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RESPONSE TO COMMENT ON THE RESOLUTION COPPER PROJECT DEIS: ACTION ITEM AQ1 – TECHNICAL RESPONSES TO COMMENTS FROM ADEQ – FEC ON THE AIR QUALITY RESOURCES SECTION OF THE DEIS.

PREPARED FOR:	Mary Rasmussen, Project Manager, USDA – Forest Service, Tonto National Forest
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PROJECT NO.:	262-37
COPIES:	Resolution Copper
DATE:	June 2, 2020

This technical memorandum provides Air Sciences Inc.'s (Air Sciences) response to Air Quality Action Item AQ1 which includes technical responses to comments from Arizona Department of Environmental Quality (ADEQ) – Facility Emissions Control (FEC) on the air quality resources section of the Draft Environmental Impact Statement (DEIS) for the Resolution Copper Project. ADEQ – FEC's comments and Air Sciences' responses are listed below in the body of the technical memo.

Technical Responses to ADEQ – FEC Comments on DEIS

- Draft EIS Pg. 277 AERMOD/AERMET

The 2019 NEPA Air Quality Impacts Analyses Report indicates that Resolution used AERMOD 18081 version and AERMET 16216 version for near-field analyses. It is not clear why AERMET 16216 instead of AERMET 18081 was used. Please note that the EPA released an updated AERMOD/AERMET version (dated 19191) on August 21, 2019. It is recommended to review the recent AERMOD/AERMET updates to check whether such updates will affect the modeled results or not.

  - The NEPA modeling plan was published in June 2018; the version 18081 was released March 2018 and the draft EIS was published for public comment on August 9, 2019 - all before EPA's release of the updated AERMOD/AERMET 2019 version (August 21, 2019).

- In October of 2018 (after the NEPA report was completed), the meteorological data was re-processed with version 18081 of AERMET and AERMOD was re-run. The AERMET data files were identical and there were no changes to impacts resulting from the revised AERMET version.

- In December 2019, the meteorological data was re-processed with version 19191 of AERMET. Again, the AERMET data files were identical.

- In January 2020, a test run of AERMOD ver. 19191 with AERMET ver. 19191 meteorological data (19191 Test Model). The test run included all alternatives at the maximum impact locations as determined by the DEIS model run. The impacts from the DIES model and the 19191 Test Model were identical.

- The AERMET data file comparisons and the results of the 19191 Test model are strong indications that NAAQS impact results disclosed in the DEIS would not change based on the revisions to AERMOD and AERMET in 2019 (version 19191). Further, U.S. EPA's changes to AERMOD focus on miscellaneous bug fixes. Modeled impacts presented in 2019 NEPA Air Quality Impacts Analysis Report and disclosed in the DEIS are all well below the ambient standard (78% is the highest) and findings/conclusions in the DEIS would not change solely due to utilizing the most recent version of AERMET/AERMOD.

- Draft EIS Pg. 277 CALPUFF

In the 2017 Appendix W Final Rule, EPA removes CALPUFF as a preferred model for long-range transport assessments. It is recommended to provide justification why the use of CALPUFF is appropriate for Class I area PDS increment and AQRV analyses.

- The model plan for far-field analyses proposed CALPUFF (per FLAG 2010 guidance, and pre-2017 EPA recommended models) and was reviewed and approved by participants of the DIES air quality working group including: Pinal County Air Quality Control District (PCAQCD); ADEQ; and USDA – FS). For the DEIS, the selection and use of CALPUFF was agreed to by these reviewing authorities.

  - Part 51 Appendix W §4.2.(c)(ii) "For assessment of the significance of ambient impacts for NAAQS and/or PSD increments, there is not a preferred model or screening approach for distances beyond 50 km. Thus, the appropriate reviewing authority (paragraph 3.0(b)) and the EPA Regional Office shall be consulted in determining the appropriate and agreed upon screening technique to conduct the second level assessment."

- Since its release in 1990, CALPUFF has undergone dozens of updates and improvements and many rounds of approval by U.S. EPA. CALPUFF has been relied upon by state agencies and federal land managers (FLMs) in thousands of analyses to assess long range transport of pollutants and their impacts on Class I areas. CALPUFF continues to be listed by U.S. EPA as an alternative model and EPA continues to recommend its use for regulatory applications on scales of tens to hundreds of kilometers (the scale of the modeling done for the DEIS). Currently there is no specific replacement model for long-range transport and thus CALPUFF continues to be a relied upon model for this type of analysis.
  - From April 2003 until January 2017, CALPUFF was the EPA preferred model for long-range transport for the purposes of assessing NAAQS and/or PSD increments. As stated in Section 6 of the Final Rulemaking for the January 2017 revision of the U.S. EPA Guideline on Air Quality Models (82 FR 5196), "EPA's final action to remove CALPUFF as a preferred Appendix A model in this Guideline does not affect its use under the FLM's guidance regarding AQRV assessments (FLAG 2010)…"
- Although far-field impacts to PSD increments and AQRV's have been estimated using CALPUFF, impacts are actually presented in the EIS that are based on the AERMOD analysis at the nearest receptor to the Class I area that is 50 km from the proposed source. The text in the EIS will be re-worded to address that fact. The data from the NEPA Air Quality Analysis Report Section 3.2.2.2 Tables 3-25 through 3-28 were used to develop the data presented in the EIS in Table 3.6.4-2. The text will be clarified to indicate that the results were from the "AERMOD nearest-receptor" analysis.

- Draft EIS Pg. 277 Years of Meteorological Data

It is recommended to delete the statement of "The dispersion models [rely] on 2 continuous years of meteorological data collected from the on-site monitors". While AERMOD used 2-years site-specific meteorological data, CALPUFF used 3 years of gridded data.

- Agreed. The sentence should be deleted. The sentence following clearly states the situation. *"The AERMOD dispersion models used 2 continuous years of* *meteorological data collected from the on-site monitors, and the DCALPUFF model used 3 years of gridded data (2015-2017)."*

- Draft EIS Pg. 277 Types of Emissions Sources

The statement that the emission sources were categorized into two groups (point source and area source) is incorrect. Depending on the source release characteristics, the emission sources were characterized as point source, area source, volume source as well as line source (see NEPA Air Quality Impacts Analyses Report). For example, emissions from material transfer processes were modeled as volume source and emissions from roadways were modeled as LINE source.

- Agree. The text should be revised to: "… emission sources were categorized into four groups (point, area, volume, and line sources.")

- Draft EIS Pg. 281 Background Concentrations

The most recent 3 years of monitoring data show that the concentration levels in Year 2017 were higher than previous years. However, the NEPA Air Quality Impacts Analyses does not consider the 2017 monitoring data for the background concentrations determination. Would it be a concern?

- Background data were chosen to coincide with approved, complete, meteorological data sets (2015-2016) as discussed in the Model Plan and approved by PCAQCD and TNF. The original modeling analysis was completed in March 2018, prior to PCAQCD's certification of the 2017 data.

- From White Paper "METEOROLOGICAL DATA PERIOD" (Appendix H, Page 12; Final AQIA Modeling Plan)

    - …Resolution has collected 8 quarters (2015 Q1 – 2016 Q4) of contemporaneous meteorological data that meet regulatory data collection requirements at EP met, WP met, HW met, and HW SoDAR. According to EPA's Appendix W, this data period (1- year or greater) could be considered minimally sufficient.

- The technical memo "Response to Comment on the Resolution Copper Project DEIS: Action Item AQ2 – 2017 Air Quality Data Potential to Influence DEIS Meteorological Data and Background Air Quality Data" (Air Sciences Inc., 2020) is included in Attachment 1. This memo presents the findings of a detailed evaluation of the potential for 2017 air quality data to influence the background concentrations derived from 2015-2016 data that were used in the DEIS. While the evaluation indicated occurrences of increased pollutant concentrations in 2017, the analyses indicate that accounting for the increased concentrations in 2017 would not result in modeled plus background concentrations greater than the AAQS for any pollutant for any averaging period. The background values and meteorological periods used in the DEIS sufficiently represent the range of representative conditions for the Project area, including the conditions in 2017 that were evaluated to respond to this comment.

- Draft Pg. 285 Table 3.6.4-1 and Pg. 289 Table 3.6.4-2

It is recommended to split "Pollutant" column into two columns, "Pollutant" and "Averaging Time Period". Readers may have difficulty to understand "No2_AN", "NO2_1H",… etc.

  - Agreed.

- Draft Pg. 285 Table 3.6.4-1

For 1-hr and 8-hr CO, it is not appropriate to use "3rd high over 2 years" as the modeled design concentration. The form of the NAAQS for CO is "Not to be exceeded more than once per year", which differs from the form of the NAAQS for PM10 ("Not to be exceeded more than once per year on average over 3 years"). It is recommended to determine highest, second highest concentrations (H2H) over the entire receptor network for each year modeled and then select the highest concentration as the modeled design concentration (see ADEQ's modeling guidance).

  - Agreed. This is correct, and representative of the values presented. Additionally, Air Sciences has the corrected Table 3.6.4-1 with this form of the standard specified and has included the corrected table in Attachment 2.

Readers may be confused by the background concentration of 9 μg/m3 for 1-hr NO2. Figure 3.6.3-1 indicates that the background concentration for 1-hr NO2 is around 10 ppb (19 μg/m3). It is recommended to add a footnote to clarify that a temporally varying NO2 background concentration profile was used for modeling.

  - This was a detailed concept/process and generally left for the reader to review in the basic referenced documents (Air Sciences 2018, specifically Figure 3.6.3.1). We agree with the comment and this should be clarified in the EIS with a statement that "The background NO_2 concentration is based on a diurnally and seasonally derived value in accord with EPA guidance. (40 CFR 51 Appendix W, § 8.3.2(c)(iii)).”

- 2019 NEPA Air Quality Impacts Analyses Report Pgs 53-54 – Tailings Storage Facility (TSF) Wind Erosion Emissions Estimate and Modeling

It is recommended to provide clarifications for the following items:

- The wind speed dataset used (location, elevation, height of meteorological tower and the data duration);
  - As stated on page 59 of the NEPA Air Quality Analysis Report, the meteorological data were taken from the Hewett station for all TSF characterizations, using the data set for calendar years 2015 and 2016. This is discussed in more detail in the White Paper “TAILINGS EMISSIONS AND MODELING METHODS” (Appendix H, Page 12; Final AQIA Modeling Plan).
  - The above and following clarifications could be incorporated into the FEIS as a summary of the detailed information contained in the NEPA Air Quality Analysis Report and the technical memoranda included in Appendix H.
- Justification for using a factor of 1.2 to convert hourly wind speed to fastest mile (the report cited an EPA study which modeled a coal mine at Wyoming; however, a representative factor could vary from one region to another. It is recommended to review the wind speed data from a nearby NWS station to select an appropriate conversion factor).
  - This has been a common approach, to use the Wyoming-derived data. A technical memorandum is included in Attachment 3 which provides additional rationale for the 1.2 conversion factor.
- Justification for using a control efficiency of 90% (any citation?)
  - Discussed in White Paper “CONTROL EFFICIENCIES FOR FUGITIVE DUST CONTROL TREATMENT” (Appendix H, Page 26; Final AQIA Modeling Plan).
  - Resolution’s General Plan of Operation (GPO) (p. 123) commits to surveil fugitive dust emissions during operations at the TSF and actively manage the fugitive dust with sprinklers, as necessary. The sprinklers will deliver the necessary amount of water for the given time of day and season of the year for

adequate dust suppression. Using U.S. EPA AP-42 references pertaining to watering control effectiveness for unpaved travel surfaces, a moisture content after water application of 2.5 percent is estimated to achieve 90% control and reasonable to accomplish with Resolution's planned water application rates and frequency. The Fugitive Dust Control Plan (PDCP) for the Project, to be issued by PCAQCD as part of the air permit, will include enforceable conditions to achieve this level of control.

- The base elevation and release height of area source being modeled (did the modeling consider the altitude of TSF in Year 14 of mining life?).
    - Assume ADEQ is referring to year 41 for TSF (year 14 is the maximum production/emissions year for EPS).
    - The maximum potential wind erosion (year 41) did not consider the change in elevation; however, the assumptions made for elevations at current levels are conservative.
    - Air Sciences expects that an evaluation of impacts due to emissions from the TSF at higher base elevations based on projected TSF elevations would result in lower impacts.

ATTACHMENT A

Technical Memo – "Response to Comment on the Resolution Copper Project DEIS: Action Item AQ2 – 2017 Air Quality Data Potential to Influence DEIS Meteorological Data and Background Air Quality Data" (Air Sciences Inc., 2020)

TECHNICAL MEMORANDUM

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RESPONSE TO COMMENT ON THE RESOLUTION COPPER PROJECT DEIS: ACTION ITEM AQ2 – 2017 AIR QUALITY DATA POTENTIAL TO INFLUENCE DEIS METEOROLOGICAL DATA AND BACKGROUND AIR QUALITY DATA

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COPIES:	Resolution Copper
DATE:	May 31, 2020

1.0 Introduction

In the comments to the Resolution Copper Project's (Resolution) Draft Environmental Impact Statement (DEIS), the following comment #278-5 was provided by the Arizona Department of Environmental Quality (ADEQ):

> *Draft EIS Pg. 281 Background Concentrations*
>
> *The most recent 3 years of [air quality] monitoring data show that the concentration levels in Year 2017 were higher than previous years. However, the NEPA Air Quality Impacts Analyses does not consider the 2017 monitoring data for the background concentrations determination. Would it be a concern?*

The background values used in the DEIS were derived from data collected during 2015-2016 at monitoring stations located at the four functional areas of the Project: East Plant Site (EPS), West Plant Site (WPS), near the base of the proposed Alternative 2 tailings storage facility (Hewitt Station), and the Filter Plant Loadout Facility (FPLF). The monitoring stations were installed and operated by Air Sciences Inc. per criteria and procedures stipulated in a Resolution Copper Mine Monitoring Plan – Revision 3 (Air Sciences, 2016) approved by Pinal County Air Quality Control District (PCAQCD). The background values derived from the monitoring sites were submitted as part of Resolution's Final Air Quality Impacts Analysis Modeling Plan (Air

Sciences, 2018) (Modeling Plan). PCAQCD reviewed and approved the Modeling Plan, including the background values, in 2018. The background values for all pollutants, except CO, were developed from data monitored at the EPS and WPS locations. The two years of site-specific meteorological data and ambient pollution levels are considered representative of the range of conditions for the site. The lengths of the data periods meet or exceed the recommendations as described in the Environmental Protection Agency's (EPA) Guideline on Air Quality Models. The DEIS background values and their forms are presented in Table 1.

Table 1. Resolution DEIS Background Values

Pollutant	DEIS Background	Unit	Form of the Background Concentration
CO 1-hour	3.1	ppm[3]	Highest from 3 years (2014-2016)
CO 8-hour	2.2	ppm[3]	Highest from 3 years (2014-2016)
NO_2 1-hour	Profile	-	3-year average highest monthly and hour-of-day (2012/4 - 2015/3)
NO_2 annual	1.6	ppb[4]	Highest from 3 years (2012/4 - 2015/3)
$PM_{2.5}$ 24-hour	Profile[1,2]	-	24-hour averages paired with modeled impacts (2015-2016)
$PM_{2.5}$ annual	Profile[1,2]	-	24-hour averages paired with modeled impacts (2015-2016)
PM_{10} 24-hour	Profile[1,2]	-	24-hour averages paired with modeled impacts (2015-2016)
PM_{10} annual	Profile[1,2]	-	24-hour averages paired with modeled impacts (2015-2016)
SO_2 1-hour	9.3	ppb[4]	3-year average 99th percentile of daily maximum 1-hour values (2013, 2015, 2016)
SO_2 3-hour	11.7	ppb[4]	3-year maximum 3-hour average (2013, 2015, 2016)
SO_2 24-hour	4.2	ppb[4]	3-year maximum 24-hour average (2013, 2015, 2016)
SO_2 annual	0.8	ppb[4]	3-year maximum annual average (2013, 2015, 2016)

[1] Concentrations monitored at two locations, East Plant and West Plant, and combined with modeled impacts via a paired-sums approach.
[2] At the direction of Pinal County Air Quality Control Division, and after review of the background concentrations and meteorology, some limited exceptional events were removed from the data period.

[3] ppm = parts per million.

[4] ppb = parts per billion.

In order to investigate if increased levels of ambient pollution in 2017 would be a concern, monitored concentrations from 2017 for applicable Ambient Air Quality Standards (AAQS) have been compared to the monitored concentrations from 2015-2016 and evaluated to determine if and how the 2017 concentrations could potentially affect model results presented in the DEIS and whether the potential changes to model results would have changed the conclusions in the DEIS. Table 2 summarizes the evaluation methods and findings for all the pollutants and averaging periods disclosed in the DEIS.

The details and results of these analyses are provided in the following sections. While the evaluation indicated occurrences of increased pollutant concentrations in 2017 (including elevated concentrations that could have been influenced by exceptional events), the analyses indicate that accounting for the increased concentrations in 2017 would not result in modeled plus background concentrations greater than the AAQS for any pollutant. The background values and meteorological periods used in the DEIS sufficiently represent the range of representative conditions for the Project area, including the conditions in 2017 that were evaluated to respond to this comment.

Table 2 - Summary of Methods to Evaluate 2017 Data Affecting 2015-2016 Meteorological and Background Data Period

	Polllutant	Averaging Period	Section in Memo	Evaluaton Method	Summary of Results	Notes
	Ozone	8-hour	1.0	No additional evaluation.	N/A	Not utilized in MERP analysis.
2017 Value Is LESS than DEIS Background	CO	1-hour	2.1	Compared 2017 value to DEIS background.	2017 value < DEIS Background	
	CO	8-hour	2.1	Compared 2017 value to DEIS background.	2017 value < DEIS Background	
	NO2	Annual	2.1	Compared 2017 value to DEIS background.	2017 value < DEIS Background	
	SO2	3-hour	2.1	Compared 2017 value to DEIS background.	2017 value < DEIS Background	
	SO2	24-hour	2.1	Compared 2017 value to DEIS background.	2017 value < DEIS Background	
2017 Data Indicatee Increased Concentrations Relative to DEIS Background	Ozone	1-hour	3.1	Statistical comparision of quarterly 1-hr ozone data for 2015-2017.	Range of 1-hr ozone in 2015-16 representative of range of 1-hr ozone in 2017 data	1-hr ozone paired in time with met data for NO2 1-hr and annual AERMOD modeling (OLM).
	NO2	1-hour	3.1	Comparison of NO_2 Profiles and added 2017 increase to DEIS results.	Increase does not result in concentrations >= AAQS. No change in findings presented in DEIS.	Time varying profiles were used for background.
	PM2.5	Annual	2.2.2	Modeled impact + background + increase with inclusion of 2017 data.	Increase does not result in concentrations >= AAQS. No change in findings presented in DEIS.	
	PM10	Annual	2.2.2	Modeled impact + background + increase with inclusion of 2017 data.	Increase does not result in concentrations >= AAQS. No change in findings presented in DEIS.	
	SO2	Annual	2.2.1	Modeled impact + background + increase with inclusion of 2017 data.	Increase does not result in concentrations >= AAQS. No change in findings presented in DEIS.	
	SO2	1-hour	2.2.1	Modeled impact + background + increase with inclusion of 2017 data.	Increase does not result in concentrations >= AAQS. No change in findings presented in DEIS.	
	PM2.5	24-hour	3.2	Compared the range of 2015-16 data to the range of 2017 data.	Increase does not result in concentrations >= AAQS. No change in findings presented in DEIS.	Paired sums approach was used.
	PM10	24-hour	3.2	compared the range of 2015-16 data to the range of 2017 data..	Increase does not result in concentrations >= AAQS. No change in findings presented in DEIS.	Paired sums approach was used.

2.0 Pollutants/Averaging Periods for Which Basic Analysis Reveals 2017 Monitoring Data Present No Concern to DEIS Background

2.1 – 2017 Value is Less than DEIS Background

For CO 1-hour and 8-hour, NO_2 annual, and SO_2 3-hour and 24-hour, the 2017 data indicated reduced levels relative to the DEIS background. Therefore, inclusion of the 2017 data would not alter the conclusions of the DEIS for these pollutants. No further evaluations were performed and the data comparisons for these pollutants and averaging periods are shown in Table 3.

Table 3. Comparison of DEIS Background Values with 2017 Concentrations

Pollutant	DEIS Background	2017 Value	Unit
CO 1-hour	3.1	2.4	ppm
CO 8-hour	2.2	1.8	ppm
NO_2 annual	1.6	0.8	ppb
SO_2 3-hour	11.7	10.5	ppb
SO_2 24-hour	4.2	3.31	ppb

2.2 Adding Potential Increase due to 2017 Data to DEIS Modeled Impact + Background is Less than Ambient Air Quality Standard

2.2.1 SO2 1-hour and Annual

For the SO_2 1-hour and annual AAQS, the 2017 values are 5.4 ppb and 0.1 ppb higher than the DEIS backgrounds, respectively. By adding these increases to the appropriate total concentrations (modeled project impacts + background) for the worst-case alterative as from the DEIS, 2017-included total concentrations (modeled project impacts + background + increase) are compared to the AAQS. The DEIS total concentrations, increases, and 2017-included total concentrations are presented in Table 4.

Table 4. 2017-Included SO_2 1-Hour and Annual Concentrations

	DEIS Total	2017 Increase	2017-Included Total	AAQS	Unit
SO_2 1-hour	44.7	5.4	50.1	74.8	ppb
SO_2 annual	1.1	0.1	1.2	30.5	ppb

The 2017-included total concentrations are less than the AAQS. Therefore, consideration of the 2017 data would not change the conclusions of the DEIS for the SO_2 1-hour and SO_2 annual standards.

2.2.2 PM2.5 Annual and PM10 Annual

The modeled $PM_{2.5}$ and PM_{10} annual impacts in the DEIS were combined in a paired-sums approach with daily background concentrations from the 2015-2016 monitoring period. Even though the 2015-2016 data excluded some limited exceptional events (as determined by PCAQCD), the 2017 period did not exclude any exceptional events and all 2017 data and total concentrations were included. $PM_{2.5}$ and PM_{10} were monitored at two locations: East Plant and West Plant. The 2017 increases were calculated for changes from both locations and combined with the worst-case total concentrations from the DEIS. For the estimate of the PM_{10} annual 2017-included concentration, the maximum annual concentration from 2015 and 2016 was compared to the maximum annual concentration of 2015, 2016, and 2017. For the estimate of the $PM_{2.5}$ annual 2017-included concentration, the average annual concentration from 2015 and 2016 was compared to the average annual concentration of 2015, 2016, and 2017. The comparisons of the annual backgrounds are presented in Table 5.

Table 5. $PM_{2.5}$ and PM_{10} Annual Concentrations for the 2015-2016 and 2015-2017 Periods

Pollutant	Monitor Site	2015	2016	2017	Background (2015-2016)	Background (2015-2017)	Unit
$PM_{2.5}$ annual	East Plant	3.3	4.0	4.2	3.65	3.83	μg/m³
$PM_{2.5}$ annual	West Plant	4.2	4.7	4.5	4.45	4.47	μg/m³
PM_{10} annual	East Plant	12.5	15.7	18.0	15.7	18.0	μg/m³
PM_{10} annual	West Plant	12.6	18.7	18.1	18.7	18.7	μg/m³

The DEIS total concentrations, 2017-included total concentrations, and comparisons to the AAQS are presented in Table 6.

Table 6. 2017 Included $PM_{2.5}$ and PM_{10} Annual Concentrations

Pollutant	Monitor Site	DEIS Total Concentration	2017 Increase	Included Total Concentration	AAQS	Unit
$PM_{2.5}$ annual	East Plant	6.0	0.18	6.18	12	μg/m³
$PM_{2.5}$ annual	West Plant	6.0	0.02	6.0	12	μg/m³
PM_{10} annual	East Plant	24.5	2.3	26.8	50	μg/m³
PM_{10} annual	West Plant	24.5	0.0	24.5	50	μg/m³

The 2017-included total concentrations are less than the applicable AAQS. Therefore, inclusion of the 2017 data would not change the conclusions of the DEIS regarding the $PM_{2.5}$ and PM_{10} annual standards.

3.0 Pollutants/Averaging Periods for Which Detailed Analysis Reveals 2017 Data Present No Concern to DEIS Background

3.1 NO_2 1-hour Profiles and Hourly Ozone Data (Used for OLM)

For the NO_2 1-hour modeling, a three-year average background profile of the maximum hourly concentrations by month and hour-of-day (MHOD) was included in the near-field AERMOD modeling. The period of the data included was April 2012 through March 2015. The profile from the AQIA used for the DEIS modeling is presented in Table 7.

Table 7. DEIS NO_2 1-Hour Background Profile

Month	Hours	Hourly NO2 Concentration (ppb)							
January	1 - 8	4.4	2.5	2.9	3.6	3.0	3.0	4.4	8.1
	9 - 16	8.6	5.4	4.5	5.1	5.0	3.7	3.5	4.2
	17 - 24	3.9	5.3	10.5	8.0	4.0	4.0	3.6	4.8
February	1 - 8	3.4	3.0	4.2	4.4	4.2	3.9	4.0	7.7
	9 - 16	7.1	8.4	4.7	4.0	4.4	3.9	2.4	2.3
	17 - 24	2.5	3.0	4.7	4.4	4.7	3.7	3.7	4.3
March	1 - 8	2.4	3.2	2.3	2.2	2.1	3.2	2.6	3.3
	9 - 16	5.8	2.5	5.6	1.7	1.5	1.2	1.1	2.0
	17 - 24	1.2	1.0	1.3	1.5	1.6	2.5	3.7	3.2
April	1 - 8	7.8	6.3	9.1	7.1	5.9	9.1	6.6	9.3
	9 - 16	4.5	3.3	2.4	1.3	2.1	1.6	2.2	1.5
	17 - 24	2.1	2.0	1.7	3.0	5.2	5.8	10.5	7.9
May	1 - 8	6.8	6.3	9.9	10.6	5.5	6.2	8.8	12.2
	9 - 16	4.5	4.3	3.6	2.0	1.2	1.3	1.1	0.8
	17 - 24	0.8	1.7	2.4	1.3	1.8	2.7	3.5	5.9
June	1 - 8	4.1	4.8	5.7	5.3	6.6	8.7	6.9	5.0
	9 - 16	3.0	2.7	2.5	2.0	1.0	1.3	0.9	1.0
	17 - 24	0.5	0.4	0.3	0.4	1.4	3.3	7.6	5.1
July	1 - 8	4.1	4.0	4.4	3.7	7.2	5.8	4.4	3.7
	9 - 16	2.3	3.8	0.8	1.2	0.9	0.8	0.9	0.6
	17 - 24	0.6	1.9	3.3	2.5	2.6	3.7	3.0	4.9
August	1 - 8	6.9	6.2	7.0	5.2	4.6	5.8	11.8	6.0
	9 - 16	4.4	6.4	2.8	2.5	1.6	2.6	1.6	3.3
	17 - 24	0.5	0.4	1.3	3.7	2.7	2.5	6.6	9.0
September	1 - 8	6.0	6.6	7.9	8.0	6.3	12.6	7.0	5.2
	9 - 16	6.1	1.5	1.8	0.6	0.8	1.3	1.7	1.0
	17 - 24	0.6	1.3	9.5	2.3	3.9	5.3	6.6	9.3
October	1 - 8	7.4	8.7	12.0	7.7	7.8	10.7	6.6	7.6
	9 - 16	10.1	4.0	4.0	3.6	3.7	3.3	2.8	2.8
	17 - 24	3.0	2.2	3.8	4.9	5.6	7.9	6.7	8.0
November	1 - 8	8.4	8.8	7.1	8.6	7.4	8.4	10.3	11.4
	9 - 16	8.5	6.1	8.4	5.8	4.4	4.1	4.9	4.7
	17 - 24	4.5	6.8	6.2	5.8	6.7	6.6	7.0	9.1
December	1 - 8	10.3	9.3	12.0	12.3	7.1	8.5	7.9	8.2
	9 - 16	8.4	5.7	5.1	4.6	3.4	3.3	3.0	3.9
	17 - 24	3.7	5.3	6.2	5.0	6.0	8.5	7.2	13.1

A similar profile was constructed that incorporated the 2017 hourly NO2 data. This profile is four-year average background profile constructed by taking the weighted average of the three-year profile with the 2017 profile. The four-year background profile is presented in Table 8.

Table 8. 2017-Included NO_2 1-Hour Background Profile

Month	Hours	Hourly NO2 Concentration (ppb)							
January	1 - 8	4.2	2.6	3.0	3.4	2.7	3.8	4.8	8.1
	9 - 16	7.4	5.0	3.8	4.3	4.7	3.2	3.0	3.4
	17 - 24	3.7	4.3	8.7	6.7	3.3	4.1	3.6	4.0
February	1 - 8	3.5	3.2	4.3	5.6	4.2	3.8	4.1	8.0
	9 - 16	8.2	7.1	4.3	3.6	4.2	3.5	2.3	2.4
	17 - 24	2.4	2.8	4.3	4.2	4.5	3.9	4.0	4.5
March	1 - 8	2.7	3.5	3.0	2.1	2.3	3.7	2.7	4.5
	9 - 16	5.7	3.1	5.5	2.3	2.6	1.7	1.3	1.9
	17 - 24	1.4	1.2	1.6	2.0	1.9	2.5	3.9	3.5
April	1 - 8	11.7	8.5	8.5	7.0	6.3	9.3	9.8	12.5
	9 - 16	6.4	4.1	2.8	1.9	2.8	2.4	2.6	1.9
	17 - 24	2.6	2.6	2.1	5.6	6.6	5.5	9.7	8.4
May	1 - 8	5.8	5.9	8.1	8.5	4.8	5.6	7.6	11.0
	9 - 16	4.6	4.0	3.0	1.8	1.3	1.3	1.2	1.0
	17 - 24	1.0	1.7	2.4	1.6	2.5	3.2	3.8	5.3
June	1 - 8	6.4	5.0	4.8	4.7	6.2	7.1	8.3	4.9
	9 - 16	3.6	3.3	2.2	2.1	1.2	1.3	1.1	1.0
	17 - 24	0.7	0.6	0.6	1.9	2.6	3.5	6.5	5.0
July	1 - 8	4.4	4.5	4.7	4.1	7.8	5.5	4.7	4.5
	9 - 16	2.6	4.3	1.4	1.2	1.0	0.9	1.0	0.7
	17 - 24	0.7	1.5	3.2	3.6	3.1	4.1	3.4	5.1
August	1 - 8	7.8	7.1	8.2	6.9	6.4	8.5	13.7	7.7
	9 - 16	4.5	6.5	3.9	2.8	1.6	3.1	2.2	3.2
	17 - 24	0.8	1.0	1.2	3.6	6.6	4.7	11.0	10.9
September	1 - 8	7.8	8.0	11.4	8.8	9.2	13.0	8.4	7.2
	9 - 16	6.2	2.8	2.4	0.9	1.1	1.3	1.5	0.9
	17 - 24	0.6	1.7	7.6	2.9	4.5	6.7	10.1	9.8
October	1 - 8	10.2	20.1	17.9	10.6	11.2	15.5	10.8	10.2
	9 - 16	9.5	4.0	3.9	3.2	3.3	3.1	2.8	3.2
	17 - 24	2.8	2.2	3.6	4.3	5.2	8.9	9.1	11.3
November	1 - 8	8.2	9.8	8.1	8.9	6.7	8.2	9.3	10.3
	9 - 16	9.2	5.5	7.3	5.6	4.6	3.7	4.2	4.0
	17 - 24	4.6	7.1	6.4	6.2	6.8	7.2	7.8	8.4
December	1 - 8	11.3	10.3	10.3	10.8	6.7	9.0	7.6	7.3
	9 - 16	8.1	5.6	5.6	4.3	4.2	3.3	3.4	4.2
	17 - 24	4.6	5.2	6.1	6.1	6.0	10.7	9.1	12.0

The 2017-included profile is generally higher than the DEIS profile, especially during the morning hours of October. An estimate of total concentrations including the 2017 data in the profile was calculated by adding the maximum profile increase, 11.4 ppb for the MHOD of October at 2 a.m., to the worst-case total concentration in the EIS. The estimate of 2017-included total impacts is presented in Table 9.

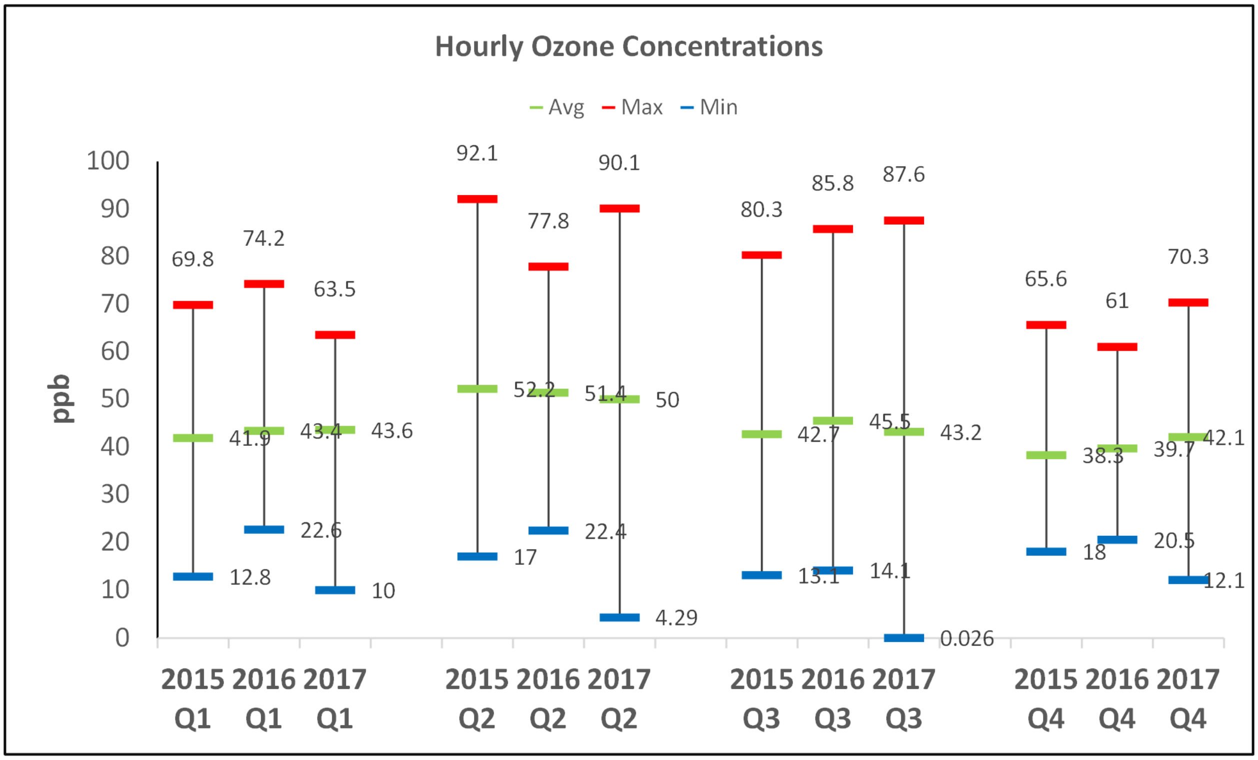
Table 9. Estimate of 2017-Included Total NO_2 1-Hour Concentrations

Pollutant	DEIS Total Concentration	2017 Increase	2017-Included Concentration	AAQS	Unit
NO_2 1-hour	79.7	11.4	91.1	100.0	ppb

The estimated NO_2 1-hour total concentration, with the maximum increase between the profiles, is less than the AAQS. Therefore, the inclusion of the 2017 monitoring data is unlikely to influence the conclusions presented in the DEIS.

Another aspect of the NO_2 modeling with AERMOD is the use of the Ozone Limiting Method (OLM). The OLM option in AERMOD requires an ozone concentration or concentration profile in order to provide estimates of NO_X conversion to NO_2. For the DEIS analysis, hourly ozone values paired in time with meteorological data (2015-2016) were used. The highest hourly concentration occurred in the second quarter of 2015, and average values are similar across the three years. The ranges and average hourly ozone concentrations from 2015, 2016, and 2017, summarized by quarter for the three years, are presented in Figure 1. An analysis of the hourly values for 2015, 2016, and 2017 indicate that the range of hourly ozone values in 2015 and 2016 sufficiently represents the range of values in the 2017 data. Incorporating the 2017 hourly ozone values in the modeling analysis using the OLM option would have had no measurable effect on NO_2 modeling and, therefore would not change the conclusions of the DEIS regarding the NO_2 standards.

Figure 1. Summary by Quarter of Hourly Ozone Data for 2015-2017



3.2 PM_{10} and $PM_{2.5}$ 24-Hour Concentrations

3.2.1 Comparison of Monitored Concentrations

PCAQCD reviewed and approved the Modeling Plan which included the paired-sums approach for incorporating background concentrations of PM_{10} 24-hour and $PM_{2.5}$ 24-hour. The paired-sums approach involves pairing calendar day-specific 24-hour monitored concentrations with modeled 24-hour impacts for the same calendar day. The paired-sums approach necessitates that the ambient monitoring data and meteorological data periods align.

As part of PCAQCD's review process for the paired-sums approach, a detailed analysis was performed to identify and remove a few limited PM concentrations determined to be influenced by exceptional events (e.g., regional dust storms) from the PM_{10} and/or $PM_{2.5}$ monitoring data sets. Elevated PM concentrations for three 24-hour periods in the 2015-2016 data sets were determined to be influenced by exceptional events and were flagged and removed from the PM_{10} and $PM_{2.5}$ background datasets used for the modeling analysis. The flagged and removed 24-hour concentrations were replaced with gap-filled data according to monthly PM_{10} and $PM_{2.5}$ profiles developed from the monitoring data and in consultation with PCAQCD.

For this evaluation of whether the 2017 $PM_{2.5}$ and PM_{10} 24-hour concentrations would cause concern about using the 2015-2016 data, it is important to note that the 2017 data have not been vetted through the exceptional events process so elevated 24-hour concentrations of PM_{10} and $PM_{2.5}$ that may been influenced by exceptional events have not been flagged and removed from the 2017 data.

Summary statistics from the 2015, 2016, and 2017 data sets are provided in Table 10. Concentrations for each station and pollutant are summarized according to the statistical form of the AAQS for each year. Additionally, the multi-year form of the standard is calculated for the two-year DEIS data period (2015-2016) as well as for the three-year period including 2015-2017.

Table 10. Summary of $PM_{2.5}$ and PM_{10} Single- and Multi-year Concentrations (2015-2017)

Pollutant	Site	Single Year Rank	2015	2016	2017	Multi-Year Form	2015-16	2015-17	Units
PM_{10} 24-hour[1]	East Plant	2nd High	44.0	54.1	110.0	N+1[2]	54.1	91.2	µg/m³
PM_{10} 24-hour[1]	West Plant	2nd High	67.1	71.2	117.0	N+1[2]	71.2	81.2	µg/m³
$PM_{2.5}$ 24-hour	East Plant	8th High	8.2	9.6	11.8	Average 8th High	8.9	9.9	µg/m³
$PM_{2.5}$ 24-hour	West Plant	8th High	12.6	9.8	14.0	Average 8th High	11.2	12.1	µg/m³

[1] The PM_{10} 24-hour standard is based on PM_{10} concentrations converted to Standard Temperature and Pressure (STP).
[2] The form of the PM_{10} 24-hour concentrations is the rank N+1 concentration, where N is the number of years of data.

It is evident from the summary values in Table 10 that the potential influence of exceptional events on the most elevated concentrations collected during the 2017 data period could have a substantial effect on 2nd high 24-hour concentrations. Time-series plots of the 24-hour values from 2015-2017 for the East Plant and West Plant monitoring stations are provided in Figure 2 and Figure 3, respectively. Several outlying high concentrations, that could, with additional investigation, prove to be influenced by exceptional events, are present in the 2017 data set. Flagging and removing one or more elevated 24-hour 2017 concentrations determined to be influenced by an exceptional event(s) would reduce the conservative 2015-17 values of the multi-year estimated background values presented in Table 10.

Figure 2. Time-series of East Plant $PM_{2.5}$ and PM_{10} 24-hour Concentrations

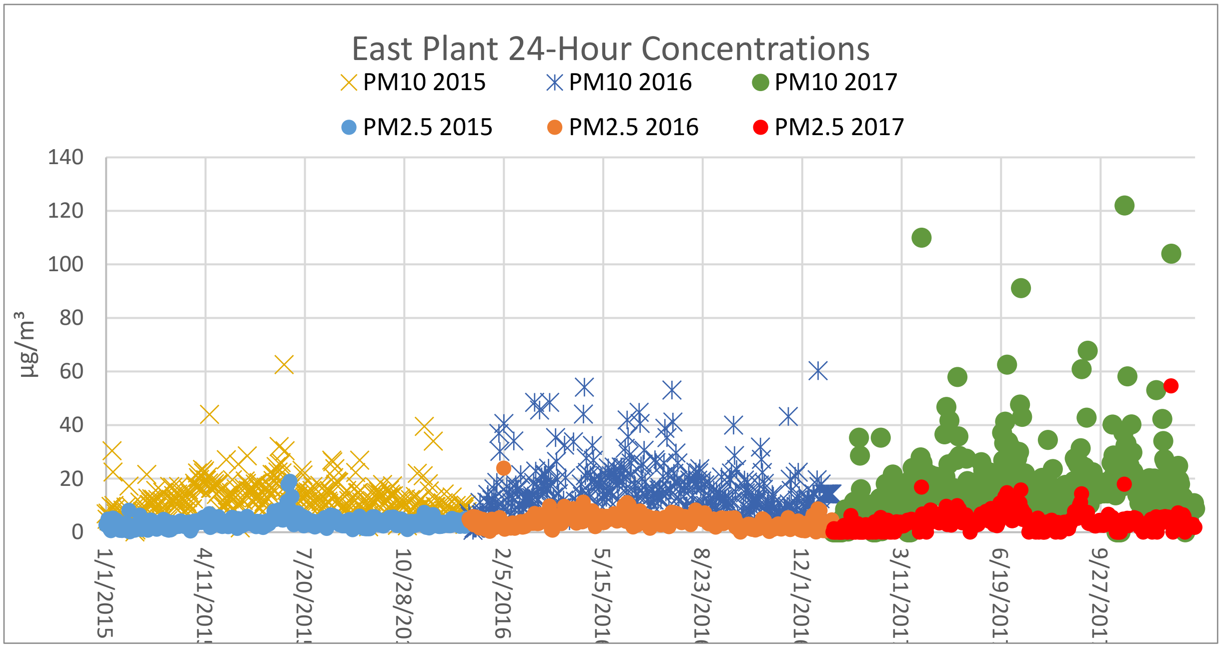
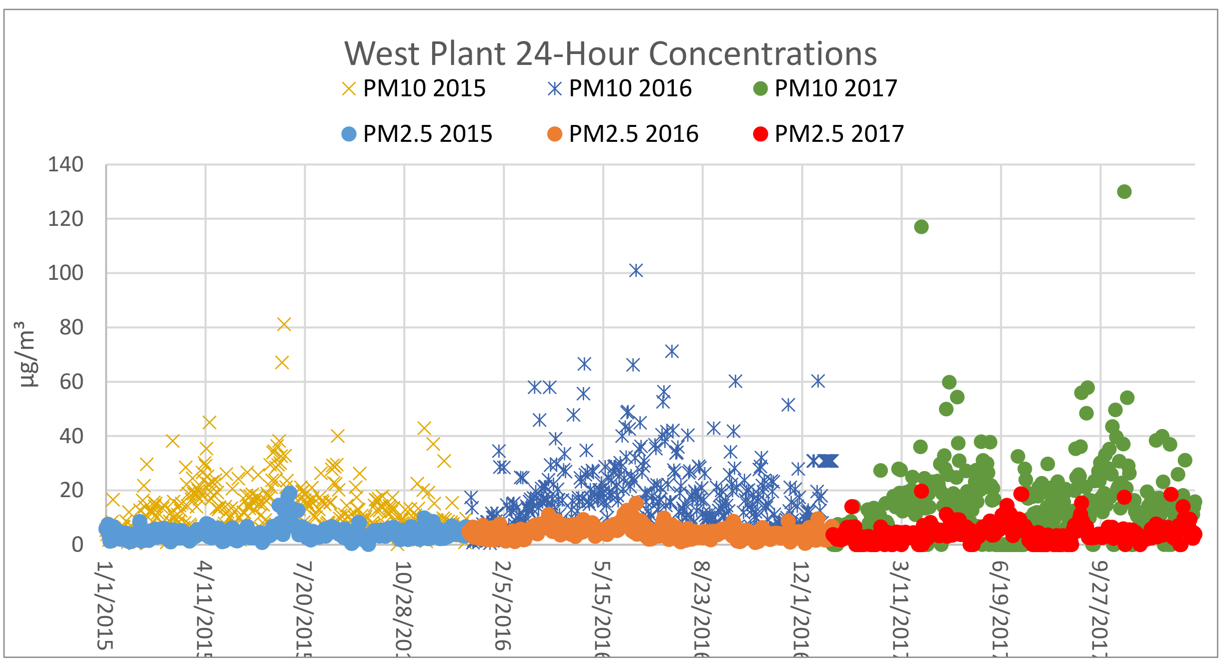


Figure 3. Time-series of West Plant $PM_{2.5}$ and PM_{10} 24-hour Concentrations



After consideration of the 2017 data, the increase of pollutant concentrations from the 2015-2016 background values to the estimated 2015-2017 background was determined to be a conservative estimate of the effect of elevated 2017 concentrations on the DEIS background PM_{10} and $PM_{2.5}$ data Estimates of $PM_{2.5}$ and PM_{10} 24-hour concentrations adjusted by the potential increases indicated by the 2017 data are provided in Table 11.

Table 11. Estimates of 2017-Included Total Concentrations for $PM_{2.5}$ and PM_{10} 24-Hour

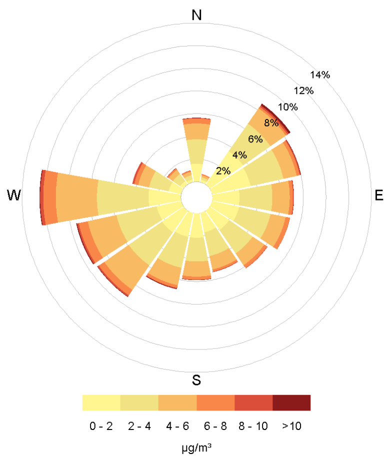
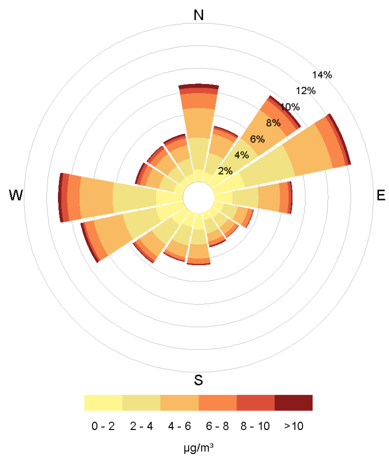
Pollutant	Monitor Site	DEIS Total Concentration	2017 Increase	2017-Included Concentration	AAQS	Unit
PM_{10} 24-hour	East Plant	99.5	37.1	136.6	150	μg/m³
PM_{10} 24-hour	West Plant	99.5	10.0	109.5	150	μg/m³
$PM_{2.5}$ 24-hour	West Plant	17.8	0.92	18.72	35	μg/m³
$PM_{2.5}$ 24-hour	West Plant	17.8	0.92	18.72	35	μg/m³

The 2017-included total concentrations are less than the applicable AAQS. Therefore, inclusion of the 2017 data would not change the conclusions of the DEIS regarding the $PM_{2.5}$ and PM_{10} 24-hour standards.

3.2.2 Comparison of Distribution of PM Concentrations Across Wind Directions

For a paired-sums approach, the relationships between the wind data and the particulate values were evaluated to verify that the high particulate concentrations in the 2017 data set were associated with similar winds in the 2015 and 2016 data sets. Hourly particulate concentration frequencies were aggregated by wind direction for each monitoring site and pollutant. East Plant particulate concentrations were paired with East Plant winds, and West Plant particulate concentrations were paired with West Plant winds. The resultant concentration frequency diagrams of $PM_{2.5}$ and PM_{10} are provided in Figure 4 and Figure 5, respectively. These graphical representations of the distribution of PM concentrations and wind data are very similar across the three years for PM_{10} and $PM_{2.5}$. The similarity suggests that the 2015-2016 distributions of PM and wind data sufficiently capture the distributions of the 2017 data.

Figure 4. Hourly $PM_{2.5}$ Frequency Diagrams, 2015-2017

<table>
<tr><th></th><th>East Plant</th><th>West Plant</th></tr>
<tr><td>2015</td><td>
</td><td>
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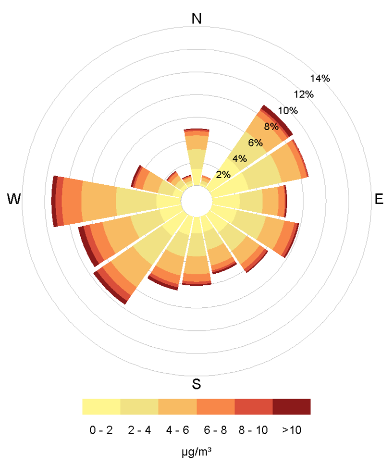
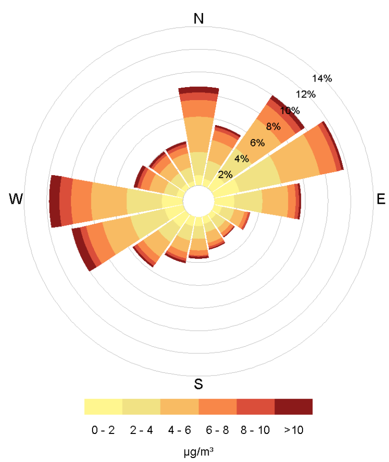
<tr><td>2016</td><td>
</td><td>
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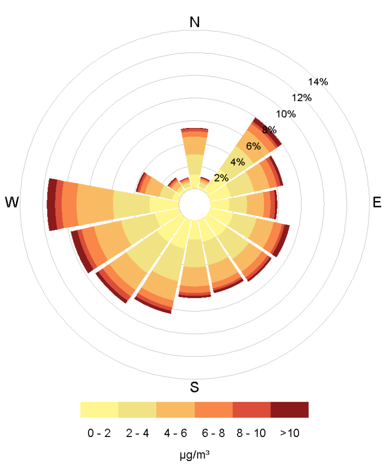
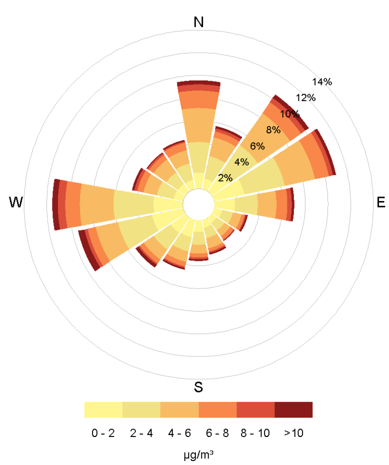
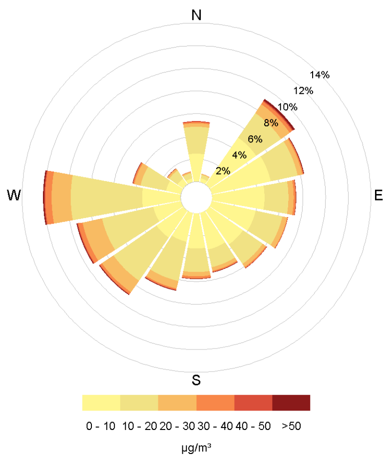
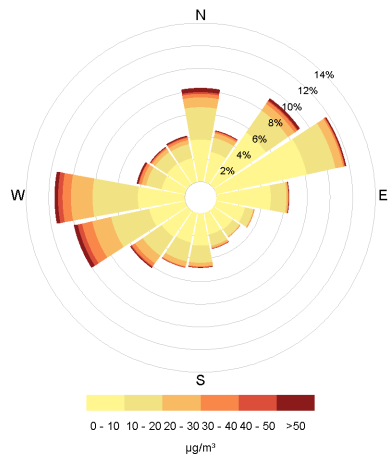
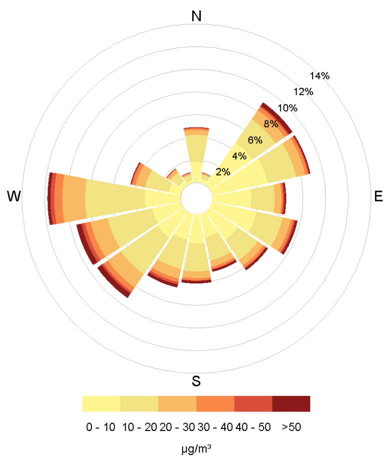
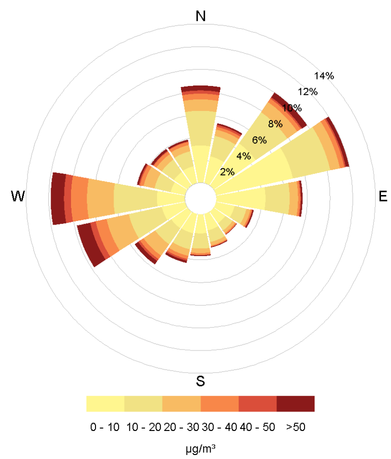
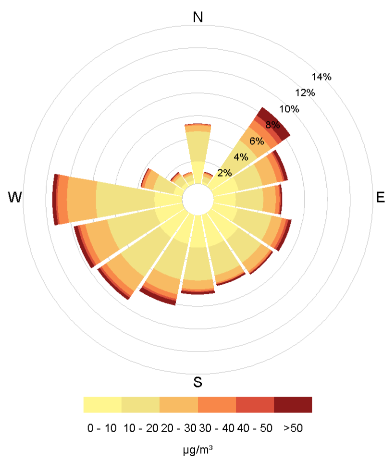
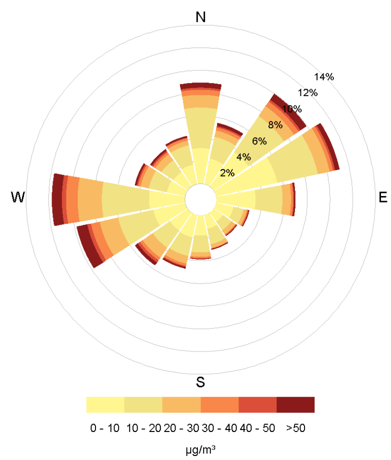
<tr><td>2017</td><td>
</td><td>
</td></tr>
</table>

Figure 5. Hourly PM_{10} Frequency Diagrams, 2015-2017

	East Plant	West Plant
2015		
2016		
2017		

3.3 Comparisons of 2015, 2016, and 2017 Meteorological Data

Comparisons are provided for the East Plant, West Plant, and Hewitt Station sites. Summary data ranges and averages by quarter for temperature and pressure are provided in Figure 6 and Figure 7, respectively. Wind frequency diagrams are provided in Figure 8. The average values are similar across the three years, and the range of 2017 conditions is reasonably represented by the 2015 and 2016 data period. The wind frequency diagrams indicate that hourly winds during 2017 were similar to winds during 2015 and 2016. These similarities across all meteorological parameters indicate that the 2015-2016 meteorological period used for the DEIS modeling analysis sufficiently captures the range of meteorological parameters measured in 2017.

Figure 6. Summary by Quarter of 2015, 2016, and 2017 Temperatures

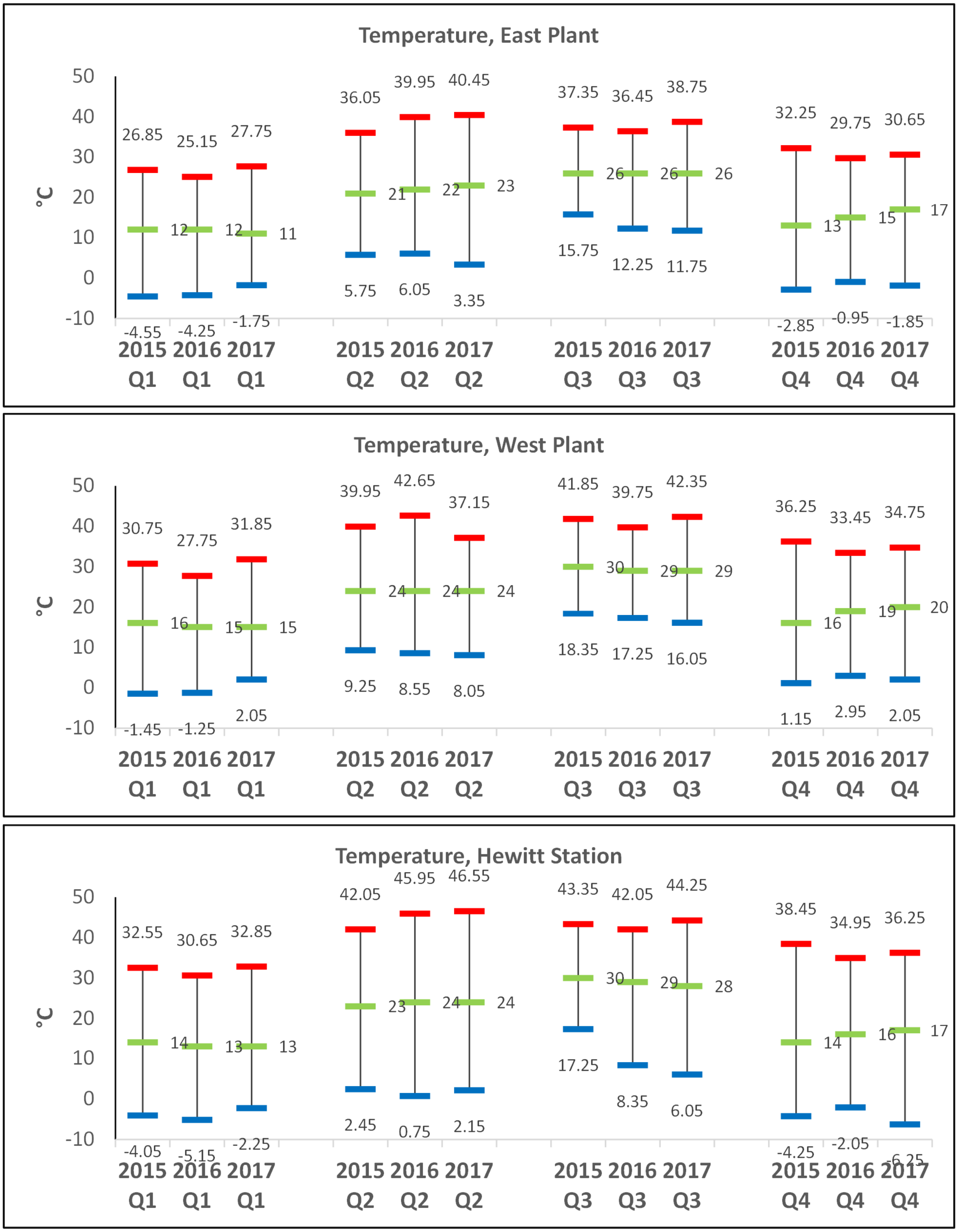


Figure 7. Summary by Quarter of 2015, 2016, and 2017 Barometric Pressures

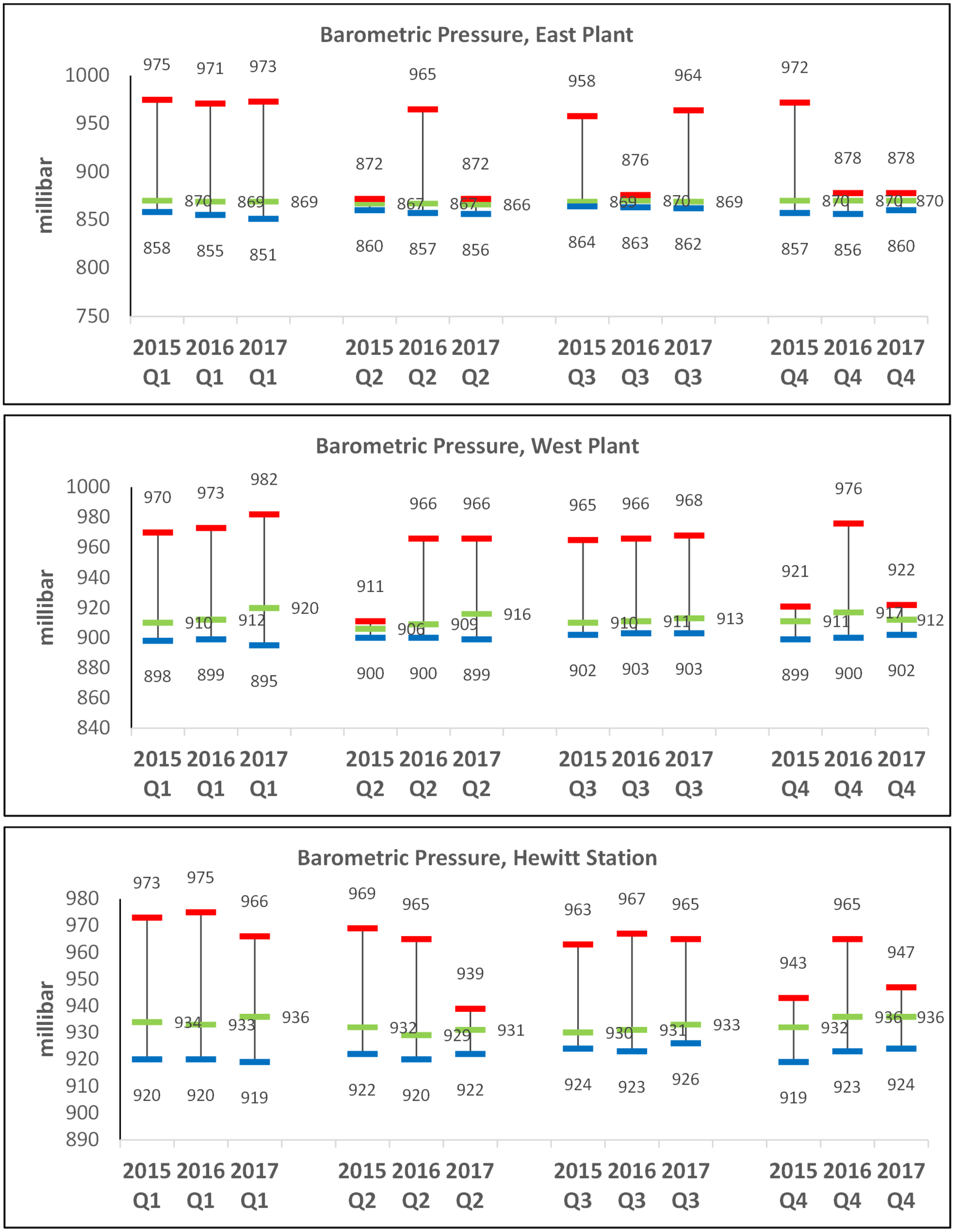
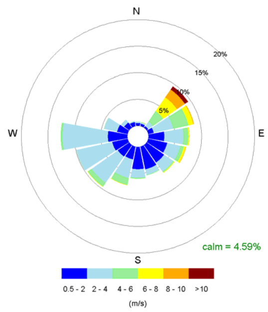
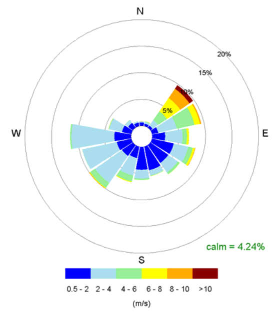
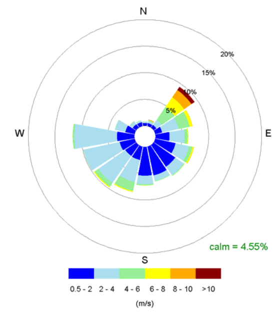
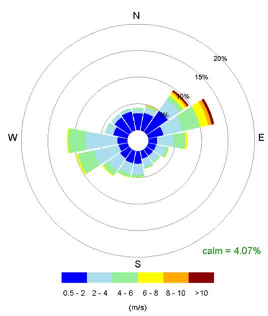
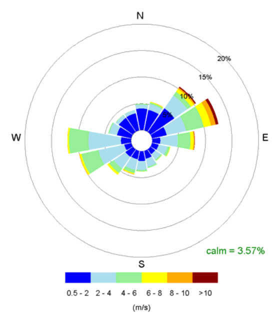
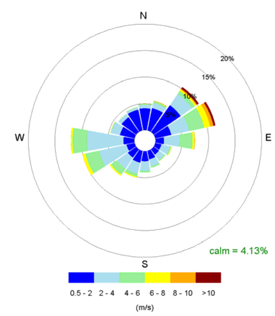
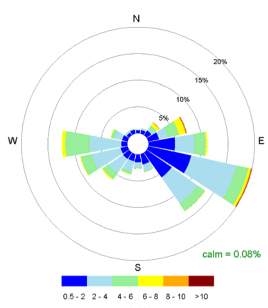
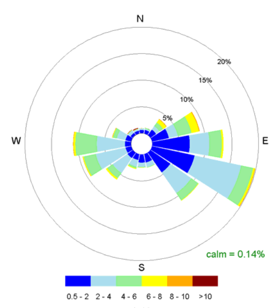
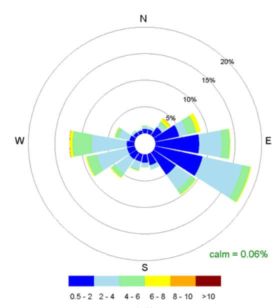


Figure 8. Wind Frequency Diagrams for 2015, 2016, and 2017

	2015	2016	2017
East Plant			
West Plant			
Hewitt Station			

ATTACHMENT B

Revised DEIS Table 3.6.4-1

Table 3.6.4-1. Maximum air quality impacts for proposed operations and Alternative 2 - Near West Proposed Action

Pollutant	Model Result/Form of Standard	Proposed Action Impact Only ($\mu g/m^3$)	Background ($\mu g/m^3$)	Total Maximum Impact ($\mu g/m^3$)	Standard ($\mu g/m^3$)	Total Maximum Impact as a Percentage of Standard
CO_1H	not to be exceeded more than once per year	4,531	3,550	8,081	40,000	20
CO_8H	not to be exceeded more than once per year	1,040	2,519	3,559	10,000	36
NO2_1H	98th percentile over 2 years	138	9	146	188	78
NO2_AN	Max annual over 2 years	2	3	5	100	5
PM10_24H	3rd High over 2 years	26	71	97	150	65
PM10_AN*	Max annual over 2 years	7	17	25	50	49
PM25_24H	98th percentile over 2 years	11	6	18	35	51
PM25_AN	Average annual over 2 years	2	4	6	12	49
SO2_1H	99th percentile over 2 years	92	24	117	196	59
SO2_3H	2nd High over 2 years	56	31	86	1,300	7
SO2_24H*	2nd High over 2 years	9	11	20	365	6
SO2_AN*	Max annual over 2 years	1	2	3	80	4

Note: µg/m3 = micrograms per cubic meter

*Not a Federal standard

ATTACHMENT C

Technical Memo - "Conversion of Hourly Mean Wind Speed to Fastest Mile Wind Speed" (Air Sciences Inc., 2015)

AIR SCIENCES INC.
DENVER • PORTLAND

CONVERSION OF HOURLY MEAN WIND SPEED TO FASTEST MILE WIND SPEED

PREPARED FOR: [redacted]

PREPARED BY: K. Lewis and M. Hampson – Air Sciences Inc.

PROJECT NO.: 281-15-2

DATE: February 27, 2015

The Environmental Protection Agency's AP-42, Section 13.2.5 (EPA 2006) provides a methodology for estimating particulate emissions (all size fractions) from erodible surfaces. Site-specific data required for this methodology include the following:

- Erodible surface area
- Fastest mile wind speed

The site-specific wind speed data for the [redacted] project are available as hourly averages (mean). To convert these hourly data to fastest mile wind speed, Air Sciences Inc. (Air Sciences) proposes to use a conversion factor of 1.2. This memorandum provides supporting technical justification for the 1.2 conversion factor. It also addresses the Alaska Department of Environmental Conservation (ADEC) question regarding the potential effect of complex vs. flat terrain on this factor.

EPA's Use of the 1.2 Conversion Factor

In EPA's guidance document for modeling fugitive dust impacts from coal mines, EPA provides a conversion factor of 1.2 for converting an hourly mean wind speed to a fastest mile wind speed. Page 37 of this document states the following:

> *"Assuming that the ratio of the fastest mile to the hourly mean wind speed is 1.2; an hourly mean wind speed of 23 mph will be assumed to produce a fastest mile of 27 mph."* (EPA 1994)

Other Examples of Use of the 1.2 Conversion Factor

A web search for other examples where the 1.2 conversion factor (or similar factor) is used includes the following:

- Guidelines for Electrical Transmission Line Structural Loading (Wong and Miller 2010). Appendix D of this Guideline from the American Society of Civil Engineers references a

1960 journal article by C. S. Durst, which is described in the next section. Appendix D also provides an example conversion from the fastest mile wind gust of 72 miles per hour (mph) (averaging time of 50 seconds) to mean hourly wind speed of 57 mph using a factor 1.26 (Wong and Miller 2010). As shown in Table 1 in the following section, 1.26 (50-second average) is within the range of the 1-minute average ratio of 1.24 and the 30-second average ratio of 1.32.

- Wind Loads: The Nature of Wind (Quimby 2007). In this presentation by Professor T. Bart Quimby, P.E., Ph.D., of the University of Alaska Anchorage, a graph is provided that shows the ratio of the 2-minute wind gust over the hourly mean wind speed to be between 1.15 and 1.20.

- Erosion Potential Tests in the Vicinity of East Helena Using a Portable Wind Tunnel (Wisner et al. 1991). In this report, a gust factor of 1.2 is used "to convert hourly average wind to fastest mile." Note that Helena, Montana, is in an area of complex terrain.

Durst 1960 Article

In a meteorological journal article authored by C. S. Durst (Durst) in 1960, Durst provides a table of the probable values of the short-term (0.5-second to 10-minute) wind gusts for varying hourly mean wind speeds. This table is summarized as follows:

Table 1. Excerpts from Table VIII of the Durst Article (Durst 1960)

Mean Hourly Wind Speed (mph)*	Short-Term Gust*			Ratio: Gust over Hourly		
	10-min	1-min	30-sec	10-min	1-min	30-sec
20	21	25	26	1.05	1.25	1.30
30	32	37	40	1.07	1.23	1.33
40	43	50	53	1.08	1.24	1.33
50	53	62	66	1.06	1.23	1.32
60	64	74	79	1.07	1.24	1.32
70	74	87	92	1.06	1.24	1.31
80	85	99	106	1.06	1.24	1.33
			Ratio Average	**1.06**	**1.24**	**1.32**

*(Durst 1960)

Linearly interpolating between the 10-minute gust ratio and the 1-minute gust ratio yields a value of 1.22 for the 2-minute gust ratio. The 2-minute wind speed provides a reasonable estimate of the fastest mile wind speed.[1]

As noted by ADEC, the Durst article states the following regarding terrain:

> *"It must, however, be noted that the figures and Table VIII strictly refer only to a site in which the wind has an unobstructed field and the topography is flat. Data do not appear to be available for any other type of exposure. However, it is believed that the values given in Table VIII can be reasonably applied to sites where the countryside is undulating but slopes are not steep." (Durst 1960)*

The [redacted] project is in an area of complex terrain. In order to assess the potential effect of complex vs. flat terrain on the gust ratio, Air Sciences has downloaded and analyzed measured 2-minute wind speed data from meteorological stations in both complex and flat terrain. This analysis is discussed in the following section.

Analysis of 2-Minute Wind Speed Data

In an effort to assess the potential effect of flat vs. complex terrain on the gust ratio, five years of 1-minute National Weather Service (NWS), Automated Surface Observing System (ASOS) data were downloaded for three sites: McGrath, Alaska; Reno, Nevada; and Emporia, Kansas (NWS 2015). Note that these data only provide 2-minute average wind speeds for each minute.

These sites provide examples of both complex and flat terrain. The data were compiled into mean hourly wind speeds and, for each hour, the maximum 2-minute average wind gust. For each hour with a mean hourly wind speed of greater than or equal to 20 mph, the 2-minute gust ratio was calculated. Table 2 provides a summary of this analysis.

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[1] "The duration of the fastest mile, typically about 2 minutes (for a fastest mile of 30 mph), matches well with the half-life of the erosion process, which ranges between 1 and 4 minutes." (EPA 2006)

Table 2. Wind Speed Data

Station	Location	No. of Hourly Mean Winds over 20 mph	Hourly Mean (mph)*	Wind Speed Ratio: 2-Minute Gust over Hourly Mean		Terrain Description
				Average	Median	
PAMC**	McGrath, AK	57	22.47	1.26	1.25	Flat
KRNO**	Reno, NV	1,540	24.49	1.26	1.24	Complex
KEMP**	Emporia, KS	3,155	23.73	1.20	1.18	Flat
AMR	American Ridge, AK	1,041	23.89	ND	ND	Complex

*Excluding hours with wind speeds of less than 20 mph.
**(NWS 2015)

As shown in Table 2, Stations KRNO and KEMP had a significant number of mean hourly winds above 20 mph, similar to the Donlin AMR station. PAMC had limited mean hourly winds above 20 mph and therefore may not be statistically significant.

The 2-minute gust ratios for KRNO are 1.26 (average) and 1.24 (median). KRNO is in an area of complex terrain. The 2-minute gust ratios for KEMP are 1.20 (average) and 1.18 (median). KEMP is in an area of flat terrain. The ratios for both of these stations are consistent with the Durst article, which provides a 2-minute gust ratio of 1.22 for winds over 20 mph.

Histograms of the 2-minute gust ratios are provided in Figure 1 for the KRNO station and Figure 2 for the KEMP station.

Figure 1. KRNO Wind Data Histogram

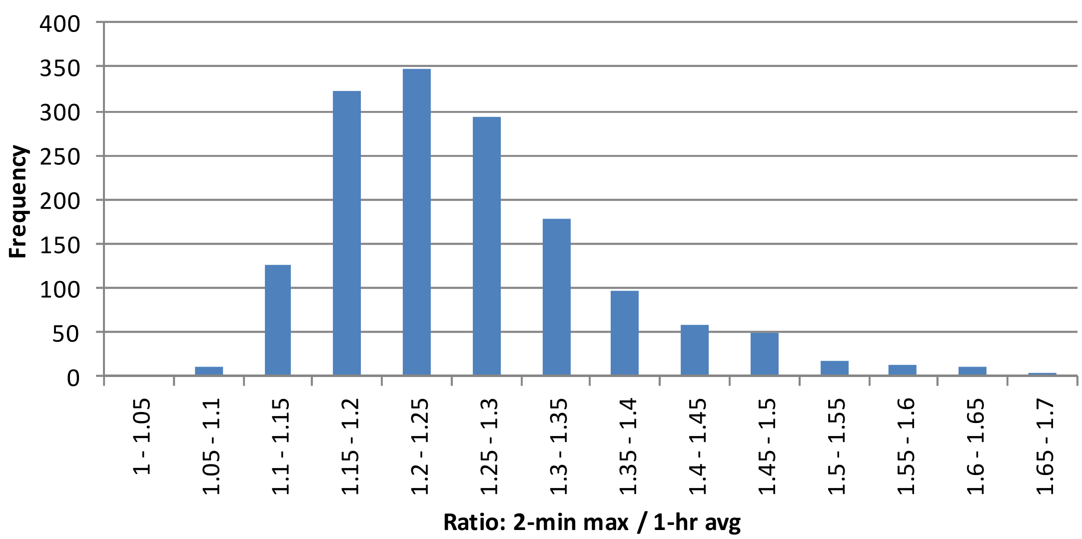
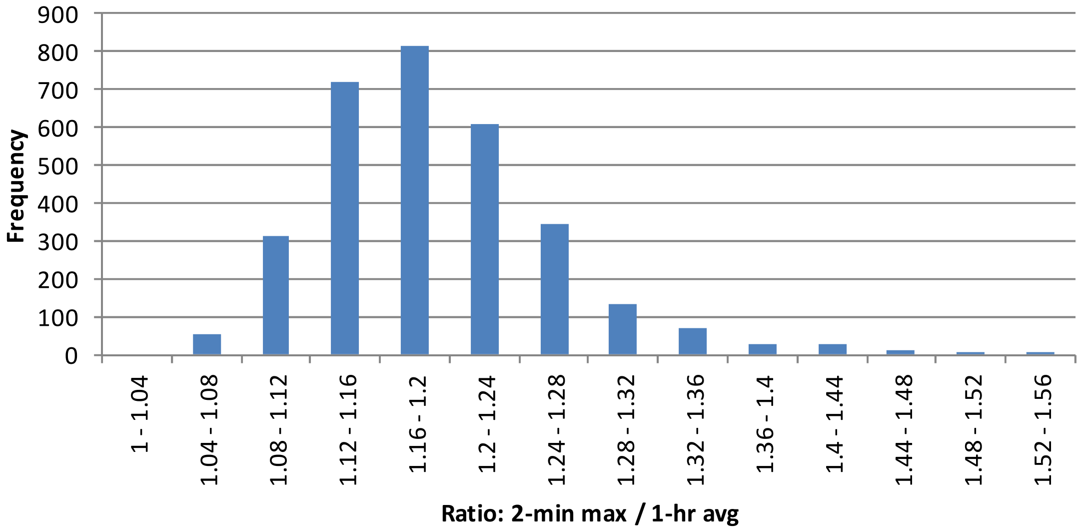


Figure 2. KEMP Wind Data Histogram



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