



**DELIVERED VIA E-MAIL**

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**RE: Utah Petroleum Association's Comments on the Proposed Rulemaking, Revisions to Section IX, Control Measures for Area and Point Sources, Part H, Emissions Limits & Amend R307-110-17**

Dear Mr. Bird and UDAQ staff,

The Utah Petroleum Association (UPA) submits the enclosed two sets of comments on the proposed rulemaking: Revisions to Section IX, Control Measures for Area and Point Sources, Part H, Emission Limits and R307-110-17, Section IX, Control Measures.

UPA was founded in 1958 and its members comprise every segment of the petroleum industry in Utah. UPA's members include four companies that own and operate refineries – i.e., Big West Oil LLC, Chevron Products Company, HollyFrontier Woods Cross Refining LLC, and Tesoro Refining & Marketing Company LLC – that are identified as major stationary sources subject to the emission limitations and other requirements proposed in this rulemaking. In addition to these associational comments, individual member companies will also be submitting comments addressing specific issues related to their operations.

UPA appreciates the opportunity to provide these comments and appreciates the Utah Air Quality Board's (AQB) decision to provide a 45-day comment period for the rulemaking actions. Furthermore, UPA appreciates the expertise and professionalism that the Utah Division of Air Quality (UDAQ) brings to its work in addressing the Salt Lake City Nonattainment Area's PM2.5 nonattainment issues and, particularly, in working with UPA to provide the association with information critical to forming these comments.

In Enclosure No. 1, UPA presents two principal comments.

- The first principal comment addresses UDAQ's proposal to impose additional controls on potential precursor emissions from major stationary sources even though the emissions of those precursors are shown to insignificantly contribute to PM2.5 levels and their control will not advance attainment. This comment is supported by a technical modeling report, titled, **Major Stationary Source Precursor Demonstration for NO<sub>x</sub>, SO<sub>x</sub>, VOC, and NH<sub>3</sub> in the Salt Lake City**

**24-hour PM2.5 Serious Nonattainment Area**, which is attached as Attachment A to Enclosure No. 1. This report was prepared by Ramboll, which is the firm that developed the CAMx model, the model that UDAQ is using to develop the attainment plan and demonstration for the SLC NAA. Moreover, the demonstration relies upon the same model inputs data sets as UDAQ is utilizing in its attainment demonstration modeling. In addition to this report, UPA has also delivered the modeling input and output files to UDAQ.

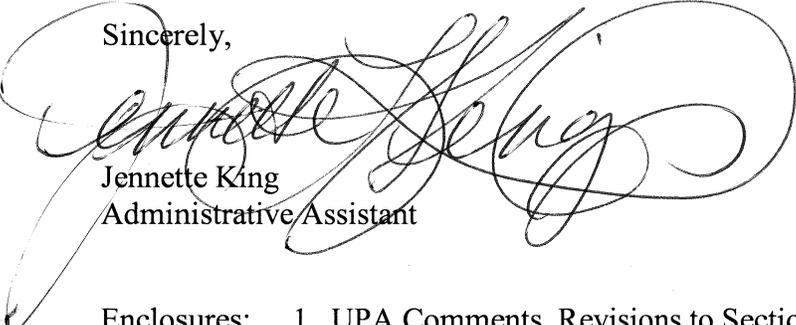
This report and the associated comments shows that the controls UDAQ has proposed in this rulemaking are not necessary. Both the Clean Air Act and its implementing regulations provide a sensible exemption from requiring a SIP to include such controls. Because the Utah Air Conservation Act authorizes the Board to adopt only those control measures that are shown to be necessary, the Board should reject UDAQ's major stationary source BACT proposal.

- The second principle comment is the flip side of the first; UDAQ has failed to include control measures for residential wood combustion in its proposal that the State is legally obligated to adopt and which have the potential to make a very significant contribution to attaining and maintaining the 24-hour PM2.5 standard. This comment is also supported by a technical modeling report titled, **Modeled Contributions of Residential Wood Combustion to PM2.5 in the Salt Lake City 24-hour PM2.5 Serious Nonattainment Area**, which is attached as Attachment B to Enclosure No. 1.

Enclosure No. 2 contains UPA's second set of comments that provide comment on specific provisions contained in Parts H.1, H.2, H.11, and H.12.

UPA appreciates UDAQ's and the AQB's consideration of these comments. UPA and its members are available to discuss these documents and modeling reports with you and your staff.

Sincerely,



Jennette King  
Administrative Assistant

- Enclosures:
1. UPA Comments, Revisions to Section IX, Control Measures for Area and Point Sources, Part H. Emission Limits, Major Stationary Source Precursor Demonstration & BACM for Residential Wood Combustion.
  2. UPA Comments, Revisions to Section IX, Control Measures for Area and Point Sources, Part H. Emission Limits, Specific Comments on Parts H.1, H.2, H.11 & H.12

cc: Bill Reiss  
Dave McNeill  
Thomas Gunter

# **ENCLOSURE NO. 1**

**Utah Petroleum Association Comments**

**Revisions to Section IX, Control Measures for Area and Point  
Sources, Part H, Emission Limits**

**Major Stationary Source Precursor Demonstration  
& BACM for Residential Wood Combustion**

August 15, 2018

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## ATTACHMENTS

- Attachment A: Major Stationary Source Precursor Demonstration for NO<sub>x</sub>, SO<sub>x</sub>, VOC, and NH<sub>3</sub> in the Salt Lake City 24-hour PM<sub>2.5</sub> Serious Nonattainment Area, Final Report, August 2018
- Attachment B: Modeled Contribution of Residential Wood Combustion to PM<sub>2.5</sub> in the Salt Lake City 24-hour PM<sub>2.5</sub> Serious Nonattainment Area, Final Report, August 2018
- Attachment C: Utah Petroleum Association's Petition for a Rule Change, August 15, 2018

## EXHIBITS

- Exhibit 1: Memorandum to Regional Air Division Directors from Stephen D. Paige, Director re: Draft PM2.5 Demonstration Guidance, Nov. 17, 2016
- Exhibit 2: Technical Basis for the EPA's Development of the Significant Impact Thresholds for PM2.5 and Ozone, EPA-454/R-18-001, April 2018
- Exhibit 3: Alaska Department of Environmental Conservation, Preliminary Draft Precursor Demonstration, March 22, 2017
- Exhibit 4: Northern Sierra Air Quality Management District, Portola Fine Particulate Matter (PM2.5) Attainment Plan, January 2017
- Exhibit 5: San Joaquin Valley Air Pollution Control District, 2018 PM2.5 SIP, Precursor Demonstrations for Ammonia, SOx, and ROG, Draft, July 2018
- Exhibit 6: Utah, State Implementation Plan, Control Measures for Area and Point Sources, Fine Particulate Matter, PM2.5, SIP for the Salt Lake City, UT Nonattainment Area, Section IX, PartA.21, December 3, 2014
- Exhibit 7: Utah, State Implementation Plan, Control Measures for Area and Point Sources, Fine Particulate Matter, PM2.5, SIP for the Salt Lake City, UT Nonattainment Area, Section IX, PartA.21, December 4, 2013
- Exhibit 8: UDAQ, Salt Lake Area Source BACM Analysis, Draft, August 21, 2017
- Exhibit 9: Utah Implementation Plan, July 26, 1993
- Exhibit 10: San Joaquin Valley Air Pollution Control District, Rule 4901, Wood Burning Fireplaces and Wood Burning Heaters
- Exhibit 11: UDAQ, Wood Smoke Contribution
- Exhibit 12: EPA comments on ADEC Preliminary Draft Serious SIP Development Materials for the Fairbanks Serious PM2.5 nonattainment area
- Exhibit 13: Puget Sound Clean Air Agency, Relative Emissions of Fine Particles
- Exhibit 14: Fairbanks, Alaska Regulations, 18 AAC 50.076, 18 AAC 50.077, and 18 AAC 50.990
- Exhibit 15: Puget Sound Clean Air Agency Regulations, Article 13: Solid Fuel Burning Device Standards
- Exhibit 16: California Air Resources Board, Greater Portola Wood Stove Change-Out Program

## OVERALL

The Utah Petroleum Association (“UPA”) appreciates the opportunity to provide these comments on the proposed rulemaking, SIP Subsection IX. Part H: Emission Limits and Operating Practices and R307-110-17, Section IX, Control Measures for Area and Point Sources, Part H, Emission Limits.<sup>1</sup> UPA is comprised of companies from every segment of the petroleum industry including refiners. Four of UPA’s member companies – Big West Oil LLC, Chevron Products Company, HollyFrontier Woods Cross Refining LLC, and Tesoro Refining & Marketing Company LLC – operate refineries that are identified in the SIP as major stationary sources subject to the emission limits being proposed in this rulemaking. Individual member companies will be submitting additional comments addressing specific concerns with the proposed rulemaking.

As the Utah Division of Air Quality (“UDAQ”) knows all too well, the PM2.5 nonattainment problem is complex and not amenable to easy solutions. It is imperative that the data analyses, modeling evaluations, and control measure reviews are complete and competent to ensure the development of a plan that will succeed. The more analytically sound the SIP, the greater the prospects of achieving actual and lasting attainment. On the other hand, an ill-conceived plan will result in misdirected resources without advancing the goal of attainment.

These comments reveal the consequences of an incomplete analysis. On the one hand, the proposal includes costly control measures that are demonstrably shown to have an insignificant contribution to reducing PM2.5 levels. On the other hand, the proposal overlooks necessary control measures that would address a principal contributor to PM2.5 levels during wintertime inversions.

The first principal comment addresses UDAQ’s proposal to impose additional controls on potential precursor emissions from major stationary sources even though the emissions of those precursors are shown to insignificantly contribute to PM2.5 levels and their control will not advance attainment.<sup>2</sup> Accordingly, such controls are not necessary. Both the Clean Air Act and its implementing regulations provide a sensible exemption from requiring a SIP to include such controls. Because the Utah Air Conservation Act authorizes the Board to adopt only those control measures that are shown to be necessary, the Board should reject UDAQ’s major stationary source BACT proposal.

The second principle comment is the flip side of the first; UDAQ has failed to include control measures in its proposal that the State is legally obligated to adopt and which have the potential to make a very significant contribution to attaining and maintaining the 24-hour PM2.5 standard.<sup>3</sup> These measures include wood burning controls that other nonattainment areas have adopted and that EPA has required. The Board should direct UDAQ to evaluate and include such controls in the SIP.

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<sup>1</sup> 2018-13 Utah Bull. pp. 34-36 (July 1, 2018); *see also* Utah Air Quality Board, Final Agenda, Items VIII and IX (June 6, 2018).

<sup>2</sup> *See* Major Stationary Source Precursor Demonstration for NO<sub>x</sub>, SO<sub>x</sub>, VOC, and NH<sub>3</sub> in the Salt Lake City 24-hour PM2.5 Serious Nonattainment Area, Final Report, August 2018, attached hereto as Attachment A.

<sup>3</sup> *See* Modeled Contributions of Residential Wood Combustion to PM2.5 in the Salt Lake City 24-hour PM2.5 Serious Nonattainment Area, Final Report, August 2018, attached hereto as Attachment B.

## ACKNOWLEDGMENT

UPA appreciates the opportunity to provide these comments. We recognize the expertise and high level of professionalism that UDAQ staff have brought to bear in addressing the PM2.5 nonattainment problem. We believe that UDAQ has done much good work in addressing the PM2.5 nonattainment problem. In fact, UDAQ and UPA fundamentally agree on the underlying data and modeling tools that form the basis for informing decisions on appropriate control measures for addressing the PM2.5 problem. The point made by these comments is simply that UDAQ has not completed the analyses required to properly evaluate the controls that are necessary and appropriate for achieving attainment and maintenance of the PM2.5 NAAQS in the SLC NAA. Recognizing this deficiency, UPA has engaged the model developer to complete the required analyses.

UPA wishes to acknowledge and thank UDAQ staff for their forthrightness in providing UPA with the necessary information to replicate the State's modeling efforts. UDAQ and representatives of UPA have engaged in information sharing that has allowed UPA to build on UDAQ modeling efforts to provide a more complete and accurate understanding of the PM2.5 nonattainment problem and, in so doing, identifying the control measures that will (as well as those control measures that will not) result in achieving and maintaining attainment.

Because we have confidence that UDAQ will agree with the quantitative, analytical results provided by these analyses, we are optimistic that UDAQ will revise the SIP control strategy accordingly.

### **FIRST COMMENT: THERE IS NO LEGAL OR TECHNICAL JUSTIFICATION FOR REGULATING MAJOR STATIONARY SOURCE PM2.5 PRECURSORS IN THE SLC-NAA**

#### **I. SUMMARY**

There is a difference between direct PM2.5 and PM2.5 precursors. While controlling direct emissions of PM2.5 can fairly be assumed to have a corresponding benefit on reducing PM2.5 levels, the same may not be said for PM2.5 precursors. The efficacy of controls of PM2.5 precursors on reducing ambient PM2.5 levels is much less certain and depends on the specific circumstances present in an airshed. That is why the Clean Air Act ("CAA" or the "Act") provides an exception for requiring controls on precursors that make an insignificant contribution to PM2.5 levels.

In the case of the SLC NAA, based on the modeling tools and inputs being relied upon by UDAQ, it is demonstrated that the emissions of precursors from major stationary sources has an insignificant contribution to PM2.5 levels. Under the CAA and its implementing rules, therefore, controls of these precursors, from this group of sources, are not required. Furthermore, for much the same reason, such controls are not authorized by the Utah Air Conservation Act; to the contrary, there is no legal basis for imposing controls where modeling shows the controls will provide an insignificant contribution.

For these reasons, the Board should not adopt the proposed revisions to Section IX, Part H, Emissions Limits and Operating Practices, for the Utah SIP, as these revisions apply to major stationary sources.

## II. THE CONTROL OF PRECURSORS

### A. The Precursor Relationship

There has long been a recognition that fine particulate matter (“PM”), be it PM10 or PM2.5, is formed by emissions of both direct PM as well as its precursors. A PM precursor is something that is not emitted as PM *per se* but is, instead, emitted in a non-particulate form that has the potential following discharge into the atmosphere to form particulate matter given the right conditions. Based on this relationship, the following PM2.5 precursors have been defined: VOC, NH3, NOx, and SO2.<sup>4</sup> Each of these has the potential to contribute to PM2.5 levels.

Importantly, in any given airshed, the extent to which a particular precursor will or will not contribute to PM2.5 levels can vary significantly. In the proposed PM2.5 Implementation Rule, EPA explained that “[t]he composition of PM2.5 is complex and highly variable” due to the “complexity of secondary particle formation processes.”<sup>5</sup> EPA presented data supporting its conclusion of “broad observed spatial patterns across the U.S. in PM2.5 concentrations and its compositions.”<sup>6</sup>

This complex and variable contribution of precursors to PM2.5 concentrations makes it imperative for a state to examine and understand the extent to which a particular precursor, and the sources of that precursor, contribute to the ultimate PM2.5 levels that it seeks to reduce. Not doing so could very well lead to misdirected controls and a significant expenditure of resources that simply does not advance the objective of attaining and maintaining the PM2.5 NAAQS.

In the case of the SLC NAA, we need not speculate as to whether certain precursor controls will or will not be effective in reducing PM2.5. As these comments and the attached report from Ramboll make clear, imposing controls on major stationary sources of precursor emissions in the SLC NAA would result in an insignificant reduction in PM2.5 levels.<sup>7</sup>

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<sup>4</sup> 51.1000 (definition of “PM2.5 precursor”).

<sup>5</sup> 80 Fed. Reg. 15340, 15344/2 (March 23, 2015).

<sup>6</sup> *Id.* at 15345/3.

<sup>7</sup> This is due in large part to the fact that, through past rulemaking actions taken by UDAQ, emissions of both direct PM2.5 and its precursors have been reduced significantly.

## B. The CAA's and EPA's Approach to Addressing Precursors

At one time, there was no express recognition in the CAA of the role played by precursors in contributing to air pollutant levels.<sup>8</sup> In time, however, the relationship came to be understood, resulting in an express recognition for the need to control precursors as might be necessary:

The control requirements applicable under plans in effect under this part for major stationary sources of [PM-2.5] shall also apply to major stationary sources of [PM-2.5] precursors, *except* where the Administrator determines that such sources do not contribute significantly to [PM-2.5] levels which exceed the standard in the area. The Administrator shall issue guidelines regarding the application of the preceding sentence.<sup>9</sup>

In implementing these requirements, EPA explained, in accordance with the *NRDC* decision, that the Act establishes a scheme whereby precursors are presumptively subject to controls but such presumption may be overcome by an appropriate technical demonstration referred to as a precursor demonstration: “EPA’s interpretation of subpart 4 requirements with respect to precursors in attainment plans ... contemplates that the state may develop an attainment plan that regulates only those precursors that are necessary to control for purposes of timely attainment in the nonattainment area, i.e., states may determine that only certain precursors need to be regulated in a particular PM2.5 nonattainment area for attainment purposes.”<sup>10</sup> EPA explained that “in some PM2.5 nonattainment areas, a particular precursor or precursors may not contribute significantly to PM2.5 levels ....”<sup>11</sup>

EPA also explained that “[e]ven though CAA section 189(e) only explicitly contemplates exceptions to control requirements for PM2.5 precursors from major stationary sources in nonattainment areas, the EPA believes that by analogy it has authority to promulgate regulations that allow states to determine that it is not necessary to regulate PM2.5 precursors from other sources in nonattainment areas as well, under appropriate circumstances.”<sup>12</sup>

Accordingly, the PM2.5 Implementation Rule provides that “[a] state may elect to submit to the EPA one or more precursor demonstrations for a specific nonattainment area.”<sup>13</sup> The PM2.5 Implementation Rule addresses three different types of precursor demonstrations:

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<sup>8</sup> Compare the definition of “air pollutant” appearing in the CAA before and after the 1990 amendments to the CAA. The definition was expanded in the 1990 amendments to include “any precursor to the formation of any air pollutant.” See CAA § 302(g).

<sup>9</sup> CAA 189(e) (emphasis added). This provision was added by the CAAA of 1990. The Act expressly makes references only to PM10, however, in *NRDC v. EPA*, the Court of Appeals for the D.C. Circuit, held that this (and other) provisions of the Act applied equally to PM2.5. 706 F.3d 428 (D.C. Cir. 2013).

<sup>10</sup> 81 Fed. Reg. 58010, 58019/1 (August 24, 2016).

<sup>11</sup> *Id.* at 58017/1.

<sup>12</sup> *Id.* at 58018.

<sup>13</sup> 40 CFR § 51.1006(a).

- Comprehensive Precursor Demonstration (“CPD”)
- Major Stationary Source Precursor Demonstration (“MSSPD”)
- NSR Precursor Demonstration (“NSRPD”)

The concept behind each of these precursor demonstrations is to provide some measure of relief for a state from having to regulate PM<sub>2.5</sub> precursors upon making a demonstration that particular precursors from all sources or from major stationary sources (depending on the scope of the demonstration) do not contribute significantly to PM<sub>2.5</sub> concentrations.<sup>14</sup> Furthermore, the precursor demonstrations allow the state to focus its controls on those controls most likely to bring the area into timely attainment.

Both a CPD and a MSSPD address only *existing* sources. Should a state submit and EPA approve one of these demonstrations, the state will not be required to control emissions of the relevant precursor from certain existing sources, depending on the scope – comprehensive or major stationary source – of the precursor demonstration. Assuming that a state successfully makes either a CPD or a MSSPD for a particular precursor, any new major stationary sources or major modifications involving that precursor would still trigger major NSR review, including the need to provide offsets. However, a state also has the option of submitting a NSRPD which can demonstrate that it is unnecessary to subject major stationary sources or modifications of a particular precursor to major nonattainment NSR.

The analysis conducted by Ramboll and submitted as part of these comments provides a MSSPD only; it does not include a CPD or a NSRPD. These comments do not address the NSRPD further. However, for purposes of context, the following discussion addresses the scope of both the CPD and MSSPD. It is important to appreciate the differences in scope between these two demonstrations to understand the implications for control measures.

1. *The Respective Scopes of a Comprehensive Precursor Demonstration (“CPD”) and a Major Stationary Source Precursor Demonstration (“MSSPD”)*

The regulations provide the following instruction for making a CPD: “A comprehensive precursor demonstration must show that emissions of a particular precursor from ***all existing stationary, area, and mobile sources*** located in the nonattainment area do not contribute significantly to PM<sub>2.5</sub> levels that exceed the standard in the area.”<sup>15</sup> As this language makes clear, a CPD must address all emissions in the nonattainment area including emissions from area and mobile sources, hence the name, ***Comprehensive*** Precursor Demonstration.

Contrast the CPD to the requirements for a MSSPD: “A major stationary source precursor demonstration must show that emissions of a particular precursor ***from all existing major stationary sources*** located in the nonattainment area do not contribute significantly to PM<sub>2.5</sub>

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<sup>14</sup> The next section of these comments address what constitutes a significant contribution.

<sup>15</sup> 40 CFR § 51.1006(a)(1) (emphasis added).

levels that exceed the standard in the area.”<sup>16</sup> The scope of emissions addressed by a MSSPD is limited to those from existing “major stationary sources” in the nonattainment area.<sup>17</sup>

In explaining the differences between a CPD and a MSSPD, EPA explains that, “[t]he use of the term ‘comprehensive’ here refers to the fact that the demonstration covers all existing stationary, area, and mobile sources, rather than major sources alone.”<sup>18</sup> Furthermore, “[t]he requirements for a stationary source precursor demonstration are nearly identical to those of the comprehensive precursor demonstration, except the state would only need to show that a particular precursor from *all existing major stationary sources* located in the nonattainment area do not contribute significantly to PM<sub>2.5</sub> levels that exceed the standard in the area.”<sup>19</sup>

EPA explains that, in certain circumstances, even though a CPD might not be possible, a MSSPD may nonetheless be feasible due to the relative amounts of precursor emissions emitted from mobile, area, and major stationary sources, respectively:

Note that a state might consider developing a major stationary source demonstration to avoid the requirement to adopt nonattainment planning control measures for a particular precursor emitted from existing major stationary sources in the area if the state does not believe that it could comprehensively demonstrate that the precursor does not have a significant contribution, and if major stationary source emissions of the precursor do not make up a very large percentage of the emissions inventory in the area. For example, it might be possible that in a particular area the overwhelming amount of emissions of a certain precursor could originate from mobile or area sources, or both, but not from existing major stationary sources. If the EPA approves a major stationary source precursor demonstration, the attainment plan would still need to evaluate and potentially impose control requirements for the relevant precursor for existing non-major stationary sources, area sources and mobile sources in order to demonstrate expeditious attainment.<sup>20</sup>

## 2. *The Difference between a Concentration-Based Contribution Analysis and a Sensitivity-Based Contribution Analysis*

When making a precursor demonstration, whether a CPD or a MSSPD, the first type of analysis required is an existing source contribution analysis that would demonstrate whether emissions of

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<sup>16</sup> *Id.* at § 51.1006(a)(2) (emphasis added).

<sup>17</sup> The PM<sub>2.5</sub> Implementation Rule defines “major stationary sources” to mean “any *stationary source* of air pollutant(s) that emits, or has the potential to emit 100 tons per year or more of direct PM<sub>2.5</sub> or any PM<sub>2.5</sub> precursor in any Moderate nonattainment area for the PM<sub>2.5</sub> NAAQS, or 70 tons per year or more of direct PM<sub>2.5</sub> or any PM<sub>2.5</sub> precursor in any Serious nonattainment area for the PM<sub>2.5</sub> NAAQS.” *Id.* at § 51.1000 (emphasis added). The 70 tpy major source threshold now applies in the SLC NAA since it is classified as a Serious NAA.

Furthermore, “[t]he term ‘stationary source’ means generally any source of an air pollutant except those emissions resulting directly from an internal combustion engine for transportation purposes or from a nonroad engine or nonroad vehicle as defined in section 7550 of this title.” CAA § 302(z).

<sup>18</sup> 81 Fed Reg. at 58021/1.

<sup>19</sup> 81 Fed Reg. at 58021/3.

<sup>20</sup> 81 Fed Reg. at 58022/1.

a particular precursor from *all* existing sources (in the case of a CPD) or *all* major stationary sources (in the case of a MSSPD) in the nonattainment area “significantly contribute” to PM2.5 concentrations. EPA refers to this as a concentration-based contribution analyses.<sup>21</sup> It effectively requires zeroing-out the emissions of the precursor being evaluated in the model used to evaluate the measures required to bring an area into attainment.

For example, for a MSSPD, a contribution-based analysis would zero-out from the modeling inventory all of the major stationary source emissions of the particular precursor being evaluated in order to evaluate the significance of that precursor’s contribution to PM2.5 levels. This is obviously an extreme, conservative assessment. If zeroing out the emissions for a particular precursor in this fashion shows an insignificant amount of impact to PM2.5 levels, then controls for that precursor will not be required for the major sources in the NAA.<sup>22</sup>

The second type of precursor demonstration focuses on the efficacy of *realistic* decreases in precursor emission on PM2.5 concentrations (as opposed to the complete zeroing-out required by the concentration-based contribution analysis).<sup>23</sup> EPA refers to this as a sensitivity-based contribution analysis. This analysis is only necessary if the concentration-based contribution analyses do not show “insignificant contribution.” The sensitivity-based contribution analysis examines the degree to which concentrations in the nonattainment area are sensitive to decreases of a precursor. EPA explains that it believes that, “it is a reasonable interpretation of the statute to allow a precursor to be excluded from control requirements if the PM2.5 concentration in the area is insensitive to decreases of that precursor.”<sup>24</sup>

EPA has released draft guidance for conducting precursor demonstrations that addresses, among other things, the appropriate percentage reductions in emissions to be used in conducting a sensitivity-based contribution analysis.<sup>25</sup> EPA concludes that, “[f]or a major source sensitivity based analysis, the EPA recommends modeling reductions of 30%-70% of anthropogenic emissions of the precursor from existing major stationary sources in the nonattainment area.”<sup>26</sup> EPA notes that while “[a]ir agencies can perform multiple model runs to test various sensitivity levels and provide a range of impacts ... modeling the highest end of the percent reduction range as the initial model run will potentially limit the resources involved in the analysis. If the modeled PM2.5 concentration change at the highest end of the percent reduction range is below the

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<sup>21</sup> 40 CFR § 51.1006(a)(1)(i), (a)(2)(i).

<sup>22</sup> A similar analysis can be done on a comprehensive basis; however, because UPA is providing only MSSPD’s, these comments will not further address CPD’s.

<sup>23</sup> 40 CFR § 51.1006(a)(1)(ii), (a)(2)(ii).

<sup>24</sup> See 81 Fed Reg. at 58023/3.

<sup>25</sup> See draft *PM2.5 Precursor Demonstration Guidance* (Nov. 17, 2016) (the *Demonstration Guidance*). The guidance is available at <https://www.epa.gov/pm-pollution/pm25-precursor-demonstration-guidance> and attached hereto as Exhibit No. 1. The guidance was open to comment by state, local and tribal air agencies, as well as the public. The comment period ended March 31, 2017.

<sup>26</sup> *Id.* at 29-30.

recommended threshold, then additional lower percentage model sensitivity runs will likely not be needed.”<sup>27</sup>

### C. Determining a Significant/Insignificant Contribution

Consistent with the section 189(e) of the CAA, the PM2.5 Implementation Rule provides that control measures are not required for sources that “do not contribute significantly to PM2.5 levels that exceed the standard in the area.”<sup>28</sup> Rather than expressly defining significance in the Implementation Rule, “EPA ... decided that the best approach is for the final rule to codify the availability and basic requirements for precursor demonstrations, but to provide technical details (such as a recommended approach for assessing whether a particular air quality concentration threshold can be considered to be insignificant in a given area) in guidance supporting this final rule.”<sup>29</sup>

In the *Demonstration Guidance*, EPA explains the methodology it used to determine significance:

The Technical Basis Document describes that compliance with the NAAQS is determined by comparing the measured "design value" (DV) at an air quality monitor to the level of the NAAQS for the relevant pollutant. The EPA believes that an insignificant level of change in ambient air quality can be defined and quantified based on characterizing the observed variability of ambient air quality levels. The Technical Basis Document analysis has been designed to take into account the ambient data used to determine DVs for both the annual and 24-hour PM2.5 NAAQS. The EPA’s technical approach, referred to as the “Air Quality Variability” approach, relies upon the fact that there is spatial and temporal variability in the observed ambient data and then uses statistical theory and methods to identify a level of change in DVs that is not statistically discernible from the original DV, thereby representing an “insignificant” change in air quality.

\* \* \*

This approach for quantifying a degree of impact that contributes to PM2.5 air quality is fundamentally based on the idea that an anthropogenic perturbation of air quality that is within a specified range may be considered indistinguishable from the inherent variability in the measured atmospheric concentrations and is, from a statistical standpoint, insignificant at the given confidence level.

\* \* \*

The concept of insignificance as expressed in the Technical Basis Document is that an anthropogenic perturbation of air quality that is less than the inherent variability

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<sup>27</sup> *Id.* at 28.

<sup>28</sup> 40 CFR §51.1006.

<sup>29</sup> 81 Fed. Reg. 58023/1.

in the measured atmospheric concentration is, from a statistical standpoint, insignificant.<sup>30</sup>

In other words, EPA has based a determination of significance on a very conservative statistical basis. To be considered “insignificant,” a modeled precursor demonstration must show that the modeled impacts, whether based on either a concentration-based contribution analysis or a sensitivity-based contribution analysis, are less than the inherent variability in the monitored concentrations.

Based on this approach, EPA recommends 1.5 µg/m<sup>3</sup> (24-hour average) as the appropriate threshold “for identifying an air quality change that is ‘insignificant’ and thus does not ‘contribute’ to PM<sub>2.5</sub> concentrations subject to the current PM<sub>2.5</sub> NAAQS.”<sup>31</sup>

### III. OTHER STATES HAVE PRUDENTIALY INCLUDED PRECURSOR DEMONSTRATIONS IN THEIR SERIOUS AREA NONATTAINMENT SIPS

Reliance on precursor demonstrations as the basis for assessing the need for controls is not novel or without precedent. Several other state/local regulators have either completed and submitted such precursor demonstrations or are in the process of doing so. (In fact, as noted below, Utah has previously relied upon precursor demonstrations to rule out controls for a particular precursor.) For example, on June 4, 2018, EPA proposed to approve a precursor demonstration submitted by the Ohio Environmental Protection Agency (“OEPA”) for the Cleveland nonattainment area.<sup>32</sup> The OEPA prepared comprehensive precursor demonstrations for NH<sub>3</sub> and VOC for the Cleveland nonattainment area, which is a Moderate NAA for the annual PM<sub>2.5</sub> NAAQS. OEPA’s precursor demonstration relied on a sensitivity analysis that applied a 40% emission reduction of both NH<sub>3</sub> and VOC. EPA acknowledged that this figure was on the low end of EPA’s suggested range of 30% to 70%, but EPA still accepted the precursor demonstration because it met EPA’s guidance.<sup>33</sup>

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<sup>30</sup> *Demonstration Guidance* at 13-14 (footnotes omitted).

<sup>31</sup> See *Technical Basis for the EPA's Development of the Significant Impact Thresholds for PM<sub>2.5</sub> and Ozone* (April 2018) at 48. The most recent version of the *Technical Basis Document* may be found at [https://www.epa.gov/sites/production/files/2018-04/documents/ozone\\_pm2.5\\_sils\\_technical\\_document\\_final\\_4-17-18.pdf](https://www.epa.gov/sites/production/files/2018-04/documents/ozone_pm2.5_sils_technical_document_final_4-17-18.pdf) and attached hereto as Exhibit No. 2. The *Technical Basis Document* is in support of the *Demonstration Guidance*. The initial EPA technical basis analysis concluded, and the draft EPA *Demonstration Guidance* recommended, 1.3 µg/m<sup>3</sup> for the PM<sub>2.5</sub> 24-hour NAAQS as the appropriate threshold “for identifying an air quality change that is ‘insignificant’ and thus does not ‘contribute’ to PM<sub>2.5</sub> concentrations subject to the current PM<sub>2.5</sub> NAAQS.” More recently, however, EPA updated and finalized their technical basis document, which now recommends a threshold for identifying significance of 1.5 µg/m<sup>3</sup>.

<sup>32</sup> 83 Fed. Reg. 25608, 25612-13 (proposed June 4, 2018).

<sup>33</sup> *Id.* at 25612/2. Additionally, EPA relied on the thresholds identified in the agency’s draft precursor guidance for the purposes of assessing whether a contribution is significant. *Id.* at 25612/3. In reviewing the submission, EPA acknowledged that the sensitivity analysis indicated that one monitor would exceed the suggested contribution level of 0.2 µg/m<sup>3</sup> (annual average) found in EPA’s *Demonstration Guidance*. Nonetheless, EPA determined that NH<sub>3</sub> did not significantly contribute to PM<sub>2.5</sub> concentrations in the Cleveland NAA. *Id.*

One noteworthy precursor demonstration is the one being prepared by the Alaska Department of Environmental Conservation (ADEC) for the Fairbanks NAA.<sup>34</sup> The Fairbanks NAA and the Salt Lake County NAA are similarly situated; EPA has designated both areas as nonattainment for the 24-hour PM<sub>2.5</sub> NAAQS. Furthermore, EPA reclassified the Fairbanks NAA and the Salt Lake County NAA to Serious in the same rulemaking, meaning Alaska and Utah regulators are subject to the same criteria and deadlines for submitting SIP revisions.<sup>35</sup>

While ADEC's precursor demonstration is not final, ADEC has made an initial determination that, consistent with the PM<sub>2.5</sub> Implementation Rule and the *Demonstration Guidance*, it can pursue a comprehensive precursor demonstration for VOC emissions. ADEC has completed both CPD and MSSPD for NO<sub>x</sub>. For the CPD, ADEC performed a sensitivity-based analysis that was below EPA's significance threshold. ADEC further refined the analysis by conducting a separate MSSPD in which it zeroed-out the major source NO<sub>x</sub> emissions (that is, a concentration-based contribution analysis). This also showed contributions below the significance threshold.

Two California air quality management districts are also pursuing PM<sub>2.5</sub> precursor demonstrations. Most notably, the Northern Sierra Air Quality Management District (NSAQMD) completed a precursor demonstration for the Plumas County PM<sub>2.5</sub> NAA, which is nonattainment for the annual PM<sub>2.5</sub> NAAQS.<sup>36</sup> The NSAQMD determined that all precursor emissions were insignificant because direct PM<sub>2.5</sub> emissions dominate the excessive concentrations in the NAA.

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<sup>34</sup> ADEC Preliminary Draft Precursor Demonstration, March 22, 2017 (hereinafter ADEC Precursor Demonstration), available at <http://dec.alaska.gov/air/anpms/communities/fbks-pm2-5-serious-sip-development>, attached hereto as Exhibit No. 3.

<sup>35</sup> 82 Fed. Reg. 21711, 21712-13 (May 10, 2017). In this final rule and in response to an ADEC comment, EPA stated that the deadline to submit a Serious NAA SIP for both the Fairbanks and Salt Lake County areas was December 31, 2017. *Id.* at 21713-14. EPA identified the December 2017 deadline by applying 40 CFR 51.1003(b)(2)(ii), which requires Serious SIPs to be submitted "2 years before the attainment date;" the attainment date for both the Fairbanks and Salt Lake County NAAs is December 31, 2019. But EPA's application of section 51.1003(b)(2)(ii) is contrary to the express directive of the CAA. CAA section 189(b)(2) provides that "***the State shall submit*** the attainment demonstration ***within 18 months after reclassification to Serious. A State shall submit*** the provisions described under paragraph (1)(B) [BACM/BACT requirements] ***no later than 18 months after reclassification*** of the area as a Serious area." (emphasis added). This provision establishes what ***the states*** (i.e., UDAQ) must submit and by when. The deadlines for these submissions – "within 18 months" and "no later than 18 months" – are directives speaking to the states and are not subject to being shortened at EPA's discretion. EPA does not have the "power to revise clear statutory terms that turn out not to work in practice." *Utility Air Regulatory Group v. EPA*, 134 S.Ct 2427, 2446 (2014).

EPA reclassified both the Salt Lake County and Fairbanks NAAs to Serious on May 10, 2017. As a result, UDAQ and ADEC have until December 9, 2018 to submit their respective attainment demonstrations and BACM/BACT determinations. And in fact, ADEC has adopted this position and has affirmatively stated that its SIP submission is not due until December 2018. *See* ADEC Precursor Demonstration, p. 2 ("This analysis applies to the BACT/BACM and MSM control analysis under development now and which will be included in the Serious Area plan due in December 2018.").

<sup>36</sup> *See* NSAQMD, Portola Fine Particulate Matter (PM<sub>2.5</sub>) Attainment Plan, January 2017, pp. 46-54, available at [http://myairdistrict.com/wp-content/uploads/2016/12/2017\\_sip.pdf](http://myairdistrict.com/wp-content/uploads/2016/12/2017_sip.pdf), excerpted copy attached hereto as Exhibit No. 4. Additionally, the San Joaquin Valley Air Pollution Control District has prepared a draft precursor demonstration showing that ammonia, SO<sub>x</sub>, and reactive organic gases do not contribute significantly to PM<sub>2.5</sub> exceedances of either the annual or 24-hour PM<sub>2.5</sub> NAAQS. *See* SJVAPCD 2018 PM<sub>2.5</sub> SIP, Draft Precursor Demonstrations for

UDAQ/UAQB have, in fact, invoked the precursor demonstration authority for the Salt Lake City, Provo and Logan PM2.5 NAAs. For instance, in the control measures provisions for the Salt Lake City moderate SIP, UDAQ stated,

Clean Air Act Section 189(e) requires that the control requirements applicable in plans for major stationary sources of PM10 shall also apply to major stationary sources of PM10 precursors, except where the Administrator determines that such sources do not contribute significantly to PM10 levels which exceed the standard in the area.

As this paragraph now applies also to PM2.5 plans the following should be said about the way this plan is structured.

...

When evaluating the cost per ton necessary to reduce emissions, consideration was given to the resulting PM2.5 concentrations. Through this process, reasonable controls were identified affecting PM2.5, SO2, NOx and VOC.

No such controls were identified for ammonia. Ammonia occurs in such abundance that PM2.5 concentrations are not sensitive to reductions in ammonia unless those reductions are very large. Within the stationary source category, there really were no significant amounts of ammonia to evaluate. The largest contributor to the ammonia inventory was the agricultural sector, and the maximum possible amount of ammonia reduction from that sector would still not be enough to affect a reduction in PM2.5.<sup>37</sup>

UDAQ reached its conclusion on the impact of reductions in ammonia emissions by conducting modeled (CMAQ) sensitivity simulations which analyzed the impact on PM2.5 concentrations by reducing ammonia by 10%, 30% and 50%.<sup>38</sup> The modeling demonstrated that ammonia was in such abundance that concentrations of nitrate and ammonium are insensitive to ammonia reductions of 10% and 30%; in contrast, nitrate and ammonium concentrations began to reduce (by 20%) when ammonia emissions were cut by 50%. UDAQ relied on this modeling to submit a precursor demonstration to EPA that concluded: “The results of the sensitivity model runs indicate that large reductions in NH3 emissions (up to 50%) are needed in order to see a substantial

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Ammonia, Sox, and ROG, July 2018 *available at* <http://www.valleyair.org/pmplans/>, attached hereto as Exhibit No. 5.

<sup>37</sup> Utah SIP, Control Measures for Area and Point Sources, Section IX. Part A.21, pp. 14-15 (December 3, 2014), attached hereto as Exhibit No. 6. The Provo and Logan SIPs contain identical language. *Id.* Part A.22, pp.14-15, Part A.23, pp. 13-14; *see also* Utah Admin. Code R307-101-2 (defining “PM2.5 Precursor” as including an exemption for ammonia in the Logan NAA; “In the Logan UT-ID PM2.5 nonattainment area – Ammonia is exempted”); 82 Fed. Reg. 25992, 25994/3 (June 6, 2017) (acknowledging that UDAQ submitted a “demonstration that ammonia is not a significant precursor to PM2.5” in the Logan NAA).

<sup>38</sup> PM2.5 SIP; Weight-of-Evidence to the Model Attainment Test, pp. 58-61 (October 1, 2014).

reduction in ammonium and nitrate.” EPA has proposed to approve the attainment demonstration for the Logan area, which was based in part on a comprehensive NH<sub>3</sub> precursor demonstration.<sup>39</sup>

#### IV. THE (NON-) OPTIONAL PRECURSOR DEMONSTRATION

As discussed above, the PM<sub>2.5</sub> Implementation Rule provides that “[a] state *may elect* to submit to the EPA one or more precursor demonstrations for a specific nonattainment area.”<sup>40</sup> Should a state submit and EPA approve such a demonstration, the state will not be required to control emissions of the relevant precursor from certain sources, depending on the scope – comprehensive or major source – of the precursor demonstration. This mechanism provides states with a tool for avoiding the need to impose costly and ineffective controls, allowing a state to prudentially direct efforts and resources where they can make a difference.

While the inclusion of such a demonstration in a SIP is optional vis-à-vis the state and EPA, such optionality does not exist as a matter of state rulemaking. In order to understand why this is the case, it is necessary to understand the respective roles of EPA, on the one hand, and the state, on the other hand, in effectuating a SIP strategy.

##### A. The Respective Roles of the States and EPA and the Limits of EPA’s Authority to Dictate a State’s Attainment Strategy

The CAA is premised on state control over pollution reduction decisions. As Congress determined in enacting the statute, “air pollution prevention ... at its source is the primary responsibility of States and local governments.”<sup>41</sup> The result has been a unique, and successful, federal/state partnership. The CAA has, in fact, been accurately described as “a bold experiment in cooperative federalism.”<sup>42</sup>

Discussing the federal/state partnership under the CAA, the D.C. Circuit Court of Appeals stated:

The Clean Air Act creates a partnership between the states and the federal government. The state proposes, the EPA disposes. The federal government through the EPA determines the ends – the standards of air quality – but Congress has given the states the initiative and a broad responsibility regarding the means to achieve those ends through state implementation plans and timetables of compliance.... The Clean Air Act is an experiment in federalism, and the EPA may not run roughshod over the procedural prerogatives that the Act has reserved to the states, ... especially when, as in this case, the agency is overriding state policy.... [T]he 1990 amendments did not alter the division of responsibilities between EPA and the states in the section 110 process.... Congress did not give EPA authority

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<sup>39</sup> See 82 Fed. Reg. 57183 (December 4, 2017).

<sup>40</sup> 40 CFR § 51.1006(a) (emphasis added).

<sup>41</sup> 42 U.S.C. § 7401(a)(3); 42 U.S.C. § 7407(a) (“Each state shall have the primary responsibility for assuring air quality within the entire geographic area comprising such State ....”).

<sup>42</sup> *Connecticut v. EPA*, 696 F.2d 147, 151 (2d Cir. 1982); see *Env’tl. Def. Fund, Inc. v. EPA*, 82 F.3d 451, 468 - 69 (D.C. Cir. 1996) (discussing the CAA’s regime of state and federal cooperation and integrated planning).

to choose the control measures or mix of measures states would put in their implementation plans.<sup>43</sup>

The CAA created a federal/state partnership in which states have the primary role in designing their SIPs, while EPA has a limited role in approving or disapproving the control measures states put in their SIPs.

In practice, the federal government establishes national air quality standards by promulgating NAAQS, while the states are responsible for developing and implementing individual SIPs to meet those requirements.<sup>44</sup> The division of responsibility is straightforward and logical. EPA, the federal agency charged with administering the Act, has the task of establishing the NAAQS. The states then have the responsibility of submitting SIPs designed to achieve and maintain these uniform standards to EPA for approval.

In frequently cited language, the Supreme Court described this arrangement as follows:

[EPA] is plainly charged by the Act with the responsibility for setting the national ambient air standards. Just as plainly, however, it is relegated by the Act to a secondary role in the process of determining and enforcing the specific, source-by-source emission limitations which are necessary if the national standards it has set are to be met.... The Act gives the Agency no authority to question the wisdom of a State's choices of emission limitations if they are part of a plan which satisfies those standards [of the CAA].<sup>45</sup>

It is against this backdrop that the “optional” precursor demonstration provision must be considered. In view of the primary role that a state is accorded in designing its air quality plan, it is not for EPA to dictate to the state whether the state must pursue or not pursue such a demonstration. So, as between EPA and the state, the submission of a precursor demonstration is optional.<sup>46</sup> EPA has no role to play in determining whether a state, in accordance with the state's judgment and pursuant to its rulemaking procedures, includes a precursor demonstration as part of its SIP. Importantly, this optionality, as between the state and EPA, does not alter or usurp the very distinct state rulemaking authority and obligations that attend that authority.

### **B. In Exercising Its Rulemaking Authority to Establish Emission Control Requirements Pursuant to the Utah Air Conservation Act, the Board's Evaluation of the “Necessity” of the Controls is Not Optional**

As discussed in the preceding section, vis-à-vis EPA, Utah's determination to pursue a precursor demonstration is “optional.” That does not mean, however, that UDAQ/UAQB may act in an

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<sup>43</sup> *Commonwealth of Virginia v. EPA*, 108 F.3d 1397, 1408-10 (D.C. Cir. 1997) (citing *Bethlehem Steel Corp. v. Gorsuch*, 742 F.2d 1028 (7th Cir. 1984)).

<sup>44</sup> See *United States v. Gen. Motors Corp.*, 876 F.2d 1060, 1062 (1st Cir. 1989).

<sup>45</sup> *Train v. Natural Res. Def. Council, Inc.*, 421 U.S. 60, 79 (1975); see *Union Electric Co. v. EPA*, 427 U.S. 246, 250 (1976); *Florida Power & Light Co. v. Costle*, 650 F.2d 579, 586 (5th Cir. 1981).

<sup>46</sup> Once the state determines to include such a demonstration, absent error in the state's submission, EPA must accept such demonstration and allow the state to forego controls for the precursor(s) addressed by the demonstration.

arbitrary manner in determining the controls that are needed to bring a nonattainment area such as the SLC NAA into attainment.

The Utah Air Conservation Act empowers the UAQB to make rules, in accordance with the Utah Administrative Rulemaking Act, governing various aspects of air quality including rules “regarding the control, abatement, and prevention of air pollution . . . .”<sup>47</sup> Of course, such authority is not to be exercised without regard to the need for such controls: “The board may establish emission control requirements by rule that *in its judgment may be necessary* to prevent, abate, or control air pollution that may be statewide or may vary from area to area, taking into account varying local conditions.”<sup>48</sup>

The Air Conservation Act calls upon the Board to exercise its judgment to consider the necessity of such controls. In doing so, the law distinguishes between controls that may be applicable state wide, on the one hand, and those that might “vary” based on the specific “local conditions” that prevail. In the context of the instant rulemaking, the local conditions relate to the prevailing PM2.5 concentrations as defined by the “design value” and the applicable modeling tools that UDAQ has decided to utilize.

As these comments and the supporting analysis make clear, certain precursors are shown to insignificantly contribute to PM2.5 levels and, therefore, control of such precursors is not only necessary but will result in the expenditure of resources that are misdirected and will not contribute toward achieving the goal of attainment.

### C. The Relationship Between Making an Attainment Demonstration and BACT

In its memorandum to the Board, UDAQ informs that, “EPA’s Fine Particulate Matter Implementation Rule explains that BACM/BACT is ‘generally independent’ of attainment, and is to be determined without regard to the specific attainment demonstration for the area. For this reason, the Division of Air Quality (DAQ) is presenting the Air Quality Board an opportunity to release the proposed revisions to Part H for public review and comment prior to the completion of the accompanying modeling and attainment demonstration.”<sup>49</sup>

As indicated by the qualifier “generally,” there are limits to the independence of the linkage between the attainment demonstration<sup>50</sup> and the requirement to impose BACT (or any other controls). The concept and phrase “generally independent” originates in the preamble to EPA’s

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<sup>47</sup> Utah Code Ann. § 19-2-104(1)(a).

<sup>48</sup> *Id.* at § 19-2-109(2)(a) (emphasis added). Section 19-2-104(1) enumerates various, discretionary rulemaking authorities assigned to the UAQB. For two of these authorities – the establishment of emission controls and the adoption of air quality standards – section 19-2-109 imposes certain procedural requirements and considerations on the Board when exercising its rulemaking powers. Not surprisingly, before imposing emission controls, the Board is directed to make a judgement on the “necessity” of such controls.

<sup>49</sup> Memorandum from Bill Reiss, through Bryce Bird, to the Air Quality Board, regarding, “PROPOSE FOR PUBLIC COMMENT: Amend SIP Subsection IX. Part H: Emission Limits and Operating Practices. Specifically Proposed for Amendment are Requirements in Subparts H. 1, 2, 11, and 12.” (May 24, 2018), hereinafter *Memo to Board*.

<sup>50</sup> When using the term “attainment demonstration,” these comments are intending for it to encompass a precursor demonstration as well.

PM2.5 Implementation Rule and the context of EPA’s statement is important. EPA’s statement that BACT is “generally independent of attainment”<sup>51</sup> comes in a discussion of why BACT/BACM is different from its RACT/RACM counterpart that applies to Moderate Area SIPs; that difference being that RACT/RACM “emphasizes the attainment needs of the area” while BACT/BACM emphasis is on “identifying measures that are feasible to implement.”<sup>52</sup>

In other words, *if* BACT is required to be implemented, the determination of what constitutes a BACT-level control is generally made irrespective of what the control’s benefit will be on air quality.<sup>53</sup> But the “if” qualification is important and is a precedent question that must be addressed prior to moving on to a BACT determination. In no way does EPA’s statement that “BACM and BACT measures are generally independent of the attainment needs of the area” negate a state’s authority to provide a demonstration in the first instance that a particular *precursor* need not be subject to BACT-level control measures. To the contrary, both the preamble and the regulatory text make clear that a precursor demonstration may negate entirely the need to impose BACT for emissions of PM2.5 precursors subject to the demonstration.

EPA specifically enacted regulations that allow for analyses that make the case that certain PM2.5 precursor emissions have an insignificant contribution to PM2.5 levels and therefore allow state regulators to forgo implementation of further control measures for those precursors.<sup>54</sup> These analyses are called “precursor demonstrations” and are codified in 40 CFR § 51.1010 (for Serious NAAs), which states,

(a) The state shall identify, adopt, and implement best available control measures, including control technologies, on sources of direct PM2.5 and sources of emissions of PM2.5 plan precursors located in any Serious PM2.5 nonattainment area or portion thereof located within the state and consistent with the following:

...

(2) The state shall identify all potential control measures to reduce emissions from all sources of direct PM2.5 emissions and sources of PM2.5 plan precursors in the nonattainment area identified under paragraph (a)(1) of this section.

...

(ii) The state *is not required* to identify and evaluate potential control measures to reduce emissions of a particular PM2.5 precursor from *any*

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<sup>51</sup> 81 Fed. Reg. at 58081/2.

<sup>52</sup> *Id.* at 58081/3.

<sup>53</sup> This distinguishes RACM/RACT from BACM/BACT. In the case of the former, “[m]easures that are not necessary for attainment need not be considered as RACM/RACT.” *Id.* at 58035/1.

<sup>54</sup> The PM2.5 Implementation Rule imposes a default determination that SO<sub>2</sub>, NO<sub>x</sub>, VOC, and NH<sub>3</sub> are precursors to PM2.5. 40 CFR § 51.1000 (defining “PM2.5 precursors”). A precursor demonstration only eliminates the need to implement controls for the particular precursors subject to the demonstration, meaning that BACT will still be required for direct PM2.5 emissions and any precursor that cannot be shown to have an insignificant impact on PM2.5 levels.

*existing sources* if the state has submitted *a comprehensive precursor demonstration* approved by EPA . . . .

(iii) The state *is not required* to identify and evaluate potential control measures to reduce emissions of a particular PM<sub>2.5</sub> precursor from any existing major stationary sources if the state has submitted *a major stationary source precursor demonstration* approved by the EPA . . . .<sup>55</sup>

This regulation directs the state to implement BACT subject to two express exemptions: (1) completion of a “comprehensive precursor demonstration” or (2) completion of a “major stationary source precursor demonstration.”

In the preamble to the implementation rule, EPA was clear about the impact that a major source precursor demonstration would have on the state’s obligation to implement BACT on existing major stationary sources: “If such a demonstration is approved by the EPA, then in developing the attainment plan for the area, *the state would not be required to adopt control measures for the precursor for existing major stationary sources* in the nonattainment area.”<sup>56</sup> By proposing to finalize its BACT determinations before concluding its modeling analyses, UDAQ is putting the cart (BACT determinations) before the horse (the attainment and precursor demonstrations).

In summary, it is simply not correct for UDAQ to represent to the Board that BACT must be imposed for all precursor emissions regardless of whether the modeling shows such controls to be necessary. *It is in fact to the contrary; that is, there is no legal basis for imposing controls where the modeling shows the controls will provide an insignificant contribution.*

## V. IN ASSESSING THE NECESSITY OF THE PROPOSED CONTROL REQUIREMENTS, THE BOARD MUST EVALUATE THE PRECURSOR DEMONSTRATIONS SUBMITTED BY UPA

A fundamental requirement of the rulemaking process is the opportunity for the public to provide comment.<sup>57</sup> In turn, UDAQ/AQB are required to “review and evaluate all public comments submitted in writing.”<sup>58</sup>

UPA has submitted a detailed modeling-based analysis that shows that controlling certain precursors from major sources will not further the underlying goal of advancing attainment and

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<sup>55</sup> *Id.* § 51.1010(a) (emphasis added); *see also id.* § 51.1000 (defining BACM to “include[] best available control technology (BACT)”).

<sup>56</sup> 81 Fed. Reg. at 58022/1 (emphasis added). Furthermore, the preamble’s discussion appears to hit on the reality of the SLC NAA emission inventory: “Note that a state might consider developing a major stationary source demonstration to avoid the requirement to adopt nonattainment planning control measures for a particular precursor emission from existing major stationary sources in the areas if the state does not believe that it could comprehensively demonstrate that the precursor does not have a significant contribution, and if major stationary source emissions of the precursor do not make up a very large percentage of the emissions inventory in the area. For example, it might be possible that in a particular area the overwhelming amount of emissions of a certain precursor could originate from mobile or area sources, or both, but not from existing major stationary sources.” *Id.*

<sup>57</sup> Utah Code Ann. § 63G-3-301(11)(a).

<sup>58</sup> *Id.* at § 63G-3-301(11)(b).

such controls are, therefore, not necessary. While the need for UDAQ/UAB to evaluate and respond to the UPA precursor demonstrations is a fundamental requirement of the Utah Administrative Rulemaking Act, it is also mandated under EPA's PM2.5 Implementation Rule. In discussing the importance of public review and input pertaining to precursor demonstrations, EPA explained that,

as required under any rulemaking process, the state ha[s] to consider and provide a response in the rulemaking record to any information or evidence brought forward by commenters during the state's SIP planning, development and review process. By ensuring that this important issue [submission of a precursor demonstration] [is] explicitly addressed and supported in any attainment plan ... submitted to the EPA, the EPA [can] better evaluate the precursor demonstration in accordance with its obligations under the CAA. The EPA believes these are sound procedural steps for a state rulemaking process, and the final rule includes similar language requiring public review of any proposed precursor demonstration.<sup>59</sup>

Accordingly, as a matter of Utah rulemaking law and the federal SIP requirements,<sup>60</sup> UDAQ/AQB are obligated to consider the merits of the proffered precursor demonstration analyses.

## **VI. AN ANALYSIS OF PRECURSORS UTILIZING UDAQ'S MODELING TOOLS AND INPUTS DEMONSTRATES THAT PM2.5 PRECURSORS MAKE AN INSIGNIFICANT CONTRIBUTION TO PM2.5 LEVELS IN THE SLC NAA**

UDAQ is proposing to have the Board impose additional<sup>61</sup> control measures for the purported purpose of bringing about attainment of the PM2.5 NAAQS in the SLC NAA. These proposed measures include, in addition to controls for direct PM2.5 emissions, controls for PM2.5 precursor emissions. As UDAQ readily admits, it has decided to propose these controls for precursors without even considering their necessity or usefulness in addressing PM2.5 levels. It has taken this course of action based on a determination that BACT/BACM is "generally" independent of the attainment demonstration.<sup>62</sup>

As explained above, however, and as UDAQ acknowledges, this general independence gives way to a demonstration that controlling a particular precursor will have an insignificant contribution to reducing PM2.5 levels. Due to the uncertain role that precursors might play in any given airshed, the CAA and its implementing regulations do not, quite sensibly, require controls for those precursors shown to result in an insignificant contribution to PM2.5 levels. In such cases, the control of precursors is neither necessary nor required.

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<sup>59</sup> 81 Fed. Reg. 58024/3.

<sup>60</sup> In exercising its rulemaking authority, the Board is obligated to take action that "meet[s] the requirements of federal air pollution laws." Utah Code Ann. § 19-2-104(3)(b)(iii).

<sup>61</sup> Additional in the sense that many of the existing emission units at major stationary sources have been subject to control requirements pursuant to various federal and state rulemaking and permitting actions. Most, if not all, of these emission units are already well controlled.

<sup>62</sup> See discussion *supra* Part IV.C.

UPA has included as part of these comments, and incorporates by this reference, a report by Ramboll that discusses the results of major stationary source precursor demonstrations performed for all four PM2.5 precursors, SO<sub>2</sub>, NO<sub>x</sub>, VOC, and NH<sub>3</sub>.<sup>63</sup> These demonstrations show that controlling any of these precursors from “major” sources would have an insignificant effect on PM2.5 levels; that is, such controls are not “necessary” as required by the Utah Air Conservation Act. Accordingly, there is no technical, rational, or legal basis for imposing such controls. As discussed above, UDAQ and the Board are obligated to evaluate these demonstrations when determining the necessity of imposing controls.

### **A. The Approach**

The Ramboll Report provides a detailed discussion of how the precursor demonstrations were conducted and should be consulted for a more complete explanation. Following are some key aspects of the precursor demonstrations.

- The demonstrations are conducted consistent with EPA’s PM2.5 Implementation Rule, the draft *PM2.5 Precursor Demonstration Guidance*, and the associated *Technical Basis Document*.
- The precursor demonstrations utilize the CAMx model. CAMx has been used for two decades to support numerous ozone and PM2.5 SIP demonstrations throughout the United States and has been endorsed by EPA for making precursor demonstrations.<sup>64</sup> CAMx is the model being used by UDAQ to make its attainment demonstration.
- Ramboll is the developer of the CAMx model and is, therefore, uniquely qualified to configure, run, and evaluate the model.
- The precursor demonstrations utilized the same model input data sets<sup>65</sup> as UDAQ is utilizing in its attainment demonstration modeling subject to limited adjustments to emissions data as specifically noted to ensure accuracy. In other words, the results are expected to be identical to what UDAQ would obtain were it to conduct the precursor demonstrations.
  - As part of this submittal, UPA has delivered the modeling input and output files to UDAQ.<sup>66</sup>

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<sup>63</sup> See Major Stationary Source Precursor Demonstration for NO<sub>x</sub>, SO<sub>x</sub>, VOC, and NH<sub>3</sub> in the Salt Lake City 24-hour PM2.5 Serious Nonattainment Area, attached hereto as Attachment A.

<sup>64</sup> See *Demonstration Guidance* at 30-31.

<sup>65</sup> This includes meteorological data, emissions source locations, emission rates (subject to limited adjustments and corrections to ensure accuracy as noted in the Ramboll report), and topographical information.

<sup>66</sup> The data files were sent via FedEx to UDAQ’s Chris Pennell on August 13, 2018 – UPA received notice on August 14, 2018 that the disk drive with the data files were delivered to UDAQ’s offices – and are incorporated into these comments by this reference.

- The precursor demonstrations are *Major* Stationary Source Precursors Demonstrations. Therefore, they only address the need for controls on existing major stationary sources; the demonstrations do *not* address or otherwise affect determinations regarding the appropriateness of requiring area or mobile source controls.
- Concentration-based contribution demonstrations were conducted for all four precursors. As discussed above, this type of analysis is very conservative and examines the impacts associated with completely zeroing-out the emissions of the precursor from all major stationary sources. Additionally, for SO<sub>2</sub>, an additional sensitivity-based contribution analysis was conducted.<sup>67</sup> The concept behind this type of analysis is to examine the impacts associated with a more realistic scenario for reducing emissions.

## B. Summary of Results

The Ramboll Report provides a detailed discussion of the precursor demonstration results and should be consulted for the complete results. The table below summarizes the results. The table shows, for each precursor, for the duration of the January 7, 2011 episode (December 31, 2010 – January 10, 2011), the maximum decrease occurring at any of the State’s monitoring stations in the SLC NAA, as well as the maximum decrease occurring at the Hawthorne and Rose Park monitoring stations (as these are deemed the controlling monitors), resulting from the complete zeroing-out of major source emissions for each precursor. Additionally, for SO<sub>2</sub> only, results are shown for an additional sensitivity-based analysis in which SO<sub>2</sub> emissions from major stationary sources are reduced by 70%.<sup>68</sup>

**Summary of Ramboll Precursor Demonstration Analysis**

Precursor	Percentage Reduction	Decrease in PM <sub>2.5</sub> (µg/m <sup>3</sup> )			Significance Threshold (µg/m <sup>3</sup> )	Significant contribution?
		<i>Max. Station</i>	<i>Hawthorne</i>	<i>Rose Park</i>		
<i>NO<sub>x</sub></i>	100%	0.86	0.33	0.40	1.5	No
<i>VOC</i>	100%	0.58	0.50	0.29		
<i>NH<sub>3</sub></i>	100%	1.06	0.62	1.06		

<sup>67</sup> This additional analysis was done for SO<sub>2</sub> because a complete zeroing-out resulted in impacts that were only slightly below the significance threshold. See discussion below.

<sup>68</sup> Although the concentration-based contribution analysis (100% reduction) was below the significance threshold, thereby satisfying the EPA criteria for determining significance, it was only marginally below that threshold. Therefore, a sensitivity-based analysis was conducted in order to provide an additional basis for demonstrating the insignificant contribution associated with major stationary source SO<sub>2</sub> emissions. This additional analysis shows impacts well below the significance threshold, confirming that additional reductions in emissions of SO<sub>2</sub> from major stationary sources would be unwarranted.

SO <sub>2</sub>	100%	1.47	0.99	1.21		
	70%	0.92	0.64	0.75		

As indicated by the table, successful major source precursor demonstrations were made for all four precursors, NO<sub>x</sub>, SO<sub>2</sub>, VOC, and NH<sub>3</sub>. In considering these results, it is important to understand the very conservative nature of the demonstrations made. In each case, the major source emissions were completely zeroed-out for each respective precursor from all major sources. The effect on modeled concentrations are then compared to a threshold that is within the statistical noise of measured atmospheric concentrations (1.5 µg/m<sup>3</sup>). In other words, even if a given precursor was removed from the emissions inventory for all the major stationary sources, the effect on air quality would be less than the inherent statistical variability in the measured concentrations.

This is consistent with the sensible rationale underlying the CAA’s exception for precursors; it is senseless to impose costly, misdirected controls that can be demonstrated to provide an insignificant benefit to addressing the air quality problem faced by an airshed. This provision addresses the fact that each airshed will, depending on numerous variables, be responsive to different control strategies. And states and the regulated community should not be required to implement controls which can be demonstrated to provide an insignificant benefit.

## VII. THE STATE OF UTAH’S POLICY

Prudential governance requires adherence to basic but important principles. In particular, we do not believe it is (or should be) the State of Utah’s policy to (i) act in contravention of the available evidence and (ii) impose control measures on precursor emission that are shown to insignificantly contribute to air quality levels.

The concept behind providing states with the opportunity to include a precursor demonstration makes sense in view of the fact that not all precursors will contribute to a particular area’s nonattainment problem. Requiring costly controls to reduce emissions of a pollutant that has been shown *not* to contribute to an area’s nonattainment problem is a waste of resources that might be redirected to meritorious controls that can actually benefit an area’s air quality.<sup>69</sup>

Therefore, we urge UDAQ/UAQB not to adopt the proposed changes to the Emission Limits and Operating Practices for major stationary sources in Section IX, Part H, of the Utah State Implementation Plan.

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<sup>69</sup> We understand that there might be some temptation to perhaps take the view that, “Well it’s still pollution and all pollution is inherently bad.” Or, “Well, maybe we don’t need to control NO<sub>x</sub> [to pick a precursor] from the existing major sources to address the PM<sub>2.5</sub> problem but it might help with ozone.” But this is not an appropriate basis for the Board to wield its rulemaking power. See discussion *supra* in Section IV.B of these comments. The Board is charged with adopting rules that are “necessary” to address a particular problem. For example, it might prove correct that certain NO<sub>x</sub> controls that won’t be productive in addressing the PM<sub>2.5</sub> problem might yet prove effective in addressing ozone concerns. It is in the context of an *ozone* SIP rulemaking, however, that such controls must be considered.

## **SECOND COMMENT: THE PROPOSED SIP CONTAINS INADEQUATE CONTROL MEASURES FOR RESIDENTIAL WOOD BURNING EMISSIONS**

### **I. SUMMARY**

In contrast to the prior comments that document a lack of necessity to further control precursor emissions from major stationary sources, overwhelming evidence demonstrates that direct PM<sub>2.5</sub> emissions from residential wood combustion (“RWC”) are significant contributors to the SLC NAA’s PM<sub>2.5</sub> concentrations. Yet, in the face of this substantial evidence, UDAQ has, at best, provided a cursory BACM evaluation of potential RWC controls and required no additional control measures.<sup>70</sup> The agency’s BACM analysis for this critical source of emissions was limited to the review of a single comparable rule from another nonattainment area; and even that evaluation was incomplete as UDAQ limited its evaluation to only a portion of the controls required by that rule. Consequently, UDAQ’s RWC BACM evaluation is inadequate as it fails to meet the requirements of the PM<sub>2.5</sub> Implementation Rule, which directs UDAQ to conduct a comprehensive survey of other NAAs rules and either adopt the measures of the other NAAs or provide a detailed justification for why those identified controls need not be implemented in the SLC NAA.

In the following comments, UPA explains why UDAQ’s review and rejection of elements of the San Joaquin Valley Air Pollution Control District’s RWC rule is insufficient under the PM<sub>2.5</sub> Implementation Rule. Furthermore, these comments provide a survey of other NAAs rules – the survey that UDAQ was obligated to conduct, but failed to do so – and identifies various other provisions that UDAQ must evaluate and implement in the SLC NAA (or provide a reasoned justification for declining to adopt the provisions). In particular, UPA calls upon UDAQ to take a close look at provisions that cause owners and operators of solid fuel combustion devices to retire or change-out older units that produce greater emissions because those retirements and change-outs will produce quantifiable emission reductions. Furthermore, UDAQ should adopt measures to strengthen the reductions from its rules as well as to strengthen compliance with its rules.

### **II. A PROCEDURAL NOTE**

The proposed rulemaking does not expressly address area source controls, focusing instead on controls for major stationary sources.<sup>71</sup> However, the control measures required for a Serious nonattainment area must address BACM for areas sources in addition to those for major stationary sources.<sup>72</sup> While the AQB has previously enacted rules imposing controls on area sources of PM<sub>2.5</sub>, it has *not* done so for the specific purpose of satisfying the Serious SIP BACM

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<sup>70</sup> See section II of this comment which address the ambiguous nature of UDAQ’s evaluation of BACM controls for area sources, including RWC.

<sup>71</sup> See *Memo to Board*, p. 1 (“The emission limits and operating practices expressed in Part H. subparts 11 and 12 have been developed to meet this requirement with respect to the *large stationary “point” sources* within the PM<sub>2.5</sub> nonattainment area.” (emphasis added)).

<sup>72</sup> See, e.g., 40 CFR § 51.1010; 81 Fed. Reg. 58084-85 (discussing the need to evaluate area and mobile sources BACM).

requirements.<sup>73</sup> Furthermore, we have seen no announcement from UDAQ explaining how or when it plans to address area source BACM requirements.

We are submitting these comments now because it is not clear to us whether UDAQ intends to take additional rulemaking action to address BACM for area sources including RWC.<sup>74</sup> Should UDAQ intend to engage in a SIP rulemaking action aimed at evaluating BACM for area sources, including RWC, we offer these comments for the agency's consideration in advance of that rulemaking.

In the event that UDAQ/AQB determine not to take further rulemaking action on area source BACM controls, including RWC, these comments are submitted as a petition for rulemaking (agency action) in accordance with Utah Code Ann. 63G-3-601 and Utah Admin. Code R15-2, Public Petitioning for Rulemaking. A petition for a rule change is contained in Attachment C.

### **III. UTAH'S SIP MUST EVALUATE AND IMPLEMENT ADDITIONAL AREA SOURCE CONTROLS THAT ARE CONTAINED IN OTHER IMPLEMENTATION PLANS**

As part of developing its SIP control strategy for areas sources, Utah is obligated to “survey other NAAQS nonattainment areas in the U.S. and identify any measures for direct PM<sub>2.5</sub> and PM<sub>2.5</sub> plan precursors not previously identified by the state during the development of the Moderate area attainment plan for the area.”<sup>75</sup> To the extent such measures are identified, the State “shall adopt and implement [the] control measures” subject to certain limited exceptions.<sup>76</sup> In particular, if a state intends *not* to adopt a control measure included in another state's plan, it must “make a demonstration that [the] measure ... is not technologically or economically feasible to implement

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<sup>73</sup> See Utah SIP Section IX. Part A.21, p. 58 (stating that the controls for area sources “centered on whether reasonable control measures are available for a given source category) (December 3, 2014) Exhibit No. 6, *id.* pp. 16-17, 54 (stating that UDAQ was implementing RACM and RACT in the December 3, 2014 version of the SIP); Utah SIP Section IX. Part A.21, pp. 44, 51, 54-57 (providing a history of implementation of UDAQ's rule controlling RWC and stating that the measures were included in the PM<sub>2.5</sub> SIP as part of UDAQ's obligation to implement RACM/RACT) (December 4, 2013), attached hereto as Exhibit No. 7; *see also* 81 Fed. Reg. 71988, 71989 (October 19, 2016) (“EPA is finalizing the conditional approval of Utah's determination that R307-302 constitutes RACM for the Utah PM<sub>2.5</sub> SIP for solid fuel burning devices”). The AQB further revised R307-302 in early 2017. These revisions were done at the request of EPA, which conditionally approved the revisions to R307-302 upon UDAQ's commitment to make specific revisions to the rule; the revisions, however, were necessary to EPA to determine that the PM<sub>2.5</sub> SIP met all requirements for RACM. 81 Fed. Reg. at 71989/2 (discussing RACM and UDAQ's commitment to revise R307-302); *see also* 2016-19 Utah Bull. pp. 38-40 (October 1, 2016) (“The amendment is being proposed in response to a request for the EPA that the rule should provide controls during start-up and refueling.”); 2017-01 Utah Bull. pp. 102-104 (January 1, 2017) (providing a notice of change to the rule proposed on October 1, 2016).

<sup>74</sup> While UDAQ has not engaged in formal rulemaking to evaluate and implement BACM for RWC, UDAQ included a “DRAFT” “Salt Lake Area Source BACM Analysis” on its website identifying the Control Strategies and agency review of the BACT analyses for major stationary point sources. UPA is providing comments on this draft analysis at this time because it provides the only indication from UDAQ regarding its thinking on BACM for RWC and the exact intent of UDAQ's posting this draft is unclear.

<sup>75</sup> 40 CFR § 51.1010(a)(2)(i).

<sup>76</sup> *Id.* at § 51.1010(a)(4).

....”<sup>77</sup> Furthermore, in doing so, “[t]he state shall submit to the EPA as part of its Serious area attainment plan submission a detailed written justification for eliminating from further consideration any potential control measure identified ... on the basis of technological or economic infeasibility.”<sup>78</sup>

In the preamble to the PM2.5 Implementation Rule, EPA provides the following explanation:

Area and mobile sources. With respect to determining whether a given control measure might not be technologically feasible as BACM for an area or mobile source, a state may consider factors in conducting its analysis that are similar to factors the state may have considered during the RACM and RACT determination process, such as local circumstances, the condition and extent of needed infrastructure, or population size or workforce type and habits, which may prohibit certain potential control measures from being implementable. However, in the instance where a given control measure has been applied *in another NAAQS nonattainment area* (for PM2.5 or other pollutant), the state will need to *provide a detailed justification for rejecting any potential BACM measure* as technologically infeasible. Furthermore, if the state identifies a certain control measure for area or mobile sources that has been implemented *in another nonattainment area* and may qualify as BACM or BACT, *the state must provide a reasoned justification* if it deems it technologically infeasible to implement the same control measure *to the same extent or magnitude* as it was applied in the other nonattainment area.<sup>79</sup>

Pursuant to this regulatory and preamble language, UDAQ is under an affirmative obligation to conduct a comprehensive analysis of BACM for area sources of PM2.5 and PM2.5 precursor emissions by surveying “other NAAQS nonattainment areas” as part of the state’s development of a Serious PM2.5 SIP. If, after completing that mandatory survey of other NAAs, UDAQ determines that such SIP measures implemented in other NAAs should not be implemented in the SLC NAA, it must provide detailed justification for rejecting the control option. As a result, UDAQ’s BACM analysis must not only be comprehensive – as a result of looking broadly to other NAA rules – but it must be rigorous and on the record – as it explains with specific justification why certain controls should not be implemented.

#### **IV. UDAQ IMPROPERLY FAILED TO SURVEY AND EVALUATE AREA SOURCE MEASURES CONTAINED IN OTHER STATE AND LOCAL IMPLEMENTATION PLANS**

While these comments identify specific control measures for area sources, wood burning in particular, that UDAQ has improperly failed to adopt as BACM, UPA begins with a general

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<sup>77</sup> *Id.* at § 51.1010(a)(3).

<sup>78</sup> *Id.* at § 51.1010(a)(3)(iii).

<sup>79</sup> 81 Fed. Reg. 58084-85 (emphasis added).

comment that identifies an issue that significantly undermines UDAQ’s BACM determination for area source rules.

**A. UDAQ Committed Procedural Error by Failing to Consider Control Measures Adopted in Other NAAs**

In the document titled “Draft” “Salt Lake Area Source BACM Analysis,” UDAQ states the following:

The BACM analysis was conducted based on:

...

- ❖ A comparison of other serious nonattainment air district rules for ozone and/or PM2.5 to UDAQ rules:
  - San Joaquin Valley (SJ) – PM2.5
  - South Coast Air District (SC) – PM2.5
  - Ventura County, CA – ozone
  - Sacramento Metro, CA – ozone

Additional air district rules may also be reviewed if the air districts listed above do not have a comparable UDAQ rule.<sup>80</sup>

UDAQ restricted its review of area source rules promulgated in other NAAQS NAAs to other *serious* NAAs for PM2.5 and ozone. UDAQ only looked beyond the four serious NAAs identified if those areas had not enacted a comparable area source rule. Such a restriction is in conflict with section 51.1010, which does not limit UDAQ’s review to serious NAAs. Section 51.1010 directs UDAQ to “survey *other NAAQS nonattainment areas* in the U.S;” EPA did not limit this requirement to other similarly classified NAAs (e.g., to other serious NAAs). UDAQ’s decision to only review similar rules from serious NAAs is not merely a procedural error but, as shown in the comments below, UDAQ’s self-imposed limitation on the area source rules it evaluated compromised the agency’s BACM analysis because UDAQ failed to consider rules that may constitute BACM and reduce emissions from area sources in the Salt Lake City NAA.

**B. UDAQ Failed to Conduct a Comprehensive Survey of Other NAAs rules Controlling Residential Wood Burning and Failed to Implement all Feasible Controls for this Area Source Category**

Beginning with the PM10 SIP, UDAQ implemented area source rules that control emissions from RWC.<sup>81</sup> UDAQ updated the rule as part of the moderate PM2.5 SIP earlier this decade as part of

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<sup>80</sup> UDAQ, Salt Lake Area Source BACM Analysis, Draft: August 21, 2017, p. 1, available at <https://deq.utah.gov/legacy/pollutants/p/particulate-matter/pm25/serious-area-state-implementation-plans/control-strategies.htm>, hereinafter “UDAQ BACM Analysis” (emphasis added), attached hereto as Exhibit No. 8.

<sup>81</sup> See Utah Implementation Plan, section IX.A.6.d (July 26, 1993) (discussing the significance of RWC to the nonattainment status and the controls that UDAQ implement through r307-1-4.13), attached hereto as Exhibit No. 9.

the development of a Moderate PM<sub>2.5</sub> SIP and the current RWC regulation is contained in Utah Administrative Code R307-302.

1. *Why it Matters: Residential wood combustion contributes significantly to the Salt Lake City NAA's PM<sub>2.5</sub> concentrations*

As the SLC NAA's status for PM<sub>2.5</sub> has progressed from moderate to serious classification, it has become more than apparent that RWC is a major factor contributing to wintertime PM<sub>2.5</sub> concentrations. The UDAQ BACM Analysis attributes 2.41 tpd of PM<sub>2.5</sub> to RWC in the SLC NAA, which is the largest area source of direct PM<sub>2.5</sub> emissions.<sup>82</sup> However, there is evidence that UDAQ has underestimated the emissions attributable to RWC.<sup>83</sup> There is mounting evidence that supports the conclusion that RWC contributes significantly to the Salt Lake City NAA's PM<sub>2.5</sub> concentrations; indeed, the authors of the 2017 Utah Winter Fine Particulate Study surveyed the existing research on RWC in Utah's NAAs and stated the following:

Kelly et al. found primary PM<sub>2.5</sub> contributions for wood smoke to be 40% and 20-70% at [Hawthorne] and [Bountiful], respectively, and 40% at [Lindon] on days when PM<sub>2.5</sub> exceeded 20 µg/m<sup>3</sup>. The authors reported that these [i.e., RWS] values are larger than UDAQ's inventory estimates, as important as the gasoline exhaust contributions to primary PM<sub>2.5</sub> at these sites during PCAPs. The authors also noted that the sampling sites could be influenced by wood smoke due to their location in older residential neighborhoods. Kotchenruther et al. estimated, using PMF analysis of 2007-2014 chemical speciation network (CSN) data, that 12% and 9% of total PM<sub>2.5</sub> come from primary wood smoke during December and January months at [Bountiful] and [Lindon] respectively. Based on this analysis, total primary and aged wood smoke contributions are estimated to be 3.3 µg/m<sup>3</sup> on average, or 22% and 17.8 % of total winter PM<sub>2.5</sub> at the respective sites.<sup>84</sup>

The information collected in the 2017 Study leaves little doubt as to the significant role that RWC plays in Salt Lake City's PM<sub>2.5</sub> concentrations. As a complement to the 2017 Study, UPA has included as part of these comments, and incorporates by this reference, a report by Ramboll that discusses the results of a modeling study of the contribution of RWC on the SLC NAA.<sup>85</sup>

The Ramboll report provides a detailed discussion of how the modeling study was conducted and should be consulted for a more complete explanation. Following are some key aspects of the modeling study.

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<sup>82</sup> UDAQ BACM Analysis at p. 2. Additionally, the UDAQ BACM Analysis attributes 2.63 tpd of VOC and 0.05 tpd of SO<sub>2</sub> emissions to wood combustion. *Id.* at pp. 10 & 23.

<sup>83</sup> See 2017 Utah Winter Fine Particulate Study, Final Report, March 16, 2018, p. 140 (citing to a 2013 study and stating that "the authors reported that these [i.e., RWC] values are larger than UDAQ's inventory estimates, as important as the gasoline exhaust contributions to primary PM<sub>2.5</sub> at these sites during PCAPs").

<sup>84</sup> *Id.*

<sup>85</sup> Modeled Contributions of Residential Wood Combustion to PM<sub>2.5</sub> in the Salt Lake City 24-hour PM<sub>2.5</sub> Serious Nonattainment Area, Final Report, August 2018, Attachment B, hereinafter "Ramboll Modeled Contribution of RWC."

- The modeling uses UDAQ's CAMx photochemical modeling platform that the agency developed for the SLC NAA SIP. As such, the demonstration is parallel to UDAQ's technical analysis.
- The demonstration was based on RWC activity in UDAQ's 2014 base year inventory.
- The demonstration zeroed out RWC emissions for the Salt Lake City NAA by reprocessing the UDAQ 2014 emission inventory using the SMOKE processing system. UDAQ provided to Ramboll the agency's entire SMOKE system of run scripts, raw inventory files, and ancillary supporting data files.
- Ramboll ran the photochemical model for the entirety of the January 2011 modeling episode.
- In terms of determining regulatory significance, Ramboll relied on the 1.5  $\mu\text{g}/\text{m}^3$  figure that EPA identified in its *Technical Basis Document* cited to earlier in these comments.
- Ramboll identified two model outputs, the first (expressed in Table 1 of the study) shows the impact of RWC using UDAQ's unmodified 2014 RWC inventory, the second (expressed in Table 2 of the study) shows the impact of RWC while accounting for reductions in RWC due to UDAQ's burn ban.

The Ramboll report provides a detailed discussion of the results of the modeling study and should be consulted for a complete explanation. Following are some key findings of the study.

- The zero-out case derived from UDAQ's unmodified 2014 base year inventory – meaning the modeling does not take any credit for reductions caused by UDAQ's burn ban – found impacts on the Rose Park and Hawthorne sites ranged from 1.1 to 7.7  $\mu\text{g}/\text{m}^3$  over the course of the inversion episode. However, there were just two days (December 31, 2010 and January 10, 2011, the first and last days of the episode model period) at the Rose Park site that were below EPA's significance threshold of 1.5  $\mu\text{g}/\text{m}^3$ . The highest concentration for each of these monitors was 4.1  $\mu\text{g}/\text{m}^3$  at the Rose Park location and 7.7  $\mu\text{g}/\text{m}^3$  at the Hawthorne location.
- The zero-out case derived from modified 2014 base case – which reflects UDAQ's estimated 61% reduction in emissions due to a regulatory burn ban – resulted in similarly high contributions from RWC. For instance, impacts from RWC ranged from 0.7 to 7.1  $\mu\text{g}/\text{m}^3$  at the Rose Park and Hawthorne locations. The highest concentrations attributable to RWC during the inversion episode was 4.0  $\mu\text{g}/\text{m}^3$  at Rose Park location and 7.1  $\mu\text{g}/\text{m}^3$  at the Hawthorne site.
- The Ramboll demonstration also included an un-monitored area analysis of model results (i.e., an analysis of all grid cells, not just monitoring sites) based on a RWC inventory that accounted for emission reductions due to implementation of a burn ban. According to the model, estimated RWC contributions peaked at between 8

and 9 µg/m<sup>3</sup> in the initial days of the inversion episode. The concentrations subsided for several days and then rebuilt to 4.5 µg/m<sup>3</sup> and a peak of 8 µg/m<sup>3</sup> later in the episode.

These results demonstrate that RWC has a significant impact on PM<sub>2.5</sub> concentrations in the SLC NAA. These results emphasize the need for UDAQ to evaluate available control measures as indicated by other state and local plans in accordance with the requirements of the PM<sub>2.5</sub> Implementation Rule.

2. *UDAQ improperly ruled out BACM measures for RWC.*

Despite the clear evidence of the significance of RWC to the NAA’s PM<sub>2.5</sub> concentrations, UDAQ appears to have conducted only a cursory BACM evaluation of potential controls for RWC. Indeed, as discussed specifically below, UDAQ limited its review to a comparison of current rule R307-302 to an analogous rule adopted by the San Joaquin Valley Air Pollution Control District (SJVAPCD), thereby eliminating from consideration numerous controls implemented by a number of other NAAs aimed at reducing RWC emissions. Moreover, in evaluating the SJVAPCD rule, UDAQ failed to evaluate all of the controls included in that rule and did not provide a detailed justification for rejecting the controls that it did evaluate. Ultimately, UDAQ’s evaluation of BACM for RWC is inadequate.

UPA’s comments now turn to where UDAQ’s BACM review for RWC began and ended, that being SJVAPCD Rule 4901, Wood Burning Fireplaces and Wood Burning Heaters.<sup>86</sup> The following table provides a side-by-side comparison of some of the main elements of R307-302 to Rule 4901.

Topic	UDAQ R307-302	SJVAPCD Rule 4901
<b>Burn Ban</b>	R307-302-3(4). When the ambient concentrations of PM <sub>2.5</sub> measured by monitors ... are forecasted to reach or exceed 25 microgram per cubic meter, the director will issue a public announcement ... that a mandatory no burn period for solid fuel burning devices is in effect.	5.6.1. The APCO shall declare a Level One Episodic Wood Burning Curtailment for a geographic region whenever the potential for PM <sub>2.5</sub> concentrations is forecast to equal or exceed 20 µg/m <sup>3</sup> but not exceed 60 µg/m <sup>3</sup> for the geographic region.  5.6.1.1. A wood burning fireplace, low mass fireplace, masonry heater, outdoor wood burning device, or nonregistered wood burning heater shall not be operated within the geographic region for which a Level one Episodic Wood Burning Curtailment is in effect.

<sup>86</sup> SJVAPCD Rule 4901 is attached hereto as Exhibit No. 10.

Topic	UDAQ R307-302	SJVAPCD Rule 4901
<b>Burn Ban Exemptions</b>	R307-302-3(4). A person . . . shall not use a solid fuel burning device unless it is the sole source of heat for an entire residence and registered with the director.	5.6.1.2. A wood burning heater that has an approved and current registration with the District may be operated within the geographic region for which a Level One Episodic Wood Burning Curtailment is in effect provided the wood burning heater: 5.6.1.2.1. Is not fired on a prohibited fuel type pursuant to section 5.5. 5.6.1.2.2. Is maintained according to manufacturer instructions. 5.6.1.2.3. Is operated according to manufacturer instructions, and 5.6.1.2.4. Has no visible smoke when operated under normal operating conditions.
<b>Wood-Burning Device Sales Restrictions</b>	R307-302-6(1). No person shall sell, offer for sale, supply, install, or transfer a wood burning stove that is not EPA certified or a fireplace that is not EPA qualified.	5.1.1. New wood burning heaters. No person shall advertise, sell, offer for sale, install, or transfer a new wood burning heater unless it is either: 5.1.1.1. EPA certified with a Phase II Certification or a more stringent certification as currently enforced in the NSPS at the time of sale or transfer, or 5.1.1.2. A pellet-fueled wood burning heater that is exempt from EPA certification pursuant to the requirements of the NSPS .... 5.1.2. Used wood burning heaters. No person shall advertise, sell, offer for sale, supply, install, or transfer a used wood burning heater unless it has been rendered permanently inoperable, satisfies the requirements of Section 5.1.1., or is a low mass fireplace, masonry heater, or other wood-burning device of a make and model that meets all federal requirements and has been approved in writing by the APCO.
<b>Replacement during Real Estate Transfer</b>	R307-302-6(2). Ownership of a non EPA certified stove within a residential dwelling installed prior to March 6, 2014 may be transferred as part of a real estate transaction, so long as the unit remains intact within the real property of sale.	5.2.1. No person shall sell or transfer any real property which contains a wood burning heater without first assuring that each wood burning heater included in the real property is: 5.2.1.1 EPA Phase II Certified or has a more stringent certification under the NSPS at time of purchase or installation, or 5.2.1.2 A pellet-fueled wood burning heater that was exempt from EPA Certification pursuant to requirements in the NSPS at the time of purchase or installation, or 5.2.1.3 Rendered permanently inoperable.

Topic	UDAQ R307-302	SJVAPCD Rule 4901
<b>New Residential Developments</b>	No equivalent provision	<p>5.3.2.1 No person shall install a wood burning fireplace in a residential development with a density greater than two (2) dwelling units per acre.</p> <p>5.3.2.2 No person shall install more than two (2) EPA Phase II Certified or more stringent certification as currently enforced under the NSPS, wood burning heaters per acre in any residential development with a density greater than two (2) dwelling units per acre.</p> <p>5.3.2.3 No person shall install more than one (1) wood burning fireplace or EPA Phase II Certified or more stringent certification, as currently enforced under the NSPS, per dwelling unit in any residential development with a density equal to or less than two (2) dwelling units per acre.</p>
<b>Public Awareness Information</b>	No equivalent provision	<p>5.1.3 Retailers selling or offering for sale new wood burning heaters shall supply public awareness information with each sale of a wood burning heater in the form of pamphlets, brochures, or fact sheets on the following topics listed in Sections 5.1.3.1 through 5.1.3.6. Public awareness information shall be subject to the review and approval of the APCO.</p> <p>5.1.3.1 Proper installation, operation, and maintenance of the woodburning heater,</p> <p>5.1.3.2 Proper fuel selection and use,</p> <p>5.1.3.3 Health effects from wood smoke,</p> <p>5.1.3.4 Weatherization methods for the home,</p> <p>5.1.3.5 Proper sizing of wood burning heaters, and</p> <p>5.1.3.6 Episodic Wood Burning Curtailment levels as defined in Section 5.6.</p>
<b>Wood Sales</b>	No equivalent provision <sup>87</sup>	<p>5.4.1 No person shall sell, offer for sale, or supply any wood which is orally or in writing, advertised, described, or in any way represented to be “seasoned wood” unless the wood has a moisture content of 20 percent or less by weight.</p>

Given this comparison, it is evident that UDAQ has not adopted all of the provisions of SJVAPCD Rule 4901.<sup>88</sup> Pursuant to 40 CFR 51.1010, the decision to not adopt these control measures must be supported by a written justification of why they are either technologically or economically

<sup>87</sup> Utah Admin. Code R307-302-5(3) requires operators of solid fuel burning devices to burn “seasoned wood,” which is defined as wood with a moisture content of less than or equal to 25%.

<sup>88</sup> Indeed, UDAQ’s BACM analysis only compares the burn ban and real estate transfer provisions of the two rules.

infeasible to implement in the Salt Lake City NAA. The following constitutes the entirety of UDAQ's analysis of other state rules governing RWC.

**Comparison of Other State Rules:** SJ Rule 4901, Wood Burning Fireplaces and Wood Burning Heaters was evaluated and compared to R30[7]-302. There are many similarities in the way the Rule 4901 and R307-302 are structured. The no burn thresholds are both based on forecasted PM<sub>2.5</sub> levels. The Rule 4901 no burn threshold is a range in which the low point is set at 20 µg/m<sup>3</sup> with an allowable exemption for EPA certified wood stoves that have been inspected and registered with SJ. The no burn threshold in R307-302 is more stringent in that regard.

R307-302 permits a real estate transfer containing a non EPA certified stove within a residential dwelling that was installed prior to March 6, 2014 so long as the unit remains intact within the real property sale. Rule 4901 does not permit real estate transfer containing a wood stove unless the wood stove is an EPA Phase II or better under a current NSPS, is a pellet stove exempt from EPA certification or is rendered inoperable. Rule 4901 is more stringent in this regard.

**BACM Conclusion:** Overall, R307-302 is more stringent because there is no exemption from the NSPS, nor does it exempt EPA certified stoves.

An area of improvement to R307-302 may be to consider a requirement to remove non-EPA certified stoves during real estate transactions, although that is likely beyond BACM.<sup>89</sup>

UDAQ's conclusion that R307-302 is more stringent than the corresponding San Joaquin control measures is predicated on the flawed premise that R307-302 will achieve 100% compliance with the burn ban. Under this hopeful, but unrealistic, premise, UDAQ concludes that there is simply no reason to evaluate other measures.

However, UDAQ is well aware that there is a relatively low rate of compliance with the ban.<sup>90</sup> In direct communications with UPA, UDAQ has suggested a 60% compliance rate with the burn ban while other evidence offered by UDAQ suggests a much lower rate of compliance.<sup>91</sup> For example, one document provided on UDAQ's website states,

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<sup>89</sup> UDAQ BACM Analysis, p. 6.

<sup>90</sup> The lack of compliance with a mandatory burn ban could be the result of several reasons: the number of burn ban days in the season (people may get weary of bans), the number of years that have incurred burn bans (no enforcement or not much enforcement, so why comply), the price of home heating with whatever fuel the household has as their primary heating fuel (higher primary cost results in greater desire to supplement with cheaper wood), how cold it is (may still want to supplement with cheaper wood), and other factors that contribute to human decisions.

<sup>91</sup> UDAQ has not provided UPA or its members a basis for the 60% figure. However, the figure may be based on a historic estimation, as the 1993 version of the PM<sub>10</sub> SIP identified an identical compliance figure. Utah Implementation Plan, July 1993, section IX.A.6.d(3)(f) ("The implementation of the mandatory no burn period in Salt Lake City and the affected areas of Davis and Utah counties by the BAQ and the local health department will result in a 60% decrease in emissions from wood burning devices."). See Exhibit No. 9.

Levoglucosan displayed a similar trend at all sampling sites throughout northern Utah, with concentrations varying across burn and no-burn days. Comparable or higher concentrations overall were measured on mandatory no-burn days compared to days when there were no burning restrictions in place. This was true even during periods when inversion conditions were present. . . . This suggests that residential wood-burning contributes to PM2.5 during inversion episodes.<sup>92</sup>

The implications of these observations is something far less than 100% compliance.

The failure to acknowledge the relatively low compliance with the “mandatory” burn ban is a fundamental flaw in UDAQ’s analysis that allows the highest polluting devices to burn freely on burn ban days.<sup>93</sup> EPA has addressed this very issue:

The EPA considers measures that prevent PM-10 emissions over the long term (e.g., requiring gas logs in new fireplaces) to be preferable to those measures that will only temporarily reduce emissions (e.g., curtailment of wood stove use during air pollution episodes or treatment of fugitive dust sources with water). This is because such preventive measures are inherently more effective and involve significantly fewer resources for surveillance, enforcement, and administration. Moreover, increasing emphasis on prevention over mitigation is more likely to be both economically and environmentally beneficial over the long term.<sup>94</sup>

While a rule *seeking* a complete burn ban is certainly appropriate, the reality of a high rate of noncompliance must be acknowledged and other complimentary measures must be considered and adopted. This includes the other measures implemented in Rule 4901 – particularly the mandatory change out requirement during real estate transactions.

Likewise, UDAQ’s justification for rejecting Rule 4901’s provision requiring the retirement of older equipment during real estate transfers is inadequate. In its explanation, UDAQ acknowledged that such a provision would provide greater reductions in RWC emissions than the

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<sup>92</sup> Wood Smoke Contribution, *available at* <https://documents.deq.utah.gov/air-quality/planning/technical-analysis/research/residential-wood-burning/DAQ-2017-014365.pdf>, attached hereto as Exhibit No. 11.

<sup>93</sup> EPA has already highlighted this issue in comments to Alaska regulators as ADEC works to prepare a serious PM2.5 SIP. “The ‘date-certain’ removal of uncertified woodstoves in Tacoma, Washington appears more stringent than the current Moderate SIP approved Fairbanks ordinance in terms of the regulation and in practice. While the current ordinance appears to provide similar protection during stage 1 alerts, *this is dependent on 100% compliance* and the curtailment program remaining in its current form. *Removal of uncertified stoves guarantees reductions in emissions* in the airshed during both the curtailment periods and throughout the heading season.” EPA comments on ADEC Preliminary Draft Serious SIP Development materials for the Fairbanks serious PM2.5 nonattainment area, *available at* <http://fnspb.us/transportation/AQDocs/EPA%20comments%20to%20March%202018%20ADEC%20draft%20SIP%20documents.pdf>, attached hereto as Exhibit No. 12. The specifics of the Tacoma provision are provided in the table below, which UDAQ did not consider as part of its BACM analysis.

<sup>94</sup> 59 Fed. Reg. 41998, 42011/1 (Aug. 16, 1994) (State Implementation Plans for Serious PM-10 Nonattainment Areas, and Attainment Date Waivers for PM-10 Nonattainment Areas Generally; Addendum to the General Preamble for the Implementation of Title I of the Clean Air Act Amendments of 1990).

equivalent Utah provisions.<sup>95</sup> Yet, UDAQ only provides a cursory statement as to why UDAQ is not implementing the measure as UDAQ says Rule 4901’s real estate provision “is likely beyond BACM.”<sup>96</sup>

This statement is inadequate. It does not meet the requirement that UDAQ provide a detailed justification for rejecting the control. UDAQ has provided no explanation for why the measure is beyond BACM. This statement does not overcome the presumption that the inclusion of such a measure in another SIP means it *is* technically and economically feasible. Additionally, by using the word “likely,” UDAQ is effectively saying that it suspects that the measure is beyond what is required for BACT. Section 51.1010 requires UDAQ to explain why the measure is either not BACM based on technological or economic feasibility. UDAQ’s determination must be based on something more than the agency’s suspicions.

3. *UDAQ failed to survey the RWC controls from numerous other NAAs.*

There are numerous other SIPs that have implemented area source rules controlling RWC emissions that UDAQ did not evaluate. These include the rules from the following NAAs: Fairbanks, Alaska; Portola, California, and Tacoma, Washington. To complete its BACM analysis, UDAQ must conduct a comprehensive review of the RWC rules from these NAAs and either implement the rules or provide a detailed justification for why the implementation of the controls are either technologically or economically infeasible. The following table provides a summary of some of the provisions that UDAQ must evaluate.

NAA	Citation	BACM Requirement
Fairbanks, AK	18 AAC 50.076(b) & 50.990(134)	Standards for wood moisture content set at EPA’s recommended maximum of 20% moisture content as opposed to 25%, as imposed in R307-302.
Fairbanks, AK	18 AAC 50.076	Standards for wood seller registration and practices.
Fairbanks, AK	18 AAC 50.077	Standards for wood heating devices
Fairbanks, AK <sup>97</sup>	18 AAC 50.077	Change out wood burning appliances at real estate transfer and lease

<sup>95</sup> UDAQ BACM Analysis, p. 6 (stating that R4901 is more stringent than R307-302 and that the real estate provision could improve Utah’s rule).

<sup>96</sup> Information on the website for the Puget Sound Clean Air Agency shows that wood burning fireplaces have the highest annual emissions, emissions from an EPA-certified woodstove are 40% of the emissions from an uncertified woodstove, and emissions from a pellet stove are only 11% of the emissions of an uncertified woodstove (<http://www.pscleanair.org/DocumentCenter/View/2433/Heating-Choice-Comparison-Chart---Annual-Emissions-PDF?bidId=>), attached hereto as Exhibit No. 13. And, of course, emissions from natural gas stoves are just a fraction of the emissions from a pellet stove. Thus, replacements can provide better emissions reductions than a ban with low compliance.

<sup>97</sup> The cited Fairbanks, Alaska regulations are attached hereto as Exhibit No. 14.

NAA	Citation	BACM Requirement
Fairbanks, AK	ADEC public education site <a href="http://dec.alaska.gov/air/burnwise.aspx">http://dec.alaska.gov/air/burnwise.aspx</a> <sup>98</sup>	Provides information on ADEC's Burn Wise program. Information includes: <ul style="list-style-type: none"> <li>• Regulations, health effects, brochures, and other information related to RWC</li> <li>• Provides information on wood moisture and how to measure it</li> </ul>
Fairbanks, AK	ADEC wood seller/buyer information <a href="http://dec.alaska.gov/air/burnwise/wood-seller">http://dec.alaska.gov/air/burnwise/wood-seller</a>	Provides public information related to acceptable wood moisture meters, registration for sellers, and the wood moisture program
Tacoma, WA	Puget Sound Clean Air Agency (PSCAA) Regulation 1-13.04	Allowing operators to burn wood of not more than 20% moisture content, EPA's recommended maximum.
Tacoma, WA	PSCAA Regulation 1-13.06	Emission standards for solid fuel burning devices.
Tacoma, WA	Puget Sound Clean Air Agency regulation 1-13.07 <sup>99</sup>	Prohibitions on Wood Stoves that Are Not Certified Wood Stoves "Any person who owns or is responsible for a wood stove that is both (a) not a certified wood stove and (b) is located in the Tacoma, Washington fine particulate nonattainment area must remove and dispose of it or render it inoperable by September 30, 2015." <ul style="list-style-type: none"> <li>• Subparagraph (3) provides an exception for sole source residences</li> </ul>

<sup>98</sup> While this and the next provision cited in the table are not regulations adopted by ADEC, ADEC committed to providing public education in its SIP. See Fairbanks North Star Borough PM2.5 Control Plan, section 5.7, December 8, 2017, available at <https://dec.alaska.gov/air/anpms/communities/fbks-pm2-5-moderate-sip/>, p. 11.

<sup>99</sup> The Tacoma regulations contain a tiered burn ban provision. When the agency has declared a "first stage of impaired air quality," owners of equipment meeting the current NSPS may continue to combust wood. But, when the agency has declared a "second stage of impaired air quality," the regulations eliminate the exemption for equipment meeting the NSPS and only allow wood combustion by sole source operators. PSCAA Regulation 1-13.05. The cited Tacoma, Washington regulations are attached hereto as Exhibit No. 15.

NAA	Citation	BACM Requirement
Portola, CA	City of Portola, Ordinance No. 344.15.10.040 <sup>100</sup>	<p>“(1) In order to complete any escrow transaction, on any residential or commercial property, the current property within the City limits owner must obtain either a 1) Certificate of Compliance or a 2) Notice of Exemption.”</p> <ul style="list-style-type: none"> <li>• Subsection 15.10.020 defines a Certificate of Compliance as a document certifying that a building has wood burning heaters that are “EPA-certified,” which refer to the most stringent NSPS in effect.</li> </ul> <p>“(2) It is prohibited for any person to complete, or allow the completion of any Escrow transaction upon any residence or mobile home, or other parcel containing a building within the City limits unless each building on the parcel has been issued a Certificate of Compliance by the Control Officer as having no more than two wood burning heaters which are EPA-Certified and no uncertified wood burning heaters.”</p> <p>“(7) If the disclosure report indicates that a wood burning heaters on the property within the City limits is uncertified, the wood burning heater must be removed from the property and destroyed/recycled at an approved facility.”</p> <p>“(12) Upon a change of ownership, no uncertified wood-burning heater may remain in any property within the City limits.”</p>
Portola, CA	Ordinance 344.15.10.050	Allowing operators to burn wood of not more than 20% moisture content, consistent with EPA’s recommended maximum.
Portola, CA	Ordinance 344.15.10.080	<p>“Retailers or Contractors selling or offering to sale new Wood Burning Devices within the City limits shall supply public awareness information with each sale of a Wood Burning Device in the form of pamphlets, brochures, or fact sheets on the following topics:</p> <ol style="list-style-type: none"> <li>A. Proper installation, operation, and maintenance of the Wood Burning Device.</li> <li>B. Proper fuel selection and use.</li> <li>C. Health effects from wood smoke.</li> <li>D. Weatherization methods for the home.</li> <li>E. Proper sizing of Wood Burning Devices.</li> <li>F. Episodic Wood Burning Curtailment levels as defined in Section 15.10.060.</li> </ol>

<sup>100</sup> A summary of the RWC rules for the City of Portola are summarized in the Portola Fine Particulate Matter Attainment Plan. See Portola Fine Particulate Matter Attainment Plan, January 2017, pp. 33-34 and Appendix M, available at [http://myairdistrict.com/wp-content/uploads/2016/12/2017\\_sip.pdf](http://myairdistrict.com/wp-content/uploads/2016/12/2017_sip.pdf), Exhibit No. 4. The Portola Attainment Plan also describes the agency’s public education campaign, which included the purchase and distribution of moisture meters to the public. *Id.* pp. 34-36.

NAA	Citation	BACM Requirement
Portola, CA	Northern Sierra Air Quality Management District, Wood Stove Change-Out Program <sup>101</sup>	Provides a SIP-approved incentive program to replace inefficient wood fired devices with new equipment.

UPA also directs UDAQ’s attention to two additional sources of information. The first of these is EPA comments on ADEC’s Preliminary Draft Serious SIP Development materials. In this document, EPA identifies a number of additional control measures that it believes ADEC should consider as it evaluates BACM for the Fairbanks North Star NAA. Specifically, EPA identifies the following potential controls:

- Date-certain removal of uncertified woodstoves. EPA identified the requirement for a date-certain removal of uncertified woodstoves as a viable measure appearing in Tacoma, Washington’s SIP as being more stringent than the measures contained in Fairbanks’ SIP.
- Registration and Inspection Requirements. EPA identifies registration and inspection programs that vest regulators with the authority to verify that devices are maintained and operated properly.
- Ban on Coal Burning. EPA identifies a regulation from Telluride that prohibits coal burning.
- Surcharge on Solid Fuel Burning Appliances. EPA suggest ADEC consider a surcharge on such equipment as a means of offsetting the costs of enforcement for RWC and other wood smoke programs.
- Rental Unit Replacements. EPA suggests ADEC evaluate a regulation requiring rental units to replace uncertified devices with newer, more-efficient devices.
- Weatherization Programs. EPA directs ADEQ to study whether existing homes could be subject to energy audits to increase efficiency.<sup>102</sup>

Additionally, UDAQ did not review EPA guidance related to RWC. Specifically, the document *Technical Information Document for Residential Wood Combustion Best Available Control Measures* is relevant to UDAQ’s BACM analysis.<sup>103</sup> As part of UDAQ’s BACM analysis for RWC, UDAQ should review the Technical Information Document as part of its survey of potential controls and either implement the provisions or provide a detailed justification as to why the

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<sup>101</sup> <https://www.arb.ca.gov/planning/sip/woodsmoke/portolawoodstove.htm>, attached hereto as Exhibit No. 16.

<sup>102</sup> EPA comments on ADEC Preliminary Draft Serious SIP Development materials for the Fairbanks serious PM2.5 nonattainment area, pp. 6-7, Exhibit No. 12.

<sup>103</sup> EPA-450/2-92-002, September 1992. The utility of this technical guidance is evidenced by the fact that EPA continues to cite the document when reviewing SIP submissions from the states. 68 Fed. Reg. 56180, 56182/1-2 (September 30, 2003) (identifying the guidance document as setting out EPA’s “national policy” and identifying three measures (mandatory episodic curtailment, requiring upgrades during property sales, and limiting the number of wood stoves/fireplaces in new residential developments) from the policy as likely to be achievable).

implementation of the controls are either technologically or economically infeasible. While UDAQ is obligated to conduct this review independently, the following is a summary of some of the critical elements that EPA identified as being BACM for RWC.

- Public Awareness and Education. “[P]ublic awareness and education (PAE) is critical to the success of RWC emission control programs. The BACM PAE program should serve to inform the public about the RWC control program, (including program operational details, program justification and citizen responsibilities); and persuade and convince them to meet their responsibilities under the RWC control program.
- Control of Wood Moisture Content. Provides guidance on adopting measures that inform the public on the importance of burning drier woods, materials and equipment to check moisture content, and provisions for wood sellers to have wood certified prior to sale.
- Weatherization of Homes with Wood Stoves. Provides guidance on measures aimed at increasing energy efficiency for homes that burn wood as a heat source.
- Educational Opacity Program. Provides guidance on adopting a program to educate the public about proper combustion techniques for RWC.
- Replacement and conversion of existing wood-burning equipment. States that regulators can eliminate wood smoke emissions from existing devices by requiring conversions and change-out to EPA certified equipment.

4. *Additional issues related to UDAQ’s BACM evaluation.*

Additionally, UPA has several miscellaneous comments on R307-302.

- As a SIP contingency measure, R307-302-3(5) provides that UDAQ will initiate no-burn periods when concentrations of PM<sub>2.5</sub> reach 15 µg/m<sup>3</sup>, as opposed to 25 µg/m<sup>3</sup>. It appears that the contingency measure was triggered when the SLC NAA failed to attain the NAAQS by the moderate attainment date.<sup>104</sup> UDAQ should acknowledge that the contingency measure has been triggered and begin implementing burn bans consistent with R307-302-3(5).
- In the UDAQ BACM Analysis, UDAQ acknowledges that RWC is a source of VOC and SO<sub>2</sub> emissions.<sup>105</sup> UDAQ provides no BACM analysis for RWC for either of these PM<sub>2.5</sub> precursors.

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<sup>104</sup> Utah State Implementation Plan, Section IX. Part A.21.9.2.

<sup>105</sup> UDAQ BACM Analysis, pp. 10 & 23.

- R307-302-5 continues to allow operators to burn coal in solid wood burning devices.<sup>106</sup> A number of other NAAs have implemented regulations prohibiting the combustion of coal in such devices.<sup>107</sup> Consistent with these regulations, UDAQ must prohibit the use of coal in solid wood burning devices located within the SLC NAA.

## OVERALL CONCLUSION

These comments show that existing major stationary sources of PM<sub>2.5</sub> precursor emissions result in insignificant contributions to ambient PM<sub>2.5</sub> levels in the SLC NAA. As such, there is no technical or legal bases for imposing BACT on PM<sub>2.5</sub> precursor emissions from existing major stationary sources in the SLC NAA. We, therefore, request that UDAQ and the UAQB act accordingly and reject the proposed changes to the Emission Limits and Operating Practices for major stationary sources in Section IX, Part H, of the Utah State Implementation Plan.

These comments also show that residential wood burning (combustion) results in significant (and likely undercounted) contribution to ambient PM<sub>2.5</sub> levels in the SLC NAA. As such, UDAQ and the AQB should undertake a comprehensive review of wood burning measures that are included in other state nonattainment SIPs or that are currently under consideration in nonattainment areas and take action to adopt such measures unless they are demonstrated to be technically or economically feasible.

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<sup>106</sup> See UAC R307-302-1(2) & 5(2) (defining a solid fuel burning device as “fireplaces, wood stoves and boilers used for burning wood, coal, or any other nongaseous and non-liquid fuel and listing prohibited fuels but omitting any reference to coal).

<sup>107</sup> Portola Ordinance 344.15.10.050 (limiting fuels in wood burning devices to seasoned wood, uncolored paper, and manufactured logs and pellets); PSCAA Regulation 13.04(5) & 13.07(a)(2) (limiting coal use to “Coal with sulfur content less than 1.0% by weight burned in a coal-only heater” and requiring owners of coal-only heaters to remove and dispose of the heaters by September 30, 2015), Exhibit No. 4.

# **ATTACHMENT A**

**Major Stationary Source Precursor Demonstration for  
NO<sub>x</sub>, SO<sub>x</sub>, VOC, and NH<sub>3</sub> in the Salt Lake City  
24-hour PM<sub>2.5</sub> Serious Nonattainment Area**

Final Report

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## EXECUTIVE SUMMARY

This report documents a major stationary source precursor demonstration (MSSPD) for the Salt Lake City (SLC) 24-hour Fine Particulate (PM<sub>2.5</sub>) Serious Nonattainment Area (NAA). The demonstration addresses four emitted compounds known to contribute to secondary formation of ambient PM<sub>2.5</sub>: nitrogen oxides (NO<sub>x</sub>), sulfur oxides (SO<sub>x</sub>), volatile organic compounds (VOC), and ammonia (NH<sub>3</sub>). The approach follows the US Environmental Protection Agency's (EPA) draft precursor demonstration guidance (EPA, 2016b) for both contribution-based and sensitivity-based analyses. The demonstration employs the current Utah Division of Air Quality's (UDAQ) January 2011 photochemical modeling platform supporting the development of the SLC NAA State Implementation Plan (SIP)<sup>1</sup>, and so this demonstration is directly relevant and parallel to UDAQ's technical analyses. We have adopted EPA's recommended threshold of 1.5 µg/m<sup>3</sup> for assessing whether a contribution is significant.<sup>2</sup>

EPA defines stationary facility sources in Serious PM<sub>2.5</sub> Nonattainment Areas as "major" if direct PM<sub>2.5</sub> or any precursor emissions equal or exceed 70 tons per year (TPY) based on their permitted "potential to emit" (PTE) rates (40 CFR 51.1000 Definitions). We cross-referenced stationary sources in the UDAQ point source inventory to their permitted PTE rates, and identified 19 facilities within the SLC NAA that may emit at least 70 TPY of PM<sub>2.5</sub> or any precursor emissions as major stationary sources for this demonstration (Section 2.1).

The photochemical modeling platform provided by UDAQ included a 2014 "base year" emissions scenario and a 2019 "future year" scenario. Initial MSSPD analyses for NO<sub>x</sub> and SO<sub>x</sub> were conducted using the 2014 scenario (Appendix B) and are not discussed further here. Based on discussions with UDAQ, final MSSPD analyses for NO<sub>x</sub>, SO<sub>x</sub>, VOC and NH<sub>3</sub> were conducted using the 2019 scenario, as described below (Sections 3-6). UDAQ had not completed their 2019 point source projections at the time Ramboll received the 2019 emission files, so we carried forward the 2014 point source emissions to the 2019 scenario while including SO<sub>x</sub> reductions at three refineries to account for emission controls implemented since 2014, and a correction to reported NH<sub>3</sub> emissions at one refinery (Section 2.2). Our model results show that the refinery SO<sub>x</sub> adjustments result in PM<sub>2.5</sub> reductions of up to 3.6 µg/m<sup>3</sup> at the limiting SLC monitoring site (Hawthorne) during peak episode days.

For the 2019 MSSPD analyses, we zeroed-out NO<sub>x</sub>, SO<sub>x</sub>, VOC and NH<sub>3</sub> precursor emissions from major stationary sources to determine PM<sub>2.5</sub> contribution. Additionally, we reduced SO<sub>2</sub> emissions from major stationary sources by 30, 50 and 70% to determine PM<sub>2.5</sub> sensitivity to that precursor. We made no modifications to emissions of any other species or sectors. We

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<sup>1</sup> The UDAQ photochemical model is run for an exceedance PM<sub>2.5</sub> episode that occurred during the cold air pool event of January 1-10, 2011. See Appendix A for more information.

<sup>2</sup> Draft EPA (2016b) guidance recommended 1.3 µg/m<sup>3</sup> for the PM<sub>2.5</sub> 24-hour NAAQS as the appropriate threshold "for identifying an air quality change that is 'insignificant' and thus does not 'contribute' to PM<sub>2.5</sub> concentrations subject to the current PM<sub>2.5</sub> NAAQS." This was based on the initial EPA (2016a) technical basis analysis. More recently, however, EPA (2018) updated and finalized their technical basis document, which now recommends a threshold for identifying significance of 1.5 µg/m<sup>3</sup>.

ran the model for the entirety of the January 2011 modeling episode with the 2019 emissions inventory, and compared the resulting concentration fields of total 24-hour  $PM_{2.5}$  to output from model runs using the zeroed-out point source  $NO_x$ ,  $SO_x$ , VOC, and  $NH_3$  emissions, and the 30, 50, and 70%  $SO_2$  emission reductions. Following EPA guidance, concentration differences calculated at each monitoring site within the SLC NAA and for all days encompassed by the 2011 modeling episode determined major stationary source contributions and sensitivity.

Estimated 2019  $NO_x$  contributions (via zero-out) to daily 24-hour  $PM_{2.5}$  at each monitoring site fell well below the significance threshold of  $1.5 \mu g/m^3$ . Estimated 2019  $SO_x$  contributions from major stationary sources approached the  $1.5 \mu g/m^3$  threshold on a single episode day at one site, but remained less than the threshold over all sites and days. We also performed  $SO_x$  sensitivity reductions of 30 to 70% for major stationary sources, which showed  $PM_{2.5}$  sensitivity well below the threshold. Estimated 2019 VOC contributions from major stationary sources also resulted in  $PM_{2.5}$  impacts orders of magnitude smaller than the threshold. Finally, the model also indicated no 2019  $NH_3$  contributions from major stationary sources above the threshold.

From this major stationary source precursor modeling demonstration, we conclude that the model shows contributions from major stationary source  $NO_x$ ,  $SO_x$ , VOC and  $NH_3$  precursor emissions to 24-hour  $PM_{2.5}$  concentrations within the SLC NAA that are below EPA's  $1.5 \mu g/m^3$  threshold for significance. Although  $NH_3$  emissions from major stationary sources are well-quantified, two factors complicate understanding their contributions to  $PM_{2.5}$ :

- (1) A poor understanding of non-point  $NH_3$  emission sources in the region;
- (2) UDAQ's artificial "injection" of additional  $NH_3$  emissions into the model to address an underestimate of  $NH_3$  in their inventory, which UDAQ diagnosed through comparison of modeled and measured ammonium.

UDAQ's adjustment may influence the stationary source  $NH_3$  contributions reported here.

## 1.0 INTRODUCTION

The US Environmental Protection Agency (EPA) designated the Salt Lake City (SLC) Nonattainment Area (NAA) as Serious for the 24-hour fine particulate (PM<sub>2.5</sub>) National Ambient Air Quality Standard (NAAQS) (Federal Register, 2017). The PM<sub>2.5</sub> State Implementation Plan (SIP) Requirements Rule issued by EPA in August 2016 for Serious Areas (Federal Register, 2016) requires SIP revisions that include an attainment demonstration of the PM<sub>2.5</sub> NAAQS. To provide the technical underpinnings of the SLC Serious Area PM<sub>2.5</sub> SIP, the Utah Division of Air Quality (UDAQ) has developed a photochemical modeling platform that simulates conditions during a January 2011 persistent cold air pool (PCAP) event that resulted in exceedances of the PM<sub>2.5</sub> NAAQS over multiple days in SLC. The UDAQ photochemical modeling platform is based on the Comprehensive Air quality Model with extensions (CAMx; Ramboll, 2018). UDAQ has prepared emission inventories for this modeling platform that represent the years 2014, 2016 and 2019, from which the model will project future-year 24-hour PM<sub>2.5</sub> Design Values (DV). Besides accounting for economic and population projections in the region, the 2019 emission inventory must reflect local emission reductions for area and industrial point sources, as well as federal programs affecting on-road and non-road mobile sources, that will result in the SLC NAA attaining the PM<sub>2.5</sub> NAAQS.

The PM<sub>2.5</sub> SIP Requirements Rule identifies nitrogen oxides (NO<sub>x</sub>), sulfur oxides (SO<sub>x</sub>), volatile organic compounds (VOC) and ammonia (NH<sub>3</sub>) as the PM<sub>2.5</sub> precursors that must presumptively be evaluated for potential control measures. The rule allows this presumption to be overcome on a precursor-specific basis as long as it can be demonstrated that any one of these precursors emitted within the nonattainment area does not significantly contribute to NAAQS levels. It also allows for a similar analysis for Nonattainment New Source Review (NNSR) programs, which is not considered here. The scope of such precursor demonstrations may extend comprehensively to all sources (a “comprehensive precursor demonstration”) or may be limited to major sources (a “major stationary source precursor demonstration”) depending on the extent of the demonstration. If a precursor demonstration is approved by the EPA, the state will not be required to control emissions of the relevant precursor for sources consistent with the scope of the demonstration.

The PM<sub>2.5</sub> SIP Requirements Rule outlines a two-step analysis<sup>3</sup> applicable to both comprehensive and major source demonstrations. The first step determines whether all emissions of a precursor from the sources being evaluated contribute significantly to PM<sub>2.5</sub> levels. Analyses may be based on air quality monitoring data in the area or on air quality modeling. If the first step does not support a finding of insignificant contribution, a second step may be performed, referred to as a “sensitivity-based” analysis, which evaluates the effect of reducing emissions of a precursor on PM<sub>2.5</sub> levels in the area. PM<sub>2.5</sub> precursor demonstration guidance from EPA (2016b) recommends an emission reduction range of 30 to 70% for sensitivity analyses.

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<sup>3</sup> 40 CFR 51.1006(a)(1) and 40 CFR 51.1006(a)(2)

This report documents a major stationary source precursor demonstration (MSSPD) performed for NO<sub>x</sub>, SO<sub>x</sub>, VOC, and NH<sub>3</sub> in the SLC NAA. The approach is consistent with EPA's draft precursor demonstration guidance (EPA, 2016b). The demonstration employs the UDAQ 2011 photochemical modeling platform that will support the development of the SLC NAA SIP, and so this demonstration is directly relevant and parallel to UDAQ's technical analyses<sup>4</sup>. Appendix A details UDAQ's delivery of modeling datasets to Ramboll and which versions of their modeling platform were used in the analyses documented here. A determination of significance was based on EPA's recommended threshold of 1.5 µg/m<sup>3</sup> EPA (2018)<sup>5</sup>.

Section 2 describes the UDAQ 2014 base and 2019 future emission inventories employed in this analysis, along with adjusted SO<sub>x</sub> and NH<sub>3</sub> emissions for certain refinery point sources to better reflect their emissions in 2019. Sections 3 through 6 report results from the MSSPD analyses conducted for NO<sub>x</sub>, SO<sub>x</sub>, VOC and NH<sub>3</sub>, respectively, using the UDAQ 2019 future year emissions inventory along with the updated point source inventory. Section 7 provides a brief summary of results. Appendix B describes preliminary MSSPD analyses for NO<sub>x</sub> and SO<sub>x</sub> using the UDAQ 2014 base year emissions inventory. The author's biographical summaries are presented in Appendix C.

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<sup>4</sup> The UDAQ photochemical model is run for a PM<sub>2.5</sub> exceedance episode that occurred during the cold air pool event of January 1-10, 2011. See Appendix A for more information.

<sup>5</sup> The initial EPA (2016a) technical basis analysis concluded, and the draft EPA (2016b) demonstration guidance recommended, 1.3 µg/m<sup>3</sup> for the PM<sub>2.5</sub> 24-hour NAAQS as the appropriate threshold "for identifying an air quality change that is 'insignificant' and thus does not 'contribute' to PM<sub>2.5</sub> concentrations subject to the current PM<sub>2.5</sub> NAAQS." More recently, however, EPA (2018) updated and finalized their technical basis document, which now recommends a threshold for identifying significance of 1.5 µg/m<sup>3</sup>.

## 2.0 EMISSION INVENTORIES FOR THE DEMONSTRATION

We assessed major stationary source contributions to 24-hour PM<sub>2.5</sub> using the UDAQ January 2011 photochemical modeling platform. In February 2018, UDAQ provided their extensive modeling dataset to Ramboll, and we conducted an initial simulation of the UDAQ 2014 “base year” modeling scenario to ensure that we could replicate UDAQ-provided output files. Appendix A provides details on the versions of the modeling datasets provided by UDAQ and the dates when Ramboll received them. We then conducted preliminary MSSPD assessments for NO<sub>x</sub> and SO<sub>x</sub> using the 2014 base year emissions, as described in Appendix B. In early May 2018, we obtained an initial version of UDAQ’s 2019 future year model-ready emission files. As described below and in Sections 3 through 6, all final MSSPD assessments were conducted using this version of UDAQ’s 2019 future year emission inventory subject to certain adjustments.<sup>6</sup>

### 2.1 UDAQ 2014 Base Year Modeling Inventory

EPA defines stationary facility sources in Serious PM<sub>2.5</sub> Nonattainment Areas as “major” if direct PM<sub>2.5</sub> or any precursor emissions equal or exceed 70 tons per year (TPY) based on their permitted “potential to emit” (PTE) rates (40 CFR 51.1000 Definitions). We cross-referenced stationary sources in the UDAQ 2014 base year point source inventory to their permitted PTE rates, and identified those facilities within the SLC NAA that may emit at least 70 TPY of PM<sub>2.5</sub> or any precursor emissions as major stationary sources for this demonstration. Table 1 lists the major stationary facility sources in the SLC NAA. We then zeroed-out specific precursor emissions from these facilities in the raw stationary inventory file provided by UDAQ, and processed this file through the Sparse Matrix Operator Kernel Emissions (SMOKE) system using UDAQ’s scripts and supporting files to generate new, model-ready, low-level and elevated point source inputs for the CAMx model. We performed this separately for precursor species NO<sub>x</sub>, SO<sub>x</sub>, VOC, and NH<sub>3</sub> resulting in four different sets of zero-out emission input files. All other emission species and sectors were unmodified.

### 2.2 UDAQ 2019 Future Year Modeling Inventory

On May 9, 2018, UDAQ provided model-ready emission files representing their projected 2019 emission inventory for on-road mobile, non-road mobile, and area source sectors. At that time, UDAQ had not completed their 2019 point source projections. To conduct a MSSPD for the 2019 future year projection, we carried forward the 2014 point source emissions to the 2019 inventory. However, the UDAQ 2014 point source emission inventory does not account for SO<sub>x</sub>

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<sup>6</sup> We understand that UDAQ has since updated their 2019 future year inventory. It was necessary to “lock-in” the 2019 inventory we received in May so that we could complete the MSSPD modeling analyses reported here before the end of the SIP public comment period. It is not anticipated that the updates made to the inventory would affect the conclusions of insignificant contribution.

**Table 1. List of “major” stationary facility sources within the SLC NAA and their 2014 primary PM<sub>2.5</sub> and precursor emissions (TPY). Table from UDAQ web site<sup>7</sup>.**

Source: UDAQ 11/14/17			2014 Baseline Emissions				
County	Site ID	Site Name	PM <sub>2.5</sub> (tons/yr)	SO <sub>x</sub> (tons/yr)	NO <sub>x</sub> (tons/yr)	VOC (tons/yr)	NH <sub>3</sub> (tons/yr)
<b>Salt Lake Non-Attainment Area</b>							
Box Elder	10008	Nucor Steel- Nucor Steel	37.5	135.0	156.8	31.7	1.9
Box Elder	10009	ATK Launch Systems - Promontory	19.1	1.9	51.0	31.2	0.4
Box Elder	10028	Vulcraft - Division of Nucor Corporation- Steel Products Manufacturing	9.3	0.4	5.8	38.1	0.0
Box Elder	14107	Procter and Gamble-Paper Manufacturing Plant	38.9	0.3	27.2	18.6	0.2
Davis	10119	Chevron Products Co - Salt Lake Refinery	32.9	23.9	375.6	298.1	8.9
Davis	10121	Hill Air Force Base - Main Base	8.5	4.0	151.4	126.4	1.5
Davis	10122	Big West Oil - Flying J Refinery	45.9	57.1	92.3	307.4	117.4
Davis	10123	Holly Corp- HRMC and HEP Woods Cross Operations	12.7	102.3	168.4	155.3	17.6
Davis	10129	Wasatch Integrated Waste Mgt District- County Landfill & Energy Recovery Facility (DCERF)	9.8	17.2	236.4	23.2	0.0
Salt Lake	10335	Tesoro Refining & Marketing Company LLC	89.1	708.3	358.1	250.4	3.8
Salt Lake	10346	Kennecott Utah Copper LLC- Smelter & Refinery	420.0	704.4	160.0	10.4	5.6
Salt Lake	10354	University of Utah- University of Utah facilities	14.4	0.7	72.2	9.8	3.0
Salt Lake	10355	Pacificorp Energy- Gadsby Power Plant	16.9	1.5	117.4	9.6	13.1
Salt Lake	10571	Kennecott Utah Copper LLC- Mine & Copperton Concentrator**	105.4	0.0	5.6	4.7	1.8
Salt Lake	10572	Kennecott Utah Copper LLC- Power Plant Lab Tailings Impoundment	71.8	1500.3	1322.5	8.2	0.2
Salt Lake	11386	Hexcel Corporation- Salt Lake Operations	72.0	27.9	145.8	160.6	79.4
Salt Lake	12495	UAMPS - West Valley Power Plant	3.9	0.4	8.6	1.3	0.0
Tooele	10707	Lhoist North America - Grantsville Plant	0.2	0.0	0.2	0.1	0.0
Weber	10917	Compass Minerals Ogden Inc. - Production Plant	28.2	8.7	134.6	16.4	3.1

\*\* The original table from UDAQ included non-road equipment tailpipe emissions operating within the Kennecott mine facility. The definition of a “major” stationary source does not include tail pipe emissions, so the non-road emissions were removed to show just stationary source emissions at the Kennecott mine facility. Non-tailpipe, mechanically generated particulate emissions associated with the non-road equipment’s operation (for example, road dust) remain in the inventory.

reductions implemented since 2014 at some of the major stationary facilities. Figure 1 shows that SLC petroleum refineries have reduced SO<sub>x</sub> emissions by more than 80% since 2014, which translates to about a 40% decrease over all major point sources<sup>8</sup>. Based on data supplied by the petroleum refinery operators, we reduced refinery SO<sub>x</sub> emissions at three facilities to derive an adjusted 2014 point source inventory (Figure 1):

- (1) Tesoro from 708 TPY to 58 TPY<sup>9</sup>;
- (2) Big West Oil from 57 to 33 TPY<sup>10</sup>;
- (3) Holly Frontier from 102 to 43 TPY<sup>11</sup>.

This resulted in a reduction in total refinery emissions from 891 TPY to 160 TPY (82%). Additionally, we corrected NH<sub>3</sub> emissions from the Big West Oil facility from 117.4 TPY to 6.7 TPY<sup>10</sup>. All other emission species and sectors were unmodified. We processed the adjusted

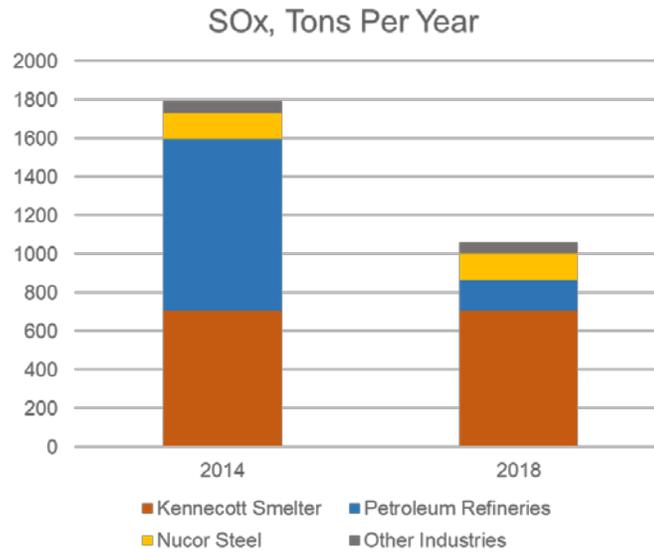
<sup>7</sup> <https://deg.utah.gov/legacy/pollutants/p/particulate-matter/pm25/serious-area-state-implementation-plans/posted-inventories.htm>.

<sup>8</sup> SO<sub>x</sub> emissions of 1500 TPY listed for the Kennecott Power Plant facility in Table 1 are not applicable to the winter season, as the current SIP and permit requirements require that facility to switch from coal to natural gas during winter; this is properly reflected in the UDAQ 2014 emission modeling files.

<sup>9</sup> Based on 2017 emissions inventory submittal adjusted for wet gas scrubber startup in January 2018.

<sup>10</sup> Based on 2017 emissions inventory submission for Big West refinery.

<sup>11</sup> Based on 2017 emissions inventory submission for HollyFrontier refinery.



**Figure 1. Comparison of 2014 and 2018 major point source SOx emissions (TPY).**

point source inventory through the SMOKE system to generate 2019 model-ready, low-level and elevated point source inputs for the CAMx model. Tables 2(a) and 2(b) compare 2014 and 2019 model-ready daily emission totals (tons per day, TPD) by major source sector for each of the criteria air pollutants and chlorides (Cl<sub>2</sub> and HCl). Note that these values represent emissions for a single day of the modeling episode, the peak PM<sub>2.5</sub> day of January 7, and are summed over the entire 1.33-km modeling domain. Table 2(b) reflects the point source SOx and NH<sub>3</sub> adjustments described above.

**Table 2(a). 2014 UDAQ model-ready daily emission totals (TPD) for the January 7 episode day over the entire 1.33-km modeling domain.**

Sector	CO	NOx	VOC	NH <sub>3</sub>	SO <sub>2</sub>	PM <sub>2.5</sub>	Cl <sub>2</sub>	HCl
Area	61.90	23.36	88.23	81.01	0.35	10.66	0.00	0.13
Nonroad	161.10	39.01	25.25	0.03	0.36	2.33	0.00	0.00
Mobile	596.03	110.83	59.56	2.19	0.61	5.31	0.00	0.01
Points	11.75	14.60	16.05	1.33	5.84	4.67	3.77	2.08
<b>Total</b>	<b>830.78</b>	<b>187.80</b>	<b>189.09</b>	<b>84.57</b>	<b>7.16</b>	<b>22.96</b>	<b>3.77</b>	<b>2.22</b>

**Table 2(b). 2019 model-ready daily emission totals (TPD) for the January 7 episode day over the entire 1.33-km modeling domain, used for the 2019 MSSPD. Note that point source emissions are held constant at 2014 rates, except that SOx emissions at three refineries, and NH<sub>3</sub> emissions at Big West Oil, have been updated as described in the text.**

Sector	CO	NOx	VOC	NH <sub>3</sub>	SO <sub>2</sub>	PM <sub>2.5</sub>	Cl <sub>2</sub>	HCl
2019 Area	60.61	20.13	79.92	80.66	0.91	10.93	0.00	0.14
2019 Nonroad	152.72	33.22	19.83	0.03	0.36	1.83	0.00	0.00
2019 Mobile	443.42	78.02	41.92	1.95	0.66	4.08	0.00	0.00
Adjusted 2014 Points	11.75	14.60	16.05	1.02	3.80	4.67	3.77	2.08
<b>Total</b>	<b>668.50</b>	<b>145.97</b>	<b>157.71</b>	<b>83.66</b>	<b>5.73</b>	<b>21.51</b>	<b>3.77</b>	<b>2.23</b>

### 2.3 Comparison of total PM<sub>2.5</sub> Predictions Among 2014 and 2019 Inventories

We ran CAMx for the January 2011 modeling episode with the 2014 base and the 2019 future year model-ready emission inventories described above. Additionally, we ran a third case with the 2014 base emissions, but with the adjusted SO<sub>x</sub> point source emissions described in Section 2.2 to isolate the effect on PM<sub>2.5</sub> concentrations from the refinery SO<sub>x</sub> emissions reductions (i.e., not including the Big West NH<sub>3</sub> reduction). For each of these three cases, resulting hourly gridded concentrations of all PM<sub>2.5</sub> components (sulfate, nitrate, ammonia, elemental and organic carbon, sodium, chloride, and primary PM<sub>2.5</sub>) were summed to total PM<sub>2.5</sub> mass concentrations, and averaged each day (midnight-midnight) to derive 24-hour PM<sub>2.5</sub>. We tabulated resulting 24-hour PM<sub>2.5</sub> concentrations for each day and at each monitoring site within the SLC NAA, as shown in Tables 3(a)-(c). Comparing Tables 3(a) and (b), simulated changes in PM<sub>2.5</sub> from 2014 to 2019 range from -4.4 to +2.0 µg/m<sup>3</sup>, with an average change over all sites and days of -1.3 µg/m<sup>3</sup>. The episode-average reductions at Hawthorne and Rose Park monitors, the limiting DV sites in the SLC NAA, are similar at about -1.5 µg/m<sup>3</sup>. Comparing Tables 3(a) and 3(c), simulated changes in PM<sub>2.5</sub> resulting from the 80% refinery SO<sub>x</sub> reductions since 2014 account for PM<sub>2.5</sub> reductions of up to 3.6 µg/m<sup>3</sup> and 2.6 µg/m<sup>3</sup> at Hawthorne and Rose Park monitors on January 6, respectively, and reductions of 3.0 µg/m<sup>3</sup> and 2.4 µg/m<sup>3</sup> on the January 7 peak day, respectively.

**Table 3(a). Total 24-hour PM<sub>2.5</sub> concentrations on each modeled day of the January 2011 episode and at each monitor in the SLC NAA, as simulated in the 2014 base year case.**

Base Case			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	9.9	6.8	4.3	12.8	19.1	8.6	13.7	34.7	33.1	10.6	9.7
Tooele	490450003	Tooele	9.5	8.2	12.5	20.6	19.1	13.5	23.2	36.3	31.7	10.7	9.0
Cottonwood	490350003	Cottonwood West	14.0	11.8	14.4	33.0	33.3	26.6	38.9	50.8	43.7	14.2	13.2
Erda	490450004	Erda	10.2	8.3	11.8	21.3	17.8	14.2	24.9	30.5	29.2	11.5	8.4
Hawthorne	490353006	Salt Lake City	16.0	12.7	19.4	28.9	33.7	23.4	43.7	53.1	51.0	16.6	13.7
Magna	490351001	Magna	9.6	8.4	13.0	23.3	24.1	19.8	27.7	40.4	42.7	9.7	12.5
Rose Park	490353010	Salt Lake City	16.6	13.9	14.3	32.5	33.9	25.9	42.3	50.0	46.8	15.2	16.3
Bountiful Viewmont	490110004	Bountiful	11.2	7.1	9.5	26.9	23.1	15.0	35.6	40.2	43.0	9.3	10.7
Ogden	490570002	Ogden	11.7	8.0	8.4	13.8	22.3	14.6	34.5	35.9	35.0	9.2	12.0
Harrisville	490571003	Harrisville	11.7	8.0	7.3	10.7	20.2	12.6	24.3	35.5	29.2	9.7	9.3
Brigham City	490030003	Brigham City	9.2	9.3	7.8	8.7	13.0	13.8	18.7	29.0	26.8	6.8	9.4

**Table 3(b). Total 24-hour PM<sub>2.5</sub> concentrations on each modeled day of the January 2011 episode and at each monitor in the SLC NAA, as simulated in the 2019 future year case.**

Future Year 2019			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	9.7	6.6	4.2	12.1	17.6	8.2	13.3	34.9	30.9	10.3	8.8
Tooele	490450003	Tooele	9.4	7.9	11.7	18.7	17.2	12.7	21.5	33.0	28.3	10.2	8.6
Cottonwood	490350003	Cottonwood West	13.7	11.4	14.3	31.9	31.8	25.6	38.1	51.8	43.1	13.1	12.4
Erda	490450004	Erda	10.0	8.0	11.1	18.9	15.9	13.3	23.3	26.5	25.3	11.0	7.8
Hawthorne	490353006	Salt Lake City	15.7	12.3	19.0	27.8	31.9	22.1	39.2	51.1	49.7	15.3	12.8
Magna	490351001	Magna	9.5	8.2	12.0	21.2	21.6	18.3	26.9	38.0	40.8	9.3	11.8
ROSE PARK	490353010	Salt Lake City	16.3	13.5	13.9	30.5	31.8	24.7	39.1	46.4	45.0	14.2	15.3
Bountiful Viewmont	490110004	Bountiful	11.0	7.0	9.1	25.1	21.4	14.0	37.7	37.1	40.4	8.9	9.9
Ogden	490570002	Ogden	11.4	7.6	7.9	12.4	19.9	13.3	32.7	32.0	31.6	8.7	10.8
Harrisville	490571003	Harrisville	11.4	7.7	6.8	9.7	17.9	11.5	22.0	31.2	25.7	9.1	8.5
Brigham City	490030003	Brigham City	9.1	8.8	7.2	7.9	11.3	12.6	16.6	24.8	23.0	6.5	8.3

**Table 3(c). Total 24-hour PM<sub>2.5</sub> concentrations on each modeled day of the January 2011 episode and at each monitor in the SLC NAA, as simulated in the 2014 base year case using the adjusted point source inventory for SOx.**

Adjusted Base Case PM <sub>2.5</sub>			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	9.9	6.8	4.3	12.7	19.0	8.6	13.7	34.4	32.9	10.6	9.7
Tooele	490450003	Tooele	9.5	8.2	12.5	20.6	19.1	13.5	23.1	36.1	31.6	10.7	9.0
Cottonwood	490350003	Cottonwood West	14.0	11.8	14.4	32.5	33.0	26.6	38.4	49.3	43.4	13.8	13.1
Erda	490450004	Erda	10.2	8.3	11.8	21.2	17.7	14.1	24.9	30.3	29.0	11.5	8.4
Hawthorne	490353006	Salt Lake City	16.0	12.7	19.1	28.5	33.1	23.4	40.1	50.1	50.7	15.9	13.6
Magna	490351001	Magna	9.6	8.4	13.0	23.3	23.9	19.7	27.5	40.0	42.5	9.7	12.5
ROSE PARK	490353010	Salt Lake City	16.6	13.9	14.2	31.5	33.3	25.8	39.7	47.5	46.5	14.8	16.2
Bountiful Viewmont	490110004	Bountiful	11.2	7.1	9.5	26.2	22.7	14.8	34.5	39.3	42.6	9.2	10.6
Ogden	490570002	Ogden	11.7	8.0	8.4	13.8	21.9	14.6	33.9	35.5	34.7	9.2	11.9
Harrisville	490571003	Harrisville	11.7	8.0	7.3	10.7	20.0	12.5	24.1	35.1	28.9	9.7	9.2
Brigham City	490030003	Brigham City	9.2	9.3	7.8	8.7	13.0	13.7	18.6	28.7	26.5	6.8	9.3

### 3.0 MAJOR STATIONARY SOURCE PRECURSOR DEMONSTRATION FOR NOX

#### 3.1 Precursor Demonstration for NOx Contribution

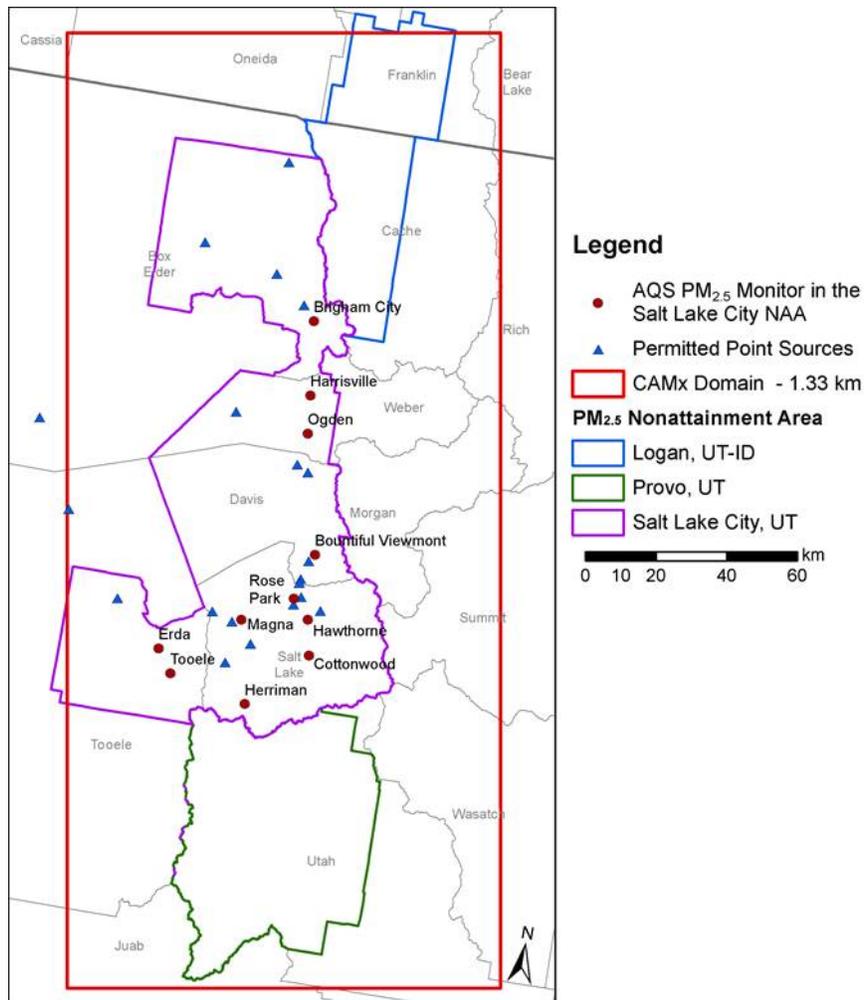
We ran CAMx for the entirety of the January 2011 modeling episode with the 2019 emission scenario in which major stationary source NOx emissions were zeroed out. Resulting hourly gridded concentrations of all PM<sub>2.5</sub> components (sulfate, nitrate, ammonia, elemental and organic carbon, sodium, chloride, and primary PM<sub>2.5</sub>) were summed to form total PM<sub>2.5</sub> mass concentrations, and averaged each day (midnight-midnight) to derive 24-hour PM<sub>2.5</sub>. Following EPA guidance, we calculated 24-hour PM<sub>2.5</sub> concentration differences between the 2019 future year case (Table 3(b)) and NOx zero-out run (Table 4(a)) for each day and at each monitoring site within the SLC NAA to determine major stationary source NOx precursor contributions; results are shown in Table 4(b). Figure 2 shows the locations of permitted stationary sources in the region and the SLC NAA monitoring sites.

**Table 4(a). 24-hour PM<sub>2.5</sub> concentrations on each modeled day of the January 2011 episode and at each monitor in the SLC NAA, as simulated in the 2019 major stationary source NOx zero-out case.**

NOx Control PM <sub>2.5</sub>			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	9.7	6.6	4.2	12.1	17.3	8.1	13.3	34.9	30.7	10.2	8.7
Tooele	490450003	Tooele	9.4	7.9	11.7	18.6	16.9	12.6	21.4	32.7	28.0	10.2	8.6
Cottonwood	490350003	Cottonwood West	13.6	11.4	14.3	31.9	31.5	25.6	38.2	52.3	43.1	13.0	12.3
Erda	490450004	Erda	10.0	8.0	11.0	18.6	15.7	13.2	23.2	26.1	24.9	11.0	7.8
Hawthorne	490353006	Salt Lake City	15.6	12.3	19.1	27.8	31.6	22.1	39.7	51.8	49.6	15.2	12.8
Magna	490351001	Magna	9.5	8.2	11.9	20.8	21.2	18.2	26.9	37.7	40.5	9.2	11.7
ROSE PARK	490353010	Salt Lake City	16.2	13.5	14.0	30.4	31.4	24.7	39.7	46.7	44.8	14.0	15.2
Bountiful Viewmont	490110004	Bountiful	10.9	7.0	9.2	25.0	21.0	14.0	39.2	37.0	39.8	8.8	9.7
Ogden	490570002	Ogden	11.3	7.6	7.8	12.3	19.3	13.2	32.6	31.2	31.0	8.6	10.7
Harrisville	490571003	Harrisville	11.4	7.7	6.8	9.6	17.5	11.4	21.7	30.4	25.1	9.0	8.4
Brigham City	490030003	Brigham City	9.1	8.7	7.2	7.8	11.1	12.4	16.2	23.9	22.1	6.5	8.2

**Table 4(b). Change in total 24-hour PM<sub>2.5</sub> concentrations on each modeled day of the January 2011 episode and at each monitor in the SLC NAA, as simulated in the 2019 major stationary source NOx zero-out case. Green shade indicates impacts below the 1.5 µg/m<sup>3</sup> threshold for significant contributions.**

(Future Year 2019 - NOx Control PM <sub>2.5</sub> )			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	0.02	0.00	0.00	0.04	0.22	0.02	0.00	-0.07	0.20	0.06	0.05
Tooele	490450003	Tooele	0.01	0.00	0.02	0.15	0.26	0.04	0.11	0.28	0.29	0.05	0.02
Cottonwood	490350003	Cottonwood West	0.03	0.00	-0.02	0.04	0.28	0.00	-0.19	-0.57	-0.01	0.13	0.06
Erda	490450004	Erda	0.01	0.00	0.02	0.26	0.22	0.05	0.12	0.44	0.40	0.04	0.02
Hawthorne	490353006	Salt Lake City	0.04	0.00	-0.08	0.04	0.33	0.04	-0.42	-0.72	0.13	0.13	0.07
Magna	490351001	Magna	0.01	0.00	0.05	0.35	0.43	0.12	0.04	0.32	0.23	0.07	0.08
ROSE PARK	490353010	Salt Lake City	0.05	0.01	-0.11	0.14	0.40	0.03	-0.59	-0.31	0.21	0.14	0.07
Bountiful Viewmont	490110004	Bountiful	0.05	0.01	-0.01	0.06	0.44	-0.05	-1.50	0.14	0.56	0.07	0.17
Ogden	490570002	Ogden	0.04	0.02	0.01	0.12	0.55	0.12	0.08	0.80	0.61	0.06	0.15
Harrisville	490571003	Harrisville	0.03	0.03	0.01	0.07	0.37	0.11	0.34	0.77	0.64	0.05	0.09
Brigham City	490030003	Brigham City	0.01	0.08	0.05	0.08	0.24	0.18	0.40	0.86	0.83	0.02	0.10



**Figure 2. Locations of permitted stationary sources (blue triangles) and UDAQ monitoring sites (red circles) located within the SLC NAA (purple outline). Neighboring PM<sub>2.5</sub> nonattainment areas and county boundaries are also depicted. The UDAQ CAMx modeling domain is shown by the red rectangular boundary.**

Values in Table 4(b) shaded green indicate NO<sub>x</sub> contributions below the significance threshold of 1.5 µg/m<sup>3</sup>. The modeled NO<sub>x</sub> contributions are always well below the threshold. In fact, NO<sub>x</sub> reductions occasionally result in small increases in PM<sub>2.5</sub> on some days and at certain monitors, shown as negative numbers in Table 4, the result of subtracting a higher PM<sub>2.5</sub> value in the NO<sub>x</sub> zero-out case from a lower corresponding PM<sub>2.5</sub> value in the 2019 future year case.

Higher PM<sub>2.5</sub> in the zero-out case may occur for nitrate, sulfate and/or ammonium because of non-linear gas and PM chemistry. This is a common characteristic of areas with high NO<sub>x</sub> and related nitrate concentrations, and is parallel to so-called “NO<sub>x</sub>-disbenefit” and “weekend-weekday” effects seen with ozone. Appendix B shows similar results for major stationary source NO<sub>x</sub> precursor contributions calculated from the 2014 base year scenario.

## 4.0 MAJOR STATIONARY SOURCE PRECURSOR DEMONSTRATION FOR SOX

### 4.1 Precursor Demonstration for SOx Contribution

Following the same methodology for NO<sub>x</sub>, we ran CAMx for the January 2011 modeling episode with the 2019 emission scenario in which major stationary source SO<sub>x</sub> emissions were zeroed out. We calculated PM<sub>2.5</sub> concentration differences between the 2019 future year case (Table 3(b)) and SO<sub>x</sub> zero-out run (Table 5(a)) for each day and at each monitoring site within the SLC NAA; results are shown in Table 5(b). Values shaded green indicate SO<sub>x</sub> contributions below the significance threshold of 1.5 µg/m<sup>3</sup>. Note that no PM<sub>2.5</sub> increases occur with the SO<sub>x</sub> removal. According to the model, there are no contributions greater than the significance threshold of 1.5 µg/m<sup>3</sup>.

**Table 5(a). 24-hour PM<sub>2.5</sub> concentrations on each modeled day of the January 2011 episode and at each monitor in the SLC NAA, as simulated in the 2019 major stationary source SO<sub>x</sub> zero-out case.**

SO <sub>x</sub> Control PM <sub>2.5</sub>			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	9.7	6.6	4.2	12.0	17.3	8.1	13.3	34.3	30.5	9.8	8.7
Tooele	490450003	Tooele	9.4	7.9	11.7	18.5	16.8	12.6	21.1	32.4	27.8	10.1	8.6
Cottonwood	490350003	Cottonwood West	13.7	11.4	14.3	31.7	31.3	25.5	37.8	51.1	42.9	13.0	12.3
Erda	490450004	Erda	10.0	8.0	11.1	18.7	15.7	13.1	23.1	25.6	24.6	11.0	7.7
Hawthorne	490353006	Salt Lake City	15.7	12.3	18.9	27.7	31.3	22.1	38.4	50.1	49.4	15.1	12.7
Magna	490351001	Magna	9.5	8.2	12.0	21.1	20.4	18.1	26.7	36.5	40.0	9.1	11.4
ROSE PARK	490353010	Salt Lake City	16.2	13.5	13.9	30.2	31.1	24.7	38.5	45.2	44.6	14.0	15.1
Bountiful Viewmont	490110004	Bountiful	11.0	7.0	9.1	24.9	21.0	13.9	37.3	36.5	40.0	8.7	9.8
Ogden	490570002	Ogden	11.4	7.6	7.9	12.4	19.5	13.2	32.4	31.5	31.2	8.6	10.7
Harrisville	490571003	Harrisville	11.4	7.7	6.8	9.6	17.7	11.4	21.9	30.9	25.4	9.0	8.4
Brigham City	490030003	Brigham City	9.1	8.8	7.2	7.8	11.2	12.5	16.5	24.5	22.6	6.5	8.3

**Table 5(b). Change in total 24-hour PM<sub>2.5</sub> concentrations on each modeled day of the January 2011 episode and at each monitor in the SLC NAA, as simulated in the 2019 major stationary source SO<sub>x</sub> zero-out case. Green shade indicates impacts below the 1.5 µg/m<sup>3</sup> threshold for significant contributions.**

(2019 Base Case PM <sub>2.5</sub> - SO <sub>x</sub> Control PM <sub>2.5</sub> )			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	0.02	0.00	0.00	0.13	0.26	0.02	0.01	0.53	0.43	0.43	0.11
Tooele	490450003	Tooele	0.00	0.00	0.00	0.20	0.37	0.05	0.37	0.65	0.51	0.10	0.03
Cottonwood	490350003	Cottonwood West	0.01	0.00	0.01	0.19	0.47	0.08	0.26	0.63	0.18	0.15	0.09
Erda	490450004	Erda	0.00	0.00	0.00	0.16	0.28	0.11	0.26	0.88	0.75	0.07	0.05
Hawthorne	490353006	Salt Lake City	0.01	0.01	0.05	0.14	0.58	0.07	0.84	0.99	0.27	0.23	0.10
Magna	490351001	Magna	0.00	0.00	0.00	0.06	1.20	0.16	0.23	1.47	0.80	0.25	0.40
ROSE PARK	490353010	Salt Lake City	0.01	0.01	0.03	0.30	0.68	0.06	0.56	1.21	0.34	0.18	0.11
Bountiful Viewmont	490110004	Bountiful	0.01	0.01	0.00	0.26	0.45	0.13	0.33	0.60	0.41	0.13	0.13
Ogden	490570002	Ogden	0.00	0.01	0.01	0.06	0.33	0.11	0.29	0.45	0.36	0.07	0.13
Harrisville	490571003	Harrisville	0.00	0.01	0.00	0.05	0.21	0.10	0.12	0.30	0.32	0.07	0.11
Brigham City	490030003	Brigham City	0.00	0.03	0.01	0.05	0.12	0.11	0.09	0.29	0.39	0.04	0.09

Appendix B shows similar, yet slightly larger major stationary source SO<sub>x</sub> precursor contributions calculated from the 2014 base year scenario.

## 4.2 Precursor Demonstration for SOx Sensitivity

Although the zero-out (100% reduction) analysis was below the significance threshold, we conducted an additional sensitivity-based analysis in order to provide an additional basis for demonstrating the insignificant contribution associated with major stationary source SO<sub>2</sub> emissions.

Page 30 of the draft EPA (2016b) precursor demonstration guidance states:

“...the EPA recommends comparing the estimated impacts of precursor emissions on PM<sub>2.5</sub> mass from sensitivity modeling to the contribution thresholds for the annual average and 24-hour NAAQS, as appropriate, identified in Section 2.2. The EPA generally expects that if modeling demonstrates that reductions in the 30-70% range produce an air quality impact below these thresholds, then it would approve such a demonstration as adequate to show that the precursor is insignificant.”

For the SOx precursor sensitivity demonstration, we reduced SOx emissions from the major stationary source facilities by 30%, 50%, and 70% from the adjusted 2014 levels described in Section 2.2, and compared the impact of this reduction on modeled PM<sub>2.5</sub> to the 1.5 µg/m<sup>3</sup> significance threshold. We processed the new inventory file through SMOKE system to generate new, model-ready, low-level and elevated point source inputs for the CAMx model. All other emission species and sectors were unmodified. We ran CAMx for the January 2011 modeling episode with the 30%, 50% and 70% SOx reductions and calculated the 24-hour PM<sub>2.5</sub> concentration differences between the 2019 future year case (Table 3(b)) and each SOx reduction case (Tables 6(a)-(c)) for all days and at each monitoring site within the SLC NAA. Tables 7(a)-(c) list total PM<sub>2.5</sub> sensitivity to the major stationary source SOx reductions on each day and at each monitor. According to the model, all SOx reduction sensitivity cases result in 24-hour PM<sub>2.5</sub> impacts of less than 1.5 µg/m<sup>3</sup> at all sites and for all days.

**Table 6(a)-(c). 24-hour PM<sub>2.5</sub> concentrations on each modeled day of the January 2011 episode and at each monitor in the SLC NAA, as simulated in the 2019 major stationary source SOx 30%, 50% and 70% SOx reduction cases.**

SOx 30% Control PM <sub>2.5</sub>			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	9.7	6.6	4.2	12.1	17.5	8.2	13.3	34.7	30.8	10.2	8.8
Tooele	490450003	Tooele	9.4	7.9	11.7	18.7	17.1	12.7	21.4	32.8	28.1	10.2	8.6
Cottonwood	490350003	Cottonwood West	13.7	11.4	14.3	31.9	31.7	25.6	38.0	51.6	43.0	13.1	12.4
Erda	490450004	Erda	10.0	8.0	11.1	18.8	15.8	13.2	23.2	26.3	25.1	11.0	7.8
Hawthorne	490353006	Salt Lake City	15.7	12.3	19.0	27.8	31.7	22.1	39.0	50.8	49.6	15.2	12.8
Magna	490351001	Magna	9.5	8.2	12.0	21.1	21.3	18.2	26.8	37.7	40.6	9.2	11.7
ROSE PARK	490353010	Salt Lake City	16.3	13.5	13.9	30.4	31.6	24.7	38.9	46.1	44.9	14.1	15.2
Bountiful Viewmont	490110004	Bountiful	11.0	7.0	9.1	25.0	21.3	14.0	37.6	36.9	40.3	8.8	9.9
Ogden	490570002	Ogden	11.4	7.6	7.9	12.4	19.8	13.3	32.6	31.8	31.5	8.6	10.8
Harrisville	490571003	Harrisville	11.4	7.7	6.8	9.7	17.8	11.5	22.0	31.1	25.6	9.1	8.4
Brigham City	490030003	Brigham City	9.1	8.8	7.2	7.8	11.3	12.5	16.5	24.7	22.9	6.5	8.3



SOx 50% Control PM <sub>2.5</sub>			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	9.7	6.6	4.2	12.1	17.4	8.1	13.3	34.6	30.7	10.1	8.7
Tooele	490450003	Tooele	9.4	7.9	11.7	18.6	17.0	12.7	21.3	32.7	28.0	10.2	8.6
Cottonwood	490350003	Cottonwood West	13.7	11.4	14.3	31.8	31.6	25.6	37.9	51.5	43.0	13.1	12.3
Erda	490450004	Erda	10.0	8.0	11.1	18.8	15.8	13.2	23.2	26.1	24.9	11.0	7.8
Hawthorne	490353006	Salt Lake City	15.7	12.3	19.0	27.7	31.6	22.1	38.8	50.6	49.6	15.2	12.8
Magna	490351001	Magna	9.5	8.2	12.0	21.1	21.1	18.2	26.8	37.4	40.4	9.2	11.6
ROSE PARK	490353010	Salt Lake City	16.3	13.5	13.9	30.4	31.5	24.7	38.8	45.9	44.8	14.1	15.2
Bountiful Viewmont	490110004	Bountiful	11.0	7.0	9.1	25.0	21.2	13.9	37.5	36.8	40.2	8.8	9.8
Ogden	490570002	Ogden	11.4	7.6	7.9	12.4	19.7	13.2	32.6	31.8	31.4	8.6	10.7
Harrisville	490571003	Harrisville	11.4	7.7	6.8	9.7	17.8	11.5	22.0	31.0	25.6	9.0	8.4
Brigham City	490030003	Brigham City	9.1	8.8	7.2	7.8	11.3	12.5	16.5	24.6	22.8	6.5	8.3

SOx 70% Control PM <sub>2.5</sub>			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	9.7	6.6	4.2	12.0	17.4	8.1	13.3	34.5	30.6	10.0	8.7
Tooele	490450003	Tooele	9.4	7.9	11.7	18.6	16.9	12.7	21.2	32.6	27.9	10.1	8.6
Cottonwood	490350003	Cottonwood West	13.7	11.4	14.3	31.8	31.5	25.5	37.9	51.4	43.0	13.0	12.3
Erda	490450004	Erda	10.0	8.0	11.1	18.8	15.7	13.2	23.1	25.9	24.8	11.0	7.8
Hawthorne	490353006	Salt Lake City	15.7	12.3	18.9	27.7	31.5	22.1	38.7	50.4	49.5	15.1	12.8
Magna	490351001	Magna	9.5	8.2	12.0	21.1	20.8	18.2	26.8	37.1	40.2	9.1	11.5
ROSE PARK	490353010	Salt Lake City	16.3	13.5	13.9	30.3	31.3	24.7	38.7	45.6	44.7	14.0	15.2
Bountiful Viewmont	490110004	Bountiful	11.0	7.0	9.1	24.9	21.1	13.9	37.4	36.7	40.1	8.8	9.8
Ogden	490570002	Ogden	11.4	7.6	7.9	12.4	19.6	13.2	32.5	31.7	31.3	8.6	10.7
Harrisville	490571003	Harrisville	11.4	7.7	6.8	9.7	17.7	11.5	22.0	31.0	25.5	9.0	8.4
Brigham City	490030003	Brigham City	9.1	8.8	7.2	7.8	11.2	12.5	16.5	24.6	22.7	6.5	8.3

**Table 7(a)-(c). Change in total 24-hour PM<sub>2.5</sub> concentrations on each modeled day of the January 2011 episode and at each monitor in the SLC NAA, as simulated in the 2019 30%, 50% and 70% SOx reduction cases. Green shade indicates impacts below the 1.5 µg/m<sup>3</sup> threshold for significant contributions.**

(2019 Base Case PM <sub>2.5</sub> - SOx 30% Control PM <sub>2.5</sub> )			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	0.01	0.00	0.00	0.04	0.07	0.00	0.00	0.15	0.12	0.11	0.03
Tooele	490450003	Tooele	0.00	0.00	0.00	0.06	0.11	0.01	0.11	0.19	0.15	0.03	0.01
Cottonwood	490350003	Cottonwood West	0.00	0.00	0.00	0.06	0.13	0.02	0.08	0.17	0.05	0.04	0.03
Erda	490450004	Erda	0.00	0.00	0.00	0.05	0.08	0.03	0.08	0.26	0.22	0.02	0.01
Hawthorne	490353006	Salt Lake City	0.00	0.00	0.02	0.03	0.16	0.02	0.25	0.25	0.07	0.07	0.03
Magna	490351001	Magna	0.00	0.00	0.00	0.02	0.32	0.04	0.07	0.35	0.20	0.07	0.08
ROSE PARK	490353010	Salt Lake City	0.00	0.00	0.01	0.09	0.20	0.02	0.17	0.28	0.09	0.05	0.03
Bountiful Viewmont	490110004	Bountiful	0.00	0.00	0.00	0.08	0.12	0.04	0.10	0.17	0.11	0.04	0.04
Ogden	490570002	Ogden	0.00	0.00	0.00	0.02	0.10	0.03	0.09	0.13	0.11	0.02	0.04
Harrisville	490571003	Harrisville	0.00	0.00	0.00	0.01	0.06	0.03	0.03	0.09	0.09	0.02	0.03
Brigham City	490030003	Brigham City	0.00	0.01	0.00	0.01	0.04	0.03	0.03	0.09	0.12	0.01	0.03

(2019 Base Case PM <sub>2.5</sub> - SOx 50% Control PM <sub>2.5</sub> )			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	0.01	0.00	0.00	0.06	0.13	0.01	0.01	0.26	0.21	0.19	0.05
Tooele	490450003	Tooele	0.00	0.00	0.00	0.10	0.18	0.02	0.19	0.32	0.25	0.05	0.01
Cottonwood	490350003	Cottonwood West	0.01	0.00	0.00	0.09	0.22	0.04	0.13	0.29	0.08	0.07	0.04
Erda	490450004	Erda	0.00	0.00	0.00	0.08	0.14	0.06	0.13	0.43	0.37	0.03	0.02
Hawthorne	490353006	Salt Lake City	0.00	0.00	0.03	0.06	0.28	0.03	0.42	0.44	0.12	0.11	0.05
Magna	490351001	Magna	0.00	0.00	0.00	0.03	0.55	0.07	0.11	0.62	0.34	0.12	0.15
ROSE PARK	490353010	Salt Lake City	0.00	0.00	0.01	0.14	0.33	0.03	0.28	0.50	0.15	0.09	0.06
Bountiful Viewmont	490110004	Bountiful	0.00	0.00	0.00	0.13	0.21	0.07	0.16	0.28	0.19	0.06	0.06
Ogden	490570002	Ogden	0.00	0.00	0.00	0.03	0.16	0.05	0.14	0.22	0.18	0.03	0.06
Harrisville	490571003	Harrisville	0.00	0.01	0.00	0.02	0.10	0.05	0.06	0.15	0.16	0.03	0.05
Brigham City	490030003	Brigham City	0.00	0.01	0.00	0.02	0.06	0.06	0.05	0.15	0.19	0.02	0.04



(2019 Base Case PM <sub>2.5</sub> - SOx 70% Control PM <sub>2.5</sub> )			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	0.01	0.00	0.00	0.09	0.18	0.01	0.01	0.36	0.29	0.28	0.08
Tooele	490450003	Tooele	0.00	0.00	0.00	0.14	0.25	0.03	0.26	0.45	0.36	0.07	0.02
Cottonwood	490350003	Cottonwood West	0.01	0.00	0.00	0.13	0.32	0.06	0.18	0.42	0.12	0.10	0.06
Erda	490450004	Erda	0.00	0.00	0.00	0.11	0.19	0.08	0.18	0.61	0.52	0.05	0.03
Hawthorne	490353006	Salt Lake City	0.00	0.00	0.04	0.09	0.39	0.05	0.59	0.64	0.18	0.16	0.07
Magna	490351001	Magna	0.00	0.00	0.00	0.04	0.80	0.10	0.16	0.94	0.51	0.17	0.23
ROSE PARK	490353010	Salt Lake City	0.00	0.00	0.02	0.20	0.47	0.04	0.39	0.75	0.22	0.13	0.08
Bountiful Viewmont	490110004	Bountiful	0.01	0.00	0.00	0.19	0.30	0.09	0.23	0.41	0.27	0.09	0.09
Ogden	490570002	Ogden	0.00	0.01	0.00	0.04	0.23	0.08	0.20	0.31	0.25	0.05	0.09
Harrisville	490571003	Harrisville	0.00	0.01	0.00	0.04	0.14	0.07	0.08	0.21	0.22	0.05	0.07
Brigham City	490030003	Brigham City	0.00	0.02	0.00	0.03	0.08	0.08	0.06	0.20	0.27	0.03	0.06

Appendix B shows similar results for major stationary source SOx precursor sensitivity calculated from the 2014 base year and SOx-adjusted 2014 scenarios.

## 5.0 PRECURSOR DEMONSTRATION FOR VOC CONTRIBUTION

We ran CAMx for the entirety of the January 2011 modeling episode for the 2019 emission scenario in which major stationary source VOC emissions were zeroed. We calculated PM<sub>2.5</sub> concentration differences between the 2019 future year case (Table 3(b)) and the VOC zero-out run (Table 8(a)) for each day and at each monitoring site within the SLC NAA; results are shown in Table 8(b). Values shaded green indicate VOC contributions below the significance threshold of 1.5 µg/m<sup>3</sup>. VOC contributions are always well below the threshold.

**Table 8(a). 24-hour PM<sub>2.5</sub> concentrations on each modeled day of the January 2011 episode and at each monitor in the SLC NAA, as simulated in the 2019 major stationary source VOC zero-out case.**

VOC Control PM <sub>2.5</sub>			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	9.7	6.6	4.2	12.1	17.5	8.2	13.3	34.7	30.8	10.3	8.8
Tooele	490450003	Tooele	9.4	7.9	11.7	18.7	17.2	12.7	21.5	33.0	28.3	10.2	8.6
Cottonwood	490350003	Cottonwood West	13.7	11.4	14.3	31.8	31.7	25.6	37.9	51.3	42.9	13.1	12.4
Erda	490450004	Erda	10.0	8.0	11.1	18.9	15.9	13.3	23.3	26.5	25.3	11.0	7.8
Hawthorne	490353006	Salt Lake City	15.7	12.3	19.0	27.7	31.8	22.1	39.1	50.6	49.5	15.3	12.8
Magna	490351001	Magna	9.5	8.2	11.9	21.1	21.6	18.3	26.9	37.9	40.6	9.3	11.8
ROSE PARK	490353010	Salt Lake City	16.2	13.5	13.9	30.4	31.7	24.7	38.8	46.1	44.8	14.1	15.3
Bountiful Viewmont	490110004	Bountiful	10.9	7.0	9.1	24.9	21.3	13.8	37.1	36.9	40.3	8.8	9.9
Ogden	490570002	Ogden	11.3	7.6	7.8	12.4	19.8	13.2	32.5	31.9	31.5	8.6	10.8
Harrisville	490571003	Harrisville	11.4	7.7	6.8	9.7	17.9	11.5	21.9	31.1	25.7	9.1	8.4
Brigham City	490030003	Brigham City	9.1	8.8	7.2	7.9	11.3	12.5	16.5	24.8	23.0	6.5	8.3

**Table 8(b). Change in total 24-hour PM<sub>2.5</sub> concentrations on each modeled day of the January 2011 episode and at each monitor in the SLC NAA, as simulated in the 2019 major stationary source VOC zero-out case. Green shade indicates impacts below the 1.5 µg/m<sup>3</sup> threshold for significant contributions.**

(Base Case PM <sub>2.5</sub> - VOC Control PM <sub>2.5</sub> )			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	0.00	0.00	0.00	0.03	0.02	0.00	0.01	0.18	0.08	0.00	0.00
Tooele	490450003	Tooele	0.00	0.00	0.00	0.01	0.00	0.00	0.02	0.02	0.01	0.00	0.00
Cottonwood	490350003	Cottonwood West	0.00	0.00	0.01	0.11	0.08	0.04	0.13	0.46	0.19	0.01	0.00
Erda	490450004	Erda	0.00	0.00	0.01	0.02	0.00	0.00	0.02	0.01	0.01	0.00	0.00
Hawthorne	490353006	Salt Lake City	0.01	0.00	0.01	0.13	0.09	0.02	0.20	0.50	0.20	0.02	0.00
Magna	490351001	Magna	0.00	0.00	0.02	0.04	0.02	0.02	0.06	0.10	0.13	0.00	0.00
ROSE PARK	490353010	Salt Lake City	0.02	0.00	0.03	0.13	0.09	0.03	0.24	0.29	0.17	0.02	0.00
Bountiful Viewmont	490110004	Bountiful	0.04	0.00	0.07	0.17	0.07	0.16	0.58	0.21	0.13	0.06	0.02
Ogden	490570002	Ogden	0.02	0.01	0.01	0.02	0.05	0.05	0.23	0.11	0.07	0.02	0.03
Harrisville	490571003	Harrisville	0.02	0.00	0.01	0.01	0.02	0.02	0.11	0.09	0.04	0.01	0.02
Brigham City	490030003	Brigham City	0.00	0.01	0.01	0.01	0.01	0.02	0.05	0.04	0.02	0.00	0.01

## 6.0 PRECURSOR DEMONSTRATION FOR NH<sub>3</sub> CONTRIBUTION

We ran CAMx for the entirety of the January 2011 modeling episode for the 2019 emission scenario in which major stationary source NH<sub>3</sub> emissions were zeroed. We calculated PM<sub>2.5</sub> concentration differences between the 2019 future year case (Table 3(b)) and NH<sub>3</sub> zero-out run (Table 9(a)) for each day and at each monitoring site within the SLC NAA; results are shown in Table 9(b). Values shaded green indicate NH<sub>3</sub> contributions below the significance threshold of 1.5 µg/m<sup>3</sup>. According to the model, NH<sub>3</sub> contributions are always below the threshold, although NH<sub>3</sub> contributions increase later in the episode. The results in Table 9 are consistent with finding from the Utah Winter Fine Particulate Study (UWFPS; Baasandorj et al., 2018), which indicate that fine particulate ammonium nitrate within SLC may be near a balance between nitrate-limited and NH<sub>3</sub>-limited conditions, with a tendency towards NH<sub>3</sub>-limited conditions later during cold air pool events.

**Table 9(a). 24-hour PM<sub>2.5</sub> concentrations on each modeled day of the January 2011 episode and at each monitor in the SLC NAA, as simulated in the 2019 major stationary source NH<sub>3</sub> zero-out case.**

NH <sub>3</sub> Control PM <sub>2.5</sub>			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	9.7	6.6	4.2	12.1	17.5	8.2	13.3	34.6	30.8	10.3	8.8
Tooele	490450003	Tooele	9.4	7.9	11.7	18.7	17.2	12.7	21.5	33.0	28.3	10.2	8.6
Cottonwood	490350003	Cottonwood West	13.7	11.4	14.3	31.9	31.6	25.6	38.1	51.2	42.8	13.1	12.4
Erda	490450004	Erda	10.0	8.0	11.1	18.9	15.9	13.3	23.3	26.5	25.3	11.0	7.8
Hawthorne	490353006	Salt Lake City	15.7	12.3	19.0	27.7	31.8	22.1	39.2	50.5	49.3	15.3	12.8
Magna	490351001	Magna	9.5	8.2	12.0	21.1	21.6	18.3	26.9	37.6	39.9	9.3	11.7
ROSE PARK	490353010	Salt Lake City	16.3	13.5	13.9	30.5	31.7	24.7	39.1	45.3	44.4	14.2	15.3
Bountiful Viewmont	490110004	Bountiful	11.0	7.0	9.1	25.1	21.0	14.0	37.6	36.8	39.6	8.8	9.9
Ogden	490570002	Ogden	11.4	7.6	7.9	12.4	19.8	13.3	32.7	32.0	31.4	8.7	10.8
Harrisville	490571003	Harrisville	11.4	7.7	6.8	9.7	17.9	11.5	22.0	31.2	25.6	9.1	8.5
Brigham City	490030003	Brigham City	9.1	8.8	7.2	7.9	11.3	12.6	16.6	24.8	22.9	6.5	8.3

**Table 9(b). Change in total 24-hour PM<sub>2.5</sub> concentrations on each modeled day of the January 2011 episode and at each monitor in the SLC NAA, as simulated in the 2019 major stationary source NH<sub>3</sub> zero-out case. Green shade indicates impacts below the 1.5 µg/m<sup>3</sup> threshold for significant contributions.**

(Base Case PM <sub>2.5</sub> - NH <sub>3</sub> Control PM <sub>2.5</sub> )			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	0.00	0.00	0.00	0.01	0.03	0.00	0.00	0.28	0.12	0.01	0.00
Tooele	490450003	Tooele	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.02	0.00	0.00
Cottonwood	490350003	Cottonwood West	0.00	0.00	0.00	0.02	0.17	0.00	0.00	0.61	0.31	0.02	0.00
Erda	490450004	Erda	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.02	0.00	0.00
Hawthorne	490353006	Salt Lake City	0.00	0.00	0.00	0.06	0.13	0.00	0.01	0.62	0.41	0.01	0.00
Magna	490351001	Magna	0.00	0.00	0.00	0.09	0.03	0.00	0.00	0.41	0.85	0.00	0.02
ROSE PARK	490353010	Salt Lake City	0.00	0.00	0.00	0.03	0.12	0.00	0.01	1.06	0.54	0.01	0.00
Bountiful Viewmont	490110004	Bountiful	0.00	0.01	0.00	0.05	0.43	0.01	0.01	0.28	0.78	0.01	0.00
Ogden	490570002	Ogden	0.00	0.00	0.00	0.00	0.04	0.01	0.01	0.02	0.16	0.00	0.00
Harrisville	490571003	Harrisville	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.01	0.09	0.00	0.00
Brigham City	490030003	Brigham City	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.03	0.00	0.00

## 7.0 SUMMARY

Table 10 summarizes maximum modeled 24-hour PM<sub>2.5</sub> contributions from major stationary source NO<sub>x</sub>, SO<sub>x</sub>, VOC and NH<sub>3</sub> emissions, and maximum modeled 24-hour PM<sub>2.5</sub> sensitivity to major stationary source SO<sub>x</sub> reductions of 30%, 50%, and 70%, over all days of the January 2011 modeling episode and over all monitoring sites. Table 10 also shows the impacts specifically at Hawthorne and Rose Park monitoring sites, the two SLC NAA monitoring sites with the highest design values.

**Table 10. Summary of maximum 24-hour PM<sub>2.5</sub> contributions (µg/m<sup>3</sup>) from major stationary source NO<sub>x</sub>, SO<sub>x</sub>, VOC and NH<sub>3</sub> emissions, and maximum PM<sub>2.5</sub> sensitivity (µg/m<sup>3</sup>) to major stationary source SO<sub>x</sub> reductions of 30%, 50%, and 70%, over all days and sites; results at Hawthorne and Rose Park are also shown.**

Demonstration Case	Hawthorne	Rose Park	Maximum (Site)
NO <sub>x</sub> Contribution	0.33	0.40	0.86 (Brigham City)
VOC Contribution	0.50	0.29	0.58 (Bountiful)
NH <sub>3</sub> Contribution	0.62	1.06	1.06 (Rose Park)
SO <sub>x</sub> Contribution	0.99	1.21	1.47 (Magna)
SO <sub>x</sub> 30% Sensitivity	0.25	0.28	0.35 (Magna)
SO <sub>x</sub> 50% Sensitivity	0.44	0.50	0.62 (Magna)
SO <sub>x</sub> 70% Sensitivity	0.64	0.75	0.92 (Magna)

## 8.0 REFERENCES

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## **APPENDIX A**

### **Timeline for Data Acquisition and MSSPD Analysis**

## Appendix A Timeline for Data Acquisition and MSSPD Analyses

The UDAQ photochemical model is run for a PM<sub>2.5</sub> episode that occurred during the cold air pool event of January 1-10, 2011 and included multiple exceedance days. UDAQ has developed two “base” emission scenarios representing the years 2014 and 2016, and a “future” emission scenario representing the year 2019. The analyses reported here were performed prior to the availability of the 2016 base year emissions.

Below we outline the steps in obtaining the UDAQ photochemical modeling database for the 2014 base and 2019 future years, and the process of running the model for the 2014 and 2019 MSSPD analyses. The process was iterative and included on-going dialogue between Ramboll and UDAQ staff. Therefore, the analyses documented in this report are based on the same modeling tools and inputs (with appropriate adjustments as noted in Section 2.2) as UDAQ is relying on for its air quality analyses.

On February 6, 2018, UDAQ sent the entire 2014 base year modeling platform to Ramboll via hard disk drive. The data contents included<sup>12</sup>:

- All 2014 emissions in both sector-based (pre-merged) and model-ready (merged) files;
- All meteorological input files;
- All initial/boundary condition files;
- All photolysis rate and ozone column input files;
- CAMx v6.30 source code and run scripts;
- 2014 CAMx output generated by UDAQ;
- The entire 2014 SMOKE emissions processing system, including raw 2014 inventory files for all sectors, run scripts and supporting speciation and temporal profiles, spatial allocation files, and related cross-reference files.

Ramboll conducted an initial simulation of the UDAQ 2014 “base year” to ensure that we could replicate UDAQ-provided output files. Once confirmed, we used the 2014 modeling database to conduct a preliminary NO<sub>x</sub> and SO<sub>x</sub> MSSPD analyses by identifying point sources as “major” if their 2014 actual emissions (as opposed to PTE) reported in the UDAQ emission inventory exceeded 70 TPY for direct PM<sub>2.5</sub> or any precursor species (Appendix B, Table B-1). Ramboll also conducted major source SO<sub>x</sub> contribution and sensitivity analyses using a SO<sub>x</sub>-adjusted 2014 point source inventory (Section 2.2 and Appendix B). The ammonia emissions adjustment for Big West Oil had not yet been implemented at this time.

On May 9, 2018, UDAQ provided 2019 future year emission projections for mobile, area and point sources. This was in response to an e-mail request from Chris Emery, Ramboll, on May 9,

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<sup>12</sup> Data contents were specifically outlined in the December 15, 2017 e-mail from Marise Textor, Andeavor, and confirmed in the UDAQ response letter from Bryce Bird to Marise Textor dated January 19, 2019 (DAQP-002-18).

2018, and a prior phone call between Emery and UDAQ on May 8. At that point UDAQ had not completed their 2019 point source projections. The 2019 emission files were provided as both pre-merged and merged surface gridded files in model-ready format. This data transfer was conducted electronically from a guest account set up by UDAQ on a University of Utah FTP server.

In the final 2019 MSSPD analyses for NO<sub>x</sub>, SO<sub>x</sub>, VOC, and NH<sub>3</sub>, Ramboll used the SO<sub>x</sub>- and NH<sub>3</sub>-adjusted 2014 point source inventory (Section 2.2) in place of the UDAQ's initial 2019 point source inventory. In these analyses, we identified point sources as "major" if their permitted PTE emission exceeded 70 TPY for direct PM<sub>2.5</sub> or any precursor species (Section 2.1). This added five additional point sources (Table 1, Section 2.1) relative to the 2014 MSSPD analyses described in Appendix B. The 2019 MSSPD analyses were run with all other UDAQ 2019 emission inputs. Although UDAQ has since updated their 2019 future year inventory, it was necessary to "lock-in" the 2019 inventory we received in early May so that we could complete the MSSPD modeling analyses reported here before the end of the SIP public comment period.

## **APPENDIX B**

### **Preliminary Major Stationary Source Precursor Demonstrations for NOx and SOx Based on the 2014 UDAQ Emission Inventory**

## **Appendix B Preliminary Major Stationary Source Precursor Demonstrations for NO<sub>x</sub> and SO<sub>x</sub> Based on the 2014 UDAQ Emission Inventory**

### **B.1 UDAQ 2014 Base Year Modeling Inventory**

EPA defines stationary facility sources in Serious PM<sub>2.5</sub> Nonattainment Areas as “major” if direct PM<sub>2.5</sub> or any precursor emissions equal or exceed 70 tons per year (TPY) based on their permitted “potential to emit” (PTE) rates (40 CFR 51.1000 Definitions). In our preliminary MSSPD analyses using the 2014 UDAQ emission inventory, we cross-referenced stationary sources to their 2014 actual rates (as opposed to permitted PTE rates), and identified those facilities within the SLC NAA that emitted at least 70 TPY of PM<sub>2.5</sub> or any precursor emissions as major stationary sources for this demonstration. Table B-1 lists the major stationary facility sources in the SLC NAA that were used in the 2014 MSSPD analyses (note that these differ from the corrected set of major stationary sources based on PTE used in the 2019 MSSPD analyses described in the main report). We then zeroed-out specific precursor emissions from these facilities in the raw stationary inventory file provided by UDAQ, and processed this file through the Sparse Matrix Operator Kernel Emissions (SMOKE) system using UDAQ’s scripts and supporting files to generate new, model-ready, low-level and elevated point source inputs for the CAMx model. We performed this separately for precursor species NO<sub>x</sub> and SO<sub>x</sub> resulting in two different zero-out emission input files. All other emission species and sectors were unmodified.

### **B.2 2014 Precursor Demonstration for NO<sub>x</sub> Contribution**

We ran CAMx for the entirety of the January 2011 modeling episode with the major stationary source NO<sub>x</sub> emissions in the 2014 UDAQ inventory zeroed out. We performed the same simulation for the 2014 CAMx base year replication run (using the unaltered emission inventory). Resulting hourly gridded concentrations of all PM<sub>2.5</sub> components (sulfate, nitrate, ammonia, elemental and organic carbon, sodium, chloride, and primary PM<sub>2.5</sub>) were summed to total PM<sub>2.5</sub> mass concentrations, and averaged each day (midnight-midnight) to derive 24-hour PM<sub>2.5</sub>. Following EPA guidance, we calculated 24-hour PM<sub>2.5</sub> concentration differences between the 2014 base year (Table B-2(a)) and NO<sub>x</sub> zero-out runs (Table B-2(b)) for all days and at each monitoring site within the SLC NAA to determine major stationary source NO<sub>x</sub> precursor contributions.

Table B-2(c) lists the major stationary source NO<sub>x</sub> contributions on total PM<sub>2.5</sub> on each day and at each monitor. Values shaded green indicate NO<sub>x</sub> contributions below the significance threshold of 1.5 µg/m<sup>3</sup>. The model shows NO<sub>x</sub> contributions were always well below the threshold.

**Table B-1. List of “major” stationary facility sources within the SLC NAA and their 2014 primary PM<sub>2.5</sub> and precursor emissions (TPY). Those facilities highlighted in color are considered “major” according to actual 2014 emissions greater than 70 TPY (as opposed to PTE). Table from UDAQ web site<sup>13</sup>.**

Source: UDAQ 11/14/17			2014 Baseline Emissions				
County	Site ID	Site Name	PM <sub>2.5</sub> (tons/yr)	SO <sub>x</sub> (tons/yr)	NO <sub>x</sub> (tons/yr)	VOC (tons/yr)	NH <sub>3</sub> (tons/yr)
<b>Salt Lake Non-Attainment Area</b>							
Box Elder	10008	Nucor Steel- Nucor Steel	37.5	135.0	156.8	31.7	1.9
Box Elder	10009	ATK Launch Systems - Promontory	19.1	1.9	51.0	31.2	0.4
Box Elder	10028	Vulcraft - Division of Nucor Corporation- Steel Products Manufacturing	9.3	0.4	5.8	38.1	0.0
Box Elder	14107	Procter and Gamble-Paper Manufacturing Plant	38.9	0.3	27.2	18.6	0.2
Davis	10119	Chevron Products Co - Salt Lake Refinery	32.9	23.9	375.6	298.1	8.9
Davis	10121	Hill Air Force Base - Main Base	8.5	4.0	151.4	126.4	1.5
Davis	10122	Big West Oil - Flying J Refinery	45.9	57.1	92.3	307.4	117.4
Davis	10123	Holly Corp- HRMC and HEP Woods Cross Operations	12.7	102.3	168.4	155.3	17.6
Davis	10129	Wasatch Integrated Waste Mgt District- County Landfill & Energy Recovery Facility (DCERF)	9.8	17.2	236.4	23.2	0.0
Salt Lake	10335	Tesoro Refining & Marketing Company LLC	89.1	708.3	358.1	250.4	3.8
Salt Lake	10346	Kennecott Utah Copper LLC- Smelter & Refinery	420.0	704.4	160.0	10.4	5.6
Salt Lake	10354	University of Utah- University of Utah facilities	14.4	0.7	72.2	9.8	3.0
Salt Lake	10355	Pacificorp Energy- Gadsby Power Plant	16.9	1.5	117.4	9.6	13.1
Salt Lake	10571	Kennecott Utah Copper LLC- Mine & Copperton Concentrator **	105.4	0.0	5.6	4.7	1.8
Salt Lake	10572	Kennecott Utah Copper LLC- Power Plant Lab Tailings Impoundment	71.8	1500.3	1322.5	8.2	0.2
Salt Lake	11386	Hexcel Corporation- Salt Lake Operations	72.0	27.9	145.8	160.6	79.4
Salt Lake	12495	UAMPS - West Valley Power Plant	3.9	0.4	8.6	1.3	0.0
Tooele	10707	Lhoist North America - Grantsville Plant	0.2	0.0	0.2	0.1	0.0
Tooele	10726	Morton Salt Inc.	14.9	3.3	38.3	2.8	0.4
Weber	10917	Compass Minerals Ogden Inc. - Production Plant	28.2	8.7	134.6	16.4	3.1

\*\* The original table from UDAQ included non-road equipment tailpipe emissions operating within the Kennecott mine facility. The definition of a “major” stationary source does not include tail pipe emissions, so the non-road emissions were removed to show just stationary source emissions at the Kennecott mine facility. Non-tailpipe, mechanically generated particulate emissions associated with the non-road equipment’s operation (for example, road dust) remains in the inventory.

**Table B-2(a). Total 24-hour PM<sub>2.5</sub> concentrations on each modeled day of the January 2011 episode and at each monitor in the SLC NAA, as simulated in the 2014 base year case.**

Base Case			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	9.9	6.8	4.3	12.8	19.1	8.6	13.7	34.7	33.1	10.6	9.7
Tooele	490450003	Tooele	9.5	8.2	12.5	20.6	19.1	13.5	23.2	36.3	31.7	10.7	9.0
Cottonwood	490350003	Cottonwood West	14.0	11.8	14.4	33.0	33.3	26.6	38.9	50.8	43.7	14.2	13.2
Erda	490450004	Erda	10.2	8.3	11.8	21.3	17.8	14.2	24.9	30.5	29.2	11.5	8.4
Hawthorne	490353006	Salt Lake City	16.0	12.7	19.4	28.9	33.7	23.4	43.7	53.1	51.0	16.6	13.7
Magna	490351001	Magna	9.6	8.4	13.0	23.3	24.1	19.8	27.7	40.4	42.7	9.7	12.5
Rose Park	490353010	Salt Lake City	16.6	13.9	14.3	32.5	33.9	25.9	42.3	50.0	46.8	15.2	16.3
Bountiful Viewmont	490110004	Bountiful	11.2	7.1	9.5	26.9	23.1	15.0	35.6	40.2	43.0	9.3	10.7
Ogden	490570002	Ogden	11.7	8.0	8.4	13.8	22.3	14.6	34.5	35.9	35.0	9.2	12.0
Harrisville	490571003	Harrisville	11.7	8.0	7.3	10.7	20.2	12.6	24.3	35.5	29.2	9.7	9.3
Brigham City	490030003	Brigham City	9.2	9.3	7.8	8.7	13.0	13.8	18.7	29.0	26.8	6.8	9.4

<sup>13</sup> <https://deq.utah.gov/legacy/pollutants/p/particulate-matter/pm25/serious-area-state-implementation-plans/posted-inventories.htm>.

**Table B-2(b). 24-hour PM<sub>2.5</sub> concentrations on each modeled day of the January 2011 episode and at each monitor in the SLC NAA, as simulated in the 2014 major stationary source NOx zero-out case.**

NOx Control PM <sub>2.5</sub>			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	9.9	6.8	4.3	12.8	18.9	8.6	13.7	34.9	33.1	10.6	9.6
Tooele	490450003	Tooele	9.5	8.2	12.5	20.5	18.9	13.5	23.1	36.0	31.4	10.7	9.0
Cottonwood	490350003	Cottonwood West	14.0	11.8	14.4	33.1	33.3	26.6	39.1	51.6	44.1	14.1	13.2
Erda	490450004	Erda	10.1	8.3	11.8	21.1	17.6	14.1	24.9	30.2	28.9	11.5	8.4
Hawthorne	490353006	Salt Lake City	16.0	12.7	19.5	29.1	33.7	23.4	43.9	53.9	51.4	16.5	13.7
Magna	490351001	Magna	9.6	8.4	13.0	23.1	23.8	19.7	27.8	40.3	42.8	9.6	12.4
Rose Park	490353010	Salt Lake City	16.6	13.9	14.5	32.7	33.8	25.8	42.6	50.3	47.0	15.1	16.2
Bountiful Viewmont	490110004	Bountiful	11.1	7.1	9.6	27.4	23.0	15.0	37.2	40.3	42.8	9.3	10.6
Ogden	490570002	Ogden	11.7	8.0	8.4	13.8	22.0	14.6	34.8	35.6	34.7	9.2	11.9
Harrisville	490571003	Harrisville	11.7	8.0	7.2	10.7	20.0	12.5	24.2	35.1	28.7	9.7	9.2
Brigham City	490030003	Brigham City	9.2	9.3	7.8	8.7	12.9	13.7	18.4	28.4	26.2	6.8	9.3

**Table B-2(c). Change in total 24-hour PM<sub>2.5</sub> concentrations on each modeled day of the January 2011 episode and at each monitor in the SLC NAA, as simulated in the 2014 major stationary source NOx zero-out case. Green shade indicates impacts below the 1.5 µg/m<sup>3</sup> threshold for significant contributions.**

(Base Case PM <sub>2.5</sub> - NOx Control PM <sub>2.5</sub> )			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	0.01	0.00	0.00	0.01	0.15	0.02	0.00	-0.20	0.03	0.04	0.04
Tooele	490450003	Tooele	0.00	0.00	0.02	0.11	0.23	0.03	0.07	0.21	0.23	0.04	0.01
Cottonwood	490350003	Cottonwood West	0.02	0.00	-0.02	-0.18	0.00	0.01	-0.19	-0.77	-0.40	0.08	0.05
Erda	490450004	Erda	0.01	0.00	0.02	0.19	0.20	0.04	0.06	0.34	0.31	0.03	0.02
Hawthorne	490353006	Salt Lake City	0.03	0.00	-0.06	-0.12	0.01	0.03	-0.25	-0.81	-0.40	0.08	0.07
Magna	490351001	Magna	0.01	0.00	0.03	0.17	0.32	0.09	-0.08	0.09	-0.05	0.06	0.07
Rose Park	490353010	Salt Lake City	0.04	0.00	-0.13	-0.19	0.08	0.02	-0.37	-0.34	-0.24	0.11	0.07
Bountiful Viewmont	490110004	Bountiful	0.04	0.01	-0.04	-0.47	0.15	-0.04	-1.54	-0.07	0.15	0.04	0.14
Ogden	490570002	Ogden	0.03	0.02	0.01	0.05	0.26	0.09	-0.29	0.33	0.35	0.05	0.13
Harrisville	490571003	Harrisville	0.02	0.03	0.01	0.06	0.21	0.09	0.10	0.42	0.44	0.04	0.08
Brigham City	490030003	Brigham City	0.00	0.06	0.04	0.06	0.17	0.13	0.29	0.59	0.61	0.02	0.08

### B.3 2014 Precursor Demonstration for SOx Contribution

Following the same methodology for NOx, we ran CAMx for the January 2011 modeling episode with the major stationary source SOx emissions zeroed out. We calculated PM<sub>2.5</sub> concentration differences between the 2014 base year (Table B-2(a)) and SOx zero-out run (Table B-3(a)) for all days and at each monitoring site within the SLC NAA, as shown in Table B-3(b). Values shaded green indicate SOx contributions below the significance threshold of 1.5 µg/m<sup>3</sup>; values shaded in red indicate SOx contribution above that threshold. Note that no PM<sub>2.5</sub> increases occur with the SOx removal. According to the model, contributions greater than the threshold occur for several locations and dates, with maxima of 4.5 and 4.4 µg/m<sup>3</sup> at Hawthorn and Rose Park, respectively, on January 7 (the peak observed exceedance day).

**Table B-3(a). 24-hour PM<sub>2.5</sub> concentrations on each modeled day of the January 2011 episode and at each monitor in the SLC NAA, as simulated in the 2014 major stationary source SOx zero-out case.**

SOx Control PM <sub>2.5</sub>			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	9.9	6.8	4.3	12.6	18.7	8.6	13.7	33.9	32.5	10.2	9.6
Tooele	490450003	Tooele	9.5	8.2	12.5	20.4	18.7	13.5	22.7	35.5	31.1	10.6	9.0
Cottonwood	490350003	Cottonwood West	14.0	11.8	14.4	32.3	32.6	26.5	38.1	48.1	43.2	13.6	13.1
Erda	490450004	Erda	10.2	8.3	11.8	21.1	17.4	14.0	24.6	29.5	28.3	11.4	8.3
Hawthorne	490353006	Salt Lake City	16.0	12.7	19.1	28.4	32.6	23.3	39.2	48.6	50.4	15.7	13.5
Magna	490351001	Magna	9.6	8.4	13.0	23.2	22.9	19.6	27.3	38.9	41.8	9.4	12.1
Rose Park	490353010	Salt Lake City	16.6	13.9	14.2	31.2	32.6	25.8	39.1	45.6	46.2	14.6	16.1
Bountiful Viewmont	490110004	Bountiful	11.2	7.1	9.5	25.9	22.3	14.7	34.2	38.7	42.2	9.1	10.5
Ogden	490570002	Ogden	11.7	8.0	8.4	13.7	21.6	14.5	33.6	35.1	34.4	9.1	11.8
Harrisville	490571003	Harrisville	11.7	8.0	7.2	10.6	19.8	12.4	24.0	34.8	28.6	9.6	9.1
Brigham City	490030003	Brigham City	9.2	9.3	7.8	8.7	12.8	13.6	18.5	28.4	26.2	6.7	9.2

**Table B-3(b). Change in total 24-hour PM<sub>2.5</sub> concentrations on each modeled day of the January 2011 episode and at each monitor in the SLC NAA, as simulated in the 2014 major stationary source SOx zero-out case. Green shade indicates impacts below the 1.5 µg/m<sup>3</sup> threshold for significant contributions; red shade indicates impacts above that threshold.**

(Base Case PM <sub>2.5</sub> - SOx Control PM <sub>2.5</sub> )			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	0.02	0.00	0.00	0.18	0.30	0.02	0.01	0.81	0.61	0.44	0.13
Tooele	490450003	Tooele	0.00	0.00	0.00	0.22	0.41	0.05	0.42	0.73	0.58	0.11	0.03
Cottonwood	490350003	Cottonwood West	0.04	0.00	0.03	0.68	0.68	0.10	0.85	2.69	0.52	0.58	0.15
Erda	490450004	Erda	0.00	0.00	0.00	0.20	0.32	0.12	0.31	0.99	0.83	0.08	0.05
Hawthorne	490353006	Salt Lake City	0.02	0.01	0.36	0.57	1.11	0.08	4.46	4.49	0.64	0.90	0.17
Magna	490351001	Magna	0.00	0.00	0.01	0.10	1.19	0.17	0.39	1.53	0.92	0.26	0.40
Rose Park	490353010	Salt Lake City	0.01	0.01	0.16	1.26	1.23	0.08	3.14	4.37	0.63	0.59	0.18
Bountiful Viewmont	490110004	Bountiful	0.02	0.01	0.01	1.02	0.84	0.28	1.47	1.48	0.78	0.28	0.28
Ogden	490570002	Ogden	0.01	0.01	0.01	0.08	0.65	0.13	0.91	0.83	0.66	0.10	0.22
Harrisville	490571003	Harrisville	0.01	0.02	0.01	0.07	0.37	0.11	0.30	0.74	0.60	0.09	0.17
Brigham City	490030003	Brigham City	0.00	0.05	0.02	0.06	0.19	0.15	0.15	0.55	0.65	0.04	0.15

#### B.4. 2014 Adjusted Precursor Demonstration for SOx Contribution

We ran CAMx for the January 2011 modeling episode with the SOx-adjusted 2014 point source emissions (Section 2.2) and calculated PM<sub>2.5</sub> concentration differences between the SOx-adjusted case (Table B-4(a)) and the SOx zero-out run described previously (Table B-3(a)) for all days and at each monitoring site within the SLC NAA; results are shown in Table B-4(b). Note that at the time this case was run, we had not yet made the NH<sub>3</sub> adjustment to the Big West facility, as described in Section 2.2. According to the model, SOx contributions remain slightly greater than the 1.5 µg/m<sup>3</sup> significance threshold on January 7 at Hawthorne and Rose Park.

**Table B-4(a). 24-hour PM<sub>2.5</sub> concentrations on each modeled day of the January 2011 episode and at each monitor in the SLC NAA, as simulated in the 2014 base year case using the adjusted point source inventory for SOx.**

Adjusted Base Case PM <sub>2.5</sub>			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	9.9	6.8	4.3	12.7	19.0	8.6	13.7	34.4	32.9	10.6	9.7
Tooele	490450003	Tooele	9.5	8.2	12.5	20.6	19.1	13.5	23.1	36.1	31.6	10.7	9.0
Cottonwood	490350003	Cottonwood West	14.0	11.8	14.4	32.5	33.0	26.6	38.4	49.3	43.4	13.8	13.1
Erda	490450004	Erda	10.2	8.3	11.8	21.2	17.7	14.1	24.9	30.3	29.0	11.5	8.4
Hawthorne	490353006	Salt Lake City	16.0	12.7	19.1	28.5	33.1	23.4	40.1	50.1	50.7	15.9	13.6
Magna	490351001	Magna	9.6	8.4	13.0	23.3	23.9	19.7	27.5	40.0	42.5	9.7	12.5
ROSE PARK	490353010	Salt Lake City	16.6	13.9	14.2	31.5	33.3	25.8	39.7	47.5	46.5	14.8	16.2
Bountiful Viewmont	490110004	Bountiful	11.2	7.1	9.5	26.2	22.7	14.8	34.5	39.3	42.6	9.2	10.6
Ogden	490570002	Ogden	11.7	8.0	8.4	13.8	21.9	14.6	33.9	35.5	34.7	9.2	11.9
Harrisville	490571003	Harrisville	11.7	8.0	7.3	10.7	20.0	12.5	24.1	35.1	28.9	9.7	9.2
Brigham City	490030003	Brigham City	9.2	9.3	7.8	8.7	13.0	13.7	18.6	28.7	26.5	6.8	9.3

**Table B-4(b). Change in total 24-hour PM<sub>2.5</sub> concentrations on each modeled day of the January 2011 episode and at each monitor in the SLC NAA, as simulated in the SOx-adjusted 2014 case and the major stationary source SOx zero-out case. Green shade indicates impacts below the 1.5 µg/m<sup>3</sup> threshold for significant contributions; red shade indicates impacts above that threshold.**

(Adjusted Base Case PM <sub>2.5</sub> - SOx Control PM <sub>2.5</sub> )			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	0.02	0.00	0.00	0.13	0.22	0.01	0.01	0.52	0.41	0.42	0.11
Tooele	490450003	Tooele	0.00	0.00	0.00	0.18	0.35	0.05	0.37	0.62	0.48	0.10	0.03
Cottonwood	490350003	Cottonwood West	0.01	0.00	0.01	0.19	0.41	0.08	0.27	1.12	0.21	0.14	0.09
Erda	490450004	Erda	0.00	0.00	0.00	0.15	0.27	0.11	0.25	0.84	0.70	0.07	0.05
Hawthorne	490353006	Salt Lake City	0.01	0.01	0.05	0.17	0.54	0.06	0.84	1.54	0.30	0.22	0.10
Magna	490351001	Magna	0.00	0.00	0.00	0.06	1.04	0.14	0.22	1.18	0.70	0.25	0.37
Rose Park	490353010	Salt Lake City	0.01	0.01	0.03	0.31	0.66	0.06	0.56	1.93	0.34	0.18	0.11
Bountiful Viewmont	490110004	Bountiful	0.01	0.01	0.00	0.26	0.41	0.12	0.34	0.58	0.45	0.13	0.12
Ogden	490570002	Ogden	0.00	0.01	0.01	0.06	0.28	0.10	0.30	0.41	0.31	0.06	0.12
Harrisville	490571003	Harrisville	0.00	0.01	0.00	0.05	0.19	0.08	0.11	0.30	0.28	0.06	0.10
Brigham City	490030003	Brigham City	0.00	0.02	0.01	0.05	0.11	0.10	0.08	0.29	0.34	0.04	0.09

## B.5 2014 Adjusted Precursor Demonstration for SOx Sensitivity

For the SOx precursor sensitivity demonstration, we reduced major stationary source SOx emissions by 30% from the SOx-adjusted 2014 case, and compared the impact of this reduction on modeled PM<sub>2.5</sub> to the 1.5 µg/m<sup>3</sup> significance threshold. We processed the new inventory file through SMOKE system to generate new, model-ready, low-level and elevated point source inputs for the CAMx model. All other emission species and sectors were unmodified. We ran CAMx for the January 2011 modeling episode with the 30% SOx reduction point source inputs and calculated the PM<sub>2.5</sub> concentration differences between the SOx-adjusted 2014 case (Table B-4(a)) and SOx 30% reduction case (Table B-5(a)) for all days and at each monitoring site within the SLC NAA; results are shown in Table B-5(b). According to the model, PM<sub>2.5</sub> sensitivity in this case always falls below the 1.5 µg/m<sup>3</sup> significance threshold.



**Table B-5(a). 24-hour PM<sub>2.5</sub> concentrations on each modeled day of the January 2011 episode and at each monitor in the SLC NAA, as simulated in the 2014 major stationary source SOx 30% reduction case.**

SOx 30% Control PM <sub>2.5</sub>			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	9.9	6.8	4.3	12.7	18.9	8.6	13.7	34.3	32.8	10.5	9.6
Tooele	490450003	Tooele	9.5	8.2	12.5	20.5	19.0	13.5	23.0	36.0	31.4	10.7	9.0
Cottonwood	490350003	Cottonwood West	14.0	11.8	14.4	32.4	32.9	26.6	38.3	49.0	43.3	13.7	13.1
Erda	490450004	Erda	10.2	8.3	11.8	21.2	17.6	14.1	24.8	30.1	28.8	11.5	8.4
Hawthorne	490353006	Salt Lake City	16.0	12.7	19.1	28.5	33.0	23.4	39.8	49.7	50.6	15.9	13.6
Magna	490351001	Magna	9.6	8.4	13.0	23.2	23.7	19.7	27.5	39.7	42.4	9.6	12.4
ROSE PARK	490353010	Salt Lake City	16.6	13.9	14.2	31.4	33.1	25.8	39.5	47.0	46.4	14.8	16.2
Bountiful Viewmont	490110004	Bountiful	11.2	7.1	9.5	26.1	22.6	14.8	34.4	39.1	42.5	9.2	10.5
Ogden	490570002	Ogden	11.7	8.0	8.4	13.8	21.8	14.6	33.8	35.3	34.6	9.2	11.8
Harrisville	490571003	Harrisville	11.7	8.0	7.3	10.7	19.9	12.5	24.1	35.0	28.8	9.7	9.2
Brigham City	490030003	Brigham City	9.2	9.3	7.8	8.7	12.9	13.7	18.6	28.6	26.4	6.8	9.3

**Table B-5(b). Change in total 24-hour PM<sub>2.5</sub> concentrations on each modeled day of the January 2011 episode and at each monitor in the SLC NAA, as simulated in the 30% SOx reduction case. Green shade indicates sensitivity below the 1.5 µg/m<sup>3</sup> threshold for significant contributions.**

(Adjusted Base Case PM <sub>2.5</sub> - SOx 30% Control PM <sub>2.5</sub> )			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	0.01	0.00	0.00	0.04	0.06	0.00	0.00	0.15	0.12	0.11	0.03
Tooele	490450003	Tooele	0.00	0.00	0.00	0.05	0.10	0.01	0.11	0.18	0.14	0.03	0.01
Cottonwood	490350003	Cottonwood West	0.00	0.00	0.00	0.06	0.11	0.02	0.08	0.31	0.06	0.04	0.03
Erda	490450004	Erda	0.00	0.00	0.00	0.04	0.08	0.03	0.08	0.25	0.21	0.02	0.01
Hawthorne	490353006	Salt Lake City	0.00	0.00	0.02	0.05	0.15	0.02	0.25	0.43	0.08	0.07	0.03
Magna	490351001	Magna	0.00	0.00	0.00	0.02	0.27	0.03	0.07	0.30	0.18	0.07	0.07
ROSE PARK	490353010	Salt Lake City	0.00	0.00	0.01	0.09	0.19	0.02	0.17	0.52	0.09	0.05	0.03
Bountiful Viewmont	490110004	Bountiful	0.00	0.00	0.00	0.08	0.11	0.03	0.10	0.16	0.12	0.04	0.03
Ogden	490570002	Ogden	0.00	0.00	0.00	0.02	0.08	0.03	0.09	0.12	0.09	0.02	0.03
Harrisville	490571003	Harrisville	0.00	0.00	0.00	0.01	0.06	0.02	0.03	0.09	0.08	0.02	0.03
Brigham City	490030003	Brigham City	0.00	0.01	0.00	0.01	0.03	0.03	0.02	0.08	0.10	0.01	0.03

## **APPENDIX C**

### **Author Biographies**

## Appendix C Author Biographies

**Chris Emery** has 27 years of experience in numerical modeling and analysis of urban and regional air pollution and meteorology. His expertise includes design, development and application of air quality modeling systems. Chris co-authors the Comprehensive Air Quality Model with extensions (CAMx)—a regional nested grid photochemical model with Plume-in-Grid and Probing Tool extensions. He also prepares the CAMx User’s Guide, and manages public distributions of CAMx and support programs. He has delivered CAMx training for numerous US and international clients including private, governmental, and academic institutions for over fifteen years. He has applied a variety of models for private and public clients, in both local and regional regulatory arenas, throughout the US and abroad. His projects have included ozone, particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>) and carbon monoxide modeling to support regulatory planning; determining effects of alternative and innovative air quality management strategies; analyzing source contributions and emission sensitivity; modeling fate of toxic air pollutants; studying prospective and retrospective air quality trends; estimating North American background ozone; and simulating source impacts on national parks and wilderness areas. Chris has applied and evaluated meteorological models and global chemical transport models to develop inputs needed by regional photochemical modeling applications. He has served as a member of the American Meteorological Society’s Board of the Urban Environment.

**Susan Kemball-Cook, PhD** has over 20 years of experience in atmospheric physics and model development and application. Her expertise includes photochemical modeling, emission inventory development, global and regional climate modeling, and climate change risk assessment. Sue is the Ramboll Service Line Coordinator for Climate Model Downscaling. Sue has managed projects assisting several Texas Ozone Near Nonattainment Areas in staying in attainment of the National Ambient Air Quality Standard for ozone. These projects have included quantifying ozone transport, emission inventory evaluation using satellite data, exceptional event analysis, control strategy evaluation, and conceptual model development. She has led numerous CAMx modeling projects, including the first evaluation of CAMx performance in the upper troposphere/lower stratosphere against aircraft data and the development of a capability to more accurately model the stratospheric contribution to background ozone. Sue has worked on air quality impact assessments for Texas shale gas development and has managed air quality and air quality related values (AQRVs) impact assessments for numerous National Environmental Policy Act (NEPA) studies for proposed oil and gas developments in the western U.S. She has extensive experience in application and evaluation of CAMx, CMAQ and WRF in NEPA studies and in oil and gas emission inventory development.

**Michele Jimenez** has extensive experience in emission inventory modeling and the development of software tools to support such efforts. She has directed the development of regional emission inventories in the United States which include emissions modeling for the multi-state regional RPO nested modeling grid. In addition, Michele has experience in data base

management systems, scientific software design and implementation, graphics software development, and PC applications.

**Ross Beardsley, PhD** is experienced in both the development and use of air quality models. He has advanced knowledge of atmospheric processes, as well as environmental monitoring and data analysis. Ross has developed new atmospheric modeling tools and utilized such regional and global models as CAMx, CMAQ, and GEOS-Chem. Ross was the primary developer of a comprehensive secondary organic aerosol (SOA) model that predicts the chemical and physical transformation of volatile organic compounds (VOCs) in the atmosphere. He also co-developed the fully automated Florida Air Quality Modeling System (<http://data.as.essie.ufl.edu/faqms/>) that generates three-day forecasts of Florida's air quality using WRF for meteorology and CMAQ for air quality. A strong technical programmer, Ross is proficient in Fortran, Linux/Unix, Shell Script, Python, R, and VBA.

**Tejas Shah** has more than ten years of experience with air pollution analyses. His expertise includes emission modeling, air quality modeling, emission inventory development, spatial analysis with GIS, database tool development, control-measure evaluation and economic impact analysis. Additionally, he has extensive experience using the RPOs emissions inventory, the USEPA's national emissions inventory (NEI) and the Environment Canada national inventory. Tejas' work at Ramboll Environ includes Sparse Matrix Operator Kernel Emissions (SMOKE) processing of regional and project-level emission inventories for various oil and gas EIS projects in the Intermountain West; preparing gridding surrogates and speciation profiles for the SMOKE model input; augmenting SPECIATE—a repository of speciation profiles; spatial analyses and preparing landuse/landcover files for the Comprehensive Air Quality Model with extensions (CAMx) and MEGAN models using GIS; and developing database tools.

# **ATTACHMENT B**

# **Modeled Contributions of Residential Wood Combustion to PM<sub>2.5</sub> in the Salt Lake City 24-hour PM<sub>2.5</sub> Serious Nonattainment Area**

Final Report

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## 1.0 INTRODUCTION

This report documents a modeling analysis to estimate the contribution of residential wood combustion (RWC) emissions to 24-hour fine particulate (PM<sub>2.5</sub>) concentrations in the Salt Lake City (SLC) Serious Nonattainment Area (NAA). The analysis employs the Utah Division of Air Quality (UDAQ) photochemical modeling platform supporting the development of the SLC NAA State Implementation Plan (SIP)<sup>1</sup>, and so this demonstration is directly relevant and parallel to UDAQ's technical analyses. EPA (2018) states that peak 24-hour average PM<sub>2.5</sub> impacts > 1.5 µg/m<sup>3</sup> can be considered "significant" contributions; we have adopted that threshold for this analysis.

## 2.0 APPROACH

We assessed SLC NAA RWC emission contributions to PM<sub>2.5</sub> by zeroing all criteria air pollutant emissions related to RWC activity in UDAQ's 2014 base year emissions inventory for grid cells contained within the SLC NAA boundary (Figure 1). We made no modifications to any other emission sectors or regions.<sup>2</sup>

Ramboll zeroed out the SLC NAA RWC emissions by reprocessing the UDAQ 2014 emission inventory using the Sparse Matrix Operator Kernel Emissions (SMOKE) processing system. UDAQ provided to Ramboll their entire SMOKE system of run scripts, raw inventory files, and ancillary supporting data files (e.g., temporal and speciation factors). By running SMOKE with the emissions database provided by UDAQ, we were able to reproduce UDAQ's 2014 base year model-ready emission inputs. As we configured SMOKE to zero-out the RWC emissions, we found that UDAQ had processed RWC emissions without applying reductions during "burn-ban" days<sup>3</sup>. We discussed this finding with UDAQ staff, who acknowledged that the burn-ban reductions had been unintentionally omitted due to an obscure complication in SMOKE. Figure 2 shows the differences in daily RWC PM<sub>2.5</sub> emissions between the uncontrolled 2014 scenario (as processed by UDAQ for photochemical modeling) and UDAQ's intended controlled scenario that includes the effects of the burn ban. The figure shows emissions reductions on burn-ban days between January 4 through 8 of 61%. This is the compliance rate that UDAQ assumes based on an analysis of levoglucosan<sup>4</sup> concentrations measured in several counties during December 2015 through February 2016 (UDAQ, 2017). UDAQ indicated that they plan to fix the

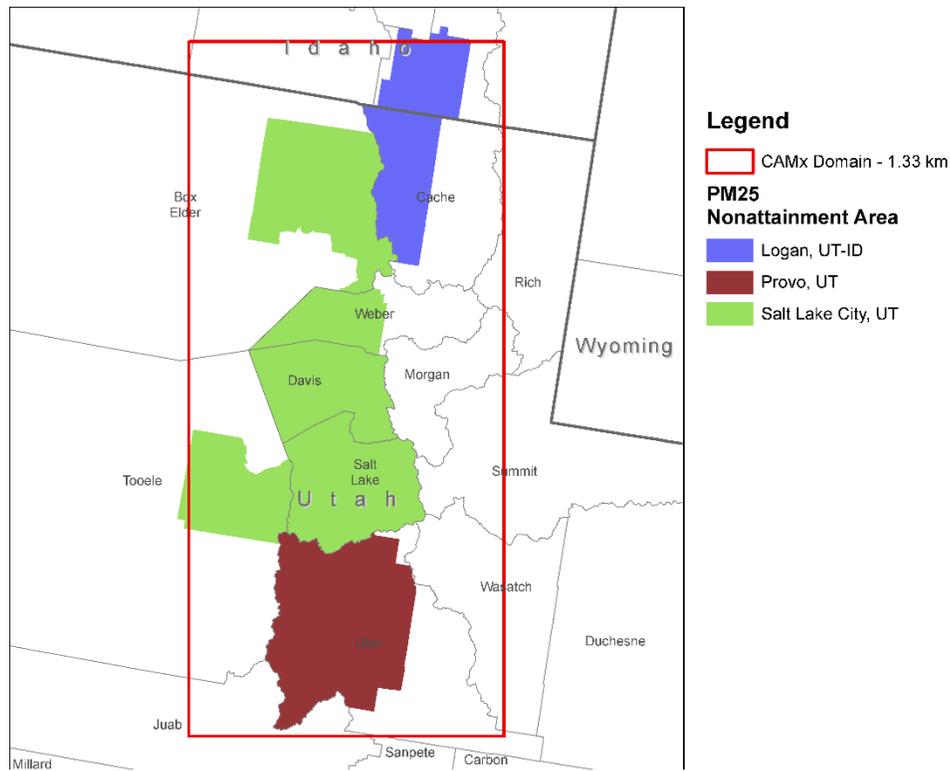
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<sup>1</sup> The UDAQ photochemical model is run for an exceedance PM<sub>2.5</sub> episode that occurred during a cold air pool event of January 1-10, 2011. In February 2018, UDAQ provided to Ramboll a complete modeling database that included a "base" emissions scenario representing the year 2014.

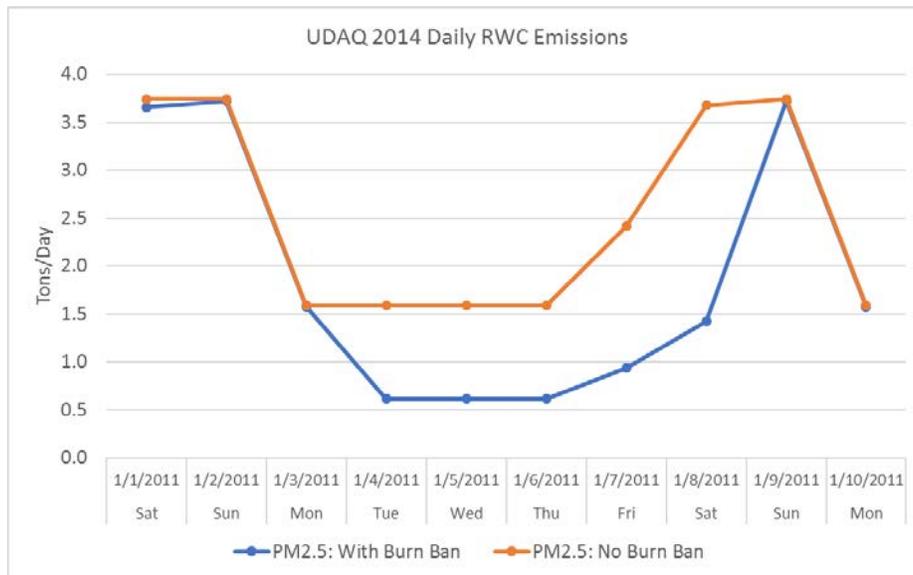
<sup>2</sup> We did not assess RWC contributions under UDAQ's new 2016 base year or 2019 future year inventory scenarios because we did not possess the emission data processing system necessary to revise the model-ready inventories for those years. If there are no significant differences in the RWC inventories among these years, results would not be materially different since the principal impacts associated with RWC result from direct PM<sub>2.5</sub> emissions.

<sup>3</sup> When UDAQ forecasts possible exceedances of the 24-hour PM<sub>2.5</sub> NAAQS during winter episodes, they call daily burn bans to reduce contributions to PM<sub>2.5</sub> from RWC.

<sup>4</sup> Levoglucosan is an organic marker of biomass burning aerosols; it is quite variable for different fuels and its concentration in a fire plume decreases as the plume ages (Baasandorj et al., 2018).



**Figure 1.** PM<sub>2.5</sub> nonattainment areas in Utah (shaded) and the boundary of UDAQ’s inner photochemical modeling grid with 1.33 km grid resolution (red outline).



**Figure 2.** Comparison of RWC PM<sub>2.5</sub> emissions on each day of the UDAQ January 2011 modeling episode, between a scenario assuming a 61% compliance rate on “burn-ban” days (blue; UDAQ, 2017) and a scenario with no burn ban (orange).

RWC SMOKE processing issue in their new emission scenarios for 2016 and 2019.

We ran the photochemical model for the entirety of the January 2011 modeling episode with the RWC zero-out emission inventory. We then compared the resulting concentration fields of total 24-hour PM<sub>2.5</sub> to model output from runs using the unmodified 2014 UDAQ RWC inventory (which does not reflect burn-ban days) and our re-processed RWC inventory (which reflects 61% emission reductions on burn-ban days). PM<sub>2.5</sub> concentration differences were calculated at each monitoring site within the SLC NAA and for all days of the modeling episode.

### 3.0 RESULTS

Based on UDAQ’s unmodified 2014 base year inventory (no burn-ban days), model-estimated PM<sub>2.5</sub> contributions from RWC frequently exceed the EPA’s significance threshold of 1.5 µg/m<sup>3</sup> at all but one monitoring site and for all days of the episode (Table 1). Impacts at Rose Park and Hawthorne range between 1.1 to 7.7 µ/m<sup>3</sup>, and the respective maxima at these two sites are 4.1 and 7.7 µ/m<sup>3</sup>. These two sites consistently measure the highest wintertime PM<sub>2.5</sub> concentrations in the SLC NAA and are the monitors with the highest Design Values.

**Table 1. Change in total 24-hour PM<sub>2.5</sub> concentrations on each modeled day of the January 2011 episode and at each monitor in the SLC NAA, as simulated in the 2014 RWC zero-out case relative to the unmodified 2014 UDAQ base case (no burn-ban). Green shade indicates impacts below EPA’s 1.5 µg/m<sup>3</sup> threshold for significant contributions. Red shade indicates impacts above the threshold.**

(Base Case PM2.5 - no RWC PM2.5)			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	0.54	0.40	0.53	1.40	1.14	0.32	1.32	2.77	2.76	1.54	0.36
Tooele	490450003	Tooele	0.55	1.15	1.70	1.30	0.88	0.77	1.11	1.06	1.48	1.19	0.56
Cottonwood	490350003	Cottonwood West	1.54	2.72	3.68	3.89	2.62	2.26	3.51	4.10	4.98	2.62	1.77
Erda	490450004	Erda	0.58	0.57	1.41	1.51	0.74	0.42	0.91	0.96	1.52	1.25	0.23
Hawthorne	490353006	Salt Lake City	2.69	4.08	7.12	5.13	3.41	2.91	4.84	6.73	7.74	4.49	1.89
Magna	490351001	Magna	0.35	0.91	1.77	2.29	1.03	0.94	1.24	1.57	2.31	0.67	0.79
ROSE PARK	490353010	Salt Lake City	1.13	2.41	2.10	4.06	2.12	1.82	2.92	2.01	2.26	1.69	1.28
Bountiful Viewmont	490110004	Bountiful	0.48	0.57	1.30	2.87	1.02	0.69	2.47	1.44	2.12	0.93	0.70
Ogden	490570002	Ogden	0.79	0.91	1.43	1.57	1.24	0.98	2.16	1.88	2.45	1.13	1.04
Harrisville	490571003	Harrisville	1.08	1.10	1.83	1.46	1.43	0.98	1.39	1.67	2.10	1.68	0.57
Brigham City	490030003	Brigham City	0.26	0.74	1.15	0.56	0.52	0.56	0.64	0.83	1.08	0.50	0.42

Table 2 is similar, but shows modeled RWC contributions using the re-processed 2014 RWC inventory (with burn-ban days). Again, model-estimated PM<sub>2.5</sub> contributions from RWC often exceed the EPA’s significance threshold of 1.5 µg/m<sup>3</sup>, but for fewer days and sites, particularly during the middle and late days of the episode when the burn-ban took effect (January 4 through 8). Impacts at Rose Park and Hawthorne range between 0.7 to 7.1 µ/m<sup>3</sup>, and the respective maxima at these two sites are 4.0 and 7.1 µ/m<sup>3</sup>.

Figure 3 shows the simulated spatial distribution of 24-hour PM<sub>2.5</sub> contributions from RWC on each day of the UDAQ 2011 modeling episode, based on our re-processed 2014 RWC inventory (with burn-ban days). An un-monitored area analysis based on Figure 3 shows that RWC contributions build up to peak values of 8 to 9 µg/m<sup>3</sup> in the SLC NAA on January 2 and 3 prior to

**Table 2. Change in total 24-hour PM<sub>2.5</sub> concentrations on each modeled day of the January 2011 episode and at each monitor in the SLC NAA, as simulated in the 2014 RWC zero-out case relative to the 2014 base case reflecting burn-ban days. Green shade indicates impacts below EPA’s 1.5 µg/m<sup>3</sup> threshold for significant contributions. Red shade indicates impacts above the threshold.**

(RWC w/Burn Ban PM2.5 - no RWC PM2.5)			24-Hour PM <sub>2.5</sub> (µg/m <sup>3</sup> )										
Site Name	AQS ID	City	12/31/2010	1/1/2011	1/2/2011	1/3/2011	1/4/2011	1/5/2011	1/6/2011	1/7/2011	1/8/2011	1/9/2011	1/10/2011
Herriman	490353013	Herriman	0.54	0.39	0.53	1.39	0.74	0.14	0.52	1.10	1.06	1.43	0.36
Tooele	490450003	Tooele	0.55	1.12	1.68	1.29	0.86	0.75	0.98	0.49	0.59	1.08	0.55
Cottonwood	490350003	Cottonwood West	1.54	2.66	3.65	3.86	1.74	0.92	1.39	1.61	1.94	2.28	1.76
Erda	490450004	Erda	0.58	0.56	1.40	1.50	0.73	0.39	0.79	0.48	0.61	1.12	0.22
Hawthorne	490353006	Salt Lake City	2.69	3.99	7.07	5.10	2.02	1.17	1.91	2.65	3.02	4.20	1.88
Magna	490351001	Magna	0.35	0.89	1.75	2.27	0.75	0.42	0.53	0.64	0.91	0.64	0.78
ROSE PARK	490353010	Salt Lake City	1.13	2.36	2.08	4.04	1.46	0.74	1.16	0.80	0.88	1.53	1.27
Bountiful Viewmont	490110004	Bountiful	0.48	0.56	1.29	2.85	0.78	0.29	0.98	0.59	0.83	0.74	0.70
Ogden	490570002	Ogden	0.79	0.89	1.42	1.57	1.11	0.41	0.88	0.74	0.96	1.06	1.03
Harrisville	490571003	Harrisville	1.08	1.07	1.83	1.46	1.38	0.43	0.58	0.66	0.83	1.52	0.57
Brigham City	490030003	Brigham City	0.26	0.73	1.14	0.55	0.50	0.41	0.30	0.34	0.43	0.48	0.42

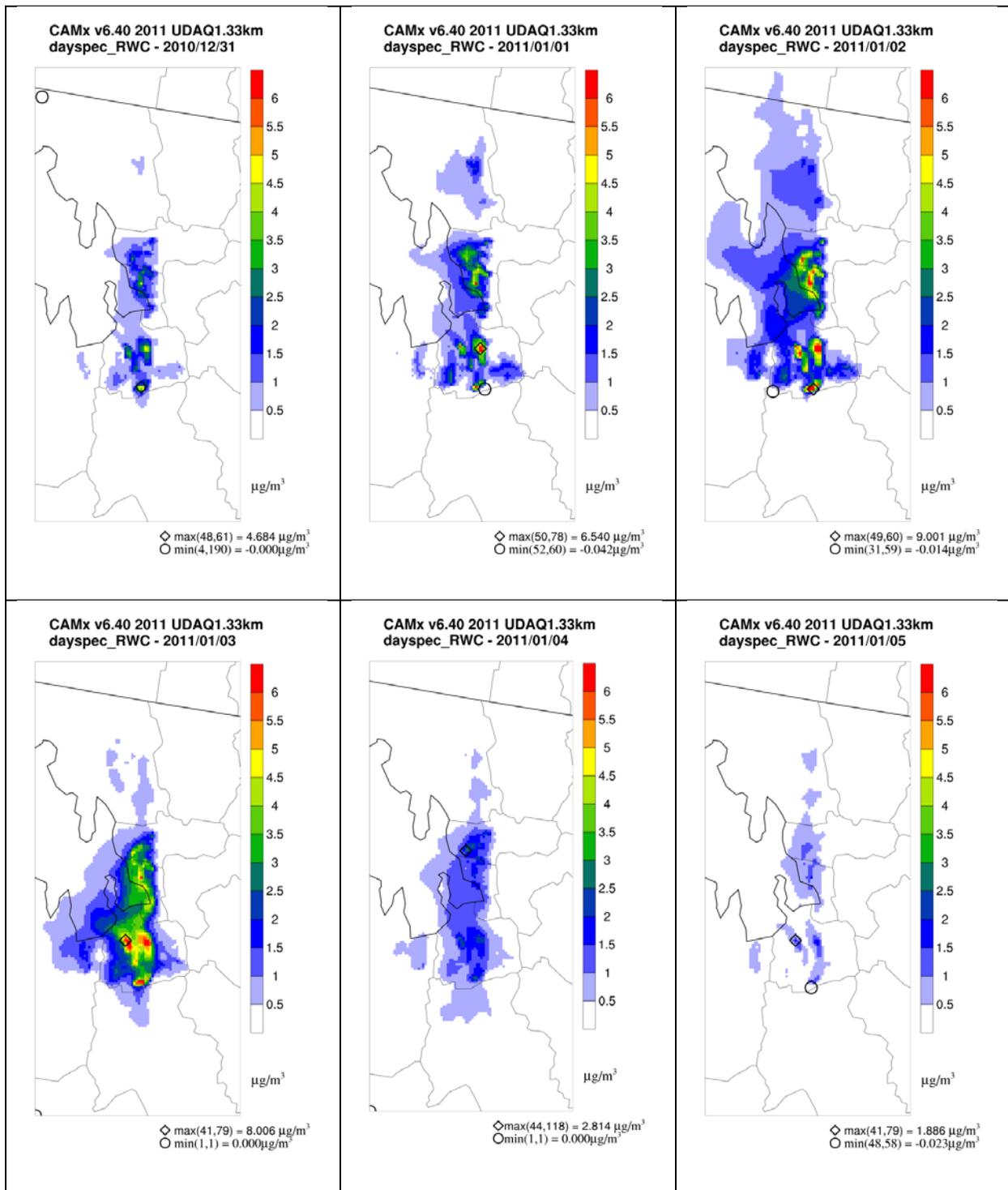
the burn-ban, subside for a few days, then re-build to about 4.5 µg/m<sup>3</sup> on January 7 and 8. They peak again at nearly 8 µg/m<sup>3</sup> on January 9 as the burn-ban expires (Figure 2) before subsiding on the last day of the episode. In contrast, modeled RWC contributions peaked at about 12 µg/m<sup>3</sup> on January 7 and 8 in the simulation using UDAQ’s unmodified 2014 emission inventory without the burn ban effects (not shown).

Given the linear response of PM<sub>2.5</sub> concentrations to primary RWC PM<sub>2.5</sub> emissions, the reduction from 12 to 4.5 µg/m<sup>3</sup> (63%) on the highest PM<sub>2.5</sub> days of the episode agrees very well with the assumed 61% compliance rate during burn-ban days. The lowest peak PM<sub>2.5</sub> contribution among all modeled days reaches nearly 2 µg/m<sup>3</sup>. Average PM<sub>2.5</sub> contributions throughout the SLC NAA consistently remain above 1 µg/m<sup>3</sup> during the episode.

#### 4.0 SUMMARY

Our modeling demonstration using an RWC emission inventory that accounts for burn-ban days shows:

- Even with an assumed burn-ban compliance rate of 61%, contributions from RWC far exceed the EPA’s threshold for significant contributions (1.5 µg/m<sup>3</sup>) at nearly all monitoring sites for many days of the UDAQ 2011 modeling episode.
- The model estimates peak contributions of 7 µg/m<sup>3</sup> at monitoring sites and an un-monitored area (domain-wide) peak contribution of 9 µg/m<sup>3</sup>.
- Overall, the model results show that the SLC NAA exhibit RWC contributions to PM<sub>2.5</sub> greater than 1.5 µg/m<sup>3</sup> at un-monitored areas on all days of the simulation, and over large areas on most days.



**Figure 3. Spatial distribution of RWC contributions ( $\mu\text{g}/\text{m}^3$ ) over the entire 1.33-km modeling grid and for each day of the January 2011 modeling episode, estimated by the zero-out scenario relative to a 2014 base year inventory reflecting burn-ban days.**

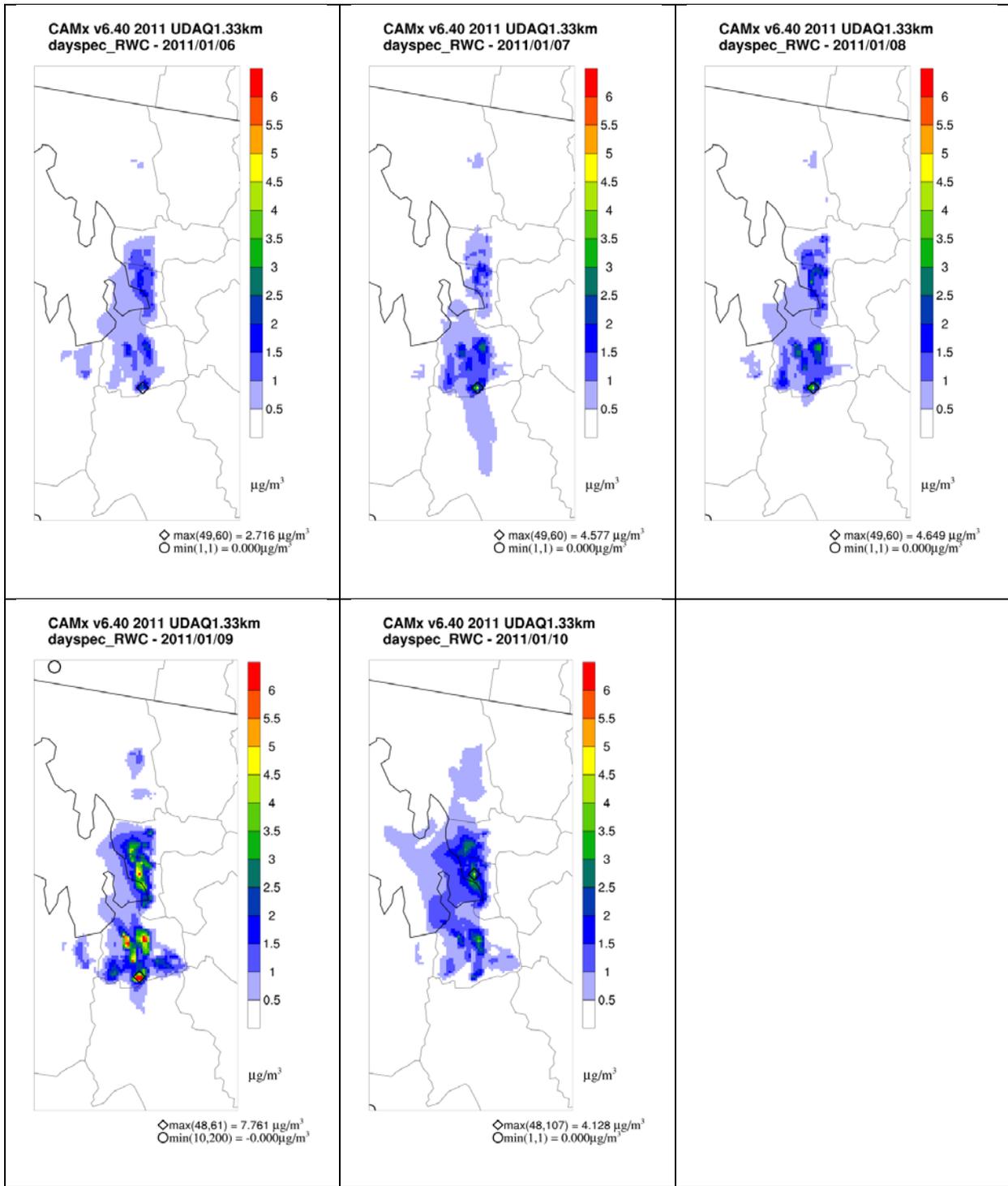


Figure 3. (concluded).

## 5.0 REFERENCES

- Baasandorj, M., et al., 2018. 2017 Utah Winter Fine Particulate Study Final Report. Prepared for the Utah Division of Air Quality (UDAQ), March 16, 2018. <https://documents.deq.utah.gov/air-quality/planning/technical-analysis/research/northern-utah-airpollution/utah-winter-fine-particulate-study/DAQ-2018-004037.pdf>.
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- US EPA, 2018. "Technical Basis for the EPA's Development of the Significant Impact Thresholds for PM<sub>2.5</sub> and Ozone (EPA-454/R-18-001)." U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Air Quality Assessment Division, Research Triangle Park, NC (April 2018). [https://www.epa.gov/sites/production/files/2018-04/documents/ozone\\_pm2.5\\_sils\\_technical\\_document\\_final\\_4-17-18.pdf](https://www.epa.gov/sites/production/files/2018-04/documents/ozone_pm2.5_sils_technical_document_final_4-17-18.pdf)

## **APPENDIX A**

### **Author Biographies**

## Appendix A Author Biographies

**Chris Emery** has 27 years of experience in numerical modeling and analysis of urban and regional air pollution and meteorology. His expertise includes design, development and application of air quality modeling systems. Chris co-authors the Comprehensive Air Quality Model with extensions (CAMx)—a regional nested grid photochemical model with Plume-in-Grid and Probing Tool extensions. He also prepares the CAMx User’s Guide, and manages public distributions of CAMx and support programs. He has delivered CAMx training for numerous US and international clients including private, governmental, and academic institutions for over fifteen years. He has applied a variety of models for private and public clients, in both local and regional regulatory arenas, throughout the US and abroad. His projects have included ozone, particulate matter (PM10 and PM2.5) and carbon monoxide modeling to support regulatory planning; determining effects of alternative and innovative air quality management strategies; analyzing source contributions and emission sensitivity; modeling fate of toxic air pollutants; studying prospective and retrospective air quality trends; estimating North American background ozone; and simulating source impacts on national parks and wilderness areas. Chris has applied and evaluated meteorological models and global chemical transport models to develop inputs needed by regional photochemical modeling applications. He has served as a member of the American Meteorological Society’s Board of the Urban Environment.

**Michele Jimenez** has extensive experience in emission inventory modeling and the development of software tools to support such efforts. She has directed the development of regional emission inventories in the United States which include emissions modeling for the multi-state regional RPO nested modeling grid. In addition, Michele has experience in data base management systems, scientific software design and implementation, graphics software development, and PC applications.

**Ross Beardsley, PhD** is experienced in both the development and use of air quality models. He has advanced knowledge of atmospheric processes, as well as environmental monitoring and data analysis. Ross has developed new atmospheric modeling tools and utilized such regional and global models as CAMx, CMAQ, and GEOS-Chem. Ross was the primary developer of a comprehensive secondary organic aerosol (SOA) model that predicts the chemical and physical transformation of volatile organic compounds (VOCs) in the atmosphere. He also co-developed the fully automated Florida Air Quality Modeling System (<http://data.as.essie.ufl.edu/faqms/>) that generates three-day forecasts of Florida’s air quality using WRF for meteorology and CMAQ for air quality. A strong technical programmer, Ross is proficient in Fortran, Linux/Unix, Shell Script, Python, R, and VBA.

**Tejas Shah** has more than ten years of experience with air pollution analyses. His expertise includes emission modeling, air quality modeling, emission inventory development, spatial analysis with GIS, database tool development, control-measure evaluation and economic impact analysis. Additionally, he has extensive experience using the RPOs emissions inventory,

the USEPA's national emissions inventory (NEI) and the Environment Canada national inventory. Tejas' work at Ramboll Environ includes Sparse Matrix Operator Kernel Emissions (SMOKE) processing of regional and project-level emission inventories for various oil and gas EIS projects in the Intermountain West; preparing gridding surrogates and speciation profiles for the SMOKE model input; augmenting SPECIATE—a repository of speciation profiles; spatial analyses and preparing landuse/landcover files for the Comprehensive Air Quality Model with extensions (CAMx) and MEGAN models using GIS; and developing database tools.

**Pradeepa Vennam, PhD** has over 7 years of experience in air quality modeling, with a strong background in environmental and chemical engineering. She specializes in modeling analysis, emission calculations, and regulatory compliance analysis, including photochemical grid (CMAQ and CAMx) modeling. She has advanced knowledge of atmospheric chemistry and transport processes and has used models both at regional and hemispheric scales. She has developed modeling frameworks and assessed aircraft emissions impacts on surface and upper troposphere air quality. She is highly experienced in evaluating air quality models with surface monitoring observations (using EPA's AMET tool) and in-situ aircraft observations. Pradeepa is proficient in programming languages such as MATLAB, PYTHON, LINUX (Shell scripting) and NCL (NCAR Command Language), as well as big data processing, statistical analysis and Linux-based high performance supercomputing clusters. She is also skilled in ArcGIS, R, FORTRAN, SQL, java-based GUI tools (VERDI, PAVE).

**Susan Kemball-Cook, PhD** has over 20 years of experience in atmospheric physics and model development and application. Her expertise includes photochemical modeling, emission inventory development, global and regional climate modeling, and climate change risk assessment. Sue is the Ramboll Service Line Coordinator for Climate Model Downscaling.

Sue has managed projects assisting several Texas Ozone Near Nonattainment Areas in staying in attainment of the National Ambient Air Quality Standard for ozone. These projects have included quantifying ozone transport, emission inventory evaluation using satellite data, exceptional event analysis, control strategy evaluation, and conceptual model development. She has led numerous CAMx modeling projects, including the first evaluation of CAMx performance in the upper troposphere/lower stratosphere against aircraft data and the development of a capability to more accurately model the stratospheric contribution to background ozone. Sue has worked on air quality impact assessments for Texas shale gas development and has managed air quality and air quality related values (AQRVs) impact assessments for numerous National Environmental Policy Act (NEPA) studies for proposed oil and gas developments in the western U.S. She has extensive experience in application and evaluation of CAMx, CMAQ and WRF in NEPA studies and in oil and gas emission inventory development.

# **ATTACHMENT C**

**ATTACHMENT C**  
**PETITION FOR A RULE CHANGE**

**August 15, 2018**

(a) This constitutes a "petition for a rule change." The following information is provided in accordance with R15-2-4. The *UPA Comments* submitted by UPA on *the PM2.5 Rulemaking* on August 15, 2018 are hereby incorporated by this reference.<sup>1</sup>

(b) State the petitioner's name: Utah Petroleum Association ("UPA") including the following individual member companies: Big West Oil LLC, Chevron Products Company, HollyFrontier Woods Cross Refining LLC, and Tesoro Refining & Marketing Company LLC.

(c) State the petitioner's interest in the rule, including relevant affiliation, if any: UPA is comprised of companies from every segment of the petroleum industry including refiners. Four of UPA's member companies – Big West Oil LLC, Chevron Products Company, HollyFrontier Woods Cross Refining LLC, and Tesoro Refining & Marketing Company LLC – operate refineries that are identified in the Utah's PM2.5 SIP rulemaking as major stationary sources subject to the emission limits being proposed in this rulemaking. UPA and each of these companies are interested in seeing Utah implement appropriate control measures, including for area sources and residential wood combustion ("RWC"), that will contribute to the attainment and maintenance of the PM2.5 National Ambient Air Quality Standards in the Salt Lake City Nonattainment Area (SLC NAA). Absent effective control measures, UPA and its member companies will be subject to ever more stringent control measures.<sup>2</sup>

(d) Include a statement as required by Subsection 63G-3-601(4) regarding the requested rule change: The proposed action is within the jurisdiction and appropriate to the powers of the Utah Division of Air Quality and the Utah Air Quality Board ("Board"). The Board is authorized to "establish emission control requirements by rule that in its judgment may be necessary to prevent, abate, or control air pollution that may be statewide or may vary from area to area, taking into account varying local conditions."<sup>3</sup> In fact, the Board has previously enacted R307-302, Solid Fuel Burning Devices in Box Elder, Cache, Davis, Salt Lake, Tooele, Utah, and Weber Counties, which regulates RWC.

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<sup>1</sup> SIP Subsection IX. Part H: Emission Limits and Operating Practices and R307-110-17, Section IX, Control Measures for Area and Point Sources, Part H, Emission Limits. See 2018-13 Utah Bull. pp. 34-36 (July 1, 2018); see also Utah Air Quality Board, Final Agenda, Items VIII and IX (June 6, 2018) (collectively referred to as "*the PM2.5 Rulemaking*").

UPA has submitted comments on the proposed *PM2.5 Rulemaking* (referred to herein as *UPA Comments*). The second comment, "THE PROPOSED SIP CONTAINS INADEQUATE CONTROL MEASURES FOR WOOD BURNING EMISSIONS," addresses in detail the legal and technical reasons for Utah adopting additional control measures to control emissions associated with residential wood combustion.

<sup>2</sup> See, e.g., 40 CFR § 51.1010(b) (requiring "most stringent measures" for Serious nonattainment areas that cannot make an attainment demonstration by the attainment deadline); *id.* § 51.1010(c) (requiring a five percent reduction in direct PM2.5 or its precursors for Serious nonattainment areas that fail to demonstrate attainment by the attainment deadline).

<sup>3</sup> Utah Code Ann. § 19-2-109(2)(a).

(e) State the approximate wording of the requested rule change: In the UPA Comments, UPA identified a number of state regulations governing RWC that UDAQ has yet to consider as well as measures from the one state regulation (i.e., the San Joaquin Valley Air Pollution Control District Rule 4901) that UDAQ reviewed but did not implement. UPA believes that a Best Available Control Measures (“BACM”) analysis of RWC would result in the adoption of the following measures as BACM for the SLC NAA:<sup>4</sup>

- Provisions imposing mandatory change-out of existing solid fuel burning devices (“SFBD”) (Puget Sound Clean Air Agency (“PSCAA”).
- Requirements to change-out existing SFBD during real estate transactions or to render existing SFBD inoperable during real estate transactions (Fairbanks, City of Portola).
- Requirements limiting the installation of SFBD in new residential developments (SJVAPCD).
- Adoptions of an incentive program for SFBD change-outs (City of Portola).
- Adoption of more stringent requirements on the moisture content of fuel burned and public education regarding moisture content in fuel (SJVAPCD, PSCAA, City of Portola).
- Requirements for retailers selling SFBD and fuel for SFBD (Fairbanks, City of Portola).
- Review of emission standards imposed by other air agencies (Fairbanks, PSCAA).
- Conduct ongoing public education campaign(s) to inform the public on the impacts of RWC and proper use of SBFDS (SJVAPCD, Fairbanks).

(f) Describe the reason for the rule change: RWC contributes significantly to the SLC NAA’s PM<sub>2.5</sub> concentrations. Current Utah rules and proposed rules do not address the legal requirements for controlling RWC emissions. Absent appropriate controls, UPA and its member companies will be subject to increasingly stringent controls that will prove costly and ineffective. The reason for the requested rule change is set forth more fully in *UPA Comments*.

(g) Include an address, an e-mail address when available, and telephone where the petitioner can be reached during regular business hours:

Utah Petroleum Association  
10714 S. Jordan Gateway, Suite 160  
South Jordan, Utah 84095  
801-619-6680

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<sup>4</sup> In the subsequent list, UPA identifies the state/local agency that adopted the condition that UPA believes constitutes BACM for the SLC NAA. Please refer to UPA’s Comment, which provides additional details on the measures adopted by these state and local air quality agencies as well as precise legal citations for those regulations. UPA’s survey of state regulations governing RWC was not exhaustive and, as such, UPA encourages UDAQ to conduct a comprehensive survey of other state regulation as EPA directed in the PM<sub>2.5</sub> Implementation Rule. 40 CFR § 51.1010(a)(2)(i); 81 Fed. Reg. 58010, 58084/2 (August 24, 2016).

jking@utahpetroleum.org

(h) This petition is respectfully submitted by the Utah Petroleum Association this 15<sup>th</sup> day of August, 2018.

Utah Petroleum Association

By:

  
\_\_\_\_\_  
Jennette King

Its:

\_\_\_\_\_  
Administrative Assitant

# **EXHIBIT 1**



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
RESEARCH TRIANGLE PARK, NC 27711

NOV 17 2016

OFFICE OF  
AIR QUALITY PLANNING  
AND STANDARDS

**MEMORANDUM**

**SUBJECT:** Draft PM<sub>2.5</sub> Precursor Demonstration Guidance

**FROM:** Stephen D. Page, Director  
Office of Air Quality Planning and Standards

**TO:** Regional Air Division Directors, Regions 1 – 10

The Environmental Protection Agency (EPA) is providing a draft version of "PM<sub>2.5</sub> Precursor Demonstration Guidance" to state, local and tribal air agencies, as well as the public, for consideration, review, and comment. This document reflects the EPA's recommendations to assist air agencies to develop and submit optional PM<sub>2.5</sub> precursor demonstrations as permitted by the recently finalized PM<sub>2.5</sub> State Implementation Plan (SIP) Requirements Rule (PM<sub>2.5</sub> SIP Requirements Rule) (81 FR 58010).

The PM<sub>2.5</sub> SIP Requirements Rule contains details on planning requirements that apply to areas designated nonattainment for any PM<sub>2.5</sub> NAAQS. The rule addresses the statutory SIP requirements for state, local and tribal air agencies, such as: general requirements for attainment plan due dates and attainment dates; emissions inventories; attainment demonstrations; provisions for demonstrating reasonable further progress (RFP); quantitative milestones; contingency measures; and nonattainment New Source Review (NNSR) permitting programs.

The PM<sub>2.5</sub> SIP Requirements Rule identifies the PM<sub>2.5</sub> precursor pollutants that must be evaluated in the development of all PM<sub>2.5</sub> nonattainment area SIPs (SO<sub>2</sub>, NO<sub>x</sub>, VOC and ammonia). The rule requires that all PM<sub>2.5</sub> precursors be evaluated for potential control measures in any PM<sub>2.5</sub> attainment plan or any NNSR program. However, the rule permits air agencies to submit an optional precursor demonstration designed to show that for a specific PM<sub>2.5</sub> nonattainment area, emissions of a particular precursor from sources within the nonattainment area do not or would not contribute significantly to PM<sub>2.5</sub> levels that exceed the standard in the area. If the EPA approves the demonstration, the attainment plan or NNSR program for a particular PM<sub>2.5</sub> nonattainment area may exclude that precursor from certain control requirements under the Clean Air Act, depending on the type of demonstration provided.

This guidance is designed to assist air agencies who may wish to submit PM<sub>2.5</sub> precursor demonstrations as permitted by the PM<sub>2.5</sub> SIP Requirements Rule. This guidance is intended for use by air agencies; the EPA Headquarters and Regional offices; and the public. This document does not substitute for provisions or regulations of the Clean Air Act, nor is it a regulation itself. As the term "guidance" suggests, it provides recommendations or guidelines, as authorized under the Clean Air Act, that will be useful to air agencies in developing the precursor demonstrations by which the EPA can ultimately determine whether sources of a particular precursor contribute significantly to PM<sub>2.5</sub> levels that exceed the standard in a particular nonattainment area. Thus, it does not impose binding, enforceable

requirements on any party, nor does it assure that the EPA will approve a precursor demonstration in all instances where the guidance is followed, as the guidance may not apply to a particular situation based upon the circumstances of a particular nonattainment area.

#### **REVIEW AND COMMENT**

The EPA will accept comments on the draft PM<sub>2.5</sub> Precursor Demonstration Guidance submitted by January 31, 2017. Comments should be electronically submitted to Brian Timin of EPA's Air Quality Assessment Division at [timin.brian@epa.gov](mailto:timin.brian@epa.gov) or Patrick Lessard of the Air Quality Policy Division at [lessard.patrick@epa.gov](mailto:lessard.patrick@epa.gov). The draft guidance document is available electronically on the EPA's website: <https://www.epa.gov/pm-pollution/implementation-national-ambient-air-quality-standards-naaqs-fine-particulate-matter#additional-resources>.

Please distribute to air agencies in your Region. If you have any questions concerning this document, please contact Brian Timin at (919) 541-1850 or [timin.brian@epa.gov](mailto:timin.brian@epa.gov) or Patrick Lessard at (919) 541-5383 or [lessard.patrick@epa.gov](mailto:lessard.patrick@epa.gov).

Attachment



# PM<sub>2.5</sub> Precursor Demonstration Guidance



# PM<sub>2.5</sub> Precursor Demonstration Guidance

U.S. Environmental Protection Agency  
Office of Air Quality Planning and Standards  
Air Quality Assessment Division and Air Quality Policy Division  
Research Triangle Park, NC

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## Acronyms Used in this Guidance

BACT	Best Available Control Technology
CAA	Clean Air Act
CAMx	Comprehensive Air Quality Model with Extensions
CI	Confidence Interval
CMAQ	Community Multiscale Air Quality model
CSN	Chemical Speciation Network
CTM	Chemical transport model
DDM	Direct Decoupled Method
DV	Design Value
EC	Elemental carbon
EGU	Electric Generating Units
EPA	Environmental Protection Agency
FEM	Federal Equivalent Method
FRM	Federal Reference Method
IMPROVE	Interagency Monitoring of Protected Visual Environments
Km	Kilometer
LAER	Lowest Achievable Emissions Rate
NAAQS	National ambient air quality standards
NNSR	Nonattainment New Source Review
NO <sub>x</sub>	Oxides of nitrogen
NSR	New Source Review
OM	Organic matter
PM	Particulate matter
PM <sub>10</sub>	Particulate matter with diameter 10 microns or less
PM <sub>2.5</sub>	Particulate matter with diameter 2.5 microns or less
PSD	Prevention of Significant Deterioration
RACM	Reasonably Available Control Measures
RACT	Reasonably Available Control Technology
RFP	Reasonable Further Progress
RRF	Relative response factor
SANDWICH	Sulfate, adjusted nitrate, derived water, inferred carbonaceous balance
SIL	Significant Impact Levels
SIP	State Implementation Plan
SMAT	Software for the Modeled Attainment Test
SOA	Secondary Organic Aerosol
SO <sub>2</sub>	Sulfur dioxide
VOC	Volatile Organic Compound

## 1.0 Introduction

The Environmental Protection Agency (EPA) has finalized a fine particulate matter (PM<sub>2.5</sub>) State Implementation Plan (SIP) Requirements Rule<sup>1</sup> (PM<sub>2.5</sub> SIP Requirements Rule), which contains details on planning requirements that apply to areas designated nonattainment for any PM<sub>2.5</sub> national ambient air quality standards (NAAQS). The rule addresses the statutory SIP requirements for state, local and tribal air agencies, (hereafter known as “air agencies”), such as: general requirements for attainment plan due dates and attainment dates; emissions inventories; attainment demonstrations; provisions for demonstrating reasonable further progress (RFP); quantitative milestones; contingency measures; and nonattainment New Source Review (NNSR) permitting programs.

The PM<sub>2.5</sub> SIP Requirements Rule identifies the PM<sub>2.5</sub> precursor pollutants that apply to all PM<sub>2.5</sub> nonattainment area SIPs (sulfur dioxide (SO<sub>2</sub>); oxides of nitrogen (NO<sub>x</sub>); volatile organic compounds (VOC); and ammonia (NH<sub>3</sub>)). The rule establishes that PM<sub>2.5</sub> precursors must be evaluated for potential control measures in any PM<sub>2.5</sub> attainment plan or any NNSR program. The rule does not include any national presumption that excludes sources of emissions of a particular precursor from further analysis for attainment plan or NNSR control requirements in a PM<sub>2.5</sub> nonattainment area. However, the rule indicates that air agencies may choose to submit an optional precursor demonstration designed to show that for a specific PM<sub>2.5</sub> nonattainment area, emissions of a particular precursor from sources within the nonattainment area do not or would not contribute significantly to PM<sub>2.5</sub> levels that exceed the standard. If the EPA approves the demonstration, the attainment plan for a particular PM<sub>2.5</sub> nonattainment area may exclude that precursor from certain control requirements under the Clean Air Act (CAA or Act) (*e.g.*, reasonably available control measures (RACT); reasonably available control technology (RACT); reasonable further progress (RFP); or NNSR), depending on the type of demonstration provided.

This guidance is designed to assist air agencies who may wish to submit PM<sub>2.5</sub> precursor demonstrations as permitted by the PM<sub>2.5</sub> SIP Requirements Rule.<sup>2</sup> This guidance is intended for use by air agencies; the EPA Headquarters and Regional offices; and the public. This document does not substitute for provisions or regulations of the CAA enumerated above, nor is it a regulation itself. As the term “guidance” suggests, it provides recommendations or guidelines, as authorized under CAA section 189(e), that will be useful to air agencies in developing the precursor demonstrations by which the

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<sup>1</sup> See Fine Particulate Matter National Ambient Air Quality Standards: State Implementation Plan Requirements (PM<sub>2.5</sub> SIP Requirements Rule), 81 FR 58010 (Aug. 24, 2016).

<sup>2</sup> By default, all PM<sub>2.5</sub> precursors are plan precursors and precursor demonstrations are not required for PM<sub>2.5</sub> SIPs. However, if a state wishes to exclude a precursor from planning requirements, a precursor demonstration is required.

EPA can ultimately determine whether sources of a particular precursor contribute significantly to PM<sub>2.5</sub> levels that exceed the standard in a particular nonattainment area. Thus, it does not impose binding, enforceable requirements on any party, nor does it assure that the EPA will approve a precursor demonstration in all instances where the guidance is followed, as the guidance may not apply to a particular situation based upon the circumstances of a particular nonattainment area.

Where appropriate, air agencies retain the discretion to develop precursor demonstrations on a case-by-case basis that differ from this guidance. Final decisions by the EPA to approve a particular precursor demonstration as part of a plan submission will only be made based on the requirements of the statute and applicable regulations, and will only be made following an air agency's final submission of the precursor demonstration to the EPA, and after appropriate notice and opportunity for public review and comment. Interested parties may raise questions and objections about the appropriateness of the application of this guidance to a particular nonattainment area; the EPA and air agencies should consider whether or not the recommendations in this guidance are appropriate for each situation.

### 1.1 Precursor Demonstrations

The PM<sub>2.5</sub> SIP Requirements Rule permits states to submit separate precursor demonstrations to exclude sources of a particular precursor from control requirements under either the attainment plan or the NNSR program.

For a plan designed to demonstrate attainment of the standard as expeditiously as practicable, and no later than a future required attainment date, an air agency could choose to provide an optional precursor demonstration showing that existing emissions of a particular precursor “do not contribute significantly to PM<sub>2.5</sub> levels that exceed the standard in the area.”<sup>3</sup> As noted in the preamble to the PM<sub>2.5</sub> SIP Requirements Rule, the EPA has described a potential two-step analytical process. The first analysis would be to determine whether all emissions of the precursor(s) “contribute” to total PM<sub>2.5</sub> concentrations (a “concentration based analysis”). This analysis can be in the form of (1) a “comprehensive precursor demonstration,” which would evaluate the change in PM<sub>2.5</sub> air quality resulting from all existing emissions sources on PM<sub>2.5</sub> levels in the area; or (2) a “major stationary source precursor demonstration,” which would evaluate the change in PM<sub>2.5</sub> air quality resulting from only existing major stationary sources on PM<sub>2.5</sub> levels in the area. This analysis can be documented through the assessment of recent air quality monitoring data for PM<sub>2.5</sub> component species in the area or through air quality modeling.

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<sup>3</sup> See 40 CFR 51.1006(a)(1).

The final rule also provides for an optional second step, whereby, if the concentration-based analysis does not support a finding of insignificant contribution, based on the facts and circumstances of the area, then the air agency could still choose to conduct an optional analysis for a plan designed to demonstrate attainment of the standard (a “sensitivity-based analysis”).<sup>4</sup> This analysis can also be in the form of a “comprehensive precursor demonstration,” which would evaluate the effect of reducing emissions from all existing emissions sources on PM<sub>2.5</sub> levels in the area; or a “major stationary source precursor demonstration,” which would evaluate the effect of reducing emissions from only existing major stationary sources on PM<sub>2.5</sub> levels in the area. If the EPA approves a comprehensive precursor demonstration for a particular nonattainment area, the air agency would not be required to control emissions of the relevant precursor in the attainment plan for the area.<sup>5</sup> Similarly, if the EPA approves a major stationary source precursor demonstration for a particular nonattainment area, the air agency would not be required to control emissions of the relevant precursor from major stationary sources in the attainment plan for the area.<sup>6</sup>

Under the final rule, a separate analysis is available for air agencies who seek to demonstrate that new major source growth associated with a particular precursor would not contribute significantly to PM<sub>2.5</sub> levels that exceed the standard in the nonattainment area.<sup>7</sup> For this demonstration, an air agency would need to provide a separate NNSR precursor demonstration that evaluates the effect of emissions increases from major stationary sources of a particular precursor at (hypothetical) new and existing locations within the nonattainment area. If the EPA approves this type of demonstration for a particular nonattainment area, the air agency would be able to exempt new major stationary sources and major modifications of the particular precursor from the NNSR requirements for PM<sub>2.5</sub> in 40 CFR 51.165.<sup>8</sup>

This guidance document contains additional details on the recommended procedures for completing each of the three PM<sub>2.5</sub> precursor demonstrations defined in the final rule, including techniques for conducting these analyses and recommended insignificance thresholds for this purpose. See the PM<sub>2.5</sub> SIP Requirements Rule for more information on these precursor demonstrations, including details on the specific SIP elements that do not need to be addressed based on the approval of a particular precursor demonstration.<sup>9</sup>

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<sup>4</sup> See 40 CFR 51.1006(a)(1)(ii) and 51.1006(a)(2)(ii).

<sup>5</sup> See 40 CFR 51.1006(a)(1)(iii).

<sup>6</sup> See 40 CFR 51.1006(a)(2)(iii).

<sup>7</sup> See 40 CFR 51.1006(a)(3).

<sup>8</sup> See 40 CFR 51.1006(a)(3)(ii).

<sup>9</sup> See PM<sub>2.5</sub> SIP Requirements Rule at 81 FR 58017.

## Policy Guidance

### 2.0 Overview

As discussed above, the PM<sub>2.5</sub> NAAQS SIP Requirements Rule establishes that SO<sub>2</sub>, NO<sub>x</sub>, VOC, and ammonia are precursors for which sources are presumptively evaluated for potential control measures in an attainment plan or any NNSR program for any PM<sub>2.5</sub> nonattainment area. The rule also indicates that an air agency may choose to submit an optional precursor demonstration designed to show that, for a particular PM<sub>2.5</sub> nonattainment area, emissions of a particular precursor from sources within the nonattainment area do not or would not contribute significantly to PM<sub>2.5</sub> levels that exceed the standard. This section discusses the factors that EPA recommends using to determine the degree of impact that reflects a significant contribution on annual and 24-hour PM<sub>2.5</sub> concentrations. Later sections of the guidance describe specific details about how to conduct recommended technical analyses for the three types of precursor demonstrations (comprehensive, major source, and NNSR) included in the final rule.

#### 2.1 Interpretation of “Contribute Significantly” in Section 189(e) of the Clean Air Act and the PM<sub>2.5</sub> SIP Requirements Rule

Section 189(e) of the Clean Air Act requires that control requirements “for major stationary sources of PM<sub>10</sub> shall also apply to major stationary sources of PM<sub>10</sub> precursors, except where the Administrator determines that such sources do not contribute significantly to PM<sub>10</sub> levels which exceed the standard in the area.” Consistent with the D.C. Circuit’s decision in *NRDC v. EPA*, 706 F.3d 428 (D.C. Cir. 2013), this provision also applies to the regulation of sources of PM<sub>2.5</sub> precursors in designated PM<sub>2.5</sub> nonattainment areas. To implement this exception provided by that provision, the PM<sub>2.5</sub> SIP Requirements Rule permits states to submit separate precursor demonstrations to exclude sources of a particular precursor from control requirements under either the attainment plan or the NNSR program. Consistent with the statute, section 51.1006 of EPA’s regulations states that a precursor demonstration must show that sources “do not contribute significantly to PM<sub>2.5</sub> levels that exceed the standard in the area.”<sup>10</sup>

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<sup>10</sup> See PM<sub>2.5</sub> SIP Requirements Rule, 81 FR 58010 (August 24, 2016). Page 58018 states: “Even though CAA section 189(e) only explicitly contemplates exceptions to control requirements for PM<sub>2.5</sub> precursors from major stationary sources in nonattainment areas, the EPA believes that by analogy it has authority to promulgate regulations that allow states to determine that it is not necessary to regulate PM<sub>2.5</sub> precursors from other sources in nonattainment areas as well, under appropriate circumstances.”

The phrase “contribute significantly” and the included terms “contribute” and “significantly” are not defined in section 189, section 302 or any other part of the CAA. EPA’s regulations likewise do not include a definition of the term “contribute significantly.”<sup>11</sup>

The United States Court of Appeals for the District of Columbia Circuit (D.C. Circuit) has observed that the term “contribute” is ambiguous. *Catawba County, N.C. v. EPA*, 571 F.3d 20, 38-39 (D.C. Cir. 2009). In this case, the court considered the use of this term in section 107(d) of the CAA, which governs EPA actions to designate specific areas as in attainment or nonattainment with the NAAQS. Under this provision, a nonattainment area must include any area that does not meet the NAAQS or “that contributes to ambient air quality in a nearby area that does not meet” the NAAQS. The petitioners argued that the EPA was required to interpret the word “contribute” in this context to require a “significant causal relationship” in order to include a nearby area in a nonattainment area. The petitioners also argued that the EPA must establish a quantified amount of impact that qualifies as a contribution before the EPA could include a nearby area in a nonattainment area. *Id.* The court held that “section 107(d) is ambiguous as to how EPA should measure contribution and what degree of contribution is sufficient to deem an area nonattainment.” Consequently, the court held that EPA was not compelled to apply the petitioners’ preferred meaning of the term “contribute” in the context of section 107(d). The court recognized that the EPA had the discretion to interpret the term “contribute” in section 107(d) of the Act to mean “sufficiently contribute” and that EPA could use a multi-factor test, rather than a quantified threshold, to determine when a nearby area contributed to nonattainment.

Section 189(e) is one of several provisions in the CAA that uses the term “contribute,” or similar forms of this term. The reasoning of the *Catawba County* opinion supports the view that EPA has the discretion under section 189(e) to exercise judgment to determine the degree of impact that “contributes” to adverse air quality conditions based on the particular context in which the term “contribute” is used in the Act. *See*, 571 F.3d at 39. Furthermore, this opinion supports EPA’s discretion to identify qualitative or quantitative criteria or factors that may be used to determine whether something “contributes,” as long as the Agency provides a reasoned basis to justify using such criteria or factors to represent a “contribution.”

Although there is ambiguity regarding the degree of impact that “contributes” to an air quality condition, Congress has provided at least some direction regarding the degree of contribution that is required under section 189(e) of the Act. In this provision, Congress included the term “significantly” after the word “contributes.” This indicates that Congress intended to exempt sources of PM<sub>2.5</sub> precursor emissions from control

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<sup>11</sup> EPA’s New Source Review Permitting regulations contain a definition of the term “significant,” but this definition does not modify the term “contribute” and applies in a different context. *See e.g.*, 40 CFR 51.166(b)(2), (b)(23), (j)(2)-(3).

requirements where there is an impact greater than a simple contribution, but how much greater is not specified.

The D.C. Circuit has also observed that the term “significant” is ambiguous and may be subject to different meanings in different contexts. *Michigan v. EPA*, 213 F.3d 663, 677- (D.C. Cir. 2000). In this case, the court considered the use of this term in section 110(a)(2)(D)(i)(I) of the CAA, which requires state plans to prohibit those emissions which “contribute significantly” to nonattainment of a NAAQS in a downwind state. The EPA defined the amount of emissions from each state that “contribute significantly” to nonattainment as those emissions exceeding a specified threshold and which could be reduced using “highly cost-effective controls.” *Id.* at 675. petitioners challenged the EPA’s reliance on cost-effectiveness to define the level of upwind state contribution that qualified as “significant.” petitioners presented conflicting arguments to the court as to whether the statute permitted any consideration of cost, and, as such, the court determined that it could therefore discern no clear congressional intent to preclude the consideration of cost. *Id.* at 676-77. The court explained that “[t]he term ‘significant’ does not itself convey a thought that significance should be measured only in one dimension – here, in the petitioners’ view, health alone.” *Id.* at 677. Rather, the court explained that the meaning of “significant” may depend on its context and can, in some contexts, “beg a consideration of costs.” *Id.* Thus, the court held that “nothing in the text, structure, or history of [section] 110(a)(2)(D) . . . bars EPA from considering costs in its application.” *Id.* at 679. Consistent with the reasoning in *Michigan*, the use of the term “significant” in section 189(e) is ambiguous and is subject to a reasonable interpretation based on the context of the term’s use. Thus, it is within the Agency’s discretion to identify additional qualitative or quantitative criteria or factors to determine whether a contribution is “significant,” as long as the Agency provides a reasoned basis to justify using such additional criteria or factors.

## 2.2 Criteria for Identifying an Insignificant Contribution

This guidance document on precursor demonstrations for the PM<sub>2.5</sub> SIP Requirements Rule describes the factors that the EPA recommends that states consider when seeking to demonstrate that sources of a particular precursor “do not contribute significantly” to PM<sub>2.5</sub> levels that exceed the NAAQS, for the specific purpose of attainment plan and NNSR program implementation for nonattainment areas. These factors include quantitative “contribution” values that are described in the 2016 EPA document, “Technical Basis for the EPA’s Development of Significant Impact Thresholds for PM<sub>2.5</sub> and Ozone” (EPA, 2016a), hereafter, referred to as the “Technical Basis Document.”

The EPA first began developing these values for use in the PSD permitting program to implement section 165(a)(3) of the CAA, which requires that an applicant for a PSD permit demonstrate that the proposed source will not “cause or contribute” to a violation of any NAAQS or PSD increment. The statistical methods and analysis detailed in the Technical Basis Document focus on using the concept of statistical significance to identify levels of change in air quality concentrations that can be considered to

represent a contribution to air quality degradation. The EPA believes the values derived through this method may be used as quantified levels of air quality change that “cause or contribute” to an exceedance of the NAAQS. Conversely, an impact below any such level may be viewed as an impact that does not contribute to an exceedance of the NAAQS.

Since section 189(e) also uses the term “contribute,” these values have relevance in this context also. However, as discussed above, in section 189(e) the term “contribute” is modified by the term “significantly.” As a result, the EPA believes that other factors should be considered in determining the degree of air quality impact that “contributes significantly” to PM<sub>2.5</sub> levels that exceed the applicable NAAQS. Under the PM<sub>2.5</sub> SIP Requirements Rule, the significance of a precursor’s contribution is to be determined “based on the facts and circumstances of the area.”<sup>12</sup>

The concept of statistical significance and insignificance is well established, with a basis in commonly accepted scientific and mathematical theory. The Technical Basis Document notes that the statistical methods and data reflected in that analysis may be applicable for multiple regulatory applications where EPA seeks to identify a level of change in air quality that is either significant or insignificant. As described below, a precursor demonstration for a PM<sub>2.5</sub> SIP is an example of a regulatory application for which the EPA believes it is appropriate to rely on the Technical Basis Document analysis and associated thresholds to first determine whether there is a “contribution” before looking at other factors to determine if the contribution is significant.

The Technical Basis Document describes that compliance with the NAAQS is determined by comparing the measured “design value” (DV) at an air quality monitor to the level of the NAAQS for the relevant pollutant.<sup>13</sup> The EPA believes that an insignificant level of change in ambient air quality can be defined and quantified based on characterizing the observed variability of ambient air quality levels. The Technical Basis Document analysis has been designed to take into account the ambient data used to determine DVs for both the annual and 24-hour PM<sub>2.5</sub> NAAQS. The EPA’s technical approach, referred to as the “Air Quality Variability” approach, relies upon the fact that there is spatial and temporal variability in the observed ambient data and then uses statistical theory and methods to identify a level of change in DVs that is not statistically discernible from the original DV, thereby representing an “insignificant” change in air quality.

Based on these observed ambient data, the EPA’s technical analysis has determined the changes in air quality levels of PM<sub>2.5</sub> that may be considered an insignificant impact through applying a well-established statistical technique known as bootstrapping. Bootstrapping is a method that allows one to determine the accuracy of sample

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<sup>12</sup> 40 CFR 51.1006.

<sup>13</sup> A design value is a statistic that describes the air quality status of a given location to be compared to the level of the NAAQS. More information may be found at <https://www.epa.gov/air-trends>.

statistics (e.g., mean, percentiles) for a population of data (Efron, 1979; Efron, 2003). The bootstrap approach applied in the Technical Basis Document uses a non-parametric, random resampling with replacement, which recreates the sample dataset (e.g., in this case, the ambient data underlying the DVs), resulting in many resampled datasets. This approach allows one to determine measures of accuracy of sample statistics based on these resampled datasets when the underlying distribution of the statistic is not known (Efron, 1993).

The bootstrap technique, as applied in the Air Quality Variability analysis, quantifies the degree of air quality variability in an area and then allows one to determine appropriate confidence intervals (CIs), *i.e.*, statistical measures of the variability associated with the monitor-based DVs, to inform the degree of air quality change that can be considered “insignificant.” This approach for quantifying a degree of impact that contributes to PM<sub>2.5</sub> air quality is fundamentally based on the idea that an anthropogenic perturbation of air quality that is within a specified range may be considered indistinguishable from the inherent variability in the measured atmospheric concentrations and is, from a statistical standpoint, *insignificant* at the given confidence level.

Specifically, the analysis uses 15 years (2000-2014) of nationwide ambient PM<sub>2.5</sub> measurement data to generate a large number of resampled datasets for PM<sub>2.5</sub> DVs at each monitor. These resampled datasets were used to determine statistical CIs that provide a measure of the inherent variability in air quality at the monitor location. This variability may be driven by the frequency of various types of meteorological and/or emissions conditions affecting a particular location. The analysis estimates a range of CIs for each monitor; the 50 percent CI was selected to quantify the level of air quality change that can be considered “statistically insignificant” for the purposes of meeting requirements under the Prevention of Significant Deterioration (PSD) program. The Technical Basis Document explains the analysis design and describes how the results are applicable to Significant Impact Levels (SILs) in the PSD program.

We believe the Air Quality Variability analysis described in the Technical Basis Document is also suitable for determining in the first instance whether emissions of a PM<sub>2.5</sub> precursor “contribute” to PM<sub>2.5</sub> levels that exceed the NAAQS, as part of a precursor demonstration under the PM<sub>2.5</sub> SIP Requirements Rule. The concept of insignificance as expressed in the Technical Basis Document is that an anthropogenic perturbation of air quality that is less than the inherent variability in the measured atmospheric concentration is, from a statistical standpoint, insignificant. The insignificant impact analysis is a general statistical analysis of ambient air quality variability. It is not dependent on the source of the anthropogenic perturbation (e.g., single point source, versus multiple sources across an area). The analysis is based on ambient data measurements, which are driven by the variability in meteorology and emissions from *all* sources. This includes near source and long range impacts from single sources and groups of sources (including major stationary sources, cars, minor sources, etc.). Accordingly, this statistical insignificance concept is equally appropriate to apply in a number of circumstances (e.g., PSD and attainment plans). In this case, the statistical

analysis is directly applicable to precursor demonstrations that attempt to show that a particular perturbation in anthropogenic emissions does not contribute significantly to PM<sub>2.5</sub> levels which exceed the standard in the area. This includes both comprehensive demonstrations (examining the impacts from all emissions sources) and major stationary source demonstrations (examining the impacts from only major stationary sources).

As noted above, the 50 percent CI was selected to quantify the level of air quality change that can be considered “statistically insignificant” for the purposes of meeting requirements under the PSD program. The 50 percent level was chosen as a conservative (low) level, below which would clearly represent an insignificant impact<sup>14</sup> on air quality. We believe the same logic applies to identifying an impact that “contributes” in the context of precursor demonstrations and therefore we recommend use of the same 50 percent CI (and numerical thresholds) for precursor demonstrations. The threshold can be considered a value below which air quality impacts (from both emissions decreases and increases) are insignificant, and thus to do not “contribute” to PM<sub>2.5</sub> concentrations that exceed the standard.

In addition, the statistical insignificance analysis calculates the inherent variability in the ambient data both above and below the median observed concentrations. In this way, the variability analysis is equally applicable to examining the impact of both emissions *increases* (which would generally lead to higher observed or modeled concentrations) and emissions *decreases* (which would generally lead to lower observed or modeled concentrations), relative to a base case.

The Technical Basis Document recommends specific concentration values that represent the change in PM<sub>2.5</sub> air quality that can serve to quantify air quality impacts that “contribute” to PM<sub>2.5</sub> concentrations in each area. Consistent with the Technical Basis Document analysis, the EPA recommends using the following values for this purpose, as part of an optional precursor demonstration under the PM<sub>2.5</sub> SIP Requirements Rule:

- 0.2 µg/m<sup>3</sup> for the annual PM<sub>2.5</sub> NAAQS, and

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<sup>14</sup> In this context, EPA is purposefully using the term “impact” and intends for this term to have a meaning that is distinct from “contribution.” Our reason for drawing this distinction is to promote clarity when applying the results of this statistical analysis within the context of statutory provisions that use the terms “contribute” and “contribute significantly.” Consistent with the application of the Technical Basis Document in the PSD context, this memorandum uses the term “significant impact” to describe a degree of change in air quality that EPA’s statistical analysis shows to be more than “negligible” or “trivial” and thus can be regarded as an impact that “contributes” to air quality concentrations. Given that Congress gave more specific direction that we consider whether precursor emissions “contribute significantly” in the context of section 189(e), we have endeavored in this guidance to use the term “contribute significantly” or “significant contribution” only when discussing whether the criteria in section 189(e) for a precursor exemption has been satisfied.

- 1.3  $\mu\text{g}/\text{m}^3$  for the  $\text{PM}_{2.5}$  24-hour NAAQS.

The EPA believes that these recommended thresholds are appropriate guidelines for identifying an air quality change that is “insignificant” and thus does not “contribute” to  $\text{PM}_{2.5}$  concentrations subject to the current  $\text{PM}_{2.5}$  NAAQS.<sup>15</sup>

Depending on the type of precursor demonstration conducted, the “perturbation” in air quality can be represented in different ways: as the precursor’s impact on ambient  $\text{PM}_{2.5}$  levels due to emissions from all sources or all major stationary sources in the nonattainment area; a decrease in precursor emissions from all sources or all major stationary sources in the nonattainment area; or, in the case of a NNSR demonstration, as an increase in precursor emissions from major stationary sources. As explained above, the thresholds should be appropriate for interpreting the significance of the perturbation for each of these analyses, regardless of whether the evaluation involves the impact of one or more new sources intending to locate in the nonattainment area, or examining the combined impact on  $\text{PM}_{2.5}$  concentrations from multiple existing sources of emissions.

### 2.3 Locations at Which to Evaluate Air Quality Changes

For the comprehensive or major stationary source precursor demonstrations, the EPA believes that air quality changes of concern should be evaluated at existing or relevant historical  $\text{PM}_{2.5}$  monitor locations (*i.e.*, as part of an air quality modeling analysis) because it is at those locations where NAAQS compliance will be determined. The evaluation of air quality changes at monitor locations for attainment plan precursor demonstrations is consistent with the  $\text{PM}_{2.5}$  SIP Requirements Rule’s treatment of monitor locations for modeled attainment demonstrations for  $\text{PM}_{2.5}$  nonattainment areas.<sup>16</sup>

For an NNSR precursor demonstration, the EPA believes that the analysis should evaluate the potential air quality change from potential future major sources in generally all parts of the nonattainment area (*i.e.*, all grid cells in an air quality modeling analysis) rather than just at monitor locations. The reason for this is that the overall objective of the NNSR program is to prevent future violations. While a monitor-based analysis makes sense for nonattainment area planning, where the existing  $\text{PM}_{2.5}$

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<sup>15</sup> As described in the Technical Basis Document, the monitoring site variability is first calculated as a percentage of the measured  $\text{PM}_{2.5}$ . Then the median percent variability from all sites is multiplied by the level of the NAAQS to get the threshold concentrations. Therefore, these thresholds represent a percentage of the 2006 24-hour NAAQS (35  $\mu\text{g}/\text{m}^3$ ) and the 2012 annual NAAQS (12  $\mu\text{g}/\text{m}^3$ ). Different thresholds may be applicable to other levels and/or forms of the NAAQS (either past or future).

<sup>16</sup> See  $\text{PM}_{2.5}$  SIP Requirements Rule at 81 FR 58051.

ambient monitoring network is designed to represent air quality based on the geographic orientation and magnitude of existing sources, this contrasts with NNSR, where new major stationary sources might locate in parts of the nonattainment area that are not currently well represented by the current monitoring network. It is therefore important to examine the sensitivity of the entire nonattainment area to potential increases in precursor emissions to support a request to exempt sources of that precursor from NNSR permitting. This recommendation is consistent with how new major sources are treated in modeling analyses required to be conducted for the PSD program (USEPA, 2014a).

## 2.4 Considering Additional Information

An approvable precursor demonstration must show that the air quality change at all relevant locations (as described above) does not “contribute significantly” to PM<sub>2.5</sub> levels that exceed the standard. The EPA generally expects that a precursor demonstration will be adequate to support exempting sources of a precursor from control requirements if the analysis shows that the air quality impact at all relevant locations does not exceed the recommended contribution thresholds in the Technical Basis Document (i.e., 0.2 µg/m<sup>3</sup> for the annual PM<sub>2.5</sub> NAAQS, and 1.3 µg/m<sup>3</sup> for the PM<sub>2.5</sub> 24-hour NAAQS).

If the estimated air quality impact exceeds the recommended contribution thresholds in the Technical Basis Document, this fact does not necessarily preclude approval of the precursor demonstration. There may be cases where it could be determined that precursor emissions have an impact above the recommended contribution thresholds, yet do not “significantly contribute” to levels that exceed the standard in the area (pursuant to section 189(e)). Under the PM<sub>2.5</sub> SIP Requirements Rule, the significance of a precursor’s contribution is to be determined “based on the facts and circumstances of the area.”

Air agencies may thus provide the EPA with information related to other factors they believe should be considered in determining whether the contribution of emissions of a particular precursor to levels that exceed the NAAQS is “significant” or not. Such factors may include: the amount by which a precursor’s contribution exceeds the recommended contribution thresholds; the severity of nonattainment at relevant monitors and/or grid cell locations in the area; source characteristics (*e.g.*, source type, stack height, location); anticipated growth or loss of sources; analyses of speciation data and precursor emission inventories; chemical tracer studies; special intensive measurement studies to evaluate specific atmospheric chemistry in an area; and trends in ambient speciation data and precursor emissions.

The air agency may provide other information not listed here as well. Any air agency providing additional information should provide a clear rationale explaining how such

information supports their claim that the precursor does or does not contribute significantly to PM<sub>2.5</sub> levels that exceed the standard. The EPA will consider such additional information in its review of the precursor demonstration.

## Technical Guidance

### 3.0 Concentration-Based Analysis

PM<sub>2.5</sub> precursor demonstrations are only required for air agencies wishing to exclude pollutants from PM<sub>2.5</sub> precursor nonattainment requirements. If an air agency chooses to perform a precursor demonstration for an attainment plan (either a comprehensive or major stationary source analysis), the final rule requires that the demonstration must include a concentration-based analysis.<sup>17</sup> This demonstration can consist of analyses using ambient data or it could optionally include air quality modeling. The goal of the comprehensive plan analysis is to examine the overall impact on PM<sub>2.5</sub> air quality in the nonattainment area as a result of emissions of a particular precursor from all existing sources (including point, mobile, and area sources). A major stationary source analysis should examine the overall impact on PM<sub>2.5</sub> air quality as a result of emissions of a particular precursor from all existing major stationary sources.

The recommended starting point for such an analysis is an evaluation of all available ambient air quality monitoring data for the area (and possibly nearby areas). The EPA recommends an examination of total PM<sub>2.5</sub> data (in the form of Federal Reference Method (FRM) measurements, Federal Equivalent Methods (FEM) measurements, Interagency Monitoring of Protected Visual Environments (IMPROVE) data, and/or other special study or research data), and ambient PM<sub>2.5</sub> speciation data which characterizes the composition of total mass. PM<sub>2.5</sub> species data are critical for this analysis, since they allow for an accounting of ambient secondary PM<sub>2.5</sub> concentrations and provide a way to link precursor emissions to secondary PM<sub>2.5</sub> components. See details on PM<sub>2.5</sub> species components and accounting for the various measured species in Section 3.1, below.

#### 3.1 Ambient Data Analysis of Secondarily-Formed PM<sub>2.5</sub>

PM<sub>2.5</sub> is a complex and highly variable mixture, but the majority of PM<sub>2.5</sub> mass is comprised of five constituents: (i) organic matter (OM); (ii) elemental carbon (EC); (iii) crustal material; (iv) ammonium sulfate ((NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>); and (v) ammonium nitrate (NH<sub>4</sub>NO<sub>3</sub>) (Hand, 2012) (Seinfeld, 2006). In general, EC and crustal PM<sub>2.5</sub> are considered “primary” components (*i.e.*, they are emitted directly from sources and are not the product of chemical reactions of precursor gases in the atmosphere). Ammonium sulfate and ammonium nitrate are considered “secondarily formed” PM<sub>2.5</sub> components

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<sup>17</sup> See 40 CFR 51.1006(a)(1).

because they are the product of chemical reactions of precursor gases in the atmosphere.<sup>18</sup> OM can have both primary and secondary components. Since this guidance addresses precursors to secondary PM<sub>2.5</sub>, we will focus the discussion on the most common secondary PM<sub>2.5</sub> components.

A large number of possible chemical reactions, often non-linear in nature, can convert the gases SO<sub>2</sub>, NO<sub>x</sub>, VOC and ammonia to PM<sub>2.5</sub>. Thus, these gases are precursors to PM<sub>2.5</sub>. OM is the fraction of ambient PM<sub>2.5</sub> with the most diverse chemical composition, containing potentially thousands of different organic compounds (*i.e.*, those compounds containing carbon) composed primarily of carbon, hydrogen, oxygen and nitrogen. Both primary particles and secondary particles contribute to ambient OM concentrations. Secondary OM particle formation involves oxidation of both anthropogenic and biogenic (plant-derived) VOC, and can involve other, more complex chemical reactions. Sulfate (SO<sub>4</sub>), nitrate (NO<sub>3</sub>) and ammonium (NH<sub>4</sub>), react in the ambient air to form ammonium sulfate ((NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>) and ammonium nitrate (NH<sub>4</sub>NO<sub>3</sub>). If there is not enough ammonia in the ambient air to neutralize fully the available sulfate, ammonium bi-sulfate (NH<sub>4</sub>HSO<sub>4</sub>) or sulfuric acid (H<sub>2</sub>SO<sub>4</sub>) may also form. In addition, particle-bound water is often also associated with sulfate and nitrate PM<sub>2.5</sub>. A brief discussion of SO<sub>4</sub>, NO<sub>3</sub> and Secondary Organic Aerosol (SOA) formation, as well as the role of ammonia in their formation, follows.

### 3.1.1 Ammonium Sulfate

SO<sub>2</sub> is a gas-phase species emitted mostly from the combustion of fossil fuels (the largest source is coal combustion from electric utility boilers). When SO<sub>2</sub> oxidizes, it forms aerosol sulfuric acid. In the presence of ammonia, however, sulfuric acid will react to form ammonium sulfate [(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>], a less acidic compound and one of the five major components of PM<sub>2.5</sub>. If there is not enough ammonia present to fully neutralize the sulfuric acid, part of it may convert to ammonium bi-sulfate (NH<sub>4</sub>HSO<sub>4</sub>), which is more acidic than ammonium sulfate [(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>], but less so than sulfuric acid. All three products [H<sub>2</sub>SO<sub>4</sub>, NH<sub>4</sub>HSO<sub>4</sub>, and (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>] solely reside as particle-phase (or aqueous-phase) species in the atmosphere. There is a large amount of emerging scientific evidence that SO<sub>2</sub> may also contribute to the formation of SOA from biogenic VOC emissions (*see* section later on SOA). Sulfate levels in the ambient air peak in summer months due to increased SO<sub>2</sub> emissions, generally from electric generating units (EGUs), and from meteorological conditions that are conducive to sulfate formation.

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<sup>18</sup> There is a small primary component to both sulfate and nitrate ions, but the vast majority of measured sulfate and nitrate is secondary in nature.

### 3.1.2 Ammonium Nitrate

The main sources of oxides of nitrogen ( $\text{NO}_x$ ) emissions are combustion of fossil fuel in boilers (e.g., electric utility boilers) and internal combustion engines (e.g., cars and trucks).  $\text{NO}_x$  reacts in the atmosphere to form nitric acid. Nitric acid converts to ammonium nitrate, one of the five main components of  $\text{PM}_{2.5}$ , in the presence of ammonia. Low temperatures and high relative humidity create ideal conditions for the formation of ammonium nitrate, typically leading to higher atmospheric levels in winter months and lower levels in summer months (Hand, 2012). At high temperatures and low relative humidity, particulate nitrate (most commonly in the form of ammonium nitrate) converts back into its component species of nitric acid ( $\text{HNO}_3$ ) and ammonium ion ( $\text{NH}_4$ ). Therefore, nitrate ion ( $\text{NO}_3$ ) cannot exist in particulate form without being neutralized by ammonia or another neutralizing cation.<sup>19</sup> Similarly, ammonia would not exist in particle form if not for the presence of acidic species (sulfate or nitrate) with which it can combine to form a particle.

### 3.1.3 SOA

VOCs (both anthropogenic and biogenic) are key precursors to the SOA component of  $\text{PM}_{2.5}$ . The relative importance of these compounds in the formation of organic particles varies between geographic areas, depending upon local emission sources, atmospheric chemistry and season of the year. It should be further noted that not all inventoried VOC might be contributing to the formation of organic particles. For example, chemical reactions involving VOC are generally accelerated in warmer temperatures, and for this reason, studies show that SOA typically comprises a higher percentage of  $\text{PM}_{2.5}$  in the summer than in the winter (Pandis, 1992).

Anthropogenic sources of VOC include mobile sources, petrochemical manufacturing, oil and gas emissions and solvents (USEPA, 2016b). In addition, some biogenic VOC, emitted by vegetation, such as trees, can contribute significantly to SOA formation, especially in heavily forested areas, such as the Southeast U.S. It should be noted, however, that anthropogenic impacts on SOA are likely highest in the wintertime when biogenic SOA levels are lower; conversely, in the summertime, the influence of biogenic emissions on SOA is likely higher (Carlton, 2010a). Despite significant progress that has been made in understanding the origins and properties of SOA, it remains the least understood component of  $\text{PM}_{2.5}$  and continues to be a significant topic of research and investigation.

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<sup>19</sup> If ammonia is not available, nitric acid can also be neutralized by calcium (Ca) or sodium (Na) (if available) to form calcium nitrate [ $\text{Ca}(\text{NO}_3)_2$ ] and sodium nitrate ( $\text{NaNO}_3$ ), respectively. Unlike ammonium nitrate,  $\text{Ca}(\text{NO}_3)_2$  and  $\text{NaNO}_3$  do not convert back to the gas phase at higher temperatures.

### 3.1.4 Role of NO<sub>x</sub> and SO<sub>2</sub> in Secondary PM Chemistry

In addition to the influencing secondary particulate nitrate formation, NO<sub>x</sub> also reacts with anthropogenic and biogenic VOC to enhance the secondary formation of sulfate and organic compounds that make up SOA (Carlton, 2010b). NO<sub>x</sub> is thus involved in all secondary PM chemistry, not just in particulate nitrate formation. Similarly, recent research has indicated that SO<sub>2</sub> can impact SOA formation (Surrat, 2010). One recent study found that chemical reactions involving SO<sub>2</sub> and NO<sub>x</sub> combined may be responsible for up to 70% of the total measured organic aerosol in the Southeast U.S. in the summer (Xu, 2015). Consequently, when NO<sub>x</sub> or SO<sub>2</sub> emissions are decreased or increased in the atmosphere, there can be effects on all secondary PM<sub>2.5</sub> species, including ammonium ion, nitrate ion, sulfate ion, and SOA.

### 3.1.5 Assigning PM<sub>2.5</sub> Species to Precursors - Summary

Ambient PM<sub>2.5</sub> species data are generally measured and reported as OM, EC, crustal, nitrate, sulfate, and ammonium. For the purpose of precursor demonstrations, elemental carbon and crustal PM<sub>2.5</sub> can be ignored (since they are primary species). One basic way of developing a concentration-based analysis for a particular precursor is to calculate the portion of the total PM<sub>2.5</sub> mass measured at the relevant location that is associated with the precursor. The EPA's default recommendation for "assigning" the measured secondary PM<sub>2.5</sub> species to their respective precursors is shown in Table 1 below:

**Table 1. Default Recommended Assignment of PM<sub>2.5</sub> Precursors to PM<sub>2.5</sub> Species**

PM <sub>2.5</sub> Precursor	Recommended Assignment to PM <sub>2.5</sub> Species	Comment
NO <sub>x</sub>	Nitrate ion + portion of ammonium associated with nitrate	Include all measured nitrate ion plus the ammonium that is in the form of ammonium nitrate (do not include the ammonium attached to sulfate).
SO <sub>2</sub>	Sulfate ion	All measured sulfate ion.
NH <sub>3</sub>	Ammonium + nitrate ion	Include all measured ammonium and nitrate ion.
VOC	SOA	Estimate the secondary component of OM. This can be further disaggregated into the impact on SOA from anthropogenic VOC sources.

Further explanation of the recommended assignments outlined in Table 1 is provided as follows:

- **NO<sub>x</sub>** - the default recommendation assigns measured nitrate to NO<sub>x</sub> as well as the portion of ammonium that is attached to nitrate in the form of ammonium nitrate. When considering the impact of NO<sub>x</sub> on PM<sub>2.5</sub>, NO<sub>x</sub> directly influences the formation of ammonium nitrate. However, nitrate ion cannot exist in the atmosphere as a particle without being neutralized by ammonia (it would exist as a gas in the form of nitric acid). Therefore, the ammonium portion of ammonium nitrate should also be counted when evaluating whether NO<sub>x</sub> contributes to PM<sub>2.5</sub> mass.
- **SO<sub>2</sub>** - The default recommendation assigns measured sulfate to SO<sub>2</sub>. Note that the ammonium attached to sulfate (mostly in the form of ammonium sulfate) is not counted toward the SO<sub>2</sub> impact on PM<sub>2.5</sub> mass because sulfate can exist in the atmosphere as a particle in the form of sulfuric acid even if it is not neutralized by ammonia.
- **NH<sub>3</sub>** - The default recommendation assigns all measured ammonium to NH<sub>3</sub> as well as the entire nitrate ion mass. This is for the same reason that part of ammonium is assigned to NO<sub>x</sub>. Ammonium nitrate cannot exist in the atmosphere as a particle without being neutralized by ammonia. Therefore, if no ammonia were present, nitrate would exist only as a gas (in the form of nitric acid). As a result, all of the mass of ammonium nitrate should also be counted towards ammonia's impact on PM<sub>2.5</sub> mass.<sup>20</sup>
- **VOC** - The default recommendation assigns measured SOA to VOC. The most conservative assumption is to assume that all of the measured organic aerosol mass is SOA.<sup>21</sup> However, SOA is only a portion of measured organic mass and is not directly measured. Therefore, in some cases, the SOA portion can be estimated through data analysis techniques (Cabada, 2004; Saylor, 2006; Lewandowski, 2008; and Rutter, 2014). In some areas, a high percentage of SOA originates from biogenic sources (especially in the summer). Therefore, if SOA is estimated as a percentage of total organic mass, the SOA concentration can be

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<sup>20</sup> If an air agency submits precursor demonstrations for both ammonia and NO<sub>x</sub>, the nitrate component should be counted towards the contribution of both precursors to ambient PM<sub>2.5</sub> levels. This is appropriate since particulate ammonium nitrate formation is dependent on having both nitric acid (from NO<sub>x</sub>) and ammonia available.

<sup>21</sup> The measured organic carbon should be multiplied by an appropriate factor (typically 1.4 to 1.8) to convert from organic carbon to organic mass (which includes additional mass attached to the carbon).

further refined by estimating the portion of SOA that is a result of anthropogenic VOC emissions.<sup>22</sup>

The default recommendations above are the simplest and most straightforward assignment of precursors to species. However, other methods may be used to estimate alternative PM<sub>2.5</sub> concentration apportionment. For example, the PM<sub>2.5</sub> attainment demonstration modeling guidance recommends the use of the “sulfate, adjusted nitrate, derived water, inferred carbonaceous material balance approach” (SANDWICH) (Frank, 2006) to adjust measured PM<sub>2.5</sub> species data to match better the total PM<sub>2.5</sub> mass, which is measured on FRM filters. The FRM mass, which is compared to the NAAQS to determine attainment/nonattainment, suffers from various artifacts, which can affect the concentration of some PM<sub>2.5</sub> species collected on Teflon filters. For example, organic mass experiences both positive and negative artifacts, and nitrate mass is generally lower (negative artifact) on FRM filters compared to species measurements, due to temperature and humidity influences. In addition, the SANDWICH technique estimates particle bound water mass, which is attached to both sulfate and nitrate particles. The water mass should be counted in assessing a contribution to PM<sub>2.5</sub> because it is collected on the filter and counted as PM mass that is part of total PM<sub>2.5</sub>. In addition to SANDWICH, there may be other technically credible adjustments that can be applied to measured species data, depending on the nature of the species, the area of the country, and the season in which the measurement occurs. All adjustments to ambient data should be discussed with the EPA Regional office and carefully documented and explained.

### 3.1.6 Evaluating Concentration Based Analysis Results

The estimated impact on PM<sub>2.5</sub> mass from a specific precursor should be compared to the recommended “contribution” thresholds for the annual average and/or 24-hour NAAQS that were identified in Section 2.2.

### 3.1.7 Additional Information

In addition to ambient PM<sub>2.5</sub> species data, other information can be used to support the concentration-based analyses. Emissions inventory data for the nonattainment area can help support claims that a precursor does not contribute significantly to PM<sub>2.5</sub> concentrations in the nonattainment area, particularly when emissions of the precursor are small. Other considerations in the demonstration can be the size of the nonattainment area, the population of the nonattainment area, geographical considerations (such as an isolated mountain valley area), meteorological

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<sup>22</sup> Due to the difficulty in calculating SOA and the contribution of VOC to ambient PM<sub>2.5</sub> data, air quality modeling may be the most straightforward way to determine the VOC contributions (see Section 5).

considerations, etc. The default recommendation is to compare the measured ambient PM<sub>2.5</sub> species data to the relevant air quality “contribution” threshold. However, there are other techniques that can be used to attempt to further account for the impact of sources in the nonattainment area on ambient data concentrations. Analyses to support the disaggregation of ambient data into the local nonattainment area impact should be as detailed as possible, focused on the precursor(s) of interest in the demonstration, and discussed with the appropriate EPA Regional office. Note also that air quality modeling is the most technically credible way to calculate the concentration of PM<sub>2.5</sub> mass due to emissions sources from within the nonattainment area. See Section 3.2 below for more details.

### 3.2 Air Quality Modeling

Air quality modeling can also be used to quantify the impact of precursors on PM<sub>2.5</sub> concentrations in a nonattainment area. In general, air quality modeling is resource intensive, but it is the most direct method to capture the non-linear and complicated associations between PM<sub>2.5</sub> precursors and PM<sub>2.5</sub> concentrations. For example, in the ambient data analysis section above, we delineated many caveats and assumptions that need to be considered when estimating the impact of precursor emissions on measurements of specific PM<sub>2.5</sub> species. Many of those assumptions are not necessary when evaluating air quality modeling outputs (although there are different considerations and assumptions that are involved). A photochemical grid model takes into account the complicated chemical interactions among precursors and tracks the individual species concentrations, including species like SOA<sup>23</sup>, which cannot be directly measured. Photochemical modeling also allows a more precise accounting of impacts from precursor emissions in the nonattainment area. In addition, since air quality modeling is both a statutory and regulatory requirement for Moderate and Serious PM<sub>2.5</sub> attainment demonstrations,<sup>24</sup> most nonattainment areas will have photochemical air quality modeling available to support their modeled attainment demonstration.

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<sup>23</sup> Photochemical modeling of SOA is generally more uncertain than the other PM<sub>2.5</sub> components. SOA formation is not yet fully understood mechanistically and therefore cannot yet be reliably modeled. Because we lack reliable tools for distinguishing between primary and secondary organic aerosol in the ambient air and have even less confidence that models can reliably simulate SOA formation, it is difficult to validate a modeled conclusion that VOC precursor emissions have an insignificant contribution to PM<sub>2.5</sub>. Therefore, especially in the case of VOC as a precursor, additional evidence should be submitted to help validate modeling results. Additional information could include ambient data analyses, special study data and research, and detailed emissions information (for example, VOC speciation data showing that the makeup of the nonattainment area VOC emissions are not likely to form SOA).

<sup>24</sup> See CAA section 189(a)(1)(B), CAA section 189(b)(1)(A), 40 CFR 51.1009(a)(4) and 40 CFR 51.1010(a)(5).

Air agencies have several choices to analyze modeled air quality impacts of precursor emissions on PM<sub>2.5</sub> as part of a concentration-based analysis. The simplest approach would be to perform brute force “zero-out” model runs which involves at least two model runs; one “baseline” run with all emissions, and one with anthropogenic emissions of the precursor of interest removed from the nonattainment area in the original baseline simulation (Cohan et al., 2005). The difference between these simulations provides an estimate of the air quality change due to the precursor emissions.

An alternative approach to isolating precursor impacts in photochemical grid models is “photochemical source apportionment.” Some photochemical models have been developed with a photochemical source apportionment capability, which tracks emissions from specific sources or groups of sources and/or source regions through chemical transformation, transport, and deposition processes to estimate the apportionment of predicted PM<sub>2.5</sub> species concentrations (Kwok et al., 2015; Kwok et al., 2013). Source apportionment (ENVIRON, 2016; Kwok et al., 2015; Kwok et al., 2013; Wang et al., 2009) has been implemented in modeling systems such as the Comprehensive Air Quality Model with Extensions (CAMx) (ENVIRON, 2016) and the Community Multiscale Air Quality (CMAQ) (Byun and Schere, 2006).

### 3.2.1 Evaluating Modeling Results

The calculated impact of the precursor on total PM<sub>2.5</sub> concentrations should be compared to the “contribution” thresholds for annual and 24-hour PM<sub>2.5</sub> identified in Section 2.2. See Section 5 for more details on the choice of models, model setup, and post-processing of the model results.

## 4.0 Sensitivity Based Analysis

The PM<sub>2.5</sub> SIP Requirements Rule also allows for an optional “sensitivity-based” analysis for attainment plan demonstrations.<sup>25</sup> This modeling analysis examines the sensitivity of ambient PM<sub>2.5</sub> concentrations in the nonattainment area to certain amounts of decreases in the precursor emissions in the area. This type of optional analysis is only necessary if the concentration-based analysis described above does not adequately demonstrate insignificant impacts to PM<sub>2.5</sub> concentrations in the nonattainment area. By performing a sensitivity analysis, it may still be possible for an air agency to demonstrate adequately that any precursor contribution is insignificant. Where decreases in emissions of the precursor result in negligible air quality impacts (*i.e.*, the area is “not sensitive” to decreases), such a small degree of impact is not significant and can be considered to not “contribute” to PM<sub>2.5</sub> concentrations for the purposes of determining whether control requirements should apply. Accordingly, the EPA expects

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<sup>25</sup> See 40 CFR 51.1006(a)(1)(ii) and 40 CFR 51.1006(a)(2)(ii).

that it will approve a precursor demonstration if it can be adequately shown that the area is not sensitive to precursor emissions reductions. Note that the sensitivity analysis described in this section is only applicable to evaluating emissions reductions as part of the attainment plan part of the SIP. A similar but distinct sensitivity analysis is applicable to NNSR precursor demonstrations, but addresses sensitivity to precursor emissions *increases* rather than decreases (see section 6 for more details on NNSR precursor demonstrations).

A sensitivity-based analysis demonstrates the degree to which concentrations in the nonattainment area are sensitive to decreases of a precursor. Changes in PM<sub>2.5</sub> concentrations at a particular location often will not be linear with respect to changes in PM<sub>2.5</sub> precursor emissions. As previously discussed, several PM<sub>2.5</sub> components are secondarily formed in the atmosphere as the result of chemical reactions between various PM<sub>2.5</sub> precursors. In some nonattainment areas, one precursor may be abundant while a second precursor, with which it primarily reacts, may be less abundant. In such cases, a modeled sensitivity analysis may find that PM<sub>2.5</sub> concentrations in the area are relatively insensitive to emissions reductions of the more abundant precursor.

#### 4.1 Modeling for Sensitivity Demonstrations

Precursor demonstrations analyze the relationship between precursor emissions and the formation of secondary PM<sub>2.5</sub> components. Air quality models are the most appropriate tool to be able to predict the impact of precursor emissions reductions on PM<sub>2.5</sub> concentrations. Since PM<sub>2.5</sub> precursors form secondary PM<sub>2.5</sub> through chemical reactions, a chemical transport model (CTM) is best able to examine the sensitivity of precursor emissions to secondary PM<sub>2.5</sub> concentrations. See Section 5 for more details on CTMs.

As part of performing a sensitivity analysis, there are two additional questions that need to be addressed:

- 1) What amount of emissions reduction should be examined as part of a sensitivity analysis?
- 2) What air quality concentration threshold should be used to determine if the modeled air quality change from the precursor is insignificant?

##### 4.1.1 Emissions Reductions for Sensitivity Analyses

When deciding on the appropriate emissions reduction to model in a sensitivity analysis, it is important to consider the nature of the question being asked. In this case, the CAA and the PM<sub>2.5</sub> SIP Requirements Rule allow a demonstration to show that emissions of a precursor in the area do not contribute significantly to PM<sub>2.5</sub> levels that exceed the

standard in the area.<sup>26</sup> Given the emissions makeup and resultant interactions between precursors in the area, the pertinent question is whether PM<sub>2.5</sub> concentrations in the nonattainment area are “insensitive” to certain amounts of emissions reductions of the precursor. This question should not be confused with whether there are known available emissions reductions of a certain size within the nonattainment area. For example, an air agency may identify only a very small percentage precursor reduction from available controls. However, modeling the sensitivity of the area to that very small percentage reduction and then comparing it to EPA’s recommended thresholds does not effectively answer whether the area is sensitive to the precursor. The analysis should use a percentage emissions reduction (or a series of different percentage reductions model runs) that is large enough to provide a robust answer (given non-linearities due to complex secondary PM<sub>2.5</sub> chemistry).

The EPA recommends modeling a range of percentage emissions reductions for all sensitivity analyses. For attainment plan analyses of existing emissions sources, a fixed tonnage reduction of a precursor would not be appropriate since the number of tons of precursors in each nonattainment area may vary by orders of magnitude. Therefore, a percentage reduction is appropriate for this type of analysis because it allows for consistency between nonattainment areas and takes into consideration the amount of existing emissions of the particular precursor in each area.

The definition of the range of percentage emissions reductions to model should consider two basic factors:

- 1) The reduction should be large enough to test the interaction and non-linearity of the secondary PM<sub>2.5</sub> components, such as those considered in the published literature.
- 2) The reduction should not be so large that it alters the chemistry in such a way that gives an unrealistic PM<sub>2.5</sub> concentration response, especially given emissions reductions that could possibly occur within the 6-10 year timeframe of Moderate and Serious area attainment demonstrations.

The percentage reduction should not be solely based on an analysis of potential emissions reductions over the next 6-10 year period. This approach could lead to claims of very small emissions reductions, which may not be large enough to truly test whether the area is sensitive to precursor emissions reductions. Therefore, the EPA is recommending a range of percentage precursor emissions reductions that is applicable to all sensitivity demonstrations.

Based on the information available at this time, the EPA recommends application of multiple percentage emissions reductions sensitivities, which span what has typically

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<sup>26</sup> See CAA section 189(e) and 40 CFR 51.1006(a).

been seen in the published literature.<sup>27</sup> The EPA recommends a range of 30-70% reductions in precursor emissions in the nonattainment area to test the PM<sub>2.5</sub> concentration sensitivity of an area. Multiple model runs can be conducted which test the PM<sub>2.5</sub> sensitivity within the recommended range. For example, model runs of 30%, 50%, and 70% precursor reductions would test the entire sensitivity range to see whether the insignificance threshold is exceeded within the range of reductions. Air agencies can perform multiple model runs to test various sensitivity levels and provide a range of impacts. However, modeling the highest end of the percent reduction range as the initial model run will potentially limit the resources involved in the analysis. If the modeled PM<sub>2.5</sub> concentration change at the highest end of the percent reduction range is below the recommended threshold, then additional lower percentage model sensitivity runs will likely not be needed. If, however, the modeled concentration change is above the threshold, then additional lower percentage sensitivity model runs are recommended to help identify the point where the threshold is exceeded. For the reasons stated above, in most cases, the EPA recommends that air agencies do not use percent reductions of less than 30% for sensitivity analyses.

Review of recent projections of expected emission changes suggests that this recommended range is not unrealistic or arbitrary. For example, the EPA compiled the estimated state level percent change in precursor emissions between 2011 and 2017 from the Cross State Air Pollution Rule (CSAPR) Update rulemaking documentation (USEPA, 2016b). This represents an emissions change, which occurred over a 6-year period, which is the same amount of time allowed for a Moderate PM<sub>2.5</sub> area to attain the NAAQS. Table 2 shows a summary of the emissions analysis.

**Table 2. Nationwide State Level<sup>28</sup> Total Percent Change in Anthropogenic<sup>29</sup> PM<sub>2.5</sub> Precursors Between 2011 and 2017**

PM <sub>2.5</sub> Precursor	Median % emissions change	High % emissions change	Low % emissions change
NOx	-31.8%	-39.9%	-7.7%
SO2	-63.6%	-89.0%	-15.2%
VOC	-18.8%	-26.9%	57.5%
NH3	0.8%	-9.3%	6.1%

<sup>27</sup> The EPA examined examples in the published literature of general sensitivity modeling studies that look at the impact of across-the-board percentage reductions in precursor emissions on secondary pollutants (including PM<sub>2.5</sub>, PM<sub>10</sub>, and ozone) (Vieno, 2016; Megaritis, 2013; Harrison, 2013; Derwent, 2014; Liu, 2010; Pun, 2001). The majority of studies have used across the board percentage precursor emissions reductions of between 30% and 60%, with the most common reduction percentages being 30% and 50%.

<sup>28</sup> The percent change in precursor emissions was calculated for each of the lower 48 states.

<sup>29</sup> Emissions totals do not include biogenic (NOx or VOC) emissions or fires.

The percent change in emissions in Table 2 show a wide variation by precursor. In general, the largest reductions were seen in SO<sub>2</sub> emissions (median value of -64%), with NO<sub>x</sub> having the second largest reductions (median value of -32%). VOC had a larger range of changes (including some increases) and more than half of the states had estimated increases in NH<sub>3</sub> over the example 6-year period. The emissions data show that at least half of the states achieve more than a 30% reduction in NO<sub>x</sub> and SO<sub>2</sub> in the 6-year period. This shows that large emissions reductions are both likely and possible over a short period of time.

In addition, it can be seen in Table 2 that certain PM<sub>2.5</sub> precursors (*e.g.*, SO<sub>2</sub>) have been reduced by as much as 60-90% over the 2011-2017 period. This does not mean that it is possible or even likely that an additional 60 plus percentage reduction in SO<sub>2</sub> (or any other precursor) will occur in any future 6 or 10-year period. However, it may be appropriate, depending on the circumstances in the area, to consider emissions sensitivities that are much larger than a 30% reduction. This is especially true in nonattainment areas which can expect large additional emissions reductions of certain precursors from on-the-books controls and in areas that are dominated by one or a few point sources or categories of sources that are largely uncontrolled.

Consistent with the PM<sub>2.5</sub> SIP Requirements Rule, the EPA may in some cases require air agencies to evaluate available emissions controls in support of a precursor demonstration that relies on a sensitivity analysis.<sup>30</sup> It is particularly important for states to evaluate available controls where the recommended contribution threshold is close to being exceeded at the low end of the recommended sensitivity range (*e.g.*, 30%). In these cases, the EPA may determine that to sufficiently evaluate whether the area is sensitive to reductions, the state must determine the potential precursor emission reductions achievable through the implementation of available and reasonable controls for a Moderate area (or best controls for a Serious area). For example, an area that determines it is close to exceeding the contribution threshold with a 30% precursor emissions reduction generally will need to evaluate the impact (*i.e.*, the percent reduction in the precursor) of the application of reasonably available controls of the relevant precursor. The EPA would be less likely to require an evaluation of potential controls for areas that do not exceed the contribution threshold at a higher modeled percent reduction (*e.g.*, 50-70%). The air agency should consult the appropriate EPA Regional office to determine whether an emissions control analysis is needed to support a particular precursor demonstration.

In summary, for a comprehensive sensitivity-based analysis, the EPA recommends modeling reductions of 30%-70% of all anthropogenic emissions of the precursor (including point, mobile, and non-point sources) in the nonattainment area. For a major source sensitivity based analysis, the EPA recommends modeling reductions of 30%-70%

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<sup>30</sup> See 40 CFR 51.1009(a)(2) and 51.1010(a)(2).

of anthropogenic emissions of the precursor from existing major stationary sources in the nonattainment area. In addition, the EPA may in some cases require air agencies to evaluate available emissions controls in support of a precursor demonstration.

#### 4.1.2 Evaluating Sensitivity Modeling Results

As noted previously, the EPA recommends comparing the estimated impacts of precursor emissions on PM<sub>2.5</sub> mass from sensitivity modeling to the contribution thresholds for the annual average and 24-hour NAAQS, as appropriate, identified in Section 2.2.<sup>31</sup> The EPA generally expects that if modeling demonstrates that reductions in the 30-70% range produce an air quality impact below these thresholds, then it would approve such a demonstration as adequate to show that the precursor is insignificant. However, the higher the modeled percentage reduction, the stronger the demonstration. Therefore, modeling the high end of the range is encouraged. The EPA recommends submittal of supporting information for all sensitivity demonstrations, especially for demonstrations that can only pass the recommended threshold(s) at the low end of the range. As noted previously, the approach set forth in the Technical Basis Document is a reasonable interpretation of insignificance, and an air agency seeking to offer a different interpretation would need to present a compelling argument why its interpretation should be accepted instead.

## 5.0 Modeling for Attainment Plan Precursor Demonstrations

Quantifying secondary pollutant formation requires simulating chemical reactions and thermodynamic gas-particle partitioning in a realistic chemical and physical environment. Chemical transport models treat atmospheric chemical and physical processes such as deposition and transport. There are two types of chemical transport models which are differentiated based on a fixed frame of reference (Eulerian grid based), or a frame of reference that moves with parcels of air between the source and receptor point (Lagrangian) (McMurry et al., 2004).

A variety of Lagrangian and Eulerian modeling systems exist that could potentially be used to estimate impacts on secondarily-formed PM<sub>2.5</sub>. These modeling systems represent varying levels of complexity in the treatment of chemistry and the chemical and physical environment in which precursors exist. Photochemical grid models are three-dimensional grid-based models that treat chemical and physical processes in each grid cell and use Eulerian diffusion and transport processes to move chemical species to other grid cells (McMurry et al., 2004). Photochemical models are advantageous by providing a spatially and temporally dynamic realistic chemical and physical

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<sup>31</sup> Note that when calculating the PM<sub>2.5</sub> impact of the precursor sensitivity, all components of modeled PM<sub>2.5</sub> mass should be added together to get the total PM<sub>2.5</sub> impact from the individual precursor emissions.

environment for plume growth and chemical transformation (Baker and Kelly, 2014; Zhou et al., 2012). Publicly available and documented Eulerian photochemical grid models such as CMAQ (Byun and Schere, 2006) and CAMx (Environ, 2016) treat emissions, chemical transformation, transport, and deposition using time and space variant meteorology. These modeling systems include primarily emitted species and secondarily-formed pollutants such as ozone and PM<sub>2.5</sub> (Chen et al., 2014; Civerolo et al., 2010; Russell, 2008; Tesche et al., 2006). These models have been used extensively to support SIPs and to explore relationships between inputs and air quality impacts in the United States and beyond (Cai et al., 2011; Civerolo et al., 2010; Hogrefe et al., 2011).

## 5.1 Modeling Demonstrations

In general, attainment plan precursor demonstration modeling should follow the recommendations in the PM<sub>2.5</sub> photochemical modeling guidance for attainment demonstrations [*Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM<sub>2.5</sub>, and Regional Haze* (USEPA, 2014b)]. As noted above, since air quality modeling is a required element of PM<sub>2.5</sub> attainment demonstrations, most air agencies will already have a photochemical grid modeling platform available to use for precursor demonstrations. Where a grid modeling platform is available for an attainment demonstration, the process of setting up and running the model will generally be the same for a precursor demonstration. If a photochemical modeling platform is not available, the air agency should consult with the appropriate EPA Regional office to discuss options. Possible alternative options include the use of a simplified box model, regional or national photochemical grid modeling that may separately be available, or other conservative techniques for estimating the impact of precursor emissions on PM<sub>2.5</sub> concentrations in the particular area.

### 5.1.1 Air Quality Modeling Process

Typically, the air quality modeling process starts with the development of base year emissions and meteorology for input to an air quality run to evaluate model performance. The photochemical PM<sub>2.5</sub> modeling guidance describes the process for evaluating model performance and performing diagnostic analyses. After evaluating the model and making any necessary input changes or adjustments, the model is run for a future year, which corresponds to the appropriate attainment year for the area. The air quality model outputs are then used to apply the modeled attainment test to support an attainment demonstration.

At the beginning of the modeling process, the EPA recommends a modeling protocol be developed to support the modeling exercise. A modeling protocol is intended to communicate the scope of the analysis and generally includes the types of analysis performed, the specific steps taken in each type of analysis, the rationale for the choice of modeling system, names of organizations participating in preparing and

implementing the protocol, and a complete list of model configuration options. The protocol should detail and formalize the procedures for conducting all phases of the modeling study, such as describing the background and objectives for the study, creating a schedule and organizational structure for the study, developing the input data, conducting model performance evaluations, interpreting modeling results, describing procedures for using the model to demonstrate whether regulatory levels are met, and producing documentation to be submitted for review and approval.

If a modeling protocol is already available in support of an attainment demonstration, then it may not be necessary to develop a separate protocol to document a precursor demonstration. In that case, the details of the modeling and analyses to support a precursor demonstration can be incorporated into the existing structure of the modeling protocol. If a modeling protocol is not otherwise available, the EPA recommends developing a separate protocol that outlines the elements of the precursor demonstration. A modeling protocol should include the following elements at a minimum.

#### 1. Overview of Modeling/Analysis Project

- Participating organizations
- Schedule for completion of the project
- Description of the conceptual model for the project source/receptor area
- Identify how modeling and other analyses will be archived and documented
- Identify specific deliverables to the review authority

#### 2. Model and Modeling Inputs

- Rationale for the selection of air quality, meteorological, and emissions models
- Modeling domain specifications
- Horizontal resolution, vertical resolution and vertical structure
- Episode selection and rationale for episode selection
- Description of meteorological model setup
- Description of emissions inputs
- Specification of initial and boundary conditions
- Methods used to quality assure emissions, meteorological, and other model inputs

#### 3. Model Performance Evaluation

- Identify relevant ambient data and provide relevant model performance in the modeling domain with a focus on the nonattainment area
- List evaluation procedures
- Identify possible diagnostic testing that could be used to improve model performance

#### 4. Model Outputs

- Describe the process for calculating precursor impacts to annual average and/or 24-hour average PM<sub>2.5</sub> concentrations in the nonattainment area.

The existing attainment demonstration modeling guidance provides recommendations on all of the protocol elements above (USEPA, 2014b). This includes selecting air quality models, meteorological modeling, episode selection, the size of the modeling domain, the grid size and number of vertical layers, and model performance. Precursor demonstrations for attainment plans should generally follow the recommendations in the attainment demonstration modeling guidance.

### 5.2 Base Year and Future Year Model Assessments

Modeled attainment demonstrations typically include modeling for both a base year (used to evaluate model performance) and a future year, which typically corresponds to the attainment date. Meteorological fields are developed for the base year and held constant in the future year modeling. Future year emissions fields are used to simulate the impact of emissions controls (including growth) on future air quality concentrations. Attainment demonstrations use the future year modeled air quality concentrations to determine if attainment is likely to be reached by the nonattainment area attainment deadline.

The EPA recommends that a precursor demonstration generally should be based on current conditions to demonstrate that precursor emissions do not contribute significantly to PM<sub>2.5</sub> concentrations in the nonattainment area. The base year modeling has less uncertainty compared to the future year since model performance is known for the base year and the modeling does not depend on projections of emissions to a future year. In addition, some control requirements (*e.g.*, RACT) may apply before the maximum statutory future year attainment date. However, as explained in Section 6 of this guidance, there may be situations, such as with the NNSR precursor demonstration, where it could be more appropriate to model future conditions that provide a more representative sensitivity analysis based on the period of time when a new source will begin to operate.

In most cases, the modeled base year is the best representation of current conditions. Note however that the modeled base year is not necessarily the same as modeling a “current” year. In some cases, the base year used for modeling purposes may be several years or more in the past. Therefore, future year baseline modeling may in some cases be more appropriate for attainment plan modeled precursor demonstrations. As such, air agencies should consult the appropriate EPA Regional office to determine the appropriate analysis year(s).

### 5.3 Modeling Approaches

The simplest sensitivity modeling approach (brute force change to emissions) would be to simulate two sets of conditions, one with all emissions and one with an across the board anthropogenic emissions reduction (or zero precursor emissions in the case of a “zero-out” model run). The difference between these simulations provides an estimate of the air quality change related to the change in emissions from the precursor. Additionally, some photochemical models have been instrumented with source apportionment, which tracks emissions from specific sources, source sectors, and/or source regions through chemical transformation, transport, and deposition processes to estimate the apportionment of predicted PM<sub>2.5</sub> species concentrations (Kwok et al., 2015; Kwok et al., 2013). Source apportionment has been used to calculate the contribution from multiple states on model predicted ozone and PM<sub>2.5</sub> as part of several transport related rulemakings (USEPA, 2011; USEPA, 2016c). Air agencies can choose the most efficient modeling technique for their particular situation and should discuss the options with the appropriate EPA Regional office.

### 5.4 Calculating the Modeled Impact from Precursors

The modeled precursor impact on PM<sub>2.5</sub> levels can be calculated as either the absolute modeled concentration change, or as the relative concentration change, based on the percent modeled change in PM<sub>2.5</sub> species, applied to ambient data. The photochemical modeling guidance recommends performing a “relative” attainment test for modeled attainment demonstrations. The recommended test uses model estimates in a “relative” rather than “absolute” sense to estimate future year design values. The fractional changes in air pollutant concentrations between the model future year and model base year are calculated for all valid monitor locations. These ratios are called *relative response factors* (RRF). Future PM<sub>2.5</sub> design values are estimated at existing monitoring sites by multiplying the modeled relative response factor for each monitor by the monitor-specific base year design value. The resulting estimates of future concentrations are then compared to the NAAQS. The relative attainment test has the benefit of anchoring the projected PM<sub>2.5</sub> concentrations to measured ambient data, which helps mitigate modeled over or under-predictions, relative to the level of the NAAQS.

In contrast to an attainment demonstration, precursor demonstrations do not examine changes in emissions between a base year and a future year. Instead, the calculation of relative changes in PM<sub>2.5</sub> concentrations occur between a modeled case with all emissions and a modeled case with reduced precursor emissions.

Even though it may be appropriate to calculate absolute modeled PM<sub>2.5</sub> concentration changes, there are advantages to calculating relative concentration changes, using the modeling guidance recommended procedures for the modeled attainment test. The

recommended procedure involves applying adjustments to the ambient data to reconstruct the measured species components so that they add up to the measured FRM mass. Data analyses (Frank, 2006) have noted that the FRM monitors do not measure the same components and do not retain all of the PM<sub>2.5</sub> that is measured by routine speciation samplers and, therefore, cannot be directly compared to speciation measurements from the Chemical Speciation Network (CSN).<sup>32</sup> The FRM mass measurement does not retain all ammonium nitrate and other semi-volatile materials (negative sampling artifacts) and includes particle bound water associated with sulfates, nitrates and other hygroscopic species (positive sampling artifacts). This results in FRM measured concentrations (and percent attribution of PM<sub>2.5</sub> mass) which may be different from the ambient levels of some PM<sub>2.5</sub> chemical constituents. Using the SANDWICH technique, it is possible to reconstruct PM<sub>2.5</sub> species so that they more closely match the composition of mass retained by the FRM. This adjustment can be applied to the modeled change in PM<sub>2.5</sub> species components. This will result in calculated PM<sub>2.5</sub> species mass, which is anchored to the measured mass, and more closely reflects the species concentrations that are retained on the FRM filters, including an estimate of particle bound water. See the photochemical modeling guidance (USEPA, 2014b; Frank, 2006) for more details on the recommended calculations.

The EPA provides a software package called the Software for the Modeled Attainment Test (SMAT), which provides default ambient data and performs the relative attainment test calculations. Assuming that the precursor impacts are calculated using base year modeling, a single SMAT run is needed to calculate precursor impacts. SMAT can be run with the base case concentrations as the “base year” and the zero-out/source apportionment or sensitivity model run case(s) as the “future year” (even though the model run does not actually represent a future year). The “future year” PM<sub>2.5</sub> concentration values are subtracted from the base year values to get the total PM<sub>2.5</sub> contribution from the precursor. The precursor impact is then compared to the threshold(s) identified in Section 2.2. If the precursor impacts are calculated using future year modeling, two SMAT runs are needed to calculate precursor impacts. The first SMAT run will calculate future year base case PM<sub>2.5</sub> concentrations using the base case and future year model outputs. The second SMAT run will calculate future year PM<sub>2.5</sub> concentrations from the zero-out/source apportionment or sensitivity model run(s). The two future year PM<sub>2.5</sub> concentration values are subtracted from each other to get the total PM<sub>2.5</sub> impact from the precursor. The precursor impact is then compared to the threshold(s) identified in Section 2.2.

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<sup>32</sup> The information in this section applies to the most common samplers in the CSN. Some networks use alternative special purpose samplers to collect both PM<sub>2.5</sub> and PM<sub>2.5</sub> speciation data. The characteristics of the sampler and the analytical procedures used to produce chemical speciation data should be considered in determining which, if any, adjustments are appropriate to make the data useful for comparison to FRM data.

When calculating modeled precursor impacts to PM<sub>2.5</sub>, it is important to consider model performance. This is especially true in cases where air agencies choose to use absolute model results. If the model over predicts PM<sub>2.5</sub> species concentrations, the absolute modeled concentration changes may be biased high. Similarly, if the model under predicts PM<sub>2.5</sub> species concentrations, the absolute modeled concentration changes may be biased low. Therefore, model under predictions are a particular concern since this could lead to modeled precursor impacts that may be biased low.

#### 5.4.1 Estimating the Annual PM<sub>2.5</sub> Impact from Precursors

The first step for estimating annual PM<sub>2.5</sub> impacts from a precursor is to estimate the annual average PM<sub>2.5</sub> at each monitor location (the grid cell where the monitor is located) for the baseline scenario. Second, calculate the annual average PM<sub>2.5</sub> at each monitor for the zero-out/source apportionment or sensitivity scenario. Calculate the difference between the zero-out/source apportionment or sensitivity scenario annual average PM<sub>2.5</sub> and baseline scenario annual average PM<sub>2.5</sub> for each monitor location. This difference is the impact from the PM<sub>2.5</sub> precursor. Based on the recommendation in Section 2.3, the impacts are calculated at monitor locations. When using the relative attainment test, the default recommendation is to average the concentrations at the nine (9) surrounding grid cells (a 3 x 3 matrix of grid cells, with the monitor in the center grid cell).

#### 5.4.2 Estimating the Daily PM<sub>2.5</sub> Impact from Precursors

The first step for estimating 24-hour PM<sub>2.5</sub> impacts from a precursor is to estimate the 24-hour average PM<sub>2.5</sub> mass at each monitor location (the grid cell where the monitor is located) for the baseline scenario. Second, calculate the 24-hour average PM<sub>2.5</sub> at each monitor for the zero-out/source apportionment or sensitivity scenario. Calculate the difference between the zero-out/source apportionment or sensitivity scenario 24-hr average PM<sub>2.5</sub> and baseline scenario 24-hour average PM<sub>2.5</sub> for each day for each monitor location. This difference is the contribution from the PM<sub>2.5</sub> precursor. Based on the recommendation in Section 2.3, the contributions are calculated at monitor locations. When using the relative attainment test, the default recommendation is to use the single grid cell where the monitor is located to represent the location of the monitor.

When calculating absolute daily impacts, the highest 24-hour average PM<sub>2.5</sub> impact from the modeled time period should be compared to the daily PM<sub>2.5</sub> “contribution” threshold at each monitor location. If the highest daily average secondarily-formed PM<sub>2.5</sub> impact is greater than the level of the threshold, then a second tier analysis may be appropriate to further examine the precursor impacts on the high modeled and/or observed PM<sub>2.5</sub> days. Air agencies should consult with the appropriate EPA Regional office to discuss the details of the calculations.

Application of the relative attainment test (using SMAT) for the 24-hour NAAQS already takes into consideration the high measured PM<sub>2.5</sub> days. Therefore, no further (2<sup>nd</sup> tier) analysis is necessary to calculate the impact on exceedance days. The SMAT 24-hour air quality impact is calculated on high measured PM<sub>2.5</sub> days in the area.

## 6.0 Nonattainment New Source Review (NNSR) Precursor Demonstration

The PM<sub>2.5</sub> SIP Requirements Rule identifies a specific type of precursor demonstration that air agencies may use to demonstrate that sources of a particular precursor do not need to be controlled with respect to that precursor under the NNSR program for a particular PM<sub>2.5</sub> nonattainment area.<sup>33</sup> As detailed in the PM<sub>2.5</sub> SIP Requirements Rule, the NNSR precursor demonstration is based on the premise that the sensitivity of a particular nonattainment area to precursor emissions from future new major stationary sources and major modifications is best indicated by an emissions *increase* test. The sensitivity of an area to precursor increases may be different from the sensitivity of that same area to decreases (for example, where there is currently very little of the precursor). Therefore, for NNSR, the rule allows an air agency to undertake a sensitivity-based *increase* test in order to demonstrate that increases in emissions of a particular precursor would not contribute significantly to PM<sub>2.5</sub> levels that exceed the standard, and that sources of such precursor therefore may be exempted from PM<sub>2.5</sub> controls for that precursor(s) under the NNSR permitting requirements. Note that the NNSR precursor demonstration is optional and an air agency may satisfactorily demonstrate that a precursor is insignificant for all other control requirements other than NNSR, using the analyses previously described in this guidance or other appropriate analyses, without analyzing whether the precursor significantly contributes to PM<sub>2.5</sub> levels for the purposes of NNSR. In such cases, the nonattainment planning requirements would not apply to existing sources of that precursor, but the NNSR requirements would apply in the event that a new major source or major modification in that area triggers NNSR permitting. Such an approach may be efficient for air agencies who do not want to expend the resources necessary to complete an NNSR precursor demonstration because they expect few or no new or modified major sources of the precursor in question.

The NNSR precursor demonstration differs from the other two demonstrations (comprehensive and major source precursor demonstrations), which are attainment plan tests, in that the latter two demonstrations examine air quality changes resulting from emissions reductions from existing sources. By its nature, an attainment demonstration deals with existing emissions sources and how emissions reductions

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<sup>33</sup> See 40 CFR 51.1006(a)(3).

from those sources can help a nonattainment area reach attainment of the NAAQS. In contrast, the statutorily required NNSR program addresses the management of major source growth (new major stationary sources and major modifications) in the nonattainment area. Thus, by its nature, NNSR deals with *increases* of emissions in the nonattainment area. This is true even for an area that currently has no existing major stationary sources. In that case, it would be meaningless to examine decreases in emissions from “existing” major sources (because there are none). Nevertheless, PM<sub>2.5</sub> precursors from *new* major source growth occurring in the nonattainment area could still contribute significantly to PM<sub>2.5</sub> levels in the area. Therefore, the PM<sub>2.5</sub> SIP Requirements Rule mandates that NNSR precursor demonstrations be based on a sensitivity analysis involving potential increases of emissions in the nonattainment area.<sup>34</sup>

Similar to the questions described in Section 4.1, in performing a sensitivity analysis for NNSR, there are several questions that need to be addressed:

- 1) What amount of emissions increase should be examined as part of the NNSR sensitivity analysis?
- 2) What location(s) should be used to model the precursor emissions increases resulting from potential major source growth?
- 3) What air quality concentration threshold should be used to determine if the modeled air quality change from the precursor is insignificant?

The EPA recognizes that there may be a number of factors inherent to a particular nonattainment area that could influence the potential emissions increase from new major stationary sources and major modifications. The following section addresses these factors and sets forth guidance for air agencies to consider in completing the NNSR precursor demonstration.

## 6.1 NNSR Demonstrations

The purpose of the NNSR precursor demonstration is to determine if the nonattainment area is sensitive to PM<sub>2.5</sub> precursor emissions increases that may occur in a particular area from new major stationary sources and/or major source modifications. It would be appropriate for the air agency to base estimates of any potential emissions increases in part on the types and size of new major stationary sources that are most likely to locate within the nonattainment area and/or existing sources most likely to undergo a major modification. To help determine the size and types of potential sources, the EPA also recommends an examination of recent (*e.g.*, the last 5 years) major source permits in the region. In order to gather enough information on recently permitted emissions sources, it will likely be necessary to examine a broad region encompassing the

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<sup>34</sup> See 40 CFR 51.1005(a)(3)(i).

nonattainment area. For example, an air agency may want to examine permits issued within the entire Northeast, Southeast, or Midwest region. The importance of gathering information concerning permitted major sources that have located elsewhere is that the air agency can utilize information (magnitude of emissions, stack parameters, etc.) from those permits that will make the modeling of precursor emissions more realistic.

The identified range of emissions from recently permitted major sources may vary widely among PM<sub>2.5</sub> precursors. SO<sub>2</sub>, NO<sub>x</sub> and VOC are PM<sub>2.5</sub> precursors that are also regulated as pollutants associated with other NAAQS, while ammonia is not nationally regulated under any NAAQS. All new major sources and major modifications of SO<sub>2</sub>, NO<sub>x</sub> and VOC must already meet Best Available Control Technology (BACT) level controls and all other NSR program requirements (and Lowest Achievable Emissions Rate [LAER] controls if they are located in nonattainment areas). The treatment of SO<sub>2</sub>, NO<sub>x</sub> and VOC under the NSR program for other NAAQS pollutants (besides PM<sub>2.5</sub>) has an impact on the potential increase of PM<sub>2.5</sub> precursor emissions from new sources even absent controls as a PM<sub>2.5</sub> precursor. Therefore, how the particular precursor is treated as a result of regulation pursuant to other NAAQS is an important consideration when determining the potential emissions increases that should be modeled for a PM<sub>2.5</sub> NNSR precursor demonstration.

Other important considerations for determining the amount of emissions increase that should be analyzed in the NNSR precursor demonstration include but are not limited to: the size of the nonattainment area, the number of existing major stationary sources (from which major modifications could occur), natural resources available to support new sources, economic focus of the area and associated potential growth (conducive to a particular industry/source category).

Upon the EPA's approval of a NNSR precursor demonstration, the air agency would not need to apply the PM<sub>2.5</sub> control requirements to new major stationary sources and major modifications with respect to that precursor under the NNSR program for PM<sub>2.5</sub> (for the current SIP). Therefore, the NNSR demonstration should include a conservative representation of potential emissions increases from new and modified major sources. For example, the modeled size of sources (in tons per year of emissions) and the number and location of sources should be adequately conservative to analyze more than what is merely "likely" to occur in the area. The goal of the NNSR demonstration is not simply to determine the PM<sub>2.5</sub> air quality impact of likely new sources. Instead, it is to examine whether the nonattainment area is sensitive to increases of precursor emissions and whether the resulting PM<sub>2.5</sub> air quality change that could result from potential major source growth would be a significant contribution to PM<sub>2.5</sub> levels that exceed the NAAQS in a PM<sub>2.5</sub> nonattainment area. It is, however, important to consider the potential size and number of new sources of PM<sub>2.5</sub> precursors that may possibly locate in the nonattainment area (using conservative assumptions) when planning the analysis.

## 6.2 Modeling for NNSR Demonstrations

The fundamental approach for analyzing changes in emissions pursuant to the NNSR precursor demonstration involves the use of a photochemical model to project the air quality changes associated with various potential emissions increases from hypothetical new major stationary sources or major modifications. In most cases, it will not be sufficient to model emissions increases from existing major sources in the area. Some nonattainment areas may only have one or, in some cases, no existing major sources. Moreover, it is important to examine the area's sensitivity to emissions increases from potential source locations across the entire nonattainment area because a new source may locate in any part of the nonattainment area. New and/or modified sources could contribute significantly to existing monitored locations within the nonattainment area or cause new exceedances of the standard in other parts of the nonattainment area. Therefore, in most cases it will be necessary to model a number of hypothetical new sources, placed in various locations across the nonattainment area. The location of existing major sources and the stack parameters of those sources can be used to help design the NNSR modeling demonstration. The existing major source information can be the starting point of the analysis, with additional hypothetical new sources (that may or may not resemble existing sources) placed in other parts of the area, as necessary.

The EPA also recommends modeling multiple hypothetical sources with emission rates and stack release characteristics typical of existing sources in the area or region. The overall approach for hypothetical source impact assessment would be generally similar to the analysis documented in "Estimating ozone and secondary PM<sub>2.5</sub> impacts from hypothetical single source emissions in the central and eastern United States" (Baker, 2015). Choices made for these hypothetical sources should be done in consultation with the appropriate EPA Regional office.

Due to the unique sensitivity levels of nonattainment areas to air quality impacts from individual PM<sub>2.5</sub> precursors, the EPA is not making default recommendations on the size and number of hypothetical new and/or existing sources to model in a NNSR demonstration. The details of the analysis, including a modeling protocol, should be discussed in advance with the appropriate EPA Regional office.

### 6.2.1 Types of Models

Quantifying secondary pollutant formation requires simulating chemical reactions and thermodynamic gas-particle partitioning in a realistic chemical and physical environment. Therefore, in most cases, the EPA believes it will be necessary to employ a CTM for NNSR precursor demonstrations. CTMs treat atmospheric chemical and physical processes such as deposition and transport. In some limited cases, a simplified box model that employs chemistry may be sufficient. Below, we describe additional details

for the purposes of estimating the magnitude of secondarily-formed PM<sub>2.5</sub> from PM<sub>2.5</sub> precursor emissions associated from major source growth.

### 6.2.2 Modeling for Major Point Sources

A variety of Lagrangian and Eulerian modeling systems exist that could potentially be used to estimate point source impacts from major sources on secondarily-formed pollution such as PM<sub>2.5</sub>. These modeling systems represent varying levels of complexity in the treatment of plume chemistry and the chemical and physical environment in which the plume exists. It is important that any Lagrangian or Eulerian modeling system be appropriately applied for assessing the effects of major stationary sources on secondarily-formed pollutants such as PM<sub>2.5</sub> for the purposes of a precursor demonstration (USEPA, 2005).

Lagrangian modeling systems that have been used to assess single source impacts in North America include CALPUFF, HYSPLIT, FLEXPART, SCIPUFF, and SCICHEM. Some Lagrangian models treat in-plume gas and particulate chemistry. These models require time and space varying oxidant concentrations and, in the case of PM<sub>2.5</sub>, also neutralizing agents (such as ammonia) as important secondary impacts happen when plume edges start to interact with the surrounding chemical environment (Baker and Kelly, 2014; ENVIRON, 2012). These oxidant and neutralizing agents are not routinely measured, but can be generated with a three dimensional photochemical transport model and subsequently input to a Lagrangian modeling system.

It is therefore possible to use a Lagrangian model to support an NNSR precursor demonstration but, since it is likely that multiple hypothetical sources will need to be modeled and the Lagrangian model requires realistic background oxidant information (which can be supplied from a photochemical model), it will be easier in most cases to use a photochemical grid model for the demonstration. See Section 5 for more details on photochemical grid models.

It is important that modeling systems used for these assessments be fit for this purpose and evaluated for skill in replicating meteorology and atmospheric chemical and physical processes that result in secondary pollutant formation and deposition. A candidate model for use in estimating the effects of precursors emitted from potential major point sources on secondarily-formed PM<sub>2.5</sub> for the purposes of a NNSR precursor demonstration should meet the general criteria for an “alternative model” outlined in 40 CFR part 51, Appendix W, Section 3.2 (USEPA, 2005). The determination of acceptability of a particular model and approach for that model application is an EPA Regional office responsibility.

### 6.2.3 Modeling Approaches for NNSR Demonstrations

The simplest modeling approach to calculate impacts for a NNSR precursor demonstration (brute force change to emissions) is to simulate two sets of conditions: one with all existing emissions and one that includes an increase in emissions of the precursor that could result from major source growth (new major stationary sources and major modifications) (Baker and Kelly, 2014; Bergin et al., 2008; Kelly et al., 2015; Zhou et al., 2012). The difference between these simulations provides an estimate of the air quality change related to the increase in emissions from the precursor. Additionally, some photochemical models have been instrumented with source apportionment, which tracks emissions from specific sources, source sectors, and/or source regions through chemical transformation, transport and deposition processes to estimate an impact to predicted air quality (Kwok et al., 2015; Kwok et al., 2013). Source apportionment has been used to differentiate the impact from single sources on model predicted ozone and PM<sub>2.5</sub> (Baker and Foley, 2011; Baker and Kelly, 2014; Baker et al., 2015).

Alternatively, the Direct Decoupled Method (DDM) source sensitivity technique has also been used to estimate ozone and PM<sub>2.5</sub> impacts from specific sources (Baker and Kelly, 2014; Bergin et al., 2008; Cohan et al., 2005; Cohan et al., 2006; Kelly et al., 2015).

Since a NNSR precursor demonstration may require modeling multiple sources in multiple locations, an advanced technique such as source apportionment may save resources compared to numerous brute force model runs. Air agencies can choose the most efficient modeling technique for their particular situation; discussing the options in advance with the appropriate EPA Regional office is strongly advised.

### 6.2.4 Horizontal Grid Resolution for NNSR Demonstrations

Major stationary source assessments for nonattainment areas should be conducted at horizontal grid resolutions between ~1 kilometer (km) up to ~12 km. Photochemical grid model application up to 12 km has been shown to capture similar changes in air quality due to changes in emissions from a specific source on secondary pollutants in an urban area estimated with finer grid resolution (Cohan et al., 2006). In instances where sources may be modeled at coarser resolutions or at resolutions finer than 1 km, consultation with the appropriate EPA Regional office is advised.

Even though single source emissions are averaged into a grid volume, photochemical transport models have been shown to adequately capture single source impacts when compared with downwind in-plume measurements (Baker and Kelly, 2014; Zhou et al., 2012). Where set up appropriately for the purposes of assessing the impact of single sources on secondarily-formed pollutants, photochemical grid models could be used with a variety of approaches to estimate these impacts (see Section 6.2.3, above).

In some instances, where the source and key receptors are in very close proximity, the source and receptor may be located in the same photochemical grid model cell. Since physical and chemical processes represent a volume average, this may not adequately represent the gradients of pollution possible between the source and receptor when they are located in such proximity. The preferred approach to better represent the spatial gradient in source-receptor relationships when they are in close proximity is to use smaller sized grid cells. In such cases, grid resolution should be defined such that the source and receptor are no longer in the same grid cell. Ideally, there should also be several grid cells between the source and receptor to resolve best near-source pollution gradients.

In situations of close proximity between the source and receptor, a photochemical model instrumented with sub-grid plume treatment and sampling could potentially represent these relationships. Sub-grid plume treatment extensions in photochemical models typically solve for in-plume chemistry and use a set of physical and chemical criteria for a determination of when puff mass is merged back into the host model grid. A notable limitation of sub-grid plume treatments is that these implementations do not have more refined information related to meteorology or terrain than the host grid cell. In addition to tracking puffs at sub-grid scale, the host modeling systems must be able to track and output surface layer sub-grid puff concentrations, “sub-grid plume sampling,” to best represent receptor concentrations that are in close proximity to the source (Baker et al., 2014). Another important reason sub-grid plume sampling is necessary is that inherently in this type of system (sub-grid plume treatment in a photochemical grid model) some of the source’s impacts on air quality are resolved in puffs at the sub-grid scale and some have been resolved in the 3-dimensional grid space. Just extracting sub-grid plume information or just 3-dimensional model output would miss some of the source’s impacts on air quality, which means that accounting for both is necessary either with sub-grid sampling or options that integrate puffs within a grid cell with grid cell concentrations. Sub-grid plume treatments in photochemical grid models do not track grid-resolved source impacts separately from other sources in the model simulation. When either sub-grid treatment is applied for a NNSR precursor demonstration, source apportionment or source sensitivity is necessary to track the grid-resolved source impact in addition to sub-grid plume treatment to fully capture source impact.

### 6.3 Location of Potential Major Source Growth

Air agencies should consult with the appropriate EPA Regional office to determine the appropriate number and location of potential major sources in a NNSR precursor demonstration. Enough locations should be included in the demonstration such that new sources are placed in a variety of chemical regimes to provide full coverage over the nonattainment area. “Estimating ozone and secondary PM<sub>2.5</sub> impacts from hypothetical single source emissions in the central and eastern United States” (Baker,

2015) provides examples of different types of hypothetical sources, modeled to examine secondary PM<sub>2.5</sub> impacts. The journal article examined the PM<sub>2.5</sub> concentration impacts from several different size sources with different stack parameters. For example, hypothetical sources were modeled in different areas across the country using stack parameters that represented both elevated sources and near ground level sources. The techniques applied in that study may be useful for designing future major sources for sensitivity modeling in NNSR precursor demonstrations. In addition, the air agency may demonstrate that certain locations are clearly unsuitable for major source growth (*e.g.*, agricultural, residential and resort areas) so that they can be eliminated as potential growth sites for the modeling analysis.

#### 6.4 Significant Impact Thresholds

The EPA recommends that the sensitivity analysis for NNSR, which involves potential future emissions increases associated with new major stationary sources and major modifications, rely on the same recommended thresholds that were described earlier in Section 2.2 of this guidance.

#### 6.5 Base Year and Future Year Model Assessments

Modeled attainment demonstrations typically include modeling for both a base year (used to evaluate model performance) and a future year, which typically corresponds to the attainment date. Meteorological fields are developed for the base year and held constant in the future year modeling. Future year emissions fields are used to simulate the impact of emissions controls (including growth) on future air quality concentrations. Attainment demonstrations use the future year modeled air quality concentrations to determine if attainment is likely to be reached by the applicable attainment deadline. Accordingly, air agencies should evaluate emissions controls in the context of achieving needed air quality improvements in the attainment year. On the other hand, air agencies should account for the fact that new major stationary sources could locate in the nonattainment area at any time between the nonattainment designation date and the date when the area is eventually redesignated to attainment. Since NNSR provisions are effective immediately after the area is designated as nonattainment, there is some basis for using base case modeling for a NNSR precursor demonstration. However, in some situations, particularly where no new major source permit applications have yet been filed and any new major sources would, therefore, not be in operation for a number of years, air agencies may find that future year modeling could more accurately reflect atmospheric conditions for secondary PM<sub>2.5</sub> formation when precursor emissions increases from potential major source growth may occur. Air agencies should consult the appropriate EPA Regional office to determine the appropriate analysis years.

## 6.6 Calculating the Modeled Impact from Precursors

The modeled precursor impacts on PM<sub>2.5</sub> concentrations can be calculated either as the absolute modeled concentration changes or as relative concentration changes, based on the percent modeled change in PM<sub>2.5</sub> species, applied to ambient data. The photochemical modeling guidance recommends performing a “relative” attainment test for modeled attainment demonstrations. However, modeling for PSD analyses of single point sources typically uses absolute model results (USEPA, 2005 and USEPA, 2014a). Since the modeled emissions and stack parameters from major sources are well characterized and known, the use of absolute concentration change estimates from those sources in a photochemical model is in most cases appropriate. Adjusting the single source impacts up or down based on overall modeled concentrations of species (using the relative attainment test procedures) may in some cases inappropriately adjust the absolute modeled concentration change. Additionally, it is necessary to estimate source impacts throughout the area potentially impacted by major sources, not just at locations where monitors exist. Therefore, the EPA recommends using absolute model outputs to calculate major source impacts for NNSR precursor demonstrations. There may be some cases where relative impacts for a NNSR precursor demonstration may be appropriate. However, air agencies should consult with the appropriate EPA Regional office to determine the most appropriate post-processing procedures for the area.

### 6.6.1 Estimating the Annual PM<sub>2.5</sub> Impact from Precursors - NNSR Demonstration

The first step for estimating annual PM<sub>2.5</sub> impacts from a precursor is to estimate the annual average PM<sub>2.5</sub> at each receptor in the nonattainment area (if using a grid model, each grid cell is a receptor) for the baseline scenario. The second step is to calculate the annual average PM<sub>2.5</sub> at each receptor for the sensitivity scenario. The final step is to calculate the difference between the sensitivity scenario annual average PM<sub>2.5</sub> and baseline scenario annual average PM<sub>2.5</sub> for each receptor. This difference yields the impact from the PM<sub>2.5</sub> precursor. Based on the recommendation in Section 2.3, the impacts are calculated for all locations (grid cells) within the nonattainment area and should be compared to the thresholds recommended in Section 2.2.

### 6.6.2 Estimating the Daily PM<sub>2.5</sub> Impact from Precursors

The first step for estimating 24-hour PM<sub>2.5</sub> impacts from a precursor is to estimate the 24-hour average PM<sub>2.5</sub> at each receptor in the nonattainment area (if using a grid model, each grid cell is a receptor) for the baseline scenario. The second step is to calculate the 24-hour average PM<sub>2.5</sub> at each receptor for the sensitivity scenario. The final step is to calculate the difference between the sensitivity scenario 24-hour average PM<sub>2.5</sub> and baseline scenario 24-hour average PM<sub>2.5</sub> for each day for each receptor. This difference yields the impact from the PM<sub>2.5</sub> precursor. Based on the recommendation in Section

2.3, the contributions are calculated for all locations (grid cells) within the nonattainment area.

When calculating absolute daily impacts, the highest 24-hour average PM<sub>2.5</sub> impact from the modeled time period should be compared to the daily PM<sub>2.5</sub> threshold at each grid cell. If the highest daily average secondarily-formed PM<sub>2.5</sub> contribution is greater than the level of the threshold, then a second tier analysis may be appropriate to further examine the precursor impacts on the highest modeled PM<sub>2.5</sub> days. Air agencies should consult with the appropriate EPA Regional office to discuss the details of the calculations.

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Air Quality Assessment Division and  
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# **EXHIBIT 2**



# Technical Basis for the EPA's Development of the Significant Impact Thresholds for PM<sub>2.5</sub> and Ozone



Technical Basis for the EPA's Development of the Significant Impact Thresholds for  
PM<sub>2.5</sub> and Ozone

U.S. Environmental Protection Agency  
Office of Air Quality Planning and Standards  
Air Quality Assessment Division  
Research Triangle Park, NC

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## 1.0 Introduction:

In order to understand the nature of air quality, the EPA statistically estimates the distribution of pollutants contributing to ambient air quality and the variation in that air quality. The statistical methods and analysis detailed in this report focus on using the conceptual framework of *statistical significance* to calculate levels of change in air quality concentrations that have a “significant impact” or an “insignificant impact” on air quality degradation. *Statistical significance* is a well-established concept with a basis in commonly accepted scientific and mathematical theory. This analysis examines *statistical significance* for a range of values measured by air quality monitors. The statistical methods and data reflected in this analysis may be applicable for multiple regulatory applications where EPA and state agencies seek to quantify a level of impact on air quality that they consider to be either “significant” or “not significant.” Note: We have adopted the following convention throughout the document: a “significant impact” (in quotes) refers to a level of air quality change that can be used in the permit analysis of the ambient impacts from a facility to determine if it “causes, or contributes to” a violation of the applicable National Ambient Air Quality Standards (NAAQS) or Prevention of Significant Deterioration (PSD) increment, whereas we use *significant* (italicized) to refer to a mathematical assessment of probabilistic properties.

While this technical analysis may have utility in several contexts, the primary purpose of this document is to quantify the degree of air quality impacts corresponding to different confidence intervals (related to the statistical analysis presented here) that can be used in determining what is an “insignificant impact” when considering an application for a permit under the PSD program. In order to obtain a preconstruction permit under the PSD program, an applicant must demonstrate that the increased emissions from its proposed modification or construction will not “cause or contribute to” a violation of any NAAQS or PSD increment.<sup>1</sup> One way that this criterion can be met is by showing that the increased emissions from a proposed source will not have a significant impact on ambient air quality at any location, including locations where an exceedance of the NAAQS or PSD increment is occurring or may be projected to occur.<sup>2</sup> For the purposes of a PSD permit, the EPA has promulgated analytical methods involving air quality modeling and monitoring for conducting these compliance demonstrations.<sup>3</sup> More generally (*e.g.*, for purposes of designating areas as attainment or nonattainment), compliance with the NAAQS is determined by comparing the measured “design value” (DV) at an air quality monitor to the level of the NAAQS for the relevant pollutant.<sup>4</sup> A DV is a statistic or summary metric based on the most recent one or three years (depending on the specific standard) of

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<sup>1</sup> 40 Code of Federal Regulations (CFR) 51.166 and 52.21.

<sup>2</sup> Memorandum from Peter Tsigotis, EPA Office of Air Quality Planning and Standards, Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program, April 17, 2018.

<sup>3</sup> 40 CFR, part 51, Appendix W, 82 FR 5182 (January 17, 2017), Revisions to the Guideline on Air Quality Models: Enhancements to the AERMOD Dispersion Modeling System and Incorporation of Approaches to Address Ozone and Fine Particulate Matter.

<sup>4</sup> A design value is a statistic that describes the air quality status of a given location relative to the level of the NAAQS. More information may be found at: <http://www3.epa.gov/airtrends/values.html>.

monitored data that describes the air quality status of a given location relative to the level of the NAAQS.

The EPA has decided that an “insignificant impact” level of change in ambient air quality can be characterized by the observed variability of ambient air quality levels. Since the cause or contribute test is applied to the NAAQS in the PSD program, this analysis has been designed to take into account the ambient data used to determine DVs and the form of the relevant NAAQS. The EPA’s technical approach, referred to as the “Air Quality Variability” approach, relies upon the fact that there is inherent variability in the observed ambient data, which is in part due to the intrinsic variability of the emissions and meteorology controlling transport and formation of pollutants, and uses statistical theory and methods to model that intrinsic variability in order to facilitate identification of a level of change in DVs that is acceptably similar to the original DV, thereby representing a change in air quality that is not significant.<sup>5</sup> The DVs and background ambient concentrations that are used in the PSD compliance demonstrations are obtained through the U.S. ambient monitoring network with measured data being archived for analysis in the EPA’s Air Quality System (AQS).<sup>6</sup>

Based on these observed ambient data, the EPA has estimated the variability of the air quality levels of ozone and PM<sub>2.5</sub> through applying a well-established statistical approach known as bootstrapping. Bootstrapping is a method that allows one to construct measures to quantify the uncertainty of sample statistics (*e.g.*, mean, percentiles) for a population of data.<sup>7,8</sup> The bootstrap approach applied here uses a non-parametric, random resampling with replacement on the sample dataset (in this case, the ambient air quality concentration data underlying the DVs), resulting in many resampled datasets. This approach allows measures of uncertainty for sample statistics when the underlying distribution of the sample statistic is unknown and/or the derivation of the corresponding estimates is computationally unfeasible or intractable.<sup>7</sup> Bootstrapping is also commonly utilized to overcome issues that can occur when quantifying uncertainty in samples with correlated measurements. Bootstrapping has been used across a variety of scientific disciplines and in a wide range of applications within the environmental sciences.<sup>9,10,11,12</sup> For example, bootstrapping has been used to evaluate the economic value of

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<sup>5</sup> This approach is applied here strictly for the purpose of section 165(a)(3) and no other parts of the Clean Air Act.

<sup>6</sup> The AQS contains ambient air pollution data collected by EPA, state, local, and tribal air pollution control agencies from over thousands of monitors. These data are used to assess air quality, assist in attainment/nonattainment designations, evaluate State Implementation Plans for nonattainment areas, perform modeling for permit review analysis, and other air quality management functions. More information may be found at: <http://www.epa.gov/aqs>.

<sup>7</sup> Efron, B. (1979); Bootstrap methods: Another look at the jackknife. *The Annals of Statistics* 7 (1): 1–26. doi:10.1214/aos/1176344552.

<sup>8</sup> Efron, B. (2003); Second Thoughts on the Bootstrap. *Stat. Sci.*, 18, 135-140.

<sup>9</sup> Schuenemeyer, J., Drew, L. (2010); *Statistics for Earth and Environmental Scientists*, John Wiley & Sons, Inc. <http://dx.doi.org/10.1002/9780470650707.ch3>.

<sup>10</sup> Park, Lek, Baehr, Jørgensen, eds. (2015); *Advanced Modelling Techniques Studying Global Changes in Environmental Sciences*, 1st Edition, Elsevier. ISBN 9780444635365.

<sup>11</sup> Chandler, R., Scott, M. (2011); *Statistical Methods for Trend Detection and Analysis in the Environmental Sciences*, John Wiley & Sons, Inc. ISBN: 978-0-470-01543-8.

<sup>12</sup> Mudelsee, M. & Alkio, M. (2007); Quantifying effects in two-sample environmental experiments using bootstrap confidence intervals, *Env. Mod. & Software*, 22, 84-96.

clinical health analyses<sup>13</sup> and environmental policies,<sup>14</sup> in evaluations of environmental monitoring programs,<sup>15</sup> and in determining uncertainty in emissions inventories.<sup>16</sup> Additionally, the EPA has used bootstrapping techniques as a key component in evaluating air quality model performance for use in our nation's air quality management system.<sup>17,18</sup>

The bootstrap technique, as applied in this analysis, quantifies the degree of air quality variability at an ambient monitoring site and allows one to determine confidence intervals (CIs), *i.e.*, statistical measures of the variability associated with the monitor-based DVs, to inform the degree of air quality change that can be considered an “insignificant impact” for PSD applications. This approach is fundamentally based on the idea that an anthropogenic perturbation of air quality that is within a specified range may be considered indistinguishable from the inherent variability in the measured atmospheric concentrations and is, from a statistical standpoint, *not significant* at the given confidence level. Specifically, the analysis uses 17 years (2000-2016) of nationwide ambient ozone and PM<sub>2.5</sub> measurement data from the AQS database to generate a large number of resampled datasets for ozone and PM<sub>2.5</sub> DVs at each monitor from which the appropriate design values are calculated. The DVs from the resampled datasets are used to determine CIs that provide a measure of the inherent variability in air quality at the monitor location. This variability may be driven by the frequency of various types of meteorological and/or emissions conditions impacting a particular location. The analysis estimates a range of CIs for each monitor. As discussed in Section 4.1.1 of this document and in the Policy Document,<sup>2</sup> the 50% CI was chosen to quantify the bounds of a change in air quality that can be considered an “insignificant impact” for the purposes of meeting requirements under the PSD program.

This technical basis document explains the analysis design and results provide the EPA's rational basis to recommend Significant Impact Levels (SILs) values that can be applied as a tool for making the PSD compliance demonstration required by the Clean Air Act (CAA) and PSD regulations. The second section of this document provides an overview of EPA's Air Quality Variability approach, including details on the ambient monitoring network, the ambient ozone and PM<sub>2.5</sub> data from AQS that are used to derive monitor-specific DVs, a general review of *statistical significance* and confidence intervals, and a description of the bootstrap technique as applied to characterize air quality variability. The third section presents the measures of air quality variability determined from applying the bootstrap technique to the AQS data for ozone and PM<sub>2.5</sub>. The last section provides an analysis of confidence intervals for the ozone and PM<sub>2.5</sub> DVs and the implications of the geographical analysis performed in response to peer reviewer

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<sup>13</sup> Campbell, M., & Torgerson, D. (1999); Bootstrapping: Estimating Confidence Intervals for Cost-effectiveness Ratios, *Q. J. of Med.*, 92, 177-182.

<sup>14</sup> Kochi, I., Hubbell, B., & Kramer, R. (2006); An Empirical Bayes Approach to Combining and Comparing Estimates of the Value of a Statistical Life for Environmental Policy Analysis, *Env. & Resource Econ.*, 34, 385-406.

<sup>15</sup> Levine, C., et al (2014); Evaluating the efficiency of environmental monitoring programs, *Ecol. Ind.*, 39, 94-101.

<sup>16</sup> Tong, L., et al (2012); Quantifying uncertainty of emission estimates in National Greenhouse Gas Inventories using bootstrap confidence intervals, *Atm. Env.*, 56, 80-87.

<sup>17</sup> Hanna, S. (1989); Confidence limits for air quality model evaluations, as estimated by bootstrap and jackknife resampling methods, *Atm. Env.*, 6, 1385-1398.

<sup>18</sup> Cox, W. & J. Tikvart (1980); A statistical procedure for determining the best performing air quality simulation model, *Atm. Env.*, 9, 2387-2395.

comments. The resulting values chosen by the EPA can serve as SIL levels for the ozone NAAQS and the annual and 24-hour PM<sub>2.5</sub> NAAQS.

## 2.0 Background on Air Quality Variability Approach

This section provides details on the ambient monitoring data for ozone and PM<sub>2.5</sub> that were used in the EPA's Air Quality Variability approach and the statistical methods that form the technical basis for the EPA's Air Quality Variability approach.

### 2.1 U.S. Ambient Monitoring Data

The EPA's understanding of the nation's air quality is based on an extensive ambient monitoring network, which is used for multiple purposes, including to determine compliance with the various NAAQS. In addition, the monitoring network is used to inform the public about the status of air quality across the nation and to support air pollution research, particularly in the evaluation and development of updated NAAQS. The general requirements of the monitoring network are given in 40 CFR part 58, Appendix D (Network Design Criteria for Ambient Air Quality Monitoring). These general requirements and choices made by the state and local air agencies conducting monitoring have resulted in monitoring sites across the nation with a variety of characteristics in terms of location, monitoring equipment, and operating schedule.

NAAQS compliance is determined by comparing the measured DV derived from a monitor's data to the level of the NAAQS for the relevant pollutant. The DV is a particular statistic determined from the distribution of data from each monitor and is consistent with the averaging period and statistical form of the relevant NAAQS. The DVs from an area's monitoring network are used to determine attainment status for that area. The DVs for PM<sub>2.5</sub> and ozone are determined as follows:

- For the primary ozone NAAQS, the DV is the 3-year average of the annual 4<sup>th</sup>-highest daily maximum 8-hr average (MDA8) ozone concentration.<sup>19</sup> A monitor is in compliance if the DV is less than or equal to the level of the standard, which was recently revised to be 0.070 ppm (70 ppb.)<sup>20</sup>
- For the primary annual PM<sub>2.5</sub> NAAQS, the DV is the 3-year average of the PM<sub>2.5</sub> annual mean mass concentrations.<sup>21</sup> The annual mean is defined as the mean of the data in each of the 4 quarters of the year (*i.e.*, the mean of the quarterly means). A monitor is in compliance with the 2012 annual primary PM<sub>2.5</sub> standard if the DV is less than or equal to 12.0 µg/m<sup>3</sup>.<sup>22</sup>

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<sup>19</sup> Appendix U to Part 50 - Interpretation of the Primary and Secondary National Ambient Air Quality Standards for Ozone.

<sup>20</sup> National Ambient Air Quality Standards for Ozone, 80 FR 65292 – 65468 (Oct. 26, 2015).

<sup>21</sup> Appendix N to Part 50—Interpretation of the National Ambient Air Quality Standards for PM<sub>2.5</sub>.

<sup>22</sup> There is a secondary PM<sub>2.5</sub> NAAQS, with a level of 15.0 µg/m<sup>3</sup>. The work here focuses only on the primary NAAQS at 12.0 µg/m<sup>3</sup>, since compliance with the primary standard explicitly implies compliance with the secondary standard as well.

- For the 24-hr PM<sub>2.5</sub> NAAQS, the DV is the 3-year average of the annual 98<sup>th</sup> percentile 24-hr average PM<sub>2.5</sub> mass concentration. A monitor is in compliance with the 24-hr PM<sub>2.5</sub> standard if the DV is less than or equal to 35 µg/m<sup>3</sup>.

### 2.1.1 Ozone Monitoring Network

The ozone monitoring network consists of only one type of monitor, Federal Equivalent Method (FEM) monitors.<sup>23</sup> The FEM for ozone uses ultraviolet (UV) light to determine ozone concentrations at high temporal resolutions, on the order of seconds to minutes, although only hourly averages are typically recorded. Unlike PM<sub>2.5</sub> monitors, most ozone monitors are not required to operate year-round, and are instead required to operate only during the “ozone season.” The ozone season is the time of year that high ozone concentrations (which may potentially exceed the NAAQS) can be expected at a particular location. The ozone season varies widely by location, but is generally focused on the summer months, with a typical season spanning March through October. During the period of 2000 through 2016, a total of 1,708 ozone monitors reported data, with the locations of the ozone monitors shown in Figure 1 along with the average number of days sampled each year that the monitor was active.

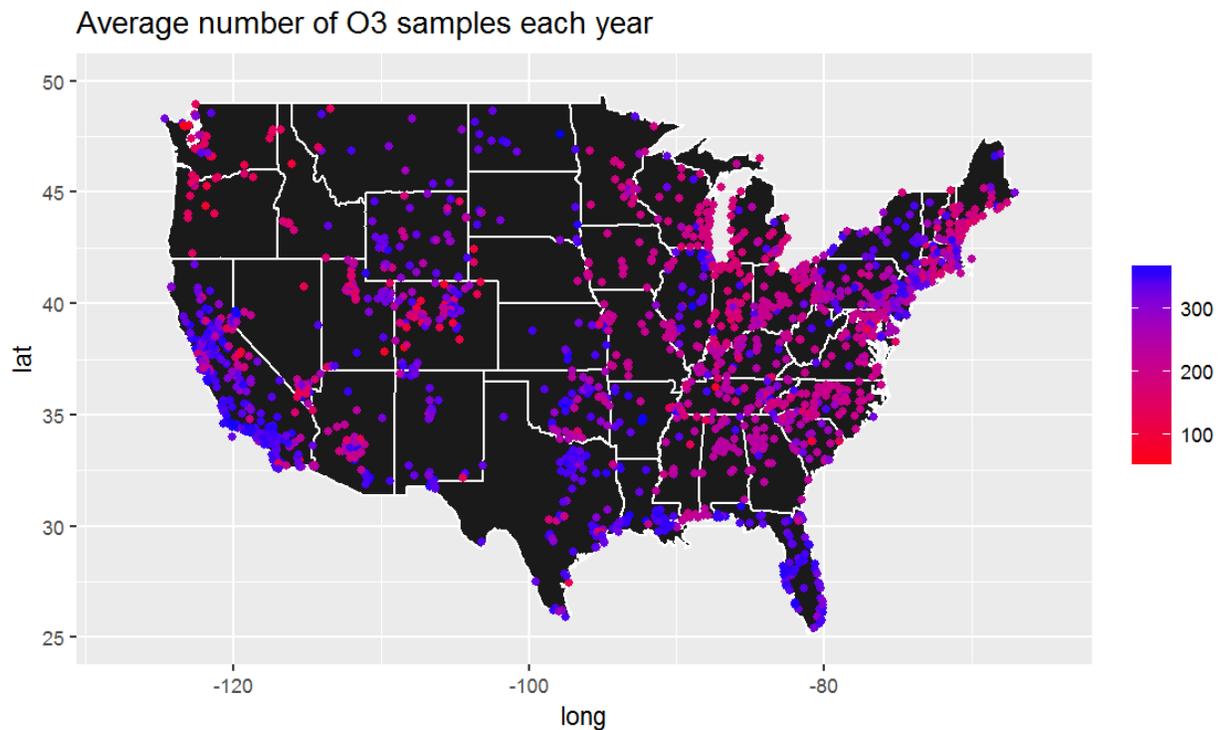


Figure 1 - Location and average number of monitored ozone days each year from the ozone sampling network for the years 2000-2016.

<sup>23</sup> FEM monitors are approved on an individual basis. The list of approved monitors and the accompanying CFR references can be found at <http://www3.epa.gov/ttn/amtic/criteria.html>.

### 2.1.2 PM<sub>2.5</sub> Monitoring Network

The PM<sub>2.5</sub> monitoring network consists of two types of monitors: Federal Reference Method (FRM)<sup>24</sup> and FEM<sup>23</sup> monitors. FRM monitors use a filter-based system, passing a low volume of air through a filter over a period of 24 hours (midnight to midnight) to determine 24-hr average concentrations. All monitors operate year-round, but not all monitors operate every day throughout the year. Although some FRM sites operate every day (*i.e.*, 1:1 monitors), most operate every third day (1:3 monitors), while a smaller number of monitors operate only every sixth day (1:6 monitors), according to a common schedule provided by the EPA. Newer FEM monitors are “continuous” monitors that can provide hourly (or shorter) PM<sub>2.5</sub> measurements and have undergone testing to demonstrate conformance (including linear regression, slope/intercept, time series, and mean concentration ratios) with the FRM monitors.<sup>25</sup> FEM monitors operate on a 1:1 schedule and daily averages from FEM monitors are determined by averaging the 24 hourly measurements collected throughout the day. FEM monitors are slowly replacing FRM monitors, so monitoring sites with a long data record may have data derived from either an FEM, FRM, or combination of both types of monitors. Although the FRM and FEM monitors have small differences in their performance, the largest impact to the bootstrap technique of this transition from all FRM monitors to a mix of FRM and FEM monitors is the gradual increase in the frequency of PM<sub>2.5</sub> measurements over time. During the period of 2000 through 2016, a total of 1,773 PM<sub>2.5</sub> monitors reported data, with the locations of the PM<sub>2.5</sub> monitors shown in Figure 2 along with the average number of days sampled each year that the monitor was active.

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<sup>24</sup> Appendix B to Part 50—Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method).

<sup>25</sup> Noble, C. A. et al (2001); Federal Reference and Equivalent Methods for Measuring Fine Particulate Matter, *Aerosol Sci. & Tech*, 34:5, 457-464.

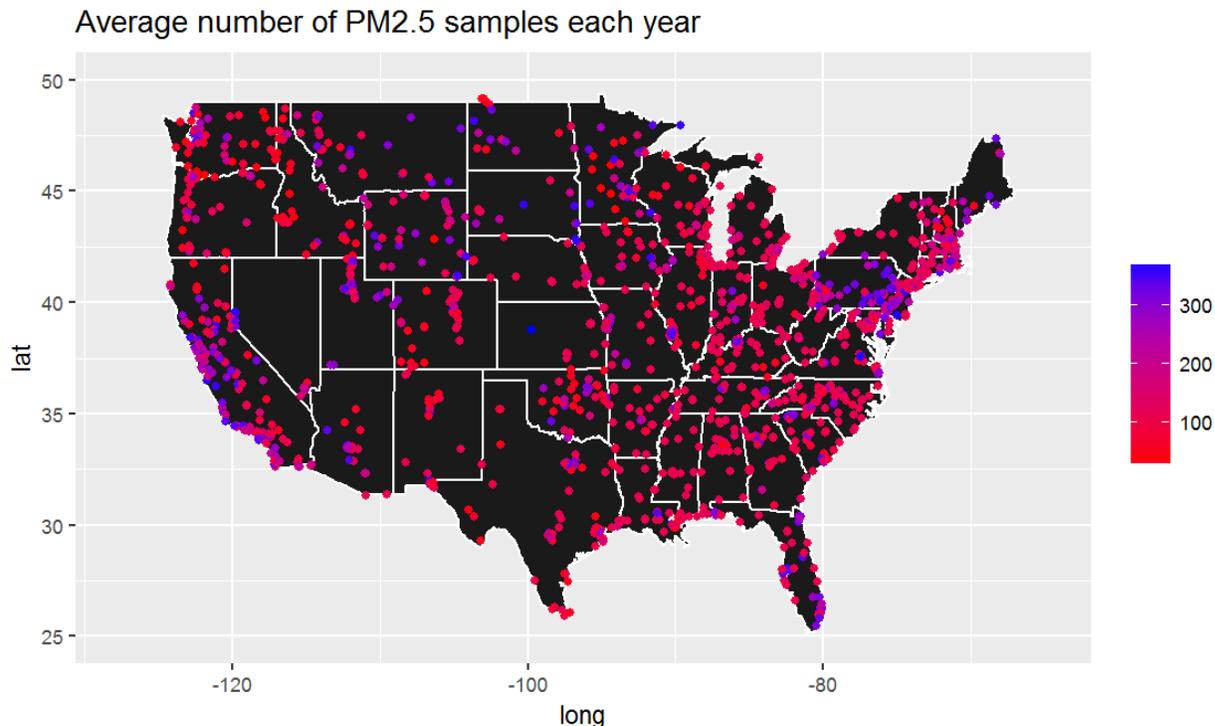


Figure 2 - Location and average number of monitored PM days each year from the PM<sub>2.5</sub> sampling network for the years 2000-2016.

### 2.1.3 Monitoring Network Design

The ambient air monitoring network is designed to support several objectives. In consideration of the location and measurement taken, each monitor is assigned a spatial scale. Spatial scales are generally associated with the size of the area that a pollutant monitor represents. The monitor spatial scales are defined in 40 CFR part 58, Appendix D as:

1. *Microscale*—Defines the concentrations in air volumes associated with area dimensions ranging from several meters up to about 100 meters.
2. *Middle scale*—Defines the concentration typical of areas up to several city blocks in size with dimensions ranging from about 100 meters to 0.5 kilometer.
3. *Neighborhood scale*—Defines concentrations within some extended area of the city that has relatively uniform land use with dimensions in the 0.5 to 4.0 kilometers range. The neighborhood and urban scales listed below have the potential to overlap in applications that concern secondarily formed or homogeneously distributed air pollutants.
4. *Urban scale*—Defines concentrations within an area of city-like dimensions, on the order of 4 to 50 kilometers. Within a city, the geographic placement of sources may result in there being no single site that can be said to represent air quality on an urban scale.
5. *Regional scale*—Defines usually a rural area of reasonably homogeneous geography without large sources, and extends from tens to hundreds of kilometers.

6. *National and global scales*—These measurement scales represent concentrations characterizing the nation and the globe as a whole.

Depending on the distribution and types of sources in an area and the need to determine particular aspects of the air quality, there may be multiple types of monitors placed in an area. For example, a large metropolitan area, due to its size, may require several “urban scale” or “neighborhood” scale monitors to capture the range of air quality in the area. Such an area might also have “microscale” monitors placed in order to assess the impacts from a single source or small group of sources as well as a “regional scale” monitor to establish the background air quality in an area in order to differentiate the impacts from the urban area. Conversely, for a smaller urban area a single “urban scale” monitor may be considered sufficient to fully characterize the local air quality. Thus, there are wide variety of monitors in any area, covering a range of air quality monitoring needs. For ozone, the appropriate spatial scales are neighborhood, urban, and regional scale. For PM<sub>2.5</sub>, in most cases the appropriate spatial scales are neighborhood, urban, or regional scales; however, in some cases it may be appropriate to monitor at smaller scales, depending on the monitoring objective.

#### 2.1.4 Air Quality System (AQS) Database

The EPA’s AQS database contains ambient air pollution data collected by state, local, and tribal air pollution control agencies, as well as EPA and other federal agencies, from the monitoring stations described above (as well as monitoring stations for other NAAQS).<sup>6</sup> AQS also contains meteorological data, descriptive information about each monitoring station, and data quality assurance/quality control information. The Office of Air Quality Planning and Standards (OAQPS), state and local air agencies, tribes, and other AQS users rely upon the system data to assess air quality, assist in attainment/nonattainment designations, evaluate state implementation plans for nonattainment areas, perform modeling for permit review analysis, and execute other air quality management functions related to the CAA.

## 2.2 Statistical Methods and Assessing Significance Using Confidence Intervals

This section provides a general overview of statistical methods, how air quality variability is characterized for this analysis, and the bootstrapping approach employed to estimate air quality variability.

### 2.2.1 General Overview of Statistical Methods

Statistics is the application of mathematical and scientific methods used to interpret, analyze and organize collections of data. Most statistical techniques are based on two concepts, a “population” and a “sample.” The *population* represents all possible measurements or instances of the entity being studied. The *sample* is a subset of the *population* that is able to be collected or measured. Since the *sample* is only a portion of the *population*, any observations or conclusions made about the *population* based on the *sample* will have uncertainty, *i.e.*, there will be some error in those observations or conclusions due to the fact that only a subset of the population was sampled or measured. Consider the following example:

As discussed above, the ambient monitoring network is designed to capture a range of ambient impacts from facilities and to characterize both background and local air quality. Suppose we want to determine the average ground-level PM<sub>2.5</sub> levels in a remote state wilderness area over the course of a year. Assuming the wilderness area does not have major PM<sub>2.5</sub> sources and the area is remote (*i.e.*, there are no major metropolitan areas upwind), a single, well-placed “regional scale” monitor may be sufficient to capture the nature of PM<sub>2.5</sub> levels in the area (*i.e.*, the PM<sub>2.5</sub> levels within the wilderness area are homogenous). Due to the remote nature of the monitor, it is only operated on a 1-in-every-6 days schedule, such that one 24-hr average PM<sub>2.5</sub> measurement is made every six days. In this case, we may consider the *population* to be the 24-hr average PM<sub>2.5</sub> concentrations every day (365 potential samples over the whole year) within the wilderness area. The *sample* would be the 1-in-every-6 days 24-hr average PM<sub>2.5</sub> measurements (60 samples taken over the whole year). From this *sample* of the *population*, a mean 24-hr average PM<sub>2.5</sub> concentration can be calculated, which can be characterized as representing the mean 24-hr average PM<sub>2.5</sub> concentration from the *population*, with some amount of error between the *sample* mean and the *population* mean. By using information about the size and distribution of the *sample*, an estimate of the population variability (*i.e.*, the spread of the distribution), can be determined (*e.g.*, the standard deviation).

*Significance* testing, or determining the *statistical significance* of a particular value as it relates to a *sample*, is a major application of statistics. In formal hypothesis testing, a statement of non-effect or no difference – termed the null hypothesis – is established prior to taking a sample in order to test the effect of interest. A statistical test is then carried out to determine whether a *significant* effect (or difference) is present at the desired level of confidence. Note that not finding a *statistically significant* difference is not a claim of the null hypothesis being true or a claimed probability of the truth of the null hypothesis.<sup>26</sup> *Non-significance* simply shows the data to be compatible with the null hypothesis under the set of assumptions associated with the statistical test.<sup>26</sup> A CI can be used as a mathematically equivalent procedure<sup>26</sup> to a formal hypothesis test for significance. CIs are constructed based on the desired confidence level and characteristics of the *sample*, including the sample variance, to determine error bars for the statistic of interest, such as the mean. Error bars constructed in this fashion are referred to as CI because they convey the confidence in the *sample* estimate of the *population* given the size of and the variability in the sample. This can then be used to determine if the mean is *significantly* different from a particular value of interest, such as zero or some other threshold for the pollutant, by examining whether the value of interest is within the CI or outside the bounds of the CI.

The most well-known approach to deriving CIs uses the characteristics of sampling distributions and the Central Limit Theorem. The sampling distribution of the mean results from sampling all possible samples of a specified size *n* from the true population and considering the distribution of the resulting means from each sample. The Central Limit Theorem is based on the fact that the

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<sup>26</sup> Gelman, A. P values and Statistical Practice, *Epidemiology*, 2013, Vol 24, Num 1, pg 70.

sampling distribution of the sample mean will center around the population mean. Regardless of the distribution of the original population, the sampling distribution of the mean will be normally distributed.<sup>27</sup> Additionally, the sampling distribution will have a spread, with a standard deviation that is inversely proportional to the square root of the sample size  $n$  (*i.e.*, the larger the sample size, the tighter the spread of the sampling distribution of the mean around the true mean of the population). This allows for the derivation of a CI by calculating the estimated mean plus/minus the standard error, which is a function of the sample size, the standard deviation, and the desired level of confidence.

To relate these statistical tests to a practical application, we continue the hypothetical example from above:

Suppose that the observed annual mean PM<sub>2.5</sub> concentration for a given year is  $7 \mu\text{g}/\text{m}^3$ , and that based on the Central Limit Theorem utilizing the properties of the sampling distribution, the 95% CI for the annual mean is determined to be  $6.4\text{-}7.6 \mu\text{g}/\text{m}^3$  ( $7 \mu\text{g}/\text{m}^3 \pm 0.6 \mu\text{g}/\text{m}^3$ , where  $0.6 \mu\text{g}/\text{m}^3$  has been determined based on the standard error and the desired level of confidence). Since the CI contains the value  $7.5 \mu\text{g}/\text{m}^3$ , we may, therefore, conclude based on this specific sample that the mean of the population is *not significantly* different from  $7.5 \mu\text{g}/\text{m}^3$  at the 0.95 confidence level. Conversely, if the 95% CI for the annual mean PM<sub>2.5</sub> concentration is  $6.7\text{-}7.3 \mu\text{g}/\text{m}^3$  ( $7 \mu\text{g}/\text{m}^3 \pm 0.3 \mu\text{g}/\text{m}^3$ ), then the CI does not contain  $7.5 \mu\text{g}/\text{m}^3$  and it could be concluded that the mean of the population is *significantly* different from  $7.5 \mu\text{g}/\text{m}^3$  at the 0.95 confidence level.

The Central Limit Theorem also tells us that due to the Gaussian (Normal Distribution) properties of a sampling distribution, 68/95/99.7 percent of the values in the theoretical sampling distribution will be within 1/2/3 standard deviations of the true population mean respectively. Additionally, in any symmetric distribution such as the Gaussian obtained with the theoretical sampling distribution, the mean is equal to the median, where the median is the center value such that 50% of the values are below the median and 50% above. Thus, an alternative approach to deriving a CI directly utilizes these characteristics of the sampling distribution to consider the spread around the sampling distribution mean. For example, a 95% CI would be defined as the lowest value to the highest value of the 95% of the distribution that centers around the sampling distribution mean. This corresponds to the 0.025 and 0.975 quantiles of the sampling distribution. An example of this method of determining CIs is given in Figure 3, which shows a distribution of the mean determined from repeated *samples* from the *population*. Note that in practice the sampling distribution is approximately Normal. The average of the sample means is  $6.98 \mu\text{g}/\text{m}^3$ . In order to determine the 95% CI, the data are first rank-ordered from smallest to the largest concentration value, then the bounds of the 0.025 and 0.975 quantiles are the bounds of the CI (the 50% CI is also shown as an example).

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<sup>27</sup> These are asymptotic properties given that the sample size  $n$  is large and that the number of samples ( $N$ ) drawn from the population is large – in theory, all possible samples of size  $n$  are drawn from the population. (Moore and McCabe, 4<sup>th</sup> Ed, 2003 – p. 262.) In practice,  $n \geq 30$  and  $N$  is often 1,000, 10,000, or as determined by convergence of distributional characteristics, and the resulting sampling distribution is approximately normal.

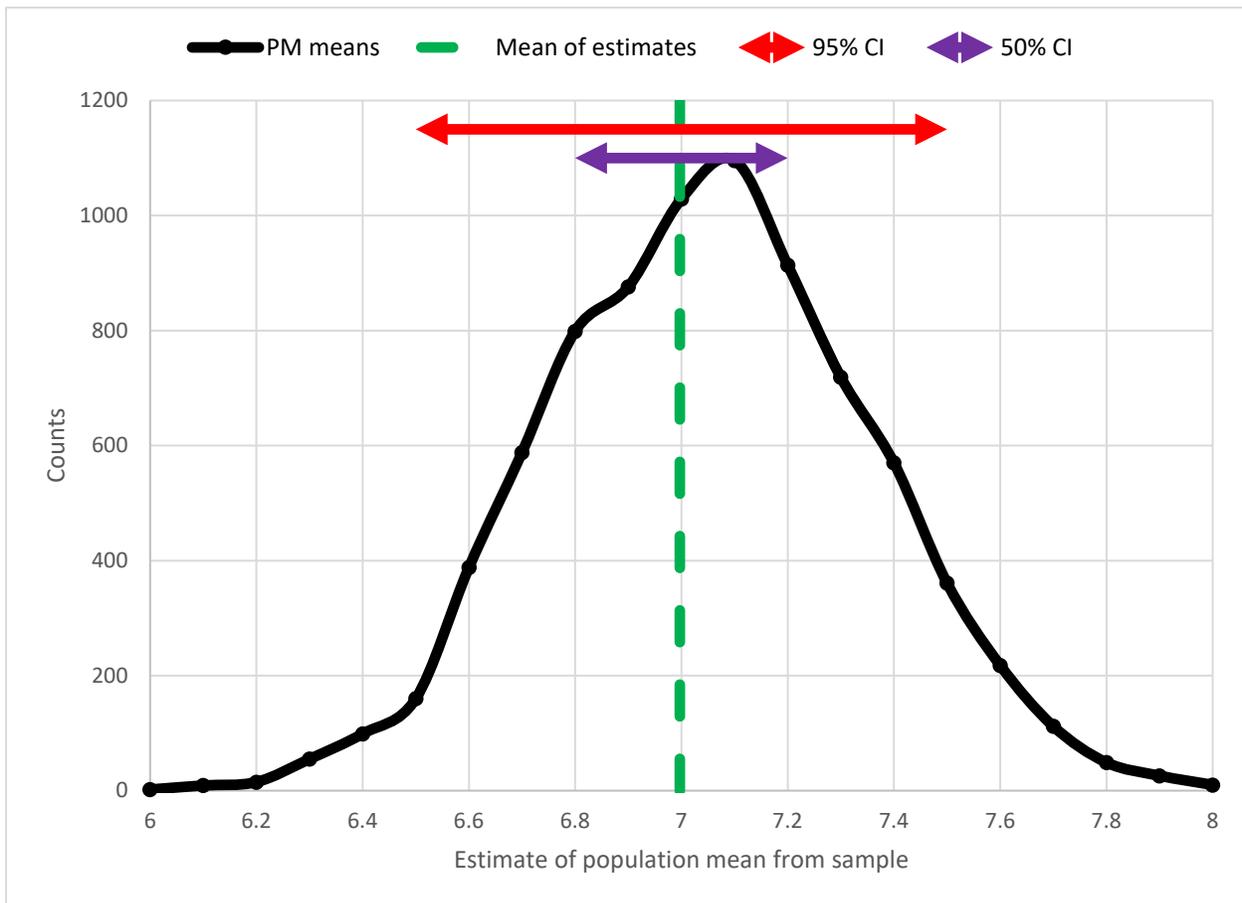


Figure 3- Example of CIs determined from a distribution of sample means.

The techniques utilizing the sampling distribution to make inferences about the population mean can be applied to other statistics as well, such as sample quantiles. Additionally, a statistical technique applied as resampling from one particular drawn sample, known as bootstrapping, can be used to generate estimated CIs for any desired statistic. Bootstrapping is further explained in Section 2.2.3.

The CIs for any sample comparison are generally affected by three main factors: the size of the sample, the variability within the sample, and the confidence limits desired for the comparison (*e.g.*, 0.95 level of confidence was used in the example above). Increasing the sample size (taking more measurements or samples) will increase the representativeness of the sample of the population and decrease the variance associated with the calculated measurement, resulting in narrower CIs. Samples from populations with greater inherent variability will have greater uncertainty and result in larger CIs. Finally, increasing the confidence level of the inferred conclusion will necessitate larger CIs, while lower confidence thresholds will result in narrower CIs. There are clearly many complicated aspects of significance testing, many of which require subjective selections by the analyst to insure that the results are appropriate to the application

and to reduce the influence of uncontrolled variables on the results and conclusions. These selections are usually made based on convention and standard practice, such as choosing a 95% CI. While there are many more applications of statistical techniques and nuances of the principles described above, these basic concepts of the population, sample, CIs (and their relationship to probability) are the fundamental concepts used in the development of “significant impact” thresholds presented here.

### 2.2.2 Characterizing Air Quality Variability

As discussed in Section 2.1, the DV from a particular monitor is the air quality statistic that is used to describe the air quality in an area (*e.g.*, the annual mean was the statistic from the example above) and is compared to the NAAQS to determine attainment status for that area. Within the conceptual framework discussed in the previous section, the ambient data from a single monitor are a *sample* of a *population* of the air quality in an area and the uncertainty in that sample stems from the inherent variability that occurs in air quality. The inherent variability is driven by a collection of factors, both natural (meteorological) and anthropogenic (emissions), which can be grouped into spatial and temporal categories.

#### 2.2.2.1 Spatial variability

The spatial variability is the change in air quality that is present at any one moment across an area. This variability is driven by the spatial distribution of sources (causing localized increases in ambient concentrations due to their emissions), removal or sinks (causing localized decreases in ambient concentrations due to physical or chemical processes), variations in chemical production for secondarily formed PM<sub>2.5</sub> and ozone (which do not have direct emissions sources), and meteorology (wind patterns may transport air from areas with higher emissions to areas that typically have lower concentrations due to fewer localized emissions). The spatial variability is directly addressed in the network design (*i.e.*, the spatial scale associated with each monitor and the potential need for multiple monitors to characterize the air quality in an area). One way to estimate the spatial variability is to compare ambient monitors that are in close proximity to one another. Such monitors would likely show similar trends in the ambient concentrations, with some variation due to changes in emissions and meteorology responsible for transporting pollutants and affecting chemical conversion, creation, and removal of atmospheric species that are specific to each individual location.

These spatial variations occur in the population of air quality levels and can be estimated from the existing sample (*i.e.*, data available from the ambient monitoring network). Depending on the intended scale of the monitor, there is some room for interpretation as to the population that sample represents (*e.g.*, a sample from an area-wide monitor theoretically represents the population of air quality across a wide area), and this interpretation has implications for the determination of the uncertainty associated with the sample (*e.g.*, a sample from an area-wide monitor is less likely to accurately represent air quality across the whole area at any moment, thus having greater uncertainty as to its ability to characterize the population of air quality it is intended to represent). Given the nature of the variability in air quality, there are three potential

populations represented by the sample and the spatial variability between the sample and the population:

1. If the population is considered to be the air quality at the location of the monitor only, then there is no spatial variability.
2. If the population is considered to be the air quality in the immediate vicinity of the monitor, then there will be some spatial variability, the degree of which will depend on nearby sources and sinks and the distance of the location of interest from these sources and sinks. For  $PM_{2.5}$ , if there is a nearby source of primary  $PM_{2.5}$ , changes in wind direction and mixing conditions will change where these nearby sources have impacts, such that there would be more spatial variability on this small scale. If there is no nearby source of primary  $PM_{2.5}$ , then secondary  $PM_{2.5}$  would dominate and there would likely be little small-scale spatial variability on this small scale. For ozone, the same is true, in that there will likely be little spatial variability unless there are nearby sources that act as a sink (*i.e.*, major  $NO_x$  source such as a highway or point source). Without a nearby sink, then the secondary nature of ozone would generally indicate that there is little spatial variability on this small scale.
3. If the population is considered to be the air quality over a larger scale (*e.g.*, a county or Core Based Statistical Area or CBSA), then there is much more spatial variability. As with case 2, the presence and location of sources and sinks will impact how much spatial variability is present, though on such a large scale, there are likely to be many sources and sinks across the area, resulting in more spatial variability.

As discussed in Section 2.2.1, monitoring sites are assigned a spatial scale, which are associated with the size of the area for which a particular monitoring site should be representative of the air quality. For secondarily formed pollutants, Appendix D to Part 58 states that the highest concentration monitors may include urban or regional scale monitors (*i.e.*, 50 to hundreds of km spatial scale). Intuitively, it would be expected that the air quality changes across these distance scales, such that the air quality across such a large area is not identical to the air quality as determined by a single monitor. Indeed, these classifications are supportive of the idea that there are spatial variations, such that multiple monitors are generally needed to adequately characterize the air quality in an urban area. However, in rural areas with few emissions sources, a single monitor may be sufficient to characterize the air quality over hundreds of square km (as was the case in the example above).

#### *2.2.2.2 Temporal variability*

In the example introduced in Section 2.2.1, there may be uncertainty not only from the limited sampling of the population, but also based on changes in the *population* occurring with time.

Temporal variability is the variability in air quality that occurs over time, which is driven by changes in emissions and meteorology over a range of time scales. For shorter time scales, diurnal patterns in both emissions and meteorological processes can impact most atmospheric pollutants. Mobile source emissions, which can substantially contribute to atmospheric pollution, have particularly strong daily (*i.e.*, rush-hour) and weekly (no rush-hour on the weekends)

patterns. Day-to-day meteorological variability (*i.e.*, frontal passages and synoptic weather patterns) can also cause temporal variability on the timescale of days to weeks. At intermediate time scales, seasonal changes in weather can have a major impact in transport patterns and chemical reactions. There can be seasonal trends in emission patterns as well, particularly those associated with energy production and mobile source emissions. At longer time scales, there can be longer-term trends in meteorology (*e.g.*, particularly warm or wet years) and emission sources (sources being added or removed or changes in emissions due to emissions controls or economic conditions) that result in long-term air quality variability. Temporal variability is reflected in the form of the standard (*i.e.*, compliance with each ozone and PM<sub>2.5</sub> standard is based on 3 years of data in order to reduce from the impact of temporal variability on NAAQS implementation programs). This variability can be addressed by requiring continuous monitoring in an area, even after air quality levels in an area are below the level of the standard. The long-term temporal variability can be characterized by examining changes in air quality over time at a particular monitor (*e.g.*, trends in DVs or other metrics from the monitor). The shorter-term temporal variability can be described by examining the hourly and daily changes in air quality or by comparing data from periods with similar meteorological conditions (*e.g.*, afternoon, weekdays versus weekends, or summertime concentrations).

Whatever the spatial scale of the monitor, temporal variability will always contribute to the air quality variability, as there will always be day-to-day changes in meteorology and emissions and variability between seasons and years, which may or may not include any trends in emissions and meteorology. The form of the standard (*e.g.*, annual average or a ranked daily value), the temporal resolution of the monitoring data (*e.g.*, hourly or 24-hr averaged samples), and the frequency of the sampling (*e.g.*, daily samples or samples taken every sixth day) may affect the ability of the monitoring data to fully capture the inherent temporal variability and thus increase the uncertainty in any statistic or DV derived from a particular sample. If a monitor has some missing data, then it is easy to conceptualize that there is some uncertainty caused by temporal variability in that there are days and hours that are not represented by the monitor. On the other hand, if a monitor has a perfect sampling record, then the uncertainty due to reduced sampling frequency is eliminated, but there remains long-term variability. Since the PM<sub>2.5</sub> and ozone DVs are based on 3 years of data, there is variability between the years that affect the DVs. As noted above, the use of a 3-year DV, rather than a DV derived from 1 or 2 years of data, is intended to increase the stability (or reduce the variability) of the DVs.

The importance of temporal variability is perhaps more apparent when the application of the DVs are considered. For area designations purposes, the DVs are historical (updated DVs for a particular year are published in the following calendar year), such that the DV is an estimate of the current state of the air quality in an area. Furthermore, in the permitting process, DVs are paired with modeling of past years of meteorology and planned future emissions. Thus, the changes from year-to-year and the uncertainty in estimating future air quality levels are illustrative of important factors affecting temporal variability that impacts regulatory applications and exists regardless of the completeness of the sampling record or the spatial scale defining the population discussed above.

Continuing the example from Section 2.2.1:

Suppose that after 1 year of sampling, there is some commercial development adjacent to the wilderness area, such that new buildings and larger traffic volumes are present during the second year of the monitor's operation. One might want to assess whether or not the new activity has had a notable impact on the average PM<sub>2.5</sub> concentrations within the wilderness area. A comparison between the scenarios can be considered, and the idea that the difference between the two may be "notable" can be evaluated by comparing that difference to the estimated CIs created by the bootstrap procedure using the concepts in significance testing (Section 2.2.1).

### 2.2.2.3 Assessing air quality variability

Based on the description of the population determined above, the DV can be understood to be a statistic determined from a sample of the population. CI's for a particular DV can then be used to compare the DV with another DV or a constant value (*e.g.*, the NAAQS). If the CI for the DV contains the value of interest, then the DV and the value of interest are statistically indistinguishable from one another, given the sample data available at a particular confidence level. In the context of an air quality analysis, if a CI can be determined for a DV, then it can be concluded that a value within some given amount of variation of a DV (*i.e.*, within a CI for that DV) is statistically not significant with respect to that selected level of confidence. Note that in this context *non-significance* simply shows the data to be compatible with an assumption of no difference between the value and the DV.<sup>26</sup>

### 2.2.3 Bootstrapping Method

For annual-average standards (*i.e.*, averages of many samples during 1 or 3 years), there are standard parametric methods (*e.g.*, the standard deviation) that might be used to estimate variability associated with DVs. When the statistic of interest has a variance that is difficult to estimate with parametric assumptions, such as a rank order statistic, some other approach must be taken to determine CIs. For non-normal populations, there are some adjustments that can be made to determine CIs of the mean if the data conform to some standard distribution (*e.g.*, log-normal). For small sample sizes, other non-parametric tests such as the Mann-Whitney<sup>28</sup> test or the Wilcoxon signed-rank test<sup>29</sup> may be used. However, for many statistics (*e.g.*, the 98<sup>th</sup> percentile), the underlying distribution of the statistic may be complicated or unknown, and thus determination of the CIs for these statistics can be difficult or impossible to determine with traditional metrics.<sup>30</sup> Of the three NAAQS considered here, the annual PM<sub>2.5</sub> standard is the only NAAQS that is based on a sample mean. However, the calculation of the DV statistic for the annual PM<sub>2.5</sub> NAAQS is more complicated than merely taking a simple arithmetic average of the 24-hr PM<sub>2.5</sub> values across 3 years; thus, deriving the distribution of the annual PM<sub>2.5</sub> DV statistic

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<sup>28</sup> Mann, H. B.; Whitney, D. R. (1947). On a Test of Whether one of Two Random Variables is Stochastically Larger than the Other. *Annals of Mathematical Statistics* 18 (1): 50–60. doi:10.1214/aoms/1177730491.

<sup>29</sup> Wilcoxon, F. (Dec 1945). Individual comparisons by ranking methods. *Biometrics Bulletin* 1 (6): 80–83.

<sup>30</sup> Woodruff, R. S. (1952); Confidence intervals for medians and other position measure. *J. Amer. Stat. Assoc.*, 47, 635–646, doi:10.1080/01621459.1952.10483443.

is not straightforward. The CIs for the 24-hr PM<sub>2.5</sub> and ozone NAAQS are based on rank-order statistics (98<sup>th</sup> percentile for PM<sub>2.5</sub> and 4<sup>th</sup> highest daily maximum 8-hr ozone concentration, see Section 2.1), which cannot be easily described using standard statistical techniques. Thus, for the three DV statistics being analyzed here, an alternative technique to determine CIs is needed.

The bootstrapping method mentioned above is a well-established and accepted statistical method that allows one to estimate the underlying distribution of many sample statistics (*e.g.*, mean, percentiles, and correlation coefficients) when the theoretical distribution is complicated or unknown.<sup>7, 8, 9</sup> The bootstrap method relies on the underpinnings and characteristics of sampling distributions discussed in Section 2.2. The estimate of the distribution is accomplished by resampling with replacement from the initial dataset many times, resulting in many resampled datasets (bootstrapped samples). The sample statistic of interest is then computed from each resampled dataset, resulting in an empirical estimate of the sampling distribution for the desired statistic. This estimate of the sampling distribution can then be used to determine CIs for the statistic of interest. Bootstrapping does not require any distributional assumptions for the population, nor does it require that there be an established formula for estimating the uncertainty in the statistic.

Meaningful information on the variability associated with the ozone and PM<sub>2.5</sub> DVs can be derived by using bootstrapping to assess the variability associated with the three DV statistics (*i.e.*, the ozone DV, the annual PM<sub>2.5</sub> DV, and the 24-hr PM<sub>2.5</sub> DV).<sup>9</sup> This analysis uses ambient PM<sub>2.5</sub> and ozone measurement data taken from the EPA's AQS database to determine CIs for each monitor for 3-year DV periods (*i.e.*, the 3 years of ambient data required to compute a DV for these NAAQS). The CIs give a measure of the temporal and spatial variability in the air quality represented by each monitor. A nationwide analysis of the variability and changes in this variability over time is also conducted. Finally, the results from this analysis of air quality variability are used to calculate levels of change in pollutant concentrations that can serve as “significant impact” thresholds in the context of source-specific “cause or contribute” determinations.

The dataset used for this technical analysis comes from the AQS database described in Section 2.1 and is the same dataset that would be used for determining the DV at any particular monitor. The ambient PM<sub>2.5</sub> concentration data used for this analysis consist of 24-hr averaged samples, while the ozone data consist of 8-hr averaged concentrations (*i.e.*, the MDA8's). This includes data from all of the monitoring sites in the EPA's AQS database from the years of 2000 to 2016.<sup>31</sup>

The bootstrapping estimates used in this analysis were calculated independently for each monitoring site, and the bootstrapping resamples at each site were taken independently within

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<sup>31</sup> Raw daily and hourly measurements from FRM and FEM monitors are aggregated by AQS into a single daily value for each sampling site and NAAQS (annual and 24-hr) according to the procedures described in Appendix N of Part 50. The aggregation procedures in AQS include accounting for multiple monitors at sites, handling of exceptional events (which can be different between the two PM<sub>2.5</sub> NAAQS), and calculating a 24-hr value from 1-hr measurements. These results reside in the "site\_daily\_values" table of AQS, which were downloaded for use in the current analysis.

each calendar year. The re-sampling within each year is completed such that the re-sampled year contains the same number of days as the original data. The number of measurements varies by monitoring site and can have important implications for the inherent variability. The variation in the sampling schedule is explored further in Section 3.2.2. The re-sampling and computation of new DVs at each site are conducted to mimic the DV calculation procedures as closely as possible, which differ for each NAAQS.<sup>19,21</sup>

- For the annual PM<sub>2.5</sub> NAAQS, the data from each year was further subset by quarter (*i.e.*, Jan-Mar, Apr-Jun, Jul-Sep, Oct-Dec), such that the re-sampling did not allow for data from one quarter to occur in another quarter. The resulting re-sampled dataset was averaged by quarter; then the quarterly means were averaged to find the annual mean, with the DV being computed as the average of the three annual means. Design values for the annual PM<sub>2.5</sub> NAAQS were rounded to the tenth  $\mu\text{g}/\text{m}^3$  (*i.e.*, the one decimal), consistent with the computation of DVs for designation purposes.
- For the 24-hr PM<sub>2.5</sub> NAAQS, the data from each year was subset by quarter (*i.e.*, Jan-Mar, Apr-Jun, Jul-Sep, Oct-Dec), such that the re-sampling did not allow for data from one quarter to occur in another quarter. The number of days in each quarter was kept equal to the corresponding number in the original dataset. While this isolation of quarters is not a feature of the DV calculation procedure, it was applied as a precaution to avoid changing the seasonal balance in the bootstrapped samples. The resulting re-sampled dataset was then ranked, and the 98<sup>th</sup> percentile value was selected based on the number of daily measurements in each year, as described in Table 1 of Appendix N. The DVs were then computed as the average of the three annual 98<sup>th</sup> percentile values. Design values for the 24-hr PM<sub>2.5</sub> NAAQS were rounded to the nearest  $\mu\text{g}/\text{m}^3$ , consistent with the computation of design values for designation purposes.
- For the ozone NAAQS, all available data at each site were used. The ozone monitoring regulations require monitoring for the “ozone season,” which varies by state. Many states operate a subset of ozone monitors outside of the required monitoring season and when those data are available it is used in determining DVs for regulatory purposes. Therefore, if a monitor operated beyond the required ozone season, all valid data were included in the DV calculation. For example, if the required monitoring season was from April-October, but data from November were also available, then the MDA8 values from April-November were ranked in order to find the 4<sup>th</sup> highest value. The DVs were then computed as the average of the three annual 4<sup>th</sup> highest MDA8 values. Design values for the ozone NAAQS were truncated to the nearest ppb, consistent with the computation of design values for designation purposes. Though the regulations for processing ozone data to compute a DV do not involve segregation of the data by season, a sensitivity analysis was conducted to determine the impact of applying the same quarterly segregation used for PM<sub>2.5</sub>. The results are summarized in Section A.4 of the Appendix, but the results indicated relatively little sensitivity to this choice for most sites and, thus, no quarterly segregation was applied for the final analysis.

For both PM<sub>2.5</sub> and ozone, each year of data from each site was re-sampled 20,000 times. During initial development of the method, the distributions derived from the bootstrap analysis did not appear to change after 3,000-4,000 re-samples for several single calendar years. Therefore, 20,000 re-samples were chosen to conservatively ensure that stable results were obtained for all cases. For each 1-year re-sample for each pollutant, the relevant annual statistic was computed (annual mean for PM<sub>2.5</sub>, 98<sup>th</sup> percentile for PM<sub>2.5</sub>, and 4<sup>th</sup> highest MDA8), giving 20,000 estimates of the annual statistic for each year. In order to replicate the way in which the standard is calculated, the data from each year are resampled separately from the other years. In order to calculate the bootstrap samples in a manner consistent with the DV calculations (*i.e.*, calculating averages and 98<sup>th</sup> percentile values in each year independently), then averaging the three annual values, each of the 20,000 estimates for year 1 were averaged with the corresponding 20,000 estimates for year 2 and year 3, giving 20,000 estimates of the DV. From the 20,000 estimates, the mean, median, standard deviation, maximum, minimum, 25%, 50%, 68%, 75% and 95% CIs for the mean,<sup>32</sup> were computed and retained for further analysis. For symmetric distribution such as the Normal Distribution obtained with the sampling distribution, the mean is equal to the median, where the median is the center value such that 50% of the values are below the median and 50% above. Thus, a bootstrapped CI for the mean is analogous to a bootstrapped CI for the median and the CIs can be calculated by rank-ordering the bootstrap results and selecting the bounds that contain the corresponding percentage of data. Since data from 2000-2014 were processed, all possible 3-year DVs from 2002-2014 were computed, for a total of 13 DV-years, including five 3-year periods that had non-overlapping years (*i.e.*, 2000-2002, 2003-2005, 2006-2008, 2009-2011, and 2012-2016).<sup>33</sup> As we are defining the CIs as the bounds of the uncertainty and a measure of the air quality variability, we frequently refer to each CI as the uncertainty associated with the actual DV.

The following gives an example of how the CIs are determined utilizing the percentile method<sup>34</sup> for the 24-hr PM<sub>2.5</sub> DVs from a monitor:

- Consider the dataset  $X_0$ , which contains 150 measurements of 24-hr averaged PM<sub>2.5</sub> monitoring values from year 1. Datasets  $Y_0$  and  $Z_0$  contain data from the same site, but for years 2 and 3 respectively, and contain 250 and 350 days of data respectively.
- From  $X_0$ , we calculate the 98<sup>th</sup> percentile as the 3<sup>rd</sup> highest value in the dataset. From  $Y_0$ , we calculate the 98<sup>th</sup> percentile as the 5<sup>th</sup> highest value in the dataset. From  $Z_0$ , we calculate the 98<sup>th</sup> percentile as the 7<sup>th</sup> highest value in the dataset. The DV for this site is the average of the 98<sup>th</sup> percentiles from  $X_0$ ,  $Y_0$ , and  $Z_0$ .

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<sup>32</sup> Here, and elsewhere in this document, a CI for the median is the interval spanning the data that contains ½ of the CI of the data above the median and ½ of the CI of the data below the median of the re-sampled DV estimates. For example, the 50% CI consists of the 25% of the data above the median and the 25% of the data below the median.

<sup>33</sup> Later in this document, whenever a single year is used to identify a DV, it refers to the last year of the 3-year period.

<sup>34</sup> Efron, B.; Tibshirani, R. (1993); An Introduction to the Bootstrap. Boca Raton, FL: Chapman & Hall/CRC. ISBN 0-412-04231-2.

- From  $X_0$ , 20,000 new sample datasets,  $X_1, X_2, \dots, X_{20,000}$ , each with 150 measurements of  $PM_{2.5}$  are sampled with replacement from the original dataset  $X_0$ . Likewise, 20,000 new sample datasets are sampled with replacement from  $Y_0$ , and  $Z_0$ .
- For each  $X_i$ , the 98<sup>th</sup> percentile value is the 3<sup>rd</sup> highest value, for each  $Y_i$ , the 98<sup>th</sup> percentile is the 5<sup>th</sup> highest value, and for each  $Z_i$ , the 98<sup>th</sup> percentile is the 7<sup>th</sup> highest value. Thus, the DV for each subset,  $DV_i$ , is the average of the 3<sup>rd</sup> high value from  $X_i$ , the 5<sup>th</sup> highest value from  $Y_i$ , and the 7<sup>th</sup> highest value from  $Z_i$ . This calculation yields 20,000 different DVs.
- To determine the CIs from these 20,000 DVs, the DVs are ranked from low to high. Then the lower bound for the 50% CI is the 5,000<sup>th</sup> ranked DV, and the upper bound for the 50% CI is the 15,000<sup>th</sup> ranked DV. That is, the CIs are determined simply by ranking the resulting distribution of DVs and the  $(1-q)\%$  CI for the mean is the bounds of the center of the data that contains  $q$  percentage of the results (*i.e.*, the lower bound is the  $(q/2)$ <sup>th</sup> percentile and the upper bound is the  $(1-q/2)$ <sup>th</sup> percentile).

Section A.1 provides several illustrative examples of the bootstrapping analysis for both the annual and 24-hr  $PM_{2.5}$  NAAQS with actual data from six different sites.

## 3.0 Results of the Air Quality Variability Approach

This section provides results on characterizing the variability of air quality for ozone and  $PM_{2.5}$  based on EPA's Air Quality Variability approach.

### 3.1 Ozone results

The results from the bootstrap analysis for the 2014-2016 ozone DVs are shown in Figure 4, which shows the mean, median, minimum, and maximum bootstrap DVs for each monitor, as well as the upper and lower bounds of the 25%, 50%, 68%, 75%, and 95% CIs for the median DV calculated from the 20,000 bootstrap samples as a function of the DV determined from the original dataset (top panel), the relative differences between the CI DVs and the actual DVs (middle panel), and box-and-whisker plots of the distribution of the relative difference at each CI (bottom plot). The mean and median of the bootstrap DVs for the ozone NAAQS replicate the actual DV from the original site data fairly well, with some very small deviations (maximum deviation is less than 5%). Even though the ozone NAAQS is based on peak values (similar to the 24-hr  $PM_{2.5}$  NAAQS), the magnitude of the relative variability in the ozone bootstrap DVs ranges from 1-5%, with maximums around 25-30%. This is likely due to the nature of ozone formation (*i.e.*, ozone is almost exclusively a secondarily formed pollutant, with precursors typically originating from multiple sources, rather than a single source). There is a component of reaction/formation time, both of which are likely to reduce the spatial variability and temporal variability of the ambient ozone. There is an increase in the absolute variability with an increase in the baseline DVs, but there is not an apparent trend in the relative variability. This indicates that the baseline air quality does not systematically affect the relative amount of variability at a site. This is especially important because it indicates that a central tendency value for the relative

variability in the DV for the ozone NAAQS is stable across levels of ozone concentrations. Therefore, a representative value can be multiplied by the level of that NAAQS to obtain a value in concentration units (ppb for ozone) that is appropriately used to characterize variability for sites with air quality that “just complies” with the NAAQS.

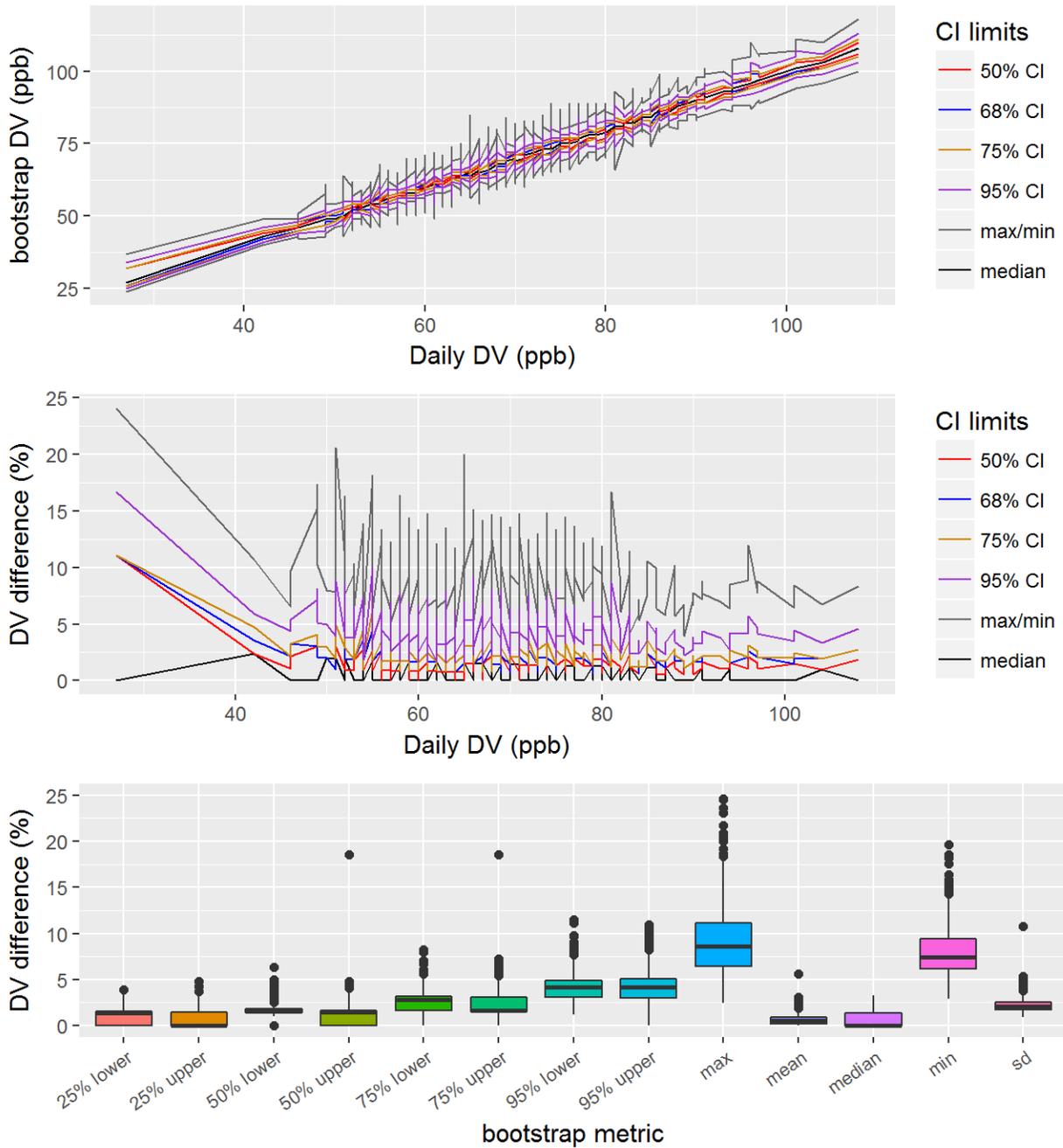


Figure 4 - Bootstrap results for the ozone 2014-2016 DVs (25%, 50%, 68%, 75%, and 95% CIs, along with the mean and median bootstrap DVs) Top panel shows the values for the DVs at the various CIs, the middle panel shows the average of the relative difference between the upper and lower bounds of the CI and the actual DV, and the bottom panel shows the distribution of the relative differences between the CI and the actual DV.

### 3.2 PM<sub>2.5</sub> Results (Annual and 24-hr)

The results from the bootstrap analysis for the 2014-2016 DVs are shown in Figures 5 and 6. The top two panels of Figure 5 show the upper and lower limits of the 25%, 50%, 68%, 75%, and 95% CIs for the median as well as the mean, median, minimum and maximum DVs calculated from the 20,000 bootstrap samples as a function of the DV determined from the original dataset. Variability is greater for the 24-hr PM<sub>2.5</sub> NAAQS than the annual PM<sub>2.5</sub> NAAQS. This is not surprising since the mean is expected to be a more stable statistic than the 98<sup>th</sup> percentile. Since the PM<sub>2.5</sub> data distributions tend to be skewed to the right (see examples in the Appendix), the presence of a few very high concentration values, or “outliers,” in the original dataset for a year would tend to increase the variability associated with any metric based on the highest concentrations (*e.g.*, if the 50<sup>th</sup> percentile value were determined, it would likely have much less variability than the 98<sup>th</sup> percentile). The mean and median of the bootstrap DVs for the annual NAAQS almost perfectly replicate the actual DV from the original site data. While some deviations of the mean and median bootstrap DVs from the actual 24-hr NAAQS DV are evident, there are only a few sites where the mean and median bootstrap DVs deviate substantially from the actual DV.

The relative variability (*i.e.*, the difference between the bounds of the bootstrapped CI and the actual design value for a single monitoring site, divided by the actual design value for the site) is also shown in Figure 5, with distributions of the relative differences for each CI across monitoring sites shown in Figure 6. Viewing the results on a relative scale allows the display of finer details of the deviations between the bootstrap results and the actual DVs. The relative variability shows that for the annual NAAQS there are relatively small differences in the values corresponding to the 25%, 50%, 68%, and 75% CIs compared to the difference between these and the 95% CI. Similarly, for the 24-hr NAAQS, the values corresponding to the 50%, 68% and 75% CIs are fairly close to each other, with greater differences between these and the 25% CI on the low end and the 95% CI on the high end. The relative variability shows an important feature: that from a relative sense, the air quality variability is fairly stable as the baseline air quality worsens. That is, there is no notable increase in the relative variability of the bootstrap DV as the actual DV increases. This is important because it indicates that the magnitude of the actual DV does not systematically affect the relative variability in the bootstrap DV at a site and because it indicates that a central tendency value for the relative variability in the DV. Therefore, a representative value can be multiplied by the level of that NAAQS to obtain a value in concentration units ( $\mu\text{g}/\text{m}^3$  for PM<sub>2.5</sub>) that is appropriately used to characterize variability for sites with air quality that “just complies” with that NAAQS.

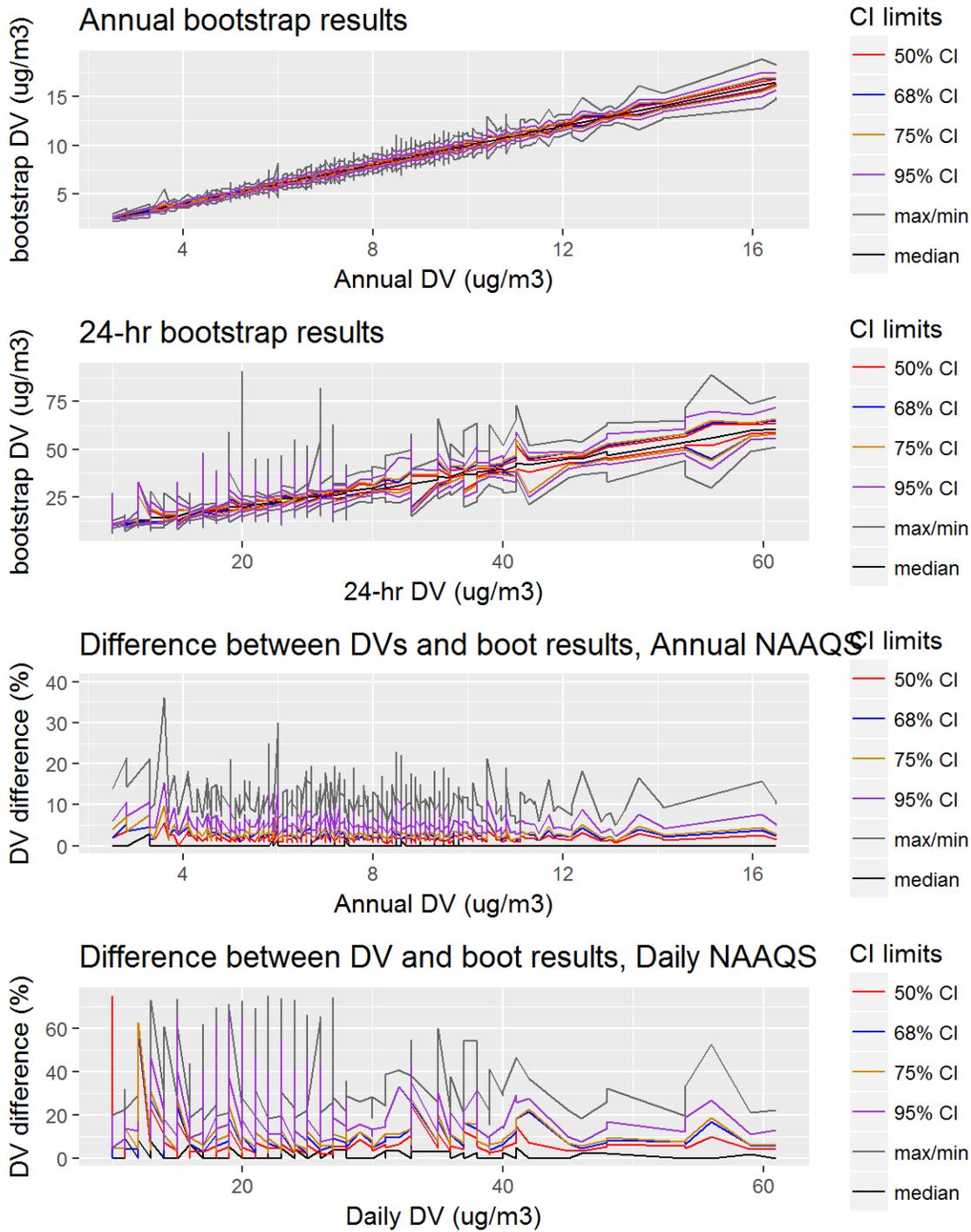


Figure 5 - Bootstrap results for the PM<sub>2.5</sub> 2014-2016 DVs (25%, 50%, 68%, 75%, and 95% CIs, along with the mean and median bootstrap DVs). The top two panels show the values for the DVs at the various CIs, while the bottom two panels show the average of the percent difference between the upper and lower bounds of the CI and the actual DV.

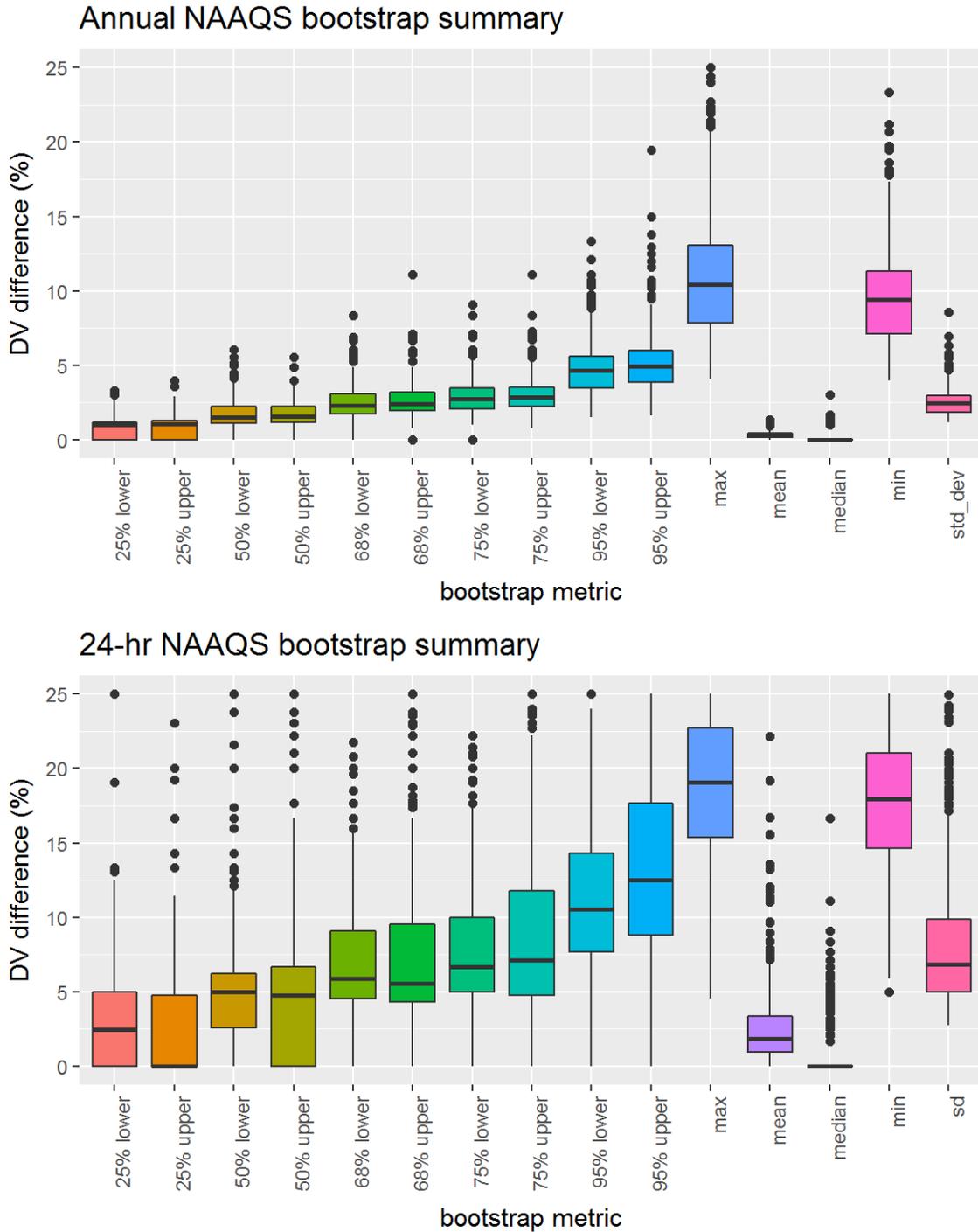


Figure 6 - Bootstrap results for the PM<sub>2.5</sub> 2014-2016 DVs, showing distribution of the relative differences between the upper and lower bounds of the bootstrap DVs and the actual DV at the 25%, 50%, 68%, 75%, and 95% CIs, along with the mean, median, maximum, minimum, standard deviations of the relative differences.

### 3.2.1 Analysis of PM<sub>2.5</sub> Spatial Variability

Section 2.1.3 discusses the design of the monitoring network and the spatial scales associated with each monitor. While there may be changes to the area around a monitor after the scale was determined when the monitor was sited, the monitor scale should be somewhat reflective of air quality within the area indicated. This basic need for multiple monitor scales and multiple monitors in an area to assess an area's air quality is due to the fact that there is an inherent spatial variability of air quality. For example, due to the inherent variability in the location of emission sources and changes in meteorological patterns, two “urban scale” monitors located a few blocks from each other would likely record different daily values, resulting in different DVs. The analysis conducted here seeks to quantify that spatial variability by identifying pairs of monitors that are located in proximity to one another to determine the relative difference between the two monitors, as indicated by the DVs. The differences between the DVs are interpreted as a measure of the spatial variability in the area and provide a benchmark to evaluate the variability determined from the Bootstrap analysis.

The analysis was conducted using the 2012-2016 annual and 24-hr PM<sub>2.5</sub> DVs and focused on pairs of monitors which collected PM<sub>2.5</sub> samples every day (1:1 monitors) in order to reduce the impact of temporal variability (see Section 4.3.1 for an analysis of the temporal variability). A total of 70 1:1 monitors were identified that were separated by a distance of less than 50 km, with 13 less than 10 km apart. We did not investigate whether -- based on emission sources, winds, and terrain -- any of these sites could reasonably be considered representative for particular locations at which a new source could seek a permit in the future.

The results from the analysis are summarized in Table 1 (monitor pairs within 10 km) and in Figures 7, 8 and 9 (monitor pairs within 50 km). There is a fairly strong correlation between the DVs in the site pairs (top panels in Figure 7), with a slope of 0.8 ( $r^2$  of 0.51) between monitor pairs less than 50 km apart for the annual NAAQS and a slope of 0.87 ( $r^2$  of 0.59) for the 24-hr NAAQS. There are no obvious trends in the differences between the monitors, either the absolute differences or the relative differences (defined as the absolute difference between the DVs from the two monitors divided by the average DV). The relative differences range from 0% to 66%, with a median relative difference of 9% for the annual DVs. For the 24-hr DVs, the relative differences range from 0% to 67%, with a median relative difference of 6%. When the subset of monitors within 10 km are considered, the slope between paired monitors is similar for the annual NAAQS, though the  $r^2$  increases to 0.82, while the slope for the 24-hr NAAQS increases to 0.97 and the  $r^2$  increases to 0.94. For this subset, the maximum relative differences drop to 23% and 16% for the annual and 24-hr DVs, respectively, and the median relative differences drop to 5% and 4%, respectively.

These results are interesting and seem to somewhat contrast the results from the bootstrap analysis, which suggest less variability in the annual NAAQS than in the 24-hr NAAQS. This comparison suggests that there is more spatial variability associated with the annual NAAQS, while the bootstrap results show that there is less variability in the annual NAAQS. Conversely, this comparison suggests that there is less spatial variability associated with the 24-hr NAAQS, while the bootstrap results show that there is more variability in the 24-hr NAAQS. Despite this

apparent contradiction, these results make sense in the context of secondary pollutants, particularly  $PM_{2.5}$ . In general, the highest concentrations associated with pollutants that have a substantial portion due to secondary formation occur in widespread “events”. These events are an important aspect of the air quality in an area and are associated with unique meteorological conditions, which can either transport air from polluted upwind regions, increasing the background concentrations, or trap local pollutants and facilitate in-situ production. Events are also associated with unique emissions episodes, such as dust storms or biomass burning events that emit large quantities of primary and precursor pollutants. Because of the nature of  $PM_{2.5}$  events, there would tend to be a stronger correlation of the higher concentrations across larger spatial scales. The average air quality (annual NAAQS), on the other hand, would not be as heavily impacted by the unique (and wide-spread events) and instead would be more heavily affected by local emissions and production. As such, the prevailing meteorological conditions and the prevalent local emission sources would have the most impact on the annual DVs. In this case, localized differences in emissions could cause monitors to have greater differences in the annual DVs than is seen at a number of site pairs.

The result from the spatial variability analysis of  $PM_{2.5}$  also suggests an important link to temporal variability of  $PM_{2.5}$ . The occurrence of these transport and emissions events is infrequent with varying intensity, such that they may not occur in every year and their frequency and duration would vary. Even when these events do occur, the intensity and impact on regional and local air quality would vary and also be difficult to predict. Since the bootstrap results show that 24-hr NAAQS has the most variability, this seems to imply that temporal variability is the most important component of the 24-hr NAAQS variability, while the spatial variability may be the most important component of the annual NAAQS variability, based on the results from the spatial analysis.

Table 1 - Summary of results from PM<sub>2.5</sub> spatial variability analysis for monitor pairs within 10 km of one another.

State	City	Dist (km)	Monitor 1 ID	Annual DV 1	Monitor 2 ID	Annual DV 2	Delta (%) <sup>35</sup>
Minnesota	Washington	1.0	271630447	8.1 µg/m <sup>3</sup>	271630448	8.8 µg/m <sup>3</sup>	8%
Hawaii	Honolulu	1.7	150031001	4.9 µg/m <sup>3</sup>	150031004	5.6 µg/m <sup>3</sup>	14%
Pennsylvania	Philadelphia	2.6	421010047	10.3 µg/m <sup>3</sup>	421010057	10.9 µg/m <sup>3</sup>	5%
Pennsylvania	Philadelphia	3.1	421010055	11.6 µg/m <sup>3</sup>	421010047	10.3 µg/m <sup>3</sup>	12%
Louisiana	East Baton Rouge	5.4	220330009	9.0 µg/m <sup>3</sup>	221210001	9.2 µg/m <sup>3</sup>	3%
Nevada	Washoe	5.5	320310016	7.9 µg/m <sup>3</sup>	320311005	10.0 µg/m <sup>3</sup>	23%
Pennsylvania	Northampton	5.7	420950025	10.5 µg/m <sup>3</sup>	420950027	10.1 µg/m <sup>3</sup>	4%
Rhode Island	Providence	5.9	440070022	7.1 µg/m <sup>3</sup>	440071010	7.4 µg/m <sup>3</sup>	3%
Iowa	Clinton	6.4	190450019	10.6 µg/m <sup>3</sup>	190450021	9.4 µg/m <sup>3</sup>	11%
Utah	Salt Lake	7.3	490353006	9.2 µg/m <sup>3</sup>	490353010	9.7 µg/m <sup>3</sup>	5%
New Mexico	Bernalillo	7.9	350010023	6.5 µg/m <sup>3</sup>	350010024	6.3 µg/m <sup>3</sup>	3%
Indiana	Marion	8.9	180970078	11.1 µg/m <sup>3</sup>	180970081	11.8 µg/m <sup>3</sup>	6%
Indiana	Clark	9.3	180190006	11.8 µg/m <sup>3</sup>	211110067	11.3 µg/m <sup>3</sup>	4%
State	City	Dist (km)	Monitor 1 ID	24-hr DV 1	Monitor 2 ID	24-hr DV 2	Delta (%) <sup>35</sup>
Minnesota	Washington	1.0	271630447	20.6 µg/m <sup>3</sup>	271630448	21.1 µg/m <sup>3</sup>	3%
Hawaii	Honolulu	1.7	150031001	10.9 µg/m <sup>3</sup>	150031004	11.4 µg/m <sup>3</sup>	5%
Pennsylvania	Philadelphia	2.6	421010047	24.3 µg/m <sup>3</sup>	421010057	25.2 µg/m <sup>3</sup>	4%
Pennsylvania	Philadelphia	3.1	421010055	26.4 µg/m <sup>3</sup>	421010047	24.3 µg/m <sup>3</sup>	8%
Louisiana	East Baton Rouge	5.4	220330009	19.7 µg/m <sup>3</sup>	221210001	19.4 µg/m <sup>3</sup>	2%
Nevada	Washoe	5.5	320310016	26.8 µg/m <sup>3</sup>	320311005	31.5 µg/m <sup>3</sup>	16%
Pennsylvania	Northampton	5.7	420950025	27.2 µg/m <sup>3</sup>	420950027	28.3 µg/m <sup>3</sup>	4%
Rhode Island	Providence	5.9	440070022	18.3 µg/m <sup>3</sup>	440071010	18.6 µg/m <sup>3</sup>	2%
Iowa	Clinton	6.4	190450019	24.7 µg/m <sup>3</sup>	190450021	22.8 µg/m <sup>3</sup>	8%
Utah	Salt Lake	7.3	490353006	42.3 µg/m <sup>3</sup>	490353010	41.0 µg/m <sup>3</sup>	3%
New Mexico	Bernalillo	7.9	350010023	15.4 µg/m <sup>3</sup>	350010024	15.1 µg/m <sup>3</sup>	2%
Indiana	Marion	8.9	180970078	25.0 µg/m <sup>3</sup>	180970081	26.4 µg/m <sup>3</sup>	5%
Indiana	Clark	9.3	180190006	24.2 µg/m <sup>3</sup>	211110067	22.8 µg/m <sup>3</sup>	6%

<sup>35</sup> Defined as the difference between the two monitored DVs divided by the mean DV of the two monitors.

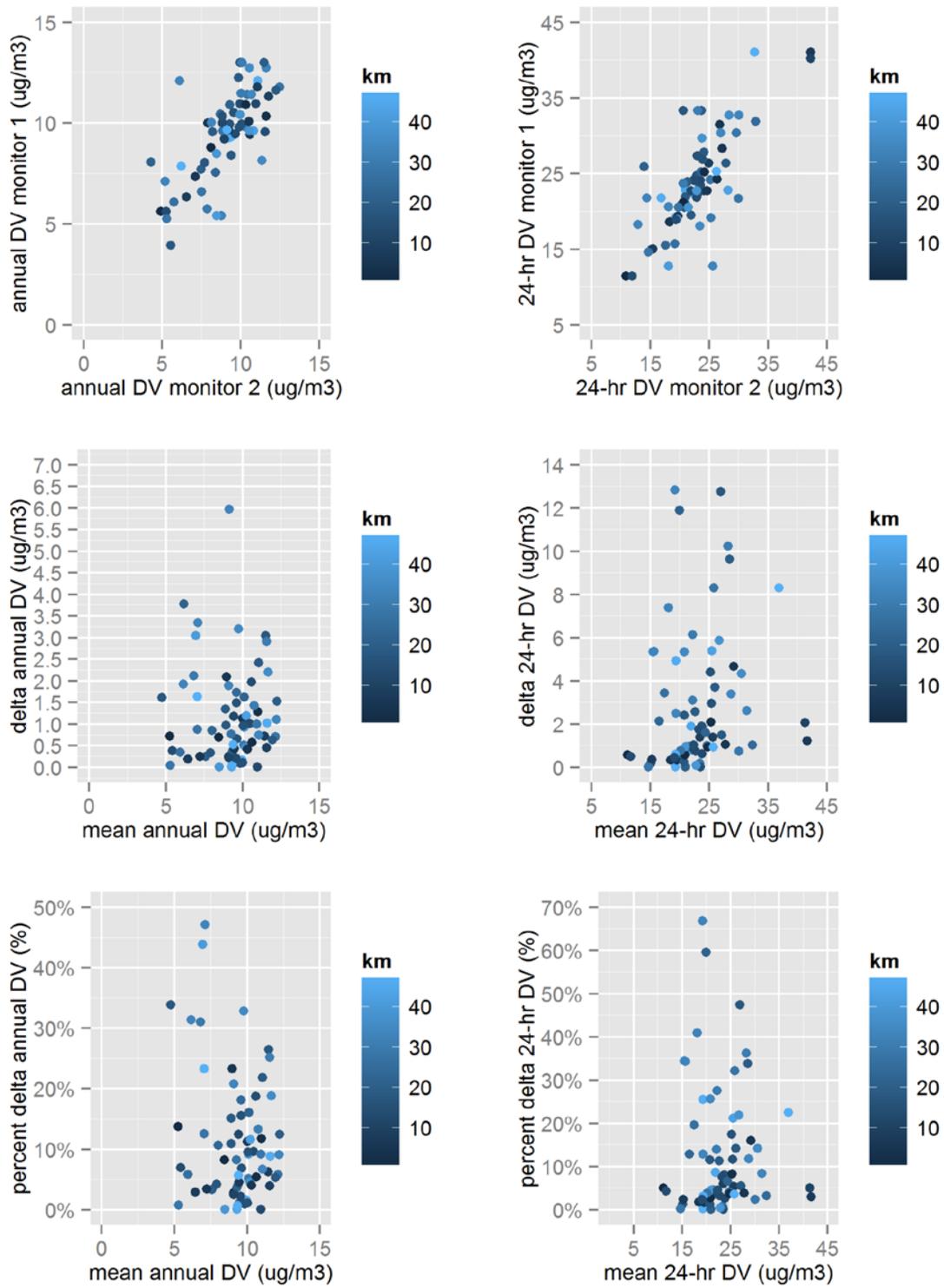


Figure 7 - Results from the analysis of spatial variability. Left column shows results for annual PM<sub>2.5</sub> NAAQS and the right column shows the results for the 24-hr PM<sub>2.5</sub> NAAQS.

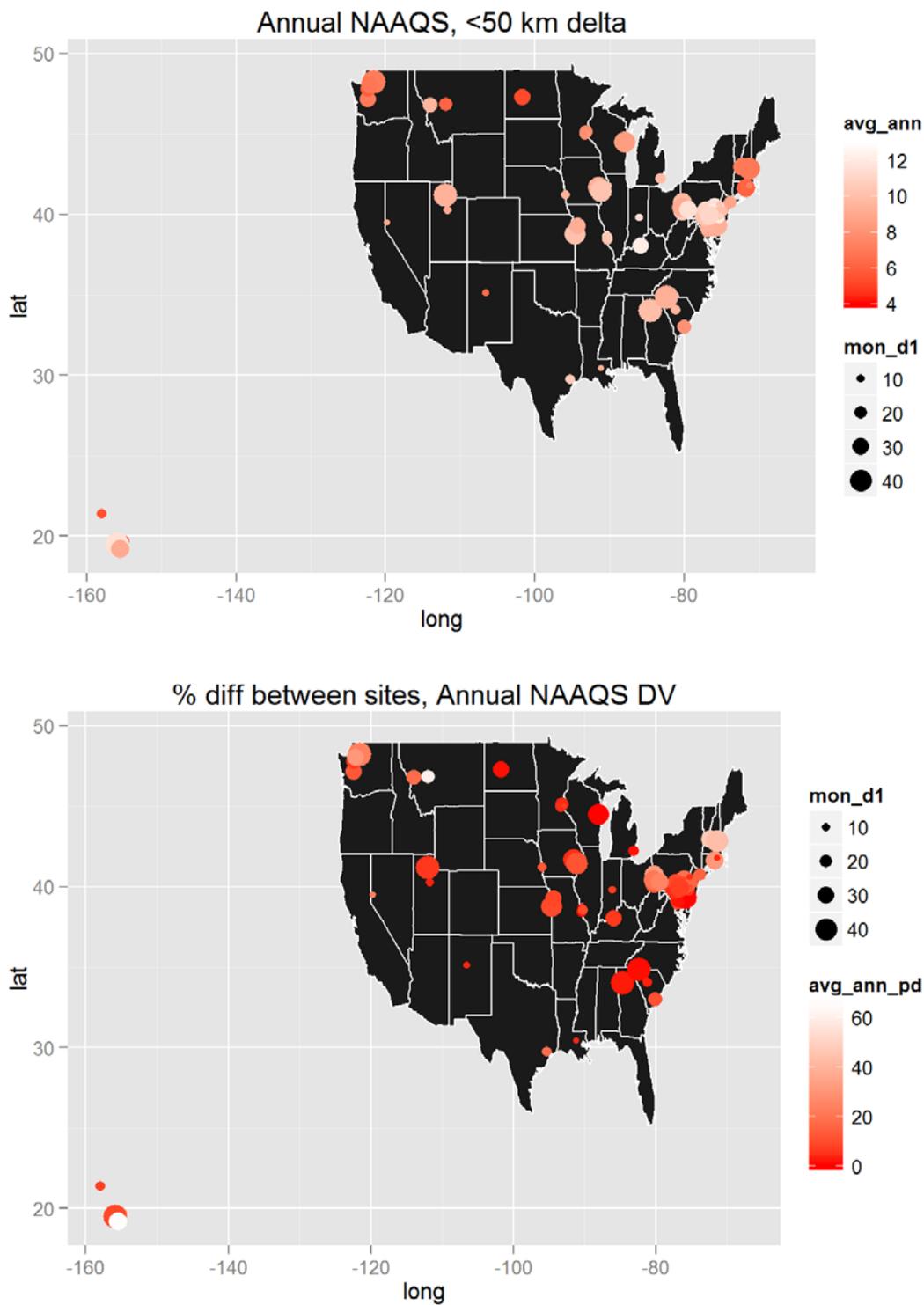


Figure 8 - Spatial distribution of the difference between the DVs from spatial analysis of the 2012-2016 PM<sub>2.5</sub> annual DVs. Top panel shows the absolute value of the difference between the two monitors while the bottom panel shows the percent difference between monitors.

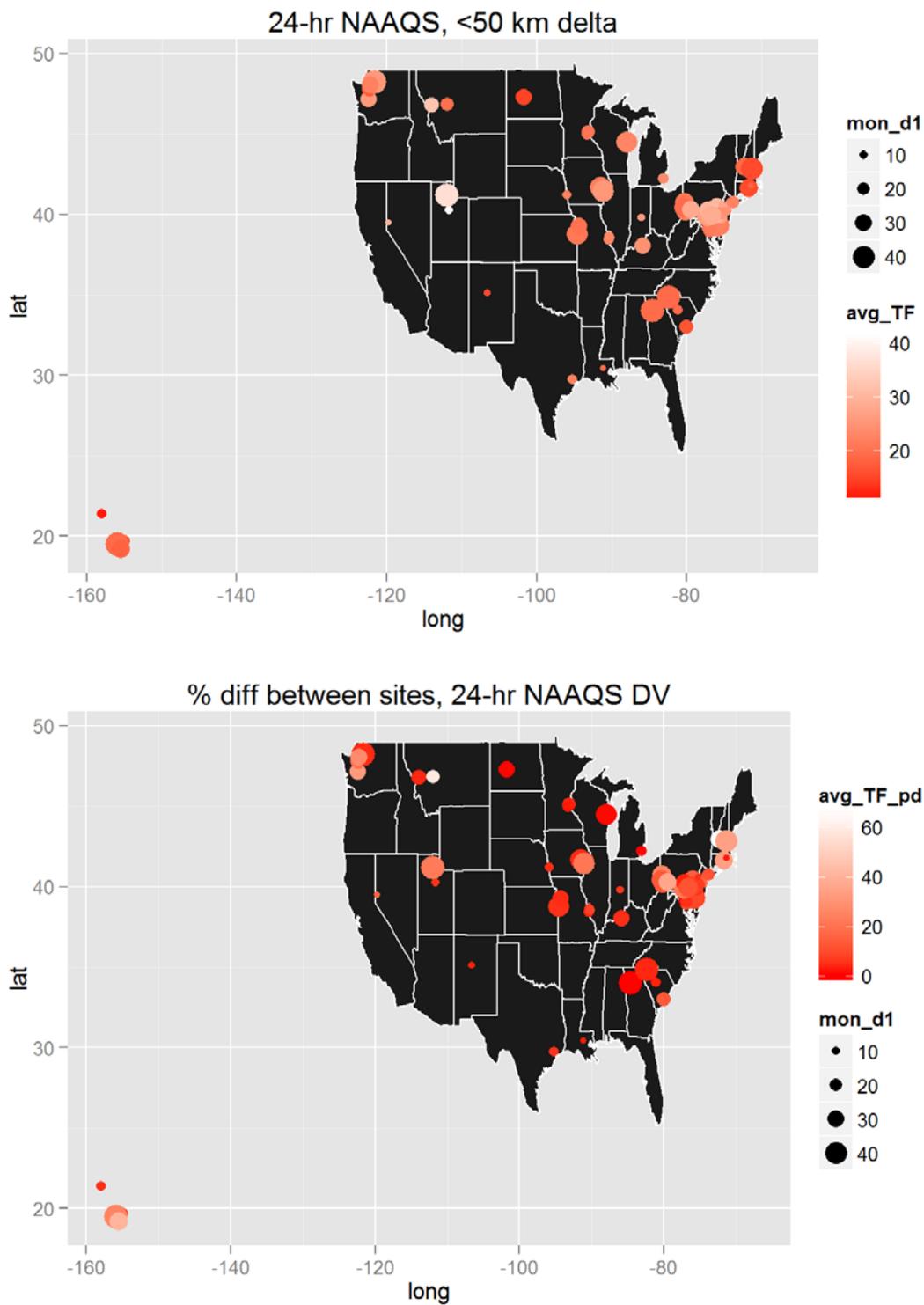


Figure 9 - Spatial distribution of the difference between the DVs from spatial analysis of the 2012-2016 PM<sub>2.5</sub> 24-hr DVs. Top panel shows the absolute value of the difference between the two monitors while the bottom panel shows the percent difference between the two monitors.

### 3.2.2 Analysis of the Influence of PM<sub>2.5</sub> Monitor Sampling Frequency

The PM monitoring network was been designed to operate continuously. When initially designed and deployed, the monitoring requirements for PM indicated that many sites only needed to sample on every third or sixth day, with a smaller number required to sample every day. This was partly due to the technology available at the time, which required a person to collect the filter sample and reload the filter cartridge for each sample taken. The filters were then transported to a laboratory for weighting analysis. While much of the PM<sub>2.5</sub> network still relies on filter-based sampling, systems that can load multiple filters and automatically swap out filters after each 24-hr monitoring period have reduced the labor requirements. Non-filter based measurement techniques have also been developed that allow for continuous operation (as well as 1-hr sampling) so that concentration values are provided for every 24-hr period. Additionally, the requirements for sampling frequency have tightened, requiring more frequent sampling, particularly in areas with DVs close to the NAAQS. The result of the technological and regulatory changes is a sampling network with varied sampling frequency, with notable changes in the sampling frequency over time (see Figure 10). The total number of sites in the network has decreased, but the number of 1:1 sites has increased. Many 1:6 and 1:3 sites have been replaced by 1:1 sites, a trend most obviously starting around 2008. (The site classification was based solely on the number of daily samples during the course of the year, *i.e.*, sites with 60 or less samples were 1:6, sites with 121 samples or less but more than 60 were classified as 1:3, and sites with 122 or more samples were classified as 1:1.)

Due to the nature of temporal variability, it would generally be expected that data from datasets from sites with less frequent sampling would in general have a higher sample variance and therefore wider confidence intervals. Sensitivity tests conducted with the 2010-2013 DVs indeed showed that statistics from the subset of sites with daily monitoring (1:1) have tighter confidence intervals than the subset of sites with 1:3 monitoring and all data (which includes 1:6 monitors) (see Table 2). However, since the 1:1 monitors are not sampling the same air as the 1:3 monitors, it is difficult to directly compare the results from these subsets as a definitive indicator of the inherent increase in variability due to less frequent sampling. However, the results do support what is generally expected from reduced sampling frequency (*i.e.*, while 1:1 monitoring might capture a wider range of air quality, less frequent sampling would likely result in increased sample variance and wider confidence intervals for statistics from the air quality measurement data).

Since the monitor sampling frequency can have a notable impact on the calculated air quality variability, an important question arises regarding which monitors should be used to characterize air quality variability. Using only the 1:1 monitors would likely produce smaller estimates of the sample variance due to the increased sample size while possibly capturing a wider range of air quality across a more widely sampled spectrum. However, the 1:3 and 1:6 monitors are part of the monitoring network and will continue to be present for the foreseeable future. Additionally, despite an increase in the number of 1:1 monitors, the overall air quality variability indicated by the network has been fairly stable for the annual and 24-hr PM<sub>2.5</sub> NAAQS (see Section 4.3.1). This suggests that the inherent variability in the air quality is more influential than the increased

variability induced by the presence of 1:3 and 1:6 monitors. In addition, the much greater number of monitoring sites available when sites with all schedules are considered (see Table 2) provides more confidence that the results are representative of the U.S. as a whole.

Table 2 - Summary of comparison of the air quality variability determined by the bootstrap analysis for PM for three design periods for monitors with different sampling frequencies.

Monitor class	all	1 in 1	1 in 3	all	1 in 1	1 in 3	all	1 in 1	1 in 3
Year/NAAQS	2014 annual			2015 annual			2016 annual		
Difference, median bootstrap vs actual	0.04%	0.02%	0.04%	0.03%	0.03%	0.06%	0.04%	0.03%	0.03%
Avg. 25% CI span	0.67%	0.57%	0.94%	0.70%	0.58%	0.91%	0.71%	0.62%	0.88%
Avg. 50% CI span	1.63%	1.14%	1.81%	1.65%	1.24%	1.85%	1.69%	1.22%	1.85%
Avg. 68% CI span	2.44%	1.72%	2.67%	2.46%	1.77%	2.74%	2.45%	1.79%	2.76%
Avg. 75% CI span	2.80%	1.92%	3.11%	2.83%	2.00%	3.09%	2.82%	2.08%	3.18%
Avg. 95% CI span	4.72%	3.33%	5.26%	4.86%	3.43%	5.38%	4.79%	3.47%	5.48%
Year/NAAQS	2014 24-hr			2015 24-hr			2016 24-hr		
Difference, median bootstrap vs actual	1.14%	0.67%	1.54%	1.36%	0.84%	1.78%	1.23%	1.01%	1.40%
Avg. 25% CI span	2.27%	1.89%	2.38%	2.27%	1.92%	2.50%	2.50%	2.17%	2.63%
Avg. 50% CI span	4.29%	2.94%	4.76%	4.17%	3.45%	4.65%	4.35%	3.13%	5.13%
Avg. 68% CI span	6.00%	4.76%	7.02%	6.25%	5.09%	7.14%	6.52%	5.00%	7.89%
Avg. 75% CI span	6.82%	5.36%	8.33%	7.50%	5.56%	8.33%	7.69%	5.77%	8.88%
Avg. 95% CI span	12.50%	9.40%	14.14%	12.50%	10.00%	14.81%	13.16%	9.62%	16.67%
Number of sites	507	182	274	531	210	270	535	237	240

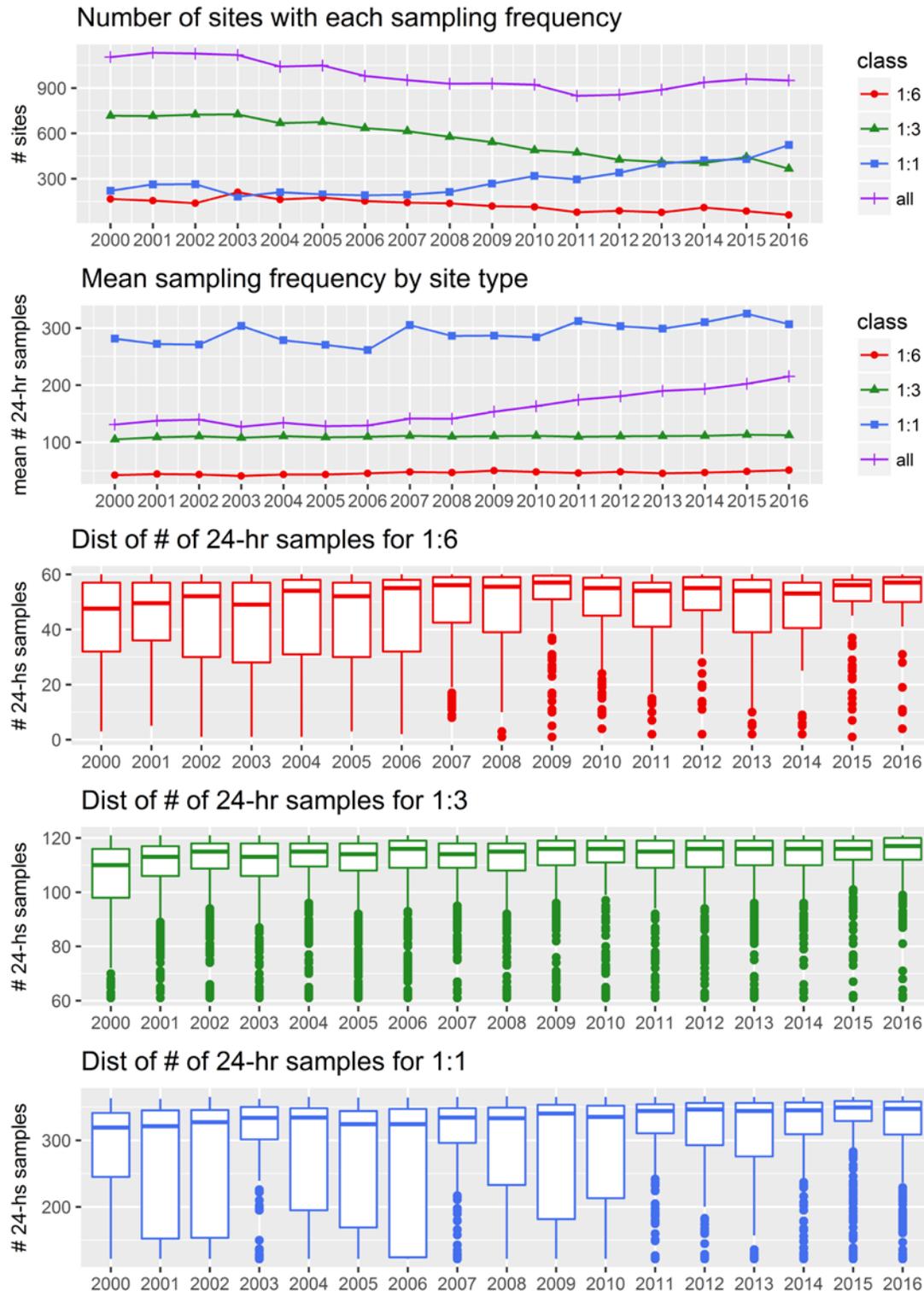


Figure 10 - PM<sub>2.5</sub> monitor network statistics. Top row shows the number of sites with each sampling frequency by year. Second row shows the average number of samples at each site type. Third, fourth and fifth rows show the distribution of the number of samples for each site type.

## 4.0 Application of Air Quality Variability to Calculate SILs for the PSD Program

For a specific change in air quality concentrations to be used to show that a proposed source does not cause or contribute to a violation of the NAAQS, the concentration change must represent a level of impact on ambient air quality that is “insignificant” or not meaningful. The EPA has taken into account the necessary policy considerations in conjunction with the statistical analysis presented here to provide a rational basis to select values derived from the statistical analysis that can be applied to represent “insignificant impacts.”

Section 3 presented the results from the bootstrap analysis, which produced variability estimates at the 25%, 50%, 68%, 75%, and the 95% CIs for all the AQS data across the U.S. from 2000-2016. This section presents the technical considerations related to the policy<sup>2</sup> considerations guiding the application of the above results to identify an appropriate SIL for each context, and the final values the EPA has selected from the study results.<sup>36</sup>

### 4.1 PSD Air Quality Analyses and Statistical Significance

The following four factors are important for EPA’s choice of a SIL: determining a CI to represent the inherent variability for purposes of the NAAQS compliance demonstration, an approach for scaling local variability to the level of the NAAQS, the geographic extent of each summary value, and the DV year or years from which to use the variability results. The EPA has balanced the necessary policy considerations in conjunction with technical information discussed here and in the Policy Document<sup>2</sup> to develop SIL values that represents, in the Agency’s judgment, an appropriate measure of “insignificant impact” that can be used by PSD permitting authorities to determine if emissions from proposed construction will “cause or contribute” to a violation of the corresponding NAAQS.

#### 4.1.1 Confidence Interval

The bootstrap analysis produced estimates for the 25%, 50%, 68%, 75%, and 95% CIs in order to characterize the range of the inherent variability and to provide options for selecting an appropriate “insignificant impact” level that will be applied to determine each SIL. The statistical framework that forms the basis for the bootstrap CIs can be related to more traditional assessments of statistical significance and statistical significance testing. In contrast to the usage here, the traditional application of statistical significance testing seeks to determine if a deviation from the base value is *significant* (rather than *not significant*, which is the usage here). In order to make this determination, larger CIs are typically selected (*e.g.*, 90-99%, which results in a

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<sup>36</sup> The methods, analysis, and application to the PSD program was subject to a peer-review. The results of that peer-review and the subsequent changes to the analysis and the document are detailed in a companion report, U.S. EPA, 2018, Peer review report for the technical basis for the EPA’s development of significant impact thresholds for PM<sub>2.5</sub> and ozone, RTP, NC, EPA 454/S-18-001, available from the U.S. EPA RTP library.

high level of confidence that a deviation from the base value is indeed *significant*). In practice, the smallest CI that might be considered for a similar *significance* determination would be the 68% CI, which corresponds to one standard deviation of the mean for a normally distributed sample. Thus, any deviation larger than the bounds of the 68% CI could traditionally be identified as a *significant* deviation from the mean. In this application for the PSD program, however, we are seeking for each NAAQS a value below which we can conclude that the change in air quality is “not statistically significant” (*i.e.*, that there will not be a notable difference in air quality after the new source begins operation). Thus, a CI that could potentially be considered to represent a *significant* value would not simultaneously be appropriate for identifying a value that is *statistically not significant*. As such, CIs used for identifying a value that is *not statistically significant* value should be below 68%. For the reasons described in the Policy Document, the 50% CI was chosen as the benchmark statistic from the bootstrap analysis to represent the recommended SILs in PSD permitting for ozone and PM<sub>2.5</sub> NAAQS.

#### 4.1.2 Adjustment to the Level of the NAAQS

Since air quality variability may have different characteristics at different baseline air quality levels (e.g., areas with smaller DVs may have less variability than areas with higher DVs), it is reasonable to characterize the variation in the air quality across a range of air quality levels. Sections 4.2 and 4.3 present the 50% CI value on both an absolute scale (ug/m<sup>3</sup> and ppb) and a relative scale (percentage), where the relative variability is defined as the percent change from the base DV at each site. The figures in these sections indicate that there is less of a trend in the relative variability compared to the absolute variability, and no trend in the relative variability for the ozone DV at any of the CIs (*i.e.*, the relative variability is not particularly higher or lower at higher or lower baseline DVs: see Figures 11 and 14). However, the relative variability was fairly consistent across the range of design values, suggesting a commonality in the relative variability across a wide range of geographic regions, chemical regimes, and baseline air quality levels. These results suggest that there is an inherent aspect to the variability, regardless of the baseline air quality. Thus, for reasons explained in the policy memorandum, the relative variability values are used for the SILs development.

#### 4.1.3 Selection of a Geographic Scale

A fundamental question raised in using air quality variability to inform the selection of a value for a SIL is whether the variability-based SIL value should be based on an analysis of air quality variability at the particular site of the new source or modification, or whether the SIL value should reflect the central tendency of all monitored sites in the U.S., regardless of the new source’s or modification’s planned location.

The EPA recognizes that the air quality data and the nature of the emissions and chemical formation of ozone and PM<sub>2.5</sub> can impact areas differently and, thus, should be considered as part of this evaluation. The analysis presented in Sections 4.2 and 4.3 (Figures 11 and 14) examine the relative variability represented by the 50% CI to explore any spatial trends in the data. The analysis indicates that while there is evidence of local spatial correlation (*i.e.*, most areas have fairly similar levels of relative variability and that sites with higher variability are isolated), there

are no large scale (*i.e.*, region-to-region) trends in ambient air variability. While there is a fairly consistent range of variability across the U.S., the magnitude of the variability differs from site-to-site within a state or region with few instances of regional patterns and no strong instances of east/west or north/south trends.

The analysis shows that a small number of sites with particularly high variability have an effect on the average network-wide variability. A median network-wide variability is not overly influenced by a few outliers. Thus, for the reasons explained in the Policy Document, the median variability from the 50% CI from the entire U.S. ambient monitoring network is used to calculate SIL values.

#### 4.1.4 Selection of the Three Most Recent Design Value Years

Sections 4.2.1 and 4.3.1 present trends in the median nation-wide variability at the 50% CI from 2000-2016 (equivalent to DV years of 2002-2016). For all three NAAQS considered here, there are general downward trends in the computed variability across these years. Since the SILs should reflect the most representative state of the atmosphere, the analysis uses for each NAAQS the lower variability observed in the more recent periods, rather than all the data since 2000. However, it may be advantageous to avoid relying on a single 3-year period that may have been influenced by unusual circumstances, particularly in light of the slightly different trends in the last several years across pollutants (*i.e.*, most recently the 24-hr PM<sub>2.5</sub> NAAQS median 50% CI has increased, while the annual PM<sub>2.5</sub> and ozone NAAQS median 50% CIs have continued to decrease). Faced with a similar selection of DV periods for use in attainment demonstrations for nonattainment areas,<sup>37</sup> the EPA also recommended using the average of three DV periods to be used along with a modeling analyses. Thus, for the reasons explained in the Policy Document, the three most recent DV periods (*i.e.*, 2012-2014, 2013-2015, 2014-2016) were used for determining SILs for PM<sub>2.5</sub> and ozone.

#### 4.2 Analysis for Ozone

Figure 11 shows, for each monitoring site, the half-width of the 50% CI divided by the actual design value, from the 2014-2016 data for the ozone NAAQS.<sup>38</sup> The scatter plot for the relative variability values shows that the data are fairly well concentrated around 1-2%, with a small number of sites exceeding 3% and a maximum around 4.5% (with one exception). The variability is fairly consistent across the range of baseline air quality levels, indicating that there is no particular trend with actual design value in the site level variability. The median and mean variability values are fairly similar

The spatial distribution of the relative variability from the 50% CI is also shown in Figure 11, with 2014-2016 DV period site data colored according to their relative variability and sites with insufficient data during this period in gray. There appears to be no notable large-scale spatial

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<sup>37</sup> Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM<sub>2.5</sub>, and Regional Haze. R. Wayland, AQAD, Dec. 3, 2014.

<sup>38</sup> The plots for ozone show a distinct banding in the results. This is a feature of the truncation conventions that were applied to the AQS data prior to the air quality variability analysis.

trends in highest relative variability. The lack of any large-scale spatial trend indicates that there is indeed a fundamental characteristic to the relative ambient air quality variability (see Section 4.1.3).

#### 4.2.1 Ozone Temporal Trends

The median air quality variability from the 15 DV periods for ozone is shown in Figure 12 (each period is 3 years). This analysis shows how the combination of changes in the network design (*e.g.*, the change in the monitoring season) and the changes in emissions and meteorology over this period have impacted the variability in the DVs from the network. There has been a small decrease in the variability for ozone (0.03 percentage points per year), though most of that decrease occurred in the form of a large drop in the variability between the 2003-2005 and 2004-2006 DV periods. There were increases in the variability for the 2008 and 2012 DV periods, indicating that there is some variability between years. The median air quality variability values at the 50% CI for the three most recent DV periods (*i.e.*, 2012-2014, 2013-2015, 2014-2016) as shown in Table 3, when averaged result in a SIL value for the ozone 8-hour NAAQS of 1.47%. This corresponds to 1.0 ppb at the level of the 2015 ozone NAAQS (70 ppb).

Table 3 - Summary of ozone bootstrap results for three design periods, 2012-2014, 2013-2015, and 2014-2016

Year/NAAQS	2014 annual	2015 annual	2016 annual
<b>Difference, mean of median bootstrap vs actual DV</b>	0.44%	0.48%	0.43%
<b>Avg. 25% CI span</b>	0.74%	0.76%	0.75%
<b>Avg. 50% CI span</b>	1.47%	1.47%	1.47%
<b>Avg. 68% CI span</b>	2.14%	2.05%	2.11%
<b>Avg. 75% CI span</b>	2.38%	2.34%	2.31%
<b>Avg. 95% CI span</b>	4.31%	3.97%	3.97%
<b>Number of sites</b>	1148	1131	1131

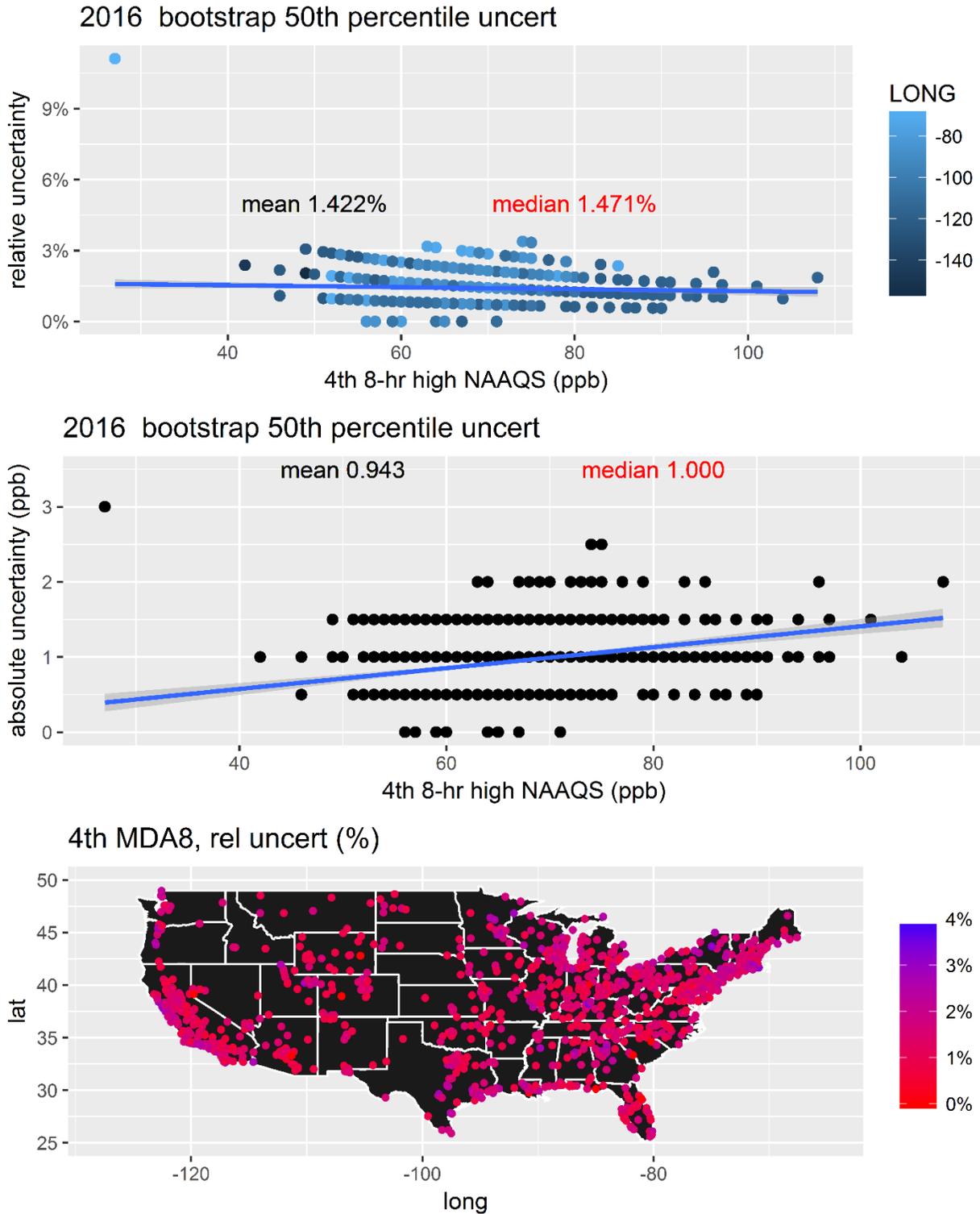


Figure 11 - Bootstrap results from the 50% CIs for the 2016 ozone DVs. The top panel shows the relative difference between the span of the CI and the actual DV across the range of actual DVs, the middle panel shows the absolute difference between the values across the same range, and

the bottom panel shows the spatial distribution of the relative difference between the values at each site.

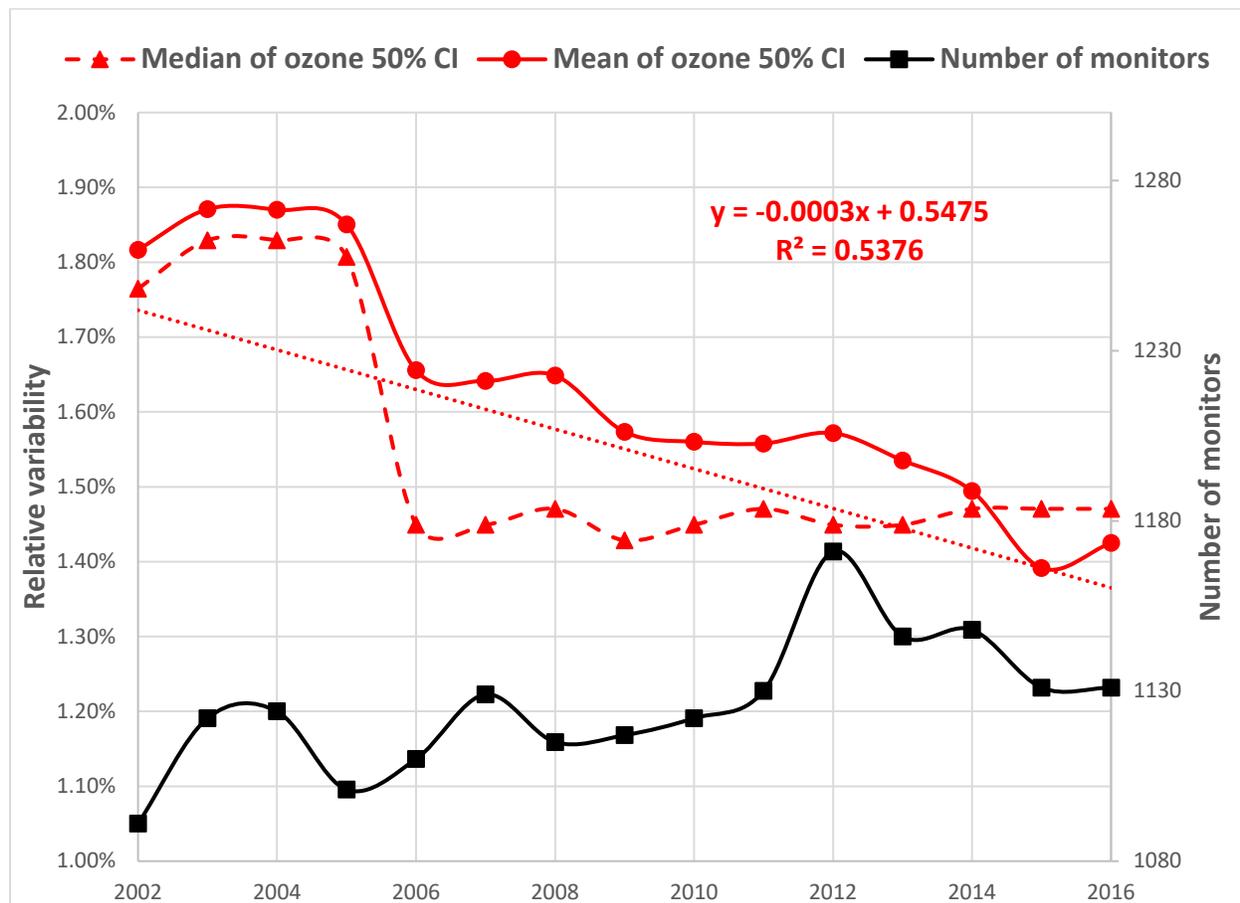


Figure 12 - Median and mean variability in the network determined from the bootstrap analysis for the 15 DV periods from 2002-2016 for ozone (each DV period represents 3 years of data and the data are plotted on the ending year, *i.e.*, the 2016 DV period is from 2014-2016 and plotted at 2016).

### 4.3 Analysis for PM<sub>2.5</sub>

Figure 13 shows, for each monitoring site, the half-width of the 50% CI divided by the DVs, for both the annual and 24-hr PM<sub>2.5</sub> NAAQS. This figure shows that the relative variability using these assumptions is indeed stable across the range of baseline air quality levels, while the absolute variability increases as the baseline air quality levels increase.<sup>39</sup> The values for relative variability are fairly well concentrated around 1-2% for the annual NAAQS, with a small number of sites exceeding 3% and a maximum slightly less than 5%. For the 24-hr NAAQS, the data are

<sup>39</sup> The rounding conventions for PM<sub>2.5</sub> result in striations in the data, which are clearly visible in Figure 13. While these striations appear to represent trends in the data, this is a function of the display and not actual trends in the data. Linear regression lines have been added to each panel, which clearly show an increase in the absolute variability with increasing DVs, while the relative variability is relatively unaffected by changes in the DVs.

concentrated around 4-5%, with a small number of sites exceeding 10%. The outliers occur across the range of baseline air quality levels, indicating that there is no particular trend with actual DV in the occurrence of sites with especially high variability. When assessed as a whole, despite their relatively infrequent occurrence, these outliers do tend to increase the average variability. As with ozone, the median variability is less influenced by these outliers and appears to be more representative of the central tendency of the distribution of relative variability values than the average. Unlike the ozone results, the median is smaller than the mean

The spatial distribution of the relative variability from Figure 13 is shown in Figure 14, with sites having data during the 2014-2016 DV period colored according to their relative variability (sites with insufficient data during the 2014-2016 DV period are not shown, data from other years are presented in the Appendix). Based solely a visual inspection, there appears to be no notable large-scale spatial trends in highest relative variability in either the annual or 24-hr PM<sub>2.5</sub> NAAQS. The sites with larger variability tend to occur in the western half of the U.S., though the sites are isolated and generally not grouped into any specific geographic region. The exceptions to this appears in Western U.S. and along the Ohio River Valley, where there are a collection of sites with higher variability (generally above 7.5%) in the 24-hr NAAQS (though the annual NAAQS does not display this apparently higher variability). This result may be related to the nature of high PM events in the western half of the U.S. (*e.g.*, the typical PM<sub>2.5</sub> levels may be lower in the western states, but the events that do occur produce much higher concentrations than the typical background, which would result in greater skew and thus greater variability in DVs computed from these data, particularly in the 24-hr PM<sub>2.5</sub> DVs). These sites also tend to have a lower sampling frequency (see Figure 2), which we have shown to artificially increase the apparent variability. There are also trends in missing data that are important to consider when exploring regional trends in variability. In particular, for the period 2008 through 2013, the data were invalidated for several states. Late in 2014, a problem was found with the PM<sub>2.5</sub> data from these states and, as a result, the data were invalidated for a number of years.<sup>40</sup>

In response to comments received during the peer-review of the initial public draft of this document, several more detailed spatial analyses are presented for the annual and 24-hr PM<sub>2.5</sub> data in Section 7 of the Appendix to this document. The analysis attempts to identify natural groupings of sites based on location and the level of air quality variability using cluster analysis. The analysis applied both an iterative (K-means) and a hierarchical clustering algorithm using various combination of the site-level variability, latitude, and longitude, resulting in 12 different sets of clusters. The analysis also considered comparing sites by grouping them using the National Oceanic and Atmospheric Administration (NOAA) “climate regions,” which are groupings of states known by NOAA to have similar climatic conditions. While some of the analysis did identify some unique clusters, these groups were often not spatially grouped. Many

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<sup>40</sup> The dates and specific monitors affected in each state vary. For DC, data were invalidated in Q4 of 2016. For FL, data were invalidated from 2011-2014. For GA, data were invalidated in Q1 of 2011. For ME, data were invalidated from 1998-2015. For ID, data were invalidated from 2011-2014. For IL, data were invalidated from 2011-2013 and Q1-Q2 of 2014. For Louisville, KY, data were invalidated from 2009-2013. For the South Coast Air Basin, CA, data were invalidated in 2014. For MS, data were invalidated in 2014. For TN, data were invalidated from 2011-2014. For WA, data were invalidated from 2011-2015. The invalidation may not have affected every monitor in each state, but these dates cover the time spans for which the data invalidation occurred.

of the analyses did not identify any unique clusters. When the results from the special cluster analysis are considered as a whole, they do not indicate any consistent large-scale trends. The lack of any consistent regional trend indicates that there is indeed a fundamental characteristic to the relative ambient air quality variability (see Section 4.1.2).

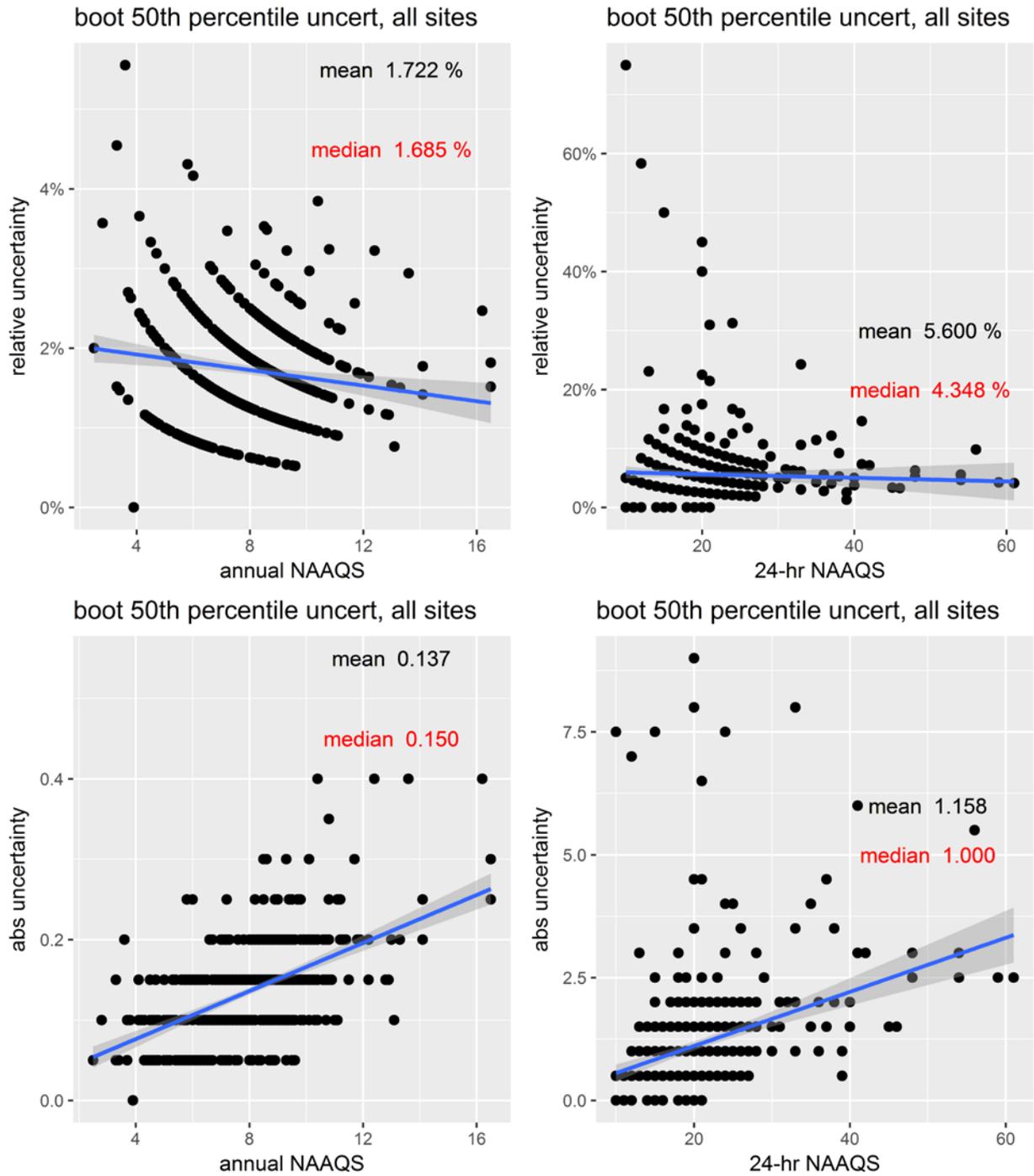


Figure 13 - Bootstrap results from the 50% CIs for the 2016 PM<sub>2.5</sub> DVs. The top two panels show the relative difference between the span of the CI and the actual DV across the range of actual DV, and the bottom two panels show the absolute difference between the values across the same range.

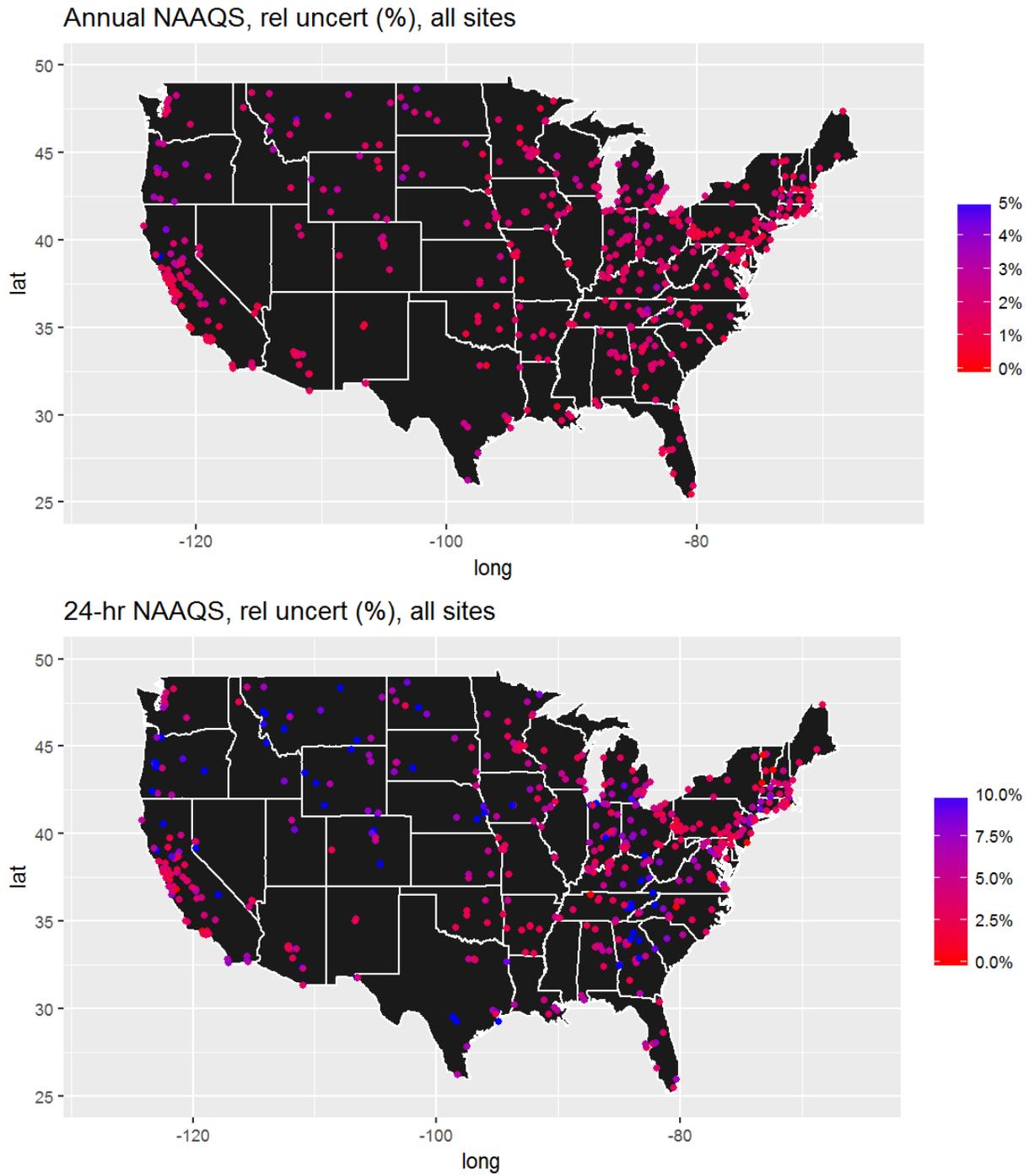


Figure 14 - Spatial distribution of the relative difference between the span of the 50% CI and the actual DV for the 2014-2016  $PM_{2.5}$  DVs.

#### 4.3.1 PM<sub>2.5</sub> Temporal Trends

The median air quality variability from the 13 DV periods for both the annual and 24-hr PM<sub>2.5</sub> NAAQS are shown in Figure 15. This analysis shows how the combination of the changes in the network design (*e.g.*, the change in the monitoring frequency) and the changes in emissions and meteorology have impacted the network variability. There has been a greater decrease in the variability in the 24-hr PM<sub>2.5</sub> NAAQS than in the variability for the annual PM<sub>2.5</sub> NAAQS (0.03 percentage points per year versus 0.02 percentage points per year). The analysis in Section 3.2.2 showed that the 24-hr NAAQS is more affected by the monitoring frequency than the annual NAAQS, so it is likely that the change in monitoring frequency played some role in the larger decrease in the variability for the 24-hr PM<sub>2.5</sub> NAAQS. The median air quality variability at the 50% CI for the three most recent DV periods (*i.e.*, 2012-2014, 2013-2015, 2014-2016) is shown in Table 4, and when averaged result in a SIL value of 1.66% for the annual PM<sub>2.5</sub> NAAQS (12 µg/m<sup>3</sup>) and 4.27% for the PM<sub>2.5</sub> 24-hr NAAQS (35 µg/m<sup>3</sup>). These values correspond to 0.2 µg/m<sup>3</sup> at the level of 12 µg/m<sup>3</sup> for the annual NAAQS, and 1.5 µg/m<sup>3</sup> at the level of 35 µg/m<sup>3</sup> for the NAAQS.

Table 4 - Summary of comparison of the air quality variability determined by the bootstrap analysis for three design periods.

Year/NAAQS	2014 annual	2015 annual	2016 annual
Difference, median bootstrap vs actual	0.04%	0.03%	0.04%
Avg. 25% CI span	0.67%	0.70%	0.71%
Avg. 50% CI span	1.63%	1.65%	1.69%
Avg. 68% CI span	2.44%	2.46%	2.45%
Avg. 75% CI span	2.80%	2.83%	2.82%
Avg. 95% CI span	4.72%	4.86%	4.79%
Year/NAAQS	2014 24-hr	2015 24-hr	2016 24-hr
Difference, median bootstrap vs actual	1.14%	1.36%	1.23%
Avg. 25% CI span	2.27%	2.27%	2.50%
Avg. 50% CI span	4.29%	4.17%	4.35%
Avg. 68% CI span	6.00%	6.25%	6.52%
Avg. 75% CI span	6.82%	7.50%	7.69%
Avg. 95% CI span	12.50%	12.50%	13.16%
Number of sites	507	531	535

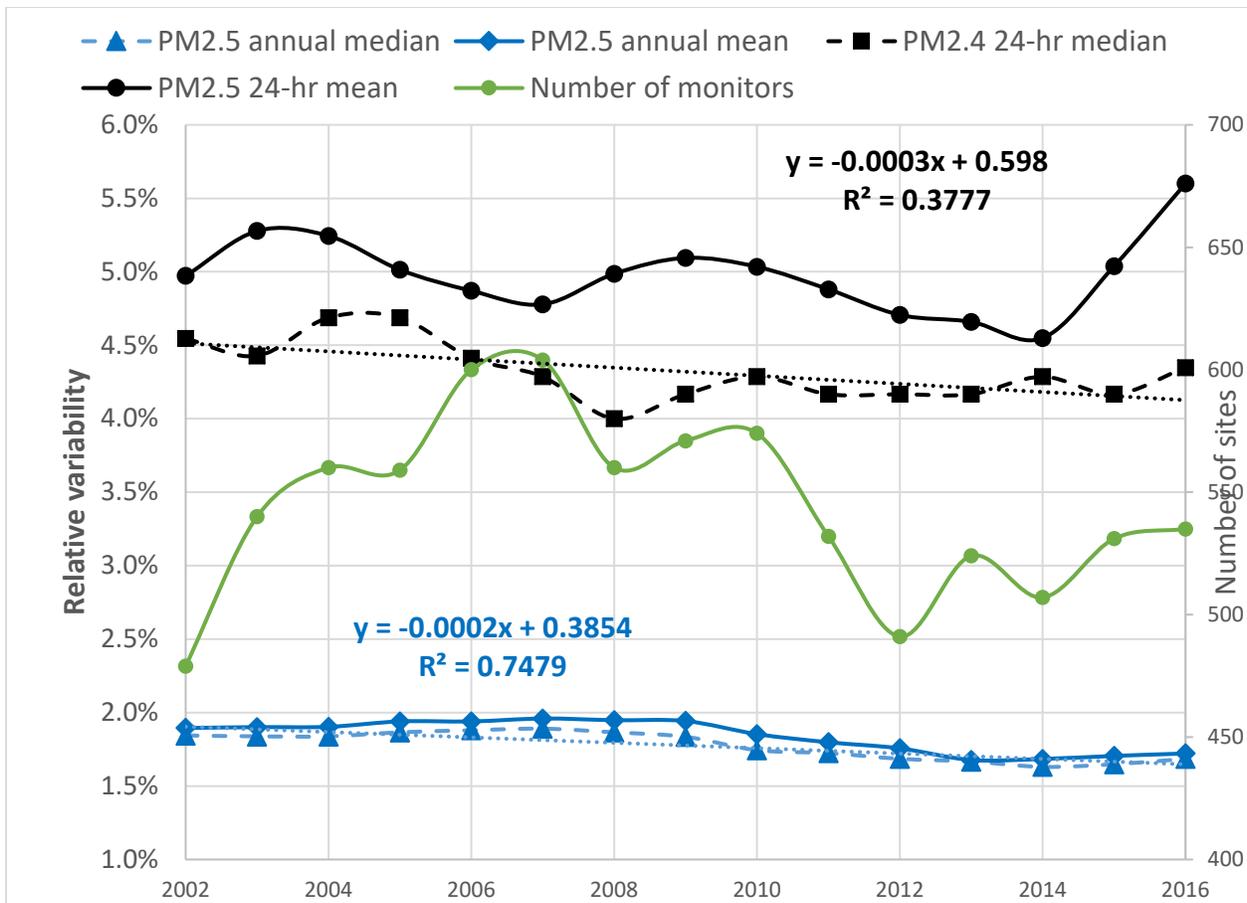


Figure 15 - Median and mean variability in the network determined from the bootstrap analysis (50% CI) for the 15 DV periods from 2002-2016 for PM<sub>2.5</sub> (each DV period represents 3 years of data and the data is plotted on the ending year: *i.e.*, the 2016 DV period is from 2014-2016 and plotted at 2016).

## 5. Additional Information

Data for the analyses presented in this document can be obtained by contacting:

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Environmental Protection  
Agency

Office of Air Quality Planning and Standards  
Air Quality Analysis Division  
Research Triangle Park, NC

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# **EXHIBIT 3**

**Preliminary Draft  
Precursor Demonstration**

**DRAFT**

**March 22, 2017**

**As part of requirements for subpart 4 Non-Attainment Area (NAA) PM2.5 State Implementation Plan (SIP), all of the precursor gases that contribute to PM2.5 (NO<sub>x</sub>, SO<sub>2</sub>, NH<sub>3</sub> and VOCs) are addressed for potential controls in addition to the primary PM2.5 com.**

## EXECUTIVE SUMMARY

This document serves as a preliminary optional precursor demonstration for the PM<sub>2.5</sub> Serious SIP. Precursor gases include (sulfur dioxide, nitrogen oxides, ammonia, and volatile organic compounds) and contribute to the formation of PM<sub>2.5</sub> in the Fairbanks, Alaska Non-Attainment Area (NAA). The goal of the precursor demonstration is to determine whether controls are not needed on any of the four precursors in order to attain the standard. EPA has provided guidance to produce a precursor demonstration.<sup>1</sup> This analysis has chosen a threshold of 1.3 µg/m<sup>3</sup> in assessing the need for controls of a precursor. This is the value suggested by the EPA guidance. This analysis applies to the BACT/BACM and MSM control analysis under development now and which will be included in the Serious Area plan due in December, 2018.

As part of the Serious SIP development the Clean Air Act (Subpart 4 of Part D of Title I, id. 7513-7513b (Subpart 4)) calls upon states to develop an analysis called BACM (Best Available Control Measures) for all source sectors that emit PM<sub>2.5</sub> and the four major precursor gases. The BACM process treats area and mobile sources differently from major stationary sources. A Best Available Control Technology (BACT) analysis is conducted specifically for the major stationary sources as a part of the BACM process. BACM and BACT are required to be evaluated regardless of the level of contribution by the source to the problem or its impact on the areas ability to attain<sup>2</sup>. If the state seeks an extension of the attainment date of the area then further control measures must also be evaluated. These measures are called Most Stringent Measures (MSM). The PM<sub>2.5</sub> NAAQS Final SIP Requirements Rule states if the state determines through a precursor demonstration that controls for a precursor gas are not needed for attaining the standard, then the controls identified as BACT/BACM and MSM for the precursor gas are not required to be implemented<sup>3</sup>.

SO<sub>2</sub>: Direct emissions and atmospheric formation of particulate sulfate contribute to measured sulfate concentrations. Most of the sulfate is in the form of ammonium sulfate; in absolute terms sulfate contributes 5.4 µg/m<sup>3</sup> in Fairbanks and 4.9 µg/m<sup>3</sup> in North Pole on the average of high concentration days. These values are above the 1.3 µg/m<sup>3</sup> and SO<sub>2</sub> does not pass a contribution-based analysis. Given the magnitude of these exceedances above the threshold no sensitivity-based precursor demonstration was pursued. As a result SO<sub>2</sub> precursor emissions are considered significant and any controls deemed feasible for the Fairbanks nonattainment area would be implemented.

NO<sub>x</sub>: Ammonium nitrate is the main particulate compound formed from NO<sub>x</sub> emissions. The underlying chemistry and sensitivity are explained in the following chapter. Concentrations of ammonium nitrate were calculated as 2.4 µg/m<sup>3</sup> in Fairbanks, 2.0 µg/m<sup>3</sup> in North Pole Fire Station, and 1.0 µg/m<sup>3</sup> in North Pole Elementary. The Fairbanks and North Pole Fire Station

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<sup>1</sup> 40 CFR 51.1006 – Optional PM<sub>2.5</sub> precursor demonstrations

<sup>2</sup> <https://www.gpo.gov/fdsys/pkg/FR-2016-08-24/pdf/2016-18768.pdf>, Clean Air Act 189 (b)(1)(B) and 189 (e) and CFR 51.1010(4)(i) require the implementation of BACT for point sources and precursors emissions and BACM for area sources.

<sup>3</sup> Federal Register, Vol. 81, No. 164, August 24, 2016 (FR 81 58010).

sites do not pass a comprehensive contribution-based analysis. ADEC has decided to perform an optional modeling precursor demonstration for NO<sub>x</sub> from all sources (comprehensive) and from major stationary sources. For the comprehensive demonstration NO<sub>x</sub> passes a 75% sensitivity-based analysis. A separate major stationary source analysis shows that NO<sub>x</sub> passes a zero-out sensitivity-based analysis. Both of these demonstrations and supplemental analysis are provided in this document.

NH<sub>3</sub>: Emitted ammonia is a precursor to the formation of particulate ammonium nitrate and ammonium sulfate. The major contributors to PM<sub>2.5</sub> from ammonia (biomass burning, mobile, home heating) in wintertime Fairbanks are drastically different from those commonly found in the contiguous US, where ammonia from agricultural activities typically dominate with smaller contributions from vehicles, and other industrial activities. In the Fairbanks nonattainment area, ammonium nitrate is a minor contributor to the total PM<sub>2.5</sub> while ammonium sulfate does contribute significantly to ambient concentrations of PM<sub>2.5</sub>. Contributions of emitted ammonia to PM<sub>2.5</sub> were calculated as 4.6 µg/m<sup>3</sup> and 4.2 µg/m<sup>3</sup> at the Fairbanks monitors and 4.4 µg/m<sup>3</sup> and 2.1 µg/m<sup>3</sup> at the North Pole monitors. These values do not pass the contribution-based analysis. No sensitivity tests were performed for ammonia.

VOCs: Emissions of VOCs contribute to PM<sub>2.5</sub> by condensing after exiting a high temperature stack and then undergoing further chemical processing in the atmosphere to form secondary organic aerosols (SOA). Given the atmospheric and meteorological conditions in wintertime Fairbanks, VOCs are not expected to be major contributors to PM<sub>2.5</sub> in the nonattainment area. A contribution-based analysis of ambient data for VOC was not performed. A contribution-based zero-out air quality modeling demonstration shows VOC's contributing well below the threshold of 1.3 µg/m<sup>3</sup> at all monitors. For this reason we believe the contribution from VOCs to PM<sub>2.5</sub> are insignificant and do not plan to implement the BACT/BACM and MSM controls for VOCs.

EPA's *Draft PM<sub>2.5</sub> Precursor Demonstration Guidance* recommends five analyses that can be performed to demonstrate that a precursor gas is not significant in contributing to concentrations of PM<sub>2.5</sub>. There are two main steps in the precursor demonstration process first a concentration-based analysis is conducted and failing that a sensitivity based analysis can be conducted. These analyses can be performed in a comprehensive manner meaning that it considers precursor emissions from all sources or they can be performed specifically for major stationary sources. The concentration based analysis is initially conducted using ambient data collected at monitors within the nonattainment area where the precursor gas contributions are measured and assessed against the threshold of 1.3 µg/m<sup>3</sup> for 24-hour PM<sub>2.5</sub>. Air quality modeling can also be used to perform the concentration based analysis by zeroing out the emissions of a precursor and running a photochemical grid model (PGM) to estimate the impact on PM<sub>2.5</sub>. Should the concentration based analysis show impacts above the threshold a sensitivity based analysis can be performed with an air quality model. There are three recommended tiers in the sensitivity based analysis, 70%, 50%, and 30%. For each tier the PGM is configured to reduce a precursor's emissions by a large percentage, and the impacts on PM<sub>2.5</sub> concentration are modeled. These impacts are compared to the same threshold as the concentration based analysis. Supplemental analysis may also be included to further support the findings of the precursor demonstration.

A preliminary precursor demonstration has been conducted for NO<sub>x</sub> and VOC. Table 1 summarizes the precursor demonstration tests that were passed at all monitor sites. VOCs were shown to be insignificant using a comprehensive air quality modeling zero-out analysis. NO<sub>x</sub> was demonstrated to be insignificant from a 75% sensitivity based analysis. A second NO<sub>x</sub> demonstration was performed for major stationary sources with a zero-out air quality modeling analysis. This major stationary source demonstration was conducted in the event that EPA does not approve the comprehensive sensitivity based analysis.

**Table 1: NO<sub>x</sub> and VOC Precursor Demonstrations**

<b>Precursor</b>	<b>Source(s)</b>	<b>Test Details</b>	<b>Pass</b>
NO <sub>x</sub>	Comprehensive	Sensitivity Based Analysis 75%	Y
NO <sub>x</sub>	Major Stationary Source	Concentration Based Analysis - Air Quality Modeling zero-out	Y
VOC	Comprehensive	Concentration Based Analysis - Air Quality Modeling zero-out	Y

## FAIRBANKS AMBIENT AIR QUALITY OVERVIEW

Addressing the precursor gases and how they are related to PM<sub>2.5</sub> requires understanding the Fairbanks and North Pole wintertime characteristics that lead to the formation of PM<sub>2.5</sub> from both direct and secondary formations. Precursor gases form secondary PM<sub>2.5</sub> and this component of PM<sub>2.5</sub> is addressed through reviewing current knowledge of the chemistry involved in the secondary formation in the Fairbanks and North Pole NAA.

State Office Building winter FRM-derived species percentage of high PM 2.5 days from years 2011-2015 and average modeling design value (DV) of 38.9 ug/m3

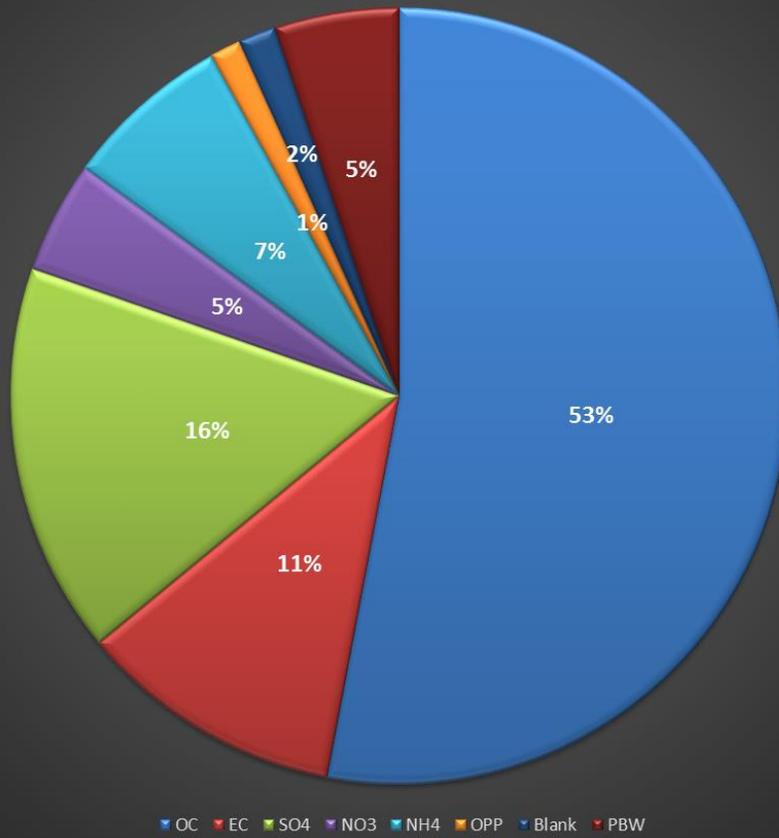


Figure 1: 24-hr average FRM-derived PM<sub>2.5</sub> speciation concentrations based on the design value (DV) of 131.6 µg/m<sup>3</sup> for the high PM<sub>2.5</sub> winter days at North Pole Fire Station

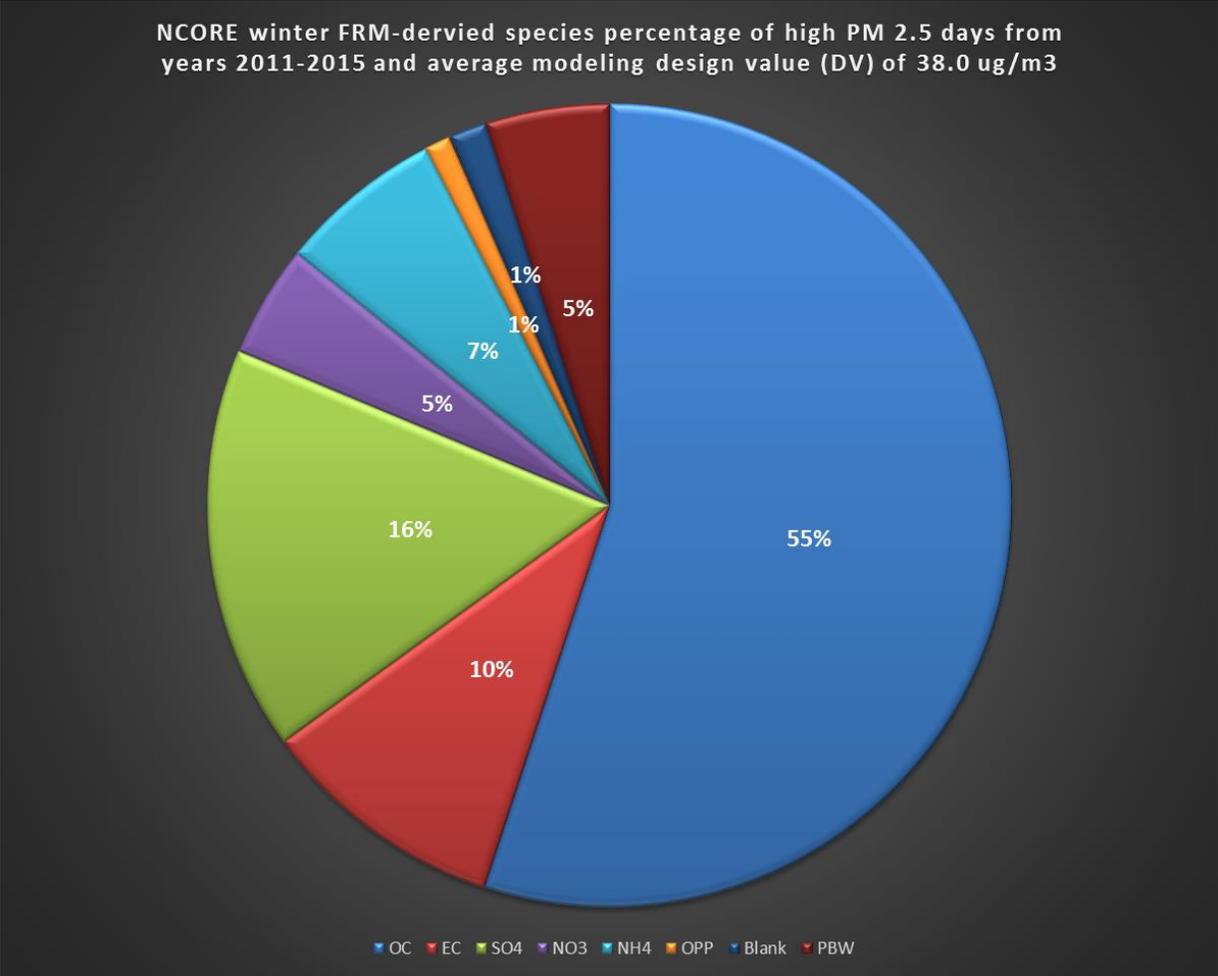


Figure 2: 24-hr average FRM-derived PM<sub>2.5</sub> speciation concentrations based on the design value (DV) of 38.0 μg/m<sup>3</sup> for Fairbanks NCORE Monitor.

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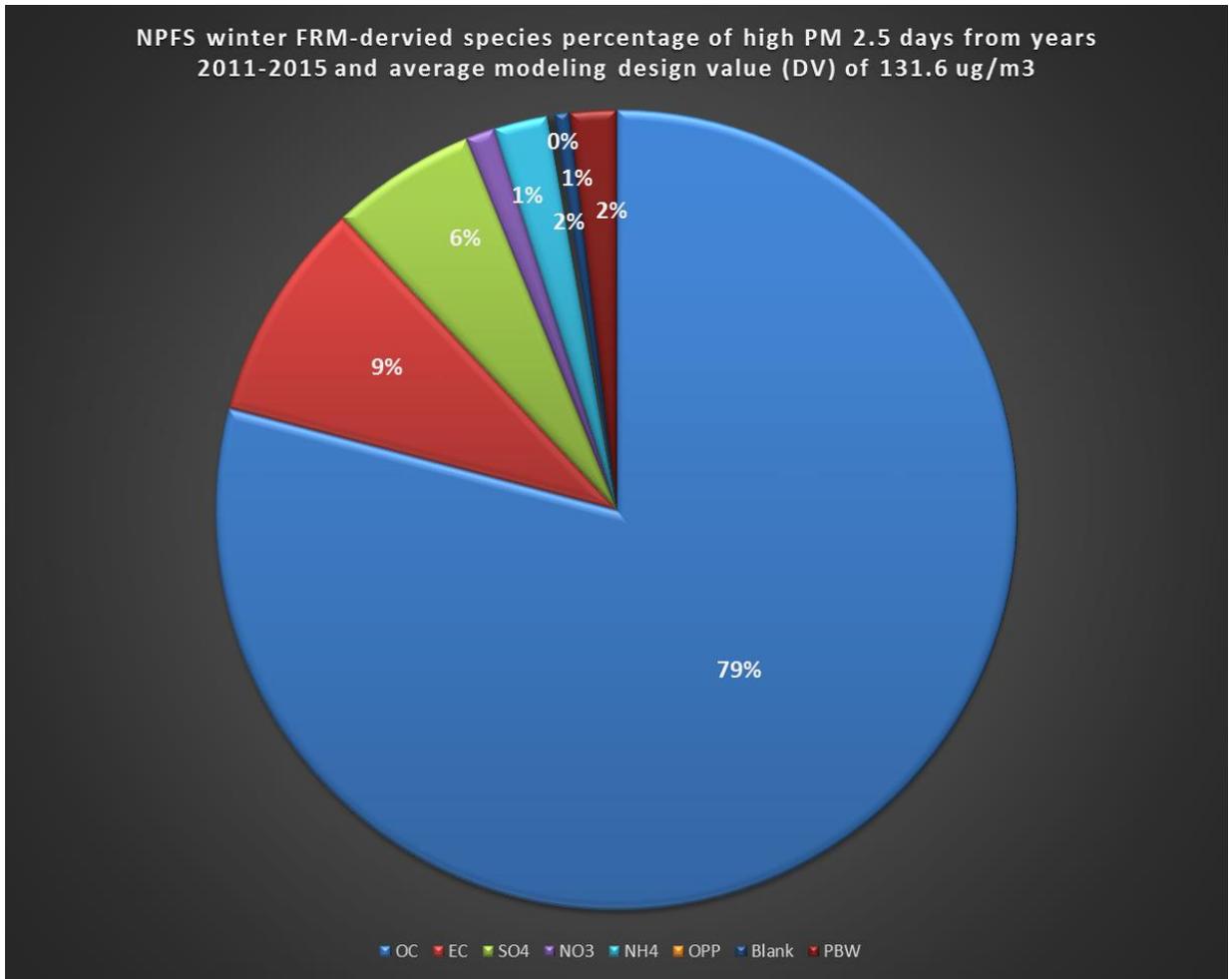


Figure 3: 24-hr average FRM-derived PM<sub>2.5</sub> speciation concentrations based on the design value (DV) of 38.9 μg/m<sup>3</sup> for Fairbanks State Office Building Monitor.

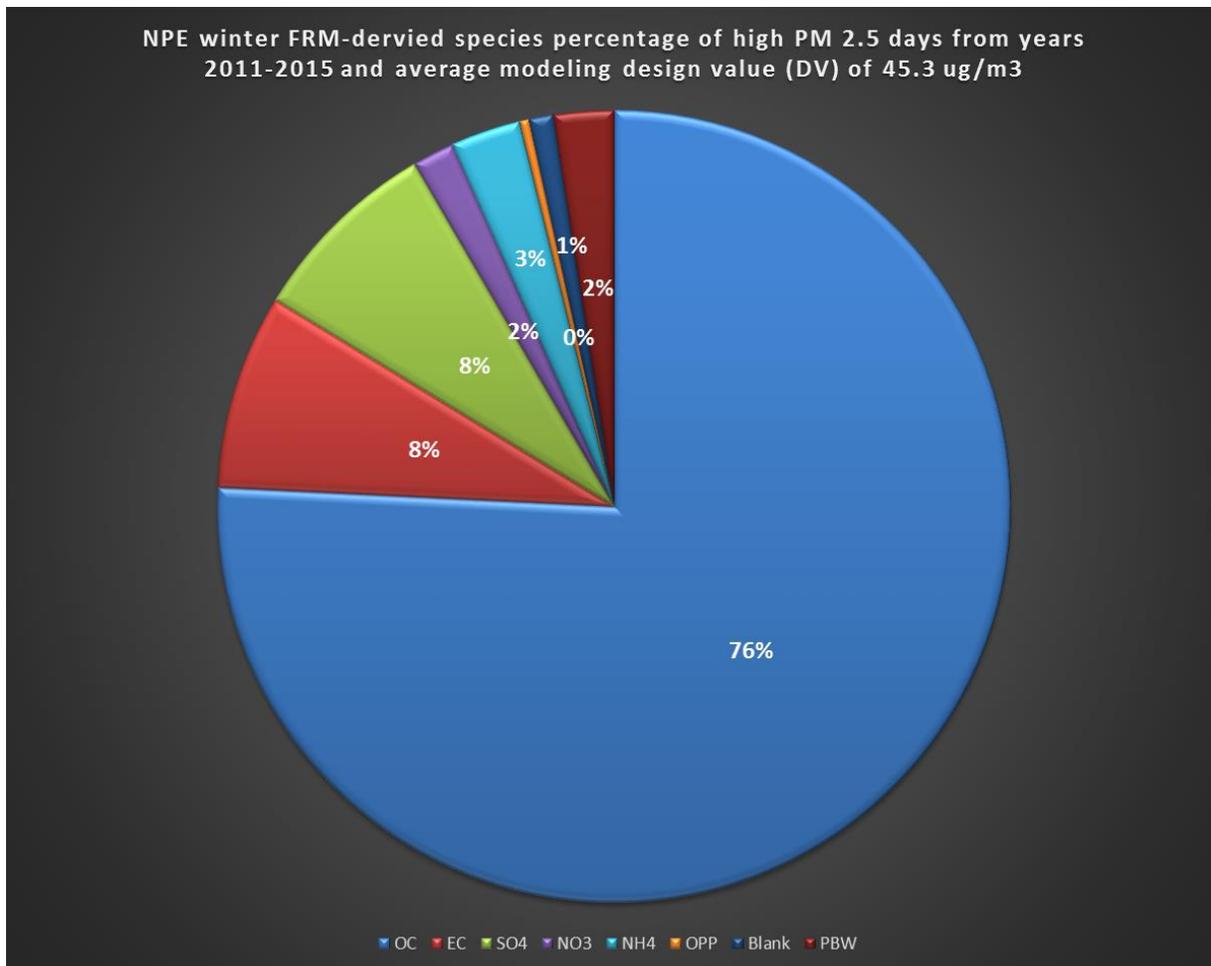


Figure 4: 24-hr average FRM-derived PM<sub>2.5</sub> speciation concentrations based on the design value (DV) of 45.3 μg/m<sup>3</sup> for North Pole Elementary School Monitor.

Particulate Matter (PM<sub>2.5</sub>) is directly emitted into the atmosphere or formed by secondary chemical reactions from precursor gases. The major components of atmospheric aerosols formed by secondary chemistry are nitrate (NO<sup>-3</sup>), sulfate (SO<sub>2</sub><sup>-4</sup>) and ammonium (NH<sub>4</sub><sup>+</sup>). These species are formed primarily from chemical reactions in the atmosphere involving the gas-phase precursors, nitrogen oxides (NO<sub>x</sub>), sulfur dioxide (SO<sub>2</sub>) and ammonia (NH<sub>3</sub>). The major component of Fairbanks PM<sub>2.5</sub> is organic carbon and is directly emitted as particles, condenses to existing particles, or contributes to the formation of new particles from gaseous molecules.

The NO<sub>x</sub> emissions by source category are 62% point sources, 21% mobile, 14% area, 3% non-road and less than 1% for all other sources combined. In the winter, nitrate composes 1% -5% (Figure 1-4) of the total PM<sub>2.5</sub> in the nonattainment area.

Sulfates are a major component of the PM<sub>2.5</sub> mass; estimates show that sulfates comprise approximately 6-16% of the total mass of Fairbanks PM<sub>2.5</sub> (Figures 1-4). Direct emissions and atmospheric formation of particulate sulfate contribute to measured sulfate concentrations. The speciation profiles used for the different emission categories show that primary sulfate is emitted

by point, area (home heating) and mobile sources. Direct emissions of sulfate are not enough to account for the amount of sulfate observed in Fairbanks and North Pole. The CMAQ inventory for point and area sources reveal that point sources are a majority of primary sulfate emissions, but not concentrations at the monitors. Sulfate contribution at the monitors is 6-16% (Figure 1-4) and that equates to 4.9-5.4  $\mu\text{g}/\text{m}^3$ .

Speciation data shows that 3-8 % of total PM<sub>2.5</sub> mass on violation days is ammonium (Figure 1-4). Based on the emissions inventory used in the CMAQ modeling the leading sources of ammonia are automobiles and industrial sources.

Speciation of the Fairbanks winter PM<sub>2.5</sub> components (Figure 1) are derived from the high PM<sub>2.5</sub> days from the years 2011-2015. The speciation concentrations that represent the breakdown of the components of PM<sub>2.5</sub> in the Fairbanks area are measured from the SASS (Speciation Air Sampling System) speciation instrument. The speciation SASS monitor is different from the Federal Reference Monitor (FRM) that measures total PM<sub>2.5</sub>, we want to compare the components of PM<sub>2.5</sub> measured by the SASS instrument to the FRM measurements that measure total PM<sub>2.5</sub> for regulatory purposes, but have different measurement artifacts. The goal is to derive concentrations of chemical components as they would be found on the official Federal Reference Method (FRM) monitor filter, not as they are found through the SASS instrument. To convert the concentrations of each chemical species from the measurement by the SASS to what would have been found on the FRM filter, we use the SANDWICH method<sup>4</sup>. A detailed account of the adjustments made to compare speciation measurements to FRM total PM<sub>2.5</sub> measurements as well conversion of precursor gases and chemistry are found in Appendix III.D.5.8 of the Moderate Area SIP.

The largest component of PM<sub>2.5</sub> in the Fairbanks area is organic carbon. Organic carbon is primarily due to direct emission with very little resulting from secondary formation. The direct PM<sub>2.5</sub> reductions will be addressed as part of BACM, which is evaluating controls for all source sectors for PM<sub>2.5</sub> and precursor gases except point sources which are evaluated through BACT.

## PRECURSOR GAS CHEMISTRY OVERVIEW

### Nitrogen oxide precursors and nitrates

Nitrogen oxides are referred to as the chemical family NO<sub>x</sub> (NO<sub>2</sub>+NO), NO and NO<sub>2</sub> with primary emissions coming from combustion processes, home heating, vehicles and industry. Typically, during the day, NO<sub>x</sub> is oxidized by reacting with ozone and OH radical chemistry and forms nitric acid (HNO<sub>3</sub>) and during the night NO<sub>x</sub> is oxidized to form N<sub>2</sub>O<sub>5</sub> (g), which reacts on aerosol surfaces to form HNO<sub>3</sub> (aq) and deposition to snowpack. Particles containing nitrate are neutralized via reaction with ammonia gas (NH<sub>3</sub>) to form ammonium nitrate.

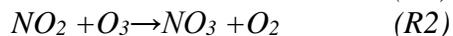
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<sup>4</sup> Frank, N. (2006): Retained nitrate, hydrated sulfates, and carbonaceous mass in Federal Reference Method fine particulate matter for six Eastern U.S. cities. J. Air and Waste Manage. Assoc. 56:500-511.

The photochemistry in Fairbanks and North Pole areas due to the low to no sunlight and cold conditions during the winter, limits the photochemical production of nitric acid from the daytime processes of OH and NO<sub>2</sub>. In addition at night, NO titrates the ozone removing the main oxidant to form nitrate (Joyce et. al, 2012). Joyce showed that ammonium nitrate is formed downwind of downtown, adding to the probability that aerosol nitrate from nitric acid is not being formed in downtown Fairbanks. Heterogeneous nighttime chemistry from N<sub>2</sub>O<sub>5</sub> is thought to be responsible for 80% of the nitric acid formation at high latitudes<sup>5</sup>, but in polluted areas the fast reaction of excess NO with the nitrate radical, nitric acid formation is hindered at night<sup>6</sup>. Nitric acid formation is further oxidized to form particle nitrate, it is important to understand the production of nitric acid and ammonium nitrate.

Aerosol processes play a dominant role in the formation of nitrate. Most nitrate is formed in the atmosphere from NO<sub>x</sub> emissions that transform into ammonium nitrate from secondary processes. The monitored observations show that ammonium nitrate accounts for between 1% and 5% and of the total PM<sub>2.5</sub>. As mentioned in the Moderate Area Plan, ammonium nitrate production is limited by the dark and cold conditions and by NO emissions hindering the nitrate production. The formation of ammonium nitrate is controlled by day time processes of OH and NO<sub>2</sub>, at night NO titrates the ozone removing the main oxidant to form nitrate<sup>7</sup>. During the day the photochemistry is limited by low sunlight and under low wind conditions when PM<sub>2.5</sub> is high, the NO emissions hinder further formation of nitrate (Figure 11). There are no OH measurements to compare to the model in the Fairbanks area, but there is no high ozone days which would form from reactions with VOCs and sunlight. Figure 11 shows that daytime ozone measurements are near background and photochemistry for ozone is not present and therefore the OH forming from photochemistry and producing nitric acid that creates particle nitrate is also low.

The modeling precursor demonstration for NO<sub>x</sub> having the potential to create ammonium nitrate should be representative of the ammonium nitrate that we see on the filters, in that only a few percent of PM<sub>2.5</sub> even on the highest days is ammonium nitrate. The modeling outputs were examined for NO, O<sub>3</sub>, and NO<sub>2</sub>. In the modeling outputs, ozone is titrated a majority of the time as can be seen in Figure 8 and 9. When the ozone is not titrated out and NO is low, the presence of wind and/or snow have reduced the PM<sub>2.5</sub>. The background level ozone present under clean air quality conditions (approximately 40 ppb) on 1/23/2008 until 1/24/2008, is when there is a light wind of 5-10 mph. During these conditions PM<sub>2.5</sub> is reduced by the wind. Under the conditions when we have high PM<sub>2.5</sub> (Figure 8 from date 2/3-2/7): low wind, strong inversion in place, a buildup of excess NO and low ozone, further oxidation of NO<sub>x</sub> and reactions with ammonia that produce particle nitrate are hindered (R2).



<sup>5</sup> Dentener, F. J. and Crutzen, P. J.: Reaction of N<sub>2</sub>O<sub>5</sub> on tropospheric aerosols: Impact on the global distributions of NO<sub>x</sub>, O<sub>3</sub>, and OH, J. Geophys. Res., 98, 7149–7163, doi:10.1029/92jd02979, 1993

<sup>6</sup> Seinfeld and Pandis, Atmospheric Chemistry and Physics, 1998

<sup>7</sup> Joyce, P.L., Gasow, R.V., Simpson, W.R., The fate of NO<sub>x</sub> emissions due to nocturnal oxidation at high latitudes: 1-D simulations and sensitivity experiments, Atoms. Chem. Physics. 14 7601-7616, 2014

At night when there is no excess NO and temperature is cold, the following is the dominant pathway to form nitric acid.<sup>8</sup>



$N_2O_5$  further reacts on a surface to form nitric acid. Once nitric acid is formed, the remaining reactions depend on the availability of ammonia, temperature and the pH of the aerosol to form ammonium nitrate. Joyce et al found in a modeling study that secondary formation of particulate nitrate downtown Fairbanks does not contribute significantly to the  $PM_{2.5}$  concentration, but there is a potential to react with ammonia downwind of the Fairbanks area.

At night, when there is no photolysis controlling the oxidation of  $NO_x$ , the reaction of NO and  $NO_3$  is very fast and if there was enough ozone to produce  $NO_3$ , it would quickly be removed by fresh NO emissions (5 seconds)<sup>9</sup> in an urban polluted environment.



The CMAQ model version 4.7.1 was applied in the precursor demonstrations to estimate  $PM_{2.5}$  concentrations. The model has full representations of gas and aerosol phase chemistry. Nitrate formation involves chemical reactions in both gas and aerosol phases. The chemical reactions related to nitrate formation represented in the model is illustrated in Figure 1.

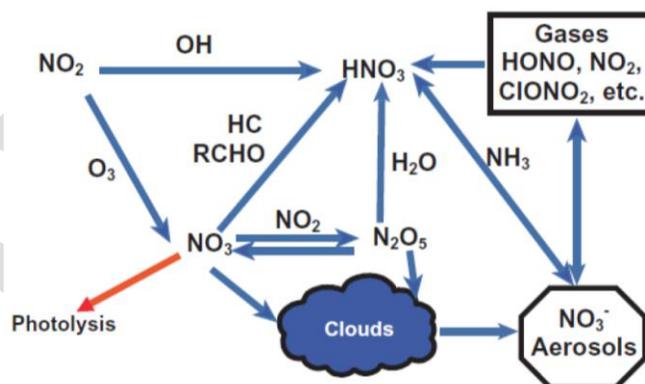


Figure 7. Chemistry processes related to nitrate formation represented in CMAQ<sup>10</sup>

Two major pathways of nitrate formation are parameterized in CMAQ 4.7.1:

1. Heterogeneous reaction of  $N_2O_5$ ; and
2. Thermodynamic equilibrium reactions among  $HNO_3$ ,  $NH_3$  and aerosols.

$N_2O_5$  is considered the reservoir for  $NO_x$  and it's thermally unstable. Its reaction with water on aerosol surface was found to be a significant source for aerosol nitrate<sup>11</sup>. Parameterization of heterogeneous reactions of  $N_2O_5$  in CMAQ 4.7.1 is based on the method developed by Davis et

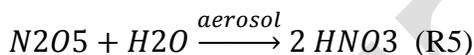
<sup>8</sup> Dentener, F. J. and Crutzen, P. J.: Reaction of  $N_2O_5$  on tropospheric aerosols: Impact on the global distributions of  $NO_x$ ,  $O_3$ , and OH, J. Geophys. Res., 98, 7149–7163, doi:10.1029/92jd02979, 1993

<sup>9</sup> Seinfeld and Pandis, Atmospheric Chemistry and Physics, 1998, pg 283

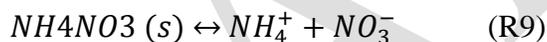
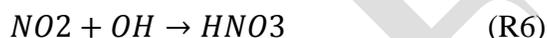
<sup>10</sup> NARSTO 2004. PDF version is available here: <http://www.narsto.org/sites/narsto-dev.ornl.gov/files/Ch3813KB.pdf>

<sup>11</sup> [https://www.atmos.illinois.edu/~nriemer/papers/riemer\\_n2o5\\_2003.pdf](https://www.atmos.illinois.edu/~nriemer/papers/riemer_n2o5_2003.pdf)

al. (2008)<sup>12</sup>, which calculates the N<sub>2</sub>O<sub>5</sub> hydrolysis probability as a function of temperature, relative humidity (RH), inorganic aerosol composition, and phase state. The N<sub>2</sub>O<sub>5</sub> photolysis probability is defined as the fraction of collisions between N<sub>2</sub>O<sub>5</sub> molecules and particle surfaces that lead to the production of HNO<sub>3</sub>. The photolysis probability is higher at lower temperature and higher RH, so nitrate formation through this pathway is more active at nighttime when N<sub>2</sub>O<sub>5</sub> is accumulated and the temperature is low and RH is high. The N<sub>2</sub>O<sub>5</sub> hydrolysis can be simply represented by the reaction below. More detailed reactions can be found in Reactions R1a – R3 of Davis et al. (2008).



Nitrate formation through the second pathway occurs when gas phase HNO<sub>3</sub>, NH<sub>3</sub>, and aerosols try to reach a thermodynamic equilibrium<sup>13</sup>. The major reactions represented in the model are listed below:



Reaction R6 produces gas phase HNO<sub>3</sub> during daytime. Gas phase HNO<sub>3</sub> and NH<sub>3</sub> react to form NH<sub>4</sub>NO<sub>3</sub> particles. Both gas phase HNO<sub>3</sub> and NH<sub>4</sub>NO<sub>3</sub> particles hold thermodynamic equilibrium with aerosols, as shown in reactions R8 and R9. The thermodynamic equilibrium is simulated by a thermodynamic model implemented in CMAQ.

## Sulfur Dioxide precursor gas and Sulfate

It is very likely that SO<sub>2</sub> is converted into sulfate in the atmosphere after being emitted and thus accounts for the remainder of the observed sulfate. As control strategies are adopted for BACT and BACM, for example, switching from fuel oil has higher SO<sub>2</sub> and primary sulfate emissions to ULSD will reduce the SO<sub>2</sub> and sulfate. Due to the complex nature of the sulfate chemistry a white paper on sulfur chemistry was included in the Moderate Area SIP, the white paper concludes that the lack of oxidants available in the dark and cold conditions would impede production of sulfate by the most common photochemical pathways<sup>14</sup>.

## Ammonia precursor gas and ammonium

Ammonia gas (NH<sub>3</sub>) reacts with acid aerosols containing nitrate (NO<sub>3</sub><sup>-</sup>) and sulfate (SO<sub>4</sub><sup>2-</sup>) to form ammonium nitrate (NH<sub>4</sub>NO<sub>3</sub>) and ammonium sulfate ((NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>). Nitrate is assumed to be

<sup>12</sup> <https://www.atmos-chem-phys.net/8/5295/2008/>

<sup>13</sup> [http://nenes.eas.gatech.edu/Preprints/ISORROPIA\\_AGPP.pdf](http://nenes.eas.gatech.edu/Preprints/ISORROPIA_AGPP.pdf)

<sup>14</sup> Peltier, R.E. (2011): Aerosol Chemistry in Fairbanks: A Summary of Prevailing Conditions, May 27, 2011.

all ammonium nitrate. Sulfates are partially neutralized to form ammonium sulfate and are associated with a degree of neutralization. As discussed in the moderate area SIP, if sulfate is reduced in Fairbanks, PM<sub>2.5</sub> is reduced by the weight of the sulfate reduced and also by the weight of the ammonium.

## Volatile Organic Compounds

The emissions of Volatile Organic Compounds (VOCs) are precursor gas emissions that contribute to the secondary formation of PM<sub>2.5</sub> by forming particulate organic carbon through condensing in the cold air after emission and through photochemistry to form secondary organic aerosols (SOA). The VOC emissions for home heating are 15.9 TPD. The condensable fraction of PM from point sources, gases that are emitted and form particles right out of the high temperature stack could be significant from the condensation due to low temperature.

## PRELIMINARY PRECURSOR DEMONSTRATION

### Methodology

We applied a tiered approach to the precursor demonstration for both NO<sub>x</sub> and VOCs in the Fairbanks North Star Borough 24-hour PM<sub>2.5</sub> Nonattainment Area. This process is in keeping with EPA's *Draft PM<sub>2.5</sub> Precursor Demonstration Guidance*<sup>15</sup> and 2016 PM<sub>2.5</sub> Implementation rule<sup>16</sup>. The tiered analysis can be broken down into five stages each with a decreasing level of confidence in the demonstration. The various precursor demonstration available are the following:

- Concentration Based Analysis
  - Ambient data
  - Air Quality Modeling (zero-out)
- Sensitivity Based Analysis
  - 70% Reduction
  - 50% Reduction
  - 30% Reduction

These analyses are broken down further in the sections below. EPA recommends a threshold of 1.3 µg/m<sup>3</sup> as a starting point for the precursor demonstration for 24-hour PM<sub>2.5</sub><sup>17</sup>. This analysis has chosen the recommended threshold. A precursor can be identified as not significant when it does not exceed the threshold. Except for the ambient data analysis the precursor demonstration can be conducted in either a comprehensive manner meaning that it applies to all sources or specifically for major stationary sources. The ambient data analysis test can only be conducted on a comprehensive basis. The threshold for significance is the same in both the comprehensive or major stationary source tests.

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<sup>15</sup> *Draft PM<sub>2.5</sub> Precursor Demonstration Guidance*, US EPA Office of Air Quality Planning and Standards, November 17 2016.

<sup>16</sup> Federal Register, Vol. 81, No. 164, August 24, 2016 (FR 81 58010).

<sup>17</sup> IBID.

## CONCENTRATION-BASED AMBIENT DATA ANALYSIS

First the concentration-based analysis is performed using ambient data. For this step we assessed the concentration of different precursor contributions for all four monitor sites between 2011 and 2015 on the highest concentration days. The high concentration days are described in the Speciated Modeled Attainment Test (SMAT) portion of the Technical Analysis Protocol (TAP), which is included as an attachment in this review. In short, the top 25% days were analyzed for the N CORE, SOB, and NPE monitors and all days over  $35 \mu\text{g}/\text{m}^3$  were used for the NPFS monitor. The speciated  $\text{PM}_{2.5}$  data was analyzed using the results of the SANDWICH<sup>18</sup> data processing technique. The ambient dataset is the same that is used in the attainment plan portion of the Serious area plan.

Contributions from  $\text{SO}_2$ ,  $\text{NO}_x$ , and  $\text{NH}_4$  could be determined from the data available, but the data was not analyzed in such a way that VOC contributions could be determined. Section 3.1.5 of EPA's *Draft  $\text{PM}_{2.5}$  Precursor Demonstration Guidance* summarizes the means by which each precursor gas is assigned to a  $\text{PM}_{2.5}$  species in the ambient  $\text{PM}_{2.5}$  measurements. These assignments are summarized for  $\text{SO}_2$ ,  $\text{NO}_x$ , and  $\text{NH}_3$  below. Contributions for  $\text{SO}_2$  were assessed using the mass of sulfate measured on the filters on the highest concentration days at each monitor site. Contributions for  $\text{NO}_x$  were assessed as the concentration of nitrate and the portion of the ammonium associated with nitrate. This is calculated as the sum of the nitrate concentration with the molar ratio equivalent amount of ammonium. If the ammonium is assumed to perfectly balance the nitrate then we determine the concentration of ammonium associated with nitrate in  $\mu\text{g}/\text{m}^3$  as  $18/62$  multiplied by the nitrate concentration in  $\mu\text{g}/\text{m}^3$ .  $\text{NH}_3$  contributions were calculated from the ambient data as the sum total of all ammonium and all nitrate. Any precursor demonstrations using ambient data would be considered comprehensive meaning that controls for that precursor would not be required on any source.

## CONCENTRATION-BASED AIR QUALITY MODELING ANALYSIS

An air quality modeling analysis of precursor impacts on  $\text{PM}_{2.5}$  utilizes a photochemical grid model (PGM) that can account for the non-linear secondary effects of precursor gases. PGMs account for the atmospheric chemistry, transport, and deposition of pollutants using local emissions and meteorological data. This demonstration used the Community Multiscale Air Quality (CMAQ) model version 4.7.1 as configured for the Moderate and Serious  $\text{PM}_{2.5}$  SIPs for Fairbanks<sup>19</sup>. Precursor significance for Fairbanks was determined using the zero-out approach. The zero-out approach compares a baseline model run with a model run where a precursor's emissions are set to zero in order to determine the influence of that precursor on  $\text{PM}_{2.5}$  formation. The emissions base year was updated to 2013 for this preliminary analysis. The final demonstrations will be updated to use the 2019 projected baseline to better represent the impacts for the attainment year. The CMAQ model was run with the 2013 baseline inventory first without any alterations to generate baseline modeled concentrations for the nonattainment area.

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<sup>18</sup> Frank, N. (2006): Retained nitrate, hydrated sulfates, and carbonaceous mass in Federal Reference Method fine particulate matter for six Eastern U.S. cities. *J. Air and Waste Manage. Assoc.* 56:500-511.

<sup>19</sup> Moderate SIP Chapter 5.08.

Separate runs were performed for VOC and NOx where each precursor's emissions were set to zero for all sources while all other emissions were left at baseline 2013 levels. Another separate model run was conducted where NOx emissions from major stationary sources were set to zero.

## SENSITIVITY BASED MODELING ANALYSIS

### Modeling Performance

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### Results

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**Table 1: NOx Comprehensive and Major Stationary Precursor Demonstrations**

NOx Episode Average Contributions (SMAT $\mu\text{g}/\text{m}^3$ )						
Test	SOB	NCORE	NCORE BAM	NPFS	NPE	Max Cell
Comprehensive Ambient	2.4	2.4	2.4	2.0	1.0	N/A
CMAQ 100%	1.5	1.4	1.5	1.3	0.5	1.6
CMAQ 75%	0.7	0.7	0.7	0.8	0.3	0.8
Major Stationary Zero-out	0.3	0.3	0.3	0.4	0.1	0.3

**Table 2: VOC Comprehensive Precursor Demonstrations**

VOC Episode Average Contributions (SMAT $\mu\text{g}/\text{m}^3$ )						
Test	SOB	NCORE	NCORE BAM	NPFS	NPE	Max Cell
Comprehensive Ambient						N/A
Modeled Zero-out	0.1	0.1	0.1	0.1	0.0	0.1

## Supporting Analysis

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**Table 3: NO<sub>x</sub> Comprehensive and Major Stationary Precursor Demonstrations Maximum Daily Impacts**

NO <sub>x</sub> Highest Daily Contributions (SMAT μg/m <sup>3</sup> )						
Test	SOB	NCORE	NCORE BAM	NPFS	NPE	Max Cell
Modeled Zero-out	1.81	1.69	1.84	1.33	0.62	1.85
Modeled 75% Sensitivity	0.81	0.76	0.83	0.72	0.35	0.89
Major Stationary Sources Zero-out	0.38	0.38	0.36	0.39	0.74	0.29

The following figures are the histograms of the daily PM<sub>2.5</sub> differences at the grid cells where the monitors are located. The differences were calculated based on the raw CMAQ output by subtracting the control case results (i.e., PT0NOX and NOX75OFF) from the baseline for each day of the total 35 episode days.

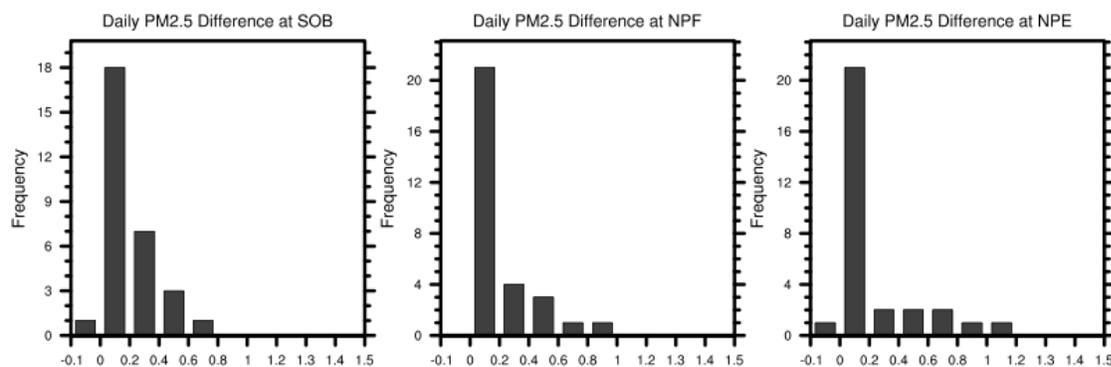


Figure 5. Histograms of the daily PM<sub>2.5</sub> differences at monitor grid cells for the point source NO<sub>x</sub> knock out run (PT0NOX).

For the point stationary source NO<sub>x</sub> zero out case, the reductions in daily PM<sub>2.5</sub> at the three grid cells containing monitored locations are mostly (~20 days) less than 0.2 μg/m<sup>3</sup>. None of the daily differences exceed the 1.3 μg/m<sup>3</sup> threshold. There is one day at the SOB grid cell monitor and another day at the NPE grid cell monitor with a slight increase (less than 0.1 μg/m<sup>3</sup>) in daily PM<sub>2.5</sub> when point source NO<sub>x</sub> emissions were removed. The nitrate concentration was decreased for both days, but the other PM<sub>2.5</sub> species were slightly increased due to the removal of point source NO<sub>x</sub> emissions. Both days have a relatively low nitrate concentrations, and it could be that the interaction of various PM<sub>2.5</sub> species on those days is very sensitive to the changes in NO<sub>x</sub> emissions.

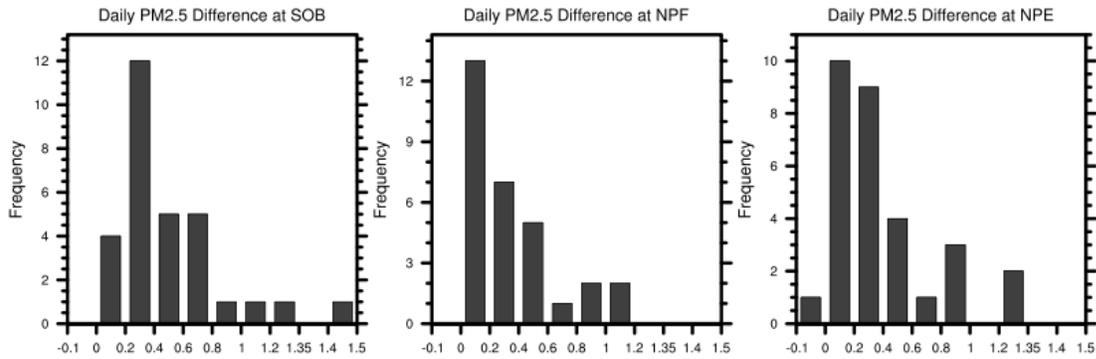


Figure 6. Histograms of the daily PM<sub>2.5</sub> differences at monitor grid cells for the comprehensive NO<sub>x</sub> 75% off sensitivity run (NOX75OFF).

For the comprehensive NO<sub>x</sub> 75% off case, most of the days have a reduction of PM<sub>2.5</sub> less than 0.6 µg/m<sup>3</sup>. There is one day at SOB with a reduction slightly larger than 1.3 µg/m<sup>3</sup>. There are two days at NPE that have a reduction above 1.3 µg/m<sup>3</sup>, but below 1.35 µg/m<sup>3</sup>. When rounded to the nearest tenth of a µg/m<sup>3</sup>, these days fall within the threshold value.

<<< Text to be completed >>>

Table 4: Bounding Runs NO<sub>x</sub> Comprehensive and Major Stationary Precursor Demonstrations

NO <sub>x</sub> Episode Average Contributions (SMAT µg/m <sup>3</sup> )						
Test	SOB	NCORE	NCORE BAM	NPFS	NPE	Max Cell
Comprehensive Ambient	2.4	2.4	2.4	2.0	1.0	N/A
CMAQ Zero-out						
Modeled 75%	0.24	0.23	0.25	0.57	0.24	0.57
Major Stationary Zero-out	0.03	0.03	0.03	0.19	0.09	0.00

Table 5: Bounding Runs NO<sub>x</sub> Comprehensive and Major Stationary Precursor Demonstrations Maximum Daily Impacts

NO <sub>x</sub> Highest Daily Contributions (SMAT µg/m <sup>3</sup> )						
Test	SOB	NCORE	NCORE BAM	NPFS	NPE	Max Cell

<b>CMAQ Zero-out</b>						
<b>Modeled 75%</b>	0.62	0.58	0.64	0.36	0.22	0.89
<b>Major Stationary Zero-out</b>	0.50	0.47	0.52	0.14	0.12	0.12

**Table 6: Sensitivity Runs NOx Comprehensive and Major Stationary Precursor Demonstrations Maximum Daily Impacts**

<b>NOx Highest Daily Contributions (Unprocessed Modeled <math>\mu\text{g}/\text{m}^3</math>)</b>						
<b>Test</b>	<b>SOB</b>	<b>NCORE</b>	<b>NCORE BAM</b>	<b>NPFS</b>	<b>NPE</b>	<b>Max Cell</b>
<b>CMAQ Zero-out</b>						
<b>Modeled 75%</b>	2.16	2.16	2.16	2.15	2.29	3.13
<b>Major Stationary Zero-out</b>	0.87	0.87	0.87	0.84	1.13	1.13

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## NITRATE CHEMISTRY COMPARISON

In addition to the bounding and sensitivity runs we developed a comparison of the modeled and ambient chemistry to provide confidence that the photochemical model was producing a reasonable nitrate response to changes in emitted NO<sub>x</sub>.

### Modeled Nitrate Chemistry Investigation

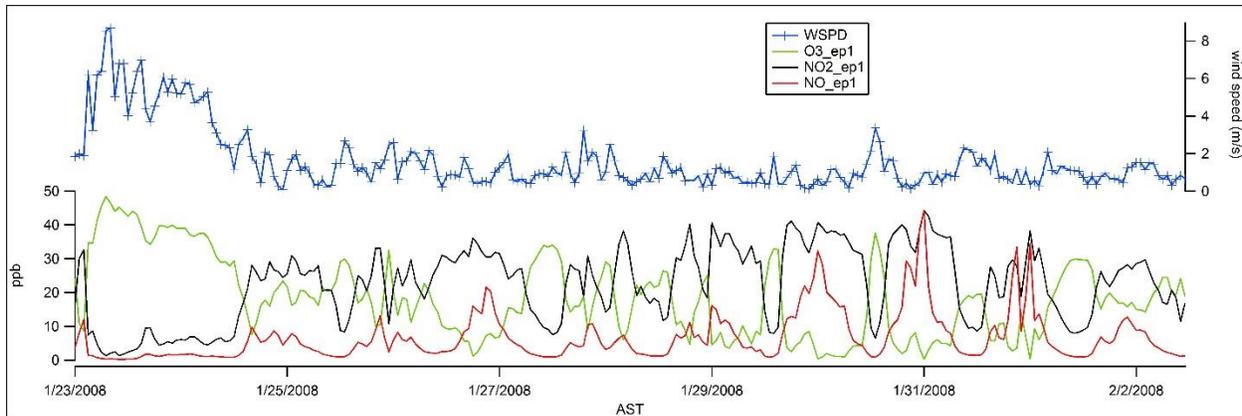


Figure 8 CMAQ modeling output for episode 1 for NO (red), NO<sub>2</sub> (black), O<sub>3</sub> (green) all in ppb and wind speed (blue) in m/s.

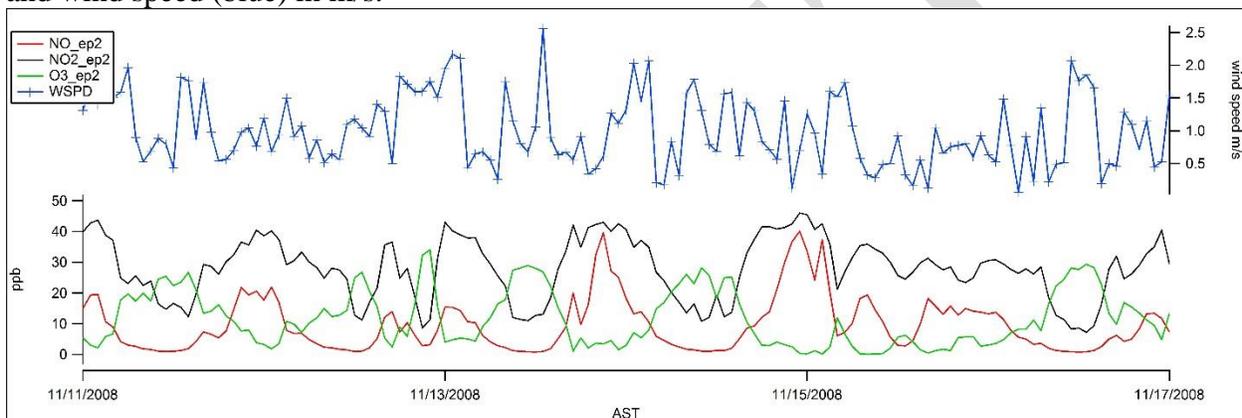


Figure 9 CMAQ modeling output for episode 2 for NO (red), NO<sub>2</sub> (black), O<sub>3</sub> (green) all in ppb and wind speed (blue) in m/s.

The episode average ozone and NO<sub>2</sub> are similar to ambient winter average O<sub>3</sub> and NO<sub>2</sub> measured at the NCORE monitor for episode 1 and 2. The winter averages from 2012 through 2016 at the NCORE site for ozone is 9 ppb, NO<sub>2</sub> is 22 ppb and the NO is 35 ppb. In comparison the modeling average hourly data for the episodes is 13 ppb O<sub>3</sub>, 25 ppb of NO<sub>2</sub> and 10 ppb for NO. The NO in the model is lower than ambient NO for the base case model run, this could be due to the grid cell emission rate in the model or the higher advection the model has compared to ambient zero wind conditions. We do not have ambient measurements outside of town, but away from the urban polluted downtown Fairbanks area, we would expect to see clean background concentrations of ozone around 40 ppb and the extracted northeast corner of the modeling domain has ozone levels of 40-45 ppb during both modeling episodes and only a few hours of NO<sub>x</sub> at <3 ppb over both episodes.

As mentioned in the precursor demonstration section, the NO emissions were increased by 3.6 times in order to see if the model produces more ammonium nitrate if we add more precursor NO<sub>x</sub> emissions. Figure 10 shows the modeled outputs and a large increase in NO up to 250 ppb. The model is presenting a worst case scenario and the O<sub>3</sub> is titrated as expected with the excess NO hindering the oxidation process.

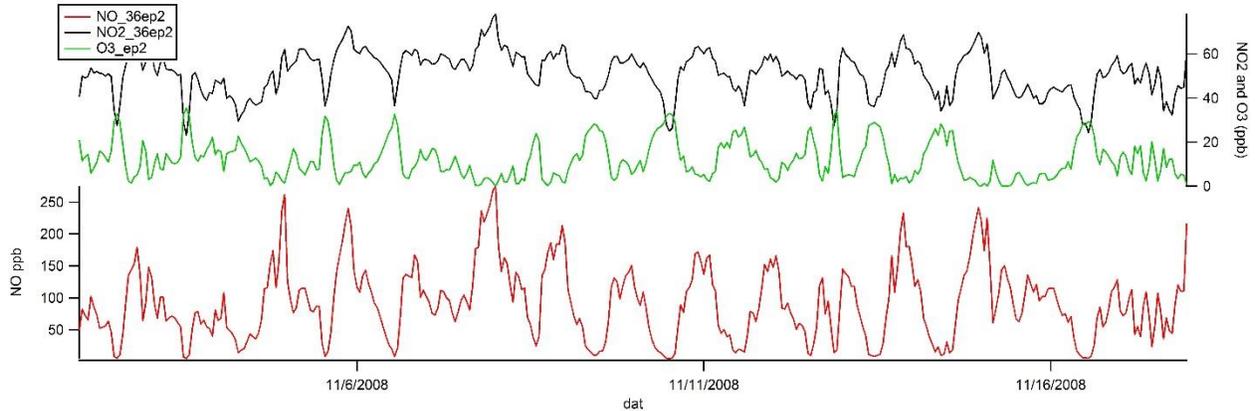


Figure 10 CMAQ modeling output for episode 2 for the NO<sub>x</sub> sensitivity run, NO (red), NO<sub>2</sub> (black), O<sub>3</sub> (green) all in ppb and wind speed (blue) in m/s.

At night the photolysis of NO<sub>x</sub> is not present and to check the model outputs, NO<sub>2</sub> and O<sub>3</sub> are correlated. There should be no concentrations above background ozone (approximately 40 ppb) when there is no photochemistry at night. Therefore NO<sub>2</sub> plus ozone should equal the background as seen in Figure 11. Figure 11 is all daytime and nighttime NO<sub>2</sub> and ozone. There are concentrations about background during the day, this means that most likely there is little photochemistry in the Fairbanks area for NO<sub>x</sub> and VOC/NO<sub>x</sub> ratios that generally produce photochemical ozone are not applicable under cold, low sunlight conditions. This low photochemical production lead to low OH radical production which forms nitric acid and as reviewed earlier nitric acid forms particle nitrate in PM 2.5 after reacting with water and ammonia gas.

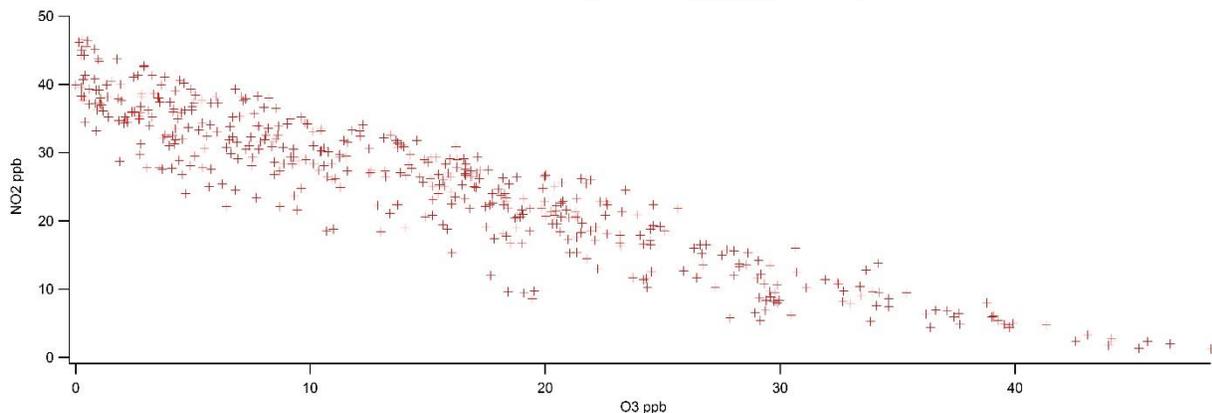


Figure 11. Correlation of hourly NO<sub>2</sub> and O<sub>3</sub> from episode 1.

# **EXHIBIT 4**

## Portola Fine Particulate Matter (PM2.5) Attainment Plan



January 2017

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# I. Background

## A. Introduction

In December 2012, the U.S. Environmental Protection Agency (U.S. EPA) strengthened the annual PM<sub>2.5</sub> National Ambient Air Quality Standards (NAAQS or standard) by lowering the level from 15 µg/m<sup>3</sup> to 12 µg/m<sup>3</sup> and retained the 24-hour standard of 35 µg/m<sup>3</sup>. The term PM<sub>2.5</sub> refers to fine particulate matter (PM) two and a half microns or less in diameter. Fine particulate matter contains microscopic solids or liquid droplets that are small enough to be inhaled deeply into the lungs where they accumulate and aggravate respiratory conditions, particularly asthma. Fine particulates are associated with heart and lung disease, increased respiratory symptoms and disease, decreased lung function, and premature death. Chronic exposure to fine particulates has also been implicated in increased risk for cardiac events. Populations especially at risk include children, the elderly, and those with existing health problems.

Title I of the Clean Air Act (CAA) requires the U.S. EPA to designate areas in the United States (US) as being in “attainment” or “nonattainment” following the adoption or revision of the NAAQS. The region is given a classification that describes the degree of nonattainment. This classification dictates specific planning requirements under the CAA, including the time provided to attain the standard. Effective April 15, 2016, the U.S. EPA designated the City of Portola (City) and surrounding areas of Plumas County (County), California as a federal Moderate nonattainment for the annual PM<sub>2.5</sub> standard of 12 µg/m<sup>3</sup>. The area is officially referred to as the Plumas County PM<sub>2.5</sub> Nonattainment Area (Nonattainment Area).

Following the nonattainment designation, the area is required to submit an attainment plan (Attainment Plan or Plan) to U.S. EPA by October 15, 2016, 18 months after the initial designation on January 15, 2015. Sections 189(a),(c), and (e) of the CAA require that Moderate area attainment plans contain the following: (i) an approved permit program for construction of new and modified major stationary sources (CAA section 189(a)(1)(A)); (ii) a demonstration that the plan provides for attainment no later than the applicable Moderate area attainment date or demonstration that attainment by that date is impracticable (CAA section 189(a)(1)(B)); (iii) provisions for the implementation of Reasonably Achievable Control Measures (RACM) and Reasonably Achievable Control Technologies (RACT) no later than four years after designation (CAA section 189(a)(1)(C)); (iv) quantitative milestones that will be used to evaluate compliance with the requirement to demonstrate Reasonable Further Progress (RFP) (CAA section 189(c)); and (v) evaluation and regulation of PM<sub>2.5</sub> precursors (in general to meet RACM and RACT and other attainment planning requirements, and as specifically provided for major stationary sources under CAA section 189(e)). In addition, the plan must include

the following subpart 1 elements: (i) a description of the expected annual incremental reductions in emissions that will demonstrate RFP (CAA section 172(c)(2)); (ii) emission inventories, as necessary (CAA section 172(c)(3)); (iii) other control measures (beside RACM and RACT) needed for attainment (CAA section 172(c)(6); and (iv) contingency measures (CAA section 172(c)(9)).

The Attainment Plan demonstrates that the Plumas County PM<sub>2.5</sub> Nonattainment Area will reach attainment by the applicable Moderate area attainment date, December 31, 2021. The Plumas County's nonattainment status will remain in effect until the PM<sub>2.5</sub> annual design value meets the annual PM<sub>2.5</sub> standard and when certain demonstrations and requirements are met.

## B. Nonattainment Area Description

The Plumas County PM<sub>2.5</sub> Nonattainment Area includes the City of Portola and the nearby communities of Iron Horse, Delleker, C-Road, Mohawk Vista, Plumas-Eureka, Blairsden-Graeagle, Gold Mountain, Whitehawk, Clio, Johnsville, and portions of Lake Davis. The nonattainment boundaries are consistent with previously established PM<sub>2.5</sub> nonattainment boundaries for California State PM<sub>2.5</sub> Standard. Air Resources Board (ARB) utilized hydrographic boundaries based on watersheds. A watershed boundary defines a ridge of high land that separates areas drained by different river systems. Specifically, ARB identified the Portola Valley State PM<sub>2.5</sub> Nonattainment Area as that portion of Plumas County within the following Super Planning Watersheds: Humbug Valley, Sulpher Creek, Frazier Creek, and Eureka Lake.

Plumas County is large, covering 2,613 square miles. The vast majority of the area is zoned as Timber Resource Land, with more than 75 percent of the county owned and managed by the federal government. Plumas County has approximately 20,000 residents with four main population centers, all rural in character and separated by mountainous terrain: Portola, Quincy, Greenville, and Chester (Figure 1). The Portola area is located in an intermountain basin isolated by rugged mountains, transitioning from conifer-dominated forests to the north, west and south, to grassland/high desert to the east. The mountain chains that dominate the topography of Plumas County drastically affect the climate of Portola. First, as Portola is on the leeward side of the Sierra range, it receives much less precipitation than areas further west and averages only 20 inches annually<sup>1</sup>. Even Quincy, less than 30 miles to the northwest receives twice the amount of precipitation, averaging 40 inches a year. Second, Portola's high elevation, 4,890 feet, affects the temperature and precipitation patterns. Third, the Portola area has very cold temperatures - the average daily low temperature for the

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<sup>1</sup> Based on data from the Western Regional Climate Center (<http://www.wrcc.dri.edu/>) Cooperative Climatological Data Summaries (<http://www.wrcc.dri.edu/climatedata/climsum/>).

practices in wood burning is further reinforced when District staff visits the residence few months later to follow-up on the installation.

In order to meet the standard by December 31, 2021, the District needs to replace 600 stoves between 2016 and 2020. Since the change-out program is voluntary, the District took extra steps to ensure sufficient participation. From early on the District embarked on an aggressive outreach campaign to educate the residents on the importance of reducing PM<sub>2.5</sub> for their own health and the well-being of the community. The District widely advertised the change-out program throughout the community by distributing flyers and promoting program through the website and local newspapers. A key element of the advertising the campaign was a kick-off meeting which provided an opportunity for residents to complete applications on site and talk to the retailers. The District will conduct a similar event during each year of the program. To have a continuous presence in the community the District maintains a satellite office at Portola, with District staff providing assistance with filling applications and answering questions related to the program. The District also hired a translator to help communicate with the Spanish-speaking community.

#### D. City of Portola Wood Stove and Fireplace Ordinance

The Portola City Wood Stove and Fireplace Ordinance was previously adopted in 2002 as Portola Ordinance 298. On June 22, 2016, upon the District's request, the City of Portola adopted a new Ordinance, 344, to address the PM<sub>2.5</sub> pollution problem. The fully adopted City Ordinance is presented in Appendix M. The ordinance contains many different strategies to reduce emissions from wood burning heaters which are effective immediately upon adoption. The following PM<sub>2.5</sub> measures are currently being implemented at the local level to achieve compliance with the annual PM<sub>2.5</sub> NAAQS:

1. Existing homes
  - a. Prohibit the installation of uncertified heating devices.
  - b. Prohibit the installation of unqualified fireplaces.
  - c. Limit certified wood stoves to two per property
2. Change of ownership
  - a. Require removal or replacement of uncertified wood stoves.
  - b. Limit the number of certified wood heating devices to two per property.
3. New constructions
  - a. Require new constructions to offer non-wood heat.
4. New constructions or remodeling
  - a. Limit the number of certified wood stoves to two per property.
  - b. Limit the number of EPA-qualified fireplaces to one per home.
5. Prohibit the installation of wood fired boilers or hydronic heaters.

6. Restrict burning materials to seasoned wood, uncolored paper, pellets, and manufactured logs.
7. Require wood stove retailers to distribute educational materials provided by the District.

In addition to measures which took effect immediately, the ordinance includes a mandatory burning curtailment rule which will take effect on January 1, 2021. This rule will make it illegal to burn in an uncertified stove on days when high atmospheric stability would limit pollutant dispersion. The purpose of this rule is two-fold. First, the rule encourages owners of uncertified stoves to upgrade to certified stoves or risk not being able to heat their home. Second, the rule provides a mechanism for preventing PM<sub>2.5</sub> concentrations from reaching high levels on days when stable atmospheric conditions limit pollutant dispersion. The rule will take effect on January 1, 2021 to give homeowners enough time to change their stoves to EPA certified devices. The rule will make it illegal to burn wood when pollution is forecast to exceed 30 µg/m<sup>3</sup> unless an EPA-certified stove is used.

## E. Additional Strategies for Attainment

In addition to the wood stove change-out program and the requirements in the City's Wood Stove and Fireplace ordinance, the District is including the following strategies as part of the SIP.

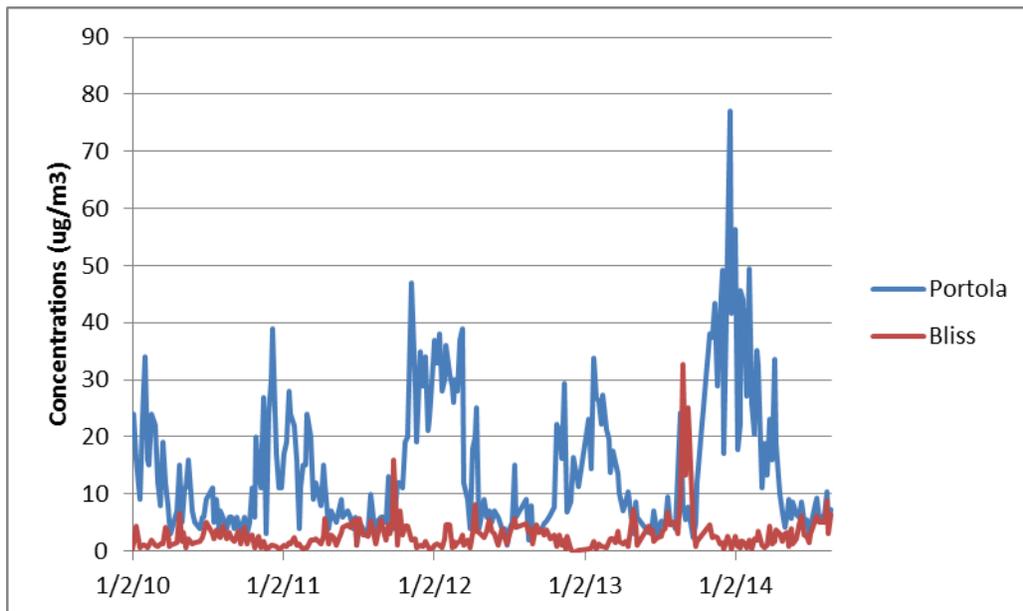
### 1. Educational Campaign

Ever since Portola and the surrounding area have been designated nonattainment for the annual PM<sub>2.5</sub> standard, the District has been working with the community to inform them about the health effects of PM<sub>2.5</sub> and the implications of the nonattainment designation. The District staff reached out to the City Council and the District Board for support in working with the community. The District enlisted outreach partners such as the local hardware and grocery store, post office, library, senior community center, and schools to assist in the distribution of educational materials and advertise the change-out program. The District distributed press releases to local newspapers to inform the public about the problem. An example of a press release is included in Appendix N.

On March 19, 2015, the District hosted a wood stove workshop for Portola residents to discuss proper burning techniques and demonstrate new EPA-certified heating devices. Two local wood stove retailers demonstrated various models of EPA-certified wood, pellet, and propane stoves. The event included several presentations about the PM<sub>2.5</sub> designation status, health effects of PM<sub>2.5</sub>, and the District's plan to reduce PM<sub>2.5</sub> concentrations. The presenters included Gretchen Bennett, the District Executive

Overall, the Bliss IMPROVE site is an appropriate background site for Portola. The two sites have similar concentrations during summer months, while winter concentrations increase at Portola but remain low at Bliss. Figure 18 further illustrates the daily differences between the two sites.

Figure 18. Comparison of PM<sub>2.5</sub> Concentrations at Portola and Bliss State Park

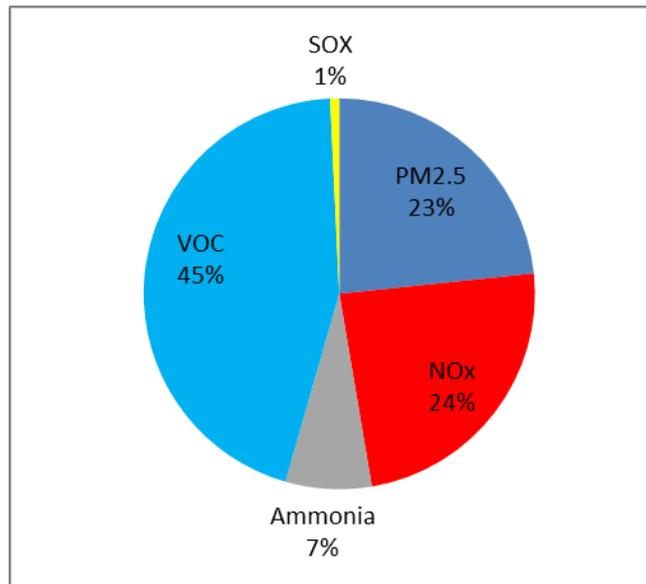


### C. Evaluation of Significant Precursors

In addition to direct emissions, particulate matter is formed in the atmosphere from precursors. Sulfur oxides (SO<sub>x</sub>), nitrogen oxides (NO<sub>x</sub>), volatile organic compounds (VOC) and ammonia (NH<sub>3</sub>) all contribute to the formation of particulate matter. For this analysis, ARB staff evaluated PM<sub>2.5</sub> precursors consistent with the PM<sub>2.5</sub> NAAQS Implementation Final Rule.<sup>6</sup> Specifically, ARB staff developed a technical demonstration indicating that emissions of a particular precursor do not significantly contribute to PM<sub>2.5</sub> levels. The PM<sub>2.5</sub> Implementation Rule recommends evaluating chemical speciation data and emissions inventories. However, in the case of Portola, evaluation of the emission inventories does not appropriately characterize main contributors to the PM<sub>2.5</sub> problem. As illustrated in Figure 19, emissions of directly emitted PM<sub>2.5</sub> are lower than emissions of NO<sub>x</sub> or VOC.

<sup>6</sup> <https://www.epa.gov/pm-pollution/pm25-naaqs-implementation-final-rule-and-fact-sheet-july-2016>

Figure 19. Make-up of 2013 Portola Nonattainment Area Baseline Emissions



The emission inventories suggest that PM<sub>2.5</sub> precursors, particularly VOC and NO<sub>x</sub>, are important contributors to the total emissions; however, chemical composition data suggests otherwise. Figure 19, for example, shows that approximately three quarters of the emissions are from precursors, but chemical composition data illustrated in Figure 20 indicates that only 7 percent of the mass is from secondary formation and the remaining 93 percent is from direct PM<sub>2.5</sub> emissions.<sup>7</sup> This apparent inconsistency is the result of meteorological conditions which favor accumulation of direct PM<sub>2.5</sub> over secondary formation. Furthermore, Portola precursor emissions are so low in comparison to other areas of the State, that there could be a lot of noise in the data. For example, Table 7 compares Portola NO<sub>x</sub> emissions to other areas of the State.

Table 7. Comparison of Portola NO<sub>x</sub> Emission to Other Areas in California

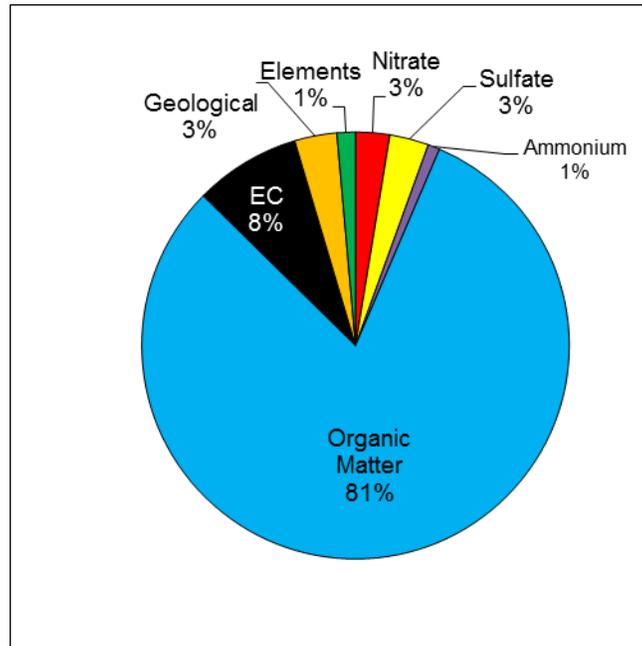
Area	NO <sub>x</sub> Emissions (tpd)
Portola Nonattainment Area	0.504
Sacramento County	46.565
Fresno County	77.086
Kern County	103.996

<sup>7</sup> 93 percent of PM<sub>2.5</sub> mass is directly emitted assuming that all of organic matter is primary in nature. Some organic matter is secondary in nature but since most of it originates from wood burning, control strategies aimed at reducing wood burning emissions will also reduce emissions of secondary organics.

## 1. Concentration-based Contribution Analysis

This section relies on chemical speciation data, summarized in Chapter II.C.1, Chemical Composition, to demonstrate contribution of a particular precursor to the PM<sub>2.5</sub> design value. Figure 20 shows that directly emitted PM<sub>2.5</sub> (organic matter, elemental carbon, geological material, and elements) contribute 93 percent of PM<sub>2.5</sub> mass. For Portola it is appropriate to assume that most of the organic matter is directly emitted since diurnal profiles point to an overwhelming contribution of PM<sub>2.5</sub> during nighttime hours, consistent with the time when the majority of people burn wood for heat. Although wood burning could lead to formation of Secondary Organic Aerosols (SOAs), relatively little is known about its formation, composition, and potential contribution to PM<sub>2.5</sub> mass. It is safe to assume that controls aimed at reducing wood burning emissions would also reduce SOA formation. The paragraphs that follow examine each precursor.

Figure 20. 2013-2014 Annual Average Composition



### Sulfur Oxides - SO<sub>x</sub>

Since sulfate can exist in the atmosphere in the form of sulfuric acid if it's not neutralized by ammonia, the SO<sub>x</sub> contribution to PM<sub>2.5</sub> design value is evaluated by estimating sulfate contribution to the PM<sub>2.5</sub> design value. Sulfate contributes 0.41 µg/m<sup>3</sup> or 2.9 percent of the PM<sub>2.5</sub> mass.

## Nitrogen Oxides - NO<sub>x</sub>

Since NO<sub>x</sub> contributes directly to ammonium nitrate formation, its impact on the PM<sub>2.5</sub> design value was evaluated by estimating the ammonium nitrate contribution.

Ammonium nitrate contributes 0.46 µg/m<sup>3</sup> or 3.3 percent to the PM<sub>2.5</sub> annual design value.

## Ammonia – NH<sub>3</sub>

Since in the absence of ammonia, nitrate would only exist as a gas, ammonia contribution to the PM<sub>2.5</sub> design value is represented by all measured ammonium plus nitrate ion. The two components together contribute 0.48 µg/m<sup>3</sup> or 3.4 percent to the PM<sub>2.5</sub> annual design value. Therefore, based on chemical speciation data, ammonia could potentially contribute 0.48 ug/m<sup>5</sup> or 3.4 percent to the annual design value.

## Volatile Organic Compounds - VOC

There are two routes by which VOCs can contribute to ambient PM<sub>2.5</sub>. The first is through various chemical reactions leading to the formation of SOAs. The second is through photochemical reactions that create oxidants such as ozone and hydroxyl radicals, which in turn oxidize NO<sub>x</sub> emissions leading to the formation of particulate ammonium nitrate. As noted above, ammonium nitrate is not a significant component of PM<sub>2.5</sub>. Therefore, the impact of VOC emissions on the PM<sub>2.5</sub> design value through nitrate formation is also insignificant. If there is any contribution of SOAs to ambient PM<sub>2.5</sub> levels, it would be mostly from biogenic emissions and mainly formed during summer when temperatures are warmer and concentrations are lowest. Man-made sources of SOA precursors include solvents, catalyst gasoline engines, wood smoke, and non-catalytic gasoline engines. Due to the lack of SOA data specific to Portola, we examined broader aspects of SOA concentrations in California:

- 1) San Joaquin Valley – ARB air quality modeling exercises conducted as part of the SJV 2008 PM<sub>2.5</sub> Plan attainment demonstration analysis using the CMAQ model showed that SOA derived from anthropogenic VOC emissions contribute three to five percent of the organic aerosol concentrations.<sup>8</sup> In Portola, the PMF model identified two sources of organic aerosols: wood burning and motor vehicles. Any controls targeting directly emitted PM<sub>2.5</sub> from wood burning would also reduce VOC emissions. Motor vehicle emissions contribute 1 µg/m<sup>3</sup> to the 5-year weighted design value. If three to five percent of that mass is from secondary formation, the total mass would be no more than 0.05 µg/m<sup>3</sup>.

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<sup>8</sup> See Appendix A of ARB Review of San Joaquin Valley PM<sub>2.5</sub> State Implementation Plan (April 20, 2015): [http://www.arb.ca.gov/planning/sip/planarea/2015sjv/WOE\\_SJV\\_2015\\_PM25\\_Plan.pdf](http://www.arb.ca.gov/planning/sip/planarea/2015sjv/WOE_SJV_2015_PM25_Plan.pdf)

- 2) South Coast - Special study data collected in the South Coast Air Basin were used to estimate potential SOA concentrations in Portola.<sup>9</sup> The amount of SOA produced is related to both VOC emissions and meteorology. For the purpose of this estimate, ARB staff discounted the effect of meteorology, which results in a worst-case scenario estimate, and focused on comparing emissions. In Los Angeles, 304 tons per day of emissions could produce 0.65  $\mu\text{g}/\text{m}^3$  of SOA. In Riverside, 70 tons of emissions per day could produce 0.86  $\mu\text{g}/\text{m}^3$  of SOA. Since VOC emissions at Portola are less than 1 ton per day, it follows that the corresponding SOA concentrations should be less than 0.02  $\mu\text{g}/\text{m}^3$ .
- 3) IMPROVE Sites - The organic aerosol tracer tool located at the Western Regional Air Partnership (WRAP) Technical Support System (TSS) website (<http://vista.cira.colostate.edu/tss/>) can be used to investigate the contribution of primary and secondary anthropogenic and biogenic sources on modeled carbon at Class I areas. Annual average anthropogenic SOA concentrations at three California IMPROVE Sites (Bliss State Park, Trinity Alps, and Lava National Park) were estimated to be about 0.06  $\mu\text{g}/\text{m}^3$  for the 2002-2004 baseline.
- 4) There is discontinuity between the temporal patterns seen in SOA formation and  $\text{PM}_{2.5}$  concentrations at Portola. Both CMAQ model outputs and IMPROVE data demonstrate that SOA are formed mostly during summertime and are primarily derived from biogenic emission sources. During summer, when the conditions are optimal for SOA formation,  $\text{PM}_{2.5}$  organic carbon concentrations at Portola are very low and are essentially indistinguishable from background levels. Figure 21 compares Portola's monthly average OC concentrations to Bliss State Park. Based on this comparison, we may assume that the average SOA concentration at Portola is comparable to the 0.06  $\mu\text{g}/\text{m}^3$  estimated for the three IMPROVE sites.

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<sup>9</sup> Heo, J.B., Dulger, M., Olson, M.R., McGinnis, J.E., Shelton, B.R., Matsunaga, A., Sioutas, C., Schauer, J.J., 2013. Source apportionments of  $\text{PM}_{2.5}$  organic carbon using molecular marker positive matrix factorization and comparison of results from different receptor models. *Atmos. Environ.* 73, 51-61.

Figure 21. Seasonal Patterns in Organic Carbon Concentrations at Portola and Bliss State Park.

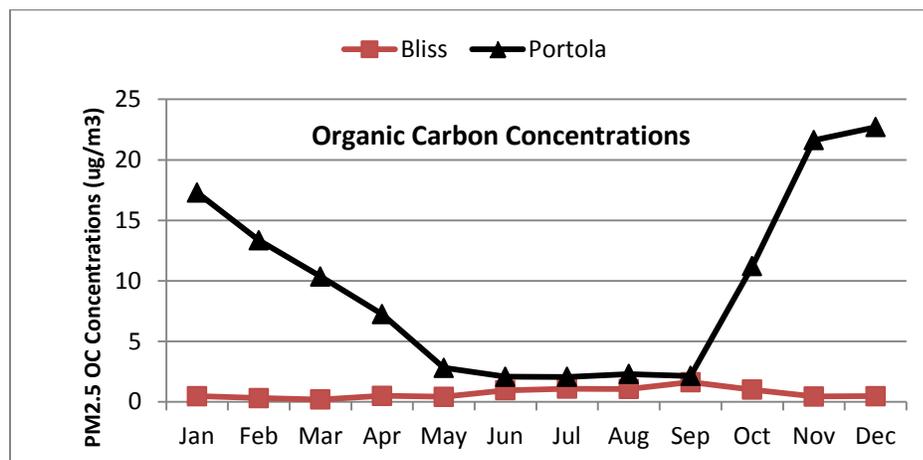


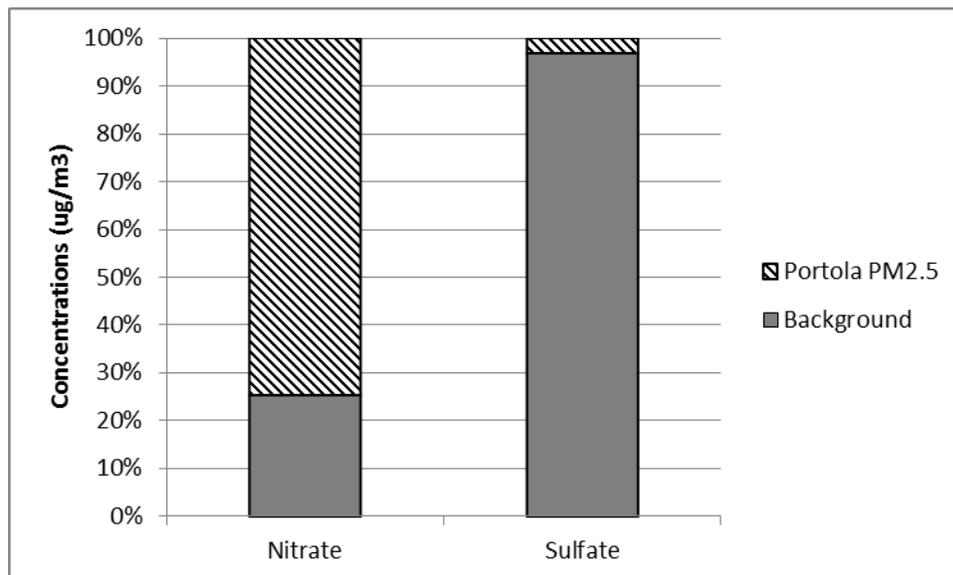
Table 8 summarizes each precursor contribution to the PM<sub>2.5</sub> design value.

Table 8. Contribution to the PM<sub>2.5</sub> design value based on 2013-2014 chemical composition data.

PM <sub>2.5</sub> Precursor	Assigned to PM <sub>2.5</sub> Species	Concentrations (µg/m <sup>3</sup> )	Scaled to DV (µg/m <sup>3</sup> )	% Of DV
NO <sub>x</sub>	Nitrate + Ammonium	0.58	0.46	3.3
SO <sub>x</sub>	Sulfate Ion	0.52	0.41	2.9
NH <sub>3</sub>	Ammonium	0.16	0.12	3.4
	Nitrate	0.45	0.35	
	Total	0.61	0.48	
VOC	SOA		0.06	0.4

It is important to note that concentrations of secondary components are close to the background levels and not likely to decrease much. As illustrated in Figure 22, background concentrations comprise 25 percent of nitrate and 97 percent of sulfate.

Figure 22. Comparison of Background Concentrations to Measured Concentrations for Select Secondary Components.

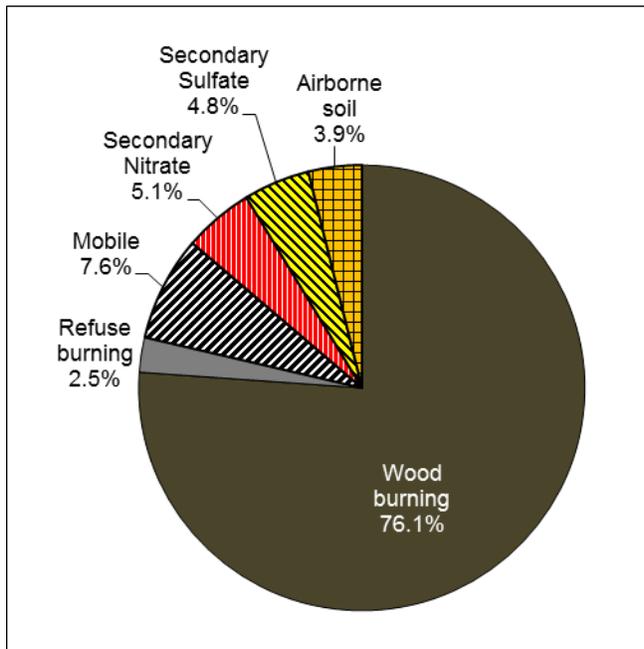


## 2. Sensitivity-based Contribution Analysis

The sensitivity-based analysis was used to demonstrate the degree to which concentrations in the Nonattainment Area are sensitive to decrease of a precursor. The PMF results which were used in the proportional rollback to demonstrate attainment are also used in the sensitivity analysis. PMF modeling identified two secondary components contributing to  $PM_{2.5}$  mass in Portola, secondary nitrate and secondary sulfate (Figure 23). As part of the sensitivity analysis, precursor emissions were reduced 10, 25, 30, 50, and 70 percent in the rollback model to evaluate the impact on the design value. Since PMF results do not separately include ammonium, ammonium was separated from ammonium nitrate and ammonium sulfate using stoichiometric proportions<sup>10</sup> and rolled against ammonia inventory. The same approach was used to estimate ammonium background concentrations using IMPROVE data.

<sup>10</sup> The ammonium fraction of ammonium nitrate is calculated as molecular weight of ammonium (18) divided by the molecular weight of ammonium nitrate (80). The ammonium fraction of ammonium sulfate is calculated as molecular weight of ammonium (36) divided by the molecular weight of ammonium sulfate (132). The combined ammonium fraction is the average of these two values.

Figure 23. 5-Year Weighted Average Annual PMF Source Contribution.



Assuming a 1-to-1 ratio for NO<sub>x</sub> to nitrate, SO<sub>x</sub> to sulfate, and ammonia to ammonium conversion, precursor emissions were reduced in the rollback model to evaluate the impact on the design value. As illustrated in Table 9, even significant reductions in ammonia and SO<sub>x</sub> emissions would have a negligible impact on the attainment year design value. NO<sub>x</sub> is the only precursor impacting the PM<sub>2.5</sub> design value. However the impact is very small, as a 30 percent reductions in NO<sub>x</sub> emissions would reduce the design value by only 0.16 µg/m<sup>3</sup>. If the 2021 attainment design concentrations were rounded, consistent with the NAAQS, 30 percent reductions in NO<sub>x</sub> emissions would yield 0.1 µg/m<sup>3</sup> reductions in design value. Furthermore, about 90 percent of NO<sub>x</sub> emissions in Portola come from the mobile sector that already has the most stringent controls in the nation. The remaining 10 percent comes from wood burning; a sector that will be targeted by the control measures included in this plan.

Table 9. Impact of Reducing Precursor Emissions on Attainment Year Design Value

Emission Reductions	Attainment Year Design Values (µg/m <sup>3</sup> )		
	NO <sub>x</sub>	SO <sub>x</sub>	Ammonia
10%	11.98	12.02	12.01
25%	11.89	12.00	11.99
30%	11.87	11.99	11.98
50%	11.75	11.97	11.95
70%	11.64	11.94	11.92

### 3. Conclusions

PM<sub>2.5</sub> concentrations in Portola are dominated by primary PM<sub>2.5</sub> emissions rather than by secondarily formed PM<sub>2.5</sub>. The comprehensive analysis of emissions, precursor contribution, and sensitivity-based contribution demonstrates that secondary formation is negligible compared with directly emitted PM<sub>2.5</sub> and reductions in emissions of PM<sub>2.5</sub> precursors would not expedite attainment. Portola will attain the standard by the end of 2021 by targeting directly emitted PM<sub>2.5</sub>. Implementing additional controls on precursors would not be effective in reducing PM<sub>2.5</sub> concentrations and would lead to insignificant air quality changes. We conclude that precursor controls do not need to be included in the evaluation of potential control measures.

#### D. Rollback Model

The method chosen to demonstrate attainment of the PM<sub>2.5</sub> annual and 24-hour NAAQS is a rollback proportional model. The proportional rollback model assumes a linear correlation between emissions and measured concentrations. It further assumes that any reductions from control strategies will result in corresponding reductions in emissions. As a result, concentrations in a future year (2021) can be predicted based on reductions in emissions, and their corresponding ambient concentrations, from the base year (2013). In the proportional rollback each source category is rolled individually against the corresponding emissions. The rollback model is an appropriate tool for demonstrating attainment in the Portola PM<sub>2.5</sub> Nonattainment Area for the following reasons:

- 1) The PM<sub>2.5</sub> mass in Portola is dominated by carbonaceous aerosols from wood smoke. Lack of natural gas and reliance on wood for heat combined with frequent temperature inversion and stagnant air leads to elevated PM<sub>2.5</sub> concentrations.
- 2) Photochemistry plays a minor role in PM<sub>2.5</sub> formation in Portola.
- 3) Secondary PM<sub>2.5</sub>, including sulfate, nitrate, and SOAs are minor constituents of the total PM mass.
- 4) Since the PM<sub>2.5</sub> problem in Portola is driven by local emissions sources and the small Nonattainment Area is located in a valley region with highly complex terrain, the use of a photochemical grid model is not appropriate. Specifically, the strong PM<sub>2.5</sub> spatial gradient resulting from local emissions sources and complex terrain would not be well characterized in a grid model and a model such as CMAQ would not reliably simulate the impacts of wood burning on PM<sub>2.5</sub> in the region.

## Appendix M

City of Portola Wood Stove and Fireplace Ordinance

Ordinance Number 344

ORDINANCE NO. 344

AN ORDINANCE OF THE CITY OF PORTOLA, COUNTY OF PLUMAS  
AMENDING CHAPTER 15.10 OF THE CITY OF PORTOLA MUNICIPAL CODE  
PROVIDING FOR REGULATION OF WOOD STOVES AND FIREPLACES

The Council of the City of Portola, California, does ordain as follows:

**Section 1.** Chapter 15.10 of the Portola Municipal Code is hereby amended to read as follows:

Title 15- BUILDINGS AND CONSTRUCTION

Chapter 15.10- WOOD STOVE AND FIREPLACE ORDINANCE

Sections:

- 15.10.010 Purpose.**
- 15.10.020 Definitions.**
- 15.10.030 Requirements for New Wood Burning Devices.**
- 15.10.040 Requirements for Existing Wood Burning Devices.**
- 15.10.050 Permitted Fuels in Wood Burning Devices, Wood Burning Fireplaces, Wood-Fired Cookstoves, Wood-Fired Fire Pits.**
- 15.10.060 Mandatory Curtailment of Wood Burning Heaters, Wood Burning Fireplaces, Wood-Fired Fire Pits and Wood-Fired Cookstoves During Stagnant Conditions.**
- 15.10.070 Outdoor Wood-Fired Boiler Installation Prohibited.**
- 15.10.080 Wood Stove Retailers/Contractors Required to Provide Educational Materials.**
- 15.10.090 Violations.**
- 15.10.100 Continuing Violations- Each day being a separate violation.**

**15.10.010 Purpose.**

- A. This chapter shall be cited as the “Wood Burning Device Ordinance”
- B. This chapter is enacted for the purpose of improving the air quality within the City limits and protecting the general welfare of the citizens and residents of Portola. The EPA officially designated the Greater Portola area as federal nonattainment for the federal annual standard for PM 2.5 (Particulate Matter with an aerodynamic diameter of 2.5 microns or less), on April 15, 2015. High PM2.5 levels are mostly due to impacts from residential wood burning. The City Council finds there is a need to regulate and reduce harmful emissions of exhaust gases from wood-burning heaters and fireplaces, and that an appropriate method of regulation is a wood burning device ordinance.

**15.10.020 Definitions.**

As used in this chapter:

- 1. “Air District” means the Northern Sierra Air Quality Management District.
- 2. “Building” means any residence, mobile home, commercial property or other structure.

3. "Certificate of Compliance" means a document issued by the Control Officer certifying that a building has no more than two wood burning heaters which are EPA-certified and no uncertified wood burning heaters.
4. "City" means the City of Portola.
5. "Control officer" means the official designated by the City Manager.
6. "EPA" shall mean the United States Environmental Protection Agency.
7. "EPA - Certified" means any wood burning heater with a Phase II certification or a more stringent certification as currently enforced in the NSPS.
8. "EPA-Qualified Fireplace" means any fireplace model or retrofit device that has been qualified by EPA under EPA's Voluntary Fireplace Program as emitting no more than 5.1 g/kg.
9. "Fireplace" means any permanently installed indoor or outdoor masonry or factory-built device used for aesthetic or space-heating purposes and designed to operate with an air to fuel ratio greater than or equal to 35 to 1.
10. "New Construction" means any single or multi-family housing unit, for which construction began on or after the effective date of this ordinance. Construction is deemed to occur when the foundation for the structure is installed.
11. "Notice of Exemption" means a document issued by the Control Officer certifying that a building has no wood burning heaters.
12. "NSPS" means New Source Performance Standard. For purposes of this rule the NSPS is the Code of Federal Regulations, Title 40, Part 60, Subpart AAA.
13. "Outdoor Wood-fired Boiler" or "Hydronic Heater" means a fuel burning device designed: (1) to burn primarily wood or wood pellet fuel; (2) not to be located inside structures ordinarily occupied by humans; and (3) to heat spaces or water by the distribution through pipes of a fluid, typically water or water and antifreeze mixture, heated in the device.
14. "Pellet Fueled Wood Heater" means a pellet-fueled heater, comprising a forced draft heater with an automatic feed which supplies appropriately sized feed material or compressed pellets of wood, corn, or other biomass material to the firebox.
15. "Permanently Inoperable" means modified in such a way that the wood burning heater can no longer function as a wood burning heater or easily be remodified to function as a wood burning heater. Conversion to other fuels, such as propane, is permitted.
16. "Wood Burning Device" means any wood burning heater or fireplace. Wood burning devices do not include wood-fired residential or commercial barbecue devices, wood-fired fire pits, or wood-fired cookstoves.
17. "Uncertified Wood Burning Device" means any wood burning device that does not meet the performance and emissions standards of a Phase II certification or a more stringent certification as currently enforced in the NSPS. Uncertified wood burning devices do not include wood-fired residential or commercial barbecue devices, wood-fired fire pits, or wood-fired cookstoves.
18. "Wood-Fired Cookstove" means a wood-fired appliance that is designed primarily for cooking food and that has the following characteristics:
  - a. An oven, with a volume of 0.028 cubic meters (1 cubic foot) or greater,
  - b. A device for measuring temperatures,
  - c. A flame path that is routed around the oven,
  - d. A shaker grate,
  - e. An ash pan,

- f. An ash clean-out door below the oven, and
  - g. The absence of a fan or heat channels to dissipate heat from the appliance.
19. "Wood Burning Heater" means an enclosed wood-burning device capable of and intended for space heating such as a wood stove, pellet-fueled wood heater, or wood-burning fireplace insert.

**15.10.030 Requirements for New Wood Burning Devices.**

**A. Installation of Wood Burning Devices.**

1. Wood Burning Heaters: No person shall advertise, sell, offer for sale, supply, transfer or install in any residence or other structure any wood burning heater within the City limits unless it is an EPA certified wood burning heater at the time of sale or transfer.
  - a. No local government authority within the City limits may issue a building permit to any person to install an uncertified wood burning heater; and
  - b. Certified devices shall have a label permanently affixed to them from the United States Environmental Protection Agency (USEPA) which states that the stove is certified to comply with the NSPS standards.
2. Wood Burning Fireplaces: No local government authority within the City limits may issue a building permit to any person to install a wood burning fireplace unless it is an EPA-qualified fireplace or EPA-certified fireplace.

**B. Limitation on Number of Wood Burning Devices in New Construction and Remodels.**

1. The number of EPA certified wood burning heaters installed on any residential or non-residential property for which a building permit is required shall not exceed one per individual dwelling unit; and
2. The number of EPA-qualified fireplaces installed on any residential or non-residential property for a which a building permit is required shall not exceed one per individual dwelling unit; and
3. No local government authority within the City limits may issue a building permit to any person to install a wood burning device in new construction or remodel, unless it is an EPA-qualified fireplace or EPA certified fireplace or wood heater certified to the level of the current NSPS; and
4. Wood burning devices shall not be considered the sole source of heat in any new construction within the City limits; and
5. The above limitations do not apply to devices that are defined as low emitting:
  - a. EPA-certified pellet fueled wood heater;
  - b. Devices that are exclusively gaseous- or liquid-fueled; and
  - c. EPA-certified wood burning devices that meet a certified emission rate of 1 gram/hour or less of particulate matter.

**15.10.040 Requirements for Existing Wood Burning Devices.**

**A. Existing Wood Burning Heaters and Change of Ownership.**

1. In order to complete any escrow transaction, on any residential or commercial property, the current property within the City limits owner must obtain either a 1) Certificate of Compliance or a 2) Notice of Exemption.
2. It is prohibited for any person to complete, or allow the completion of any Escrow transaction upon any residence or mobile home, or other parcel containing a building within the City limits unless each building on the parcel has been issued a Certificate of

Compliance by the Control Officer as having no more than two wood burning heaters which are EPA-Certified and no uncertified wood burning heaters.

3. A Certificates of Compliance or Notice of Exemption shall be issued by the Control Officer only upon physical inspection or documentary evidence that reliably establishes compliance with this section.
4. A Certificate of Compliance shall identify all of the following:
  - a. Owner's name.
  - b. Model number and manufacturer for each wood burning heater in the building.
  - c. The street address, Assessor's parcel number, or legal description of the parcel of real property where the building is located.
  - d. The location of the building and the specific location in the building where the wood burning heater is located.
5. A Notice of Exemption shall identify all of the following:
  - a. Owner's name.
  - b. The street address, Assessor's Parcel number, or legal description of the parcel of real property where the building is located.
  - c. The location of the building and whether a space heat source is exclusively utilized, and if so, what heat source is exclusively utilized.
6. The buyer and seller of any real property within the City limits shall observe this section and any disclosure statements supplied by the real estate agents relating to the requirement under this regulation for the inspection of any wood burning heater installed in a building on the property.
7. If the disclosure report indicates that a wood burning heater on the property within the City limits is uncertified, the wood burning heater must be removed from the property and destroyed/recycled at an approved facility or agency. Re-inspection and a copy of documentation from the destroying/recycling facility or agency is required by the Control Officer prior to issuance of a Certificate of Compliance.
8. The Control Officer may issue a Certificate of Compliance for a residence within the City limits without conducting a physical inspection if a person provides evidence that the EPA-certified wood burning heater has been installed in compliance with all applicable building, fire and other codes. This documentation shall include a receipt or invoice from the installation or purchase that includes the manufacturer and model name of the wood burning device.
9. A Certificate of Compliance issued pursuant to this section:
  - a. Remains valid until the residential or commercial property is transferred or conveyed to a new owner or for nine months, whichever comes sooner.
  - b. Does not constitute a warranty or guarantee by the Control Officer that the wood burning heater within the residence or commercial property meets any other standards of operation, efficiency or safety, except the certification standards contained in these regulations.
10. If a residential or commercial property within the City limits is to be sold and does not contain any wood burning heaters, a form approved by the Control Officer, containing the signatures of both the buyer and seller, attesting to that fact, may be accepted in lieu of an inspection, and the Control Officer may issue a Notice of Exemption. The completed form shall be submitted to the Control Officer within ten days of close of escrow. If the residential or commercial property contains an uncertified wood burning heater which

must be removed, the form must not be executed by either the buyer or seller until the removal has been completed. On any subsequent sale, a new Notice of Exemption is required.

11. Upon a change of ownership, no more than two EPA Certified wood burning heaters per building may remain in any property within the City limits, except for the low emitting devices outlined in 15.10.030(B)(5).
  12. Upon a change of ownership, no uncertified wood-burning heater may remain in any property within the City limits.
  13. The Control Officer may conduct audits after properties have closed escrow and have been recorded under the new owner's name in order to determine compliance with this ordinance. If the Control Officer finds that there is an uncertified wood burning heater in the building, the Control Officer shall require that the uncertified wood burning heater be destroyed/recycled at an approved scrappage/recycling facility or agency within 30 days of notifying the current property owner. A financial penalty may be assessed if noncompliance has been identified or if the current property owner fails to destroy/recycle the heater within the time prescribed in the notice.
- B. Existing individual dwelling units with two or more existing EPA Certified Wood Burning Heaters.
- Existing individual dwelling units with two or more existing EPA Certified Wood Burning Heaters may not install additional Wood Burning Heaters (certified or uncertified). The above limitation does not apply to heaters that are defined as low emitting, including without limitation the following:
1. EPA certified pellet fueled wood heaters;
  2. Devices that are exclusively gaseous- or liquid fueled; and
  3. EPA certified wood burning heaters that meet a certified emission rate of 1 gram/hour or less of particulate matter.

**15.10.050 Permitted Fuels in Wood Burning Devices, Wood Burning Fireplaces, Wood-Fired Cookstoves, Wood-Fired Fire Pits.**

Burning of any fuels or materials in a Wood Burning Device other than the following fuels within City limits shall be in violation of this ordinance:

- A. Seasoned wood (less than 20% moisture content).
- B. Uncolored paper.
- C. Manufactured logs, pellets, and similar manufactured products (i.e., processed fire starters).

**15.10.060 Mandatory Curtailment of Wood Burning Heaters, Wood Burning Fireplaces, Wood-Fired Fire Pits and Wood-Fired Cookstoves During Stagnant Conditions.**

- A. Episodic Wood Burning Curtailment Requirements.
  1. Effective January 1, 2021, the requirements of this section shall be in effect during the months of January, February, November, and December. The Air District shall determine when a mandatory curtailment of solid fuel combustion in the City is necessary, notify the community that mandatory curtailment is required, and make such other determinations as are necessary to carry out the objectives of this chapter.
  2. No person shall operate a wood burning heater, wood burning fireplace, wood-fired fire pit or wood-fired cookstove within the City limits when a mandatory curtailment is in effect

unless the device is an approved and currently registered EPA-Certified Wood Burning Heater.

3. The approved and currently registered EPA-Certified Wood Burning Heater will be maintained and operated according to manufacturer instructions.
4. The Air District will declare a mandatory curtailment whenever it determines that the 24-hour average PM<sub>2.5</sub> concentration may exceed 30 ug/m<sup>3</sup> AND when adverse meteorological conditions are expected to persist.
5. The criteria for issuing a mandatory curtailment is as follows:
  - a. The Air District will analyze the available air monitoring data and determine whether a trend is continuing; and
  - b. The Air District will contact the National Weather Service located in either Reno or Sacramento to request a specific meteorological forecast specific for the Portola area; and
  - c. If the National Weather Service forecasts adverse meteorological conditions to persist and the Air District ascertains that there is a marked trend of continuing high concentrations of PM<sub>2.5</sub> possible, then the Air District will declare a mandatory curtailment.
6. Upon determination that mandatory curtailment is required, the Air District shall notify the public through one or more of the following methods:
  - a. A recorded telephone message.
  - b. Messages posted on the Air District website.
  - c. Electronic mail messages to persons or entities that have requested such notice.
  - d. Notifying broadcast, print or social media operating within the boundaries of the City of Portola.
  - e. Any additional method that the Air District determines is appropriate.

#### Registration of EPA-Certified Devices.

1. Eligibility Requirements – Any EPA-Certified Wood Burning Heater is eligible to be registered with the Air District.
  2. Registration Process – Effective July 1, 2020, persons applying to register a Wood Burning Heater shall submit a completed application and supplemental documentation demonstrating compliance with the eligibility requirements to the District. Supplemental documentation shall include the following:
    - a. Receipt or invoice from the installation or purchase that includes the manufacturer and model name of the Wood Burning Heater, or
    - b. A certification from the Air District verifying that the Wood Burning Heater meets the eligibility requirements.
  3. Administrative Requirements – The person who registers the Wood Burning Heater shall retain a copy of the Air District issued registration and make it available upon request.
- B. Penalties – Any person that violates the provisions of 15.10.060 is subject to the following
1. First time violators: a Notice to Comply or Warning will be issued. The Notice to Comply will require that any EPA-Certified Wood Burning Heater be registered within 30 days.
  2. Second time violators: Completion of a wood smoke awareness course that has been approved by the Air District, or payment of a penalty of \$50, or submission of proof of replacement of non-certified device with an EPA-Certified Wood Burning Heater or exclusively gaseous- or liquid-fueled heater.

3. Third time violators: payment of a penalty of \$150 or submission of proof of replacement of non-certified device with an EPA-Certified Wood Burning Heater or exclusively gaseous- or liquid-fueled heater.
4. Fourth time violators: payment of a penalty of \$500 or submission of proof of replacement of non-certified device with an EPA-Certified Wood Burning Heater or exclusively gaseous- or liquid-fueled heater.

**15.10.070 Outdoor Wood-Fired Boiler Installation Prohibited.**

All outdoor wood-fired boilers are prohibited from installation within the City of Portola.

**15.10.080 Wood Stove Retailers/Contractors Required to Provide Educational Materials.**

Retailers or Contractors selling or offering for sale new Wood Burning Devices within the City limits shall supply public awareness information with each sale of a Wood Burning Device in the form of pamphlets, brochures, or fact sheets on the following topics:

- A. Proper installation, operation, and maintenance of the Wood Burning Device.
- B. Proper fuel selection and use.
- C. Health effects from wood smoke
- D. Weatherization methods for the home,
- E. Proper sizing of Wood Burning Devices.
- F. Episodic Wood Burning Curtailment levels as defined in Section 15.10.060.

**15.10.090 Violations.**

Any person who violates any of the requirements of this chapter, or who falsely attests as to information as part of compliance with this chapter, is subject to penalties and punishments as set forth in Chapter 1.10 of this Municipal Code, may be subjected to the applicable penalties and punishments prescribed by law for perjury, and may have any license or permit issued by the City be revoked, including but not limited to a building permit or certificate of occupancy.

**15.10.100 - Continuing violations—Each day being a separate violation.**

After any person who is responsible for a violation of any provision in this chapter has been given notice of the violation, and such person does not comply or otherwise correct the violation within the time prescribed in the notice, then from that day forward, the continuing violation shall be deemed to be a separate offense on each and every day that the violation persists. A person who knowingly commits or suffers the continuing violation shall be guilty of a separate offense each and every day that the violation persists.

**Section 2. Approval.** The City of Portola Wood Stove and Fireplace Ordinance Amendment concerns revisions to wood stove regulations. The text changes reflecting the Amendment are incorporated by reference as if fully set forth herein into Title 15 of the Portola Municipal Code, and are hereby approved.

**Section 3. Enactment.** The City of Portola Wood Stove and Fireplace Ordinance Amendment shall be effective 30 days from the date of its approval by the City Council.

**Section 4. Summary Publication and Posting.** Within thirty (30) days after final adoption of this Ordinance, the City Clerk shall have a summary of this ordinance prepared by the City Attorney and published as required by the California Government Code. Within fifteen (15) days after final adoption of this ordinance, the City Clerk shall have it posted in three (3) public places.

This ordinance was introduced, read and the second reading was waived at a Regular Meeting of the City Council of the City of Portola duly held on June 8, 2016. The ordinance was finally passed and adopted at the Regular Meeting of the City Council of the City of Portola duly held on June 22, 2016, by the following vote:

AYES: Mayor Pro tem Larrieu  
Councilmember Gault  
Councilmember Oels

NOES:  
ABSTAIN:  
ABSENT: Vacant  
Mayor Powers

  
\_\_\_\_\_  
MAYOR PRO TEM LARRIEU

ATTEST:

  
\_\_\_\_\_  
CITY CLERK, Melissa Klundby

I, Melissa Klundby, City Clerk of the City of Portola, do hereby certify that the foregoing Ordinance was duly and regularly passed by the City Council of the City of Portola at a Regular Meeting held on June 22, 2016.

  
\_\_\_\_\_  
CITY CLERK, Melissa Klundby



# **EXHIBIT 5**

**San Joaquin Valley Air Pollution Control District  
2018 PM2.5 SIP**

**Precursor Demonstrations for Ammonia, SO<sub>x</sub>, and ROG**

DRAFT

Appendix: Precursor Demonstrations for Ammonia, SO<sub>x</sub>, and ROG  
San Joaquin Valley PM<sub>2.5</sub> SIP

## INTRODUCTION

Fine particulate matter (PM<sub>2.5</sub>) is made up of many constituent particles that are either directly emitted, such as soot and dust, or formed through complex reactions of gases in the atmosphere. Oxides of nitrogen (NO<sub>x</sub>), sulfur dioxide (SO<sub>2</sub>), volatile organic compounds (VOCs), and ammonia (NH<sub>3</sub>) are gases that are precursors to PM<sub>2.5</sub>, transforming into particles through physical and chemical atmospheric processes.

The United States Environmental Protection Agency (U.S. EPA) finalized a PM<sub>2.5</sub> State Implementation Plan (SIP) Requirements Rule<sup>1</sup> (Rule) that identifies the four PM<sub>2.5</sub> precursor pollutants—NO<sub>x</sub>, SO<sub>2</sub>, VOCs, and ammonia—that “must be evaluated for potential control measures in any PM<sub>2.5</sub> attainment plan.”<sup>2</sup> The Rule permits air agencies to “submit an optional precursor demonstration designed to show that for a specific PM<sub>2.5</sub> nonattainment area, emissions of a particular precursor from sources within the nonattainment area do not or would not contribute significantly to PM<sub>2.5</sub> levels that exceed” the National Ambient Air Quality Standards (NAAQS).<sup>3</sup> If the agency’s demonstration is approved by U.S. EPA, the attainment plan “may exclude that precursor from certain control requirements under the Clean Air Act.”<sup>4</sup>

This appendix includes precursor demonstrations for three PM<sub>2.5</sub> precursors: ammonia, oxides of sulfur (SO<sub>x</sub>), and reactive organic gases (ROG). The California Air Resources Board (CARB) inventory tracks SO<sub>x</sub> rather than SO<sub>2</sub> specifically, but SO<sub>x</sub> consists mostly of SO<sub>2</sub>. ROG is similar, although not identical, to U.S. EPA’s term “VOC.”<sup>5</sup> CARB’s inventory tracks ROG as a subset of total organic gases (TOG). This appendix does not include a precursor demonstration for NO<sub>x</sub>, since NO<sub>x</sub> is an important and significant precursor to PM<sub>2.5</sub> and is controlled extensively in the SIP, and because reductions of NO<sub>x</sub> emissions are essential to the attainment strategy for the San Joaquin Valley (Valley).

Following U.S. EPA guidance, the three precursor demonstrations analyze “the relationship between precursor emissions and the formation of secondary PM<sub>2.5</sub> components”<sup>6</sup> using an air quality model, and take into consideration additional relevant factors.

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<sup>1</sup> 81 FR 58010 (August 24, 2016)

<sup>2</sup> United States Environmental Protection Agency. *PM<sub>2.5</sub> Precursor Demonstration Guidance: Draft for Public Review and Comment*. 17 Nov. 2016. Web. 3 Oct. 2017. <[www.U.S. EPA.gov/sites/production/files/2016-11/documents/transmittal\\_memo\\_and\\_draft\\_pm25\\_precursor\\_demo\\_guidance\\_11\\_17\\_16.pdf](http://www.U.S. EPA.gov/sites/production/files/2016-11/documents/transmittal_memo_and_draft_pm25_precursor_demo_guidance_11_17_16.pdf)>. Page 7

<sup>3</sup> *Ibid.* 7

<sup>4</sup> *Ibid.* 7

<sup>5</sup> See: California Air Resources Board. “FACT SHEET #1: Development of Organic Emission Estimates For California’s Emission Inventory and Air Quality Models.” Aug. 2000. Web. 24 May 2018.

<[www.arb.ca.gov/ei/speciate/factsheetsmodeleispeciationtog082000.pdf](http://www.arb.ca.gov/ei/speciate/factsheetsmodeleispeciationtog082000.pdf)>

See also: California Air Resources Board. “Definitions of VOC and ROG.” Jan. 2009. Web. 24 May 2018.

<[www.arb.ca.gov/ei/speciate/voc\\_rog\\_dfn\\_1\\_09.pdf](http://www.arb.ca.gov/ei/speciate/voc_rog_dfn_1_09.pdf)>

<sup>6</sup> U.S. EPA. *PM<sub>2.5</sub> Precursor Demonstration Guidance: Draft for Public Review and Comment*. Page 26

## U.S. EPA PM<sub>2.5</sub> PRECURSOR DEMONSTRATION GUIDANCE

In November 2016, U.S. EPA published a draft guidance document to “assist air agencies who may wish to submit PM<sub>2.5</sub> precursor demonstrations.”<sup>7</sup> The document provides recommendations or guidelines, as authorized under the Clean Air Act, “that will be useful to air agencies in developing the precursor demonstrations by which the EPA can ultimately determine whether sources of a particular precursor contribute significantly to PM<sub>2.5</sub> levels that exceed the standard in a particular nonattainment area.”<sup>8</sup> Recommendations include modeling procedures for conducting the required analysis and contribution thresholds to determine the impact of a precursor on PM<sub>2.5</sub> levels.<sup>9</sup> The guidance also describes an analytical process to perform the precursor demonstration, involving a sensitivity-based analysis followed by a consideration of additional information.

### Sensitivity-Based Analysis

The evaluation of the precursors begins with a sensitivity-based analysis to determine whether precursor emissions contribute to total PM<sub>2.5</sub> concentrations. According to the guidance:

This modeling analysis examines the sensitivity of ambient PM<sub>2.5</sub> concentrations in the nonattainment area to certain amounts of decreases in the precursor emissions in the area.... Where decreases in emissions of the precursor result in negligible air quality impacts (i.e., the area is “not sensitive” to decreases), such a small degree of impact is not significant and can be considered to not “contribute” to PM<sub>2.5</sub> concentrations for the purposes of determining whether control requirements should apply.<sup>10</sup>

Generally, U.S. EPA recommends that the precursor demonstration “should be based on current conditions to demonstrate that precursor emissions do not contribute significantly to PM<sub>2.5</sub> concentrations in the nonattainment area.”<sup>11</sup> This means evaluating emissions in a selected base year, which may be the present or a previous year.

For each existing PM<sub>2.5</sub> monitor location in the area,<sup>12</sup> the first step for estimating PM<sub>2.5</sub> impacts from ammonia, SO<sub>x</sub>, or ROG in the base year is to estimate the average PM<sub>2.5</sub> concentration on an annual and 24-hour basis. The second step is to calculate the annual and 24-hour average PM<sub>2.5</sub> concentration at each monitor with a specified percent reduction in precursor emissions, still in the base year.<sup>13</sup> The difference between these two calculated PM<sub>2.5</sub> values is the impact on PM<sub>2.5</sub> levels from precursor emissions reductions.<sup>14</sup> Note that “precursor demonstrations do not examine changes in emissions *between a base year and a future year*. Instead, the calculation of relative

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<sup>7</sup> Ibid. 7

<sup>8</sup> Ibid. 7-8

<sup>9</sup> Ibid. 9

<sup>10</sup> Ibid. 25

<sup>11</sup> Ibid. 33

<sup>12</sup> Ibid. 16

<sup>13</sup> Ibid. 36

<sup>14</sup> Ibid. 36

changes in PM<sub>2.5</sub> concentrations occur *between a modeled case with all emissions and a modeled case with reduced precursor emissions*” (emphasis added).<sup>15</sup> In addition, U.S. EPA recommends modeling reductions of between 30 and 70 percent of precursor emissions.<sup>16</sup>

The third step in the sensitivity-based analysis is to compare the modeled impact on PM<sub>2.5</sub> levels from a decrease in ammonia, SO<sub>x</sub>, or ROG emissions to contribution thresholds for annual and 24-hour PM<sub>2.5</sub>.<sup>17</sup> U.S. EPA recommends values for these thresholds, or air quality concentrations below which air quality impacts are not statistically significantly different from “the inherent variability in the measured atmospheric conditions,” and thus do not contribute to PM<sub>2.5</sub> concentrations that exceed the NAAQS.<sup>18</sup> These thresholds are 0.2 micrograms per cubic meter (µg/m<sup>3</sup>) for the annual PM<sub>2.5</sub> standard, and 1.3 µg/m<sup>3</sup> for the 24-hour PM<sub>2.5</sub> standard.<sup>19</sup> If the calculated PM<sub>2.5</sub> impact is greater than 0.2 µg/m<sup>3</sup> for the annual standard or greater than 1.3 µg/m<sup>3</sup> for the 24-hour standard, then PM<sub>2.5</sub> levels are sensitive to the modeled percent reduction in ammonia, SO<sub>x</sub>, or ROG emissions.

### **Consideration of Additional Information**

To supplement modeling analysis, U.S. EPA guidance also allows an air agency to consider additional information, assessing the significance of a precursor “based on the facts and circumstances of the area.”<sup>20</sup> The guidance states:

If the estimated air quality impact exceeds the recommended contribution thresholds..., this fact does not necessarily preclude approval of the precursor demonstration. There may be cases where it could be determined that precursor emissions have an impact above the recommended contribution thresholds, yet do not “significantly contribute” to levels that exceed the standard in the area.<sup>21</sup>

In these cases, an air agency may “provide the [U.S.] EPA with information related to other factors they believe should be considered in determining whether the contribution of emissions of a particular precursor to levels that exceed the NAAQS is ‘significant’ or not.”<sup>22</sup> Such factors may include: trends in emissions of other precursors such as NO<sub>x</sub>,<sup>23</sup> anticipated growth or loss of emissions sources,<sup>24</sup> and the consequent appropriateness of modeling impacts in a future year instead of a base year,<sup>25</sup> “available emissions controls,”<sup>26</sup> and “the severity of nonattainment at relevant monitors.”<sup>27</sup> These factors are discussed in the context of the precursor analyses for the Valley in the subsequent sections.

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<sup>15</sup> Ibid. 34

<sup>16</sup> Ibid. 29

<sup>17</sup> Ibid. 25

<sup>18</sup> Ibid. 14, 15

<sup>19</sup> Ibid. 15-16

<sup>20</sup> Ibid. 17

<sup>21</sup> Ibid. 17

<sup>22</sup> Ibid. 17

<sup>23</sup> Ibid. 17

<sup>24</sup> Ibid. 17

<sup>25</sup> Ibid. 33

<sup>26</sup> Ibid. 29

<sup>27</sup> Ibid. 17

Other factors the agency may consider are: the amount by which a precursor's contribution exceeds the recommended contribution thresholds; source characteristics (e.g., source type, stack height, location); analyses of speciation data and precursor emission inventories; chemical tracer studies; and special intensive measurement studies to evaluate specific atmospheric chemistry in an area. The agency may also provide other information not listed here.<sup>28</sup>

The following sections contain sensitivity-based analyses and supplemental information demonstrating that ammonia, SO<sub>x</sub>, and ROG are not significant precursors to PM<sub>2.5</sub> in the Valley.

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<sup>28</sup> Ibid. 17

## **AMMONIA ANALYSIS**

Ammonium nitrate ( $\text{NH}_4\text{NO}_3$ ) is a constituent of  $\text{PM}_{2.5}$ , making up about 40 percent of fine particulate matter mass in the Valley. Ammonium nitrate forms when nitrogen dioxide ( $\text{NO}_2$ ) reacts with highly oxidizing species in the atmosphere to form nitric acid ( $\text{HNO}_3$ ). Nitric acid then reacts with ammonia ( $\text{NH}_3$ ) to yield ammonium nitrate as a particle. Since ammonia reacts chemically in this way to form a particle, ammonia is a precursor to  $\text{PM}_{2.5}$ .

Lowering  $\text{PM}_{2.5}$  concentrations to levels that meet the NAAQS will rely upon an effective control strategy for ammonium nitrate. The amount of ammonium nitrate that can form in the atmosphere is limited by whichever precursor, either  $\text{NO}_x$  or ammonia, is in least supply, and research studies confirm that there are relatively fewer  $\text{NO}_x$  molecules in the air in the Valley than ammonia. This implies that reducing  $\text{NO}_x$ , the limiting precursor in this case, is more effective for reducing ammonium nitrate concentrations and thus improving  $\text{PM}_{2.5}$  air quality.

Following the analytical process outlined in the U.S. EPA precursor demonstration guidance and summarized above, CARB has evaluated ammonia in the Valley. The results of the sensitivity-based analysis and consideration of additional information are presented below.

### **Sensitivity-Based Analysis**

CARB staff used an air quality model to estimate the  $\text{PM}_{2.5}$  design value for the annual and 24-hour standards in the base year of 2013 at each Valley monitor. Then, CARB staff applied the recommended lower bound of a 30 percent reduction to ammonia emissions and used the air quality model to estimate the  $\text{PM}_{2.5}$  design values, as shown in Table 1. The difference between the two design values represents the modeled impact on  $\text{PM}_{2.5}$  levels of a 30 percent reduction in ammonia emissions in 2013. This is the value that is compared to U.S. EPA's recommended contribution thresholds of  $0.2 \mu\text{g}/\text{m}^3$  for the annual standard and  $1.3 \mu\text{g}/\text{m}^3$  for the 24-hour standard to establish if  $\text{PM}_{2.5}$  levels are sensitive to this level of ammonia reduction.

Table 1. Base Year 2013 PM<sub>2.5</sub> – 30 Percent Ammonia Reduction

Site*	Annual			24-Hour		
	2013 Baseline DV	2013 DV with 30% Ammonia Reduction <sup>+</sup>	Difference	2013 Baseline DV	2013 DV with 30% Ammonia Reduction	Difference
Bakersfield-Planz	17.19	16.76	0.43	55.5	53.3	2.2
Madera	16.93	16.29	0.64	51.0	49.2	1.7
Hanford	16.54	15.82	0.72	60.0	57.8	2.1
Visalia	16.20	15.82	0.38	55.5	53.5	2.0
Clovis	16.12	15.80	0.32	55.8	54.0	1.9
Bakersfield-California	16.02	15.58	0.44	64.1	60.8	3.3
Fresno-Garland	14.98	14.69	0.29	60.0	58.0	2.0
Turlock	14.88	14.46	0.42	50.7	49.3	1.5
Fresno-HW	14.22	13.95	0.27	59.3	57.4	2.0
Stockton	13.14	12.84	0.30	42.0	41.0	1.0
Merced-S Coffee	13.10	12.65	0.45	41.1	40.0	1.1
Modesto	13.03	12.66	0.37	47.9	46.5	1.5
Merced-M	10.97	10.77	0.20	46.9	45.9	1.0
Manteca	10.09	9.85	0.24	36.9	36.0	0.9
Tranquility	7.72	7.33	0.39	29.5	27.2	2.2

\* The site at Corcoran does not have a valid design value because of missing data, and is thus excluded from all precursor analyses.

+ Numbers may not sum exactly due to rounding.

For completeness, CARB staff repeated this analysis, applying instead the U.S. EPA-recommended upper bound of a 70 percent reduction to ammonia emissions in the base year, as shown in Table 2.

Table 2. Base Year 2013 PM<sub>2.5</sub> – 70 Percent Ammonia Reduction

Site	Annual			24-Hour		
	2013 Baseline DV	2013 DV with 70% Ammonia Reduction	Difference	2013 Baseline DV	2013 DV with 70% Ammonia Reduction	Difference
Bakersfield-Planz	17.19	15.72	1.47	55.5	46.5	9.0
Madera	16.93	14.81	2.12	51.0	43.4	7.6
Hanford	16.54	14.24	2.30	60.0	50.6	9.4
Visalia	16.20	14.80	1.40	55.5	45.8	9.7
Clovis	16.12	14.95	1.17	55.8	47.0	8.8
Bakersfield-California	16.02	14.47	1.55	64.1	51.7	12.4
Fresno-Garland	14.98	13.91	1.07	60.0	52.5	7.5
Turlock	14.88	13.46	1.42	50.7	44.4	6.3
Fresno-HW	14.22	13.17	1.05	59.3	49.7	9.6
Stockton	13.14	12.10	1.04	42.0	37.9	4.1
Merced-S Coffee	13.10	11.60	1.50	41.1	36.6	4.5
Modesto	13.03	11.78	1.25	47.9	41.6	6.4
Merced-M	10.97	10.23	0.74	46.9	41.9	5.0
Manteca	10.09	9.27	0.82	36.9	33.4	3.5
Tranquility	7.72	6.46	1.26	29.5	20.7	8.8

From this analysis, the estimated air quality impact of reducing ammonia emissions by the lower bound of 30 percent in the base year exceeds U.S. EPA’s recommended thresholds at all but a few Valley monitors, for both the annual and 24-hour standards. Reducing emissions by the upper bound of 70 percent also shows impacts above the thresholds.

It is not possible, however, to conclude from this analysis that emissions of ammonia “significantly contribute.” In this case, ammonia emissions have an impact above the recommended contribution thresholds even at the lower bound, but, as the U.S. EPA guidance indicates, this does not necessarily mean the precursor contributes significantly to PM<sub>2.5</sub> levels that exceed the NAAQS. Making the appropriate determination about the ammonia emission reduction impact requires further analysis of additional factors.

### **Consideration of Additional Information**

To supplement modeling analysis, U.S. EPA guidance also allows an air agency to consider additional information, assessing the significance of a precursor “based on the facts and circumstances of the area.”<sup>29</sup> CARB staff believes that there are several critical factors that must be considered in determining whether ammonia is a significant precursor to PM<sub>2.5</sub> in the Valley.

### *Emissions Trends and Studies*

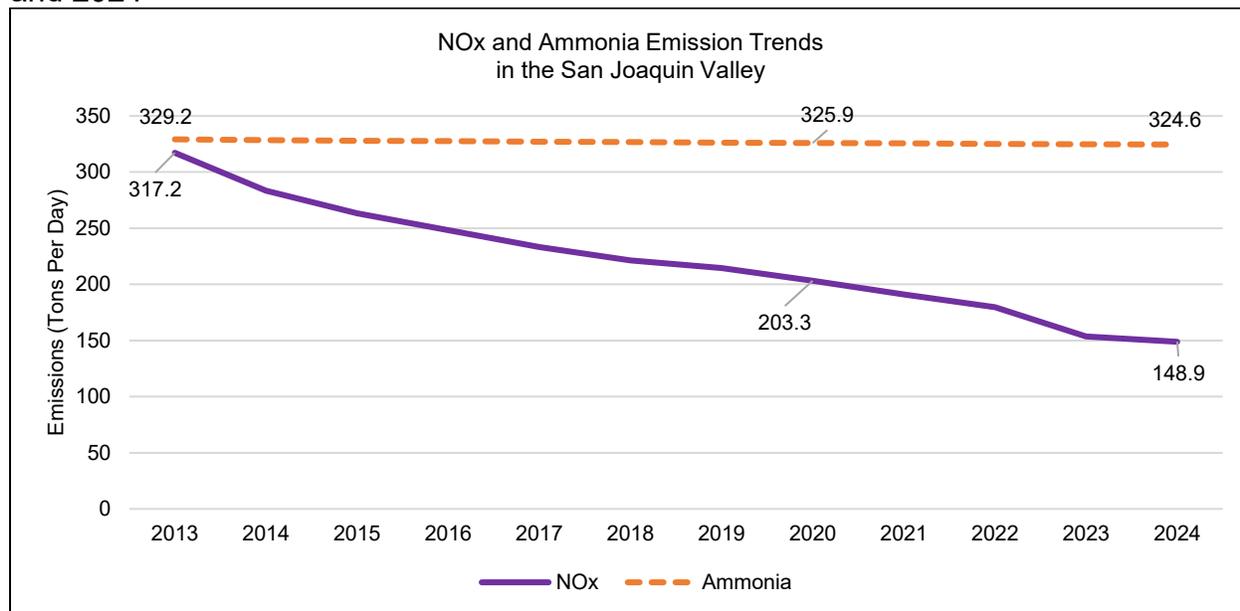
CARB has an extensive suite of measures in place to reduce NOx emissions from mobile sources that reduce ammonium nitrate. Between 2013 and 2020—the attainment year for the 1997 annual and 24-hour PM<sub>2.5</sub> standards—total NOx emissions are expected to decline 36 percent, and between 2013 and 2024—the attainment year for the 2006 24-hour PM<sub>2.5</sub> standard—total NOx emissions are projected to decline 53 percent. Meanwhile, total ammonia emissions are expected to remain flat, as shown in Figure 1. The San Joaquin Valley Air Pollution Control District (District) adopted four rules<sup>30</sup> between 2004 and 2011 with measures that provided ammonia emissions reductions in the Valley of approximately 50 tons per day (tpd); however, reductions from these existing control measures are already accounted for in the inventory, prior to the base year of 2013. In the future, emissions from the main sources of ammonia—dairies, fertilizer, and non-dairy livestock operations—are not anticipated to either increase or decrease substantially.

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<sup>29</sup> Ibid. 17

<sup>30</sup> District Rule 4550: Conservation Management Practices (adopted 2004); Rule 4565: Biosolids, Animal Manure, and Poultry Litter Operations (adopted 2007); Rule 4566: Organic Material Composting Operations (adopted 2011); and Rule 4570: Confined Animal Facilities (adopted 2006, amended 2010)

Figure 1. NOx and ammonia emission trends in the San Joaquin Valley between 2013 and 2024



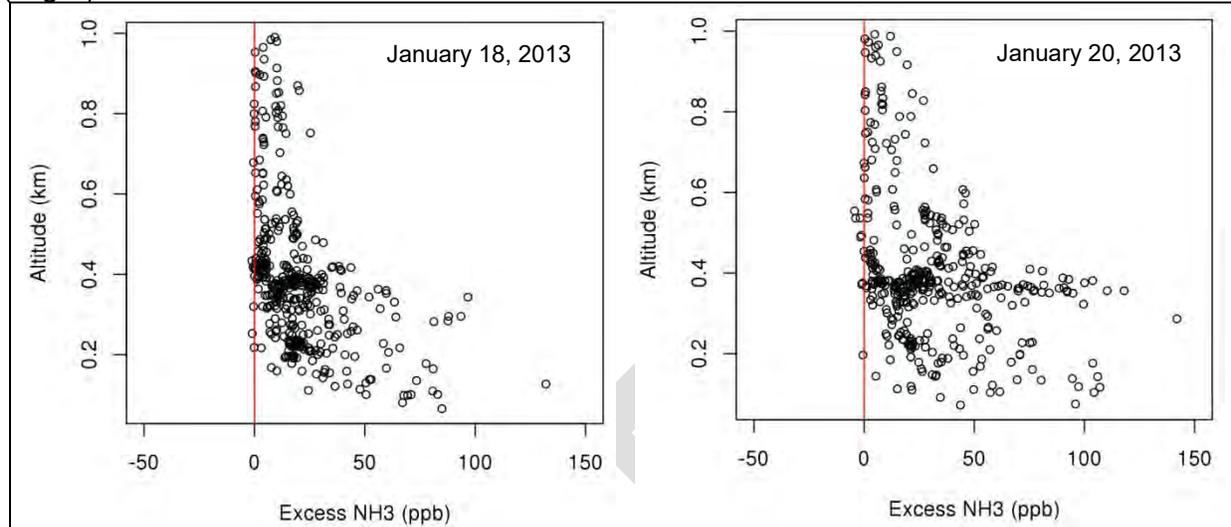
Source: CEPAM Inventory version 1.05

The steep downward trend of NOx emissions and the stability of ammonia emissions between 2013 and 2024 lead CARB staff to conclude that modeling the impact of ammonia emissions reductions in the future, rather than the base year, is appropriate and more representative of the Valley’s emissions conditions. U.S. EPA guidance states that, in some situations, it may be “more appropriate to model future conditions that provide a more representative sensitivity analysis.”<sup>31</sup> This approach is applicable in the Valley. Although emissions of NOx and ammonia are of roughly similar magnitude in the base year, thereby leading to some modeled sensitivity of PM<sub>2.5</sub> levels to a 30 percent reduction in ammonia emissions, these conditions do not persist and are not representative in the future.

Recent research further supports the fact that ammonia emissions are already in excess in the Valley. Field study measurements conducted during the 2013 DISCOVER-AQ study indicate that ammonia is in excess of NOx on peak PM<sub>2.5</sub> days in the Valley, as illustrated in Figure 2. These data imply that ammonium nitrate formation in the Valley is limited by the amount of NOx present in the air.

<sup>31</sup> U.S. EPA. *PM<sub>2.5</sub> Precursor Demonstration Guidance: Draft for Public Review and Comment*. Page 33

Figure 2. Excess ammonia (NH<sub>3</sub>) in the San Joaquin Valley on Jan 18 (Left) and Jan 20 (Right) based on NASA aircraft measurements in 2013



This finding that nitrate formation in the Valley is in a NO<sub>x</sub>-limited regime is consistent with previous research. For instance, Lurmann et al. (2006) note that “[t]he consistent excess of NH<sub>3</sub> over nitric acid levels indisputably shows that secondary ammonium nitrate formation is more limited by nitric acid availability than NH<sub>3</sub> within the SJV and in the foothills.”<sup>32</sup> Since ammonium nitrate formation is limited by NO<sub>x</sub>, reducing NO<sub>x</sub> emissions is the more effective strategy for reducing ammonium nitrate and PM<sub>2.5</sub>. Other research has found that ammonia concentrations in the San Joaquin Valley have increased, further confirming that NO<sub>x</sub> reductions are the most effective path to reducing PM<sub>2.5</sub>.

#### *Future Year Modeling*

CARB staff therefore repeated the sensitivity-based analysis of ammonia for the future attainment years of 2020 and 2024.<sup>33</sup> Staff used an air quality model to estimate the PM<sub>2.5</sub> design value for the annual and 24-hour standards in 2020 and 2024 at each Valley monitor. Then, CARB staff applied a 30 percent reduction to ammonia emissions and used the air quality model to estimate the PM<sub>2.5</sub> design values in 2020 and 2024, shown in Tables 3 and 4 respectively. The difference between the two design values represents the modeled impact on PM<sub>2.5</sub> levels of a 30 percent reduction in ammonia emissions in each attainment year.

<sup>32</sup> Lurmann et al. “Processes influencing secondary aerosol formation in the San Joaquin Valley during winter.” Journal of the Air & Waste Management Association. 2006. Web. 3 Oct. 2017. <<http://www.tandfonline.com/doi/pdf/10.1080/10473289.2006.10464573>>. Page 1688

<sup>33</sup> CARB did not conduct sensitivity analysis for the 2025 attainment year for the 2012 annual PM<sub>2.5</sub> standard due to the close proximity of the attainment years for the 2012 and 2006 standards. Precursor sensitivities in 2025 are assumed to be very similar to those modeled in 2024.

Table 3. Future Year 2020 PM<sub>2.5</sub> – 30 Percent Ammonia Reduction

Site	Annual			24-Hour		
	2020 Baseline DV	2020 DV with 30% Ammonia Reduction	Difference	2020 Baseline DV	2020 DV with 30% Ammonia Reduction	Difference
Bakersfield-Planz	14.58	14.34	0.24	41.2	39.8	1.4
Madera	14.15	13.79	0.36	38.9	37.8	1.0
Hanford	13.30	12.88	0.42	43.7	42.3	1.4
Visalia	13.51	13.28	0.23	42.8	41.5	1.3
Clovis	13.43	13.25	0.18	41.1	40.3	0.9
Bakersfield-California	13.48	13.24	0.24	47.6	45.7	1.9
Fresno-Garland	12.42	12.25	0.17	44.3	43.2	1.1
Turlock	12.47	12.20	0.27	37.8	36.8	1.0
Fresno-HW	11.86	11.70	0.16	45.6	44.5	1.1
Stockton	11.43	11.23	0.20	33.5	32.8	0.7
Merced-S Coffee	10.86	10.60	0.26	30.0	29.4	0.5
Modesto	10.97	10.74	0.23	35.8	34.9	0.9
Merced-M	9.34	9.22	0.12	32.9	32.3	0.6
Manteca	8.67	8.51	0.16	30.1	29.6	0.5
Tranquility	6.40	6.19	0.21	21.5	20.3	1.2

In 2020, the modeled air quality impact of reducing ammonia emissions by 30 percent falls under U.S. EPA's recommended threshold at all but four Valley monitors for the 24-hour standard. The air quality impact remains above U.S. EPA's recommended annual threshold at most sites.

Table 4. Future Year 2024 PM<sub>2.5</sub> – 30 Percent Ammonia Reduction

Site	Annual			24-Hour		
	2024 Baseline DV	2024 DV with 30% Ammonia Reduction	Difference	2024 Baseline DV	2024 DV with 30% Ammonia Reduction	Difference
Bakersfield-Planz	12.03	11.79	0.12	30.0	29.2	0.7
Madera	11.98	11.77	0.21	30.2	29.5	0.7
Hanford	10.52	10.26	0.26	30.1	29.1	1.0
Visalia	11.09	10.97	0.12	30.2	29.4	0.8
Clovis	11.37	11.27	0.10	30.7	30.0	0.7
Bakersfield-California	11.01	10.78	0.12	33.3	32.2	1.0
Fresno-Garland	10.43	10.33	0.10	32.8	32.1	0.7
Turlock	11.14	10.95	0.19	30.2	29.5	0.7
Fresno-HW	10.02	9.92	0.10	35.1	34.4	0.8
Stockton	10.66	10.50	0.16	28.6	28.1	0.5
Merced-S Coffee	9.65	9.47	0.18	24.2	23.8	0.4
Modesto	9.97	9.79	0.18	29.1	28.5	0.6
Merced-M	8.61	8.53	0.08	27.4	27.0	0.5
Manteca	7.97	7.85	0.12	25.8	25.4	0.4
Tranquility	5.54	5.42	0.12	16.2	15.6	0.6

In 2024, the modeled air quality impact of reducing ammonia emissions by 30 percent falls under U.S. EPA’s recommended annual threshold at all but two Valley monitors, and falls under the 24-hour threshold at all sites.

For completeness, CARB staff repeated this analysis, applying instead the U.S. EPA-recommended upper bound of a 70 percent reduction to ammonia emissions in 2020 and 2024, as shown in Tables 5 and 6.

Table 5. Future Year 2020 PM<sub>2.5</sub> – 70 Percent Ammonia Reduction

Site	Annual			24-Hour		
	2020 Baseline DV	2020 DV with 70% Ammonia Reduction	Difference	2020 Baseline DV	2020 DV with 70% Ammonia Reduction	Difference
Bakersfield-Planz	14.58	13.79	0.79	41.2	35.8	5.4
Madera	14.15	12.97	1.18	38.9	35.2	3.6
Hanford	13.30	12.00	1.30	43.7	39.1	4.6
Visalia	13.51	12.72	0.79	42.8	37.0	5.8
Clovis	13.43	12.79	0.64	41.1	36.4	4.7
Bakersfield-California	13.48	12.66	0.82	47.6	41.2	6.4
Fresno-Garland	12.42	11.82	0.60	44.3	39.7	4.6
Turlock	12.47	11.62	0.85	37.8	34.5	3.2
Fresno-HW	11.86	11.23	0.63	45.6	39.8	5.8
Stockton	11.43	10.77	0.66	33.5	31.4	2.1
Merced-S Coffee	10.86	10.02	0.84	30.0	27.8	2.2
Modesto	10.97	10.22	0.75	35.8	32.5	3.3
Merced-M	9.34	8.93	0.41	32.9	30.6	2.3
Manteca	8.67	8.15	0.52	30.1	28.5	1.6
Tranquility	6.40	5.76	0.64	21.5	17.6	4.0

Table 6. Future Year 2024 PM<sub>2.5</sub> – 70 Percent Ammonia Reduction

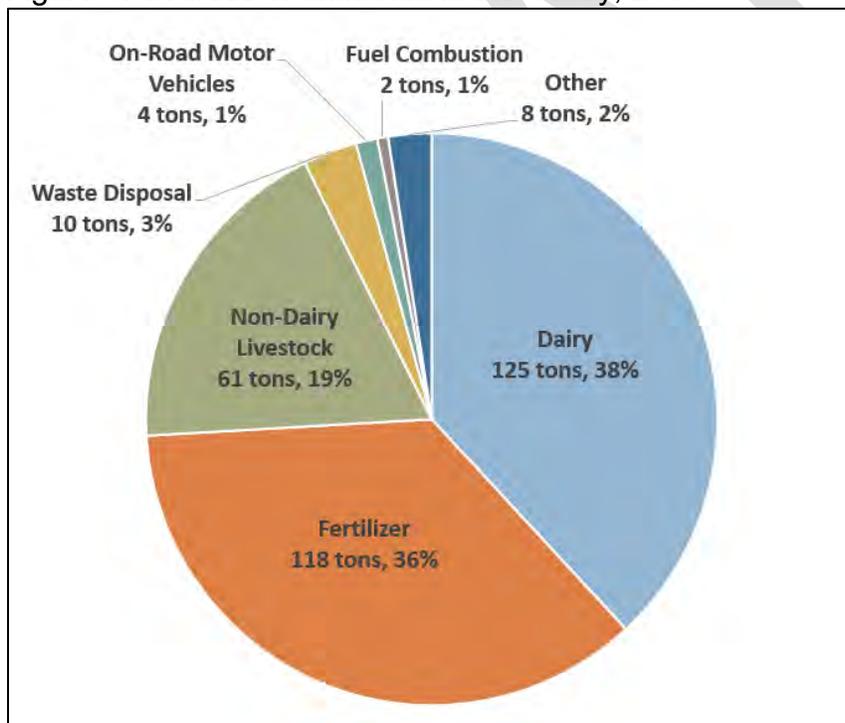
Site	Annual			24-Hour		
	2024 Baseline DV	2024 DV with 70% Ammonia Reduction	Difference	2024 Baseline DV	2024 DV with 70% Ammonia Reduction	Difference
Bakersfield-Planz	12.03	11.55	0.36	30.0	27.6	2.2
Madera	11.98	11.32	0.66	30.2	28.6	1.6
Hanford	10.52	9.77	0.75	30.1	27.1	3.0
Visalia	11.09	10.71	0.38	30.2	27.6	2.5
Clovis	11.37	11.05	0.32	30.7	28.4	2.3
Bakersfield-California	11.01	10.54	0.36	33.3	30.3	2.8
Fresno-Garland	10.43	10.22	0.32	32.8	30.9	1.9
Turlock	11.14	10.53	0.61	30.2	28.1	2.1
Fresno-HW	10.02	9.68	0.34	35.1	32.2	2.9
Stockton	10.66	10.14	0.52	28.6	27.1	1.5
Merced-S Coffee	9.65	9.12	0.53	24.2	23.0	1.2
Modesto	9.97	9.41	0.56	29.1	26.9	2.2
Merced-M	8.61	8.35	0.26	27.4	26.0	1.4
Manteca	7.97	7.57	0.40	25.8	24.4	1.4
Tranquility	5.54	5.19	0.35	16.2	14.4	1.8

From this analysis, the estimated air quality impact of reducing ammonia emissions by the upper bound of 70 percent in 2020 and 2024 exceeds U.S. EPA’s recommended thresholds for both the annual and 24-hour standards at all sites except one.

*Available Emissions Controls*

Available emissions controls on ammonia are also relevant to the decision-making process, influencing the extent of reasonable modeled reductions. While U.S. EPA recommends modeling emissions reductions of between 30 and 70 percent to estimate PM<sub>2.5</sub> impacts,<sup>34</sup> CARB staff have not identified controls that are technologically and economically feasible to achieve reductions even at the low end of the recommended sensitivity range (i.e. 30 percent). Emissions of ammonia in the Valley are approximately 329 tpd, as shown in Figure 3, meaning reductions would need to be in the range of approximately 99 to 230 tpd (30 to 70 percent). The District’s existing rules that provide ammonia emissions reductions reflect the best available control measures for ammonia sources in the Valley, and implementation of these measures cannot feasibly reduce emissions by 30 percent. Therefore, CARB staff determined that modeled emissions reductions of 30 percent were an upper bound for potential ammonia reductions.

Figure 3. Sources of ammonia in the Valley, 2013



Source: CEPAM Inventory version 1.05

*Relevant Monitors*

The impact of ammonia on PM<sub>2.5</sub> at monitors that form the basis of the attainment finding for the Valley is the focus of this analysis. For purposes of demonstrating

<sup>34</sup> U.S. EPA. *PM<sub>2.5</sub> Precursor Demonstration Guidance: Draft for Public Review and Comment*. Page 29

attainment of all three PM<sub>2.5</sub> NAAQS, the relevant monitor is at the site in Bakersfield which currently records the highest levels. U.S. EPA guidance permits consideration of “the severity of nonattainment at relevant monitors,”<sup>35</sup> and in 2024, PM<sub>2.5</sub> levels are not sensitive to ammonia reductions at this relevant site.

The sites at Madera and Hanford show an impact over the recommended threshold for the annual standard. Madera’s design value, however, is not representative of air quality in the area; CARB has previously documented that this design value is an artifact of inaccurate monitor data. In addition, the Madera monitor is already nearing the 12 µg/m<sup>3</sup> PM<sub>2.5</sub> standard. For Hanford, while the impact is over U.S. EPA’s recommended significance level, achieving the level of controls needed for a 30 percent reduction of ammonia is not feasible, as discussed above.

### **Conclusion**

CARB has followed U.S. EPA guidance to evaluate whether ammonia contributes significantly to PM<sub>2.5</sub> levels that exceed the NAAQS. Considering relevant contextualizing information such as emissions, research, and available controls, along with performing sensitivity-based analysis in future years, CARB determined that emissions of ammonia do not contribute significantly to PM<sub>2.5</sub> levels that exceed the 1997, 2006, or 2012 NAAQS in the area. Therefore, CARB has excluded ammonia from control requirements in the SIP.

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<sup>35</sup> Ibid. 17

## SULFUR DIOXIDE ANALYSIS

Ammonium sulfate ( $[\text{NH}_4]_2\text{SO}_4$ ) is a constituent of  $\text{PM}_{2.5}$ , making up about 10 percent of fine particulate matter mass in the Valley. Sulfur oxides ( $\text{SO}_x$ ) emitted from stationary and mobile combustion sources, mostly as sulfur dioxide ( $\text{SO}_2$ ), are oxidized in the atmosphere to ultimately form sulfuric acid ( $\text{H}_2\text{SO}_4$ ). Sulfuric acid then combines with ammonia to form ammonium sulfate. Since  $\text{SO}_x$  reacts chemically in this way to form a particle,  $\text{SO}_x$  is a precursor to  $\text{PM}_{2.5}$ .

Following the analytical process outlined in the U.S. EPA precursor demonstration guidance and summarized above, CARB has evaluated  $\text{SO}_x$  in the Valley. The results of the sensitivity-based analysis and consideration of additional information are presented below.

### Sensitivity-Based Analysis

CARB staff used an air quality model to estimate the  $\text{PM}_{2.5}$  design value for the annual and 24-hour standards in the base year of 2013 at each Valley monitor. Then, CARB staff applied the recommended lower bound of a 30 percent reduction to  $\text{SO}_x$  emissions and used the air quality model to estimate the  $\text{PM}_{2.5}$  design values, as shown in Table 7. The difference between the two design values represents the modeled impact on  $\text{PM}_{2.5}$  levels of a 30 percent reduction in  $\text{SO}_x$  emissions in 2013. This is the value that is compared to U.S. EPA's recommended contribution thresholds of  $0.2 \mu\text{g}/\text{m}^3$  for the annual standard and  $1.3 \mu\text{g}/\text{m}^3$  for the 24-hour standard to establish if  $\text{PM}_{2.5}$  levels are sensitive to this level of  $\text{SO}_x$  reduction.

Table 7. Base Year 2013  $\text{PM}_{2.5}$  – 30 Percent  $\text{SO}_x$  Reduction

Site	Annual			24-Hour		
	2013 Baseline DV	2013 DV with 30% $\text{SO}_x$ Reduction	Difference	2013 Baseline DV	2013 DV with 30% $\text{SO}_x$ Reduction	Difference
Bakersfield-Planz	17.19	17.15	0.04	55.5	55.9	-0.4
Madera	16.93	16.92	0.01	51.0	51.3	-0.3
Hanford	16.54	16.53	0.01	60.0	60.4	-0.4
Visalia	16.20	16.15	0.05	55.5	55.8	-0.3
Clovis	16.12	16.11	0.01	55.8	56.0	-0.2
Bakersfield-California	16.02	15.98	0.04	64.1	64.5	-0.4
Fresno-Garland	14.98	14.95	0.03	60.0	60.1	-0.1
Turlock	14.88	14.83	0.05	50.7	50.8	-0.1
Fresno-HW	14.22	14.18	0.04	59.3	59.4	-0.1
Stockton	13.14	13.07	0.07	42.0	41.8	0.2
Merced-S Coffee	13.10	13.08	0.02	41.1	41.2	-0.1
Modesto	13.03	12.97	0.06	47.9	47.9	0.1
Merced-M	10.97	10.95	0.02	46.9	47.0	-0.1
Manteca	10.09	10.02	0.07	36.9	36.6	0.2
Tranquility	7.72	7.73	-0.01	29.5	29.5	0.0

For completeness, CARB staff repeated this analysis, applying instead the recommended upper bound of a 70 percent reduction to the SOx emissions in the base year, as shown in Table 8.

Table 8. Base Year 2013 PM<sub>2.5</sub> – 70 Percent SOx Reduction

Site	Annual			24-Hour		
	2013 Baseline DV	2013 DV with 70% SOx Reduction	Difference	2013 Baseline DV	2013 DV with 70% SOx Reduction	Difference
Bakersfield-Planz	17.19	17.11	0.08	55.5	56.5	-1.0
Madera	16.93	16.95	-0.02	51.0	52.2	-1.2
Hanford	16.54	16.54	0.00	60.0	61.4	-1.4
Visalia	16.20	16.10	0.10	55.5	56.3	-0.8
Clovis	16.12	16.10	0.02	55.8	56.4	-0.6
Bakersfield-California	16.02	15.95	0.07	64.1	65.2	-1.1
Fresno-Garland	14.98	14.93	0.05	60.0	60.6	-0.6
Turlock	14.88	14.77	0.11	50.7	51.1	-0.4
Fresno-HW	14.22	14.15	0.07	59.3	59.8	-0.5
Stockton	13.14	12.99	0.15	42.0	41.9	0.2
Merced-S Coffee	13.10	13.08	0.02	41.1	41.4	-0.3
Modesto	13.03	12.90	0.13	47.9	48.0	-0.1
Merced-M	10.97	10.93	0.04	46.9	47.2	-0.3
Manteca	10.09	9.95	0.14	36.9	36.4	0.5
Tranquility	7.72	7.77	-0.05	29.5	29.7	-0.2

From this analysis, the estimated air quality impact of reducing SOx emissions in the base year by the lower bound of 30 percent is well under U.S. EPA's recommended thresholds at all Valley monitors for both the annual and 24-hour standards. In fact, in some cases, the estimated air quality impact is negative, implying that a reduction in SOx emissions would in fact increase the modeled design value at certain sites. Reducing emissions by the upper bound of 70 percent also shows impacts below the recommended thresholds.

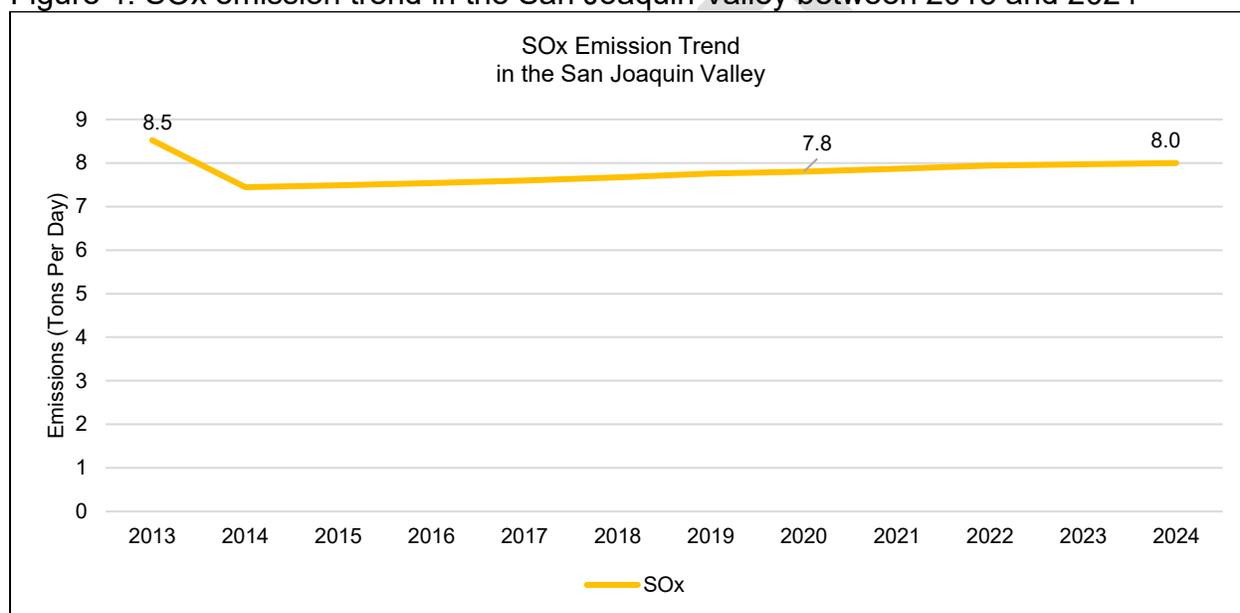
### Consideration of Additional Information

To supplement modeling analysis, U.S. EPA guidance also allows an air agency to consider additional information. Accordingly, CARB evaluated the trend of SOx emissions in the Valley to support the sensitivity-based analysis.

*Emissions Trend*

CARB’s SOx inventory indicates that emissions remain roughly constant between 2013 and 2024, as shown in Figure 4. Ammonia emissions also remain flat over the same time frame, as shown above in Figure 1. Thus, conditions for ammonium sulfate formation are similar in the base and future years, with relative levels of ammonia and SOx remaining the same. The sensitivity-based analysis performed for 2013 and reflected in Tables 7 and 8 above is therefore representative into the future, and it is redundant to additionally model the sensitivity of PM<sub>2.5</sub> formation to SOx emissions reductions in 2020 or 2024. Precursor sensitivities in the future years are assumed to be very close to those modeled in 2013 due to the similarity of emissions conditions over time, so 2020 and 2024 analyses are not included here.

Figure 4. SOx emission trend in the San Joaquin Valley between 2013 and 2024



Source: CEPAM Inventory version 1.05

**Conclusion**

CARB has followed U.S. EPA guidance to evaluate whether SOx contributes significantly to PM<sub>2.5</sub> levels that exceed the NAAQS. Using sensitivity-based analysis in the base year and considering that base year conditions are representative into the future, CARB determined that emissions of SOx do not contribute significantly to PM<sub>2.5</sub> levels that exceed the 1997, 2006, or 2012 NAAQS in the area. Therefore, CARB has excluded SOx from control requirements in the SIP.

## ROG ANALYSIS

Following the analytical process outlined in the U.S. EPA precursor demonstration guidance and summarized above, CARB has evaluated ROG in the San Joaquin Valley. The results of the sensitivity-based analysis and consideration of additional information are presented below.

### Sensitivity-Based Analysis

CARB staff used an air quality model to estimate the PM<sub>2.5</sub> design value for the annual and 24-hour standards in the base year of 2013 at each Valley monitor. Then, CARB staff applied the recommended lower bound of a 30 percent reduction to ROG emissions and used the air quality model to estimate the PM<sub>2.5</sub> design values, as shown in Table 9. The difference between the two design values represents the modeled impact on PM<sub>2.5</sub> levels of a 30 percent reduction in ROG emissions in 2013. This is the value that is compared to U.S. EPA's recommended contribution thresholds of 0.2 µg/m<sup>3</sup> for the annual standard and 1.3 µg/m<sup>3</sup> for the 24-hour standard to establish if PM<sub>2.5</sub> levels are sensitive to this level of ROG reduction.

Table 9. Base Year 2013 PM<sub>2.5</sub> – 30 Percent ROG Reduction

Site	Annual			24-Hour		
	2013 Baseline DV	2013 DV with 30% ROG Reduction	Difference	2013 Baseline DV	2013 DV with 30% ROG Reduction	Difference
Bakersfield-Planz	17.19	17.08	0.11	55.5	54.3	1.2
Madera	16.93	16.83	0.10	51.0	50.1	0.9
Hanford	16.54	16.47	0.07	60.0	58.8	1.1
Visalia	16.20	16.04	0.16	55.5	53.6	1.9
Clovis	16.12	16.01	0.11	55.8	54.9	0.9
Bakersfield-California	16.02	15.92	0.10	64.1	62.8	1.4
Fresno-Garland	14.98	14.87	0.11	60.0	59.1	0.9
Turlock	14.88	14.80	0.08	50.7	50.1	0.7
Fresno-HW	14.22	14.10	0.12	59.3	58.2	1.1
Stockton	13.14	13.09	0.05	42.0	41.5	0.5
Merced-S Coffee	13.10	13.04	0.06	41.1	40.7	0.4
Modesto	13.03	12.97	0.06	47.9	47.4	0.6
Merced-M	10.97	10.92	0.05	46.9	46.5	0.4
Manteca	10.09	10.03	0.06	36.9	36.3	0.5
Tranquility	7.72	7.71	0.01	29.5	29.4	0.1

For completeness, CARB staff repeated this analysis, applying instead the U.S. EPA-recommended upper bound of a 70 percent reduction to ROG emissions in the base year, as shown in Table 10.

Table 10. Base Year 2013 PM<sub>2.5</sub> – 70 Percent ROG Reduction

Site	Annual			24-Hour		
	2013 Baseline DV	2013 DV with 70% ROG Reduction	Difference	2013 Baseline DV	2013 DV with 70% ROG Reduction	Difference
Bakersfield-Planz	17.19	16.90	0.29	55.5	52.4	3.0
Madera	16.93	16.69	0.24	51.0	48.8	2.1
Hanford	16.54	16.35	0.19	60.0	56.9	3.0
Visalia	16.20	15.80	0.40	55.5	50.7	4.8
Clovis	16.12	15.84	0.28	55.8	53.6	2.2
Bakersfield-California	16.02	15.76	0.26	64.1	60.5	3.6
Fresno-Garland	14.98	14.73	0.25	60.0	57.7	2.2
Turlock	14.88	14.68	0.20	50.7	49.1	1.6
Fresno-HW	14.22	13.94	0.28	59.3	56.7	2.7
Stockton	13.14	13.01	0.13	42.0	40.7	1.3
Merced-S Coffee	13.10	12.96	0.14	41.1	40.1	1.0
Modesto	13.03	12.88	0.15	47.9	46.7	1.3
Merced-M	10.97	10.85	0.12	46.9	45.9	1.0
Manteca	10.09	9.96	0.13	36.9	35.6	1.2
Tranquility	7.72	7.67	0.05	29.5	29.2	0.2

From this analysis, the estimated air quality impact of reducing ROG emissions in the base year by the lower bound of 30 percent is under U.S. EPA's recommended thresholds at all but two Valley monitors for the 24-hour standard, and falls below the recommended annual threshold at all sites. Reducing emissions by the upper bound of 70 percent shows impacts above the thresholds at about half the sites.

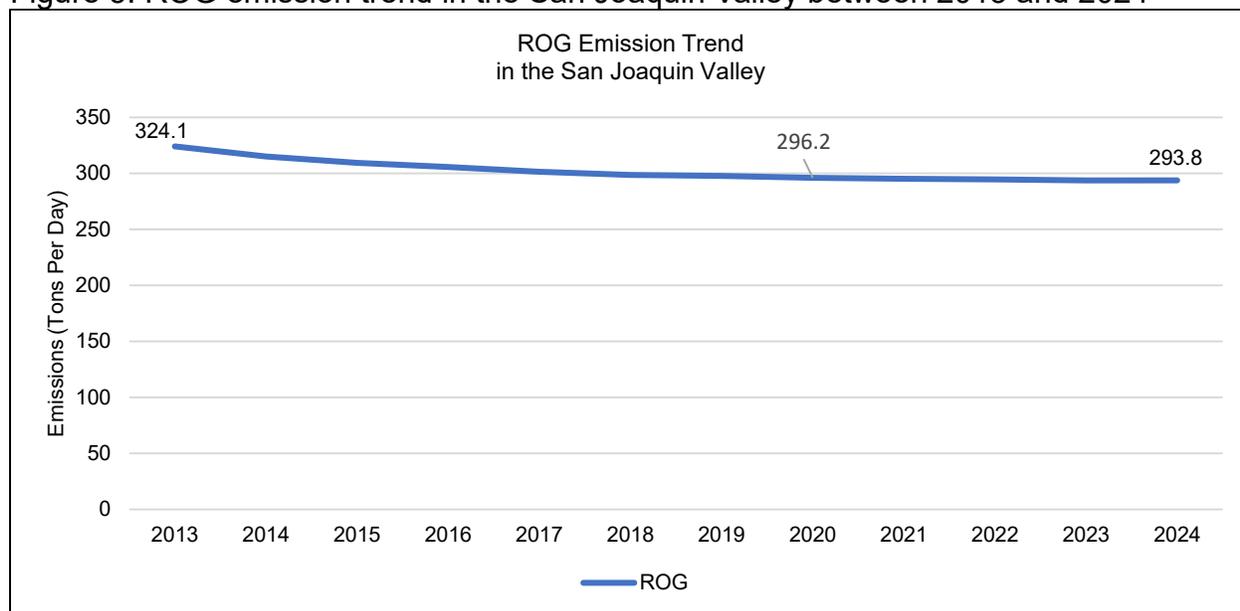
### Consideration of Additional Information

To supplement modeling analysis, U.S. EPA guidance also allows an air agency to consider additional information. Accordingly, CARB evaluated the trend of ROG emissions in the Valley to support the sensitivity-based analysis and conducted future year sensitivity modeling.

#### *Emissions Trend*

CARB has an extensive suite of measures in place to reduce ROG emissions, particularly in the area of regulating consumer products. In addition, the District has numerous rules that provide ROG emissions reductions in the Valley. CARB's ROG inventory indicates that these existing controls reduce emissions by approximately 30 tons, or nine percent, between 2013 and 2024, as shown in Figure 5. Thus, the role ROG plays in PM<sub>2.5</sub> formation may differ in the base and future years, and the sensitivity-based analysis performed for 2013 is not representative into the future.

Figure 5. ROG emission trend in the San Joaquin Valley between 2013 and 2024



Source: CEPAM Inventory version 1.05

**Future Year Modeling**

Even though the estimated air quality impact of reducing ROG emissions in the base year by 30 percent is under U.S. EPA’s recommended thresholds at all but two Valley monitors for the 24-hour standard, and falls below the recommended annual threshold at all sites, CARB staff repeated the sensitivity-based analysis of ROG for the future attainment years of 2020 and 2024 for completeness.<sup>36</sup> Staff used an air quality model to estimate the PM<sub>2.5</sub> design value for the annual and 24-hour standards in 2020 and 2024 at each Valley monitor. Then, CARB staff applied a 30 percent reduction to ROG emissions and used the air quality model to estimate the PM<sub>2.5</sub> design values in 2020 and 2024, shown in Tables 11 and 12 respectively. The difference between the two design values represents the modeled impact on PM<sub>2.5</sub> levels of a 30 percent reduction in ROG emissions in each attainment year.

<sup>36</sup> CARB did not conduct sensitivity analysis for the 2025 attainment year for the 2012 annual PM<sub>2.5</sub> standard due to the close proximity of the attainment years for the 2012 and 2006 standards. Precursor sensitivities in 2025 are assumed to be very similar to those modeled in 2024.

Table 11. Future Year 2020 PM<sub>2.5</sub> – 30 Percent ROG Reduction

Site	Annual			24-Hour		
	2020 Baseline DV	2020 DV with 30% ROG Reduction	Difference	2020 Baseline DV	2020 DV with 30% ROG Reduction	Difference
Bakersfield-Planz	14.58	14.55	0.03	41.2	40.9	0.3
Madera	14.15	14.12	0.03	38.9	38.6	0.2
Hanford	13.30	13.35	-0.50	43.7	43.7	0.0
Visalia	13.51	13.47	0.04	42.8	42.2	0.6
Clovis	13.43	13.37	0.06	41.1	40.9	0.3
Bakersfield-California	13.48	13.47	0.01	47.6	47.5	0.1
Fresno-Garland	12.42	12.37	0.05	44.3	44.0	0.3
Turlock	12.47	12.46	0.01	37.8	37.7	0.1
Fresno-HW	11.86	11.80	0.06	45.6	45.2	0.4
Stockton	11.43	11.42	0.01	33.5	33.4	0.1
Merced-S Coffee	10.86	10.86	0.00	30.0	29.9	0.0
Modesto	10.97	10.96	0.01	35.8	35.7	0.1
Merced-M	9.34	9.33	0.01	32.9	32.9	0.0
Manteca	8.67	8.66	0.01	30.1	30.0	0.1
Tranquility	6.40	6.41	-0.01	21.5	21.6	-0.1

Table 12. Future Year 2024 PM<sub>2.5</sub> – 30 Percent ROG Reduction

Site	Annual			24-Hour		
	2024 Baseline DV	2024 DV with 30% ROG Reduction	Difference	2024 Baseline DV	2024 DV with 30% ROG Reduction	Difference
Bakersfield-Planz	12.03	11.92	-0.01	30.0	30.0	-0.2
Madera	11.98	11.99	-0.01	30.2	30.3	-0.1
Hanford	10.52	10.59	-0.07	30.1	30.5	-0.4
Visalia	11.09	11.1	-0.01	30.2	30.4	-0.3
Clovis	11.37	11.34	0.03	30.7	30.7	0.0
Bakersfield-California	11.01	10.91	-0.01	33.3	33.5	-0.4
Fresno-Garland	10.43	10.41	0.02	32.8	32.9	-0.1
Turlock	11.14	11.16	-0.02	30.2	30.3	-0.1
Fresno-HW	10.02	9.99	0.03	35.1	35.2	0.0
Stockton	10.66	10.67	-0.01	28.6	28.6	-0.1
Merced-S Coffee	9.65	9.67	-0.02	24.2	24.3	-0.1
Modesto	9.97	9.98	-0.01	29.1	29.2	-0.1
Merced-M	8.61	8.61	0.00	27.4	27.8	-0.1
Manteca	7.97	7.98	-0.01	25.8	25.8	0.0
Tranquility	5.54	5.55	-0.01	16.2	16.3	-0.1

In both 2020 and 2024, the modeled air quality impact of reducing ROG emissions by 30 percent falls under U.S. EPA's recommended thresholds at all sites.

For completeness, CARB staff repeated this analysis, applying instead the recommended upper bound of a 70 percent reduction to ROG emissions in 2020 and 2024, as shown in Tables 13 and 14.

Table 13. Future Year 2020 PM<sub>2.5</sub> – 70 Percent ROG Reduction

Site	Annual			24-Hour		
	2020 Baseline DV	2020 DV with 70% ROG Reduction	Difference	2020 Baseline DV	2020 DV with 70% ROG Reduction	Difference
Bakersfield-Planz	14.58	14.51	0.07	41.2	40.3	1.0
Madera	14.15	14.09	0.06	38.9	38.3	0.6
Hanford	13.30	13.40	-0.10	43.7	43.5	0.2
Visalia	13.51	13.40	0.11	42.8	41.3	1.5
Clovis	13.43	13.27	0.16	41.1	40.4	0.7
Bakersfield-California	13.48	13.44	0.04	47.6	47.2	0.5
Fresno-Garland	12.42	12.29	0.13	44.3	43.5	0.8
Turlock	12.47	12.43	0.04	37.8	37.5	0.2
Fresno-HW	11.86	11.71	0.15	45.6	44.6	1.0
Stockton	11.43	11.41	0.02	33.5	33.2	0.3
Merced-S Coffee	10.86	10.85	0.01	30.0	29.8	0.1
Modesto	10.97	10.95	0.02	35.8	35.6	0.2
Merced-M	9.34	9.30	0.04	32.9	32.9	0.1
Manteca	8.67	8.64	0.03	30.1	29.8	0.3
Tranquility	6.40	6.41	-0.01	21.5	21.7	-0.2

In 2020, the modeled air quality impact of reducing ROG emissions by 70 percent falls under U.S. EPA's recommended annual threshold at all sites, and under the recommended 24-hour threshold at all sites but one.

Table 14. Future Year 2024 PM<sub>2.5</sub> – 70 Percent ROG Reduction

Site	Annual			24-Hour		
	2024 Baseline DV	2024 DV with 70% ROG Reduction	Difference	2024 Baseline DV	2024 DV with 70% ROG Reduction	Difference
Bakersfield-Planz	12.03	11.94	-0.03	30.0	30.3	-0.5
Madera	11.98	12.01	-0.03	30.2	30.4	-0.3
Hanford	10.52	10.70	-0.18	30.1	31.1	-1.0
Visalia	11.09	11.11	-0.02	30.2	30.7	-0.5
Clovis	11.37	11.29	0.08	30.7	30.7	0.0
Bakersfield-California	11.01	10.94	-0.04	33.3	34.0	-0.9
Fresno-Garland	10.43	10.37	0.06	32.8	33.0	-0.2
Turlock	11.14	11.19	-0.05	30.2	30.5	-0.3
Fresno-HW	10.02	9.95	0.07	35.1	35.2	-0.1
Stockton	10.66	10.67	-0.01	28.6	28.7	-0.1
Merced-S Coffee	9.65	9.69	-0.04	24.2	24.5	-0.3
Modesto	9.97	9.99	-0.02	29.1	29.3	-0.2
Merced-M	8.61	8.60	0.01	27.4	27.7	-0.3
Manteca	7.97	7.98	-0.01	25.8	25.9	-0.1
Tranquility	5.54	5.57	-0.03	16.2	16.6	-0.4

In 2024, the modeled air quality impact of reducing ROG emissions by 70 percent falls under U.S. EPA's recommended thresholds at all sites.

**Conclusion**

CARB has followed U.S. EPA guidance to evaluate whether ROG contributes significantly to PM<sub>2.5</sub> levels that exceed the NAAQS. Using sensitivity-based analysis in the base and future years, CARB determined that emissions of ROG do not contribute significantly to PM<sub>2.5</sub> levels that exceed the 1997, 2006, or 2012 NAAQS in the area. Therefore, CARB has excluded ROG from control requirements in the SIP.

DRAFT

# **EXHIBIT 6**

**UTAH**  
**State Implementation Plan**

**Control Measures for Area and Point Sources, Fine Particulate Matter,  
PM<sub>2.5</sub> SIP for the Salt Lake City, UT Nonattainment Area**

**Section IX. Part A.21**

Adopted by the Utah Air Quality Board

December 3, 2014

Each of these three areas was designated, by the EPA, based on the weight of evidence of the following nine factors recommended in its guidance and any other relevant information:

- pollutant emissions
- air quality data
- population density and degree of urbanization
- traffic and commuting patterns
- growth
- meteorology
- geography and topography
- jurisdictional boundaries
- level of control of emissions sources

EPA also used analytical tools and data such as pollution roses, fine particulate composition monitoring data, back trajectory analyses, and the contributing emission score (CES) to evaluate these areas.

While the general meteorological characteristics are identical between the Wasatch Front and Cache Valley, there are two important differences related to topography. First, the Cache Valley is a closed basin while the Wasatch Front has many large outlets that connect it to the larger Great Basin. The large outlets along the Wasatch Front provide the potential for greater advection of pollutants and for a potentially weaker cold pool. Second, the Cache Valley is a narrow (<20 km) valley bordered by extremely steep mountains. These topographical differences lead to faster forming, more intense, and more persistent cold pools in Cache Valley relative to the Wasatch Front.

Because of these differences, the two Wasatch Front areas and the Cache Valley are designated as separate nonattainment areas; however, they have all been modeled together within the same modeling domain.

## **1.6 PM<sub>2.5</sub> Precursors**

The majority of ambient PM<sub>2.5</sub> collected during a typical cold-pool episode of elevated concentration is secondary particulate matter, born of precursor emissions. The precursor gasses associated with fine particulate matter are SO<sub>2</sub>, NO<sub>x</sub>, volatile organic compounds (VOC), and ammonia (NH<sub>3</sub>).

Clean Air Act Section 189(e) requires that the control requirements applicable in plans for major stationary sources of PM<sub>10</sub> shall also apply to major stationary sources of PM<sub>10</sub> precursors, except where the Administrator determines that such sources do not contribute significantly to PM<sub>10</sub> levels which exceed the standard in the area.

As this paragraph now applies also to PM<sub>2.5</sub> plans the following should be said about the way this plan is structured.

CAA Section 172 does not include any specific applicability thresholds to identify the size of sources that States and EPA must consider in the plan's RACT and RACM analysis. In developing the emissions inventories underlying the SIP, the criteria of 40 CFR 51 for air emissions reporting requirements was used to establish a 100 ton per year threshold for identifying a sub-group of stationary point sources that would be evaluated individually. For the Salt Lake City, UT nonattainment area, there are 28 stationary point sources that met or meet the criteria of 100 tons per year for PM<sub>2.5</sub> or any PM<sub>2.5</sub> precursor.

The control evaluations for each of these sources included PM<sub>2.5</sub> as well as PM<sub>2.5</sub> precursors. This principle was extended to the non-stationary source categories as well.

When evaluating the cost per ton necessary to reduce emissions, consideration was given to the resulting PM<sub>2.5</sub> concentrations. Through this process, reasonable controls were identified affecting PM<sub>2.5</sub>, SO<sub>2</sub>, NO<sub>x</sub> and VOC.

No such controls were identified for ammonia. Ammonia occurs in such abundance that PM<sub>2.5</sub> concentrations are not sensitive to reductions in ammonia unless those reductions are very large. Within the stationary source category, there really were no significant amounts of ammonia to evaluate. The largest contributor to the ammonia inventory was the agricultural sector, and the maximum possible amount of ammonia reduction from that sector would still not be enough to affect a reduction in PM<sub>2.5</sub>.

Additional information regarding control measures may be found in Chapter 6 as well as the Technical Support Document (TSD).

## Chapter 2 – REQUIREMENTS FOR 2006, PM<sub>2.5</sub> PLAN REVISIONS

### 2.1 Requirements for Nonattainment SIPs

Section 110 of the Clean Air Act lists the requirements for implementation plans. Many of these requirements speak to the administration of an air program in general. Section 172 of the Act contains the plan requirements for nonattainment areas. Some of the more notable requirements identified in these sections of the Act that pertain to this SIP include:

- Implementation of Reasonably Available Control Measures (RACM) as expeditiously as practicable
- Reasonable Further Progress (RFP) toward attainment of the National Ambient Air Quality Standards by the applicable attainment date
- Enforceable emission limits as well as schedules for compliance
- A comprehensive inventory of actual emissions
- Contingency measures to be undertaken if the area fails to make reasonable further progress or attain the NAAQS by the applicable attainment date

On January 4, 2013, D.C. Circuit Court of Appeals found that EPA had incorrectly interpreted the Clean Air Act when determining how to implement the National Ambient Air Quality Standards (NAAQS) for PM<sub>2.5</sub>. The January 4, 2013 court ruling held that the EPA should have implemented the PM<sub>2.5</sub> NAAQS based on *both* Clean Air Act (CAA) Subpart 1 (“Nonattainment Areas in General” of “Part D – Plan Requirements for Nonattainment Areas”) *and* Subpart 4 (“Additional Provisions for Particulate Matter Nonattainment Areas”) of Part D, title 1. EPA had (incorrectly) required states to develop their SIPs based only on Subpart 1. Therefore, as of January 4, 2013, Subpart 4 also applies.

Under Subpart 4, nonattainment areas for particulate matter may carry the classification of either moderate or serious. Subpart 4 addresses the attainment dates and planning provisions for both moderate and serious PM nonattainment areas.

In the wake of the decision by the D.C. Circuit, EPA has promulgated a “Deadlines Rule” that identifies each of Utah’s three PM<sub>2.5</sub> nonattainment areas as moderate. It specifies December 31, 2014 as the SIP submission deadline for these moderate PM<sub>2.5</sub> nonattainment areas, and further specifies December 31, 2015 as the attainment date for each area.

More specific requirements for the preparation, adoption, and submittal of implementation plans are specified in 40 CFR Part 51. Subpart Z of Part 51 had contained provisions for Implementation of PM<sub>2.5</sub> National Ambient Air Quality Standards. However, one consequence of the January 4, 2013 Court ruling was to revoke Subpart Z. This leaves only the more general requirements of Part 51.

## **2.2 PM<sub>2.5</sub> SIP Guidance**

Beyond what had been codified in Subpart Z of Part 51 concerning the Implementation of the PM<sub>2.5</sub> NAAQS, EPA had provided additional clarification and guidance in its Clean Air Particulate Implementation Rule for the 1997, PM<sub>2.5</sub> NAAQS (FR 72, 20586) and its subsequent Implementation Guidance for the 2006, 24-Hour Fine Particle NAAQS (March 2, 2012). This too was revoked by the D.C. Circuit Court's decision. Until such time as a new implementation rule for PM<sub>2.5</sub> is promulgated, the Deadlines Rule recommends the General Preamble, EPA's longstanding general guidance that interprets the 1990 amendments to the CAA, as the applicable guidance for states to follow while preparing SIPs for PM<sub>2.5</sub> nonattainment areas.

## **2.3 Summary of this SIP Proposal**

This implementation plan was developed to meet the requirements specified in the law, rule, and appropriate guidance documents identified above. Discussed in the following chapters are: air monitoring, reasonably available control measures, modeled attainment demonstration, emission inventories, reasonable further progress toward attainment, transportation conformity, and contingency measures. Additional information is provided in the technical support document (TSD).

## 6.5 SIP Controls

Beyond the benefits attributable to the controls already in place, there are new controls identified by this SIP that provide additional benefit toward reaching attainment. A summary of the plan strategy is presented here for each of the emission source sectors.

Overall, within the Salt Lake City – UT nonattainment area, the strategy to reduce emissions results in 27.4 tons per day of combined PM<sub>2.5</sub>, SO<sub>2</sub>, NO<sub>x</sub> and VOC in 2015.

## 6.6 Reasonably Available Control Measures (RACM/RACT)

Section 172 of the CAA requires that each attainment plan “provide for the implementation of all reasonably available control measures (RACM) as expeditiously as practicable (including such reductions in emissions from existing sources in the area as may be obtained through the adoption, at a minimum, of reasonably available control technology (RACT)), and shall provide for attainment of the NAAQS.”

Now that the Courts have determined that Subpart 4 applies to PM<sub>2.5</sub> nonattainment areas, it is also instructive to consider paragraph 189(a)(1)(C), which requires that “provisions to assure that reasonably available control measures ... shall be implemented no later than ... 4 years after designation in the case of an area classified as moderate after the date of the enactment of the Clean Air Act Amendments of 1990.” All three of Utah’s nonattainment areas for PM<sub>2.5</sub> were designated so on December 14, 2009. Hence, December 14, 2013 was the date by which all RACM was to have been implemented.

EPA interprets RACM as referring to measures of any type that may be applicable to a wide range of sources (mobile, area, or stationary), whereas RACT refers to measures applicable to stationary sources. Thus, RACT is a type of RACM specifically designed for stationary sources. For both RACT and RACM, potential control measures must be shown to be both technologically and economically feasible.

Pollutants to be addressed by States in establishing RACT and RACM limits in their PM<sub>2.5</sub> attainment plans will include primary PM<sub>2.5</sub> as well as precursors to PM<sub>2.5</sub>. For the control strategy in this plan, those pollutants include SO<sub>2</sub>, NO<sub>x</sub> and VOC.

In general, the combined approach to RACT and RACM includes the following steps: 1) identification of potential measures that are reasonable, 2) modeling to test the control strategy, and 3) selection of RACT and RACM.

This basic process was applied to each of the four basic sectors of the emissions inventory:

### Stationary Point sources:

*Reasonably Available Control Technology* – As stated above, RACT refers to measures applicable to stationary sources. Thus, RACT is a type of RACM specifically designed for stationary sources.

# **EXHIBIT 7**

**UTAH**  
**State Implementation Plan**

**Control Measures for Area and Point Sources, Fine Particulate Matter,  
PM<sub>2.5</sub> SIP for the Salt Lake City, UT Nonattainment Area**

**Section IX. Part A.21**

Adopted by the Utah Air Quality Board

December 04, 2013

SIPs for ozone and SO<sub>2</sub> in 1981 affected all of the precursors to secondary particulate. There were SO<sub>2</sub> reductions at the copper smelter and VOC reductions at the refineries. In addition, Control Techniques Guideline documents (CTGs) affecting VOC emissions at a variety of industrial source categories were incorporated into Utah's air quality rules.

In the early 1990s, stationary sources were required to reduce PM<sub>10</sub>, SO<sub>2</sub>, and NO<sub>x</sub> to address wintertime PM<sub>10</sub> nonattainment.

Any of the source-specific emission controls or operating practices that has been required as a result of the forgoing has been reflected in the baseline emissions calculated for the large stationary sources, and therefore evaluated in the modeled attainment demonstration.

#### Area sources:

Stage 1 vapor control was introduced in Salt Lake and Davis Counties as part of the 1981 ozone SIP. This is a method of collecting VOC vapors, as underground gasoline storage tanks are filled at gas stations, and returning those vapors to a facility where they are collected and recycled. Since that time it has been extended to include the entire state.

Part of the PM<sub>10</sub> control for Salt Lake and Davis Counties in the early 1990s was a program to curtail woodsmoke emissions during periods of atmospheric stagnation. Woodsmoke is rich in VOC emissions in addition to the particulate matter which is almost entirely within the PM<sub>2.5</sub> size fraction. In 2006 the woodburning program was extended to include the western half of Weber County as well.

CTGs adopted into Utah's air quality rules to control VOC emissions in Salt Lake and Davis Counties, as part of the 1981 ozone SIP, are also effective in controlling emissions from area sources.

#### Energy Efficiency

EPA recognizes the benefits of including energy efficiency programs in SIP's as a low cost means of reducing emissions. Two established energy efficiency programs that result in direct emission reductions within the Wasatch Front are already in place.

#### *Questar Gas ThermWise Rebate Programs*

Questar started the ThermWise Rebate Programs on January 1, 2007 as a way to promote the use of energy-efficient appliances and practices among its customers. The ThermWise Programs offer rebates to help offset the initial cost of energy-efficient appliances and weatherization. There are also rebates available for energy efficient new construction. The cost of rebates is built into the Questar gas rate. The rebates are vetted by the Utah Public Service Commission's strict "cost-effectiveness" tests. To pass these tests, Questar must prove that the energy cost savings produced by the ThermWise Programs exceeds the cost of the rebates. There is no scheduled end to the ThermWise Programs. According to the Questar program information, the program will remain in place as long as rebates remain cost-effective.

## 6.5 SIP Controls

Beyond the benefits attributable to the controls already in place, there are new controls identified by this SIP that provide additional benefit toward reaching attainment. A summary of the plan strategy is presented here for each of the emission source sectors.

Overall, within the Salt Lake City – UT nonattainment area, the strategy to reduce emissions results in 22.3 tons per day of combined PM<sub>2.5</sub>, SO<sub>2</sub>, NO<sub>x</sub> and VOC in 2014, 43.1 tons per day in 2017, and 64.5 tons per day in 2019.

## 6.6 Reasonably Available Control Measures (RACM/RACT)

Section 172 of the CAA requires that each attainment plan “provide for the implementation of all reasonably available control measures (RACM) as expeditiously as practicable (including such reductions in emissions from existing sources in the area as may be obtained through the adoption, at a minimum, of reasonably available control technology (RACT)), and shall provide for attainment of the NAAQS.”

EPA has interpreted these requirements in the April 25, 2007 Clean Air Fine Particulate Implementation Rule, at 72 FR 20586-20667, and supplemental guidance issued March 2, 2012 (memorandum from Stephen D. Page to Regional Air Directors).

EPA interprets RACM as referring to measures of any type that may be applicable to a wide range of sources (mobile, area, or stationary), whereas RACT refers to measures applicable to stationary sources. Thus, RACT is a type of RACM specifically designed for stationary sources. For both RACT and RACM, potential control measures must be shown to be both technologically and economically feasible.

Pollutants to be addressed by States in establishing RACT and RACM limits in their PM<sub>2.5</sub> attainment plans will include primary PM<sub>2.5</sub> as well as any pollutant identified in the plan as a significant contributor to PM<sub>2.5</sub> formation. For this plan, those pollutants include SO<sub>2</sub>, NO<sub>x</sub> and VOC.

In general, the combined approach to RACT and RACM includes the following steps: 1) identification of potential measures that are reasonable, 2) modeling to identify the attainment date that is as expeditious as practicable, and 3) selection of RACT and RACM.

EPA’s final rule requires States to conduct an analysis to identify RACT for all affected stationary sources. States can thereafter determine that RACT does not include controls that would not otherwise be necessary to meet Reasonable Further Progress (RFP) requirements or to attain the NAAQS as expeditiously as practicable. Any measures that, collectively, would not advance attainment by at least one year are not required for PM<sub>2.5</sub> RACT/RACM, even if those measures are individually reasonable. RACT may vary in different nonattainment areas based on the reductions needed for attainment as expeditiously as practicable.

Typical Winter Inversion Weekday Emissions (tons/day)											
NA Area	Site Name	2017 (R2)					2019 (R57)				
		PM2_5	NOX	VOC	NH3	SO2	PM2_5	NOX	VOC	NH3	SO2
Salt Lake City - UT	ATK Thiokol Promontory	0.15	0.36	0.15	0.00	0.05	0.15	0.37	0.16	0.00	0.05
	Big West Refinery	0.17	0.69	1.28	0.31	1.05	0.09	0.62	1.26	0.31	0.39
	Bountiful City Power	0.08	0.21	0.05		0.00	0.08	0.21	0.05		0.00
	Central Valley Water	0.00	0.04	0.03	0.00	0.00	0.00	0.04	0.03	0.00	0.00
	CER Generation II LLC - WVC	0.02	0.04	0.00		0.00	0.02	0.04	0.00		0.00
	Chemical Lime Company	0.05	0.06	0.00	0.00	0.05	0.05	0.05	0.00	0.00	0.05
	Chevron Refinery	0.10	0.95	1.23	0.02	0.07	0.10	2.27	1.23	0.02	1.09
	Geneva Rock Point of Mountain	0.08	0.34	0.06		0.05	0.08	0.34	0.06		0.05
	Great Salt Lake Minerals - Production Plant	0.13	0.33	0.06	0.00	0.03	0.14	0.35	0.07	0.00	0.03
	Hexcel Corporation Salt Lake Operations	0.16	0.48	0.42	0.08	0.16	0.16	0.30	0.47	0.10	0.09
	Hill Air Force Base Main	0.04	0.61	0.88	0.01	0.01	0.04	0.65	0.96	0.01	0.01
	Holly Refining Marketing	0.22	1.09	0.67	0.30	0.31	0.13	0.93	0.70	0.65	0.31
	Interstate Brick Brick										
	Kennecott Mine Concentrator	0.85	12.13	0.65	0.00	0.01	0.90	14.33	0.78	0.01	0.02
	Kennecott NC-UPP-Lab-Tailings	0.30	0.20	0.07	0.00	0.03	0.30	0.20	0.07	0.00	0.03
	Kennecott Smelter & Refinery	0.89	0.82	0.07	0.03	4.09	0.96	0.88	0.08	0.03	4.47
	Murray City Power										
	Nucor Steel	0.37	1.01	0.37	0.00	0.87	0.40	1.08	0.40	0.00	0.94
	Olympia Sales Co.	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.11	0.00	0.00
	Pacificorp Gadsby	0.07	0.40	0.03	0.07	0.01	0.07	0.40	0.03	0.07	0.01
	Pacificorp Little Mountain										
	Proctor & Gamble Paper Products Co.	0.61	0.71	0.69		0.01	0.66	0.76	0.75		0.01
	Silver Eagle Refining										
	Tesoro Refinery	0.28	1.17	1.08	0.01	2.24	0.27	0.82	1.01	0.01	0.82
	University of Utah	0.03	0.21	0.02	0.01	0.00	0.03	0.17	0.02	0.01	0.00
	Utility Trailer										
Vulcraft	0.05	0.03	0.25	0.00	0.00	0.05	0.04	1.13	0.00	0.00	
Wasatch Integrated IE	0.03	1.23	0.05	0.05	0.40	0.03	0.96	0.05	0.06	0.43	
	<b>Salt Lake City NA Total</b>	<b>4.68</b>	<b>23.12</b>	<b>8.22</b>	<b>0.90</b>	<b>9.45</b>	<b>4.72</b>	<b>25.82</b>	<b>9.43</b>	<b>1.28</b>	<b>8.79</b>

**Table 6.3, Point Source Emissions; Baseline and Projections with Growth and Control**

Area sources:

As part of the RACT analysis for area sources, consideration was given to a broad list of source categories. Table 6.4 identifies these categories as well as the pollutant(s) likely to be controlled, and provides some remarks as to whether a control strategy was ultimately pursued. In considering what source categories might be considered, Utah made use of EPA recommendations as well as control strategies from other states. DAQ evaluated each strategy for technical feasibility as part of the RACT analysis. The screening column in table 6.4 identifies whether or not a strategy was retained for rulemaking or screened out for impracticability.

**Table 6.4 Area Source Strategy Screening**

Strategy	Constituent(s)	SCREENING STATUS	REMARKS
<p>1. Repeal current surface coating rule, R307-340. Replace this rule with individual rules for each category. New rules include PM<sub>2.5</sub> nonattainment areas. New rules update applicability and control limits to most current CTG. Current rule includes, paper, fabric and vinyl, metal furniture, large appliance, magnet wire, flat wood, miscellaneous metal parts and graphic arts.</p>	VOC	Retained	R307-340 previously applied to Davis and Salt Lake counties. R307-340 was withdrawn and re-enacted as separate rules for each existing category. The new rules were expanded to nonattainment areas and updated to the most current RACT based limit(s).
<p>2. New separate surface coating rules for following sources:</p> <ul style="list-style-type: none"> <li>a. Aerospace</li> <li>b. High performance</li> <li>c. Architectural</li> <li>d. Marine</li> <li>e. Sheet, strip &amp; coil</li> <li>f. Traffic markings</li> <li>g. Plastic parts</li> </ul>	VOC	See Remarks Column	<p>Aerospace – retained</p> <p>High performance – screened, regulated under Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)</p> <p>Architectural – initially screened, further research indicated that adopting the Ozone Transport Commission model rule is feasible.</p> <p>Marine – screened, only 1.2 tpy</p> <p>Sheet, strip &amp; coil – retained</p> <p>Traffic markings - screened, regulated under FIFRA</p> <p>Plastic parts - retained</p>
<p>3. Agricultural practices using Natural Resources Conservation Service (NRSC) practice standards</p>	VOC, PM <sub>2.5</sub> , ammonia	Screened	The NRCS has already enrolled most farmers in the erodible regions in their program thereby negating the need for rulemaking
<p>4. Consumer products rule regulating VOC content</p>	VOC	Retained	
<p>5. Adhesives and sealant rule</p>	VOC	Retained	
<p>6. Expand current solvent degreasing rule R307-335 to PM<sub>2.5</sub> nonattainment areas and add a new section on industrial solvent cleaning</p>	VOC	Retained	
<p>7. Automobile refinishing rule</p>	VOC	Retained	
<p>8. Expand wood furniture manufacturing rule to PM<sub>2.5</sub> nonattainment areas. Update to most current CTG.</p>	VOC	Retained	
<p>9. Lower the no burn cut point for residential use of solid fuel burning devices. Require new sale of EPA certified stoves/fireplaces. Prohibit the sale/resale of noncertified stoves in nonattainment areas.</p>	VOC, PM <sub>2.5</sub> , NO <sub>x</sub> , SO <sub>x</sub> , ammonia	Retained	
<p>10. Ban new sales of stick type outdoor wood boilers in nonattainment areas.</p>	VOC, PM <sub>2.5</sub> , NO <sub>x</sub> , SO <sub>x</sub> , ammonia	Retained	
<p>11. Industrial bakery rule</p>	VOC	Initially Retained	Screened out after analysis of public comment, cost benefit analysis does not support rulemaking, high cost-low VOC reduction
<p>12. Chain-driven charbroiler restaurant emission control</p>	VOC, PM <sub>2.5</sub>	Retained	
<p>13. Appliance pilot light phase out</p>	VOC, PM <sub>2.5</sub> , NO <sub>x</sub> , SO <sub>x</sub> , ammonia	Retained	

Strategy	Constituent(s)	SCREENING STATUS	REMARKS
14. Expand current fugitive dust rule, R307-309 to PM <sub>2.5</sub> nonattainment areas. Require BMP's for dust plans.	PM <sub>2.5</sub>	Retained	
15. Amend fugitive dust rule to include cattle feed lot	PM <sub>2.5</sub>	Screened	Sizeable feed lots are not located in nonattainment areas
16. Low NO <sub>x</sub> burners in commercial, industrial, and institutional boilers	VOC, NO <sub>x</sub>	Retained	
17. Chemical additives to manure	VOC, ammonia	Screened	Costly with limited control efficiency. Excess ammonia in inventory that would not be sufficient to be effective
18. Ban testing of back-up generators on red-alert days	VOC, PM <sub>2.5</sub> , NO <sub>x</sub> , SO <sub>x</sub>	Initially Retained	Screened out after review of public comment, rule implementation was more complicated than anticipated, generators cannot be easily reprogrammed
19. Prohibit use of cutback asphalt	VOC	Screened	Cities and highway administration personnel need stockpile for winter time road repair. Very small inventory.
20. Control limits on aggregate processing operations and asphalt manufacturing	PM <sub>2.5</sub> , NO <sub>x</sub> , SO <sub>x</sub>	Retained	
21. R307-307 Road Salt and Sanding	PM	Retained	Expand current rule to nonattainment areas

EPA has developed control measure guidance documents called, control techniques guidelines (CTGs) for volatile organic compounds (VOCs). CTGs are used as presumptive RACT for VOCs and are guidance in SIP rulemaking. DAQ has evaluated all VOC CTGs for area sources as part of the SIP process.

As noted above, many CTGs were previously adopted into Utah's air quality rules to address ozone nonattainment in Salt Lake and Davis Counties. In conducting this evaluation, consideration was given to whether an expansion of applicability for an existing CTG into additional counties would provide a benefit for PM<sub>2.5</sub>, and whether a strengthening of existing CTG requirements in Salt Lake and Davis Counties would result in an incremental benefit that was economically feasible. Furthermore, EPA has updated some of its existing CTGs and added some new ones to the list.

As part of this SIP, Utah has identified relevant source categories covered by CTGs, and assembled draft rules, based on these CTGs, for reducing emissions from these categories. These rules will apply to the following source categories:

- Control of Volatile Organic Emissions from Surface Coating of Cans, Coils, Paper, Fabrics, Automobiles, and Light-Duty Trucks
- Control of Volatile Organic Emissions from Solvent Metal Cleaning
- Control of Volatile Organic Emissions from Surface Coating of Insulation of Magnet Wire
- Control of Volatile Organic Emissions from Graphic Arts
- Control of Volatile Organic Compound Emissions from Wood Furniture Manufacturing Operations
- Control Techniques Guidelines for Industrial Cleaning Solvents
- Control Techniques Guidelines for Flat Wood Paneling Coatings

- Control Techniques Guidelines for Paper, Film, and Foil Coatings
- Control Techniques Guidelines for Large Appliance Coatings
- Control Techniques Guidelines for Metal Furniture Coatings
- Control Techniques Guidelines for Miscellaneous Metal and Plastic Parts Coatings
- Control of Volatile Organic Emissions from Coating Operations at Aerospace Manufacturing and Rework Operations

While most VOC sources are addressed by CTGs, the remaining emission sources must be evaluated by engineering analysis, including an evaluation of rulings by other states including model rules developed by the Ozone Transport Commission. These include VOCs from autobody refinishing, restaurant charbroiling, and phasing out appliance pilot lights.

CTGs for PM<sub>2.5</sub> emissions sources do not exist. RACT for PM<sub>2.5</sub> has been established through information from varied EPA and other state SIP sources. A useful source of data is the AP 42 Compilation of Air Pollutant Emission Factors, first published by the US Public Health Service in 1968. In 1972, it was revised and issued as the second edition by the EPA. The emission factor/control information was applied to fugitive dust and mining strategies.

Table 6.5 shows the effectiveness (emissions reductions) of the area source SIP control strategy for the Salt Lake City, UT nonattainment area. Most of these rules become effective by January 1, 2014.

Salt Lake City - UT Nonattainment Area												
	2014 lb/day				2017 lb/day				2019 lb/day			
	NOX	PM2.5	SO2	VOC	NOX	PM2.5	SO2	VOC	NOX	PM2.5	SO2	VOC
<b>Area Source Rules</b>												
R307-302, Solid fuel burning	1,633.5	13,188.8	273.1	16,501.5	2,041.8	16,485.9	341.3	20,627.1	3,480.8	28,162.2	581.3	35,234.9
R307-303, Commercial cooking		380.1		98.1		370.4		95.6		407.0		105.0
R307-309, Fugitive dust		196.0				191.8				255.0		
R307-312, Aggregate processing operations		5.0				4.7				5.0		
R307-335, Degreasing				4,079.0				986.7				4,325.0
R307-342, Adhesives & sealants				2,227.0				2,169.6				2,387.0
R307-343, Wood manufacturing				1,206.0				1,175.9				1,276.0
R307-344, Paper, film & foil coating				1,315.0				1,279.2				1,328.0
R307-345, Fabric & vinyl coating				37.0				1,462.4				1,871.0
R307-346, Metal furniture coating				100.0				97.6				100.0
R307-347, Large appliance coating				3.0				3.4				3.0
R307-348, Magnet wire coating				9.0				9.3				9.0
R307-349, Flat wood panel coating				77.0				74.9				116.0
R307-350 Miscellaneous metal parts coating				2,653.0				2,587.7				2,681.0
machinery				151.0				147.0				159.0
other transportation				234.0				229.3				242.0
Special				4.0				4.1				5.0
R307-351, Graphic arts				1,917.0				1,917.2				2,215.0
R307-352, Metal containers				185.0				182.4				185.0
R307-353, Plastic coating				412.0				304.7				390.0
R307-354, Auto body refinishing				2,618.0				2,553.1				2,766.0
R307-355, Aerospace coatings				463.0				454.4				480.0
R307-356, Appliance pilot light	663.8	3.0	4.2	38.8	3,002.5	13.7	19.2	175.7	2,918.5	13.4	18.6	170.8
R307-357, Consumer products				3,840.0				3,735.6				4,116.0
R307-361, Architectural coatings				8,473.0				18,244.0				9,082.0
<b>TOTAL</b>	<b>2,297.3</b>	<b>13,773.0</b>	<b>277.3</b>	<b>46,641.5</b>	<b>5,044.3</b>	<b>17,066.6</b>	<b>360.5</b>	<b>58,516.9</b>	<b>6,399.3</b>	<b>28,842.5</b>	<b>600.0</b>	<b>69,246.6</b>

**Table 6.5, Emissions Reductions from Area Source SIP Controls**

# **EXHIBIT 8**

# Salt Lake Area Source BACM Analysis

## BACM Analysis Process

One of the requirements for a serious nonattainment area plan is to demonstrate that the plan includes the best available control measures (BACM) that can be feasibly and cost effectively implemented for all precursors. EPA defines BACM as being more stringent than reasonably available control measures (RACM), but less stringent than the lowest achievable emission rate (LAER), which does not take into consideration the cost effectiveness of implementing a particular control measure. The BACM analysis was conducted based on:

- ❖ Literature review of EPA guidance documents and regulations including:
  - Control Techniques Guidelines (CTG)
  - Alternative Control Techniques (ACT)
  - New Source Performance Standards (NSPS)
- ❖ A comparison of existing rules to the CTG to assure that all appropriate CTG's have been addressed in rulemaking
- ❖ Ozone Transport Commission (OTC) model rules
- ❖ A comparison of other serious nonattainment air districts rules for ozone and/or PM<sub>2.5</sub> to UDAQ rules:
  - San Joaquin Valley (SJ) – PM<sub>2.5</sub>
  - South Coast Air District (SC) – PM<sub>2.5</sub>
  - Ventura County, CA – ozone
  - Sacramento Metro, CA – ozone

Additional air district rules may also be reviewed if the air districts listed above do not have a comparable UDAQ rule.

- ❖ An evaluation of technological/economical feasibility for newly identified controls or enhancement of existing controls

The BACM analysis is based on a seasonally adjusted inventory. That is to say that source categories that do not occur in the winter are not included. Temporal adjustments are also made in the inventory. For example, exterior coating operations are not performed during the winter-inversion periods.

**Direct PM<sub>2.5</sub> BACM Assessment**

Source Category	Source Category Code	Utah Existing Rules and Federal Rules	Comments	2014 Uncontrolled Inventory Tons/winter Week Day
Combustion, Wood, All Devices	2104008320 2104008310 2104008330 2104008400 2102008000 2104008100 2103008000 2104008610 2104008210 2104008220 2104008510 2104008230 2104008700	R307-208 Outdoor Wood Boilers R307-302 Solid Fuel Burning Devices		2.41
Construction, Buildings	262003 231102 231101	Construction, Buildings		1.13
Commercial Cooking	2302002200 2302003000 2302003100 2302003200		Existing CA rules only apply to very large sources due to extreme cost (at least \$15K/ton) Prohibitive cost would shutter most sources.	1.03
Mining & Quarrying, All Processes	2325	R307-309 Fugitive Emissions & Fugitive Dust		0.77
Construction, Roads	231103	R307-309 Fugitive Emissions & Fugitive Dust		0.32
Backyard BBQ	2810025		Statutory exemption	0.13
Commercial Cooking, Chain-Driven Charbroiler	23020021	R307-303 Commercial Cooking		0.13
Combustion, Natural Gas, Residential	2104006000	R307-356 Appliance Pilot Light		0.05
Combustion, Natural Gas, Commercial & Institutional	2103006	40 CFR 63 Subpart DDDDD	MACT requires PM reduction	0.01
Landfills	2620030000	R307-309 Fugitive Emissions & Fugitive Dust		0.006
Combustion, Natural Gas, Industrial	2102006	40 CFR 63 Subpart DDDDD	MACT requires PM reduction	0.003
Combustion, Oil	2104004 2102005	R307-312 Aggregate Processing Operations  40 CFR 63 Subpart DDDDD	EPA-600/2-75-069-a Guidelines for Residential Oil-Burner Adjustments Procedures to Minimize Air Pollution	0.001
Combustion, LPG	2102007 2104007		No known control	9.3 x 10 <sup>-4</sup>
Cremation, Human	28100601	R307-201-3 Visible Emissions Standards	Opacity Requirement May also use PM collection systems	6 x 10 <sup>-4</sup>
Combustion, Kerosene	2103011000		No known control	1.1 x 10 <sup>-4</sup>

Seven area source rules have been adopted that provide control of direct PM<sub>2.5</sub>. Most of these rules are also helpful in providing control for precursors, such as VOC's. This section is dedicated to those control measures that provide the greatest control for direct PM<sub>2.5</sub>. The rules discussed in this section are annotated in the table in bold print.

R307-312 and R307-356 are discussed in other sections dedicated to the SO<sub>x</sub> and NO<sub>x</sub> precursors.

Utah Existing Rules	Control	Parameter
R307-208 Outdoor Wood Boilers	Prohibits sale of units in nonattainment areas	VOC, PM <sub>2.5</sub> , NO <sub>x</sub>
R307-302 Solid Fuel Burning Devices	Establishes an emission standard and allowable burning period	VOC, PM <sub>2.5</sub> , NO <sub>x</sub> , SO <sub>x</sub>
R307-303 Commercial Cooking	Emission controls for chain-driven charbroilers	PM <sub>2.5</sub> , VOC
R307-307 Road Salting & Sanding	Emission control	PM
R307-309 Fugitive Emissions & Fugitive Dust	Emission control	PM
R307-312 Aggregate Processing Operations	Emission control	SO <sub>x</sub> , PM <sub>2.5</sub> , NO <sub>x</sub>
R307-356 Appliance Pilot Light	Prohibits sale of pilot lights in the nonattainment areas	NO <sub>x</sub> , PM <sub>2.5</sub> , VOC, SO <sub>x</sub> , NH <sub>3</sub>

### PM<sub>2.5</sub> Source Category Analysis

**R307-208 Outdoor Wood Boilers:** Prohibits the sale of new units in the nonattainment area and established a registry for units within the nonattainment area in existence prior to rule promulgation. Units on the Registry may be replaced with outdoor wood boilers with an EPA Phase 2 qualified wood pellet outdoor wood boiler. New EPA Phase 2 units may be sold in attainment areas.

The rule also prohibits the burning of waste and hazardous materials, establishes a 20% opacity limit and prohibits burning during restricted burning days.

**Federal Regulation or Guidance:** EPA published the residential wood burning NSPS on February 3, 2015. The NSPS included a PM emission limit for outdoor wood boilers however, the NSPS does not resolve the issues that may lead outdoor boilers to cause nuisance emissions.

### Comparison of Other State Rules:

- ❖ Outdoor wood boilers have been banned in 16 towns in Connecticut – Rocky Hill, Granby, Tolland, Hebron, Woodbridge, South Windsor, Portland, Norfolk, Ridgefield, Haddam, Cheshire, West Hartford, Hamden, North Haven, New Fairfield and Avon.
- ❖ Manufacturers who wish to sell wood-fired hydronic heaters in Washington State must have the device tested using EPA Method 28 WHH or ASTM E2618 but using Douglas fir test fuel; and submit test results to the State showing the device emits no more than 4.5 grams of fine particles per hour. This rate limit applies to both the annual average emissions and the highest individual test run emissions.

- ❖ Maine Department of Environmental Protection Chapter 150: Control of Emissions from Outdoor Wood Boilers, establishes a particulate matter emission limit of 0.60 lbs/MMBtu heat input, setback and stack height limits.

**BACM Conclusion:** Some Connecticut towns have also banned new sales. The remaining state rules are less stringent than R307-208.

Any replacement unit permitting under R307-208 would have to meet the NSPS. UDAQ estimates that there are less than 50 outdoor wood burning units in the nonattainment area. This estimate is based on the number of people who attended the two public hearings held during the R307-208 public comment period.

There are no opportunities beyond the current ban that would lead to further emission reductions.

R307-302 Solid Fuel Burning Devices: Residential fireplaces and wood stoves contribute PM emissions to the atmosphere. To minimize the amount of emissions from these devices, they are regulated by an opacity standard. When operated properly, these devices will produce visible emissions of less than 20% opacity from the chimney or smoke stack. The proper operation of these devices is required to meet the visible emission standard of 20% opacity during normal operation. The 20% opacity limit applies at all times except for an initial start-up period of 15 minutes and a 15 minute period in any three hour period for reloading the device.

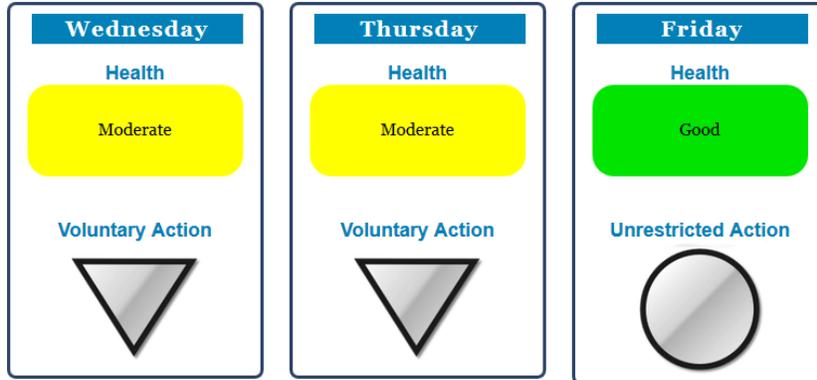
UDAQ issues mandatory no burn actions when PM<sub>2.5</sub> levels build up to unhealthy levels during winter inversions. The no-burn period extends from November 1st to March 1st. R307-302 prohibit residents from burning wood or coal on no burn days. The Division reports current action levels twice a day to local media outlets such as newspapers, TV, and radio stations. The Division posts action levels on its Web site. Residents can register to receive free e-mail air quality alerts or download the UtahAir app for Androids (Google Play) and iPhones (Apple Apps store, coming soon) to get the latest information on current conditions and air quality actions by county.

UDAQ Web Page Forecast

Salt Lake County—3 Day Forecast

Box Elder Cache Carbon Davis Duchesne Salt Lake Tooele Uintah Utah Washington Weber

Last Updated: December 14, 2016 9:52 AM



Individuals are asked to voluntarily not use solid fuel burning devices, reduce/stop open burning, and reduce vehicle use by consolidating trips. Salt Lake County prohibits burning solid fuel in fireplaces or wood burning stoves and bans outdoor fires (including bonfires, patio pits and charcoal grill fires) on days that the State of Utah designates as either mandatory or voluntary air action (no burn) days. [Salt Lake County Health Regulation 35](#)

**Explanation**

The forecast indicates the highest pollution level of the day. During the **summer**, Ozone pollution levels are generally low during the morning, evening and night. During the winter, particulate matter (i.e., PM 2.5) pollution levels build up until a storm or weather system moves the air out of the valley.

The **health forecast** helps to determine how the highest pollution level of the day will affect people with various health conditions. Click on the "Health Forecast" legend to plan your physical activity to help minimize the effects of pollution on your health.

The **action forecast** notifies the public of the voluntary or mandatory actions (e.g., carpooling, wood burning) they need to adhere to for the current pollution levels. Click on the "Action Forecast" legend for a description of the action regulations.

**Action Forecast**

- Unrestricted Action 
- Voluntary Action 
- Mandatory Action 

**Health Forecast**

Air Quality Index (AQI)	PM 2.5	Ozone
Good	0 - 12.0 µg/m <sup>3</sup>	0 - 0.054 ppm
Moderate	12.1 - 35.4 µg/m <sup>3</sup>	0.055 - 0.070 ppm
Unhealthy for Sensitive Groups	35.5 - 55.4 µg/m <sup>3</sup>	0.071 - 0.085 ppm
Unhealthy	55.5 - 150.4 µg/m <sup>3</sup>	0.086 - 0.105 ppm
Very Unhealthy	150.5 - 250.4 µg/m <sup>3</sup>	0.106 - 0.200 ppm
Hazardous	Above 250.5 µg/m <sup>3</sup>	Above 0.201 ppm

Based on a 24-hour average. Based on an 8-hour average.

No solid fuel burning devices (including EPA certified units) are allowed to burn during a mandatory action period unless the device was registered as a sole source of heating for the residence with the Division.

Mandatory no burn days are called when the PM<sub>2.5</sub> levels are forecasted to reach or exceed 25 µg/m<sup>3</sup>.

The rule also includes prohibition on burning waste and hazardous materials.

Further, the rule mandates that all solid fuel burning devices sold in the nonattainment area must meet the residential wood burning NSPS requirements. The exemptions in the new NSPS are therefore not carried over into R307-302.

**Federal Regulation or Guidance:** New Source Performance Standards for Residential Wood Heaters applies emission rating for solid fuel combustion devices.

**Comparison of Other State Rules:** SJ Rule 4901, Wood Burning Fireplaces and Wood Burning Heaters was evaluated and compared to R302-302. There are many similarities in the way the Rule 4901 and R307-302 are structured. The no burn thresholds are both based on forecasted  $PM_{2.5}$  levels. Rule 4901 no burn threshold is a range in which the low point is set at  $20 \mu\text{g}/\text{m}^3$  with an allowable exemption for EPA certified wood stoves that have been inspected and registered with SJ. The no burn threshold in R307-302 is set at  $25 \mu\text{g}/\text{m}^3$  but there is no exemption for any wood stoves therefore, R307-302 is more stringent in that regard.

R307-302 permits a real estate transfer containing a non EPA certified stove within a residential dwelling that was installed prior to March 6, 2014 so long as the unit remains intact within the real property of sale. Rule 4901 does not permit real estate transfer containing a wood stove unless the wood stove is an EPA Phase II or better under a current NSPS, is a pellet stove exempt from EPA certification or is rendered inoperable. Rule 4901 is more stringent in this regard.

**BACM Conclusion:** Overall, R307-302 is more stringent because there is no exemption from the NSPS, nor does it exempt EPA certified stoves.

An area of improvement to R307-302 may be to consider a requirement to remove non-EPA certified stoves during real estate transactions, although that is likely beyond BACM.

**R307-303 Commercial Cooking:** R307-303 was promulgated as RACT for chain-driven charbroilers, which are predominately found in large fast food restaurant chains. Other cooking methods using underfire charbroilers and flat griddles account for more of the  $PM_{2.5}$  emissions from commercial cooking, but were not included in R307-303 because current control technology options are limited for these types of cooking and carry extreme cost. Emission control cost to control underfire cooking range from approximately \$10-40K/ton, depending on the selected technology with capital cost that range from \$30-70K (SC restaurant emission analysis study, August 2009).



Chain-driven Charbroiler

**Federal Regulation or Guidance:** None

**Comparison of Other State Rules:**

- ❖ Bay Area Air Quality Management District Regulation 6, Rule 2, Commercial Cooking Equipment. This rule applies to chain-driven charbroiler in a restaurant

Salt Lake Area Source BACM

that purchases 500 pounds of beef or more per week or an under-fired charbroiler in a restaurant that purchases 1,000 pounds of beef or more per week and an aggregate grill surface area of ten square feet or more. The rule targets PM<sub>10</sub> emission reduction.

R307-303 is intended to reduce direct PM<sub>2.5</sub> and VOC and applies to all commercial chain-driven charbroilers. Consequently, R307-303 is more stringent as it relates to this SIP.

- ❖ SC Rule 1138, Control of Emissions from Restaurant Operations. This rule is intended on controlling PM<sub>10</sub> and VOC emissions. Rule 1138 requires all chain-driven charbroilers that are used to cook 400 pounds or more meat per week must install a catalytic oxidizer.

R307-303 is more stringent than Rule 1138 because it applies to all chain-driven charbroilers.

- ❖ Ventura County Rule 74.25, Restaurant Cooking Operations. The rule requires the same level of control as R307-303 but provides exemptions that are not included in R307-303; therefore, R307-303 is more stringent

**BACM Conclusion:** There are no current opportunities for additional program revisions that would lead to further emission reductions.

R307-307 Road Salting & Sanding: The purpose of this rule is to establish emission control for winter time road salting. This is an existing rule that was part of the PM<sub>10</sub> SIP (Section IX, Part A, Page 57) that was approved by EPA on December 6, 1999 (64 FR 68031). A RACT analysis was conducted as part of that SIP. The rule was amended by expanding the applicability to include PM<sub>2.5</sub> nonattainment areas as part of the moderate PM<sub>2.5</sub> SIP. The actual PM emission reduction is unknown however, past UDAQ studies have indicated that road salt plays a minimal role related to this SIP. Consequently, no further analysis is warranted.

R307-309 Fugitive Emissions & Fugitive Dust: Establishes minimum work practices and emission standards for sources of fugitive emissions and dust. The rule applies to all construction and soil disturbance for areas greater than ¼ acre, requires BMP's for mining, sand & gravel processes and other types of fugitive dust generating activities. Sources must file a dust control plan using the DAQ form (online dust plan development tool) before commencing dust generating activities.

**Federal Regulation or Guidance:** None

**BACM Analysis:**

DAQ conducted a thorough analysis of the UDAQ fugitive dust program that included:

- ❖ A review of other arid western non-attainment air district fugitive dust rules
- ❖ Options described in the WRAP Fugitive Dust Handbook
- ❖ Internal UDAQ engineering and inspectors insights.

The following table provides a summary of the analysis.

Requirement	Utah	Nevada	Washoe County, NV	Clark County, NV	Maricopa, AZ	South Coast, CA	San Joaquin Valley, CA
Construction & Excavation (acreage)	0.25	5 construction 1 acre soil clearing	1	0.25	0.1	5	10 res./5 non-res.
Demolition	√	√	√	1,000 Sq. Ft.	√	5 acres or 100 cu. Yd.	5 acres or 100 cu. Yd.
Trenching	-	-	-	100 ft.	-	-	-
Bulk Materials Transport	√	√	√	√	√	√	√
Carryout and Trackout	√	-	√		√	√	√
Open Areas Disturbance	√	-	√	√	√	√	√
Unpaved Vehicle & Equipment Traffic Areas	√	√	√	√	√	√	√
Material Handling	√	√	√	√	√	√	√
Storage Piles	√	√	√	√	√	√	√
Mineral Processing Operations	√	-	√	√	√	√	√
Opacity limits (%) (property boundary – onsite)	10 -20%	20%	0	0	0 -20%	0 – 20%	20%
Additional activity specific requirements	√	-	√	√	√	√	-
Wind Event Requirements	√	-	√+	√+	√+	√	√
PM10 Classification	Moderate	Unclassifiable	Maintenance	Serious	Moderate	Moderate	Attain

The outcomes of the analysis indicate that there are similarities between R307-309 and other state rules, especially the Clark County rule because it also requires use of established fugitive control best management practices (BMP's).

## Salt Lake Area Source BACM

The most significant rule revision to R307-309 was the development and requirement of BMPs. Two BMPs are required of every plan, BMP 09 and 19 on the following table. These were determined to be most problematic for both air and stormwater due to soil disturbance projects. The following table shows the BMPs in the rule that address all fugitive dust source types.

BMP	Project Activity	Check All That Apply
01	Backfilling filling area previously excavated or trenched.	
02	Blasting soil & rock, explosive blasting of soil and rock – drilling and blasting.	
03	Clearing & grubbing, clearing and grubbing for site preparation and vacant land cleanup.	
04	Clearing forms, foundations, slab clearing and cleaning of forms, foundations and slabs prior to pouring concrete.	
05	Crushing of construction and demolition debris, rock and soil. Screening of rock, soil or construction debris.	
06	Cut and/or fill cut and/or fill soils for site grade preparation.	
07	Demolition – implosion, Implosive demolition of a structure, using explosives.	
08	Demolition - mechanical/manual demolition of walls, stucco, concrete, freestanding structures, buildings and other structures.	
<b>09</b>	<b>Disturbed Soil THIS ACTIVITY MUST BE SELECTED FOR ALL PROJECTS.</b>	X
10	Disturbed land - long term stabilization and erosion control of large tracts of disturbed land that will not have continuing activity for more than 30 days.	
11	Dust suppressants - selection and use of chemical and organic dust suppressing agents and other chemical stabilizers.	
12	Hauling materials.	
13	Mining and reclamation operations.	
14	Paving/subgrade preparation for paving streets, parking lots, etc.	
15	Sawing/cutting material, sawing or cutting materials concrete, asphalt, block or pipe.	
16	Staging areas, equipment storage, vehicle parking lots, and material storage areas.	
17	Stockpiles materials (storage), other soils, rock or debris, for future use or export.	
18	Tailings piles, ponds and erosion control.	
<b>19</b>	<b>Trackout Prevention and Cleanup THIS ACTIVITY MUST BE SELECTED FOR ALL PROJECTS.</b>	X
20	Traffic - unpaved routes and parking, construction related traffic on unpaved interior and/or access roads and unpaved employee/worker parking areas.	
21	Trenching with track or wheel mounted excavator, shovel, backhoe or trencher.	
22	Truck loading with materials including construction and demolition debris, rock and soil.	

**BACM Conclusion:** There are no current opportunities for additional program revisions that would lead to further emission reductions.

## VOC BACM Assessment

Source Category	Source Category Code	Utah Existing Rules/Statute and Federal Rules	Comments	2014 Uncontrolled Inventory Tons/winter Week Day
Surface Coatings, Architectural	2401001000	R307-361 Architectural Coatings		5.38
Solvent, Consumer Use Household Products	2460200000	R307-357 Consumer Products		5.33
Solvent, Consumer Use Personal Care Products	2460100000	R307-357 Consumer Products		4.85
Pesticide Application, Commercial/Consumer (FIFRA)	2460800000	R307-357 Consumer Products		4.31
Solvent Degreasing	2415	R307-304 Solvent Cleaning R307-335 Degreasing		4.35
Solvent, Consumer Use Auto Aftermarket	2460400000	R307-357 Consumer Products		3.30
Combustion, Wood, All Devices	2104008320 2104008310 2104008330 2104008400 2102008000 2104008100 2103008000 2104008610 2104008210 2104008220 2104008510 2104008230 2104008700	R307-302 Solid Fuel Burning Devices		2.63
Solvent, Consumer Use Coatings	2460500000	R357 Consumer Products		2.30
Solvent, Consumer Use Adhesive & Sealants	2460500000	R307-357 Consumer Products		2.30
Solvent, Consumer Use Coatings	2460500000	R307-357 Consumer Products		2.30
Surface Coatings, High Performance Maintenance and Transportation	2401055000 2401200000 2401070000	R307-350 Miscellaneous Metal Parts & Products Coating		2.18
Solvent, Graphic Arts	2425000000	R307-351 Graphic Arts		1.23
Surface Coatings, Autobody Refinishing	2401005000	R307-354 Auto Body Refinishing		1.15
Surface Coatings, Wood Furniture and Fixtures	2401020000	R307-343 Emissions Standards for Wood Furniture Manufacturing Operations		1.13
Fuel Gas/Gasohol Pipelines	2505040120	40 CFR 49 Subtitle B	U.S. Dept. of Transportation is responsible for pipeline safety and spill prevention	1.10
Bakery Yeast	2302050000		Estimated to cost at least \$19,000/ton, requires double-walled stainless steel stack plus catalytic oxidation of ethanol. High capitol cost would require a rule with high applicability threshold that would preclude regulating most bakeries that comprise these emissions.	0.85
Fuel Gas/Gasohol Under Ground Storage Tank	2501060201	DAQ enforces Federal UST regulations		0.84
Surface Coatings, Metal Furniture	2401025	R307-346 Metal Furniture Surface Coating		0.78

## Salt Lake Area Source BACM

Source Category	Source Category Code	Utah Existing Rules/Statute and Federal Rules	Comments	2014 Uncontrolled Inventory Tons/winter Week Day
Residential & Commercial Portable Gas Cans Evaporation/Spillage etc.	2501011011 2501011012 2501011013 2501011014 2501011015 2501012011 2501012012 2501012013 2501012014 2501011015 2501012011 2501012012 2501012013 2501012014 2501012015	40 CFR Part 59, Subpart F, Control of Evap. Emission from New & In-use Portable Fuel Containers		0.72
Fuel Gas/Gasohol Bulk Plants	2501055120	R307-328 Gasoline Transfer and Storage		0.70
Fuel Gas/Gasohol Bulk Plants	2501055120	R307-328 Gasoline Transfer and Storage		0.70
Combustion, Natural Gas, Residential	2104006000	R307-356 Appliance Pilot Light		0.69
Leaking Underground Storage Tanks	266000000	Title 19 Chapter 6 Part 4 Underground Storage Tank Act		0.62
Cutback Asphalt Paving	2461021000	R307-341 Cutback Asphalt		0.38
Surface Coatings, Metal Containers	240104000	R307-352 Metal Containers, Closure & Coil Coating		0.32
Fuel Gas/Gasohol Stage 1	2501060050	R307-328 Gasoline Transfer and Storage		0.25
Surface Coatings, Paper, Film, and Foil	2401030000	R307-344 Paper, Film & Foil Coating		0.16
Landfills	262003	R307-221 Emission Standards: Emission Controls for Existing Municipal Solid Waste Landfills		0.14
Commercial Cooking	2302002200 2302003000 2302003100 2302003200		Current rules only apply to very large sources due to extreme cost (at least \$15K/ton) Prohibitive cost would shutter most sources.	0.14
Combustion, Natural Gas, Commercial & Institutional	2103006	R307-356 Appliance Pilot Light		0.14
Surface Coatings, Machinery	2401055000	R307-350 Miscellaneous Metal Parts & Products Coating		0.13
Surface Coatings, Traffic Markings	240100800	R307-361 Architectural Coatings		0.12
Fuel, Jet, Stage 1	2501080050		Not technically feasible for jet fuel due to low vapor pressure (0.125 psi)	0.09
Surface Coatings, Aircraft	2401075000	R307-355 Control of Emissions from Aerospace Manufacture & Rework Facilities		0.08
Surface Coatings, Factory Finished Wood	2401015000	R307-349 Flat Wood Panel Coating		0.05
Fuel Gas/Gasohol Tank Truck Transport	2505030120	R307-328 Gasoline Transfer and Storage		0.05
Combustion, Natural Gas, Industrial	2102006	R307-312 Aggregate Processing Operations		0.04

## Salt Lake Area Source BACM

Source Category	Source Category Code	Utah Existing Rules/Statute and Federal Rules	Comments	2014 Uncontrolled Inventory Tons/winter Week Day
Surface Coatings, Electrical	2401065000	R307-348 Magnet Wire Coating		0.04
Backyard BBQ	2810025000		Statutory exemption	0.03
Commercial Cooking, Chain-Driven Charbroiler	2302002100	R037-303 Commercial Cooking		0.03
Sewer Treatment in Publicly Owned Treatment Works (POTW)	263002	Clean Water Act: all POTW's have to report to EPA VOC concentrations in discharges.	All major POTW's meet Best Available Technology	0.03
Fuel, Jet, Stage 2	25010801		Not technically feasible for jet fuel due to low vapor pressure (0.125 psi)	0.02
Surface Coatings, Railroad	2401085000	R307-350 Miscellaneous Metal Parts & Products Coating		0.002
Surface Coatings, Other Special Purpose	2401200	R307-353 Plastic Parts Coatings		0.01
Surface Coatings, Other Special Purpose	2401200	R307-350 Miscellaneous Metal Parts & Products Coating		0.01
Surface Coatings, Marine	2401080000	R307-350 Miscellaneous Metal Parts & Products Coating R307-353 Plastic Parts Coating		0.01
Solvent, Dry Cleaning	2420		Solvent dry cleaners use no transfer machines that eliminate vapor loss during transfer from washing to drying. Additional built-in controls include refrigerated condensers. Some units also include built-in stills to further recover vapors. No further controls would be feasible.	0.01
Combustion, LPG	2102007 2104007		Only controls developed for LPG combustion are to reduce NOx emissions (EPA AP 42, Section 1.5)	0.01
Fires, Structural	281005		Uncontrollable	0.005
Fires, Vehicle	281005		Uncontrollable	0.005
Surface Coatings, Appliances	2401060000	R307-347 Large Appliance Surface Coating		0.002
Tank Cleaning	246116	R307-304 Solvent Cleaning		4.7 x 10 <sup>-4</sup>
Combustion, Oil	2104004 2102005		EPA-600/2-75-069-a Guidelines for Residential Oil-Burner Adjustments Procedures to Minimize Air Pollution	3.2 x 10 <sup>-4</sup>
Cremation, Human	28100601		Catalytic oxidizer control cost would readily exceed \$15,000/ton	3.2 x 10 <sup>-5</sup>
Combustion, Kerosene	2103011000		No known control	1.8 x 10 <sup>-5</sup>

## VOC Source Category Analysis

R307-221 Emission Standards: Emission Controls for Existing Municipal Solid Waste Landfills: The rule is intended to meet federal requirements noted below. Large landfills must reduce non-methane organic compounds by 98%.

**Federal Regulation or Guidance:** 42 U.S.C. 7411(d) and 40 CFR 60.30c – 60.36c. There are no further rule enhancements.

R307-304 Solvent Cleaning: R307-304 was adopted in 2017, which was originally part of the degreasing rule R307-335. UDAQ amended R307-335 by removing the Industrial Solvent Cleaning sections R307-335-7 and 8 from R307-335. UDAQ believes that we can achieve greater VOC emission control by including the former industrial solvent cleaning sections into a new solvent use rule. The requirements for R307-335-7 were derived from the EPA guidance for industrial solvent cleaning (EPA 453/R-06-001). EPA recommends that states set industrial solvent cleaning rule applicability at 15 lbs. of VOCs/day or approximately 720 gallons of solvent/yr. R307-304 provides a lower applicability threshold for gallons of solvent used than R307-335-7. R307-304 applies to all industrial solvent usage of 55 gallons or more in any 12 month period.

**Federal Regulation or Guidance:** Control Techniques Guidelines for Industrial Cleaning Solvents.

**Comparison of Other State Rules:** UDAQ's analysis of various state and air district rules that regulate industrial solvent cleaning indicates that most apply aqueous-based solvent cleaning limits based on density, which greatly limits solvent options.

- ❖ SJ Rule 4663, Organic Solvent Cleaning, Storage, and Disposal.  
Requires aqueous-based solvent cleaning with an applicability set at 55 gallons or more of solvent products in any consecutive 12 month period. Rule 4663 is the most stringent rule that UDAQ could identify that solely regulates industrial cleaning activities.
- ❖ SC Rule 1171 Solvent Cleaning Operations.  
The rule casts a wider net by including cleaning of many source types, including coating operations. SJ regulates coating sources and their cleaning requirements in separate coating rules, therefore Rule 1171 is not directly comparable to R307-304.
- ❖ Sacramento Rule 466, Solvent Cleaning.  
This rule is similar to SJ Rule 4663.

**BACM Conclusion:** The R307-304 rule applicability of 55 gallons in a calendar year (0.15 gallon/day) essentially regulates most industrial solvent cleaning and usage within

the nonattainment area that are not already regulated under industry specific coating rules.

The use of vapor pressure instead of a density based limit offers more solvent options while reducing evaporative losses, therefore is a preferred approach to limit VOC emissions.

No further reduction opportunities were identified for R307-304.

R307-328 Gasoline Transfer and Storage: Establishes emission controls for gasoline vapors during filling of gasoline cargo tank and storage tanks state-wide. The rule is based on the federal stage I vapor recovery guidance.

**Federal Regulation or Guidance:** Control of Hydrocarbons from Tank Truck Gasoline Loading Terminals.

**Comparison of Other State Rules and BACM Conclusion:** SJ Rule 4621, Gasoline Transfer into Stationary Storage Containers, Delivery Vessels, and Bulk Plants was reviewed and no further emission reduction opportunities were found.

R307-335 Degreasing: Provides VOC emission control for large degreasing equipment. The rule was based on the EPA degreasing CTG. Large degreasing equipment have been phased out over the years such that we believe there are few left to regulate.

**Federal Regulation or Guidance:** Control of Volatile Organic Emissions from Solvent Metal Cleaning.

**Comparison of Other State Rules and BACM Conclusion:** SJ Rule 4662, Sacramento Rule 454 and Ventura Rule 74.6.1 were reviewed and no further reduction opportunities were identified.

R307-341 Cutback Asphalt: Cutback asphalt is a bituminous coating that has been thinned with a petroleum distillate so that it may be applied without heat or low heat. Cutback is used during winter months to conduct road repair when asphalt manufacturing plants are not operating. R307-341 limits the oil distillate content to 7%. Cutback is normally formulated with 10-40% of petroleum distillate in order to reduce the viscosity so that it is malleable.

**Federal Regulation or Guidance:** Control of Volatile Organic Emissions from Use of Cutback Asphalt.

**Comparison of Other State Rules:**

- ❖ The Colorado Department of Public Health and Environment Regulation Number 7 XI permits the use of cutback asphalt during winter months without limiting the organic content.
  
- ❖ SJ Rule 4641, Cutback, Slow Cure, and Emulsified Asphalt, Paving and Maintenance Operations permits up to 5% organic compounds.

**BACM Conclusion:** UDAQ consulted with Asphalt Emulsion Industries, a manufacturer of cutback, to determine whether it is feasible to reduce the petroleum distillate to 5%. A representative of the company stated that while special formulations down to 5% can be made, they do not recommend doing so for safety reasons. When the organic content is lowered to that extent, the product must be heated to 160 degrees Fahrenheit to increase the malleable, which can result in product fuming and possible flaming. Consideration must also be given to local winter time temperatures and its influence on product malleability. Consequently, there is no further emission reduction opportunity.

R307-342 Adhesive and Sealants: UDAQ adopted the most current Ozone Transport Commission (OTC) model rule. The model rule achieves VOC reductions through two basic components: sale and manufacture restrictions that limit the VOC content of specified adhesives, sealants and primers sold in the state; and use restrictions that apply primarily to commercial/industrial applications.

A reasonably available control technology determination prepared by the California Air Resources Board (CARB) in 1998 forms the basis of this model rule. In the years 1998-2001, the provisions of the CARB determination were adopted in regulatory form in various air pollution control districts in California including the Bay Area, Ventura County, Sacramento Metropolitan and San Joaquin Valley.

**Federal Regulation or Guidance:** None

**Comparison of Other State Rules:**

- ❖ SJ Rule 4653, Adhesives and Sealants is comparable to R307-342.
  
- ❖ SC Rule 1168, Adhesives and Sealants Applications contain more stringent VOC limits for some adhesive specific categories.

**BACM Conclusion:** The OTC is a multi-state organization created under the Clean Air Act in order to advise EPA on transport issues and for developing and implementing regional solutions to the ground-level ozone problem in the Northeast and Mid-Atlantic regions. The model rules developed by the OTC are relevant for secondary PM formation.

The OTC states work together on model rules and programs through three standing committees, organized by source category and/or function. Model rules are developed through a rigorous process that includes input from all stakeholders. The advantages of

a model rule is the assurance that the rule limits have been thoroughly evaluated and the continuity offered across states and regions that afford regulatory stability to manufacturers. It is for these reasons that UDAQ believes it is prudent to reserve future rule amendments to OTC model rule updates.

### Coating Rules

*Coating rule strengthening:* the Air Quality Board has approved amendments in 2017 to strengthen the following coating rules:

- ❖ R307-343. Emissions Standards for Wood Furniture Manufacturing Operations
- ❖ R307-344. Paper, Film, and Foil Coatings
- ❖ R307-345. Fabric and Vinyl Coatings
- ❖ R307-346. Metal Furniture Surface Coatings
- ❖ R307-347. Large Appliance Surface Coatings
- ❖ R307-349. Flat Wood Panel Coatings
- ❖ R307-350. Miscellaneous Metal Parts and Products Coatings
- ❖ R307-352. Metal Container, Closure, and Coil Coatings
- ❖ R307-353. Plastic Parts Coatings
- ❖ R307-354. Automotive Refinishing Coatings

The applicability thresholds were reduced from 2.7 tpy potential to emit to 20 gallons or more of VOC containing coatings and solvent usage combined per year. The 20 gallon threshold was derived after a review of SJ and SC comparable coating rules. The applicability thresholds for these air district rules ranged widely; from applying to all commercial/industrial sources to 55 gallons. UDAQ believes that a 20 gallon applicability threshold discriminates between homeowners and hobbyists who conduct coating operations from commercial/industrial sources.

R307-348. Magnet Wire Coatings applicability threshold was reduced from 2.7 tpy potential to emit to 2 tpy based on the BACM analysis where R307-348 was compared to the South Coast Rule 1126.

*Cleaning solvent limit:* rules R307-343 through R307-347 and R307-349 through R307-353 contain a cleaning solvent VOC limit of 0.21 lb/gal. This limit was adopted from certain California air district rules and guidance as part of the RACT rulemaking for the moderate PM<sub>2.5</sub> SIP in an aggressive attempt to attain the standard. This extreme VOC content limit for cleaning solutions precludes the use of any organic solvent but acetone. Acetone is not a universal solvent and is incompatible with many coating formulations. That is to say that acetone does not uniformly dissolve all coating materials so that it does not meet all cleaning requirements. An example of this limitation is explained in EPA's guidance (EPA 453/R-07-003) for coating on paper, film and foil, where EPA states, "little information is available regarding the types of low-VOC or VOC-free cleaning materials that could be used in the paper, film, and foil surface coating industry." Similarly, EPA states in its miscellaneous metals and plastic coating guidance (EPA-453/R-08-003), "cleaning materials with low VOC content would generate less VOC emissions than materials with high VOC content, but may not be feasible with the

broad range of coatings used in the miscellaneous metal product and plastic parts surface coating facilities.”

Additional concerns have been raised regarding possible equipment damage, such as rusting, by using aqueous based solutions.

The most serious concern is the extremely low flash point of acetone that could result in a fire hazard. Related to this is the rapid evaporation of acetone that limits its use in many cleaning operations and rapid drying of coatings.

These technical limitations clearly indicate that it was an over reach to use a 0.21 lb/gal VOC cleaning solvent limit for a RACT rule. In conducting our BACM analysis, we find the same technical limitations and no cost-effective alternatives to acetone. Parachlorobenzotrifluoride (PCBTF) is a VOC exempt chemical that is marketed as an alternative to VOC solvents. UDAQ requested PCBTF usage information from a host of coating sources and industry trade associations. We were unable to locate any use of PCBTF, predominately due to cost. The retail cost of a gallon of PCBTF is \$60, more than the cost of a gallon of a coating product.

A convincing argument can also be made that the 0.21 lb/gal VOC content limit is even beyond the most stringent measure (MSM) because MSM is defined as a control measure that has been reliably implemented and cost-effective. Since one aqueous limit cannot meet all coating solvent cleaning requirements, it fails to meet the reliability test.

Setting a solvent cleaning limit based on vapor pressure is a more appropriate approach and is consistent with EPA guidance. This approach expands the chemical formulation options while reducing evaporative losses from cleaning operations. All density based solvent cleaning limits have been replaced with vapor pressure limits corresponding to industry specific EPA guidance. In the absence of an EPA industry specific vapor pressure recommendation, 1 mm Hg at 20 degrees Celsius was applied based on the following rationale:

EPA determined that the “cleaning materials with VOC composite vapor pressure less than 10 millimeters of mercury (mm Hg) at 20 °C when used in conjunction with good work practices achieve a comparable emission reduction to cleaning materials containing 30 weight percent VOC (EPA-453/R-06-002, pg 12).” This ratio means that the 0.21 lb/gal is comparable to 1 mm Hg as follows:

Assuming VOC average solution weights 7 lb/gal, 0.21 lb/gal is equal to 3% VOC;

If 10 mm Hg vapor pressure is equal to 30% VOC, than 1 mm Hg is equal to 3% VOC.

R307-343 Emissions Standards for Wood Furniture Manufacturing Operations: The coating categories in R307-343 were updated in 2017 to the current types of coatings used in the industry. Polyurethanes were also included as new categories that previously fell under the topcoat or sealer category.

The VOC limits for the 2 component polyurethanes were slightly elevated from 0.9 to 1.0 lb VOC/lb solids because of the difficulty of transferring these viscous coatings to the wood surface under the previous VOC limit. UDAQ worked with the coating industry to derive the lowest workable VOC limits for these categories. We expect to mitigate the slight increase in VOC's from polyurethanes by lowering the rule applicability to 20 gallons/yr. We estimate that 75 sources throughout the 7 nonattainment counties were subject to the pre-2017 rule amendment. Reducing the applicability to 20 gallons/yr regulates an additional 191 sources within the 7 nonattainment counties with an estimated VOC emissions of 116 tpy.

**Federal Regulation or Guidance:** Control of Volatile Organic Compound Emissions from Wood Furniture Manufacturing Operations applies.

**Comparison of Other State Rules and BACM Conclusion:** The coating limits in R307-343 were reduced by half in January 1, 2015 and are more stringent than comparable rules SJ Rule 4606 and SC Rule 1136. Consequently, R307-343 is the most stringent measure available for this industry.

R307-344 Paper, Film & Foil Coating:

**Federal Regulation or Guidance:** Control Techniques Guidelines for Paper, Film, and Foil Coatings.

**Comparison of Other State Rules and BACM Conclusion:** SJ Rule 4607 and SC Rule 1128 were reviewed and were found to be comparable to R307-344

The Ventura County Rule 74.3 applies to all sources, but the coating limits in Rule 74.3 are an order of magnitude higher than those in R307-344.

The coating limits in R307-344 are extremely low, such that no further emission reduction opportunity exists based on the rule comparisons.

R307-345 Fabric & Vinyl Coating:

**Federal Regulation or Guidance:** Control of Volatile Organic Emissions from Existing Stationary Sources – Volume II: Surface Coating of Cans, Coils, Paper, Fabrics, Automobiles, and Light-Duty Trucks applies.

**Comparison of Other State Rules and BACM Conclusion:** SJ Rule 4607 and SC Rule 1128 were reviewed and no further emission reduction opportunity exists.

R307-346 Metal Furniture Surface Coating:

**Federal Regulation or Guidance:** Control Techniques Guidelines for Metal Furniture Coatings applies.

**Comparison of Other State Rules and BACM Conclusion:** SJ Rule 4603, SC Rule 1107 and Sacramento Rule 451 are comparable except that the applicability of R307-346 is stricter than Sacramento Rule 451. No further emission reduction opportunity exists.

R307-347 Large Appliance Surface Coating:

**Federal Regulation or Guidance:** Control Techniques Guidelines for Large Appliance Coatings applies.

**Comparison of Other State Rules and BACM Conclusion:** SJ Rule 4603 and SC Rule 1107 were reviewed and no further emission reduction opportunity exists.

R307-348 Magnet Wire Coating:

**Federal Regulation or Guidance:** Control of Volatile Organic Emissions from Existing Stationary Sources – Volume IV: Surface Coating of Insulation of Magnet Wire applies.

**Comparison of Other State Rules and BACM Conclusion:** SC Rule 1126 was reviewed and no further emission reduction opportunity exists.

R307-349 Flat Wood Panel Coating:

**Federal Regulation or Guidance:** Control Techniques Guidelines for Flat Wood Paneling Coatings applies.

**Comparison of Other State Rules and BACM Conclusion:**

- ❖ SJ Rule 4606 and SC Rule 1104 are comparable to R307-349
- ❖ Sacramento Rule 463, Wood Products Coatings is not a directly comparable to R307-349 because it broadly applies to many types of wood manufacturing. The rule has tighter VOC limits than R307-349 and exempts sources that use less than 55 gallons/yr., which is higher than the 20 gallon applicability of R307-349.
- ❖ Ventura Rule 74.30 is comparable to Sacramento Rule 463 with the exception that Rule 74.30 exempts sources below 200 gallons.

No further emission reduction opportunity exists.

R307-350 Miscellaneous Metal Parts & Products Coating:

**Federal Regulation or Guidance:** Control Techniques Guidelines for Miscellaneous Metal and Plastic Parts Coatings applies.

**Comparison of Other State Rules and BACM Conclusion:** SC Rule 1107, Sacramento Rule 451 and Ventura Rule 74.12 were reviewed and are comparable to R307-350.

Rule 451 is less stringent than R307-350 because it exempts sources less than 55 gallons. No further emission reduction opportunity exists.

Rule 74.12 is less stringent than R307-350 because it exempts sources less than 200 gallons.

No further emission reduction opportunity exists.

R307-351 Graphic Arts:

**Federal Regulation or Guidance:** Control of Volatile Organic Emissions from Existing Stationary Sources – Volume VIII: Graphic Arts-Rotogravure and Flexography, Control Techniques Guidelines for Offset Lithographic Printing and Letterpress Printing, Control Techniques Guidelines for Flexible Package Printing and Control of Volatile Organic Compound Emissions from Offset Lithographic Printing.

**Comparison of Other State Rules and BACM Conclusion:** Graphic art control measures were established under the original coating rule R307-340 that dated back to the ozone SIP. The rule applicability was original set at 100 tons/yr for graphic arts. R307-340 was replaced by separate industry specific coating rules during the moderate PM<sub>2.5</sub> SIP and the graphic arts section became R307-351. The rule applicability in R307-351 was set at 25 tons/yr as per the recommendations in the CTG's.

A review of 7 California air district rules indicates that all of those rules apply to more sources than R307-351 and that the California rules require more conservative VOC limits.

- South Coast Air Quality Management District Rule 1130- applies to sources that emit to 10 tons/yr.
- San Joaquin Valley Air Pollution Control District Rule 4607-applies to sources that emit 200 lb/yr.
- Bay Area Air Quality Management District Regulation 8 Rule 20-applies to sources that emit 0.5 ton/year.
- Santa Barbara County Rule 354-applies to sources that emit 1.8 ton/year.

- San Diego County Rule 67.16-applies to sources that emit 2.7 ton/year.
- Ventura Rule 74.19-applies to sources that emit 200 lb/yr.
- Sacramento Metro Rule 450-applies to sources that emit 720 lb/yr.

UDAQ has revised the rule applicability to 450 gallons/yr, which is comparable to 1 ton/yr. This level was chosen based on consultation with the American Printing Association, which stated that sources below 1 ton/yr could not likely absorb the cost.

Further, UDAQ has completely revised this complex rule. The new rule was modeled after the simpler format in SC Rule 1130. The VOC limits for ink products and fountain solutions were reduced to the levels found in SC Rule 1130.

The solvent cleaning VOC limit has been tightened to include a vapor pressure limit in accordance with the EPA recommendation in the lithographic CTG and a reduction in VOC by weight.

The resulting rule revision is estimated to reduce VOC's by 69%.

#### R307-352 Metal Containers, Closure & Coil Coating:

**Federal Regulation or Guidance:** Control of Volatile Organic Emissions from Existing Stationary Sources – Volume II: Surface Coating of Cans, Coils, Paper, Fabrics, Automobiles, and Light-Duty Trucks applies.

**Comparison of Other State Rules and BACM Conclusion:** SJ Rule 4604, SC Rule 1125 and Sacramento Rule 452 are comparable to R307-352 except that Rule 452 applies to all sources. No further emission reduction opportunity exists.

#### R307-353 Plastic Parts Coating:

**Federal Regulation or Guidance:** Control Techniques Guidelines for Miscellaneous Metal and Plastic Parts Coatings applies.

**Comparison of Other State Rules and BACM Conclusion:** SJ Rule 4603 was reviewed and no further emission reduction opportunity exists.

#### R307-354 Auto body refinishing

**Federal Regulation or Guidance:** Alternative Control Techniques Document – Automobile Refinishing applies.

**Comparison of Other State Rules and BACM Conclusion:** SC Rule 1151 and Sacramento Rule 459 were reviewed and no further emission reduction opportunity exists.

### R307-355 Control of Emissions from Aerospace Manufacture & Rework Facilities

**Federal Regulation or Guidance:** Control of Volatile Organic Compound Emissions from Coating Operations at Aerospace Manufacturing and Rework Operations applies. The CTG offers a model rule.

**Comparison of Other State Rules and BACM Conclusion:** SJ Rule 4605, SC Rule 1124 and Sacramento Rule 456 were evaluated. All jurisdictions crafted their rules generally along the CTG model rule. The VOC coating limits vary across rules.

All of the California rules allow for more exclusions than R307-355, especially Regulation 8.

The rule applicability for R307-355 is 10 tpy, while the rule applicability's for Rule 4605, 1124 and 456 are set between 55 and 1460 gallons/year. Regulation 8 applies to all sources.

UDAQ has revised the rule to lower the applicability threshold.

### R307-357 Consumer Products

**Federal Regulation or Guidance:** EPA promulgated a national regulation in 1998 (40 CFR, Part 59, Subpart C) for consumer products. CARB and the OTC member states have periodically updated their rules to obtain VOC reductions beyond those required by the federal regulation.

**Comparison of Other State Rules:** UDAQ was the first state to adopt the OTC 2014 model rule. Many east coast states are currently in the process of adopting the 2014 model rule.

The CARB consumer products rule is very similar to the OTC 2014 model rule. The OTC has established a policy that it will adopt currently enforceable CARB limits. As CARB establishes new final limits, the OTC will adopt those in the future. There are no current proposals to amend the 2014 model rule consequently, there are no further emission reduction opportunities at this time.

### R307-361 Architectural Coatings

**Federal Regulation or Guidance:** CARB and various California air management districts implemented architectural and industrial maintenance (AIM) rules in the late 1990's-2000 based on RACT analyses. Updates to these rules have been made several times since their inception. EPA promulgated a national AIM rule in January 2005 (40 CFR Part 59 Subpart D). The OTC developed its first model AIM rule in 2001 based on

the work conducted by CARB in 2000. The OTC most current rule is dated 2011 and is the most current available model rule. No further emission reduction opportunity exists.

### SO<sub>x</sub> BACM Assessment

Source Category	Source Category Code	Utah Existing Rules	Comments	2014 Uncontrolled Inventory Tons/winter Week Day
Combustion, Natural Gas, Residential	2104006	R307-356 Appliance Pilot Light		0.07
Combustion, Wood, All Devices	2104008320 2104008310 2104008330 2104008400 2102008000 2104008100 2103008000 2104008610 2104008210 2104008220 2104008510 2104008230 2104008700	R307-302 Solid Fuel Burning Devices		0.05
Combustion, Oil	2104004 2102005	R307-312 Aggregate Processing Operations	EPA-600/2-75-069-a Guidelines for Residential Oil-Burner Adjustments Procedures to Minimize Air Pollution	0.02
Combustion, Natural Gas, Commercial & Institutional	2103006	R307-356 Appliance Pilot Light		0.01
Combustion, Natural Gas, Industrial	2102006	R307-312 Aggregate Processing Operations		0.004
Combustion, Kerosene	2103011000		No known control	0.002
Cremation, Human	28100601		No known control	0.001
Combustion, LPG	2102007 2104007		Only controls developed for LPG combustion are to reduce NO <sub>x</sub> emissions (EPA AP 42, Section 1.5)	0.001

### SO<sub>x</sub> Source Category Analysis

**R307-312 Aggregate Processing Operations:** This is a Utah derived rule that establishes emission standards for sources in the aggregate processing industry, including aggregate processing equipment, hot mix asphalt plants and concrete batch plants. This rule primarily addresses SO<sub>x</sub>. Additional minor level of controls is also realized for PM<sub>2.5</sub> and NO<sub>x</sub>. While this rule applies to area sources,

Hot mix asphalt plants are able to utilize a variety of fuels. The fuel that generates the lowest emissions is natural gas or propane. The fuel that generates the highest emissions is waste/used oil. Natural gas produces approximately half of the NO<sub>x</sub> emissions that waste oil produces; however, the combustion of waste oil has beneficial uses in that the waste oil is not disposed of as a hazardous waste. The cost of the fuel

used has a great effect on the final cost of the product. Natural gas has in recent times been the lowest cost fuel available for hot mix asphalt plants; however, if natural gas prices increase or if waste oil prices decrease, it may not be economically feasible to use natural gas. During the winter inversion season, production of hot mix asphalt is significantly reduced. To allow sources the flexibility to utilize different fuels as necessary during the inversion season, sources are required to reduce hot mix asphalt production by half when utilizing a fuel other than natural gas thereby resulting in lower NO<sub>x</sub> and SO<sub>2</sub> emissions.

**Federal Regulation or Guidance:** None

**Comparison of Other State Rules:** There are no known rules in other states that directly apply to R307-312. There are no current opportunities for additional program revisions that would lead to further emission reductions.

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**NO<sub>x</sub> BACM Assessment**

Source Category	Source Category Code	Utah Existing Rules and Federal Rules	Comments	2014 Uncontrolled Inventory Tons/winter Week Day
Combustion, Natural Gas, Residential	2104006	R307-230 NO <sub>x</sub> Emission Limits for Natural Gas-Fired Water Heaters		11.75
Combustion, Natural Gas, Commercial & Institutional	2103006	R307-230 NO <sub>x</sub> Emission Limits for Natural Gas-Fired Water Heaters	UDAQ researching boiler rule option	2.5
Combustion, Natural Gas, Industrial	2102006	R307-312 Aggregate Processing Operations  Area Source Boilers NESHAP rule, 40 CFR 63.11195	UDAQ researching boiler rule option	0.72
Combustion, LPG	2102007 2104007		No known control	0.30
Combustion, Wood, All Devices	2104008320 2104008310 2104008330 2104008400 2102008000 2104008100 2103008000 2104008610 2104008210 2104008220 2104008510 2104008230 2104008700	R307-302 Solid Fuel Burning Devices		0.28
Fires, Vehicle and Structural	2810030000 2810050000		Uncontrollable	0.02
Combustion, Oil	2104004 2102005	R307-312 Aggregate Processing Operations	UDAQ researching boiler rule option	0.01
Cremation, Human	28100601		No known control	0.009
Combustion, Kerosene	2103011000		No known control	0.001

NO<sub>x</sub> emissions are dominated by combustion of natural gas in residential, commercial and institutional structures. Other combustions sources, such as wood burning, have been addressed in other sections of the area source BACM analysis. The remaining NO<sub>x</sub> sources are so insignificant that if they could be controlled, would be cost prohibitive.

**NO<sub>x</sub> Source Category Analysis**

R307-230 NO<sub>x</sub> Emission Limits for Natural Gas-Fired Water Heaters: NO<sub>x</sub>-emitting area sources include natural gas-fired furnaces, boilers and water heaters. Appliance burners are typically rated at 40 ng/Joule of NO<sub>x</sub>. Ultra-low NO<sub>x</sub> water heater burners rated from 10-14 ng/Joule of NO<sub>x</sub> are commercially available and have been in use in portions of California for nearly 10 years. The HVAC industry has been working on producing commercial ultra-low NO<sub>x</sub> furnaces and boilers however, they are not

currently available. R307-230 requires future sales of ultra-low NO<sub>x</sub> water heaters state-wide.

**Federal Regulation or Guidance:** None

**Comparison of Other State Rules:** SJVAB Rule 4902, SC Rule 4902 and BAAQMD Regulation 9 Rule 6 all require a NO<sub>x</sub> limit of 10 ng/Joule for residential units and slightly higher limits for commercial units. R307-230 is consistent with the California rules. There are no current opportunities for additional program revisions for gas fired water heaters that would lead to further emission reductions.

Future opportunities may be available regarding gas fired furnaces and boilers once the HVAC industry is able to commercially produce economical ultra-low NO<sub>x</sub> units. Several California air districts have already put in place rules for ultra-low NO<sub>x</sub> furnace in anticipation that the HVAC industry would be further along in their research and development.

R307-356 Appliance Pilot Light: Prohibits the sale of appliance pilot lights (with the exception of water heaters) after January 1, 2014. A Canadian study determined that a gas fireplace pilot light accounts for 48% of the annualized gas usage for the appliance. We assumed that this gas usage is generally applicable to other appliances with a pilot light. Prohibiting standing pilot lights reduces gas consumption that translates to a reduction in PM<sub>2.5</sub>, VOC, NO<sub>x</sub>, SO<sub>x</sub> and NH<sub>3</sub>.

**Federal Regulation or Guidance:** The Department of Energy issued a regulation on November 18, 2011 called Energy Conservation Standards for Direct Heating Equipment (FR Vol. 76, No. 223). This rule established energy efficiency standards for direct heating equipment like gas fireplaces. Appliances that do not use a standing pilot light are exempt from the energy efficiency standards, thereby encouraging the use of intermittent pilot ignition consistent with the requirement in R307-356.

**Comparison of Other State Rules:** We are not aware of other comparable state rules.

**BACM Conclusion:** There are no known opportunities for additional emission reduction for this source category.

## Ammonia BACM Assessment

### Ammonia Area Source Inventory

There are many winter time area sources categories of ammonia. The 2014 area source national emissions inventory (NEI V1) for Utah is composed of the following.

Biogenic	81.4%
Animals	14.5%
Fertilizer Application	1.6%
Human Respiration	1.4%
Combustion	1.1%
Total	100%

The nonattainment area level inventory is shown below.

Source Category	Source Category Code	2014 Uncontrolled Inventory Tons/winter Week Day
Combustion, Natural Gas, Residential	2104006000	2.5
Agricultural Livestock Cattle	2805020000	1.8
Human Respiration	2810010000	1.4
Animals, Wild (moose, antelope 25.56 tpy)	2807025000 2807030000 None for Moose and Antelope	0.57+ 0.07 (moose/antelope) = 0.64
Agricultural Livestock Poultry	2805005000	0.30
Animals, Domestic	2806010000 2806015000	0.28
Agricultural Livestock Horses	2805035000	0.20
Agricultural Livestock Turkeys	280501	0.16
Agricultural Livestock Sheep	2805040000	0.16
Combustion, Wood, All Devices	2104008320 2104008310 2104008330 2104008400 2102008000 2104008100 2103008000 2104008610 2104008210 2104008220 2104008510 2104008230 2104008700	0.13
Combustion, Natural Gas, Industrial	2102006	0.02
Agricultural Livestock Goats	2805045000	0.01
Agricultural Livestock Swine	2805025000	0.01
Combustion, Natural Gas, Commercial & Institutional	2103006	0.01
Sewer Treatment (POTW)	263002	0.006
Combustion, LPG	2102007 2104007	0.001
Combustion, Oil	2104004 2102005	5.2 x 10 <sup>-4</sup>
Combustion, Kerosene	2103011000	4.4 x 10 <sup>-5</sup>
Landfill	262003	1.4 x 10 <sup>-8</sup>

Combustion sources are addressed by R307-356, Appliance Pilot Light, R307-302 Solid Fuel Burning Devices and R307-230 NO<sub>x</sub> Emission Limits for Natural Gas-Fired Water Heaters and are further discussed in other sections because they play a greater role in reducing other parameters than ammonia.

All major POTW's meet Best Available Technology under the Clean Water Act and have an ammonia discharge limit in their permit.

Most of the ammonia is derived from commercial cattle and poultry manure, and manure processing, consequently, the BACM analysis will focus on agricultural control strategies for these source categories.

Control measures could not be identified for the remaining insignificant ammonia sources.

### **Agricultural Source Category Analysis**

Because the majority of the ammonia is derived from commercial cattle and poultry manure, the agricultural control strategy focus is on these sources.

This section provides a discussion on ammonia control strategies that are technologically feasible for winter-time manure management. Manure injection and soil incorporation (including chemical treatments prior to land application) are not included as manure management strategies because these activities cannot be performed when the ground is frozen.

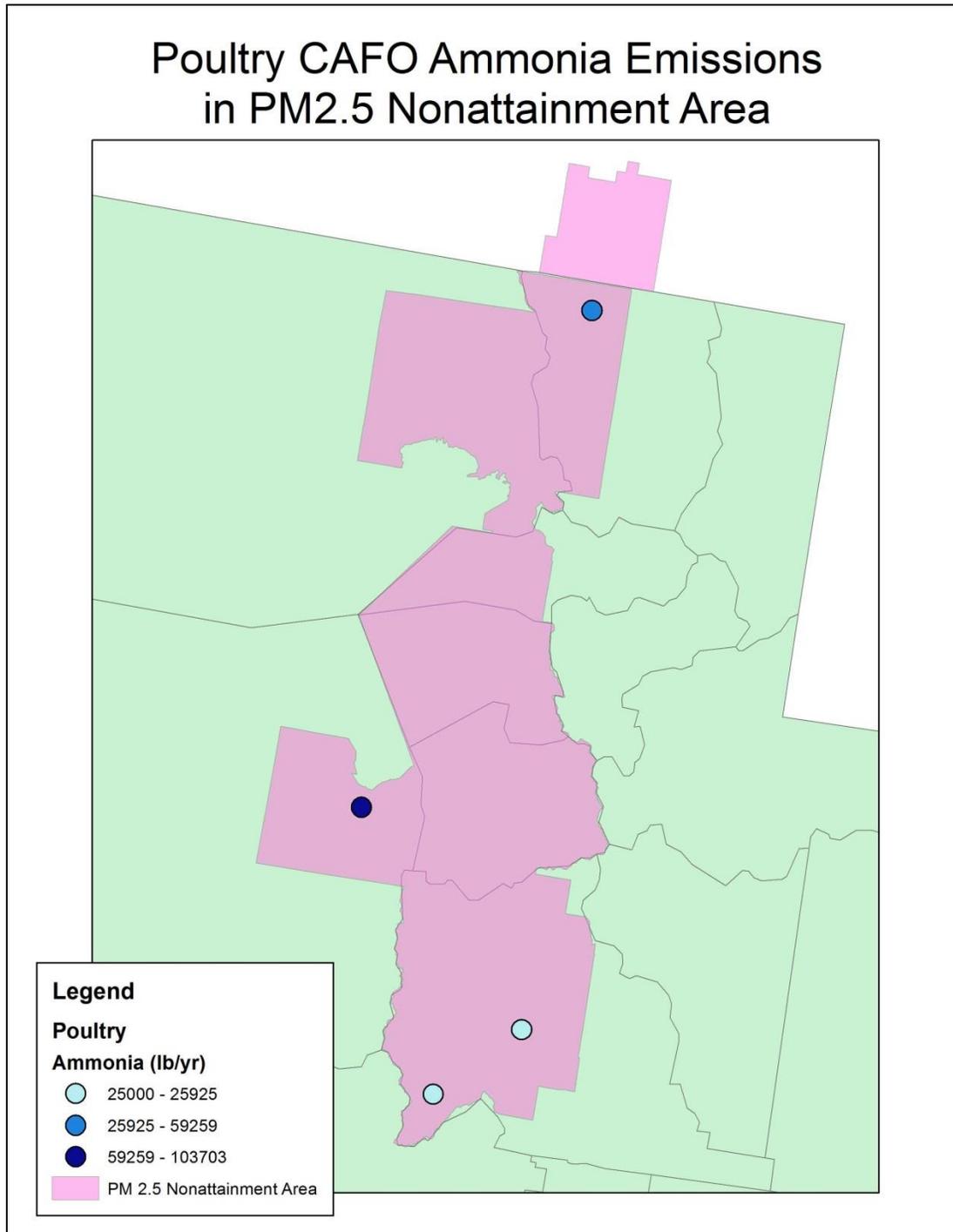
### **Ammonia Characteristics in Manure**

Agriculture is responsible for over three-fourths of the ammonia emissions in the USA and Canada, with animal production accounting for the major share. Ammonia becomes a constituent of animal waste when nitrogen-rich protein in feed is not completely converted into animal products (such as meat, milk, wool, and eggs). For example, only 25 to 35% of the nitrogen fed to dairy cows is converted into milk, with the remainder excreted in urine and manure in a variety of simple and complex forms of nitrogen. Chemical and microbial processes release ammonia into the air. Nitrogen in poultry manure is mainly in the form of uric acid, which also rapidly converts to urea and to ammonia (Bittman and Mikkelsen, 2009).

Ammonia is a colorless, lighter than air gas with a pungent odor. Significant volatilization of ammonia can occur within the first 24 hours after land application of manure. More than 50% of the total emission of ammonia can occur within the first six hours after application. Ammonia volatilization is highly dependent on manure management techniques and environmental factors, such as temperature and wind. Researchers have found that 50% of total nitrogen is volatilized as ammonia at a temperature of 30°C compared to 35% volatilization when the temperature is 25°C. Wind speed will increase the rate of ammonia volatilization as the higher wind increases the mass transfer and air exchange between the manured surface and the atmosphere. (AGRI-FACTS, Agdex 538-3, February 2008).

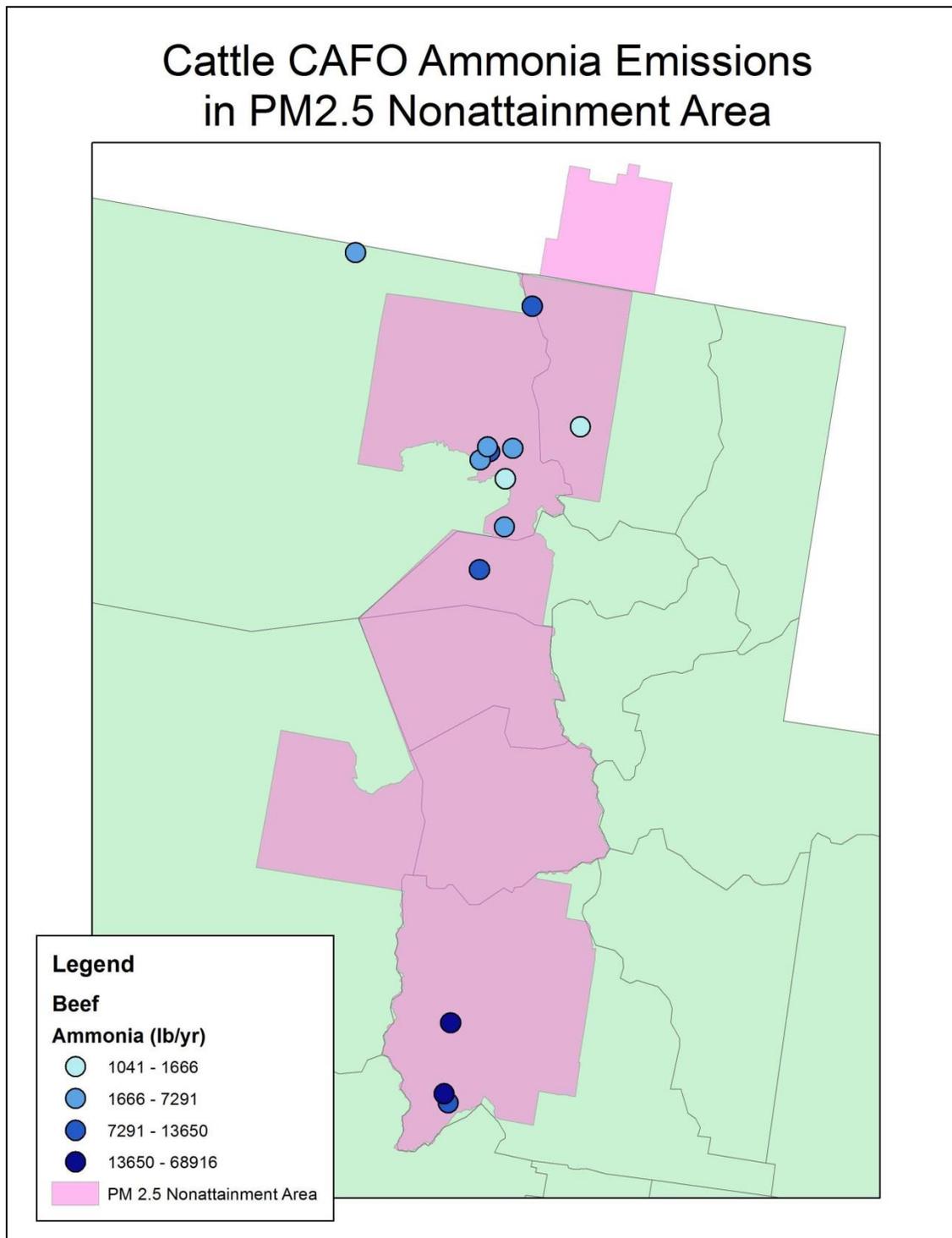
### Poultry Inventory

Commercial poultry operations within the nonattainment area are limited to egg laying production. There are no commercial broiler operations or turkey growers. Ammonia emissions for the larger poultry operations can be calculated using the CAFO database. There are two in Utah County, one in Tooele County and one in Cache County.



### Cattle Inventory

Cattle operations within the nonattainment area include dairy and beef production. The cattle CAFO's and their ammonia emissions are shown below.



## Ammonia Control Strategies in Livestock and Poultry Manure

### *Dietary Manipulations*

Excess nutrients not absorbed in the digestive tract are voided in the manure and urine. Dietary protein provides amino acids, nitrogen, sulfur, and other elements needed for animal reproduction, growth, and milk or egg production. Animals use less than half of the nitrogen that they consume, with the remaining excreted in the feces or urine. Fecal and urinary nitrogen are ammonia emission sources. Limiting crude protein levels in the diet to only that used by the animal limits nitrogen excreted in urea or uric acid, which contributes to emissions.

While reducing crude protein content will reduce nitrogen excretion and ammonia emissions, reductions in crude protein can severely impact animal performance. To effectively reduce crude protein concentrations of diets for poultry, additional supplementation of synthetic amino acids is needed. Animals require a specific ratios of available amino acids; thus, lowering crude protein levels requires supplementation with select amino acids that otherwise would be insufficient. Specific synthetic amino acids can be added to meet the nutritional needs of an animal according to genetic lines, age, sex, and other factors (Air Quality Education in Animal Agriculture, January 2012).

Research has shown that high-quality, protein-limited diets with appropriate supplementation of amino acids can effectively reduce nitrogen excretion and ammonia emissions from poultry, dairy and beef cattle operations without a loss in animal productivity. Commonly used amino acids are lysine, methionine, and threonine. Other amino acids may not be economically feasible (Applegate et al., 2008).

Researchers have found that for every one percent reduction in crude protein, there is an 8.5-10% reduction in ammonia in dairy beef and poultry. Addition of fermentable carbohydrates (bran or pulp) results in a 14% ammonia reduction (Iowa State Univ. Extension, 2004).

Undesirable sulfurous compounds often originate from sulfur-containing amino acids and sulfur-containing mineral sources. Limiting unnecessary sources of sulfur can reduce emissions of hydrogen sulfide and other volatile sulfur compounds (Air Quality Education in Animal Agriculture, January 2012).

Ultimately producers formulate their own feed and may rely on feed ingredients based on lowest market cost that will result in acceptable yield. Supplementing diets with amino acids other than lysine, methionine, or threonine may not be economically feasible at this time.

Dietary manipulation for the purposes of reducing ammonia production would require monitoring of a host of physiological factors, as well as monitoring feed ratio. Given the many complex variables, we cannot develop a universal SIP enforceable standard that would yield reliable control reduction while guaranteeing productive growth and/or yield. Consequently, dietary manipulation is screened out as a viable strategy.

## Manure Management

### *Poultry Litter Amendments*

Poultry litter is a mixture of bedding materials, excrement, spilled food and feathers. Acidifying litter with aluminum sulfate (alum) creates an acidic condition in the litter that result in converting ammonia to ammonium sulfate. Additional benefits of alum amendment include phosphorous binding, killing pathogens, causes the birds to grow faster and assist in using feed more efficiently. Due to the benefits of this practice (and cost-effectiveness), over one billion broiler chickens are grown with alum each year. The United States Department of Agriculture (USDA) supports the use of alum amendment through some cost-sharing programs (direct communications with Philip Moore, USDA).

Poultry manure treatment with alum in broiler houses has been demonstrated to reduce ammonia on average by 70% (Moore et al., 1999 and 2000). Alum is normally applied between each flock of birds at a rate of two tons of alum per broiler house. Alum costs about \$250/ton (USDA, *Treating Poultry Litter with Aluminum Sulfate (Alum)*).

Utah does not have commercial scale broiler houses but does have four large egg farms within the nonattainment counties. Given the successful use of alum in broiler houses, we explored the possibility of extending this control strategy for hen laying litter.

According to Philip Moore of the USDA, there has only been one good study conducted by the USDA on the use of liquid alum in high-rise laying hen houses. An automated misting delivery system was built at an Arkansas operation at a cost of \$30,000. The system delivered 1,000 gallons of liquid alum per month onto the litter at a cost of \$440/month. System testing showed ammonia levels were reduced from 70-90 ppm to around 10 ppm. Ammonia flux was reduced by 33%. Moore noted that the study high-rise house had higher than normal ammonia levels than one would find in newer high-rise houses with better management practices. Consequently, the dramatic ammonia reduction in this study was attributable to the very high levels of ammonia at the study site. Feed conversion and egg production were improved with alum such that there was a net return of \$426/week (excluding the capitol construction cost) (Moore et al., USDA grant report and direct communication). Moore stated during direct communications on this matter that he is not aware of any egg producer using an alum system.

This control strategy may be economically beneficial if a lower cost delivery system can be manufactured. At this juncture, there is no reliable data to support an expected control efficiency based on Moore's commentary that the ammonia levels in the project house were above normal. In the absence of verifiable control efficiency data and cost, we cannot retain this control strategy for SIP inclusion.

### *Mechanical Poultry Manure Processing*

Automatic manure belt systems are belts that travel on rollers under egg laying hens. The belts deliver the manure to the end of the cage row where manure cross conveyors remove it from the hen house to a manure storage area. The manure can be more readily disposed of or treated on a timely basis. According to one of the larger poultry producers in Cache County and a representative of the Utah Farm Bureau, poultry

houses are preferably migrating to this expensive technology because removing the manure immediately after generation greatly reduces the fly population, rodents and odor. This mechanical process in itself does not reduce ammonia volatilization but it does collect the manure in a central storage area permitting timely treatment before large quantities of ammonia can evolve.

### *Composting*

Ammonia loss during composting depends on the carbon to nitrogen (C:N) ratio. Ammonia volatilization is significant below a C:N of 15:1. Increased use of bedding (wood shavings, straw, etc.) helps maintain a higher C:N ratio. Application of a layer of 38% zeolite, placed on the surface of a composting poultry manure, reduced ammonia losses by 44% (Iowa State University Extension, July 2004). Composting requires routine pile mixing which would likely require amendment re-application. The cost for this control strategy is based on the amendment used and would be expected to be fairly low for carbon-based amendments like straw. One of the Cache County egg producers is currently composting his chicken litter with wood shaving and straw, then selling it commercially. A representative of the Utah Farm Bureau stated that producers are composting year round and that the piles generate enough heat to be effective even in winter. Since this strategy is already in common practice as a BMP, there is no reason to consider it further in the SIP.

### *Permeable Covers*

Permeable covers, or biocovers, act as biofilters on the top of manure storage areas. Materials often used as covers include straw, cornstalks, peat moss, foam, geotextile fabric, and Leka rock. Permeable biocovers reduce emissions, in part, by reducing both the radiation onto the manure storage surface and the wind velocity over the liquid surface of the storage area. At the solution/air interface, humidity is relatively high, which creates a stabilized boundary that slows the emission rate of odorous volatiles. The aerobic zone within the biocover allows the growth of aerobic microorganisms that utilize the carbon, nitrogen, and sulfur from the emissions for growth. By further degrading and making use of these compounds prior to exiting the biocover, odors emitted from the biocover are altered and reduced. Reports of odor reductions of 40-50% are common whenever various straw materials are used. An odor reduction efficiency of 85% has been noted following the use of a floating mat or corrugated materials. Although ammonia emission reductions are undocumented, the processes that occur in the biocovers suggest that ammonia emissions may be reduced to the same extent (Iowa State University Extension, July 2004). Cost would vary greatly, with the greatest cost for a geotextile fabric.

Producers who practice composting are adding straw and wood shavings as the carbon source, essentially incorporating biocovers into their composting process. This control strategy is not retained for further consideration because it is already employed to some degree as a BMP and there is no reliable data to support an expected control effectiveness value for ammonia.

### *Liquid-Solid Manure Separation and Storage*

Because ammonia results from the interaction of urine and feces in ruminants, efforts to separate them immediately upon excretion have reduced ammonia emissions

successfully (Iowa State University Extension, July 2004). The ammonia emissions reductions of urine-feces segregation in cattle has been reported to range from 21% with a 3% sloped solid floor collection (Braam et al., 1997a) to as much as 65% using a V-shaped pit floor with the gutter at the V (Braam et al., 1997b). A conveyor belt system was reported to reduce ammonia by 47-49% (Lachance et al., 2005; Stewart et al., 2004). All reported studies show ammonia reduction. The limiting factor is the cost of installing a system, maintenance, and ease versus cost of operation. Most dairies within the nonattainment area may already be using some liquid-solid separation method.

Given the structural complexity involved in installing these systems and the potential for high cost, we believe that this option is not well suited for SIP consideration, but should be encouraged as part of the USDA best management practices.

### *Animal Housing-Biofilters and Scrubbers*

Biofiltration is a pollution control technique using living material contained on a fixed surface to capture and aerobically biologically degrade pollutants.

P.M. Ndegwa, of Washington State University, presented a review of emission mitigation techniques at the Mitigating Air Emissions from Animal Feeding Operations Conference in 2008. He reported that the literature presents a broad range of biofilter efficiencies in the removal of ammonia in carrier-air from 9-100%. The variability was attributed to the wide range of biofilter-material, bed moisture, residence time, ammonia loading and bed biological activity.

System cost in 2004 was reported to be \$150—200 per 1,000 cfm of air treated. Operational cost was estimated at \$0.25 per piglet, amortized over a 3-year for a 700-head farrow-to-wean swine facility. Reduction of ammonia emission at that operation was approximately 74% (Iowa State University Extension, July 2004).

Biofiltration will only work when there is a complete air capture system in place which limits this application in the nonattainment area to egg laying producers, who as an industry, have chosen to move towards installing expensive mechanical belt manure removal systems.

**Federal Regulation or Guidance:** EPA published the Utah Animal Feeding Operations (AFOs) and Concentrated Animal Feeding Operations (CAFOs) regulation in July 2012. The regulation requires CAFOs that discharge to water bodies to obtain a NPDES permit. The Utah Division of Water Quality (DWQ) is authorized to implement the NPDES CAFO program. As such, the DWQ issued a state rule that reflects the federal CAFO requirements. R317-8-10 authorizes the issuances of this general permit. Sources subject to the rule must develop a nutrient management plan (NMP) that is certified by a Natural Resources Conservation Service (NRCS) certified planner. While the NMP is designed to address surface body discharge, the plans utilize the NRCS BMPs that also serve as ammonia control.

**Comparison of Other State Rules:** A search was conducted of state rules designed to control agricultural ammonia sources. The following state rules have been identified.

Salt Lake Area Source BACM

- ❖ South Coast Air Quality Management District (SC) Rule 1127, Emission Reductions from Livestock Waste. The rule is intended to control ammonia, VOC, and PM<sub>10</sub> from dairy farms and associated cattle operations, composting operations and anaerobic digesters. The rule requires the use of best management practices (BMPs) for manure collection, minimization of water usage in corrals, manure disposal, manure disposal, composting and feed stock preparation. Sources may propose alternative control options. The rule applies to dairy farms with more than 50 cows, heifers, and/or calves.

The Utah inventory includes dairy operations that are being regulated under the CAFO rule R317-8-10.

- ❖ SC Rule 1133.2, Emission Reductions From Co-Composting Operations. The rule is intended to control ammonia and VOC from all co-composting operations that engage in composting chipped and ground greenwaste, woodwaste, and/or foodwaste with manure. The rule requires that all active co-composting be confined within a controlled enclosure with a controlled vent that permits no more than 20% release by weight.

There are no known co-composting operations in the non-attainment area in order to consider Rule 1133.2.

- ❖ San Joaquin Valley Air Pollution Control District (SJ) Rule 4565, Biosolids, Animal Manure, and Poultry Litter Operations. While this rule is intended to control VOC from operations involving the management of biosolids, animal manure, or poultry litter, certain provisions may also be helpful in controlling ammonia. This rule only applies to major sources whose throughput consists entirely or in part of biosolids, animal manure, or poultry litter and the operator who landfills, land applies, composts, or co-composts these materials. The requirements include operational constraints, the use of covers and 80% VOC control efficiency.

A representative of the Utah Farm Bureau stated that producers are composting year round and that the piles generate enough heat to be effective even in winter. Since this strategy is already in common practice as a BMP, there is no reason to consider it further in the SIP.

- ❖ Idaho permit by rule for dairy farms (IDAPA 58.01.01). The rule applies to dairy farms with a capacity to produce 100 or more tons of ammonia emissions per year. The rule prescribes various BMPs to control ammonia emissions, ranging from installing certain types of waste storage and treatment systems to implementing composting practices to exporting manure. A point value is assigned to each BMP. Dairy farms must employ BMPs totaling 27 points. The Idaho BMP's are in line with the control strategies under the NRCS BMP program.

Large dairy farms in Utah would be permitted under Utah R317-8-10.

**BACM Conclusion:** Utah has implemented the EPA CAFO rule under the Utah NPDES program that requires a certified nutrient management plan.

The USDA has derived manure BMPs that it encourages producers to follow and it appears that the few air districts that regulate agricultural ammonia have applied these BMPs. As presented above, many producers are actively engaged in BMP practices and some have an economic incentive to manage their manure in such a way as to reduce ammonia evolution (less ammonia loss results in a higher grade fertilizer) because they sell their finished compost.

There are numerous complex factors involved in ammonia agricultural controls, complicated by winter-time conditions, which make it impractical to derive further uniform air quality rulemaking.

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DRAFT

# **EXHIBIT 9**

STATE OF UTAH  
DEPARTMENT OF ENVIRONMENTAL QUALITY  
DIVISION OF AIR QUALITY

UTAH IMPLEMENTATION PLAN

Encompassing a Mechanism and Schedule  
for Achieving Ambient Air Quality Standards  
throughout the State of Utah pursuant to  
Section 110 of the Federal Clean Air Act

Adopted by the Utah Air Quality Board

January 20, 1972; Revised December 1972; February 1979;  
November 1979; February 1980; June 1980; August 1980;  
November 1980; April 1981; August 16, 1981; February 16, 1982;  
July 29, 1982; September 28, 1982; December 16, 1983;  
August 23, 1984; April 15, 1985; October 4, 1985;  
April 18, 1986; January 1, 1988; August 29, 1990;  
September 24, 1990; June 28, 1991; October 31, 1991;  
February 13, 1992; April 21, 1992; November 4, 1992  
February 16, 1993; Renumbered July 26, 1993

Under Authority of 19-2-104  
Utah Code Annotated, 1953, as amended.

refineries.

IX.A.6.d. Solid Fuel Burning Devices:

Solid Fuel Burning Devices contribute a significant proportion to the PM<sub>10</sub> concentrations in Davis, Salt Lake, and Utah Counties.

In 1987 the UACC adopted Subsection r307-1-4.13, UACR, Emissions Standards for Residential Solid Fuel Burners and Fireplaces, which established a limitation on the sulfur and volatile ash content of coal sold for direct space heating for residential solid fuel burners and fireplaces, and limited the emissions from these devices to 40% opacity as measured by EPA Method 9. As part of the development process of this SIP, the maximum opacity was changed to 20%. Although no credit will be claimed for these control strategies, its enforcement can help insure the proper operation of solid fuel burning devices.

The Bureau of Air Quality is proposing the initiation of a program beginning September 1, 1992, to control emissions from residential solid fuel burning devices which is detailed below. The BAQ will collect the data necessary to verify the effectiveness of the program, and begin its information, public awareness, and public education programs before the program takes effect in 1992. The period from the promulgation of the program until the winter of 1992/1993 will also allow the BAQ the opportunity to implement and verify the proper functioning of the notification system that will be established and examine the potential of using a voluntary no-burn period to achieve the reductions in woodburning emissions required to meet the goals of this SIP. This interim period will also allow citizens who will be affected by the mandatory no-burn periods time to adjust their home heating requirements. Also, residents with sole source devices will be requested to certify these as such with the Executive Secretary or the appropriate local district health office.

(1) Emissions from wood burning devices account for 35.7  $\mu\text{g}/\text{m}^3$ , which is equivalent to 13.5% of the PM<sub>10</sub> concentrations at West Orem in Utah County. The following control strategies will be used to reduce emissions from wood burning devices in Utah County:

(a) Subsection R307-1-4.13.3, UACR establishes mandatory no burn periods (beginning September 1, 1992) for areas in Utah County which are north of the southernmost border of Payson City and east of State Route 68. The regulation establishes a mandatory no burn period when the ambient concentration of PM<sub>10</sub> reaches 120  $\mu\text{g}/\text{m}^3$  as measured by the real-time monitor located at the Lindon monitoring site. During the mandatory no-burn period, citizens may not use any solid fuel burning devices or fireplaces except those which are registered with the Bureau of Air Quality or the local health district office as being the sole source of heat for the entire residence or which have no visible emissions. The no-burn period will be in effect until the Executive Secretary issues a statement declaring an end to the no-burn period.

(b) The City County Health Department of Utah County has committed itself to adopt local regulations which mirror those which are promulgated with this plan. The Board of County Commissioners of Utah County has adopted a resolution which supports the implementation of a woodburning control program in Utah County, and a copy of that resolution is contained in the technical support document. The regulations adopted by the City-County Health Department of Utah County will be formally adopted into this SIP after they have been formally submitted to the UACC.

(c) The Utah County Commission on Clean Air has submitted a plan which is incorporated by reference into this SIP and is contained in the Technical Support Document, and which proposes the following programs be established by appropriate local government agencies in Utah County:

(i) Banning of Coal Burning.

The county proposes a ban on all forms of residential coal burning within the County. This could result in a further decrease of 30%, or an additional 0.4  $\mu\text{g}/\text{m}^3$ .

(ii) Installer and operator training programs for residential solid fuel burning devices.

A 5% reduction credit for this program is included in the "no-burn" period program.

(iii) Solid fuel burner inspection program.

A 5% reduction credit for this program is included in the "no-burn" period program.

(iv) Weatherization Requirements for Homes.

Allowable EPA credits for the implementation of requirements regarding the proper weatherization of homes has a maximum reduction of 5 percent. The state is claiming a 2% reduction in space heating emissions.

(v) All of the above strategies (a)-(d) are used as support for the adoption of the solid fuel burning device control strategy, and are used to justify the 60% emission reduction credit claimed in this SIP.

(2) Primary particulate emissions from solid fuel burning devices in the Salt Lake/Davis County area account for up to  $27.0 \mu\text{g}/\text{m}^3$ , which is equivalent to 16.03% of the  $\text{PM}_{10}$  concentrations in this area. The following control strategies will be used to reduce emissions from wood burning devices in the Salt Lake nonattainment area:

(a) Subsection R307-1-4.13.3, UACR, establishes mandatory no burn periods for all of Salt Lake County and for areas in Davis County which are south of the southern-most border of Kaysville when the ambient concentration of  $\text{PM}_{10}$  reaches  $120 \mu\text{g}/\text{m}^3$  and the forecasted weather includes a temperature inversion which is predicted to continue for at least 24 hours. During these mandatory no burn periods, it will be unlawful for individuals to use any solid fuel burning device or fireplaces except those which are registered with the Bureau of Air Quality or the local health district office as being the sole source of heat for the entire residence or devices and fireplaces having no visible emissions.

(b) Rules adopted by the Salt Lake City-County Board of Health and Davis County Board of Health which incorporate the regulations adopted by the State will be included into this SIP when they have been received from the county.

(3) The following control strategies will be implemented to reduce emissions from residential solid fuel burning devices in all  $\text{PM}_{10}$  nonattainment areas:

(a) Enforcement of the mandatory no burn period will involve an intensive effort from both the Bureau of Air Quality and the local health departments. During the mandatory no burn periods, 8 inspectors from the BAQ will conduct round-the-clock inspections. When a device or fireplace is observed burning, the inspectors may at reasonable times contact the individuals and inform them of the potential violation. The individuals using the fireplace or device may also be informed at that time of the BAQ penalty policy. The inspector will note the address of the observed burning devices or fireplaces. The following day the inspector will determine if the individuals who were burning the previous night are first time or repeat offenders and as soon as possible (within 24 hours), the inspector will implement the provisions of the penalty policy.

(b) The enforcement will also include the investigation of calls received at either the BAQ or the local health department. After a call is received, an inspector will visit the address of the suspected offender and verify if there is actually a violation of the mandatory no burn period. The individual will be contacted and notified of the possibility of penalties. The inspector will return to the office and determine if the individual is a first time or repeat offender and the inspector will implement the provisions of the penalty policy.

(c) Because the Bureau of Air Quality will have the primary responsibility to notify the public of the existence of a mandatory no burn period, the Bureau will reach an agreement by July 1, 1992 with the various news media to ensure that the public is informed of the mandatory no burn periods. A discussion of the media cooperation effort will be included in the technical support document when it is completed.

(d) To provide for a coordinated enforcement mechanism for the provisions of the mandatory no burn period, the Bureau will negotiate enforcement agreements by May 15, 1992, with the offices of the respective county sheriffs, the county fire marshals, the local fire departments, the local law enforcement agencies of each incorporated municipality, and the local city, county or district health departments.

(e) To strengthen the enforcement capabilities of the local health officers and alleviate any additional burden which penalization of those found in violation of the local county ordinances may have on the court system, the BAQ will work in cooperation

with the local health officials to seek a statutory change to allow the assessment and collection of administrative penalties by the local health departments for woodburning violations.

(f) The implementation of the mandatory no burn period in Salt Lake County and the affected areas of Davis and Utah Counties by the BAQ and the local health department will result in a 60% decrease in emissions from wood burning devices.

(g) Beginning in the spring of 1992, the BAQ will concentrate on the development of a public awareness (PA) program. The program will be geared towards informing the public of the wood burning regulations, the proper installation and operation of solid fuel burning devices, the use of clean fuels, the health effects of wood burning, and the advantages of using a EPA Phase II certified stoves or natural gas. This PA program will be accomplished by using pamphlets, seminars, a booth at the State Fair, and having public discussions on the television and in the newspapers.

(h) The penalty policy which was adopted by the UACC in R446-4 of the Utah Air Conservation Regulations is used by the Executive Secretary to determine penalty amounts to be placed on air pollution sources for violations of the UACR. Category D. of this policy allows for up to \$299 to be assessed against private citizens for non-compliance to the UACR, including the wood burning regulations.

The following guidelines will be followed for violations and penalty amounts:

Violation	Penalty/Violation
(i) First Violation	Assess Penalty \$0 -\$25 Issue a NOV
(ii) Second Violation	Assess Penalty \$50 - \$150 Issue a NOV
(iii) Third Violation	Assess Penalty \$150 - \$299 Issue NOV

Sites found with solid fuel burning devices and fireplaces operating illegally during a mandatory no-burn period will be reinspected within 24 hours and issued another notice of violation (NOV), if still not in compliance.

(4) Emissions from coal burning stoves can be significant. For example, they account for 0.6% or 1.4  $\mu\text{g}/\text{m}^3$  of the  $\text{PM}_{10}$  impact at the Lindon monitoring station. The mandatory no burn period will also preclude the use of coal burning stoves unless they are the sole source of heat, and after 1993, the use of coal stoves will be precluded unless they are able to operate with no visible emissions. The mandatory no burn will result in a 50% reduction of the emissions from coal burning stoves, or 0.7  $\mu\text{g}/\text{m}^3$ .

#### IX.A.6.e. PROVO CANYON CLOSURE TO TRUCK TRAFFIC

The Utah Department of Transportation (UDOT) is in the process of upgrading the Provo Canyon road into a four lane highway. The Provo Canyon Coalition is advocating that all non-destinational heavy duty truck traffic be banned from Provo Canyon. The coalition hired TRC Consultants to do a study of the situation. A copy of that study is contained in the Technical Support Document. Review of the study indicates that it is necessary to evaluate and consider this issue further before any action is taken by the UACC to recommend to the appropriate agency that they limit the use of the canyon by heavy duty diesel trucks. However, based on information currently available to the Committee, the Committee recommends that all non-destinational heavy duty truck which are on the interstate system should remain on the interstate system. The Committee also recommends at this time that the Utah Department of Transportation work with the Bureau of Air Quality to perform the necessary studies to determine the impact which heavy duty diesel truck traffic in Provo Canyon has on the air quality in Utah County and the impact which it would have were it moved to Salt Lake County.

#### IX.A.6.f. DIESEL INSPECTION AND MAINTENANCE PROGRAM

##### (1) BACKGROUND

# **EXHIBIT 10**

RULE 4901 WOOD BURNING FIREPLACES AND WOOD BURNING HEATERS  
(Adopted July 15, 1993; Amended July 17, 2003; Amended October 16, 2008;  
Amended September 18, 2014)

1.0 Purpose

The purpose of this rule is to limit emissions of carbon monoxide and particulate matter from wood burning fireplaces, wood burning heaters, and outdoor wood burning devices.

2.0 Applicability

This rule applies to:

- 2.1 Any person who manufactures, sells, offers for sale, or operates a wood burning fireplace, wood burning heater, or outdoor wood burning device.
- 2.2 Any person who sells, offers for sale, or supplies wood intended for burning in a wood burning fireplace or wood burning heater.
- 2.3 Any person who transfers or receives a wood burning heater as part of a real property sale or transfer.
- 2.4 Any person who installs a wood burning fireplace or wood burning heater in a new residential development.

3.0 Definitions

- 3.1 APCO: the Air Pollution Control Officer of the San Joaquin Valley Unified Air Pollution Control District.
- 3.2 ASTM: the American Society for Testing and Materials.
- 3.3 Consumer: any person other than a distributor or a retailer who buys a wood burning fireplace, wood burning heater, or outdoor wood burning device.
- 3.4 Distributor: any person other than a manufacturer or a retailer who sells, offers for sale, or supplies wood burning fireplaces, wood burning heaters, or outdoor wood burning devices to retailers or others for resale.
- 3.5 EPA: the United States Environmental Protection Agency.
- 3.6 EPA Certified: meets the performance and emissions standards set forth in the NSPS.

- 3.7 Garbage: any solid, semisolid, and liquid wastes generated from residential, commercial, and industrial sources, including trash, refuse, rubbish, industrial wastes, asphaltic products, manure, vegetable or animal solid or semisolid wastes, and other discarded solid or semisolid wastes.
- 3.8 Low Mass Fireplace: any fireplace and attached chimney, as identified in ASTM E 2558-7, "Determining Particulate Matter Emissions from Fires in Low Mass Wood-burning Fireplaces," that can be weighed (including the weight of the test fuel) on a platform scale.
- 3.9 Manufacturer: any person who constructs or imports a wood burning fireplace or wood burning heater.
- 3.10 Masonry Heater: any site-built or site-assembled, wood burning heating device constructed mainly of masonry materials in which the heat from intermittent fires burned rapidly in its firebox is stored in its structural mass for slow release to the site. Such wood burning heating devices must meet all federal requirements and be designed and constructed per specifications set forth in ASTM E 1602-3, "Guide for Construction of Solid Fuel Burning Masonry Heaters."
- 3.11 New Residential Development: any single or multi-family housing unit, for which construction began on or after January 1, 2004. Construction began when the foundation for the structure was constructed.
- 3.12 New Wood Burning Heater: any wood burning heater that has not been sold, supplied, or exchanged for the first time by the manufacturer, the manufacturer's distributor or agency, or a retailer.
- 3.13 Normal Operating Conditions: the operation of a wood burning heater as defined in this rule, except when a fire is started in the wood burning heater, when fuel is added to the wood burning heater, and when the fire is being extinguished. Visible smoke produced during these three events shall not exceed fifteen minutes per event.
- 3.14 NSPS: New Source Performance Standard. For purposes of this rule the NSPS is the Code of Federal Regulations, Part 60, Title 40, Subpart AAA.
- 3.15 Outdoor Wood Burning Device: any wood burning fireplace, or other device designed to burn wood, and that is located outside of a building or structure. This includes, but is not limited to, burn bowls, fire rings/pits, and chimineas. This does not include fire pits at state parks, national parks, or national forests.
- 3.16 Paints: any exterior and interior house and trim paints, enamels, varnishes, lacquers, stains, primers, sealers, undercoaters, roof coatings, wood preservatives, shellacs, and other paints or paint-like products.

- 3.17 Paint Solvents: any organic solvents sold or used to thin paints or clean up painting equipment.
- 3.18 Pellet-Fueled Wood Burning Heater: any wood burning heater manufactured for the purpose of heating a space and is intended to operate on pellet fuel.
- 3.19 Pellet Fuel: includes, but is not limited to, compressed sawdust, compressed paper products, and compressed forest residue, wood chips and other waste biomass, ground nut-hulls and fruit pits, corn, and cotton seed.
- 3.20 Permanently Inoperable: modified in such a way that a wood burning heater can no longer operate as a wood burning heater.
- 3.21 PM: particulate matter. PM<sub>2.5</sub> has an aerodynamic diameter equal to or less than 2.5 microns. PM<sub>10</sub> has an aerodynamic diameter equal to or less than 10 microns.
- 3.22 Real Property: the land itself and anything that is permanently affixed to the land, such as buildings, and structures. Examples of real property include heating and air conditioning systems, water lines, or electrical systems that primarily are used to control the environment for people and to benefit the land.
- 3.23 Retailer: any person engaged in the sale of wood burning fireplaces, wood burning heaters, or outdoor wood burning devices directly to the consumer.
- 3.24 Seasoned Wood: wood of any species that has been sufficiently dried so as to contain 20 percent or less moisture by weight.
- 3.25 Treated Wood: wood of any species that has been chemically impregnated, painted, or similarly modified to improve resistance to insects or weathering.
- 3.26 Used Wood Burning Heater: any wood burning heater that has been used at least once, except wood burning heaters that have been used by retailers for the purpose of demonstration.
- 3.27 Waste Petroleum Product: any petroleum product other than gaseous fuels that has been refined from crude oil, and has been used, and, as a result of use, has been contaminated with physical or chemical impurities.
- 3.28 Wood Burning Fireplace: any permanently installed masonry or factory built wood burning device designed to be used with an air-to-fuel ratio greater than or equal to 35-to-1.

3.29 Wood Burning Heater: an enclosed, wood burning appliance capable of and intended for space heating (i.e. wood stove, pellet-fueled wood burning heater, or wood burning fireplace insert).

3.30 Wood Burning Season: for purposes of this rule, the months of November, December, January, and February.

#### 4.0 Exemptions

The following devices are exempt from the provisions of this rule:

4.1 Devices that are exclusively gaseous-fueled.

4.2 Cookstoves, as described in Code of Federal Regulations 60.531.

4.3 Any burning occurring on the ground is open burning and is subject to requirements of District Rule 4103.

#### 5.0 Requirements

##### 5.1 Sale or Transfer of Wood Burning Heaters

###### 5.1.1 New wood burning heaters

No person shall advertise, sell, offer for sale, supply, install, or transfer a new wood burning heater unless it is either:

5.1.1.1 EPA certified with a Phase II Certification or a more stringent certification as currently enforced in the NSPS at the time of sale or transfer, or

5.1.1.2 A pellet-fueled wood burning heater that is exempt from EPA certification pursuant to requirements in the NSPS, until such time that amendments to the NSPS are finalized to remove exemptions for pellet-fueled wood burning heaters, then all new wood burning heaters must comply with Section 5.1.1.1.

###### 5.1.2 Used wood burning heaters

No person shall advertise, sell, offer for sale, supply, install, or transfer a used wood burning heater unless it has been rendered permanently inoperable, satisfies requirements pursuant to Section 5.1.1, or is a low mass fireplace, masonry heater, or other wood-burning device of a make and model that meets all federal requirements and has been approved in writing by the APCO.

### 5.1.3 Public Awareness Information

Retailers selling or offering for sale new wood burning heaters shall supply public awareness information with each sale of a wood burning heater in the form of pamphlets, brochures, or fact sheets on the following topics listed in Sections 5.1.3.1 through 5.1.3.6. Public awareness information shall be subject to the review and approval of the APCO.

5.1.3.1 Proper installation, operation, and maintenance of the wood burning heater,

5.1.3.2 Proper fuel selection and use,

5.1.3.3 Health effects from wood smoke,

5.1.3.4 Weatherization methods for the home,

5.1.3.5 Proper sizing of wood burning heaters, and

5.1.3.6 Episodic Wood Burning Curtailment levels as defined in Section 5.6.

5.1.4 Sections 5.1.1 and 5.1.2 do not apply to wood burning heaters subject to Section 5.2.

## 5.2 Sale or Transfer of Real Property

5.2.1 No person shall sell or transfer any real property which contains a wood burning heater without first assuring that each wood burning heater included in the real property is:

5.2.1.1 EPA Phase II Certified or has a more stringent certification under the NSPS at time of purchase or installation, or

5.2.1.2 A pellet-fueled wood burning heater that was exempt from EPA Certification pursuant to requirements in the NSPS at the time of purchase or installation, or

5.2.1.3 Rendered permanently inoperable.

5.2.2 Upon the sale or transfer of real property, the seller shall provide to the recipient of the real property, and to the APCO, documentation of compliance with Section 5.2.1. Documentation shall be in the form of a statement signed by the seller describing the type(s) of wood burning

heater(s) included in the real property transaction, and any action taken to comply with Section 5.2.1. The APCO shall make blank forms available to the public for the purpose of fulfilling this requirement.

5.2.3 Documents required by Section 5.2.2 shall be retained by the recipient of the real property and shall be made available to the APCO upon request.

### 5.3 Limitations on Wood Burning Fireplaces or Wood Burning Heaters in New Residential Developments

5.3.1 Effective until December 31, 2014

5.3.1.1 No person shall install a wood burning fireplace in a new residential development with a density greater than two (2) dwelling units per acre.

5.3.1.2 No person shall install more than two (2) EPA Phase II Certified wood burning heaters per acre in any new residential development with a density equal to or greater than three (3) dwelling units per acre.

5.3.1.3 No person shall install more than one (1) wood burning fireplace or wood burning heater per dwelling unit in any new residential development with a density equal to or less than two (2) dwelling units per acre.

5.3.2 Effective on and after January 1, 2015

5.3.2.1 No person shall install a wood burning fireplace in a residential development with a density greater than two (2) dwelling units per acre.

5.3.2.2 No person shall install more than two (2) EPA Phase II Certified or more stringent certification as currently enforced under the NSPS, wood burning heaters per acre in any residential development with a density greater than two (2) dwelling units per acre.

5.3.2.3 No person shall install more than one (1) wood burning fireplace or EPA Phase II Certified or more stringent certification, as currently enforced under the NSPS, per dwelling unit in any residential development with a density equal to or less than two (2) dwelling units per acre.

#### 5.4 Advertising Requirements for Sale of Wood

- 5.4.1 No person shall sell, offer for sale, or supply any wood which is orally or in writing, advertised, described, or in any way represented to be “seasoned wood” unless the wood has a moisture content of 20 percent or less by weight.
- 5.4.2 The APCO may delegate to another person or agency the authority to test wood for moisture content and determine compliance with Section 5.4.1.

#### 5.5 Prohibited Fuel Types

No person shall cause or allow any of the following materials to be burned in a wood burning fireplace, wood burning heater, or outdoor wood burning device:

- 5.5.1 Garbage,
- 5.5.2 Treated wood,
- 5.5.3 Plastic products,
- 5.5.4 Rubber products,
- 5.5.5 Waste petroleum products,
- 5.5.6 Paints and paint solvents,
- 5.5.7 Coal, or
- 5.5.8 Any other material not intended by a manufacturer for use as fuel in a wood burning fireplace, wood burning heater, or outdoor wood burning device.

#### 5.6 Episodic Wood Burning Curtailment

This section shall be in effect annually during the months of November through February.

##### 5.6.1 Level One Episodic Wood Burning Curtailment

The APCO shall declare a Level One Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM<sub>2.5</sub> concentration is forecast to equal or exceed 20  $\mu\text{g}/\text{m}^3$  but not exceed 65  $\mu\text{g}/\text{m}^3$  for the geographic region.

5.6.1.1 A wood burning fireplace, low mass fireplace, masonry heater, outdoor wood burning device, or nonregistered wood burning heater shall not be operated within the geographic region for which a Level One Episodic Wood Burning Curtailment is in effect.

5.6.1.2 A wood burning heater that has an approved and current registration with the District may be operated within the geographic region for which a Level One Episodic Wood Burning Curtailment is in effect provided the wood burning heater:

5.6.1.2.1 Is not fired on a prohibited fuel type pursuant to Section 5.5,

5.6.1.2.2 Is maintained according to manufacturer instructions,

5.6.1.2.3 Is operated according to manufacturer instructions, and

5.6.1.2.4 Has no visible smoke when operated under normal operating conditions.

#### 5.6.2 Level Two Episodic Wood Burning Curtailment

The APCO shall declare a Level Two Episodic Wood Burning Curtailment for a geographic region whenever the potential for a PM<sub>2.5</sub> concentration of greater than 65  $\mu\text{g}/\text{m}^3$  or for a PM<sub>10</sub> concentration of 135  $\mu\text{g}/\text{m}^3$  or greater is predicted for the geographic region. No person within the geographic region for which a Level Two Episodic Wood Burning Curtailment has been declared shall operate a wood burning fireplace, low mass fireplace, masonry heater, wood burning heater, or outdoor wood burning device when a Level Two Episodic Wood Burning Curtailment is in effect.

5.6.3 The following wood burning fireplaces and wood burning heaters are not subject to the provisions of Section 5.6.1 and 5.6.2:

5.6.3.1 Those in locations where natural gas service is not available. For the purposes of this rule, propane and butane are not considered natural gas, or

5.6.3.2 Those for whom a wood burning fireplace or wood burning heater is the sole available source of heat in a residence. This includes times of temporary service outages, as determined by the gas or electrical utility service.

5.6.4 Episodic Wood Burning Curtailment Notice

The APCO shall notify the public of each Episodic Wood Burning Curtailment by any of the following methods:

5.6.4.1 Provide notice to newspapers of general circulation within the San Joaquin Valley.

5.6.4.2 Broadcast of messages presented by radio or television stations operating in the San Joaquin Valley.

5.6.4.3 A recorded telephone message for which the telephone number is published.

5.6.4.4 Messages posted on the District's website, [www.valleyair.org](http://www.valleyair.org).

5.6.4.5 Any other method as the APCO determines is appropriate.

5.7 Registration of Wood Burning Heaters

5.7.1 Eligibility for Registration

A wood burning heater is eligible to be registered with the District provided it is either:

5.7.1.1 EPA certified with a Phase II Certification or has a more stringent certification as currently enforced under the NSPS at the time of purchase or installation, or

5.7.1.2 A pellet-fueled wood burning heater exempt from EPA certification requirements pursuant to requirements in the NSPS at the time of purchase or installation.

5.7.1.3 Wood burning heaters which do not meet the requirements of Section 5.7.1.1 or 5.7.1.2 are ineligible for registration.

5.7.1.4 Any registration of a wood burning heater which does not meet eligibility requirements is invalid.

## 5.7.2 Interim Registration of Wood Burning Heaters

- 5.7.2.1 For the wood burning season of 2014/2015 only, an Interim Registration program will be in place. A wood burning heater may participate in the Interim Registration program provided the wood burning heater:
  - 5.7.2.1.1 Meets the eligibility requirements pursuant to Section 5.7.1,
  - 5.7.2.1.2 Is registered in the Interim Registration program prior to use during Level One Episodic Wood Burning Curtailments, and
  - 5.7.2.1.3 Is operated in compliance with Section 5.5 and Section 5.6.
- 5.7.2.2 Any interim registration of a wood burning heater which does not meet qualifications pursuant to Section 5.7.1 is invalid.
- 5.7.2.3 Any interim registration of a wood burning heater may be disqualified pursuant to Section 5.9.

## 5.7.3 Registration Process

Effective during and after the 2015/2016 wood burning season, persons applying to register a wood burning heater shall:

- 5.7.3.1 Submit a completed application and supplemental documentation demonstrating compliance with the eligibility requirements specified in Section 5.7.1 to the District. Supplemental documentation shall include the following:
  - 5.7.3.1.1 Receipt or invoice from the installation or purchase that includes the manufacturer and model name of the wood burning heater, or
  - 5.7.3.1.2 A certification from a District Registered Wood Burning Heater Professional verifying that the wood burning heater meets eligibility requirements pursuant to Section 5.7.1.
  - 5.7.3.1.3 If the wood burning heater was purchased and/or installed more than one year prior to registration with the District, the person must show proof of

inspection of the wood burning heater from a District Registered Wood Burning Heater Professional.

5.7.3.2 Pay a registration fee as required by Section 3.0 of Rule 3901 (Fees for Registration of Wood Burning Heaters).

5.7.3.3 Operate the wood burning heater in compliance with the requirements in Section 5.5 and Section 5.6.

## 5.8 Renewal of Registration

5.8.1 Registration shall be valid for a period of up to three wood burning seasons from the date of registration issuance, unless the holder of the certificate is disqualified pursuant to Section 5.9.

5.8.2 Registration may be renewed by complying with the following requirements:

5.8.2.1 Complete and submit to the District a Registration Renewal application with verification that the wood burning heater has been inspected by District Registered Wood Burning Heater Professional to verify that it is maintained pursuant to manufacturer specifications.

5.8.2.2 Payment of a registration renewal fee as required by Section 4.0 of Rule 3901.

5.8.3 Failure to comply with Sections 5.8.1 or 5.8.2 may result in disqualification of registration.

## 5.9 Disqualification of Registration

5.9.1 If the District finds a registered wood burning heater is operated in violation of the requirements of this rule, the registration may be disqualified, provided that notice and an opportunity for an office conference was afforded pursuant to Section 5.9.4.

5.9.2 A registration disqualified pursuant to Section 5.9.1 may be reinstated if subsequent to the disqualification the operator of the wood burning heater demonstrates compliance with the requirements of Section 5.5 and Section 5.6.

5.9.3 Persons with a disqualified registration pursuant to Section 5.9.1 may appeal the determination by petitioning to the APCO.

#### 5.9.4 Notice of Preliminary Disqualification Determination

If the District makes a preliminary determination that a registered unit is in violation of Section 5.0, the following actions shall be taken:

5.9.4.1 Notify the person who registered the wood burning heater, in writing, that the District has made a preliminary disqualification determination and pursuant to Section 5.9.1 the District may cancel the registration 30 calendar days after the date on the notice. The notice shall include all of the relevant facts relating to the preliminary determination that are known to the District at the time of the notice.

5.9.4.2 Request as part of the notification required by Section 5.9.4.1 that the person who registered the wood burning heater confer with the District, in an office conference within 30 calendar days of the date on the notice to discuss the facts relating to the preliminary disqualification determination.

5.9.4.3 Conduct the office conference required by Section 5.9.4.2 provided that the person who registered the wood burning heater accepts the request for the office conference.

#### 5.9.5 Setting Aside a Disqualification

A disqualification determination pursuant to Section 5.9.1 shall be set aside by the APCO if the petitioner demonstrates to the satisfaction of the APCO that the violations forming the basis for the disqualification were the result of circumstances beyond the reasonable control of the petitioner and could not have been prevented by the exercise of reasonable care.

#### 5.10 Registration of Wood Burning Heater Professionals

5.10.1 To qualify to register as a Wood Burning Heater Professional with the District the applicant must meet one of the following criteria; this must be active, valid, and current:

5.10.1.1 Fireplace Investigation Research and Education (F.I.R.E.) Certified Inspector, or

5.10.1.2 Chimney Safety Institute of America (CSIA) certification, or

5.10.1.3 National Fireplace Institute (NFI) certification, or

- 5.10.1.4 A person determined to be qualified to perform inspections, maintenance, and cleaning activities on wood burning heaters by the APCO.
    - 5.10.2 Persons applying to register as a Wood Burning Heater Professional with the District shall:
      - 5.10.2.1 Submit a completed application for registration to the District.
      - 5.10.2.2 Submit any necessary supplemental documents as determined by the APCO as necessary to verify statements and qualifications as presented in the application for registration.
      - 5.10.2.3 If the applicant does not have a certification pursuant to Sections 5.10.1.1 through 5.10.1.3 the applicant may submit an application to the APCO with supplemental documentation verifying that the applicant meets the certification standards as required by certifications pursuant to Sections 5.10.1.1 through 5.10.1.3.
    - 5.10.3 Registration as a Wood Burning Heater Professional with the District is valid for up to three years from the date of issuance.
    - 5.10.4 The District shall maintain a list of registered Wood Burning Heater Professionals on the District web page.
  - 5.11 Inspection of Registered Wood Burning Heaters

The District has the right of entry for the purpose of inspecting any wood burning heater registered with the District in order to enforce or administer this rule.

## 6.0 Administrative Requirements

- 6.1 Upon request of the APCO, the manufacturer shall demonstrate that each wood burning heater subject to the requirements of Sections 5.1 or 5.2 is compliant with said requirements.
- 6.2 The person who registers the wood burning heater shall retain a copy of the District issued registration and make it available upon request.

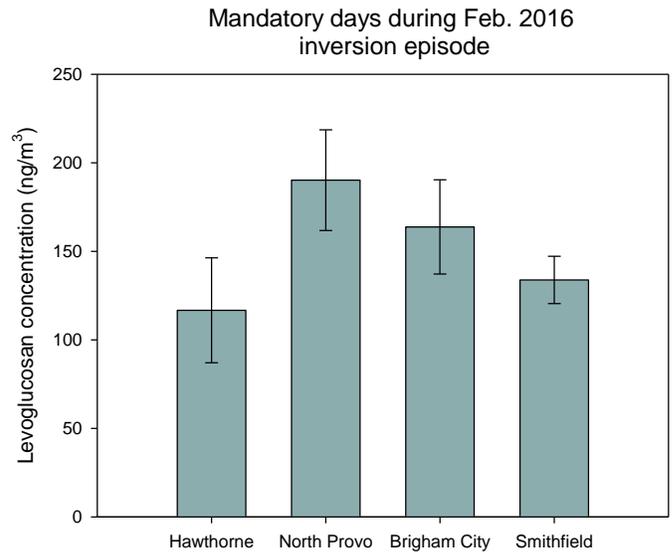
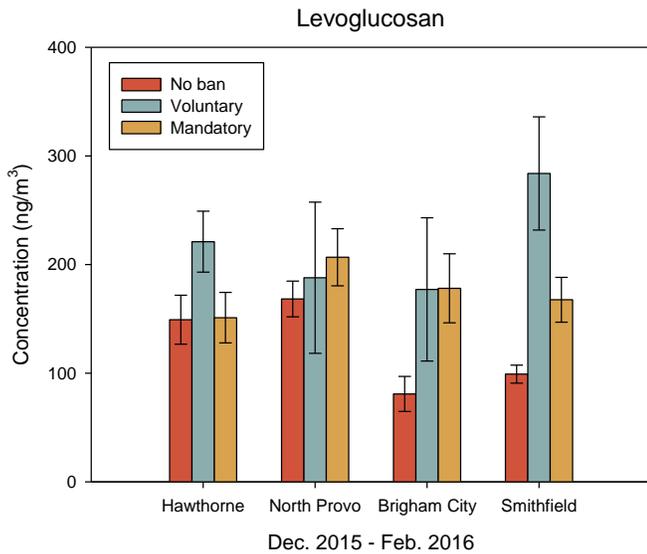
## 7.0 Test Methods

- 7.1 Moisture content of wood shall be determined by the current version of ASTM Test Method D 4442.
- 7.2 Compliance with visible-smoke free operation of the wood burning heater pursuant to Section 5.6 shall be determined using EPA Method 22 (Visible Determination of Fugitive Emissions from Material Sources and Smoke Emissions from Flares).

# **EXHIBIT 11**

## Wood Smoke Contribution

Levoglucosan displayed a similar trend at all sampling sites throughout northern Utah, with concentrations varying across burn and no-burn days. Comparable or higher concentrations overall were measured on mandatory no-burn days compared to days when there were no burning restrictions in place. This was true even during periods when inversion conditions were present. The right-hand chart shows that significant levoglucosan concentrations were measured on mandatory no-burn days during the February 2016 inversion episode. This suggests that residential wood-burning contributes to PM<sub>2.5</sub> during inversion episodes.



\* (ng/m<sup>3</sup>) = nanograms per cubic meter

# **EXHIBIT 12**

## **Attachment: EPA comments on ADEC Preliminary Draft Serious SIP Development materials for the Fairbanks serious PM<sub>2.5</sub> nonattainment area**

### **General**

The attached comments are intended to provide guidance on the preliminary drafts of SIP documents in development by ADEC. We expect that there will be further opportunities to review the more complete versions of the drafts and intend to provide more detailed comments at that point

1. Statutory Requirements - This preliminary draft does not address all statutory requirements laid out in Title I, Part D of the Clean Air Act or 40 C.F.R. Part 51, Subpart Z. The submitted Serious Area SIP will need to address all statutory and regulatory requirements as identified in Title I, Part D of the Clean Air Act, 40 C.F.R. Part 51, Subpart Z, the August 24, 2016 PM<sub>2.5</sub> SIP Requirements Rules (81 FR 58010, also referred to as the PM<sub>2.5</sub> Implementation Rule), and any associated guidance.

In the preliminary drafts, notable missing elements included: Reasonable Further Progress, Quantitative Milestones, and Conformity. This is not an exhaustive list of required elements.

The NNSR program is a required element for the serious area SIP. We understand ADEC recently adopted rule changes to address the nonattainment new source review element of the Serious SIP, and that ADEC plans to submit them to the EPA separately in October 2018. Thank you for your work on this important plan element.

2. Extension Request - This preliminary draft does not address the decision to request an attainment date extension and the associated impracticability demonstration. On September 15, 2017, ADEC sent a letter notifying the EPA that it intends to apply for an extension of the attainment date for the Fairbanks PM<sub>2.5</sub> Serious nonattainment area. The Serious Area SIP submitted to EPA will need to include both an extension request and an impracticability demonstration that meet the requirements of Clean Air Act section 188(e). In order to process an extension request, the EPA requests timely submittal of your Serious Area SIP to allow for sufficient time to review and take action prior to the current December 2019 attainment date, so as to allow, if approvable, the extension of the attainment date as requested/appropriate. For additional guidance, please refer to 81 FR 58096.
3. Split Request - We support the ADEC and the FNSB's decision to suspend their request to the EPA to split the nonattainment area. We support the effort to site a monitor in the Fairbanks area that is more representative of neighborhood conditions and thus more protective of community health. This would provide additional information on progress towards achieving clean air throughout the nonattainment area.
4. BACM (and BACT), and MSM - Best Available Control Measures (including Best Available Control Technologies) and Most Stringent Measures are evaluative processes inclusive of steps to identify, adopt, and implement control measures. Their definitions are found in 51.1000, 51.1010(a).

All source categories, point sources – area sources – on-road sources – non-road sources, need to be evaluated for BACM/BACT and MSM. De minimis or minimal contribution are not an allowable rationale for not evaluating or selecting a control measure or technology.

The process for identifying and adopting MSM is separate from, yet builds upon, the process of selecting BACM. Given that Alaska is intent on applying for an extension to the attainment date, Alaska must identify BACM and MSM for all source categories. These processes are described in 51.1010(a) and 51.1010(b) and in the PM<sub>2.5</sub> Implementation Rule preamble at 81 FR 58080 and 58096. We further discuss this process in the “BACM (and BACT), MSM” section that starts on page 3 below.

5. Resources and Implementation - The serious area PM<sub>2.5</sub> attainment plan will be best able to achieves its objectives when all components of the SIP, both the ADEC statewide and FNSB local measures, are sufficiently funded and fully implemented.
6. Use of Consultants- For the purpose of clarity, it will be important to identify that while contractors are providing support to ADEC, all analyses are the responsibility of the State.

### **Emissions Inventory**

1. Extension Request Emission Inventories - Emissions inventories associated with the attainment date extension request will need to be developed and submitted. Table 1 of the Emissions Inventory document is one example where the submittal will need to include the additional emissions inventories, including RFP inventories, extension year inventories for planning and modeling, and attainment year planning and modeling inventories, associated with the attainment date extension request.
2. Modeling Requirements - Related to emissions inventory requirements, the serious area SIP will need to model and inventory 2023 and 2024, at minimum. We recommend starting at 2024 and modeling earlier and earlier until there is a year where attainment is not possible. That would satisfy the requirement that attainment be reached as soon as practicable.
3. Condensable Emissions - All emissions inventories and any associated planning, such as Reasonable Further Progress schedules, need to include condensable emissions as a separate column or line item, where available. Where condensable emissions are not available separately, provide condensable emissions as included (and noted as such) in the total number. The following are examples of where this would need to be incorporated in to the Emissions Inventory document:
  - a. Page 20, paragraph 5 (or 2<sup>nd</sup> from the bottom).
  - b. Page 34, Table 8. Include templates.

### **Precursor Demonstration**

1. Ammonia Precursor Demonstration - The draft Concepts and Approaches document, Table 4 on page 9, states that a precursor demonstration was completed for ammonia and that the result was “Not significant for either point sources or comprehensively.” The Precursor Demonstration chapter does not include an analysis for ammonia. Please include the precursor demonstration for ammonia in the Serious Plan or amend this table.
2. Sulfur Dioxide Precursor Description - The draft Concepts and Approaches document, Table 4 on page 9, states that sulfur dioxide was found to be significant. All precursors are presumptively considered significant by default and the precursor demonstration can only show that controls on a precursor are not required for attainment. Suggested language is, “No precursor demonstration possible.”

### **BACM (and BACT), MSM**

#### *Overall*

The EPA appreciates ADECs efforts to identify and evaluate BACM for eventual incorporation into the Serious Area SIP. The documents clearly display significant effort on the part of the state and are a good first step in the SIP development process. In particular, we are supportive of ADECs efforts to evaluate BACT for the major stationary sources in the nonattainment area, as control of these sources is required by the CAA and PM<sub>2.5</sub> SIP Requirements Rule.

1. BACM/BACT and MSM: Separate Analyses - The “Possible Concepts and Potential Approaches” document appears to conflate the terms BACM/BACT and MSM, as well as, the analyses for determining BACM/BACT and MSM. BACM and MSM have separate definitions in 40 CFR 51.1000. By extension, the processes for selecting BACM and MSM are laid out separately in the PM<sub>2.5</sub> SIP Requirements Rule (compare 40 CFR 51.1010(a) for BACM and 40 CFR 51.1010(b) for MSM). Accordingly, the serious area SIP submission will need to have both a BACM/BACT analysis and an MSM analysis. We believe that there is flexibility in how these analyses can be presented, so long as the submission clearly satisfies the requirements of both evaluations, methodologies, and findings.
2. Selection of Measures and Technologies - The CAA and the PM<sub>2.5</sub> SIP Requirements Rule requires that ***all*** available control measures and technologies that meet the BACM (including BACT) and MSM criteria need to be implemented. All source categories need to be evaluated including: point sources (including non-major sources), area sources, on-road sources, and non-road sources.
3. Technological Feasibility - All available control measures and technologies include those that have been implemented in nonattainment areas or attainment areas, or those potential measures and technologies that are available or new but not yet implemented. Similarly, Alaska may not automatically eliminate a particular control measure because other sources or nonattainment areas have not implemented the measure. The regulations do not have a quantitative limit on number of controls that should be implemented.

For technological feasibility, a state may consider factors including local circumstances, the condition and extent of needed infrastructure, or population size or workforce type and habits, which may prohibit certain potential control measures from being implementable. However, in the instance where a given control measure has been applied in another NAAQS nonattainment area, the state will need to provide a detailed justification for rejecting any potential BACM or MSM measure as technologically infeasible (81 FR 58085).

A Borough referendum prohibiting regulation of home heating would not be an acceptable consideration to render potential measures technologically infeasible. The State would be responsible for implementing the regulations in the case that the Borough was not able. We believe that the most efficient path to clean air in the Borough is through a local, community effort.

4. Economic Feasibility - The BACM (including BACT) and MSM analyses need to identify the basis for determining economic feasibility for both the BACM and MSM analyses. In general, the PM<sub>2.5</sub> SIP Requirements Rule requires the state apply more stringent criteria for determining the feasibility of potential MSM than that used to determine the feasibility of BACM and BACT, including consideration of higher cost/ton values as cost effective.
5. Timing - The evaluations will need to identify the time for selection, adoption, and implementation for all measures. BACT must be selected, adopted, and implemented no later than 4 years after reclassification (June 2021). MSM must be selected, adopted, and implemented no later than 1 year prior to the potentially extended attainment date (December 2023 at latest). The RFP section of the serious area plan will need to identify the BACM and MSM control measures, their time of implementation, and the time(s) of expected emissions reductions. Timing delays in selection, adoption, implementation are not considered for BACM and MSM.

As mentioned in the comment above in the “General” comment section, there are three criteria distinguishing between BACM and MSM, not one.

#### *BACM - General*

1. BACM definition, evaluations - The definition of BACM at 40 CFR 51.1000 describes BACM as any measure “that generally can achieve greater permanent and enforceable emissions reductions in direct PM<sub>2.5</sub> and/or PM<sub>2.5</sub> plan precursors from sources in the area than can be achieved through the implementation of RACM on the same sources.” We believe that potential measures that are no more stringent than existing measures already implemented in FNSB, those that do not provide additional direct PM<sub>2.5</sub> and/or PM<sub>2.5</sub> precursors emissions reductions, do not meet the definition of BACM. These would need to be evaluated in the BACM and MSM analysis.

For measures that are currently being implemented in Fairbanks that provide equivalent or more stringent control, we recommend identifying the ADEC or Borough implemented measure as part of the BACM control strategy. These implemented measures should be listed in their BACM findings at the end of the document. This comment applies to all of the

measures that were screened out from consideration due to not being more stringent than the already implemented measure.

The analyses for a number of measures (e.g., Measure 30, Distribution of Curtailment Program information at time of woodstove sale) conclude that the emission reductions would be insignificant and difficult to quantify and, therefore, the measure is not technologically feasible. These measures may be technologically feasible. However, if existing measures constitute a higher level of control or if implementation of the measures is economically infeasible those would be valid conclusions if properly documented. De minimis or minimal contribution is not a valid rationale for not considering or selecting a control measure or technology.

The conclusion “not eligible for consideration as BACM” is not valid as all assessments for BACM and MSM are part of the evaluation. More appropriate conclusions could include that existing measures qualify as BACM or MSM, or are more stringent. Additional conclusions could include that evaluated measures were not technologically feasible, economically feasible, or could not practically be adopted and implemented prior to the required timeframe for BACM or MSM.

2. BACM and MSM, Ammonia - In the Approaches and Concepts document, Table 5 references that there are no applicable control measures or technologies for the PM<sub>2.5</sub> precursor ammonia. No information to substantiate this claim are found in the preliminary draft documents. Unless NH<sub>3</sub> is demonstrated to be insignificant for this area, the serious area plan will need to include an evaluation of NH<sub>3</sub> and potential controls for all source categories including points sources.
3. Backsliding Potential - When benchmarking the BACM and MSM analyses for stringency, ensure that the evaluation is based on the measures approved into the current Moderate SIP. This will relate primarily to the current ADEC/FNSB curtailment program but also other related rules. Many wood smoke control measures are interrelated, and changes to those measures may affect determinations on stringency of directly related and indirectly related measures. Examples of this can be found in multiple measures including, but not limited to Measures 5, 7, and 16.
4. Transportation Control Measures - The Approaches and Concepts document, on Page 13, states that the MOVES2014 model does not estimate a PM benefit as a result of an I/M program, and therefore the I/M is not technologically feasible. This is not a valid conclusion given that the Fairbanks area operated an I/M program to reduce carbon monoxide and the Utah Cache Valley nonattainment areas has an I/M program for VOC control. This measure will need to be evaluated. Referring to the 110(l) analysis for the Fairbanks CO I/M program may provide insight into how to quantify the emissions associated with an I/M program.

With regard to control measures related to on-road sources, we have received inquiries from the community regarding idling vehicles and further evaluation emission benefits would be responsive to citizen concern and may provide additional air quality benefit.

### *BACM - Specific Measures*

- Measure 16, page 34-35. Date certain Removal of Uncertified Devices. The “date certain” removal of uncertified woodstoves in Tacoma, Washington appears more stringent than the current Moderate SIP approved Fairbanks ordinance in terms of the regulation and in practice. While the current ordinance appears to provide similar protection during stage 1 alerts, this is dependent on 100% compliance and the curtailment program remaining in its current form. Removal of uncertified stoves guarantees reductions in emissions in the airshed during both the curtailment periods and throughout the heating season. The information provided does not support the conclusion that the Fairbanks controls provides equivalent or more stringent control. Date certain removal of uncertified wood stoves needs to be considered for the area.

Measures R4, R9, and R12, page 64, 68 and 71. These measures do not reference the Puget Sound Clean Air Agency (Section 13.07) requirement for removal of all uncertified stoves by September 30, 2015. This is equivalent to having all solid fuel burning appliances be certified and would be more stringent than the current SIP approved rules in Fairbanks. We believe that these measures need to be evaluated in the BACM and MSM analyses.

Measure R4 and R9, page 64 and 68. All Wood Stoves Must be Certified. These measure should be evaluated.

- Measure 19-20 and 25, page 36-38 and 39. Renewal and Inspection Requirements. ADEC has not adequately demonstrated their conclusion that Fairbanks has a more stringent measure than Missoula and San Joaquin. We believe that the renewal requirements and inspection/maintenance requirements associated with the Missoula alert permits and San Joaquin registrations allows the local air agency an opportunity to verify on a regular basis that the device operates properly over times. Wood burning appliances require regular maintenance in order to achieve the certified emissions ratings. The FNSB Stage 1 waivers do not have an expiration and do not have an inspection and maintenance component making it less stringent.
- Measure 31, page 43. While the Borough has SIP approved dry wood requirements that prohibit the burning of wet wood and moisture disclosure requirements by sellers, we believe that a measure limiting the sale of wet wood during the winter months should be further analyzed for BACM (and MSM) consideration.
- Measures 33, 35, 36, 37, 43. Multiple Measures identify that recreational fires have been exempted from existing regulations. Small unregulated recreational fires, bonfires, fire pits,

and warming fires have the potential to contribute emissions during a curtailment period. The FNSB and ADEC regulations should be re-evaluated for removing this exclusion.

- Measure 49, page 58. Ban on Coal Burning. We believe the regulations in Telluride are more stringent than in Fairbanks. Telluride prohibits coal burning all year whereas in Fairbanks an existing coal stove can burn when there is no curtailment which could contribute additional emissions to the airshed, especially during poor conditions when a curtailment may not have been called. We do not agree with the conclusion that the PM<sub>10</sub> controls are ineligible for consideration for control of PM<sub>2.5</sub>.
- Measure R20, page 76. Transportation Control Measures related to Vehicle Idling. We have received multiple inquiries regarding community interest in controlling emissions from idling vehicles. These types of control measures should be further evaluated in the BACM and MSM analyses.
- Measure 1, page 79-81. Surcharge on Solid Fuel Burning Appliances. For purposes of implementing an effective program to reduce PM<sub>2.5</sub> in the Borough we believe that a surcharge may be a helpful way to supplement limited funds. Implementation efforts within the nonattainment area could benefit from \$24,000 of additional funding whether used for a code enforcer or other support of the wood smoke programs.
- Additional controls that should be further evaluated for BACM and MSM include:
  - Measure R1, page 63: Natural gas fired kiln or regional kiln.
  - Measure R12, page 71: Replace uncertified stoves in rental units.
  - Measure R17, page 75: Ban use of wood stoves
  - Measure R6, page 65: Remove Hydronic Heaters at Time of Home Sale & Date certain removal of Hydronic heaters. We suggest evaluating these measures at the state and local level.
  - Weatherization / heat retention programs should be evaluated. These should be evaluated for existing homes through energy audits and increasing insulation and energy efficiency. For new construction, building codes (Fairbanks Energy Code) should be evaluated with reference to the IECC Compliance Guide for Homes in Alaska [http://insulationinstitute.org/wp-content/uploads/2015/12/AK\\_2009.pdf](http://insulationinstitute.org/wp-content/uploads/2015/12/AK_2009.pdf), and the DOE R-value recommendations, <http://www.fairbanksalaska.us/wp-content/uploads/2011/07/ENERGY-CODE.pdf>. (Note: More recent information may be available.)
  - Fuel oil boiler upgrades / operation & maintenance programs should be evaluated.

#### *BACM - Ultra-Low Sulfur Fuel*

1. Incomplete Analysis - The report findings provide analysis of the demand curve over a relatively short (12 month) time frame. This analysis appears to be based on a partial equilibrium model. This is a misleading time frame given the volatility of demand side fuel oil pricing. Also, in order to determine the equilibrium price, the analysis must also analyze

the supply curve. The report does not include information about the future supply side costs but needs to in order to make conclusions about the cost to the community of ultra-low sulfur heating oil.

2. Analysis of Increased Supply, Consumption - The report does not address future change in the market nor potential economies of scale to be achieved by an increase in ultra-low sulfur fuel consumption. Page 3 of the report identifies that, “the additional premium to purchase ULS over HS, decreased significantly since 2008-2010. It is likely that, this can be attributed to increased ULS capacity.” We believe that the report should further explore the supply side costs.
3. Supply Cost Analysis - A supply side cost analysis is necessary to better understand the cost to the supplier to produce and provide ULS heating fuel. The BACM analysis must start with a transparent and detailed economic analysis of exclusively supplying ultra-low sulfur heating oil to the nonattainment area.
4. BACM Assessment - The current analysis does not provide information needed to assess BACM economic feasibility. The report should analyze the total cost to industry of delivering ultra-low sulfur heating oil to the entire community in terms of standard BACM metrics, \$/ton.

## *BACT*

### General Comments

At this time, EPA is providing general comments based on review of the draft BACT analyses prepared by ADEC as well as addressing certain issues discussed in earlier BACT comments provided by EPA. Detailed comments regarding each individual analysis are not being provided at this time. While EPA appreciates the time and effort invested by ADEC staff in preparing the draft BACT analyses, the basic cost and technical feasibility information needed to form the basis for retrofit BACT analyses at the specific facilities has not been prepared. In other words, analyses which are adequate to guide decision making regarding control technology decisions for these rather complex retrofit projects cannot be prepared without site specific evaluation of capital control equipment purchase and installation costs, and site specific evaluation of retrofit considerations. EPA will conduct a thorough review of any future BACT or MSM analyses which are prepared based on adequate site specific information, and will provide detailed comments relative to each emission unit and pollutant at that time.

1. Level of Analysis – The analyses are presented as “preliminary BACT/MSM analyses” on the website, but the documents themselves are titled only as BACT analyses and the conclusions only reflect BACT. Additionally, the determinations may not be stringent enough to be considered BACT given that better performing SO<sub>2</sub> control technologies have not been adequately analyzed. These analyses cannot be considered to provide sufficient basis to support a selection of MSM.
2. Site-Specific Quotes Needed – The cost analyses, particularly for SO<sub>2</sub> control technologies, must be based on emission unit-specific quotes for capital equipment purchase and

installation costs at each facility. These are retrofit projects which must be considered individually in order to obtain reliable study/budget level (+/- 30%) cost estimates which are appropriate to use as the basis for decision making in determining BACT and potentially MSM. EPA believes that control decisions of this magnitude justify the relatively small expense of obtaining site-specific quotes.

3. SO<sub>2</sub> Control Technologies – The analyses must include evaluation of circulating dry scrubber (CDS) SO<sub>2</sub> control technology. This demonstrated technology can achieve SO<sub>2</sub> removal rates comparable to wet flue gas desulfurization (FGD) at lower capital and annual costs, and is more amenable to smaller units and retrofits. Modular units are available.
4. Control Equipment Lifetime – The analyses must use reasonable values for control equipment lifetime, according to the EPA control cost manual (EPA CCM). EPA believes that the following equipment lifetimes reflect reasonable assumptions for purposes of the cost analysis for each technology as stated in the EPA control cost manual and other EPA technical support documents. Use of shorter lifetimes for purposes of the cost analysis must include evidence to support the proposed shortened lifetime. One example where EPA agrees a shortened lifetime is appropriate would be where the subject emission unit has a federally enforceable shutdown date. Certain analyses submitted in the past have claimed shortened equipment lifetimes based on the harshness of the climate in Fairbanks. In order to use an equipment life that is shortened based on the harsh climate, evidence must be provided to support the claim. This evidence could include information regarding the actual age of currently operating control equipment, or design documents for associated process equipment such as boilers. Lacking adequate justification, all cost analyses must use the following values for control equipment lifetime:
  - a. SCR, Wet FGD, DSI, CDS, SDA – 30 years
  - b. SNCR – 20 years
5. Availability of Control Technologies – Technologically feasible control technologies may only be eliminated based on lack of availability if the analysis includes documented information from multiple control equipment vendors (who provide the technology in question) which confirms the technology cannot be available within the appropriate implementation timeline for the emission unit in question.
6. Assumptions and Supporting Documents – All documents cited in the analyses which form the basis for costs used and assumptions made in the analyses must be provided. Assumptions made in the analyses must be reasonable and appropriate for the control technologies included in the cost analysis.
7. Interest Rate – All cost analyses must use the current bank prime interest rate according to the revised EPA CCM. As of May 10, 2018, this rate is 4.75%. See <https://www.federalreserve.gov/releases/h15/> (go to bank prime rate in the table).
8. Space Constraints – In order to establish a control technology as not technologically feasible due to space constraints or other retrofit considerations, detailed site specific information must be submitted in order to establish the basis for such a determination, including detailed drawings, site plans and other information to substantiate the claim.
9. Retrofit Factors – All factors that the facility believes complicate the retrofit installation of each technology should be described in detail, and detailed substantiating information must be submitted to allow reasonable determination of an appropriate retrofit factor or whether installation of a specific control technology is technologically infeasible. EPA Region 10

believes that installation factors which would complicate the retrofit installation of the control technology should be evaluated by a qualified control equipment vendor and be reflected in a site-specific capital equipment purchase and installation quote. Lacking site-specific cost information, all factors that the facility believes complicate the retrofit installation of each technology should be described in detail, and detailed substantiating information must be submitted to allow reasonable determination of an appropriate retrofit factor. One example of the many retrofit considerations that must be evaluated is the footprint required for each control technology. A vendor providing a wet scrubber will be able to estimate the physical space required for the technology, and evaluate the existing process equipment configuration and available space at each subject facility. The determination of whether a specific control technology is feasible and what the costs will be may be different at each facility based on this and other factors. Site-specific evaluation of these factors must be conducted in order to provide a reasonable basis for decision making.

10. Control Efficiency – Cost effectiveness calculations for each control technology must be based on a reasonable and demonstrated high end control efficiency achievable by the technology in question at other emission units, or as stated in writing by a control equipment vendor. If a lower pollutant removal efficiency is used as the basis for the analysis, detailed technical justification must be provided. For example, the ability of SCR to achieve over 90% NO<sub>x</sub> reduction is well established, yet the ADEC draft analyses assume only 80% control. Use of this lower control efficiency requires robust technical justification.
11. Condensable Particulate Matter – Although the existing control technology on the coal fired boilers may be evaluated as to whether it meets the requirement for BACT for particulate matter, baghouses primarily reduce emissions of filterable particulate matter rather than condensable PM. Given that all condensable PM emitted by the coal fired boilers would be classified as PM<sub>2.5</sub>, the BACT analyses must include consideration of control options for these emissions. Where control technologies evaluated for control of other pollutants may provide a collateral benefit in reducing emissions of PM<sub>2.5</sub>, this should be evaluated as well.
12. Guidance Reference – The steps followed to perform the BACT analysis mentioned in section 2 are from draft NSR/PSD guidance. The correct reference should be 81 FR 58080, 8/24/2016. As a result of this, some of the steps outlined in the BACT analysis need to be updated.
13. Community Burden Estimate – The concepts and approaches document labels capital purchase and installation costs for air pollution control technology at the major source facilities as “community burden” (see Tables 7 and 8, pages 10-11). EPA believes it is important to properly label the cost numbers being used as capital purchase and installation costs, since presenting them as community burden appears to attribute the entire initial capital investment for the various control technologies to the community in a single year, and also ignores annual operation and maintenance costs. As described in the EPA CCM, the cost methodology used by EPA for determining the cost effectiveness of air pollution control technology amortizes the initial capital investment over the expected life of the control device, and includes expected annual operating and maintenance expenses. EPA believes presentation of this annualized cost over the life of the control technology more accurately represents the actual cost incurred and is consistent with how cost effectiveness is estimated in the context of a BACT analysis.
14. Conversion to Natural Gas – For any emission units capable of converting to natural gas combustion (with the requisite changes to the burners, etc), the MSM analysis in particular

should thoroughly evaluate the feasibility of this option. For example, GVEA has stated the combustion turbines at its North Pole Expansion Power Plant have the ability to burn natural gas, and the IGU has indicated the intent to expand the supply of natural gas to Fairbanks and North Pole.

## APPENDIX:

### Additional Comments and Suggestions

#### **Possible Concepts and Potential Approaches**

Throughout all SIP documents references to design values should include a footnote to the source of the information (e.g., “downloaded from AQS on XX/XX/XXX” or “downloaded from [state system] on XX/XX/XXXX”) and how exceptional events were treated.

We suggest referencing the August 24, 2016 81 FR 58010 Fine Particulate Matter NAAQS: State Implementation Plan Requirements rule with one consistent term. We suggest the 2016 PM<sub>2.5</sub> Implementation Rule.

Page 4, Figure 1. The comparative degree days and heating related information is better suited for the sections evaluating BACM and economic feasibility. If intending on using this information to differentiate Fairbanks from other cold climates and/or nonattainment areas, depicting comparative home heating costs would be more supportive.

Page 4, Table 1. The design values in the table and in the discussion need to be updated for 2015-2017.

Page 6-7: The “Totals” row in Table 3 (non-attainment areas emissions by source sector) does not appear to be the sum of the individual source sector emissions.

Page 7: The statement about FNSB experiencing high heating energy demand per square foot needs to be referenced.

Page 7: The discussion of Eielson AFB growth needs a reference to the final EIS.

Page 9: Table 4’s title should be changed to “Preliminary Precursor Demonstration Summary”

Page 9: Table 4 includes a column “Modeling Assessment”. Not all precursors were assessed with modeling, and modeling is just one tool for the precursor demonstration. A suggestion for the column title is “Result of Precursor Demonstration.”

Page 9: Table 5’s title should be changed to “Preliminary BACT Summary.” Table 5 also needs to update the title to reference “Precursor Demonstration” as the term “Precursor Significance Evaluation” is the incorrect terminology for this analysis.

Page 10: ADEC’s proposal to only require one control measure per major stationary source to meet BACT and MSM for SO<sub>2</sub>, is not consistent with the Act or rule. As discussed above, BACM and MSM have separate definitions in 40 CFR 51.1000. By extension, the processes for

selecting BACM and MSM are laid out separately in the PM2.5 SIP Requirements Rule (compare 40 CFR 51.1010(a) for BACM and 40 CFR 51.1010(b) for MSM).

Page 10: Table 6 should identify the specific dry sorbent injection selected as BACT.

Page 11: Suggest changing “less sources” to “fewer sources.”

Page 13: The statement about an I/M program providing PM benefit needs to be clarified. Is this referring just to NOx and VOC precursor contribution to PM2.5, or also direct PM2.5 benefits?

Page 14: The statement “ADEC interprets the main difference between BACT/BACM and MSM as the time it takes to implement a control” is inaccurate. As discussed above, although the rule sets out different schedules for implementation of MSM and BACM, this is not the only major difference between those concepts. Notably, the rule contemplates a higher stringency for MSM as well as a higher cost/ton threshold for determining economic feasibility of the measure.

### **Technical Analysis Protocol**

Page 2: The design values at the top of the page need to be updated to 2015-2017.

Page 2: Recommend removing the sentence “This site will be included in the Serious SIP’s attainment plan...” as the North Pole Elementary will be involved in the redesignation to attainment in the sense that all past and current monitoring data will be a part of an unmonitored area analysis to show that the entire area has attained the standard in addition to the regulatory monitor locations.

Page 2: Remove the discussion of the nonattainment area split.

Page 2: Paragraph 2, sentence 3 should refer to the unmonitored area analysis.

Page 2: The timeline described at the bottom of the page needs to be modified to reflect a current schedule. No projected year modeling was included in the preliminary draft documents. Control scenario modeling will likely not be completed in Q2 2018.

Page 3: We suggest a sentence overview of the unmonitored area analysis in Section 3.1.

Page 3: Section 3.2 needs to refer to the SPM data and how that will be used in the Serious Plan unmonitored area analysis. This section should discuss current DEC efforts to site a new monitor in Fairbanks.

Page 3: Section 3.4 needs to describe the CMAQ domain in addition to the WRF domain. A figure (map) would help.

Page 4: Section 3.5 needs a more developed discussion of the WRF assessment, including describing the criteria that were used to assess the state-of-the-art, what the current version is, and what version was used.

Page 4: Section 3.6 needs to reference all emission inventories in development, including potential attainment date extension years and RFP years.

Page 4: In Section 4.1, the statement about the Moderate SIP covering the relevant monitors for the Serious SIP is inaccurate. The statement needs to qualify whether it is referring to regulatory monitors or non-regulatory monitors. In addition, the North Pole Fire Station, NCore, and North Pole Elementary monitors were not included in the Moderate SIP.

Page 5: Table 4.1-1's title suggests that all SPM sites are listed, but only sites with regulatory monitors are listed. Please list all the SPM sites used in the unmonitored area analysis in a separate table and modify this title of Table 4.1-1 to reflect that it lists sites that are regulatory.

Page 5: North Pole Elementary was a regulatory site for a part of the baseline period and was NAAQS comparable. Table 4.1-1 needs to be updated.

Page 8: Table 4.2-1 should be updated to include 2011-2017 98<sup>th</sup> percentiles. Table 4.2-2 should be updated to include 3-year design values for 2013-2017. For clarity, we recommend the 3-year design values include the full period in order to better distinguish from Table 4.2-1. For instance, "2013" would be "2011-2013".

Page 8: The statement starting, "a clear indication..." needs to be amended or removed. It is inaccurate. The prevalence of organic carbon does not indicate the dominance of wood burning, much less a clear indication. Many sources in Fairbanks emit organic carbon.

Page 8: The statement starting "The concentration share..." need to be amended or removed. Suggest removing "drastically". There is no scientific definition of a drastic change in percentages of PM<sub>2.5</sub> species, nor does the different 56% to 80% appear "drastic."

Page 9: The detailed description of the Simpson and Nattinger analysis does not reflect that SANDWICH process and it is preliminary data. It should be included within the body of the Serious Plan appendix on monitoring, but is out of place in a summary TAP.

Page 9: there are two different tables with the same table number (Table 4.3-1).

Page 10: Please clarify Table 4.4-1. This appears to be the design value calculation for the 5-year baseline design value, 2011-2015. If correct, then please label the 3-year design values according to the three years (e.g., "2011-2013"), clarify the table heading as being the "Five Year Baseline Design Value, 2011-2015 ( $\mu\text{g}/\text{m}^3$ )", and clarify that the last column is the 5 Year Baseline Design Value associated with the table heading.

Page 11: At the end of section 5, please refer to the emission inventory chapter's meteorological discussion of the episodes.

Page 11: Section 6 needs to justify the extent, resolution, and vertical layer structure of the CMAQ domain (and the WRF domain) or refer to where that is included in the Moderate Plan.

Page 13: We suggest changing "PMNAA" to "NAA" to be consistent with the EI chapter.

Page 15, Section 8.1: There needs to be mention of how the F-35 deployment will be considered, with a reference to the final EIS.

Page 15-19: section 8.2-8.6 use the future tense for tasks that have been completed and are inconsistent with the schedule at the beginning of the TAP. Please adjust based on current status.

Page 20, section 9.2 states that “a BACT analysis is an evaluation of all technically available control technologies for equipment emitting the triggered pollutants and a process for selecting the best option based on feasibility, economics, energy, and other impacts.” This sentence should be revised to reflect that the technological feasibility assessment occurs after identification of all potential control measures for each source and source category.

Page 20, section 9.3 the second sentence should read: “BACM measures found to be economically infeasible for BACM *must* be analyzed for MSM.”

Page 21: Section 10.1 needs to be updated to reflect the current CMAQ version (5.2.1) and a discussion of why that model has not been used.

Page 21: Suggest sentence starting “There will be a gap...” be changed to “There is a gap in terms of assessing the performance at the North Pole Fire Station monitor for the Serious Plan because the State Office Building in Fairbanks was the only regulatory monitor at the time of the 2008 base case modeling episodes.”

Page 23: Please explain the solid and dashed lines in the soccer plot.

Page 23: Please be sure to include a full discussion of North Pole performance in this section. Even though we lack measurements, we can discuss the ratio of the modeling results at NPFS versus SOB versus that ratio from more recent monitoring data (2011-2015 baseline design value period).

Page 23: Please clarify what is meant by “Moderate Area SIP requirements.”

Page 24: The discussion of the 2013 base year discusses representative meteorological conditions without describing what the representative meteorological conditions are for high PM<sub>2.5</sub>. Please reference the discussion of representative meteorological conditions that will be found elsewhere in the SIP.

Page 24: The discussion of the modeling years needs to be consistent and reflect the extension request past 2019. The attainment year cannot be earlier than 2019. Each extension year must be individually requested. For modeling efficiency, we recommend starting with 2024. If that year attains, then 2023 and so on until we have one year that attains and the year before that does not. This should give us the information about what is the earliest year for attainment.

Page 25: We suggest changing “modeling design value” to “design value for modeling”

Page 26: Please clarify the “SMAT” label in the tables. They may be the SANDWICH concentrations and the “5-yr DV” rows are the SMAT concentrations. Please clarify the units in the rows.

## **Emission Inventory**

Clarification – In the EI document we would like to understand the functional difference between the base year, and baseline year

Please identify the methodology for generating ammonia and condensable PM emissions numbers.

Page 1: Please be consistent in “emission inventory” versus “emissions inventory”.

Page 1: “CAA” to “Clean Air Act” for clarity

Page 3: It would be helpful to refer to 172(c)(3) in Section 1.2, bullet 1 as the planning and reporting requirements.

Page 5: Please include extension years and RFP years in Table 1’s calendar years similar to what was done for Table 2. There should be one RFP projected inventory and QM beyond the extended attainment date. It would be helpful to include basic information about extension years and RFP years to better foreshadow Table 2.

Page 7: Please clarify the “winter season” inventory as the “seasonal” inventory that represents the daily average emissions across the baseline episodes.

Page 7, paragraph 1. Please include reference documentation for the following statement, “results in extremely high heating energy demand per square foot experienced in no other location in the lower-48.”

Page 9: Please change “Violations” to “Exceedances.” Exceedance is the term for concentrations over the standard. Violations is the term for dv over the standard.

Page 9: Add “No exceedances were recorded outside the months tabulated in Table 3 that were not otherwise flagged by Alaska DEC as Exceptional Events.”, to the end of the last paragraph on the page.

Page 13: Please clarify the provenance of the BAM data (e.g., “downloaded from [state database or AQS] on XX/XX/XXXX). In particular, it is important to note if the data has been calibrated to the regulatory measurement (aka, corrected BAM).

Page 17-18. Sentence Unclear “For example, a planning inventory based on average daily emissions across the entire six-month nonattainment season will likely reflect a relatively lower fraction of wood use-based space heating emissions than one based on the modeling episode day average since wood use for space heating Fairbanks tends to occur as a secondary heating source on top of a “base” demand typically met by cleaner home heating oil when ambient temperatures get colder.”

Page 19: Remove “Where appropriate,”. All source sectors should be re-inventoried for 2013, even if the emissions for the sector ends up being the same as in 2008.

Page 19: Change “projected forward” to “re-inventoried”, or similar wording. Reserve “project” for when the emission inventory is estimating emissions in a future year.

Page 20: Please refer to EPA’s memo on the use of MOVES2014a for the plug in adjustment. As a reminder, this information is sufficient only for development of the emissions inventory, not for SIP credit.

Page 20: Please submit the technical appendix referenced on page 20. When that is submitted, we expect to provide additional comment. To allow for review, we request expedited submission.

Page 21: At bottom of page, “project” should be “re-inventoried” or something that refers to an inventory produced after the fact.

Page 22, paragraph 1, Space heating area sources. Please further explain how the combined survey data best represents 2013 emissions.

Page 23: Add information about how NH<sub>3</sub> was inventoried for this category.

Page 23, 2<sup>nd</sup> paragraph from bottom. Facilities need to provide direct PM and all precursors, whether directly submitted or calculated from emissions factors.

Page 23, last paragraph.

- Potential typo – we believe that 2018 should be 2013.
- Question – Does scaling emissions cause any point source to exceed its PTE?

Page 25, bullet 3, Laboratory – Measured Emissions Factors for Fairbanks Heating Devices. The statement “first and most comprehensive systematic” would be more credible if simplified.

Page 27: Clarify how data from the 2014 NEI was modified to reflect emissions in 2013. Were they assumed to be the same between the two years? Or adjusted based on population change, or some other information?

Page 33: Please include information on how the Speciate database was used to develop the modeling inventory (and perhaps elsewhere for the planning inventory, if appropriate).

## **Precursor Demonstration**

Throughout the Serious Area SIP we recommend using the terminology, Precursor Demonstration, to be consistent with the PM<sub>2.5</sub> Implementation Rule.

General: The overview of the nitrate chemistry is complicated. We suggest you combine the two discussions into one and organize it with the following logic:

1. Describe the two chemical environments: (1) daytime and (2) nighttime.
2. Describe the information that supports that daytime chemistry is not relevant here.
3. Describe the information that supports that nighttime chemistry is limited by excess NO.

4. Describe what happens if the entire emission inventory was increasing by a factor of 3.6 to get appropriate concentrations in the North Pole area. How does ammonium nitrate change?
5. Describe how increasing the emission inventory and then reducing all source sectors by 75% results in less of a reduction in  $PM_{2.5}$  than reducing all source sectors by 75% in the original emission inventory.
6. NOTE: We are willing to provide a rough draft of this organization, if provided the original word document.

Title page: remove “com”

Page 2: Recommend using Section 188-190 instead of 7513-7513b.

Page 2: Recommend moving the last three sentences of the first paragraph to the end of the second paragraph.

Page 2: Please add “threshold” after 1.3 in the third paragraph.

Page 2: Please explain concentration-based and sensitivity-based before using the terms.

Page 2: Please add a footnote whether the numbers in the Executive Summary are SANDWICHed or not.

Page 3: Please change “has decided” to “decided.”

Page 3: Make sure the concentrations listed for ammonia include ammonium sulfate and ammonium nitrate.

Page 5-7: The figure captions say that concentrations are presented but the images themselves have percentages. Please use concentrations for this analysis.

Page 9: The first paragraph says that the point sources are not responsible for the majority of sulfate at the monitors. Please substantiate that claim, or modify it.

Page 13: Please explain the relevance of referring to the VOC emissions of home heating in this summary of VOCs.

Page 14: Recommend adding “... and adjusted to reflect speciated concentrations for a total  $PM_{2.5}$  equal to the five year 2011-2015 design value” to the sentence that starts “The speciated  $PM_{2.5}$  data [were] analyzed.”

Page 14: Please include the results of the concentration based analysis, perhaps as a table.

Page 14: Clarify that the concentration used for  $NH_3$  is the ammonium sulfate and ammonium nitrate. See the draft EPA Precursor Demonstration Guidance.

Page 17: Recommend removing “slightly” and removing the sentence referring to rounding to the nearest tenth of a microgram.

Page 17-18: To help understand what is going on with the bounding run versus the normal run, it would be helpful to have the RRFs for the Modeled 75% scenario.

## **BACM**

Page 9 and throughout: For clarity, please refer to the implementation rule as “PM<sub>2.5</sub>” not “PM”.

Page 14, Table 3. It would be helpful to include filter speciation data.

Page 16, Table 4: Please identify the RACM measures that were technologically and economically feasible but could not be implemented in the RACM timeline or note there were none.

Page 20 and 25, Table 6 and 7: For the final Table identifying the control measures evaluated, it would be helpful to identify the following: measure, cost/ton, BACM determination, MSM determination, and any additional comments.

Page 24: 12 measures were eliminated because they were determined to offer marginal or unquantifiable benefit. However, a measure may offer marginal benefit but may also cost very little. If there is another explanation for why these measures were not considered that follows the BACM steps, please include that in the Serious Area Plan.

Page 28: Stage 1 alerts are referred to multiple times including in Measure 2 on page 28 and Measure 33, pg 47 and pg 48. Please clarify in these analyses whether the measure applies during all stages of alerts and the associated level of control with each stage.

Page 33: Measure 13 identified that no SIPs existed or EPA guidance/requirements for the measure and incorrectly used that rationale as the conclusion for not considering the measure.

Page 34: The discussion of Measure 15 does not clearly state how Alaska and the Borough ensure that devices are taken out at the point of sale. It also does not clearly state the process for ensuring a NOASH application doesn't involve a stove that should have been taken out at the point of sale. It also states that stoves between 2.5 g/hr and 7.5 g/hr can get a NOASH, whereas page 37 implies that a stove must be <2.5 g/hr to be eligible for a NOASH.

Page 47: Measure 33 in Klamath County and Feather River is more stringent than what exists in Fairbanks now. Fairbanks allows open burning without a permit when there is no stage restriction. Alaska DEC prohibits open burning between November 1 and March 31, but the air quality plan makes it clear that the state relies on the Borough to carry out the air quality program in Fairbanks. The fact that the local borough does not require a permit for open burning outside of curtailments makes this measure less stringent in Fairbanks than in other locations. In addition, Fairbanks does not curtail warming fires during a Stage 1.

Page 48: Measure 34 is less stringent in Fairbanks than in Klamath County. Uncertainty in weather forecasting means that Stage 1 alerts are not called correctly all the time, and not

everyone is aware of when an alert is in effect. It is much simpler and less prone to error to prohibit burn barrels and outdoor burning devices entirely.

Page 57: Measure 46 review curtailment exemptions. The current Fairbanks curtailment exemption “These restrictions shall not apply during a power failure.” should be reviewed to clarify that it only applies to homes reliant on electricity for heating. As currently written, it appears overly broad.

Page 68: Measure R7, Ban Use of Hydronic Heaters, incorrectly identifies that no other SIPs implemented the measure as rational for not evaluating.

Page 72: Measure R15 is technologically feasible.

Page 78: It may help to make a section break or Section 2 label for “Analysis of Marginal / Unquantifiable Benefit BACM Measures

Page 81-83: The discussion of Measure 6 may need additional documentation. Anecdotal evidence is that damping is common in Fairbanks and is potentially a bigger source of pollution than not having a damper at very cold conditions. If installation by a certified technician addresses this issue, that should be documented.

Page 84: The quote, “did not know if the rule had worked well” needs a reference. It is also not clear of how relevant that is. It could be implemented well in Fairbanks and the fact that it may not have worked well in another location does not make it technologically infeasible for this location.

Page 85-86: While qualitative assessments are helpful to provide context, a quantitative assessment will be necessary to evaluate the measures as BACM and MSM.

Page 88: There are references to Fairbanks in the conclusion for Measure 17, but the analysis refers to AAC code.

Page 89: There appears to be missing text in the Background section related to Method 9.

Page 91: Measure 23 could consider the solution that the decals could be reflective and would be seen by vehicle headlights. Measure 23 could also consider that the decals are used by neighbors to determine who is or is not in compliance. This may be helpful as citizen compliance assistance efforts could supplement the Borough enforcement program.

Page 98-100: Measure 40 needs to include a discussion of all the areas listed on page 22. In addition, if a date certain measure or if Measure 29 were instituted, Measure 40 would essentially be achieved.

Page 114: Measure R5 describes a similar rule in Utah but lists “none” under implementing jurisdictions. Please make consistent.

## **ULS Heating Oil**

Page vii and Page 16: Please check your information on the percentage of households who have a central oil fired furnace. Please consult ADEC's contractor for the emissions inventory and home heating surveys about (1) the percentage of homes that heat only with an oil furnace, and (2) home with a central oil burner and a wood stove. We have seen different numbers than presented here.

Page 13: Please check the labels for Fairbanks HS #2 and Fairbanks HS #1. They may be switched.

Page 14: The statement that there is "a clear explanation" may not be correct, or at minimum is an overstatement. The difference in price between HS#1 and ULSD has varied over time, and the report did not include an explanation for the variations.

Page 14: The third paragraph assumes that the capital costs of shipping ULS would be more than exists today. However, all heating oil is shipped, regardless of sulfur content, and there is no justification for the report for why shipping ULS would be higher than for HS. Additionally, it is possible that the shipping cost per unit could go down marginally if only one product is being supplied to Fairbanks and/or if the quantity supplied increases.

Page 21: The text and Table 7 present inconsistent information. For instance, the text says that the discounted net-present value of scenario 2 is \$10,232 while the table says it is \$5,768.56.

# **EXHIBIT 13**

# Relative Emissions of Fine Particles



**VERY DIRTY** **VERY CLEAN**

Highest annual pollution	244 lbs. of annual pollution	97 lbs. of annual pollution	27 lbs. of annual pollution	<1/4 lb of annual pollution	<1/6 lb of annual pollution	ZERO annual pollution
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# **EXHIBIT 14**

Alaska Administrative Code

Title 18. Environmental Conservation (Refs & Annos)

Chapter 50. Air Quality Control (Refs & Annos)

Article 1. Ambient Air Quality Management

18 AAC 50.076

18 AAC 50.076. Solid fuel-fired heating device fuel requirements; registration of commercial wood sellers.

Currentness

(a) A person operating a solid fuel-fired heating device in an area identified in [18 AAC 50.015\(b\)\(3\)](#) may use only the following fuels:

(1) for wood-fired heating devices, and subject to the additional limitations under (b) of this section,

(A) wood, if not prohibited under (c) of this section;

(B) the following wood products, if made wholly from wood not prohibited under (c) of this section:

(i) wood pellets;

(ii) manufactured compressed wood logs;

(iii) bricks;

(iv) pucks;

(C) manufacturer-recommended starter fuels, including home heating oil, propane, natural gas, or wood-based material for dual fuel-fired hydronic heaters;

(D) biomass fuels approved by the manufacturer;

(2) for coal-burning devices,

(A) coal;

(B) coal pellets;

(3) for all solid fuel-fired heating devices, a fuel that is approved by the manufacturer and not prohibited under (c) of this section.

(b) Not earlier than October 1, 2015, and between October 1 and March 31 of each year, a person operating a wood-fired heating device in an area identified in [18 AAC 50.015\(b\)\(3\)](#) may use only the following fuels:

(1) dry wood, if not prohibited under (c) of this section;

(2) the following wood products, if made wholly from wood not prohibited under (c) of this section:

(A) wood pellets;

(B) manufactured compressed wood logs;

(C) bricks;

(D) pucks;

(3) manufacturer-recommended starter fuels, including home heating oil, propane, natural gas, or wood-based material for dual fuel-fired hydronic heaters;

(4) biomass fuels approved by the manufacturer;

(5) a fuel that is approved by the manufacturer, and that is not wet wood or a fuel prohibited under (c) of this section.

(c) A person operating a solid fuel-fired heating device may not burn or incinerate in the device

(1) wood that has paint, stains, or other types of coating;

(2) wood that has been treated with preservatives, including copper chromium arsenate, creosote, or pentachlorophenol;

(3) asphalt, rubber, tires, or tar products, including materials contaminated with petroleum, petroleum derivatives, oily wastes, or oil cleanup materials;

(4) chlorinated or halogenated organic compounds, including plastics, polyurethane products, pesticides, herbicides, or fungicides;

- (5) compounds containing cyanide or asbestos;
- (6) animal carcasses;
- (7) putrescible garbage;
- (8) construction and demolition debris, including plywood and particleboard;
- (9) flooring products; or
- (10) manure.

(d) A commercial wood seller must register under (e) of this section with the department to sell or provide wood to a person located in an area that is identified in [18 AAC 50.015\(b\)\(3\)](#), if

(1) under [42 U.S.C. 7513](#) and [7602](#), EPA has designated the area as a “serious” nonattainment area with respect to PM-2.5;

(2) the department issues a finding that wood smoke is a significant component of the PM-2.5 amount that resulted in designation of the area identified in [18 AAC 50.015\(b\)\(3\)](#) as “nonattainment”; and

(3) not later than 60 days before the date on which the requirements of this subsection and (e) - (g) of this section are to apply, the department

(A) prepares a notice identifying the need for applying the requirements of this subsection and (e) - (g) of this section with regard to the sale or provision of wood to a person located in the area; and

(B) issues the notice described in (A) of this paragraph by

- (i) publication in a newspaper of general circulation;
- (ii) posting in the office of the local air pollution control program; and
- (iii) posting on the Alaska Online Public Notice System ([AS 44.62.175](#)).

(e) Before selling or providing wood to a person located in an area that is identified in [18 AAC 50.015\(b\)\(3\)](#), a commercial wood seller subject to (d) - (g) of this section must

(1) submit a registration application in a format provided by the department;

(2) have available for use a moisture content meter that the department has approved under (g)(1) of this section;

(3) have a valid business license issued under AS 43.70; and

(4) renew the registration every three years by submitting, at least 30 days before the expiration date of the existing registration, an application for renewal to the department in a format provided by the department.

(f) Upon receipt of a complete registration application and the department's determination that the commercial wood seller is in compliance with (e)(2) and (3) of this section, the department will

(1) issue a unique registration identification number to the commercial wood seller;

(2) issue the commercial wood seller a batch of uniquely numbered three-part moisture content disclosure forms for use under (g) of this section; and

(3) add the commercial wood seller to a list of registered commercial wood sellers that the department maintains and makes available to the public.

(g) A commercial wood seller who is registered as required under (d) - (f) of this section

(1) shall test, using a commercially available moisture test meter that the department has approved for accuracy, the moisture content of a load of wood at the time of sale or provision to the consumer, or if the consumer purchases one or more loads of wood for later delivery or arranges for the later delivery of one or more loads of wood, shall test the moisture content of each load at the time of delivery, unless the wood sold or delivered is subject to (2), (3), or (4) of this subsection; the department will maintain a list of commercially available moisture test meters that the department has approved for accuracy; for split wood, wood rounds, or logs that are cut at the time of or before sale and that are marketed, sold, or provided as dry wood, the commercial wood seller shall

(A) measure moisture content in at least three pieces of wood for each cord of wood purchased;

(B) randomly select the wood to be tested from differing locations throughout the entire load;

(C) ensure that each selected piece of wood undergoes a fresh cut and is tested in the center of the fresh-cut end; and

(D) document the measured moisture content on the moisture content disclosure form that the department provides under (f)(2) of this section, and fully complete and sign the form;

(2) if selling or providing frozen wood, shall note on the moisture content disclosure form that the wood is frozen and assumed to be wet wood with greater than 20 percent moisture content, and shall fully complete and sign the rest of the form; for purposes of this paragraph, “frozen wood” means wood that is

(A) cut at a temperature below 32 degrees Fahrenheit for immediate sale or provision to the consumer; or

(B) delivered at a temperature below 32 degrees Fahrenheit, if the consumer purchases one or more loads of wood for later delivery or arranges for the later delivery of one or more loads of wood;

(3) if marketing, selling, or providing wet wood, shall note on the moisture content disclosure form that the wood is wet and assumed to be greater than 20 percent moisture content, and shall fully complete and sign the rest of the form;

(4) if marketing, selling, or providing, as dry wood,

(A) wood that was split before freezing, may market, sell, or provide the wood as dry wood only if

(i) the split wood is covered and stacked for ventilation;

(ii) after splitting, covering, and stacking the wood, the commercial wood seller tests the wood as required under (1)(A) - (D) of this subsection and the test results demonstrate that each piece of wood tested is dry wood;

(iii) the commercial wood seller records and saves the test results and the date of the test; and

(iv) upon actual sale, provision, or delivery, if the temperature is below 32 degrees Fahrenheit, the commercial wood seller documents the previously recorded test results and the date on the moisture content disclosure form and fully completes and signs the rest of the form;

(B) wood that was split after freezing, may market, sell, or provide the wood as dry wood after freezing only if

(i) the wood is mechanically dried;

(ii) the wood is manufactured as pellet logs; or

(iii) the source of the wood is from fire-killed trees and has been inspected by the department and found to be dry wood;

(5) shall obtain the consumer's signature on the moisture content disclosure form, or if the consumer is unavailable, shall mark on the form that the consumer is unavailable;

(6) shall provide the consumer with a copy of the signed moisture content disclosure form;

(7) shall submit to the department, not later than the 15th day of each month, the department's copy of each moisture content disclosure form completed during the previous month;

(8) shall retain the seller's own copy of each completed moisture content disclosure form for two years after the date of the sale, provision, or delivery;

(9) shall account for each moisture content disclosure form received from the department; when making a monthly submission under (7) of this subsection, the commercial wood seller shall

(A) submit any moisture content disclosure form not given to a consumer due to damage or errors; and

(B) report the unique number of any moisture content disclosure form that is lost;

(10) shall return any unused moisture content disclosure forms if the commercial wood seller's registration expires or is revoked;

(11) is subject to one or more of the following if the commercial wood seller fails to comply with a provision of this subsection:

(A) remedial training on the requirements of (d) - (f) of this section and this subsection;

(B) a notice of violation;

(C) until the department determines that the commercial wood seller is in compliance, removal of the seller from the list that the department maintains under (f)(3) of this section;

(D) revocation of registration;

(E) enforcement under [AS 46.03.020](#), [46.03.760](#), or [46.03.790](#); and

(12) may request an informal or adjudicatory hearing as prescribed in [18 AAC 15.185](#) and [18 AAC 15.195- 18 AAC 15.340](#) if the department denies registration, denies renewal of a registration, or takes an action under (11)(A) - (D) of this subsection.

(h) In this section, “commercial wood seller”

(1) means a person who sells wood for use in space heating;

(2) does not include a person whose sales of wood consist wholly of

(A) wood products permissible under (a)(1)(B) or (b)(2) of this section;

(B) bundles of split dry wood that are sized not more than 0.75 cubic feet a bundle; or

(C) logs or rounds intended for resale, where the resale of the wood and measurement and documentation of their moisture content will be addressed by a commercial wood seller.

(i) A commercial wood seller is not required to meet the requirements of (g) of this section for any portion of its sales that are

(1) wood products permissible under (a)(1)(B) or (b)(2) of this section;

(2) bundles of split dry wood that are sized not more than 0.75 cubic feet per bundle; or

(3) logs or rounds intended for resale, where the resale of the wood and measurement and documentation of their moisture content will be addressed by another commercial wood seller.

#### **Credits**

(Eff. 2/28/15, Register 213; am 3/2/2016, Register 217; am 11/26/2016, Register 220)

**AUTHORITY:** [AS 46.03.020](#), [AS 46.14.010](#), [AS 46.14.020](#), [AS 46.14.030](#), Sec. 30, ch. 74, SLA 1993 A copy of the list of commercially available moisture test meters that the Department of Environmental Conservation has approved under 18 AAC 50.076(g) for use by commercial wood sellers is available at the department's offices in Anchorage, Fairbanks, and Juneau, and can be obtained by contacting the Department of Environmental Conservation, Division of Air Quality, at (907) 465-5100, or can be obtained from the Internet at [http://burnwise.alaska.gov/moisture disclosure program.htm](http://burnwise.alaska.gov/moisture%20disclosure%20program.htm). The list of registered commercial wood sellers described in 18 AAC 50.076(f) is available at the department's offices in Anchorage, Fairbanks, and Juneau, and can be obtained by contacting the Department of Environmental Conservation, Division of Air Quality, at (907) 465-5100, or can be obtained from the Internet at [http://burnwise.alaska.gov/moisture disclosure program.htm](http://burnwise.alaska.gov/moisture%20disclosure%20program.htm).

Current with amendments received through the Quarterly Supplement, July 2018, (Register 226).

Alaska Admin. Code tit. 18, § 50.076, 18 AK ADC 50.076

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 KeyCite Yellow Flag - Negative Treatment  
Proposed Regulation

Alaska Administrative Code  
Title 18. Environmental Conservation (Refs & Annos)  
Chapter 50. Air Quality Control (Refs & Annos)  
Article 1. Ambient Air Quality Management

18 AAC 50.077

18 AAC 50.077. Standards for wood-fired heating devices.

Currentness

(a) This section applies to a person who

(1) owns or operates a wood-fired heating device in an area identified in [18 AAC 50.015\(b\)\(3\)](#), if the wood-fired heating device

(A) is installed on or after February 28, 2015;

(B) was installed before February 28, 2015, and the wood-fired heating device

(i) is being sold, leased, or conveyed as part of an existing building or other property; and

(ii) lacked a valid EPA certification under [40 C.F.R. 60.533](#) or a qualifying “white tag” under EPA's Phase 2 voluntary partnership program for hydronic heaters; or

(C) is not otherwise exempted in this section; or

(2) intends to supply, sell, lease, distribute, convey, or install a wood-fired heating device for operation in an area identified in [18 AAC 50.015\(b\)\(3\)](#).

(b) Except as provided under (f), (g), or (h) of this section, a person may not operate, install, or reinstall a wood-fired hydronic heater in an area identified in [18 AAC 50.015\(b\)\(3\)](#), and may not supply, sell, lease, distribute, or convey a wood-fired hydronic heater for operation or installation in an area identified in [18 AAC 50.015\(b\)\(3\)](#), unless

(1) the model

(A) has been certified under [40 C.F.R. 60.5474\(a\)\(1\)](#) and [\(b\)\(1\)](#) (Subpart QQQQ, “Step 1” emission rates), revised as of July 1, 2017, and adopted by reference;

(B) meets the particulate matter annual average emission limit in (2) of this subsection; and

(C) has a rated size under 350,000 Btu per hour; or

(2) a laboratory with current EPA accreditation under [40 C.F.R. 60.535](#) has tested the model to meet an annual average emission level of 0.32 pounds per million Btu of heat output, a particulate matter annual average emission limit of 2.5 grams per hour, and a maximum individual test-run emission rate of 18.0 grams of fine particles per hour; the test results

(A) must be obtained using one of the following test procedures applicable to the specific device:

(i) ASTM International E 2618-13, *Standard Test Method for Measurement of Particulate Emissions and Heating Efficiency of Solid Fuel-Fired Hydronic Heating Appliances*, approved September 1, 2013, and adopted by reference, subject to conditions in 40 C.F.R. Part 60, Subpart QQQQ, revised as of July 1, 2017, and adopted by reference;

(ii) [40 C.F.R. Part 60, Appendix A-8](#), Method 28WHH-PTS, revised as of July 1, 2017, and adopted by reference;

(B) must be obtained using one of the following test procedures applicable to the specific device:

(i) ASTM International E 2515-11, *Standard Test Method for Determination of Particulate Matter Emissions Collected by a Dilution Tunnel*, approved November 1, 2011, and adopted by reference;

(ii) [40 C.F.R. Part 60, Appendix A, Method 5G](#), revised as of July 1, 2017, and adopted by reference; and

(C) obtained under (A) and (B) of this paragraph must be submitted to and approved by the department as described in (e) of this section, if the wood-fired hydronic heater is not already listed under (e) of this section by the department.

(c) Except as provided under (f), (g), or (h) of this section, a person may not operate, install, or reinstall a woodstove in an area identified in [18 AAC 50.015\(b\)\(3\)](#), and may not supply, sell, lease, distribute, or convey a woodstove for operation or installation in an area identified in [18 AAC 50.015\(b\)\(3\)](#), unless

(1) the model

(A) has a valid certification under [40 C.F.R. 60.533](#) from EPA;

(B) meets the particulate matter annual average emission limit in (2) of this subsection; however, this subparagraph applies only to a woodstove that is installed on or after August 31, 2015; and

(C) has a rated size under 350,000 Btu per hour; or

(2) a laboratory with current EPA accreditation under [40 C.F.R. 60.535](#) has tested the model to meet a particulate matter annual average emission limit of 2.5 grams per hour; the test results must be

(A) obtained using

(i) the test procedures applicable to the specific device; those procedures are set out in 40 C.F.R. Part 60, Appendix A, Methods 28, 28A, and 28R, revised as of July 1, 2017, and adopted by reference; or

(ii) alternative cordwood methods that have been approved by EPA;

(B) obtained using the emission concentration measurement procedures applicable to the specific device; those procedures are set out in 40 C.F.R. Part 60, Appendix A, Methods 5G and 5H, revised as of July 1, 2017, and adopted by reference;

(C) calculated in grams per hour; and

(D) submitted to and approved by the department as described in (e) of this section, if the woodstove is not already listed under (e) of this section by the department.

(d) Except as provided under (f), (g), or (h) of this section, and if a wood-fired heating device has a rated size of 350,000 Btu or greater per hour, a person may not operate or install the wood-fired heating device in an area identified in [18 AAC 50.015\(b\)\(3\)](#), and may not supply, sell, lease, distribute, or convey the wood-fired heating device for operation or installation in an area identified in [18 AAC 50.015\(b\)\(3\)](#), unless a laboratory with current EPA accreditation under [40 C.F.R. 60.535](#) has tested the model to meet a particulate matter annual average emission limit of 2.5 grams per hour; the test results

(1) must be obtained using one of the following test procedures applicable to the specific device:

(A) ASTM International E 2618-13, *Standard Test Method for Measurement of Particulate Emissions and Heating Efficiency of Solid Fuel-Fired Hydronic Heating Appliances*, adopted by reference in (b)(2)(A)(i) of this section;

(B) [40 C.F.R. Part 60, Appendix A-8](#), Method 28WHH, revised as of July 1, 2017, and adopted by reference;

(C) Canadian Standards Association (CSA) Method B415.1-10, *Performance Testing of Solid-Fuel-Burning Heating Appliances*, dated March 2010, reaffirmed 2015, and adopted by reference, as referenced in 40 C.F.R. Part 60, Subpart QQQQ, revised as of July 1, 2017, and adopted by reference;

(2) must be obtained using ASTM International E 2515-11, *Standard Test Method for Determination of Particulate Matter Emissions Collected by a Dilution Tunnel*, adopted by reference in (b)(2)(B)(i) of this section; and

(3) obtained under (1) and (2) of this subsection must be submitted to and approved by the department as described in (e) of this section, if the wood-fired heating device is not already listed under (e) of this section by the department.

(e) The department may review, without a prior submission by the manufacturer, test results under (b)(2), (c)(2), or (d) of this section. If the department determines that the model tested complies with the requirements of (b)(2), (c)(2), or (d) of this section, as applicable, the department will approve the test results and place the model on the list that the department prepares under this subsection. If a wood-fired heating device subject to this section is not already on that list, and is not a wood-fired hydronic heater allowable under (b)(1) of this section or a woodstove allowable under (c)(1) of this section, the installation or operation of the wood-fired heating device or the supplying, sale, lease, distribution, or conveyance of the wood-fired heating device for operation or installation may not occur unless the manufacturer submits, and the department reviews and approves, proof of compliance with the requirements of (b)(1) or (c)(1) of this section, as applicable, or test results demonstrating compliance with the requirements of (b)(2), (c)(2), or (d) of this section, as applicable. The department will make a list of the wood-fired heating devices that the department has approved under this subsection or that are allowable under (b)(1) or (c)(1) of this section and will make the list available to the public.

(f) A person described in (a)(2) of this section may supply, sell, lease, distribute, convey, or install a wood-fired heating device if that person has confirmed in writing with the buyer or operator of the device that the device will be installed and used in an area other than an area identified in [18 AAC 50.015\(b\)\(3\)](#).

(g) Subsections (b) -- (d) of this section do not apply to operation of a wood-fired heating device that is located in an area that is identified in [18 AAC 50.015\(b\)\(3\)](#), if the wood-fired heating device was installed in that building or on that property before February 28, 2015.

(h) Subsections (b) - (d) of this section do not apply to the conveyance of a wood-fired heating device under (a)(1)(B) of this section if the owner requests and receives a temporary waiver from the department or a local air quality program. The department or local air quality program may grant a temporary waiver after considering

(1) financial hardship information provided by the owner or operator;

(2) technical feasibility information provided by the owner or operator; and

(3) potential impact to locations with populations sensitive to exposure to PM-2.5; locations under this paragraph include hospitals, schools, child care facilities, health clinics, long-term care facilities, assisted living homes, and senior centers.

(i) A person who disputes a decision by the department under this section may request review under [18 AAC 15.185](#) or [18 AAC 15.195- 18 AAC 15.340](#).

### Credits

Eff. 2/28/15, Register 213; am 11/26/2016, Register 220; am 1/12/2018, Register 225

### Editors' Notes

Editor's note: For the convenience of consumers, the United States Environmental Protection Agency (EPA) keeps a list of wood-fired hydronic heaters with qualifying "white tags" under EPA's Phase 2 voluntary partnership program for hydronic heaters. That list is part of EPA's *Partners - Program Participation - List of Qualified Hydronic Heaters*, and is available on the Internet at <http://www.epa.gov/burnwise/whhlist.html>. For additional information whether a heater appearing on that list is in compliance with 18 AAC 50.077, please contact the Department of Environmental Conservation at: Department of Environmental Conservation, Division of Air Quality, 410 Willoughby Avenue, Suite 303, P.O. Box 111180, Juneau, AK 99801; telephone: (907) 465-5100.

For the convenience of consumers, the United States Environmental Protection Agency (EPA) keeps a list of wood heaters certified under 40 C.F.R. 60.533. That list, entitled *List of EPA Certified Wood Heaters (Heaters certified as meeting the 1988 Standards of Performance for New Residential Wood Heaters)*, is available on the Internet at <http://www.epa.gov/Compliance/resources/publications/monitoring/caa/woodstoves/certifiedwod.pdf>. For additional information whether a heater appearing on that list is in compliance with 18 AAC 50.077, please contact the Department of Environmental Conservation, Division of Air Quality, 410 Willoughby Avenue, Suite 303, P.O. Box 111180, Juneau, AK 99801; telephone: (907) 465-5100.

The test methods adopted by reference in 18 AAC 50.077 may be reviewed at the department's Anchorage, Fairbanks, or Juneau office. For information on how to obtain a copy of the ASTM International documents adopted by reference in 18 AAC 50.077, contact ASTM International, Publications Department, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, Pennsylvania, 19428-2959; telephone (877) 909-2786; fax (610) 832-9555. For information on how to obtain a copy of the Canadian Standards Association document adopted by reference in 18 AAC 50.077, contact the Canadian Standards Association (CSA), 178 Rexdale Boulevard, Etobicoke, ON, M9W 1R3, Canada; telephone (416) 747-4139; fax (416) 401-6621.

The list of wood-fired heating devices maintained under 18 AAC 50.077(e) is available at the department's offices in Anchorage, Fairbanks, and Juneau, is available on the Internet at <http://burnwise.alaska.gov/>, or can be obtained by contacting the Department of Environmental Conservation, Division of Air Quality, 410 Willoughby Avenue, Suite 303, P.O. Box 111180, Juneau, AK 99801; telephone: (907) 465-5100.

Current with amendments received through the Quarterly Supplement, July 2018, (Register 226).

Alaska Admin. Code tit. 18, § 50.077, 18 AK ADC 50.077

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 KeyCite Yellow Flag - Negative Treatment  
Proposed Regulation

[Alaska Administrative Code](#)  
[Title 18. Environmental Conservation \(Refs & Annos\)](#)  
[Chapter 50. Air Quality Control \(Refs & Annos\)](#)  
[Article 9. General Provisions](#)

18 AAC 50.990

18 AAC 50.990. Definitions.

**Currentness**

In this chapter unless the context requires otherwise,

- (1) “actual emissions” has the meaning given in [40 C.F.R. 52.21\(b\)\(21\)](#), adopted by reference in [18 AAC 50.040](#);
- (2) “administrator” means the administrator of the United States Environmental Protection Agency, except as otherwise provided in [18 AAC 50.306- 18 AAC 50.326](#);
- (3) “air pollutant” has the meaning given in [AS 46.14.990](#);
- (4) “air-curtain incinerator” means a device in which large amounts of combustible materials are burned in a rectangular containment equipped with an overfire air system;
- (5) “air pollution” has the meaning given in [AS 46.03.900](#);
- (6) “air pollution control equipment” means equipment or a portion of equipment designed to reduce the emissions of an air pollutant to the ambient air;
- (7) “air quality control requirement” means any obligation created by AS 46.14, this chapter, or a term or condition of a preconstruction permit issued by the department before January 18, 1997;
- (8) “allowable emissions” has the meaning given in [40 C.F.R. 52.21\(b\)](#), except that for the purposes of establishing or revising a plantwide applicability limitation (PAL) under [40 C.F.R. 52.21\(aa\)](#), adopted by reference in [18 AAC 50.040](#),
  - (A) “allowable emissions” means the emissions rate of an emission unit calculated considering any emission limitation that is enforceable as a practical matter on the emission unit's potential to emit; and
  - (B) in the definition of “potential to emit” in [40 C.F.R. 51.166\(b\)](#), the words “or enforceable as a practical matter” are added after “federally enforceable”, as provided in [40 C.F.R. 51.166\(w\)\(2\)\(ii\)\(b\)](#);

(B) well frac units;

(C) well slickline units;

(D) well hot oil units; and

(E) well wireline units;

(126) “PAL pollutant” means the pollutant for which a plantwide applicability limitation (PAL) is established at a major stationary source;

(127) “regional administrator” means the administrator of Region X of EPA;

(128) “PM-2.5” means particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers;

(129) “ozone” means a colorless gas that has a pungent odor and the molecular form O<sub>3</sub>;

(130) “transportation improvement program” has the meaning given in [40 C.F.R. 93.101](#), revised as of July 1, 2013, and adopted by reference;

(131) “CO<sub>2</sub> equivalent emissions (CO<sub>2</sub>e)” has the meaning given in [40 C.F.R. 52.21](#), adopted by reference in [18 AAC 50.040](#);

(132) “greenhouse gases” has the meaning given in [40 C.F.R. 52.21](#), adopted by reference in [18 AAC 50.040](#).

(133) “campfire” means an open fire that is

(A) less than three feet in diameter;

(B) used for cooking, personal warmth, lighting, ceremonial, or aesthetic purposes;

(C) hand-built; and;

(D) not associated with a debris disposal activity;

(134) “dry wood” means wood with a moisture content of 20 percent or less;

# **EXHIBIT 15**

# ARTICLE 13: SOLID FUEL BURNING DEVICE STANDARDS

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## SECTION 13.01 POLICY AND PURPOSE Adopted 11/10/88 (634)

Revised 09/26/91 (708), 09/09/99 (895), 10/25/12 (1258)

The Board of Directors of the Puget Sound Clean Air Agency (Board) declares it to be the public policy of the Agency to control and reduce air pollution caused by solid fuel burning devices such as wood stoves, pellet stoves, and fireplaces. It is the Agency's policy to educate the public about the health effects of wood stove emissions and cleaner heating alternatives. It is the intent of this regulation to secure and maintain levels of air quality that protect human health and to comply with the requirements of the state and federal Clean Air Acts.

The Board encourages cities, towns and counties within its jurisdiction to enhance public education and assist in the enforcement of this Regulation during declared air quality episodes and periods of impaired air quality.

## SECTION 13.02 DEFINITIONS Adopted 09/23/04 (1036)

Revised 09/22/05 (1057), 10/25/12 (1258)

When used herein:

- (a) Adequate Source of Heat means a heating system designed to maintain seventy degrees Fahrenheit at a point three feet above the floor in each normally inhabited room. If any part of the heating system has been disconnected, damaged, or is otherwise nonfunctional, the Agency shall base the assessment of the adequacy of the design on the system's capability prior to the disconnection, damage, improper maintenance, malfunction, or occurrence that rendered the system nonfunctional.
- (b) AGENCY means the Puget Sound Clean Air Agency.
- (c) Certified Wood Stove means a wood stove that:
  - (1) has been determined by Ecology to meet Washington emission performance standards, pursuant to RCW 70.94.457 and WAC 173-433-100; or
  - (2) has been certified and labeled in accordance with procedures and criteria specified in "40 C.F.R. 60 Subpart AAA - Standards of Performance for Residential Wood Heaters" as amended through July 1, 1990; or
  - (3) meets the "Oregon Department of Environmental Quality Phase 2" emissions standards contained in Subsections (2) and (3) of Section 340-21-115, and is certified in accordance with "Oregon Administrative Rules, Chapter 340, Division 21 - Woodstove Certification" dated November 1984.

- (d) Coal-only heater means an enclosed, coal burning appliance capable of and intended for residential space heating, domestic water heating, or indoor cooking and has all of the following characteristics:
  - (1) An opening for emptying ash which is located near the bottom or the side of the appliance;
  - (2) A system which admits air primarily up and through the fuel bed;
  - (3) A grate or other similar device for shaking or disturbing the fuel bed or power driven mechanical stoker; and
  - (4) The model is listed by a nationally recognized safety testing laboratory for use of coal only, except for coal ignition purposes.
- (e) Ecology means the Washington State Department of Ecology.
- (f) EPA means the United States Environmental Protection Agency.
- (g) Fine particulate or PM<sub>2.5</sub> means particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers.
- (h) Fireplace means any permanently installed masonry fireplace or any factory-built metal solid fuel burning device designed to be used with an open combustion chamber and without features to control the air to fuel ratio.
- (i) Nonaffected pellet stove means a pellet stove that has an air-to-fuel ratio equal to or greater than 35.0 to 1.0 when tested by an accredited laboratory in accordance with methods and procedures specified by the EPA in "40 CFR 60 Appendix A, Test Method 28A - Measurement of Air to Fuel Ratio and Minimum Achievable Burn Rates for Wood-Fired Appliances" as amended through July 1, 1990.
- (j) Nonattainment area means a geographical area designated by EPA at 40 C.F.R. Part 81 as exceeding a National Ambient Air Quality Standard for a given criteria pollutant. An area is nonattainment only for the pollutants for which the area has been designated nonattainment.
- (k) PM<sub>10</sub> means particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers.
- (l) PROPERLY SEASONED FUEL WOOD means untreated wood or untreated lumber with moisture content of 20% or less, wet basis, or 25% or less, dry basis.
- (m) Solid Fuel Burning Device or solid fuel heating device means a device that burns wood, coal, or any other nongaseous or nonliquid fuels, and includes any device burning any solid fuel which has a heat input less than one million British thermal units per hour. This includes, but is not limited to,

devices used for aesthetic or space-heating purposes in a private residence or commercial establishment.

- (n) **SUBSTANTIALLY REMODELED** means any alteration or restoration of a building exceeding sixty percent of the appraised value of such building within a twelve-month period.
- (o) **TACOMA, WASHINGTON Fine Particulate Nonattainment Area** means the area of Pierce County that is designated by EPA as not meeting the 2006 federal 24-hr fine particulate National Ambient Air Quality Standard and described in 40 CFR 81.348. This area is also known as the Tacoma, Pierce County Nonattainment Area.
- (p) **Treated wood** means wood or lumber of any species that has been chemically impregnated, painted, or similarly modified to prevent weathering and deterioration.
- (q) **Wood stove or wood heater** means an enclosed solid fuel burning device capable of and intended for residential space heating and domestic water heating that meets the following criteria contained in "40 CFR 60 Subpart AAA - Standards of Performance for Residential Wood Heaters" as amended through July 1, 1990:
  - (1) An air-to-fuel ratio in the combustion chamber averaging less than 35.0, as determined by EPA Reference Method 28A;
  - (2) A useable firebox volume of less than twenty cubic feet;
  - (3) A minimum burn rate less than 5 kg/hr as determined by EPA Reference Method 28; and
  - (4) A maximum weight of 800 kg, excluding fixtures and devices that are normally sold separately, such as flue pipe, chimney, and masonry components not integral to the appliance.

Any combination of parts, typically consisting of but not limited to: doors, legs, flue pipe collars, brackets, bolts and other hardware, when manufactured for the purpose of being assembled, with or without additional owner supplied parts, into a woodstove, is considered a woodstove.

**SECTION 13.03 OPACITY STANDARDS** Adopted 12/08/94 (808)  
Renumbered 09/23/04 (1036); Revised 10/25/12 (1258)

- (a) A person shall not cause or allow emission of a smoke plume from any solid fuel burning device to exceed an average of twenty percent opacity for six consecutive minutes in any one-hour period.
- (b) **Test method and procedures.** Methods and procedures specified by the EPA in "40 CFR 60 Appendix A reference method 9 –Visual Determinations of the Opacity of Emissions from Stationary Sources" as amended through July

1, 1990, shall be used to determine compliance with subsection (a) of this section.

- (c) Enforcement. Smoke visible from a chimney, flue or exhaust duct in excess of the opacity standard shall constitute prima facie evidence of unlawful operation of a solid fuel burning device. This presumption may be refuted by demonstration that the smoke was not caused by a solid fuel burning device. The provisions of this section shall not apply during the starting of a new fire for a period not to exceed twenty minutes in any four-hour period.

### **SECTION 13.04 ALLOWED AND PROHIBITED FUEL TYPES**

Adopted 10/25/12 (1258)

- (a) A person shall cause or allow only the following materials to be burned in a solid fuel burning device:
  - (1) Properly seasoned fuel wood; or
  - (2) An amount of paper necessary for starting a fire; or
  - (3) Wood pellets; or
  - (4) Biomass fire logs intended for burning in a wood stove or fireplace; or
  - (5) Coal with sulfur content less than 1.0% by weight burned in a coal-only heater.
- (b) All other materials are prohibited from being burned in a solid fuel burning device, including, but not limited to: garbage; pallets; treated lumber; fencing; treated wood; plastic and plastic products; rubber products; animal carcasses; asphaltic products; waste petroleum products; paints and chemicals; paper (other than an amount necessary to start a fire); or any substance that emits dense smoke or obnoxious odors.

### **SECTION 13.05 RESTRICTIONS ON OPERATION OF SOLID FUEL BURNING DEVICES**

Adopted 10/25/12 (1258)

- (a) No person in a residence or commercial establishment shall operate a solid fuel burning device under any of the following conditions:
  - (1) Whenever the Agency has declared the first stage of impaired air quality for a geographical area in accordance with RCW 70.94.473(1)(b)(i) or (ii), unless an exemption for the residence or commercial building has been obtained from the Agency pursuant to subsection (d) of this section or the solid fuel burning device is one of the following:

- (A) A nonaffected pellet stove; or
  - (B) A wood stove certified and labeled by the EPA under "40 CFR 60 Subpart AAA - Standards of Performance for Residential Wood Heaters" as amended through July 1, 1990; or
  - (C) A wood stove meeting the "Oregon Department of Environmental Quality Phase 2" emission standards contained in Subsections (2) and (3) of Section 340-21-115, and certified in accordance with "Oregon Administrative Rules, Chapter 340, Division 21 – Woodstove Certification" dated November 1984; or
  - (D) A solid fuel burning device approved by Ecology as meeting the standards in RCW 70.94.457(1)(a)-(b).
- (2) Whenever the Agency has declared the second stage of impaired air quality for a geographical area in accordance with RCW 70.94.473(1)(c)(i), (ii), or (iii) unless an exemption for the residence or commercial building has been obtained from the Agency pursuant to subsection (d) of this section.
- (b) Whenever a first stage of impaired air quality is declared under subsection (a)(1):
- (1) New solid fuel shall be withheld from any solid fuel burning device already in operation for the duration of the first stage of impaired air quality if that device is restricted from operating under subsection (a)(1) of this section during the first stage of impaired air quality;
  - (2) Smoke visible from a chimney, flue, or exhaust duct after three hours has elapsed from the declaration of a first stage of impaired air quality shall constitute prima facie evidence of unlawful operation of a solid fuel burning device if that solid fuel burning device is restricted from operating during a first stage of impaired air quality. This presumption may be refuted by demonstration that the smoke was not caused by a solid fuel burning device.
- (c) Whenever a second stage of impaired air quality is declared under subsection (a)(2):
- (1) New solid fuel shall be withheld from any solid fuel burning device already in operation for the duration of the second stage of impaired air quality if that device is restricted from operating under subsection (a)(2) of this section during the second stage of impaired air quality.

- (2) Smoke visible from a chimney, flue, or exhaust duct after three hours has elapsed from the declaration of a second stage of impaired air quality shall constitute prima facie evidence of unlawful operation of a solid fuel burning device if that solid fuel burning device is restricted from operating during a second stage of impaired air quality. This presumption may be refuted by demonstration that the smoke was not caused by a solid fuel burning device.
- (d) Any person desiring an exemption from the Agency for the purposes of subsections (a)(1) or (2) of this section shall apply to the Agency using procedures specified by the Agency.
  - (1) The following are eligible for exemption:
    - (A) A residence or commercial building that has no adequate source of heat other than a solid fuel burning device and the building was neither constructed nor substantially remodeled after July 1, 1992.
    - (B) A residence or commercial building that has no adequate source of heat other than a solid fuel heating device and the building:
      - i. was constructed or substantially remodeled after July 1, 1992; and
      - ii. is outside an urban growth area, as defined in RCW 36.70A; and
      - iii. is outside an area designated by EPA as a PM2.5 or PM10 particulate nonattainment area.
  - (2) Exemptions shall be valid for a period determined by the Agency. Exemptions may be renewed using procedures specified by the Agency, provided the applicant meets the applicable requirements at the time of exemption renewal. Exemptions may be revoked if the Agency determines the residence or commercial building for which the exemption was approved no longer qualifies for an exemption.

## **SECTION 13.06 EMISSION PERFORMANCE STANDARDS**

Adopted 10/25/12 (1258)

- (a) Solid fuel burning devices. A person shall not advertise to sell, offer to sell, sell, bargain, exchange, give away, or install a solid fuel burning device unless it meets both subsections (1) and (2):
  - (1) It has been certified and labeled in accordance with procedures and criteria specified in "40 CFR 60 Subpart AAA - Standards of

Performance for Residential Wood Heaters" as amended through July 1, 1990; and

- (2) It meets the following particulate air contaminant emission standards and the test methodology of EPA in effect on January 1, 1991, or an equivalent standard under any test methodology adopted by EPA subsequent to such date:
    - (A) Two and one-half grams per hour for catalytic woodstoves; and
    - (B) Four and one-half grams per hour for all other solid fuel burning devices.
  - (3) For purposes of subsection (a)(2) of this section, "equivalent" shall mean the emissions limits specified in subsection (a)(2) multiplied by a statistically reliable conversion factor determined by Ecology that relates the emission test results from the methodology established by the EPA prior to May 15, 1991, to the test results from the methodology subsequently adopted by EPA.
- (b) Fireplaces. A person shall not advertise to sell, offer to sell, sell, bargain, exchange, give away, or install a factory-built fireplace unless it meets the 1990 EPA standards for wood stoves or an equivalent standard that may be established by the state building code council by rule.
  - (c) Subsection (a) of this section shall not apply to fireplaces, including factory-built fireplaces and masonry fireplaces.

### **SECTION 13.07 PROHIBITIONS ON WOOD STOVES THAT ARE NOT CERTIFIED WOOD STOVES** Adopted 10/25/12 (1258)

- (a) Subsections (a)(1) – (a)(4) of this section shall be effective January 1, 2015 and apply only to PM<sub>2.5</sub> nonattainment areas or areas where required by EPA.
  - (1) Any person who owns or is responsible for a wood stove that is both (a) not a certified wood stove and (b) is located in the Tacoma, Washington fine particulate nonattainment area must remove and dispose of it or render it permanently inoperable by September 30, 2015.
  - (2) Any person who owns or is responsible for a coal-only heater located in the Tacoma, Washington fine particulate nonattainment area must remove and dispose of it or render it permanently inoperable by September 30, 2015.

- (3) Subsection (a)(1) of section does not apply to:
  - (A) A person in a residence or commercial establishment that does not have an adequate source of heat without burning wood; or
  - (B) A person with a shop or garage that is detached from the main residence or commercial establishment that does not have an adequate source of heat in the detached shop or garage without burning wood.
- (4) The owner or person responsible for removing or rendering permanently inoperable a wood stove under subsection (a)(1) of this section or a coal-only heater under subsection (a)(2) of this section must provide documentation of the removal and disposal or rendering permanently inoperable to the Agency using the Agency's procedures within 30 days of the removal or rendering permanently inoperable.
- (b) PM10. Subsection (b) of this section is established for the sole purpose of a contingency measure for PM10 nonattainment and maintenance areas. If the EPA makes written findings that: (1) an area has failed to attain or maintain the National Ambient Air Quality Standard for PM10, and (2) in consultation with Ecology and the Agency, finds that the emissions from solid fuel burning devices are a contributing factor to such failure to attain or maintain the standard, the use of wood stoves not meeting the standards set forth in RCW 70.94.457 shall be prohibited within the area determined by the Agency to have contributed to the violation. This provision shall take effect one year after such a determination.

# **EXHIBIT 16**



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# Wood Stove Change-Out Program for Greater Portola Nonattainment Area

*This page last reviewed August 3, 2017*

This page contains information regarding the [Northern Sierra Air Quality Management District](#) (District) comprehensive wood stove change-out program. This program was established with the help of a U.S. EPA Targeted Air Shed Grant. (Unless otherwise noted, documents are in .pdf format.)

## Background

In 2015, [U.S. EPA designated](#) the City of Portola and the surrounding communities in Plumas County as a Moderate Nonattainment Area for the annual 12.0 ug/m<sup>3</sup> fine particulate matter (PM<sub>2.5</sub>) standard with a deadline of December 2021 for attainment. The predominant source of PM<sub>2.5</sub> pollution in Portola is residential wood combustion from space heating. The elevated PM<sub>2.5</sub> concentrations occur during winter months when stagnant air conditions are coupled with increased demand for home heating. On those days, emissions from wood burning contribute almost 90 percent of particle pollution.

Many households in the Nonattainment Area heat their homes with old, highly polluting, and inefficient wood stoves. The newest U.S. EPA-certified wood stoves burn up to 80 percent cleaner than the older uncertified stoves. In an effort to protect public health and the environment, the District established the [Greater Portola Wood Stove Change-Out Program](#) (Program). This Program provides residents of the Nonattainment Area with incentives to replace their inefficient and highly polluting stoves with more efficient and cleaner-burning home heating devices. The District received approximately \$2.5 million for this Program from U.S. EPA's 2015 Targeted Air Shed Grant. This funding will provide for the change-out of approximately 600 stoves by the end of 2020.

## Greater Portola Wood Stove Change-Out Program

The Program marks the beginning of a broad-based effort to overhaul the old burning practices in the Nonattainment Area by implementing the following changes:

- Helping residents replace their old wood stoves with cleaner burning and more efficient devices;
- Requiring professional installation to ensure maximum efficiency and minimum pollution from each change-out;
- Requiring removal and destruction of the old stoves;
- Banning installation of uncertified stoves in the Nonattainment Area;

- Raising awareness of proper maintenance of heating equipment to achieve optimum performance; and
- Educating households on the importance and benefits of splitting, stacking, and covering firewood.

The main goal of the Program is to reduce pollution and help the area attain the PM2.5 standards. However, the benefits of the Program go far beyond the main goal by improving the well-being of the community, including:

- Improved Health - Exposure to woodsmoke has been linked to short- and long-term health problems, including reduced lung function, asthma complications, bronchitis, harmful birth outcomes such as low birth weight, increased impacts on the heart, and premature death.
- Reduced Fuel Costs - Consumers should be able to save approximately one-third of their annual fuels costs through the use of professionally installed, certified, high-efficiency wood stoves.
- Increased Safety - Many old wood stoves pose serious fire risks and professionally installed new stoves will meet local fire and building codes.
- Improved Comfort - A more efficient stove will make it easier to maintain a comfortable temperature in the residence at lower cost.

Residents of the Nonattainment Area are encouraged to take advantage of this opportunity. With incentives, every household in the Nonattainment Area could replace their inefficient uncertified stoves for little or no cost.

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# **ENCLOSURE 2**

**Utah Petroleum Association Comments**

**Revisions to Section IX, Control Measures for Area and Point  
Sources, Part H, Emission Limits**

**Specific Comments on Parts H.1, H.2, H.11, & H.12**

August 15, 2018

The following comments are submitted by the Utah Petroleum Association (“UPA”) on the Revisions to Section IX, Control Measures for Area and Point Sources, Part H, Emissions Limits.<sup>1</sup> These comments specifically focus on Part H.1, General Requirements: Control Measures for Area and Point Sources, Emission Limits and Operating Practices, PM10 Requirements; Part H.2, Source Specific Emission Limitations in Salt Lake County PM10 Nonattainment/Maintenance Area; Part H.11, General Requirements: Control Measures for Area and Point Sources, Emission Limits and Operating Practices PM2.5; and Part H.12, Source-Specific Emission Limitations in Salt Lake City – UT PM2.5 Nonattainment Area.

**I. Comment No. 1: Use of All U.S. EPA-Approved Test Methods Should be Permissible**

The PM SIP identifies specific U.S. Environmental Protection Agency (“EPA”)-approved test methods to be used for determining compliance with emission levels for certain sources. Following the identification of these specific EPA-approved test methods, the Rule allows for the use of other EPA-approved test methods that are “acceptable” to the Director. As UDAQ is aware, EPA-approved test methods undergo substantive evaluation and are subject to the federal rulemaking process, including public notice and comment. This long-established process provides the necessary procedure for determining whether a specific test method is appropriate. Further, UDAQ has provided no basis or criteria that the Director would use in determining whether to accept a test method approved by EPA. The lack of any such protocol could result in inconsistent and, potentially, arbitrary determinations in this regard. In light of such concerns, the phrase “acceptable to the Director” should be struck from several provisions of the Rule as shown below.<sup>2</sup> While the use of all EPA-approved test methods should be permissible, to the extent a test method is *not* approved by EPA, UPA believes it would be appropriate under such circumstance for non-EPA-approved methods to be acceptable upon approval by UDAQ.

**Subsection IX.H.1.e.i.A**

Sample Location: The emission point shall be designed to conform to the requirements of 40 CFR 60, Appendix A, Method 1, or other EPA-approved testing methods ~~acceptable to the Director~~.

**Subsection IX.H.1.e.i.B**

Volumetric Flow Rate: 40 CFR 60, Appendix A, Method 2 or EPA Test Method No. 19 “SO2 Removal & PM, SO2, NOx Rates from Electric Utility Steam Generators” or other EPA-approved testing methods ~~acceptable to the Director~~.<sup>3</sup>

**Subsection IX.H.1.e.i.C**

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<sup>1</sup> 2018-13 Utah Bull. pp. 34-36 (July 1, 2018); *see also* Utah Air Quality Board, Final Agenda, Items VIII and IX (June 6, 2018).

<sup>2</sup> Recommended insertions are shown in underlined text and deletions are shown in ~~striketrough~~.

<sup>3</sup> *See* Comment No. 3 (describing basis for additional changes).

PM<sub>10</sub>: [The following methods shall be used to measure condensable particulate emissions: ]40 CFR 51, Appendix M, Methods ~~[201 or]~~201a and 202, or other EPA approved testing methods acceptable to the Director.

**Subsection IX.H.1.e.i.D**

SO<sub>2</sub>: 40 CFR 60 Appendix A, Method 6C or other EPA-approved testing methods acceptable to the Director.

**Subsection IX.H.1.e.i.E**

NO<sub>x</sub>: 40 CFR 60 Appendix A, Method 7E or other EPA-approved testing methods acceptable to the Director.

**Subsection IX.H.2.d.iii.A**

The emission factor to be used for combustion shall be calculated based on the weight percent of sulfur, as determined by ASTM Method D-3 4294-89 or EPA-approved equivalent acceptable to the Director.

**Subsection IX.H.11.e.i.A**

Sample Location: The emission point shall be designed to conform to the requirements of 40 CFR 60, Appendix A, Method 1, or other EPA-approved testing methods acceptable to the Director.

**Subsection IX.H.11.e.i.B**

PM: 40 CFR 60, Appendix A, Method 2 or EPA Test Method No. 19 “SO<sub>2</sub> Removal & PM, SO<sub>2</sub>, NO<sub>x</sub> Rates from Electric Utility Steam Generators” or other EPA-approved testing methods acceptable to the Director.

**Subsection IX.H.11.e.i.C**

PM: 40 CFR 60, Appendix A, Method 5, Method 5B, Method 5F, or other EPA approved testing methods acceptable to the Director.<sup>4</sup>

**Subsection IX.H.11.e.i.D**

PM<sub>10</sub>: 40 CFR 51, Appendix M, Methods 201a and 202, or other EPA approved testing methods acceptable to the Director.

**Subsection IX.H.11.e.i.E**

PM<sub>2.5</sub>: 40 CFR 51, Appendix M, 201a and 202, or other EPA approved testing methods acceptable to the Director.

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<sup>4</sup> See Comment No. 3 (describing basis for additional changes).

**Subsection IX.H.11.e.i.F**

SO<sub>2</sub>: 40 CFR 60 Appendix A, Method 6C, or other EPA-approved testing methods ~~acceptable to the Director.~~

**Subsection IX.H.11.e.i.F**

NO<sub>x</sub>: 40 CFR 60 Appendix A, Method 7E, or other EPA-approved testing methods ~~acceptable to the Director.~~

**Subsection IX.H.11.e.i.H**

VOC: 40 CFR 60 Appendix A, Method 25A or other EPA-approved testing methods ~~acceptable to the Director.~~

**Subsection IX.H.12.d.iii.A**

Fuel oil & HF Alkylation polymer: The emission factor to be used for combustion shall be calculated based on the weight percent of sulfur, as determined by ASTM 45 Method D-4294-89 or EPA-approved equivalent ~~acceptable to the Director.~~

**II. Comment No. 2: Use of AP-42 Factors Should Not Be Mandated**

While useful in many circumstances, emission factors, such as those found in AP-42, represent an average of a range of emission rates and average emissions can differ from source to source.<sup>5</sup> Thus, AP-42 may not provide the most adequate estimate of emissions for a specific source. Importantly, although the causes of this variability are considered in emission factor development, according to EPA, this type of information is seldom included in emission test reports used to develop AP-42 factors.<sup>6</sup> Indeed, in its “Emissions Estimation Protocol for Petroleum Refineries”, EPA generally considers AP-42 emission factors to be the lowest ranking emissions estimating methodology.<sup>7</sup> Given the availability of more accurate and appropriate methods for estimating such emissions, the following provisions of the Rule should be modified to include the phrase “other EPA-approved methods” after references to AP-42.

**Subsection IX.H.2.d.i.A**

HF alkylation polymer: shall be determined from the latest edition of AP-42 or other EPA-approved methods (HF alkylation polymer treated as fuel oil #6)

Diesel fuel: shall be determined from the latest edition of AP-42 or other EPA-approved methods

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<sup>5</sup> See AP-42, Vol. 1, p. 2, available at: <https://www3.epa.gov/ttnchie1/ap42/c00s00.pdf>.

<sup>6</sup> *Id.* at 3.

<sup>7</sup> Emissions Estimation Protocol for Petroleum Refineries, Version 3, RTI International (April 2015), available at: <https://www3.epa.gov/ttn/chie/efpac/protocol/Protocol%20Report%202015.pdf>.

Cooling Towers: shall be determined from the latest edition of AP-42 or other EPA-approved methods

**Subsection IX.H.2.d.ii.A**

Natural gas: shall be determined from the latest edition of AP-42 or other EPA-approved methods

Alkylation polymer: shall be determined from the latest edition of AP-42 or other EPA-approved methods (as fuel oil #6)

Diesel fuel: shall be determined from the latest edition of AP-42 or other EPA-approved methods

**Subsection IX.H.12.d.i.A**

HF alkylation polymer: shall be determined from the latest edition of AP-42 or other EPA-approved methods (HF alkylation polymer treated as fuel oil #6)

Diesel fuel: shall be determined from the latest edition of AP-42 or other EPA-approved methods

**Subsection IX.H.12.d.ii.A**

Natural gas: shall be determined from the latest edition of AP-42 or other EPA-approved methods

Alkylation polymer: shall be determined from the latest edition of AP-42 or other EPA-approved methods (as fuel oil #6)

Diesel fuel: shall be determined from the latest edition of AP-42 or other EPA-approved methods

**III. Comment No. 3: General Requirements for PM<sub>10</sub> and PM<sub>2.5</sub> Should Be Consistent**

**1. Volumetric Flow Rate Test Methods**

Subsection IX.H.11.e.i.B (methods for determining volumetric flow rates during stack testing associated with PM<sub>10</sub> levels) provides for the use of either EPA Test Method 2 “Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pilot Tube)” or Method 19 “Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxide Emission Rates”.<sup>8</sup> However, the parallel provision in Subsection IX.H.1.e.i.B regarding stack testing for PM<sub>2.5</sub> provides for the use of only EPA Method 2. As shown below, Subsection IX.H.1.e.i.B (PM<sub>10</sub>) should be modified to include Method 19 as an acceptable methodology in order to be consistent with Subsection IX.H.11.e.i.B (PM<sub>2.5</sub>).

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<sup>8</sup> We note an error in the numbering for H.11.e.1.A-K, as the sequence is A, B, C, then A, B, C, D through K.

### **Subsection IX.H.1.e.i.B**

Volumetric Flow Rate: 40 CFR 60, Appendix A, Method 2, EPA Test Method No. 19 “SO<sub>2</sub> Removal & PM, SO<sub>2</sub>, NO<sub>x</sub> Rates from Electric Utility Steam Generators” or other EPA-approved testing methods ~~acceptable to the Director~~.

## **2. Particulate Matter Emissions Test Methods**

As shown below, Subsection IX.H.11.e.i.C (methods for determining PM<sub>2.5</sub> emissions) should be modified to provide for the use of EPA Method 5B (“Determination Of Nonsulfuric Acid Particulate Matter Emissions From Stationary Sources”), EPA Method 5F (“Determination of Nonsulfate Particulate Matter Emissions From Stationary Sources”), and EPA Method 17 (“Determination of Particulate Matter Emissions From Stationary Sources”) since the use of these methods is necessary to satisfy the requirements set forth in 40 C.F.R. section 60.106a (Monitoring of emissions and operations for sulfur recovery plants).

### **Subsection IX.H.11.e.i.C**

PM: 40 CFR 60, Appendix A, Method 5, Method 5B, Method 5F, Method 17 or other EPA approved testing methods ~~acceptable to the Director~~.

## **IV. Comment No. 4: Use of Undefined Terms “Particulate Emissions” and “PM” Creates Significant Ambiguity**

UDAQ’s proposal to replace the term “PM<sub>10</sub>” with the term “particulate emissions” in Subsection IX.H.1.g.i.B.III. and its use of the generic term “PM” in Subsections IX.H.11.i.A.<sup>9</sup> and IX.H.11.g.i.B.I and II create significant ambiguity. While the terms “PM<sub>2.5</sub>” and “PM<sub>10</sub>” are defined in R307-101-2, “particulate emissions” and “PM” are not defined and do not appear in other provisions of UDAQ rules.<sup>10</sup> In fact, we have identified only one instance in which the phrase “particulate emission” appears in UDAQ rules: the *title* of R307-305-4 is “Particulate Emission Limitations and Operating Parameters (PM<sub>10</sub>)”. Given that “particulate emissions” and “PM” are not defined in UDAQ rules, Subsections IX.H.1.g.i.B.III., IX.H.11.i.A., and IX.H.11.g.i.B.I and II should be modified to reference either PM<sub>2.5</sub> or PM<sub>10</sub>, as appropriate.

## **V. Comment No. 5: Applying Federal Clean Air Act NSPS Ja Requirements to Facilities Subject to NSPS J is Inappropriate**

The PM SIP inappropriately proposes to apply certain requirements of EPA’s New Source Performance Standards for Petroleum Refineries, codified in 40 C.F.R., Part 60, Subpart Ja (“NSPS Ja”). Specifically, Subsections IX.H.1.g.i.A.II and IX.H.11.g.i.A.II require demonstration of compliance with the Fluid Catalytic Cracking Units (“FCCU”) SO<sub>2</sub> limit in accordance with 40 C.F.R. section 60.105a(g). In addition, Subsections IX.H.1.g.i.B.III and IX.H.11.g.i.B.III require

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<sup>9</sup> This is the second “A.” in this Subsection. There is an error in the numbering for what should be H.11.e.1.C and D, as those sections are incorrectly identified as “A” and “B”, respectively.

<sup>10</sup> “PM<sub>2.5</sub>” means “particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers as measured by an EPA reference or equivalent method.” “PM<sub>10</sub>” means “particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers as measured by an EPA reference or equivalent method.” R307-101-2 (Definitions).

that FCCU install and operate continuous parameter monitoring system (CPMS) in accordance with 40 C.F.R. section 60.105a(b)(1).<sup>11</sup>

Imposing NSPS Ja in this regard is inappropriate as these provisions require implementation of costly monitoring equipment without any corresponding reduction in particulate matter emission. Specifically, FCCUs at Chevron Salt Lake and Big West refineries are subject to NSPS J, not NSPS Ja. As a result, these facilities would incur potentially large capital costs and need to implement extensive operating changes required by NSPS Ja. For example, 40 C.F.R. section 60.105a(b)(1) requires an outlay of considerable resources to install, operate and maintain a CPMS. Importantly, however, deployment of such extensive monitoring equipment will have *no* corresponding reduction of particulate matter emissions, as particulate matter and SO<sub>2</sub> emission limits for FCCU are the *same* under NSPS J and Ja.<sup>12</sup> In addition, while NSPS Ja requires extensive monitoring equipment, emissions are determined under NSPS J in accordance with prescribed stack tests, a method clearly endorsed under other provisions of the Rule.<sup>13</sup>

The *ad hoc* application of certain NSPS Ja provisions in this regard to facilities not subject to NSPS Ja (only NSPS J)—without any associated reductions in particulate matter emissions—is arbitrary and capricious. In light of these concerns, these provisions should be revised as follows:

**Subsection IX.H.1.g.i.A.II**

Compliance with this limit shall be determined by using a CEM in accordance with IX.H.1.f following 40 C.F.R. §60.105a(g).

**Subsection IX.H.11.g.i.A.II**

Compliance with this limit shall be determined by using a CEM in accordance with IX.H.1.f following 40 C.F.R. §60.105a(g).

**Subsection IX.H.1.g.i.B.III**

~~[By n]No later than January 1, 2019, each owner or operator of an FCCU shall install, operate and maintain a continuous parameter monitor system (CPMS) to measure and record operating parameters from the FCCU for determination of source wide [PM10 ]particulate emissions as per the requirements of 40 CFR 60.105a(b)(1).~~

**Subsection IX.H.11.g.i.B.III**

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<sup>11</sup> We note that Subsections IX.H.1.g.i.B.III and IX.H.11.g.i.B.III require CPMS to measure operating parameters for determining source-wide particulate matter *emissions*. This appears to be in error, as CPMS are required under NSPS Ja to measure and record *operating parameters* of control devices such as power input, pressure drop, liquid feed rate, exhaust gas flow rate, coke burn-off rate, as well as FCCU hours of operation—not emissions. 40 C.F.R. § 105a(b)(1). This provision also appears to conflict with Subsection IX.H.2.d.1.A. that provides for the use of *stack tests* (not CPMS operating parameters) for determining emission factors for source-wide particulate matter emissions.

<sup>12</sup> See 40 C.F.R. §§ 60.102(a)(1), 60.104(b)(1), 60.102a(b)(1)(iii), and 60.102a(b)(3).

<sup>13</sup> Subsection IX.H.2.d.1.A. (providing for the use of stack tests for determining emission factors for source-wide particulate matter emissions); see 40 C.F.R. § 60.106(b).

~~[By n]No later than January 1, 2019, each owner or operator of an FCCU shall install, operate and maintain a continuous parameter monitor system (CPMS) to measure and record operating parameters for determination of source wide PM<sub>2.5</sub> emissions as per the requirements of 40 CFR 60.105a(b)(1).~~

## **VI. Comment No. 6: Petroleum Refineries FCCU Particulate Matter Emission Limit Should Not Be Based on 3-hour Average Basis**

Subsections IX.H.1.g.i.B.I and IX.H.11.g.i.B.I provide for a particulate matter emission limit for FCCUs at petroleum refineries of 1.0 pounds PM per 1,000 pounds of coke burned. The PM SIP expressly requires that compliance with this emission limit be determined in accordance with the *stack test* protocol provided in NSPS J or NSPS Ja (for compliance with Subsection IX.H.1.g.i.B.I.)<sup>14</sup> and NSPS J (for compliance with Subsection IX.H.11.g.i.B.I.).<sup>15</sup> The stack test protocol under NSPS J requires that the “sampling time for each run shall be at least 60 minutes.”<sup>16</sup> Separately, NSPS Ja requires that particulate matter performance tests “consist of **3 valid test runs**” and that “the duration *of each test run* must be **no less than 60 minutes**.”<sup>17</sup> Thus, the stack tests protocols under NSPS J and NSPS Ja set forth specific parameters for both the number and length of each test that must be satisfied in order to conduct a valid test.

While the PM SIP expressly requires compliance demonstration in accordance with NSPS J and NSPS Ja, Subsections IX.H.1.g.i.B.I and IX.H.11.g.i.B.I both provide that the 1.0 pounds PM per 1,000 pounds of coke burned must be based on a “3-hour average basis.” This language suggests that compliance with the limit is required on a *continuous* 3-hr average basis. In reality, a stack test conducted in accordance with NSPS J or Ja does not allow PM emissions to be determined on a continuous or rolling 3-hr average. Thus, duration limits and calculation methods under Subsections IX.H.1.g.i.B.I and IX.H.11.g.i.B.I—contrary to requirements under NSPS J and NSPS Ja (expressly required by Subsections IX.H.1.g.i.B.II and IX.H.11.g.i.B.II)—effectively renders compliance with both provisions of the PM SIP impossible. Further, UDAQ has provided no technical basis for why a 3-hour average basis—contrary to long-established stack test protocols under NSPS J and NSPS Ja—are necessary and appropriate. In light of these significant issues, these provisions should be revised as follows:

### **Subsection IX.H.1.g.i.B.I**

~~[By no later than January 1, 2018, e]Each owner or operator of an FCCU shall comply with an emission limit of 1.0 pounds PM per 1000 pounds coke-burn-off, burned on a 3-hour average basis.~~

### **Subsection IX.H.11.g.i.B.I**

~~[By no later than January 1, 2018, e]Each owner or operator of an FCCU shall comply with an emission limit of 1.0 pounds PM per 1000 pounds coke-burn-off, burned on a 3-hour average basis.~~

<sup>14</sup> Subsection IX.H.1.g.i.B.II; see 40 C.F.R §§ 60.106 (NSPS J); 60.104a (NSPS Ja).

<sup>15</sup> Subsection IX.H.11.g.i.B.II.

<sup>16</sup> 40 C.F.R § 60.106(b)(2) (emphasis added).

<sup>17</sup> *Id.* at § 60.104a(d)(4)(i) (emphasis added).