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Trinity Consultants

December 13, 2016

Ms. Nancy Vehr
Air Quality Administrator
Wyoming Department of Environmental Quality
200 W. 17th Street, 3rd Floor
Cheyenne, WY 82002

RE: **Gillette Wyoming Area 1-Hour SO_2 Modeling Analysis Report**

Dear Ms. Vehr,

On behalf of Basin Electric Power Cooperative, Black Hills Corporation and PacifiCorp, Trinity Consultants is submitting a report on 1-hour SO_2 Modeling conducted for the major SO_2 sources in the vicinity of Gillette in Campbell County, Wyoming.

In discussion with WDEQ, the three utilities contracted with Trinity Consultants to perform the modeling using the latest version of AERMOD (per the protocol submitted and approved in November 2016) for the six coal-fired electric generation units in the Gillette area for the period of 2012 through 2014 using actual hourly CEMS data for each of the units and local representative meteorological data. The modeling resulted in the highest receptor concentration being less than 50% of the 1-hour SO_2 NAAQS. Thus, the modeling has demonstrated compliance with the 1-hour SO_2 NAAQS.

Enclosed with this submittal are two copies of the final report and one set of electronic modeling files on CD. If you have any questions or need further information please contact Anna Unruh at (720) 638-7647, ext. 114 or email at aunruh@trinityconsultants.com.

Sincerely,

TRINITY CONSULTANTS

Anna Unruh
Senior Consultant

Enclosures:

cc: Josh Nall, WDEQ
Mike Paul and Cris Miller, Basin Electric
Fred Carl, Tim Mordhorst, and Tim Rogers, Black Hills
Bill Lawson and Craig Lucke, PacifiCorp

REVISED 1-HOUR SO_2 AIR DISPERSION MODELING PROTOCOL FOR GILLETTE WYOMING POWER PLANT ANALYSIS

Prepared for

Basin Electric Power Cooperative
Black Hills Corporation
PacifiCorp

Submitted to

Wyoming Department of Environmental Quality
Air Quality Division

Prepared by

TRINITY CONSULTANTS
1391 North Speer Boulevard, Suite 350
Denver, CO 80204

Revised December 13, 2016

Project 150601.0033

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1. EXECUTIVE SUMMARY

The Wyoming Department of Environmental Quality, Air Quality Division (WDEQ) requested the assistance of Basin Electric Power Cooperative (Basin Electric), Black Hills Corporation (Black Hills) and PacifiCorp in determining compliance with the one-hour sulfur dioxide (SO_2) National Ambient Air Quality Standard (NAAQS) in the Gillette, Wyoming area.

The modeling analysis included the major SO_2 sources in the vicinity of Gillette, Wyoming specifically the six coal-fired electric utility units located at the Dry Fork Station, Wyodak and the Neil Simpson/WyGen generation complex. All six coal-fired electrical generating units have SO_2 air pollution control systems.

The air quality analysis was conducted with the latest AERMOD Version 15181 modeling system. The analysis included the calendar years 2012, 2013 and 2014. Meteorological data for the period was supplied by the 30-meter tower operated by Black Hills Power near the Wyodak/Neil Simpson/WyGen complex. Hourly SO_2 emissions and stack flow parameters were utilized for the three year period from each of the utility unit 40 CFR Part 75 Continuous Emission Monitoring Systems (CEMS). For modeling purposes the SO_2 background concentration was provided by WDEQ.

The air quality modeling analysis showed no exceedances of the 1-hour SO_2 NAAQS for the period 2012 through 2014. The highest receptor concentration including background was 93.72 $\mu g/m^3$ compared to the 196 $\mu g/m^3$ NAAQS. Thus, the modeling has demonstrated compliance with the 1-hour SO_2 NAAQS.

2. INTRODUCTION

In June 2010, the U.S. Environmental Protection Agency (EPA) promulgated the new 1-hour SO_2 NAAQS at a level of 75 parts per billion (196 μg/m^3) based on the 3-year average of the annual 99th percentile of 1-hour daily maximum concentrations. WDEQ requested the assistance of Black Hills, Basin Electric and PacifiCorp in characterizing the air quality of the Gillette, Wyoming area through ambient monitoring and/or air quality modeling techniques, as required by the Data Requirements Rule for the 2010 1-Hour Sulfur Dioxide Primary National Ambient Air Quality Standard (SO_2 DRR) by evaluating SO_2 emissions from the Gillette area power plants located east and north of Gillette, Wyoming.

Modeling, and not ambient monitoring, is the chosen method of satisfying the SO_2 DRR for the Gillette, Wyoming area.

Black Hills, Basin Electric and PacifiCorp contracted with Trinity Consultants to conduct the modeling study. The modeling follows applicable EPA and WDEQ guidance and utilizes the EPA AERMOD model. The modeling was conducted per the recommended guidance in the EPA draft August 2016 document, *SO_2 NAAQS Designations Modeling Technical Assistance Document (TAD)* (referred to herein as the 2016 SO_2 NAAQS Modeling TAD). The modeling follows the modeling protocol dated November 3, 2016, which was approved by the EPA on November 28, 2016.[1]

The EPA is currently going through a multi-phase designation process with respect to the 1-hour SO_2 NAAQS. An initial phase of designations has been completed and resulted in some areas of the country being designated as nonattainment. There are three more phases still to come. Two of the next three phases were the subject of the EPA's proposed Data Requirements Rule, published in May 2014 and finalized in August 2015. In consultation with WDEQ, there are no sources in Wyoming that would trigger the early designation requirement. If modeling was not able to demonstrate compliance with the one-hour SO_2 NAAQS, then ambient SO_2 monitoring would need to start data collection by January 1, 2017 to collect the necessary three years of data.

Therefore, in line with the EPA's Final SO_2 DRR, an SO_2 designation for the Gillette area will be based on the predictions of an air dispersion model. The TAD indicates that actual hourly emission rates from SO_2 Continuous Emission Monitoring Systems (CEMS) should be included in the model to characterize emissions.

The following sections of this report will discuss the utility sources, air modeling methodology, modeling results, and electronic files included on CD.

[1] The November 3, 2016 modeling protocol was approved via email from Ms. Rebecca Matichuk, EPA Region 8 to Mr. Josh Nall, WDEQ on November 28, 2016.

3. DESCRIPTION OF UTILITY SOURCES

The modeling analysis included the six Gillette Wyoming area coal-fired electric generating utility units shown in Table 3-1. All six units have SO_2 air pollution control systems.

Table 3-1. Utility Units included in Modeling Study

Utility	Plant/Unit	Size (MW)	Air Pollution Control Equipment
Basin Electric	Dry Fork Station Unit 1	385	Circulating Dry Scrubber & Fabric Filter
Black Hills	WyGen I	80	Dry Scrubber & Fabric Filter
Black Hills	WyGen II	95	Dry Scrubber & Fabric Filter
Black Hills	WyGen III	110	Dry Scrubber & Fabric Filter
Black Hills	Neil Simpson 2	90	Circulating Dry Scrubber & ESP
PacifiCorp	Wyodak Unit 1	335	Dry Scrubber & Fabric Filter

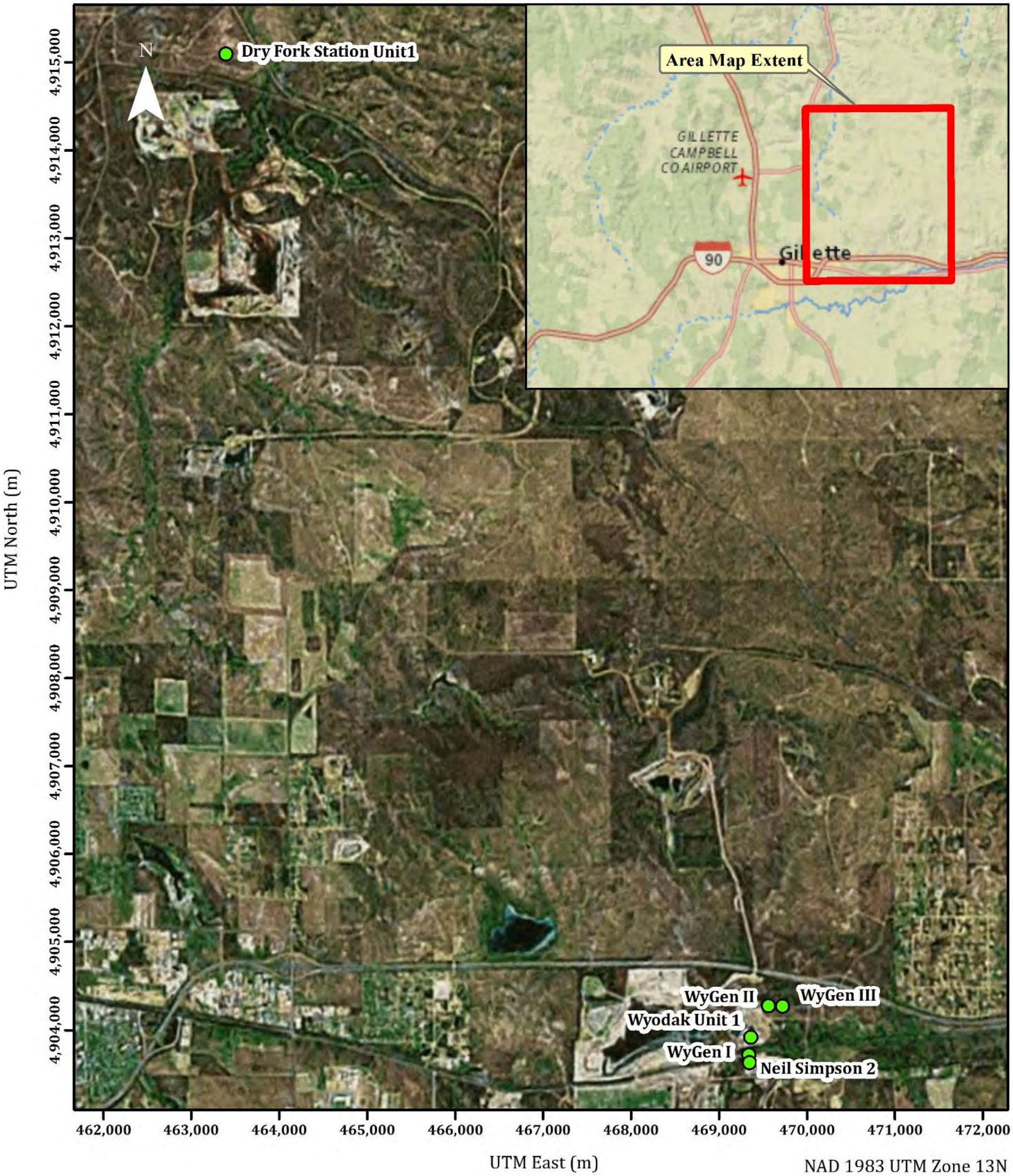
Unit stack parameters and location coordinates are shown in Table 3-2.

Table 3-2. Utility Unit Stack Parameters

Utility	Plant/Unit	Stack Height (feet)	Stack Exit ID (feet)	Elevation (feet)	Latitude	Longitude
Basin Electric	Dry Fork Station Unit 1	500	19.50	4,250	44.3882	-105.4596
Black Hills	WyGen I	295	9.25	4,420	44.2861	-105.3843
Black Hills	WyGen II	397	10.25	4,420	44.2911	-105.3815
Black Hills	WyGen III	397	10.25	4,420	44.2911	-105.3800
Black Hills	Neil Simpson 2	295	9.25	4,420	44.2853	-105.3842
PacifiCorp	Wyodak Unit 1	400	20.00	4,430	44.2879	-105.3840

Figure 3-1 shows the location of each of the units relative to the City of Gillette.

Figure 3-1. Location of 1-hour SO_2 Modeled Sources



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4.1. MODEL SELECTION

Trinity performed 1-hour SO_2 modeling using the latest AERMOD version along with Trinity's *BREEZE™* AERMOD software. The EPA AERMOD model is recommended for predicting impacts from industrial point sources as well as area and volume sources. The *BREEZE™* AERMOD graphical user interface (GUI) was used to set up the AERMOD input file. The final model runs were be performed using the current version (Version 15181) of the EPA AERMOD executable. The AERMOD model combines simple and complex terrain algorithms, and includes the Plume Rise Model Enhancement (PRIME) algorithms to account for building downwash and cavity zone impacts. All regulatory default options were used in the modeling. The pollutant ID was set to SO_2 and the output options were configured such that the model would predict an SO_2 design value based on the 3-year average of the 99th percentile of the annual distribution of the daily maximum 1-hour concentrations for comparison with the 1-hour SO_2 NAAQS of 196 μg/m^3.

The complete AERMOD modeling system is comprised of three parts: the AERMET preprocessor, the AERMAP pre-processor, and the AERMOD model. The AERMET preprocessor compiles the surface and upper-air meteorological data and formats the data for AERMOD input. The AERMAP preprocessor is used to obtain elevation and controlling hill heights for AERMOD input.

4.2. METEOROLOGICAL DATA

4.2.1. Surface Data

Trinity utilized surface meteorological data collected at the Black Hills Power 30-meter meteorological tower as input to the AERMOD model. The 30-meter tower operates near the Wyodak/WyGen/Neil Simpson complex south of I-90 and Highway 51. The tower location is shown on Figure 5-1. The tower is equipped with sensors at the 2-meter, 10-meter and 30-meter levels as shown in Table 4-1. Trinity processed hourly data from the tower for the years 2012, 2013 and 2014 (consistent with the three years of actual emissions data that were be relied upon for the six utility units).

Table 4-1. Black Hills Power Meteorological Tower Measured Parameters

Parameter	Units	Level
Wind Speed	m/s	10m
Wind Speed	m/s	30m
Wind Direction	degrees	10m
Wind Direction	degrees	30m
Sigma Theta	calculated	10m, 30m
Temperature	˚C	2m
Temperature	˚C	10m
Temperature	˚C	30m
Delta Temperature	˚C	10m – 2m
Relative Humidity	%	2m
Precipitation	inches	2m
Barometric Pressure	inches Hg	2m
Solar Radiation	W/m^2	2m

As necessary, processed data for 2012, 2013, and 2014 collected at the National Weather Service (NWS) ASOS meteorological station located at the Gillette- Campbell County Airport in Gillette, Wyoming (KGCC) was used. A determination of whether the meteorological data from the Gillette - Campbell County Airport is appropriate for use in this modeling analysis is considered by determining whether the data were representative of the location of the modeled sources. The close proximity of the airport with respect to the sources (approximately 5 to 10 miles distance), in addition to the similarity in the climatology and topography (the airport elevation is approximately 4,354 feet and source elevations range from approximately 4,250 feet to 4,430 feet) support that the meteorological conditions at the airport are representative of the meteorological conditions at the sources.

AERMOD-ready meteorological data was prepared using the latest version of the EPA's AERMET meteorological processing utility (Version 15181). Standard EPA meteorological data processing guidance was used for the analysis.

A surface data wind rose for the period 2012 through 2014 is shown in Figure 4-1. Seasonally, the predominant wind direction is northwesterly, with the exception of summer when it is bimodal in the northwesterly and southeasterly directions.

4.2.2. Upper Air Data

In addition to surface meteorological data, AERMET requires the use of data from a sunrise-time upper air sounding to estimate daytime mixing heights. Upper air data from the nearest NWS upper-air balloon station, located in Rapid City, South Dakota (KUNR), was obtained from the National Oceanic and Atmospheric Administration (NOAA) in FSL format.

4.2.3. Land Use Analysis

Parameters derived from analysis of land use data (surface roughness, Bowen ratio, and albedo) are also required by AERMET. In accordance with EPA guidance, these values were determined using the latest version of the EPA AERSURFACE tool (version 13016)[2]. The AERSURFACE settings used for processing are summarized in Table 4-2 below. The met station coordinates are for the Black Hills Power 30- meter tower. National Land Cover Dataset (NLCD) 1992 (CONUS) Land Cover data that were used in AERSURFACE processing was obtained from the Multi-Resolution Land Use Consortium (MRLC).

EPA guidance dictates that on at least an annual basis, precipitation at a surface site should be classified as wet, dry, or average in comparison to the 30-year climatological record at the site. This determination is used to set the Bowen ratio estimated by AERSURFACE. To make the determination, seasonal precipitation in each modeled year (2012-2014), as measured at the Black Hills 30-meter tower, was compared to the historical climatological record for the area surrounding the Black Hills 30-meter tower. A 30 year record (1981-2010) is available from the NWS Sheridan Wyoming site; however, data has been collected at the Gillette Campbell County Airport site since July 1998. Based on the close proximity to the Black Hills 30-meter tower location, Trinity recommended the use of this data set (July 1998 – May 2015) for the comparison. The 30th and 70th percentile values of the seasonal precipitation distribution from the dataset were calculated. Per EPA guidance, each modeled year was classified for AERSURFACE processing as “wet” if its seasonal precipitation was higher than the 70th percentile value, “dry” if its seasonal precipitation was lower than the 30th percentile value, and “average” if it was between the 30th and 70th percentile values.

Snow records for 2012-2014 were reviewed to determine whether the area had continuous winter snow cover. If all three months in a given year indicated that at least 50% of days had a snow depth of at least 1 inch, then continuous winter snow cover was assumed.

Table 4-2. AERSURFACE Input Parameters

AERSURFACE Parameter	Value
Met Station Latitude	44.2778
Met Station Longitude	-105.3765
Datum	NAD 1983
Radius for surface roughness (km)	1.0
Vary by Sector?	Yes
Number of Sectors	12
Temporal Resolution	Monthly
Continuous Winter Snow Cover?	Determined based on observed snow records
Station Located at Airport?	No
Arid Region?	No
Surface Moisture Classification	Determined based on 30th and 70th percentile of climate normals

[2] U.S. Environmental Protection Agency. 2013. “AERSURFACE User’s Guide.” EPA-454/B-08-001, Revised 01/16/2013. Available Online: http://www.epa.gov/scram001/7thconf/aermod/aersurface_userguide.pdf

4.2.4. AERMET Data Processing

The surface and upper air data was processed with AERMET along with the output from the AERSURFACE processing. Standard AERMET processing options were used.[3,4] AERMET processing included AERMINUTE files. AERMINUTE processing is designed to reduce the number of missing/calm hours. The preparation of the meteorological data files using AERMET is a three stage process. The first stage includes the extraction of raw hourly surface observations and upper air soundings. The extracted files were checked by AERMET module for consistency and any missing or calm hours were identified. The second stage merges the surface and upper air data. The third stage estimates the boundary layer parameters required by AERMOD using the AERSURFACE output.

4.3. COORDINATE SYSTEM

In all modeling input and output files, the locations of emission sources, structures, and receptors are represented in Zone 13 of the Universal Transverse Mercator (UTM) coordinate system using datum World Geodetic System (WGS) 1984, which is comparable to the North American Datum 1983 (NAD83). The locations for the six coal units included in the modeling are shown in Table 3-2 and in Figure 3-1. The base elevation of the facilities range from 4,250 to 4,430 feet above mean sea level.

4.4. RECEPTOR LOCATIONS

The dispersion modeling used a combination of a Cartesian grid system centered on the six facilities and discrete receptor points along the facility fence lines. Receptors were placed at 25 meter intervals along the fence line for each facility, 100 meter intervals out to a distance of at least 2.5 kilometers (km) from each facility, and at 500 meter intervals out to at least 10 km or further from each facility if needed. Per the 2016 SO_2 NAAQS Modeling TAD and the 2015 SO_2 Area Designation Guidance, the receptor grid covers the entire modeling domain. Since, as indicated in Section 5, there were no elevated levels of SO_2 (at least 90% of the standard) encountered near the edge of the receptor grid, there was no need to expand or adjust the receptor grid to conform to the 2016 SO_2 NAAQS Modeling TAD and the 2015 SO_2 Area Designation Guidance.

The modeled receptor grids are depicted in Figures 4-1, 4-2, and 4-3. Property fence lines utilized in the receptor grid for the six facilities are shown in Figure 4-5, Figure 4-6, Figure 4-7 and Figure 4-8. As shown in the figures, all facilities except for the Dry Fork facility are clustered together (less than 1 km apart), and the Dry Fork facility is approximately 12 km from the other facilities. As such, the receptor grid for the area containing the Wyodak, Wygen, and Neil Simpson sources was created using the combined fenceline for those receptors, and the grid for the Dry Fork facility was generated based on the fence line for the Dry Fork Facility only. Since the grid for the Dry Fork facility overlaps the grid for the other facilities, redundant receptors were removed. Caution was taken when removing receptors to maintain the minimum spacing described above. In accordance with Section 4.2 of the 2016 SO_2 NAAQS Modeling TAD, on-site receptors for neighboring facilities are included in this analysis.[5] Since the area within each facility's fenceline is considered ambient air relative to emissions generated at the other modeled facility, no on-site receptors were removed in this analysis.

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[3] Fox, Tyler, U.S. Environmental Protection Agency. 2013. "Use of ASOS Meteorological Data in AERMOD Dispersion Modeling." Available Online: http://www.epa.gov/ttn/scram/guidance/clarification/20130308_Met_Data_Clarification.pdf

[4] "User's Guide for the AERMOD Meteorological Preprocessor (AERMET)". EPA-454/B-03-002, November 2004).

[5] SO2 NAAQS Designations Modeling Technical Assistance Document, EPA, August 2016.

Figure 4-1. Receptor Locations – Full Extent

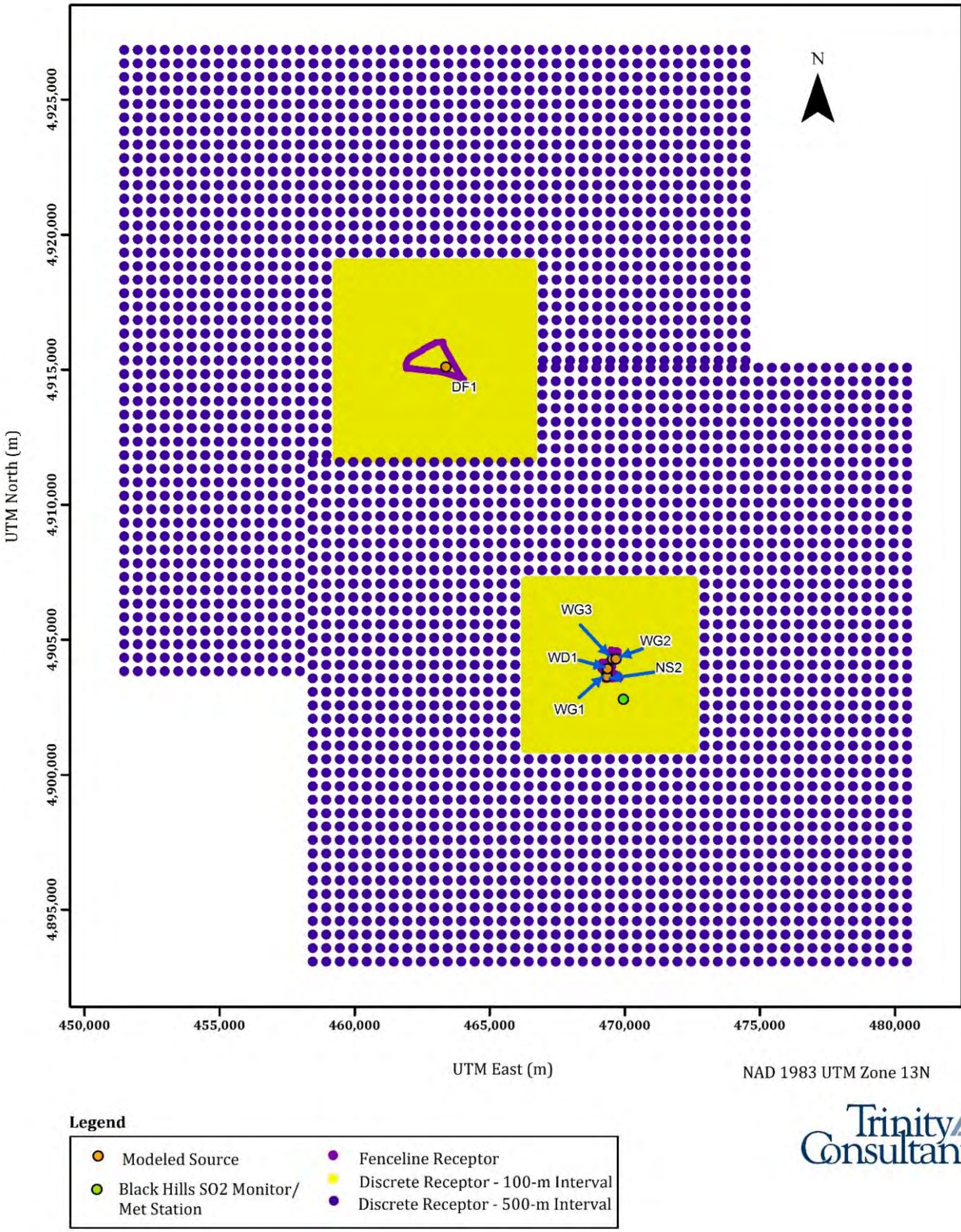


Figure 4-2. Receptor Locations – Wygen, Wyodak, and Neil Simpson Area

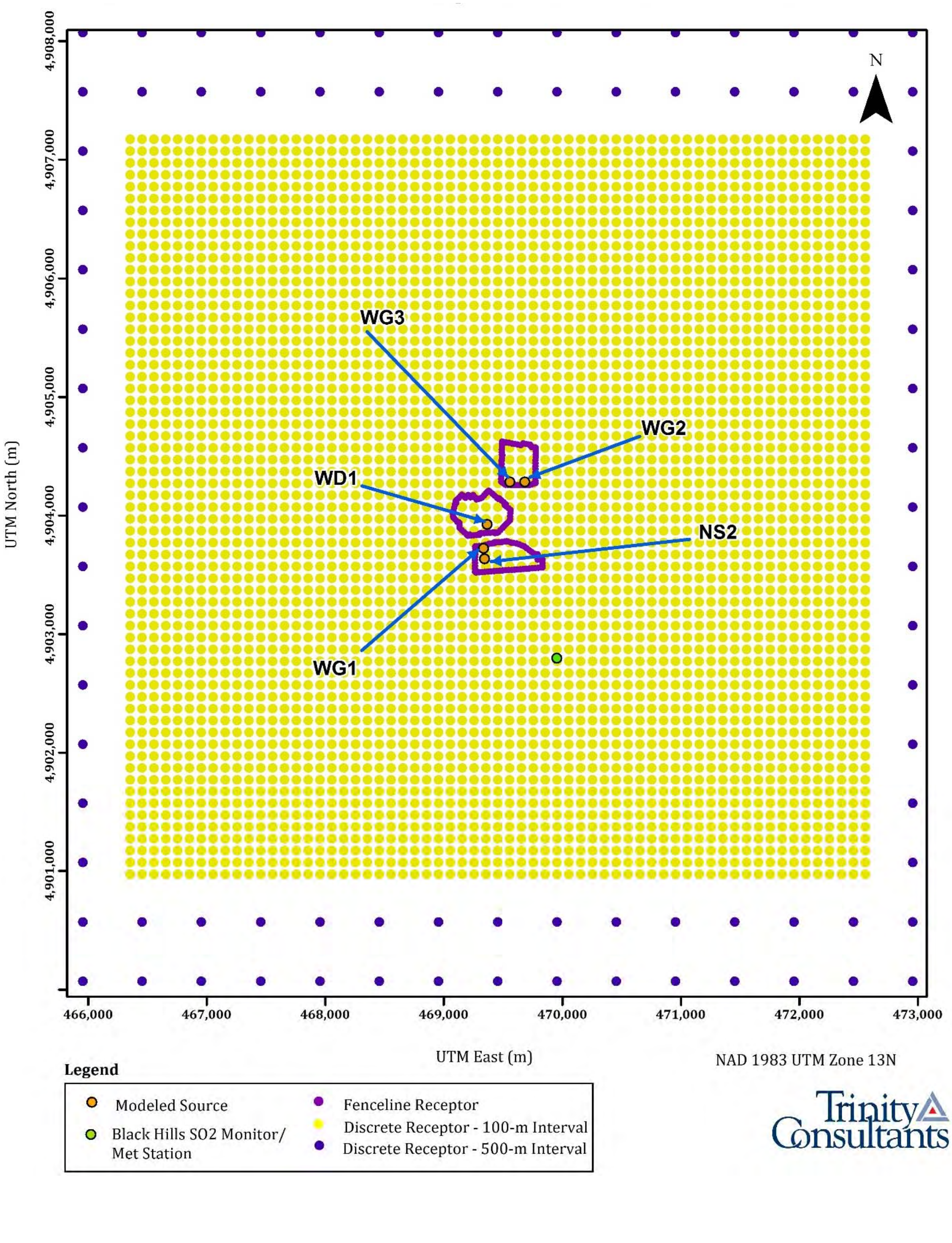
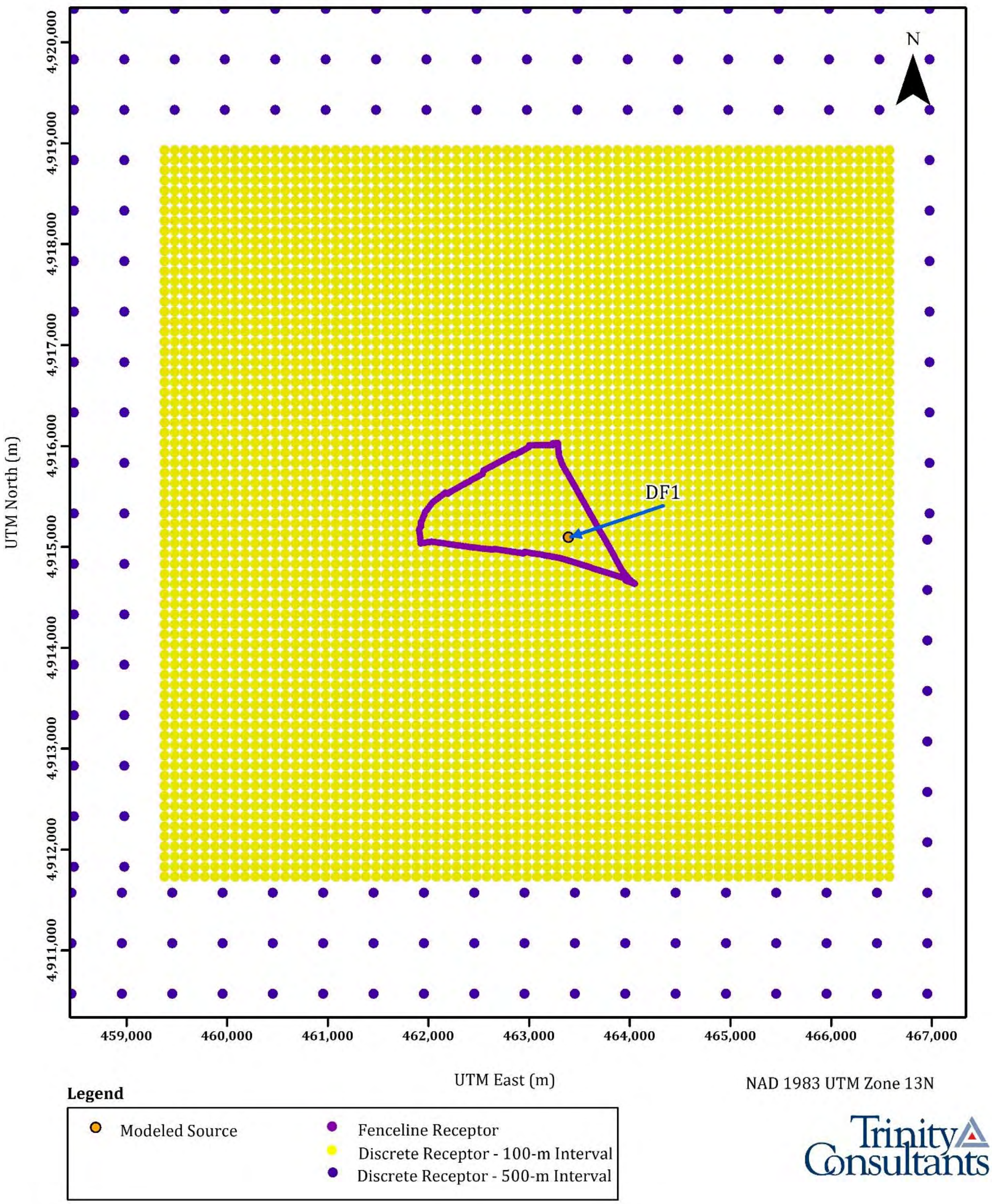


Figure 4-3. Receptor Locations – Dry Fork Area



4.5. TERRAIN ELEVATIONS

The terrain elevation for each receptor, building, and emission source was determined using USGS 1/3 arc-second National Elevation Data (NED). The NED, obtained from the USGS, has terrain elevations at 10-meter intervals. Using the AERMOD terrain processor, AERMAP (version 11103), the terrain height for each receptor, building, and emission source included in the model was determined by assigning the interpolated height from the digital terrain elevations surrounding each source.

In addition, AERMAP was used to compute the hill height scales for each receptor. AERMAP searches all NED points for the terrain height and location that has the greatest influence on each receptor to determine the hill height scale for that receptor. AERMOD then uses the hill height scale in order to select the correct critical dividing streamline and concentration algorithm for each receptor. Per the AERMAP User's Guide, care was taken to ensure that the domain of the NED file was sufficiently large enough to cover all significant terrain nodes (i.e., all terrain that is at or above a 10% slope from each and every receptor) to allow AERMAP to correctly calculate the hill height scale for each receptor.[6]

4.6. EMISSION SOURCES

The six coal-fired boilers shown in Table 3-1 were included in the analysis. Hourly 40 CFR Part 75 CEMS data from the EPA Air Market Program were prepared for the years 2012, 2013 and 2014 for each of the units. This three year period is representative of normal operations for the six units. The raw CEMS parameters collected for each unit are shown in Table 4-3. The flow parameters were then corrected to actual conditions (based on stack temperature and pressure). The modeling was conducted based on the actual hourly SO_2 emissions, stack temperatures and stack flowrates.

Table 4-3. Hourly CEMS Data Collected for Each Unit

Parameter	Units
Date	
Hour	
Unit Operation	On/Off
SO_2 Mass Flow	lb/hr
Stack Flow	SCFH
Stack Temperature	°F
Barometric Pressure	inches Hg

4.7. OTHER SOURCES

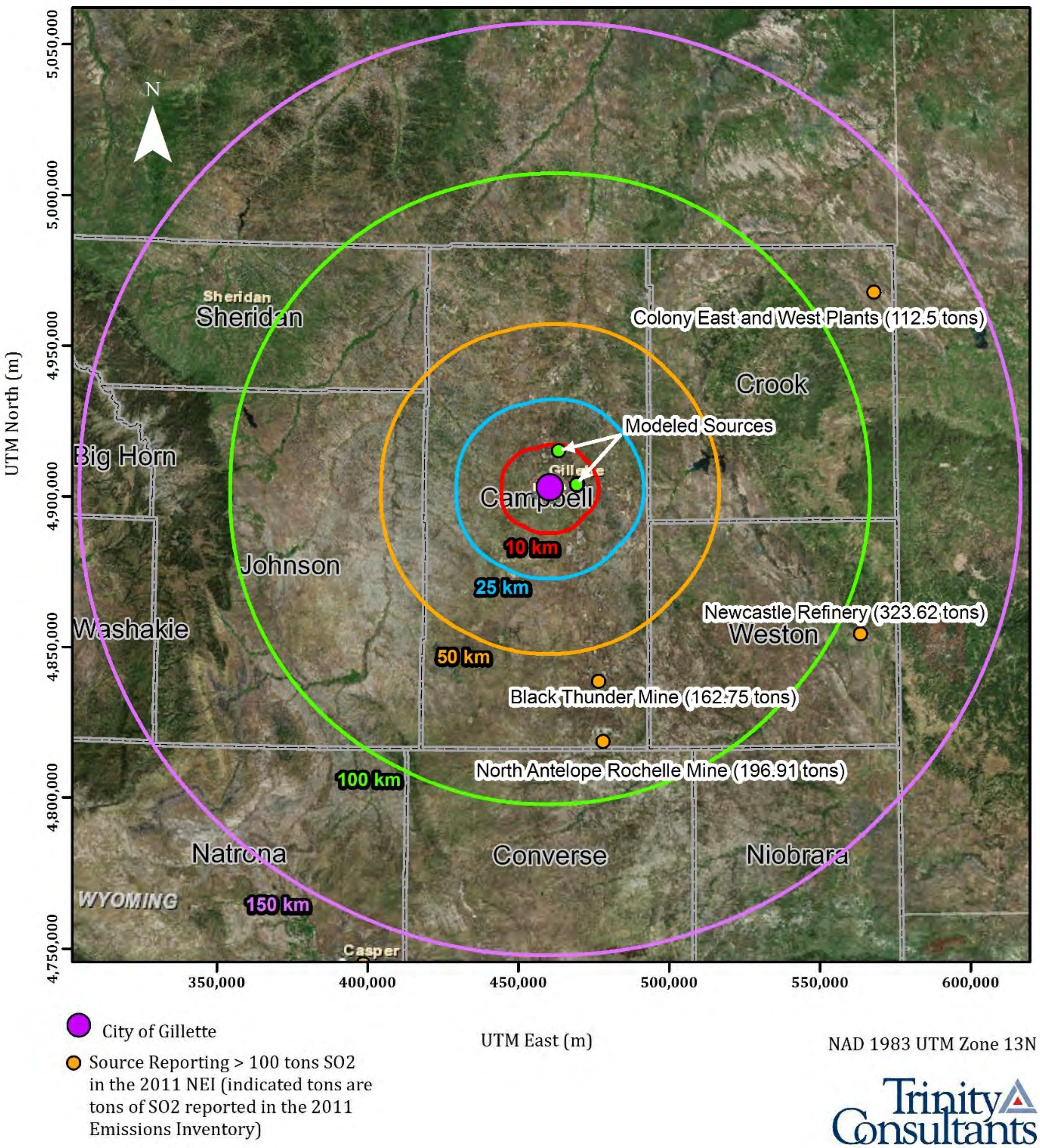
WDEQ's emission inventory indicates no other large (> 100 ton) SO_2 emission sources within 10 km of the Gillette area, so no additional emission sources were included in this analysis. This is consistent with the EPA March 1, 2011 Memorandum[7] and the 2016 SO_2 NAAQS Modeling TAD that the selection of regional background sources should be limited to within10 kilometers of the source location. The characterization methodology of evaluating only the SO_2 emissions from the six utility coal units is consistent with EPA guidance and was

[6] U.S. EPA User's Guide for the AERMOD Terrain Preprocessor (AERMAP), October 2004.

[7] U.S. EPA, 2011, Additional Clarification Regarding the Application of Appendix W Modeling Guidance for the 1-hr NO2 National Ambient Air Quality Standard. Tyler Fox Memorandum dated March 1, 2011, RTP, NC 27711. http://www3.epa.gov/ttn/scram/guidance/clarification/Additional_Clarifications_AppendixW_Hourly-NO2-NAAQS_FINAL_03-01-2011.pdf

confirmed with WDEQ. Figure 4-4 displays other sources with emissions of SO_2 greater than 100 tpy within 150 km of the modeled sources. All are greater than 50 km from the modeled sources.

Figure 4-4. Other SO_2 Emission Sources > 100 tons within 150 km



4.8. BUILDING INFLUENCES

The EPA's Building Profile Input Program (BPIP) with Plume Rise Model Enhancement (PRIME) (version 04274) was used to account for building/structure downwash influences at each of the facilities in the model. The purpose of a building downwash analysis is to determine if the plume discharged from a stack will become caught in the turbulent wake of a building or other structure, resulting in downwash of the plume. The downwash of a plume can result in elevated ground-level concentrations. At Trinity's request, WDEQ provided historical BPIP files from the Basin Electric Dry Fork Station and the Black Hills WyGen 3 permit applications. The WyGen 3 BPIP files included the buildings/structures for both WyGen 2 and 3 and some of the structures related to the Wyodak, WyGen 1 and Neil Simpson complexes. Trinity worked with the utilities to revise the BPIP files as necessary to include other major buildings/structures at the Wyodak, WyGen 1 and Neil Simpson complexes. The modeled facilities, including the major buildings and structures for each, are shown in Figures 4-5, 4-5, 4-6, and 4-8. The modeled heights of these structures are provided in Table 4-4. No non-default configuration options were used in the BPIP analysis.

Table 4-4. Height of Modeled Downwash Structures

ID	Height (ft)	ID	Height (ft)	ID	Height (ft)
WYO001	70	WYO003	143	WYG001	104.00
WYO002	101	WYO004	143	WYG002	179.76
WYO006	90	WYO005	143	WYG003	24.92
WYO007	90	WYG1_02	116	WYG004	108.76
WYO008	136	DF001	16.73	WYG005	80.75
WYO009	228	DF002	38.71	WYG006	84
WYO010	189	DF003	114.50	WYG007	108.67
WYO011	121	DF004	114.50	WYG008	84
WYO012	86	DF005	270.34	WYG009	80.74
WYO013	33	DF006	182.41	WYG010	108.75
WYG1_01	70	DF007	166.67	WYG011	179.75
NS2_01	70	DF008	85.30	WYG012	108.67
NS2_02	81	DF009	29.86	WYG013	24.93
WYG1_03	81	DF010	29.86	WYG014	104.00
NS2_03	109	DF011	13.12	WYG022	116.70
WYG1_04	109	DF012	114.83	WYG023	94.90
NS2_04	180	DF013	18.04	WYG024	123.50
WYG1_05	180	DF014	127.95	WYG025	94.90
NS2_05	129	DF015	147.64	WYG026	116.70
WYG1_06	129	DF016	42.65	WYG027	123.50
NS2_06	150	DF017	206.69	WYG028	212.00
WYG1_07	78	DF018	206.69		
NS2_07	129	DF019	114.00		

Figure 4-5. Dry Fork Station General Arrangement

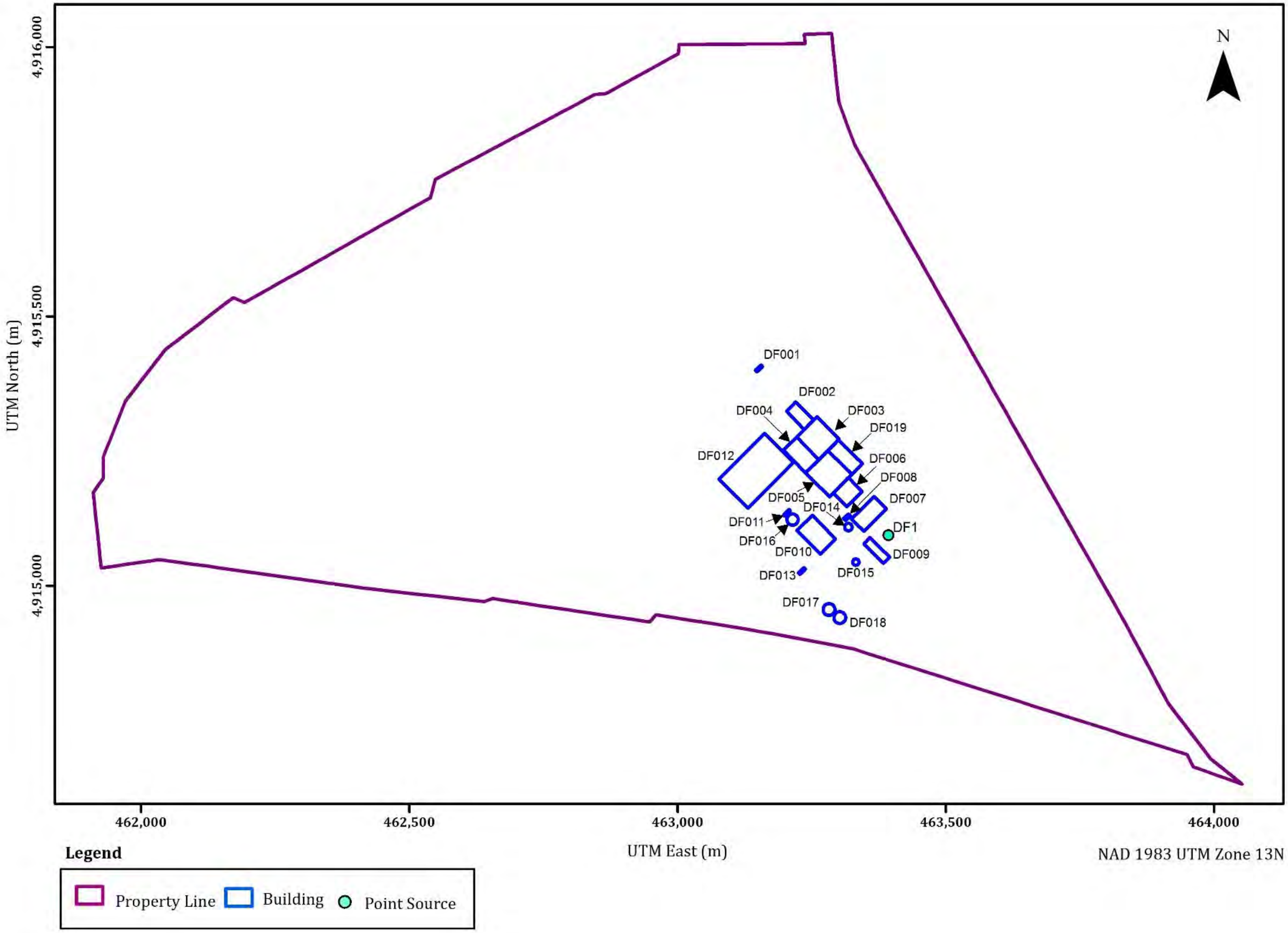


Figure 4-6. Wyodak General Arrangement

Figure 4-7. WyGen I and Neil Simpson 2 General Arrangement

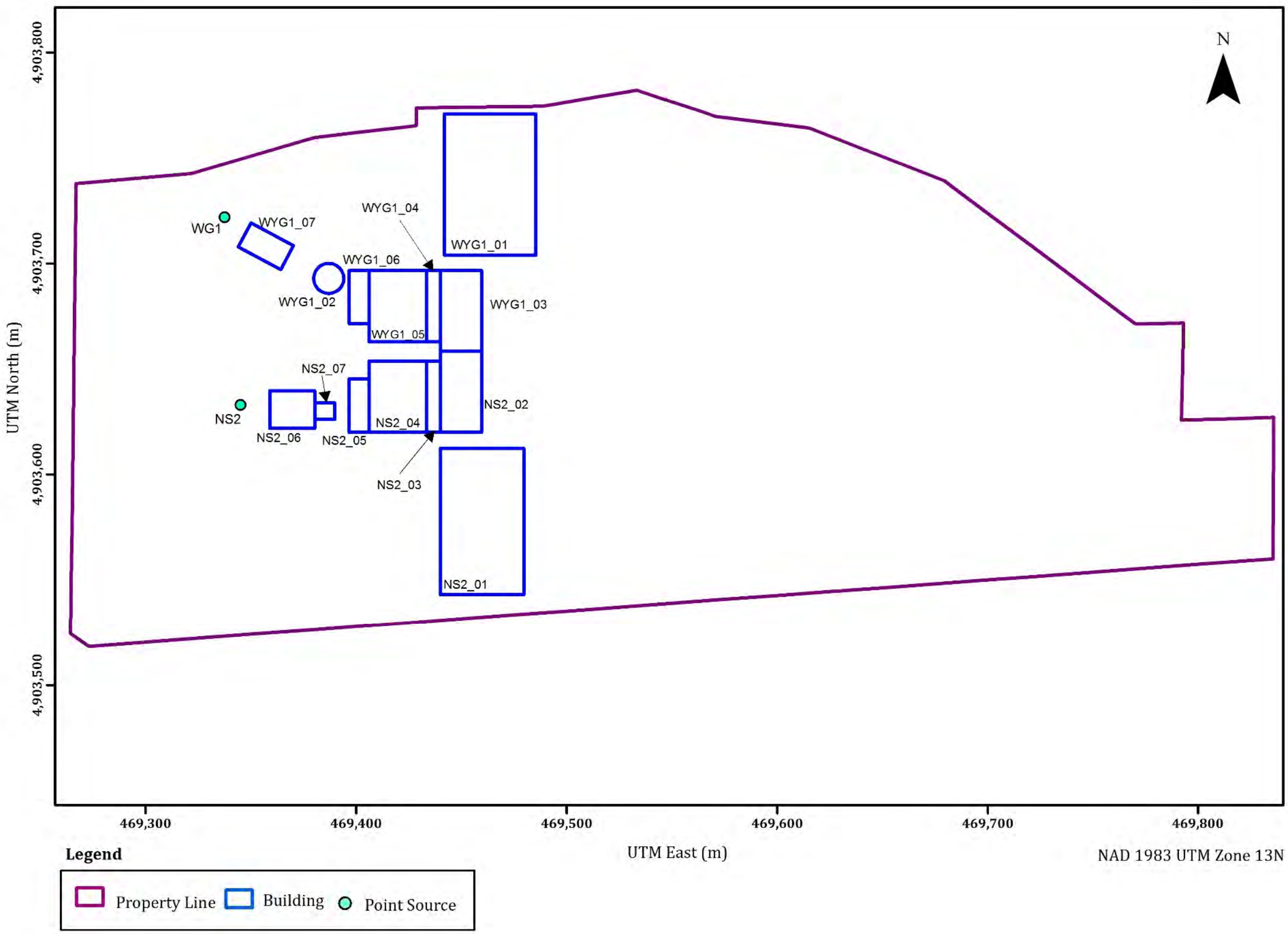
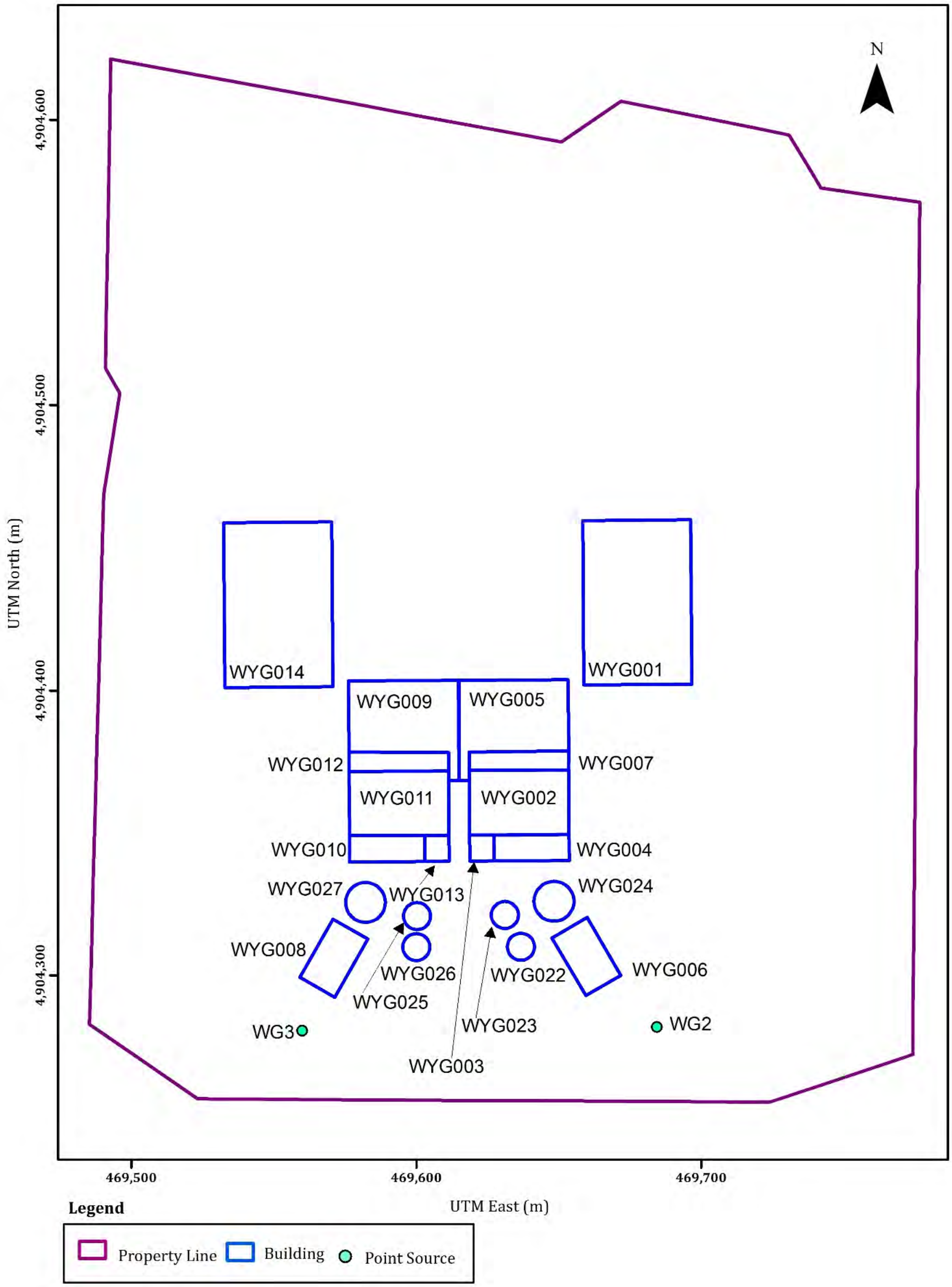


Figure 4-8. WyGen II and WyGen III General Arrangement



4.9. BACKGROUND CONCENTRATION

WDEQ provided a 6 ppm design value 1-hour SO_2 background concentration as representative of the background concentration in the vicinity of northeast Wyoming facilities. The design value is from the NCORE site near Cheyenne and is the 99th percentile three year average (2012- 2014). The background concentration was added to the modeling results, and the resulting concentration was compared to the 1-hour SO_2 NAAQS. An area map of the Wyoming SO_2 Ambient Monitoring Sites is shown in Figure 4-9.

4.10. CHARACTERIZATION OF MODELED AREA

The sources are located approximately 5-10 km from the city of Gillette, Wyoming. The area is a semi-arid climate with hot and dry summers and cold winters. The area receives some snow during the winter, but does not consistently experience continuous snow cover. The sources are located on relatively flat terrain in the Powder River Basin between the Big Horn Mountains and the Black Hills. The area is classified as attainment or unclassified for all criteria pollutants.

In order to categorize the area as rural or urban for modeling purposes, National Land Cover Dataset (NLCD) 1992 (CONUS) Land Cover data was obtained from the Multi-Resolution Land Use Consortium (MRLC). Data within a 3 km radius of each source was analyzed using the EPA AERSURFACE tool (version 13016).[8] Per Section 6.3 of the 2016 SO_2 NAAQS Modeling TAD, a source is considered urban if the land use types I1 (heavy industrial), I2 (light-moderate industrial), C1 (commercial), R2 (common residential), and R3 (compact residential) are 50 percent or more of the area within the 3 km radius circle. Otherwise, the source is considered a rural source.[9]

Based on the analysis using NLCD 1992 Land Cover data, less than 5% of the land within 3 km of each source falls into the land use type categories listed above. Although some land development has occurred in the area since the 1992 data was published, it is clear from the aerial images provided in Figures 4-10 and 4-11 that significantly less than 50% of the land within 3 km of the sources can be considered urban. As such, the sources were considered rural for the modeling analysis.

8 U.S. Environmental Protection Agency. 2013. "AERSURFACE User's Guide." EPA-454/B-08-001, Revised 01/16/2013. Available Online: http://www.epa.gov/scram001/7thconf/aermod/aersurface_userguide.pdf

9 SO2 NAAQS Designations Modeling Technical Assistance Document, EPA, August 2016.

Figure 4-9. SO_2 Ambient Monitoring Stations in Wyoming

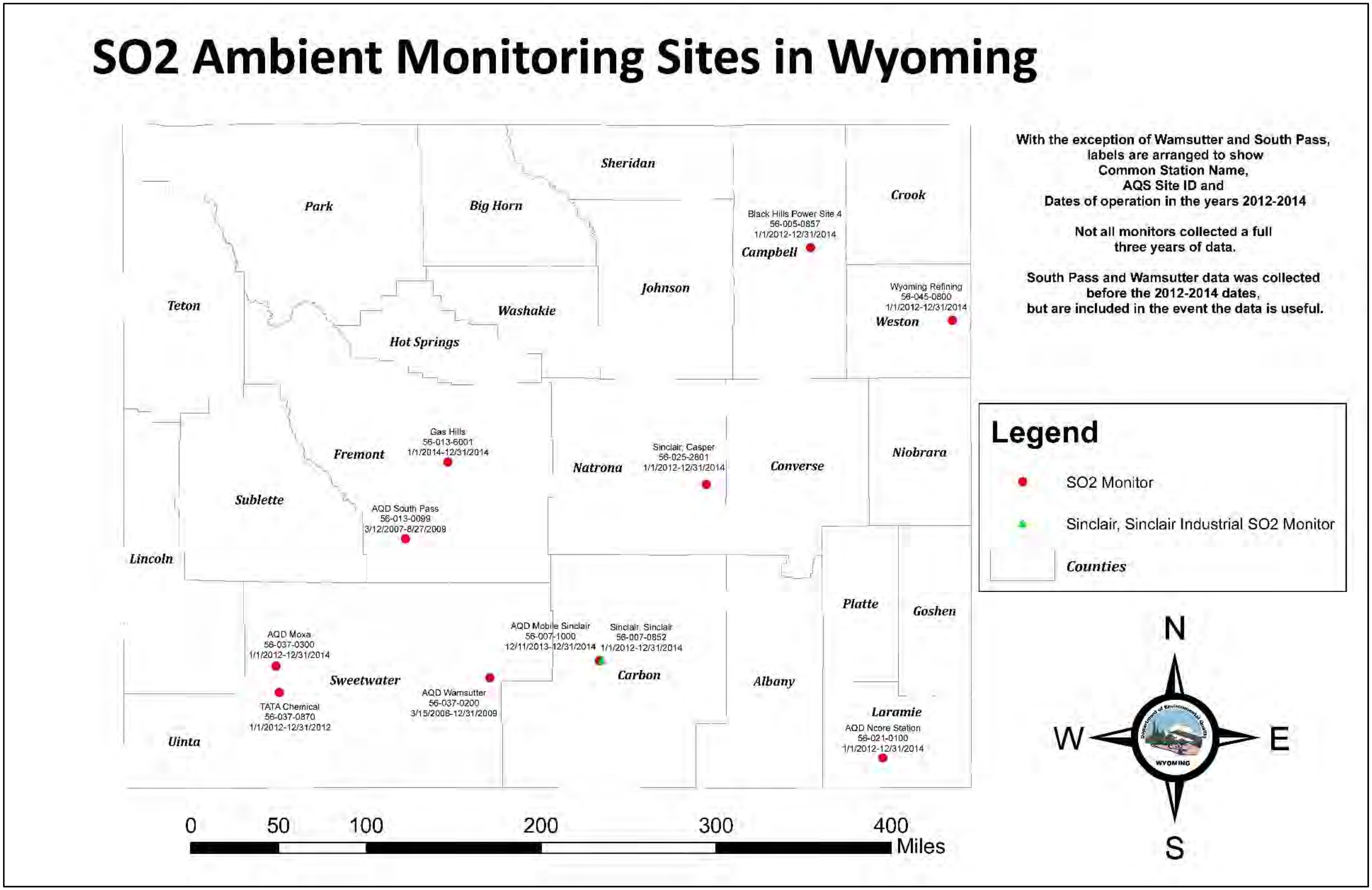


Figure 4-10. Aerial Image - Wygen, Wyodak, and Neil Simpson Area

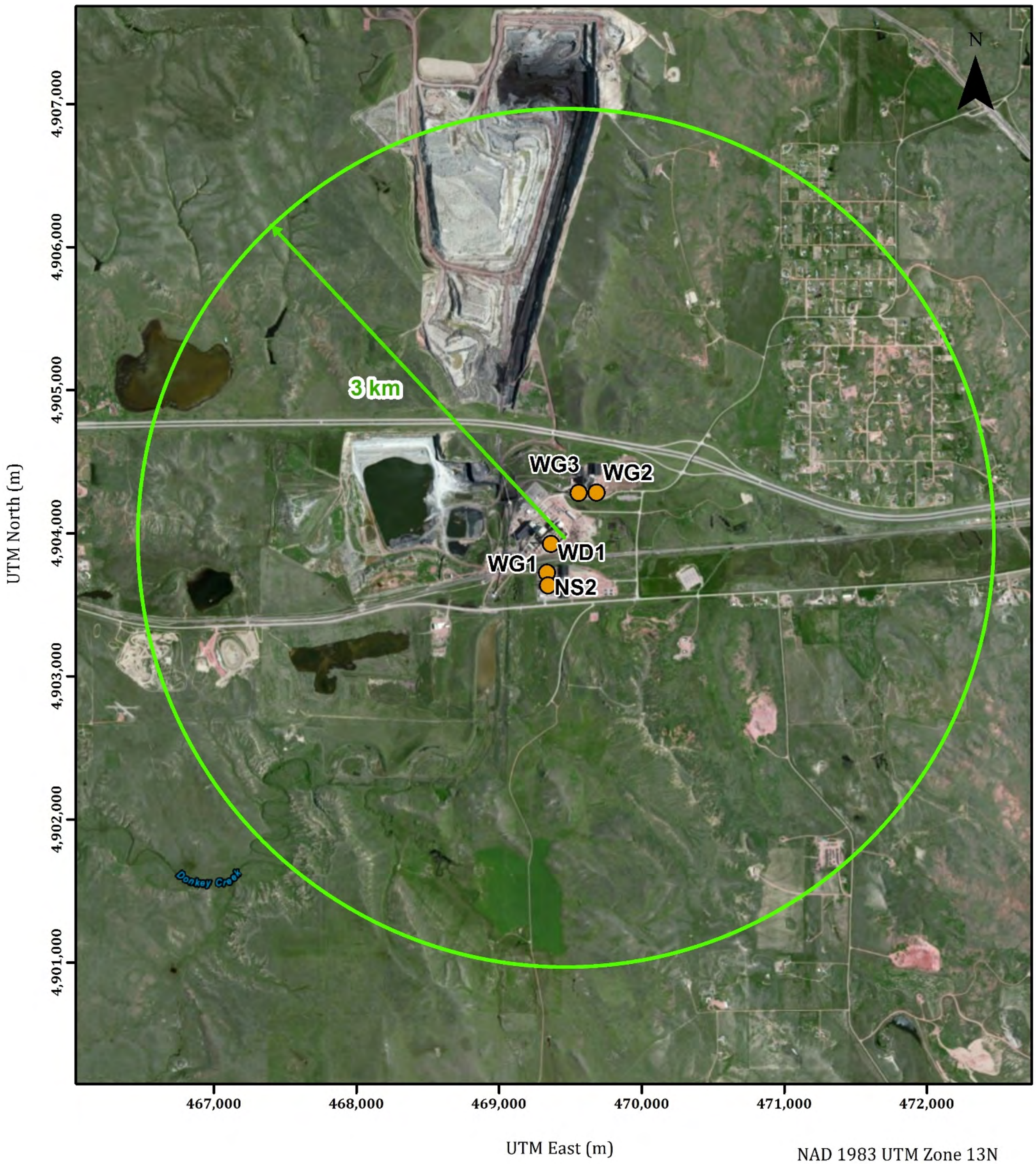
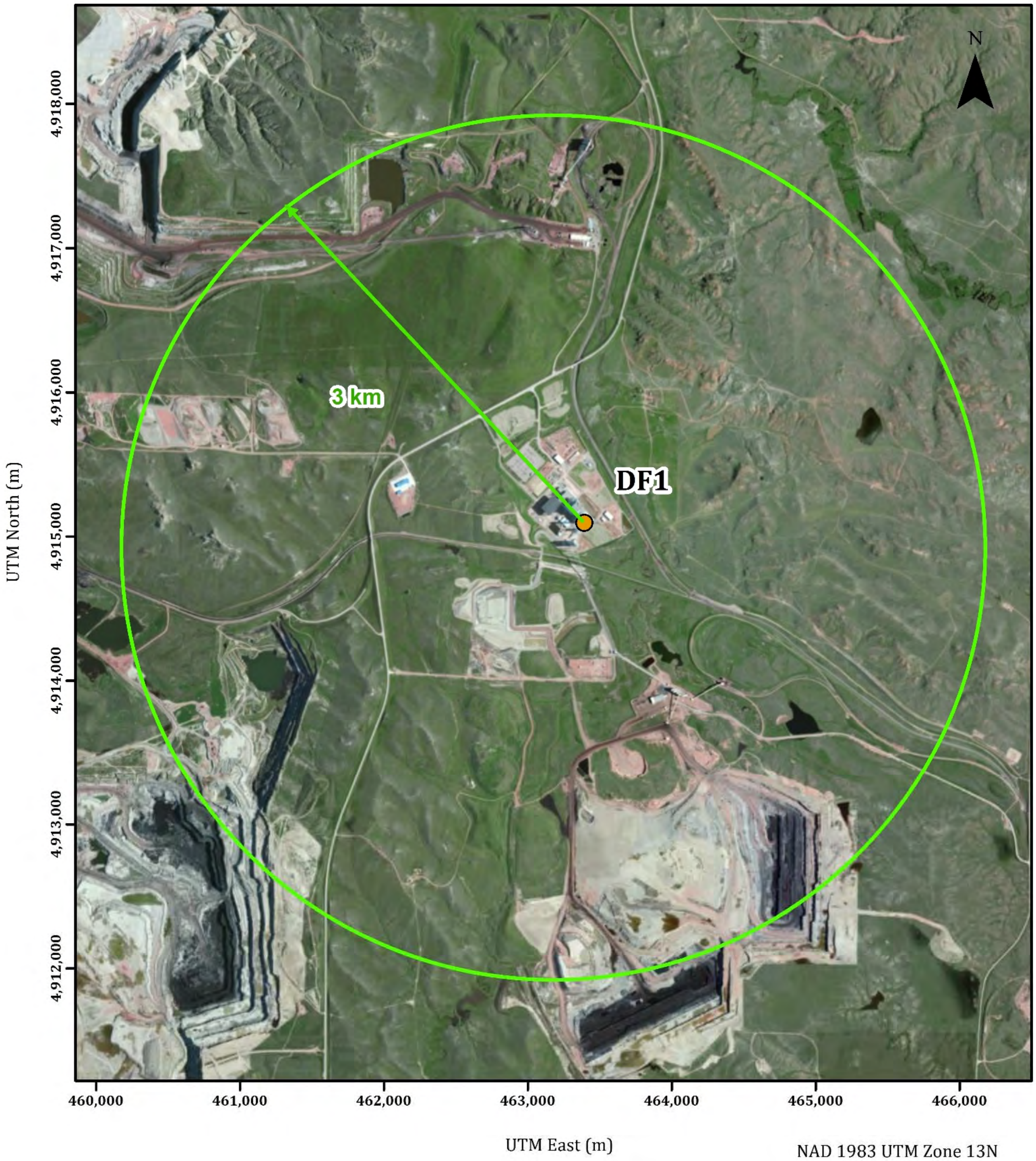


Figure 4-11. Aerial Image – Dry Fork Area



5. PRESENTATION OF MODELING RESULTS

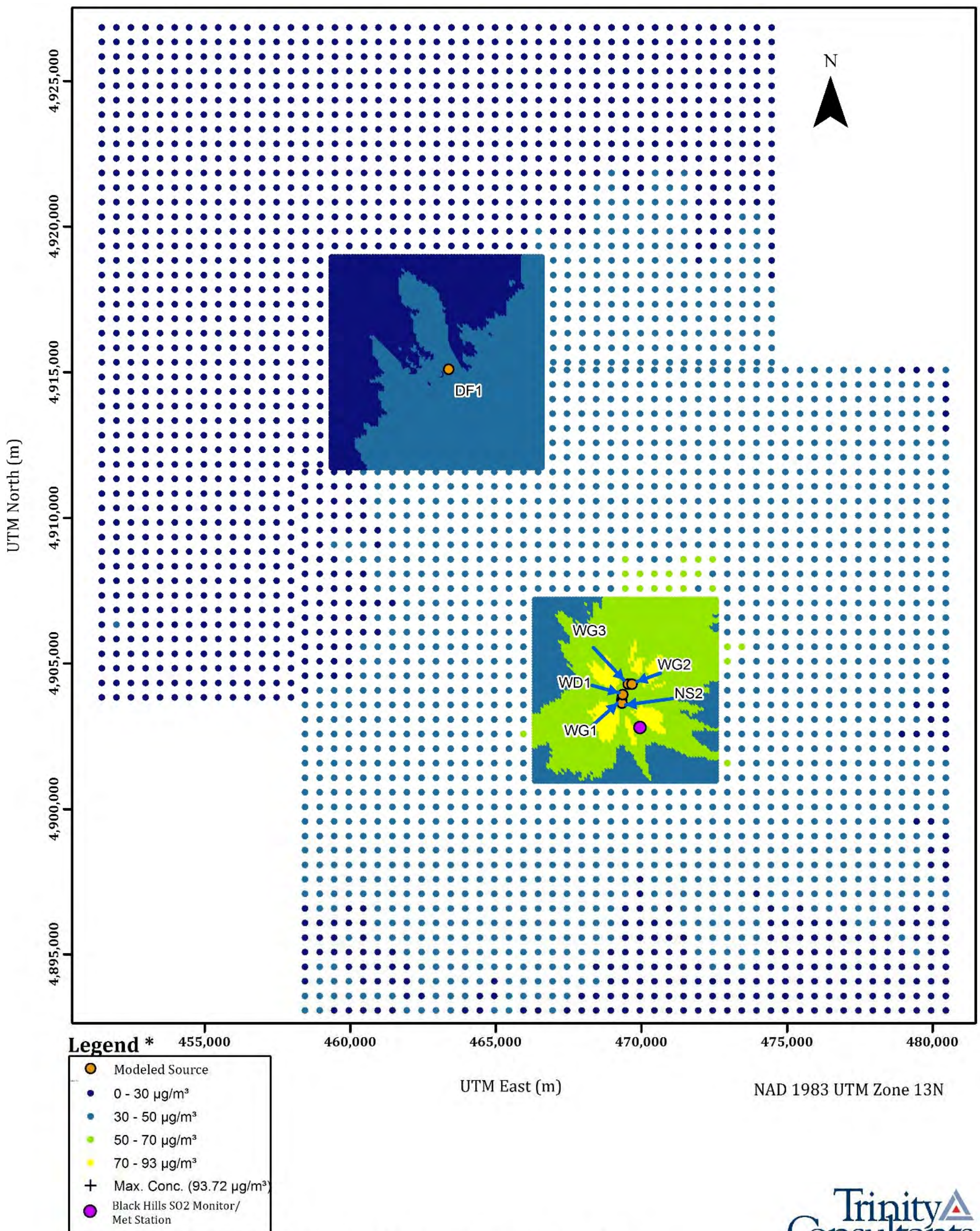
The maximum modeled ground-level concentrations obtained using the approach described in Section 3 and comparison to the 1-hour SO_2 standard are presented in this section.

There are no exceedances of the 1-hour SO_2 NAAQS for the period 2012 through 2014. Per the form of the 1-hour SO_2 NAAQS, results are reported as the 3-year average of the 99th percentile of the annual distribution of daily maximum 1-hour concentrations (i.e. 4th high value). The highest 4th highest daily maximum 1-hour concentration was 93.72 μg/m^3 compared to the 1-hour SO_2 NAAQS value of 196 μg/m^3. This value includes the 6 ppb (15.66 μg/m^3) background concentration provided by the WDEQ.

Figure 5-1 provides a graphical representation of the SO_2 concentration levels in the modeling domain. The six coal units and the Black Hills Power meteorological tower/SO_2 monitoring site are also displayed on the figure as a reference.

Based on the 2012 – 2014 modeling results (less than 50% of the standard), further analysis related to potential ambient monitor locations was not conducted since compliance with the 1-hour SO_2 NAAQS is demonstrated via modeling.

Figure 5-1. SO_2 1-Hour Concentration Plot



* Concentrations include a WDEQ-provided background concentration of 6 ppb

6. ELECTRONIC FILES

All of the air quality dispersion modeling analysis electronic data files used to generate the results presented in this report are provided in the attached CDs. These electronic data files include the following:

- All AERMOD input, output, and plot data files
- All downwash input and output files
- AERMET input and output files
- AERSURFACE files
- The boundary file specifying coordinates of the modeled fence lines
- CEMS hourly data files for all six utility units
- Electronic copy of the Air Quality Analysis

The following tables summarize the electronic files included in the attached CDs.

Table 6-1. Summary of Electronic Files

Folder/File Name	Folder/File Description
AERMOD	AERMOD Input and Output Files (see Table 6-2)
Met Data	Files associated with met data processing (see Table 6-3)
Fenceline	Fenceline boundary files
BPIP	BPIP (Downwash) input, output, and summary files
Terrain Data	NED Data used for AERMAP elevations
SO2 Modeling Report 12-2016.pdf	Electronic copy of the air quality analysis
WY Stack and CEMS Data - Clean Air Market Data Edits (2016-1206).xlsx	Emissions and stack parameter data

Table 6-2. AERMOD File Descriptions

File Name	Associated Files
WYElectricUtilitySO2Mod_1214H04.ami	Input File
HourlySrcData.src	Hourly Emission Rate File
WYElectricUtilitySO2Mod_1214H04.aml	Output File
*.plt	Plot files
WYSO2_1214H04_ALL.mdc	Daily Max. Contribution File

Table 6-3. Met Data File Descriptions

Folder Name	Description
AERMINUTE	> AERMINUTE Input and Output Files > 1-Minute Data used in AERMINUTE downloaded from ftp://ftp.ncdc.noaa.gov/pub/data/asos-onemin/
AERSURFACE	> Raw Precipitation Data for Gillette Airport > Raw Snow Cover Data for GILLETTE 4SE Station > Summary of AERSURFACE data used in AERMET (appropriate moisture determination/snow cover for each season) > Land use data downloaded from http://www.mrlc.gov/viewerjs/ > AERSURFACE input and output files for Black Hills Met Station and NWS Station • A/D/W = Average/Dry/Wet Surface Moisture • SC/NSC = Snow Cover/No Snow Cover during winter months
FSL Formatted UA Data	> Twice daily upper air data downloaded from http://www.esrl.noaa.gov/raobs/
ISHD Data	> Integrated Surface Hourly Data (ISHD) data downloaded from ftp://ftp.ncdc.noaa.gov/pub/data/noaa/
AERMET	> AERMET input and output files for 2012-2014 > Data for Black Hills Met Tower