MERPS and an Updated Status of Ozone and $PM_{2.5}$ Compliance Demonstrations

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1. Overview of where we've been
2. What triggers an analysis?
3. What are my options once triggered?
4. [A Very Basic] Case Study
5. What do I need to know?
6. Current state level policies

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Historical Perspective – the issues

- Both Ozone and $PM_{2.5}$ are the result of complex chemical reactions in the atmosphere
  - Ozone formation depends on VOCs, NO_x, meteorology
  - $PM_{2.5}$ impacts depend on combination of
    - Primary impacts of $PM_{2.5}$ directly emitted from the source
    - Secondary impacts from reactions primarily involving SO_2 and NO_x
- Some sophisticated chemical transports computer models had been developed to predict impacts (CAM_x, etc)
  - Very case-specific
  - Time-consuming ($$$)
- Therefore, prediction of transport pollutant impacts (secondary impacts) largely remained untouched for the majority of permit applicants

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Historical Perspective – 2017, 2019, and 2022 Evolution (1/2)

- 2017 revision to *Guideline to Air Quality Models*
  - Recommended a two-tier approach for addressing Ozone and secondary $PM_{2.5}$ impacts
    - Tier I – uses relationships between emissions and ambient impacts from existing modeling studies
      - Modeled Emission Rates for Precursors (MERPs) viewed as Tier I demonstration
    - Tier II – uses chemical transport models
- April 2019 Guidance
  - Rather than establish through rulemaking, EPA issued Guidance
  - Allows consideration of site-specific conditions and regional values
  - Provided framework for developing relationships between precursors and maximum downwind impacts
  - Provided illustrative MERPs – hypothetical single source impacts

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Historical Perspective – 2017, 2019, and 2022 Evolution (2/2)

- In July 2022, EPA issued final Guidance for Ozone and Fine Particulate Matter ($PM_{2.5}$) Permit Modeling
  - Intended to provide final guidance on how a PSD permit applicant can show that it will not cause or contribute to a violation of the NAAQS or PSD increments for Ozone and $PM_{2.5}$
- July 2022 Guidance provides guidance on the following:
  - *Significant Emission Rates (SERs) – do I trigger an analysis?*
  - *Significant Impact Levels (SILs) – do I contribute?*
  - Cumulative Impact Analyses
    - NAAQS (Ozone and $PM_{2.5}$)
    - PSD Increment ($PM_{2.5}$)
  - Class I areas

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What triggers an analysis?

For Sources undergoing PSD Review ONLY…

- For Ozone:
  - If NO_x => 40 tpy
  - If VOC => 40 tpy
  - Must include both pollutants in the analysis

- For $PM_{2.5}$
  - If direct $PM_{2.5}$ emissions => 10 tpy, OR
  - If NO_x emissions => 40 tpy, OR
  - If SO_2 emissions => 40 tpy
  - Must include <u>direct</u> $PM_{2.5}$ AND <u>secondary</u> $PM_{2.5}$ from NO_x and SO_2 in analysis

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Options for demonstration

- Ozone
  - Tier I – Modeled Emission Rates for Precursors (MERPs)
  - Tier II – Photochemical modeling
- $PM_{2.5}$
  - Assess primary $PM_{2.5}$ impacts via AERMOD
  - Assess secondary impacts
    - Tier I – Modeled Emission Rates for Precursors (MERPs)
    - Tier II – Photochemical modeling
- Analysis follows a two-step process familiar to PSD sources
  - First analysis determines if you make a significant impact (SIL analysis)
  - If so, further analysis needed to determine if impacts exceed NAAQS or PSD increment.

(A Very Basic) Case Study

- An example of a MERPs analysis

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How to Perform a Tier I Analysis

- **Case Study**: New source increases 45 tpy NO_x and 300 tpy VOC in mid-Missouri. Proposed stack height is 37m.
  - Since VOC > 40 tpy, ozone analysis is triggered
  - Since NO_x > 40 tpy, ozone and $PM_{2.5}$ analysis is triggered
  - Options: Tier I via MERPs or Tier II via photochemical modeling

- Choice: Tier I via MERPs as a first try

- Why: MERPs provide existing empirical relationships between single source precursor emission rates and secondary impacts. EPA has generated these relationships for hundreds of hypothetical sources with different geographic locations, stack heights, and emission rates.

Thresholds of note

- Significant Impact Levels (SILs)
  - Ozone –
    - 8-hour Class II SIL: 1 ppb
  - $PM_{2.5}$ – *New news!!*
    - Annual Class II SIL: 0.13 µg/m^3 (guidance)
      - Reduced from 0.2 µg/m^3
    - 24-hour Class II SIL: 1.2 µg/m^3
    - Must include direct and secondary impacts

- If source impacts are below the SIL, analysis is complete
- If source impact is above the SIL, cumulative analysis must begin
  - For Ozone, NAAQS analysis
  - For $PM_{2.5}$, NAAQS and PSD Increment

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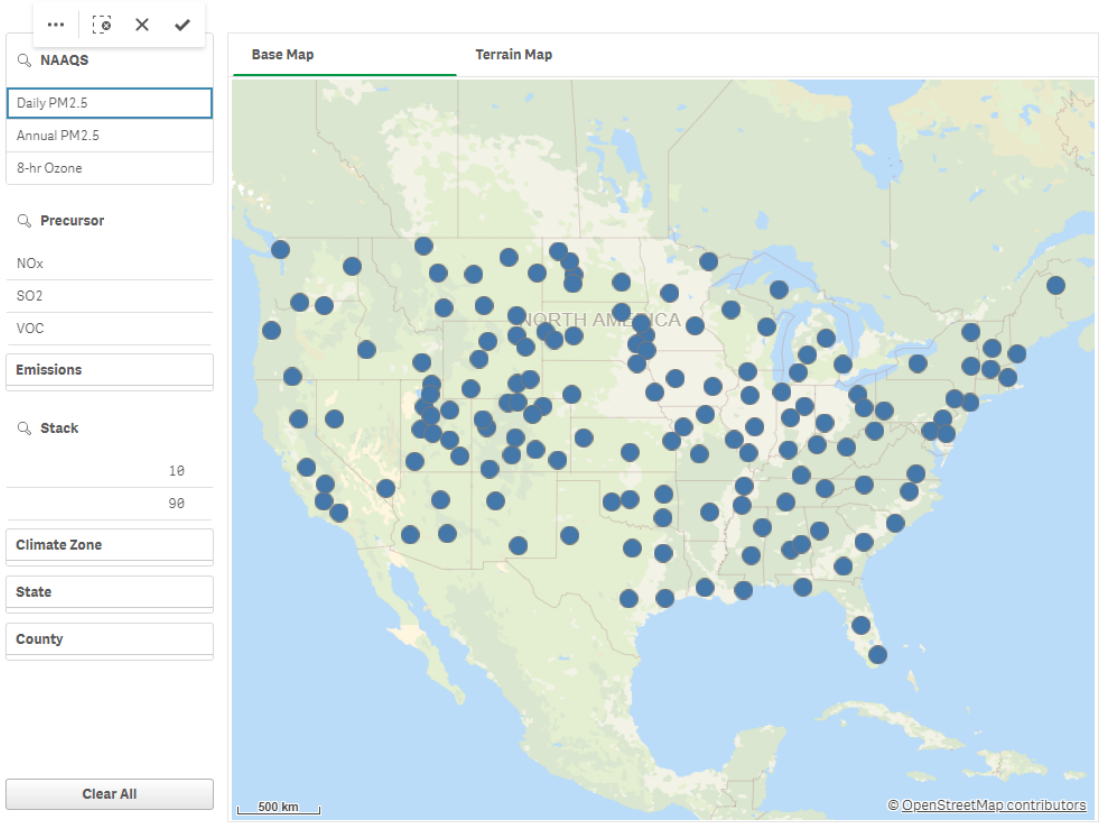
How to Perform a Tier I Analysis

- Find a representative source in EPA's Qlik database
  - https://www.epa.gov/scram/merps-view-qlik

Information intended to support Class II NAAQS Tier 1 demonstrations for permit related programs - **Illustrative hypothetical single source modeled impacts for annual and daily maximum average $PM_{2.5}$ and annual maximum daily 8-hr O_3**



Export Table

State	County	NAAQS	Precursor	Emissi...	Stack
Louisiana	Acadia	Daily PM2.5	NOx	500	10
Louisiana	Acadia	Daily PM2.5	NOx	500	90
Louisiana	Acadia	Daily PM2.5	NOx	1000	10
Louisiana	Acadia	Daily PM2.5	NOx	1000	90
Louisiana	Acadia	Daily PM2.5	NOx	3000	90
Louisiana	Acadia	Daily PM2.5	SO2	500	10
Louisiana	Acadia	Daily PM2.5	SO2	500	90
Louisiana	Acadia	Daily PM2.5	SO2	1000	10
Louisiana	Acadia	Daily PM2.5	SO2	1000	90
Louisiana	Acadia	Daily PM2.5	SO2	3000	90
Missouri	Adair Co	Daily PM2.5	NOx	1000	10
Missouri	Adair Co	Daily PM2.5	NOx	1000	90
Missouri	Adair Co	Daily PM2.5	SO2	1000	10
Missouri	Adair Co	Daily PM2.5	SO2	1000	90
Nebraska	Adams	Daily PM2.5	NOx	500	10
Pennsylva...	Adams	Daily PM2.5	NOx	500	10
Nebraska	Adams	Daily PM2.5	NOx	500	90
Pennsylva...	Adams	Daily PM2.5	NOx	500	90
Nebraska	Adams	Daily PM2.5	NOx	1000	10
Nebraska	Adams	Daily PM2.5	NOx	1000	90
Pennsylva...	Adams	Daily PM2.5	NOx	1000	90
Nebraska	Adams	Daily PM2.5	NOx	3000	90
Pennsylva...	Adams	Daily PM2.5	NOx	3000	90
Nebraska	Adams	Daily PM2.5	SO2	500	10
Pennsylva...	Adams	Daily PM2.5	SO2	500	10
Nebraska	Adams	Daily PM2.5	SO2	500	90
Pennsylva...	Adams	Daily PM2.5	SO2	500	90
Nebraska	Adams	Daily PM2.5	SO2	1000	10
Nebraska	Adams	Daily PM2.5	SO2	1000	90

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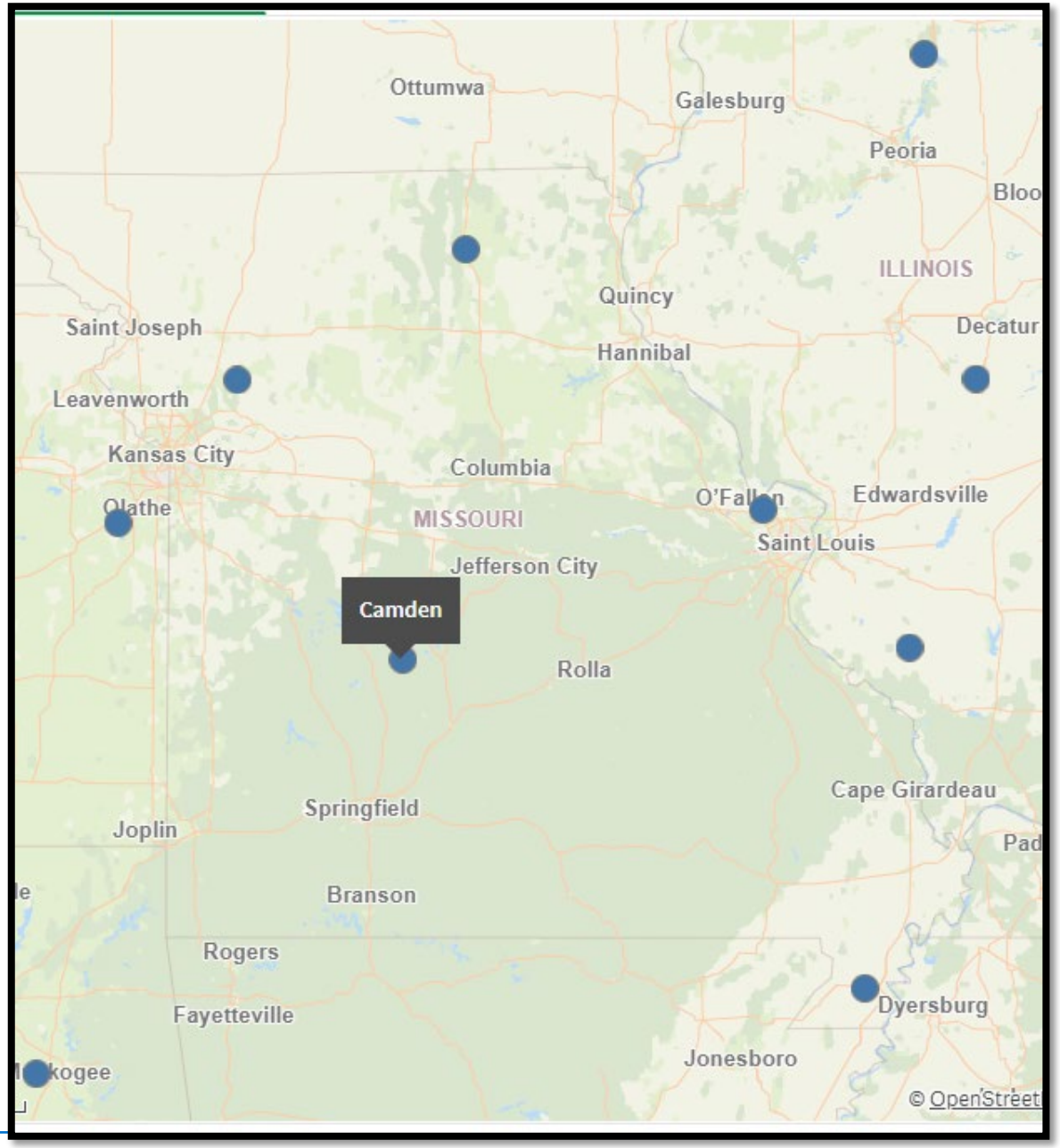
How to Perform a Tier I Analysis

- Choose your hypothetical source:
  - Camden location is central Missouri with terrain similar to source location. Consider chemical and physical environments
- EPA has used hypothetical illustrative sources and modeled them at a small handful of point source parameters
  - Stack heights of 10m or 90m
  - Emission rates of 500, 1000, or 3,000 tpy



What to do once you select your hypothetical source?

- Select source stack height (units: m)
- Select source emission rate (units: tpy)

- Calculate Project Air Quality Impact:

$$\frac{Project\ Emission\ Rate}{Hypothetical\ Source\ Emission\ Rate} * Max\ Conc$$

State	County	Metric	Precursor	Emissions	Stack	MaxConc
Missouri	Camden	8-hr Ozone	NOx	500	10	1.762336
Missouri	Camden	8-hr Ozone	NOx	500	90	2.119628
Missouri	Camden	8-hr Ozone	NOx	1000	90	3.815662
Missouri	Camden	8-hr Ozone	NOx	3000	90	9.139234
Missouri	Camden	8-hr Ozone	VOC	500	10	0.045614
Missouri	Camden	8-hr Ozone	VOC	1000	10	0.093595
Missouri	Camden	8-hr Ozone	VOC	1000	90	0.090396
Missouri	Camden	8-hr Ozone	VOC	3000	90	0.340607
Missouri	Camden	Annual PM2.5	NOx	500	10	0.007366
Missouri	Camden	Annual PM2.5	NOx	500	90	0.002579
Missouri	Camden	Annual PM2.5	NOx	1000	10	0.015433
Missouri	Camden	Annual PM2.5	NOx	1000	90	0.005595
Missouri	Camden	Annual PM2.5	NOx	3000	90	0.018746
Missouri	Camden	Annual PM2.5	SO2	500	10	0.011487
Missouri	Camden	Annual PM2.5	SO2	500	90	0.003684
Missouri	Camden	Annual PM2.5	SO2	1000	10	0.036158
Missouri	Camden	Annual PM2.5	SO2	1000	90	0.012105
Missouri	Camden	Annual PM2.5	SO2	3000	90	0.067844
Missouri	Camden	Daily PM2.5	NOx	500	10	0.107882
Missouri	Camden	Daily PM2.5	NOx	500	90	0.036279
Missouri	Camden	Daily PM2.5	NOx	1000	10	0.22067
Missouri	Camden	Daily PM2.5	NOx	1000	90	0.083721
Missouri	Camden	Daily PM2.5	NOx	3000	90	0.352825
Missouri	Camden	Daily PM2.5	SO2	500	10	1.040671
Missouri	Camden	Daily PM2.5	SO2	500	90	0.145469
Missouri	Camden	Daily PM2.5	SO2	1000	10	2.378555
Missouri	Camden	Daily PM2.5	SO2	1000	90	0.653755
Missouri	Camden	Daily PM2.5	SO2	3000	90	3.451463

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Ozone Analysis

- Ozone – two contributors!
  - Ozone Max Conc for NO_x at 10m and 500 tpy = 1.762336 ppb
  - Ozone Max Conc for VOC at 10m and 500 tpy = 0.045614 ppb
- Our project: 45 tpy NO_x; 300 tpy VOC
- Max Ozone Impact due to NO_x :

$$\frac{45\ tpy\ NOx}{500\ tpy\ NOx} * 1.762336\ ppb = 0.158610\ ppb\ O_3$$

- Max Ozone Impact due to VOC:

$$\frac{300\ tpy\ VOC}{500\ tpy\ VOC} * 0.045614\ ppb = 0.027368\ ppb\ O_3$$

State	County	Metric	Precursor	Emissions	Stack	MaxConc
Missouri	Camden	8-hr Ozone	NOx	500	10	1.762336
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Missouri	Camden	8-hr Ozone	VOC	1000	90	0.090396
Missouri	Camden	8-hr Ozone	VOC	3000	90	0.340607

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Ozone Analysis

- Ozone – two contributors!
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  - Ozone Max Conc for VOC at 10m and 500 tpy = 0.045614 ppb
- Our project: 45 tpy NO_x; 300 tpy VOC
- Max Ozone Impact due to NO_x :

$$\frac{45\ tpy\ NOx}{500\ tpy\ NOx} * 1.762336\ ppb = 0.158610\ ppb\ O_3$$

- Max Ozone Impact due to VOC:

$$\frac{300\ tpy\ VOC}{500\ tpy\ VOC} * 0.045614\ ppb = 0.027368\ ppb\ O_3$$

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Missouri	Camden	8-hr Ozone	VOC	3000	90	0.340607

Total Impact: 0.185978 ppb O_3

Project is below O_3 SIL of 1ppb

Analysis Complete!

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$PM_{2.5}$ Analysis Example – Daily

- $PM_{2.5}$ - Daily
  - $PM_{2.5}$ Max Conc for NO_x at 10m and 500 tpy = 0.107882 µg/m³
  - $PM_{2.5}$ Max Conc for SO_2 at 10m and 500 tpy = 1.040671 µg/m³
- Our project: 45 tpy NO_x; 300 tpy VOC
- Max $PM_{2.5}$ Impact due to NO_x :

$$\frac{45\ tpy\ NOx}{500\ tpy\ NOx} * 0.107882\ \mu g/m^3 = 0.158610 \mu g/m^3$$

- Max $PM_{2.5}$ Impact due to SO_2 :

$$None\ -no\ project\ SO_2\ emissions$$

Missouri	Camden	Daily PM2.5	NOx	500	10	0.107882
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$PM_{2.5}$ Analysis Example – Daily

- $PM_{2.5}$ - Daily
  - $PM_{2.5}$ Max Conc for NO_x at 10m and 500 tpy = 0.107882 µg/m³
  - $PM_{2.5}$ Max Conc for SO_2 at 10m and 500 tpy = 1.040671 µg/m³
- Our project: 45 tpy NO_x; 300 tpy VOC
- Max $PM_{2.5}$ Impact due to NO_x :

$$\frac{45\ tpy\ NOx}{500\ tpy\ NOx} * 0.107882\ \mu g/m^3 = 0.158610 \mu g/m^3$$

- Max Ozone Impact due to SO_2 :

$$None\ -no\ project\ SO_2\ emissions$$

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Missouri	Camden	Daily PM2.5	SO2	3000	90	3.451463

Total Impact: 0.158610 µg/m³
PLUS DIRECT $PM_{2.5}$ IMPACTS

Project is below $PM_{2.5}$ SIL of 1.2 µg/m³

Analysis Complete!

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Conclusions and Current State-level Guidance

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What do I need to know about this?

- With new EPA guidance, assessing a project's impacts on Ozone and $PM_{2.5}$, especially with respect to secondary pollutant formation, is a real thing!
- The analysis can get a little complicated, especially when involving $PM_{2.5}$ (with both direct and indirect impacts)
- The analysis when involving Class I areas gets more involved
- Even though this guidance was initially implemented for PSD Permit applicants, states are pondering if similar analyses should be included in state-level modeling
  - Big Question – could this type of analysis be required for state-level permitting?

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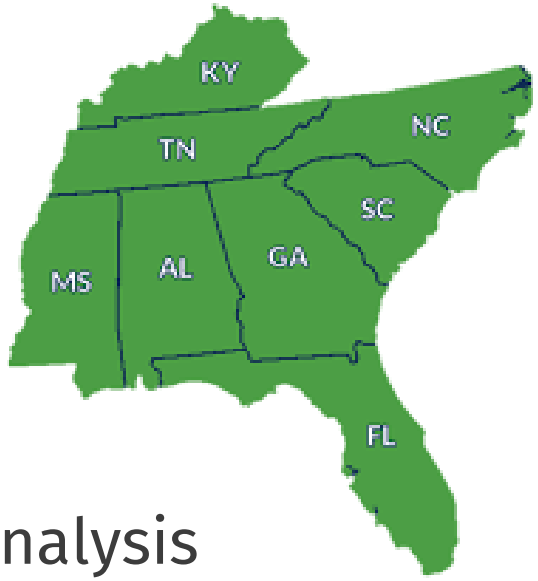
Current State-level guidance – Region IV



- North Carolina
  - Minor Source modeling has not required secondary analysis
- South Carolina
  - Minor Source modeling has not required secondary analysis
- Virginia
  - If state-level modeling is triggered, a traditional MERPs approach is used (coordinate with state agency)

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Current State-level guidance – Region V

- Michigan
  - Ozone: No requirements for minor NSR modeling
  - $PM_{2.5}$: No requirements for minor NSR modeling

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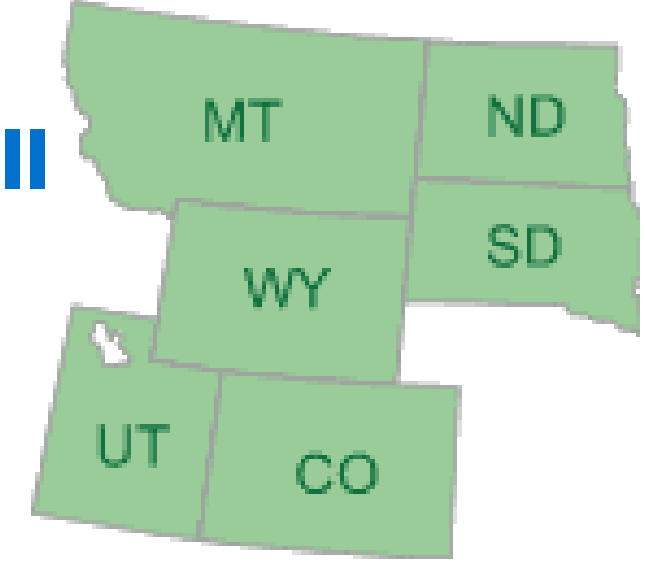
Current State-level guidance – Region VIII



- Colorado
  - Ozone: If project exceeds 200 tpy NO_x, then secondary ozone analysis is required
  - $PM_{2.5}$: If direct $PM_{2.5}$ impacts in a cumulative NAAQS analysis are within 0.5 µg/m³ of the 24-hr NAAQS (35 µg/m³), then secondary contributions from NO_x and SO_2 are required for both 24-hr and annual $PM_{2.5}$ impacts
    - No mention is update will occur due to revised annual NAAQS

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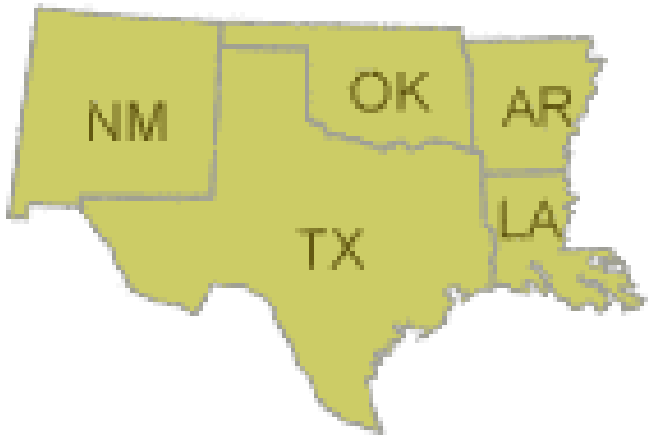
Current State-level guidance – Region VI



- Texas – for minor NSR modeling
  - Ozone: No analysis unless NO_x or VOC >100 tpy
  - $PM_{2.5}$: MERPS analysis required if project includes annual PTE increases of NO_x or SO_2
    - Secondary impacts added to direct $PM_{2.5}$ impacts at each receptor determine which receptors will be carried forward to the cumulative NAAQS analysis.
    - Requires applicants to use a workbook that automatically calculates total secondary PM2.5 impact with user-entered annual NO_x and SO_2 emissions and MERPS selection.
- Oklahoma
  - For new major Part 70 sources (>100tpy), requested analysis of ozone and secondary $PM_{2.5}$

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