AIR DISPERSION MODELING PROTOCOL

El Paso Natural Gas Company – Vail Compressor Station Facility Utilization Increase

Prepared For:

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a Kinder Morgan company

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1. EXECUTIVE SUMMARY

The El Paso Natural Gas Company, L.L.C. (EPNG), a Kinder Morgan Company, provides natural gas transportation services for natural gas suppliers and end users throughout the southwestern United States and owns and operates a large pipeline network. The Vail Compressor Station (the facility) is one of such stations that provides natural gas compression to the pipeline network. Natural gas compression is needed to maintain enough pressure in the pipeline to keep the natural gas flowing, and it is accomplished with three (3) natural gas fired General Electric (GE) M3002-RA turbines that drives the compressor units. The facility is permitted to operate 24 hours a day and 365 days a year. The facility is regulated by the Pima County Department of Environmental Quality (PDEQ) and currently operates pursuant to the conditions of PDEQ Class I Air Quality Permit 425.

The facility is located near Tucson, Arizona in Pima County. While some portions of Pima County have been classified as non-attainment with the National Ambient Air Quality Standards (NAAQS) for particulate matter less than 10 microns (PM_{10}), the facility is located in the portion of Pima County that has been classified as attainment or unclassified with the NAAQS for all regulated pollutants.[1] Therefore, with respect to the federal NSR permitting program, only Prevention of Significant Deterioration (PSD) requirements are considered to be potentially applicable to the facility. Natural Gas Compressor Stations are not on the "List of 28" in Title 40 of the Code of Federal Regulations (40 C.F.R.) §52.21(b)(1)(i). Therefore, for PSD program purposes the facility is subject to the major source threshold of 250 tpy. Because site-wide potential emissions of NOx and CO exceed 250 tpy, the facility is considered to be a PSD Major Source.

EPNG is considering modifications to two of the compressor units at the facility. The modifications include adding gas cooling and recycling to two of the three existing centrifugal compressors. The proposed project does not involve any physical or operational changes to the existing turbines that drive the centrifugal compressors and no increase in horsepower capacity will result from the proposed project. The proposed change will lead to an increased utilization of the compressor and consequently the turbines. Initial post-project emission estimates indicate that these modifications may trigger PSD for NOx and CO emissions as the emission increase may exceed the PSD Significant Emission Rate (SER) of 40 tpy and 100 tpy, respectively. Therefore, NOx and CO are the only regulated air pollutants with a potential significant net emissions increase as a result of the proposed project. As part of the PSD review process, the completion of an air quality dispersion modeling analysis is required to demonstrate that potential impacts from the proposed project will not:

- Cause or contribute to a violation of any applicable NAAQS;
- Exceed a PSD increment; or
- Significantly affect Air Quality Related Values (AQRV) and visibility in Class I areas.

This protocol describes the proposed air quality dispersion modeling methodologies for the PSD review process. The purpose of the protocol is to provide PDEQ and other reviewers with an opportunity to review and approve the proposed modeling methodology. This protocol is prepared in accordance with Appendix W of the Guideline on Air Quality Models (Revised) and the Air Dispersion Modeling Guidelines for Arizona Air Quality Permits.[2][3]

[1] Per 40 C.F.R. §81.303.

[2] U.S. EPA, 40 C.F.R. Part 51, Appendix W, January 17, 2017.

[3] Arizona Department of Environmental Quality, Air Dispersion Modeling Guidelines for Arizona Air Quality Permits, December 1, 2015.

2. PROJECT DESCRIPTION

This section presents an overview of the proposed project. Section 2.1 provides a brief description of the proposed project. Section 2.2 contains a description of the applicable regulations that require air quality dispersion modeling.

2.1. PROJECT DESCRIPTION

EPNG is considering modifications to two of the compressor units at the facility. The modifications include adding gas cooling and recycling to two of the three existing centrifugal compressors. The proposed project does not involve any physical or operational changes to the existing turbines that drive the centrifugal compressors and no increase in horsepower capacity will result from the proposed project. The proposed change will lead to an increased utilization of the compressor and consequently the turbines.

2.2. NEW SOURCE REVIEW APPLICABILITY

Two distinct federal NSR permitting programs apply depending on whether the facility is located in an attainment or nonattainment area for a particular pollutant, Prevention of Significant Deterioration (PSD) and Nonattainment NSR (NNSR), respectively. NNSR permitting applies to new construction or modifications that result in emission increases of a particular pollutant for which the area is classified as "nonattainment". The PSD permitting program applies to projects with emissions increases of pollutants for which the area is classified as "attainment" or "unclassifiable".

The facility is located near Tucson, Arizona in Pima County. While some portion of Pima County have been classified as non-attainment with the NAAQS, the facility is located in the portion of Pima County that has been classified as attainment or unclassified with the NAAQS for all regulated pollutants.[4] Therefore, with respect to the federal NSR permitting program, only PSD requirements are considered to be potentially applicable to the facility. Natural gas compressor stations are not on the "List of 28" in Title 40 of the Code of Federal Regulations (40 C.F.R.) §52.21(b)(1)(i). Therefore, for PSD program purposes the facility is subject to the major source threshold of 250 tpy. Because site-wide potential emissions of NOx exceed 250 tpy, the facility is considered to be a PSD Major Source. The Environmental Protection Agency (EPA) has a delegation agreement with the PDEQ with respect to PSD permitting in Pima County.[5]

Initial post-project emission estimates indicate that these modifications may trigger the PSD program for NOx and CO emissions will exceed their respective PSD Significant Emission Rate (SER) of 40 tpy and 100 tpy, respectively.

2.3. AIR QUALITY IMPACT ANALYSIS

As part of the PSD review process, the completion of an air quality dispersion modeling analysis is required to demonstrate that potential impacts from the proposed project will not:

- Cause or contribute to a violation of any applicable NAAQS;
- Exceed a PSD increment; or

[4] Per 40 C.F.R. §81.303.

[5] Per Agreement for Delegation of Source Review under the Federal Prevention of Significant Deterioration Program Set Forth in 40 CFR 52.21, Contract number CTNDE-18-15C, dated May 15, 2018.

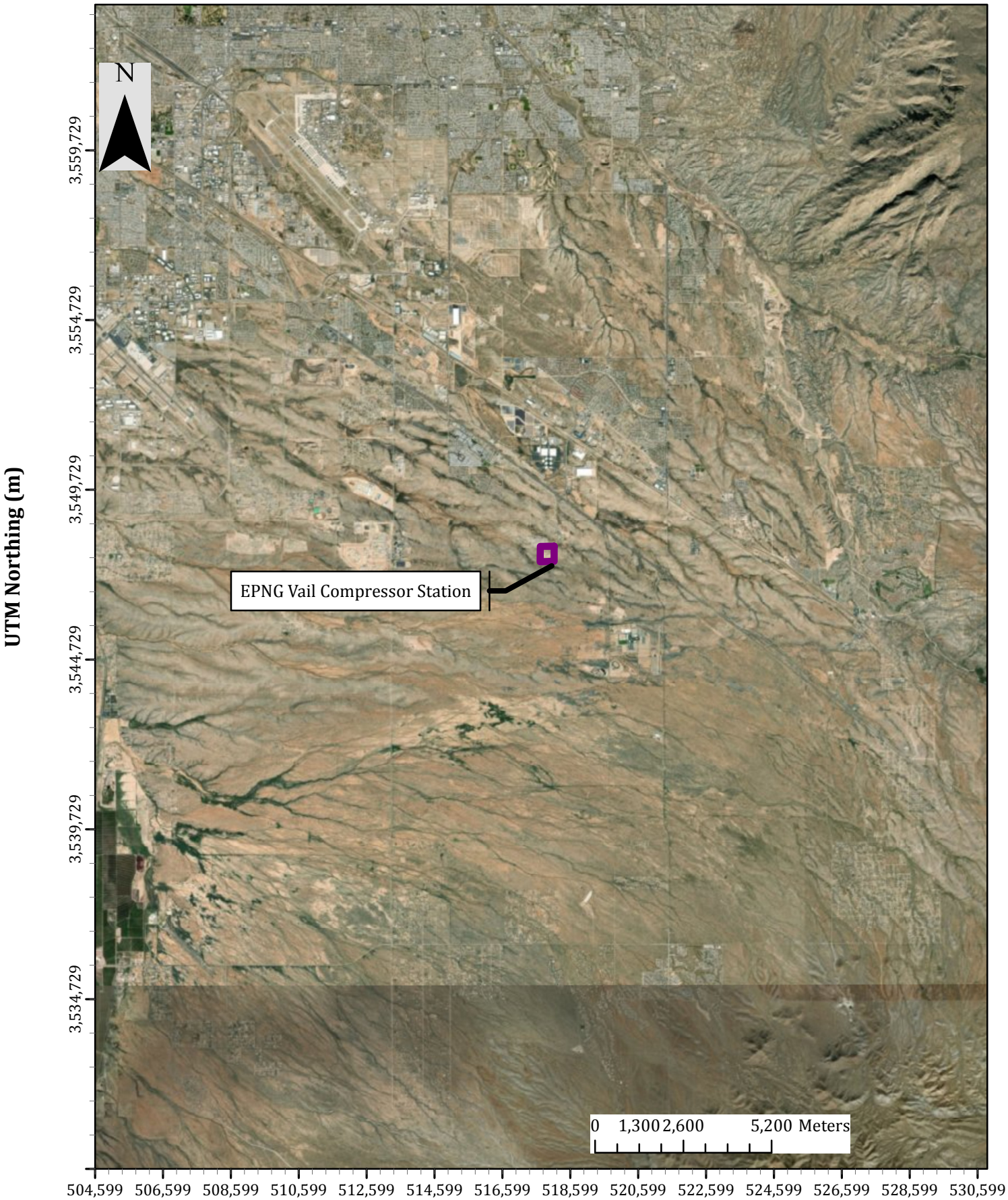
- Significantly affect AQRVs in Class I areas.

This demonstration will be performed for NOx and CO, the pollutants that trigger PSD review.

2.4. SITE LOCATION

The facility is located near Tucson, Arizona in Pima County. Figure 2-1 provides the general location of the site with respect to surrounding cities and highways. An aerial photograph of the facility is provided in Figure 2-2, which also depicts the fenceline for the site with respect to the surrounding area. Figure 2-3 depicts the location of the modeled emission sources and buildings/structures considered for downwash analysis. Note that all coordinates presented in the figures are established using the Universal Transverse Mercator (UTM) NAD83 coordinate system.

Figure 2-1 - Vail Compressor Station Location Map



All Coordinates shown in UTM Coordinates, Zone 12, NAD 83 Datum

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Figure 2-2 - Vail Compressor Station Fenceline

All Coordinates shown in UTM Coordinates, Zone 12, NAD 83 Datum

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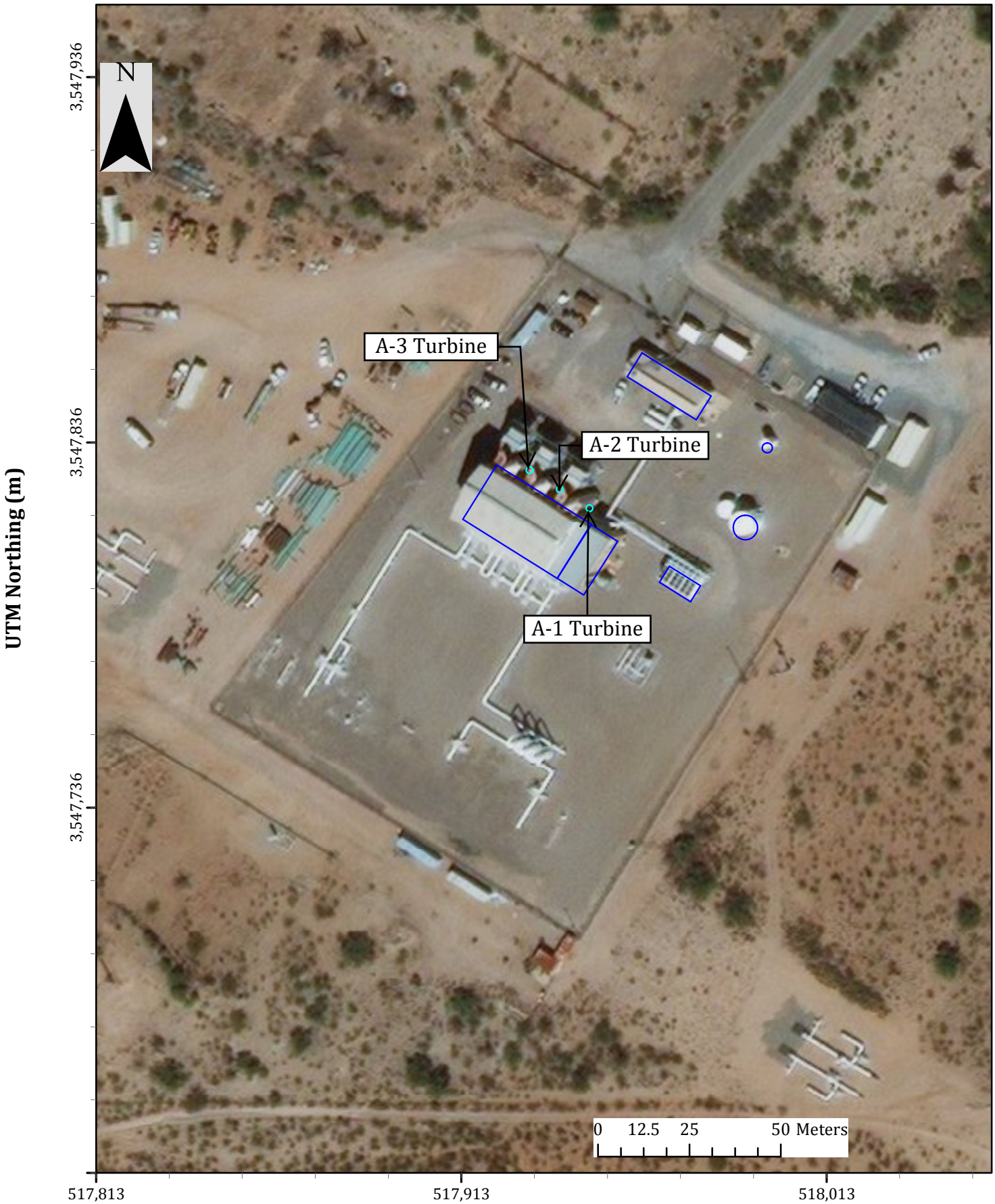
Figure 2-3 - Vail Compressor Station Plot Plan



All Coordinates shown in UTM Coordinates, Zone 12, NAD 83 Datum

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3.1. SIGNIFICANT IMPACT ANALYSIS

According to the ADEQ modeling guidelines[6], for pollutants that trigger PSD requirements, the modeling analysis is performed in the following two steps:

- Step 1 – A significant impact analysis, and if required;
- Step 2 – A full impact analysis.

In the Significant Impact Analysis, only project sources will be modeled to determine if the proposed emission changes have a significant impact on the surrounding areas. The maximum modeled concentrations from the significant impact analysis will be compared to the applicable significant impact levels (SILs), for each pollutant and averaging period.[7] If the maximum modeled concentration is less than the SIL, no further analysis is required to demonstrate compliance with the NAAQS or PSD Increment. If the maximum modeled concentration exceeds the applicable SIL, a full impact analysis will be completed. It is anticipated that a full impact analysis will only be required for NO_2 emissions. Table 3-1 summarizes the applicable SILs and NAAQS for each pollutant that will be modeled.

Table 3-1. Significant Impact Levels

Pollutant	Averaging Period	Significant Impact Level (µg/m³)		NAAQS (µg/m³)
		Class I	Class II	
NO_2	1-hour	--	7.5	188
	Annual	0.10	1	100
CO	1-hour	--	2,000	40,000
	8-hour	--	500	10,000

3.2. FULL IMPACT ANALYSIS

For pollutants with maximum modeled concentration that exceed the applicable SIL, a full impact analysis will be completed. The full impact analysis considers post-project facility-wide emissions (i.e., not just the project sources). A full impact analysis will be conducted for the significant impact area (SIA) as defined by the receptors exceeding the SIL for each pollutant and averaging period. Based on preliminary modeling, it is anticipated a full impact analysis will only be required for NOx, not CO. The approach for the NOx full impact analysis is outlined below; EPNG will use a similar approach if a full impact analysis is required for CO.

3.2.1. NO_2 NAAQS Modeling Inventory

For PSD pollutants (i.e., NOx only), the NAAQS demonstration will consider facility-wide emissions as well as off-site NOx emissions. The off-site NOx emissions will consider permitted major sources within the SIA. In addition, all permitted sources located outside the SIA and within the annular area extending 50 km from the SIA will also

[6] Arizona Department of Environmental Quality, Air Dispersion Modeling Guidelines for Arizona Air Quality Permits, December 1, 2015.

[7] Significant Impact Levels per ADEQ, Air Dispersion Modeling Guidelines for Arizona Air Quality Permits, Table 8, December 1, 2015.

be included if they have a potential to affect air quality near the source. This determination will be completed using the '20D' approach, which will be used to eliminate the majority of regional facilities from the PSD NAAQS modeling analysis that would not be expected to have a significant impact on analysis results. Under this approach, an off-site source will be excluded if its potential allowable emissions (Q) in tons/yr that is less than 20 times the distance ("20D") between it and the facility, in kilometers.[8]

3.2.2. NO_2 PSD Increment Inventory

The increment inventory to be considered in the modeling analysis will include all increment-affecting sources located within the SIA of the facility. The types of stationary point sources within the SIA that will be reviewed to determine the need to include them in the increment inventory fall under two specific time frames:

- After the major source baseline date (defined as February 8, 1988 for NO_2), which includes the following sources:
  - Existing major stationary sources having undergone a physical change or change in their method of operation; as well as
  - New major stationary sources.

- After the minor source baseline date (which has not been triggered for Pima County for NO_2), which includes the following sources:
  - Existing stationary sources having undergone a physical change or change in their method of operation; as well as
  - Existing stationary sources having increased hours of operation or capacity utilization (unless such change was considered representative of baseline operating conditions).

Because the minor source baseline date has not been triggered for NO_2, the PSD Increment inventory will be limited to existing major stationary sources within the SIA having undergone a physical change or change in their method of operation as well as new major stationary sources within the SIA.

3.3. PRE-CONSTRUCTION MONITORING ANALYSIS

As part of a PSD modeling analysis, a pre-construction monitoring analysis must be performed to determine whether preconstruction monitoring may be required to evaluate existing air quality before the permit is issued. The U.S. EPA's Significant Monitoring Concentrations (SMC) establish the levels at which a facility may need to conduct pre-construction ambient air quality monitoring for pollutants subject to PSD review in order to evaluate the existing air quality. Note that since the proposed project is expected to trigger the PSD program for NOx and CO, a pre-construction monitoring analysis will only be conducted for these pollutants. The SMCs are summarized below. EPNG will compare the applicable pollutant-averaging period maximum model concentration result from the significant impact analysis to these SMCs. If the SMCs are not exceeded, then no pre-construction monitoring is required.

[8] Significant Impact Levels per ADEQ, Air Dispersion Modeling Guidelines for Arizona Air Quality Permits, Section 6.2, December 1, 2015.

Table 3-2. Significant Monitoring Concentrations

Pollutant	Averaging Period	SMC ($\mu g/m^3$)
NO_2	1-hour Annual	-- 14
CO	1-hour 8-hour	-- 575

As mentioned above, for CO it is not anticipated that the 8-hour averaging period result will exceed the SMC. If the maximum modeled NOx annual concentration exceeds the SMC, EPNG proposes that data collected from the 22nd & Craycroft monitor be used as a surrogate for pre-construction on-site monitoring. The 22nd & Craycroft monitor selection and data is addressed below.

3.4. BACKGROUND CONCENTRATIONS

A "representative" background concentration is required for each modeled pollutant and averaging period to complete the NAAQS modeling analysis. In this modeling analysis it is anticipated that only NAAQS modeling for NO_2 will be conducted for both the 1-hour and annual averaging period. The background concentration accounts for sources of air pollution other than those explicitly modeled (i.e., the facility and the industrial neighbors identified to represent the nearby inventory sources). Typically, background concentrations are accounted for by using air quality data measured at an appropriate monitoring station. Appendix W of 40 CFR Part 50 discusses requirements for obtaining representative background concentrations. Specifically, "*air quality data should be used to establish background concentrations in the vicinity of the source(s) under consideration*".

3.4.1. NO_2 Background Monitor

There are two active NO_2 monitors in Pima County, 22nd & Craycroft and Children's Park. Based on EPA-published Greenbook data for the most recent three-year period, the data from each monitor meets the completeness criteria on a short-term and annual basis.[9] The 22nd & Craycroft monitor is closer to the facility, 17 km as opposed to 30 km away for Children's Park. Furthermore, 22nd & Craycroft has a higher published design value on a short-term basis, and is therefore a more conservative representation. Based on these considerations, EPNG proposes 22nd & Craycroft monitor as the representative NO_2 monitor for the facility. A summary of the monitor's yearly background data is contained in Table 3-3.

[9] Nitrogen Dioxide Design Values, 2018. Air Quality Design Values, EPA. https://www.epa.gov/air-trends/air-quality-design-values

Table 3-3. Representative Background Concentrations

Pollutant	Averaging Period	Site Name	Distance to the Vail Compressor Station (miles)	Year	Percent Complete [1]	Concentration Format	Concentration (µg/m³) [1]	
							Actual	Selected
NO_2	Annual	22nd & Craycroft	10.3	2016	97	Arithmetic Mean	15	16
				2017	100		16	
				2018	100		16	
	1-hr			2016	97	98th Percentile	63.0	70.2
				2017	100		70.3	
				2018	100		77.5	

[1] Background concentrations obtained from EPA's AirData Air Quality Monitors.

Actual values are converted to µg/m³ with the following conversion 1 ppb = 1.88 µg/m³.

3.4.2. Ozone Background Monitor

There are eight active ozone background monitors in Pima County. Of these, the Fairgrounds monitor is only 4 km from the facility, and is also in a similar land use and elevation. Based on EPA-published Greenbook data, the monitor meets the completeness requirements for the most recent three years, 2016-2018. EPNG proposes to use Fairgrounds as the representative ozone monitor, with the 8-hour averaging design value of 0.068 ppm (68 ppb).[10]

3.5. CONSIDERATIONS FOR 1-HOUR NO_2 MODELING

The EPA's memorandums dated June 28, 2010 and March 1, 2011 [11, 12] recommended the following three-tiered approach for 1-hour NO_2 modeling:

- Tier 1 Total Conversion - assuming full conversion of NO to NO_2 without any additional justification.
- Tier 2 Ambient Ratio Method 2 (ARM2) - multiply Tier 1 result by empirically-derived NO_2/NO_x ratio, with 0.8 as default ambient ratio for the 1-hour NO_2 standard without additional justification.
- Tier 3 - Plume Volume Molar Ratio Method (PVMRM)/ Ozone Limiting Method (OLM) - the two approaches are available as non-regulatory-default options within the AERMOD model.

In this modeling analysis, EPNG proposes to use Tier 1 approach followed by Tier 2, if needed. The Tier 3 approach is not expected to be used. However, if the Tier 3 approach is needed, EPNG will initiate discussions with PDEQ related to the detailed methodology and parameters to be used in the Tier 3 analysis.

3.6. IMPACT ANALYSIS FOR CLASS I AREA

Class I areas are federally protected areas for which more stringent air quality standards apply. "Class I" areas are generally defined as federal lands such as national parks (NP), national wilderness areas, and national monuments. There are ten (10) Class I areas within 300 km of the facility location. A list of these Class I areas,

[10] Ozone Design Values, 2018. Air Quality Design Values, EPA. https://www.epa.gov/air-trends/air-quality-design-values

[11] U.S. EPA, Applicability of Appendix W Modeling Guidance for the 1-hour NO2 National Ambient Air Quality Standard, Research Triangle Park, North Carolina 27711, June 28, 2010.

[12] U.S. EPA, Additional Clarification Regarding the Application of Appendix W Modeling Guidance for the 1-hour NO2 National Ambient Air Quality Standard, Research Triangle Park, North Carolina 27711, March 1, 2011.

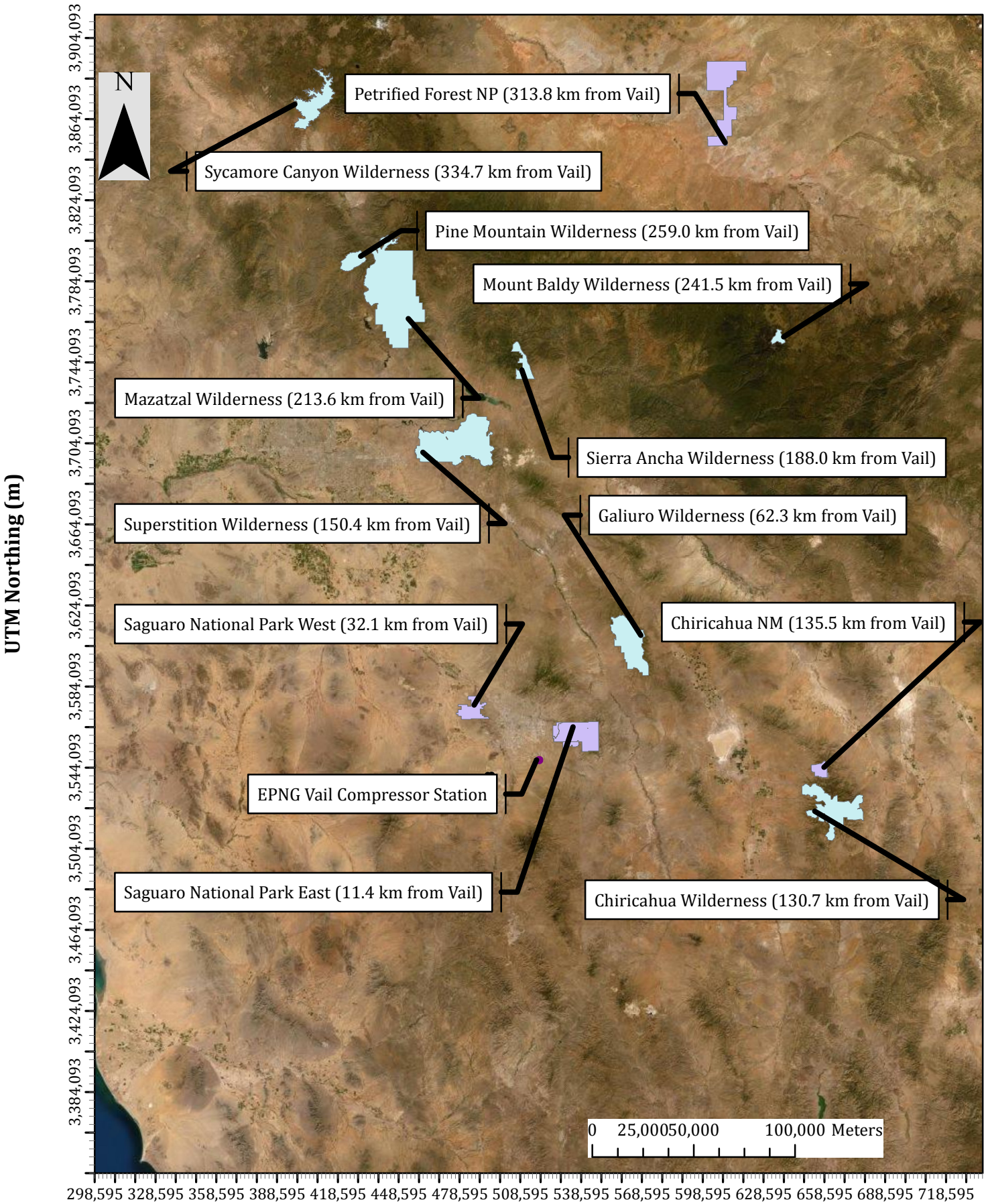
approximate distance of each area from the facility, and the responsible FLM for each area is contained in Table 3-4. Figure 3-1 depicts various Class I areas and their distances from the facility. Typically, Class I Area analyses consist of two categories:

- PSD increment consumption; and
- AQRV (typically visibility and deposition).

Table 3-4. Class I Areas within 300 km of the Vail Compressor Station

Name	Distance of Closest Point to EPNG (km)	Federal Land Manager
Saguaro National Park East	11.4	U.S. National Park Service
Saguaro National Park West	32.1	U.S. National Park Service
Galiuro Wilderness	62.3	U.S. Forest Service
Chiricahua Wilderness	130.7	U.S. Forest Service
Chiricahua NM	135.5	U.S. National Park Service
Superstition Wilderness	150.4	U.S. Forest Service
Sierra Ancha Wilderness	188.0	U.S. Forest Service
Mazatzal Wilderness	213.6	U.S. Forest Service
Mount Baldy Wilderness	241.5	U.S. Forest Service
Pine Mountain Wilderness	259.0	U.S. Forest Service

Figure 3-6 - Class I Areas within 300 km of EPNG



UTM Easting (m)

All Coordinates shown in UTM Coordinates, Zone 12, NAD 83 Datum

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3.6.1. Class I Area PSD Increment Analysis

For Class I areas within 50 km from the facility (i.e., Saguaro National Park East and West), AERMOD will be used to determine the maximum model impacts at Class I receptors developed by the National Park Service (NPS) and the modeled concentrations will be compared with Class I area SILs. Because the PSD Increment evaluation will be satisfactory at the Saguaro Wilderness East, it is assumed that no other Class I area needs to be evaluated for Class I PSD Increment impacts.

For Class I areas located more than 50 km from the facility (e.g., Chiricahua Wilderness), AERMOD modeled concentrations at the boundary of the model (i.e., 50 km from the facility) will be compared with Class I area SILs. This approach assumes that the modeled concentration will decrease as the distance increases from the facility. In order to verify this assumption, EPNG will perform the following analysis:

- Class 1 Areas within 300km of the EPNG will be overlaid onto the annual NO2 concentration isopleths to show that the modeled concentration decreases with as the distance increases.

This strategy avoids the requirement to conduct costly and time consuming long-range (e.g., CALPUFF) regional scale modeling at the Class I Areas. If it is determined that long-range modeling is required, EPNG will initiate discussion with PDEQ with regards to the modeling approach.

3.6.2. Class I Area AQRV Analysis

The Federal Land Managers (FLM) have the authority to protect AQRVs, and to consider in consultation with the permitting authority whether a proposed major source or modification will have an adverse impact on such values. AQRVs for which PSD modeling evaluations is typically conducted include visibility and deposition of sulfur and nitrogen.

Historically, Class I Area AQRV analyses were developed based on the distance between a PSD project and a Class I Area. The distance threshold has been 300+ km depending on the magnitude of emissions for a project and regulatory agency discretion. In October 2010, *The Federal Land Managers Air Quality Related Values (AQRV) Workgroup (FLAG) Phase I Report – Revised* (2010) was issued providing guidance which established a threshold ratio of emissions to distance, below which AQRV review is not required. Specifically, if:

$$Q\ (tpy)/d\ (km) < 10, \text{ no AQRV analysis required}$$

Where,

Q = Emissions increase of SO_2, NO_x, PM_{10}, and sulfuric acid mist (H_2SO_4), combined in tpy [the tpy value is based on the maximum short-term emission rates]
d = is the nearest distance to a Class I Area in km

If the *10d Rule* above per Class I Area is less than 10, then presumptively there is no adverse impact and a project "screens out" of a Class I AQRV analysis. Class I areas which demonstrate a value greater than 10 using the *10d* Rule are subject to a Class I ARQV analysis. Overall, using the distances contained in Figure 3-1 and assuming a Q of 195 tpy (which will be further refined and developed as part of the modeling report), all Class I areas other than Saguaro National Park East and West will have a Q/d < 10 and will not be subject to AQRV review.

3.6.2.1. Class I Area AQRV Analysis - Visibility

Visibility impacts at the Saguaro National Park East and West will be evaluated using the VISCREEN model. VISCREEN is a screening model designed to determine plume impairment (heterogeneous visibility impacts) at a Class I area for a plume released from a single emission source located less than 50 kilometers from areas of interest, as is the case for Saguaro National Park East and West. VISCREEN calculates visual effects parameters for a plume as observed from a given vantage point. It is designed as a conservative screening tool, and can be used for the first two levels of plume visual impact screening: Level-1 and Level-2.

VISCREEN Level-1 screening is designed to provide a very conservative estimate of plume visual impacts. Level-1 screening analysis assumes default particle size and density, and worst-case meteorological condition of stability Class F and 1.0 meter/second (3.3 feet/second) wind speed. This worst-case meteorological condition is assumed to persist for 12 hours, with a wind direction that would transport the plume directly adjacent to the observer. The results of the VISCREEN Level-1 analysis will be compared to the color difference parameter (ΔE) screening criteria of 2.0 and the plume green contrast screening criteria of 0.05. If the Level 1 screening results indicate possible exceedances of the criteria, a Level 2 analysis will be completed.

A Level 2 analysis refines the Level-1 analysis primarily by selecting a dispersion coefficient and wind speed representative of the region encompassing both the source and Class I area. In contrast, a Level-1 analysis assumes worst-case parameters (Pasquill-Gifford stability Class F, wind speed 1.0 m/s) that are not necessarily indicative of local meteorology. The first step in the selection of more representative plume dispersion parameters for the Level-2 analysis is to select a wind direction sector that most effectively transports the emissions to the Class I observer point. If the Class I area can be influenced by more than one wind direction, the necessary data can be obtained by interpolating between the multiple directions. The second step will be to obtain the Pasquill-Gifford vertical and lateral diffusion coefficients for each stability class at the observer point. With these coefficients and a wind class range indicative of the meteorological data chosen, a dispersion condition chart for each stability and wind class will be generated by multiplying the maximum speed of each wind class by the appropriate diffusion coefficients. The next step of the process is to split up the meteorological data by time of day into four periods (0001-0600, 0601-1200, 1201-1800, and 1801-2400) and identify the joint frequency of wind direction, speed, and stability class occurrences. The final step is to generate a worst case joint frequency distribution chart. A frequency analysis will be performed for each of the four daily time periods identified above. Starting from the lowest value of the dispersion conditions, the cumulative frequency of wind speed, direction, and stability classes are reviewed in order of increasing dispersion conditions. The first category encountered totaling one percent is selected as the worst-case meteorological condition appropriate to use in VISCREEN Level 2 analysis. However, the plume transport time to the Class I area is also considered. Based on U.S. EPA guidance, it is unlikely that steady state plume conditions will persist for more than 12 hours. Thus, if a transit time of more than 12 hours is required to transport a plume parcel from the emissions source to a Class I area for a given dispersion condition, that dispersion condition is not utilized. This enhanced dilution would result from daytime convective mixing and wind direction and speed changes. Per EPA guidance, the stability class can be adjusted to one level less stable when a tall feature is between the source and the Class I area.

The VISCREEN Level-2 analysis include actual particle size distributions, as well as accounting for topographic features, such as intervening terrain and differences between the height of the source and observer. Other VISCREEN Level-1 values were assumed in the Level-2 analysis for other VISCREEN parameters. The results of the VISCREEN Level-2 analysis will be compared to the color difference parameter (ΔE) screening criteria of 2.0 and the plume green contrast screening criteria of 0.05.

If the Class I areas within 50km of the source meet the visibility thresholds in the VISCREEN Level-1 or Level-2 analysis, other Class I areas greater than 50km from the source will be assumed to meet the visibility thresholds.

3.6.2.2. Class I Area AQRV Analysis - Deposition

Because of the location of the Saguaro National Park East and West within 50 km of the facility, the AERMOD model will be utilized for the assessment of deposition impacts at these area.

3.7. SECONDARY $PM_{2.5}$ & OZONE ASSESSMENT

Pursuant to 40 CFR 52.21, a proposed project with an increase of VOC or NO_X emissions in excess of 100 tpy triggers an ambient ozone impact analysis for that project. Since the project emission increase for NOx exceeds 100 tpy, an analysis must be performed.

EPA has devised a two tier approach as detailed in 40 C.F.R. 51. A Tier 1 assessment uses the relationship between source characterization and modeled concentration of a representative (hypothetical) source and location to assess potential impacts from a new source. EPA has published hypothetical source modeled concentrations with relationship to location and source characterization in the April 2019 Modeled Emission Rates for Precursors (MERP) Memo. These hypothetical sources use one year of meteorological data from 2011 to determine modeled impacts.[13]

Table 3-5 contains a summary of the maximum terrain and urban fraction between the three Arizona hypothetical facilities contained in the EPA MERP guidance as well as the facility. Similarly, Figure 3-2 depicts the locations of these facilities in Arizona. Based on an evaluation of elevations, urban fraction, and climatology unique to each location, hypothetical Facility 14 (FIPS 4007) is considered representative of the facility location.

Table 3-5. EPA Arizona MERP Facilities & Vail Compressor Station

Reference	FIPS	County	Source	Latitude	Longitude	Max Nearby Terrain (m)	Max Nearby Urban (%)
EPA MERP Guidance	4005	Coconino	36	35.428	-111.270	2,483	7.4
	4007	Gila	14	33.469	-110.789	1,592	4.3
	4012	La Paz	17	33.400	-113.408	757	0.9
EPNG Vail	-	Pima	-	32.066	-110.810	900	8.4

[13] EPA Memorandum, Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier I Demonstration Tool for Ozone and PM2.5 under the PSD Permitting Program , April 30, 2019.

Figure 3-2. Location of EPA Arizona MERP Facilities & Vail Compressor Station

To evaluate the facility's impact on secondary pollutants, EPNG will follow the EPA April 2019 MERP Memo.

- Step 1: Calculate the MERP based on the equation provided by EPA guidelines:

$$\text{MERP} = \text{SIL Value x } \frac{\text{Modeled emission rate from hypothetical source}}{\text{Modeled air quality impact from hypothetical source}}$$

The modeled emission rate and air quality impacts are obtained from EPA's December 28, 2018, workbook with underlying maximum impact and MERPs information for each hypothetical source.[14] EPNG used the hypothetical source assuming the lowest emission rate of 500 tpy and the lowest stack height of 10 m. Table 3-6 the calculated MERPs.

Table 3-6. Calculated MERPs

Secondary Pollutant	Source Pollutant	Stack Height (m)	Source #	Emission Rate (tpy)	Max Impact (ppb)	SIL (ppb)	Calculated MERP (tpy)
Ozone	NO_X	10	14	500	1.226	1	407

- Step 2: For each pollutant and averaging period, the emissions from the facility are compared to the MERP values as summarized in Table 3-7. EPNG's proposed emissions are below the MERP values in Table 3-6 so the SIL will not be exceeded.

Table 3-7. EPNG Emissions Compared to MERP

Secondary Pollutant	Source Pollutant	EPNG Emissions (tpy)	Calculated MERP (tpy)	Total Impact from Precursors (ppb)	Tier 1 MERP Modeled Air Quality Impact as % of SIL
Ozone	NO_X	195	407	0.48	48%

3.8. ADDITIONAL IMPACTS ANALYSIS

The PSD additional impacts analysis depends on existing air quality, the quantity of emissions, and the sensitivity of local soils, vegetation, and visibility in the source's impact area.

3.8.1. Growth Analysis

The elements of the growth analysis include a projection of the associated industrial, commercial, and residential growth that will occur in the area of impact due to the source, including the potential impact on ambient air due to this growth. This is an existing facility; therefore, the activities associated with this permitting action are not expected to cause a significant shift of population or an increase in industrial, commercial, and residential growth in the area. Since no significant associated commercial, industrial, or residential growth is expected as a result of this permitting action, negligible growth-related ambient air impacts are expected.

[14] The workbook is available on EPA's Clean Air Act Permit Modeling Guidance webpage, https://www.epa.gov/scram/clean-air-act-permit-modeling-guidance.

3.8.2. Soil and Vegetation Analysis

The U.S. EPA developed the secondary NAAQS in order to protect certain air quality-related values (i.e., soil and vegetation) that were not sufficiently protected by the primary NAAQS. The secondary NAAQS represent ambient air concentrations below which most types of soil and vegetation are unaffected by criteria pollutants. If ambient air concentrations are found to be less than the secondary NAAQS, emissions from the proposed sources will not result in harmful effects to either soil or vegetation.[15] The maximum modeled ground-level concentrations resulting from the proposed emission sources are compared to the secondary NAAQS to demonstrate insignificant impacts on local soils and vegetation.

[15] U.S. EPA, Office of Air Quality Planning and Standards, *New Source Review Workshop Manual*, Research Triangle Park, NC, October 1990.

4. MODEL OVERVIEW

This section contains a description of the model, meteorological data, terrain data, building wake effects, and receptors that will be used in the air dispersion modeling analysis.

4.1. DISPERSION MODEL SELECTION

The U.S. EPA American Meteorological Society / Environmental Protection Agency Regulatory Model (AERMOD) model includes a state-of-the-science downwash algorithm and utilizes AERMET, a meteorological data preprocessor that utilizes current planetary boundary layer (PBL) theory to calculate the dispersion coefficients (σ_y and σ_z).[16] The most current version of the AERMOD model (version 19191) will be used in conducting the modeling analysis. The modeling will be performed using the regulatory default option, which includes the following:

- Stack-tip downwash; and
- A routine for processing averages when calm wind conditions occur or when meteorological data is missing.

4.2. METEOROLOGICAL DATA

EPA modeling guidance allows the use of five years of off-site meteorological data or at least one year of on-site meteorological data. EPNG will utilize ADEQ model ready data developed from five years of surface and upper air meteorological data from the Tucson International Airport (station identifier KTUS). This data will be processed by ADEQ using the most recent version of EPA's AERMET (Version 19191) and used in this modeling demonstration. ADEQ has Quality Assured the data to ensure it meets EPA guidance, a meteorological database "*must be 90 percent complete (before substitution) in order to be acceptable for use in regulatory dispersion modeling*" and "*The 90 percent requirement applies on a quarterly basis such that 4 consecutive quarters with 90 percent recovery are required for an acceptable one-year data base.*"[17]

4.3. TERRAIN

The terrain elevation for each modeled receptor, building, and source will be determined using the USGS National Elevation Dataset (NED). Specifically, the USGS NED 1/3 arc second (approximately 10-meter resolution) will be used.

The terrain height for each modeled receptor will be calculated using the AERMOD terrain processor (AERMAP version 18081). In addition to terrain elevation, an additional parameter called the hill height scale is required for each receptor to execute AERMOD's terrain modeling algorithms. AERMOD computes the impact at a receptor as a weighted interpolation between horizontal and terrain-following states using a critical dividing streamline approach. This scheme assumes that part of the plume mass will have enough energy to ascend and traverse over a terrain feature and the remainder will impinge and traverse around a terrain feature under certain meteorological conditions. The hill height scale will be computed by the AERMAP terrain preprocessor for each receptor as a measure of the one terrain feature in the modeling domain that would have the greatest effect on plume behavior at that receptor.

[16] U.S. EPA, User's Guide for the AMS/EPA Regulatory Model-AERMOD, September 2004.
[17] EPA, 2000: Meteorological Monitoring Guidance for Regulatory Modeling Applications. U.S. Environmental Protection Agency, Research Triangle Park, NC.

The hill height scale does not represent the critical dividing streamline height itself, but supplies the computational algorithms with an indication of the relative relief within the modeling domain for the determination of the critical dividing streamline height for each hour of meteorological data.

According to Section 2.2.1 of the AERMOD Users Guide, the NED array boundary for AERMAP must include all terrain features that exceed a 10 percent elevation slope from any given receptor to properly calculate the hill height scale at each receptor.[18] The domain for the hill height analysis will be set to the minimum coverage required for proper handling of elevation slope.

4.4. BUILDING WAKE EFFECTS (DOWNWASH)

The emission sources considered in this analysis will be evaluated in terms of their proximity to nearby structures. The purpose of this evaluation is to determine if stack discharge might become caught in the turbulent wakes of these structures. Wind blowing around a building creates zones of turbulence that are greater than if the building was absent. Plumes entrained in the zones of turbulence experience enhanced plume growth and restricted plume rise. AERMOD incorporates the Plume Rise Model Enhancements (PRIME) algorithms using dimensions from the EPA's Building Profile Input Program (BPIP) for estimating for plumes affected by building wakes. The site layout will be used to digitize buildings and structures to be included in the downwash analysis.

Direction-specific building dimensions and the dominant downwash structure parameters will be determined using the *BREEZE*® BPIPP software, developed by Trinity Consultants, Inc. This software incorporates the algorithms of the U.S. EPA-sanctioned Building Profile Input Program with PRIME enhancement (BPIP-PRIME), version 04274.[19]

4.5. RECEPTOR GRID

4.5.1. Class II Receptor Grid

Four receptor grids will be used covering a region that extends 50 km beyond the facility fenceline. Note that all receptor coordinates will be established using the UTM NAD83 coordinate system. The primary receptor grids will include the following:[20]

1. The "fenceline grid" is a discrete receptor grid with the receptors spaced at 25 meter intervals along the fenceline.
2. The "fine grid" contains 100-meter spaced receptors extending approximately 1 km from the fenceline, excluding the receptors within the fenceline.
3. The "medium grid" contains 500-meter spaced receptors extending from 1 km to 5 km from the fenceline.
4. The "coarse grid" contains 1,000-meter spaced receptors extending from 5 km to 50 km from the fenceline.

The receptor grid elevations and scaling heights will be calculated using AERMAP based on USGS NED 1/3 arc second data files.

[18] U.S. Environmental Protection Agency, User's Guide for the AMS/EPA Regulatory Model – AERMOD, Research Triangle Park, North Carolina, EPA-454/B-03-001, September, 2004.
[19] U S. Environmental Protection Agency, User's Guide to the Building Profile Input Program, Research Triangle Park, NC, EPA-454/R-93-038.
[20] Per ADEQ, Air Dispersion Modeling Guidelines for Arizona Air Quality Permits, Section 3.6, December 1, 2015.

4.5.2. Class I Receptor Grid

As discussed in other parts of this protocol, various Class I areas are located within 300 km from EPNG, with one Saguaro Wilderness East and West located within 50 km of the facility. For Saguaro Wilderness East and West, the Class I area receptors developed by the NPS will be used in the Class I area modeling analysis.

For Class I areas located more than 50 km from EPNG, since it is not recommended that AERMOD be used for modeling domain greater than 50 km, a set of 1 km spaced receptors will be placed at 50 km from the facility fence line. Modeled concentrations at these receptors will be compared with Class I SILs. This approach assumes that the modeled concentration will decrease as the distance increase from EPNG. In order to verify this assumption, EPNG will perform the following analysis.

- Multiple sets of "ring receptors" will be set at distances of 10 km, 20 km, 30 km, 40 km, 45 km, and 50 km from the facility.
- Modeled concentrations at these rings will be plotted to demonstrate that the modeled concentration decreases with distance increases.
- The "ring receptors" will be segregated into sectors. The sectors will be determined such that the entire Class I areas will be within that sector while keeping the angle small enough to allow for fine resolution (multiple sectors). Some larger Class I areas may have to be split between multiple sectors to allow for fine resolution.
- The elevation profile for each Class I area will be analyzed and the average elevation of the receptors within each area will be determined.
- The elevation of the receptors within a single sector will be determined to be the maximum of the average elevations for the Class I areas within each sector.
- If a sector contained no Class I areas within 100 km of the facility, the elevation of the ring receptors contained in that sector will not be adjusted.

The elevations assigned to the "ring receptors" simulate the presence of the Class I areas. This approach is conservative because it assumes that the Class I areas are 50 km from the facility when, in many cases, they are located at larger distances.

4.6. LAND USE CLASSIFICATION

As depicted in Figure 2-1, the Facility is located in an area with desert shrub land and agricultural as the dominant land cover. EPA guidance provides two procedures to determine whether the character of an area is predominantly urban or rural. One procedure is based on land-use typing and the other is based on population density. Both procedures require an evaluation of characteristics within a 3-km radius from a source. The land-use typing method is based on the work of August Auer and is preferred because it is more directly related to the surface characteristics of the evaluated area that affect dispersion rates.[21] The Auer land-use approach considers four primary land-use types: Industrial (I), Commercial (C), Residential (R), and Agricultural (A). Within these primary types, subtypes are identified in Table 4-1.

[21] Per J. Appl. Meteor., Correlation of Land Use and Cover with Meteorological Anomalies, August Auer Jr., 1978.

Table 4-1. Land Use Types and Corresponding Dispersion Classification *

Type	Description	Class
I1	Heavy industrial	Urban
I2	Light/Moderate Industrial	Urban
C1	Commercial	Urban
R1	Common Residential (Normal Easements)	Rural
R2	Compact Residential (Single-Family)	Urban
R3	Compact Residential (Multi-Family)	Urban
R4	Estate Residential (Multi-Acre)	Rural
A1	Metropolitan Natural	Rural
A2	Agricultural	Rural
A3	Undeveloped (Grass/Weeds)	Rural
A4	Undeveloped (Heavily Wooded)	Rural
A5	Water Surfaces	Rural

* Per ADEQ, Air Dispersion Modeling Guidelines for Arizona Air Quality Permits, Section 3.7, December 1, 2015.

EPNG conducted a land cover analysis using the draft version of the EPA AERSURFACE model (version 19039) within 3-km radius from the facility. The draft version of AERSURFACE was used so that more recent 2011 land use data could be used. AERSURFACE provides a tally of the number of land cover grid cells for land cover categories that are present in the area of interest. Table 4-2 contains the results from the AERSURFACE model for the number of different land cover categories encountered in the 3-km analysis area. In addition, in Table 4-2, a classification of "rural" or "urban" was assigned to the land cover categories based on Table 4-1. As contained in Table 4-2, almost 92% of land within 3 km from EPNG is considered "rural." Therefore, because the land use classification is over 50% rural, the urban dispersion coefficient will not be applied.

Table 4-2. Land Cover Analysis

Category No.	Category Description	Class	Counts	% of Total
0	Missing, Out-of-Bounds, or Undefined:	Unclassified	0	0.00%
11	Open Water:	Rural	0	0.00%
12	Perennial Ice/Snow:	Rural	0	0.00%
21	Developed, Open Space	Urban	1143	3.64%
22	Developed, Low Intensity	Urban	818	2.60%
23	Developed, Medium Intensity	Urban	453	1.44%
24	Developed, High Intensity	Urban	218	0.69%
31	Bare Rock/Sand/Clay:	Rural	289	0.92%
32	Unconsolidated Shore	Rural	0	0.00%
41	Deciduous Forest:	Rural	0	0.00%
42	Evergreen Forest:	Rural	0	0.00%
43	Mixed Forest:	Rural	0	0.00%
51	Dwarf Shrub land:	Rural	0	0.00%
52	Shrub/Scrub	Rural	28,122	89.51%
71	Grasslands/Herbaceous:	Rural	373	1.19%
72	Sedge/Herbaceous	Rural	0	0.00%
73	Lichens	Rural	0	0.00%
74	Moss	Rural	0	0.00%
81	Pasture/Hay:	Rural	0	0.00%
82	Cultivated Crops:	Rural	0	0.00%
90	Woody Wetlands:	Rural	0	0.00%
91	Palustrine Forested Wetland	Rural	0	0.00%
92	Palustrine Scrub/Shrub Wetland	Rural	0	0.00%
93	Estuarine Forested Wetland	Rural	0	0.00%
94	Estuarine scrub/Shrub Wetland	Rural	0	0.00%
95	Emergent Herbaceous Wetland	Rural	0	0.00%
96	Palustrine Emergent Wetland	Rural	0	0.00%
97	Estuarine Emergent Wetland	Rural	0	0.00%
98	Palustrine Aquatic Bed	Rural	0	0.00%
99	Estuarine Aquatic Bed	Rural	0	0.00%
Total – Counts			***31,416***	**-**
Percentage – Rural			**-**	***91.62%***
Percentage – Urban			**-**	***8.38%***

5. EMISSIONS MODELED & SOURCE CHARACTERIZATION

The following sections discuss the source inventory for the modeling analysis, including the source characterization, parameters, and emission rates to be included in the modeling demonstration.

5.1. SOURCE CHARACTERIZATION

Table 5-1 contains a summary of the facility emission sources that will be modeled. The facility does not operate any other emission sources. The emission sources will be modeled as point sources with the appropriate stack parameters.

Table 5-1. Model Emission Sources & Stack Parameters

Emission		Exhaust Height		Exhaust Diameter		Exhaust Velocity		Exhaust Temperature	
Point	**Unit**	**(ft)**	**(m)**	**(ft)**	**(m)**	**(ft/sec)**	**(m/sec)**	**(deg F)**	**(deg K)**
A-1	GE M3002-RA	51	15.54	6	1.83	99.47	30.32	550	560.93
A-2	GE M3002-RA	51	15.54	6	1.83	99.47	30.32	550	560.93
A-3	GE M3002-RA	51	15.54	6	1.83	99.47	30.32	550	560.93

5.2. EMISSIONS MODELED

In the significance modeling analysis for the NAAQS demonstration, the worst-case emissions for site-wide sources will be modeled. Hourly emission rates will be used to develop the short term modeled concentrations (including 1-hour, 3-hour, 8-hour, and 24-hour), and annual emission rates will used to develop the annual modeled concentrations. For the NO_2 PSD Increment modeling analysis, the differences between post-project PTE and baseline actual emissions (i.e., PTE-BAE) will be modeled. It should be noted that the post-project PTE accounts for the two turbine units with modified compressors.

6. ELECTRONIC FILES

The electronic files to be provided will contain all of the AERMOD air dispersion modeling analyses electronic input, output, and other files used to generate the modeling results. The following is a list of files that will be included:

- All AERMOD input, output, and maximum files
- AERMOD meteorological data files
- AERMOD terrain data files
- All BPIP/BPIPP input and output files