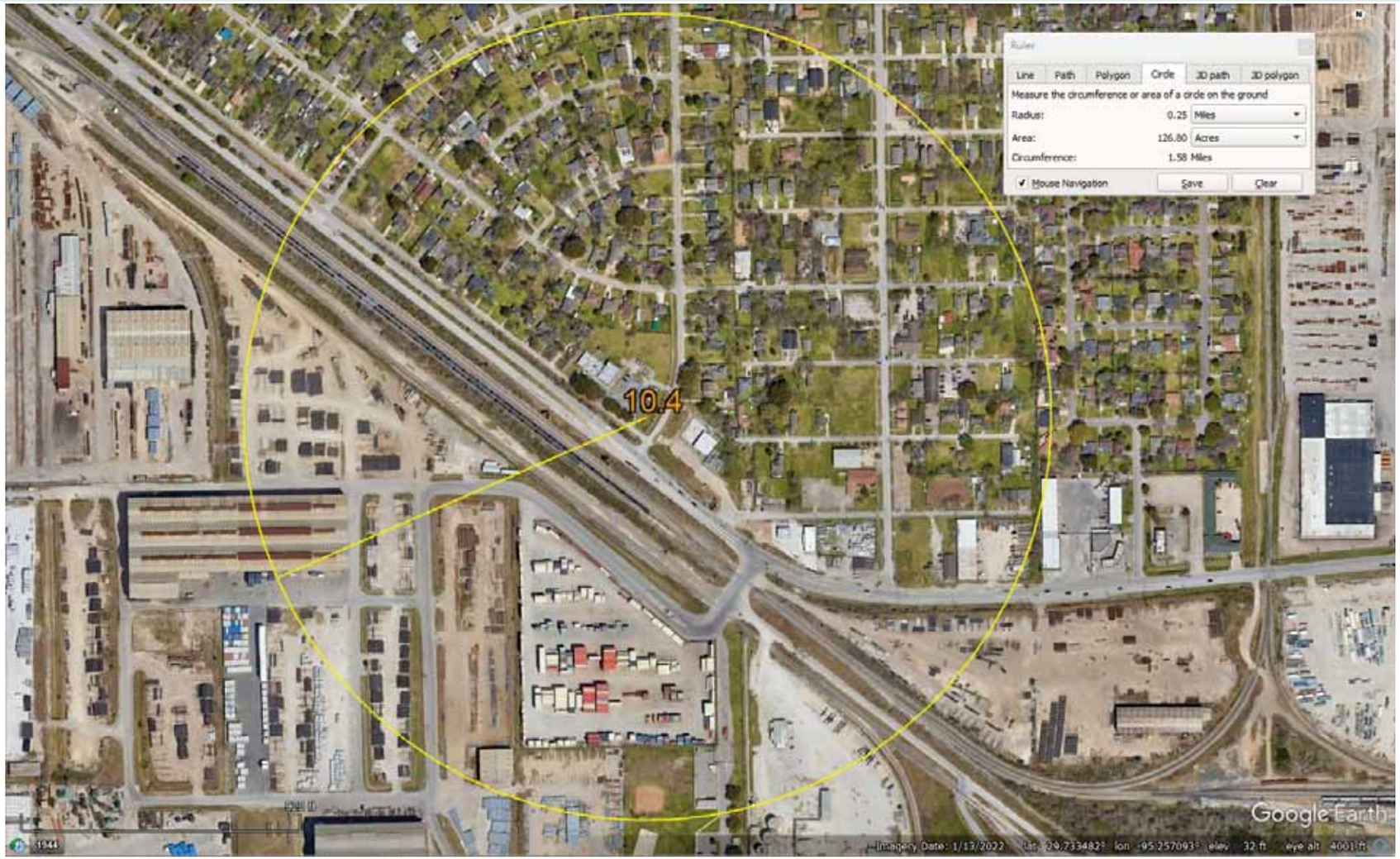
0.25-mile radius



Why Scale is Important

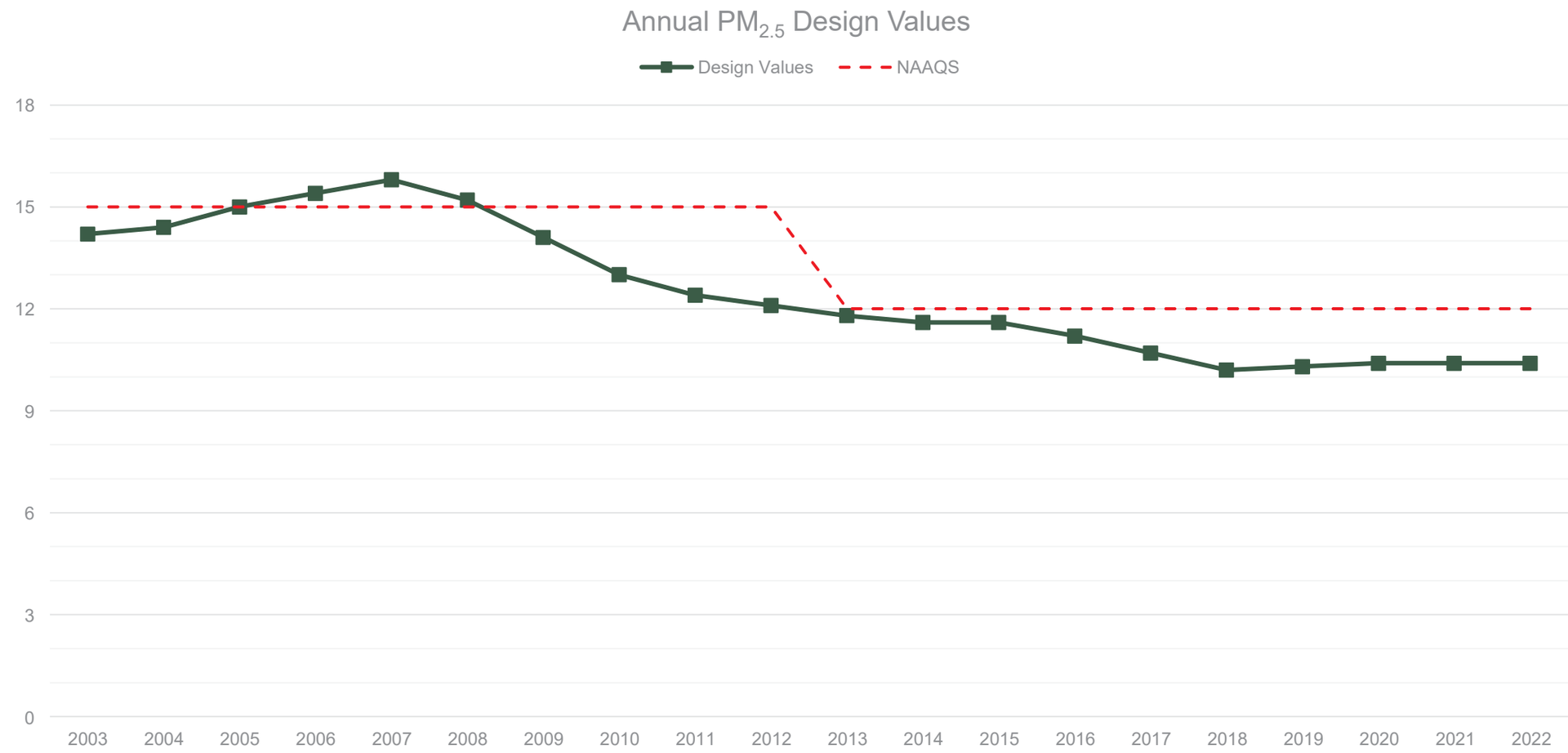
Clinton Drive Monitor

0.25-mile radius



Why *Location* is Important

Clinton Drive Monitor



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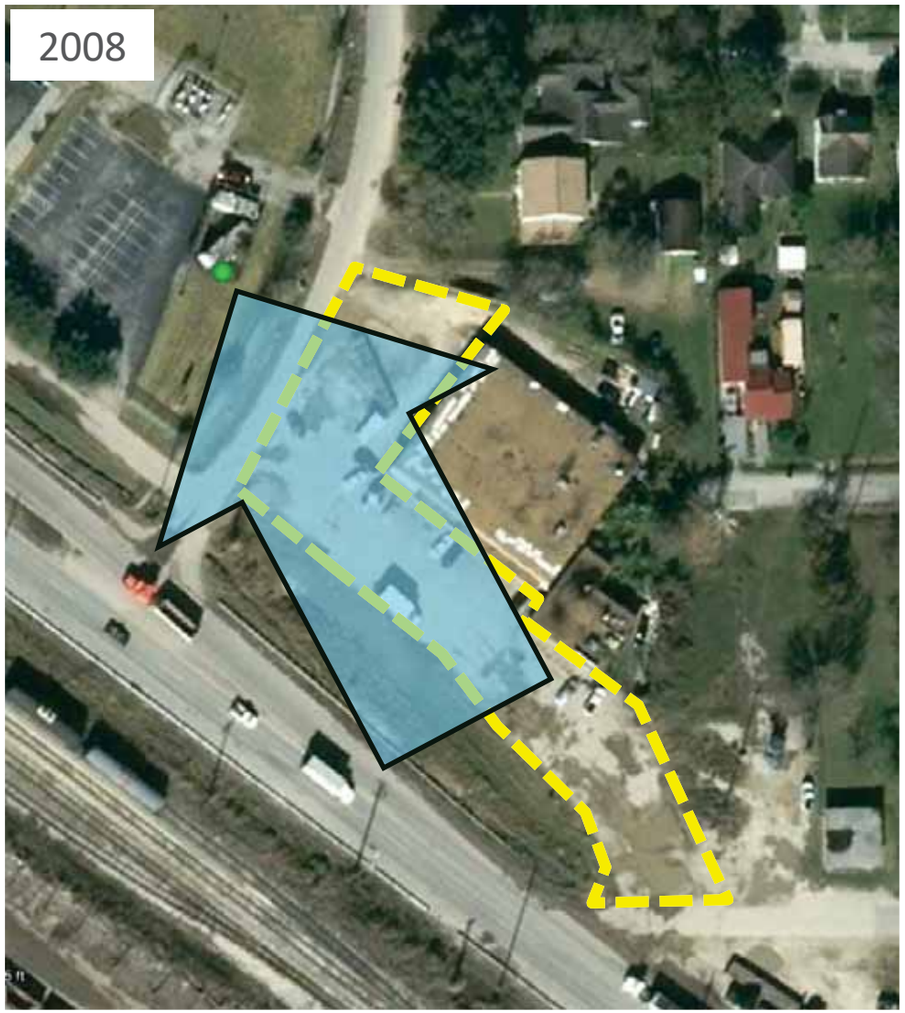
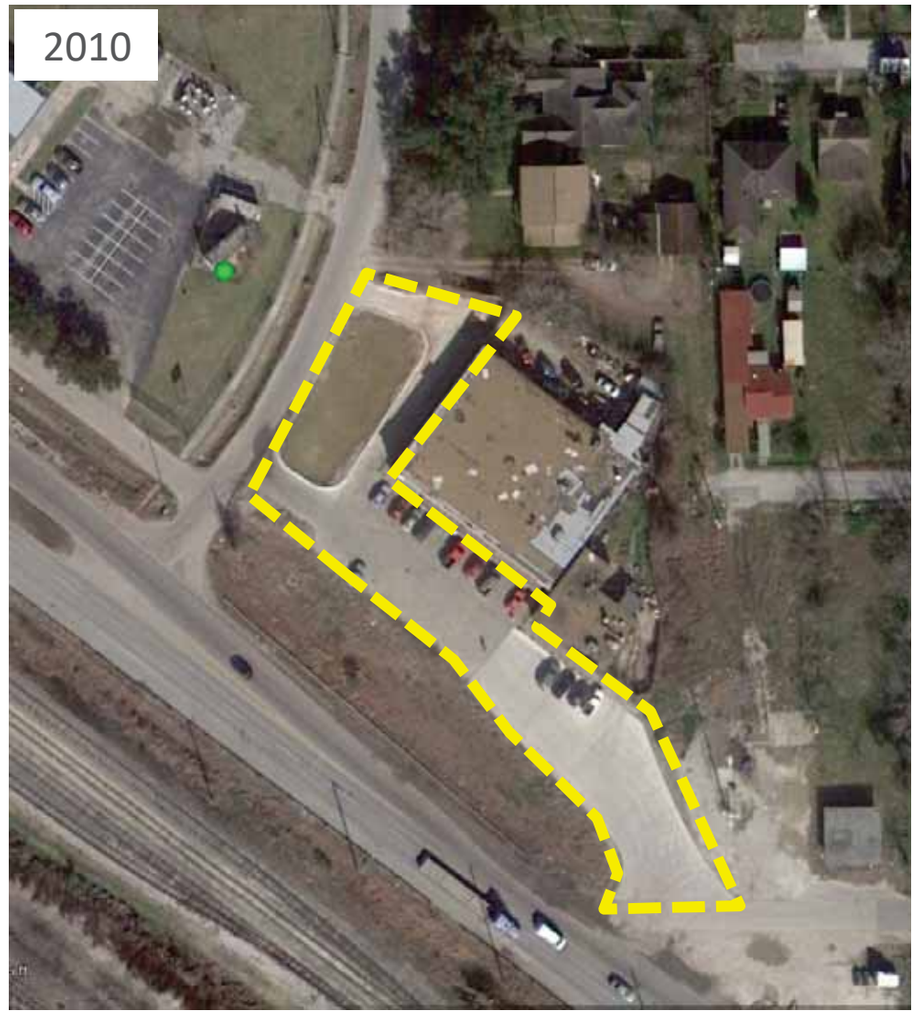




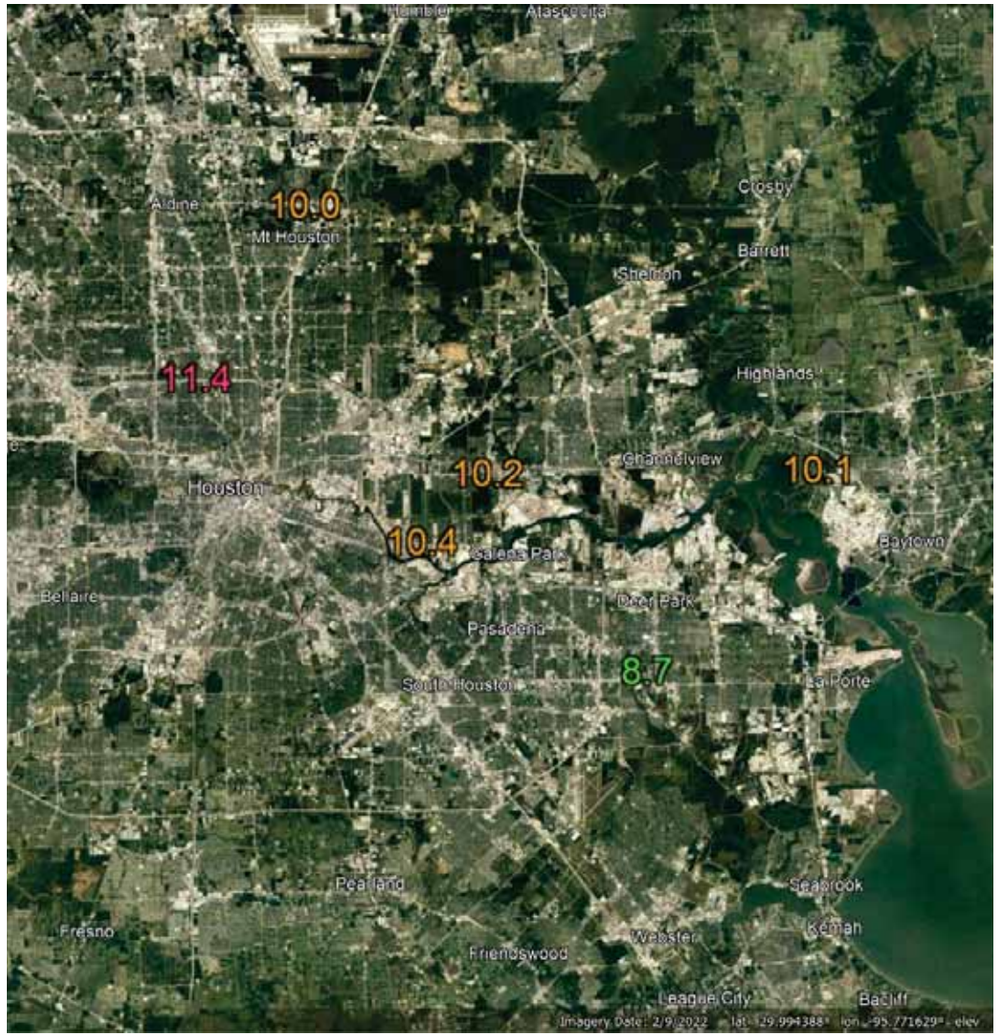
The Sky is Falling!

Current Annual NAAQS = 12 µg/m³

On 01/27/2023, EPA proposed:

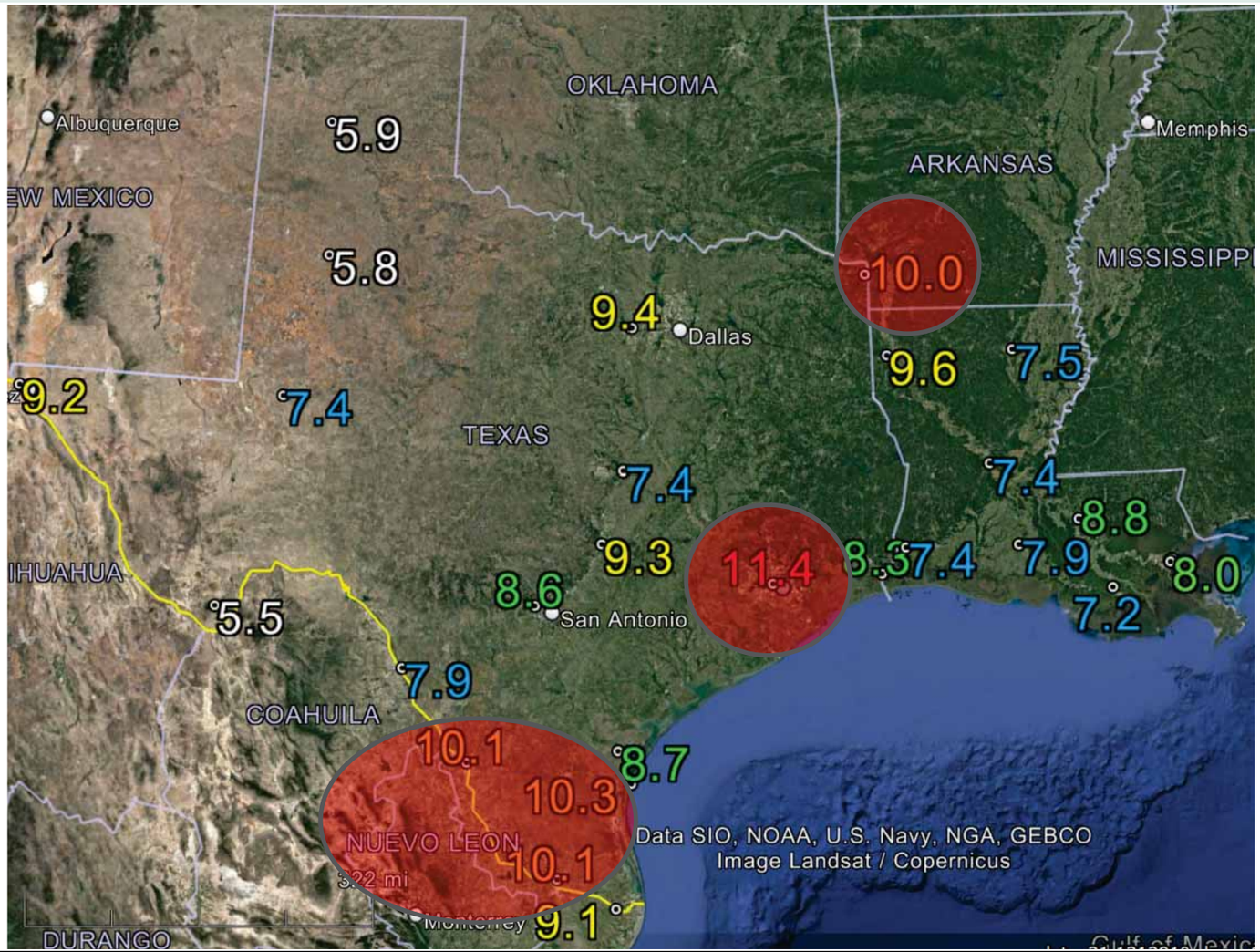
- Lowering the NAAQS to 9-10 µg/m³
- Accepting comments on 8 µg/m³

Essentially, any reduction in the NAAQS will result in Houston being designated as **<u>nonattainment</u>** relative to the annual $PM_{2.5}$ NAAQS



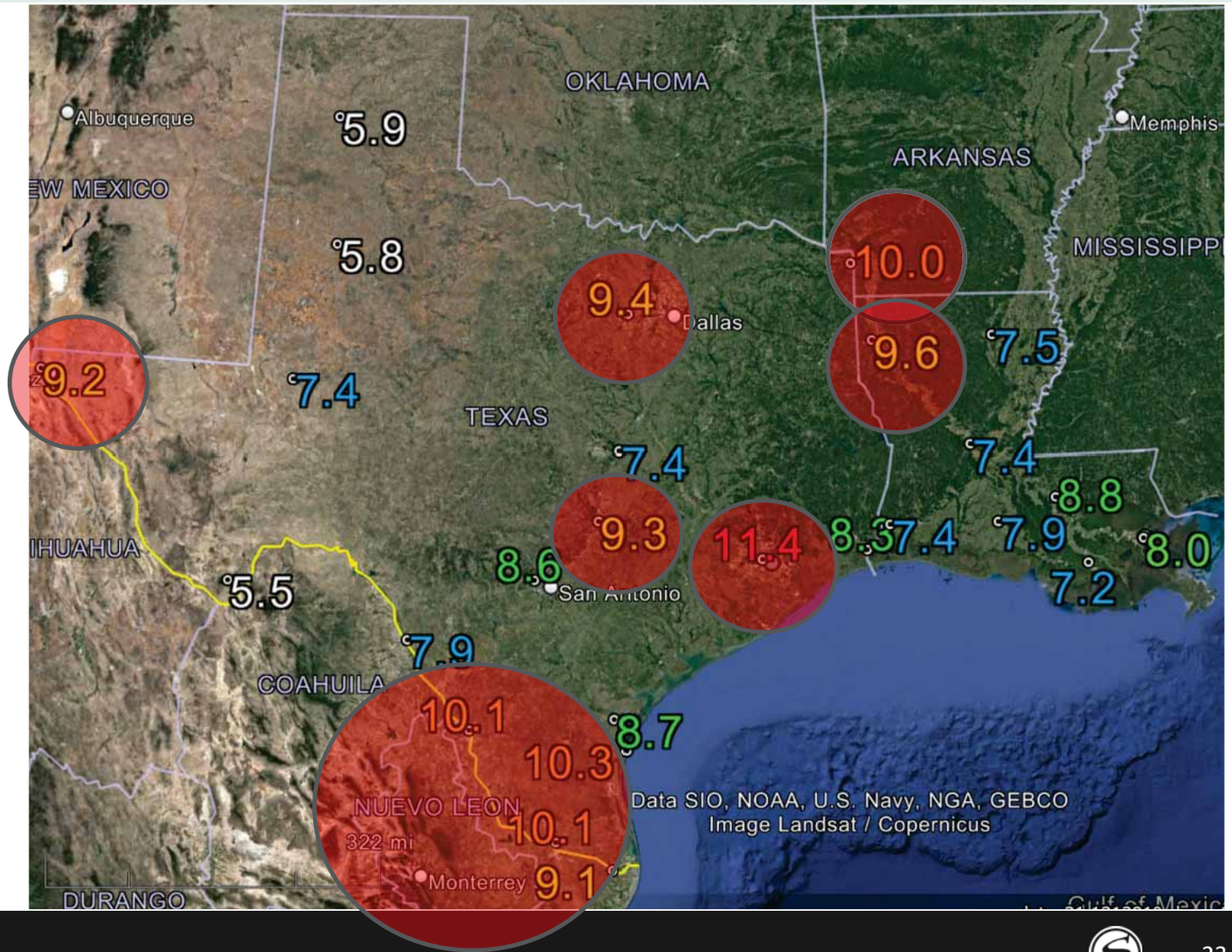
What's Next

If NAAQS = 10 µg/m³…



What's Next

If NAAQS = 9 µg/m³…



4. Implications of Being Nonattainment

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Nonattainment is a Big Problem!

1. Potential health issues
2. More major sources/complex permitting
3. Tougher to authorize expansions
4. More stringent requirements will necessitate additional controls

5. What's Next?

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What Happens Next?

Potential Implementation Timeline

Date	Event
December 2023	$PM_{2.5}$ NAAQS revision finalized
December 2024	State designation submittal
August 2025	120-day Letter from US EPA to Governor
Early 2026	Final designations effective
December 2026	Infrastructure and Transport SIPs due
July 2027	Nonattainment Area SIPs due
December 2032	Attainment Date

Let’s Continue the Conversation!

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