APPENDIX E PIPELINE AIR QUALITY MODELING REPORT

Alaska LNG™

MAIN PIPELINE COMPRESSOR STATIONS FERC AIR QUALITY MODELING REPORT

USAP-PE-SRZZZ-00-000003-000

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1.0 INTRODUCTION

The purpose of this Federal Energy Regulatory Commission (FERC) Air Quality Modeling Report (Report) is to (1) outline the methodologies used to conduct the air dispersion modeling analysis required by the FERC for the Mainline compressor stations, and (2) provide the modeling analysis results. The methodologies used for the analysis are generally consistent with modeling procedures outlined in the Alaska Department of Environmental Conservation (ADEC) and the U.S. Environmental Protection Agency (EPA) air dispersion modeling guidance documents. The results of the air dispersion model analysis demonstrate that the Main Pipeline compressor stations will not cause or contribute to an exceedance of the National Ambient Air Quality Standards (NAAQS) and Alaska Ambient Air Quality Standards (AAAQS).

Note that this modeling analysis reflects the preliminary compressor station design parameters. The modeling and modeling report will be revised if the final design parameters (equipment, stack parameters, etc.) differ from the preliminary parameters.

2.0 FACILITY DESCRIPTION

Draft Resource Report No. 1 provides the project description for the new facilities. The facility description provided below addresses the Mainline and its associated compressor, heater, and meter stations.

A new 42-inch-diameter natural gas pipeline (Mainline) approximately 804 miles in length would extend from the Liquefaction Facility to the Gas Treatment Plant (GTP) in the Prudhoe Bay Unite (PBU), including the structures, equipment, and all other associated systems. The proposed design anticipates up to eight compressor stations; one standalone heater station, one heater station collocated with a compressor station, and six cooling stations associated with six of the compressor stations; four meter stations; 53 Mainline block valves (MLBVs); one pig launcher facility at the GTP meter station, one pig receiver facility at the Nikiski meter station, and combined pig launcher and receiver facilities at each of the compressor stations; and associated infrastructure facilities.

Each of the eight compressor stations are anticipated to trigger the minor air quality control permit requirements under 18 Alaska Administrative Code Chapter (AAC) 50.502(c)(1). In contrast to the Main Pipeline compressor stations, the potential emissions from the heating station and metering stations are anticipated to be below the minor air quality permitting thresholds under 18 AAC 50.502(c)(1). As a result, this model analysis report does not include those facilities.

Table 1 provides a list of the significant emission units planned for each compressor station configuration.

Figure 1 shows a map that depicts the proposed compressor station locations. Additional detailed maps of each compressor station are provided in Appendix A of this report.

Figure 1: Compressor Station Location Map

Table 1: Compressor Station Emission Unit Inventory

Station	Station Type	Major Equipment (Number of Units)
Sagwon Compressor Station	Multi-Unit with Cooling	Gas Turbine Compressors (3) Power Generators (3) Auxiliary Utility Glycol Heaters (4) Waste Incinerator (1)
Galbraith Lake, Coldfoot, Ray River, Minto, and Healy Compressor Stations	Single-Unit with Cooling	Gas Turbine Compressor (1) Power Generators (3) Auxiliary Utility Glycol Heaters (3) Waste Incinerator (1)
Honolulu Creek Compressor Station	Single Unit without Cooling	Gas Turbine Compressor (1) Power Generators (2) Auxiliary Utility Glycol Heaters (3) Waste Incinerator (1)
Rabideux Creek Compressor Station	Single Unit with Heaters	Gas Turbine Compressor (1) Power Generators (2) Auxiliary Utility Glycol Heaters (3) Indirect Fired Gas Heaters (5) Waste Incinerator (1)

3.0 FEDERAL AND STATE AMBIENT AIR QUALITY STANDARDS

Under the Clean Air Act (CAA), the EPA has set NAAQS for the following pollutants:

- Nitrogen dioxide (NO_2);
- Particulate matter having an aerodynamic diameter of 10 microns or less (PM_{10});
- Particulate matter having an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$);
- Sulfur dioxide (SO_2);
- Carbon monoxide (CO);
- Ozone (O_3);
- Lead (Pb).

EPA has identified two types of standards. Primary standards have been established to protect public health with attention given to protecting sensitive populations such as the elderly or asthmatics. Secondary standards focus on public welfare protection and include items such as reducing visibility impairment and preventing damage to crops, livestock, and vegetation. All criteria pollutants have both a primary and secondary standard, except for CO. The State of Alaska adopted the federal NAAQS as Alaska Ambient Air Quality Standards (AAAQS) and established state ambient standards for two other air pollutants, reduced sulfur compounds and ammonia, under 18 AAC 50.010. ADEC has yet to revise the annual $PM_{2.5}$ AAAQS to the same level as the primary annual $PM_{2.5}$ NAAQS (12 $\mu g/m^3$) promulgated in December 2012. Table 2 provides a summary of the current NAAQS and AAAQS for comparison.

Table 2: National and Alaska Ambient Air Quality Standards

Air Pollutant	Averaging Period	NAAQS	AAAQS
Nitrogen Dioxide	1-Hour[1] Annual	100 ppbv 53 ppbv	188 µg/m^3 100 µg/m^3
Particulate Matter less than 10 Microns	24-Hour[2]	150 µg/m^3	150 µg/m^3
Particulate Matter less than 2.5 Microns	24-Hour[1] Annual[3]	35 µg/m^3 12 µg/m^3	35 µg/m^3 15 µg/m^3
Sulfur Dioxide	1-Hour[4] 3-Hour[2] 24-Hour[2] Annual	75 ppbv 0.5 ppbv --- ---	196 µg/m^3 1,300 µg/m^3 365 µg/m^3 80 µg/m^3
Carbon Monoxide	1-Hour[2] 8-Hour[2] Annual	35 ppmv 9 ppmv 53 ppmv	40 mg/m^3 10 mg/m^3 100 mg/m^3
Ozone	8-Hour[5]	0.075 ppmv	0.075 ppmv
Lead	Rolling 3 Month Average	0.15 µg/m^3	0.15 µg/m^3
Ammonia	8-Hour[2]	---	2.1 mg/m^3
Reduced Sulfur Compounds	30-Minute[6]	---	50 µg/m^3

Sources: EPA 2015; ADEC 2015

Abbreviations:
---: Not Applicable
µg/m3 = micrograms per cubic meter
mg/m3 = milligrams per cubic meter
ppbv = parts per billion by volume
ppmv = parts per million by volume

[1] Standard is attained when the 3-year average of the 98th percentile of the distribution of daily maximum values is less than the standard.
[2] Second-highest average concentration not to be exceeded more than once in a year.
[3] Annual PM2.5 primary standard is 12 µg/m3; secondary standard is 15 µg/m3.
[4] Standard is attained when the 3-year average of the 99th percentile of the distribution of daily maximum values is less than 75 ppb, or 196 µg/m3.
[5] Three-year average of the annual fourth-highest daily maximum 8-hour average ozone concentration.
[6] Standard is referenced to sulfur dioxide and is not to be exceeded more than once per year.

4.0 BACKGROUND AIR QUALITY

Background ambient air quality data are required in a cumulative impact analysis to represent the contribution of ambient air pollutant levels from non-modeled sources. Background ambient air quality data collected at sites representative of the compressor stations were reviewed to establish background concentration values for each modeled pollutant at each compressor station. Tables 3-1 and 3-2 show the proposed background ambient air concentrations and the ambient air monitoring station locations and periods of record for each compressor station location, respectively. The information in these tables may be updated based on further review of available and applicable ambient air quality monitoring data.

Table 3: Ambient Air Background Concentrations for Project Compressor Stations

<table>
<tr><th rowspan="3">CS</th><th colspan="12">Measured Background Concentration (μg/m³)</th></tr>
<tr><th colspan="2">NO_2</th><th>PM_{10}</th><th colspan="2">$PM_{2.5}$</th><th colspan="2">CO</th><th colspan="4">SO_2</th></tr>
<tr><th>1-Hour</th><th>Annual</th><th>24-Hour[1]</th><th>24-Hour[2]</th><th>Annual[3]</th><th>1-Hour[4]</th><th>8-Hour[4]</th><th>1-Hour[5]</th><th>3-Hour[6]</th><th>24-Hour[6]</th><th>Annual</th></tr>
<tr><td>Sagwon</td><td rowspan="5">61.2[7]</td><td rowspan="5">2.5</td><td rowspan="2">35.6</td><td rowspan="2">7.1</td><td rowspan="2">2.3</td><td rowspan="5">573</td><td rowspan="5">458</td><td rowspan="8">5.2</td><td rowspan="8">6.2</td><td rowspan="8">5.4</td><td rowspan="8">0.5</td></tr>
<tr><td>Galbraith Lake</td></tr>
<tr><td>Coldfoot</td><td rowspan="3">38.3</td><td rowspan="2">11.8</td><td rowspan="2">2.8</td></tr>
<tr><td>Ray River</td></tr>
<tr><td>Minto</td><td>10.2</td><td>2.4</td></tr>
<tr><td>Healy</td><td rowspan="3">15.5[8]</td><td rowspan="3">1.9[9]</td><td rowspan="2">18.8</td><td rowspan="2">6.7</td><td rowspan="2">1.5</td><td rowspan="3">7,962</td><td rowspan="3">5,041</td></tr>
<tr><td>Honolulu Creek</td></tr>
<tr><td>Rabideux Creek</td><td>33.4</td><td>5.6</td><td>1.7</td></tr>
</table>

[1] The background 24-hour PM10 value is represented by the highest first-high (H1H) 24-hour average concentration measured during the monitoring period.
[2] The background 24-hour PM2.5 value is represented by the 98th-percentile of the annual distribution of 24-hour PM2.5 concentrations measured during the monitoring period. If three years of data are available, the background 24-hour PM2.5 value is represented by the 3-year average of the 98th-percentile of the annual distributions of 24-hour PM2.5 concentrations.
[3] For monitoring sites with three years of PM2.5 data, the annual PM2.5 background value is represented by maximum annual average PM2.5 concentration collected during the three-year period.
[4] The background short-term average CO values are represented by the H1H 1-hour and 8-hour average CO concentrations measured during the monitoring period.
[5] The background 1-hour SO2 value is represented by the 99th-percentile of the annual distribution of daily maximum 1-hour SO2 concentrations.
[6] The background 3-hour and 24-hour average SO2 values are represented by the H1H 3-hour and 24-hour average SO2 concentrations measured during the monitoring period.
[7] The background 1-hour NO2 value is represented by the 98th-percentile of the annual distribution of daily maximum 1-hour NO2 concentrations.
[8] The background 1-hour NO2 value is represented by the two-year average of the 98th-percentile of the annual distribution of daily maximum 1-hour NO2 concentrations.
[9] The background annual NO2 value is represented by the maximum annual average NO2 concentration collected during two discrete one-year monitoring periods.

Table 4: Background Ambient Air Data Sources for Project Compressor Stations

<table>
<tr><th rowspan="2">CS</th><th colspan="5">Representative Ambient Air Monitoring Station Locations and Periods of Record</th></tr>
<tr><th>NO2</th><th>PM10</th><th>PM2.5</th><th>CO</th><th>SO</th></tr>
<tr><td>Sagwon</td><td rowspan="5">Linc Energy LLC.
Umiat, AK
7/1/13 – 6/30/14</td><td colspan="2" rowspan="2">Linc Energy LLC.
Umiat, AK
7/1/13 – 6/30/14</td><td rowspan="5">Linc Energy LLC.
Umiat, AK
7/1/13 – 6/30/14</td><td rowspan="8">Linc Energy LLC.
Umiat, AK
7/1/13 – 6/30/14</td></tr>
<tr><td>Galbraith Lake</td></tr>
<tr><td>Coldfoot</td><td rowspan="3">National Park Service (NPS)
Gates of the Arctic
IMPROVE
Bettles, AK
1/11/11 – 12/31/13</td><td rowspan="3">Tower Hills Mine
Livengood, AK
1/9/11 – 1/8/12</td></tr>
<tr><td>Ray River</td></tr>
<tr><td>Minto</td></tr>
<tr><td>Healy</td><td rowspan="3">Donlin Creek, LLC
Donlin Gold Project
~16 mi north of Crooked Creek, AK
12/1/10 – 11/30/11
4/17/12 – 4/16/13</td><td colspan="2" rowspan="2">National Park Service (NPS)
Denali National Park Headquarters
IMPROVE
Denali, AK
1/1/12 – 12/31/14</td><td rowspan="3">Municipality of Anchoarge Garden Site
Anchorage, AK
1/1/12 – 12/31/14</td></tr>
<tr><td>Honolulu Creek</td></tr>
<tr><td>Rabideux Creek</td><td colspan="2">National Park Service (NPS)
Trapper Creek
IMPROVE
Trapper Creek, AK
1/1/12 – 12/31/14</td></tr>
</table>

5.0 MODELING METHODOLOGY

This section summarizes the modeling methodology used to analyze potential impacts from the operation of the compressor stations.

5.1 MODEL SELECTION

EPA-approved dispersion models AERMOD and AERSCREEN (version 14134) were used to estimate maximum ground-level pollutant concentrations for this analysis. AERSCREEN is an EPA-recommended screening model that interfaces with the MAKEMET program (version 09183) to generate a site-specific matrix of meteorological conditions and with the EPA-approved AERMOD model to execute screening model runs (EPA, 2011a and 2011c). AERSCREEN is recommended for use in modeling single-source emissions, but can also be used for assessing impacts from projects with multiple emission sources if the modeled impacts from each emission source are adequately overlaid. AERSCREEN also interfaces with the AERMOD terrain pre-processor, AERMAP, and Building Profile Input Program with Plume Rise Model Enhancements (BPIPPRM) to model the effects of building downwash on the dispersion of emissions. In addition, the AERSURFACE model (version 08009) was used to process land use and land cover (LULC) data to develop surface characteristic inputs used to generate meteorology parameters in AERSCREEN.

AERSURFACE cannot be used for modeling sources located in Alaska without modifying the AERSURFACE code. First, the AERSURFACE algorithms will only process 1992 National Land Cover Data (NLCD92) LULC data, and the NLCD92 database is not available for most of Alaska. Second, the AERSURFACE algorithms that convert study center coordinates, input as either Universal Transverse Mercator (UTM) or longitude/latitude coordinates, to Albers Conic Equal Area projection coordinates are specific to the continental United States. Therefore, the AERSURFACE model code was modified to obtain surface characteristics from available Alaska NLCD 2001 LULC data and to convert study center coordinates to Alaska Albers Conic Equal Area coordinates. In addition, the AERSURFACE code was modified to allow for monthly moisture assignments because the AERSURFACE code is designed to assign one surface moisture classification to all months of the modeling period. Appendix B contains additional detail about the AERSURFACE modifications and includes test case results that show the modified AERSURFACE model provides appropriate surface characteristics.

5.2 METEOROLOGICAL DATA

Meteorological data for the screening model analyses were generated with the MAKEMET preprocessor using two different approaches. Appendix C contains detailed information about the methodologies used to prepare screening meteorological data.

For modeling short-term average impacts, the AERMOD model was used with screening meteorological data, but outside of the AERMOD screening mode. All model runs executed in this mode were configured to output the maximum 1-hour pollutant averages, which provide a conservative representation of all short-term (e.g., 3-hour, 8-hour, and 24-hour) average pollutant concentrations. This methodology ensures that the maximum short-term pollutant impacts were appropriately characterized, particularly for a screening model analysis of multiple emission point sources that are dispersed relative to adjacent model receptors.

For modeling annual average impacts, AERSCREEN was used to interface with AERMOD in screening mode and the maximum modeled 1-hour average concentrations were converted to annual averages using the AERSCREEN scaling factor of 0.1. When run in screening mode, AERMOD assumes all model receptors are located along the plume centerline of each source and, therefore, the use of the AERSCREEN scaling factors is appropriate.

Because two different methodologies were used for modeling short-term and annual impacts, the maximum short-term concentration may occur at a different model receptor than the maximum annual concentration for the same pollutant.

5.3 ELEVATION DATA

Digital elevation datasets were obtained from the National Elevation Dataset (NED) and used as input to the latest version of AERMAP (version 11103). NED 2 arc second data were used for the Sagwon, Galbraith Lake, Coldfoot, and Ray River compressor stations because higher resolution data were not available. NED 1 arc second data were used for Minto, Healy, Honolulu Creek, and Rabideux Creek.

Each proposed compressor station location will be graded and the NED elevation data had to be modified to reflect the appropriate site elevations. Geographical Information System (GIS) software[1] was used to modify the NED elevation data input to AERMAP to account for the grading of the proposed compressor station sites. Compressor stations installed over permafrost (Sagwon, Galbraith Lake, Coldfoot, Ray River, Minto, and Healy) will be graded with fill only and Honolulu Creek and Rabideux Creek will be graded using cut and fill methods.

5.4 RECEPTOR GRIDS

EPA defines ambient air as that portion of the atmosphere, external to buildings, to which the general public has access (40 CFR 50). For the purpose of modeling source emissions, the area to which the facility owner or operator controls public access is not ambient air. Therefore, model receptors were placed along each compressor station fenceline to represent the ambient air boundary.

Pollutant concentrations were modeled within five Cartesian receptor grids centered on each compressor station. The receptor fields were referenced to North American Datum of 1983 (NAD83) UTM coordinates and consisted of a set of nested receptor grids developed to capture maximum modeled impacts. The receptor grids utilized for the modeling analyses include:

- A fenceline receptor field consisting of receptors spaced 25 meters (m) apart along each compressor station ambient air boundary.
- A near receptor field consisting of receptors spaced 25 m apart and extending outward from the ambient air boundary to a distance of approximately 100 meters.
- A mid receptor field consisting of receptors spaced 100 m apart and extending outward from the ambient air boundary to a distance of 1 kilometer (km).
- A far receptor field consisting of receptors spaced 250 m apart and extending outward from the ambient air boundary to distances of approximately 1 to 5 km.
- A coarse receptor field consisting of receptors spaced 500 m apart and extending outward from the ambient air boundary to distances of approximately 5 to 10 km.

Appendix D contains diagrams that show the receptor grids used for each compressor station.

[1] Global Mapper v. 16 from Blue Marble Geographics.

5.5 BUILDING DOWNWASH AND STACK HEIGHT

The modeling analysis followed the guidance provided in the EPA Guidelines for Determination of Good Engineering Practice Stack Height (EPA-450/4-80-023R, June 1985). Direction-specific building downwash dimensions for use as modeling inputs were calculated using BPIPPRM, version 04274. Building coordinates and heights for each structure that could influence a modeled emission unit were entered into BPIPPRM. The output dimensions were used to ensure that no stack exceeds good engineering practice (GEP) stack height and to provide the direction-specific downwash dimensions to AERSCREEN.

5.6 EMISSION SOURCES

This section describes the emission source data, including stack parameters used in this analysis. All emission units were modeled as vertical and uncapped point sources and all point source locations were referenced to NAD83 UTM coordinates.

5.6.1 Source Parameters and Emission Rates

The eight compressor stations that were modeled were divided into the four station types, as described in Section 1.1. Table 5 provides a summary of the annual potential emissions for each type of compressor station. Appendix E contains detailed emission rates and stack parameters for each compressor station emission unit. Appendix F contains emission calculations for each compressor station type.

Table 5: Compressor Station Total Emission Rates (tons/years)

Pollutant	Multiple Turbine C S [Sagwon]	Single Turbine C S w/ Cooling [Galbraith Lake, Coldfoot, Ray River, Minto, and Healy Compressor Stations]	Single Turbine C S w/o Cooling [Honolulu Creek]	Single Turbine C S w/ Cooling and Heaters [Rabideux Creek]
NO_x	93.05	66.70	60.04	62.36
CO	107.38	80.63	67.31	72.42
SO2	0.79	0.54	0.52	0.55
$PM/PM_{10}/PM_{2.5}$[1]	21.12	14.66	13.76	14.24

5.6.2 Modeled Scenarios

The compressor stations will typically operate at or near full load. Therefore, only emission rates and stack gas exit temperatures and velocities at full load were modeled. Partial load scenarios were not modeled because the compressor stations are not designed to operate at loads significantly less than 100 percent load at site conditions. A partial load scenario may be possible during reduced gas throughput conditions; however, during reduced gas throughput one or more compressor stations are anticipated to be shut down in order to maintain the operating efficiencies of the other stations at or near full load.

Only two of the three turbines at Sagwon are anticipated to operate concurrently for any sustained period during normal operations. Therefore, all three possible operating scenarios were modeled as shown below:

[1] Potential PM_{10} and $PM_{2.5}$ emissions are conservatively assumed to equal potential PM emissions.

- Scenario 1: Concurrent operation of Turbines 1 and 2
- Scenario 2: Concurrent operation of Turbines 2 and 3
- Scenario 3: Concurrent operation of Turbines 1 and 3

5.7 NO_2 MODELING APPROACH

The NAAQS and AAAQS for nitrogen oxides (NO_X) are expressed in terms of NO_2. For modeling purposes, additional calculations and modeling approaches are used to determine NO_2 impacts from modeled NO_X emissions. Two approaches that can be used to account for the conversion of NO_X to NO_2 from the reaction with ambient ozone (O_3) concentrations are the Plume Volume Molar Ratio Method and the Ozone Limiting Method (OLM). For this analysis, the OLM approach was used in accordance with the EPA guidance memos, *Applicability of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard* (June 28, 2010) and *Clarification on the Use of AERMOD Dispersion Modeling for Demonstrating Compliance with the NO_2 National Ambient Air Quality Standard* (September 30, 2014). The OLM assumes that at any modeled receptor, the amount of NO that is converted NO_2 is determined by the ambient O_3 concentration. If the ambient O_3 concentration is less than the NO concentration, then the amount of NO_2 formed by the reaction of NO with O_3 is limited. If the ambient O_3 concentration is greater than or equal to the NO concentration, then all NO is assumed to be converted to NO_2.

The use of the OLM requires in-stack NO_2-to-NO_X ratios for the modeled emission units and background O_3 data. An in-stack NO_2-to-NOx ratio of 0.3 was assumed for the turbines based on manufacturer specifications and an in-stack NO_2-to-NOx ratio of 0.1 was assumed for the generators, heaters, and waste incinerators based on the source-specific in-stack NO_2-to-NO_X data provided in *NO_2-to-NO_X ratios per Source Tests Approved by the Alaska Department of Environmental Conservation*, updated August 23, 2013.

On-site O_3 data are not available for the compressor station locations and, therefore, ambient O_3 concentrations input to OLM were based on ambient O_3 data collected at representative ambient air monitoring stations. Consistent with the ambient air data sources identified in Table 3-2, ambient O_3 data collected at the Linc Energy, LLC, Umiat, AK (Linc Umiat) monitoring site was used to represent ambient O_3 levels at the Sagwon, Galbraith Lake, Coldfoot, Ray River, and Minto compressor stations, and ambient O_3 data collected at the Donlin Creek, LLC. Donlin Gold Project (Donlin) monitoring site was used to represent ambient O_3 levels at the Healy, Honolulu Creek, and Rabideux Creek compressor stations. The highest 1-hour average O_3 concentration during the July 1, 2013 through June 30, 2014 monitoring period at the Linc Umiat monitoring site was 53.4 ppb and was input to OLM as a conservative proxy of ambient O_3 levels at the Sagwon, Galbraith Lake, Coldfoot, Ray River, and Minto sites. The highest 1-hour average O_3 concentration during the April 17, 2012 through April 16, 2013 monitoring period at the Donlin monitoring site was 55.6 ppb, which is the O_3 value input to OLM as a conservative proxy of ambient O_3 levels at the Healy, Honolulu Creek, and Rabideux Creek sites.

5.8 MODELED OFFSITE SOURCES

This analysis does not include modeled pollutant impacts from any offsite sources. The proposed compressor stations are located in remote areas away from other stationary sources. The only exception is Galbraith Lake. The Galbraith Lake compressor station will be located approximately one km from the Alyeska Pipeline Service Company, Trans Alaska Pipeline System Pump Station 4 (PS 4). The next version of this report will include modeling analyses for Galbraith Lake that consider the potential impacts from PS 4.

6.0 MODELING RESULTS

Table 6 shows a summary of the screening model results. Detailed classified post maps illustrating the location of the maximum modeled pollutant impacts with respect to the modeled emission units are provided in Appendix G. To demonstrate that the model concentrations do not exceed applicable AAAQSs or NAAQSs, background concentrations have been added to the modeled results. As shown in Table 7 and Table 8, none of the AAAQSs or NAAQSs are exceeded for any pollutant.

Table 6: Modeling Results (μ/m³)

Station	NO_2				$PM_{10}/PM_{2.5}$[1]				SO_2				CO	
	Max 1-hr	Distance (m)	Annual	Distance (m)	Max 24-hr	Distance (m)	Annual	Distance (m)	Max 1-hr[2]	Distance (m)	Annual	Distance (m)	Max 1-hr[3]	Distance (m)
Sagwon (Sc. 1)	115.6	Fenceline	14.4	Fenceline	21.5	Fenceline	4.3	Fenceline	22.6	Fenceline	3.1	Fenceline	213.0	540
Sagwon (Sc. 2)	115.4	126	14.0	Fenceline	17.5	Fenceline	4.1	Fenceline	22.6	Fenceline	3.1	Fenceline	213.2	540
Sagwon (Sc. 3)	115.6	Fenceline	14.1	Fenceline	20.0	Fenceline	4.2	Fenceline	22.6	Fenceline	3.1	Fenceline	213.1	540
Galbraith Lake	114.8	185	13.2	99	19.3	602	3.4	99	22.7	Fenceline	2.9	Fenceline	274.2	329
Coldfoot	113.2	89	11.9	Fenceline	17.9	16	2.5	22	23.1	16	2.5	Fenceline	206.9	Fenceline
Ray River	116.1	103	11.9	Fenceline	15.5	132	2.2	Fenceline	18.1	Fenceline	2.6	Fenceline	195.1	132
Minto	113.2	81	11.9	Fenceline	15.4	Fenceline	2.0	Fenceline	19.3	Fenceline	2.2	Fenceline	139.7	96
Healy	119.0	85	12.1	117	16.7	Fenceline	2.9	116	21.5	Fenceline	2.4	Fenceline	226.1	228
Honolulu Creek	107.3	68	12.1	Fenceline	14.8	Fenceline	2.8	Fenceline	18.8	Fenceline	2.4	Fenceline	118.8	68
Rabideux Creek	120.6	67	12.1	84	18.4	Fenceline	3.1	Fenceline	22.7	44	2.5	19	207.8	Fenceline

[1] $PM_{2.5}$ concentration assumed equal to PM_{10} concentration.
[2] Maximum 3-hr and maximum 24-hr average SO_2 concentrations assumed equal to maximum 1-hr average concentration.
[3] Maximum 8-hr average CO concentration assumed equal to maximum 1-hr average concentration.

Table 7: NO_2 and PM Modeling Results Plus Background (μg/m³)

	NO_2						$PM_{2.5}$[1]					
	Max 1-hr Average			Annual Average			Max 24-hr Average			Annual Average		
Station	Model Result	Back-ground	Total	Model Result	Back-ground	Total	Model Result	Back-ground	Total	Model Result	Back-ground	Total
Sagwon (Sc. 1)	115.6	61.2	176.8	14.4	2.5	16.9	21.5	7.1	28.6	4.3	2.3	6.6
Sagwon (Sc. 2)	115.4	61.2	176.6	14.0	2.5	16.5	17.5	7.1	24.6	4.1	2.3	6.4
Sagwon (Sc. 3)	115.6	61.2	176.8	14.1	2.5	16.6	20.0	7.1	27.1	4.2	2.3	6.5
Galbraith Lake	114.8	61.2	176.0	13.2	2.5	15.7	19.3	7.1	26.4	3.4	2.3	5.7
Coldfoot	113.2	61.2	174.4	11.9	2.5	14.4	17.9	11.8	29.7	2.5	2.8	5.3
Ray River	116.1	61.2	177.3	11.9	2.5	14.4	15.5	11.8	27.3	2.2	2.8	5.0
Minto	113.2	61.2	174.4	11.9	2.5	14.4	15.4	10.2	25.6	2.0	2.4	4.4
Healy	119.0	15.5	134.5	12.1	1.9	14.0	16.7	6.7	23.4	2.9	1.5	4.4
Honolulu Creek	107.3	15.5	122.8	12.1	1.9	14.0	14.8	6.7	21.5	2.8	1.5	4.3
Rabideux Creek	120.6	15.5	136.1	12.1	1.9	14.0	18.4	5.6	24.0	3.1	1.7	4.8
NAAQS			**188**			**100**			**35**			**12**
Max % of Standard			**94.3%**			**16.9%**			**85.0%**			**55.0%**
AAAQS			**188**			**100**			**35**			**15**
Max % of Standard			**94.3%**			**16.9%**			**85.0%**			**44.0%**

[1] $PM_{2.5}$ concentration assumed equal to PM_{10} concentration; only $PM_{2.5}$ results shown here as $PM_{2.5}$ standard more stringent than PM_{10}.

Table 8: SO_2 and CO Modeling Results Plus Background (µg/m³)

Station	SO_2						CO					
	Max 1-hr Average[1]			Annual Average			Max 1-hr Average			Max 8-hr Average[2]		
	Model Result	Back-ground	Total	Model Result	Back-ground	Total	Model Result	Back-ground	Total	Model Result	Back-ground	Total
Sagwon (Sc. 1)	22.6	5.2	27.8	3.1	0.5	3.6	213.0	573.0	786.0	213.0	458.0	671.0
Sagwon (Sc. 2)	22.6	5.2	27.8	3.1	0.5	3.6	213.2	573.0	786.2	213.2	458.0	671.2
Sagwon (Sc. 3)	22.6	5.2	27.8	3.1	0.5	3.6	213.1	573.0	786.1	213.1	458.0	671.1
Galbraith Lake	22.7	5.2	27.9	2.9	0.5	3.4	274.2	573.0	847.2	274.2	458.0	732.2
Coldfoot	23.1	5.2	28.3	2.5	0.5	3.0	206.9	573.0	779.9	206.9	458.0	664.9
Ray River	18.1	5.2	23.3	2.6	0.5	3.1	195.1	573.0	768.1	195.1	458.0	653.1
Minto	19.3	5.2	24.5	2.2	0.5	2.7	139.7	573.0	712.7	139.7	458.0	597.7
Healy	21.5	5.2	26.7	2.4	0.5	2.9	226.1	7,962.0	8,188.1	226.1	5,041.0	5,267.1
Honolulu Creek	18.8	5.2	24.0	2.4	0.5	2.9	118.8	7,962.0	8,080.8	118.8	5,041.0	5,159.8
Rabideux Creek	22.7	5.2	27.9	2.5	0.5	3.0	207.8	7,962.0	8,169.8	207.8	5,041.0	5,248.8
NAAQS			**196**			**N/A**			**40,000**			**10,000**
Max % of Standard			**14.4%**			**N/A**			**20.5%**			**52.7%**
AAAQS			**196**			**80**			**40,000**			**10,000**
Max % of Standard			**14.4%**			**4.5%**			**20.5%**			**52.7%**

[1] Maximum 3-hr and maximum 24-hr average SO_2 concentrations assumed equal to maximum 1-hr average concentration; only maximum 1-hr standard shown here as maximum 1-hr is most stringent.
[2] Maximum 8-hr average CO concentration assumed equal to maximum 1-hr average concentration.

7.0 REFERENCES

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8.0 APPENDICES

Appendix A: Compressor Station Location Diagrams

FIGURE A-1
Sagwon Compressor Station Location Map
(Coordinates are UTM NAD83, in meters)

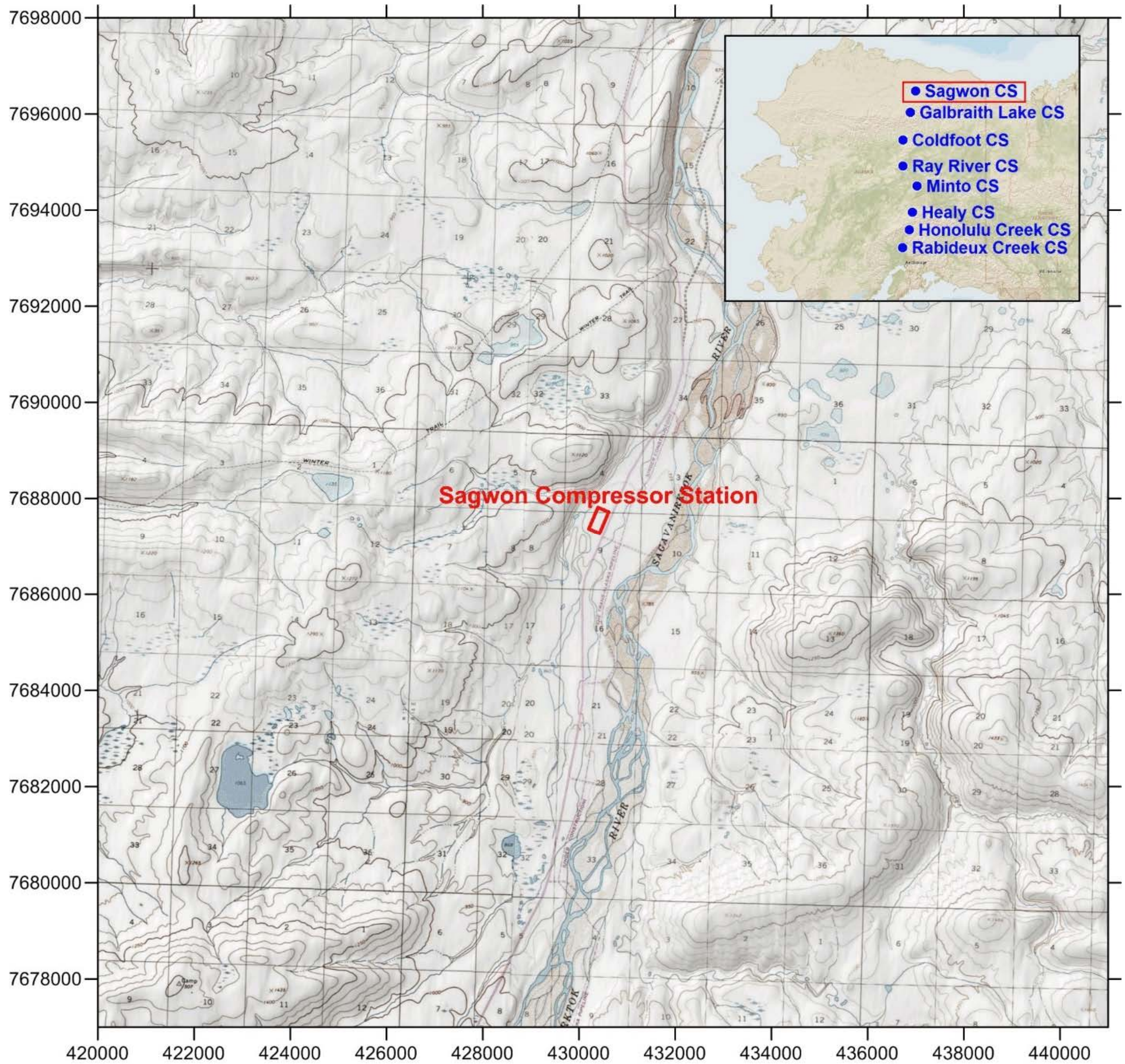


FIGURE A-2
Galbraith Lake Compressor Station Location Map
(Coordinates are UTM NAD83, in meters)

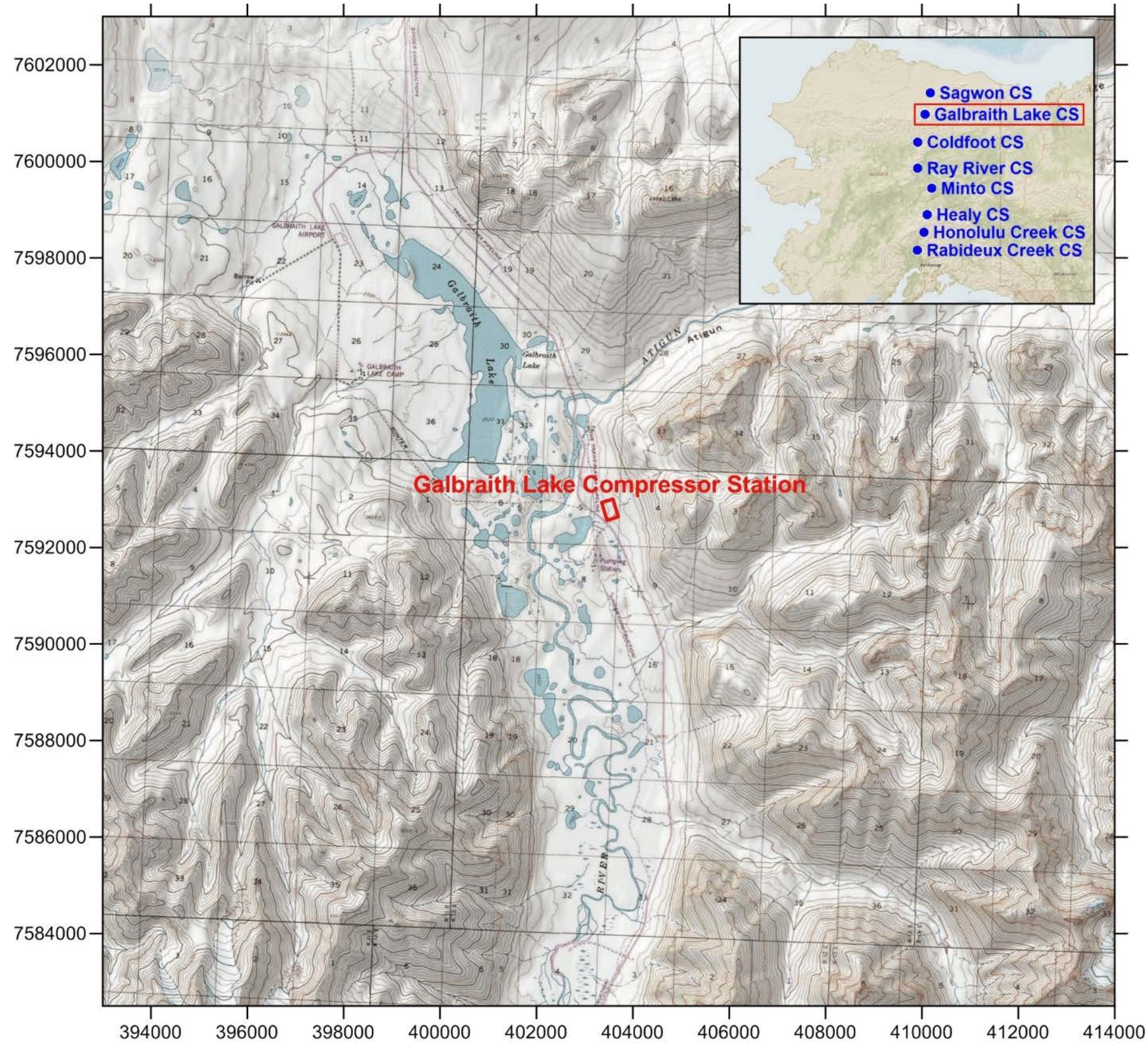


FIGURE A-3
Coldfoot Compressor Station Location Map
(Coordinates are UTM NAD83, in meters)

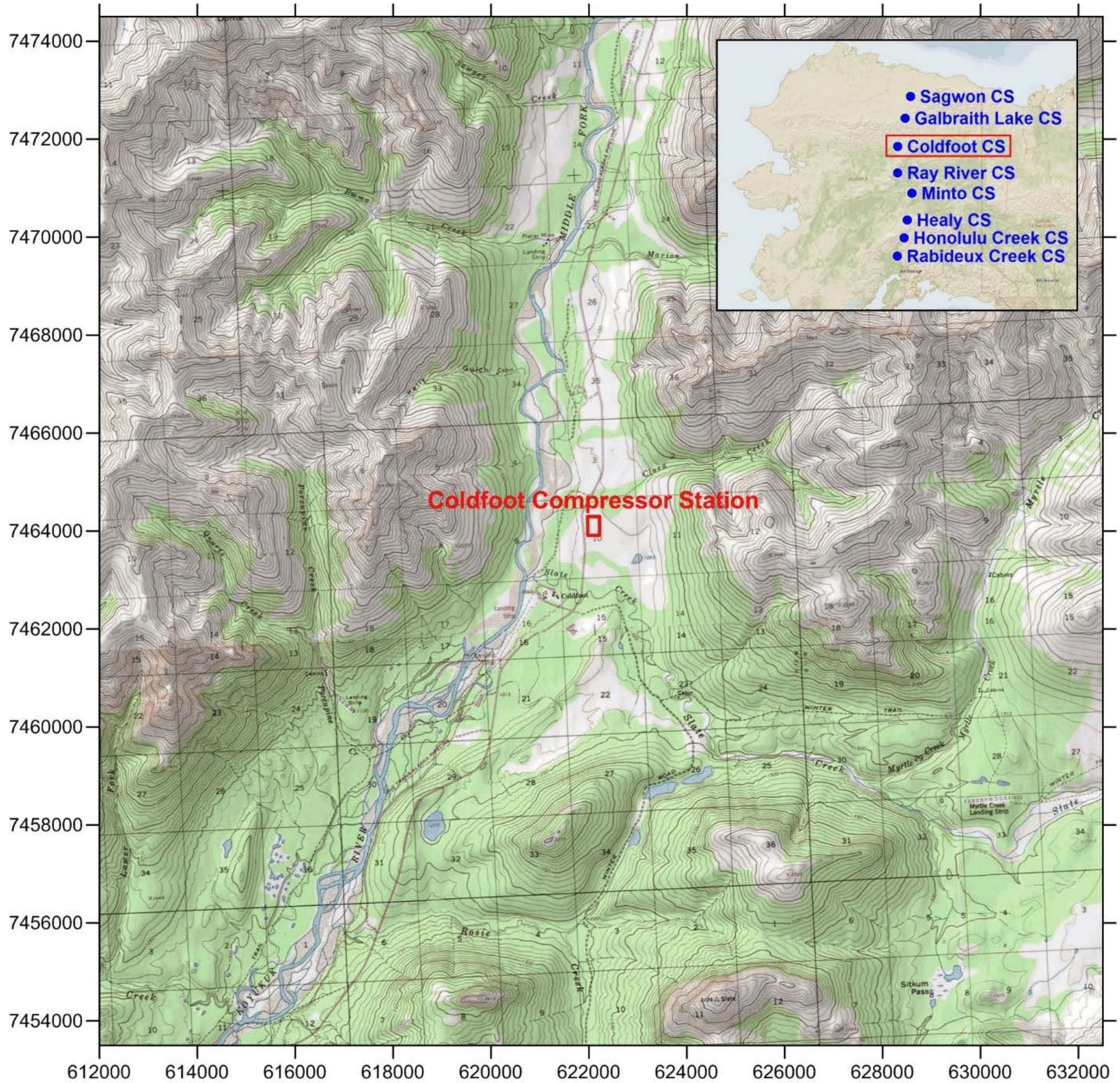


FIGURE A-4
Ray River Compressor Station Location Map
(Coordinates are UTM NAD83, in meters)

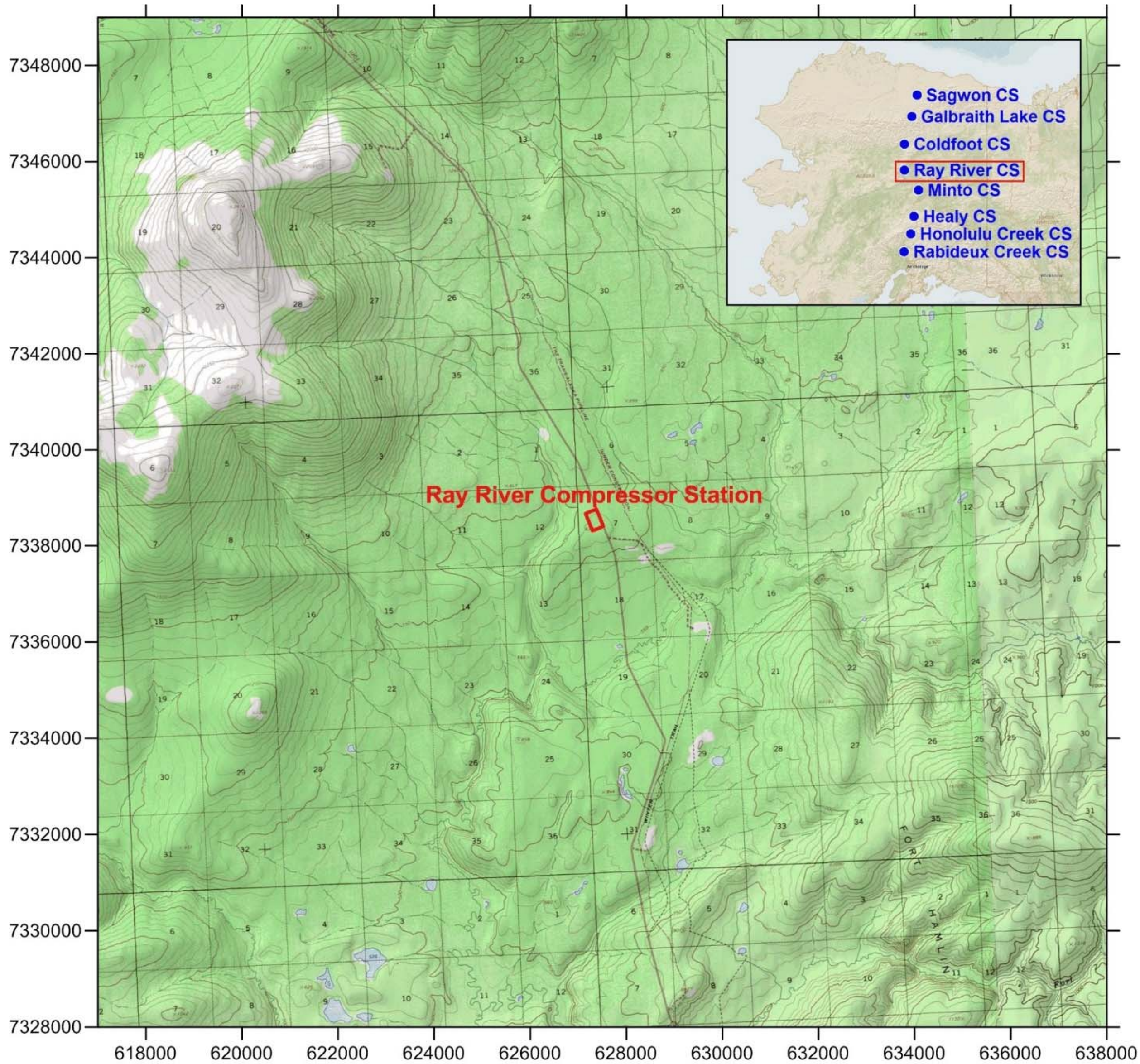


FIGURE A-5
Minto Compressor Station Location Map
(Coordinates are UTM NAD83, in meters)

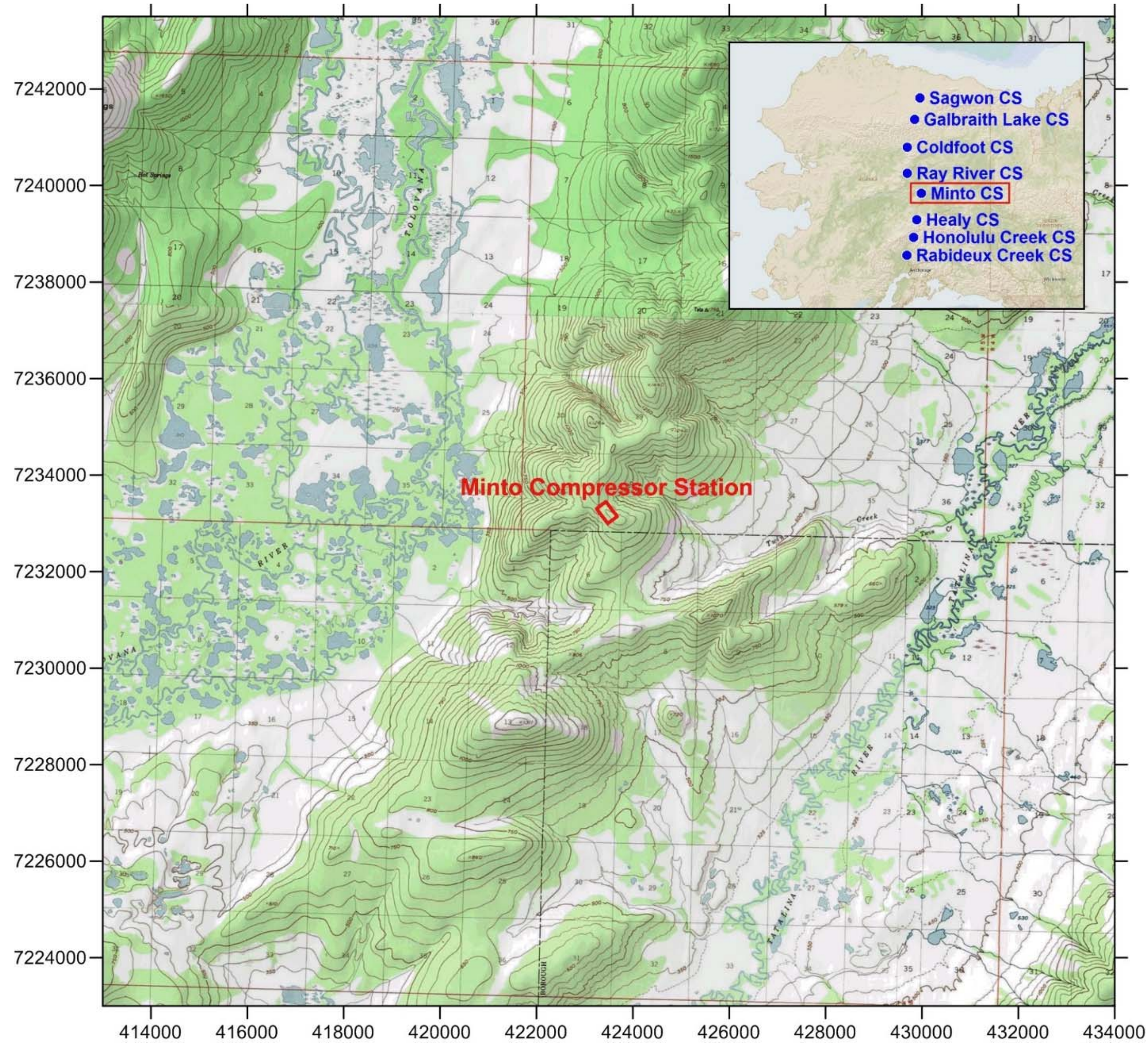


FIGURE A-6
Healy Compressor Station Location Map
(Coordinates are UTM NAD83, in meters)

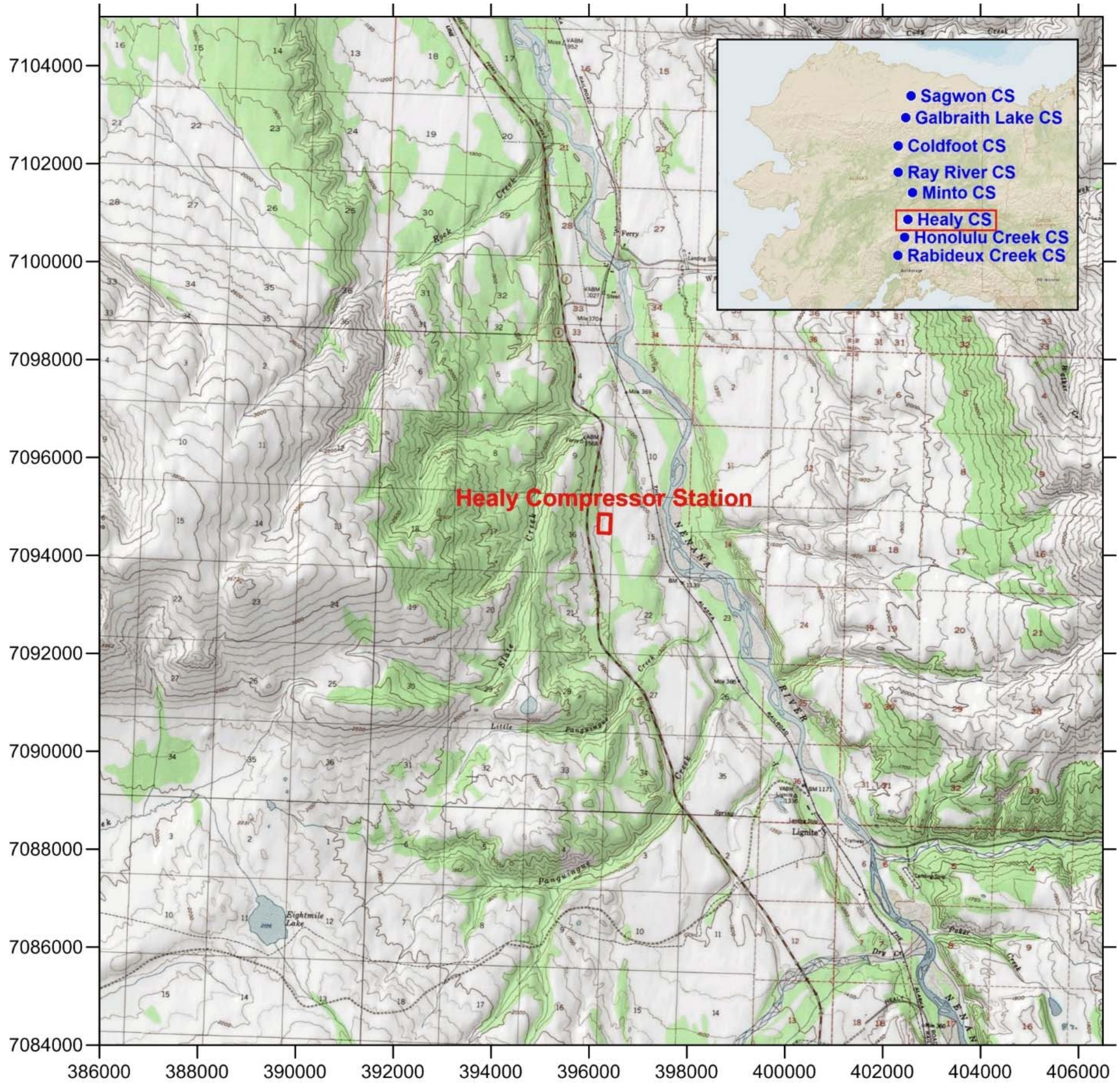


FIGURE A-7
Honolulu Creek Compressor Station Location Map
(Coordinates are UTM NAD83, in meters)

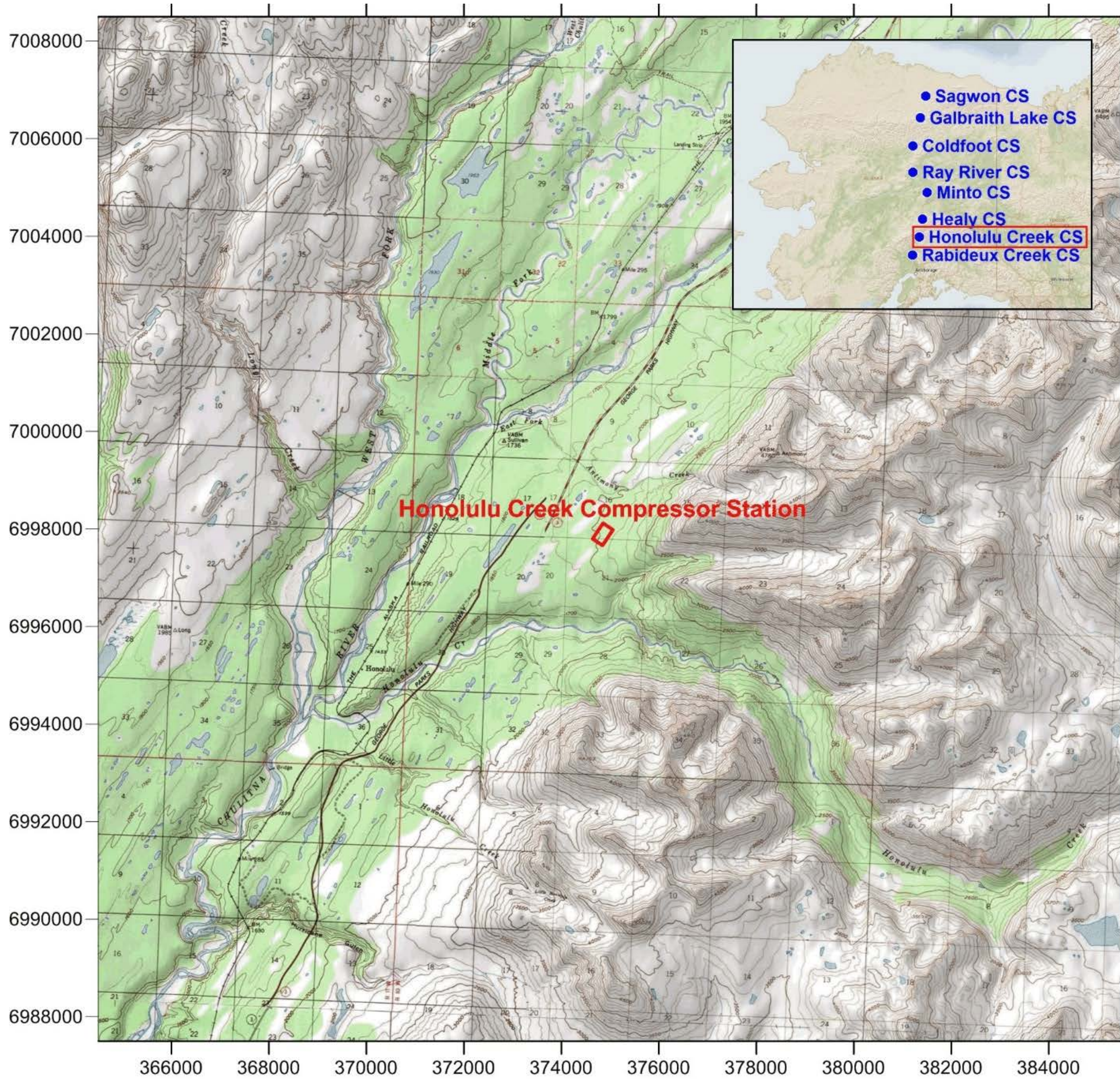
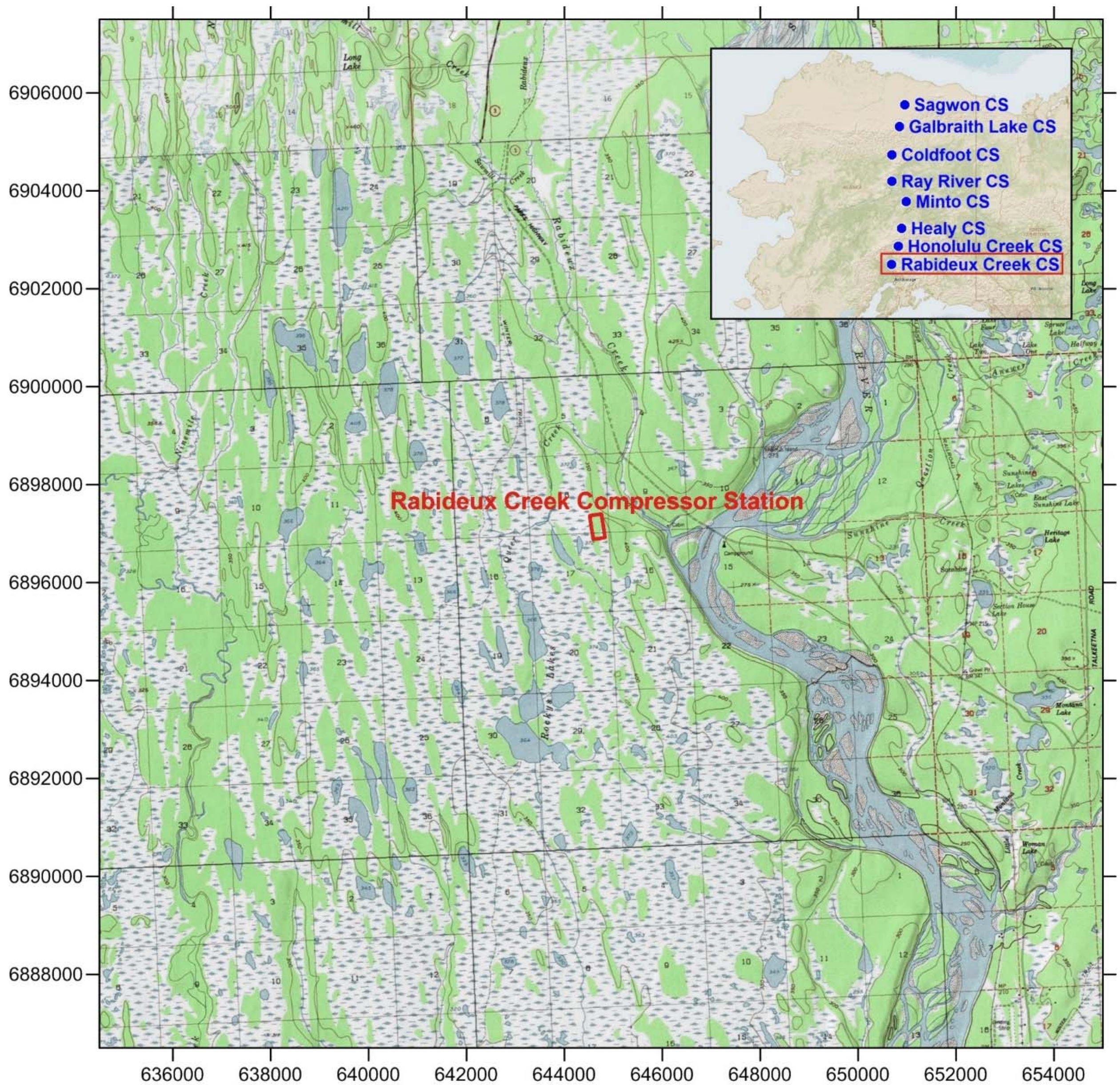


FIGURE A-8
Rabideux Creek Compressor Station Location Map
(Coordinates are UTM NAD83, in meters)



Appendix B: Modified AERSURFACE Performance Evaluation

1.0 INTRODUCTION AND PURPOSE

The current and most efficient method of determining surface characteristics for input into Stage 3 of AERMET is with the USEPA-developed program called AERSURFACE. AERSURFACE requires land cover data as input in the form of National Land Cover Data (NLCD) files. AERSURFACE has been programmed to read the 1992 version of these files (1992 NLCD). However, 1992 NLCD files were not developed for Alaska. Only 2001 NLCD files were developed for Alaska and AERSURFACE currently cannot read these files. In order to use AERSURFACE, to increase efficiency and because it has a proven track record with reviewing authorities, the AERSURFACE code was modified to read the 2001 NLCD files. To verify that the modified version of AERSURFACE was correctly interpreting the 2001 NLCD files and producing surface characteristics that are similar to surface characteristics produced using the methodology approved by the State of Alaska, a method was developed for determining the surface characteristics using ArcGIS and Excel (ArcGIS/Excel). This method follows guidance developed by ADEC for calculating surface characteristics (ADEC Land Use Guidance)[1]. If the two methods (ArcGIS and modified AERSURFACE) produce similar results, it is concluded that the modified AERSURFACE code is acceptable to use.

2.0 STUDY DESIGN

ArcGIS has the ability to read 2001 NLCD files. Therefore, ArcGIS was used to estimate the fraction of each 2001 NLCD surface characteristic category that was within each sector of a 1 km radius circle centered on a representative compressor station location for the surface roughness length and within a 10 km x 10 km box centered on the site for the albedo and Bowen Ratio. These fractions were entered into an Excel spreadsheet which used this information to calculate the geometric mean Bowen Ratio, the mean albedo, and the inverse-distance weighted geometric mean surface roughness length for the sectors examined. These calculations were based on the methodology specified in the ADEC Land Use Guidance and this technique was approved by many reviewing authorities before AERSURFACE was available. Because the surface characteristic categories differ slightly between the 1992 NLCD and 2001 NLCD files, the only difference from previous applications of the ArcGIS/Excel technique to the current application is that the 2001 NLCD surface characteristic categories had to be mapped to the corresponding 1992 NLCD surface characteristic category prior to the calculations being performed. This mapping matches the mapping coded into the modified AERSURFACE program. Table A-1 shows how the 2001 NLCD categories were mapped to the 1992 NLCD categories.

3.0 DISCUSSION OF RESULTS/ANALYSIS

One of the compressor stations, Tatalina River, was used as a test site for this evaluation. The 1 km radius circle around the site was divided into three sectors. Surface characteristics were processed for these three sectors using the modified version of AERSURFACE and the ArcGIS/Excel method following the ADEC Land Use Guidance.

A comparison of the surface characteristics produced by the modified AERSURFACE code with the output produced using the ArcGIS/Excel technique is shown in Table A-2. As seen in Table A-2 for albedo and Bowen Ratio the results are identical with only a few exceptions and for surface roughness length, there are more differences overall, however, those differences are minor. Differences in surface

[1] ADEC Guidance re AERMET Geometric Means: How to Calculate the Geometric Mean Bowen Ratio and the Inverse-Distance Weighted Geometric Mean Surface Roughness Length in Alaska. Prepared by the Alaska Department of Environmental Conservation Air Permits Program Revised June 17, 2009. http://dec.alaska.gov/air/ap/docs/Surface%20Parameter%20Geometric%20Mean%20%28Rev%202%206-17-09%29.pdf.

roughness length are generally less than 0.01 meters and were found to be related to small differences in total area per sector used by each of the methods. It was determined that if the surface characteristic values calculated by the two methods had been based on exactly the same area per sector, the agreement between the two techniques would have been imperceptible given the precision of the numbers shown. The reason that the two methods calculate slightly different total area per sector is related to differences in the precision of the methodology used to determine the sectors. To determine sectors, the ArcGIS/Excel relies on a more manual technique as opposed to the objective methodology used by AERSURFACE.

The effect of the difference in the total sector area calculated by the two techniques is suppressed when calculating albedo and Bowen Ratio given the larger area involved and because these two surface characteristics are calculated as a geometric mean rather than an inverse-distance weighted mean. Therefore, the differences between values calculated using the two different techniques on these parameters is not apparent in the values shown in Table A-2 given the precision of the numbers.

Even with the differences noted, it is clear the modified AERSURFACE code interprets the 2001 NLCD file correctly and produces results similar to the ADEC Land Use Guidance. Therefore, it is concluded that the modified AERSURFACE code is acceptable to use.

Table B-1
Land Use Category Mapping

2001 NLCD Category[2]	**Comparable 1992 NLCD Category[3]**
Open Water – 11	Open Water – 11
Perennial Ice, Snow – 12	Perennial Ice, Snow – 12
Developed Open Space – 21	Urban/Recreational Grasses – 85
Developed Low Intensity – 22	Low Intensity Residential – 21
Developed Medium Intensity – 23	High Intensity Residential – 22
Developed High Intensity – 24	Commercial/Industrial/Transportation – 23
Barren Land Rock/Sand/Clay – 31	Bare Rock/Sand/Clay – 31
	Unconsolidated Shore – 32
Deciduous Forest – 41	Deciduous Forest – 41
Evergreen Forest – 42	Evergreen Forest – 42
Mixed Forest – 43	Mixed Forest – 43
Dwarf Scrub – 51	Shrubland – 51
Scrub/Shrub – 52	
Grassland/Herbaceous – 71	Grassland/Herbaceous – 71
Sedge/Herbaceous – 72	
Lichens – 73	
Moss – 74	
Pasture/Hay – 81	Pasture/Hay – 81
Cultivated Crops – 82	Row Crops – 82
Developed, Open Space - 21	Urban – Recreational Grasses - 85
Woody Wetlands – 90	Woody Wetlands – 91
Palustrine Forested Wetlands – 91	Emergent Herbaceous Wetlands – 92
Palustrine Scrub/Shrub Wetlands – 92	
Estuarine Forested Wetlands – 93	
Estuatrine Scrub/Shrub Wetlands – 94	
Emergent Herbaceous Wetlands – 95	
Palustrine Emergent Wetlands – 96	
Estuatrine Emergent Wetlands – 97	
Palustrine Aquatic Bed – 98	
Estuatrine Aquatic Bed – 99	

[2] From Multi-Resolution Land Characteristics Consortium (www.mrlc.gov).
[3] United States Environmental Protection Agency 2008. AERSURFACE User's Guide (EPA-454/B-08-001). Office of Air Quality Planning and Standards. January 2008.

Table B-2
Comparison of Surface Characteristics

Month	From Traditional Method			From AERSURFACE		
	Sector 290-60 degrees			Sector 290-60 degrees		
	Albedo	Bowen Ratio	Surface Roughness	Albedo	Bowen Ratio	Surface Roughness
1	0.43	0.50	0.616	0.42	0.50	0.618
2	0.43	0.50	0.616	0.42	0.50	0.618
3	0.43	0.50	0.616	0.42	0.50	0.618
4	0.14	0.64	1.503	0.14	0.64	1.503
5	0.14	0.30	1.294	0.14	0.30	1.292
6	0.14	0.30	1.294	0.14	0.30	1.292
7	0.14	0.30	1.294	0.14	0.30	1.292
8	0.14	0.30	1.294	0.14	0.30	1.292
9	0.14	0.30	1.294	0.14	0.30	1.292
10	0.14	0.81	1.294	0.14	0.81	1.292
11	0.43	0.50	0.616	0.42	0.50	0.618
12	0.43	0.50	0.616	0.42	0.50	0.618
	Sector 60-170 degrees			Sector 60-170 degrees		
Month	Albedo	Bowen Ratio	Surface Roughness	Albedo	Bowen Ratio	Surface Roughness
1	0.43	0.50	0.596	0.42	0.50	0.609
2	0.43	0.50	0.596	0.42	0.50	0.609
3	0.43	0.50	0.596	0.42	0.50	0.609
4	0.14	0.64	1.009	0.14	0.64	1.010
5	0.14	0.30	1.235	0.14	0.30	1.226
6	0.14	0.30	1.235	0.14	0.30	1.226
7	0.14	0.30	1.235	0.14	0.30	1.226
8	0.14	0.30	1.235	0.14	0.30	1.226
9	0.14	0.30	1.235	0.14	0.30	1.226
10	0.14	0.81	1.235	0.14	0.81	1.226
11	0.43	0.50	0.596	0.42	0.50	0.609
12	0.43	0.50	0.596	0.42	0.50	0.609
	Sector 170-290 degrees			Sector 170-290 degrees		
Month	Albedo	Bowen Ratio	Surface Roughness	Albedo	Bowen Ratio	Surface Roughness
1	0.43	0.50	0.588	0.42	0.50	0.570
2	0.43	0.50	0.588	0.42	0.50	0.570
3	0.43	0.50	0.588	0.42	0.50	0.570
4	0.14	0.64	0.990	0.14	0.64	0.991
5	0.14	0.30	1.209	0.14	0.30	1.224
6	0.14	0.30	1.209	0.14	0.30	1.224
7	0.14	0.30	1.209	0.14	0.30	1.224
8	0.14	0.30	1.209	0.14	0.30	1.224
9	0.14	0.30	1.209	0.14	0.30	1.224
10	0.14	0.81	1.209	0.14	0.81	1.224
11	0.43	0.50	0.588	0.42	0.50	0.570
12	0.43	0.50	0.588	0.42	0.50	0.570

Note: Albedo and Bowen Ratio are unitless. Surface roughness lengths are given in meters.

Appendix C: Generation of Screening Meteorological Data

1.0 INTRODUCTION

Screening meteorological data was generated using the MAKEMET preprocessor which generates a site-specific matrix of meteorological conditions for input to the AERMOD model. MAKEMET requires surface characteristics and seasonal climatological data as inputs to the program.

2.0 SURFACE CHARACTERISTICS

Appropriate surface characteristics including surface roughness length (z_0), B_0, and r must be provided to AERMET. Surface characteristics should be assigned following guidance provided in the current version of the AERMOD Implementation Guide (AIG) (USEPA, 2009b).

The AIG recommends that the surface characteristics be determined based on digitized land cover data. USEPA has developed the AERSURFACE processor (USEPA, 2008) that was used to determine the site characteristics based on digitized land cover data in accordance with recommendations found in the AIG. AERSURFACE incorporates look-up tables of representative surface characteristic values by land cover category and seasonal category. As discussed in Section 4.1 of modeling report, the AERSURFACE code was modified to allow its use in Alaska with NLCD 2001 data.

AERSURFACE was used to calculate surface characteristics for each site for 12, 30-degree sectors beginning from the North (0 or 360 degrees) and rotating clockwise.

3.0 SEASONAL CLASSIFICATION

In AERSURFACE, the various land cover categories are linked to a set of seasonal surface characteristics. As such, AERSURFACE requires specification of the seasonal category for each month of the year. The months assigned to the five seasonal categories offered by AERSURFACE are shown in Table B-1 below:

TABLE C-1
Monthly Seasonal Classifications Used in AERSURFACE

Seasonal Category	Seasonal Assignment Number	Month
Midsummer with lush vegetation	1	July
Autumn with unharvested cropland	2	August
Late autumn after frost and harvest, or winter with no snow	3	May, September
Winter with continuous snow on ground	4	October through April
Transitional spring with partial green coverage or short annuals	5	June

4.0 TEMPERATURE

MAKEMET requires minimum and maximum temperatures to generate three ambient temperature values for which worst-case meteorological data is produced. Available climatological data from online sources including the National Climatic Data Center was reviewed, and seasonal record high and low temperatures for the most representative meteorological station were input into MAKEMET as indicated in Table B-2 below.

Table C-2
Minimum and Maximum Temperatures Per Seasonal Category Used in MAKEMET

Compressor Station	Meteorological Station	Meteorological Station Location		Seasonal max/min (deg. K)				
			Season:	1	2	3	4	5
Sagwon	Prudhoe Bay	70°15' N 148°20' W	Max Temp	301	300	293	285	301
			Min Temp	271	268	256	239	265
Galbraith Lake, Coldfoot, Ray River	Bettles	66° 32' N 151° 18' W	Max Temp	307	304	303	292	306
			Min Temp	271	264	255	236	270
Minto	Fairbanks	64° 48' N 147° 52' W	Max Temp	308	307	305	298	309
			Min Temp	275	270	257	242	271
Healy	Nenana	64° 33' N 149° 4' W	Max Temp	306	305	304	301	308
			Min Temp	236	236	236	236	238
Honolulu Creek	Denali (Minchumina AP)	63° 53' N 152° 18' W	Max Temp	303	304	299	292	304
			Min Temp	271	263	259	239	271
Rabideux Creek	Talkeetna	62° 19' N 150° 5' W	Max Temp	305	305	304	298	309
			Min Temp	274	269	261	244	271

Climatological data from the sites listed in Table B-2 were examined to obtain the range of ambient temperatures that may be expected to occur at each compressor station. Once each month was assigned the appropriate seasonal classification (see Section 3.0 above) these temperatures were used to assign minimum and maximum temperatures in MAKEMET so that each season was represented by an appropriate range of ambient temperatures.

MAKEMET used the minimum and maximum temperatures to generate three ambient temperature values for which worst-case meteorological data was produced. The range of temperatures during spring, summer, and autumn varied by only about 20°F at each station, while the range of temperatures during the winter season varied by about 40°F. Therefore, to more accurately represent wintertime conditions, winter was divided into two temperature ranges.

5.0 WIND SPEED AND WIND DIRECTION

As suggested in the AERSCREEN User's Guide (USEPA, 2011a) the threshold wind speed and anemometer height were set to 0.5 m/s and 10 m, respectively. MAKEMET was set up to generate a matrix of conditions for wind directions from 5 degrees to 360 degrees in increments of 10 degrees so that modeled wind directions all fall within the center of one of the 12 land use sectors used in AERSURFACE, rather than on a sector boundary.

ADEC staff expressed concern that modeling with screening meteorological data outside of screening mode may not provide high enough resolution if 10-degree increments of wind direction were used (i.e., the maximum concentration at a receptor may occur with a wind direction in between the 36 directions modeled). Therefore, the screening meteorological data sets were modified so that the worst-case meteorology generated by MAKEMET for each of the 12 sectors was assigned to every one degree of wind direction in that sector. This resulted in very large meteorological data sets that, due to a limitation in AERMOD of a maximum of one hundred years of meteorological data, had to be split into two met data files. AERMOD was run twice for each meteorological data file, and the highest concentration at each receptor was determined using a spreadsheet.

For annual average modeling, it was not necessary to use the one degree meteorological data as AERMOD in screening mode ignores wind direction and assumes all receptors are directly downwind from all sources. Therefore the original meteorological datasets with 10 degree increments were used.

Details on the specific steps followed to run MAKEMET in order to produce the “worst-case” screening meteorology are described in a Standard Operating Procedure provided in Appendix D.

6.0 SOIL MOISTURE DETERMINATION

Since representative precipitation data were not available for each compressor station location, and since screening meteorological data which is not tied to a particular year was used, it was assumed that soil moisture conditions were “Average” for each month.

Appendix D: Receptor Grid Diagrams

FIGURE D-1
Sagwon Compressor Station Complete Receptor Grid
(Coordinates are UTM NAD83, in meters)

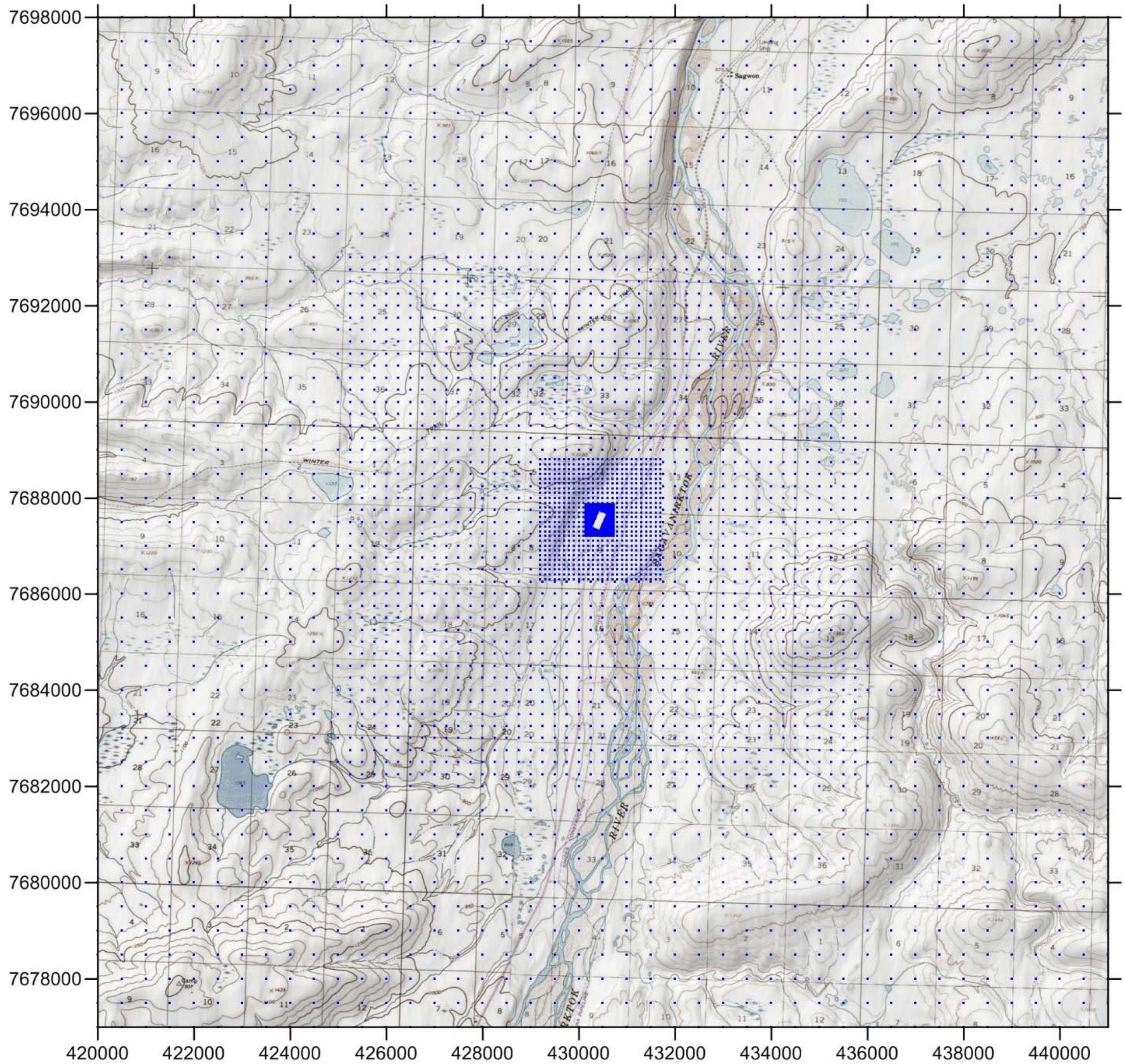


FIGURE D-2
Sagwon Compressor Station Near-Field Receptor Grid
(Coordinates are UTM NAD83, in meters)

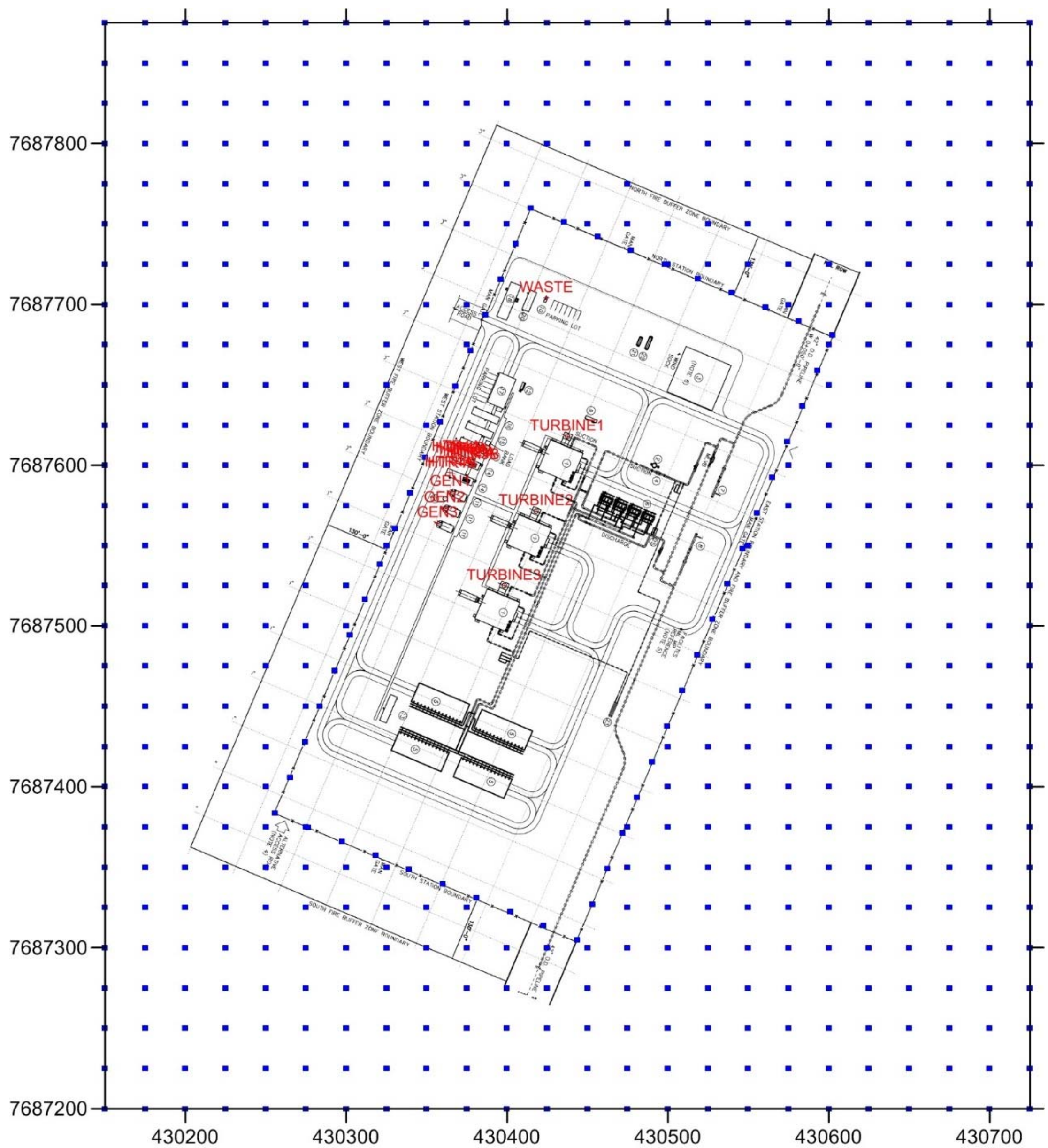


FIGURE D-3
Galbraith Lake Compressor Station Complete Receptor Grid
(Coordinates are UTM NAD83, in meters)

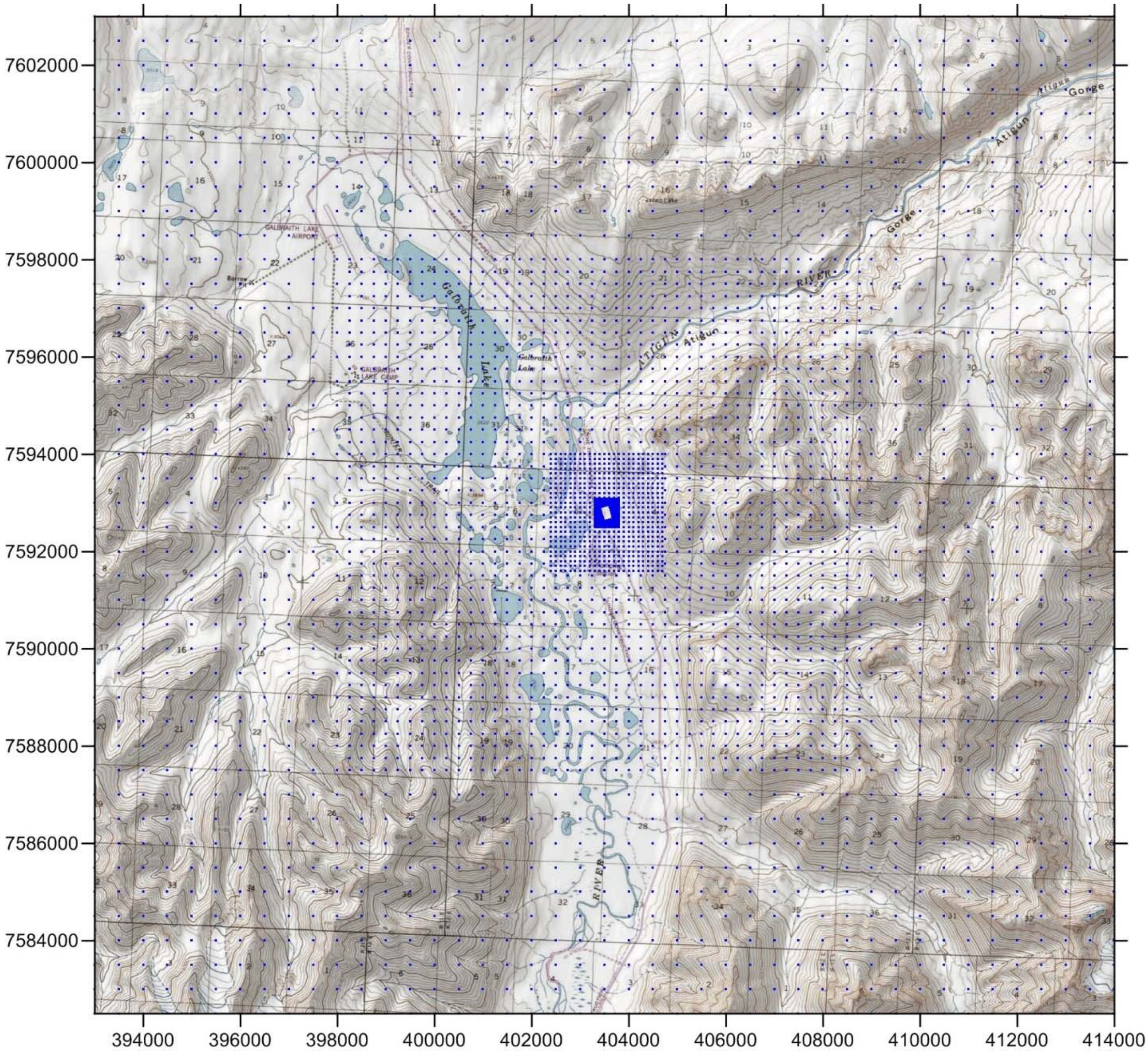


FIGURE D-4
Galbraith Lake Compressor Station Near-Field Receptor Grid
(Coordinates are UTM NAD83, in meters)

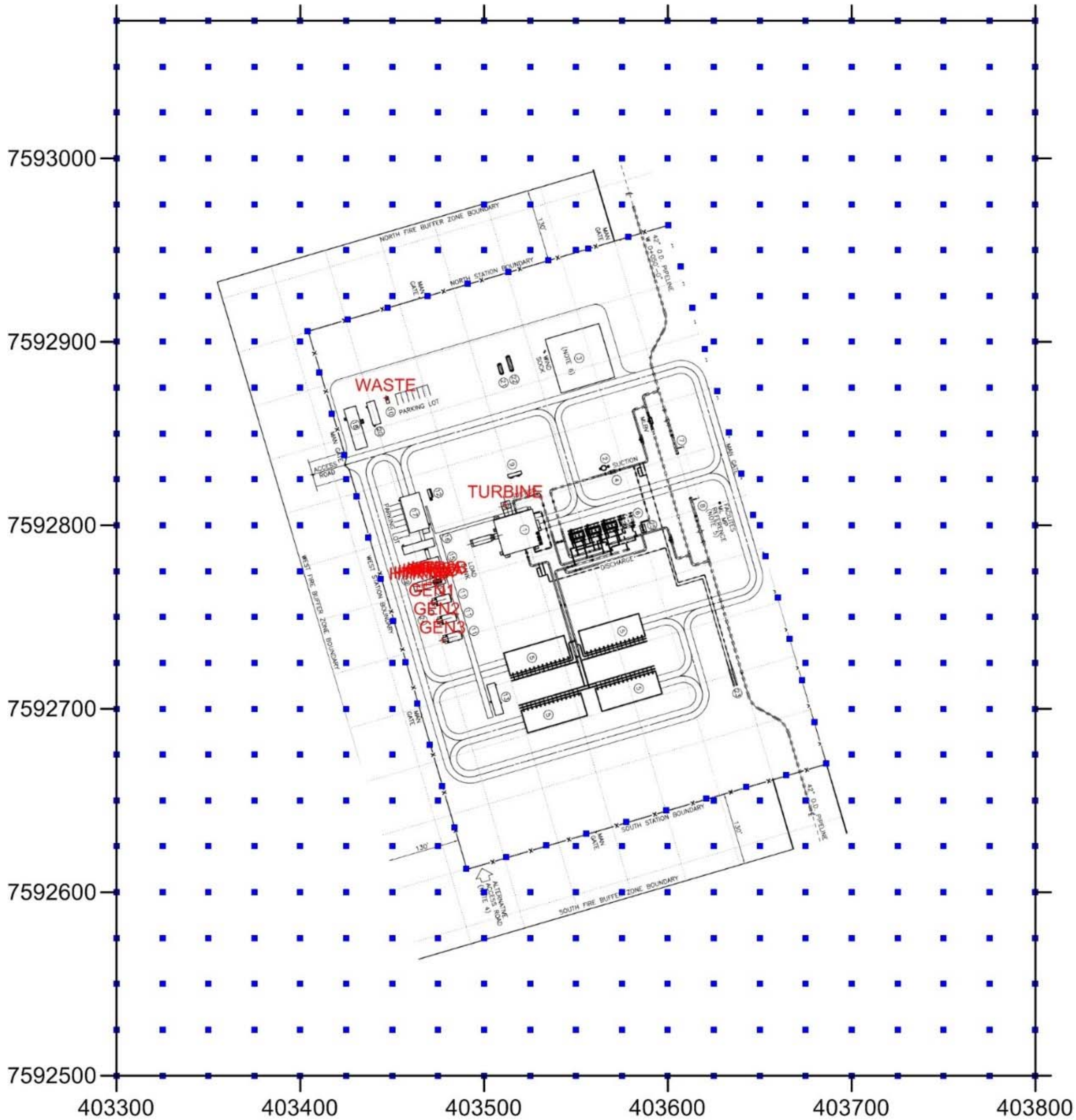


FIGURE D-5
Coldfoot Compressor Station Complete Receptor Grid
(Coordinates are UTM NAD83, in meters)

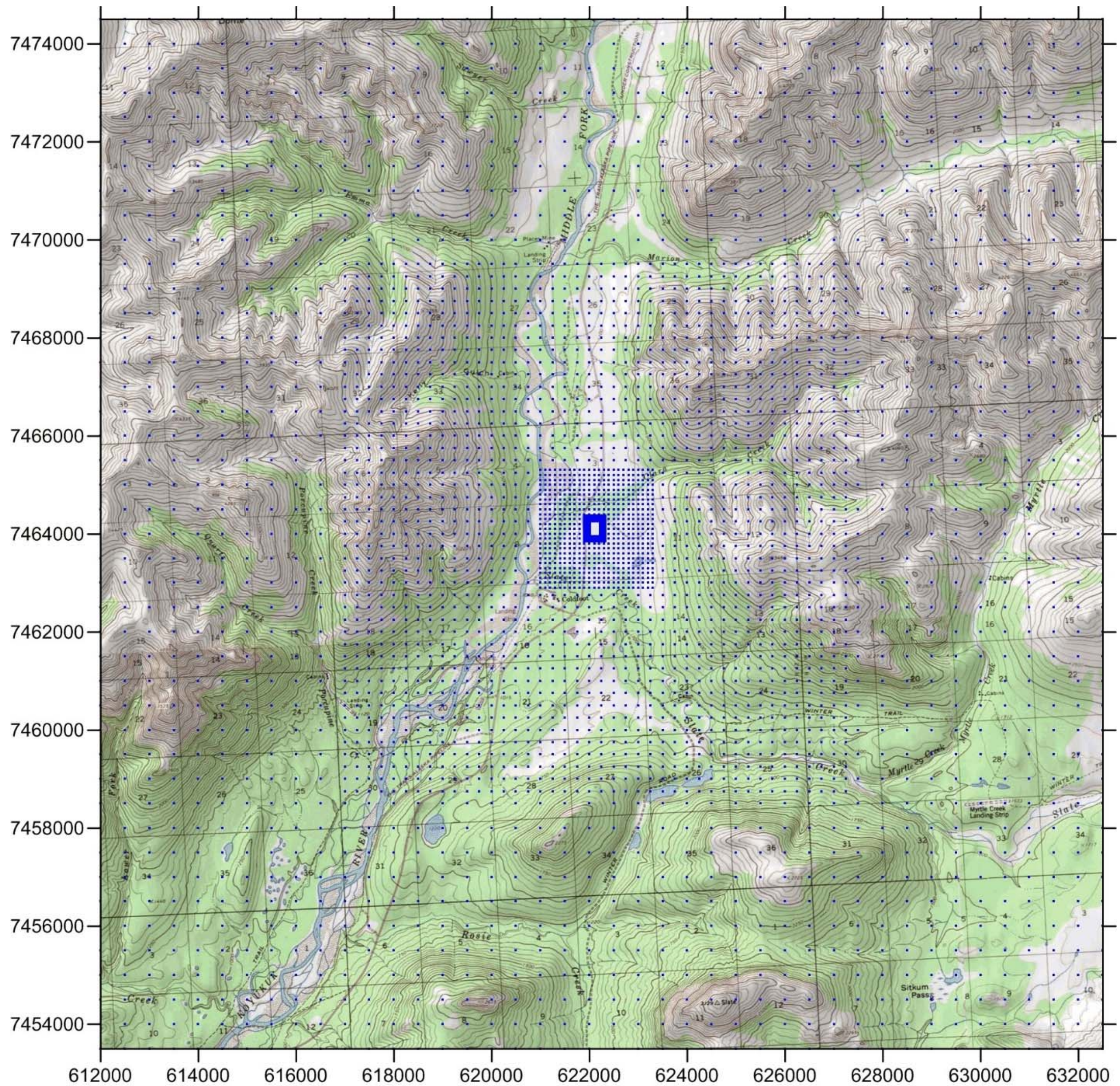


FIGURE D-6
Coldfoot Compressor Station Near-Field Receptor Grid
(Coordinates are UTM NAD83, in meters)

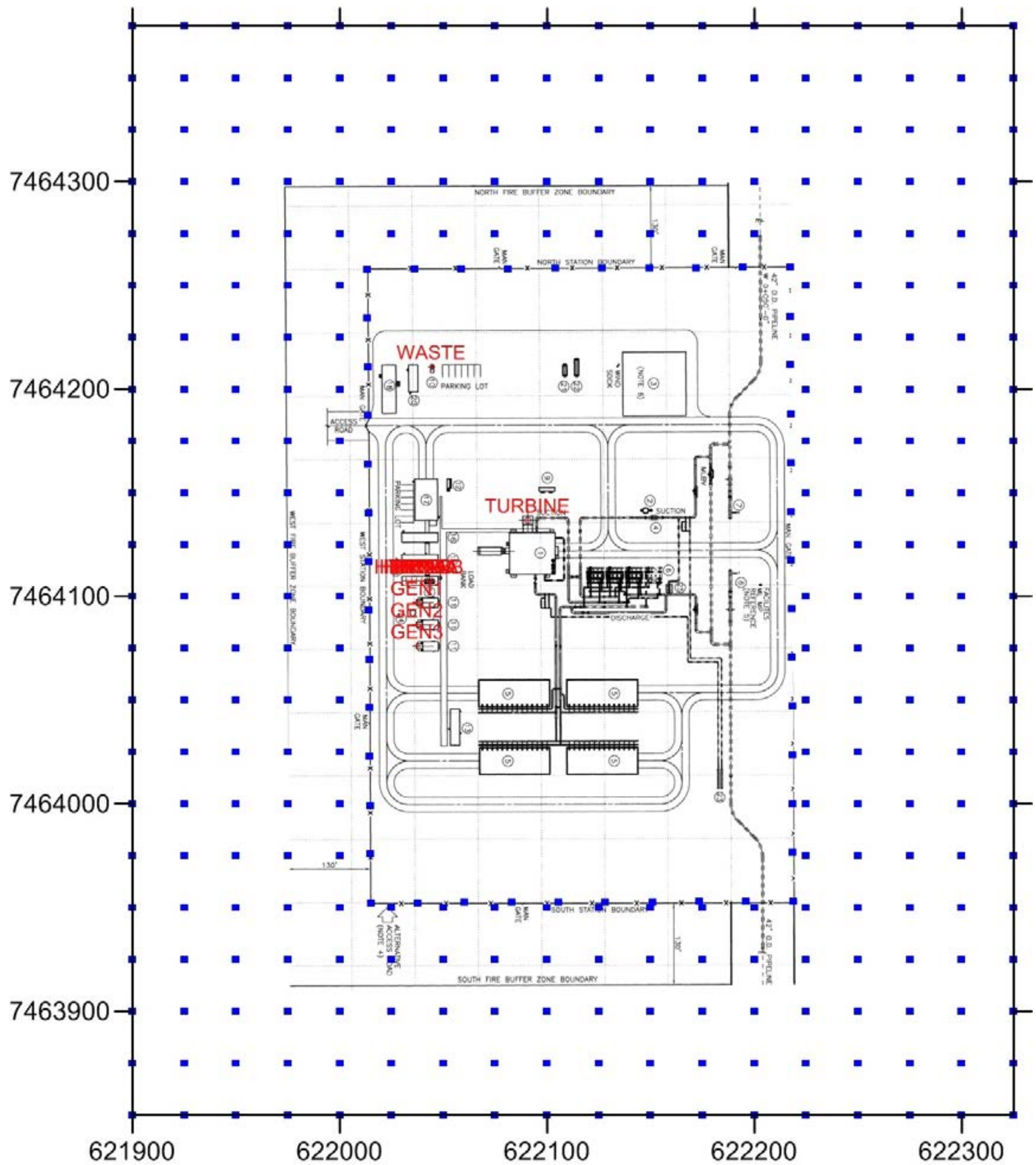


FIGURE D-7
Ray River Compressor Station Complete Receptor Grid
(Coordinates are UTM NAD83, in meters)

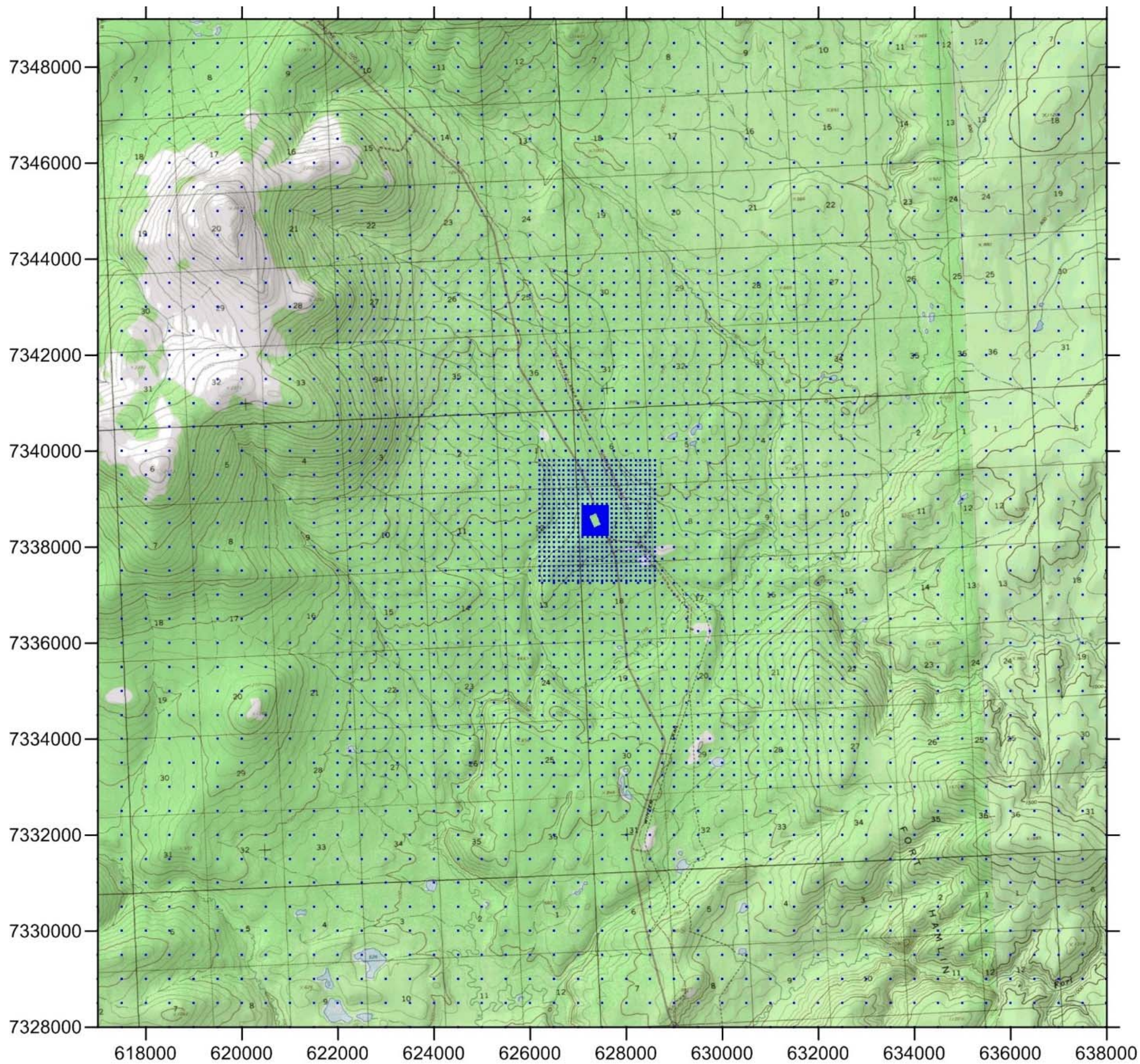


FIGURE D-8
Ray River Compressor Station Near-Field Receptor Grid
(Coordinates are UTM NAD83, in meters)

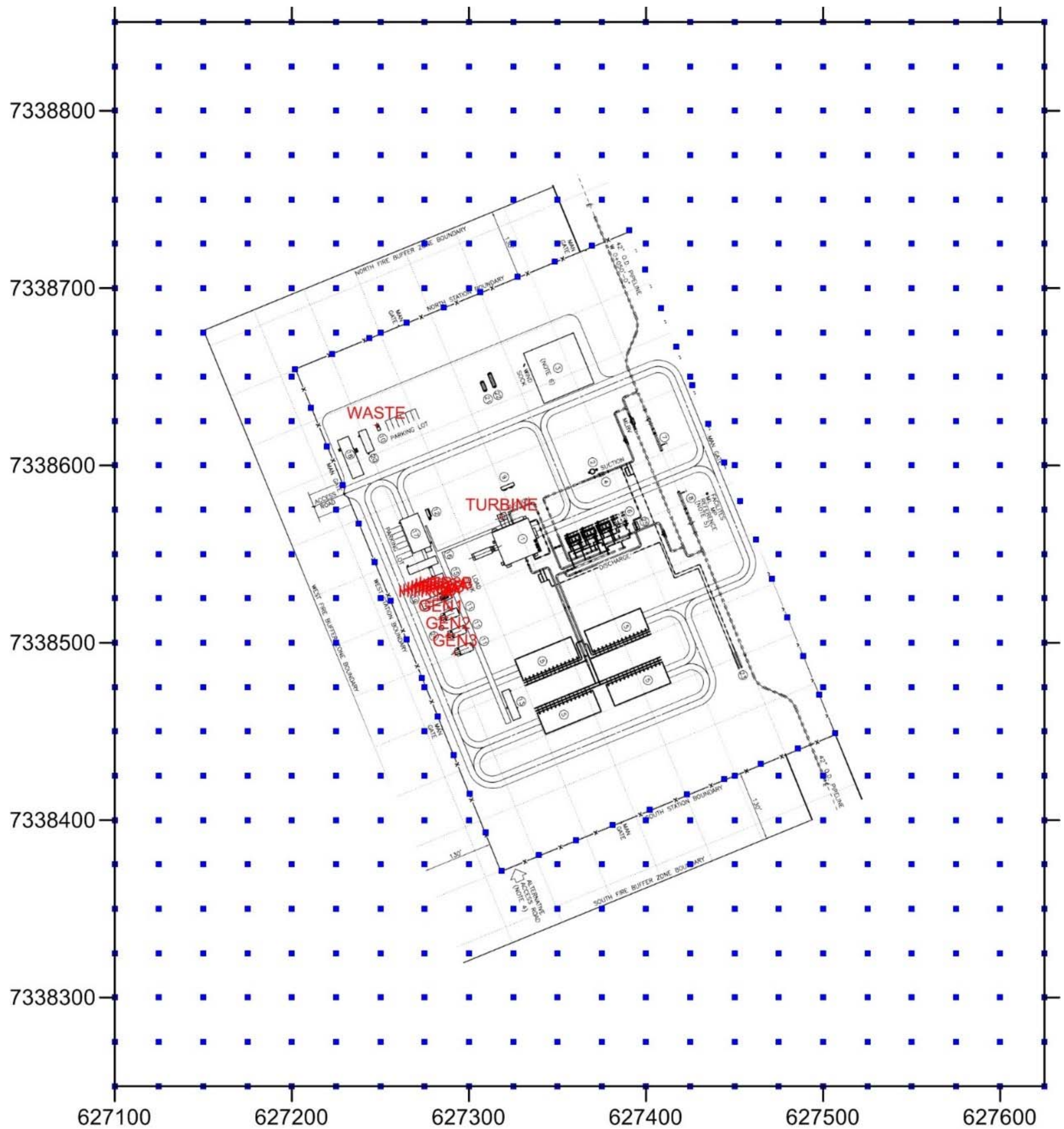


FIGURE D-9
Minto Compressor Station Complete Receptor Grid
(Coordinates are UTM NAD83, in meters)

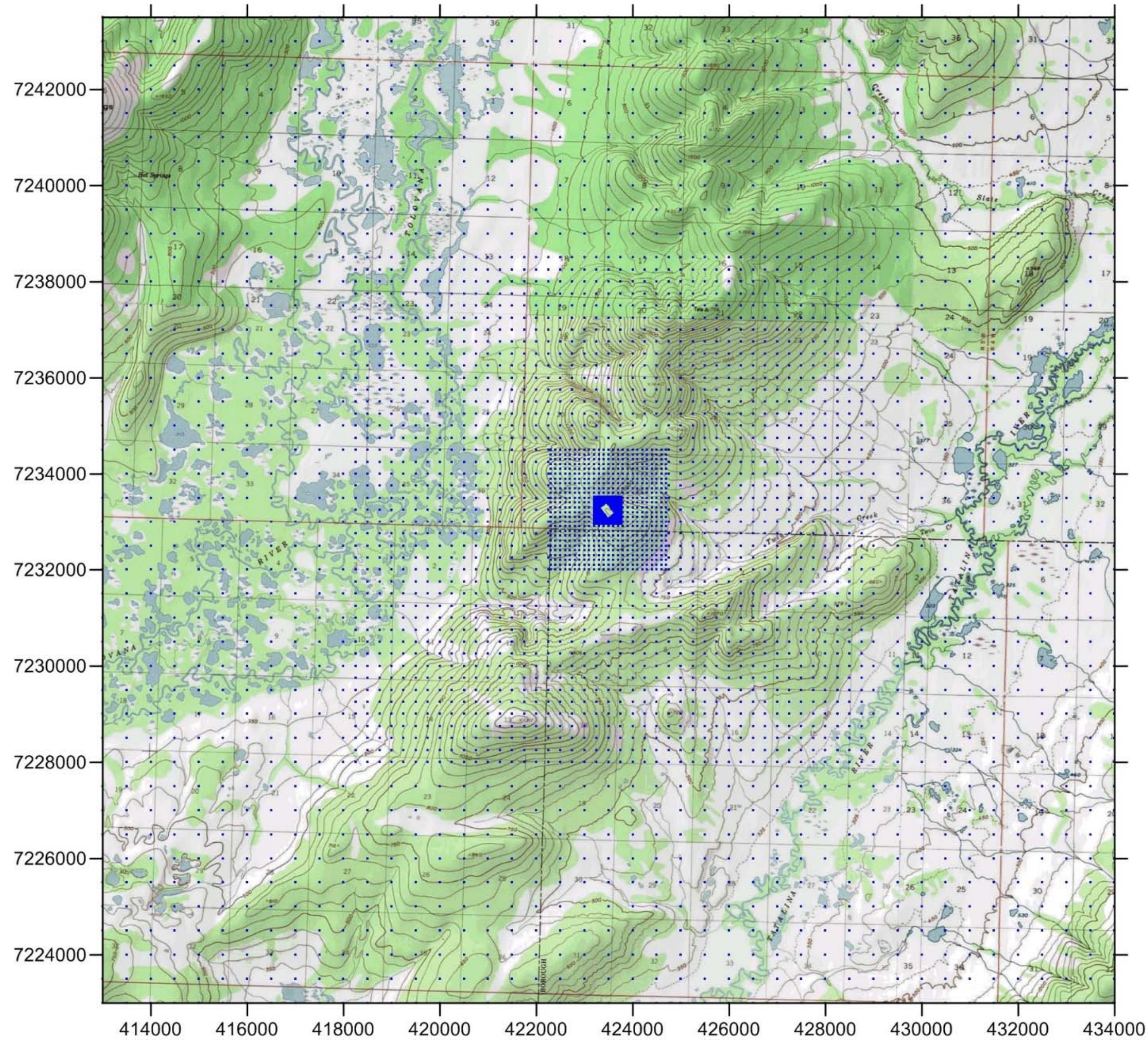


FIGURE D-10
Minto Compressor Station Near-Field Receptor Grid
(Coordinates are UTM NAD83, in meters)

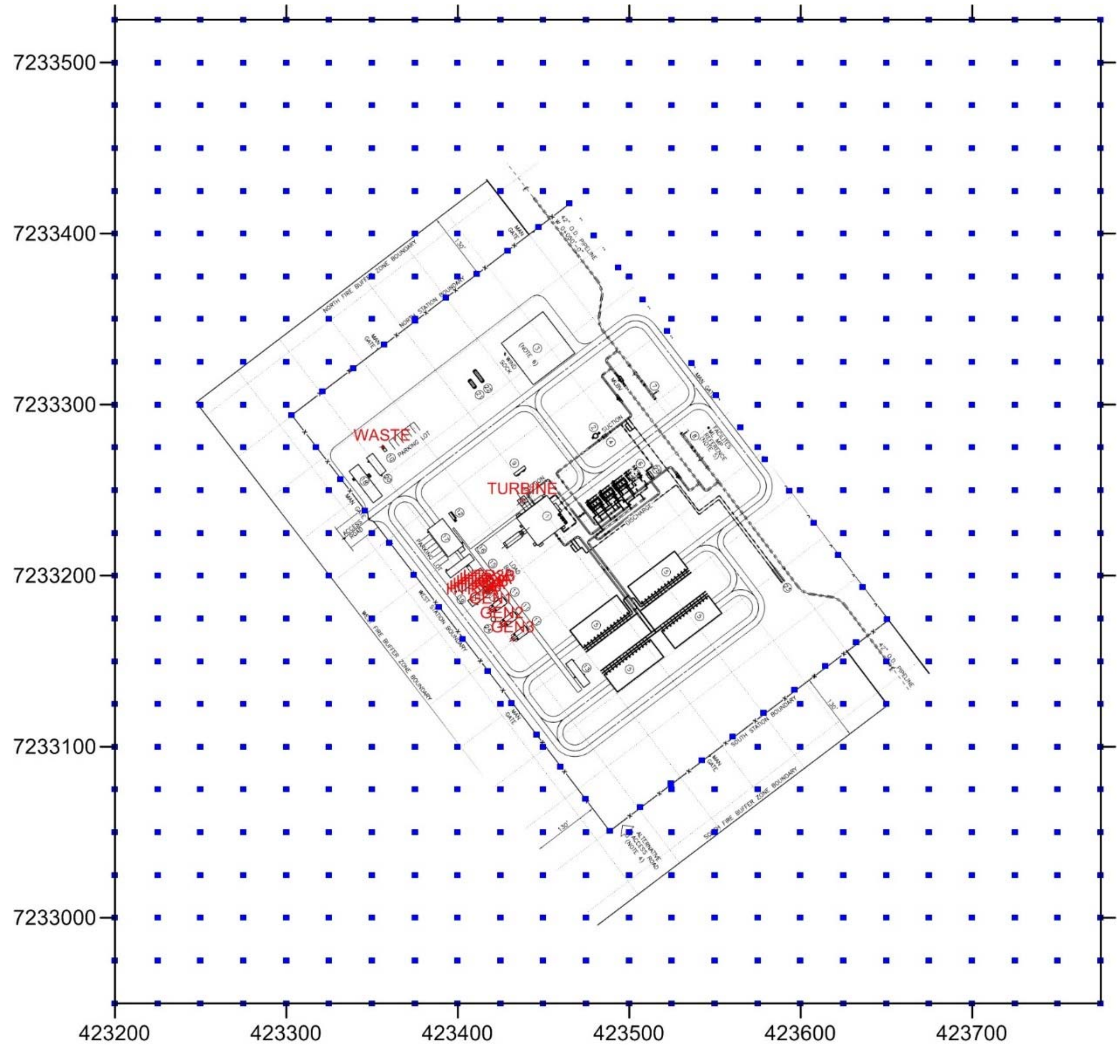


FIGURE D-11
Healy Compressor Station Complete Receptor Grid
(Coordinates are UTM NAD83, in meters)

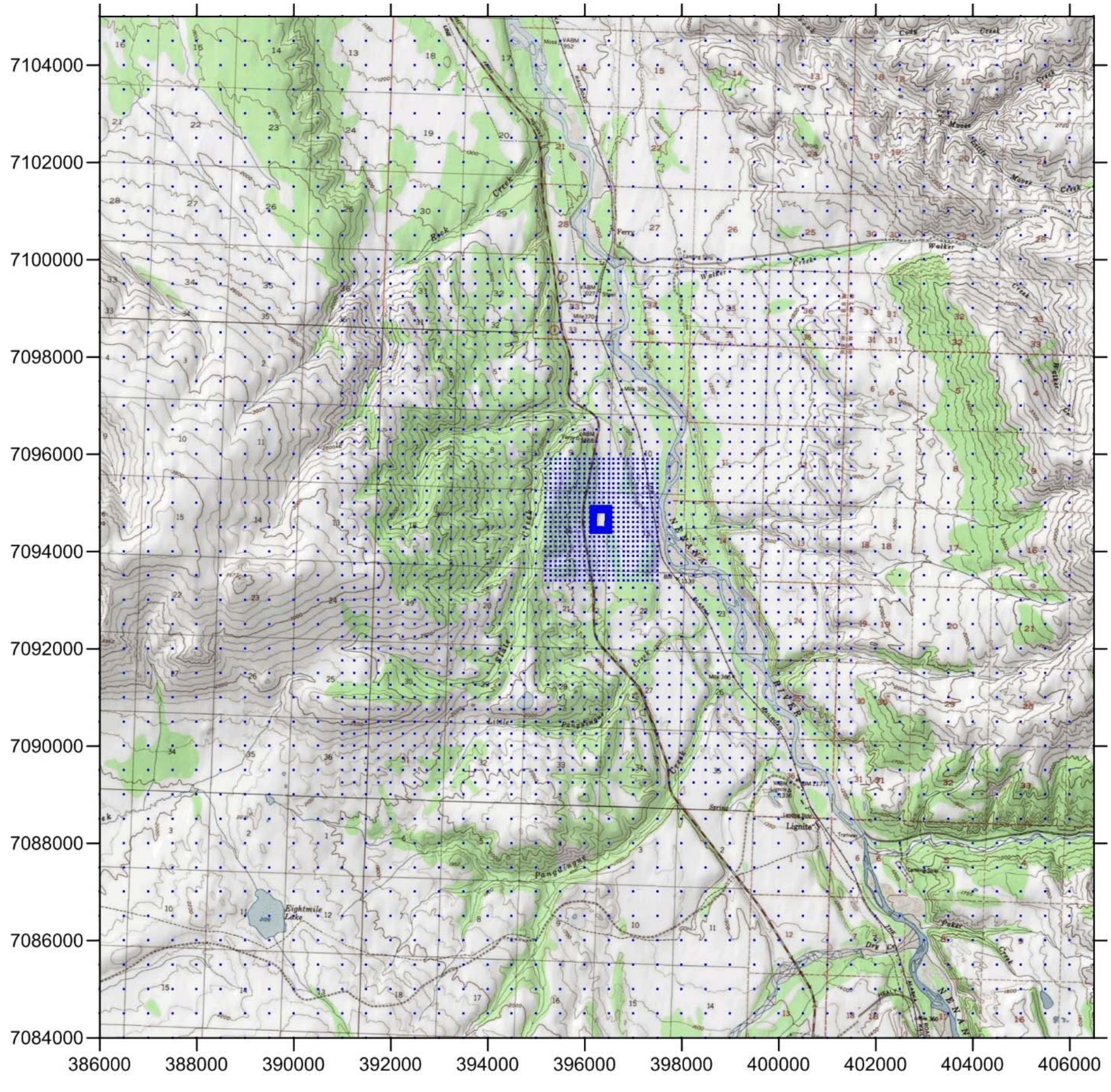


FIGURE D-12
Healy Compressor Station Near-Field Receptor Grid
(Coordinates are UTM NAD83, in meters)

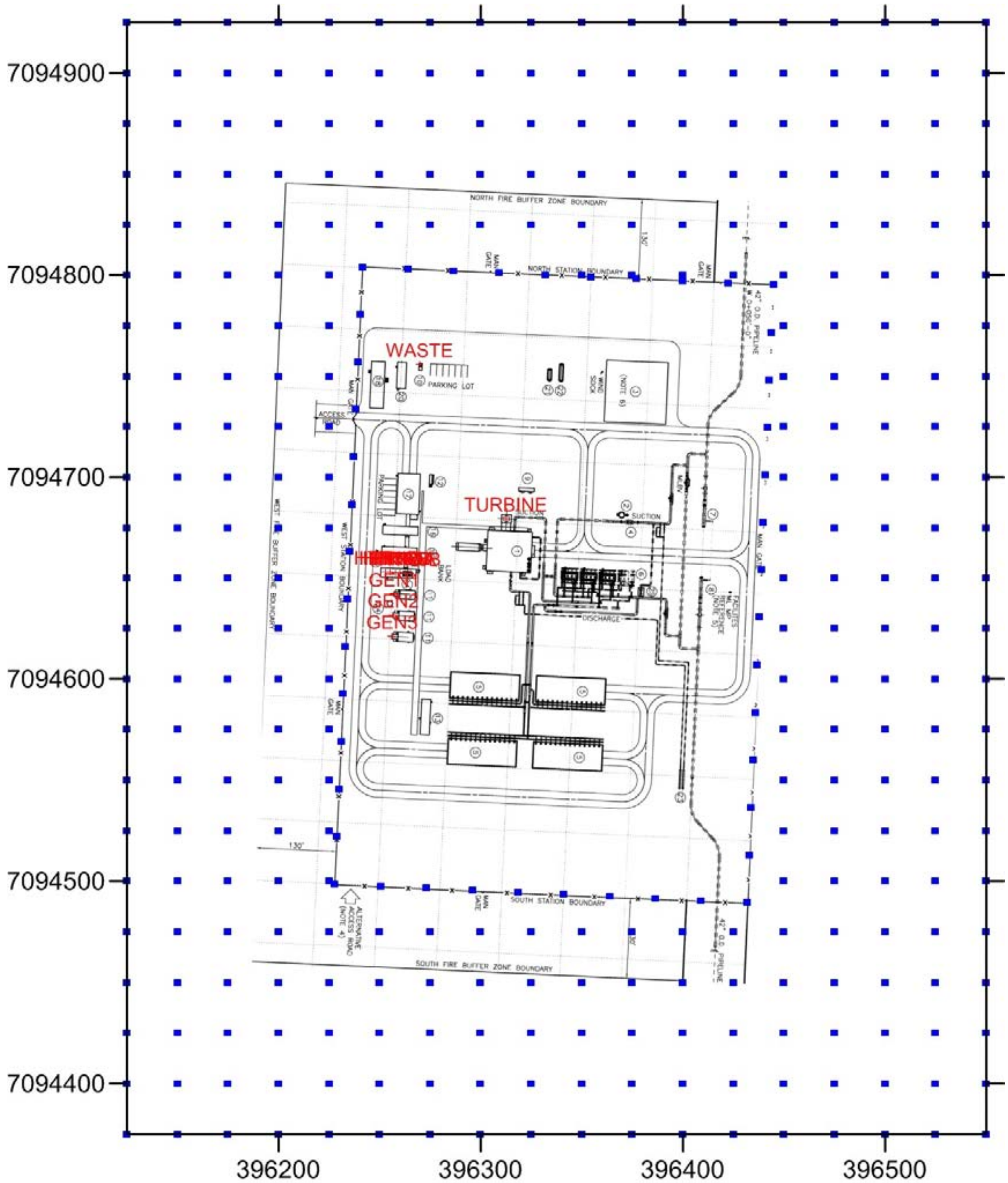


FIGURE D-13
Honolulu Creek Compressor Station Complete Receptor Grid
(Coordinates are UTM NAD83, in meters)

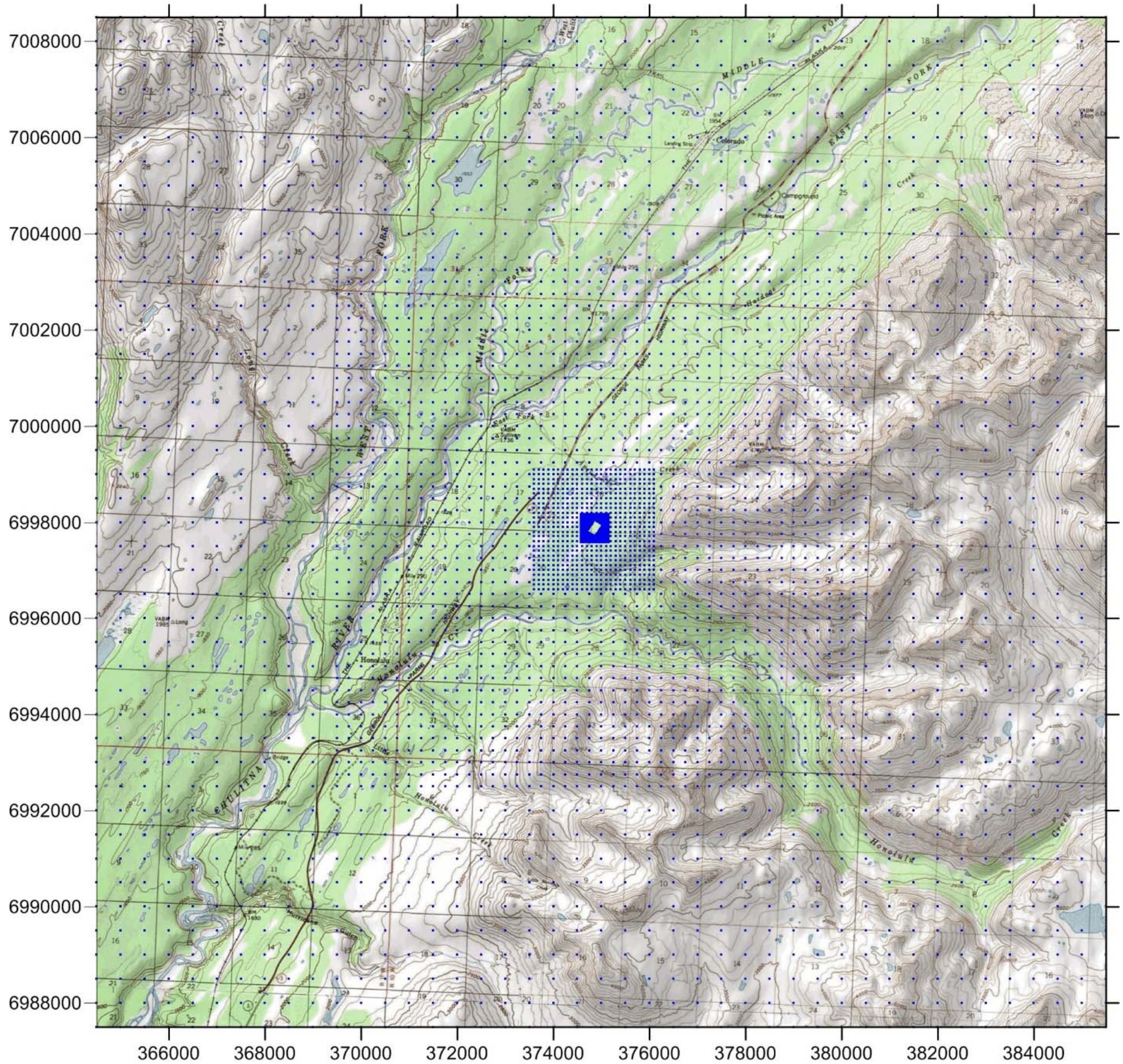


FIGURE D-14
Honolulu Creek Compressor Station Near-Field Receptor Grid
(Coordinates are UTM NAD83, in meters)

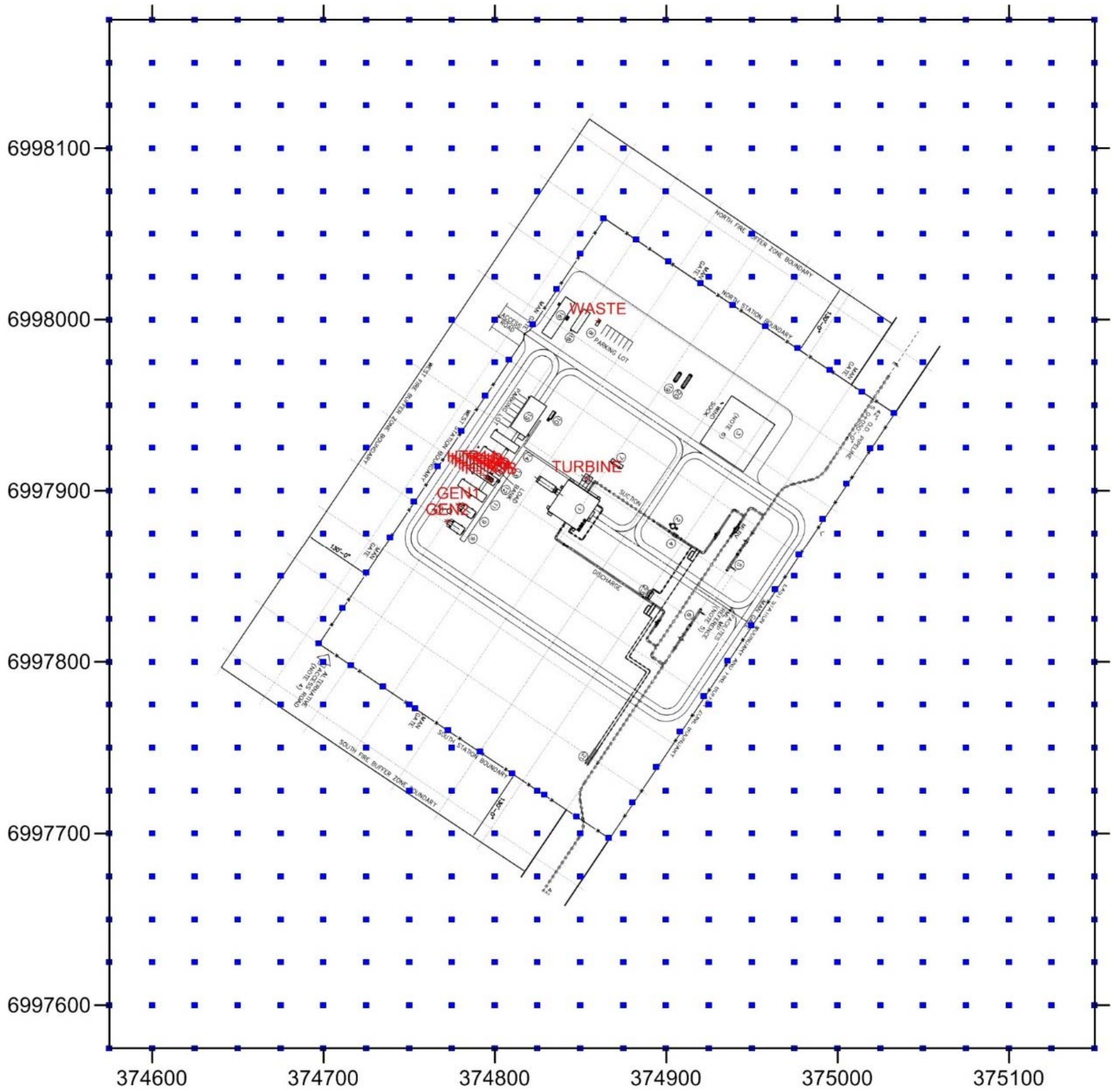


FIGURE D-15
Rabideux Creek Compressor Station Complete Receptor Grid
(Coordinates are UTM NAD83, in meters)

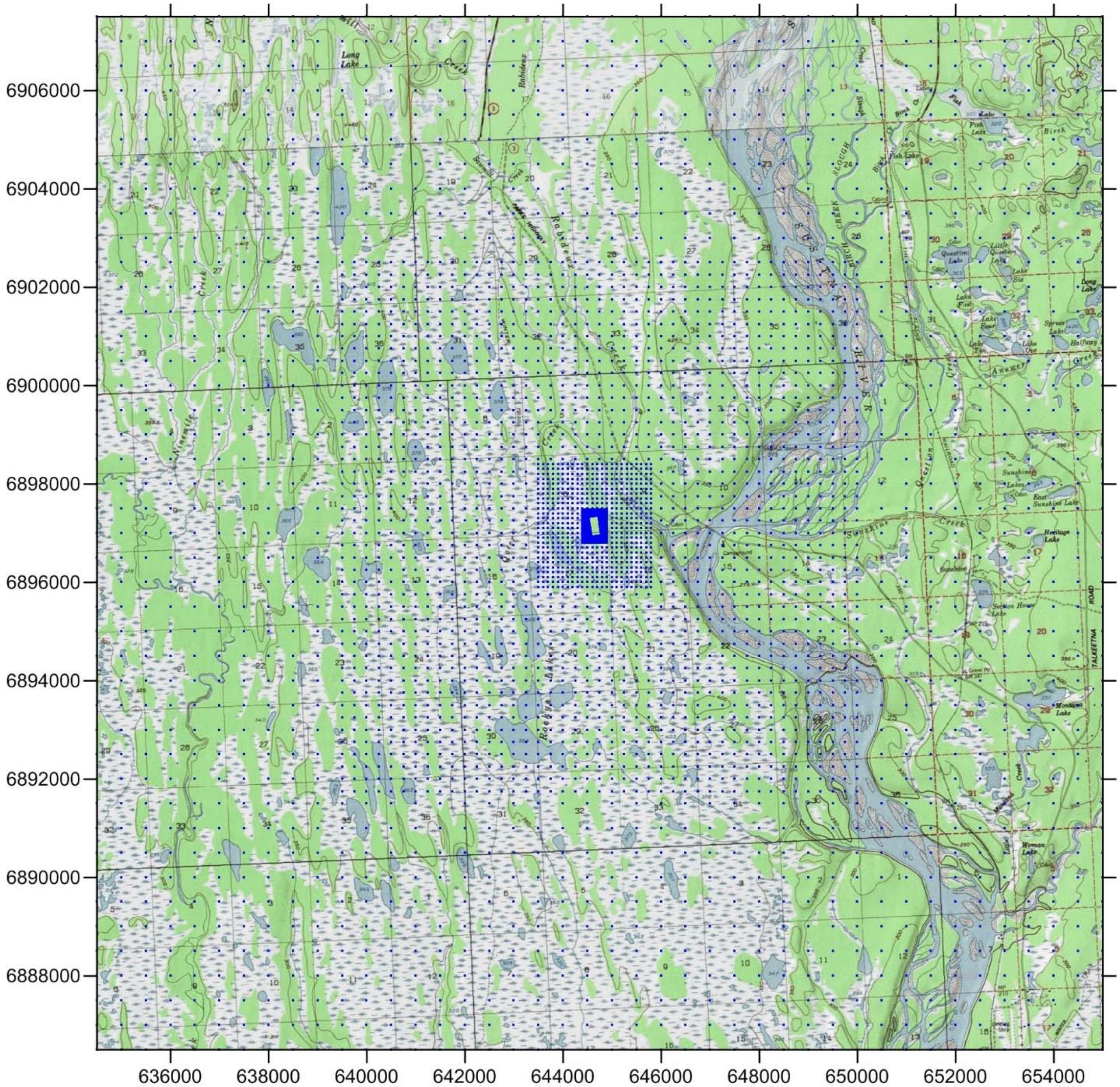
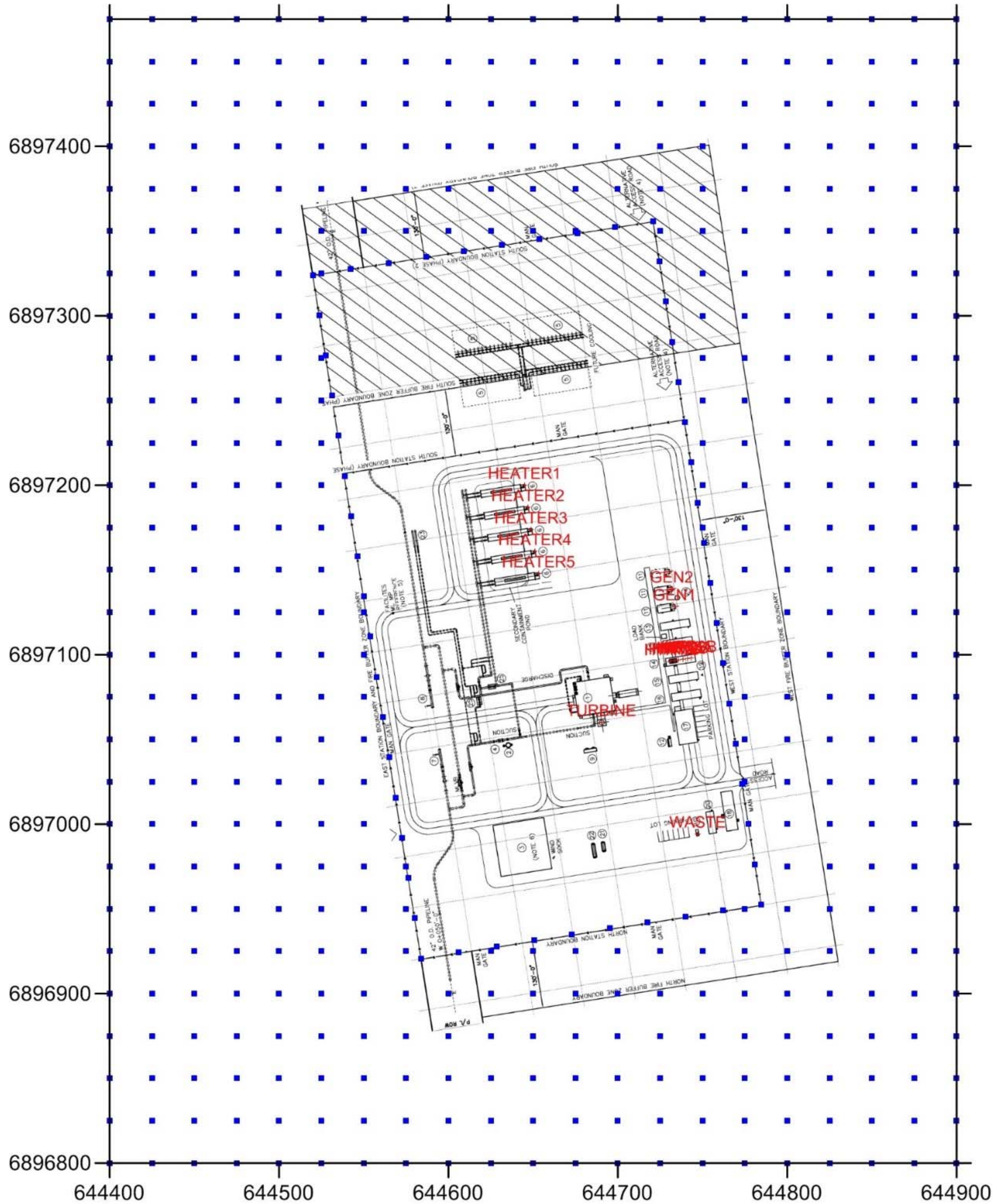


FIGURE D-16
Rabideux Creek Compressor Station Near-Field Receptor Grid
(Coordinates are UTM NAD83, in meters)



Appendix E: Emission Rates and Source Parameters

TABLE E-1
Sagwon Compressor Station Emission Rates

	NOx		PM/PM_{10}/$PM_{2.5}$		SO_2		CO	
Emission Source	**lb/hr**	**ton/yr**	**lb/hr**	**ton/yr**	**lb/hr**	**ton/yr**	**lb/hr**	**ton/yr**
Gas Turbine Compressor #1	8.590	37.62	2.158	9.45	0.081	0.353	8.720	38.19
Gas Turbine Compressor #2	8.590	37.62	2.158	9.45	0.081	0.353	8.720	38.19
Power Generator #1	1.521	6.66	0.205	0.90	0.006	0.026	3.042	13.33
Power Generator #2	1.521	6.66	0.205	0.90	0.006	0.026	3.042	13.33
Aux. Utility Glycol Heater	0.255	1.12	0.022	0.10	0.002	0.007	0.247	1.08
Aux. Utility Glycol Heaters - Turbine Intake Air Preheating #1	0.255	1.12	0.022	0.10	0.002	0.007	0.247	1.08
Aux. Utility Glycol Heaters - Turbine Intake Air Preheating #2	0.255	1.12	0.022	0.10	0.002	0.007	0.247	1.08
Aux. Utility Glycol Heaters - Turbine Intake Air Preheating #3	0.255	1.12	0.022	0.10	0.002	0.007	0.247	1.08
Waste Incinerator[1]	0.0011	0.0047	0.0857	0.0267	0.1102	0.0029	0.6000	0.0156
Total	**--**	**93.05**	**--**	**21.12**	**--**	**0.79**	**--**	**107.38**

[1] NOx hourly emissions based on assuming continuous operation at the average hourly rate - maximum hourly emissions multiple by annual operating hours divided by 8,760 hours per year (EPA, 2011b). PM_{10} and $PM_{2.5}$ maximum hourly emission rate multiplied by 2/24 to compensate for incinerator operation of 2 hours per day. SO_2 and CO use maximum hourly emissions.

TABLE E-2
Galbraith Lake, Coldfoot, Ray River, Minto, and Healy Compressor Stations Emission Rates

Emission Source	NOx		$PM/PM_{10}/PM_{2.5}$		SO_2		CO	
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
Gas Turbine Compressor	11.420	50.02	2.862	12.54	0.107	0.468	11.580	50.72
Power Generator #1	1.521	6.66	0.205	0.90	0.006	0.026	3.042	13.33
Power Generator #2	1.521	6.66	0.205	0.90	0.006	0.026	3.042	13.33
Aux. Utility Glycol Heater	0.255	1.12	0.022	0.10	0.002	0.007	0.247	1.08
Aux. Utility Glycol Heaters - Turbine Intake Air Preheating #1	0.255	1.12	0.022	0.10	0.002	0.007	0.247	1.08
Aux. Utility Glycol Heaters - Turbine Intake Air Preheating #2	0.255	1.12	0.022	0.10	0.002	0.007	0.247	1.08
Waste Incinerator[2]	0.0011	0.0047	0.0857	0.0267	0.1102	0.0029	0.6000	0.0156
Total	**--**	**66.70**	**--**	**14.66**	**--**	**0.54**	**--**	**80.63**

[2] NOx hourly emissions based on assuming continuous operation at the average hourly rate - maximum hourly emissions multiple by annual operating hours divided by 8,760 hours per year (EPA, 2011b). PM_{10} and $PM_{2.5}$ maximum hourly emission rate multiplied by 2/24 to compensate for incinerator operation of 2 hours per day. SO_2 and CO use maximum hourly emissions.

TABLE E-3
Honolulu Creek Compressor Station Emission Rates

Emission Source	NOx		PM/PM_{10}/$PM_{2.5}$		SO_2		CO	
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
Gas Turbine Compressor	11.420	50.02	2.862	12.54	0.107	0.468	11.580	50.72
Power Generator	1.521	6.66	0.205	0.90	0.006	0.026	3.042	13.33
Aux. Utility Glycol Heater	0.255	1.12	0.022	0.10	0.002	0.007	0.247	1.08
Aux. Utility Glycol Heaters - Turbine Intake Air Preheating #1	0.255	1.12	0.022	0.10	0.002	0.007	0.247	1.08
Aux. Utility Glycol Heaters - Turbine Intake Air Preheating #2	0.255	1.12	0.022	0.10	0.002	0.007	0.247	1.08
Waste Incinerator[3]	0.0011	0.0047	0.0857	0.0267	0.1102	0.0029	0.6000	0.0156
Total	**--**	**60.04**	**--**	**13.76**	**--**	**0.52**	**--**	**67.31**

[3] NOx hourly emissions based on assuming continuous operation at the average hourly rate - maximum hourly emissions multiple by annual operating hours divided by 8,760 hours per year (EPA, 2011b). PM_{10} and $PM_{2.5}$ maximum hourly emission rate multiplied by 2/24 to compensate for incinerator operation of 2 hours per day. SO_2 and CO use maximum hourly emissions.

TABLE E-4
Rabideux Creek Compressor Station Emission Rates

Emission Source	NOx		$PM/PM_{10}/PM_{2.5}$		SO_2		CO	
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
Gas Turbine Compressor	11.420	50.02	2.862	12.54	0.107	0.468	11.580	50.72
Power Generator	1.631	7.15	0.230	1.01	0.007	0.029	3.263	14.29
Aux. Utility Glycol Heater	0.255	1.12	0.022	0.10	0.002	0.007	0.247	1.08
Aux. Utility Glycol Heaters - Turbine Intake Air Preheating #1	0.255	1.12	0.022	0.10	0.002	0.007	0.247	1.08
Aux. Utility Glycol Heaters - Turbine Intake Air Preheating #2	0.255	1.12	0.022	0.10	0.002	0.007	0.247	1.08
Indirect Fired Gas Heater #1	1.021	0.37	0.209	0.08	0.016	0.006	2.306	0.83
Indirect Fired Gas Heater #2	1.021	0.37	0.209	0.08	0.016	0.006	2.306	0.83
Indirect Fired Gas Heater #3	1.021	0.37	0.209	0.08	0.016	0.006	2.306	0.83
Indirect Fired Gas Heater #4	1.021	0.37	0.209	0.08	0.016	0.006	2.306	0.83
Indirect Fired Gas Heater #5	1.021	0.37	0.209	0.08	0.016	0.006	2.306	0.83
Waste Incinerator[4]	0.0011	0.0047	0.0857	0.0267	0.1102	0.0029	0.6000	0.0156
Total	**--**	**62.36**	**--**	**14.24**	**--**	**0.55**	**--**	**72.42**

[4] NOx hourly emissions based on assuming continuous operation at the average hourly rate - maximum hourly emissions multiple by annual operating hours divided by 8,760 hours per year (EPA, 2011b). PM_{10} and $PM_{2.5}$ maximum hourly emission rate multiplied by 2/24 to compensate for incinerator operation of 2 hours per day. SO_2 and CO use maximum hourly emissions.

TABLE E-5
Sagwon Compressor Station Emission Rates

Emission Source	Unit ID	Height (m)	Ref.	Exit Temp. (K)	Ref.	Exit Vel. (m/s)	Ref.	Diam. (m)[5]	Ref.	Instack NO_2:NOx Ratio	Ref.
Gas Turbine Compressor #1	TURBINE1	12.45	1	776.48	9	20.45	15, 7	2.64	1	0.3	6
Gas Turbine Compressor #2	TURBINE2	12.45	1	776.48	9	20.45	15, 7	2.64	1	0.3	6
Power Generator #1	GEN1	5.49	1	886.48	10	41.72	12, 7	0.28	14	0.1	4
Power Generator #2	GEN2	5.49	1	886.48	10	41.72	12, 7	0.28	14	0.1	4
Aux. Utility Glycol Heater 1 (1 of 2)[6]	HTR1A	6.1	1	441.48	8	1.26	8, 7	0.43	14	0.1	4
Aux. Utility Glycol Heater 1 (2 of 2)	HTR1B	6.1	1	441.48	8	1.26	8, 7	0.43	14	0.1	4
Aux. Utility Glycol Heater 2 (1 of 2)	HTR2A	6.1	1	441.48	8	1.26	8, 7	0.43	14	0.1	4
Aux. Utility Glycol Heater 2 (2 of 2)	HTR2B	6.1	1	441.48	8	1.26	8, 7	0.43	14	0.1	4
Aux. Utility Glycol Heater 3 (1 of 2)	HTR3A	6.1	1	441.48	8	1.26	8, 7	0.43	14	0.1	4
Aux. Utility Glycol Heater 3 (2 of 2)	HTR3B	6.1	1	441.48	8	1.26	8, 7	0.43	14	0.1	4
Aux. Utility Glycol Heater 4 (1 of 2)	HTR4A	6.1	1	441.48	8	1.26	8, 7	0.43	14	0.1	4
Aux. Utility Glycol Heater 4 (2 of 2)	HTR4B	6.1	1	441.48	8	1.26	8, 7	0.43	14	0.1	4
Waste Incinerator	WASTE	3.66	1	864.82	5	5.72	5	0.28	1	0.1	4

[5] All stacks circular with the exception of the Gas Turbine Compressor stacks, which are rectangular. Diameter for rectangular stacks calculated based on equivalent cross-sectional area.
[6] Each glycol heater vents to two stacks; exit velocity reflects flow volume through two stacks.

TABLE E-6
Galbraith Lake, Coldfoot, Ray River, Minto, and Healy Compressor Stations Emission Rates

Emission Source	Unit ID	Height (m)	Ref.	Exit Temp. (K)	Ref.	Exit Vel. (m/s)	Ref.	Diam. (m)[7]	Ref.	Instack NO_2:NOx Ratio	Ref.
Gas Turbine Compressor	TURBINE	20.27	1	736.48	2	17.23	2, 7	3.27	1	0.3	6
Power Generator #1	GEN1	5.49	1	886.48	10	41.72	12, 7	0.28	1	0.1	4
Power Generator #2	GEN2	5.49	1	886.48	10	41.72	12, 7	0.28	14	0.1	4
Aux. Utility Glycol Heater 1 (1 of 2)[8]	HTR1A	6.10	1	441.48	8	1.26	8, 7	0.43	14	0.1	4
Aux. Utility Glycol Heater 1 (2 of 2)	HTR1B	6.10	1	441.48	8	1.26	8, 7	0.43	14	0.1	4
Aux. Utility Glycol Heater 2 (1 of 2)	HTR2A	6.10	1	441.48	8	1.26	8, 7	0.43	14	0.1	4
Aux. Utility Glycol Heater 2 (2 of 2)	HTR2B	6.10	1	441.48	8	1.26	8, 7	0.43	14	0.1	4
Aux. Utility Glycol Heater 3 (1 of 2)	HTR3A	6.10	1	441.48	8	1.26	8, 7	0.43	14	0.1	4
Aux. Utility Glycol Heater 3 (2 of 2)	HTR3B	6.10	1	441.48	8	1.26	8, 7	0.43	14	0.1	4
Waste Incinerator	WASTE	3.66	1	864.82	5	5.72	5	0.28	1	0.1	4

[7] All stacks circular with the exception of the Gas Turbine Compressor stacks, which are rectangular. Diameter for rectangular stacks calculated based on equivalent cross-sectional area.
[8] Each glycol heater vents to two stacks; exit velocity reflects flow volume through two stacks.

TABLE E-7
Honolulu Creek Compressor Station Source Parameters

Emission Source	Unit ID	Height (m)	Ref.	Exit Temp. (K)	Ref.	Exit Vel. (m/s)	Ref.	Diam. (m)[9]	Ref.	Instack NO_2:NOx Ratio	Ref.
Gas Turbine Compressor	TURBINE	20.27	1	736.48	2	17.23	2, 7	3.27	1	0.3	6
Power Generator	GEN1	5.49	1	886.48	10	41.72	12, 7	0.28	14	0.1	4
Aux. Utility Glycol Heater 1 (1 of 2)[10]	HTR1A	6.10	1	441.48	8	1.26	8, 7	0.43	14	0.1	4
Aux. Utility Glycol Heater 1 (2 of 2)	HTR1B	6.10	1	441.48	8	1.26	8, 7	0.43	14	0.1	4
Aux. Utility Glycol Heater 2 (1 of 2)	HTR2A	6.10	1	441.48	8	1.26	8, 7	0.43	14	0.1	4
Aux. Utility Glycol Heater 2 (2 of 2)	HTR2B	6.10	1	441.48	8	1.26	8, 7	0.43	14	0.1	4
Aux. Utility Glycol Heater 3 (1 of 2)	HTR3A	6.10	1	441.48	8	1.26	8, 7	0.43	14	0.1	4
Aux. Utility Glycol Heater 3 (2 of 2)	HTR3B	6.10	1	441.48	8	1.26	8, 7	0.43	14	0.1	4
Waste Incinerator	WASTE	3.66	1	864.82	5	5.72	5	0.28	1	0.1	4

[9] All stacks circular with the exception of the Gas Turbine Compressor stacks, which are rectangular. Diameter for rectangular stacks calculated based on equivalent cross-sectional area.
[10] Each glycol heater vents to two stacks; exit velocity reflects flow volume through two stacks.

TABLE E-8
Rabideux Creek Compressor Station Source Parameters

Emission Source	Unit ID	Height (m)	Ref.	Exit Temp. (K)	Ref.	Exit Vel. (m/s)	Ref.	Diam. (m)[11]	Ref.	Instack NO_2:NOx Ratio	Ref.
Gas Turbine Compressor	TURBINE	20.27	1	736.48	2	17.23	2, 7	3.27	1	0.3	6
Power Generator	GEN1	5.49	1	897.59	11	47.31	12, 7	0.28	14	0.1	4
Indirect Fired Gas Heater 1 of 5	HEATER1	7.01	1	449.82	13	3.07	12, 7	1.19	14	0.1	4
Indirect Fired Gas Heater 2 of 5	HEATER2	7.01	1	449.82	13	3.07	12, 7	1.19	14	0.1	4
Indirect Fired Gas Heater 3 of 5	HEATER3	7.01	1	449.82	13	3.07	12, 7	1.19	14	0.1	4
Indirect Fired Gas Heater 4 of 5	HEATER4	7.01	1	449.82	13	3.07	12, 7	1.19	14	0.1	4
Indirect Fired Gas Heater 5 of 5	HEATER5	7.01	1	449.82	13	3.07	12, 7	1.19	14	0.1	4
Aux. Utility Glycol Heater 1 (1 of 2)[12]	HTR1A	6.10	1	441.48	8	1.26	8, 7	0.43	14	0.1	4
Aux. Utility Glycol Heater 1 (2 of 2)	HTR1B	6.10	1	441.48	8	1.26	8, 7	0.43	14	0.1	4
Aux. Utility Glycol Heater 2 (1 of 2)	HTR2A	6.10	1	441.48	8	1.26	8, 7	0.43	14	0.1	4
Aux. Utility Glycol Heater 2 (2 of 2)	HTR2B	6.10	1	441.48	8	1.26	8, 7	0.43	14	0.1	4
Aux. Utility Glycol Heater 3 (1 of 2)	HTR3A	6.10	1	441.48	8	1.26	8, 7	0.43	14	0.1	4
Aux. Utility Glycol Heater 3 (2 of 2)	HTR3B	6.10	1	441.48	8	1.26	8, 7	0.43	14	0.1	4
Waste Incinerator	WASTE	3.66	1	864.82	5	5.72	5	0.28	1	0.1	4

[11] All stacks circular with the exception of the Gas Turbine Compressor stacks, which are rectangular. Diameter for rectangular stacks calculated based on equivalent cross-sectional area.
[12] Each glycol heater vents to two stacks; exit velocity reflects flow volume through two stacks.

References and Notes

1. USAP-WP-MRZZZ-00-000001
2. Vendor data – typical
3. Vendor data – typical
4. In-stack NO_2-to-NOx ratio of 0.1 was assumed for the generators, heaters, and waste incinerators based on the source-specific in-stack NO_2-to-NOx data provided in *NO_2-to-NOx ratios per Source Tests Approved by the Alaska Department of Environmental Conservation*, updated August 23, 2013.
5. Vendor data – typical
6. Vendor data – typical
7. Velocity calculated according to acfm and stack diameter.
8. Vendor data – typical
9. Vendor data – typical
10. Vendor data – typical
11. Vendor data – typical
12. Calculated based on heat input rating, EPA Method 19 F-Factor, and stack temperature.
13. Assume ~85% efficient natural gas boiler, for stack temperature of 350F.
14. Stack shape TBD - assume circular stack for modeling purposes.

Appendix F: Emission Calculations

Public

TYPICAL FACILITY EMISSIONS CALCULATIONS

USAP-PE-SCCAL-00-000001-000

Rev	Date	Revision Description	Originator	Reviewer / Endorser	Response Code	Approver
0	8-Sep-15	Issued for Information	R. Bonderer			B. Leininger
1	28-Mar-16	Issued for Review	R. Woolf			B. Leininger
1A	20-Jul-16	Issued for Review	R. Woolf			B. Leininger
1B	12-Sep-16	Issued for Review	R. Woolf			B. Leininger

Document Control No.	Country	Facility	Originator	Discipline	Type	Sub-Type	Location	Sequence	Identifier
	US	AP	PE	S	C	CAL	00	000001	000

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Table 1: Compressor and Heater Station Combined Total Emissions Summary

		Compressor Station (Single w/Coolers) [Galbraith Lake, Coldfoot, Ray River, Minto, Healy]	Compressor Station (Multiple w/Coolers) [Sagwon]	Compressor Station (Single w/o Coolers) [Honolulu Creek, Rabideux Creek]	Metering Station	Heater Station [Theodore River]
NOx	(tons/yr)	161.04	184.61	131.65	-	49.29
VOC (NMHC)	(tons/yr)	20.97	33.55	13.87	2.39	16.20
PM/PM10/PM2.5	(tons/yr)	13.11	29.08	10.61	-	8.68
SO2	(tons/yr)	4.27	4.80	3.46	-	2.59
CO	(tons/yr)	244.14	247.82	200.47	-	103.39
CO2e	(tonnes/yr)	206,381.91	233,783.97	166,012.50	785.05	125,201.09
Total HAPs	(tons/yr)	8.34	10.73	6.63	0.01	4.17
Max Individual HAP	(tons/yr)	6.29	7.90	5.03	0.00	2.12

Compressor station emissions assume that turbines operate at temperatures > -20 degrees F or are equipped with pre-heat.

Table 2: Emissions Summary - Compressor Station, Single Unit with Cooling

Pollutant	tons/year
NOx	161.04
VOC (NMHC)	20.97
PM/PM10/PM2.5	13.11
SO2	4.27
CO	244.14
CO2e	206,381.91

*VOC and CO2e emissions do not include emergency natural gas venting

Equipment Information	Fuel Type	HHV	Equipment Rating	Number of Units	Units Op. Simult.	Op. Hours/unit
Gas Turbine Compressor	Nat. Gas	1077 Btu/scf [22]	346 MMBtu/hr [1]	1	1	8,760 hr/yr [10]
Power Generator	Nat. Gas	1077 Btu/scf [22]	14.70 MMBtu/hr [6]	3	2	8,760 hr/yr [10]
Aux. Utility Glycol Heater	Nat. Gas	1077 Btu/scf [22]	10 MMBtu/hr [11]	2	2	8,760 hr/yr [10]
Waste Incinerator	Refuse	4500 Btu/lb	575 lbs/hr [11]	1	1	12 hr/yr [11]

Combustion Criteria Pollutant Emission Factors	NOx	VOC (NMHC)	PM/PM10/PM2.5	SO2	CO
Gas Turbine Compressor	99.3 lb/mmscf [2]	4.14 lb/mmscf [2,3]	0.0066 lb/mmBtu [4]	2.66 lb/mmscf [8]	144.89 lb/mmscf [2]
Power Generator	0.5 g/bhp-hr [6]	0.14 g/bhp-hr [6]	0.01941 lb/mmBtu [7]	2.66 lb/mmscf [8]	1.0 g/bhp-hr [6]
Aux. Utility Glycol Heater	65.4 lb/mmscf [13]	5.5 lb/mmscf [5]	7.6 lb/mmscf [5]	2.66 lb/mmscf [8]	99 lb/mmscf [13]
Waste Incinerator	3 lb/ton [9]	3 lb/ton [9]	0.47 kg/hr [12]	0.05 kg/hr [12]	10 lb/ton [9]

	NOx		VOC (NMHC)		PM/PM10/PM2.5		SO2		CO		CO2e	
Combustion Emissions	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
Gas Turbine Compressor	31.848	139.49	1.328	5.82	2.280	9.99	0.853	3.74	46.482	203.59	40,458.31	177,207.42
Power Generator #1	1.852	8.11	0.519	2.27	0.285	1.25	0.036	0.16	3.704	16.22	1,720.92	7,537.62
Power Generator #2	1.852	8.11	0.519	2.27	0.285	1.25	0.036	0.16	3.704	16.22	1,720.92	7,537.62
Aux. Utility Glycol Heater #1	0.608	2.66	0.051	0.22	0.071	0.31	0.025	0.11	0.924	4.05	1170.98	5,128.89
Aux. Utility Glycol Heater #2	0.608	2.66	0.051	0.22	0.071	0.31	0.025	0.11	0.924	4.05	1170.98	5,128.89
Waste Incinerator [14,15]	0.0012	0.0052	0.8625	0.0052	0.0857	0.0062	0.1102	0.0007	2.875	0.0173	782.20	4.69
Total	**--**	**161.04**	**--**	**10.81**	**--**	**13.11**	**--**	**4.27**	**--**	**244.14**	**--**	**202,545.13**
Major Source?	**--**	**FALSE**	**--**	**FALSE**	**--**	**FALSE**	**--**	**FALSE**	**--**	**FALSE**	**--**	**--**

Combustion GHG Emission Factors	CH4 [16]	N20 [16]	CO2 [16]
Gas Turbine Compressor	1.00E-03 kg/mmBtu	1.00E-04 kg/mmBtu	53.06 kg/mmBtu
Power Generator	1.00E-03 kg/mmBtu	1.00E-04 kg/mmBtu	53.06 kg/mmBtu
Aux. Utility Glycol Heater	1.00E-03 kg/mmBtu	1.00E-04 kg/mmBtu	53.06 kg/mmBtu
Waste Incinerator	3.20E-02 kg/mmBtu	4.20E-03 kg/mmBtu	2,680.0 lb/ton [18]

Compressor Seal and Blowdown NG Emissions [11]	Number of sources	lb NG /hr/source	Minutes /event	Events /year	lb NG/year	VOC [19] lb/year	VOC [19] ton/yr	CO2e [19] lb/year	CO2e [19] ton/yr	type [c]
Station Piping Including Gas to gas Exchangers, Aerial Coolers & Compressor Casing	1	737,900	5	1	6.15E+04	3875.38	1.94E+00	1.27E+06	6.35E+02	p
Unit Piping and Compressor	1	57,984	5	2	9.66E+03	609.05	3.05E-01	2.00E+05	9.99E+01	p
Station OPP - Suction Piping	1	63,850	1	1	1.06E+03	67.07	3.35E-02	2.20E+04	1.10E+01	e
Station OPP - Discharge Piping	1	6,410,608	1	1	1.07E+05	6733.58	3.37E+00	2.21E+06	1.10E+03	e
Inlet Piping Blowdown (Station Inlet ESDV to Comp Suction valve o/s building)	1	474,270	7	1	5.53E+04	3487.15	1.74E+00	1.14E+06	5.72E+02	m
Outlet Piping Blowdown (Comp discharge valve o/s building to Station outlet ESDV)	1	1,096,463	7	1	1.28E+05	8061.93	4.03E+00	2.64E+06	1.32E+03	m
Unit ESD - Discharge Blowdown	1	156,724	5	2	2.61E+04	1646.20	8.23E-01	5.40E+05	2.70E+02	m
Scrubber Dump - Sump ($8ft^3$) [a]	1	72	1	1	1.20E+00	0.08	3.78E-05	2.48E+01	1.24E-02	p
Pig trap - Launcher / Receiver ($320ft^3$) [a]	2	14,982	15	1	7.49E+03	472.10	2.36E-01	1.55E+05	7.74E+01	m
Gas / Hydraulic Valve operators ($6ft^3$) [b]	42	72	1	2	100.80	6.35	3.18E-03	2.08E+03	1.04E+00	p
Dry Gas Seals [21]	2	--	Continuous		--	--	8.80E-01	--	7.95E+02	p
Total							**9.96**		**3,772.27**	

[a] Emissions from these equipment are a mixture of natural gas, water, lube oil, and glycol - assumed to be 100% natural gas for emissions calculations

[b] Emissions from these equipment are a mixture of natural gas, water, and oil - assumed to be 100% natural gas for emissions calculations

[c] p = planned; e = emergency; m = maintenance

Piping Component Emissions [20]	TOC kg/hr /comp.	Total Comp.	VOC lb/year	VOC ton/yr	CO2e lb/year	CO2e ton/yr
Valves	4.50E-03	46	2.52E+02	1.26E-01	8.26E+04	4.13E+01
Flanges	3.90E-04	298	1.41E+02	7.07E-02	4.64E+04	2.32E+01
Total				**0.20**		**64.50**

[1] Vendor expected performance and emissions sheet. Rating was converted from LHV to HHV by multiplying by 1.11.
[2] Vendor expected performance and emissions sheet. 25 ppmv NOx, 15 ppmv HC, and 60 ppmv CO, all @ 15% O2.
[3] Assumed 80% of HC is methane (same as ratio of Methane to TOC found in AP-42 Table 3.1-2a).
[4] AP-42 Table 3.1-2a - Emission Factors for Criteria Pollutants and Greenhouse Gases from Stationary Gas Turbines.
[5] AP-42 Section 1.4: Natural Gas Combustion.
[6] Vendor Technical Data Sheet. Rating was converted from LHV to HHV by multiplying by 1.11.
[7] AP-42 Section 3.2 - Natural Gas-fired Reciprocating Engines, Table 3.2-3 (Condensable + Filterable PM- 4-Stroke Rich Burn Engine).
[8] Assumed 16 ppmv total sulfur in natural gas. SO2 assumes all S oxidized to SO2.
[9] AP-42 Section 2.1 - Refuse Combustion - Table 2.1-12: Industrial/Commercial multi chamber combustor, TOC assumed = VOC.
[10] For permitting/modeling purposes, assumes 24/7 operation
[11] USAP-WP-MRZZZ-00-000001-000; Rev 3, dated 8/23/16.
[12] Performance Source Test Data.
[13] 50 ppmv NOx and 125 ppmv CO @ 3% O2, as provided by vendor.
[14] PM10 and PM2.5 max. hourly emission rate multiplied by 2/24 to compensate for incinerator operation of 2 hours per day. SO2, CO, and VOC use max. hourly emissions.
[15] NOx hourly emissions based on assuming continuous operation at the average hourly rate - max. hourly emissions multiplied by annual operating hours/8,760.
[16] Tables C-1 and C-2 to Subpart C of Part 98—Default CO2, CH4 and N2O Emission Factors for Various Types of Fuel
[17] Table A-1 to Subpart A of Part 98—Global Warming Potentials.
[18] AP-42 Table 2.1-8 - Emission Factors for Refuse Derived Fuel Fired Combustors.
[19] Based on speciation of Pipeline GTP natural gas from Alaska LNG Design Basis Document (USAP-WP-YBDES-00-000002-000)
[20] EPA Protocol for Equipment Leak Emissions (EPA-453/R-95-017; Nov. 1995) Table 2-4
[21] EPA OAQPS - Report for Oil and Natural Gas Sector Compressors Review Panel April 2014, Table 3-11. Dry Seal Centrifugal Compressors (15.9 ton CH4/compressor/yr; 0.44 ton VOC/compressor/yr)
[22] Natural gas HHV as per Hysys calculation.

Table 3: Emissions Summary - Compressor Station, Multi-Unit with Cooling

Pollutant	tons/year
NOx	184.61
VOC (NMHC)	33.55
PM/PM10/PM2.5	29.08
SO2	4.80
CO	247.82
CO2e	233,783.97

*VOC and CO2e emissions do not include emergency natural gas venting

Equipment Information	Fuel Type	HHV	Equipment Rating	Number of Units	Units Op. Simult.	Op. Hours/unit
Gas Turbine Compressor	Nat. Gas	1077 Btu/scf [22]	187 MMBtu/hr [1]	3	2	8,760 hr/yr [13]
Power Generator	Nat. Gas	1077 Btu/scf [22]	14.70 MMBtu/hr [6]	4	3	8,760 hr/yr [13]
Aux. Utility Glycol Heater	Nat. Gas	1077 Btu/scf [22]	13 MMBtu/hr [12]	2	2	8,760 hr/yr [13]
Waste Incinerator	Refuse	4500 Btu/lb	575 lbs/hr [12]	1	1	12 hr/yr [12]

Combustion Criteria Pollutant Emission Factors	NOx	VOC (NMHC)	PM/PM10/PM2.5	SO2	CO
Gas Turbine Compressor	99.3 lb/mmscf [2]	6.90 lb/mmscf [2,3]	0.015 lb/mmBtu [4]	2.66 lb/mmscf [8]	120.74 lb/mmscf [2]
Power Generator	0.5 g/bhp-hr [6]	0.14 g/bhp-hr [6]	0.01941 lb/mmBtu [7]	2.66 lb/mmscf [8]	1.0 g/bhp-hr [6]
Aux. Utility Glycol Heater	65.4 lb/mmscf [11]	5.5 lb/mmscf [5]	7.6 lb/mmscf [5]	2.66 lb/mmscf [8]	99 lb/mmscf [13]
Waste Incinerator	3 lb/ton [9]	3 lb/ton [9]	0.47 kg/hr [10]	0.05 kg/hr [10]	10 lb/ton [9]

	NOx		VOC (NMHC)		PM/PM10/PM2.5		SO2		CO		CO2e	
Combustion Emissions	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
Gas Turbine Compressor #1	17.201	75.34	1.195	5.2	2.799	12.26	0.461	2.02	20.920	91.63	21,851.11	95,707.88
Gas Turbine Compressor #2	17.201	75.34	1.195	5.2	2.799	12.26	0.461	2.02	20.920	91.63	21,851.11	95,707.88
Power Generator #1	2.056	9.00	0.576	2.5	0.285	1.25	0.036	0.16	4.111	18.01	1,720.92	7,537.62
Power Generator #2	2.056	9.00	0.576	2.5	0.285	1.25	0.036	0.16	4.111	18.01	1,720.92	7,537.62
Power Generator #3	2.056	9.00	0.576	2.5	0.285	1.25	0.036	0.16	4.111	18.01	1,720.92	7,537.62
Aux. Utility Glycol Heater #1	0.790	3.46	0.066	0.291	0.0917	0.40	0.032	0.14	1.201	5.26	1,522.27	6,667.56
Aux. Utility Glycol Heater #2	0.790	3.46	0.066	0.291	0.0917	0.40	0.032	0.14	1.201	5.26	1,522.27	6,667.56
Waste Incinerator [14,15]	0.00118	0.0052	0.86	0.0052	0.0857	0.0062	0.11	0.0007	2.875	0.0173	782.20	4.69
Total		**184.61**		**18.62**		**29.08**		**4.80**		**247.82**		**227,368.43**
Major Source?	--	**FALSE**	--	**FALSE**	--	**FALSE**	--	**FALSE**	--	**FALSE**	--	**NA**

Combustion GHG Emission Factors	CH4 [16]	N20 [16]	CO2 [16]
Gas Turbine Compressor	1.00E-03 kg/mmBtu	1.00E-04 kg/mmBtu	53.06 kg/mmBtu
Power Generator	1.00E-03 kg/mmBtu	1.00E-04 kg/mmBtu	53.06 kg/mmBtu
Aux. Utility Glycol Heater	1.00E-03 kg/mmBtu	1.00E-04 kg/mmBtu	53.06 kg/mmBtu
Waste Incinerator	3.20E-02 kg/mmBtu	4.20E-03 kg/mmBtu	2,680.00 lb/ton [18]

Compressor Seal and Blowdown NG Emissions [12]	Number of sources	lb NG /hr/source	Minutes /event	Events /year	lb NG/year	VOC [19] lb/year	VOC [19] ton/yr	CO2e [19] lb/year	CO2e [19] ton/yr	type [c]
Station Piping Including Gas to gas Exchangers, Aerial Coolers & Compressor Casing	1	750,331	5	1	6.25E+04	3940.67	1.97E+00	1.29E+06	6.46E+02	p
Unit Piping - Compressor A	1	39,930	5	2	6.66E+03	419.42	2.10E-01	1.38E+05	6.88E+01	p
Unit Piping - Compressor B	1	39,930	5	2	6.66E+03	419.42	2.10E-01	1.38E+05	6.88E+01	p
Unit Piping - Compressor C	1	39,930	5	2	6.66E+03	419.42	2.10E-01	1.38E+05	6.88E+01	p
Station OPP - Suction Piping	1	63,850	1	1	1.06E+03	67.07	3.35E-02	2.20E+04	1.10E+01	e
Station OPP - Discharge Piping	1	6,410,608	1	1	1.07E+05	6733.58	3.37E+00	2.21E+06	1.10E+03	e
Inlet Piping Blowdown (Station Inlet ESDV to Comp Suction valve o/s building)	1	486,772	7	1	5.68E+04	3579.07	1.79E+00	1.17E+06	5.87E+02	m
Outlet Piping Blowdow (Comp discharge valve o/s building to Station outlet ESDV)	1	1,110,527	7	1	1.30E+05	8165.34	4.08E+00	2.68E+06	1.34E+03	m
Unit A ESD - Suction Blowdown	1	102,365	5	2	1.71E+04	1075.22	5.38E-01	3.53E+05	1.76E+02	m
Unit A ESD - Discharge Blowdown	1	107,806	5	2	1.80E+04	1132.37	5.66E-01	3.71E+05	1.86E+02	m
Unit B ESD - Suction Blowdown	1	102,365	5	2	1.71E+04	1075.22	5.38E-01	3.53E+05	1.76E+02	m
Unit B ESD - Discharge Blowdown	1	107,806	5	2	1.80E+04	1132.37	5.66E-01	3.71E+05	1.86E+02	m
Unit C ESD - Suction Blowdown	1	102,365	5	2	1.71E+04	1075.22	5.38E-01	3.53E+05	1.76E+02	m
Unit C ESD - Discharge Blowdown	1	107,806	5	2	1.80E+04	1132.37	5.66E-01	3.71E+05	1.86E+02	m
Scrubber Dump - Sump (8ft^3) [a]	1	72	1	1	1.20E+00	0.08	3.78E-05	2.48E+01	1.24E-02	p
Pig trap - Launcher / Receiver (320ft^3) [a]	2	14,982	15	1	7.49E+03	472.10	2.36E-01	1.55E+05	7.74E+01	m
Gas / Hydraulic Valve operators (6ft^3) [b]	53	72	1	2	127.20	8.02	4.01E-03	2.63E+03	1.31E+00	p
Dry Gas Seals [21]	6	--	Continuous		--	--	2.64E+00	--	2.39E+03	p
Total							**14.66**		**6,327.70**	

[a] Emissions from these equipment are a mixture of natural gas, water, lube oil, and glcol - assumed to be 100% natural gas for emissions calculations

[b] Emissions from these equipment are a mixture of natural gas, water, and oil - assumed to be 100% natural gas for emissions calculations

[c] p = planned; e = emergency; m = maintenance

Fugitive Component Emissions [20]	TOC kg/hr /comp.	Total Comp.	VOC (lb/year)	VOC (tons/year)	CO2e (lbs/year)	CO2e (tons/year)
Valves	4.50E-03	64	3.51E+02	1.75E-01	1.15E+05	5.75E+01
Flanges	3.90E-04	390	1.85E+02	9.26E-02	6.07E+04	3.04E+01
Total				**0.27**		**87.84**

[d] Any equipmentother than connectors, flanges, open-ended lines, pumps, or valves (i.e. compressors, diaphrams, drains, dump arms, hatches, instruments, meters, PRVs, polished rods, vents)

[1] Vendor expected performance and emissions sheet. Rating was converted from LHV to HHC by multiplying by 1.11.
[2] Vendor expected performance and emissions sheet. 25 ppmv NOx, 25 ppmv HC, and 50 ppmv CO, all @ 15% O2.
[3] Vendor estimated that 80% of THC is methane.
[4] Provided by vendor. Assumes PM10 = PM2.5
[5] AP-42 Section 1.4: Natural Gas Combustion
[6] Vendor Technical Data Sheet. Rating was converted from LHV to HHV by multiplying by 1.11.
[7] AP-42 Section 3.2 - Natural Gas-fired Reciprocating Engines, Table 3.2-3 (Condensable + Filterable PM- 4-Stroke Rich Burn Engine)
[8] Assumed 16 ppmv total sulfur in natural gas. SO2 assumes all S oxidized to SO2.
[9] AP-42 Section 2.1 - Refuse Combustion - Table 2.1-12: Industrial/Commerical multi chamber combustor, TOC assumed = VOC
[10] Performance Source Test Data
[11] 50 ppmv NOx and 125 ppmv CO @ 3% O2, as provided by vendor.
[12] USAP-WP-MRZZZ-00-000001-000; Rev 3, dated 8/23/16.
[13] For permitting/modeling purposes, assumes 24/7 operation
[14] PM10 and PM2.5 max. hourly emission rate multiplied by 2/24 to compensate for incinerator operation of 2 hours per day. SO2, CO, and VOC use max. hourly emissions.
[15] NOx hourly emissions based on assuming continuous operation at the average hourly rate - max. hourly emissions multiple by annual operating hours/8,760
[16] Table C-2 to Subpart C of Part 98—Default CH4 and N2O Emission Factors for Various Types of Fuel
[17] Table A-1 to Subpart A of Part 98—Global Warming Potentials.
[18] AP-42 Table 2.1-8 - Emission Factors for Refuse Derived Fuel Fired Combustors
[19] Based on speciation of Pipeline GTP natural gas from Alaska LNG Design Basis Document (USAP-WP-YBDES-00-000002-000)
[20] EPA Protocol for Equipment Leak Emissions (EPA-453/R-95-017; Nov. 1995) Table 2-4
[21] EPA OAQPS - Report for Oil and Natural Gas Sector Compressors Review Panel April 2014, Table 3-11. Dry Seal Centrifugal Compressors (15.9 ton CH4/compressor/yr; 0.44 ton VOC/compressor/yr)
[22] Natural gas HHV as per Hysys calculation.

Table 4: Emissions Summary - Compressor Station, Single Unit without Cooling

Pollutant	tons/year
NOx	131.65
VOC (NMHC)	13.87
PM/PM10/PM2.5	10.61
SO2	3.46
CO	200.47
CO2e	166,012.50

*VOC and CO2e emissions do not include emergency natural gas venting

Equipment Information	Fuel Type	HHV	Equipment Rating	Number of Units	Units Op. Simult.	Op. Hours/unit
Gas Turbine Compressor	Nat. Gas	1077 Btu/scf [22]	276 MMBtu/hr [1]	1	1	8,760 hr/yr [10]
Power Generator	Nat. Gas	1077 Btu/scf [22]	11.74 MMBtu/hr [6]	3	2	8,760 hr/yr [10]
Aux. Utility Glycol Heater	Nat. Gas	1077 Btu/scf [22]	10 MMBtu/hr [11]	2	2	8,760 hr/yr [10]
Waste Incinerator	Refuse	4500 Btu/lb	575 lbs/hr [11]	1	1	12 hr/yr [11]

Combustion Criteria Pollutant Emission Factors	NOx	VOC (NMHC)	PM/PM10/PM2.5	SO2	CO
Gas Turbine Compressor	99.3 lb/mmscf [2]	4.14 lb/mmscf [2,3]	0.0066 lb/mmBtu [4]	2.66 lb/mmscf [8]	144.9 lb/mmscf [2]
Power Generator	0.5 g/bhp-hr [6]	0.14 g/bhp-hr [6]	0.01941 lb/mmBtu [7]	2.66 lb/mmscf [8]	1.0 g/bhp-hr [6]
Aux. Utility Glycol Heater	65.4 lb/mmscf [13]	5.5 lb/mmscf [5]	7.6 lb/mmscf [5]	2.66 lb/mmscf [8]	99 lb/mmscf [13]
Waste Incinerator	3 lb/ton [9]	3 lb/ton [9]	0.47 kg/hr [12]	0.05 kg/hr [12]	10 lb/ton [9]

	NOx		VOC (NMHC)		PM/PM10/PM2.5		SO2		CO		CO2e	
Combustion Emissions	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
Gas Turbine Compressor	25.464	111.53	1.06	4.65	1.823	7.99	0.682	2.99	37.164	162.78	32,347.99	141,684.18
Power Generator #1	1.689	7.40	0.47	2.07	0.228	1.00	0.029	0.13	3.377	14.79	1,374.91	6,022.13
Power Generator #2	1.689	7.40	0.47	2.07	0.228	1.00	0.029	0.13	3.377	14.79	1,374.91	6,022.13
Aux. Utility Glycol Heater #1	0.608	2.66	0.05	0.22	0.071	0.31	0.025	0.11	0.924	4.05	1,170.98	5,128.89
Aux. Utility Glycol Heater #2	0.608	2.66	0.05	0.22	0.071	0.31	0.025	0.11	0.924	4.05	1,170.98	5,128.89
Waste Incinerator [14,15]	0.0012	0.0052	0.86	0.01	0.0857	0.0062	0.1102	0.0007	2.875	0.0173	782.20	4.69
Total	**--**	**131.65**	**--**	**9.25**	**--**	**10.61**	**--**	**3.46**	**--**	**200.47**	**--**	**163,990.91**
Major Source?	**--**	**FALSE**	**--**	**FALSE**	**--**	**FALSE**	**--**	**FALSE**	**--**	**FALSE**	**--**	**NA**

Combustion GHG Emission Factors	CH4 [17]	N20 [17]	CO2 [17]
Gas Turbine Compressor	1.00E-03 kg/mmBtu	1.00E-04 kg/mmBtu	53.06 kg/mmBtu
Power Generator	1.00E-03 kg/mmBtu	1.00E-04 kg/mmBtu	53.06 kg/mmBtu
Aux. Utility Glycol Heater	1.00E-03 kg/mmBtu	1.00E-04 kg/mmBtu	53.06 kg/mmBtu
Waste Incinerator	3.20E-02 kg/mmBtu	4.20E-03 kg/mmBtu	2,680.0 lb/ton [18]

Compressor Seal and Blowdown NG Emissions [11]	Number of sources	lb NG /hr/source	Minutes /event	Events /year	lb NG/year	VOC [19] lb/year	VOC [19] ton/yr	CO2e [19] lb/year	CO2e [19] ton/yr	type [c]
Station Piping	1	269,229	5	1	2.24E+04	1413.97	7.07E-01	4.64E+05	2.32E+02	p
Unit Piping and Compressor	1	57,984	5	2	9.66E+03	609.05	3.05E-01	2.00E+05	9.99E+01	p
Station OPP - Suction Piping	1	63,850	1	1	1.06E+03	67.07	3.35E-02	2.20E+04	1.10E+01	e
Station OPP - Discharge Piping	1	6,160,239	1	1	1.03E+05	6470.60	3.24E+00	2.12E+06	1.06E+03	e
Inlet Piping Blowdown (Station Inlet ESDV to Comp Suction valve)	1	262,436	7	1	3.06E+04	1929.61	9.65E-01	6.33E+05	3.16E+02	m
Outlet Piping Blowdown (Comp discharge valve to Station outlet ESDV)	1	141,941	7	1	1.66E+04	1043.65	5.22E-01	3.42E+05	1.71E+02	m
Unit A ESD - Discharge Blowdown	1	175,837	5	2	2.93E+04	1846.96	9.23E-01	6.06E+05	3.03E+02	m
Scrubber Dump - Sump ($8ft^3$) [a]	1	72	1	1	1.20E+00	0.08	3.78E-05	2.48E+01	1.24E-02	p
Pig trap - Launcher / Receiver ($320ft^3$) [a]	2	14,982	15	1	7.49E+03	472.10	2.36E-01	1.55E+05	7.74E+01	m
Gas / Hydraulic Valve operators ($6ft^3$) [b]	7	72	1	2	16.80	1.06	5.29E-04	3.47E+02	1.74E-01	p
Dry Gas Seals [21]	2	--	Continuous		--	--	8.80E-01	--	7.95E+02	p
Total							**4.54**		**1,994.63**	

[a] Emissions from these equipment are a mixture of natural gas, water, lube oil, and glcol - assumed to be 100% natural gas for emissions calculations

[b] Emissions from these equipment are a mixture of natural gas, water, and oil - assumed to be 100% natural gas for emissions calculations

[c] p = planned; e = emergency; m = maintenance

Fugitive Component Emissions [20]	TOC kg/hr /comp.	Total Comp.	VOC lb/year	VOC ton/yr	CO2e lb/year	CO2e ton/yr
Valves	4.50E-03	25	1.37E+02	6.85E-02	4.49E+04	2.25E+01
Flanges	3.90E-04	58	2.75E+01	1.38E-02	9.03E+03	4.51E+00
Total				**0.08**		**26.97**

[d] Any equipmentother than connectors, flanges, open-ended lines, pumps, or valves (i.e. compressors, diaphrams, drains, dump arms, hatches, instruments, meters, PRVs, polished rods, vents)

[1] Vendor expected performance and emissions sheet. Rating was converted from LHV to HHV by multiplying by 1.11.
[2] 25 ppmv NOx, 15 ppmv HC, and 60 ppmv CO, all @ 15% O2; Expected Performance and Emissions provded by vendor.
[3] Assumed 80% of HC is methane (same as ratio of Methane to TOC found in AP-42 Table 3.1-2a).
[4] AP-42 Table 3.1-2a - Emission Factors for Criteria Pollutants and Greenhouse Gases from Stationary Gas Turbines.
[5] AP-42 Section 1.4: Natural Gas Combustion
[6] Vendor Technical Data Sheet. Rating was converted from LHV to HHV by multiplying by 1.11.
[7] AP-42 Section 3.2 - Natural Gas-fired Reciprocating Engines, Table 3.2-3 (Condensable + Filterable PM- 4-Stroke Rich Burn Engine)
[8] Assumed 16 ppmv total sulfur in natural gas. SO2 assumes all S oxidized to SO2.
[9] AP-42 Section 2.1 - Refuse Combustion - Table 2.1-12: Industrial/Commerical multi chamber combustor, TOC assumed = VOC
[10] For permitting/modeling purposes, assumes 24/7 operation
[11] USAP-WP-MRZZZ-00-000001-000; Rev 3, dated 8/23/16.
[12] Performance Source Test Data
[13] 50 ppmv NOx and 125 ppmv CO @ 3% O2, as provided by vendor.
[14] PM10 and PM2.5 max. hourly emission rate multiplied by 2/24 to compensate for incinerator operation of 2 hours per day. SO2, CO, and VOC use max. hourly emissions.
[15] NOx hourly emissions based on assuming continuous operation at the average hourly rate - max. hourly emissions multiple by annual operating hours/8,760.
[16] Table C-2 to Subpart C of Part 98—Default CH4 and N2O Emission Factors for Various Types of Fuel
[17] Table A-1 to Subpart A of Part 98—Global Warming Potentials.
[18] AP-42 Table 2.1-8 - Emission Factors for Refuse Derived Fuel Fired Combustors
[19] Based on speciation of Pipeline GTP natural gas from Alaska LNG Design Basis Document (USAP-WP-YBDES-00-000002-000)
[20] EPA Protocol for Equipment Leak Emissions (EPA-453/R-95-017; Nov. 1995) Table 2-4
[21] EPA OAQPS - Report for Oil and Natural Gas Sector Compressors Review Panel April 2014, Table 3-11. Dry Seal Centrifugal Compressors (15.9 ton CH4/compressor/yr; 0.44 ton VOC/compressor/yr)
[22] Natural gas HHV as per Hysys calculation.

Table 5: Emissions Summary - Metering Station

Pollutant	tons/year
NOx	0.00
VOC (NMHC)	2.39
PM/PM10/PM2.5	0.00
SO2	0.00
CO	0.00
CO2e	785.05

*VOC and CO2e emissions do not include emergency natural gas venting

Compressor Seal and Blowdown NG Emissions [1]	Number of sources	lb NG /hr/source	Minutes /event	Events /year	lb NG/year	VOC [2] lb/year	VOC [2] ton/yr	CO2e [2] lb/year	CO2e [2] ton/yr	type [c]
Station Piping, Meter Scrubber & Meter Runs	1	132,750	5	1	1.11E+04	697.19	3.49E-01	2.29E+05	1.14E+02	p
Station Piping - OPP	1	63,850	1	1	1.06E+03	67.07	3.35E-02	2.20E+04	1.10E+01	e
Station Piping - ESD Blowdown	1	711,376	5	1	5.93E+04	3736.08	1.87E+00	1.23E+06	6.13E+02	m
Scrubber Dump - Sump ($8ft^3$) [a]	1	72	1	1	1.20E+00	0.08	3.78E-05	2.48E+01	1.24E-02	p
Pig trap - Launcher / Receiver ($320ft^3$) [a]	1	14,982	15	1	3.75E+03	236.05	1.18E-01	7.74E+04	3.87E+01	m
Gas / Hydraulic Valve operators ($6ft^3$) [b]	7	72	1	2	16.80	1.06	5.29E-04	3.47E+02	1.74E-01	p
Total							**2.34**		**765.78**	

[a] Emissions from these equipment are a mixture of natural gas, water, lube oil, and glcol - assumed to be 100% natural gas for emissions calculations

[b] Emissions from these equipment are a mixture of natural gas, water, and oil - assumed to be 100% natural gas for emissions calculations

[c] p = planned; e = emergency; m = maintenance

Piping Component Emissions [3]	TOC kg/hr /comp.	Total Comp.	VOC lb/year	VOC ton/yr	CO2e lb/year	CO2e ton/yr
Valves	4.50E-03	16	8.76E+01	4.38E-02	2.87E+04	1.44E+01
Flanges	3.90E-04	63	2.99E+01	1.50E-02	9.81E+03	4.90E+00
Total				**0.06**		**19.27**

[1] USAP-WP-MRZZZ-00-000001-000; Rev 3, dated 8/23/16.
[2] Based on speciation of Pipeline GTP natural gas from Alaska LNG Design Basis Document (USAP-WP-YBDES-00-000002-000)
[3] EPA Protocol for Equipment Leak Emissions (EPA-453/R-95-017; Nov. 1995) Table 2-4

Table 6: Emissions Summary - Heater Station

Pollutant	tons/year
NOx	49.29
VOC (NMHC)	16.20
PM/PM10/PM2.5	8.68
SO2	2.59
CO	103.39
CO2e	125,201.09

*VOC and CO2e emissions do not include emergency natural gas venting

Equipment Information	Fuel Type	HHV	Equipment Rating	Number of Units	Units Op. Simult.	Operating Hours
Power Generator	Nat. Gas	1077 Btu/scf [3]	11.74 MMBtu/hr [1]	3	2	8,760 hr/yr [7]
Indirect Fired Gas Heater	Nat. Gas	1077 Btu/scf [3]	24 MMBtu/hr [8]	9	9	8,760 hr/yr [7]
Waste Incinerator	Refuse	4500 Btu/lb	575 lbs/hr [8]	1	1	12 hr/yr [8]

Combustion Criteria Pollutant Emission Factors	NOx	VOC (NMHC)	PM/PM10/PM2.5	SO2	CO
Power Generator	0.5 g/bhp-hr [1]	0.14 g/bhp-hr [1]	0.01941 lb/mmBtu [4]	2.66 lb/mmscf [5]	1.0 g/bhp-hr [1]
Indirect Fired Gas Heater	39.3 lb/mmscf [2]	5.5 lb/mmscf [2]	7.6 lb/mmscf [2]	2.66 lb/mmscf [5]	84 lb/mmscf [2]
Waste Incinerator	3 lb/ton [6]	3 lb/ton [6]	0.47 kg/hr [9]	0.05 kg/hr [9]	10 lb/ton [6]

	NOx		VOC (NMHC)		PM/PM10/PM2.5		SO2		CO		CO2e	
Combustion Emissions	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
Power Generator #1	1.689	7.40	0.473	2.07	0.228	1.00	0.029	0.13	3.377	14.79	1,374.91	6,022.13
Power Generator #2	1.689	7.40	0.473	2.07	0.228	1.00	0.029	0.13	3.377	14.79	1,374.91	6,022.13
Indirect Fired Gas Heater #1	0.875	3.83	0.123	0.54	0.169	0.74	0.059	0.26	1.872	8.20	2,810.35	12,309.34
Indirect Fired Gas Heater #2	0.875	3.83	0.123	0.54	0.169	0.74	0.059	0.26	1.872	8.20	2,810.35	12,309.34
Indirect Fired Gas Heater #3	0.875	3.83	0.123	0.54	0.169	0.74	0.059	0.26	1.872	8.20	2,810.35	12,309.34
Indirect Fired Gas Heater #4	0.875	3.83	0.123	0.54	0.169	0.74	0.059	0.26	1.872	8.20	2,810.35	12,309.34
Indirect Fired Gas Heater #5	0.875	3.83	0.123	0.54	0.169	0.74	0.059	0.26	1.872	8.20	2,810.35	12,309.34
Indirect Fired Gas Heater #6	0.875	3.83	0.123	0.54	0.169	0.74	0.059	0.26	1.872	8.20	2,810.35	12,309.34
Indirect Fired Gas Heater #7	0.875	3.83	0.123	0.54	0.169	0.74	0.059	0.26	1.872	8.20	2,810.35	12,309.34
Indirect Fired Gas Heater #8	0.875	3.83	0.123	0.54	0.169	0.74	0.059	0.26	1.872	8.20	2,810.35	12,309.34
Indirect Fired Gas Heater #9	0.875	3.83	0.123	0.54	0.169	0.74	0.059	0.26	1.872	8.20	2,810.35	12,309.34
Waste Incinerator [10, 11]	0.0012	0.0052	0.8625	0.0052	0.0857	0.0062	0.1102	0.0007	2.875	0.0173	782.20	4.69
Total	--	**49.29**	--	**8.98**	--	**8.68**	--	**2.59**	--	**103.39**	--	**122,832.98**
Major Source?	--	**FALSE**	--	**FALSE**	--	**FALSE**	--	**FALSE**	--	**FALSE**	--	**NA**

Combustion GHG Emission Factors	CH4 [12]	N20 [12]	CO2 [12]
Power Generator	1.00E-03 kg/mmBtu	1.00E-04 kg/mmBtu	53.06 kg/mmBtu
Indirect Fired Gas Heater	1.00E-03 kg/mmBtu	1.00E-04 kg/mmBtu	53.06 kg/mmBtu
Waste Incinerator	3.20E-02 kg/mmBtu	4.20E-03 kg/mmBtu	2,680.00 lb/ton [14]

Compressor Seal and Blowdown NG Emissions [8]	Number of sources	lb NG /hr/source	Minutes /event	Events /year	lb NG/year	VOC [15] lb/year	VOC [15] ton/yr	CO2e [15] lb/year	CO2e [15] ton/yr	type [c]
Station Piping & Heaters	1	325,202	5	1	2.71E+04	1.71E+03	8.54E-01	5.60E+05	2.80E+02	p
Station Piping - Inlet ESD	1	500,534	7	1	5.84E+04	3.68E+03	1.84E+00	1.21E+06	6.03E+02	m
Station Piping & Heaters - Outlet ESD	1	1,125,225	7	1	1.31E+05	8.27E+03	4.14E+00	2.71E+06	1.36E+03	m
Station Piping & Heaters - OPP	1	66,349	1	1	1.11E+03	6.97E+01	3.48E-02	2.29E+04	1.14E+01	e
Pig trap - Launcher / Receiver ($320ft^3$) [a]	2	14,982	15	1	7.49E+03	4.72E+02	2.36E-01	1.55E+05	7.74E+01	m
Gas / Hydraulic Valve operators ($6ft^3$) [b]	31	72	1	2	7.44E+01	4.69E+00	2.34E-03	1.54E+03	7.69E-01	p
Total							**7.07**		**2,318.17**	

[a] Emissions from these equipment are a mixture of natural gas, water, lube oil, and glcol - assumed to be 100% natural gas for emissions calculations

[b] Emissions from these equipment are a mixture of natural gas, water, and oil - assumed to be 100% natural gas for emissions calculations

[c] p = planned; e = emergency; m = maintenance

Fugitive Component Emissions [16]	TOC kg/hr /comp.	Total Comp.	VOC (lb/year)	VOC (tons/year)	CO2e (lbs/year)	CO2e (tons/year)
Valves	4.50E-03	44	2.41E+02	1.20E-01	7.90E+04	3.95E+01
Flanges	3.90E-04	134	6.36E+01	3.18E-02	2.09E+04	1.04E+01
Total				**0.15**		**49.94**

[d] Any equipment other than connectors, flanges, open-ended lines, pumps, or valves (i.e. compressors, diaphrams, drains, dump arms, hatches, instruments, meters, PRVs, polished rods, vents)

[1] Vendor Technical Data Sheet. Rating was converted from LHV to HHV by multiplying by 1.11.
[2] AP-42 Section 1.4: Natural Gas Combustion, assume 30 ppmv (@ 3% O2) for Indirect Heater
[3] Natural gas HHV as per Hysys calculation.
[4] AP-42 Section 3.2 - Natural Gas-fired Reciprocating Engines, Table 3.2-3 (Condensable + Filterable PM- 4-Stroke Rich Burn Engine)
[5] Assumed 16 ppmv total sulfur in natural gas. SO2 assumes all S oxidized to SO2.
[6] AP-42 Section 2.1 - Refuse Combustion - Table 2.1-12: Industrial/Commerical multi chamber combustor, TOC assumed = VOC
[7] Assume 24/7 operation for modeling/permitting purposes
[8] USAP-WP-MRZZZ-00-000001-000; Rev 3, dated 8/23/16.
[9] Performance Source Test Data
[10] PM10 and PM2.5 max. hourly emission rate multiplied by 2/24 to compensate for incinerator operation of 2 hours per day. SO2, CO, and VOC use max. hourly emissions.
[11] NOx hourly emissions based on assuming continuous operation at the average hourly rate - max. hourly emissions multiple by annual operating hours/8,760
[12] Table C-2 to Subpart C of Part 98—Default CH4 and N2O Emission Factors for Various Types of Fuel
[13] Table A-1 to Subpart A of Part 98—Global Warming Potentials.
[14] AP-42 Table 2.1-8 - Emission Factors for Refuse Derived Fuel Fired Combustors
[15] Based on speciation of Pipeline GTP natural gas from Alaska LNG Design Basis Document (USAP-WP-YBDES-00-000002-000)
[16] EPA Protocol for Equipment Leak Emissions (EPA-453/R-95-017; Nov. 1995) Table 2-4

Table 7: Equipment Hazardous Air Pollutant (HAP) Emission Factors

Factor	Value	Units
Natural Gas HHV	1077	Btu/scf
Refuse HHV	4500	Btu/lb
Equipment	**Rating**	
Gas Turbine Compressor (346 MMBtu/hr)	346	MMBtu/hr
Gas Turbine Compressor (276 MMBtu/hr)	276	MMBtu/hr
Gas Turbine Compressor (187 MMBtu/hr)	187	MMBtu/hr
Power Generator (14.7 MMBtu/hr)	14.7	MMBtu/hr
Power Generator (11.7 MMBtu/hr)	11.7	MMBtu/hr
Aux. Utility Glycol Heater (13 MMBtu/hr)	13	MMBtu/hr
Aux. Utility Glycol Heater (10 MMBtu/hr)	10	MMBtu/hr
Indirect Fired Gas Heater	24	MMBtu/hr
Waste Incinerator	575	lbs/hr

Natural Gas Turbine HAP Emissions

					EF	Equipment Emissions (lbs/hr)		
Federal 112(b)(1) Listed HAP	CAS #	EF Value	EF Units	EF Source	(lb/MMBtu)	Gas Turbine Compressor (346 MMBtu/hr)	Gas Turbine Compressor (276 MMBtu/hr)	Gas Turbine Compressor (187 MMBtu/hr)
1,3-Butadiene	106990	6.05E-08	lb/MMBtu	EPA Turbine HAP Memo[a,b]	6.05E-08	2.09E-05	1.67E-05	1.13E-05
Acetaldehyde	75070	1.28E-04	lb/MMBtu	EPA Turbine HAP Memo[a,b]	1.28E-04	4.42E-02	3.54E-02	2.39E-02
Acrolein	107028	5.11E-06	lb/MMBtu	EPA Turbine HAP Memo[a,b]	5.11E-06	1.77E-03	1.41E-03	9.54E-04
Benzene (including benzene from gasoline)	71432	2.85E-06	lb/MMBtu	EPA Turbine HAP Memo[a,b]	2.85E-06	9.85E-04	7.87E-04	5.32E-04
Ethyl benzene	100414	4.67E-06	lb/MMBtu	EPA Turbine HAP Memo[a,b]	4.67E-06	1.61E-03	1.29E-03	8.71E-04
Formaldehyde	50000	2.41E-03	lb/MMBtu	EPA Turbine HAP Memo[a,b]	2.41E-03	8.33E-01	6.66E-01	4.50E-01
Naphthalene	91203	7.12E-07	lb/MMBtu	EPA Turbine HAP Memo[a,b]	7.12E-07	2.46E-04	1.97E-04	1.33E-04
Polycylic Organic Matter/PAH	NA	1.44E-07	lb/MMBtu	EPA Turbine HAP Memo[a,b]	1.44E-07	4.98E-05	3.98E-05	2.69E-05
Propylene Oxide	75569	2.86E-05	lb/MMBtu	EPA Turbine HAP Memo[a,c]	2.86E-05	9.88E-03	7.90E-03	5.34E-03
Toluene	108883	2.07E-05	lb/MMBtu	EPA Turbine HAP Memo[a,b]	2.07E-05	7.15E-03	5.72E-03	3.86E-03
Xylenes (isomers and mixture)	1330207	1.01E-05	lb/MMBtu	EPA Turbine HAP Memo[a,b]	1.01E-05	3.49E-03	2.79E-03	1.88E-03

[a] EPA Memo Revised HAP Emission Factors for Stationary Combustion Turbines, OAR-2002-0060, IV-B-09, 8/22/03

[b] HAP Emission Factor for Lean Premix Turbines Firing Natural Gas >90% Load - with and without Duct Firing <50MW

[c] HAP Emission Factor for Flame Turbines Furing Natural Gas - All Loads > 50MW (no test data for lean pre-mix turbine < 50MW)

Natural Gas IC Engine HAP Emissions

Federal 112(b)(1) Listed HAP	CAS #	EF Value	EF Units	EF Source	EF (lb/MMBtu)	Equipment Emissions (lbs/hr) Power Generator (14.7 MMBtu/hr)	Power Generator (11.7 MMBtu/hr)
1,1,2,2-Tetrachloroethane	79345	2.53E-05	lb/MMBtu	AP42 Table 3.2-3; 07/00	2.53E-05	3.72E-04	2.97E-04
1,1,2-Trichloroethane	79005	1.53E-05	lb/MMBtu	AP42 Table 3.2-3; 07/00	1.53E-05	2.25E-04	1.80E-04
1,3-Butadiene	106990	6.63E-04	lb/MMBtu	AP42 Table 3.2-3; 07/00	6.63E-04	9.74E-03	7.78E-03
1,3-Dichloropropene	542756	1.27E-05	lb/MMBtu	AP42 Table 3.2-3; 07/00	1.27E-05	1.87E-04	1.49E-04
Acetaldehyde	75070	2.79E-03	lb/MMBtu	AP42 Table 3.2-3; 07/00	2.79E-03	4.10E-02	3.28E-02
Acrolein	107028	2.63E-03	lb/MMBtu	AP42 Table 3.2-3; 07/00	2.63E-03	3.87E-02	3.09E-02
Benzene (including benzene from gasoline)	71432	1.58E-03	lb/MMBtu	AP42 Table 3.2-3; 07/00	1.58E-03	2.32E-02	1.86E-02
Carbon Tetrachloride	56235	1.77E-05	lb/MMBtu	AP42 Table 3.2-3; 07/00	1.77E-05	2.60E-04	2.08E-04
Chlorobenzene	108907	1.29E-05	lb/MMBtu	AP42 Table 3.2-3; 07/00	1.29E-05	1.90E-04	1.51E-04
Chloroform	67663	1.37E-05	lb/MMBtu	AP42 Table 3.2-3; 07/00	1.37E-05	2.01E-04	1.61E-04
Ethyl benzene	100414	2.48E-05	lb/MMBtu	AP42 Table 3.2-3; 07/00	2.48E-05	3.64E-04	2.91E-04
Ethylene dibromide (Dibromoethane)	106934	2.13E-05	lb/MMBtu	AP42 Table 3.2-3; 07/00	2.13E-05	3.13E-04	2.50E-04
Formaldehyde	50000	2.05E-02	lb/MMBtu	AP42 Table 3.2-3; 07/00	2.05E-02	3.01E-01	2.41E-01
Methanol	67561	3.06E-03	lb/MMBtu	AP42 Table 3.2-3; 07/00	3.06E-03	4.50E-02	3.59E-02
Methylene chloride (Dichloromethane)	75092	4.12E-05	lb/MMBtu	AP42 Table 3.2-3; 07/00	4.12E-05	6.05E-04	4.84E-04
Naphthalene	91203	9.71E-05	lb/MMBtu	AP42 Table 3.2-3; 07/00	9.71E-05	1.43E-03	1.14E-03
Polycylic Organic Matter/PAH	NA	1.41E-04	lb/MMBtu	AP42 Table 3.2-3; 07/00	1.41E-04	2.07E-03	1.66E-03
Styrene	100425	1.19E-05	lb/MMBtu	AP42 Table 3.2-3; 07/00	1.19E-05	1.75E-04	1.40E-04
Toluene	108883	5.58E-04	lb/MMBtu	AP42 Table 3.2-3; 07/00	5.58E-04	8.20E-03	6.55E-03
Vinyl Chloride	75014	7.18E-06	lb/MMBtu	AP42 Table 3.2-3; 07/00	7.18E-06	1.06E-04	8.43E-05
Xylenes (isomers and mixture)	1330207	1.95E-04	lb/MMBtu	AP42 Table 3.2-3; 07/00	1.95E-04	2.87E-03	2.29E-03

Natural Gas Heater HAP Emissions

Federal 112(b)(1) Listed HAP	CAS #	EF Value	EF Units	EF Source	EF (lb/MMBtu)	Equipment Emissions (lbs/hr) Aux. Utility Glycol Heater (13 MMBtu/hr)	Aux. Utility Glycol Heater (10 MMBtu/hr)	Indirect Fired Gas Heater
Benzene (including benzene from gasoline)	71432	8.00E-03	lb/MMscf	VCAPCD AB 2588[c,d]	7.43E-06	9.66E-05	7.43E-05	1.78E-04
Formaldehyde	50000	1.70E-02	lb/MMscf	VCAPCD AB 2588[c,d]	1.58E-05	2.05E-04	1.58E-04	3.79E-04
Polycylic Organic Matter/PAH	NA	4.00E-03	lb/MMscf	VCAPCD AB 2588[c,d]	3.71E-06	4.83E-05	3.71E-05	8.91E-05
Naphthalene	91203	3.00E-03	lb/MMscf	VCAPCD AB 2588[c,d]	2.79E-06	3.62E-05	2.79E-05	6.69E-05
Acetaldehyde	75070	4.30E-03	lb/MMscf	VCAPCD AB 2588[c,d]	3.99E-06	5.19E-05	3.99E-05	9.58E-05
Acrolein	107028	2.70E-03	lb/MMscf	VCAPCD AB 2588[c,d]	2.51E-06	3.26E-05	2.51E-05	6.02E-05
Propylene Oxide	75569	7.31E-01	lb/MMscf	VCAPCD AB 2588[c,d]	6.79E-04	8.82E-03	6.79E-03	1.63E-02
Toluene	108883	3.66E-02	lb/MMscf	VCAPCD AB 2588[c,d]	3.40E-05	4.42E-04	3.40E-04	8.16E-04
Xylenes (isomers and mixture)	1330207	2.72E-02	lb/MMscf	VCAPCD AB 2588[c,d]	2.53E-05	3.28E-04	2.53E-04	6.06E-04
Ethyl Benzene	100414	9.50E-03	lb/MMscf	VCAPCD AB 2588[c,d]	8.82E-06	1.15E-04	8.82E-05	2.12E-04
Hexane	110543	6.30E-03	lb/MMscf	VCAPCD AB 2588[c,d]	5.85E-06	7.60E-05	5.85E-05	1.40E-04
Arsenic Compounds (inorganic including arsine)	NA	2.00E-04	lb/MMscf	AP-42Table 1.4-4; 7/98	1.86E-07	2.41E-06	1.86E-06	4.46E-06
Beryllium Compounds	NA	0.000012	lb/MMscf	AP-42Table 1.4-4; 7/98	1.11E-08	1.45E-07	1.11E-07	2.67E-07
Cadmium Compounds	NA	1.10E-03	lb/MMscf	AP-42Table 1.4-4; 7/98	1.02E-06	1.33E-05	1.02E-05	2.45E-05
Chromium Compounds	NA	1.40E-03	lb/MMscf	AP-42Table 1.4-4; 7/98	1.30E-06	1.69E-05	1.30E-05	3.12E-05
Cobalt Compounds	NA	8.40E-05	lb/MMscf	AP-42Table 1.4-4; 7/98	7.80E-08	1.01E-06	7.80E-07	1.87E-06
Manganese Compounds	NA	3.80E-04	lb/MMscf	AP-42Table 1.4-4; 7/98	3.53E-07	4.59E-06	3.53E-06	8.47E-06
Mercury Compounds	NA	2.60E-04	lb/MMscf	AP-42Table 1.4-4; 7/98	2.41E-07	3.14E-06	2.41E-06	5.79E-06
Nickel Compounds	NA	2.10E-03	lb/MMscf	AP-42Table 1.4-4; 7/98	1.95E-06	2.53E-05	1.95E-05	4.68E-05
Selenium Compounds	NA	2.40E-05	lb/MMscf	AP-42Table 1.4-4; 7/98	2.23E-08	2.90E-07	2.23E-07	5.35E-07

[c] Natural Gas Fired External Combustion Equipment <10MMBtu (HAP EF for heaters <10MMBtu used for 10 and 13 MMBtu Aux. Utility Glycol Heaters and 24 MMBtu Indirect Heaters , <10MMBtu/hr HAP EFs are larger than HAP EF for >10 MMBtu/hr)

[d] Ventura County Air Pollution Control District AB 2588 Combustion Emission Factors Document - dated May 17, 2001

Waste Incinerator HAP Emissions

Federal 112(b)(1) Listed HAP	CAS #	EF Value	EF Units	EF Source	EF (lb/ton)	Equipment Emissions (lbs/hr) Waste Incinerator
Arsenic Compounds (inorganic including arsine)	NA	5.94E-03	lb/ton	AP-42 Table 2.1-8; 10/96*	5.94E-03	1.71E-03
Cadmium Compounds	NA	8.75E-03	lb/ton	AP-42 Table 2.1-8; 10/96*	8.75E-03	2.52E-03
Chromium Compounds	NA	1.40E-02	lb/ton	AP-42 Table 2.1-8; 10/96*	1.40E-02	4.03E-03
Mercury Compounds	NA	5.50E-03	lb/ton	AP-42 Table 2.1-8; 10/96*	5.50E-03	1.58E-03
Nickel Compounds	NA	4.36E-03	lb/ton	AP-42 Table 2.1-8; 10/96*	4.36E-03	1.25E-03
Lead Compounds	NA	2.01E-01	lb/ton	AP-42 Table 2.1-8; 10/96*	2.01E-01	5.78E-02
Hydrochloric acid	7647010	6.97	lb/ton	AP-42 Table 2.1-8; 10/96*	6.97E+00	2.00E+00

*For an "Uncontrolled" unit

Compressor Seal and Blowdown and Piping Component HAP Emissions

Based on speciation of Pipeline GTP natural gas from Alaska LNG Design Basis Document (USAP-WP-YBDES-00-000002-000)

All Equipment

Federal 112(b)(1) Listed HAP	CAS #	Equipment Emissions (lbs/hr) Gas Turbine Compressor (346 MMBtu/hr)	Gas Turbine Compressor (276 MMBtu/hr)	Gas Turbine Compressor (187 MMBtu/hr)	Power Generator (14.7 MMBtu/hr)	Power Generator (11.7 MMBtu/hr)	Aux. Utility Glycol Heater (13 MMBtu/hr)	Aux. Utility Glycol Heater (10 MMBtu/hr)	Indirect Fired Gas Heater	Waste Incinerator
1,1,2,2-Tetrachloroethane	79345	0.00E+00	0.00E+00	0.00E+00	3.72E-04	2.97E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1,1,2-Trichloroethane	79005	0.00E+00	0.00E+00	0.00E+00	2.25E-04	1.80E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1,3-Butadiene	106990	2.09E-05	1.67E-05	1.13E-05	9.74E-03	7.78E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1,3-Dichloropropene	542756	0.00E+00	0.00E+00	0.00E+00	1.87E-04	1.49E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acetaldehyde	75070	4.42E-02	3.54E-02	2.39E-02	4.10E-02	3.28E-02	5.19E-05	3.99E-05	9.58E-05	0.00E+00
Acrolein	107028	1.77E-03	1.41E-03	9.54E-04	3.87E-02	3.09E-02	3.26E-05	2.51E-05	6.02E-05	0.00E+00
Arsenic Compounds (inorganic including arsine)	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.41E-06	1.86E-06	4.46E-06	1.71E-03
Benzene (including benzene from gasoline)	71432	9.85E-04	7.87E-04	5.32E-04	2.32E-02	1.86E-02	9.66E-05	7.43E-05	1.78E-04	0.00E+00
Beryllium Compounds	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.45E-07	1.11E-07	2.67E-07	0.00E+00
Cadmium Compounds	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.33E-05	1.02E-05	2.45E-05	2.52E-03
Carbon Tetrachloride	56235	0.00E+00	0.00E+00	0.00E+00	2.60E-04	2.08E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chlorobenzene	108907	0.00E+00	0.00E+00	0.00E+00	1.90E-04	1.51E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chloroform	67663	0.00E+00	0.00E+00	0.00E+00	2.01E-04	1.61E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chromium Compounds	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.69E-05	1.30E-05	3.12E-05	4.03E-03
Cobalt Compounds	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.01E-06	7.80E-07	1.87E-06	0.00E+00
Ethyl benzene	100414	1.61E-03	1.29E-03	8.71E-04	3.64E-04	2.91E-04	1.15E-04	8.82E-05	2.12E-04	0.00E+00
Ethylene dibromide (Dibromoethane)	106934	0.00E+00	0.00E+00	0.00E+00	3.13E-04	2.50E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Formaldehyde	50000	8.33E-01	6.66E-01	4.50E-01	3.01E-01	2.41E-01	2.05E-04	1.58E-04	3.79E-04	0.00E+00
Hexane	110543	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.60E-05	5.85E-05	1.40E-04	0.00E+00
Hydrochloric acid	7647010	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.00E+00
Lead Compounds	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.78E-02
Manganese Compounds	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.59E-06	3.53E-06	8.47E-06	0.00E+00
Mercury Compounds	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.14E-06	2.41E-06	5.79E-06	1.58E-03
Methanol	67561	0.00E+00	0.00E+00	0.00E+00	4.50E-02	3.59E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Methylene chloride (Dichloromethane)	75092	0.00E+00	0.00E+00	0.00E+00	6.05E-04	4.84E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Naphthalene	91203	2.46E-04	1.97E-04	1.33E-04	1.43E-03	1.14E-03	3.62E-05	2.79E-05	6.69E-05	0.00E+00
Nickel Compounds	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.53E-05	1.95E-05	4.68E-05	1.25E-03
Polycylic Organic Matter/PAH	NA	4.98E-05	3.98E-05	2.69E-05	2.07E-03	1.66E-03	4.83E-05	3.71E-05	8.91E-05	0.00E+00
Propylene Oxide	75569	9.88E-03	7.90E-03	5.34E-03	0.00E+00	0.00E+00	8.82E-03	6.79E-03	1.63E-02	0.00E+00
Selenium Compounds	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.90E-07	2.23E-07	5.35E-07	0.00E+00
Styrene	100425	0.00E+00	0.00E+00	0.00E+00	1.75E-04	1.40E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Toluene	108883	7.15E-03	5.72E-03	3.86E-03	8.20E-03	6.55E-03	4.42E-04	3.40E-04	8.16E-04	0.00E+00
Vinyl Chloride	75014	0.00E+00	0.00E+00	0.00E+00	1.06E-04	8.43E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xylenes (isomers and mixture)	1330207	3.49E-03	2.79E-03	1.88E-03	2.87E-03	2.29E-03	3.28E-04	2.53E-04	6.06E-04	0.00E+00
Total		**9.02E-01**	**7.21E-01**	**4.87E-01**	**4.76E-01**	**3.81E-01**	**1.03E-02**	**7.94E-03**	**1.91E-02**	**2.07E+00**

Table 8: Total HAP Emissions Summary

Facility Type	HAPs (tons/year)	Major Source?
Single Unit with Cooling	8.34	FALSE
Multi Unit with Cooling	10.73	FALSE
Single Unit wo Cooling	6.63	FALSE
Metering Station	0.01	FALSE
Heater Station	4.17	FALSE

Single Unit with Cooling	**Operating Hours/Year**	**lb HAP/hr**	**Total HAPs (tons/year)**
Gas Turbine Compressor (346 MMBtu/hr)	8760	9.02E-01	3.95
Power Generator (14.7 MMBtu/hr)	17520	4.76E-01	4.17
Aux. Utility Glycol Heater (10 MMBtu/hr)	17520	7.94E-03	0.07
Waste Incinerator	52	2.07E+00	0.05
Compressor Seals and Blowdown	8760	2.13E-02	0.09
Piping Components	8760	4.03E-04	0.00
		Total	**8.34**

Multi Unit with Cooling	**Operating Hours/Year**	**lb HAP/hr**	**Total HAPs (tons/year)**
Gas Turbine Compressor (187 MMBtu/hr)	17520	4.87E-01	4.27
Power Generator (14.7 MMBtu/hr)	26280	4.76E-01	6.26
Aux. Utility Glycol Heater (13 MMBtu/hr)	17520	1.03E-02	0.09
Waste Incinerator	52	2.07E+00	0.05
Compressor Seals and Blowdown	8760	1.27E-02	0.06
Piping Components	8760	2.32E-04	0.00
		Total	**10.73**

Single Unit wo Cooling	**Operating Hours/Year**	**lb HAP/hr**	**Total HAPs (tons/year)**
Gas Turbine Compressor (276 MMBtu/hr)	8760	7.21E-01	3.16
Power Generator (11.7 MMBtu/hr)	17520	3.81E-01	3.33
Aux. Utility Glycol Heater (10 MMBtu/hr)	17520	7.94E-03	0.07
Waste Incinerator	52	2.07E+00	0.05
Compressor Seals and Blowdown	8760	3.93E-03	0.02
Piping Components	8760	7.13E-05	0.00
		Total	**6.63**

Metering Station	**Operating Hours/Year**	**lb HAP/hr**	**Total HAPs (tons/year)**
Compressor Seals and Blowdown	8760	2.02E-03	0.01
Piping Components	8760	5.09E-05	0.00
		Total	**0.01**

Heater Station	**Operating Hours/Year**	**lb HAP/hr**	**Total HAPs (tons/year)**
Power Generator (11.7 MMBtu/hr)	17520	3.81E-01	3.33
Indirect Fired Gas Heater	78840	1.91E-02	0.75
Waste Incinerator	52	2.07E+00	0.05
Compressor Seals and Blowdown	8760	6.13E-03	0.03
Piping Components	8760	1.32E-04	0.00
		Total	**4.17**

Table 9: Speciated HAP Emissions Summary

Single Unit with Cooling

Federal 112(b)(1) Listed HAP	Gas Turbine Compressor (346 MMBtu/hr)	Power Generator (14.7 MMBtu/hr)	Aux. Utility Glycol Heater (10 MMBtu/hr)	Waste Incinerator	Compressor Seals and Blowdown	Piping Components	Total (tons)
1,1,2,2-Tetrachloroethane	0.00E+00	6.51E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.26E-03
1,1,2-Trichloroethane	0.00E+00	3.94E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.97E-03
1,3-Butadiene	1.83E-01	1.71E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.54E-02
1,3-Dichloropropene	0.00E+00	3.27E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.64E-03
Acetaldehyde	3.87E+02	7.18E+02	6.99E-01	0.00E+00	0.00E+00	0.00E+00	5.53E-01
Acrolein	1.55E+01	6.77E+02	4.39E-01	0.00E+00	0.00E+00	0.00E+00	3.47E-01
Arsenic Compounds (inorganic including arsine)	0.00E+00	0.00E+00	3.25E-02	8.88E-02	0.00E+00	0.00E+00	6.07E-05
Benzene (including benzene from gasoline)	8.63E+00	4.07E+02	1.30E+00	0.00E+00	6.98E-03	1.38E-04	2.08E-01
Beryllium Compounds	0.00E+00	0.00E+00	1.95E-03	0.00E+00	0.00E+00	0.00E+00	9.76E-07
Cadmium Compounds	0.00E+00	0.00E+00	1.79E-01	1.31E-01	0.00E+00	0.00E+00	1.55E-04
Carbon Tetrachloride	0.00E+00	4.56E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.28E-03
Chlorobenzene	0.00E+00	3.32E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.66E-03
Chloroform	0.00E+00	3.53E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.76E-03
Chromium Compounds	0.00E+00	0.00E+00	2.28E-01	2.09E-01	0.00E+00	0.00E+00	2.19E-04
Cobalt Compounds	0.00E+00	0.00E+00	1.37E-02	0.00E+00	0.00E+00	0.00E+00	6.83E-06
Ethyl benzene	1.41E+01	6.39E+00	1.55E+00	0.00E+00	0.00E+00	0.00E+00	1.10E-02
Ethylene dibromide (Dibromoethane)	0.00E+00	5.48E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.74E-03
Formaldehyde	7.29E+03	5.28E+03	2.77E+00	0.00E+00	0.00E+00	0.00E+00	6.29E+00
Hexane	0.00E+00	0.00E+00	1.02E+00	0.00E+00	3.08E-02	6.09E-04	5.28E-04
Hydrochloric acid	0.00E+00	0.00E+00	0.00E+00	1.04E+02	0.00E+00	0.00E+00	5.21E-02
Lead Compounds	0.00E+00	0.00E+00	0.00E+00	3.00E+00	0.00E+00	0.00E+00	1.50E-03
Manganese Compounds	0.00E+00	0.00E+00	6.18E-02	0.00E+00	0.00E+00	0.00E+00	3.09E-05
Mercury Compounds	0.00E+00	0.00E+00	4.23E-02	8.22E-02	0.00E+00	0.00E+00	6.23E-05
Methanol	0.00E+00	7.88E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.94E-01
Methylene chloride (Dichloromethane)	0.00E+00	1.06E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.30E-03
Naphthalene	2.15E+00	2.50E+01	4.88E-01	0.00E+00	0.00E+00	0.00E+00	1.38E-02
Nickel Compounds	0.00E+00	0.00E+00	3.42E-01	6.52E-02	0.00E+00	0.00E+00	2.03E-04
Polycylic Organic Matter/PAH	4.36E-01	3.63E+01	6.51E-01	0.00E+00	0.00E+00	0.00E+00	1.87E-02
Propylene Oxide	8.66E+01	0.00E+00	1.19E+02	0.00E+00	0.00E+00	0.00E+00	1.03E-01
Selenium Compounds	0.00E+00	0.00E+00	3.90E-03	0.00E+00	0.00E+00	0.00E+00	1.95E-06
Styrene	0.00E+00	3.06E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.53E-03
Toluene	6.27E+01	1.44E+02	5.95E+00	0.00E+00	0.00E+00	0.00E+00	1.06E-01
Vinyl Chloride	0.00E+00	1.85E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.24E-04
Xylenes (isomers and mixture)	3.06E+01	5.02E+01	4.42E+00	0.00E+00	0.00E+00	0.00E+00	4.26E-02
						Total (tons)	**8.25**

Table 9: Speciated HAP Emissions Summary

Multi Unit with Cooling

Federal 112(b)(1) Listed HAP	Gas Turbine Compressor (187 MMBtu/hr)	Power Generator (14.7 MMBtu/hr)	Aux. Utility Glycol Heater (13 MMBtu/hr)	Waste Incinerator	Compressor Seals and Blowdown	Piping Components	Total (tons)
1,1,2,2-Tetrachloroethane	0.00E+00	9.77E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.89E-03
1,1,2-Trichloroethane	0.00E+00	5.91E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.95E-03
1,3-Butadiene	1.98E-01	2.56E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.28E-01
1,3-Dichloropropene	0.00E+00	4.91E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.45E-03
Acetaldehyde	4.18E+02	1.08E+03	9.09E-01	0.00E+00	0.00E+00	0.00E+00	7.48E-01
Acrolein	1.67E+01	1.02E+03	5.71E-01	0.00E+00	0.00E+00	0.00E+00	5.17E-01
Arsenic Compounds (inorganic including arsine)	0.00E+00	0.00E+00	4.23E-02	8.88E-02	0.00E+00	0.00E+00	6.55E-05
Benzene (including benzene from gasoline)	9.32E+00	6.10E+02	1.69E+00	0.00E+00	1.03E-02	1.88E-04	3.11E-01
Beryllium Compounds	0.00E+00	0.00E+00	2.54E-03	0.00E+00	0.00E+00	0.00E+00	1.27E-06
Cadmium Compounds	0.00E+00	0.00E+00	2.33E-01	1.31E-01	0.00E+00	0.00E+00	1.82E-04
Carbon Tetrachloride	0.00E+00	6.84E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.42E-03
Chlorobenzene	0.00E+00	4.98E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.49E-03
Chloroform	0.00E+00	5.29E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.65E-03
Chromium Compounds	0.00E+00	0.00E+00	2.96E-01	2.09E-01	0.00E+00	0.00E+00	2.53E-04
Cobalt Compounds	0.00E+00	0.00E+00	1.78E-02	0.00E+00	0.00E+00	0.00E+00	8.88E-06
Ethyl benzene	1.53E+01	9.58E+00	2.01E+00	0.00E+00	0.00E+00	0.00E+00	1.34E-02
Ethylene dibromide (Dibromoethane)	0.00E+00	8.23E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.11E-03
Formaldehyde	7.88E+03	7.92E+03	3.60E+00	0.00E+00	0.00E+00	0.00E+00	7.90E+00
Hexane	0.00E+00	0.00E+00	1.33E+00	0.00E+00	4.54E-02	8.29E-04	6.89E-04
Hydrochloric acid	0.00E+00	0.00E+00	0.00E+00	1.04E+02	0.00E+00	0.00E+00	5.21E-02
Lead Compounds	0.00E+00	0.00E+00	0.00E+00	3.00E+00	0.00E+00	0.00E+00	1.50E-03
Manganese Compounds	0.00E+00	0.00E+00	8.04E-02	0.00E+00	0.00E+00	0.00E+00	4.02E-05
Mercury Compounds	0.00E+00	0.00E+00	5.50E-02	8.22E-02	0.00E+00	0.00E+00	6.86E-05
Methanol	0.00E+00	1.18E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-01
Methylene chloride (Dichloromethane)	0.00E+00	1.59E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.96E-03
Naphthalene	2.33E+00	3.75E+01	6.34E-01	0.00E+00	0.00E+00	0.00E+00	2.02E-02
Nickel Compounds	0.00E+00	0.00E+00	4.44E-01	6.52E-02	0.00E+00	0.00E+00	2.55E-04
Polycylic Organic Matter/PAH	4.71E-01	5.45E+01	8.46E-01	0.00E+00	0.00E+00	0.00E+00	2.79E-02
Propylene Oxide	9.35E+01	0.00E+00	1.55E+02	0.00E+00	0.00E+00	0.00E+00	1.24E-01
Selenium Compounds	0.00E+00	0.00E+00	5.08E-03	0.00E+00	0.00E+00	0.00E+00	2.54E-06
Styrene	0.00E+00	4.60E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.30E-03
Toluene	6.77E+01	2.16E+02	7.74E+00	0.00E+00	0.00E+00	0.00E+00	1.45E-01
Vinyl Chloride	0.00E+00	2.77E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.39E-03
Xylenes (isomers and mixture)	3.30E+01	7.53E+01	5.75E+00	0.00E+00	0.00E+00	0.00E+00	5.70E-02
						Total	**10.67**

Table 9: Speciated HAP Emissions Summary

Single Unit wo Cooling

Federal 112(b)(1) Listed HAP	Gas Turbine Compressor (276 MMBtu/hr)	Power Generator (11.7 MMBtu/hr)	Aux. Utility Glycol Heater (10 MMBtu/hr)	Waste Incinerator	Compressor Seals and Blowdown	Piping Components	Total (tons)
1,1,2,2-Tetrachloroethane	0.00E+00	5.20E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.60E-03
1,1,2-Trichloroethane	0.00E+00	3.15E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.57E-03
1,3-Butadiene	1.46E-01	1.36E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.83E-02
1,3-Dichloropropene	0.00E+00	2.61E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.31E-03
Acetaldehyde	3.10E+02	5.74E+02	6.99E-01	0.00E+00	0.00E+00	0.00E+00	4.42E-01
Acrolein	1.24E+01	5.41E+02	4.39E-01	0.00E+00	0.00E+00	0.00E+00	2.77E-01
Arsenic Compounds (inorganic including arsine)	0.00E+00	0.00E+00	3.25E-02	8.88E-02	0.00E+00	0.00E+00	6.07E-05
Benzene (including benzene from gasoline)	6.90E+00	3.25E+02	1.30E+00	0.00E+00	3.18E-03	5.77E-05	1.67E-01
Beryllium Compounds	0.00E+00	0.00E+00	1.95E-03	0.00E+00	0.00E+00	0.00E+00	9.76E-07
Cadmium Compounds	0.00E+00	0.00E+00	1.79E-01	1.31E-01	0.00E+00	0.00E+00	1.55E-04
Carbon Tetrachloride	0.00E+00	3.64E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.82E-03
Chlorobenzene	0.00E+00	2.65E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.33E-03
Chloroform	0.00E+00	2.82E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.41E-03
Chromium Compounds	0.00E+00	0.00E+00	2.28E-01	2.09E-01	0.00E+00	0.00E+00	2.19E-04
Cobalt Compounds	0.00E+00	0.00E+00	1.37E-02	0.00E+00	0.00E+00	0.00E+00	6.83E-06
Ethyl benzene	1.13E+01	5.10E+00	1.55E+00	0.00E+00	0.00E+00	0.00E+00	8.97E-03
Ethylene dibromide (Dibromoethane)	0.00E+00	4.38E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.19E-03
Formaldehyde	5.83E+03	4.22E+03	2.77E+00	0.00E+00	0.00E+00	0.00E+00	5.03E+00
Hexane	0.00E+00	0.00E+00	1.02E+00	0.00E+00	1.40E-02	2.54E-04	5.20E-04
Hydrochloric acid	0.00E+00	0.00E+00	0.00E+00	1.04E+02	0.00E+00	0.00E+00	5.21E-02
Lead Compounds	0.00E+00	0.00E+00	0.00E+00	3.00E+00	0.00E+00	0.00E+00	1.50E-03
Manganese Compounds	0.00E+00	0.00E+00	6.18E-02	0.00E+00	0.00E+00	0.00E+00	3.09E-05
Mercury Compounds	0.00E+00	0.00E+00	4.23E-02	8.22E-02	0.00E+00	0.00E+00	6.23E-05
Methanol	0.00E+00	6.29E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.15E-01
Methylene chloride (Dichloromethane)	0.00E+00	8.48E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.24E-03
Naphthalene	1.72E+00	2.00E+01	4.88E-01	0.00E+00	0.00E+00	0.00E+00	1.11E-02
Nickel Compounds	0.00E+00	0.00E+00	3.42E-01	6.52E-02	0.00E+00	0.00E+00	2.03E-04
Polycylic Organic Matter/PAH	3.48E-01	2.90E+01	6.51E-01	0.00E+00	0.00E+00	0.00E+00	1.50E-02
Propylene Oxide	6.92E+01	0.00E+00	1.19E+02	0.00E+00	0.00E+00	0.00E+00	9.41E-02
Selenium Compounds	0.00E+00	0.00E+00	3.90E-03	0.00E+00	0.00E+00	0.00E+00	1.95E-06
Styrene	0.00E+00	2.45E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.22E-03
Toluene	5.01E+01	1.15E+02	5.95E+00	0.00E+00	0.00E+00	0.00E+00	8.54E-02
Vinyl Chloride	0.00E+00	1.48E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.39E-04
Xylenes (isomers and mixture)	2.44E+01	4.01E+01	4.42E+00	0.00E+00	0.00E+00	0.00E+00	3.45E-02
						Total (tons)	**6.62**

Metering Station

Federal 112(b)(1) Listed HAP	Compressor Seals and Blowdown	Piping Components	Total (tons)
Benzene (including benzene from gasoline)	1.64E-03	4.12E-05	8.39E-07
Ethyl benzene	0.00E+00	0.00E+00	0.00E+00
Hexane	7.23E-03	1.82E-04	3.70E-06
Toluene	0.00E+00	0.00E+00	0.00E+00
Xylenes (isomers and mixture)	0.00E+00	0.00E+00	0.00E+00
		Total (tons)	**0.00**

Table 9: Speciated HAP Emissions Summary

Heater Station

Federal 112(b)(1) Listed HAP	Power Generator (11.7 MMBtu/hr)	Indirect Fired Gas Heater	Waste Incinerator	Compressor Seals and Blowdown	Piping Components	Total (tons)
1,1,2,2-Tetrachloroethane	5.20E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.60E-03
1,1,2-Trichloroethane	3.15E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.57E-03
1,3-Butadiene	1.36E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.82E-02
1,3-Dichloropropene	2.61E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.31E-03
Acetaldehyde	5.74E+02	7.55E+00	0.00E+00	0.00E+00	0.00E+00	2.91E-01
Acrolein	5.41E+02	4.74E+00	0.00E+00	0.00E+00	0.00E+00	2.73E-01
Arsenic Compounds (inorganic including arsine)	0.00E+00	3.51E-01	8.88E-02	0.00E+00	0.00E+00	2.20E-04
Benzene (including benzene from gasoline)	3.25E+02	1.41E+01	0.00E+00	4.96E-03	1.07E-04	1.70E-01
Beryllium Compounds	0.00E+00	2.11E-02	0.00E+00	0.00E+00	0.00E+00	1.05E-05
Cadmium Compounds	0.00E+00	1.93E+00	1.31E-01	0.00E+00	0.00E+00	1.03E-03
Carbon Tetrachloride	3.64E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.82E-03
Chlorobenzene	2.65E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.33E-03
Chloroform	2.82E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.41E-03
Chromium Compounds	0.00E+00	2.46E+00	2.09E-01	0.00E+00	0.00E+00	1.33E-03
Cobalt Compounds	0.00E+00	1.48E-01	0.00E+00	0.00E+00	0.00E+00	7.38E-05
Ethyl benzene	5.10E+00	1.67E+01	0.00E+00	0.00E+00	0.00E+00	1.09E-02
Ethylene dibromide (Dibromoethane)	4.38E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.19E-03
Formaldehyde	4.22E+03	2.99E+01	0.00E+00	0.00E+00	0.00E+00	2.12E+00
Hexane	0.00E+00	1.11E+01	0.00E+00	2.19E-02	4.71E-04	5.55E-03
Hydrochloric acid	0.00E+00	0.00E+00	1.04E+02	0.00E+00	0.00E+00	5.21E-02
Lead Compounds	0.00E+00	0.00E+00	3.00E+00	0.00E+00	0.00E+00	1.50E-03
Manganese Compounds	0.00E+00	6.68E-01	0.00E+00	0.00E+00	0.00E+00	3.34E-04
Mercury Compounds	0.00E+00	4.57E-01	8.22E-02	0.00E+00	0.00E+00	2.70E-04
Methanol	6.29E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.15E-01
Methylene chloride (Dichloromethane)	8.48E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.24E-03
Naphthalene	2.00E+01	5.27E+00	0.00E+00	0.00E+00	0.00E+00	1.26E-02
Nickel Compounds	0.00E+00	3.69E+00	6.52E-02	0.00E+00	0.00E+00	1.88E-03
Polycylic Organic Matter/PAH	2.90E+01	7.03E+00	0.00E+00	0.00E+00	0.00E+00	1.80E-02
Propylene Oxide	0.00E+00	1.28E+03	0.00E+00	0.00E+00	0.00E+00	6.42E-01
Selenium Compounds	0.00E+00	4.22E-02	0.00E+00	0.00E+00	0.00E+00	2.11E-05
Styrene	2.45E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.22E-03
Toluene	1.15E+02	6.43E+01	0.00E+00	0.00E+00	0.00E+00	8.95E-02
Vinyl Chloride	1.48E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.39E-04
Xylenes (isomers and mixture)	4.01E+01	4.78E+01	0.00E+00	0.00E+00	0.00E+00	4.40E-02
					Total (tons)	**4.14**

Table 10: AAQS Modeling Stack Parameters

	Height (m)	Source	Temp (C)	Temp (F)	Temp (K)	Source	Stack Flow (ACFM)	Source	Stack Flow (m^3/min)	Velocity (m/s)	Source	ID (m)	Shape	Source	NO2:NOx	Source
MULTI UNIT With Cooling																
- Gas Turbine Compressor (160 MMBtu/hr)	12.45	**1**		900	755.37	**2**	247262	**8**		21.37	**6**	2.64	Square	**1**	0.3	**5**
- Power Generator (14.7 MMBtu/hr)	5.49	**1**		1179	910.37	**7**	7736	**8**		59.55	**6**	0.28	Circular	**1**	0.1	**3**
- Aux. Utility Glycol Heater (13 MMBtu/hr)	9.14	**1**		347	448.15	**1**	3369	**8**		7.84	**6**	0.51	Circular	**1**	0.1	**3**
- Waste Incinerator	5.13	**1**	592		864.82	**4**				5.72	**4**	0.28	Circular	**1**	0.1	**3**
SINGLE UNIT With Cooling																
- Gas Turbine Compressor (325 MMBtu/hr)	21.03	**1**		879.93	744.22	**9**	425074	**9**		53.53	**6**	2.18	Circular	**1**	0.3	**3**
- Power Generator (14.7 MMBtu/hr)	5.49	**1**		1179	910.37	**7**	7736	**8**		59.55	**6**	0.28	Circular	**1**	0.1	**3**
- Aux. Utility Glycol Heater (10 MMBtu/hr)	9.14	**1**		347	448.15	**1**	2591	**8**		7.45	**6**	0.46	Circular	**1**	0.1	**3**
- Waste Incinerator	5.13	**1**	592		864.82	**4**				5.72	**4**	0.28	Circular	**1**	0.1	**3**
SINGLE UNIT WO Cooling																
- Gas Turbine Compressor (279 MMBtu/hr)	21.03	**1**		966.43	792.28	**9**	345122	**9**		43.46	**6**	2.18	Circular	**1**	0.3	**3**
- Power Generator (11.7 MMBtu/hr)	5.49	**1**		1136	886.48	**7**	6018	**8**		46.33	**6**	0.28	Circular	**1**	0.1	**3**
- Aux. Utility Glycol Heater (10 MMBtu/hr)	9.14	**1**		347	448.15	**1**	2591	**8**		7.45	**6**	0.46	Circular	**1**	0.1	**3**
- Waste Incinerator	5.13	**1**	592		864.82	**4**				5.72	**4**	0.28	Circular	**1**	0.1	**3**
HEATER STATION																
- Power Generator (11.7 MMBtu/hr)	5.49	**1**		1136	886.48	**7**	6018	**8**		46.33	**6**	0.28	Circular	**1**	0.1	**3**
- Indirect Fired Gas Heater	11.28	**1**		800	699.82	**1**	9711	**8**		4.09	**6**	1.19	Circular	**1**	0.1	**3**
- Waste Incinerator	5.13	**1**	592		864.82	**4**				5.72	**4**	0.28	Circular	**1**	0.1	**3**
METERING STATION																
None																

* There are 2 stacks for each 3 MMBtu/hr Aux. Utility Glycol Heater.

Sources

[1] Worley Parsons Spreadsheet - USAP-WP-MRZZZ-00-000001-000; Rev 3, dated 8/23/16.
[2] Vendor Predicted Emission Performance
[3] In-stack NO2-to-NOx ratio of 0.1 was assumed for the generators, heaters, and waste incinerators and a value of 0.3 for turbines, based on the source-specific in-stack NO2-to-NOX data provided in *NO2-to-NOX ratios per Source Tests Approved by the Alaska Department of Environmental Conservation*, updated August 23, 2013.
[4] Performance Source Test Data
[5] Provided by vendor
[6] Velocity calculated according to acfm and stack diameter
[7] Vendor Technical Data Sheet
[8] Calculated based on heat input rating, EPA Method 19 F-Factor, and stack temperature
[9] Vendor expected performance and emissions sheet

Table 11: Pipeline GTP Natural Gas Outlet Speciation Data

Component	GTP Outlet					
	(mol%)	MW	MWi	(lb/lb)	VOC	CO2e
N_2	0.765	28.01	0.21	1.21E-02	FALSE	
CO_2	0.005	44.01	0.00	1.24E-04	FALSE	1
H_2S	0.0003	34.08	0.00	5.78E-06	FALSE	
C_1	91.097	16.04	14.61	8.27E-01	FALSE	25
C_2	5.764	30.07	1.73	9.81E-02	FALSE	
C_3	1.974	44.1	0.87	4.93E-02	TRUE	
nC_4	0.134	58.12	0.08	4.41E-03	TRUE	
iC_4	0.175	58.12	0.10	5.75E-03	TRUE	
nC_5	0.037	72.15	0.03	1.51E-03	TRUE	
iC_5	0.035	72.15	0.03	1.43E-03	TRUE	
2-Methylpentane	0.001	86.18	0.00	4.88E-05	TRUE	
n-Hexane	0.004	86.18	0.00	1.95E-04	TRUE	
Methylcyclopentane	0.001	84.16	0.00	4.76E-05	TRUE	
Benzene	0.001	78.11	0.00	4.42E-05	TRUE	
Cyclohexane	0.001	84.16	0.00	4.76E-05	TRUE	
n-Heptane	0.003	100.21	0.00	1.70E-04	TRUE	
Methylcyclohexane	0.001	98.186	0.00	5.55E-05	TRUE	
Toluene	0		0.00	0.00E+00	TRUE	
n-Octane	0.001	114.23	0.00	6.46E-05	TRUE	
E-Benzene	0		0.00	0.00E+00	TRUE	
p-Xylene	0		0.00	0.00E+00	TRUE	
o-Xylene	0		0.00	0.00E+00	TRUE	
n-Nonane	0		0.00	0.00E+00	TRUE	
n-Decane	0		0.00	0.00E+00	TRUE	
Total	**100**		**17.68**	**1**		
lb VOC/lb Natural Gas	**0.063**					
lb CO2e/lb Natural Gas	**20.67**					
HHV (BTU/ft^3)	1090.2					
Molecular weight	17.68					

***Speciation data from Alaska LNG Design Basis Document (USAP-WP-YBDES-00-000002-000)**

Appendix G: Modeling Results Diagrams

FIGURE G-1
Sagwon Compressor Station Modeling Results
Maximum 1-Hr Average NO_2 Concentrations (μg/m³)
(Coordinates are UTM NAD83, in meters)

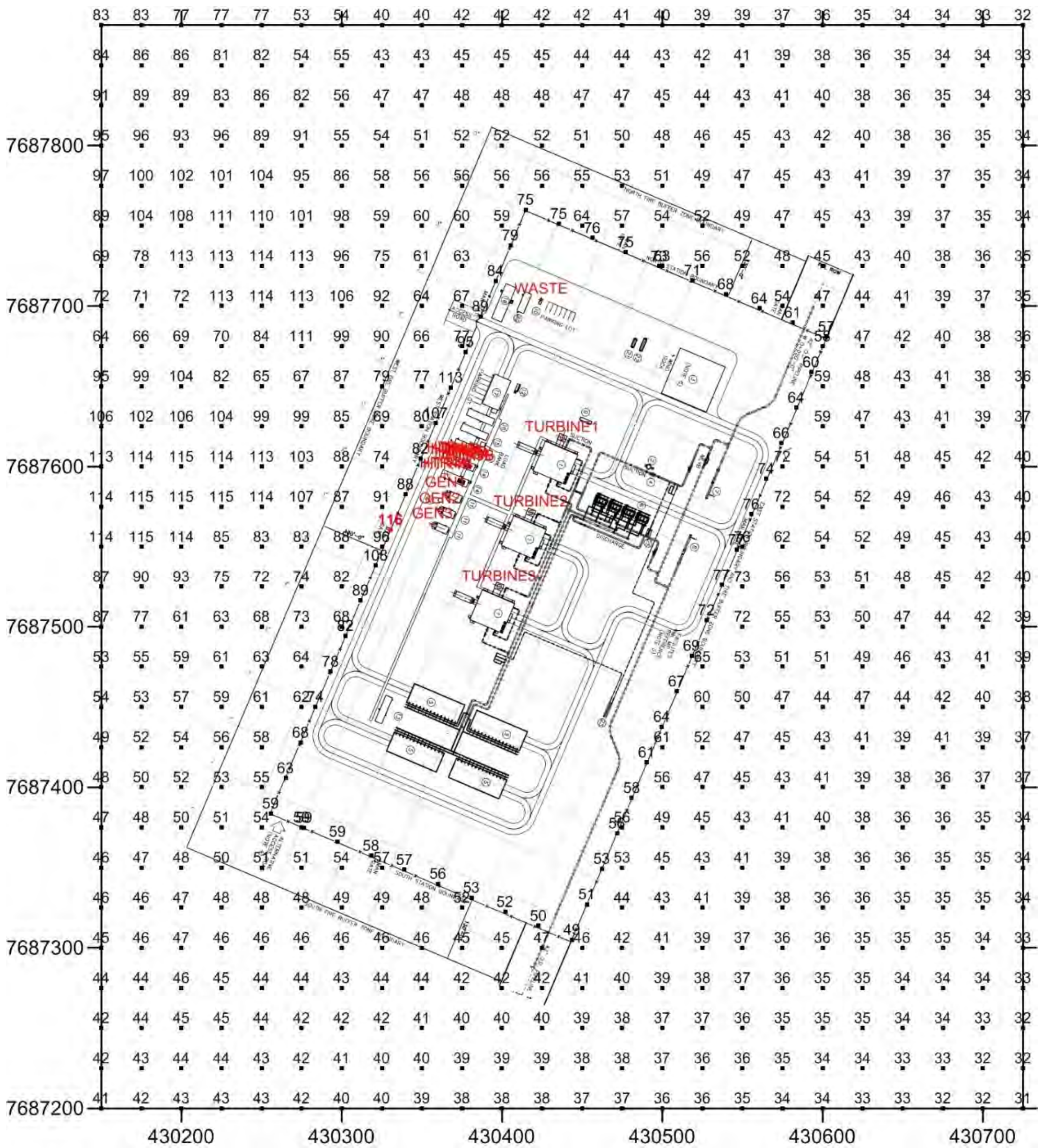


FIGURE G-2
Sagwon Compressor Station Modeling Results
Annual Average NO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

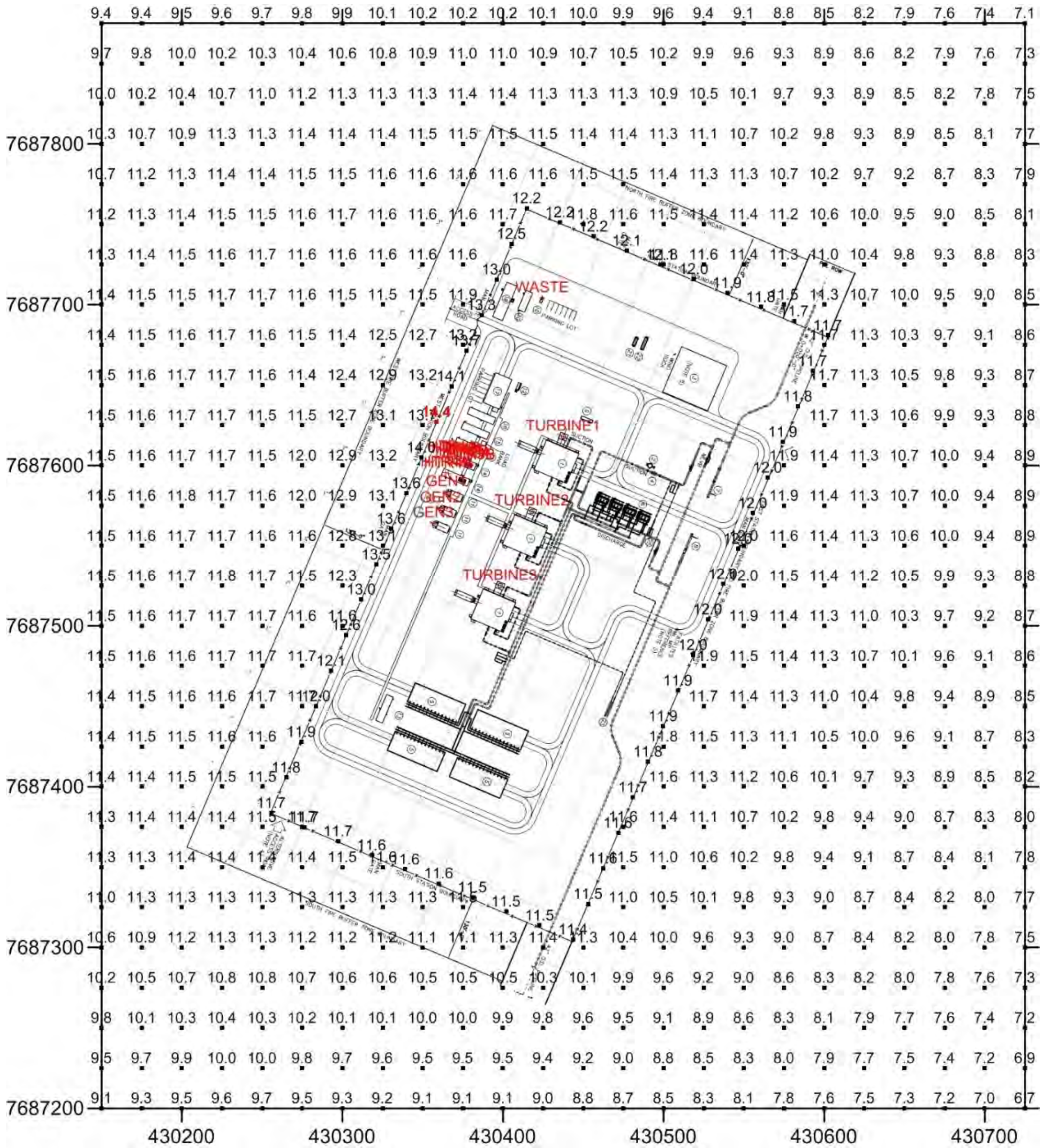


FIGURE G-3
Sagwon Compressor Station Modeling Results
Maximum 24-Hr Average $PM_{10}/PM_{2.5}$ Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

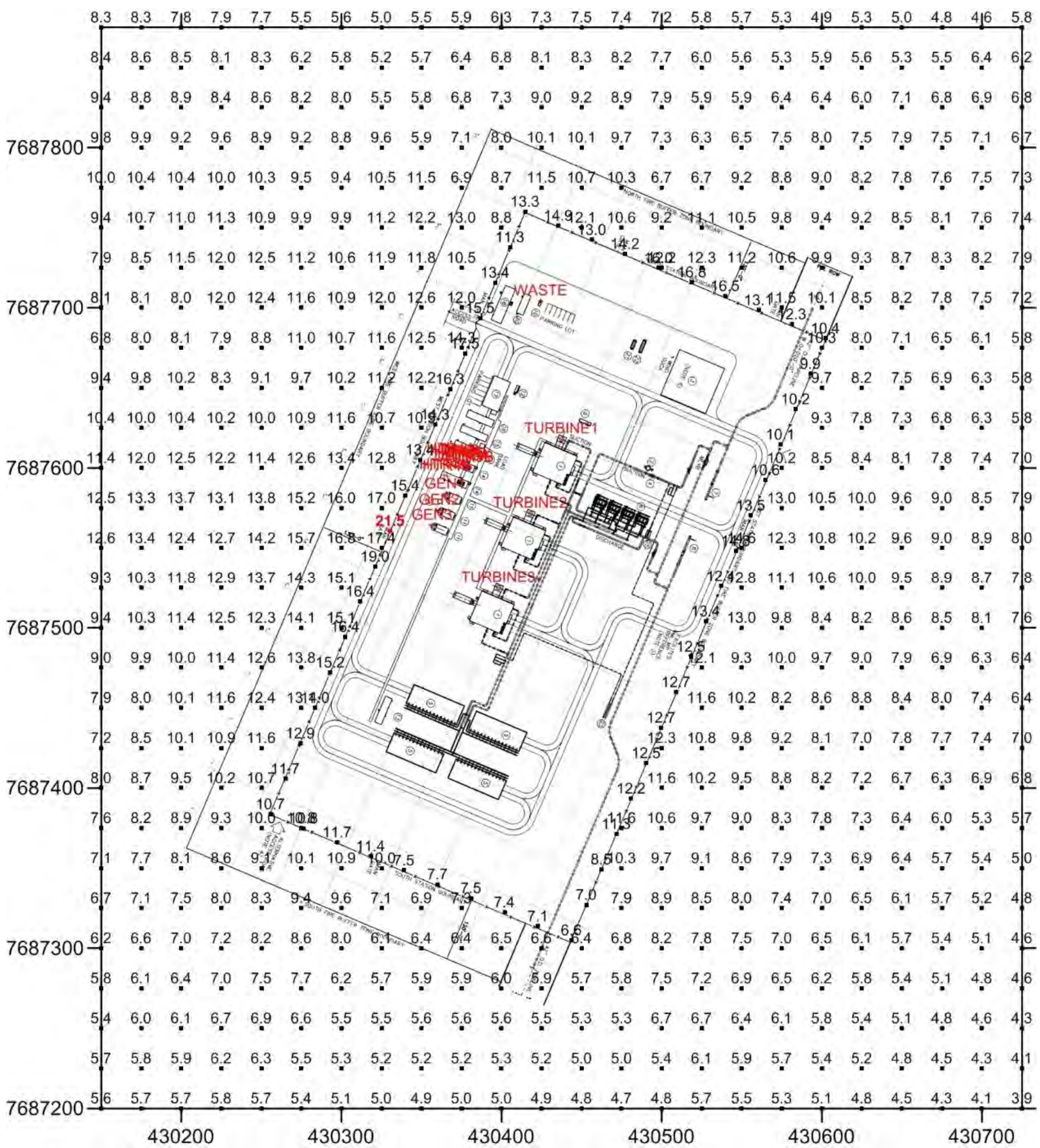


FIGURE G-4
Sagwon Compressor Station Modeling Results
Annual Average $PM_{10}/PM_{2.5}$ Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

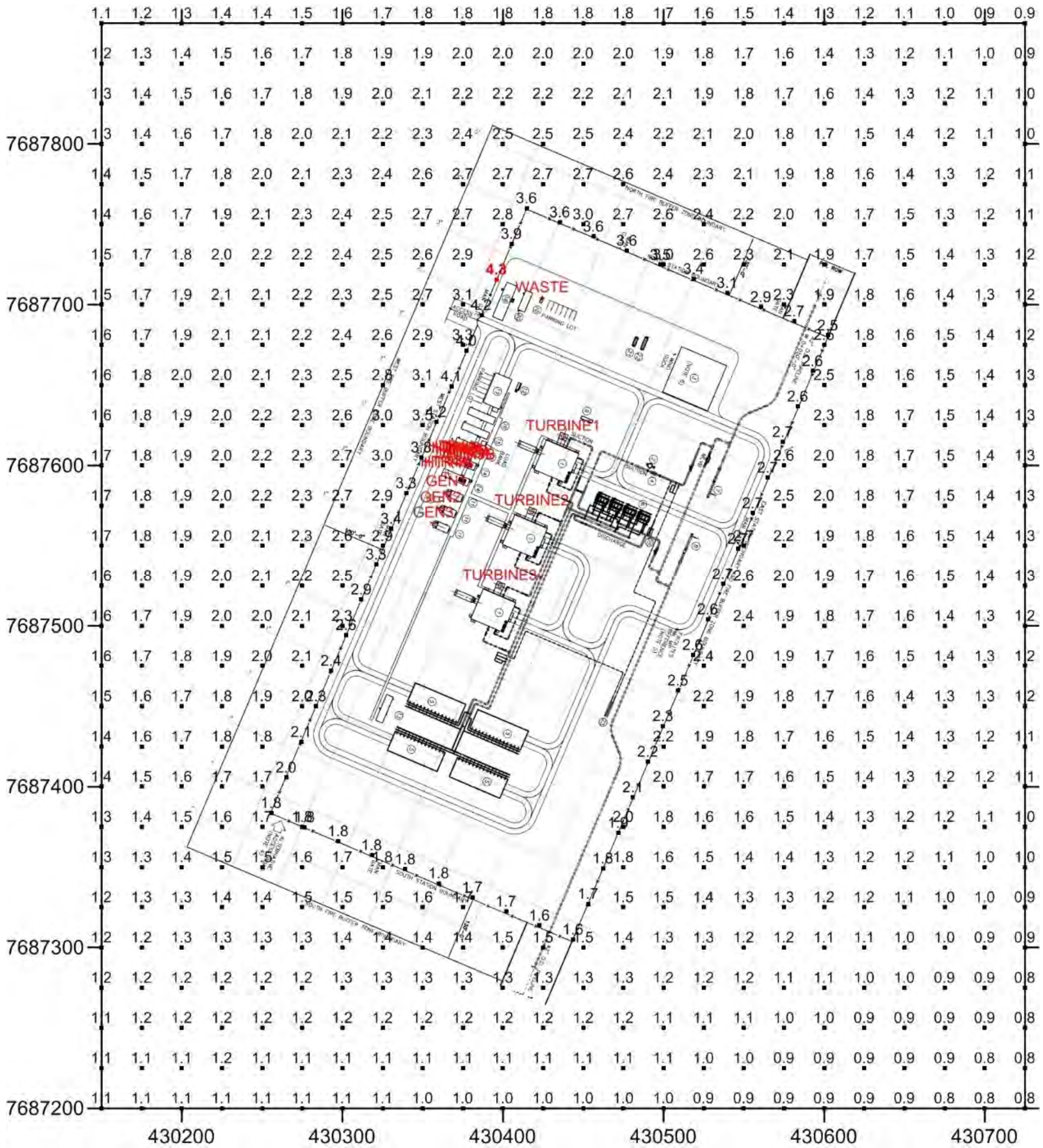


FIGURE G-5
Sagwon Compressor Station Modeling Results
Maximum 1-Hr Average SO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

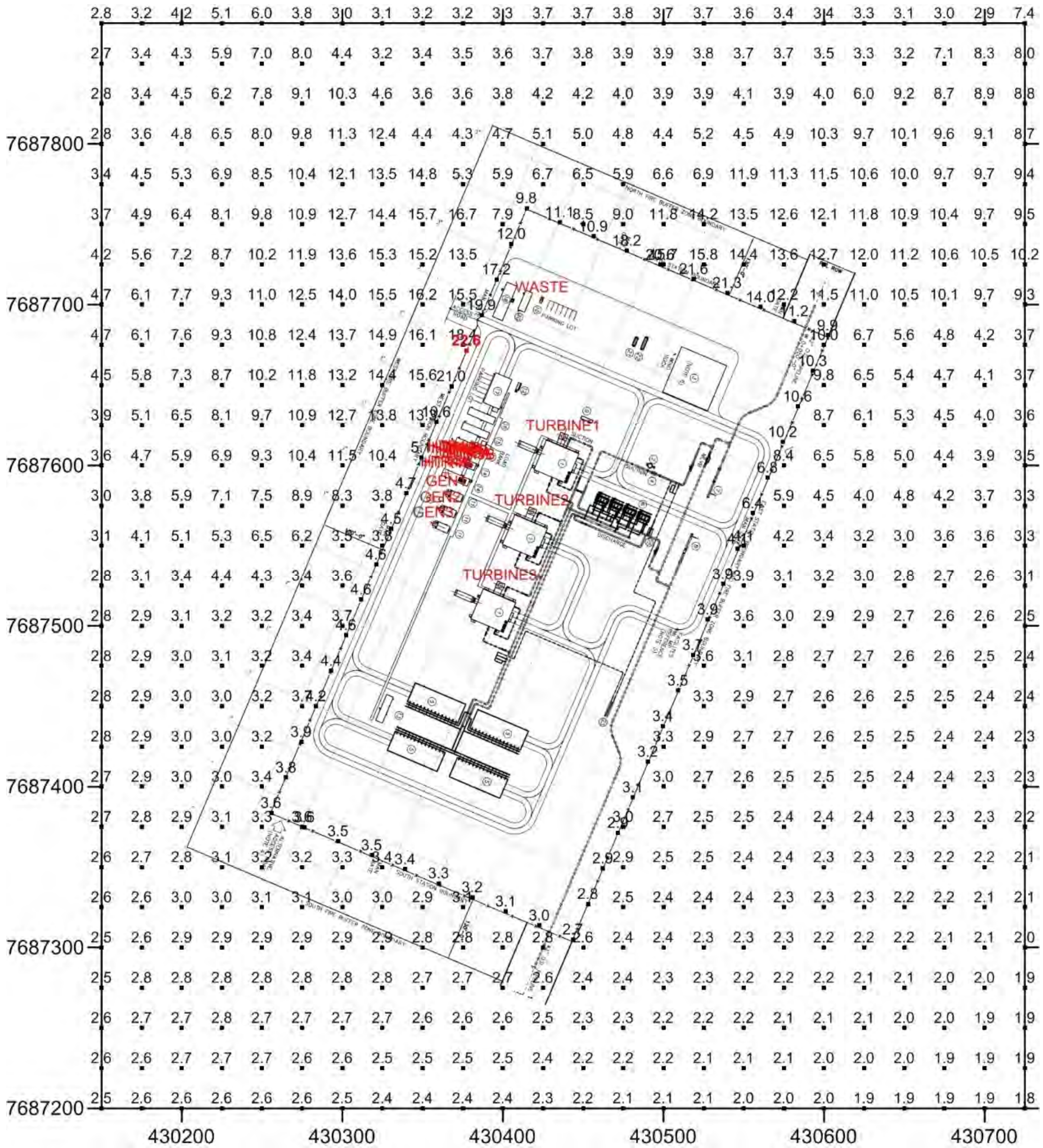


FIGURE G-6
Sagwon Compressor Station Modeling Results
Annual Average SO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

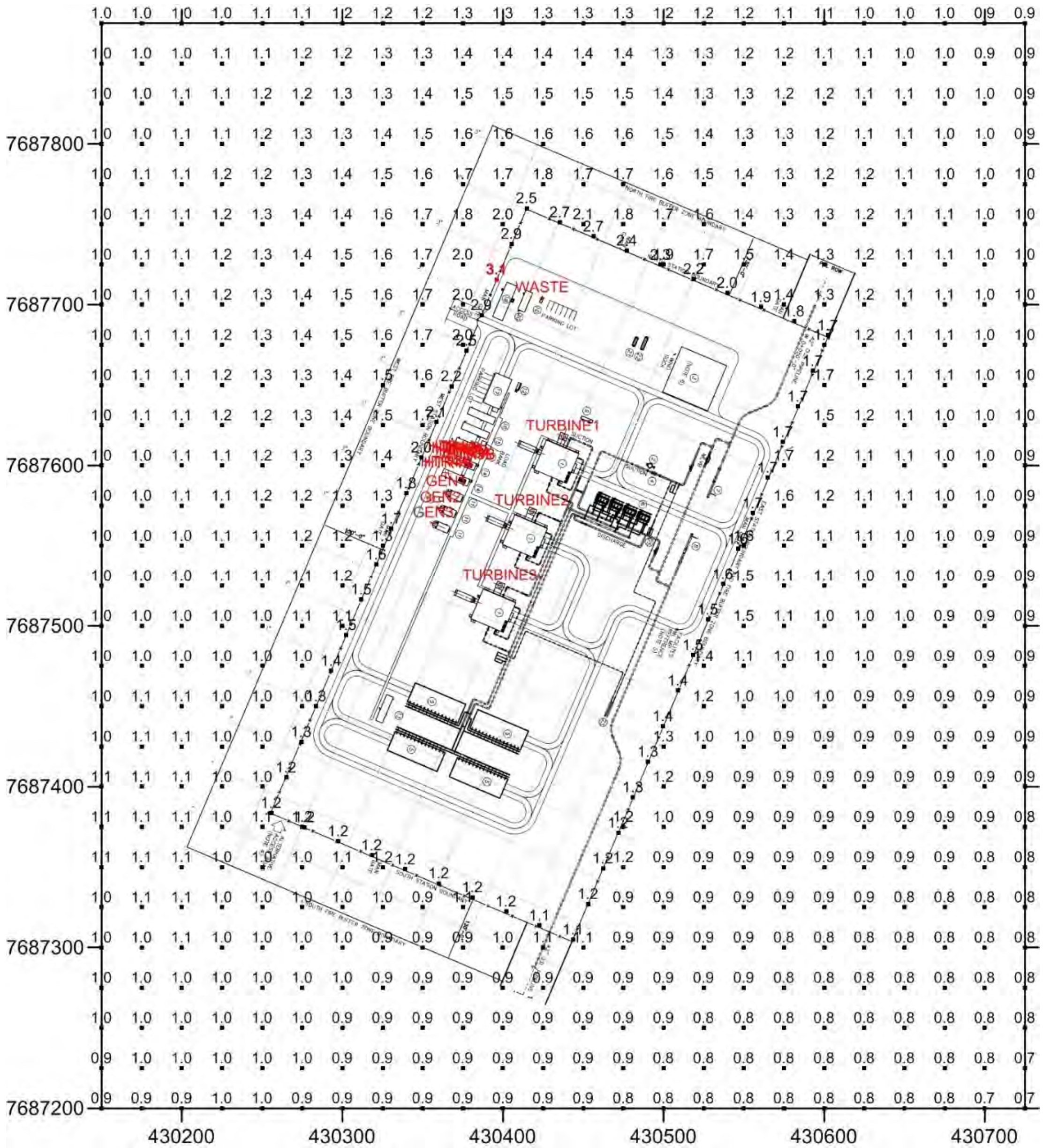


FIGURE G-7
Sagwon Compressor Station Modeling Results
Maximum 1-Hr Average CO Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

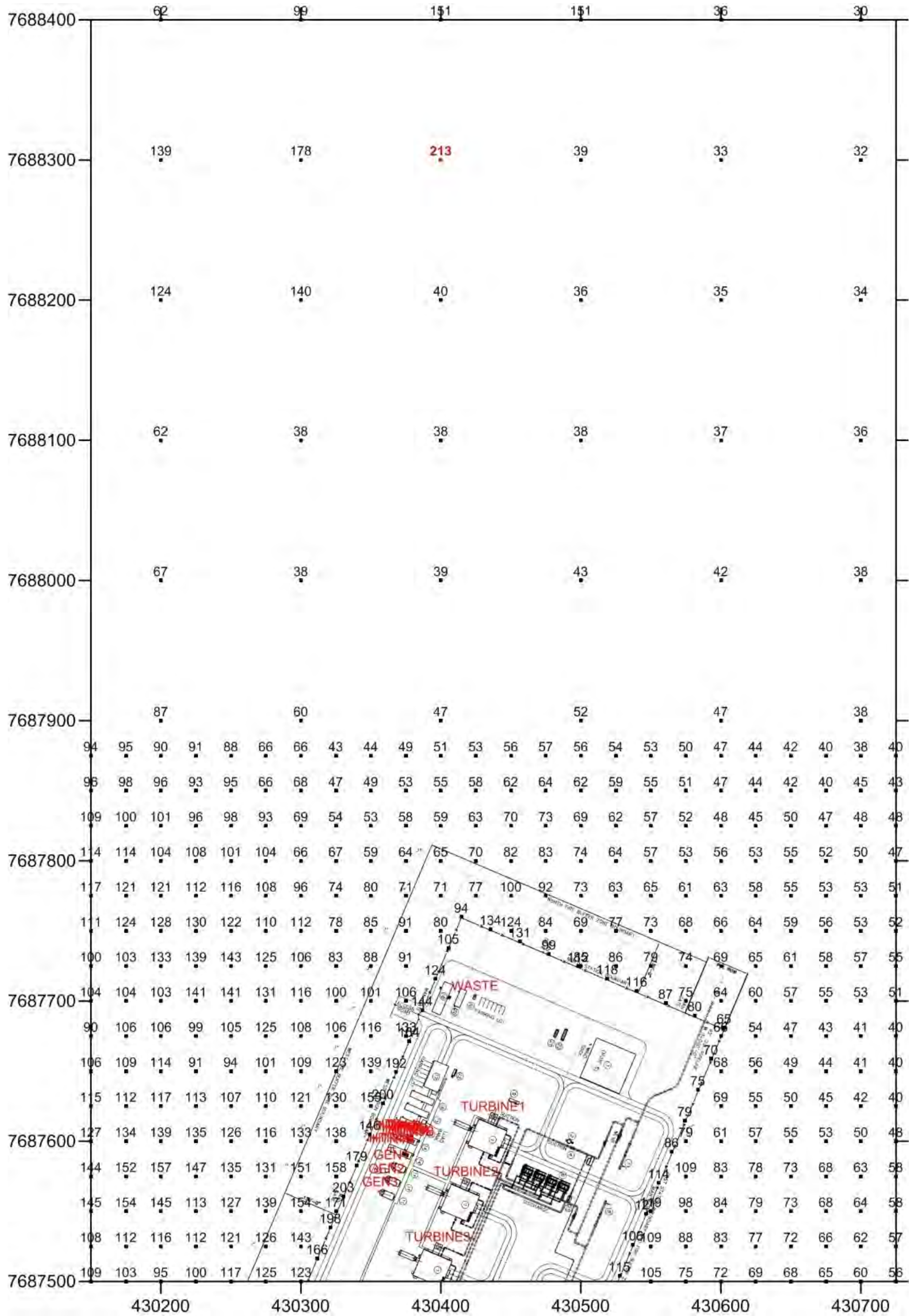


FIGURE G-8
Sagwon Compressor Station Operating Scenario 2 Modeling Results
Maximum 1-Hr Average NO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

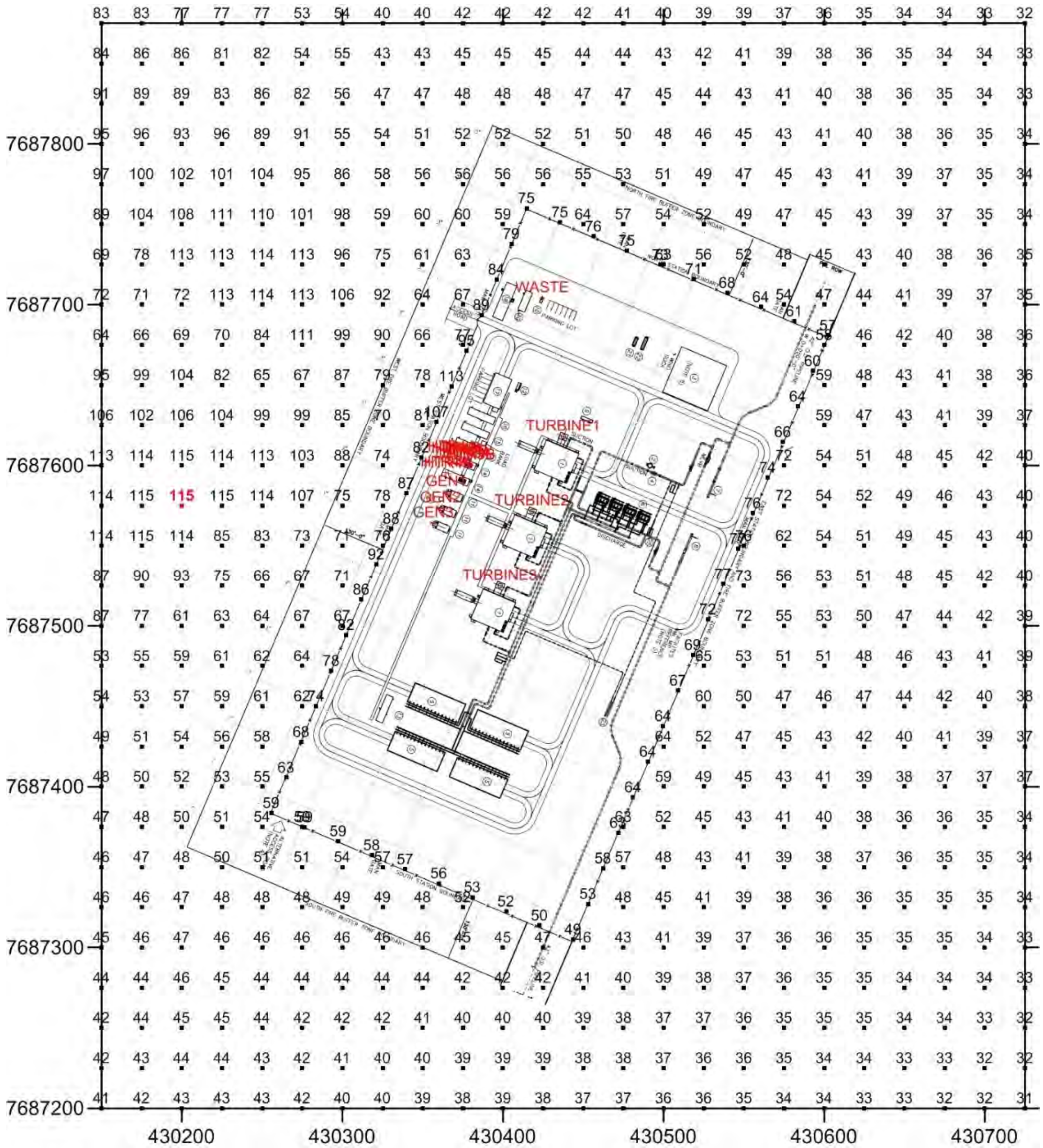


FIGURE G-9
Sagwon Compressor Station Operating Scenario 2 Modeling Results
Annual Average NO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

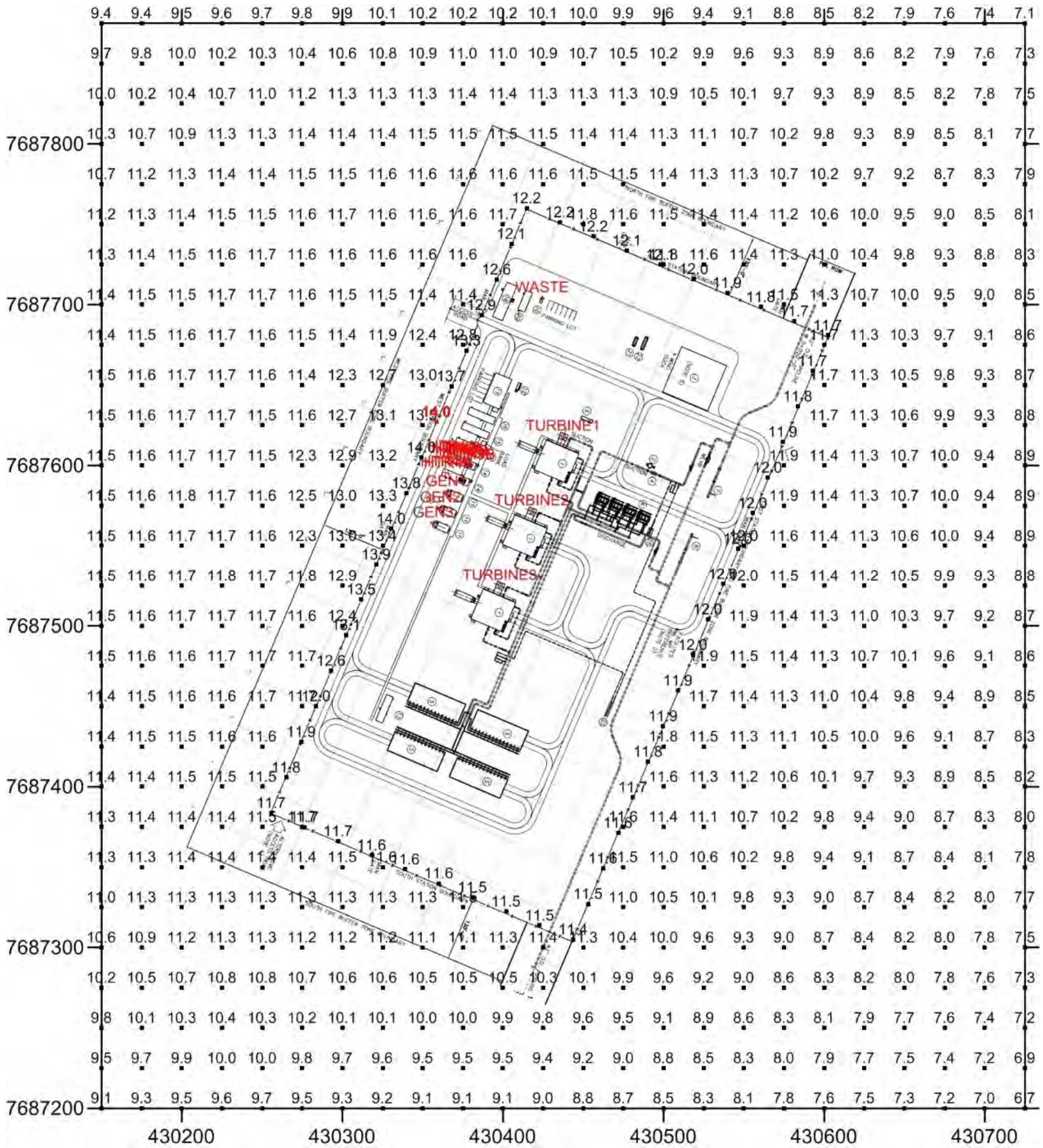


FIGURE G-10
Sagwon Compressor Station Operating Scenario 2 Modeling Results
Maximum 24-Hr Average $PM_{10}/PM_{2.5}$ Concentrations (μg/m^3)
(Coordinates are UTM NAD83, in meters)

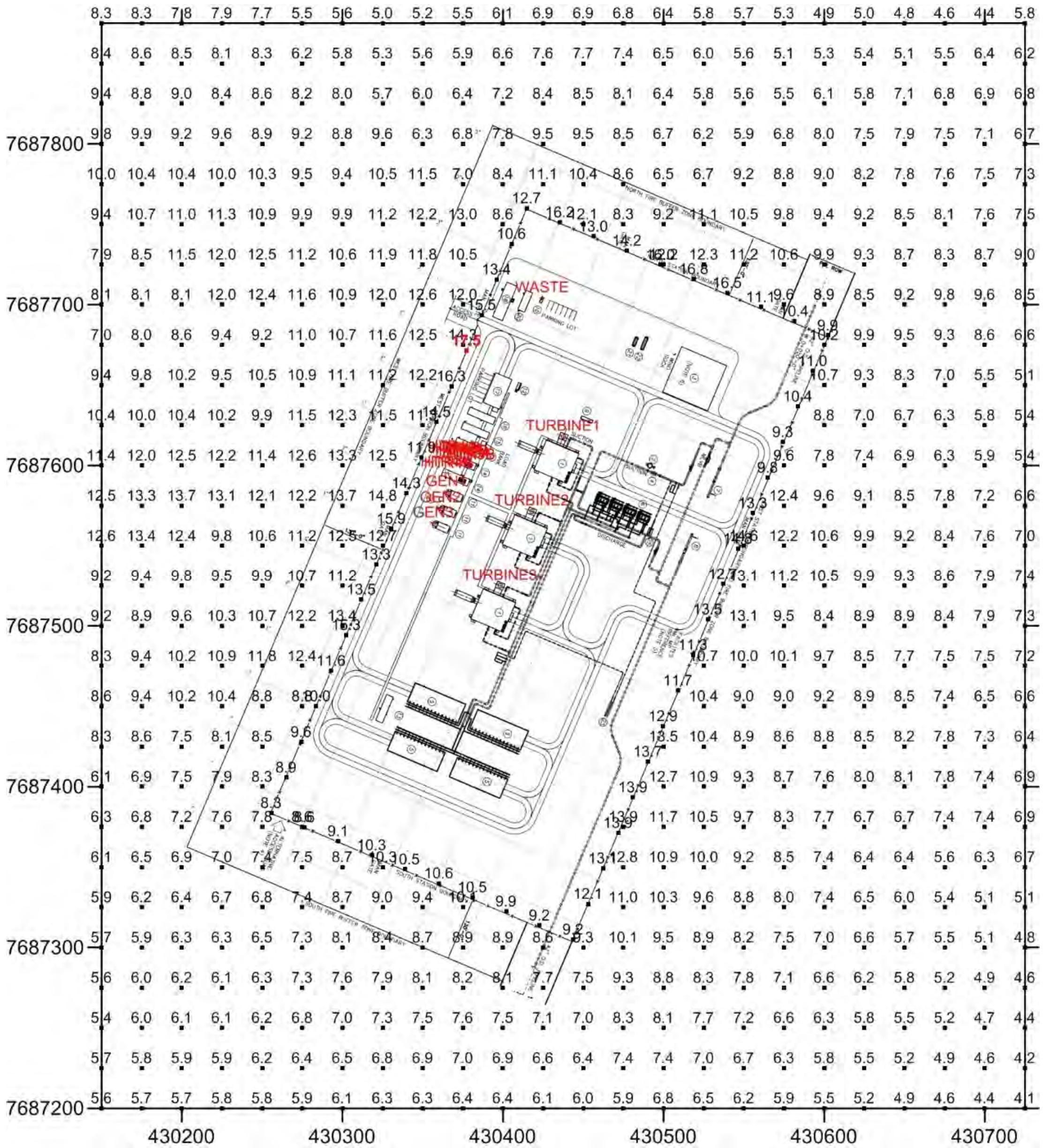


FIGURE G-11
Sagwon Compressor Station Operating Scenario 2 Modeling Results
Annual Average $PM_{10}/PM_{2.5}$ Concentrations (μg/m³)
(Coordinates are UTM NAD83, in meters)

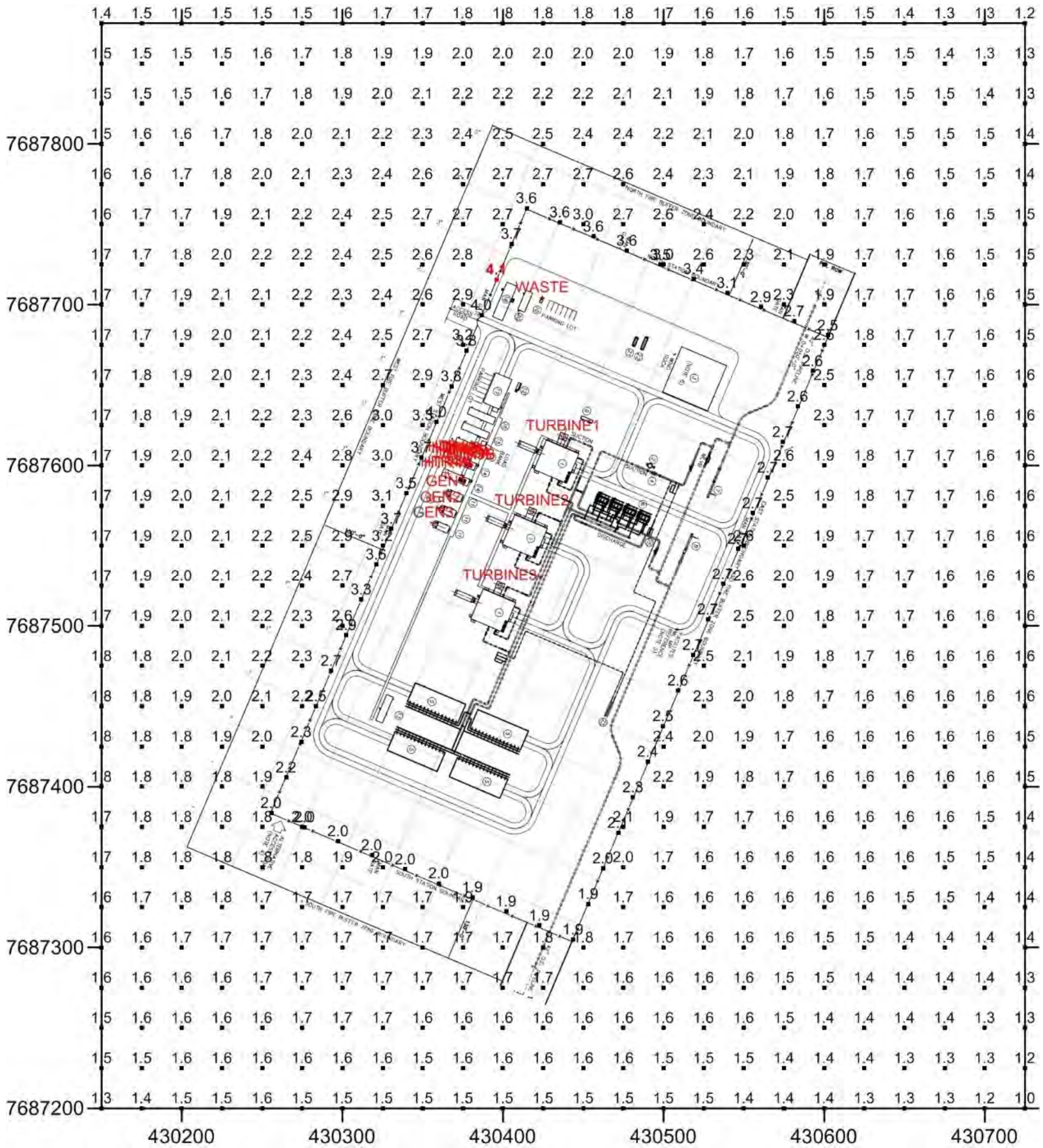


FIGURE G-12
Sagwon Compressor Station Operating Scenario 2 Modeling Results
Maximum 1-Hr Average SO_2 Concentrations (μg/m³)
(Coordinates are UTM NAD83, in meters)

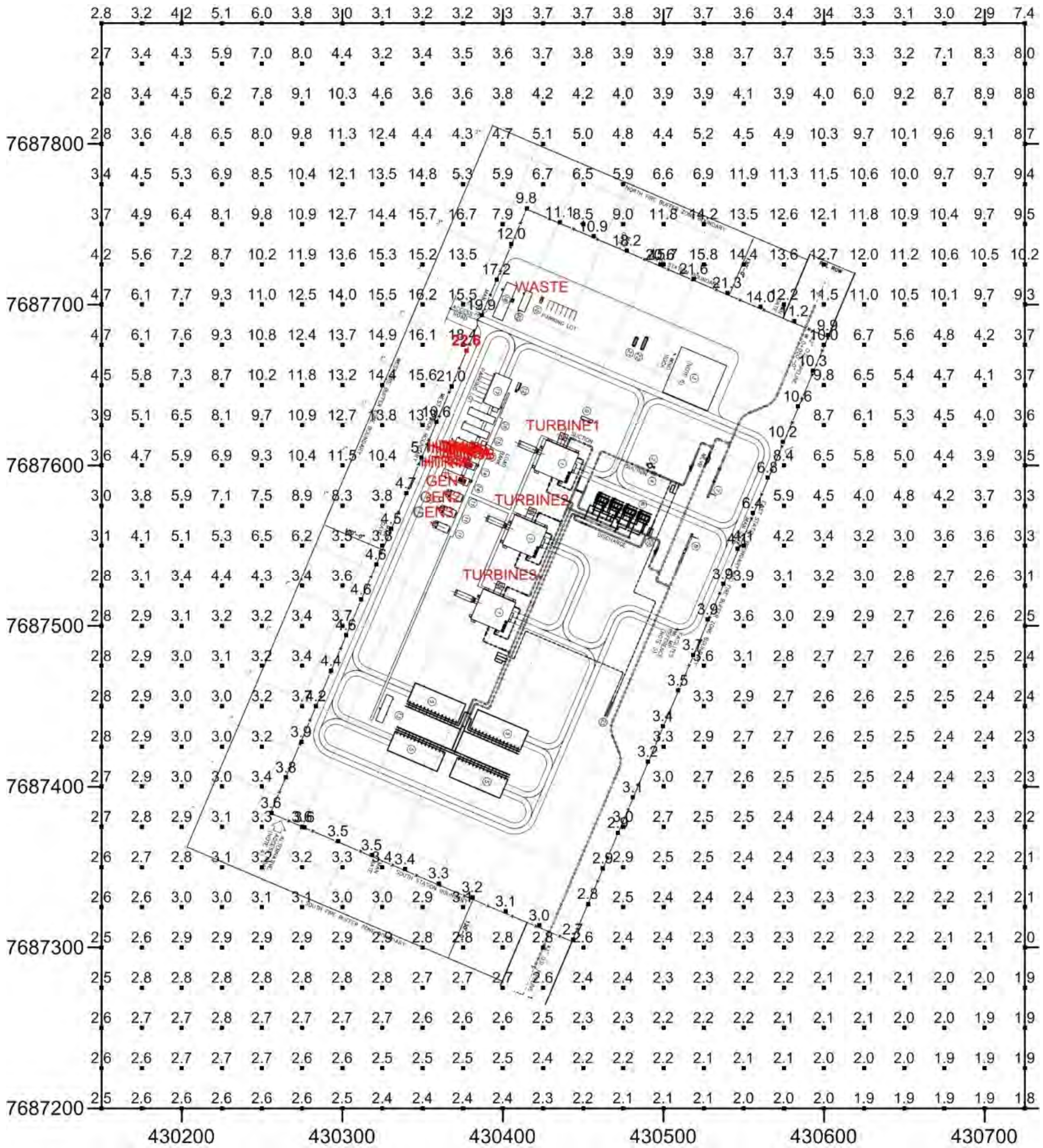


FIGURE G-13
Sagwon Compressor Station Operating Scenario 2 Modeling Results
Annual Average SO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

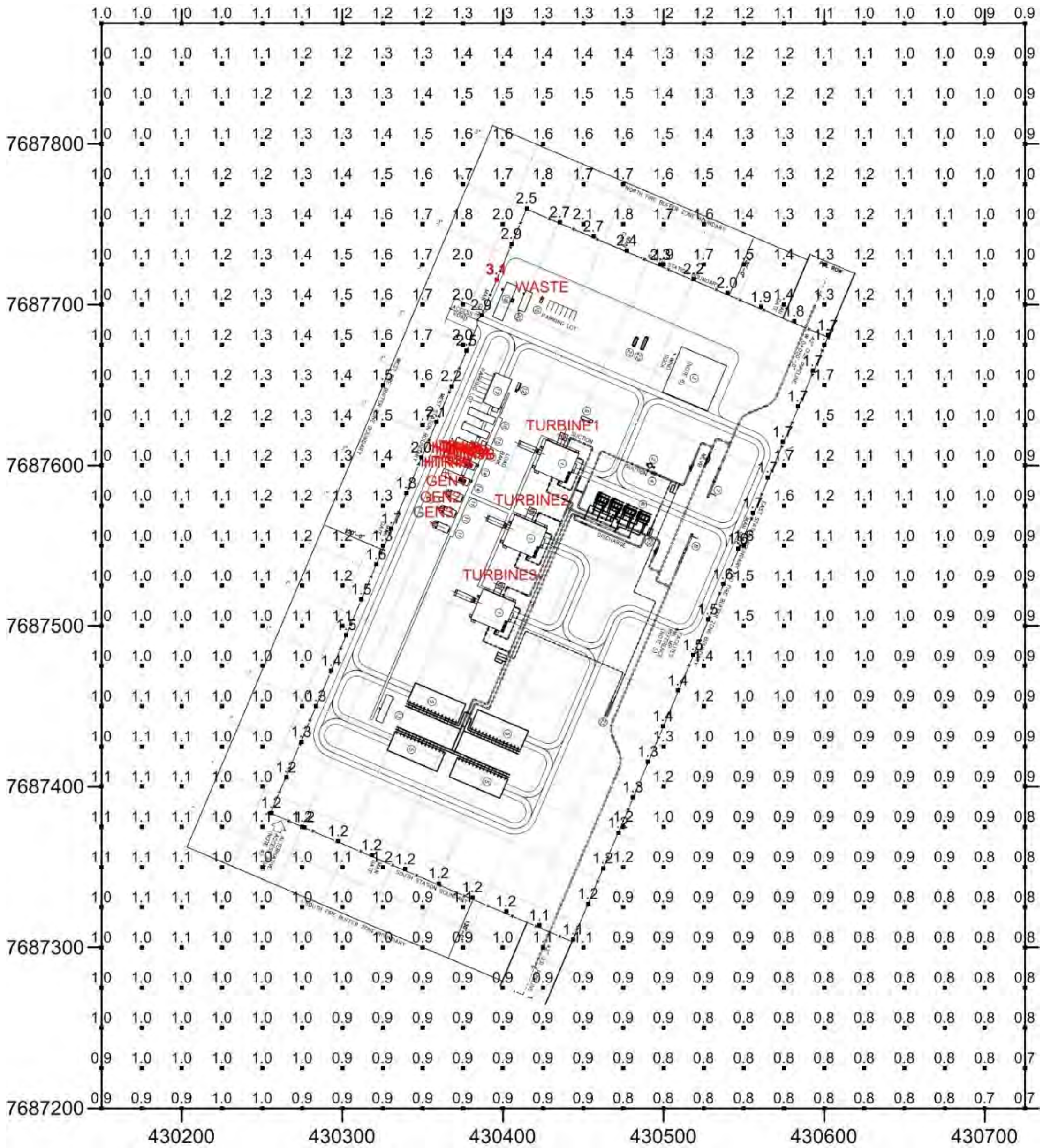


FIGURE G-14
Sagwon Compressor Station Operating Scenario 2 Modeling Results
Maximum 1-Hr Average CO Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

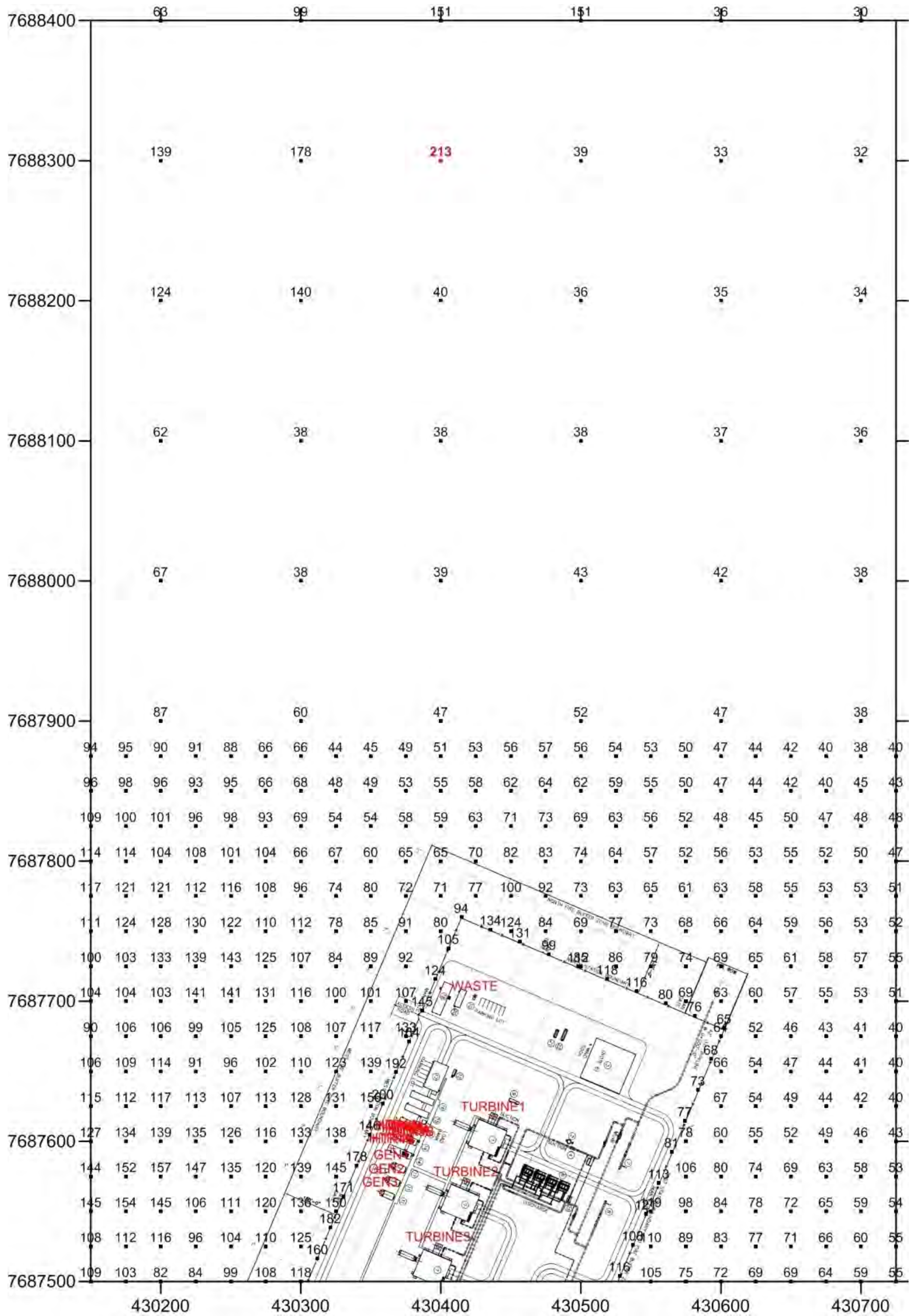


FIGURE G-15
Sagwon Compressor Station Operating Scenario 3 Modeling Results
Maximum 1-Hr Average NO_2 Concentrations (μg/m[3])
(Coordinates are UTM NAD83, in meters)

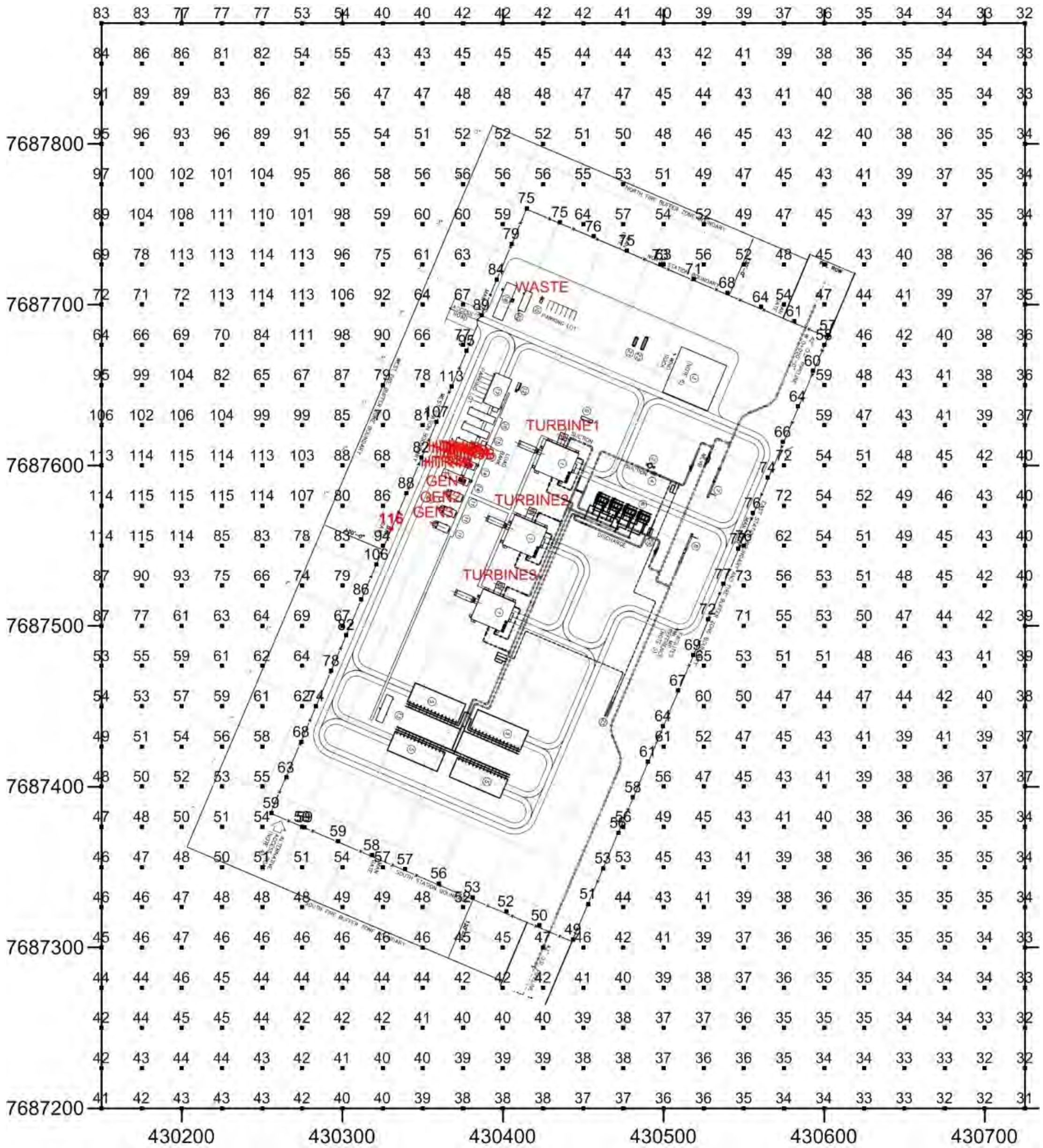


FIGURE G-16
Sagwon Compressor Station Operating Scenario 3 Modeling Results
Annual Average NO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

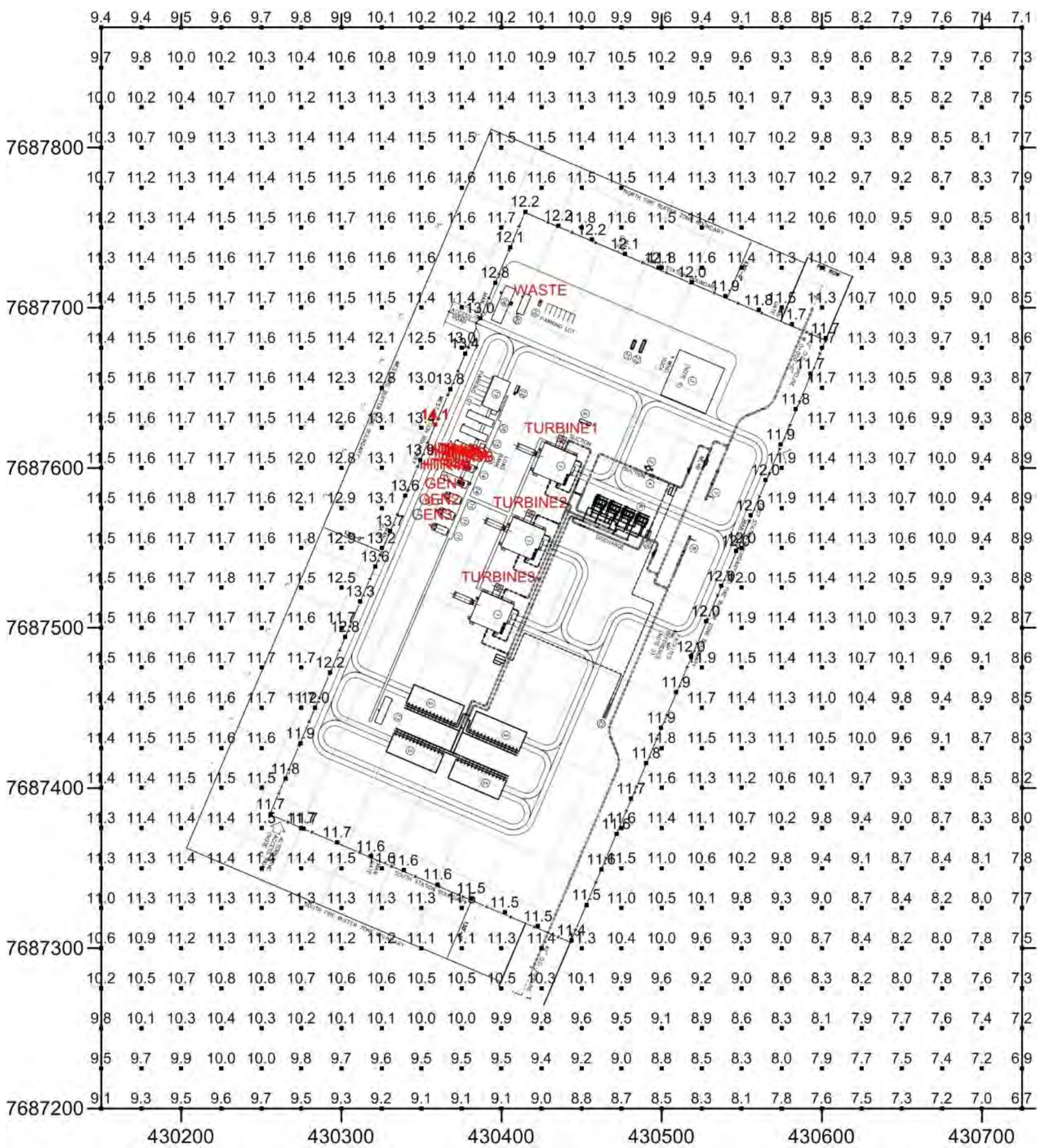


FIGURE G-17
Sagwon Compressor Station Operating Scenario 3 Modeling Results
Maximum 24-Hr Average $PM_{10}/PM_{2.5}$ Concentrations (μg/m³)
(Coordinates are UTM NAD83, in meters)

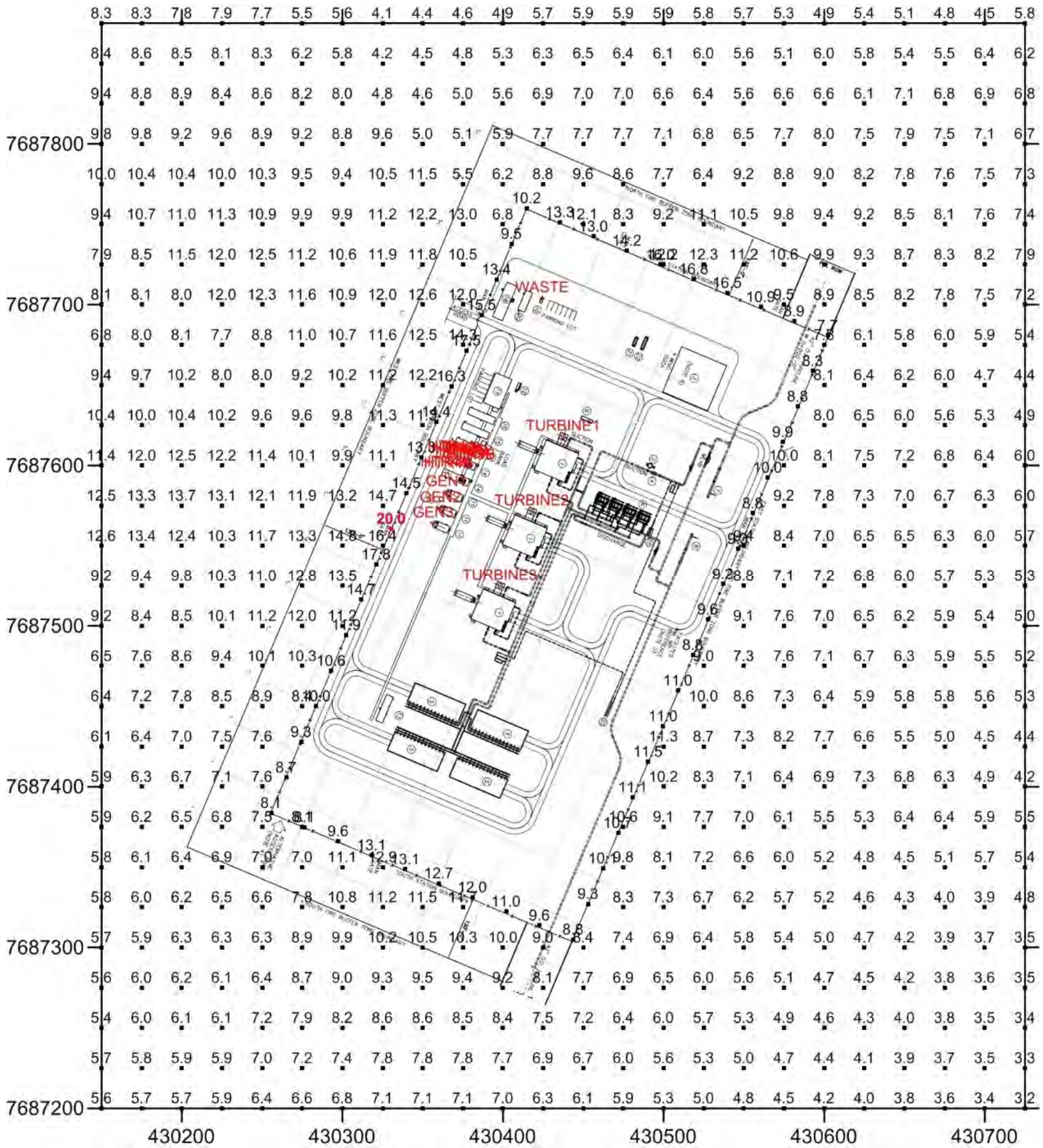


FIGURE G-18
Sagwon Compressor Station Operating Scenario 3 Modeling Results
Annual Average $PM_{10}/PM_{2.5}$ Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

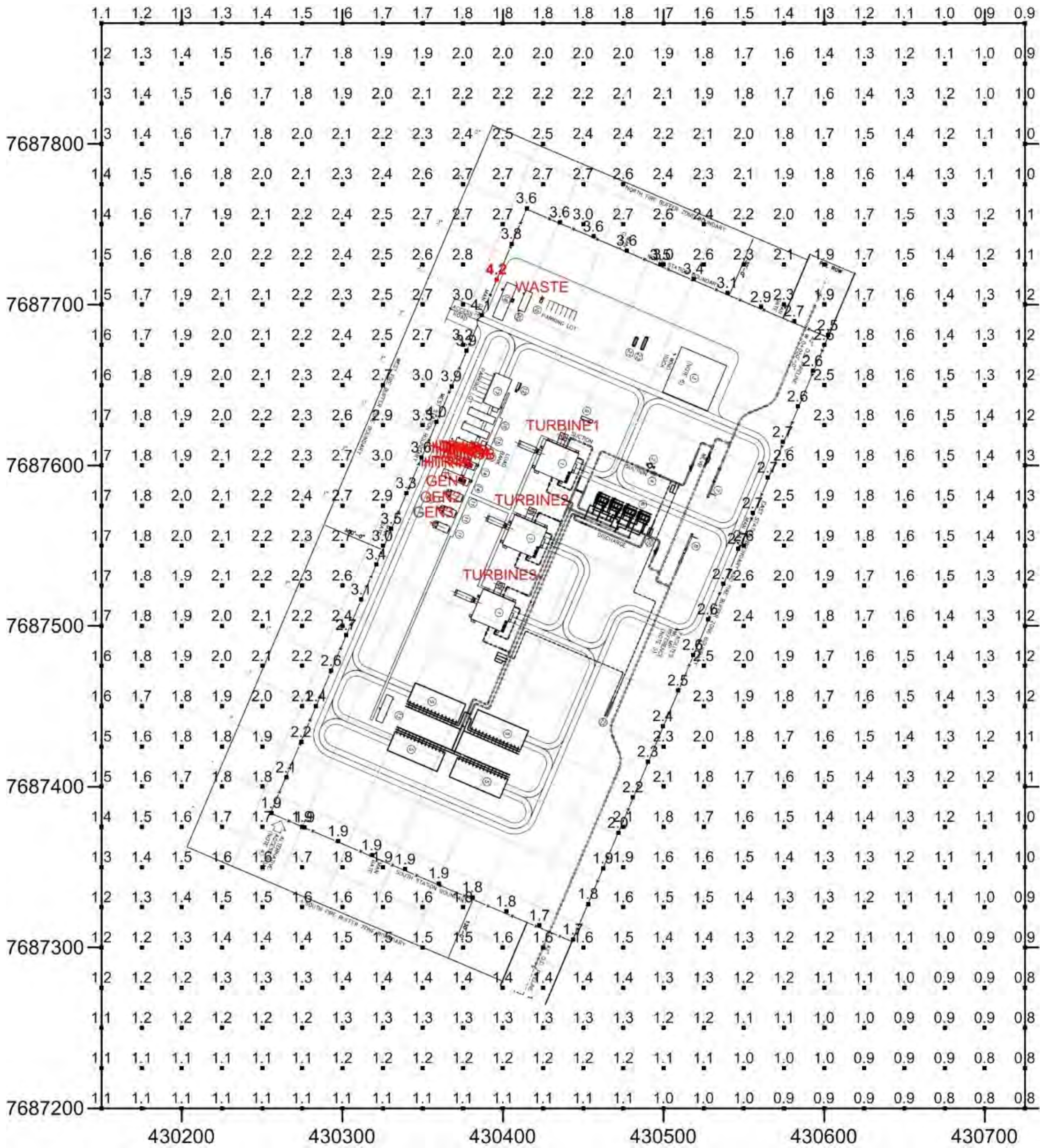


FIGURE G-19
Sagwon Compressor Station Operating Scenario 3 Modeling Results
Maximum 1-Hr Average SO_2 Concentrations (μg/m^3)
(Coordinates are UTM NAD83, in meters)

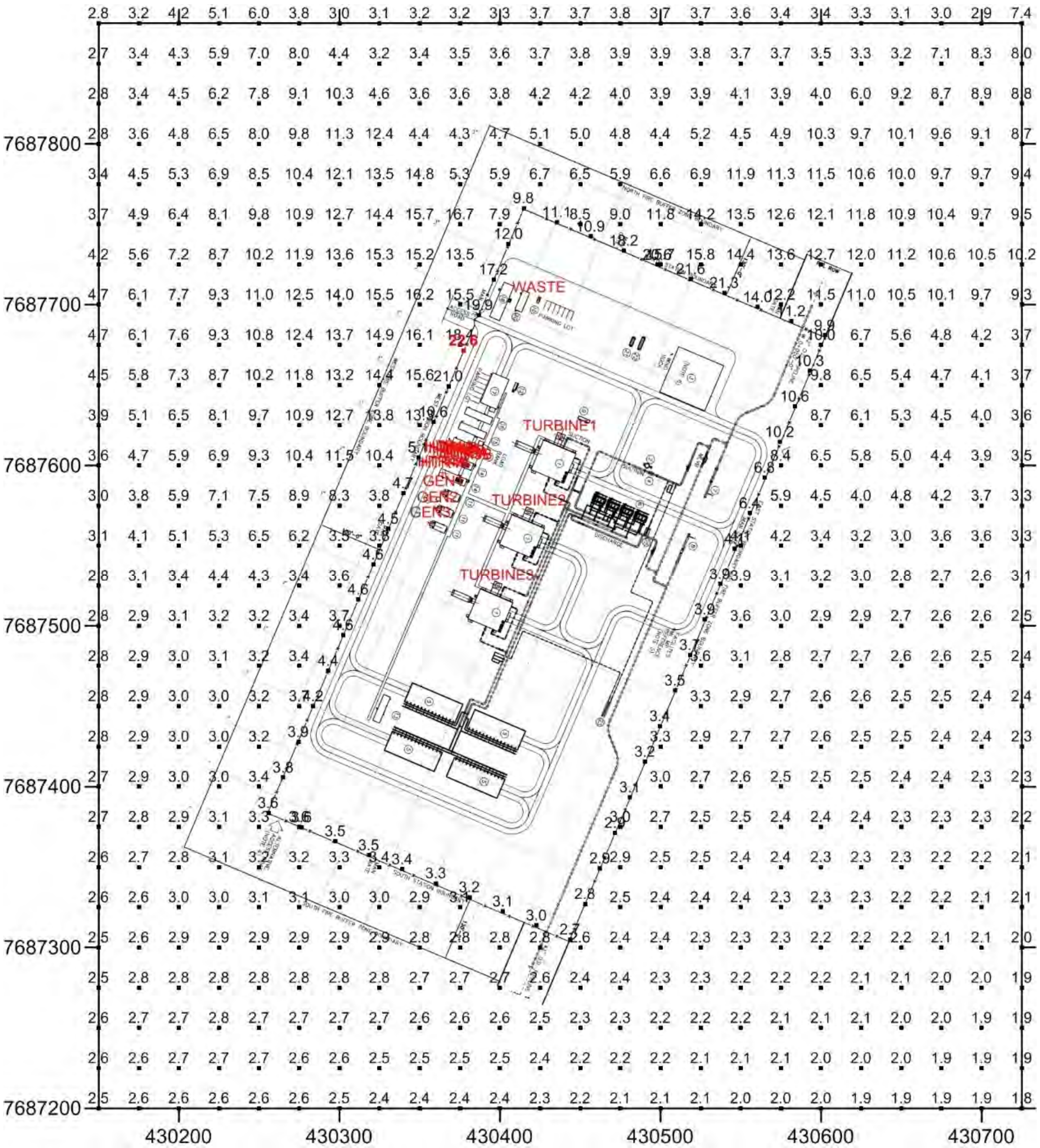


FIGURE G-20
Sagwon Compressor Station Operating Scenario 3 Modeling Results
Annual Average SO_2 Concentrations (μg/m³)
(Coordinates are UTM NAD83, in meters)

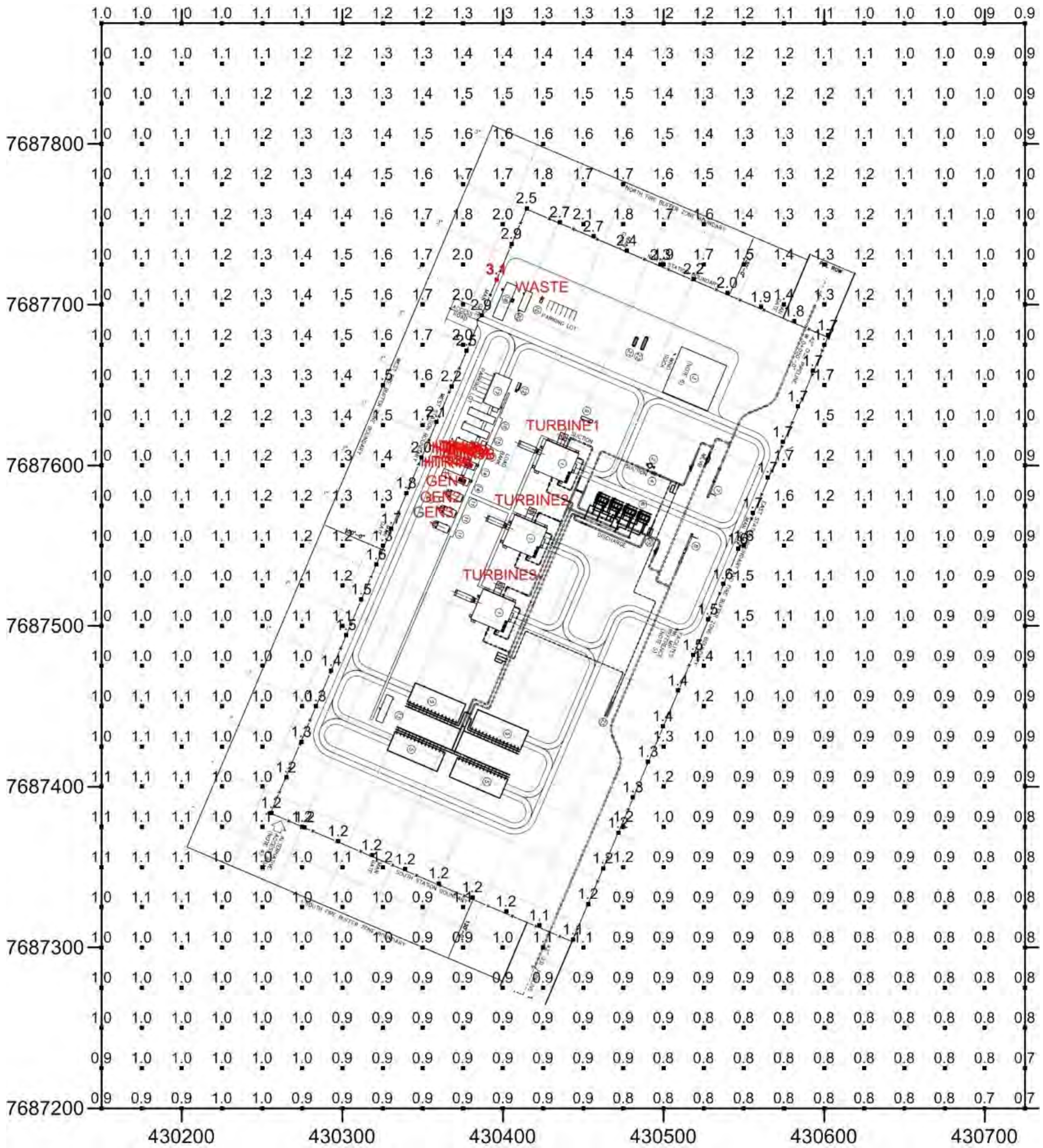


FIGURE G-21
Sagwon Compressor Station Operating Scenario 3 Modeling Results
Maximum 1-Hr Average CO Concentrations (μg/m³)
(Coordinates are UTM NAD83, in meters)

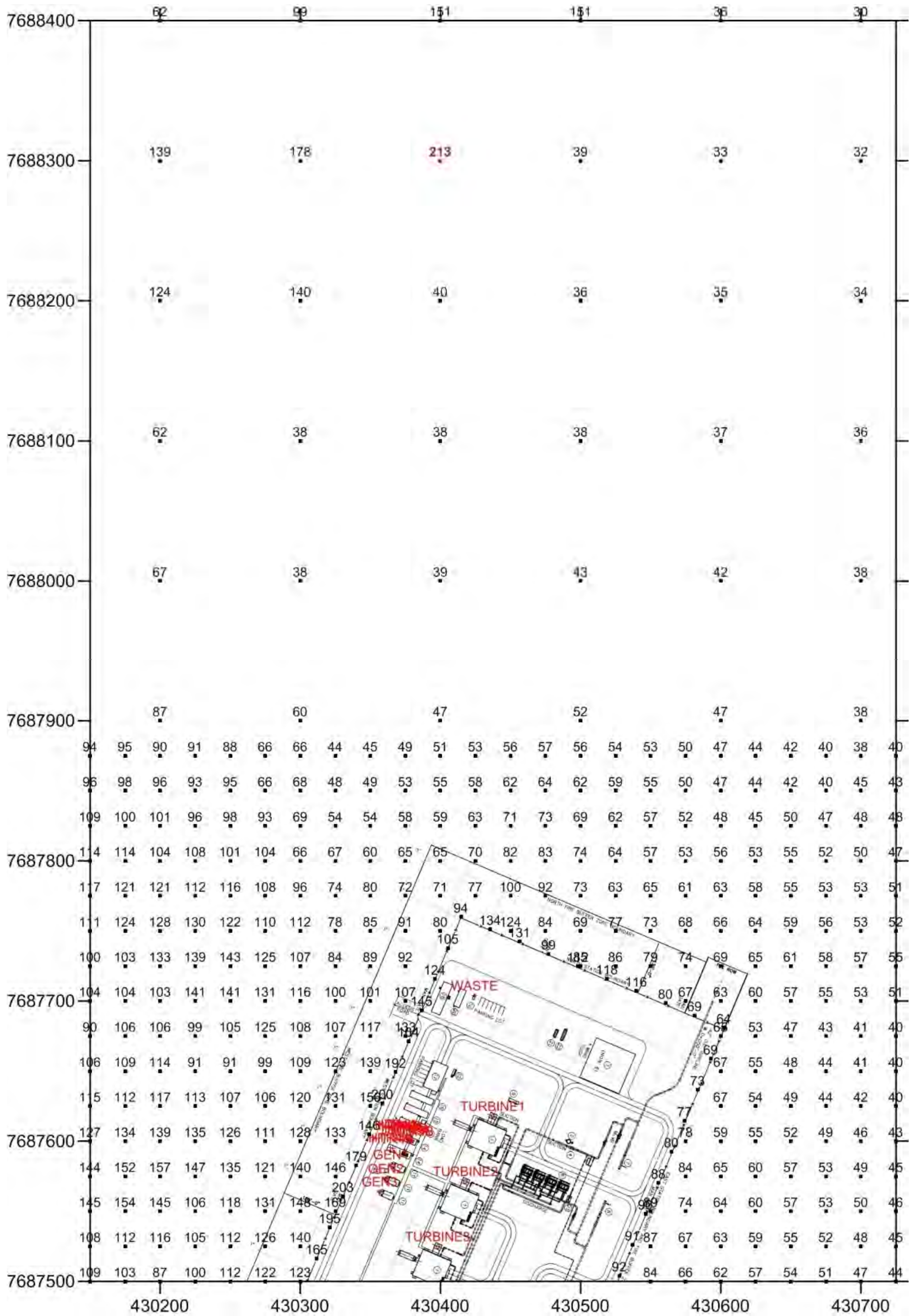


FIGURE G-22
Galbraith Lake Compressor Station Modeling Results
Maximum 1-Hr Average NO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

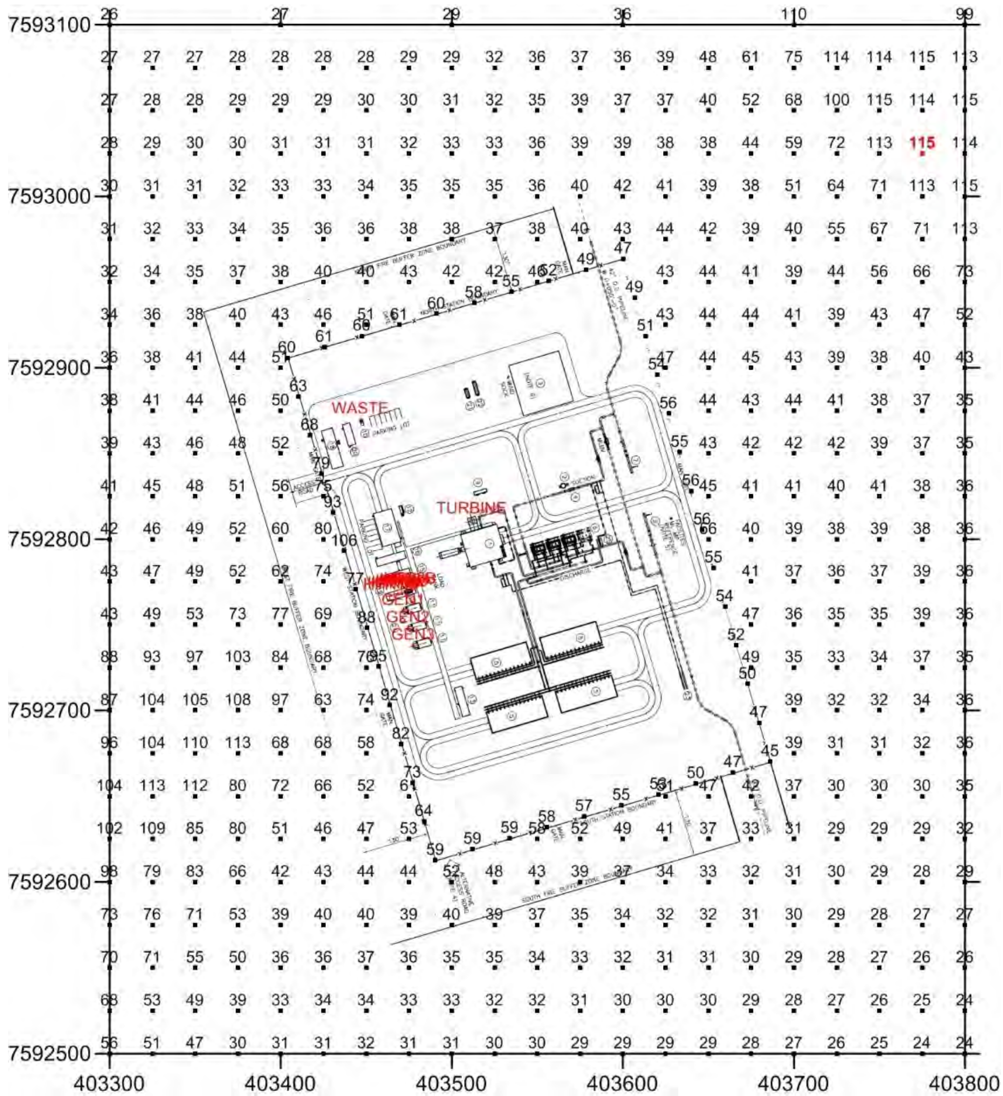


FIGURE G-23
Galbraith Lake Compressor Station Modeling Results
Annual Average NO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

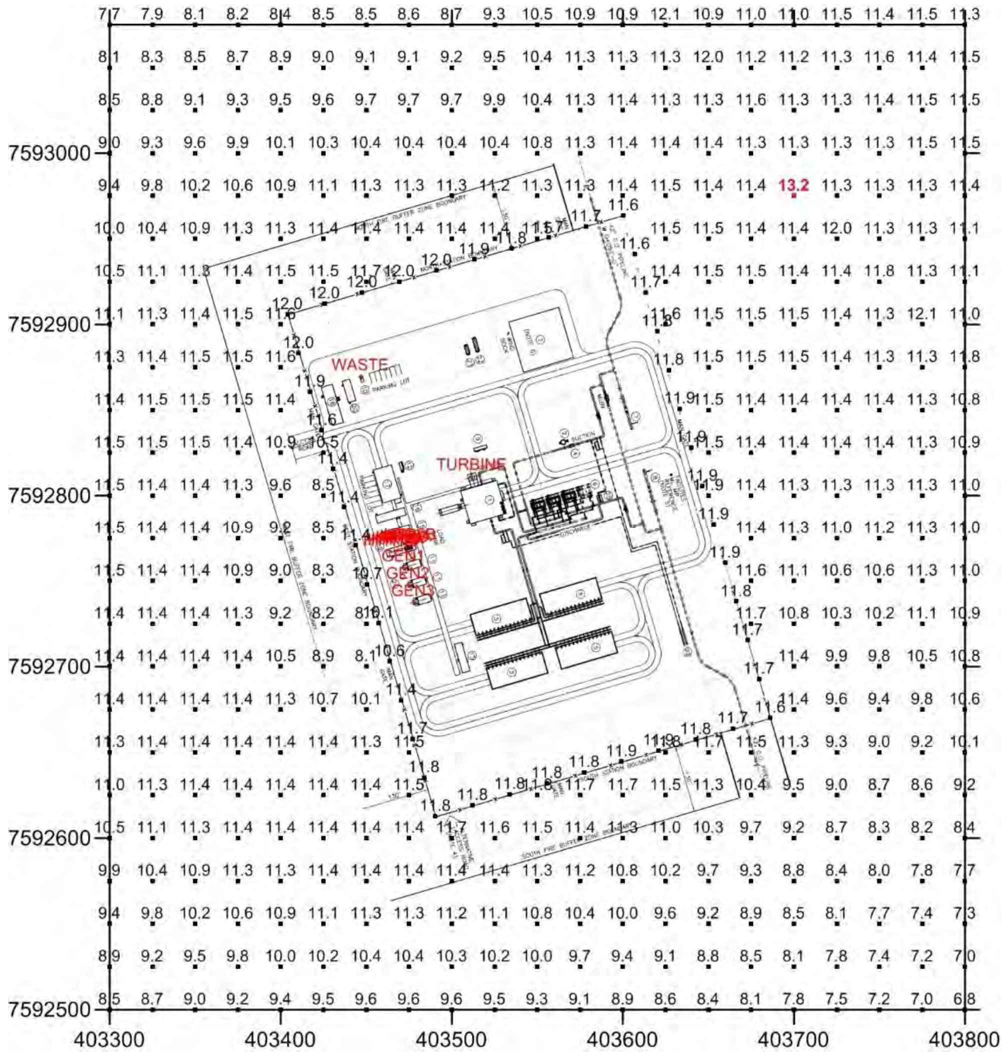


FIGURE G-24
Galbraith Lake Compressor Station Modeling Results
Maximum 24-Hr Average $PM_{10}/PM_{2.5}$ Concentrations (μg/m³)
(Coordinates are UTM NAD83, in meters)

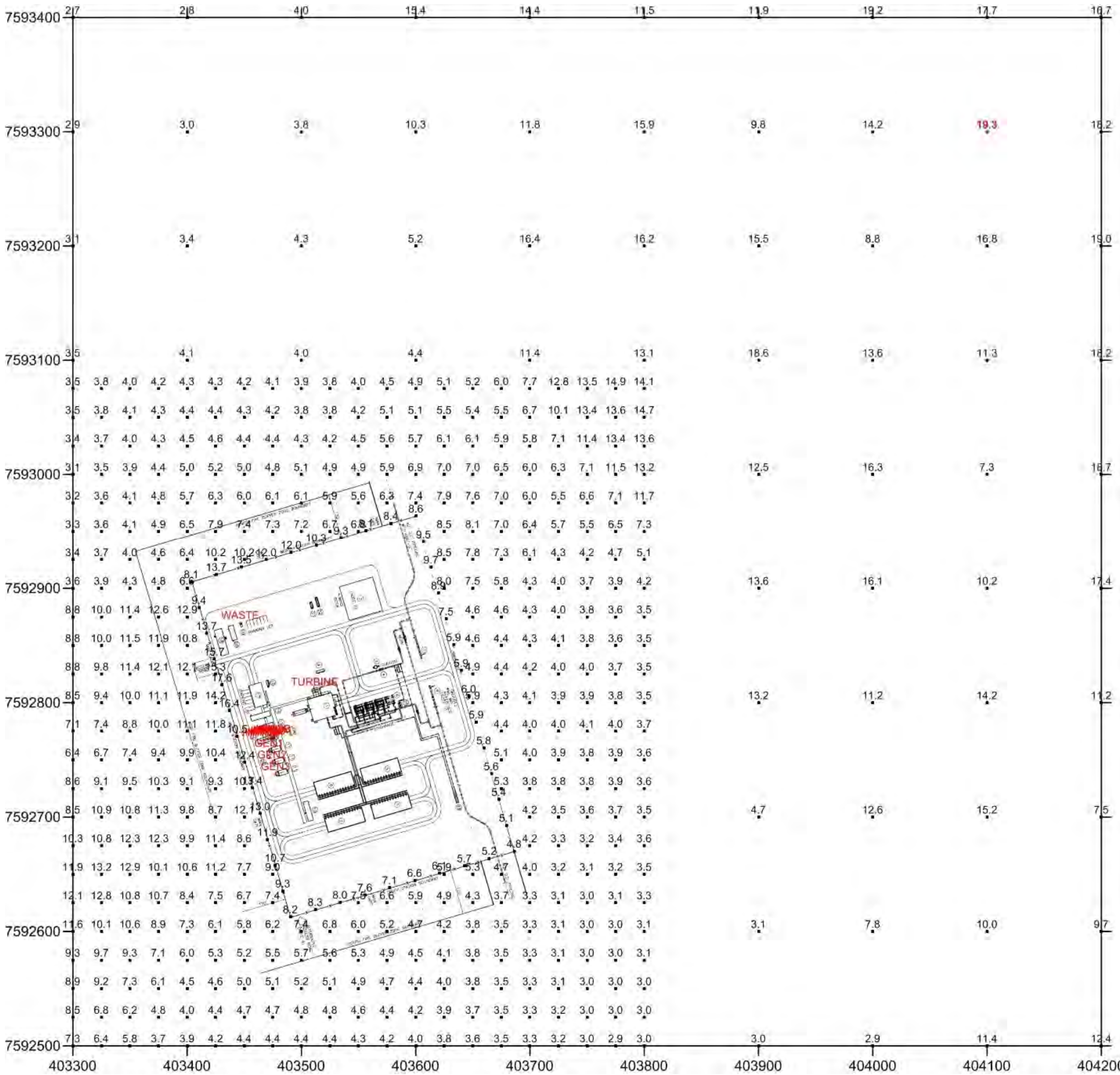


FIGURE G-25
Galbraith Lake Compressor Station Modeling Results
Annual Average PM_{10}/$PM_{2.5}$ Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

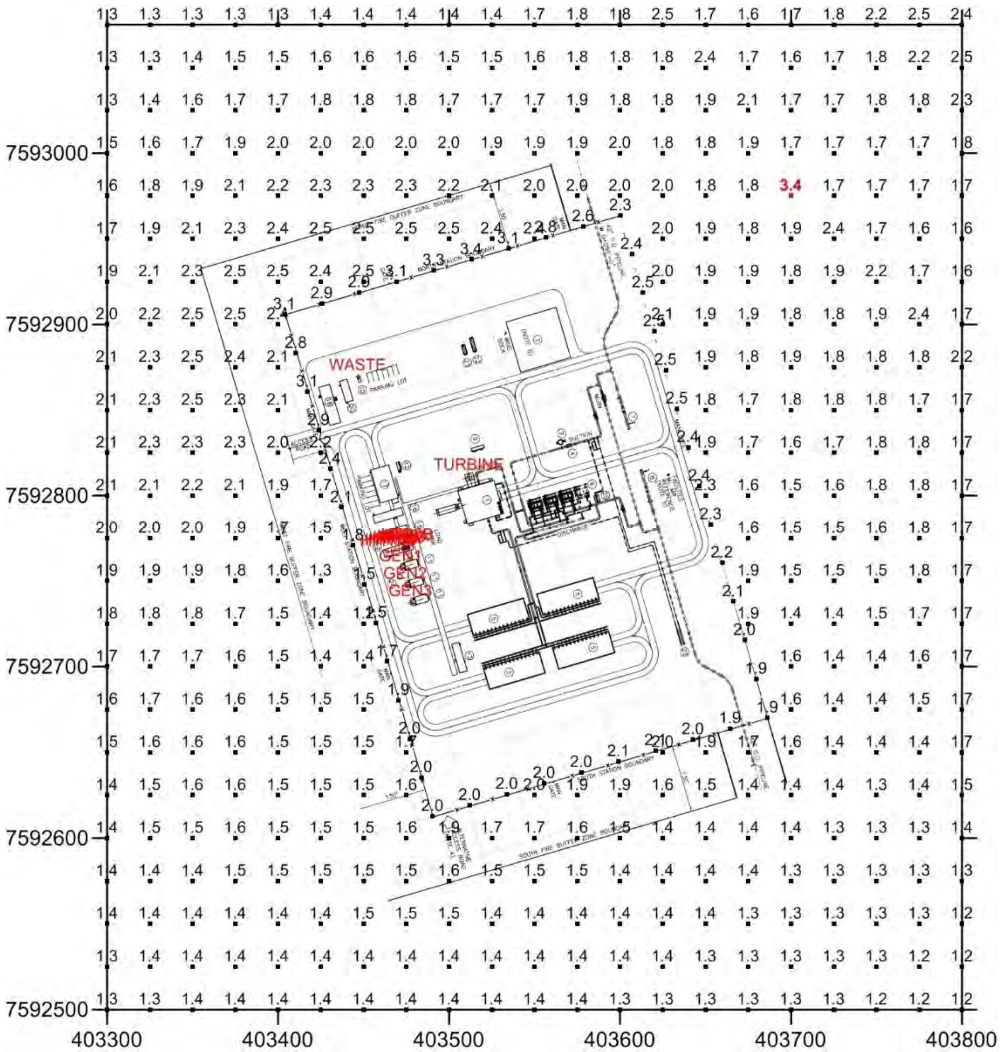


FIGURE G-26
Galbraith Lake Compressor Station Modeling Results
Maximum 1-Hr Average SO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

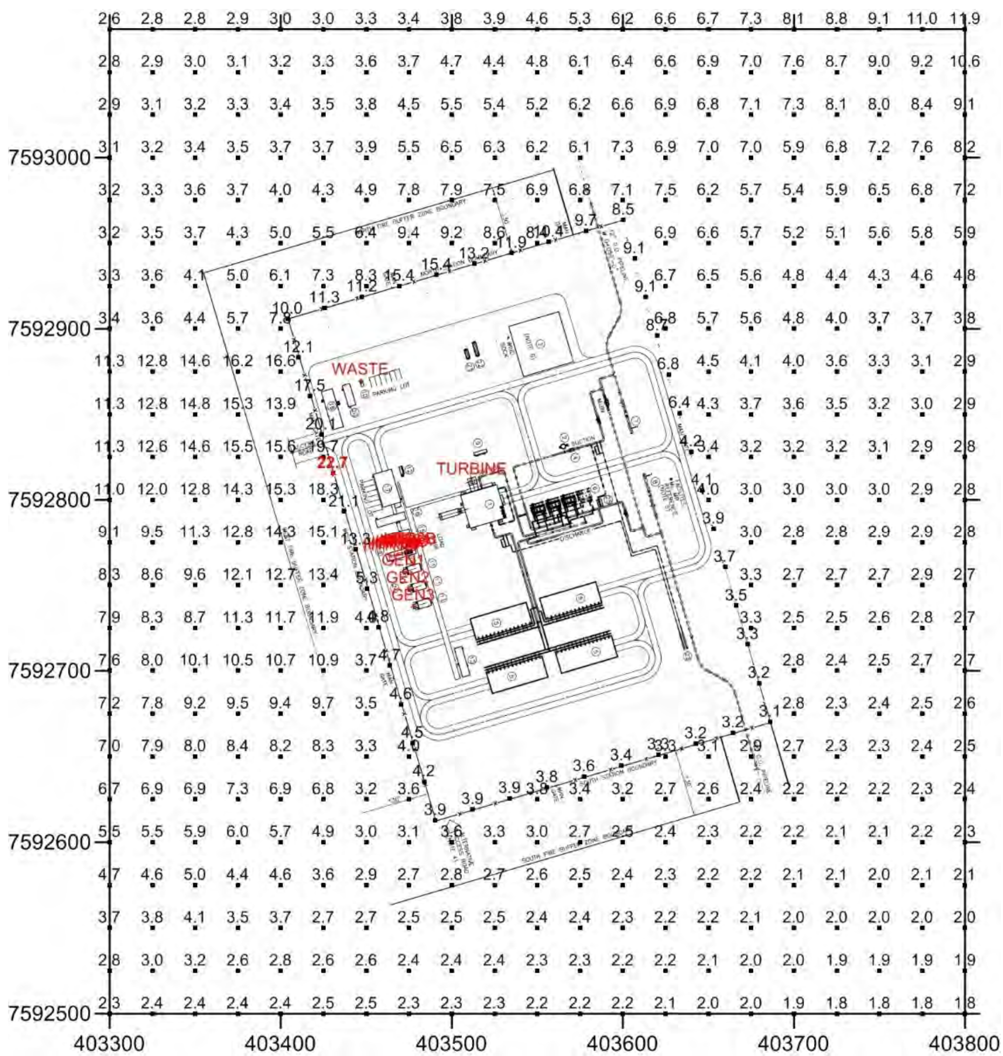


FIGURE G-27
Galbraith Lake Compressor Station Modeling Results
Annual Average SO_2 Concentrations (µg/m³)
(Coordinates are UTM NAD83, in meters)

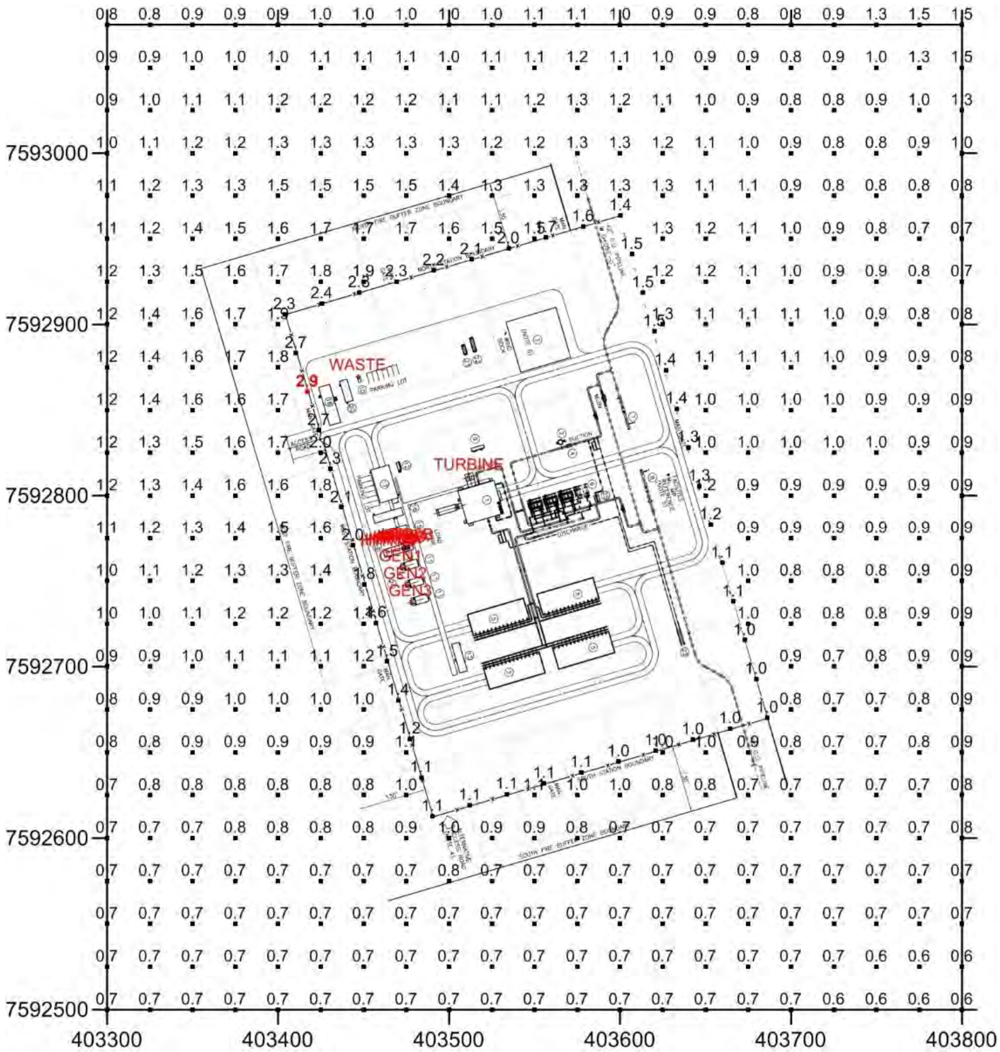


FIGURE G-28
Galbraith Lake Compressor Station Modeling Results
Maximum 1-Hr Average CO Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

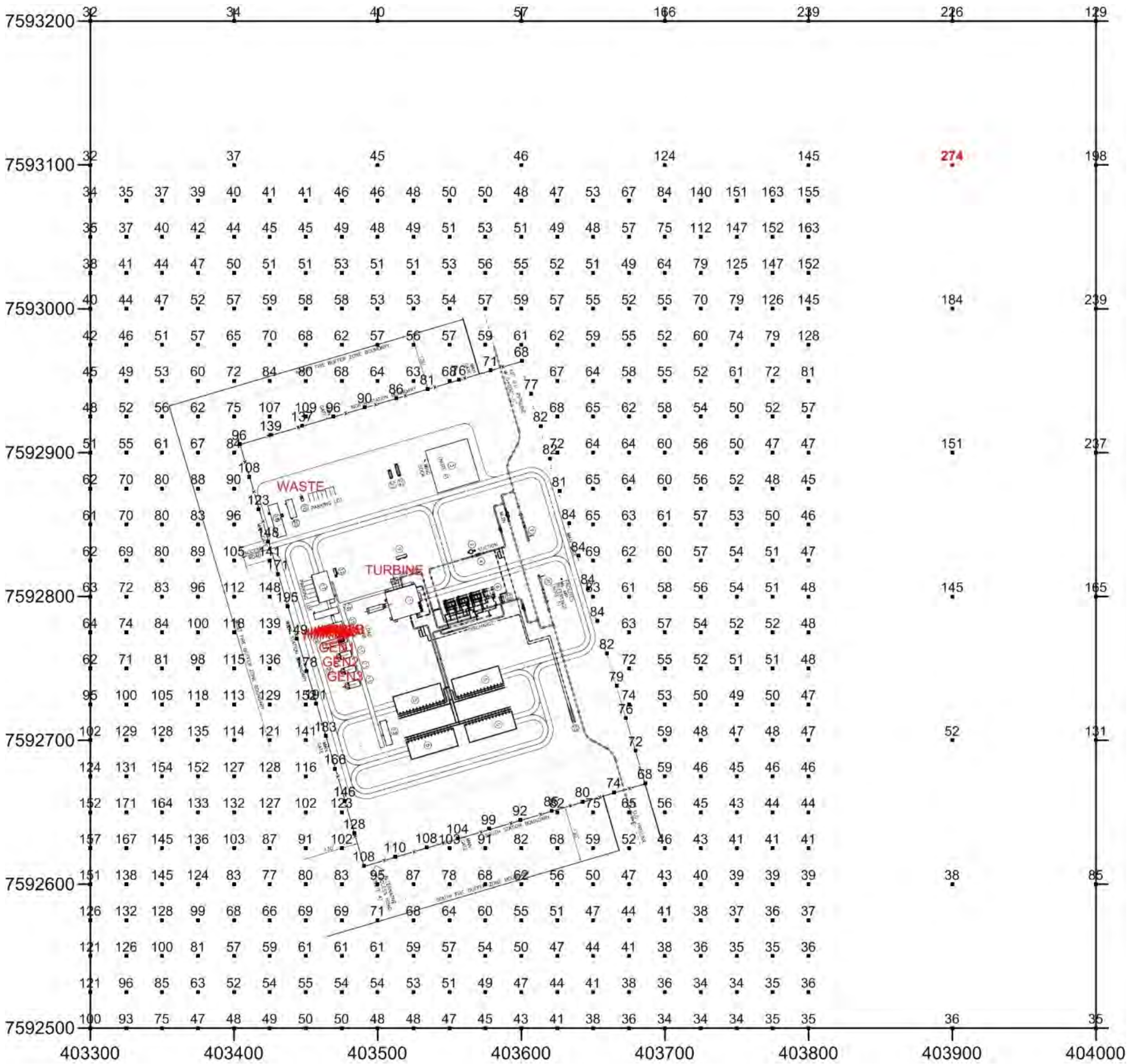


FIGURE G-29
Coldfoot Compressor Station Modeling Results
Maximum 1-Hr Average NO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

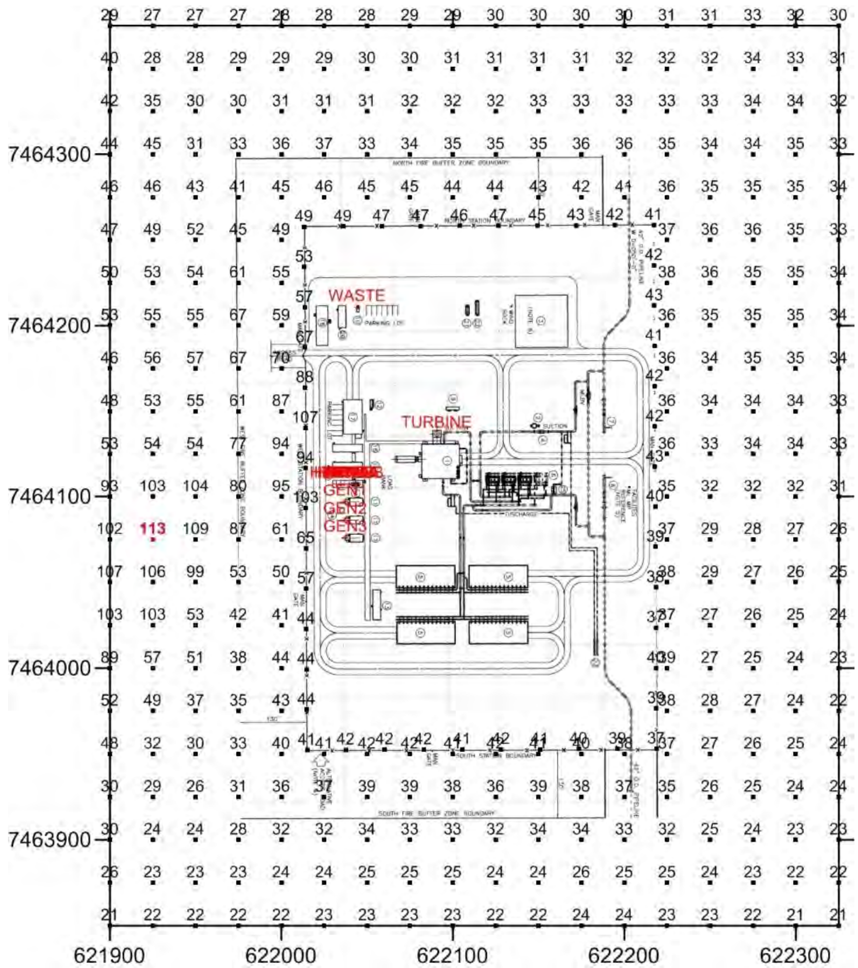


FIGURE G-30
Coldfoot Compressor Station Modeling Results
Annual Average NO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

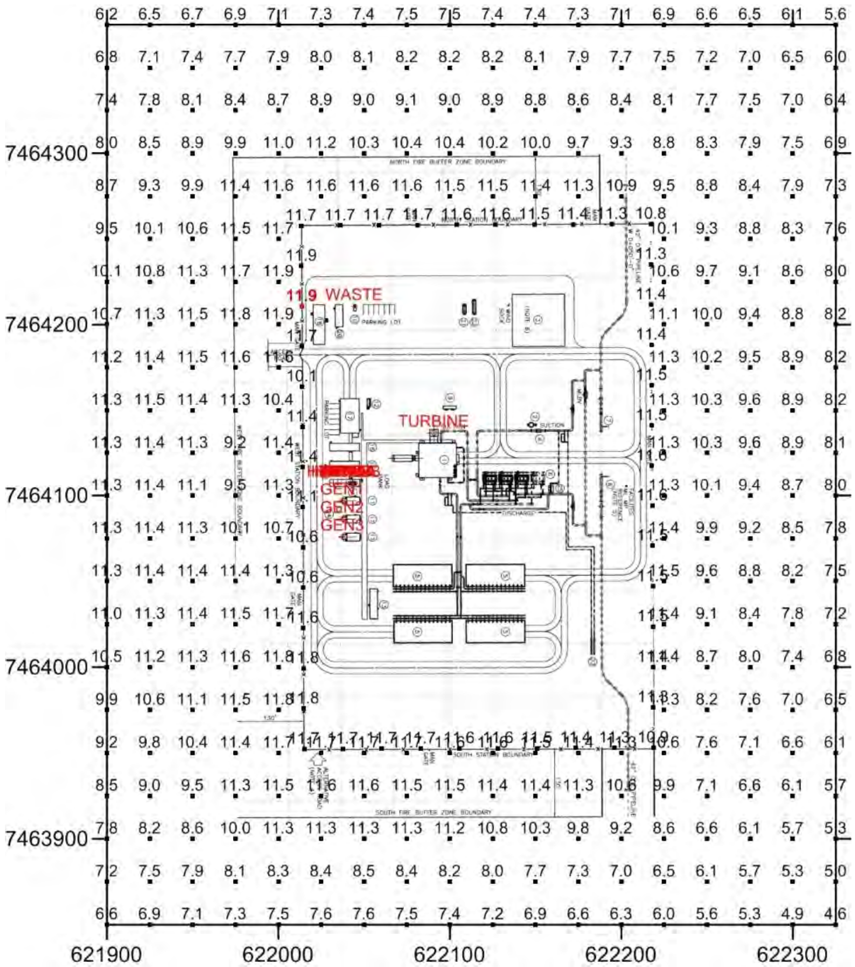


FIGURE G-31
Coldfoot Compressor Station Modeling Results
Maximum 24-Hr Average PM_{10}/$PM_{2.5}$ Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

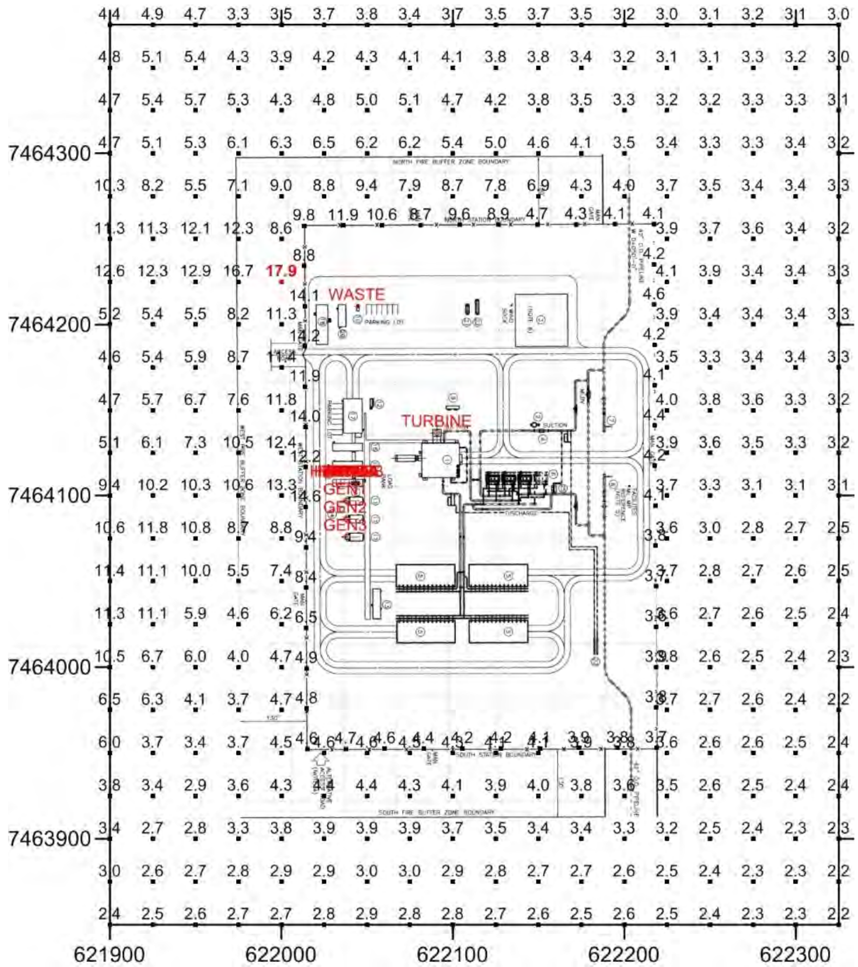


FIGURE G-32
Coldfoot Compressor Station Modeling Results
Annual Average $PM_{10}/PM_{2.5}$ Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

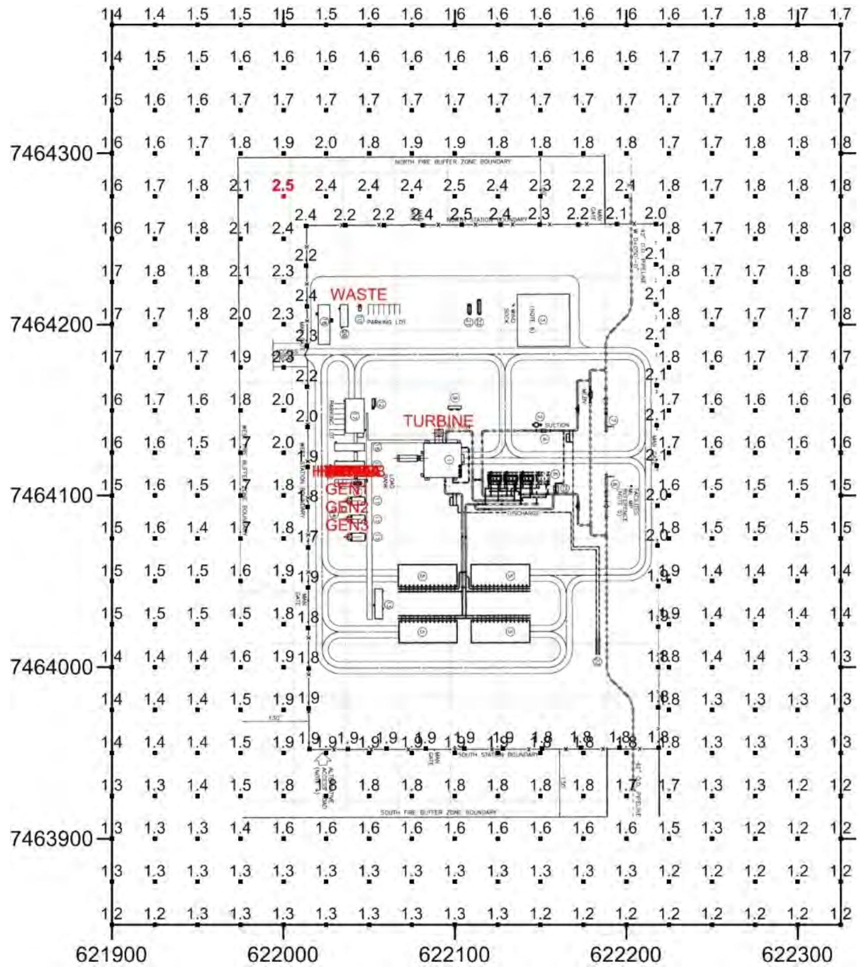


FIGURE G-33
Coldfoot Compressor Station Modeling Results
Maximum 1-Hr Average SO_2 Concentrations (μg/m³)
(Coordinates are UTM NAD83, in meters)

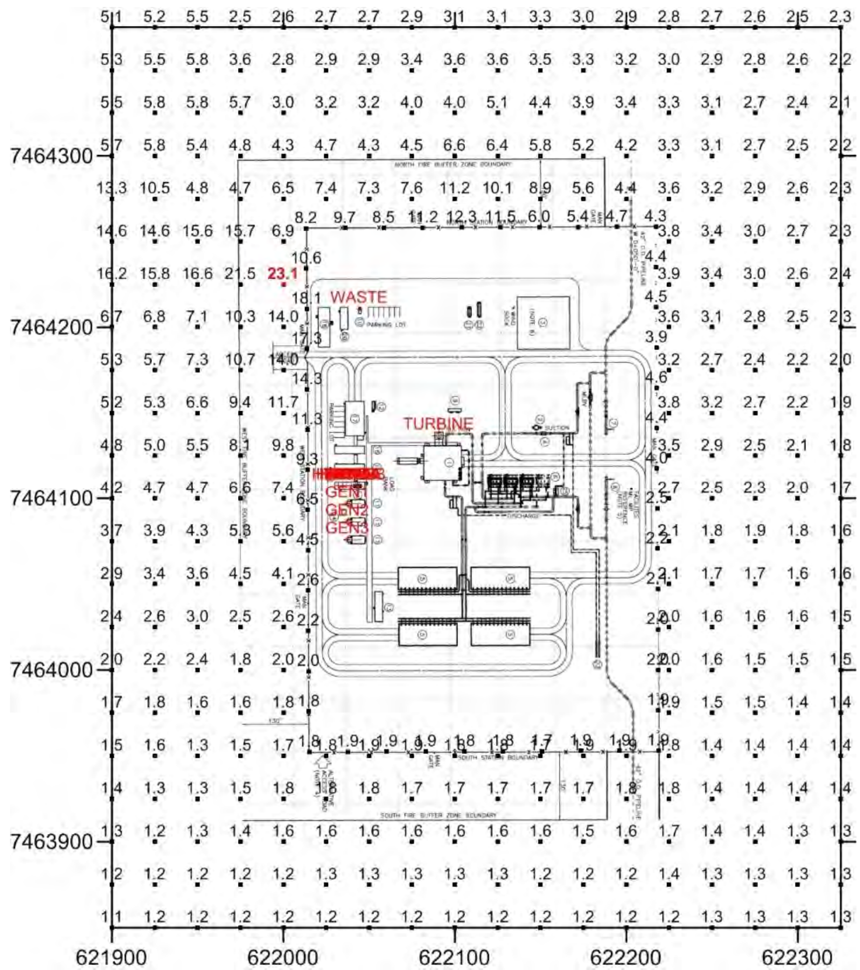


FIGURE G-34
Coldfoot Compressor Station Modeling Results
Annual Average SO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

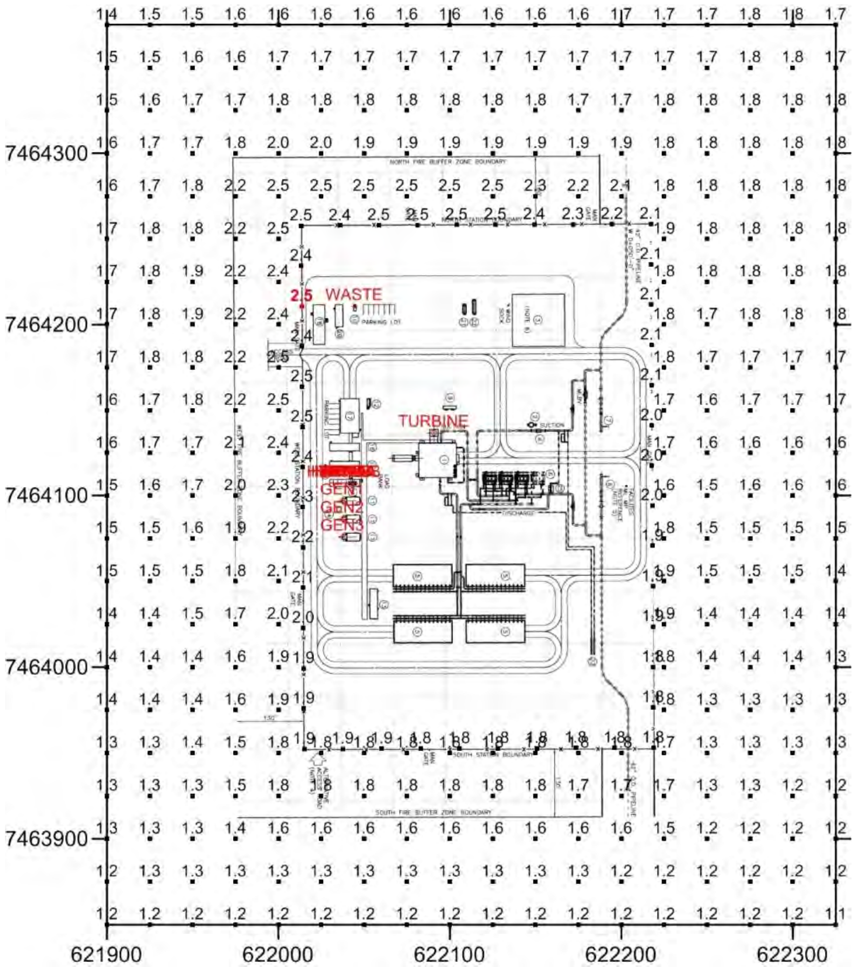


FIGURE G-35
Coldfoot Compressor Station Modeling Results
Maximum 1-Hr Average CO Concentrations (μg/m³)
(Coordinates are UTM NAD83, in meters)

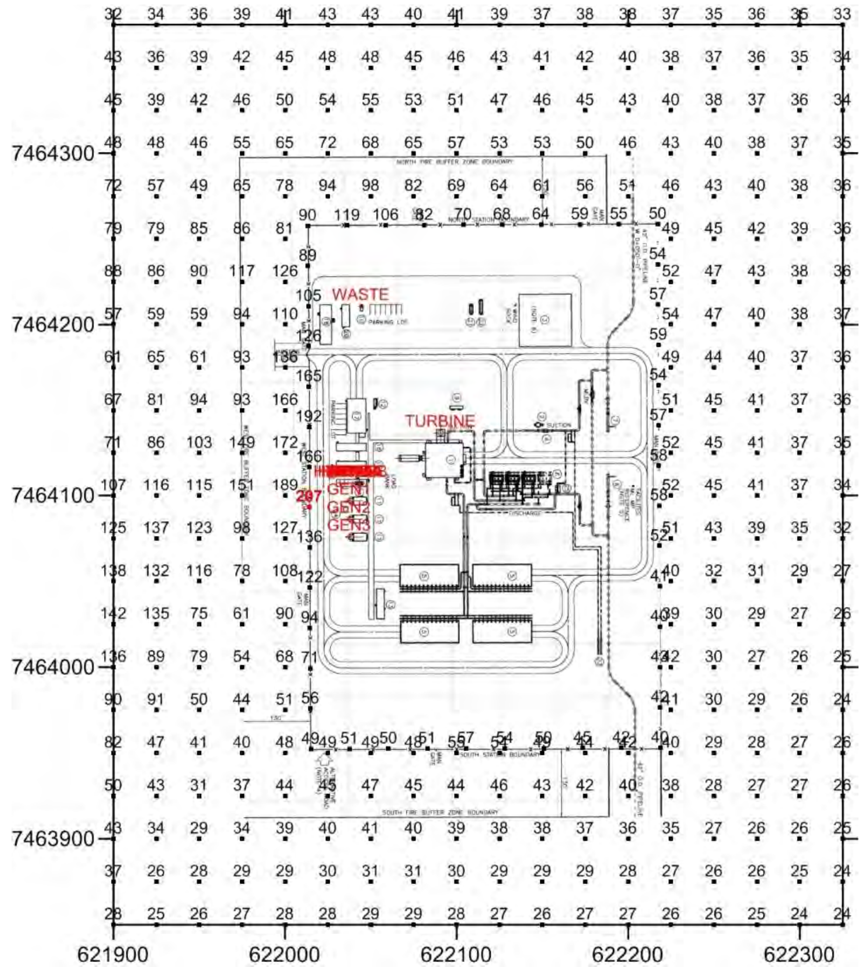


FIGURE G-36
Ray River Compressor Station Modeling Results
Maximum 1-Hr Average NO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

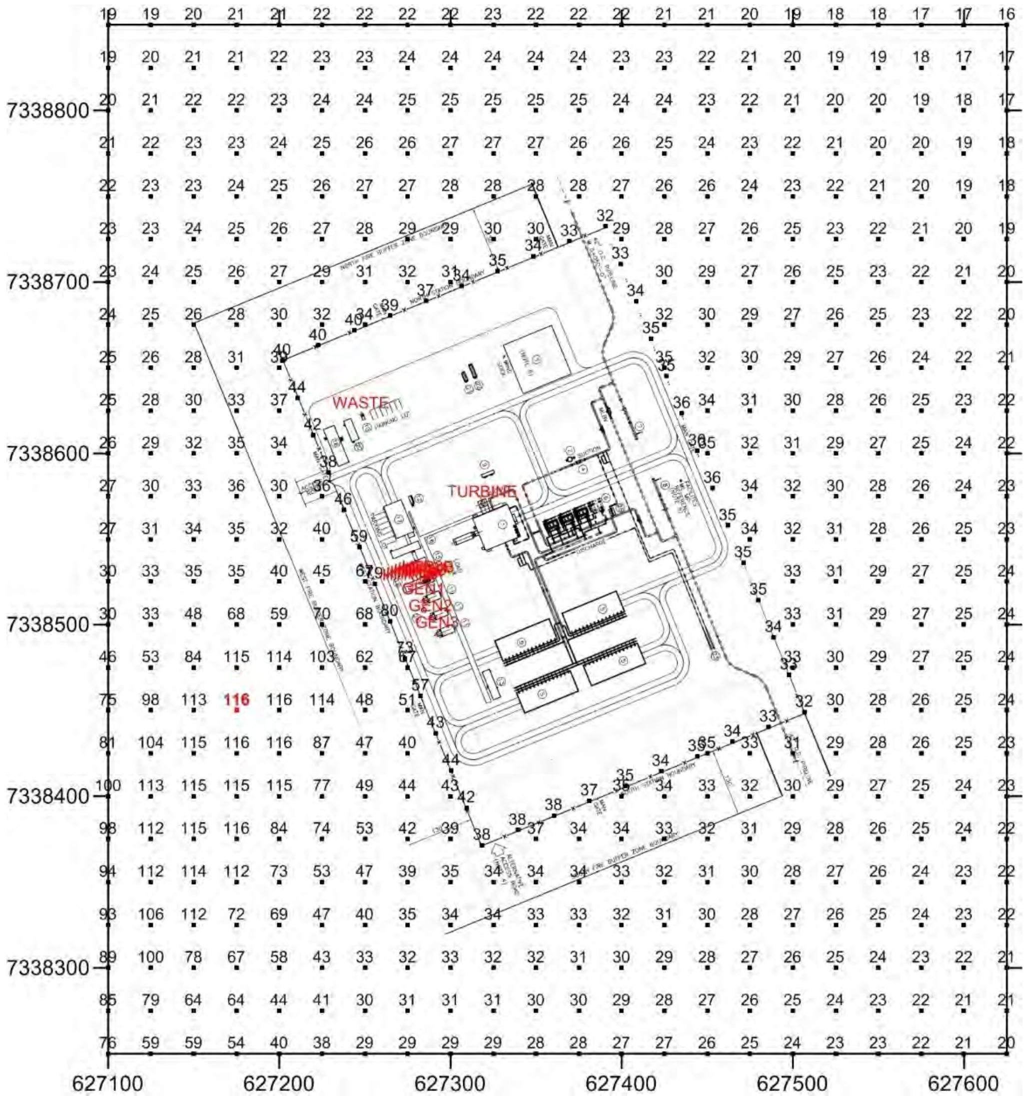


FIGURE G-37
Ray River Compressor Station Modeling Results
Annual Average NO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

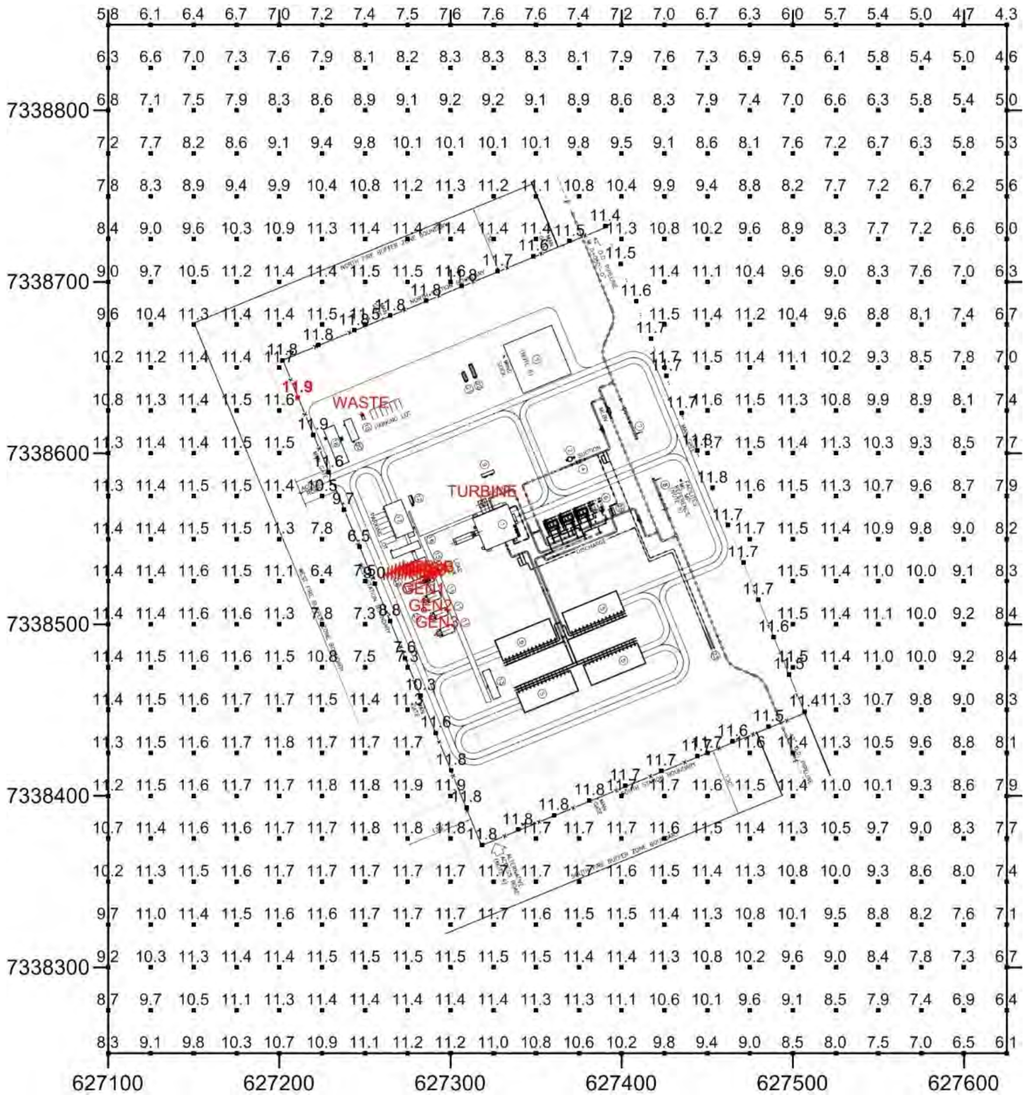


FIGURE G-38
Ray River Compressor Station Modeling Results
Maximum 24-Hr Average $PM_{10}/PM_{2.5}$ Concentrations (μg/m³)
(Coordinates are UTM NAD83, in meters)

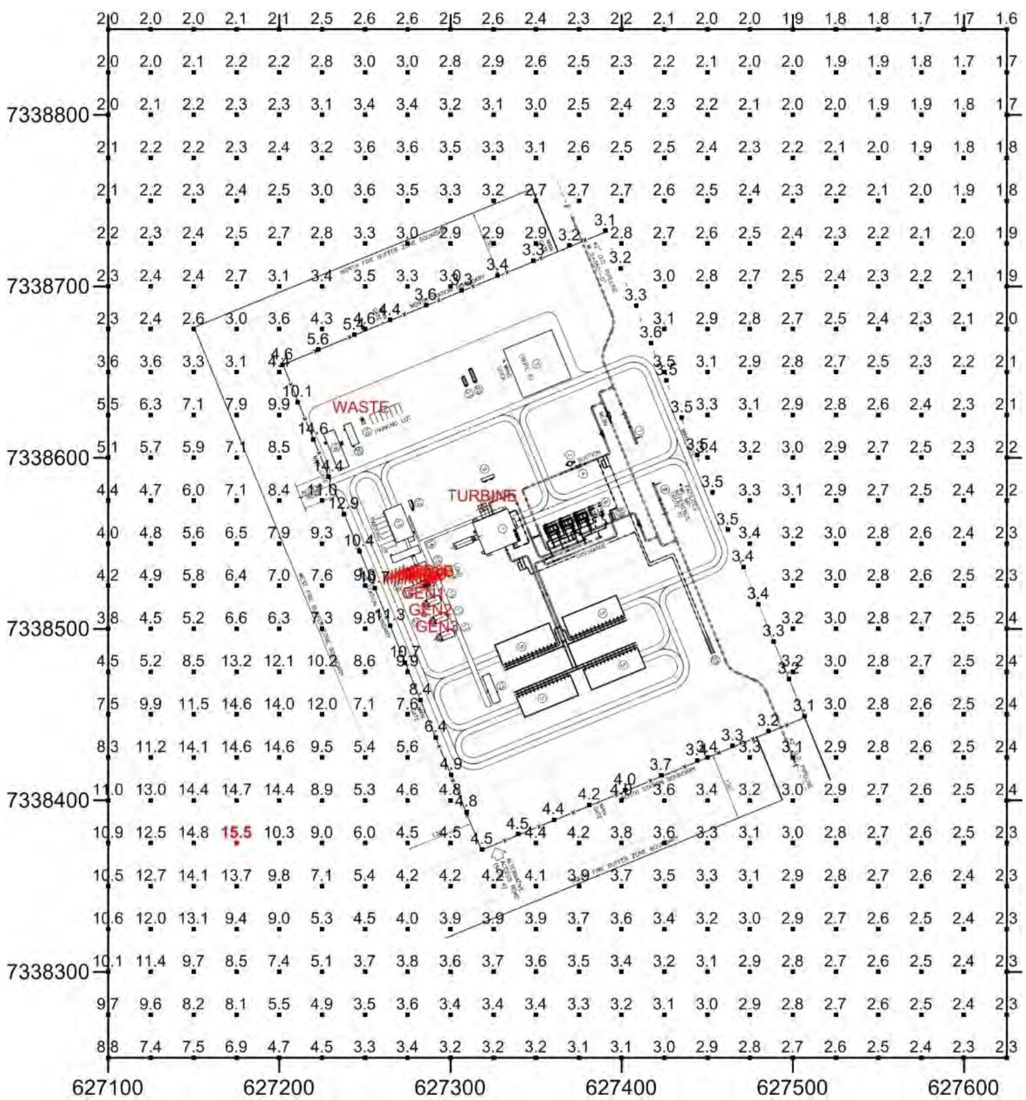


FIGURE G-39
Ray River Compressor Station Modeling Results
Annual Average $PM_{10}/PM_{2.5}$ Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

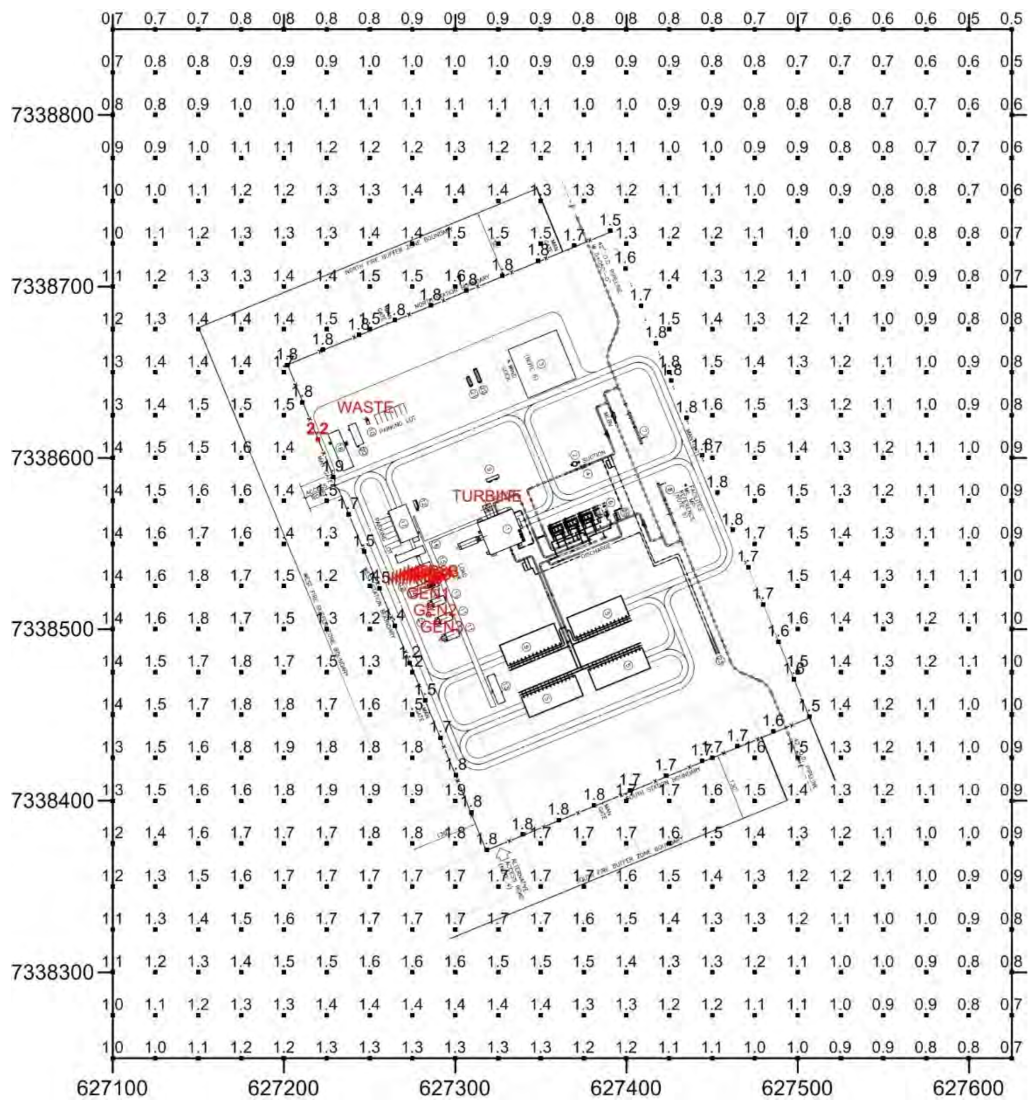


FIGURE G-40
Ray River Compressor Station Modeling Results
Maximum 1-Hr Average SO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

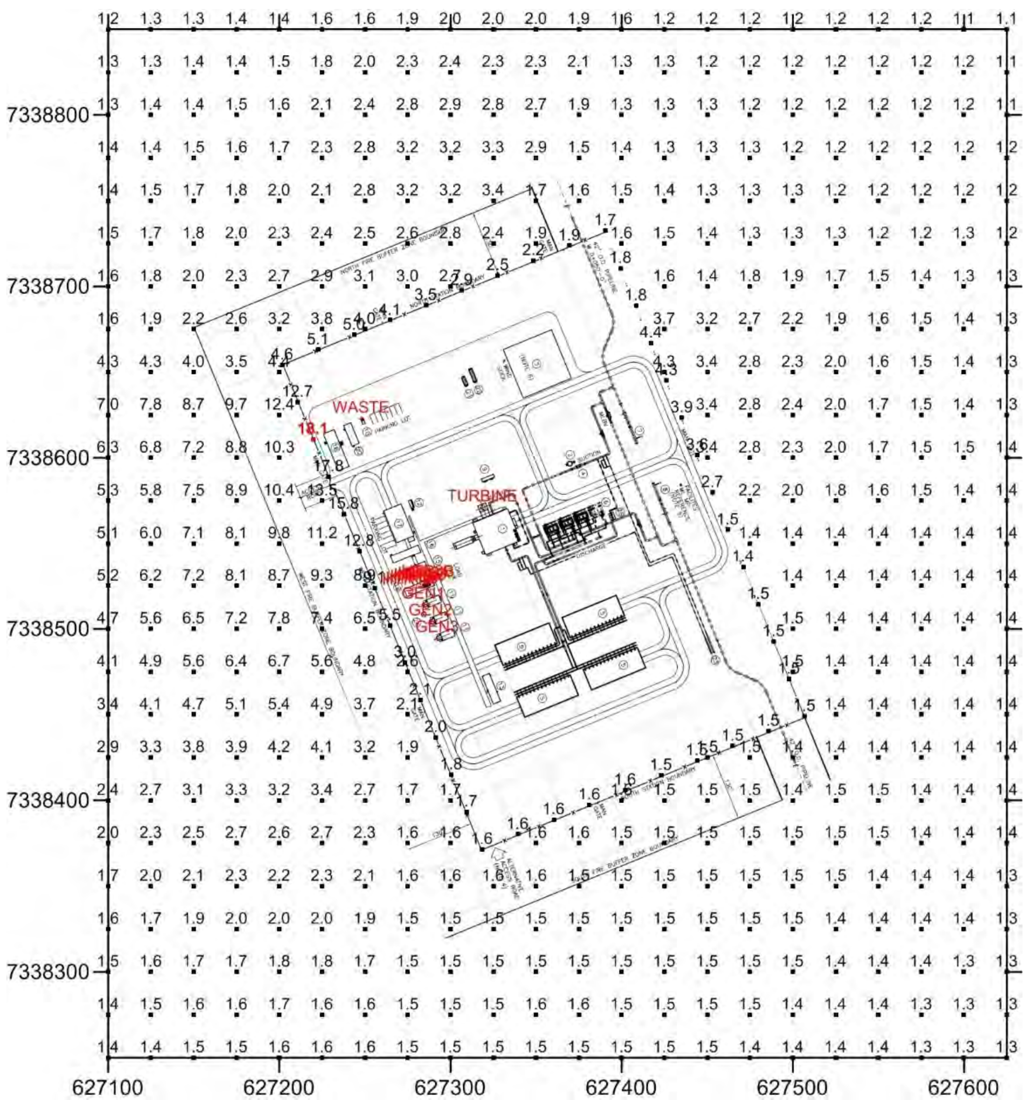


FIGURE G-41
Ray River Compressor Station Modeling Results
Annual Average SO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

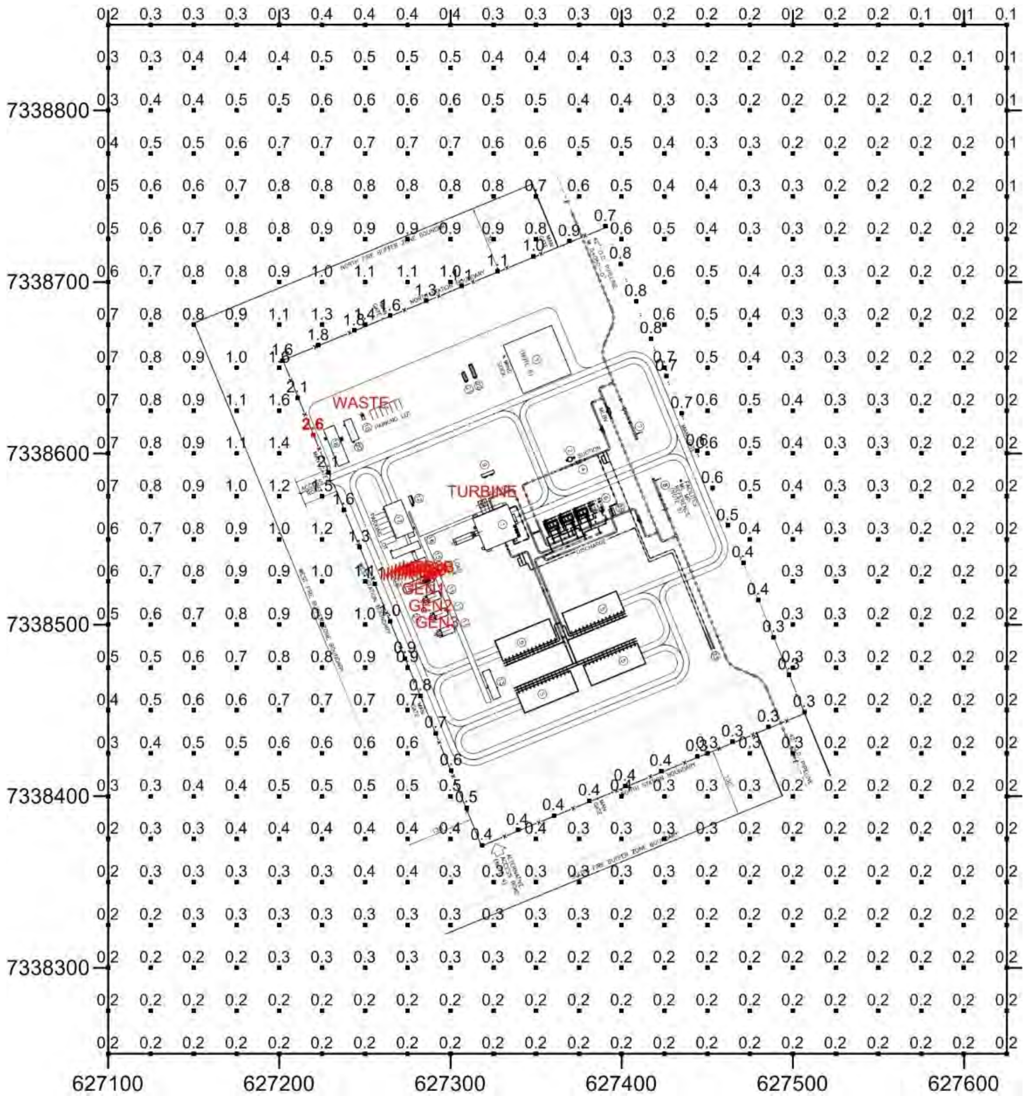


FIGURE G-42
Ray River Compressor Station Modeling Results
Maximum 1-Hr Average CO Concentrations (μg/m³)
(Coordinates are UTM NAD83, in meters)

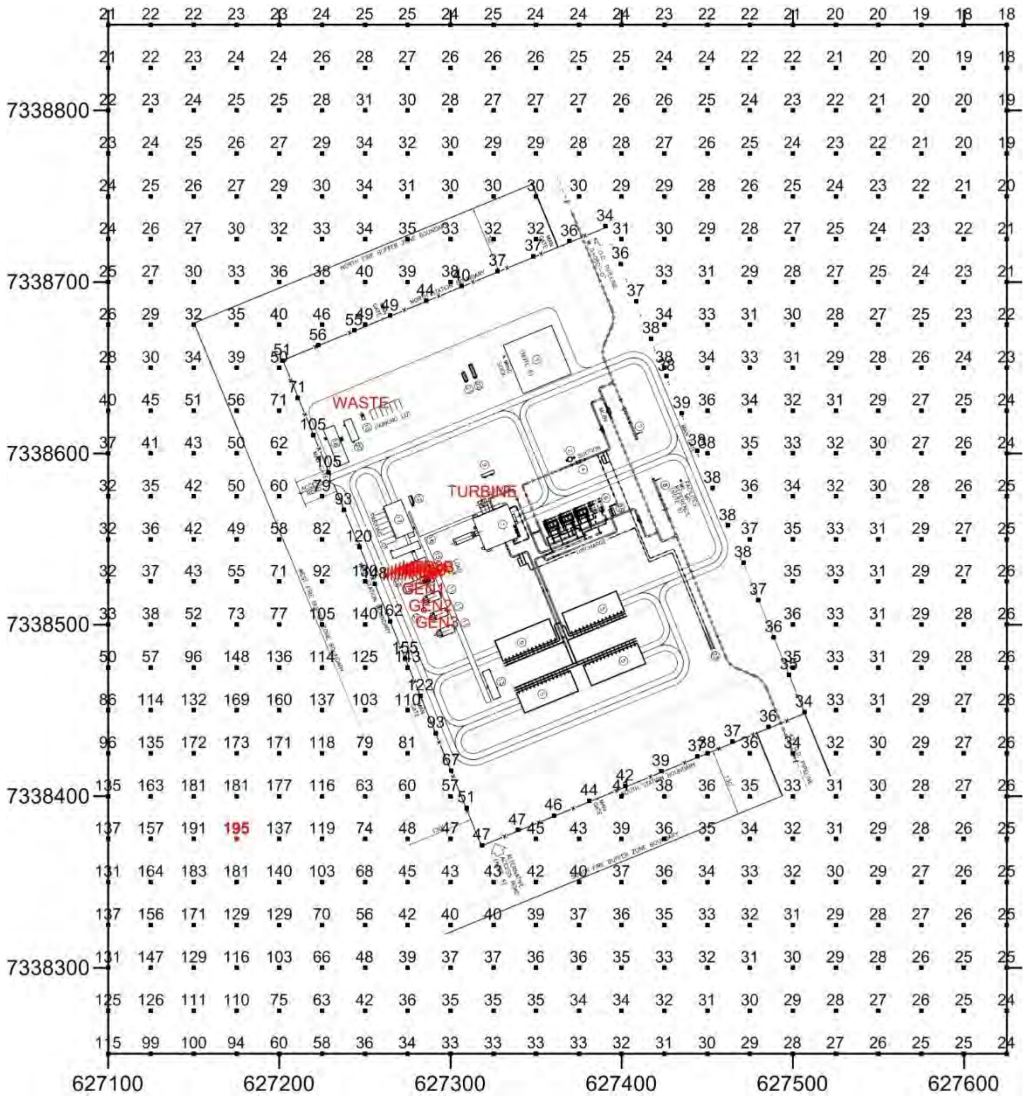


FIGURE G-43
Minto Compressor Station Modeling Results
Maximum 1-Hr Average NO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

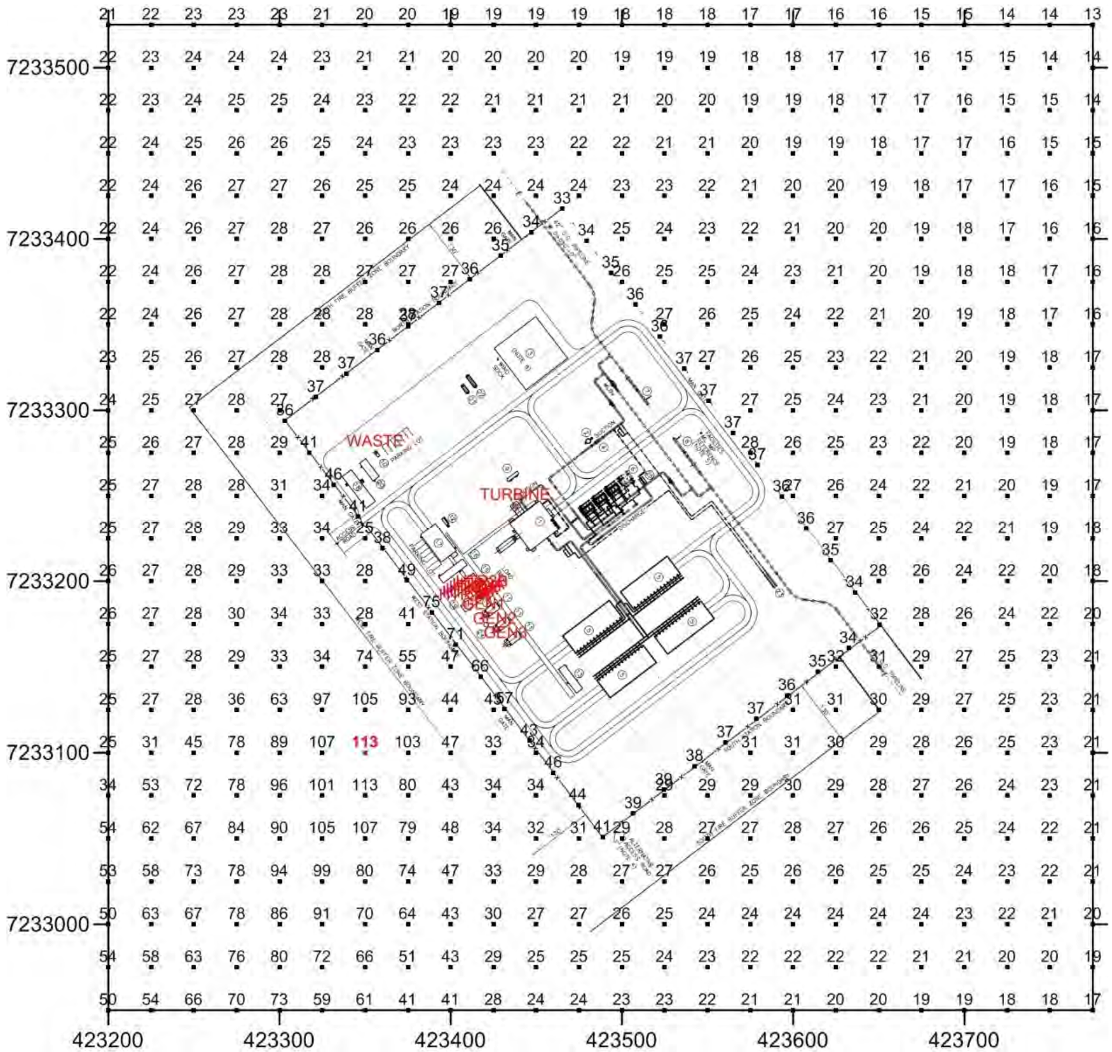


FIGURE G-44
Minto Compressor Station Modeling Results
Annual Average NO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

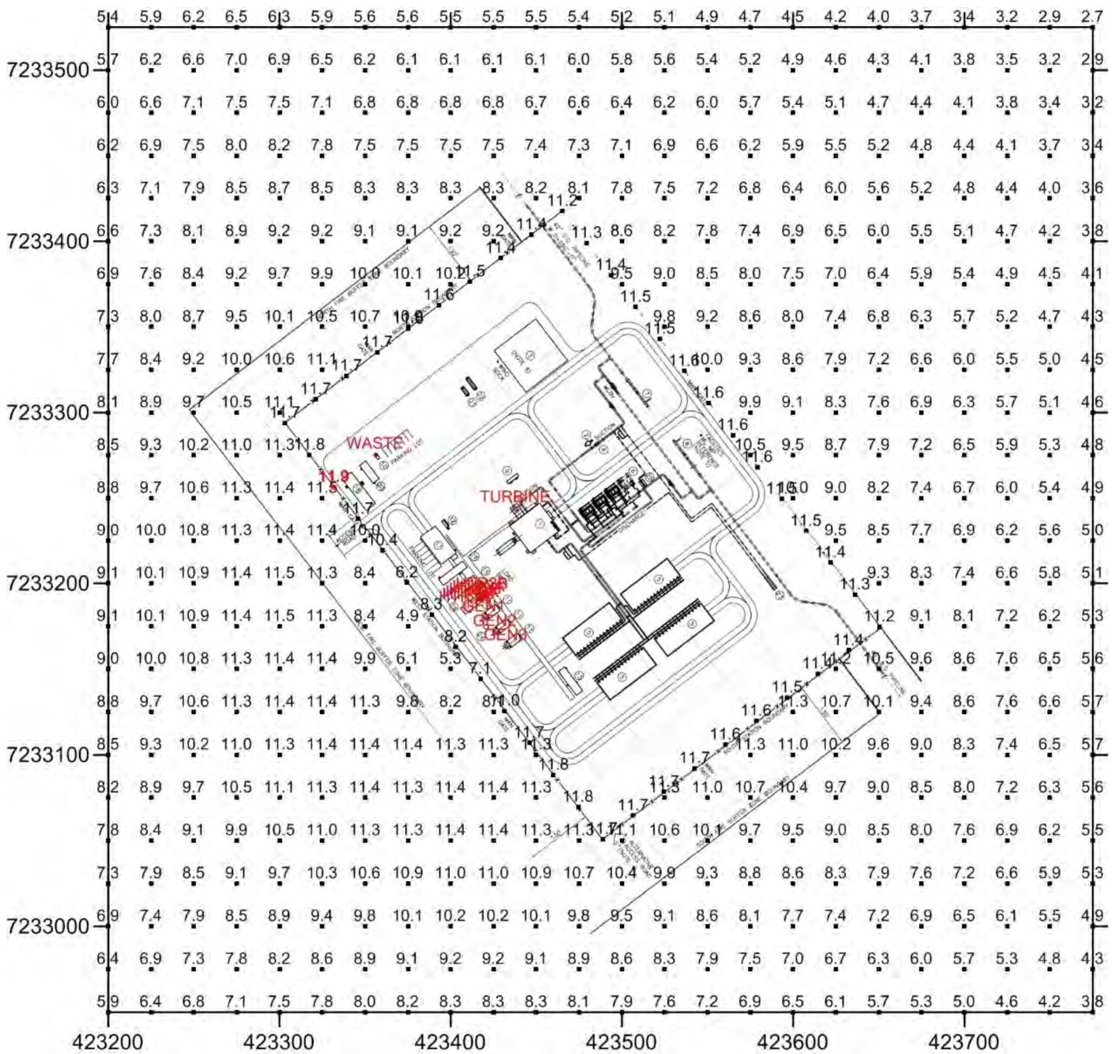


FIGURE G-45
Minto Compressor Station Modeling Results
Maximum 24-Hr Average $PM_{10}/PM_{2.5}$ Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

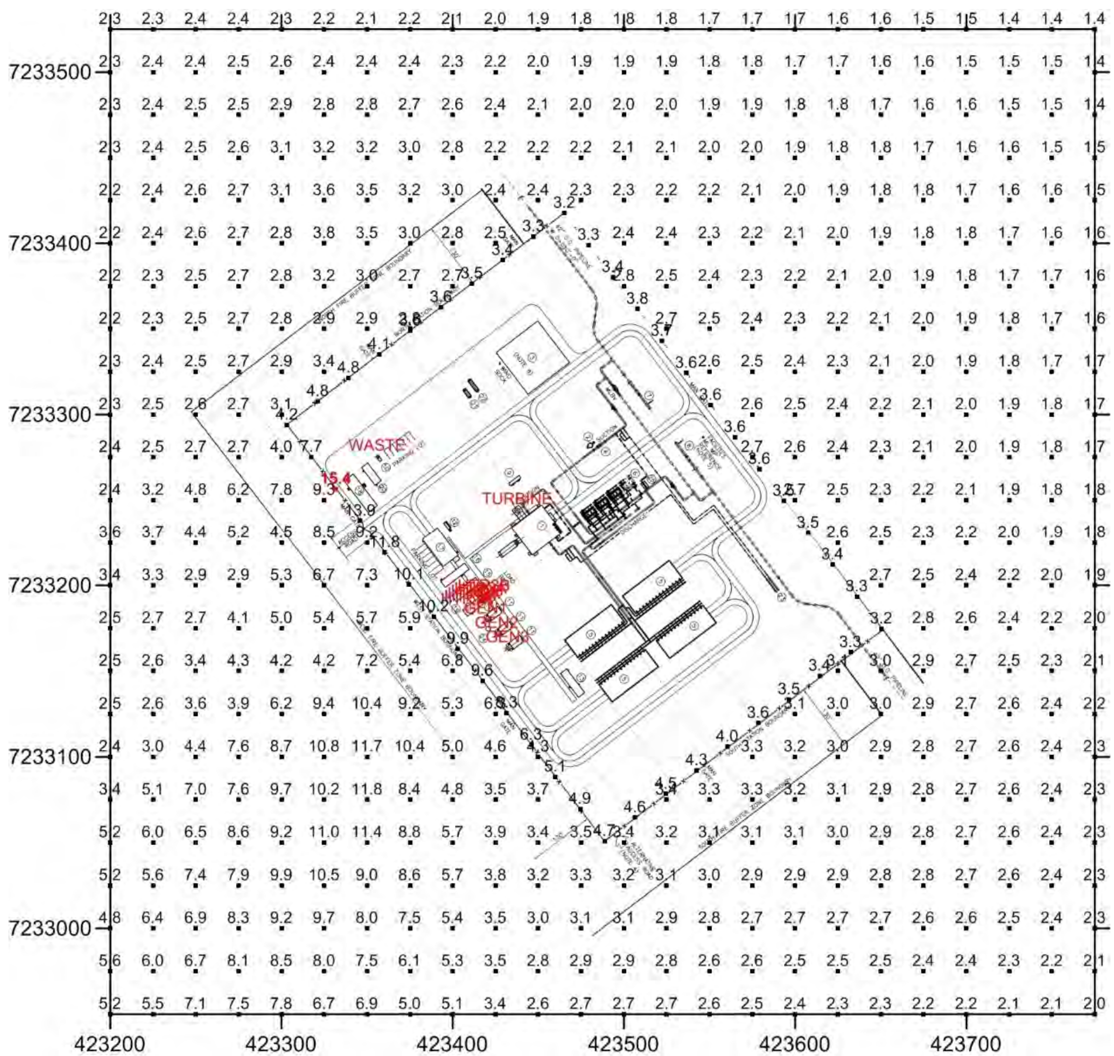


FIGURE G-46
Minto Compressor Station Modeling Results
Annual Average PM_{10}/$PM_{2.5}$ Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

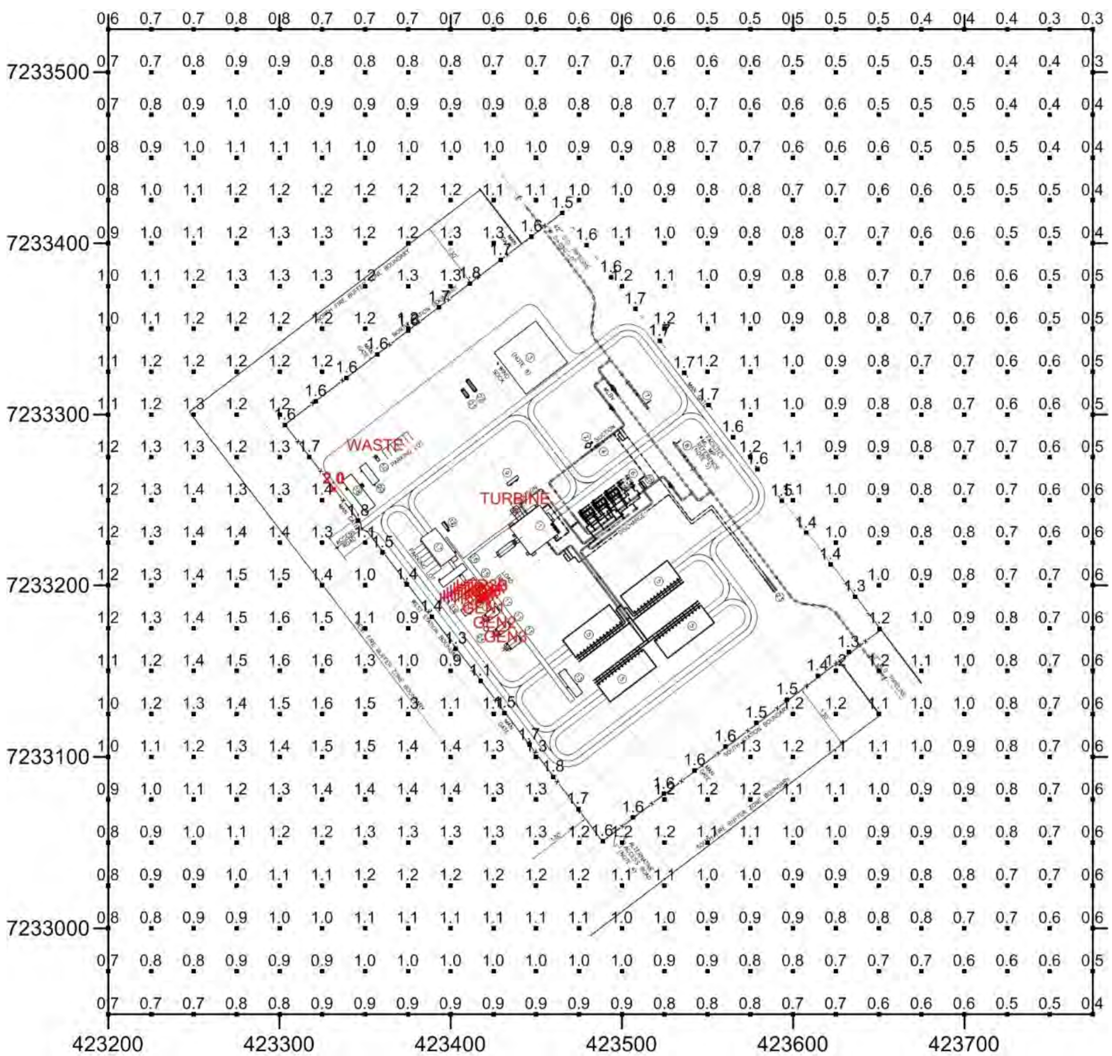


FIGURE G-47
Minto Compressor Station Modeling Results
Maximum 1-Hr Average SO_2 Concentrations (μg/m³)
(Coordinates are UTM NAD83, in meters)

FIGURE G-48
Minto Compressor Station Modeling Results
Annual Average SO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

FIGURE G-49
Minto Compressor Station Modeling Results
Maximum 1-Hr Average CO Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

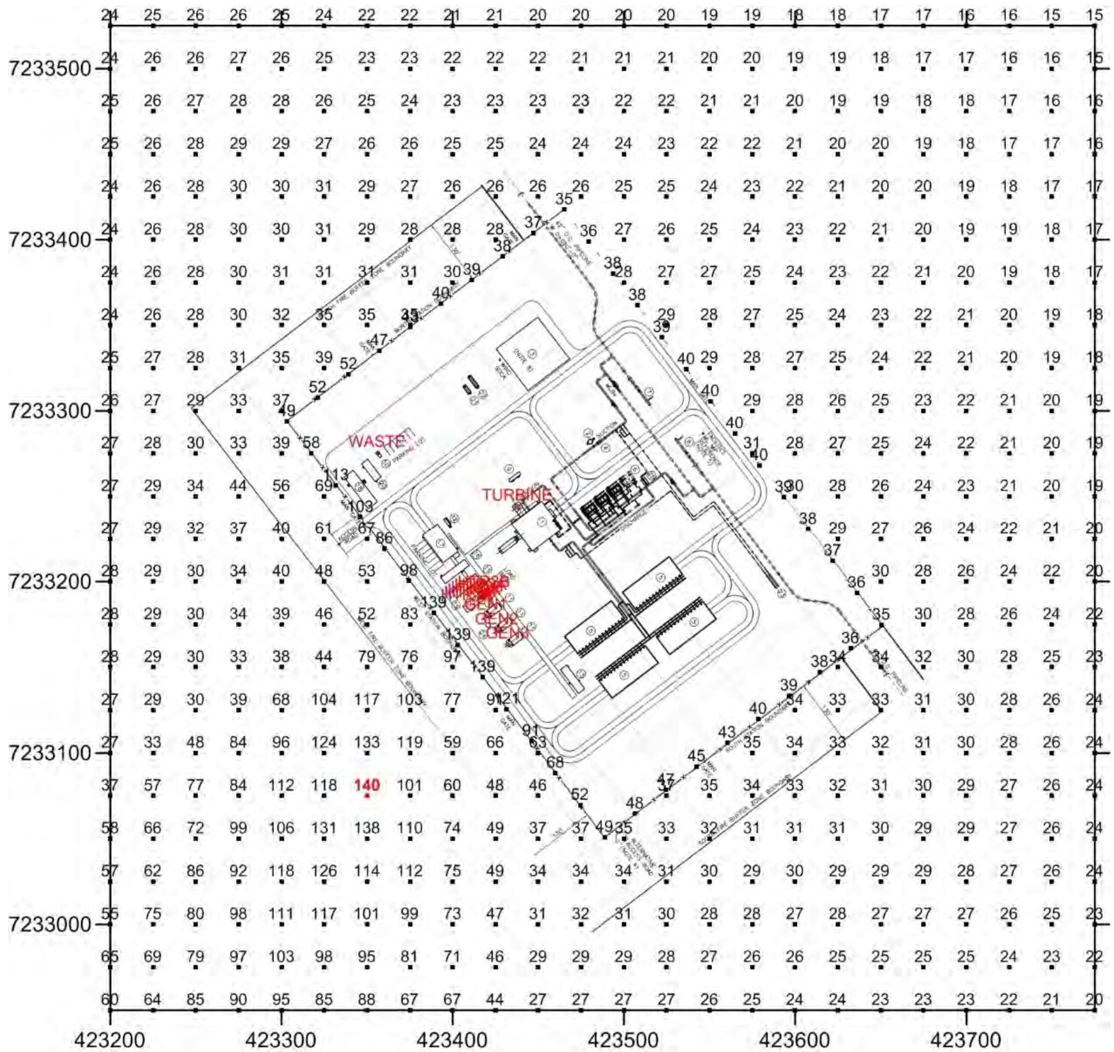


FIGURE G-50
Healy Compressor Station Modeling Results
Maximum 1-Hr Average NO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

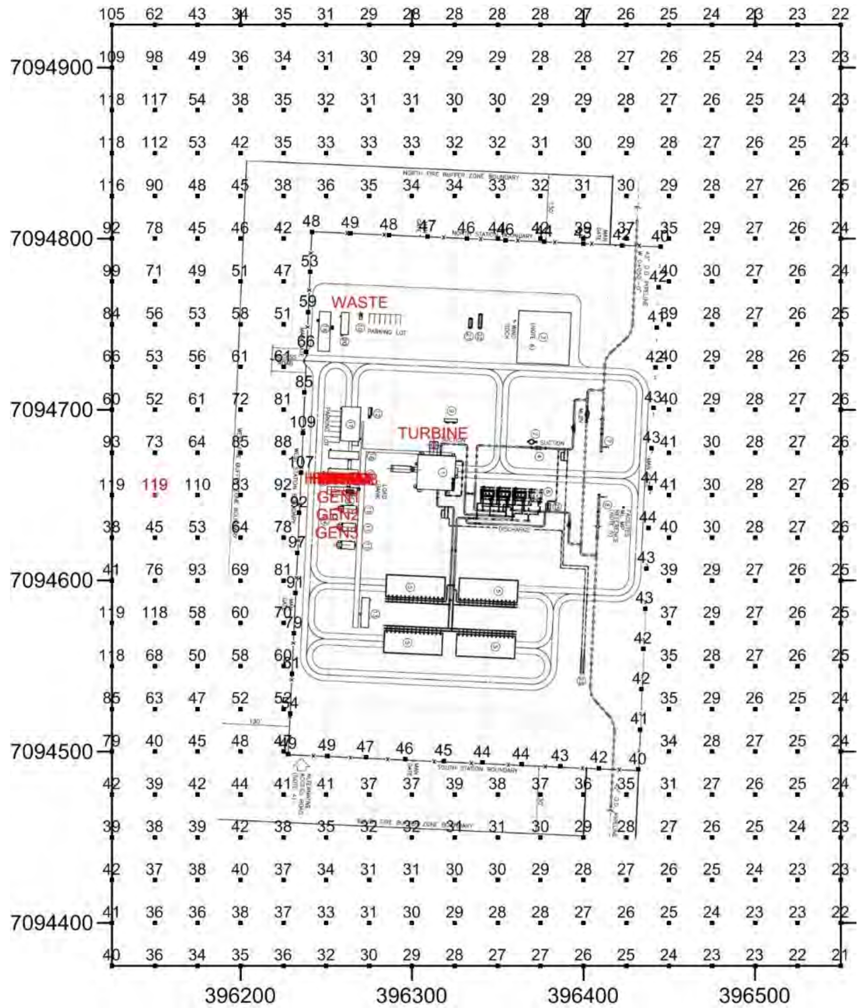


FIGURE G-51
Healy Compressor Station Modeling Results
Annual Average NO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

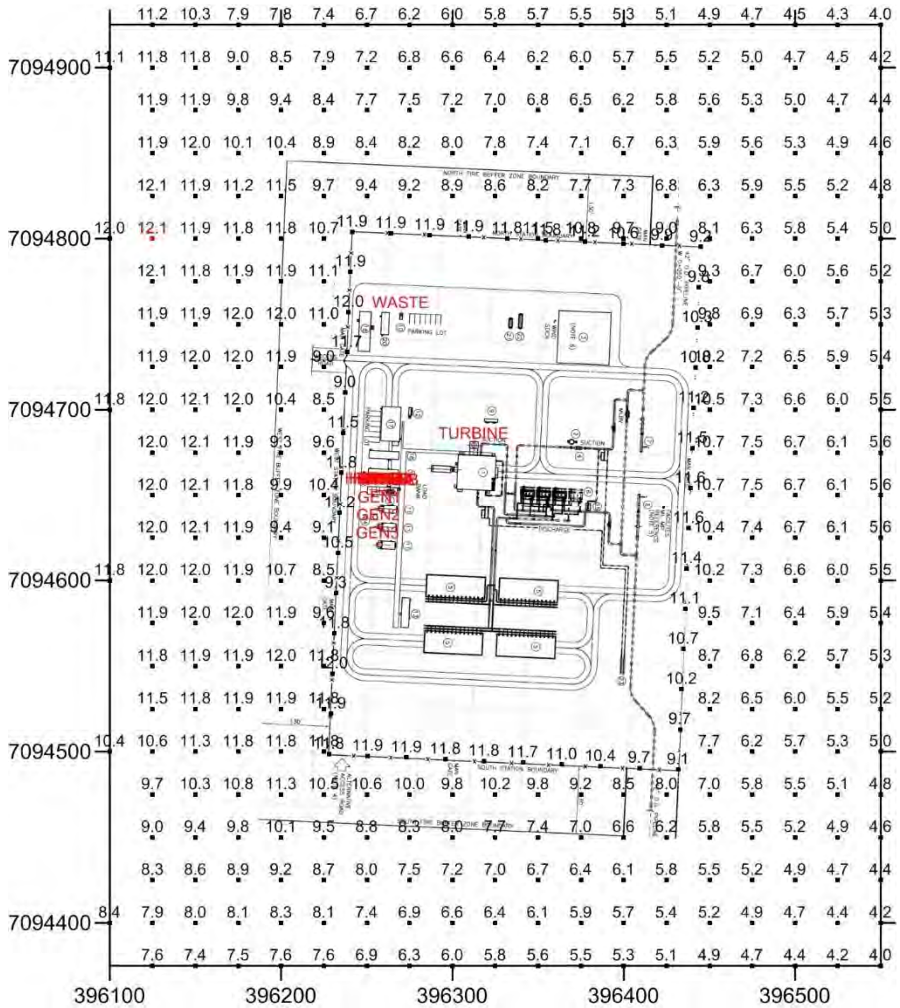


FIGURE G-52
Healy Compressor Station Modeling Results
Maximum 24-Hr Average $PM_{10}/PM_{2.5}$ Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

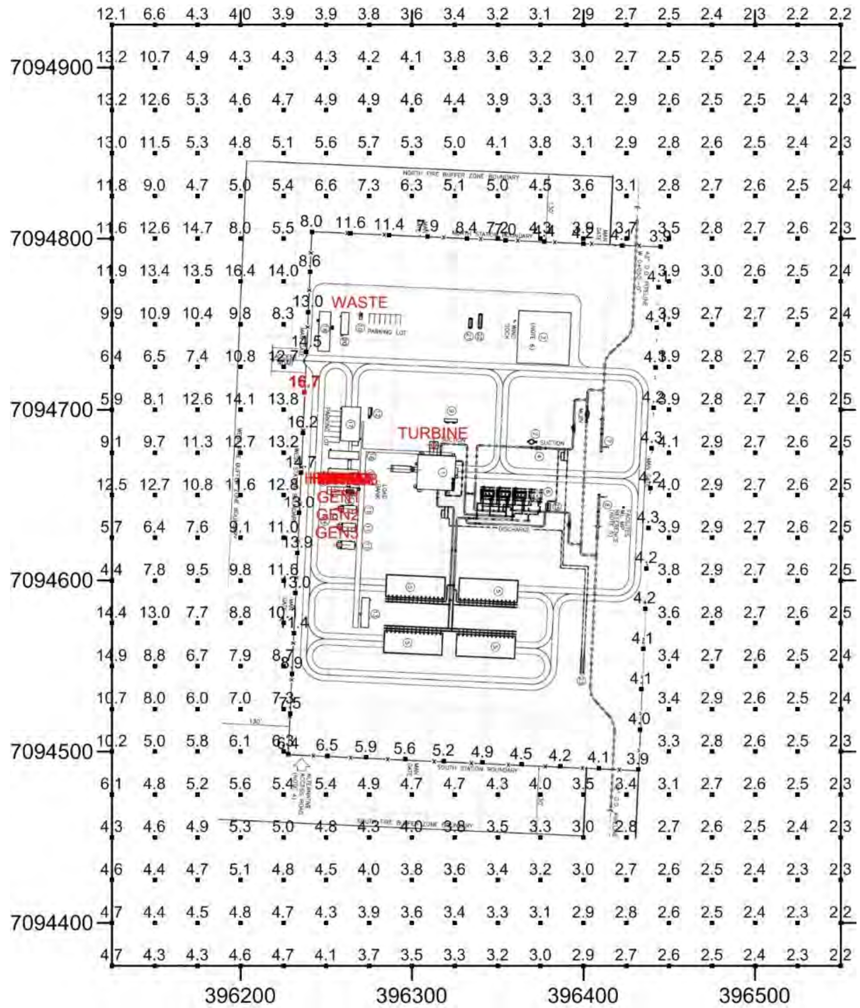


FIGURE G-53
Healy Compressor Station Modeling Results
Annual Average $PM_{10}/PM_{2.5}$ Concentrations (µg/m³)
(Coordinates are UTM NAD83, in meters)

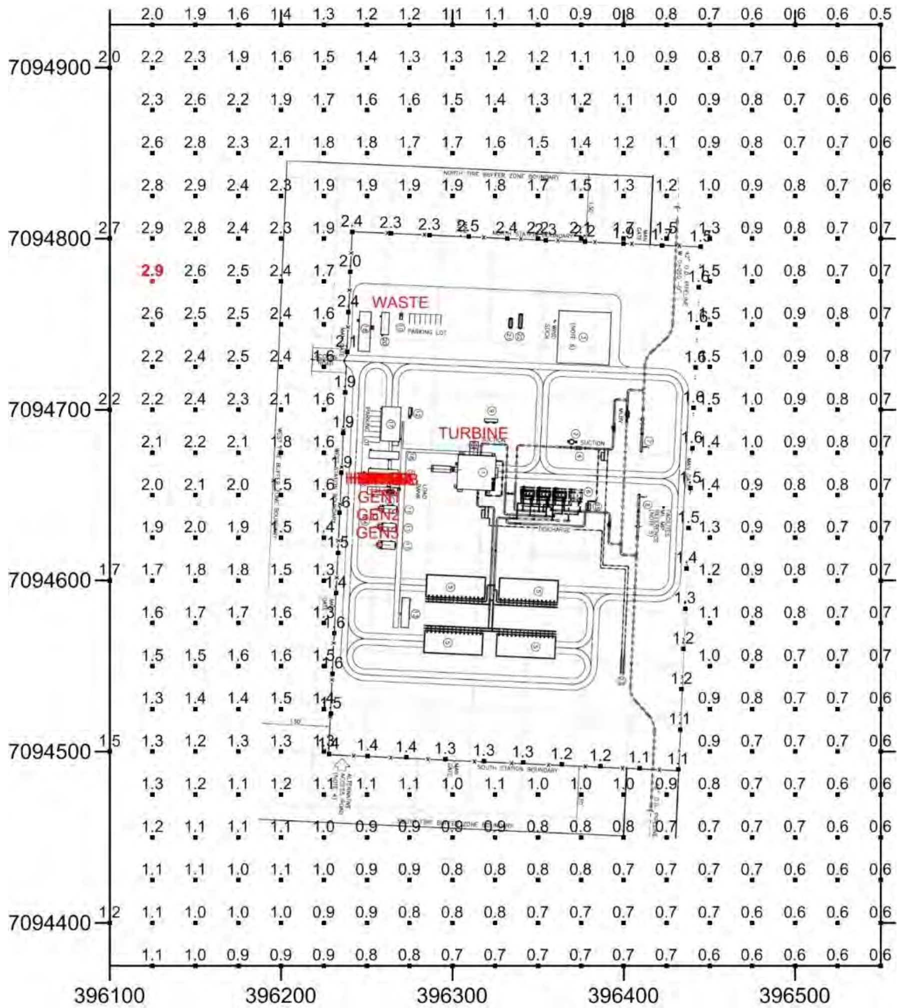


FIGURE G-54
Healy Compressor Station Modeling Results
Maximum 1-Hr Average SO_2 Concentrations (μg/m^3)
(Coordinates are UTM NAD83, in meters)

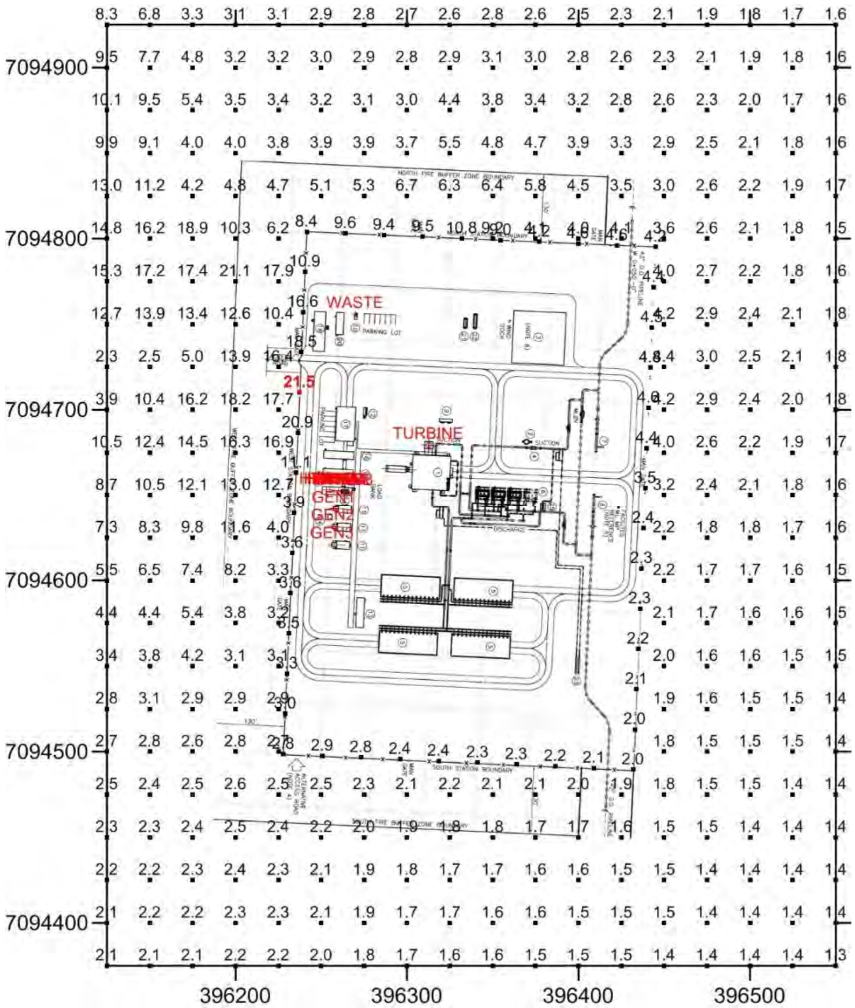


FIGURE G-55
Healy Compressor Station Modeling Results
Annual Average SO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

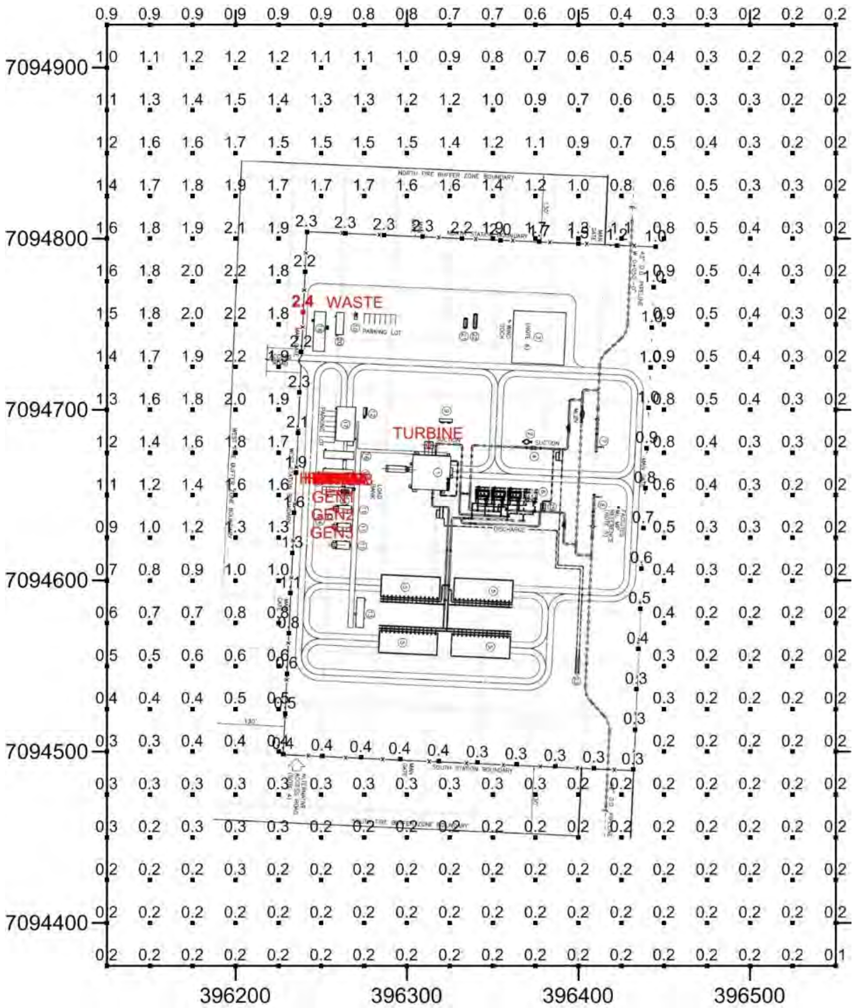


FIGURE G-56
Healy Compressor Station Modeling Results
Maximum 1-Hr Average CO Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

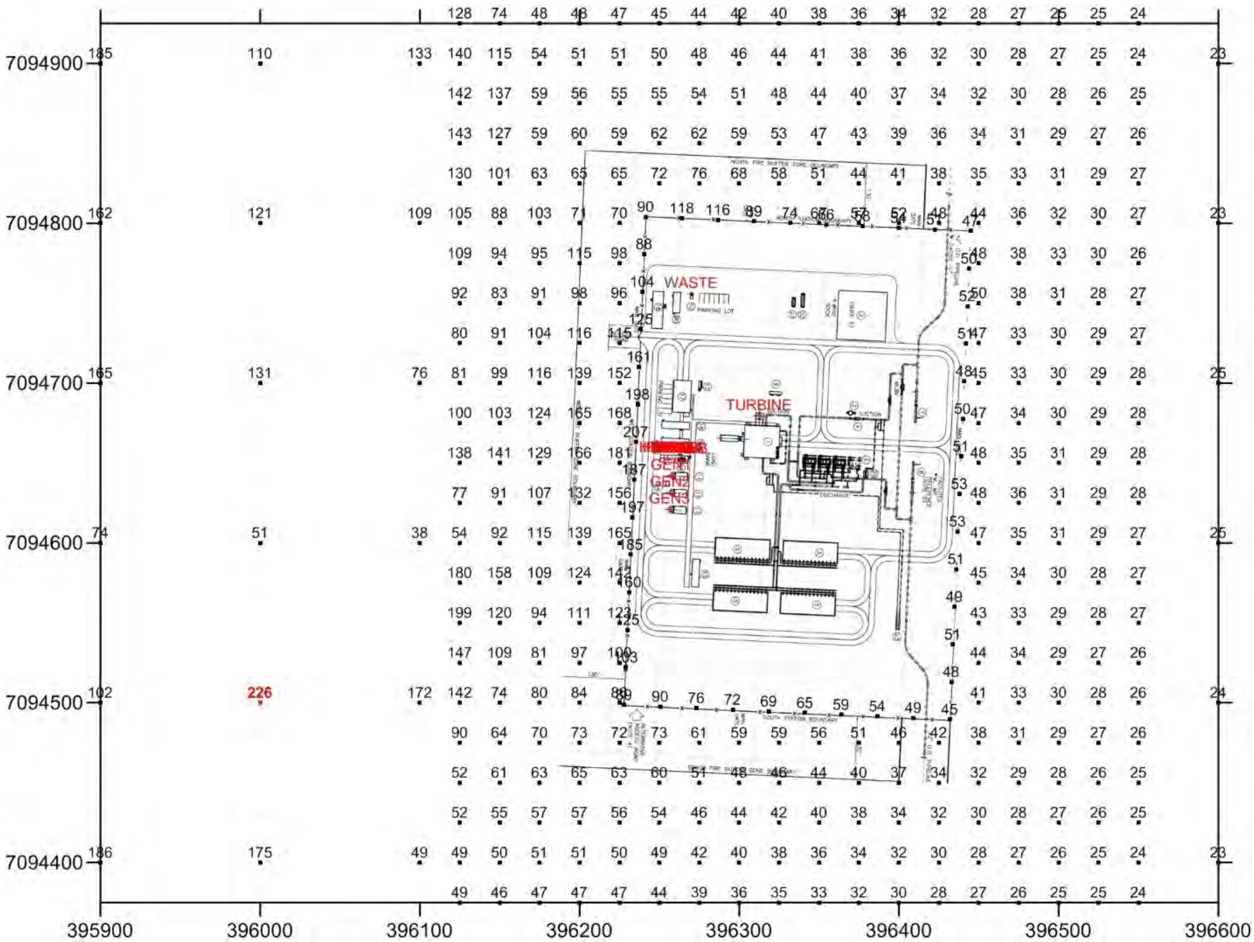


FIGURE G-57
Honolulu Creek Compressor Station Modeling Results
Maximum 1-Hr Average NO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

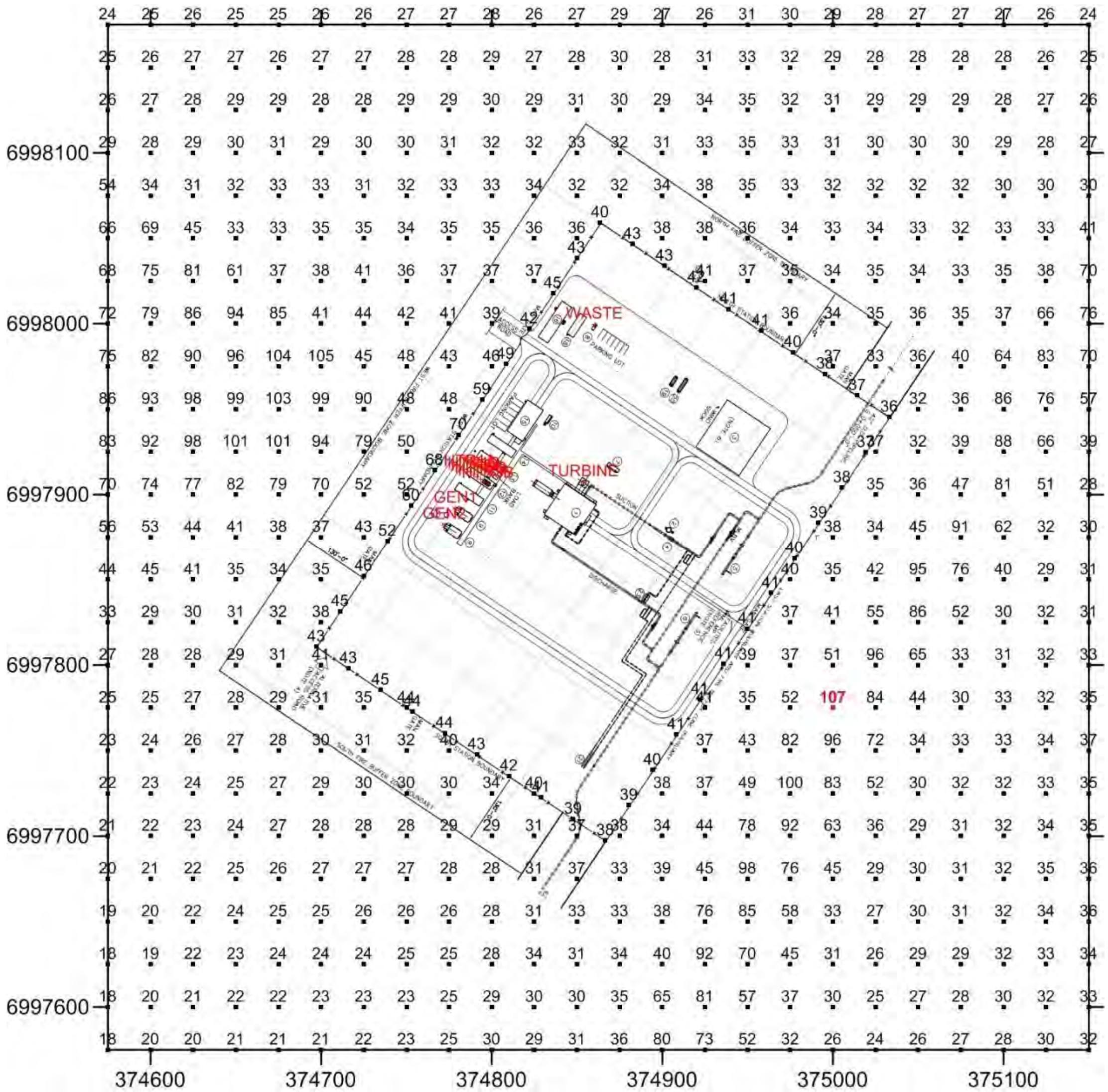


FIGURE G-58
Honolulu Creek Compressor Station Modeling Results
Annual Average NO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

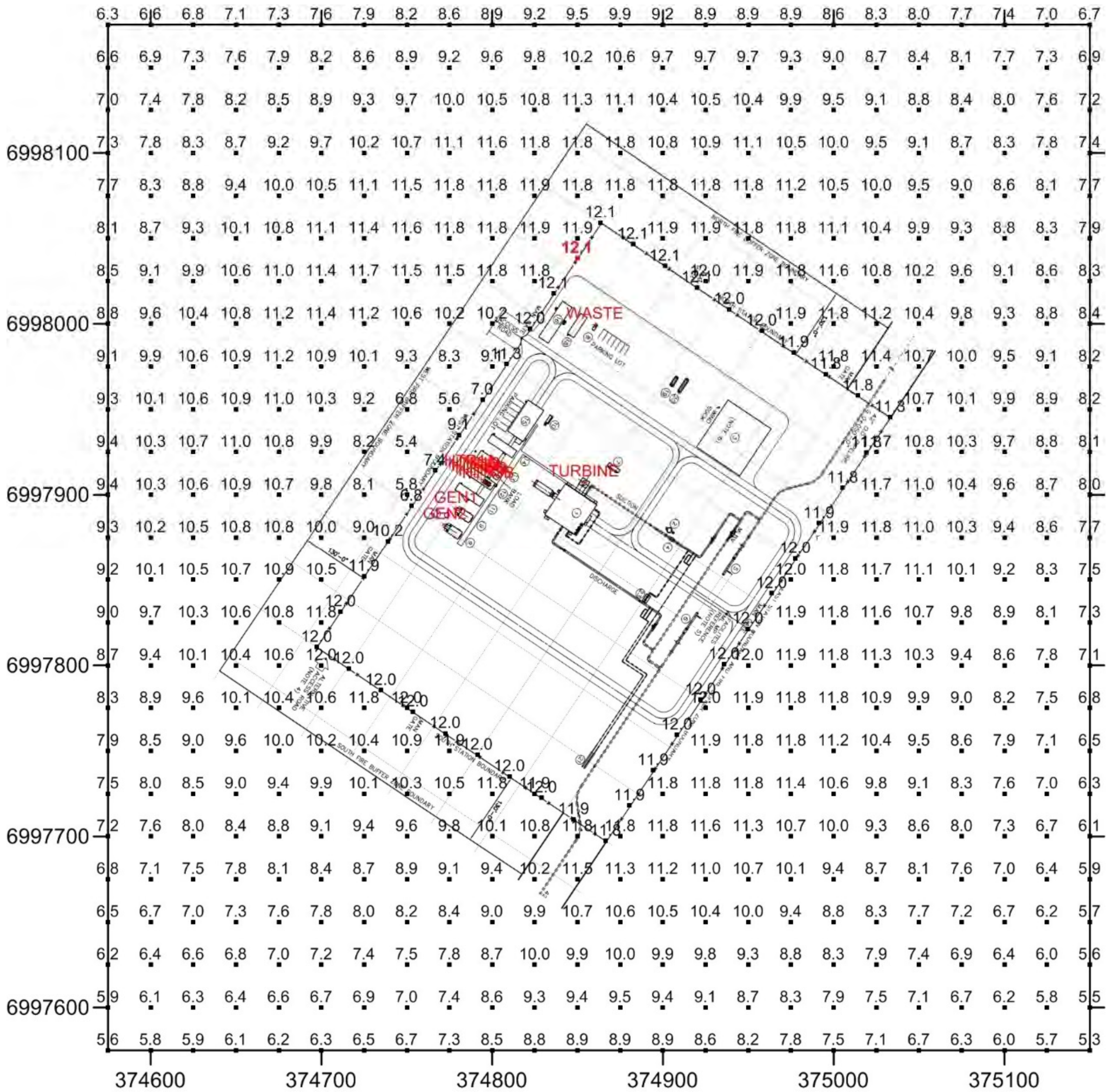


FIGURE G-59
Honolulu Creek Compressor Station Modeling Results
Maximum 24-Hr Average $PM_{10}/PM_{2.5}$ Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

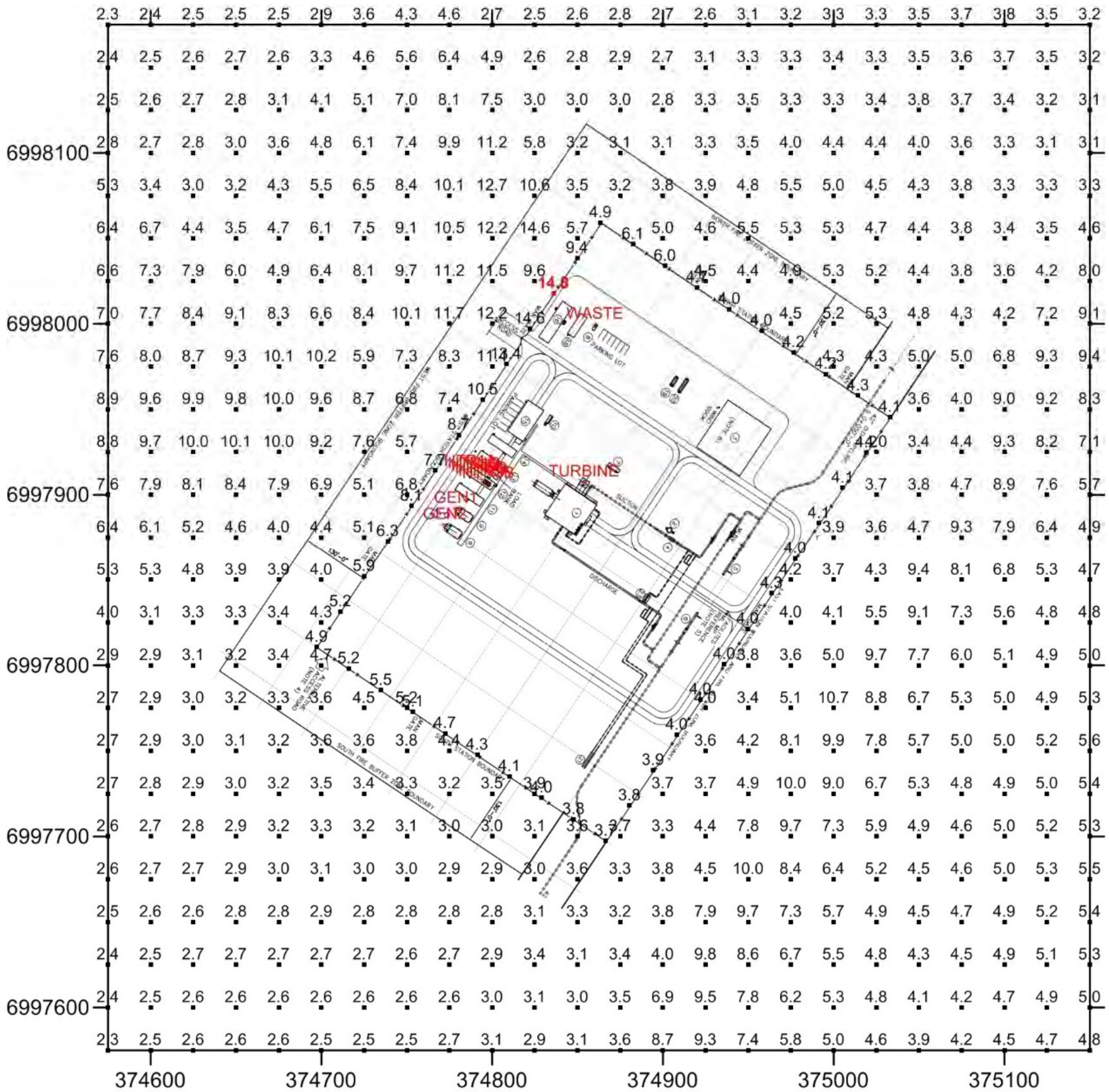


FIGURE G-60
Honolulu Creek Compressor Station Modeling Results
Annual Average $PM_{10}/PM_{2.5}$ Concentrations (μg/m³)
(Coordinates are UTM NAD83, in meters)

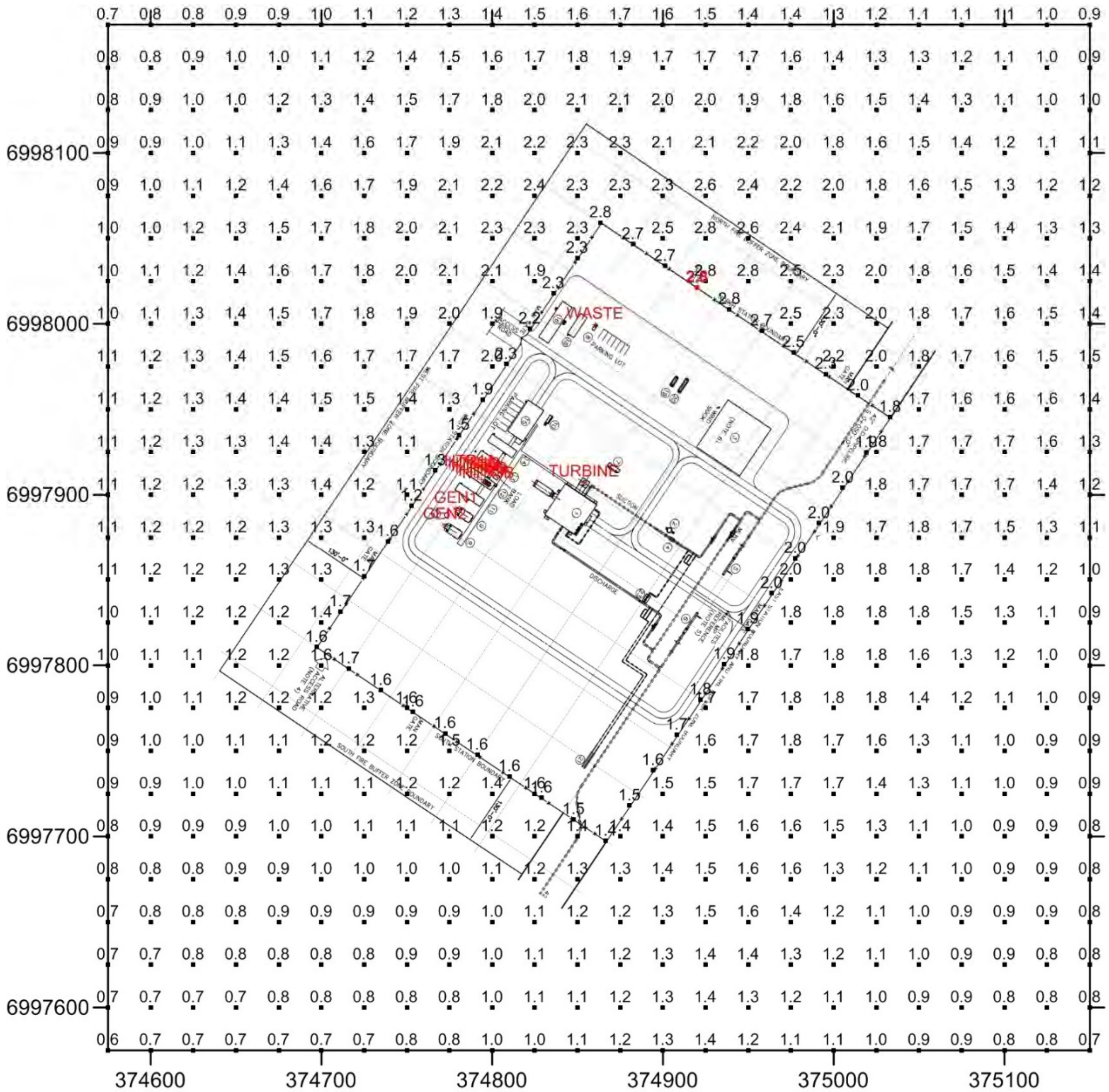


FIGURE G-61
Honolulu Creek Compressor Station Modeling Results
Maximum 1-Hr Average SO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

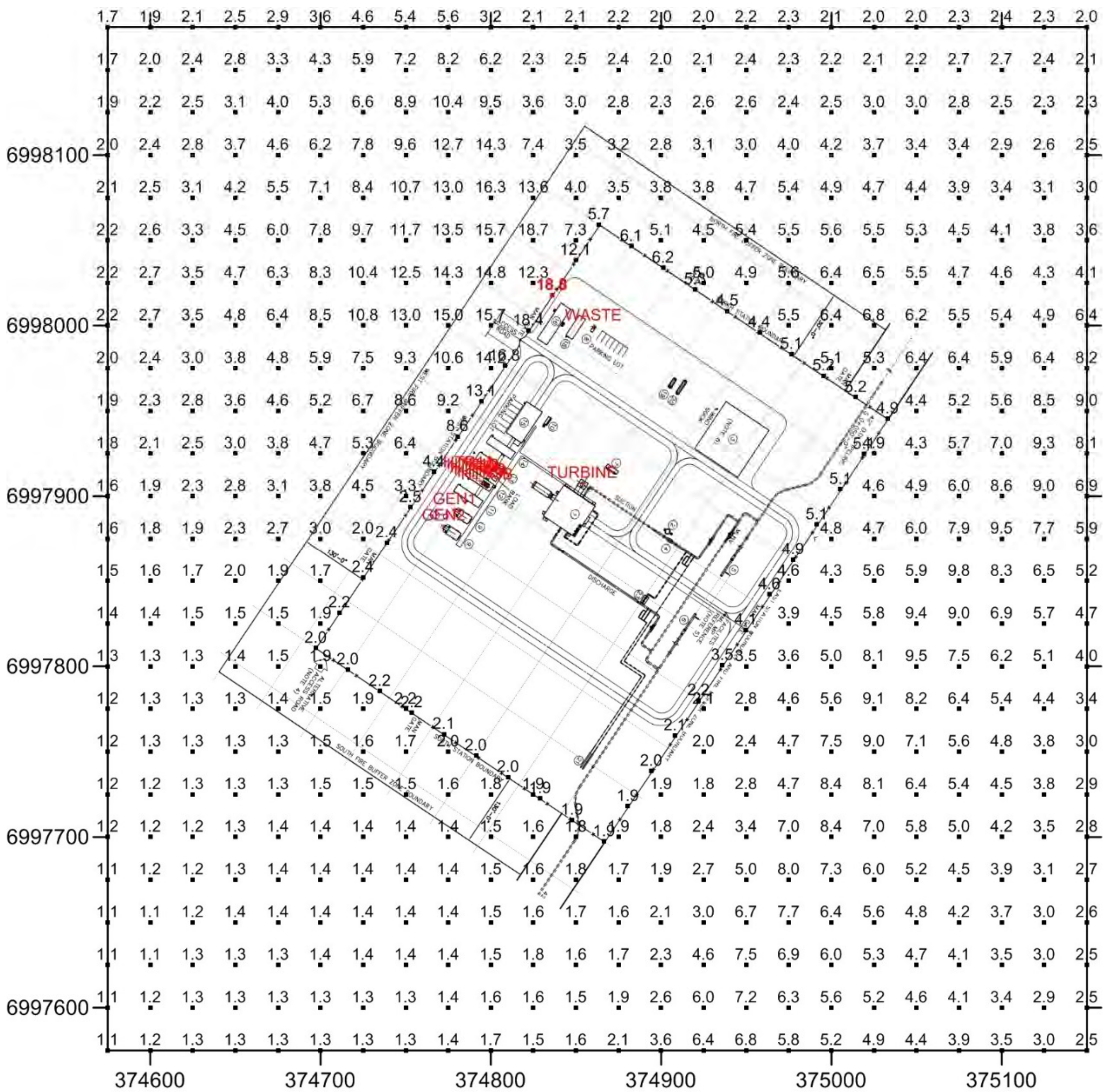


FIGURE G-62
Honolulu Creek Compressor Station Modeling Results
Annual Average SO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

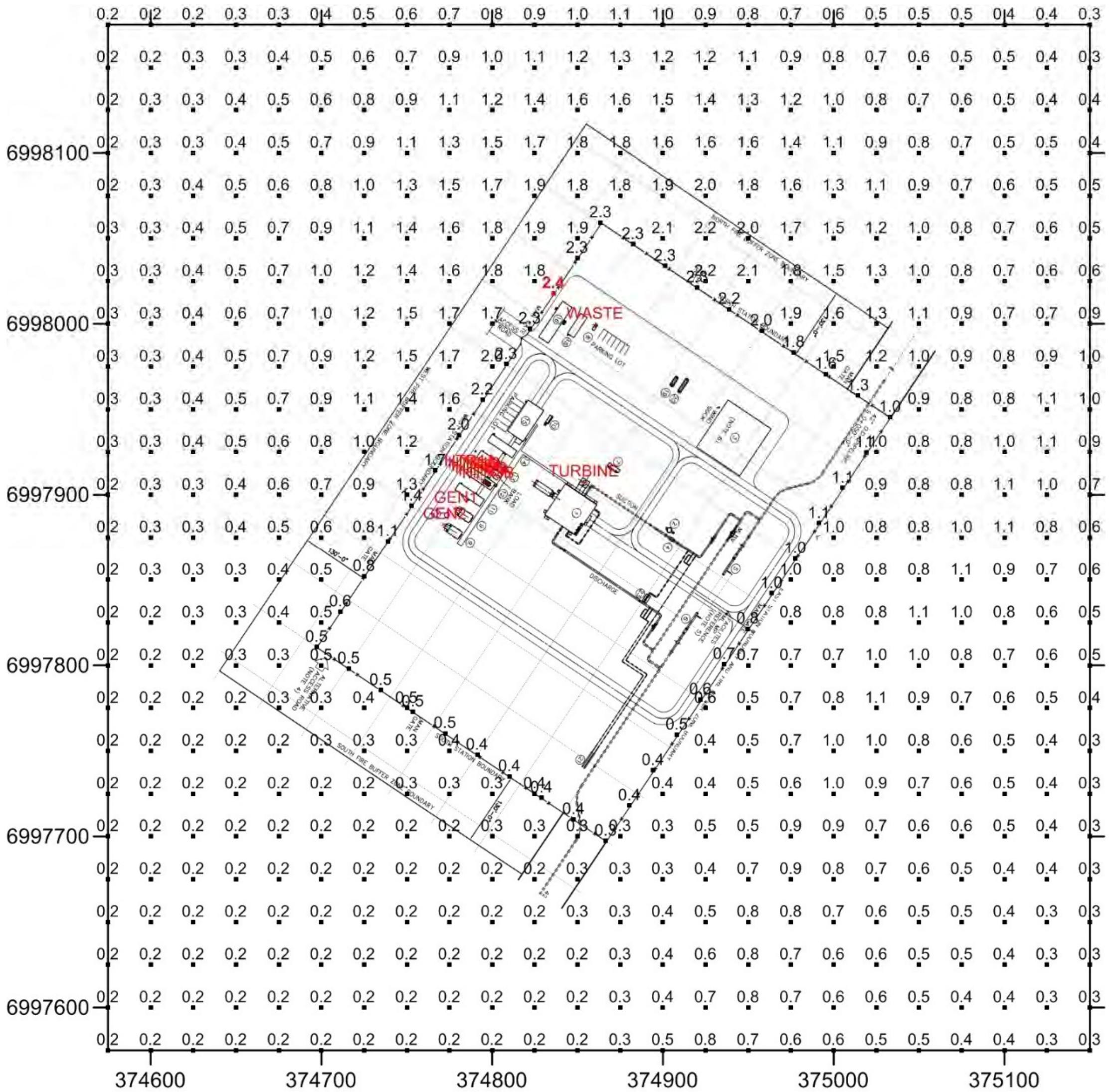


FIGURE G-63
Honolulu Creek Compressor Station Modeling Results
Maximum 1-Hr Average CO Concentrations (μg/m^3)
(Coordinates are UTM NAD83, in meters)

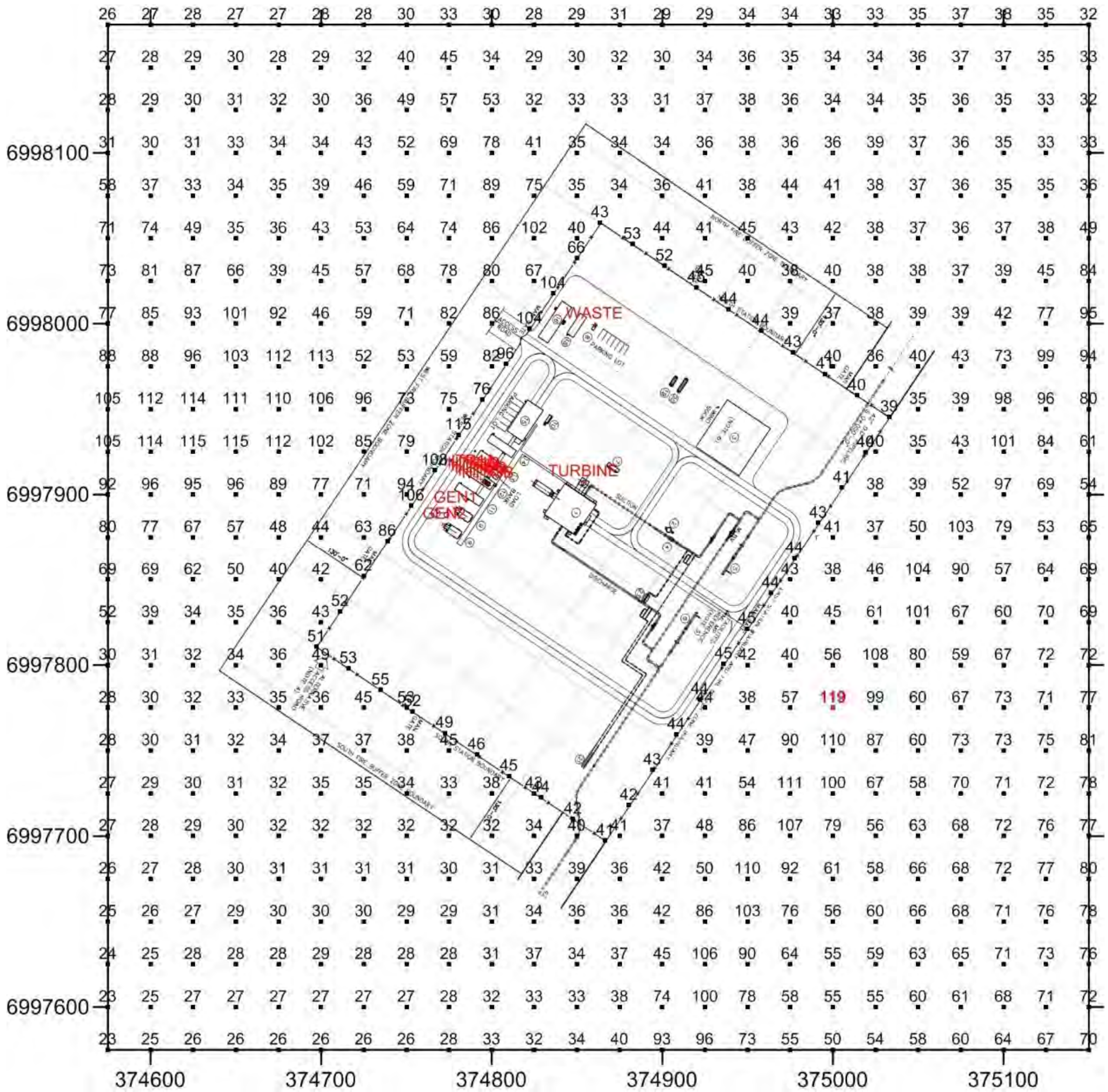


FIGURE G-64
Rabideux Creek Compressor Station Modeling Results
Maximum 1-Hr Average NO_2 Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

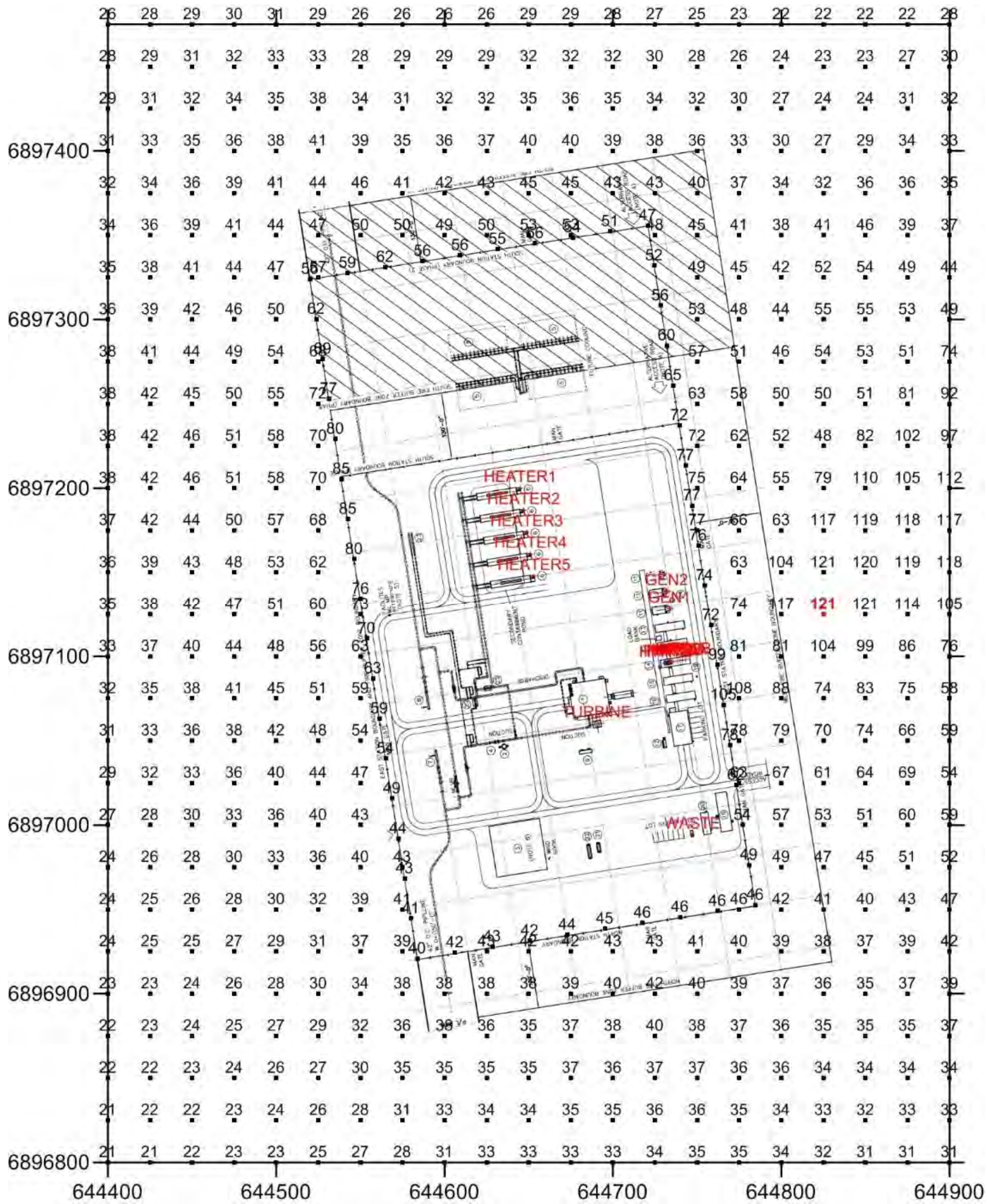


FIGURE G-65
Rabideux Creek Compressor Station Modeling Results
Annual Average NO_2 Concentrations (μg/m[3])
(Coordinates are UTM NAD83, in meters)

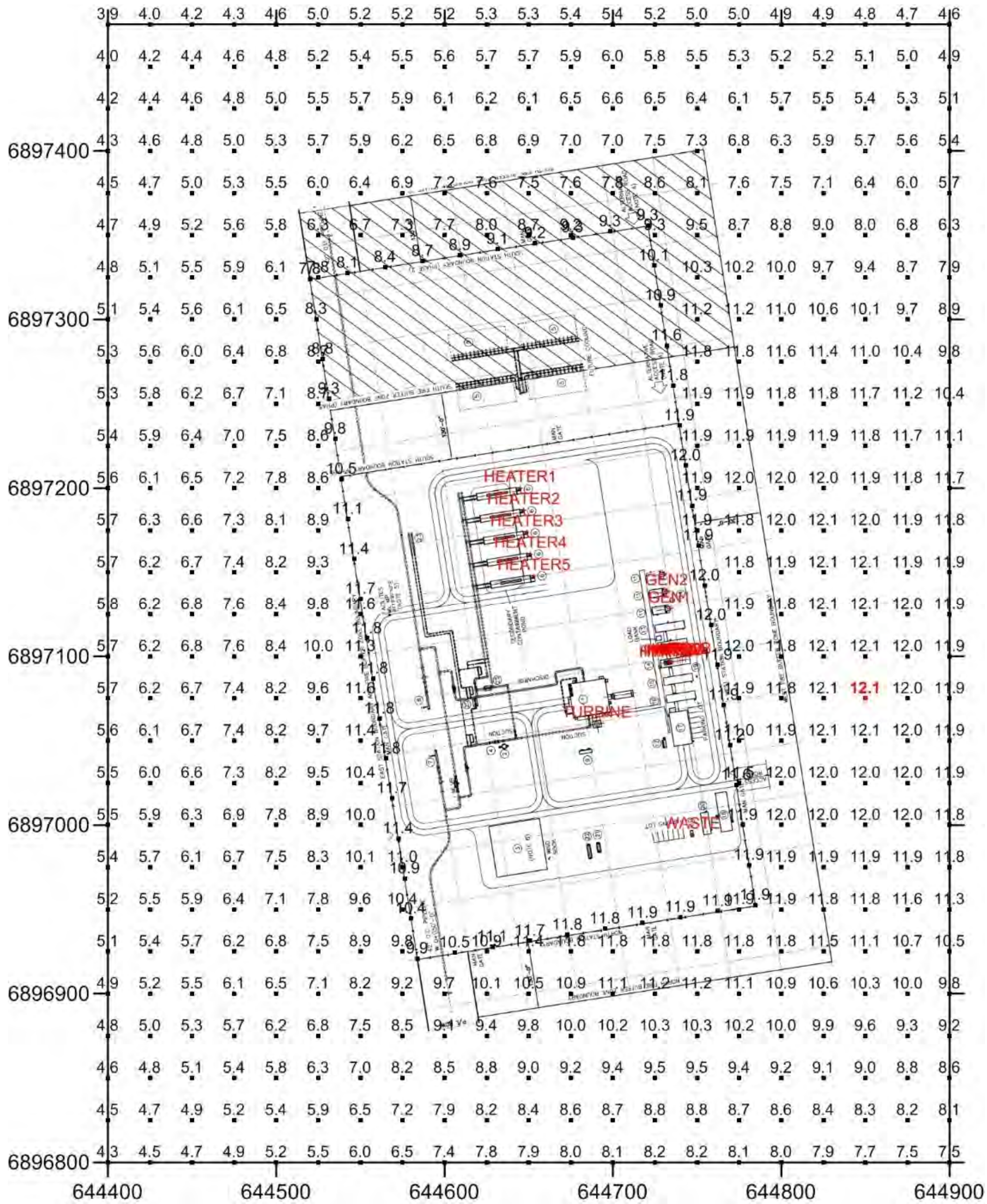


FIGURE G-66
Rabideux Creek Compressor Station Modeling Results
Maximum 24-Hr Average $PM_{10}/PM_{2.5}$ Concentrations (μg/m^3)
(Coordinates are UTM NAD83, in meters)

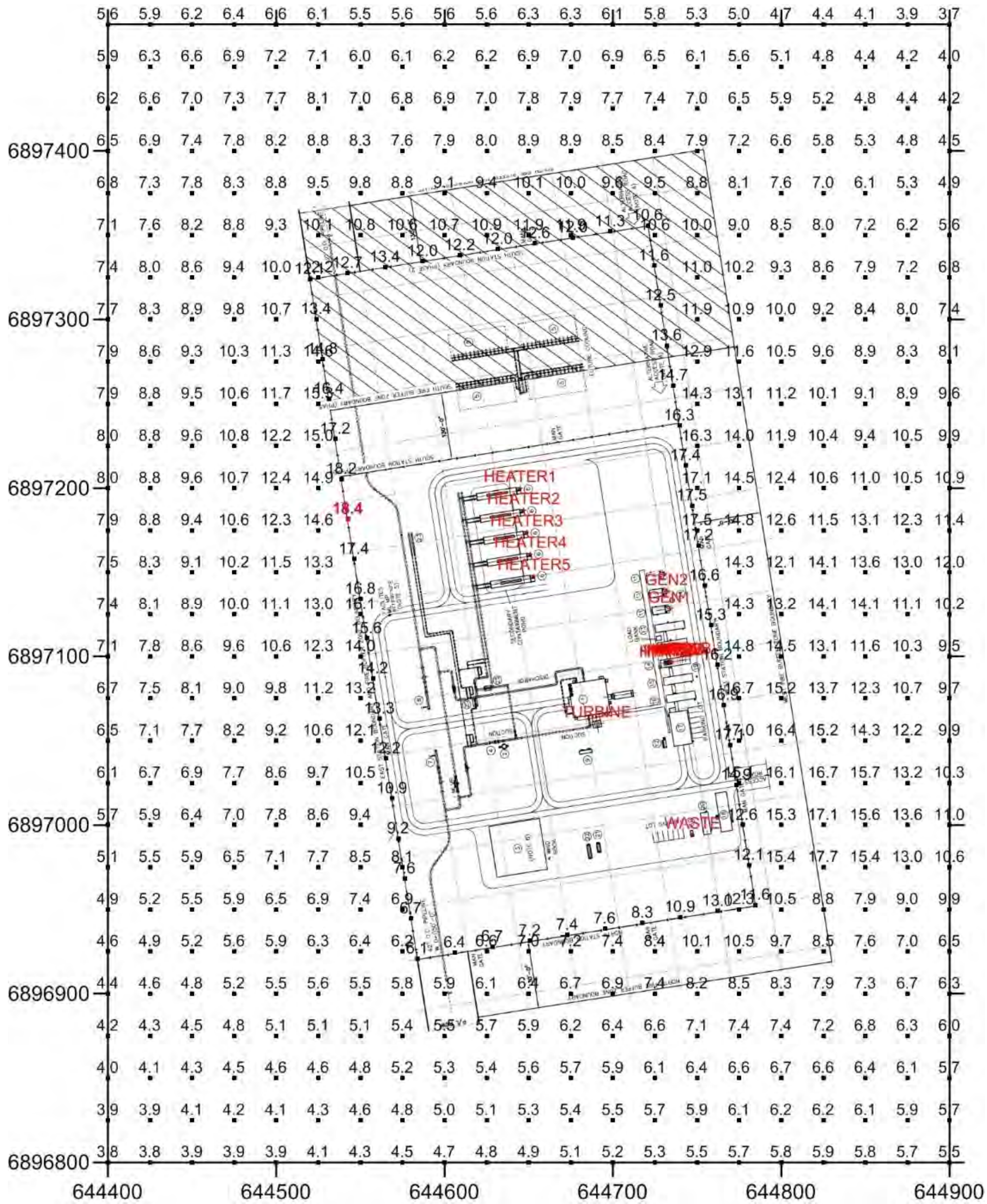


FIGURE G-67
Rabideux Creek Compressor Station Modeling Results
Annual Average $PM_{10}/PM_{2.5}$ Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)

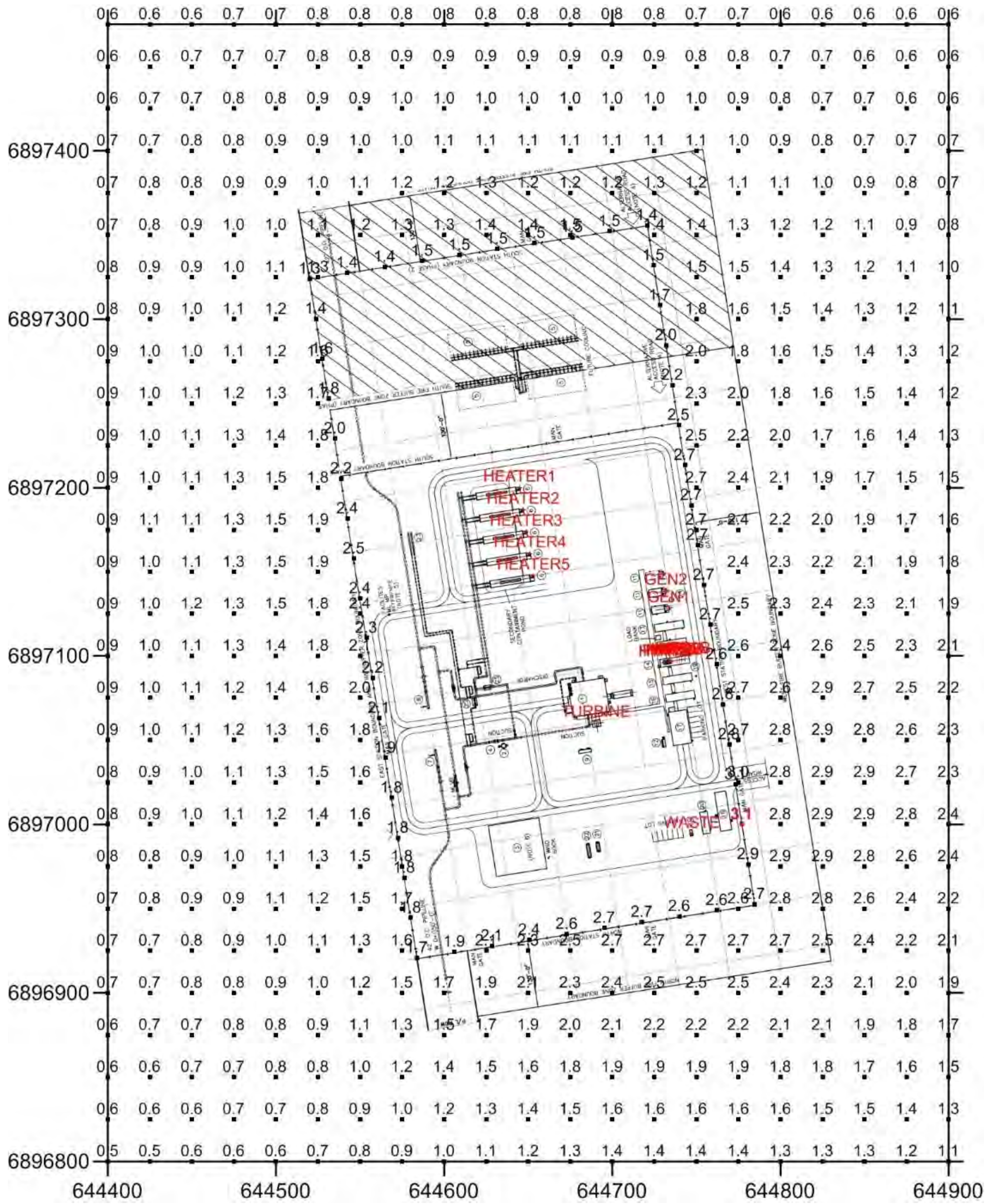


FIGURE G-68
Rabideux Creek Compressor Station Modeling Results
Maximum 1-Hr Average SO_2 Concentrations (μg/m^3)
(Coordinates are UTM NAD83, in meters)

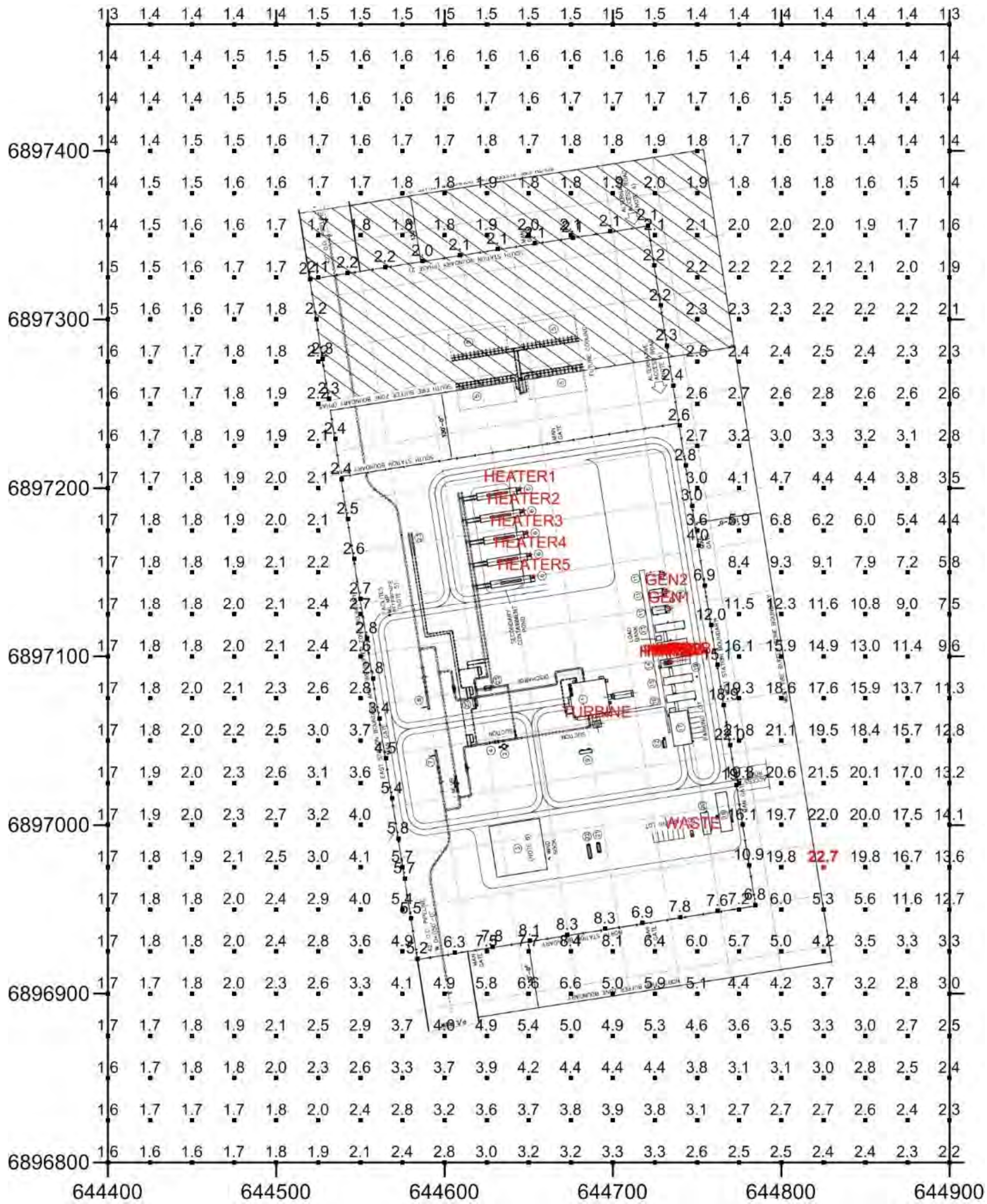


FIGURE G-69
Rabideux Creek Compressor Station Modeling Results
Annual Average SO_2 Concentrations (μg/m^3)
(Coordinates are UTM NAD83, in meters)

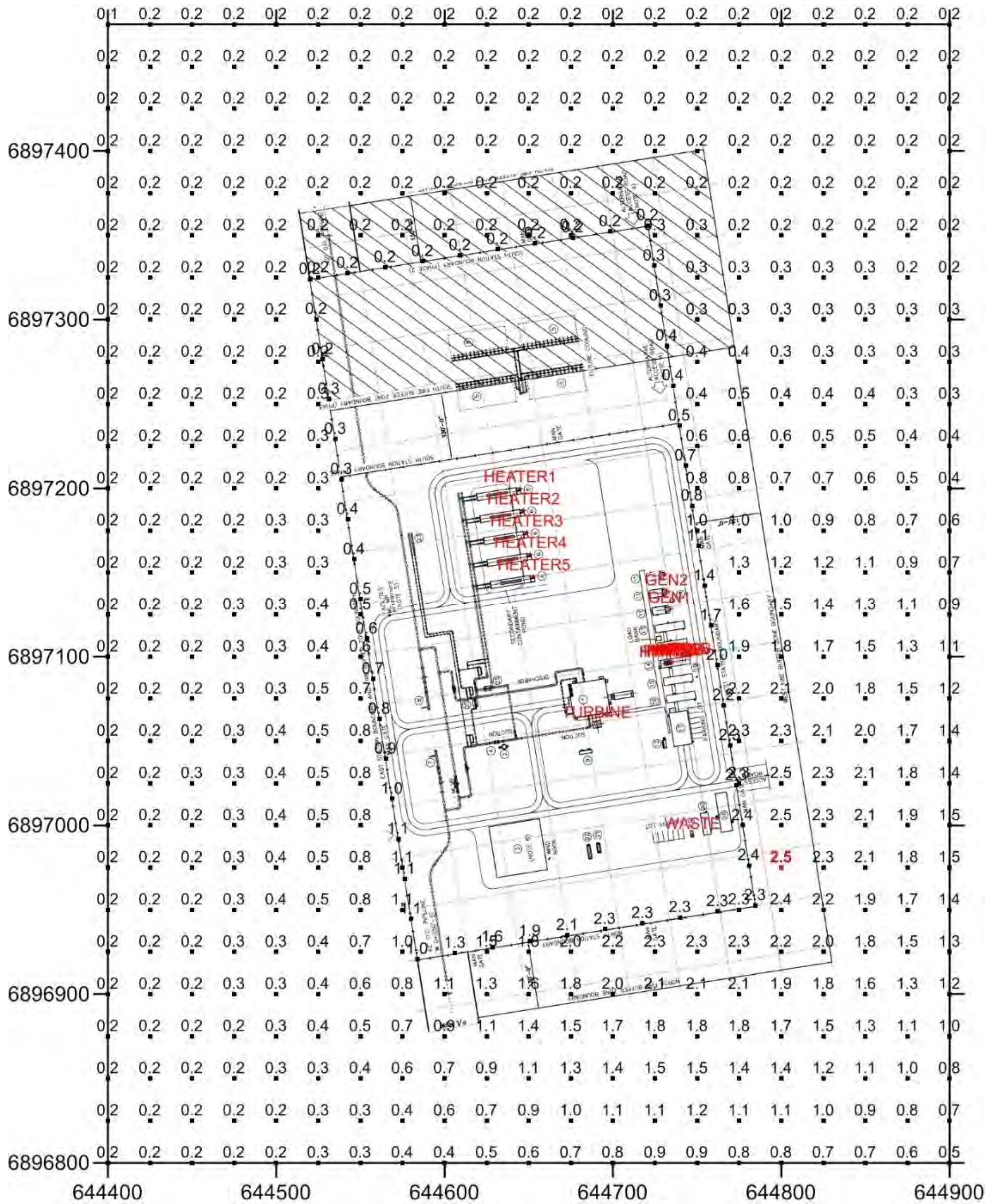
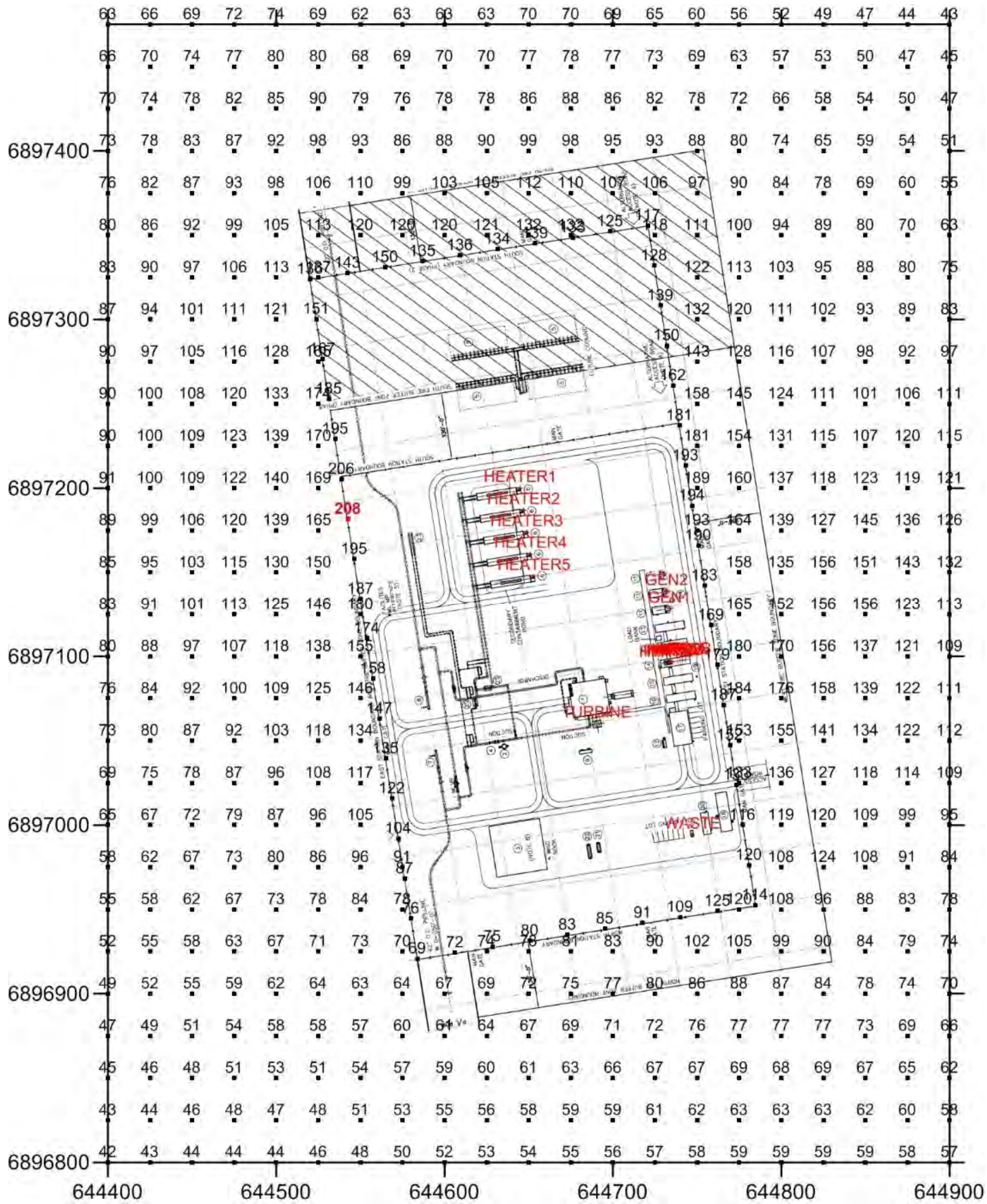


FIGURE G-70
Rabideux Creek Compressor Station Modeling Results
Maximum 1-Hr Average CO Concentrations ($\mu g/m^3$)
(Coordinates are UTM NAD83, in meters)



Appendix H: MAKEMET Screening Meteorology Standard Operating Procedure

1.0 INTRODUCTION AND PURPOSE

In lieu of hourly site-specific or National Weather Service (NWS) Automated Surface Observing System (ASOS) data, screening meteorology input data for modeling conducted with AERMOD was developed for each compressor station site using the MAKEMET pre-processor. This screening meteorology input data consists of a matrix of "worst-case" meteorological conditions. This procedure describes how to generate the worst-case input file using MAKEMET.

2.0 GENERATION OF MAKEMET SCREENING METEOROLOGY

Screening meteorological input files will be developed using the following procedure for all compressor stations utilizing screening meteorology for dispersion modeling.

1. For each site divide a 1-km radius circle centered on the main block valve into twelve 30° sectors. Run the modified AERSURFACE for each site and sector to determine the surface characteristics according to season. The procedure for determining seasonal classifications and seasonal temperature ranges is described in the project FERC Dispersion Modeling Protocol.
2. Create a MAKEMET input ASCII text file for each of the 12 sectors around the site for a total of 12 input files. Each MAKEMET input files consists of the following prompts:

   Enter Surface meteorology file name [output file]
   Enter Profile meteorology file name [output file]
   Enter minimum wind speed (m/s) ***<<set to a default of 0.5 m/s for all sites according to the FERC Dispersion Modeling Protocol>>***
   Enter anemometer height (m) ***<<set to a default of 10 m for all sites according to the FERC Dispersion Modeling Protocol>>***
   Enter number of wind directions
   Enter starting wind direction
   Enter clockwise increment
   Enter Min and Max ambient temperature (K)
   Enter Albedo
   Enter Bowen Ratio
   Enter Surface Roughness (m)
   Append another file (i.e. next season)

   a. The objective is to create 12 MAKEMET input files (one per sector) sufficient to cover 36 wind directions starting at 5° and incrementing by 10° and ending at 355°. To meet that objective using 12 sectors, each file is limited to 3 wind directions. Therefore, for the first sector (from 0° to 30°), the 'starting wind direction' should be 5° with a clockwise increment of 10°. Hence the first sector will contain 5°, 15° and 25°. The second sector should contain 35°, 45° and 55°, and so on.
   b. For the last four inputs (Min and Max Temperature, Albedo, Bowen Ratio, and Surface Roughness), the values are entered for the first season modeled, Winter with snow (1st half). The Min and Max Temperature, Albedo, Bowen Ratio and Surface Roughness values were determined for the site, season and sector determined in Step 1.
   c. MAKEMET allows the user to append another set of inputs provided the same directions are utilized. Utilizing this option, the other four seasons, namely Winter with snow (2nd half), Spring, Summer and Autumn, are entered within the same input file for a given set of wind

directions (i.e., all 5 seasons are contained within the MAKEMET input file for a single sector).

   d. Continue adding seasons into the single sector input file until all 5 seasons have been added and then start creating the input file for the next of the 12 sectors until input files for all sectors have been created.

3. Once the MAKEMET input files are created, run MAKEMET in a batch mode, passing in the input files for each sector to the program one at a time.

4. Once the twelve pairs of MAKEMET-generated surface and profile files are created concatenate them to produce a single surface and profile pair of files for each site.

5. Though the MAKEMET surface and profile files are formatted similar to a Stage 3 AERMET surface and profile files, some additional manipulation needs to be conducted so that they are compatible with running AERMOD outside of “screening mode” as follows.

   a. Replace the timestamp, with a sequential dummy timestamp (comprised of the year, month, day or month, Julian day and hour) in both the profile and surface files. Due to variations in the seasonal temperature ranges, each site will have a slightly different period length but all will be approximately twelve years long.

   b. For the Ozone Limiting Method (OLM) processing associated with NO2, fill both the surface and profile files with ‘missing data’ so that each file represents a record of complete calendar years.

   c. In the surface files, for the final five columns, replace the AERSCREEN index numbers with the appropriate ‘missing’ values for the corresponding AERMET variables.

   d. The latest version of AERMET (11053) has an additional column in the surface file which notes if any missing winds have been substituted and if so, from what data set. Since no substitutions were performed, fill the final columns with ‘NAD’.

   e. Finally, mark the surface file and profile file with a dummy header line using coordinates and call numbers for the Barrow NWS station so that AERMOD