Resource Report No. 9
Air and Noise Quality

RUBY PIPELINE LLC

FERC Docket No. CP09-___-000

January 2009

Summary of Filing Information

Minimum Requirements to Avoid Rejection	Where Found In Document	Comments
1. Describe existing air quality in the vicinity of the project. (§ 380.12(k)(1)) o Identify criteria pollutants that may be emitted above EPA-significance levels.	Section 9.1.1	
2. Quantify the existing noise levels (day-night sound level $_{(Ldn)}$ and other applicable noise parameters) at noise sensitive areas and at other areas covered by relevant state and local noise ordinances. (§ 380.12(k)(2)) o If new compressor station sites are proposed, measure or estimate the existing ambient sound environment based on current land uses and activities. o For existing compressor stations (operated at full load), include the results of a sound level survey at the site property line and nearby noise-sensitive areas. o Include a plot plan that identifies the locations and duration of noise measurements. o All surveys must identify the time of day, weather conditions, wind speed and direction, engine load, and other noise sources present during each measurement.	Section 9.2.3.4; Appendix 9G	
3. Quantify existing and proposed emissions of compressor equipment, plus construction emissions, including nitrogen oxides (NO_x) and carbon monoxide (CO), and the basis for these calculations. Summarize anticipated air quality impacts for the project. (§ 380.12(k)(3)) o Provide the emission rate of NO_x from existing and proposed facilities, expressed in pounds per hour and tons per year for maximum operating conditions, include supporting calculations, emission factors, fuel consumption rate, and annual hours of operation.	Section 9.1.3; Appendix 9A; Appendix 9B	
4. Describe the existing compressor units at each station where new, additional, or modified compressor units are proposed, including the manufacturer, model number, and horsepower of the compressor units. For proposed new, additional, or modified compressor units include the horsepower, type, and energy source. (§ 380.12(k)(4))	Section 9.1.3.2	
5. Identify any nearby noise-sensitive area by distance and direction from the proposed compressor unit building/enclosure. (§ 380.12(k)(4))	Section 9.2.1.1	
6. Identify any applicable state or local noise regulations. (§ 380.12(k)(4)) o Specify how the facility will meet the regulations.	Section 9.2.2.2	
7. Calculate the noise impact at noise-sensitive areas of the proposed compressor unit modifications or additions, specifying how the impact was calculated, including manufacturer's data and proposed noise	Section 9.2	

Summary of Filing Information

Minimum Requirements to Avoid Rejection	Where Found In Document	Comments
control equipment. (§ 380.12(k)(4))		
Additional Information Often Missing and Resulting in Data Requests		
• Provide copies of application for state air permits and agency determinations, as appropriate.	Appendices 9C, 9D, 9E, 9F	Final applications to be submitted on or before February 19, 2009.
• For major sources of air emissions (as defined by the EPA), provide copies of applications for permits to construct (and operate, if applicable) or for applicability determinations under regulations for the prevention of significant air quality deterioration and subsequent determinations.	Section 9.1.4.5	
• Describe measures and manufacturer's specifications for equipment proposed to mitigate impact to air and noise quality, including emission control systems, installation of filters, mufflers, or insulation of piping and building, and orientation of equipment away from noise-sensitive areas.	Section 9.2.4.2; Appendix 9G	

Table of Contents

Section **Page**

Table of Contents

List of Tables

List of Abbreviations and Acronyms

AQRV	air quality related value
BACT	Best Available Control Technology
CAA	Federal Clean Air Act
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
$CO_{2\text{-}e}$	carbon dioxide equivalent
dB	decibel
dBA	decibels of the A-weighted scale
EPA	Environmental Protection Agency
ESD	emergency shutdown
F	Fahrenheit
FERC	Federal Energy Regulatory Commission
GHG	greenhouse gas
H_2S	hydrogen sulfide
HAP	hazardous air pollutants
HDD	horizontal directional drill
HUD	U.S. Department of Housing and Urban Development
HP	horsepower
ISO	International Standards Organization
Km	kilometer
L_{dn}	day-night sound level
L_{eq}	equivalent sound levels
L_x	sound that exceeds level L for x percent of sampling duration
Mscf	thousand standard cubic feet
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAC	Nevada Administrative Code
NDEP	Nevada Department of Environmental Protection
NESHAP	National Emission Standards for Hazardous Air Pollutants
NO_x	oxides of nitrogen
NO_2	nitrogen dioxide
NOI	Notice of Intent
NSA	noise-sensitive area
NSPS	New Source Performance Standards

List of Abbreviations and Acronyms (Cont'd.)

PM	particulate matter
ppmvd	parts per million volume dry
Project	Ruby Pipeline Project
PSD	Prevention of Significant Deterioration
PWL	sound power level
ROW	right-of-way
Ruby	Ruby Pipeline, LLC
SIP	State Implementation Plan
SO_2	sulfur dioxide
SPL	sound pressure level
tpy	tons per year
UAC	Utah Administrative Code
UDAQ	Utah Department of Air Quality
VOC	volatile organic compounds
WAQS&R	Wyoming Air Quality Standards and Regulations
WC-AQMD	Washoe County District Health Department-Air Quality Management Department
WDEQ	Wyoming Department of Environmental Quality

9 Air and Noise Quality

The Ruby Pipeline Project (Project), proposed by Ruby Pipeline, LLC (Ruby), is comprised of approximately 675.2 miles of 42-inch diameter natural gas pipeline, along with associated compression and measurement facilities, located between Opal, Wyoming and Malin, Oregon. An approximate 2.6-mile lateral would also be constructed south from the Malin Hub in Klamath County, Oregon. The pipeline right-of-way (ROW) would cross four states: Wyoming, Utah, Nevada, and Oregon. Four new compressor stations would also be installed as part of the Project:

- The Roberson Creek Compressor Station would be constructed in Lincoln County, Wyoming. Based on preliminary design, the station would be equipped with three electric-drive compression units, each with an International Standards Organization (ISO) rating of 23,000 HP per unit. In total, the station would have an ISO compression rating of 69,000 HP, with compression of 69,000 HP available under site conditions.

- The Wildcat Hills Compressor Station would be constructed near the quarter-point of the pipeline in Box Elder County, Utah. Based on preliminary design, the station would be equipped with two Solar Mars 100 natural-gas turbine compressors. Each Mars 100 turbine has an ISO rating of approximately 14,334 HP. In total, the station would have an ISO compression rating of 28,668 HP, with compression of 26,554 HP available at site elevation and 0°F ambient.

- The Wieland Flat Compressor Station would be constructed near the midpoint of the pipeline in Elko County, Nevada. Based on preliminary design, the station would utilize two Solar Titan 130 natural-gas turbine compressors. Each Titan 130 turbine has an ISO rating of approximately 19,831 HP. In total, the station would have an ISO compression rating of 39,662 HP, with compression of 33,964 HP available at site elevation and 0°F ambient.

- The Desert Valley Compressor Station would be constructed near the three-quarter point of the pipeline in Humboldt County, Nevada. Based on preliminary design, the station would utilize one Solar Titan 130 natural gas turbine compressor. The station would have an ISO rating of 19,831 HP, with compression of 18,099 HP available at site elevation and 0°F ambient.

Construction activities would commence as early as March 2010 in areas where weather permits and where there are no restrictions designated to protect sensitive species, migrating species, or cultural resources, and would take approximately 10 to 12 months to complete. The majority of the pipeline construction would occur over a 10-month period using seven pipeline spreads, employing standard pipeline installation techniques, and constructed concurrently at different locations along the pipeline route. The compressor stations would be constructed utilizing separate contractors from the pipeline contractors. Additional information on the Project construction schedule is included in Resource Report No. 1.

This resource report describes the potential air quality and noise impacts related to construction and operation of the Project. The report details potential air pollutant emissions, noise levels, air quality and noise impacts, and control and mitigation measures.

9.1 Air Quality

The Federal Clean Air Act (CAA) designates seven criteria pollutants for which primary and secondary National Ambient Air Quality Standards (NAAQS) have been promulgated:

- Carbon monoxide (CO);
- Lead;
- Nitrogen dioxide (NO_2);
- Ozone;
- Particulate matter with an aerodynamic diameter less than or equal to 10 microns (PM_{10});
- Particulate matter with an aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$); and
- Sulfur dioxide (SO_2).

Primary NAAQS are designed to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary NAAQS are set to protect public welfare, including protection against decreased visibility, and protect animals, crops, vegetation, and buildings. State ambient air quality standards have also been adopted for most of these criteria pollutants in Nevada, Wyoming, and Oregon. Wyoming also has standards for hydrogen sulfide (H_2S), suspended sulfates, and fluorides. Utah has not adopted specific state ambient air quality standards, but has adopted NAAQS for criteria pollutants. NAAQS and state ambient air quality standards are summarized in Table 9.1-1. Ozone is not emitted directly from emission sources but is created near ground level by a chemical reaction between oxides of nitrogen (NO_x) and volatile organic compounds (VOCs) in the presence of sunlight. As a result, NO_x and VOCs are referred to as “ozone precursors” and are regulated as a means to prevent ozone formation. NO_x is primarily composed of NO_2 and nitrogen oxide (NO). Lead emissions are not expected from Project activities.

Table 9.1-1 Summary of State and National Ambient Air Quality Standards

Pollutant	Averaging Time	NAAQS		Nevada Air Quality Standards	Wyoming Air Quality Standards	Utah Air Quality Standard	Oregon Air Quality Standards
		Primary	Secondary				
CO	8-hour	9 ppm[a]	-	9 ppm[a,h] 6 ppm[a,i]	9 ppm[a]	o	9 ppm[a]
	1-hour	35 ppm[a]	-	35 ppm[a]	35 ppm[a]	o	35 ppm[a]
Lead	Quarterly (3-Month)	0.15 µg/m^3[v]	Same as Primary NAAQS	1.5 µg/m^3	1.5 µg/m^3	o	1.5 µg/m^3
NO_2	Annual	0.053 ppm (100 µg/m^3)	Same as Primary NAAQS	0.053 ppm (100 µg/m^3)	0.05 ppm (100 µg/m^3)	o	0.053 ppm (100 µg/m^3)
Ozone	8-hour	0.075 ppm[b] (0.08 ppm)[c]	Same as Primary NAAQS	-	0.08 ppm[b]	o	0.08 ppm[p]
	1-hour	0.12 ppm[d]	Same as Primary NAAQS	0.12 ppm[j] 0.10 ppm[j,k]	-	o	-
PM_{10}	Annual	-	-	50 µg/m^3	50 µg/m^3	-	50 µg/m^3
	24-hour	150 µg/m^3 (e)	Same as Primary NAAQS	150 µg/m^3 (l)	150 µg/m^3 (m)	o	150 µg/m^3 (q)
$PM_{2.5}$	Annual	15.0 µg/m^3 (f)	Same as Primary NAAQS	-	15 µg/m^3	o	-
	24-hour	35 µg/m^3 (g)	Same as Primary NAAQS	-	65 µg/m^3 (n)	o	-
SO_2	Annual	0.03 ppm (80 µg/m^3)	-	0.03 ppm (80 µg/m^3)	0.02 ppm (60 µg/m^3)	o	0.02 ppm (60 µg/m^3)
	24-hour	0.14 ppm[a] (365 µg/m^3)	-	0.14 ppm[a] (365 µg/m^3)	0.10 ppm[a] (260 µg/m^3)	o	0.10 ppm[a] (260 µg/m^3)
	3-hour	-	0.5 ppm[a] (1,300 µg/m^3)	0.5 ppm[a] (1,300 µg/m^3)	0.50 ppm[a] (1,300 µg/m^3)	o	0.50 ppm[a] (1,300 µg/m^3)
H_2S	½-hour	-	-	-	70 µg/m^3 (r) 40 µg/m^3 (s)	-	-
Suspended Sulfates	Annual	-	-	-	0.25 mg SO_3 per 100 cm^2-day	-	-
	30-day	-	-	-	0.50 mg SO_3 per 100 cm^2-day	-	-
Fluorides (ambient air	30 days	-	-	-	0.4 µg/m^3 (t)	-	-

Table 9.1-1 Summary of State and National Ambient Air Quality Standards

Pollutant	Averaging Time	NAAQS		Nevada Air Quality Standards	Wyoming Air Quality Standards	Utah Air Quality Standard	Oregon Air Quality Standards
		Primary	Secondary				
standards)	7 days	-	-	-	0.5 µg/m^{3} (t)	-	-
	24 hours	-	-	-	1.8 µg/m^{3} (t)	-	-
	12 hours	-	-	-	3.0 µg/m^{3} (t)	-	-
Fluorides (in forage for animal consumption)	1 year	-	-	-	30 ppm[u]	-	-
	60 days	-	-	-	60 ppm[u]	-	-
	30 days	-	-	-	80 ppm[u]	-	-

a. Not to be exceeded more than once per year.
b. The 2008 standard. The 3-year average of the 4th highest daily maximum 8-hour average concentration over each year must not exceed the standard.
c. The 1997 standard – and the implementation rules for this standard - will remain in place for implementation purposes as the EPA undertakes rulemaking to address the transition from the 1997 ozone standard to the 2008 ozone standard.
d. As of June 15, 2005, this standard revoked in all areas except the fourteen 8-hour ozone early action compact areas.
e. Not to be exceeded more than once per year on average over 3 years.
f. The 3-year average of the weighted annual mean concentrations must not exceed the standard.
g. The 3-year average of the 98th percentile concentrations must not exceed the standard.
h. Applicable to elevations less than 5,000 feet above mean sea level.
i. Applicable to elevations at or greater than 5,000 feet above mean sea level.
j. The 1-hour ozone standard is attained when the expected number of days per calendar year with a maximum hourly average concentration above the standard is equal to or less than one.
k. Applicable to Lake Tahoe Region, which is not affected by the Project.
l. The standard is attained when the expected number of days per calendar year with a 24-hour average concentration above the standard, rounded to the nearest 10 µg/m^3, is equal to or less than one. The expected number of days per calendar year is generally based on an average of the number of times the standard has been exceeded per year for the last 3 years.
m. Not to be exceeded more than once per year.
n. 98th percentile concentration.
o. Utah has not adopted specific state ambient air quality standards, but has adopted NAAQS for criteria pollutants.
p. Standard is attained when the average annual 4th-highest 8-hr average concentration is equal or less to the standard.
q. Standard is attained when the expected number of days per calendar year with a 24-hr average concentration above the standard is less than or equal to one.
r. Standard not to be exceeded more than 2 times per year.
s. Standard not to be exceeded more than 2 times in any five consecutive days.
t. Measured as hydrogen fluoride.
u. Measured as fluorine.
v. Standard is 3-month rolling average effective January 12, 2009.

The Environmental Protection Agency (EPA) compares ambient air measurements of criteria pollutants to the NAAQS to assess the status of air quality in the different regions of the U.S. Based on these comparisons, regions of the U.S. are designated as either “attainment,” “nonattainment,” or “unclassifiable.” A region is designated as attainment if monitoring shows that ambient concentrations of a specific pollutant are less than or equal to NAAQS. If the NAAQS are exceeded for a pollutant, then the region is designated as nonattainment for that pollutant. Nonattainment areas are further classified based on the severity of the exceedance of the relevant standard. An area is designated as unclassifiable if the ambient air monitoring data are incomplete and do not support a designation of attainment or nonattainment. If an area is redesignated from nonattainment to attainment, it is classified as a “maintenance area” for a 10-year period to ensure that the air quality improvements are sustained. Federal designations of air quality are defined in the Code of Federal Regulations (CFR), Title 40, Part 81 (40 CFR Part 81).

Hazardous air pollutants (HAPs) are pollutants that are known or suspected to cause acute or long-term serious health effects such as cancer, reproductive effects or birth defects, or adverse environmental impacts. Ambient air quality standards, in general, have not been established for these pollutants. However, federal, state, and local regulations and guidelines have been established to reduce their release to the atmosphere.

9.1.1 Existing Air Quality

The Project would be located in the following counties: Lincoln and Uinta counties in Wyoming; Rich, Cache, and Box Elder counties in Utah; Elko, Humboldt, and Washoe counties in Nevada; and Lake and Klamath counties in Oregon. Ambient monitoring throughout these states is coordinated by the following respective state and/or local agencies:

- Wyoming Department of Environmental Quality (WDEQ);
- Utah Department of Environmental Quality – Division of Air Quality (UDAQ);
- Nevada Division of Environmental Protection (NDEP), for all parts of Nevada except Washoe County;
- Washoe County District Health Department – Air Quality Management Division (WC-AQMD); and
- Oregon Department of Environmental Quality.

All of the areas in which Project activities would occur are currently designated as attainment and/or unclassifiable for all criteria pollutant NAAQS. However, on December 22, 2008, the EPA issued a final rule that would redesignate portions of Cache and Box Elder counties in Utah as nonattainment for the $PM_{2.5}$ NAAQS. These redesignations would become effective on March 22, 2009. The Cache Valley $PM_{2.5}$ nonattainment area is composed of western Cache County, Utah and southern Franklin County, Idaho. The Salt Lake City-Ogden-Clearfield-Provo-Orem $PM_{2.5}$ nonattainment area is composed of the following counties in Utah: Box Elder County (partial-eastern part), Davis County, Salt Lake County, Tooele County (partial), Utah County (partial), and Weber County (partial).

Given the remote location of the Project, few ambient monitoring stations are located in proximity to Project activities. Table 9.1-2 provides air pollutant measurements from ambient air monitoring stations located in the general area of the Project. These measurements are from urban, residential, or agricultural areas that may not be indicative of the entire Project area. Representative ambient air quality background measurements for the Project compressor stations were provided by WDEQ, UDAQ, and NDEP. These background concentrations are summarized in Table 9.1-3. The state agencies indicated that some of these measurements are based on data from urban areas or industrial sites and may represent higher values than those found in the rural areas in which the compressor stations would be located.

Table 9.1-2 Ambient Air Quality Measurements

		Ambient Air Quality Measurements [a]			
Pollutant	**Averaging Time**	**ID 560410101 Murphy Ridge, WY**	**ID 490030003 Brigham City, UT**	**ID 490037001 North Portage, UT**	**ID 320070004 Elko, NV**
CO	8-hour	1.5 ppm (2007)	-	-	-
	1-hour	1.6 ppm (2007)	-	-	-
Lead[b]	Quarterly	-	-	-	-
NO_2	Annual	0.003 µg/m^3 (2007)	-	-	-
Ozone	1-hour	0.081 ppm (2007)	0.117 ppm (2005)	0.091 ppm (2007)	-
	8-hour	0.070 ppm[c] (2007)	0.078 ppm[d] (2005-2007)	0.076 ppm[d] (2005-2007)	-
PM_{10}	Annual	12 µg/m^3 (2007)	-	-	26 µg/m^3 (2007)
	24-hour	157 µg/m^3 (2008)	-	-	163 µg/m^3 (2003)
$PM_{2.5}$	Annual	-	10.11 µg/m^3 (2004)	5.36 µg/m^3 (2005)	-
	24-hour	-	52.0 µg/m^3 [(c)] (2004)	37.6 µg/m^3 [(c)] (2004)	-
SO_2	Annual	0.001 µg/m^3 (2007)	-	-	-
	24-hour	0.006 µg/m^3 (2007)	-	-	-
	3-hour	0.007 µg/m^3 (2007)	-	-	-

Notes:

a. Data from the EPA AIRData Website. Except where noted, the maximum values measured over the period from 2003 through 2008 are listed. These measurements are from urban, residential, or agricultural areas that may not be representative of the areas in which the Project compressor stations and other activities are to be located.
b. Lead is not measured at any of the ambient air monitoring stations in the Project area.
c. Value is 4th highest value measured for the year listed.
d. Value is the 3-year average of the 4th highest value measured for each year listed.

Table 9.1-3 Ambient Air Quality Background Concentrations

Pollutant	Averaging Time	Roberson Creek Compressor Station[a]	Wildcat Hills Compressor Station[b]	Wieland Flat Compressor Station[c]	Desert Valley Compressor Station[c]
CO	8-hour	-	1 ppm	[e]	[e]
	1-hour	-	1 ppm	[e]	[e]
Lead	Quarterly	-	-	[e]	[e]
NO_2	Annual	3.4 µg/m^3	10 µg/m^3	[e]	[e]
Ozone	1-hour	-	-	[e]	[e]
	8-hour	-	-	[e]	[e]
PM_{10}	Annual	6.2 µg/m^3	10 µg/m^3	9 µg/m^3	9 µg/m^3
	24-hour	17.7 µg/m^3	34 µg/m^3	10.2 µg/m^3	10.2 µg/m^3
$PM_{2.5}$	Annual	-	[d]	[e]	[e]
	24-hour	-	[d]	[e]	[e]
SO_2	Annual	5 µg/m^3	5 µg/m^3	[e]	[e]
	24-hour	18 µg/m^3	10 µg/m^3	[e]	[e]
	3-hour	29 µg/m^3	20 µg/m^3	[e]	[e]

Notes:
a. Background concentrations provided by WDEQ in an August 12, 2008 e-mail from Jamie Sharp, WDEQ, to Paul Van Kerkhove, Ecology and Environment, Inc.
b. Background concentrations provided by UDAQ during an August 11, 2008 telephone conversation between Paul Van Kerkhove, Ecology and Environment, Inc., and Dave Prey, UDAQ. Except for annual PM_{10}, all values based on estimates for rural areas. Annual PM_{10}, value based on monitoring at ATK Solid Rocket Test Facility.
c. Background concentrations provided by NDEP on July 16, 2008. Values based on monitoring data from Lehman Caves (Baker, NV) in the Great Basin National Park.
d. Background $PM_{2.5}$ values not established by UDAQ.
e. Background values not established by NDEP for non-PSD emission sources in attainment areas.

9.1.1.1 Meteorological Conditions

The dispersion of air pollutants depends upon many factors, including meteorological conditions. The climate in the vicinity of the pipeline and compressor stations is varied. Thus, meteorological conditions are described for three representative locations: Salt Lake City, Utah; Elko, Nevada; and Winnemucca, Nevada.

Salt Lake City is located in a northern Utah valley surrounded by mountains on three sides and the Great Salt Lake to the northwest. The city varies in altitude from approximately 4,200 to 5,000 feet above sea level. The surrounding mountain ranges help to shelter the valley from storms from the southwest in the winter, but are instrumental in developing thunderstorms, which can drift over the valley in the summer. Besides the mountain ranges, the most influential natural condition affecting the climate of Salt Lake City is the Great Salt Lake. This large inland body of water, which never freezes due to its high salt content, can moderate the temperatures of cold winter winds blowing from the northwest and helps drive a lake/valley wind system. The combination of the Great Salt Lake and the surrounding mountains often enhances storm precipitation in the valley.

Salt Lake City normally has a semi-arid continental climate with four well-defined seasons. Summers are characterized by hot, dry weather, but the high temperatures are usually not oppressive because the relative humidity is generally low and the nights usually cool. July is the hottest month, with temperature readings in the 90s (degrees Fahrenheit [F]). The mean diurnal temperature range is about 30^{o}F in the summer and 18^{o}F during the winter. Temperatures above 102^{o}F in the summer or colder than -10^{o}F in the winter are likely to occur one season out of four. Winters are cold, but usually not severe. Mountains to the north and east act as a barrier to frequent invasions of cold continental air. Heavy fog can develop under temperature inversions in the winter and persist for several days. Precipitation, generally light during the summer and early fall, is heavy in the spring when storms from the Pacific Ocean are moving through the area more frequently than at any other season of the year. Winds are usually light, although occasional high winds have occurred in every month of the year, particularly in March.

Elko, located in the Humboldt River Valley of northeastern Nevada, lies at an elevation of 5,060 feet above sea level. The Ruby mountain range, with many peaks near or exceeding 10,000 feet, dominates the landscape from about 40 miles northeast to 40 miles southeast of Elko. The immediate terrain consists of sagebrush-covered valleys and hills. The highest hills are approximately 2,500 feet above the valley floors. A few areas, mostly in the higher mountains, are covered with sparse stands of juniper, aspen, pinyon pine, and spruce. Because of the high elevation and proximity of the mountains, there is a wide range between the normal high and low temperatures. The nights are cool, even in mid summer. Normal precipitation is light, especially during the summer months when it falls mostly as light showers that do not contribute much toward crop growth. The precipitation that falls between November and June (rain and snow) is critical to agriculture in the area. Based on the 1951-1980 period, the average first occurrence of 32^{o}F in the fall is September 8, and the average last occurrence in the spring is June 5.

Winnemucca, in north central Nevada, lies at an elevation of 4,295 feet above sea level and is effectively cut off by the Sierra Nevada Mountains from the moisture source of the Pacific Ocean. Winnemucca has a climate marked by warm days, cool nights, and light precipitation. Sixty-six percent of the annual precipitation occurs as rain and snow between December and May. The winter snow pack in the surrounding mountains is generally sufficient for essential summertime irrigation. As a result of the characteristic dryness of the climate, the neighboring valleys and hills are covered with sagebrush, and trees are found only along streams and in other places where water is available year round. Though it is heavier in the mountains, Winnemucca has had measurable snowfall amounts in every month except July, August, and September. Temperatures in this plateau area tend to rise sharply after sunrise and remain comparatively high during the daylight hours, then drop rapidly at sunset. Daily temperature variations of 50°F are not uncommon. Based on the 1951-1980 period, the average first occurrence of 32°F in the fall is September 10, and the average last occurrence in the spring is June 8.

9.1.2 Greenhouse Gases and Mitigation Measures

Some gases in the atmosphere affect the Earth's heat balance by absorbing infrared radiation. These layers of gas in the atmosphere can prevent the escape of heat in much the same way as glass in a greenhouse. Thus, global warming is often referred to as the "greenhouse effect." The gases most responsible for global warming are referred to as greenhouse gases (GHG). It is becoming more widely accepted that continued increases in GHGs will contribute to global warming, although there is uncertainty concerning the magnitude and timing of the warming trend. Combustion of fossil fuels during Project construction and operation would result in the emission of the following GHGs: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Emissions of GHGs are typically expressed in terms of CO_2 equivalents (CO_2e), where the potential of each gas to increase heating in the atmosphere is expressed as a multiple of the heating potential of CO_2, or its global warming potential.

Ruby is voluntarily undertaking several measures to minimize and mitigate the projected GHG emissions from construction and operation of its proposed pipeline Project. Ruby reviewed multiple options after careful consideration of the current scope of the Project, geography, market condition, and maturity of the GHG mitigation technologies. Since there is no single solution in mitigating all emissions, a "portfolio" approach would be utilized to mitigate Ruby's GHG emissions. Options still under consideration include application of renewable electric purchase power for compressor prime movers where possible, internal pipe coating, re-forestation, best management practices (BMP) to control methane (CH_4) loss, application of the U.S. Green Building Council (USGBC) Leadership in Energy and Environmental Design Leadership in Energy and Environmental Design (LEED) for buildings, and Voluntary Emissions Reduction (VER) credit purchases.

9.1.3 Air Pollutant Emissions

9.1.3.1 Construction

Air pollutant combustion emissions would be generated from diesel and gasoline engines in the various vehicles and construction equipment used in construction of the Project. Fugitive dust emissions would also be generated from vehicle traffic on paved and unpaved roads and from equipment used during construction activities. See Section 9.1.4.2 below for a discussion regarding fugitive dust mitigation. In some cases, open burning may be used for timber slash and chip disposal during Project construction. However, landowner or land management agency approval and appropriate local permits will be obtained prior to any open burning activities.

Estimates of the total criteria pollutant and total HAP emissions during the majority of construction are summarized in Table 9.1-4. Total GHG emission estimates for the majority of construction are presented in Table 9.1-5. Detailed calculations associated with these emission estimates are presented in Appendix 9A. Since the Project could be completed in less than 12 months, it is possible that all constructions emissions could occur in the same calendar year.

Table 9.1-4 Criteria Pollutant Emissions Estimates for Construction Activities

Construction Activity	Emissions (tons)						
	CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC	Total HAPs
Pipeline Construction	4,485	1,391	2,006	284	37	230	28
Roberson Creek Compressor Station Construction	38	40	231	27	1	6	1
Wildcat Hills Compressor Station Construction	53	41	276	31	1	7	1
Wieland Flat Compressor Station Construction	35	39	25	6	1	5	1
Desert Valley Compressor Station Construction	42	40	27	6	1	6	1

Table 9.1-5 Greenhouse Gas Emissions Estimates for Construction Activities

Construction Activity	GHG CO_2 Equivalent (CO_2e) Emissions (metric tons)
Pipeline Construction	178,243
Roberson Creek Compressor Station Construction	5,679
Wildcat Hills Compressor Station Construction	6,104
Wieland Flat Compressor Station Construction	5,577
Desert Valley Compressor Station Construction	5,793
TOTAL	**201,396**

See Appendix 9A, GHG Pipeline Construction Emission for details.

9.1.3.2 Operation

The designs of the compressor stations have not been finalized. However, based on recent construction of similar compressor stations, the following sources can be expected at the compressor stations: combustion turbine(s), fuel gas heater(s), stand-by generator(s), comfort/building heater(s), station blowdown vent(s), and tank(s) for new lube oil, used oil and/or pipeline liquids. All combustion equipment would be fueled with pipeline natural gas and constructed for full-time operation, except for stand-by generators. The stand-by generator at each station would be permitted to operate up to 500 hours per year, but would typically run less than 50 hours per year depending on the reliability of the power grid. Combustion equipment at Project compressor stations would generate emissions of criteria pollutants (except lead and ozone) and HAPs.

The primary emission source at the Roberson Creek Compressor Station would be the natural-gas-fired stand-by generator. The primary emission sources at the Wildcat Hills, Wieland Flat, and Desert Valley compressor stations would be the natural-gas-fired turbines. The equipment specifications and emission factors for the emission sources at each compressor station under current preliminary designs are listed in Table 9.1-6.

Even though fuel gas heater and comfort/building heater designs have not been finalized, emission estimates for natural-gas-fired heaters were developed by assuming the use of heaters with a total input fuel rating of one million British thermal units per hour (MMBtu/hr). A summary of the estimated maximum hourly emission rates of criteria pollutants and HAPs from compressor station equipment is presented in Table 9.1-7. Annual emission estimates of criteria pollutants and HAPs from compressor station equipment are summarized in Table 9.1-8. Tanks used for storage of new lube oil, used oil, and/or pipeline liquids are expected to have very little or no emissions due to the extremely low volatility of the stored materials. No natural gas dehydration systems are required at any of the compressor stations.

GHG emissions are generated during the normal operation of natural gas transmission pipelines. Emissions of CO_2, CH_4, and N_2O are produced from combustion sources at compressor stations (e.g., turbine compressors). Natural gas emissions (primarily CH_4) can be released from blowdown vents under routine operations or upset conditions. In addition, fugitive natural gas emissions (primarily CH_4) occur due to leaks from pipelines and system components such as equipment packing, seals, valves, flanges, pneumatic devices, and connectors at pipeline facilities, compressor stations, and meter and pressure regulation (M & R) stations. GHG emission estimates for pipeline and compressor station operation are presented in Table 9.1-9. Detailed calculations associated with these emission estimates are presented in Appendix 9B.

Table 9.1-6 Compressor Station Equipment and Emission Factors

Station	Equipment Description	Make & Model No.	Output Power (HP)		Annual Operation (hr/yr)	Emission Factor[b]		
			ISO	Site Conditions[a]		CO	NO_x	VOC
Roberson Creek Compressor Station	Three Electric Compressors	Siemans Electric Drive	23,000 per unit	23,000 per unit	8,760 per unit	-	-	-
	Natural Gas Stand-by Generator	TBD	270 (200 kW)	TBD	500	4.0 g/HP-hr	2.0 g/HP-hr	1.0 g/HP-hr
	Natural Gas Heaters	TBD	TBD	TBD	8,760	TBD	TBD	TBD
Wildcat Hills Compressor Station	Natural Gas Turbine #1	Solar Mars 100	14,334	13,277	8,760	25 ppmvd @15%O_2	15 ppmvd @15%O_2	TBD
	Natural Gas Turbine #2	Solar Mars 100	14,334	13,277	8,760	25 ppmvd @15%O_2	15 ppmvd @15%O_2	TBD
	Natural Gas Stand-by Generator	TBD	670 (500 kW)	TBD	500	4.0 g/HP-hr	2.0 g/HP-hr	1.0 g/HP-hr
	Natural Gas Heaters	TBD	TBD	TBD	8,760	TBD	TBD	TBD
Wieland Flat Compressor Station	Natural Gas Turbine #1	Solar Titan 130	19,831	16,982	8,760	50 ppmvd @15%O_2	25 ppmvd @15%O_2	TBD
	Natural Gas Turbine #2	Solar Titan 130	19,831	16,982	8,760	50 ppmvd @15%O_2	25 ppmvd @15%O_2	TBD
	Natural Gas Stand-by Generator	TBD	670 (500 kW)	TBD	500	4.0 g/HP-hr	2.0 g/HP-hr	1.0 g/HP-hr
	Natural Gas Heaters	TBD	TBD	TBD	8,760	TBD	TBD	TBD
Desert Valley Compressor Station	Natural Gas Turbine #1	Solar Titan 130	19,831	18,099	8,760	50 ppmvd @15%O_2	25 ppmvd @15%O_2	TBD
	Natural Gas Stand-by Generator	TBD	670 (500 kW)	TBD	500	4.0 g/HP-hr	2.0 g/HP-hr	1.0 g/HP-hr
	Natural Gas Heaters	TBD	TBD	TBD	8,760	TBD	TBD	TBD

Notes:
a. Stationary combustion emissions are based on site elevation and zero degrees F
b. ppmvd = part per million volume dry corrected to a baseline of 15 percent oxygen

Table 9.1-7 Maximum Hourly Emissions Rates of Criteria Pollutants and Hazardous Air Pollutants from Compressor Station Equipment

Station	Equipment Description	Make & Model No.	Maximum Hourly Emission Rate (lb/hr)							
			CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC	Formaldehyde	Total HAPs
Roberson Creek Compressor Station	Natural Gas Stand-by Generator	TBD	2.4	1.2	<0.1	<0.1	<0.1	0.6	0.1	0.2
	Natural Gas Heaters	TBD	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
		TOTAL	**2.5**	**1.3**	**<0.1**	**<0.1**	**<0.1**	**0.6**	**0.1**	**0.2**
Wildcat Hills Compressor Station	Natural Gas Turbine #1	Solar Mars 100	6.4	6.3	0.8	0.8	0.4	0.7	0.1	0.1
	Natural Gas Turbine #2	Solar Mars 100	6.4	6.3	0.8	0.8	0.4	0.7	0.1	0.1
	Natural Gas Stand-by Generator	TBD	5.9	3.0	<0.1	<0.1	<0.1	1.5	0.4	0.5
	Natural Gas Heaters	TBD	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
		TOTAL	**18.8**	**15.7**	**1.6**	**1.6**	**0.8**	**3.0**	**0.6**	**0.7**
Wieland Flat Compressor Station	Natural Gas Turbine #1	Solar Titan 130	15.5	12.7	0.9	0.9	0.5	0.9	0.1	0.1
	Natural Gas Turbine #2	Solar Titan 130	15.5	12.7	0.9	0.9	0.5	0.9	0.1	0.1
	Natural Gas Stand-by Generator	TBD	5.9	3.0	<0.1	<0.1	<0.1	1.5	0.4	0.5
	Natural Gas Heaters	TBD	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
		TOTAL	**37.0**	**28.5**	**1.9**	**1.9**	**1.0**	**3.3**	**0.6**	**0.7**
Desert Valley Compressor Station	Natural Gas Turbine #1	Solar Titan 130	16.5	13.5	1.0	1.0	0.5	0.9	0.1	0.2
	Natural Gas Stand-by Generator	TBD	5.9	3.0	<0.1	<0.1	<0.1	1.5	0.4	0.5
	Natural Gas Heaters	TBD	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
		TOTAL	**22.5**	**16.6**	**1.1**	**1.1**	**0.5**	**2.4**	**0.5**	**0.7**

Table 9.1-8 Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Compressor Station Equipment

Station	Equipment Description	Make & Model No.	Annual Emissions (tons/yr)							
			CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC	Formaldehyde	Total HAPs
Roberson Creek Compressor Station	Natural Gas Stand-by Generator	TBD	0.6	0.3	0.007	0.007	0.0004	0.2	0.04	0.05
	Natural Gas Heaters	TBD	0.4	0.5	0.04	0.04	0.003	0.03	0.0004	0.01
		Total	**1.0**	**0.8**	**0.05**	**0.05**	**0.003**	**0.2**	**0.04**	**0.06**
Wildcat Hills Compressor Station	Natural Gas Turbine #1	Solar Mars 100	28.1	27.7	3.3	3.3	1.7	3.2	0.4	0.5
	Natural Gas Turbine #2	Solar Mars 100	28.1	27.7	3.3	3.3	1.7	3.2	0.4	0.5
	Natural Gas Stand-by Generator	TBD	1.5	0.7	0.02	0.02	0.001	0.4	0.09	0.1
	Natural Gas Heaters	TBD	0.4	0.5	0.04	0.04	0.003	0.03	0.0004	0.01
		Total	**58**	**57**	**6.7**	**6.7**	**3.4**	**6.9**	**0.8**	**1.2**
Wieland Flat Compressor Station	Natural Gas Turbine #1	Solar Titan 130	67.7	55.6	4.0	4.0	2.1	3.9	0.4	0.6
	Natural Gas Turbine #2	Solar Titan 130	67.7	55.6	4.0	4.0	2.1	3.9	0.4	0.6
	Natural Gas Stand-by Generator	TBD	1.5	0.7	0.02	0.02	0.001	0.4	0.09	0.1
	Natural Gas Heaters	TBD	0.4	0.5	0.04	0.04	0.003	0.03	0.0004	0.01
		Total	**137**	**112**	**8.0**	**8.0**	**4.1**	**8.2**	**0.9**	**1.4**
Desert Valley Compressor Station	Natural Gas Turbine #1	Solar Titan 130	72.1	59.2	4.2	4.2	2.2	4.1	0.5	0.7
	Natural Gas Stand-by Generator	TBD	1.5	0.7	0.02	0.02	0.001	0.4	0.09	0.1
	Natural Gas Heaters	TBD	0.4	0.5	0.04	0.04	0.003	0.03	0.0004	0.01
		Total	**74**	**60**	**4.3**	**4.3**	**2.2**	**4.5**	**0.6**	**0.8**
PSD Major Source Threshold			**250**	**250**	**250**	**250**	**250**	**250**	**-**	**-**
Title V Threshold			**100**	**100**	**100**	**100**	**100**	**100**	**10**	**25**

Table 9.1-9 Annual Greenhouse Gas Emissions from Pipeline and Compressor Station Operation

GHG Emission Category	Emission Source	(GHG CO_2 Equivalent (CO_2e) Emissions[a] metric tons CO_2e /yr)
Stationary Combustion	Compressors, Stand-By Generators, Heaters	258,174
Fugitive	Pipeline	98
Fugitive	Meter Station Components	242
Fugitive	Compressor Station Components	5,168
Fugitive	Compressor Components	35,737
Process	Station Blowdown	8,550
Process	Pipeline Blowdown	11,230
Total		**319,200**

Notes:

a. Stationary combustion emissions are based on an annual average temperature of 60 degrees F for centrifugal compressors. CO_2e emissions are based on the GWPs from IPCC's Second Assessment Report (SAR) and emission factors from the INGAA GHG Emission Estimation Guidelines for Natural Gas Transmission and Storage and/or EPA AP-42.

9.1.4 Regulatory Requirements

9.1.4.1 On-Road and Off-Road Engine Standards

Air pollutant combustion emissions from engines in on-road vehicles and off-road equipment are regulated through federal emission standards required for engine manufacturers.

9.1.4.2 Fugitive Dust Control Plans and Measures

State and local air quality agencies administer regulations that can require monitoring and/or control measures to minimize the generation of fugitive dust. Project construction activities that generate fugitive dust would be subject to these dust control requirements. The NDEP and WC-AQMD require specific plans and/or permits for large-scale construction projects. An application for a surface area disturbance permit/fugitive dust control plan for Project construction activities in Elko and Humboldt counties, Nevada would be prepared and submitted to the NDEP. An application for a dust control permit for Project construction activities in Washoe County, Nevada will be prepared and submitted to the WC-AQMD. The Fugitive Dust Control Plan for the Project is presented in the Plan of Development (Appendix 1B, Resource Report No. 1).

9.1.4.3 New Source Performance Standards

New source performance standards (NSPS) set by the EPA for newly constructed or modified emission sources are intended to promote use of the best demonstrated control technologies, taking into account the cost of such technology and any other non-air quality, health, and environmental impact and energy requirements. These standards are authorized by Section 111 of the CAA, and the regulations are published in 40 CFR Part 60. The natural gas turbines proposed for each compressor station would be subject to NSPS Subpart KKKK: *Standards of Performance for Stationary Combustion Turbines*. Pursuant to these regulations, each turbine would be required to meet emission standards for NO_x and SO_2. The natural gas engine driven stand-by generators proposed for each compressor station would be subject to NSPS Subpart JJJJ: *Standards of Performance for Stationary Spark Ignition Internal Combustion Engines*. Pursuant to these regulations, the stand-by generator would be required to meet emission standards for NO_x, CO, and VOC.

9.1.4.4 National Emission Standards for Hazardous Air Pollutants

National Emission Standards for Hazardous Air Pollutants (NESHAP) are emissions standards set by the EPA for HAPs. The standards for a particular source category require the maximum degree of emission reduction that the EPA determines to be achievable, which is known as the Maximum Achievable Control Technology. These standards are authorized by Section 112 of the CAA and the regulations are published in 40 CFR Parts 61 and 63. The natural gas engine driven stand-by generators proposed for each compressor station would be subject to NESHAP Subpart ZZZZ: *National Emission Standards for Hazardous Air Pollutants for Reciprocating Internal Combustion Engines*.

According to the standards, if the owners and operators of an internal combustion engine are in compliance with NSPS Subpart JJJJ, they would also be in compliance with NESHAP Subpart ZZZZ for new and reconstructed engines located at a NESHAP area source. The Project compressor stations would be classified as a NESHAP area source because the annual emissions of all individual HAPs at each station would be less than 10 tons per year (tpy), and the annual emissions of total HAPs at each station would be less than 25 tpy. Therefore, the stand-by generators at each compressor station would be considered to be in compliance with NESHAP Subpart ZZZZ as long as they are operated in compliance with NSPS Subpart JJJJ.

9.1.4.5 Prevention of Significant Deterioration

New source review of new major stationary sources and major modifications at existing facilities in attainment areas, or Prevention of Significant Deterioration (PSD), is contained in 40 CFR 52.21. In Wyoming, these federal PSD requirements are codified under WAQS&R Chapter 6, Section 4. In Utah, PSD requirements are codified under Utah Administrative

Code (UAC) R307-405. In Nevada, PSD requirements are codified under Nevada Administrative Code (NAC) Chapter 445B, Sections 3363 to 3368.

For a new facility to be subject to PSD requirements, the facility must be classified as a major stationary source. Under PSD, a major stationary source is defined as:

- a stationary source that falls under one of the source categories listed in 40 CFR 52.21 and that has the potential to emit one or more air pollutants at a rate of over 100 tpy; or

- a stationary source that does not fall under one of the source categories listed in 40 CFR 52.21 and that has the potential to emit one or more air pollutant at a rate of over 250 tpy.

Because activities at the compressor stations do not fall under one of the source categories listed in 40 CFR 52.21, the 250 tpy PSD major source threshold is applicable for the Project. Since facility-wide emissions at each station would be less than 250 tpy, the Roberson Creek, Wildcat Hills, Wieland Flat, and Desert Valley compressor stations would not be subject to PSD requirements.

9.1.4.6 Air Permits for Construction/Air Permits to Operate

Requirements for air permits for the Roberson Creek Compressor Station are codified under the Wyoming Air Quality Standards and Regulations (WAQS&R) Chapter 6. Since projected annual emissions are less than Title V thresholds (see Table 9.1-7 above) the station would be considered a minor source and not require a major source permit to operate (Title V permit). Following final compressor station design, a final application for a permit waiver for insignificant activities for the Roberson Creek Compressor Station will be prepared accordingly and submitted to the WDEQ. ***This final application for a permit waiver will be submitted to FERC on or before February 19, 2009.***

An Approval Order from the UDAQ is necessary prior to construction of the Wildcat Hills Compressor Station. Before issuing an Approval Order, the UDAQ is required to review and assess a Notice of Intent (NOI) submitted for a proposed facility. The NOI, prepared by a project applicant, typically includes the following information contained on specified permit forms or in related appendices: detailed process description, stack data, emission rates, control equipment data, Best Available Control Technology (BACT) analysis, and air dispersion modeling analysis. Since projected annual emissions of some pollutants are less than Title V thresholds (see Table 9.1-8), the Wildcat Hills Compressor Station would not be considered a major source and would not require a major source permit to operate (Title V permit). Following final compressor station design, a final NOI for the Wildcat Hills

Compressor Station will be prepared accordingly and submitted to the UDAQ. ***This final application will be submitted to FERC on or before February 19, 2009.***

Requirements for air permits for the Wieland Flat Compressor Station and Desert Valley Compressor Station are codified under NAC Chapter 445B. Because potential CO and NO_x emissions from the Wieland Flat Compressor Station are estimated to be greater than 100 tpy, a Class I permit would need to be obtained for this station. Since the proposed emission sources at the Desert Valley Compressor Station would emit less than 100 tpy for any one regulated criteria pollutant, less than 25 tpy total HAP, and less than 10 tpy of any single HAP, a Class II permit would need to be obtained for this station. This permit would be applicable to the construction and operation of the station. Following final compressor station design, final permit to construct applications for the Wieland Flat Compressor Station and Desert Valley Compressor Station will be prepared accordingly and submitted to the NDEP. ***These final applications will be submitted to FERC on or before February 19, 2009.***

9.1.4.7 General Conformity Rule

Promulgated under 40 CFR 51 Subpart W and 40 CFR 93 Subpart B, the General Conformity Rule applies to all federal actions except for those related to transportation plans, programs, and projects. The General Conformity Rule is used to determine if federal actions meet the requirements of the CAA and the applicable state implementation plan (SIP) by ensuring that air emissions related to the action do not cause or contribute to new violations of a NAAQS; increase the frequency or severity of any existing violation of a NAAQS or interim emission reduction. A SIP is a compilation of a state's air quality control plans and rules, approved by EPA.

The General Conformity Rule defines a federal action as any activity engaged in by a department, agency, or instrumentality of the federal government or any activity that a department, agency, or instrumentality of the federal government supports in any way, provides financial assistance for, licenses, permits, or approves. The General Conformity Rule applies only to federal actions in locations designated as nonattainment or maintenance areas for any criteria air pollutant.

A Federal action is subject to the General Conformity Rule if it is not classified as an exempt activity and if the total direct and indirect emissions of a nonattainment/maintenance pollutant (or its precursors) equal or exceed de minimis emission thresholds established in the General Conformity regulations; or the emissions equal or exceed 10 percent of the total emissions budget for the entire nonattainment or maintenance area. If emissions are less than these criteria levels, then the federal action is presumed to conform with the SIP, and the General Conformity Rule is not applicable.

The only Project areas potentially subject to the General Conformity Rule would be in western Cache County, Utah (part of the Cache Valley $PM_{2.5}$ nonattainment area) and in eastern Box Elder County, Utah (part of the Salt Lake City-Ogden-Clearfield-Provo-Orem $PM_{2.5}$ nonattainment area). Pursuant to UDAQ R307-115-1, the provisions of 40 CFR Part 93, Subpart B (General Conformity Rule) is incorporated by reference into Utah air quality rules. Approximately 8.3 miles of the Project would be installed in the portion of Cache County that is part of the Cache Valley $PM_{2.5}$ nonattainment area. Approximately 44.5 miles of the Project would be installed in the portion of Box Elder County that is part of the Salt Lake City-Ogden-Clearfield-Provo-Orem $PM_{2.5}$ nonattainment area. As none of the Project compressor stations would be constructed in nonattainment areas, only short-term Project construction emissions would occur in the listed $PM_{2.5}$ nonattainment areas. The estimated construction emissions that would occur in western Cache County and eastern Box Elder County would be less than General Conformity threshold criteria (see Table 9.1-10). Therefore, the General Conformity Rule would not be applicable to the Project. Detailed calculations associated with construction emission estimates are presented in Appendix 9A.

Table 9.1-10 Comparison of Project Emissions to General Conformity Thresholds

Non Attainment Area	Air Pollutant	Construction Emissions (tons)	General Conformity Thresholds[a] (tpy)
Cache Valley $PM_{2.5}$ Nonattainment Area (includes Western Cache County, Utah)	$PM_{2.5}$	3.5	100
	NO_x ($PM_{2.5}$ precursor)	17	100
	SO_2 ($PM_{2.5}$ precursor)	0.5	28[b]
Salt Lake City-Ogden-Clearfield-Provo-Orem $PM_{2.5}$ Nonattainment Area (includes Eastern Box Elder County, Utah)	$PM_{2.5}$	19	100
	NO_x ($PM_{2.5}$ precursor)	93	100
	SO_2 ($PM_{2.5}$ precursor)	2.5	100

Notes:

a. Except where noted, de minimis thresholds are listed.

b. Threshold represents approximately 10 percent of the total emissions inventory for the entire nonattainment area, as value is less than applicable de minimis threshold.

9.1.4.8 State Specific Emission Requirements

The following regulations include state-specific emission requirements that apply to the natural-gas-fueled turbines and stand-by generators planned for the Project compressor stations. The station equipment would be designed and operated to comply with these standards as well as other emission requirements included in air quality construction/operating permits issued by the corresponding regulatory agency.

Wyoming

WAQS&R Chapter 3, Section 2. Emission Standards for Particulate Matter. Visible emissions of any contaminants discharged into the atmosphere from any single new emission source shall be limited to 20 percent opacity.

WAQS&R Chapter 6, Section 2. Permit Requirements for Construction, Modification, and Operation. A proposed facility will utilize BACT with consideration of the technical practicability and economic reasonableness of reducing or eliminating the emissions resulting from the facility.

Utah

UAC R307-401-5. Permit: New and Modified Sources - Notice of Intent. New emission sources are required to consider BACT. Control may be achieved by means of good process design, sound operating practices, emission control devices, or a combination of these means. Therefore, a BACT analysis will be prepared as part of NOI for the Wildcat Hills Compressor Station. In accordance with DAQ guidance, the following criteria will be used when analyzing strategies to achieve BACT: energy impacts, environmental impacts, economic impacts, other considerations, and cost calculations.

Nevada

NAC 445B.22017. Visible Emissions: Maximum Opacity; Determination and Monitoring of Opacity. No owner or operator may cause or permit the discharge emissions from any emission unit that have an opacity equal to or greater than 20 percent.

NAC 445B.2203. Emissions of Particulate Matter: Fuel-Burning Equipment. The allowable emissions of PM_{10} caused by the combustion of fuel in fuel combustion equipment must be calculated by the following formulas:

- For maximum heat input equal to or greater than four MMBtu/hr but less than or equal to 10 MMBtu/hour, the allowable emission is 0.6 lb/MMBtu of heat input.

- For maximum heat input greater than 10 MMBtu/hr but less than 4,000 MMBtu/hr, the allowable emissions is calculated using the following equation: $Y = 1.02X^{-0.231}$; where

"X" means the maximum operating rate (in MMBtu/hr) and "Y" means the allowable rate of emission (lb/MMBtu).

NAC 445B.22047 Sulfur emissions: Fuel-burning equipment. The allowable emission of compounds of sulfur caused by the combustion of fuel in fuel-burning equipment with a maximum heat input of less than 250 MMBtu/hr must be calculated by use of the following equation: Y = 0.7X; where "X" means the maximum operating heat input (in MMBtu/hr) and "Y" means the allowable rate of emission of sulfur (in pounds per hour).

9.1.5 Air Quality Impacts and Mitigation

9.1.5.1 Pipeline and Compressor Station Construction

The air quality impacts from the construction phase of the Project would result primarily from air pollutant combustion emissions and fugitive dust emissions. Fugitive dust emissions during construction can be associated with land clearing, ground excavation, and drilling and blasting. In addition, increases in local traffic to bring workers and supplies to the construction sites would result in increases in fugitive dust generated along the county roads and highways providing access to pipeline ROWs. The construction equipment and other mobile sources would be powered by diesel or gasoline fuels and would have intermittent and short-term emissions of CO, SO_2, NO_x, PM_{10}/$PM_{2.5}$, and VOCs.

Because pipeline construction moves through an area relatively quickly, air emissions are typically intermittent and short-term. The air quality impacts caused by construction activities are expected, in some instances, to contribute to ambient air pollutant concentrations, but the impacts would be temporary and would cease at the end of the construction period. In addition, the vast majority of construction activities would take place in remote areas far away from populated areas.

Ruby would employ standard construction practices that include measures to control the generation of fugitive dust emissions during construction and to ensure routine maintenance of construction equipment. These control measures would be outlined in the dust control plans and permits developed in conjunction with state and local air quality agencies. In addition to fugitive dust plans/permits required in the State of Nevada, a dust control plan has been prepared that covers all aspects of Project construction.

9.1.5.2 Compressor Station Operation

Air quality impacts from compressor station operation would result primarily from air pollutant combustion emissions from natural-gas-fired turbines and stand-by generators. The compressor stations would be located in remote areas far away from populated areas. Air quality impact analyses would be completed as part of the air permit-to-construct applications for the Wildcat Hills, Wieland Flat, and Desert Valley compressor stations. Given the projected low level of emissions, the WDEQ will determine the need for an air quality analysis for the Roberson Creek Compressor Station after submittal of the air permit-to-construct application. ***A summary of the results of each air quality impact analysis will be provided to FERC on or before February 19, 2009 with the completed applications for air permits to construct for the compressor stations.***

PSD regulations contain provisions intended to protect designated national parks and wilderness areas (known as "Class I areas") from the adverse impacts of air pollution. The compressor stations would be considered as minor sources, and thus, not subject to PSD requirements. The nearest Class I areas to the proposed compressor stations are listed below:

- Roberson Creek Compressor Station would be located approximately 84 miles (135 km) southwest of the Bridger Wilderness Area.
- Wildcat Hills Compressor Station would be located approximately 103 miles (165 km) east of the Jarbidge Wilderness Area.
- Wieland Flat Compressor Station would be located approximately 31 miles (50 km) southwest of the Jarbidge Wilderness Area.
- Desert Valley Compressor Station would be located approximately 68 miles (110 km) east of the South Warner Wilderness Area.

In draft guidance used for assessing air quality impacts for PSD sources, the applicable federal agencies consider a source located greater than 50 km from a Class I area to have negligible impacts with respect to Class I air quality related values (AQRVs) if its total SO_2, NO_x, PM_{10}, and hydrogen sulfide (H_2S) annual emissions (in tpy) divided by the distance (in km) from the Class I area (Q/D) is 10 or less (FLAG 2008). The applicable federal agencies for Class I areas include the U.S. Forest Service, the National Park Service, and the U.S. Fish and Wildlife Service. The maximum Q/D for any of the Project compressor stations is estimated to be well below 10 (i.e., ~2.5 for the Wieland Flat Compressor Station). It should be noted that the compressor stations are not considered as PSD sources because emissions are less than major source thresholds (Section 9.1.4.5).

Air quality impacts would be mitigated through the use of natural-gas-fired turbines and generators that are compliant with NSPS Subpart KKKK and NSPS Subpart JJJJ at all compressor stations. In addition, BACT will be applied to the turbines and stand-by generators operated at the Wildcat Hills Compressor Station. ***A final NOI will be submitted to FERC on or before February 19, 2009.***

9.2 Noise Quality

9.2.1 Existing Noise Environment

Noise is generally defined as sound with intensity greater than the ambient or background sound pressure level (SPL). The SPL is determined by measuring noise emissions in terms of sound pressure in a relationship defined as a decibel (dB). The type of decibel unit commonly used in sound level measurements is the A-weighted decibel (dBA). This scale is universally used to describe environmental noise because it simulates the variation with frequency throughout the audible range of the sensitivity to sound of typical healthy human hearing.

Outdoor noise levels change continually because of the temporal and spatial variations of noise sources. The temporal variation in the resulting sound levels is described by statistical levels in the form L_x, where L_x designates a sound that exceeds the level L for x percent of the sampling duration, or by equivalent sound levels in the form L_{eq}, defined as the stationary (constant) level with the same acoustic energy as the actual time-varying sound level over the given sampling period. The day-night average sound level (L_{dn}) is widely used by federal agencies, including the EPA and the U.S. Department of Housing and Urban Development (HUD). L_{dn} is the 24-hour equivalent level calculated by adding 10 dB to the actual sound level at night, from 10 p.m. to 7 a.m. (allowing for the increased human sensitivity to noise during sleeping hours).

9.2.1.1 Noise-Sensitive Areas

Noise-sensitive areas (NSAs) are defined as homes, schools, churches, or any location where people reside or gather. The proposed pipeline route and compressor stations are surrounded by open areas and forested areas, with few noise-sensitive receptors close to the Project area. Based on aerial imagery, there are no NSAs within a mile of the any of the proposed compressor stations. Station locations and corresponding NSAs are illustrated in each of the individual compressor station noise reports prepared by Hoover & Keith, Inc. (Hoover & Keith). These reports are provided in Appendix 9C.

A-weighted equivalent sound levels (L_{eq}) and the unweighted octave-band SPLs were measured in September 2008 by Hoover & Keith at five feet above ground using a Rion Model NA-27 Sound Level Meter (SLM) (a Type 1 SLM per American National Standards Institute [ANSI] S1.4 & S1.11) equipped with microphone and windscreen. The SLM was calibrated with a microphone calibrator (calibrated within one year of the test date). Table 9.2-1 lists the closest NSAs to each compressor station along with the ambient noise levels based on data contained in acoustical analysis reports by Hoover and Keith (see Appendix 9C).

Table 9.2-1 Construction Noise Levels at Closest NSAs

Compressor Station	Distance to Closest NSA (feet)	Ambient Sound Level Ld (dBA)	Estimated Ambient Ln (dBA)	Calculated Ldn (dBA)
Roberson Creek	25,900	25	25	31.6
Wildcat Hills	7,500	28	28	34.6
Wieland Flat	33,800	37	37	42.6
Desert Valley	23,800	24	24	30.0

9.2.2 Noise Regulations

9.2.2.1 Federal Noise Criteria

In 1974, the EPA published *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety* (EPA 1974). This publication evaluates the effects of environmental noise with respect to health and safety. The document provides information for state and local governments to use in developing their own ambient noise standards. The EPA has determined that in order to protect the public from activity interference and annoyance outdoors in residential areas, noise levels should not exceed an L_{dn} of 55 dBA. The Federal Energy Regulatory Commission (FERC) has adopted these standards and requires that the noise attributable to any new compressor engine or modifications during full load operation not exceed an L_{dn} of 55 dBA at any NSA. In addition, FERC may impose sound requirements for temporary site construction activities, and FERC generally references the sound level of 55 dBA (L_{dn}) as a “benchmark criterion” for assessing the noise of construction activities.

9.2.2.2 State Noise Criteria

Although the pipeline would cross through the states of Wyoming, Utah, Nevada, and Oregon, only the State of Oregon has established noise regulations. Under the State of Oregon Administrative Rules, 340-035-035: Noise Control Regulations for Industry and Commerce, no person owning or controlling a new industrial or commercial noise source located on a previously unused industrial or commercial site shall cause or permit the operation of that noise source if the noise levels generated or indirectly caused by that noise source (1) increase the ambient statistical noise levels, L10 or L50, by more than 10 dBA in any one hour, (2) exceed the levels specified in Table 8 of the regulations, or (3) generate a median octave band sound pressure level that exceeds applicable levels specified in Table

10 of the code. However, under the Project, there will be no compressor stations constructed by Ruby in the State of Oregon and therefore the regulations would not apply.

9.2.3 Noise Impacts

9.2.3.1 General Pipeline Construction

Construction of the pipeline would cause temporary increases in noise levels in the immediate vicinity of the construction sites. On-site construction noise would occur mainly from heavy-duty construction equipment (e.g., trucks, backhoes, excavators, loaders, cranes, and drill rigs). Typical pipeline construction equipment (both mobile and stationary) and corresponding noise emission levels are presented in Table 9.2-2. As indicated in this table, the worst-case noise level for the construction of the pipeline would be 92 dBA at 50 feet, excluding horizontal directional drill (HDD) activities, which are discussed further below. Noise levels at potential NSAs along the pipeline route will be evaluated once the determination of these locations has been completed. The worst-case noise level is derived by assuming that all of the construction equipment listed in Table 9.2-2 is operating simultaneously, which is unlikely, and combining its sound pressure levels logarithmically. Noise from on-site construction activities that may occur near a noise-sensitive receptor along the pipeline route may be intermittent or continuous, but would be limited to short durations over a period of three to four weeks at any one location.

Table 9.2-2 Construction Noise from Typical Pipeline Construction Equipment Activities

Equipment	Reference dBA @ 50 feet	Usage (percent)[b]	Estimated Noise Level, dBA at the Specified Distance from the Source (feet)					
			50	100	250	500	1000	2500
3-Ton Truck	84	40	80	74	66	60	54	46
Dump Truck	84	40	80	74	66	60	54	46
Concrete Truck	85	40	81	75	67	61	55	47
Fuel Truck	84	40	80	74	66	60	54	46
Backhoe	80	40	76	70	62	56	50	42
Trenching Machine	85	40	81	75	67	61	55	47
Crane	85	16	77	71	63	57	51	43
Front End Loader	80	40	76	70	62	56	50	42
Bulldozer	85	40	81	75	67	61	55	47
Sideboom	85	16	77	71	63	57	51	43
Boring Machine	85	20	78	72	64	58	52	44
Padding Machine	85	40	81	75	67	61	55	47
Farm Tractor	84	40	80	74	66	60	54	46
Mulching Machine	86	40	82	76	68	62	56	48
Air Compressor	80	40	76	70	62	56	50	42
Generator/Light Plant	82	50	79	73	65	59	53	45
Water Pump	77	50	74	68	60	54	48	40

Table 9.2-2 Construction Noise from Typical Pipeline Construction Equipment Activities

Equipment	Reference dBA @ 50 feet	Usage (percent)[b]	Estimated Noise Level, dBA at the Specified Distance from the Source (feet)					
			50	100	250	500	1000	2500
Water Truck	84	40	80	74	66	60	54	46
Welding Machine	73	40	69	63	55	49	43	35
Welding Truck	55	40	51	45	37	31	25	17
X-Ray Truck	55	40	51	45	37	31	25	17
Total worst case result[a]	-	-	**92**	**86**	**78**	**72**	**66**	**58**

[a] The worst case result is derived by adding the individual equipment noise levels logarithmically using the following formula: $Leq_{total} = 10\log\left(10^{\frac{Leq_1}{10}} + 10^{\frac{Leq_2}{10}} + 10^{\frac{Leq_3}{10}} ...etc.\right)$

[b]Source: FHWA Highway Construction Noise Handbook

Blasting would be required, at times, for ditch excavation and may also be required during the ROW grading operation. The amount of explosives per borehole would be limited by the proximity of existing structures and utilities. The blast area would be backfilled or covered by blasting mats and/or other material, as needed, to protect nearby existing facilities, structures, highways, railroads, or significant natural resources from thrown rock fragments. Instantaneous sound levels from typical construction blasting has been documented as approximately 93 to 94 dBA at a distance of 50 feet, which is only a few decibels higher than the expected reference sound level from several of the Project construction activities. In comparison with other construction sound, the sound from blasting would be brief and infrequent.

9.2.3.2 Horizontal Directional Drill Activities During Pipeline Construction

No crossings have been identified where HDD activities would be required. If such an area were identified, Ruby would provide a site-specific plan and perform the appropriate noise studies.

9.2.3.3 Compressor Station Construction and Unit Blowdown Events

Construction of the compressor stations would involve clearing and grading, placement of fill, and excavation for foundations for the compressor unit packages, other equipment settings, and ancillary equipment, associated unit housing, piping, and structures. Construction of all four compressor stations is planned to commence early in 2010 for a completion in March 2011. Table 9.2-3 presents typical noise emission levels at 50 feet for the noise producing equipment that would be used during the construction of the stations.

Table 9.2-3 Construction Equipment Noise at 50 Feet

Construction Activity	Equipment	SPL (dBA)
Land Clearing & Grading	Backhoe	85
	Bulldozer	80
	Chainsaw	81
	Truck	88
	Maximum Sound Level	**91**
Station Construction	Truck	88
	Forklift	83
	Backhoe	85
	Cement Truck	85
	Maximum Sound Level	**92**

Using the maximum sound level (which represents all of the equipment operating simultaneously) from the table, a worst-case maximum noise level can be calculated for the nearest NSAs using the following equation:

$$L_2 = L_1 - 20 \log\left(\frac{d_2}{d_1}\right)$$

Where:
L_2 = sound level at distance d_2
L_1 = sound level at distance d_1

Using this equation, the maximum noise levels were calculated for the closest NSAs to each station. Maximum noise levels are included in Table 9.2-4.

Table 9.2-4 Maximum Construction Noise Levels at Closest NSAs

Compressor Station	Distance to Closest NSA (Feet)	Maximum Sound Level (dBA)	Calculated L_{dn} (dBA)
Roberson Creek	25,900	38	44.4
Wildcat Hills	7,500	48	54.4
Wieland Flat	33,800	35	41.4
Desert Valley	23,800	38	44.4

As indicated in Table 9.2-4, the temporary maximum sound contribution due to compressor station construction is estimated to be lower than 55 dBA (L_{dn}), the FERC sound level requirement, at the nearby NSAs.

Blowdown Events

Two types of gas blowdown events could occur at each station: (1) a type of maintenance gas blowdown that could occur when a compressor is stopped and gas between the suction/discharge valves and compressors is vented to the atmosphere via a blowdown stack (no blowdown silencer anticipated) and (2) an emergency shutdown (ESD) that would only occur at required DOT test intervals or in an emergency situation.

Each year, a test would be performed on each station's ESD system to assure that the station valves would move to their shutdown position. Once all of the valves have moved properly, the blowdown would be interrupted to minimize gas loss. If the station was allowed to completely blowdown, the expected natural gas loss would be about 450-thousand standard cubic feet (Mscf) at the Roberson Hills Compressor Station and about 350 Mscf at the other three compressor stations. The individual gas turbine compressors would be shutdown a maximum of twice a year to perform internal inspection of the gas turbines. Blowing down the unit piping associated with a single compressor unit would vent about 60 Mscf of gas.

The unit blowdown event would occur infrequently and only for a short time frame (e.g., unit blowdown event would persist for approximately one to five minutes).

The maximum "peak" sound level of the unit blowdown event associated with the compressor units is estimated to be a sound level of 90 dBA at a distance of 300 feet. Table 9.2-5 contains the projected sound levels for a blowdown event at the closest NSA for each compressor station.

Table 9.2-5 Projected Sound Levels for Blowdown Event

	Distance to Closest NSA (Feet)	Peak Sound Level (dBA)	Ldn (dBA)
Roberson Creek	25,900	16	22 to 23
Wildcat Hills	7,500	47	53 to 54
Wieland Flat	33,800	14	20 to 21
Desert Valley	23,800	22	28 to 29

Source: Hoover & Keith October 2008

9.2.3.4 Compressor Station Operation

Long-term impacts on the existing noise environment would occur due to the operation of the compressor stations. Table 9.1-6 presents the specifications for proposed compressors.

The predicted sound levels contributed by the compressor unit(s), coolers, and aboveground piping at each station were calculated as a function of frequency from estimated unweighted octave-band sound power levels (PWLs) for each significant sound source associated with the compressor station. The Hoover & Keith reports (in Appendix 9C) explain the noise analysis methodology used to derive the operating noise levels for each compressor station listed in Table 9.2-6. As outlined in Table 9.2-6, with the operation of the compressors under full load, the results of the acoustical analysis indicate that the sound contribution of the proposed stations should be significantly lower than 55 dBA (L_{dn}) at the nearby NSAs. In addition, due to the distance of the closest NSAs from the stations, the noise resulting from a unit blowdown event or site construction activities at the station should not have a noise impact at the NSAs.

Table 9.2-6 Noise Quality Analysis for Compressor Stations

Compressor Station	NSA Description	Distance to NSA (feet)/Direction	Ambient Ld_n (dBA)	Estimated Station Ld_n (dBA)	Estimated Total Ld_n (dBA)	Potential Noise Increase (dBA)
Roberson Creek	Residence	25,900/NNW	31.6	18.1	31.8	0.2
Wildcat Hills	Residence	7,500/NNW	34.6	36.6	38.7	4.1
Wieland Flat	Residence	33,800/SSW	42.6	19.3	42.6	0.0
Desert Valley	Residence	23,800/ SSW	30	21.7	30.6	0.6

9.2.4 Mitigation

9.2.4.1 Pipeline and Compressor Station Construction

To mitigate noise impact from the construction of the pipeline and compressor stations, Ruby generally would engage in construction during daytime hours when there is less sensitivity to sound. It would also ensure that all equipment had sound control devices no less effective than those provided by the manufacturer and that no equipment had unmuffled exhausts.

9.2.4.2 Compressor Station Operation

The current design includes installing the compressor engines within an insulated building structure. If necessary, noise impacts at the compressor station would be further mitigated by the use of noise-control equipment, such as exhaust and intake silencers.

9.3 References

U.S. Environmental Protection Agency (EPA). March 1974. Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety. Prepared by the U.S. Environmental Protection Agency Office of Noise Abatement and Control. Washington, D.C.

9A. Construction Emission Calculation Tables

Table 9A-1

Summary of Emissions from Project Construction

Construction Activity	Emission Source	Emissions (tons)								GHG Emissions (metric tons)
		NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	HAPs	CO_2	CO_2
Pipeline Construction	Exhaust Emissions - Construction Equipment	1,366	222	4,417	37	85	85	27	190,921	173,203
	Exhaust Emissions - Commuter and Delivery Vehicles	25	8	68	0.5	0.5	0.5	1	5,556	5,040
	Fugitive Dust Emissions - Earth Moving Activities	-	-	-	-	153	21	-	-	-
	Fugitive Dust Emissions - Paved Roads	-	-	-	-	17	2	-	-	-
	Fugitive Dust Emissions - Unpaved Roads	-	-	-	-	1,751	175	-	-	-
	Total	**1,391**	**230**	**4,485**	**37**	**2,006**	**284**	**28**	**196,476**	**178,243**
Roberson Creek Compressor Station Construction	Exhaust Emissions - Construction Equipment	38	4	17	1	3	3	0.1	5,566	5,050
	Exhaust Emissions - Commuter and Delivery Vehicles	2	2	21	0.02	0.01	0.01	0.4	694	630
	Fugitive Dust Emissions - Earth Moving Activities	-	-	-	-	29	4	-	-	-
	Fugitive Dust Emissions - Paved Roads	-	-	-	-	4	0.4	-	-	-
	Fugitive Dust Emissions - Unpaved Roads	-	-	-	-	195	20	-	-	-
	Total	**40**	**6**	**38**	**1**	**231**	**27**	**0.5**	**6,260**	**5,679**
Wildcat Hills Compressor Station Construction	Exhaust Emissions - Construction Equipment	38	4	17	1	3	3	0.1	5,566	5,050
	Exhaust Emissions - Commuter and Delivery Vehicles	3	4	36	0.04	0.02	0.02	0.7	1,162	1,054
	Fugitive Dust Emissions - Earth Moving Activities	-	-	-	-	18	3	-	-	-
	Fugitive Dust Emissions - Paved Roads	-	-	-	-	7	1	-	-	-
	Fugitive Dust Emissions - Unpaved Roads	-	-	-	-	248	25	-	-	-
	Total	**41**	**7**	**53**	**1**	**276**	**31**	**0.8**	**6,728**	**6,104**
Wieland Flat Compressor Station Construction	Exhaust Emissions - Construction Equipment	38	4	17	1	3	3	0.1	5,566	5,050
	Exhaust Emissions - Commuter and Delivery Vehicles	2	2	18	0.02	0.01	0.01	0.4	581	527
	Fugitive Dust Emissions - Earth Moving Activities	-	-	-	-	18	3	-	-	-
	Fugitive Dust Emissions - Paved Roads	-	-	-	-	4	0.4	-	-	-
	Fugitive Dust Emissions - Unpaved Roads	-	-	-	-	0	0	-	-	-
	Total	**39**	**5**	**35**	**1**	**25**	**6**	**0.5**	**6,147**	**5,577**
Desert Valley Compressor Station Construction	Exhaust Emissions - Construction Equipment	38	4	17	1	3	3	0.1	5,566	5,050
	Exhaust Emissions - Commuter and Delivery Vehicles	2	3	25	0.03	0.01	0.01	0.5	819	743
	Fugitive Dust Emissions - Earth Moving Activities	-	-	-	-	18	3	-	-	-
	Fugitive Dust Emissions - Paved Roads	-	-	-	-	6	0.6	-	-	-
	Fugitive Dust Emissions - Unpaved Roads	-	-	-	-	0	0	-	-	-
	Total	**40**	**6**	**42**	**1**	**27**	**6**	**0.6**	**6,385**	**5,793**

Table 9A-2
Exhaust Emissions - Construction Equipment for Pipeline Installation

					Estimated Average Equipment Use for Each Spread (for 100 miles of work)					Emission Factor[e] (g/hp-hr)								Emissions (tons)							
Equipment Type[a]	**SCC**	**Fuel Type**	**Engine Rating (hp)**	**Load Factor[b]**	**No. of Units**	**Weekly Operation Per Unit (hr/week)**	**Site Duration[c] (weeks)**	**Total Operation for All Units (hrs)**	**Total Operation of All Units Entire Pipeline[d] (hrs)**	**NO_x**	**VOC**	**CO**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**HAPs**	**CO_2**	**NO_x**	**VOC**	**CO**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**HAPs**	**CO_2**
3 Ton Trucks	2270002051	Diesel	300	0.59	20	60	45	54,000	364,500	3.200	0.242	1.232	0.114	0.236	0.236	0.0069	536	227.6	17.2	87.6	8.1	16.8	16.8	0.49	38,118
3 Ton Trucks	2270002051	Diesel	300	0.59	12	25	45	13,500	91,125	3.200	0.242	1.232	0.114	0.236	0.236	0.0069	536	56.9	4.3	21.9	2.0	4.2	4.2	0.12	9,530
3 Ton Trucks	2270002051	Diesel	300	0.59	4	40	45	7,200	48,600	3.200	0.242	1.232	0.114	0.236	0.236	0.0069	536	30.3	2.3	11.7	1.1	2.2	2.2	0.07	5,082
Tractor Trailers	2270002051	Diesel	250	0.59	25	60	45	67,500	455,625	3.200	0.242	1.232	0.114	0.236	0.236	0.0069	536	237.1	17.9	91.3	8.4	17.5	17.5	0.51	39,706
Dump Trucks	2270002078	Diesel	400	0.21	1	60	45	2,700	18,225	7.060	1.077	3.989	0.133	0.843	0.843	0.0306	623	11.9	1.8	6.7	0.2	1.4	1.4	0.05	1,051
Concrete Trucks	2270002042	Diesel	400	0.43	1	12	3	36	243	6.365	0.439	2.056	0.113	0.314	0.314	0.0124	530	0.3	0.02	0.09	0.005	0.01	0.01	0.0006	24
Fuel Trucks	2270002051	Diesel	175	0.59	2	80	45	7,200	48,600	3.415	0.277	1.430	0.114	0.322	0.322	0.0080	536	18.9	1.5	7.9	0.6	1.8	1.8	0.04	2,965
Backhoes	2270002066	Diesel	150	0.21	20	60	45	54,000	364,500	6.553	1.064	4.300	0.133	0.717	0.717	0.0300	623	82.9	13.5	54.4	1.7	9.1	9.1	0.38	7,885
Cranes	2270002045	Diesel	250	0.43	1	10	3	30	203	4.377	0.295	0.907	0.113	0.199	0.199	0.0083	530	0.11	0.01	0.02	0.003	0.005	0.005	0.0002	13
Front End Loaders	2270002060	Diesel	150	0.59	2	60	40	4,800	32,400	4.352	0.339	1.588	0.114	0.334	0.334	0.0097	536	13.8	1.1	5.0	0.4	1.1	1.1	0.03	1,694
Bulldozers	2270002069	Diesel	200	0.59	30	60	45	81,000	546,750	3.860	0.281	1.256	0.114	0.252	0.252	0.0080	536	274.5	20.0	89.3	8.1	17.9	17.9	0.57	38,115
Sidebooms	2200002045	Diesel	200	0.43	20	60	45	54,000	364,500	4.377	0.295	0.907	0.113	0.199	0.199	0.0083	530	151.2	10.2	31.3	3.9	6.9	6.9	0.29	18,313
Boring Machines	2270002033	Diesel	200	0.43	3	60	21	3,780	25,515	6.202	0.480	1.886	0.113	0.368	0.368	0.0136	530	15.0	1.2	4.6	0.3	0.9	0.9	0.03	1,282
Padding Machine	2270002054	Diesel	200	0.43	3	84	21	5,292	35,721	4.446	0.299	0.924	0.113	0.203	0.203	0.0084	530	15.1	1.0	3.1	0.4	0.7	0.7	0.03	1,795
Road Sweepers	2270003030	Diesel	70	0.43	2	40	45	3,600	24,300	4.846	0.432	2.571	0.126	0.397	0.397	0.0124	589	3.9	0.3	2.1	0.1	0.3	0.3	0.01	475
Farm Tractors	2270005015	Diesel	30	0.59	3	60	44	7,920	53,460	4.807	0.477	2.969	0.127	0.514	0.514	0.0138	595	5.0	0.5	3.1	0.1	0.5	0.5	0.01	621
Mulching Machine	2270004066	Diesel	40	0.43	2	50	40	4,000	27,000	5.266	0.645	2.529	0.125	0.484	0.484	0.0183	588	2.7	0.3	1.3	0.06	0.2	0.2	0.01	301
Air Compressors	2270006015	Diesel	80	0.43	4	50	41	8,200	55,350	5.260	0.533	2.770	0.126	0.494	0.494	0.0153	589	11.0	1.1	5.8	0.3	1.0	1.0	0.03	1,236
Ditch Witches	2265002030	Gasoline	10	0.66	2	40	44	3,520	23,760	3.609	8.904	735.9	0.051	0.120	0.120	1.6944	1044	0.6	1.5	127.2	0.01	0.02	0.02	0.29	180
Generator/Light Plants	2265006005	Gasoline	15	0.68	4	25	41	4,100	27,675	3.706	8.580	672.7	0.051	0.113	0.113	1.6325	1052	1.2	2.7	209.3	0.02	0.04	0.04	0.51	327
Power Washers	2265006030	Gasoline	10	0.85	2	20	31	1,240	8,370	3.642	8.466	684.6	0.051	0.113	0.113	1.6109	1048	0.3	0.7	53.7	0.004	0.009	0.009	0.13	82
Water Pumps	2265006010	Gasoline	10	0.69	8	20	31	4,960	33,480	3.610	8.550	703.5	0.051	0.115	0.115	1.6270	1045	0.9	2.2	179.1	0.01	0.03	0.03	0.41	266
Water Trucks	2270002051	Diesel	175	0.59	1	30	21	630	4,253	3.415	0.277	1.430	0.114	0.322	0.322	0.0080	536	1.7	0.1	0.7	0.1	0.2	0.2	0.004	259
Welding Machines	2265006025	Gasoline	55	0.68	14	60	33	27,720	187,110	6.041	4.282	104.1	0.037	0.069	0.069	0.8160	768	46.6	33.0	803.0	0.3	0.5	0.5	6.29	5,924
Welding Trucks	2265002081	Gasoline	110	0.8	14	50	33	23,100	155,925	7.988	4.480	133.9	0.039	0.069	0.069	0.8534	802	120.8	67.8	2025.2	0.6	1.0	1.0	12.91	12,130
X-Ray Trucks	2265002081	Gasoline	125	0.8	3	60	33	5,940	40,095	7.988	4.480	133.9	0.039	0.069	0.069	0.8534	802	35.3	19.8	591.8	0.2	0.3	0.3	3.77	3,545
TOTAL																		**1366**	**222**	**4417**	**37**	**85**	**85**	**27**	**190,921**

Notes:

a. List includes representative equipment for all activites (clearing & grading, ditching, bending, etc.) and crew types (welding crew, coating crew, lowering crew, etc.).

b. Based on values presented in EPA guidance document "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling" (EPA420-P-04-005 dated April 2004).

c. Entire work duration of each spread is ~10 months (~45 weeks).

d. Total Operation = [Operation for All Units on Each Spread for 100 miles] x [675 miles (Total Length of Pipeline)] / [100 miles]

e. All emission factors except HAPs, generated from NONROAD5 model. HAP emission factors based on fractions presented in "Documentation for the Oonroad National Emissions Inventory (NEI) for Base Years 1970-2002" (EPA 2004).

Table 9A-3
Exhaust Emissions - Construction Equipment for Compressor Stations

						Estimated Equipment Use				Emission Factor[c,d] (g/hp-hr)								Emissions (tons)							
Station	Equipment Type[a]	SCC	Fuel Type	Engine Rating (hp)	Load Factor[b]	No. of Units	Daily Operation Per Unit (hr/day)	Site Duration (days)	Total Operation for All Units (hrs)	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	HAPs	CO_2	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	HAPs	CO_2
Roberson Creek Compressor Station	Forklift	2270002057	Diesel	200	0.59	6	10	240	14,400	4.354	0.318	1.450	0.114	0.283	0.283	0.0091	536	8.2	0.6	2.7	0.21	0.5	0.5	0.017	1004
	100-Ton Cranes	2270002045	Diesel	300	0.43	2	10	240	4,800	4.377	0.295	0.907	0.113	0.199	0.199	0.0083	530	3.0	0.2	0.6	0.1	0.1	0.1	0.006	362
	200-Ton Cranes	2270002045	Diesel	400	0.43	1	10	240	2,400	5.259	0.300	1.453	0.113	0.235	0.235	0.0085	530	2.4	0.1	0.7	0.05	0.1	0.1	0.004	241
	Cherry Picker	2270002045	Diesel	100	0.43	2	10	240	4,800	5.051	0.476	2.634	0.126	0.452	0.452	0.0136	589	1.1	0.11	0.6	0.029	0.10	0.10	0.003	134
	Bulldozers	2270002069	Diesel	500	0.59	2	10	240	4,800	4.449	0.235	1.857	0.010	0.500	0.500	0.0072	536	7	0.4	2.9	0.02	0.8	0.8	0.011	837
	Backhoes	2270002066	Diesel	200	0.21	3	10	240	7,200	6.305	0.976	3.851	0.133	0.638	0.638	0.0275	623	2.1	0.33	1.3	0.044	0.21	0.21	0.009	208
	Piledrivers	2270002033	Diesel	300	0.43	2	10	240	4,800	6.202	0.480	1.886	0.113	0.368	0.368	0.0136	529	4.2	0.33	1.3	0.08	0.25	0.25	0.009	361
	Welding Machines	2270006025	Diesel	150	0.21	10	10	240	24,000	6.694	1.243	5.327	0.133	0.858	0.858	0.0351	623	5.6	1.0	4.4	0.11	0.7	0.7	0.029	519
	Cutting Torches[e]	10301002	Propane	-	-	10	10	240	24,000	13	0.8	7.50	1.55	0.7	0.7	-	12,500	1.7	0.11	1.0	0.20	0.09	0.09	-	1650
	Generators	2270006005	Diesel	75	0.43	5	10	240	12,000	5.966	0.724	3.288	0.125	0.607	0.607	0.0206	588	3	0.3	1.4	0.05	0.3	0.3	0.009	251
	Total																	**38**	**4**	**17**	**1**	**3**	**3**	**0.1**	**5566**
Wildcat Hills Compressor Station	Forklift	2270002057	Diesel	200	0.59	6	10	240	14,400	4.354	0.318	1.450	0.114	0.283	0.283	0.0091	536	8.2	0.60	2.72	0.21	0.53	0.53	0.017	1004
	100-Ton Cranes	2270002045	Diesel	300	0.43	2	10	240	4,800	4.377	0.295	0.907	0.113	0.199	0.199	0.0083	530	3.0	0.20	0.62	0.08	0.14	0.14	0.006	362
	200-Ton Cranes	2270002045	Diesel	400	0.43	1	10	240	2,400	5.259	0.300	1.453	0.113	0.235	0.235	0.0085	530	2.4	0.14	0.66	0.05	0.11	0.11	0.004	241
	Cherry Picker	2270002045	Diesel	100	0.43	2	10	240	4,800	5.051	0.476	2.634	0.126	0.452	0.452	0.0136	589	1.1	0.11	0.60	0.03	0.10	0.10	0.003	134
	Bulldozers	2270002069	Diesel	500	0.59	2	10	240	4,800	4.449	0.235	1.857	0.010	0.500	0.500	0.0072	536	6.9	0.37	2.90	0.02	0.78	0.78	0.011	837
	Backhoes	2270002066	Diesel	200	0.21	3	10	240	7,200	6.305	0.976	3.851	0.133	0.638	0.638	0.0275	623	2.1	0.33	1.28	0.04	0.21	0.21	0.009	208
	Piledrivers	2270002033	Diesel	300	0.43	2	10	240	4,800	6.202	0.480	1.886	0.113	0.368	0.368	0.0136	529	4.2	0.33	1.29	0.08	0.25	0.25	0.009	361
	Welding Machines	2270006025	Diesel	150	0.21	10	10	240	24,000	6.694	1.243	5.327	0.133	0.858	0.858	0.0351	623	5.6	1.04	4.44	0.11	0.72	0.72	0.029	519
	Cutting Torches[e]	10301002	Propane			10	10	240	24,000	13	0.8	7.50	1.55	0.7	0.7	-	12,500	1.7	0.11	0.99	0.20	0.09	0.09	-	1650
	Generators	2270006005	Diesel	75	0.43	5	10	240	12,000	5.966	0.724	3.288	0.125	0.607	0.607	0.0206	588	3	0	1	0	0	0	0.009	251
	Total																	**38**	**4**	**17**	**1**	**3**	**3**	**0.1**	**5566**
Wieland Flat Compressor Station	Forklift	2270002057	Diesel	200	0.59	6	10	240	14,400	4.354	0.318	1.450	0.114	0.283	0.283	0.0091	536	8.2	0.60	2.72	0.21	0.53	0.53	0.017	1004
	100-Ton Cranes	2270002045	Diesel	300	0.43	2	10	240	4,800	4.377	0.295	0.907	0.113	0.199	0.199	0.0083	530	3.0	0.20	0.62	0.08	0.14	0.14	0.006	362
	200-Ton Cranes	2270002045	Diesel	400	0.43	1	10	240	2,400	5.259	0.300	1.453	0.113	0.235	0.235	0.0085	530	2.4	0.14	0.66	0.05	0.11	0.11	0.004	241
	Cherry Picker	2270002045	Diesel	100	0.43	2	10	240	4,800	5.051	0.476	2.634	0.126	0.452	0.452	0.0136	589	1.1	0.11	0.60	0.03	0.10	0.10	0.003	134
	Bulldozers	2270002069	Diesel	500	0.59	2	10	240	4,800	4.449	0.235	1.857	0.010	0.500	0.500	0.0072	536	6.9	0.37	2.90	0.02	0.78	0.78	0.011	837
	Backhoes	2270002066	Diesel	200	0.21	3	10	240	7,200	6.305	0.976	3.851	0.133	0.638	0.638	0.0275	623	2.1	0.33	1.28	0.04	0.21	0.21	0.009	208
	Piledrivers	2270002033	Diesel	300	0.43	2	10	240	4,800	6.202	0.480	1.886	0.113	0.368	0.368	0.0136	529	4.2	0.33	1.29	0.08	0.25	0.25	0.009	361
	Welding Machines	2270006025	Diesel	150	0.21	10	10	240	24,000	6.694	1.243	5.327	0.133	0.858	0.858	0.0351	623	5.6	1.04	4.44	0.11	0.72	0.72	0.029	519
	Cutting Torches[e]	10301002	Propane			10	10	240	24,000	13	0.8	7.50	1.55	0.7	0.7	-	12,500	1.7	0.11	0.99	0.20	0.09	0.09	-	1650
	Generators	2270006005	Diesel	75	0.43	5	10	240	12,000	5.966	0.724	3.288	0.125	0.607	0.607	0.0206	588	2.5	0.31	1.40	0.05	0.26	0.26	0.009	251
	Total																	**38**	**4**	**17**	**1**	**3**	**3**	**0.1**	**5566**
Desert Valley Compressor Station	Forklift	2270002057	Diesel	200	0.59	6	10	240	14,400	4.354	0.318	1.450	0.114	0.283	0.283	0.0091	536	8.2	0.60	2.72	0.21	0.53	0.53	0.017	1004
	100-Ton Cranes	2270002045	Diesel	300	0.43	2	10	240	4,800	4.377	0.295	0.907	0.113	0.199	0.199	0.0083	530	3.0	0.20	0.62	0.08	0.14	0.14	0.006	362
	200-Ton Cranes	2270002045	Diesel	400	0.43	1	10	240	2,400	5.259	0.300	1.453	0.113	0.235	0.235	0.0085	530	2.4	0.14	0.66	0.05	0.11	0.11	0.004	241
	Cherry Picker	2270002045	Diesel	100	0.43	2	10	240	4,800	5.051	0.476	2.634	0.126	0.452	0.452	0.0136	589	1.1	0.11	0.60	0.03	0.10	0.10	0.003	134
	Bulldozers	2270002069	Diesel	500	0.59	2	10	240	4,800	4.449	0.235	1.857	0.010	0.500	0.500	0.0072	536	6.9	0.37	2.90	0.02	0.78	0.78	0.011	837
	Backhoes	2270002066	Diesel	200	0.21	3	10	240	7,200	6.305	0.976	3.851	0.133	0.638	0.638	0.0275	623	2.1	0.33	1.28	0.04	0.21	0.21	0.009	208
	Piledrivers	2270002033	Diesel	300	0.43	2	10	240	4,800	6.202	0.480	1.886	0.113	0.368	0.368	0.0136	529	4.2	0.33	1.29	0.08	0.25	0.25	0.009	361
	Welding Machines	2270006025	Diesel	150	0.21	10	10	240	24,000	6.694	1.243	5.327	0.133	0.858	0.858	0.0351	623	5.6	1.04	4.44	0.11	0.72	0.72	0.029	519
	Cutting Torches[e]	10301002	Propane			10	10	240	24,000	13	0.8	7.50	1.55	0.7	0.7	-	12,500	1.7	0.11	0.99	0.20	0.09	0.09	-	1650
	Generators	2270006005	Diesel	75	0.43	5	10	240	12,000	5.966	0.724	3.288	0.125	0.607	0.607	0.0206	588	2.5	0.31	1.40	0.05	0.26	0.26	0.009	251
	Total																	**38**	**4**	**17**	**1**	**3**	**3**	**0.1**	**5566**

Notes:

a. List includes representative equipment for all activites (clearing & grading, ditching, bending, etc.) and crew types (welding crew, coating crew, lowering crew, etc.).

b. Based on values presented in EPA guidance document "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling" (EPA420-P-04-005 dated April 2004).

c. Except for cutting torches, non-HAP emission factors from EPA's NONROAD model. Emission factors for cutting torches from AP-42 Section 1.5 and are in units of lb/1000 gal.

d. HAP emission factors based on fractions presented in "Documentation for the Oonroad National Emissions Inventory (NEI) for Base Years 1970-2002" (EPA 2004).

e. Each cutting torch is assumed to have a propane fuel input rate of 1 MMBtu/hr (~11 gal/hr).

Table 9A-4
Exhaust Emissions - Commuter and Delivery Vehicles

Activity	Description	Roundtrip Distance (miles)	Average Daily Vehicles[a,b] (veh/day)	Construction Period (days)	Total Mileage (VMT)	Emission Factor[c,d,e,f] (g/VMT)								Emissions (tons)							
						NOx	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	HAPs	CO_2	NOx	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	HAPs	CO_2
Pipeline Construction[g]	Gasoline Worker Vehicles	100	140	300	4,200,000	1.09	1.49	14.05	0.0127	0.0059	0.0055	0.2811	440	5.0	6.9	65.0	0.06	0.03	0.03	1.3	2037
	Diesel Worker Vehicles	100	70	300	2,100,000	8.06	0.28	1.10	0.158	0.17	0.17	0.0079	1,400	18.7	0.6	2.5	0.366	0.394	0.394	0.02	3241
	Diesel Delivery Vehicles	100	6	300	180,000	8.06	0.28	1.10	0.158	0.17	0.17	0.0079	1,400	1.6	0.1	0.2	0.031	0.034	0.034	0.002	278
	TOTAL													**25.3**	**7.6**	**67.8**	**0.46**	**0.45**	**0.45**	**1.3**	**5556**
Roberson Creek Compressor Station Construction[h]	Gasoline Worker Vehicles	64	90	240	1,382,400	1.09	1.49	14.05	0.0127	0.0059	0.0055	0.2811	440	1.7	2.3	21.4	0.02	0.01	0.01	0.43	670
	Diesel Delivery Vehicles	64	1	240	15,360	8.06	0.28	1.10	0.158	0.17	0.17	0.0079	1,400	0.1	0.005	0.02	0.003	0.003	0.003	0.0001	24
	TOTAL													**1.8**	**2.3**	**21.4**	**0.02**	**0.01**	**0.01**	**0.4**	**694**
Wildcat Hills Compressor Station Construction[i]	Gasoline Worker Vehicles	120	80	240	2,304,000	1.09	1.49	14.05	0.0127	0.0059	0.0055	0.2811	440	2.8	3.8	35.7	0.03	0.01	0.01	0.71	1117
	Diesel Delivery Vehicles	120	1	240	28,800	8.06	0.28	1.10	0.158	0.17	0.17	0.0079	1,400	0.3	0.01	0.03	0.005	0.005	0.005	0.0002	44
	TOTAL													**3.0**	**3.8**	**35.7**	**0.04**	**0.02**	**0.02**	**0.7**	**1162**
Wieland Flat Compressor Station Construction[j]	Gasoline Worker Vehicles	60	80	240	1,152,000	1.09	1.49	14.05	0.0127	0.0059	0.0055	0.2811	440	1.4	1.9	17.8	0.02	0.007	0.007	0.36	559
	Diesel Delivery Vehicles	60	1	240	14,400	8.06	0.28	1.10	0.158	0.17	0.17	0.0079	1,400	0.1	0.004	0.02	0.003	0.003	0.003	0.0001	22
	TOTAL													**1.5**	**1.9**	**17.9**	**0.02**	**0.01**	**0.01**	**0.4**	**581**
Desert Valley Compressor Station Construction[k]	Gasoline Worker Vehicles	90	75	240	1,620,000	1.09	1.49	14.05	0.0127	0.0059	0.0055	0.2811	440	1.9	2.7	25.1	0.02	0.01	0.01	0.50	786
	Diesel Delivery Vehicles	90	1	240	21,600	8.06	0.28	1.10	0.158	0.17	0.17	0.0079	1,400	0.2	0.01	0.03	0.004	0.004	0.004	0.0002	33
	TOTAL													**2.1**	**2.7**	**25.1**	**0.03**	**0.01**	**0.01**	**0.5**	**819**

Notes:

a. For pipeline construction, average daily vehicles is based on the combined values for all pipeline spreads.

b. For compressor station construction, the number of commuter round trips is based on assumption of one roundtrip per worker per day.

c. Emission factors for gasoline worker vehicles from "Emission Facts: Average Annual Emissions and Fuel Consumption for Gasoline-Fueled Passenger Cars and Light Trucks (EPA420-F-05-22, EPA 2005). It was assumed that the vehicle make-up included 50% cars and 50% light-duty trucks/SUVs. SO2 emission factor calculated from gasoline consumption rate and a sulfur content of 80 ppm.

d. Emission factors for diesel worker and delivery vehicles (except SO2 and CO2) from "Assessing the Effects of Freight Movement on Air Quality at the National and Regional Level- Final Report" (U.S. Federal Highway Administration 2005).

e. CO2 and SO2 emission factors for diesel worker and delivery vehicles from "Greenhouse Gas Protocol - Corporate Accounting and Reporting Standard / Mobile Guide" (World Resources Institute/World Business Council for Sustainable Development 2005). SO2 emission factor calculated from diesel consumption rate and a sulfur content of 348 ppm.

f. HAP emission factors based on fractions presented in "Documentation for the Oonroad National Emissions Inventory (NEI) for Base Years 1970-2002" (EPA 2004).

g. Roundtrip distance based on assumption of an average daily road distance of 50 miles for each spread.

h. Roundtrip distance based on assumption of 32 miles of roads from Rock Springs, WY to site.

i. Roundtrip distance based on assumption of 83 miles of roads from Ogden, UT to site.

j. Roundtrip distance based on assumption of 30 miles of roads from Elko, NV to site.

k. Roundtrip distance based on assumption of 30 miles of paved road from Winnemucca, NV to site.

Table 9A-5
Fugitve Dust Emissions - Earth Moving Activities at Construction Sites

Activity	Disturbance (acres)	Duration of Activity (months)	Emission Factor[a] (ton/acre/month)		Emissions (tons)	
			PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Pipeline Construction[b]	170	10	0.090	0.0126	153	21
Roberson Creek Compressor Station Construction[c]	40	8	0.090	0.0126	29	4
Wildcat Hills Compressor Station[c]	25	8	0.090	0.0126	18	3
Wieland Flat Compressor Station[c]	25	8	0.090	0.0126	18	3
Desert Valley Compressor Station[c]	25	8	0.090	0.0126	18	3

Notes:
a. See emission factor derivation table below.
b. Pipeline construction area based on 7 concurrent spreads working on 200-ft wide corridor with a length of one mile.
c. Considers earthmoving to occur constantly during construction.

Emission Factor Derivation Table

Parameter	Units	TSP[1]	PM_{10}[(2)]	$PM_{2.5}$[(3)]
Uncontrolled Emission Factor[1] (based on 30 days/month)	ton/acre/month	0.2	0.15	0.021
Uncontrolled Emission Factor[4] (based on 24 days/month)	ton/acre/month	0.16	0.12	0.0168
Controlled Emission Factor[5] (based on 24 days/month)	ton/acre/month	0.12	0.09	0.0126

Notes:
1. Emission factor from AP-42 Section 13.2.3 for TSP.
2. PM_{10} emission factor calculated by multiplying TSP emission factor by 0.75 (AP-42 Section 11.9, Table 11.9-1)
3. $PM_{2.5}$ emission factor calculated by multiplying TSP emission factor by 0.105 (AP-42 Section 11.9, Table 11.9-1)
4. Calculated by multiplying 30-day emission factor by 0.8 (24 days/ 30 days).
5. Assume dust 25% duct control factor based on as-needed watering. Does not include any control for winter conditions (frozen ground)

Table 9A-7
Fugitive Dust Emissions - Unpaved Roads During Construction

Activity	Description	Mean Vehicle Weight (tons)	Roundtrip Distance (miles)	Average Daily Vehicles[a,b]	Construction Period (days)	Total Mileage (VMT)	Emission Factor[c] (lb/VMT)		Emissions (tons)	
							PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Pipeline Construction[d]	Gasoline Worker Vehicles	3	40	140	300	1,680,000	1.28	0.13	1071	107
	Diesel Worker Vehicles	4.25	40	70	300	840,000	1.49	0.15	626	63
	Diesel Delivery Vehicles	4.25	40	6	300	72,000	1.49	0.15	54	5
	TOTAL								**1751**	**175**
Roberson Creek Compressor Station Construction[e]	Gasoline Worker Vehicles	3	14	90	240	302,400	1.28	0.13	193	19
	Diesel Delivery Vehicles	4.25	14	1	240	3,360	1.49	0.15	2.5	0.25
	TOTAL								**195**	**20**
Wildcat Hills Compressor Station Construction[f]	Gasoline Worker Vehicles	3	20	80	240	384,000	1.28	0.13	245	24.5
	Diesel Delivery Vehicles	4.25	20	1	240	4,800	1.49	0.15	3.6	0.36
	TOTAL								**248**	**24.8**
Wieland Flat Compressor Station Construction[g]	Gasoline Worker Vehicles	3	0	80	240	0	1.28	0.13	0	0
	Diesel Delivery Vehicles	4.25	0	1	240	0	1.49	0.15	0	0
	TOTAL								**0**	**0**
Desert Valley Compressor Station Construction[h]	Gasoline Worker Vehicles	3	0	75	240	0	1.28	0.13	0	0
	Diesel Delivery Vehicles	4.25	0	1	240	0	1.49	0.15	0	0
	TOTAL								**0**	**0**

Notes:

a. For pipeline construction, average daily vehicles is based on the combined values for all pipeline spreads.
b. For compressor station construction, the number of commuter round trips is based on assumption of some carpooling.
c. See emission factor derivation table below.
d. Roundtrip distance based on assumption of an average daily unpaved road distance of 20 miles for each spread.
e. Roundtrip distance based on assumption of 7 miles of unpaved road from Rock Springs, WY to site.
f. Roundtrip distance based on assumption of 10 miles of unpaved road from Brigham City, UT to site.
g. Roundtrip distance based on assumption of no travel on unpaved road from Elko, NV to site.
h. Roundtrip distance based on assumption of no travel on unpaved road from Winnemucca, NV to site.

Emission Factor Derivation

$E = k(s/12)^a(W/3)^b$ AP-42 Section 13.2.2 (11/06 version)

where:

E = particulate emission factor (lb/VMT)
k, a, b = empirical constants for industrial roads
s = surface material silt content (%)
W = average vehicle weight (tons)

Parameter	Units	PM_{10}	$PM_{2.5}$	Reference
Constant, k	lb/VMT	1.8	0.18	Table 13.2.2-2 (worst case)
Constant, a		1	1	Table 13.2.2-2 (worst case)
Constant, b		0.45	0.45	Table 13.2.2-2 (worst case)
Silt content, s	%	8.5	8.5	Table 13.2..2-1 (construction sites)

Table 9A-8
Summary of Emissions from Project Construction in Nonattainment Areas

Pipeline Area	Pipeline Distance (miles)	Total Emissions (tons)		
		NO_x	SO_2	$PM_{2.5}$
All Areas	675	1,391	37	284
Cache Valley PM2.5 Nonattainment Area[a] (includes Western Cache County, Utah)	8.3	17	0.5	3.5
Salt Lake City-Ogden-Clearfield-Provo-Orem PM2.5 Nonattainment Area[b] (includes Eastern Box Elder County, Utah)	44.5	93	2.5	19

Notes:

a. Emissions calculated by multiplying emission for all pipeline areas by (Pipeline Distance in Area / Total Pipeline Distance)

b. Emissions calculated by multiplying emission for all pipeline areas by (Pipeline Distance in Area / Total Pipeline Distance) and addiing to half the emissions for commuting delivery trucks during construction of Wildcat Hills Compressor Station.

9B. Operational Emission Calculation Tables

Table 9B-1

Emissions for Solar Mars 100 Turbine - Wildcat Hills Compressor Station

Parameter	Value	Units
ISO Horsepower[1]	14334	bhp
Maximum Horsepower - Site Conditions[2]	13277	bhp
Maximum Fuel Flow - Site Conditions[2]	105.32	MMBtu/hr
Fuel Gas Lower Heating Value[2]	939.2	Btu/scf
Maximum Daily Operation	24	hr/day
Maximum Yearly Operation	8760	hr/yr

Pollutant Type	Pollutant	Emission Factor[3] (lb/MMBtu)	Stack Gas Concentration[4] (ppmvd@%15 O_2)	Maximum Hourly Emission Rate[4,5,6] (lb/hr)	Maximum Daily Emission Rate (lb/day)	Annual Potential-to-Emit (tpy)
Criteria	NO_x	-	15.0	6.33	152	27.7
	CO	-	25.0	6.42	154	28.1
	VOC	-	-	0.74	18	3.2
	PM_{10}	0.0066	-	0.75	18	3.3
	$PM_{2.5}$	0.0066	-	0.75	18	3.3
	SO_2	0.0034	-	0.39	9	1.7
HAPs	Formaldehyde	0.00071	-	0.08	1.9	0.36
	Total HAPs	0.001027	-	0.12	2.8	0.51

Notes:

1. Emission Performance Data Sheet for Solar Turbines Mars 100-15000S (ISO Conditions).
2. Emission Performance Data Sheet for Solar Turbines Mars 100-15000S (Conditions for Wildcat Hills Compressor Station).
3. Emission factors from AP-42 Section 3.1.
4. NO_x and CO emission rates from Emission Performance Data Sheet for Solar Turbines Mars 100-15000S (Conditions for Wildcat Hills Compressor Station).
5. VOC emission rate calculated as 20% of unburned hydrocarbon (UHC) listed in Emission Performance Data Sheet for Solar Turbines Mars 100-15000S (Conditions for Wildcat Hills Compressor Station).
6. Since emission factors are based on a natural gas HHV of 1020 Btu/scf, hourly emission rates (for all pollutants except NO_x, CO, and VOC) are corrected by a factor of 1.086 (1020 / LHV [939.2]).

Table 9B-2

Emissions for Solar Titan 130 Turbine - Wieland Flat Compressor Station

Parameter	Value	Units
ISO Horsepower[1]	19831	bhp
Maximum Horsepower - Site Conditions[2]	16982	bhp
Maximum Fuel Flow - Site Conditions[2]	126.76	MMBtu/hr
Fuel Gas Lower Heating Value[2]	939.2	Btu/scf
Maximum Daily Operation	24	hr/day
Maximum Yearly Operation	8760	hr/yr

Pollutant Type	Pollutant	Emission Factor[3] (lb/MMBtu)	Stack Gas Concentration[4] (ppmvd@%15 O_2)	Maximum Hourly Emission Rate[4,5,6] (lb/hr)	Maximum Daily Emission Rate (lb/day)	Annual Potential-to-Emit (tpy)
Criteria	NO_x	-	25.0	12.69	305	55.6
	CO	-	50.0	15.45	371	67.7
	VOC	-	-	0.89	21	3.9
	PM_{10}	0.0066	-	0.91	22	4.0
	$PM_{2.5}$	0.0066	-	0.91	22	4.0
	SO_2	0.0034	-	0.47	11	2.1
HAPs	Formaldehyde	0.00071	-	0.10	2.3	0.4
	Total HAPs	0.001027	-	0.14	3	0.6

Notes:
1. Emission Performance Data Sheet for Solar Turbines Titan 130-20502S (ISO Conditions).
2. Emission Performance Data Sheet for Solar Turbines Titan 130-20502S (Conditions for Wieland Flat Compressor Station).
3. Emission factors from AP-42 Section 3.1.
4. NO_x and CO emission rates from Emission Performance Data Sheet for Solar Turbines Titan 130-20502S (Conditions for Wieland Flat Compressor Station).
5. VOC emission rate calculated as 20% of unburned hydrocarbon (UHC) listed in Emission Performance Data Sheet for Solar Turbines Titan 130-20502S (Conditions for Wieland Flat Compressor Station).
6. Since emission factors are based on a natural gas HHV of 1020 Btu/scf, hourly emission rates (for all pollutants except NO_x, CO, and VOC) are corrected by a factor of 1.086 (1020 / LHV [939.2]).

Table 9B-3

Emissions for Solar Titan 130 Turbine - Desert Valley Compressor Station

Parameter	Value	Units
ISO Horsepower[1]	19831	bhp
Maximum Horsepower - Site Conditions[2]	18099	bhp
Maximum Fuel Flow - Site Conditions[2]	135.01	MMBtu/hr
Fuel Gas Lower Heating Value[2]	939.2	Btu/scf
Maximum Daily Operation	24	hr/day
Maximum Yearly Operation	8760	hr/yr

Pollutant Type	Pollutant	Emission Factor[3] (lb/MMBtu)	Stack Gas Concentration[2] (ppmvd@%15 O_2)	Maximum Hourly Emission Rate[4,5] (lb/hr)	Maximum Daily Emission Rate (lb/day)	Annual Potential-to-Emit (tpy)
Criteria	NO_x	-	25.0	13.52	324	59.2
	CO	-	50.0	16.46	395	72.1
	VOC	-	-	0.94	23	4.1
	PM_{10}	0.0066	-	1.0	23	4.2
	$PM_{2.5}$	0.0066	-	1.0	23	4.2
	SO_2	0.0034	-	0.50	12	2.2
HAPs	Formaldehyde	0.00071	-	0.10	2.5	0.5
	Total HAPs	0.001027	-	0.15	3.6	0.7

Notes:

1. Emission Performance Data Sheet for Solar Turbines Titan 130-20502S (ISO Conditions).
2. Emission Performance Data Sheet for Solar Turbines Titan 130-20502S (Conditions for Desert Valley Compressor Station).
3. Emission factors from AP-42 Section 3.1.
4. NO_x and CO emission rates from Emission Performance Data Sheet for Solar Turbines Titan 130-20502S (Conditions for Desert Valley Compressor Station).
5. VOC emission rate calculated as 20% of unburned hydrocarbon (UHC) listed in Emission Performance Data Sheet for Solar Turbines Titan 130-20502S (Conditions for Desert Valley Compressor Station).
6. Since emission factors are based on a natural gas HHV of 1020 Btu/scf, hourly emission rates (for all pollutants except NO_x, CO, and VOC) are corrected by a factor of 1.086 (1020 / LHV [939.2]).

Table 9B-4

Emissions for Stand-By Generator - Roberson Creek Compressor Station

Parameter	Value	Units
Power Rating[1]	200	kW
	268	hp
Heat Rate[2]	9400	Btu/bhp-hr
Engine Design Rate (LHV)	2.5	MMBtu/hr
Lower Heating Value[1]	939.2	Btu/scf
Maximum Daily Operation	24	hr/day
Maximum Yearly Operation	500	hr/yr

Pollutant Type	Pollutant	Emission Factor[3] (lb/MMBtu)	Emission Factor[4] (g/bhp-hr)	Maximum Hourly Emission Rate[5] (lb/hr)	Maximum Daily Emission Rate (lb/day)	Annual Potential-to-Emit (tpy)
Criteria	NO_x	-	2.0	1.2	28	0.30
	CO	-	4.0	2.4	57	0.59
	VOC	-	1.0	0.59	14	0.15
	PM_{10}	0.00999	-	0.027	0.66	0.0068
	$PM_{2.5}$	0.00999	-	0.027	0.66	0.0068
	SO_2	0.000588	-	0.0016	0.039	0.00040
HAPs	Formaldehyde	0.0528	-	0.14	3.5	0.036
	Total HAPs	0.06855	-	0.19	4.5	0.047

Notes:
1. Estimated from engineering design.
2. Estimated from specification sheets for Caterpillar Gas Generator Sets.
3. Emission factors from AP-42 Section 3.2 (4-stroke lean burn engines).
4. Emission limits for spark-ignition emergency generators in NSPS Subpart JJJJ.
5. Except for NO_x, CO, and VOC, emission factors are based on a natural gas HHV of 1020 Btu/scf; hourly emission rates are corrected by a factor of 1.127 (1020 / LHV [939]).

Table 9B-5

Emissions for Stand-By Generator - Wildcat Hills, Wieland Flat, and Desert Valley Compressor Stations

Parameter	Value	Units
Power Rating[1]	500	kW
	671	hp
Heat Rate[2]	9400	Btu/bhp-hr
Engine Design Rate (LHV)	6.3	MMBtu/hr
Lower Heating Value[1]	939.2	Btu/scf
Maximum Daily Operation	24	hr/day
Maximum Yearly Operation	500	hr/yr

Pollutant Type	Pollutant	Emission Factor[3] (lb/MMBtu)	Emission Factor[4] (g/bhp-hr)	Maximum Hourly Emission Rate[5] (lb/hr)	Maximum Daily Emission Rate (lb/day)	Annual Potential-to-Emit (tpy)
Criteria	NO_x	-	2.0	3.0	71	0.74
	CO	-	4.0	5.9	142	1.5
	VOC	-	1.0	1.5	35	0.37
	PM_{10}	0.00999	-	0.068	1.6	0.017
	$PM_{2.5}$	0.00999	-	0.068	1.6	0.017
	SO_2	0.000588	-	0.0040	0.10	0.0010
HAPs	Formaldehyde	0.0528	-	0.36	8.7	0.090
	Total HAPs	0.06855	-	0.47	11	0.12

Notes:
1. Estimated from engineering design.
2. Estimated from specification sheets for Caterpillar Gas Generator Sets.
3. Emission factors from AP-42 Section 3.2 (4-stroke lean burn engines).
4. Emission limits for spark-ignition emergency generators in NSPS Subpart JJJJ.
5. Except for NO_x, CO, and VOC, emission factors are based on a natural gas HHV of 1020 Btu/scf; hourly emission rates are corrected by a factor of 1.127 (1020 / LHV [939]).

Table 9B-6

Emissions for Fuel Gas and Building Space Natural Gas Heaters - All Compressor Stations

Parameter	Value	Units
Combined Input Heat Capacity	1	MMBtu/hr
Lower Heating Value[1]	939.2	Btu/scf
Maximum Daily Operation	24	hr/day
Maximum Yearly Operation	8760	hr/yr

Pollutant Type	Pollutant	Emission Factor[2] (lb/MMscf)	Maximum Hourly Emission Rate[3] (lb/hr)	Maximum Daily Emission Rate (lb/day)	Annual Potential-to-Emit (tpy)
Criteria	NO_x	100	0.12	2.8	0.51
	CO	84	0.10	2.3	0.43
	VOC	5.5	0.0064	0.153	0.028
	PM_{10}	7.6	0.0088	0.21	0.038
	$PM_{2.5}$	7.6	0.0088	0.21	0.038
	SO_2	0.6	0.00069	0.0167	0.0030
HAPs	Formaldehyde	0.075	0.000087	0.0021	0.00038
	Total HAPs	1.9	0.0022	0.053	0.0096

Notes:

1. Natural gas lower heating value assumed equal to value used for gas turbines.
2. Emission factors from AP-42 Section 1.4 (Natural Gas Combustion).
3. Since emission factors are based on a natural gas HHV of 1020 Btu/scf; hourly emission rates are corrected by a factor of 1.127 (1020 / LHV [939]).

Table 9B-7
Annual Emissions for Roberson Creek Compressor Station

Pollutant Type	Pollutant	Annual Emissions (tons/yr)		
		Stand-By Generator	Auxiliary Heater	TOTAL
Criteria	NO_x	0.30	0.51	0.80
	CO	0.59	0.43	1.0
	VOC	0.15	0.028	0.18
	PM_{10}	0.0068	0.038	0.045
	$PM_{2.5}$	0.0068	0.038	0.045
	SO_2	0.00040	0.0030	0.0034
HAPs	Formaldehyde	0.036	0.00038	0.037
	Total HAPs	0.047	0.0096	0.057

Table 9B-8
Annual Emissions for Wildcat Hills Compressor Station

Pollutant Type	Pollutant	Annual Emissions (tons/yr)				
		Mars 100 Turbine	Mars 100 Turbine	Stand-By Generator	Auxiliary Heater	TOTAL
Criteria	NO_x	27.7	27.7	0.74	0.51	57
	CO	28.1	28.1	1.5	0.43	58
	VOC	3.2	3.2	0.37	0.028	6.9
	PM_{10}	3.3	3.3	0.017	0.038	6.7
	$PM_{2.5}$	3.3	3.3	0.017	0.038	6.7
	SO_2	1.7	1.7	0.0010	0.0030	3.4
HAPs	Formaldehyde	0.36	0.36	0.090	0.00038	0.80
	Total HAPs	0.51	0.51	0.12	0.0096	1.2

Table 9B-9
Annual Emissions for Wieland Flat Compressor Station

Pollutant Type	Pollutant	Annual Emissions (tons/yr)				
		Titan 130 Turbine	Titan 130 Turbine	Stand-By Generator	Auxiliary Heater	TOTAL
Criteria	NO_x	55.6	55.6	0.74	0.51	112
	CO	67.7	67.7	1.5	0.43	137
	VOC	3.9	3.9	0.37	0.028	8.2
	PM_{10}	4.0	4.0	0.017	0.038	8.0
	$PM_{2.5}$	4.0	4.0	0.017	0.038	8.0
	SO_2	2.1	2.1	0.0010	0.0030	4.1
HAPs	Formaldehyde	0.43	0.43	0.090	0.00038	0.95
	Total HAPs	0.62	0.62	0.12	0.0096	1.4

Table 9B-10
Annual Emissions for Desert Valley Compressor Station

Pollutant Type	Pollutant	Annual Emissions (tons/yr)			
		Titan 130 Turbine	Stand-By Generator	Auxiliary Heater	TOTAL
Criteria	NO_x	59.2	0.74	0.51	60
	CO	72.1	1.5	0.43	74
	VOC	4.1	0.37	0.028	4.5
	PM_{10}	4.2	0.017	0.038	4.3
	$PM_{2.5}$	4.2	0.017	0.038	4.3
	SO_2	2.2	0.0010	0.0030	2.2
HAPs	Formaldehyde	0.46	0.090	0.00038	0.55
	Total HAPs	0.66	0.12	0.0096	0.79

Table 9B-11
Greenhouse Gas Operational Emissions - All Compressor Stations

GHG Global Warming Potentials

Parameter	Value
Global Warming Potential - CH_4	21
Global Warming Potential - CO_2	1
Global Warming Potential - N_2O	310

Natural Gas Parameters

Volume Fraction - CH_4	93.4%
Volume Fraction - CO_2	2%
Higher Heating Value (Btu/cf)	1030

Emission Factors

Source	Units	Value	Emission Factor Reference
Pipeline Fugitives	lb CH_4/mile	15	INGAA - Tier 3
Meter Station Fugitives	lb CH_4/station	2,533	INGAA - Tier 2
Compressor Station Fugitives	lb CH_4/station	135,260	INGAA - Tier 3
Station Blowdown	lb CH_4/station	223,758	INGAA - Tier 3
Pipeline Blowdown	lb CH_4/mile	1,729	INGAA - Tier 3
Compressor Fugitives	lb CH_4/centrifugal comp	467,660	INGAA - Tier 3
Compressor Combustion Emissions	lb CH_4/MMBtu	0.0086	INGAA - Tier 3
	lb N_2O/MMBtu	0.00838	INGAA - Tier 3
	lb CO_2/MMcf	119,394	Mass Balance
Stand-By Generator Combustion Emissions	lb CH_4/MMBtu	1.25	EPA AP-42 Sec 3.2
	lb CO_2/MMBtu	110	EPA AP-42 Sec 3.2
Heater Combustion Emissions	lb CH_4/MMcf	2.3	EPA AP-42 Sec 1.4
	lb N_2O/MMcf	2.2	EPA AP-42 Sec 1.4
	lb CO_2/MMcf	120,000	EPA AP-42 Sec 1.4

Key: INGAA = Interstate Natural Gas Association of America (INGAA) Greehouse Gas Emission Estimation Guidelines for Natural Gas Transmission and Storage - Vol. 1(September 2005).

Operational Parameters

Parameter	Units	Roberson Creek Compressor Station	Wildcat Hills Compressor Station	Wieland Flat Compressor Station	Desert Valley Compressor Station
Compressor stations	No.	1	1	1	1
Natural Gas Compressors	No.	0	2	2	1
Compressor Utilization Rate	%	100%	100%	100%	100%
Associated Pipeline Length	miles	170	170	170	170
Count of M&R Stations	No.	3	3	3	3
Hourly Compressor Fuel Flow	MMBtu/hr	-	191.62	228.66	121.77
Daily Compressor Fuel Flow	MMcf/day	-	4.46	5.33	2.84
Daily Compressor Operation	days/yr	365	365	365	365
Hourly Stand-By Gen Fuel Flow	MMBtu/hr	2.5	6.3	6.3	6.3
Annual Stand-By Gen Operation	hr/yr	500	500	500	500
Hourly Heater Fuel Flow	MMBtu/hr	1	1	1	1
Annual Heater Operation	hr/yr	8,760	8,760	8,760	8,760

Annual GHG Emissions (metric tons per year)

		Roberson Creek Compressor Station		Wildcat Hills Compressor Station		Wieland Flat Compressor Station		Desert Valley Compressor Station		TOTAL	
Source	**GHG**	**Actual Emissions (metric tons)**	**CO_2e Emissions (metric tons)**	**Actual Emissions (metric tons)**	**CO_2e Emissions (metric tons)**	**Actual Emissions (metric tons)**	**CO_2e Emissions (metric tons)**	**Actual Emissions (metric tons)**	**CO_2e Emissions (metric tons)**	**Actual Emissions (metric tons)**	**CO_2e Emissions (metric tons)**
Pipeline Fugitives	CH_4	1.16	24.5	1.16	24.5	1.16	24.5	1.16	24.5	**4.7**	**97.8**
	CO_2	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	**0.27**	**0.27**
Meter Station Fugitives	CH_4	2.87	60.3	2.87	60.3	2.87	60.3	2.87	60.3	**11.5**	**241**
	CO_2	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	**0.7**	**0.7**
Compressor Station Fugitives	CH_4	61.4	1,288	61.4	1,288	61.4	1,288	61.4	1,288	**245**	**5,154**
	CO_2	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	**14.4**	**14.4**
Station Blowdown	CH_4	101	2,131	101	2,131	101	2,131	101	2,131	**406**	**8,526**
	CO_2	5.96	5.96	5.96	5.96	5.96	5.96	5.96	5.96	**23.8**	**23.8**
Pipeline Blowdown	CH_4	133	2,800	133	2,800	133	2,800	133	2,800	**533**	**11,199**
	CO_2	7.83	7.83	7.83	7.83	7.83	7.83	7.83	7.83	**31.3**	**31.3**
Compressor Fugitives	CH_4	0	0	424	8,909	424	8,909	212	4,455	**1,061**	**22,274**
	CO_2	0	0	25	25	25	25	12	12	**62.3**	**62.3**
Compressor Combustion Emissions	CH_4	0	0	6.55	138	7.81	164	4.16	87	**18.52**	**389**
	N_2O	0	0	6.38	1,978	7.61	2,360	4.05	1,257	**18.0**	**5,595**
	CO_2	0	0	88,259	88,259	105,320	105,320	56,087	56,087	**249,666**	**249,666**
Stand-By Generator Combustion Emissions	CH_4	1	15	2	38	2	38	2	38	**6.1**	**127**
	CO_2	62	62	157	157	157	157	157	157	**534**	**534**
Heater Combustion Emissions	CH_4	0.009	0.2	0.009	0.2	0.009	0.2	0.009	0.2	**0.04**	**1**
	N_2O	0.008	3	0.008	3	0.008	3	0.008	3	**0.03**	**11**
	CO_2	463	463	463	463	463	463	463	463	**1,852**	**1,852**
All Sources	**CH_4**	**301**	**6,320**	**733**	**15,389**	**734**	**15,416**	**518**	**10,884**	**2,286**	**48,009**
	N_2O	**0.008**	**2.6**	**6.4**	**1,981**	**7.6**	**2,363**	**4.1**	**1,260**	**18.1**	**5,606**
	CO_2	**543**	**543**	**88,922**	**88,922**	**105,982**	**105,982**	**56,737**	**56,737**	**252,184**	**252,184**
	Total	**-**	**6,865**	**-**	**106,292**	**-**	**123,761**	**-**	**68,881**	**-**	**305,798**

9C. Application for Air Permit-to-Construct – Roberson Creek Compressor Station

To be provided on or before February 19, 2009.

9D. Notice of Intent – Wildcat Hills Compressor Station

To be provided on or before February 19, 2009.

9E. Application for Air Permit-to-Construct – Wieland Flat Compressor Station

To be provided on or before February 19, 2009.

9F. Application for Air Permit-to-Construct – Desert Valley Compressor Station

To be provided on or before February 19, 2009.

9G. Compressor Station Ambient Sound Survey and Acoustical Analysis

Subject: Roberson Creek Compressor Station (Lincoln County, Wyoming): Results of an Ambient Sound Survey and Acoustical Analysis of a Proposed New Natural Gas Compressor Station associated with the Ruby Pipeline Project

Submitted to: **Ruby Pipeline, L.L.C.** (project applicant)

H&K Report No. 2278
Date of Report: October 10, 2008
H&K Job No. 4092
Submitted by: Paul D. Kiteck, P.E., **Hoover & Keith Inc.** (primary author)

REPORT SUMMARY

This report provides the results of an acoustical analysis for the **Roberson Creek Compressor Station** (referred to as "Station" in the report) associated with the proposed **Ruby Pipeline Project**. Also included are the results of the recent ambient sound survey at the proposed site of the Station.

The following table summarizes the ambient sound level at the nearby noise–sensitive areas (NSAs), the estimated sound contribution of the Station, and the estimated total sound contribution of the Station (i.e., sound contribution of the Station plus the ambient sound level). The results provided in this table are referred to as the "Noise Quality Analysis".

Noise Quality Analysis for Roberson Creek Station associated with Ruby Pipeline Project

Closest NSA(s)	Distance and Direction of NSA to the Station	Calc'd Ambient Ldn (via Meas'd Ld & Est'd Ln)	Est'd Sound Level (Ldn) of the Station	Est'd "Total" Ldn (Station Noise + Ambient Noise)	Potential Noise Increase
NSA #1	25,900 feet (NNW)	31.6 dBA	18.1 dBA	31.8 dBA	0.2 dB

The results of the acoustical analysis indicate that the sound contribution of the proposed Station should be significantly lower than **55 dBA** (L_{dn}) at the nearby NSAs, which is the

FERC sound level requirement. Also, since the noise sources of the compressor installation that could cause perceptible vibration (e.g., turbine exhaust noise) will be adequately mitigated; there should not be any perceptible increase in vibration at any NSA after installation of the Station. In addition, due to the distance of the NSAs (i.e., approximately 4.9 miles to the closest NSA), the noise resulting from a unit gas blowdown event or site construction activities at the Station should not have a noise impact on the surrounding environment.

1.0 INTRODUCTION

In this report, H&K provides the results of an acoustical analysis for the **Roberson Creek Compressor Station** (referred to as “Station” in the report), a new natural gas compressor station associated with the proposed **Ruby Pipeline Project**. Also included are the results of the recent ambient sound survey at the proposed site of the Station. The purpose of the ambient sound survey was to quantify the ambient sound levels and verify the noise-sensitive areas (NSAs) around the Station, such as residences, hospitals and schools. The purpose of the acoustical analysis is to quantify the sound contribution of the Station at nearby NSA(s) during full load operation and determine noise control measures to meet applicable sound criteria.

2.0 SOUND LEVEL CRITERIA

Certificate conditions set forth by the Office of Energy Projects (OEP) of the Federal Energy Regulatory Commission (FERC) require that the sound attributable to a new natural gas compressor station not exceed an equivalent day-night sound level (L_{dn}) of **55 dBA** at any nearby NSA. There apparently are no applicable state/local noise regulations. The L_{dn} is an energy average of the measured daytime L_{eq} (i.e., L_d) and measured nighttime L_{eq} (i.e., L_n) plus **10 dB**. For an essentially steady sound source that operates continuously over a 24-hour period and controls the environmental sound level (e.g., natural gas compressor station), the L_{dn} is approximately **6.4 dB** above the measured L_{eq}. Consequently, an L_{dn} of **55 dBA** corresponds to an L_{eq} of **48.6 dBA**. If both the L_d and L_n are measured, then the L_{dn} is calculated using the following formula:

$$L_{\mathrm{dn}} = 10\log_{10}\left(\frac{15}{24}10^{L_{\mathrm{d}}/10} + \frac{9}{24}10^{(L_{\mathrm{n}}+10)/10}\right)$$

3.0 SITE/FACILITY DESCRIPTION

Figure 1 (**Appendix**, p. 7) is a general area layout around the Station showing the location of the nearby NSAs and the Station property line. The Station will be located in a remote and uninhabited area of Lincoln County, Wyoming, approximately 10 miles east of Kemmerer, WY. There are no NSAs within 1 mile of the Station site, and the closest NSA to the Station is a residence located approximately 25,900 feet (4.9 miles) north-northwest of the Station. In addition, the closest NSA is not in “line-of-sight” of the Station noise-generating sources due to the topography located between the NSA and Station (i.e., hills/terrain), and therefore, the topographic features could attenuate the noise of the Station. On the South Side of the proposed Station, there are other “active” natural gas pipeline facilities/stations.

The Station will consist of three (3) 23,000 HP electric motor-driven centrifugal gas compressor units. The electric motors and compressors will be installed inside a single building (i.e., Compressor Building) that is assumed to be located at the Station site center.

The following describes the anticipated auxiliary equipment and other notable items for the Station:

- Outdoor lube oil (LO) cooler that serves the compressor, gearbox and motor;
- Electrical transformers (located in the substation) and power control room (i.e., PCR);
- Air supply blower that provides ventilation air for cooling the electric motor;
- Exhaust ducting/opening for exhausting motor ventilation air outside the building;
- Gas piping and associated components, and most outdoor gas piping will be buried;

In addition, there will also be two (2) types of gas blowdown events at the Station: (1) a type of maintenance gas blowdown that can occur when a compressor is stopped and gas between the suction/discharge valves & compressors is vented to the atmosphere via a blowdown stack (no blowdown silencer anticipated), and (2) an emergency shutdown (ESD) that will only occur at required DOT test intervals or in an emergency situation (gas leak or fire). The unit blowdown event occurs infrequently and only for a short time frame (e.g., unit blowdown event would persist for approximately 1 to 5 minutes).

4.0 MEASUREMENT METHODOLOGY, LOCATIONS AND RESULTS

One (1) location was chosen for measuring the ambient sound level at the closest NSA and one (1) sound measurement location at the site of the Station was reported. The following provides a description of the nearby NSA(s) and reported sound measurement positions:

Pos. 1: NSA #1: Residence located approximately 4.9 miles (i.e., 25,900 feet) NNW of the Station, and this residence is considered the closest NSA to the proposed Station.

Pos. 2: On the site of the Station property.

The sound survey was conducted by Larry Lengyel of H&K during the daytime of September 18, 2008. During the site ambient sound survey, the temperature was 72 degree F., the wind was from the southwest and there was a clear sky. At the reported sound measurement locations, the A-wt. equivalent sound levels (i.e., L_{eq}) and the unweighted octave-band (O.B.) sound pressure levels (SPLs) were measured at 5 feet above ground. The acoustical measurement system consisted of a Rion Model NA-27 Sound Level Meter (a Type 1 SLM per ANSI S1.4 & S1.11) equipped with microphone & windscreen. The SLM was calibrated with a microphone calibrator (calibrated within 1 year of the test date).

The following **Table 1** summarizes the measured ambient L_d, estimated ambient L_n and the resulting ambient L_{dn}, as calculated from the measured ambient L_d and estimated L_n.

Meas. Pos.	Description of the Nearby NSAs and associated Sound Measurement Location	Meas'd Ambient Ld (dBA)	Est'd Ambient Ln (dBA)	Calc'd Ambient Ldn (via Meas'd Ld & Est'd Ln)
Pos. 1	NSA #1: Residence 4.9 miles NNW of the Station site	25.0 dBA	25.0 dBA	31.6 dBA
Pos. 2	On the property of the proposed Station site	54.0 dBA	54.0 dBA	60.4 dBA

Table 1: Summary of Meas'd Ambient L_d, Est'd Ambient L_n and Calc'd Ambient L_{dn}

The ambient nighttime sound level (L_n) was not measured but based on our site observations, the ambient nighttime level should be similar to the measured ambient daytime sound level. At the reported sound measurement location at NSA #1, noise sources that contributed to the A-wt. sound level included the sound of birds and insects, and occasionally, the noise of distant aircraft. At the site of the proposed Station, the noise of nearby industrial facilities was the primary noise source that contributed to the measured ambient noise level.

5.0 ACOUSTICAL ANALYSIS AND NOISE CONTROL MEASURES

5.1 Station Sound Contribution

The following Station sound sources that were considered significant during normal Station operation:

- Noise of the motors/compressors that radiates through the Compressor Building;
- Noise radiated from outdoor aboveground gas piping and associated components;
- Noise generated by the transformers in substation (i.e., utility and isolation transformers);
- Noise generated by the outdoor LO coolers;
- Noise of the power control room (PCR) and associated components;
- Noise associated with the ventilation air exhaust for the motors.

Table A (**Appendix**, p. 8) shows the calculation of the A-weighted sound level and the unweighted octave-band (O.B.) sound pressure levels (SPLs) at the closest NSA contributed by the compressor units along with the total Station sound contribution (i.e., Station noise plus ambient noise level) for standard day propagating conditions. This spreadsheet acoustical analysis includes the estimated noise reduction associated with the anticipated noise control measures. A description of the analysis methodology and source of sound data used for the analysis are provided at the end of the report (**Appendix**, p. 9–10).

5.2 Station Noise Control Measures

The following noise control measures are anticipated for the compressor units associated with the Station design:

(1) Electric motors & compressors of the compressor units will be installed inside a single insulated metal building (i.e., Compressor Building);

(2) Electric motor ventilation system will be designed with the motor air cooling blower located inside the Compressor Building;

(3) Exhaust air (EA) of each electric motor will be exhausted via an opening located on one of the building walls;

(4) Each compressor unit will employ a "standard" LO cooler.

5.3 Unit Blowdown Event and Site Construction Noise

The maximum "peak" sound level of the unit blowdown event associated with the compressor units is estimated to be an A-wt. sound level of **90 dBA** at a distance of 300 feet. As a result, the "peak" sound level of the unit blowdown event will be approximately **16 dBA** (i.e., L_{dn} of approximately **22** to **23 dBA**) at the closest NSA, located approximately 25,900 feet from the unit blowdowns. A description of the acoustical analysis methodology and source of sound data related to blowdown noise are provided in the **Appendix** (p. 10).

Due to the distance of the closest NSA (i.e., approximately 4.9 miles), the noise resulting from site construction activities at the Station should be significantly lower than **55 dBA** (L_{dn}), and consequently, site construction noise should not have a noise impact on the surrounding environment.

6.0 SUMMARY AND FINAL COMMENT

The following **Table 2** summarizes the estimated sound contribution of the Station at the closest NSA along with the total sound contribution of the Station (i.e., Station noise plus the ambient level). The results in this table are defined as the "Noise Quality Analysis".

Closest NSAs	Distance and Direction of NSA to the Station	Calc'd Ambient Ldn (via Meas'd Ld & Est'd Ln)	Est'd Ldn Of the Station	Est'd "Total" Ldn (Station Noise + Ambient Noise)	Potential Noise Increase
NSA #1	25,900 feet (NNW)	31.6 dBA	18.1 dBA	31.8 dBA	0.2 dB

Table 2: Noise Quality Analysis of the Roberson Creek Station for the Ruby Pipeline Project

The results of the acoustical analysis indicate that if the sound contribution of the proposed Station should be significantly lower than **55 dBA** (L_{dn}) at the nearby NSAs, which is the FERC sound level requirement. Also, since the noise sources of the compressor units that could cause perceptible vibration (e.g., turbine exhaust noise) will be adequately mitigated; there should not be any perceptible increase in vibration at any NSA after installation of the Station. In addition, due to the distance of the closest NSA from the Station (i.e., approximately 4.9 miles), the noise resulting from a unit blowdown event or site construction activities at the Station should not have a noise impact on the surrounding environment.

APPENDIX

- **FIGURE 1: GENERAL AREA LAYOUT AROUND THE SITE OF THE STATION SHOWING THE STATION PROPERTY**

- **ACOUSTICAL ANALYSIS OF THE STATION AND UNIT BLOWDOWN EVENT**

- **ANALYSIS METHODOLOGY (NOISE ATTRIBUTABLE TO THE COMPRESSOR UNITS AND UNIT BLOWDOWN EVENT) AND THE SOURCE OF SOUND DATA**

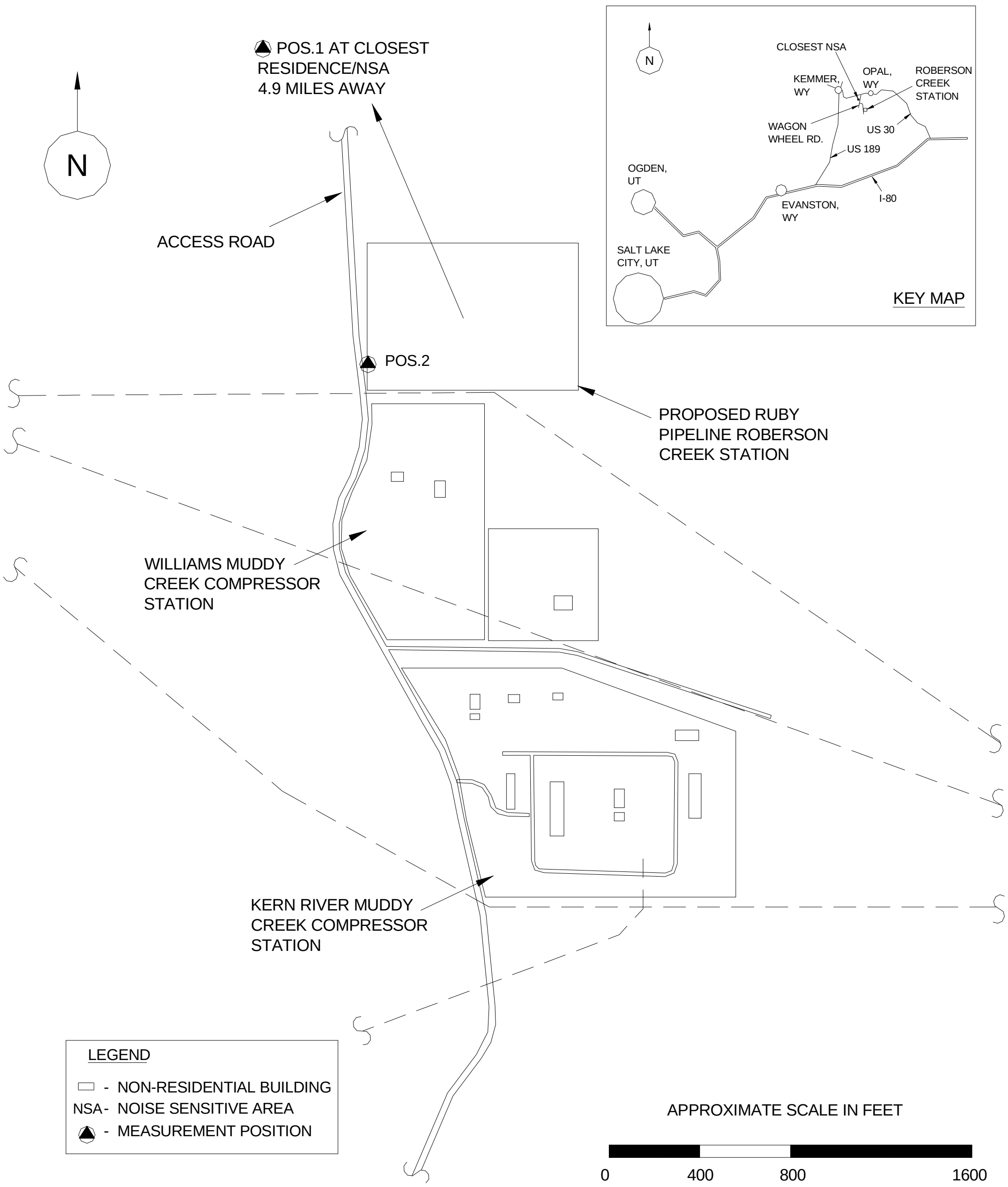

Figure 1: Roberson Creek Station (Ruby Pipeline Project): Area/Site Layout Showing the Area around the Site of the Station and the Nearby NSA(s)

Source No. & Dist (Ft)	Noise Sources and Other Conditions/Factors associated with Acoustical Analysis	PWL or SPL in dB Per Octave-Band Center Frequency (Hz) 31.5	63	125	250	500	1000	2000	4000	8000	A-Wt. Level	Calc'd Ldn
1)	PWL of Motor-Compr. Noise radiated thru Bldg.	115	112	112	112	110	110	120	115	110	123	
	Atten. of Bldg. (Includes Noise of Vent System)	-2	-8	-12	-15	-20	-22	-24	-25	-25		
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
25900	Hemispherical Radiation	-86	-86	-86	-86	-86	-86	-86	-86	-86		
25900	Atm. Absorption (50% R.H., 60 deg F)	-2	-3	-5	-10	-18	-39	-78	-197	-355		
25900	Source Sound Level Contribution	25	15	9	1	0	0	0	0	0	7	
2)	PWL of the Transformers (Substation Area)	90	100	95	85	80	78	65	55	45	84	
	Atten. of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
25900	Hemispherical Radiation	-86	-86	-86	-86	-86	-86	-86	-86	-86		
25900	Atm. Absorption (50% R.H., 60 deg F)	-2	-3	-5	-10	-18	-39	-78	-197	-355		
25900	Source Sound Level Contribution	2	11	4	0	0	0	0	0	0	7	
3)	PWL of Aboveground Piping & Components	100	100	98	98	102	110	120	112	108	122	
	Atten. of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
25900	Hemispherical Radiation	-86	-86	-86	-86	-86	-86	-86	-86	-86		
25900	Atm. Absorption (50% R.H., 60 deg F)	-2	-3	-5	-10	-18	-39	-78	-197	-355		
25900	Source Sound Level Contribution	12	11	7	2	0	0	0	0	0	7	
4)	PWL of "Standard" L.O. Coolers (3 Units)	115	112	108	105	102	100	95	92	90	105	
	NR of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
25900	Hemispherical Radiation	-86	-86	-86	-86	-86	-86	-86	-86	-86		
25900	Atm. Absorption (50% R.H., 60 deg F)	-2	-3	-5	-2	-18	-39	-78	-197	-355		
25900	Source Sound Level Contribution	27	23	17	17	0	0	0	0	0	11	
5)	PWL of PCRs & associated Equipment	100	106	95	85	82	80	78	75	72	87	
	NR of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
25900	Hemispherical Radiation	-86	-86	-86	-86	-86	-86	-86	-86	-86		
25900	Atm. Absorption (50% R.H., 60 deg F)	-2	-3	-5	-10	-18	-39	-78	-197	-355		
25900	Source Sound Level Contribution	12	17	4	0	0	0	0	0	0	7	
6)	PWL of the Motor Exhaust Opening (3 Units)	100	95	92	100	90	82	85	90	82	96	
	Atten. of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
25900	Hemispherical Radiation	-86	-86	-86	-86	-86	-86	-86	-86	-86		
25900	Atm. Absorption (50% R.H., 60 deg F)	-2	-3	-5	-10	-18	-39	-78	-197	-355		
25900	Source Sound Level Contribution	12	6	1	4	0	0	0	0	0	7	
Est'd Total Sound Contribution of Sound Sources at NSA #1		**29**	**25**	**18**	**18**	**0**	**0**	**0**	**0**	**0**	**11.7**	**18.1**

Meas'd Ambient Noise Level at NSA #1: Note (1)	**31.6**
"Total" Sound Contirbution: Est'd Station Noise and Ambient Noise	31.8
Potential Increase in Ambient Noise due to Station (dB)	**0.2**

Table A: Ruby Pipeline Roberson Creek Station: Est'd Sound Contribution of the Compressor Installation at the Closest NSA (i.e., NSA#1, located 25,900 Ft. NNW of the Station Site Center). Included is the Est'd Increase in the Ambient Noise Level as a Result of the Compressor Installation.

Note (1): Existing ambient noise level based on meas'd sound data by H&K during a recent sound survey at site of Station.

NOTE: Muffler DIL & Equipment PWL values on this spreadsheet should not be used as the specified values. Refer to "Noise Control Measures" section in report or other company specifications for actual specified values.

DESCRIPTION OF ANALYSIS METHODOLOGY AND SOURCE OF SOUND DATA

ANALYSIS METHODOLOGY

In general, the predicted sound level contributed by the compressor units at the Station was calculated as a function of frequency from estimated unweighted O.B. PWLs for each significant sound source associated with the compressor units. The following summarizes the acoustical analysis procedure for the Station:

- Initially, unweighted O.B. PWL values of the significant noise sources associated with the compressor units were determined from equipment manufacturer's sound data and/or actual sound level measurements performed by H&K at similar type of equipment/components expected for this natural gas compressor facility.

- Then, expected noise reduction (NR) or attenuation in dB per O.B. frequency due to any noise control measures, hemispherical sound propagation (discussed in more detail below*) and atmospheric sound absorption (discussed in more detail below**) were subtracted from the unweighted octave-band PWLs to obtain the unweighted O.B. SPLs of each noise source. Since sound shielding by buildings can influence the sound level contributed at the NSAs, we also included the sound shielding due to buildings, if appropriate. The sound attenuation effect due to foliage or land contour was not considered in the analysis although there probably will be some attenuation due to the topography located between the Station and nearby NSAs.

- Finally, the resulting estimated unweighted O.B. SPLs for all noise sources associated with the compressor unit (with noise control and other sound attenuation effects) were logarithmically summed, and the total O.B. SPLs for all noise sources were corrected for A-weighting to provide the estimated overall A-wt. sound level contributed by the compressor unit at the closest NSA. The previous estimated sound contribution of the Station at the closest NSA was utilized to estimate the Station noise contribution after installation of the compressor units.

*<u>Attenuation due to hemispherical sound propagation</u>: Sound propagates outwards in all directions (i.e., length, width, height) from a point source, and the sound energy of a noise source decreases with increasing distance from the source. In the case of hemispherical sound propagation, the source is located on a flat continuous plane/surface (e.g., ground), and the sound radiates hemispherically (i.e., outward, over and above the surface) from the sound source. The following equation is the theoretical decrease of sound energy when determining the resulting SPL values of a noise source at a specific distance ("r") of a receiver from the estimated PWL values:

> Decrease in SPL ("hemispherical propagation") from a noise source = **20*log(r) – 2.3 dB** where "r" is distance of the receiver from the noise source.

<u>Attenuation due to air absorption</u>: Air absorbs sound energy, and the amount of absorption ("attenuation") is dependent on the temperature and relative humidity (R.H.) of air and frequency of sound. For example, the attenuation due to air absorption for 1000 Hz O.B. SPL is approximately **1.5 dB per 1,000 feet for standard day conditions (i.e., no wind, 60 deg. F. and 70% or 50% R.H.).

ANALYSIS METHODOLOGY (NOISE ATTRIBUTABLE TO A BLOWDOWN EVENT)

The noise resulting from a blowdown event was estimated by using the "inverse-square law" and included some attenuation due to atmospheric sound absorption. Consequently, the estimated noise of a blowdown event at the receptor (closest NSA) was calculated as follows and assumes that the unsilenced unit gas blowdown is approximately **90 dBA** at 300 feet, and the closest NSA is approximately 25,900 feet from the unit blowdown silencer for the compressor addition:

SPL (receptor)= (Blowdown SPL at R1) – 20*log(R2/R1) – Atm. Atten. = **90 dBA** – 20*log (25,900/300) – 35 dB = **16 dBA**

Where: R1 = Distance of Specified Blowdown Noise Level Requirement (i.e., 300 ft.)

R2 = Distance of the Receptor from the Blowdown Event (25,900 ft.)

SOURCE OF SOUND DATA

The following describes the source of sound data used for estimating the source sound levels and/or the source PWLs (i.e., motors/compressors, auxiliary equipment and other components associated with the compressor installation).

(1) The estimated PWL values of equipment inside the building (i.e., electric motors & compressors) were calculated from sound data measured by H&K on a similar type of gas compressor installation.

(2) The noise radiated from aboveground gas piping is primarily a result the noise generated by the gas compressors. Consequently, measurement of both near field and far field sound data on gas piping is presumed to be an accurate method of quantifying the noise associated with the new gas piping, and the estimated PWL values for gas piping used in the analysis were determined from near field and far field sound data by H&K on a similar type of compressor to that of the compressor installation.

(3) The estimated PWL values for the turbine LO cooler were designated to meet the design noise goal. Note that the estimated PWL for the coolers utilized in the acoustical analysis assumes some noise associated with piping associated with the coolers. The noise level for the LO cooler used in the analysis is generally higher than the sound level requirement in order that the analysis incorporates an acoustical "margin of safety."

(4) The estimated PWL values for other miscellaneous equipment (i.e., motor blower noise, motor air exhaust noise & noise of transformers) were calculated from measured sound data in the field tests by H&K on similar equipment and similar type of operations.

(5) The estimated sound level of an unsilenced unit blowdown event was calculated from sound data measured on similar type of gas blowdown event.

End of Report

Subject: Wildcat Hills Compressor Station (Box Elder County, Utah): Results of an Ambient Sound Survey and Acoustical Analysis of a Proposed New Natural Gas Compressor Station associated with the Ruby Pipeline Project

Submitted to: **Ruby Pipeline, L.L.C.** (project applicant)

H&K Report No. 2279
Date of Report: October 10, 2008
H&K Job No. 4093
Submitted by: Paul D. Kiteck, P.E., **Hoover & Keith Inc.** (primary author)

REPORT SUMMARY

This report provides the results of an acoustical analysis for the **Wildcat Hills Compressor Station** (referred to as "Station" in the report) associated with the proposed **Ruby Pipeline Project**. Also included are the results of the recent ambient sound survey at the proposed site of the Station.

The following table summarizes the ambient sound level at the nearby noise–sensitive areas (NSAs), the estimated sound contribution of the Station, and the estimated total sound contribution of the Station (i.e., sound contribution of the Station plus the ambient sound level). The results provided in this table are referred to as the "Noise Quality Analysis".

Noise Quality Analysis for Wildcat Hills Station associated with Ruby Pipeline Project

Closest NSA(s)	Distance and Direction of NSA to the Station	Calc'd Ambient Ldn (via Meas'd Ld & Est'd Ln)	Est'd Sound Level (Ldn) of the Station	Est'd "Total" Ldn (Station Noise + Ambient Noise)	Potential Noise Increase
NSA #1	7,500 feet (NNW)	34.6 dBA	36.6 dBA	38.7 dBA	4.1 dB

The results of the acoustical analysis indicate that the sound contribution of the proposed Station should be significantly lower than **55 dBA** (L_{dn}) at the nearby NSAs, which is the FERC sound level requirement. Also, since the noise sources of the compressor installation that could cause perceptible vibration (e.g., turbine exhaust noise) will be adequately mitigated; there should not be any perceptible increase in vibration at any NSA after installation of the Station. In addition, due to the distance of the NSAs (i.e., approximately 1.4 miles to the closest NSA), the noise resulting from a unit gas blowdown event or site construction activities at the Station should not have a noise impact on the surrounding environment.

1.0 INTRODUCTION

In this report, H&K provides the results of an acoustical analysis for the **Wildcat Hills Compressor Station** (referred to as "Station" in the report), a new natural gas compressor station associated with the proposed **Ruby Pipeline Project**. Also included are the results of the recent ambient sound survey at the proposed site of the Station. The purpose of the ambient sound survey was to quantify the ambient sound levels and verify the noise-sensitive areas (NSAs) around the Station, such as residences, hospitals and schools. The purpose of the acoustical analysis is to quantify the sound contribution of the Station at nearby NSAs during full load operation and determine noise control measures to meet applicable sound criteria.

2.0 SOUND LEVEL CRITERIA

Certificate conditions set forth by the Office of Energy Projects (OEP) of the Federal Energy Regulatory Commission (FERC) require that the sound attributable to a new natural gas compressor station not exceed an equivalent day-night sound level (L_{dn}) of **55 dBA** at any nearby NSA. There apparently are no applicable state/local noise regulations. The L_{dn} is an energy average of the measured daytime L_{eq} (i.e., L_d) and measured nighttime L_{eq} (i.e., L_n) plus **10 dB**. For an essentially steady sound source that operates continuously over a 24-hour period and controls the environmental sound level (e.g., natural gas compressor station), the L_{dn} is approximately **6.4 dB** above the measured L_{eq}. Consequently, an L_{dn} of **55 dBA** corresponds to an L_{eq} of **48.6 dBA**. If both the L_d and L_n are measured, then the L_{dn} is calculated using the following formula:

$$L_{dn} = 10\log_{10}\left(\frac{15}{24}10^{L_d/10} + \frac{9}{24}10^{(L_n+10)/10}\right)$$

3.0 SITE/FACILITY DESCRIPTION

Figure 1 (**Appendix**, p. 7) is a general area layout around the Station showing the location of the nearby NSAs and the Station property line. The Station will be located in a remote and uninhabited area of Box Elder County, Utah, approximately 25 miles southwest of Snowville, UT. There are no NSAs within 1 mile of the Station site, and the closest NSA to the Station is a residence located approximately 7,500 feet (1.4 miles) north-northwest of the Station. In addition, the closest NSA is not in "line-of-sight" of the Station noise-generating sources due to the topography located between the NSA and Station (i.e., hills/terrain), and therefore, the topographic features could attenuate the noise of the Station.

The Station will consist of two (2) Solar Mars 100 gas turbine-driven centrifugal gas compressor units. The turbines/compressors will be installed inside a single building (i.e., Compressor Building) that is assumed to be located at the Station site center. The following describes the anticipated auxiliary equipment and other notable items associated with each compressor unit:

- Turbine exhaust system designed with a stack and "standard" Solar exhaust muffler;
- Turbine air intake filter system designed with a "standard" Solar silencer;
- Aboveground gas piping and associated components;
- "Standard" Solar outdoor lube oil cooler and back-up ("stand-by") generator(s).

In addition, there will also be two (2) types of gas blowdown events at the Station: (1) a type of maintenance gas blowdown that can occur when a compressor is stopped and gas between the suction/discharge valves & compressors is vented to the atmosphere via a blowdown stack (no blowdown silencer anticipated), and (2) an emergency shutdown (ESD) that will only occur at required DOT test intervals or in an emergency situation (gas leak or fire). The unit blowdown event occurs infrequently and only for a short time frame (e.g., unit blowdown event would persist for approximately 1 to 5 minutes).

4.0 MEASUREMENT METHODOLOGY, LOCATIONS AND RESULTS

One (1) location was chosen for measuring the ambient sound level at the closest NSA and one (1) sound measurement location at the site of the Station was reported. The following provides a description of the nearby NSA(s) and reported sound measurement positions:

Pos. 1: NSA #1: Residence located approximately 1.4 miles (i.e., 7,500 feet) NNW of the Station, and this residence is considered the closest NSA to the proposed Station.

Pos. 2: On the site of the Station property.

The sound survey was conducted by Larry Lengyel of H&K during the daytime of September 17, 2008. During the site ambient sound survey, the temperature was 85 degree F., the wind was from the south and there was a mostly clear sky. At the reported sound measurement locations, the A-wt. equivalent sound levels (i.e., L_{eq}) and the unweighted octave-band (O.B.) sound pressure levels (SPLs) were measured at 5 feet above ground. The acoustical measurement system consisted of a Rion Model NA-27 Sound Level Meter (a Type 1 SLM per ANSI S1.4 & S1.11) equipped with microphone & windscreen. The SLM was calibrated with a microphone calibrator (calibrated within 1 year of the test date).

The following **Table 1** summarizes the measured ambient L_d, estimated ambient L_n and the resulting ambient L_{dn}, as calculated from the measured ambient L_d and estimated L_n.

Meas. Pos.	Description of the Nearby NSAs and associated Sound Measurement Location	Meas'd Ambient Ld (dBA)	Est'd Ambient Ln (dBA)	Calc'd Ambient Ldn (via Meas'd Ld & Est'd Ln)
Pos. 1	NSA #1: Residence 1.4 miles NNW of the Station site	28.0 dBA	28.0 dBA	34.6 dBA
Pos. 2	On the property of the proposed Station site	32.0 dBA	32.0 dBA	38.4 dBA

Table 1: Summary of Meas'd Ambient L_d, Est'd Ambient L_n and Calc'd Ambient L_{dn}

The ambient nighttime sound level (L_n) was not measured but based on our site observations, the ambient nighttime level should be similar to the measured ambient daytime sound level. At the reported sound measurement location at NSA #1, noise sources that contributed to the A-wt. sound level included the sound of birds and insects, the noise of distant aircraft and occasionally, wind-related noise (i.e., wind blowing in the grass/foliage).

5.0 ACOUSTICAL ANALYSIS AND NOISE CONTROL MEASURES

5.1 Station Sound Contribution

The following Station sound sources that were considered significant during normal Station operation:

- Noise of the turbines/compressors that penetrates the Compressor Building;
- Noise of the turbine exhaust for each unit, and the turbine exhaust noise is considered the primary noise source that could generate perceptible vibration at the nearby NSAs;
- Noise radiated from outdoor aboveground gas piping;
- Noise of the outdoor lube oil cooler for each unit;
- Noise generated by the turbine air intake system for each unit;
- Noise radiated from the outdoor turbine exhaust ducting and body of exhaust muffler.

Table A (**Appendix**, p. 8) shows the calculation of the A-weighted sound level and the unweighted octave-band (O.B.) sound pressure levels (SPLs) at the closest NSA contributed by the compressor units along with the total Station sound contribution (i.e., Station noise plus ambient noise level) for standard day propagating conditions. This spreadsheet acoustical analysis includes the estimated noise reduction associated with the anticipated noise control measures. A description of the analysis methodology and source of sound data used for the analysis are provided at the end of the report (**Appendix**, p. 9–10).

5.2 Station Noise Control Measures

The following noise control measures are anticipated for the compressor units associated with the Station design:

(1) Turbines/compressors of the compressor units will be installed inside a single insulated metal building (i.e., Compressor Building);
(2) Exhaust system for each turbine will employ a “standard” Solar exhaust muffler;
(3) Air intake system will employ a “standard” Solar air intake silencer and filter;
(4) Each turbine will employ a “standard” Solar lube oil cooler.

5.3 Unit Blowdown Event and Site Construction Noise

The maximum "peak" sound level of the unit blowdown event associated with the compressor units is estimated to be an A-wt. sound level of **90 dBA** at a distance of 300 feet. As a result, the "peak" sound level of the unit blowdown event will be approximately **47 dBA** (i.e., L_{dn} of approximately **53** to **54 dBA**) at the closest NSA, located approximately 7,500 feet from the unit blowdowns. A description of the acoustical analysis methodology and source of sound data related to blowdown noise are provided in the **Appendix** (p. 10).

Due to the distance of the closest NSA (i.e., approximately 1.4 miles), the noise resulting from site construction activities at the Station should be significantly lower than **55 dBA** (L_{dn}), and consequently, site construction noise should not have a noise impact on the surrounding environment.

6.0 SUMMARY AND FINAL COMMENT

The following **Table 2** summarizes the estimated sound contribution of the Station at the closest NSA along with the total sound contribution of the Station (i.e., Station noise plus the ambient level). The results in this table are defined as the "Noise Quality Analysis".

Closest NSAs	Distance and Direction of NSA to the Station	Calc'd Ambient Ldn (via Meas'd Ld & Est'd Ln)	Est'd Ldn Of the Station	Est'd "Total" Ldn (Station Noise + Ambient Noise)	Potential Noise Increase
NSA #1	7,500 feet (NNW)	34.6 dBA	36.6 dBA	38.7 dBA	4.1 dB

Table 2: Noise Quality Analysis of the Wildcat Hills Station for the Ruby Pipeline Project

The results of the acoustical analysis indicate that if the sound contribution of the proposed Station should be significantly lower than **55 dBA** (L_{dn}) at the nearby NSAs, which is the FERC sound level requirement. Also, since the noise sources of the compressor units that could cause perceptible vibration (e.g., turbine exhaust noise) will be adequately mitigated; there should not be any perceptible increase in vibration at any NSA after installation of the Station. In addition, due to the distance of the closest NSA from the Station (i.e., approximately 1.4 miles), the noise resulting from a unit blowdown event or site construction activities at the Station should not have a noise impact on the surrounding environment.

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APPENDIX

- **FIGURE 1: GENERAL AREA LAYOUT AROUND THE SITE OF THE STATION SHOWING THE STATION PROPERTY**

- **ACOUSTICAL ANALYSIS OF THE STATION AND UNIT BLOWDOWN EVENT**

- **ANALYSIS METHODOLOGY (NOISE ATTRIBUTABLE TO THE COMPRESSOR UNITS AND UNIT BLOWDOWN EVENT) AND THE SOURCE OF SOUND DATA**

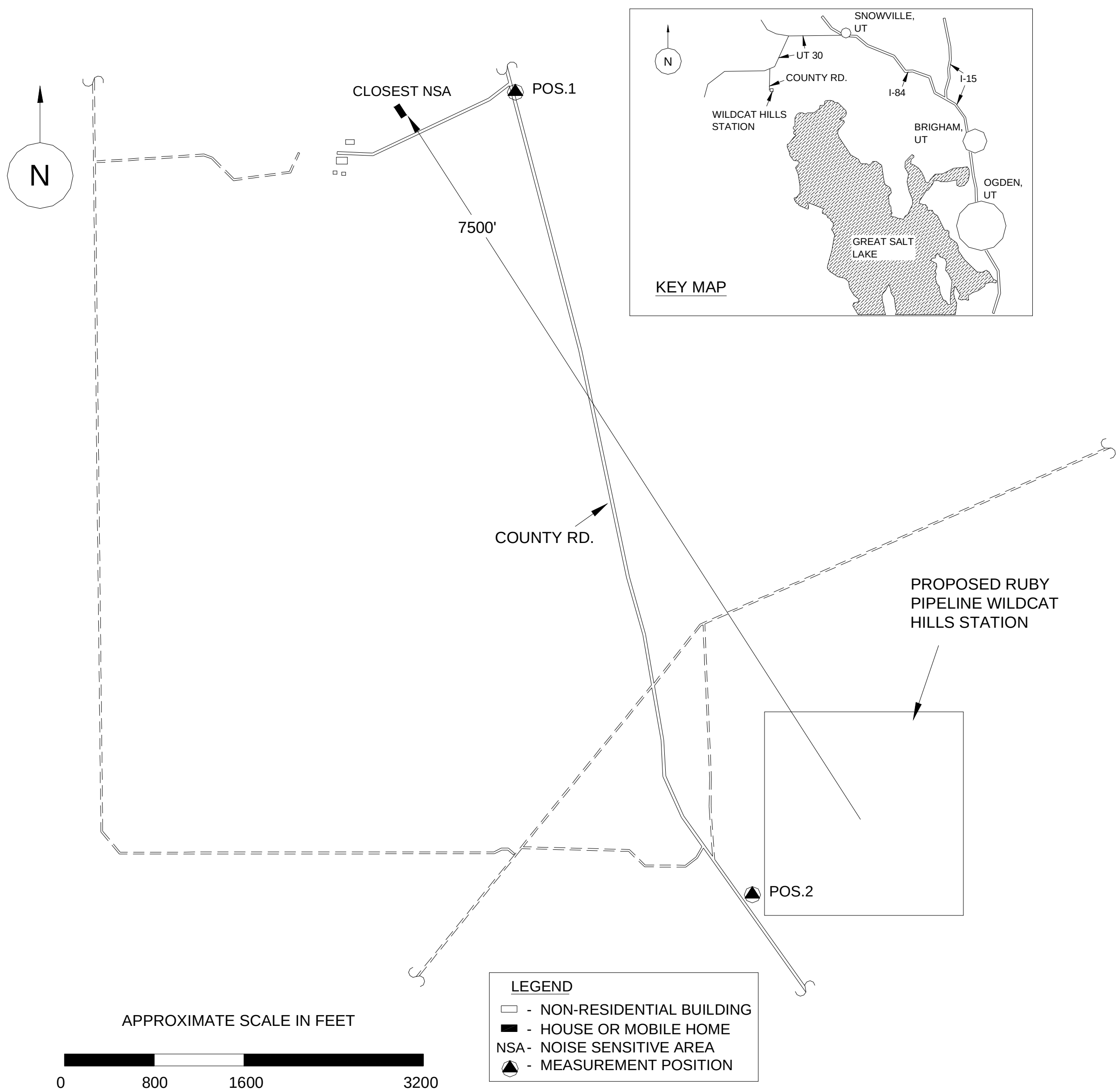

Figure 1: Wildcat Hills Station (Ruby Pipeline Project): Area/Site Layout Showing the Area around the Site of the Station and the Nearby NSA(s)

Source No.	Noise Sources and Other Conditions/Factors	PWL or SPL in dB Per Octave-Band Center Frequency (Hz)									A-Wt.	
& Dist (Ft)	associated with Acoustical Analysis	31.5	63	125	250	500	1000	2000	4000	8000	Level	
1)	PWL of Turbines/Compressors radiated thru Bldg	112	112	114	115	114	115	116	120	116	124	
	Atten. of Bldg. (Includes Noise of Vent System)	-2	-8	-12	-18	-20	-22	-24	-25	-25		
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
7500	Hemispherical Radiation	-75	-75	-75	-75	-75	-75	-75	-75	-75		
7500	Atm. Absorption (50% R.H., 60 deg F)	-1	-1	-2	-3	-5	-11	-23	-57	-103		
7500	Source Sound Level Contribution	34	28	25	19	14	7	0	0	0	16	
2)	PWL of Unsilenced Turbine Exhaust (2 Units)	127	128	127	127	131	125	118	111	98	130	
	Atten. of Noise Control ("Standard" Muffler)	-3	-5	-10	-19	-28	-34	-34	-33	-22		
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
7500	Hemispherical Radiation	-75	-75	-75	-75	-75	-75	-75	-75	-75		
7500	Atm. Absorption (50% R.H., 60 deg F)	-1	-1	-2	-3	-5	-11	-23	-57	-103		
7500	Source Sound Level Contribution	48	47	40	30	23	5	0	0	0	28	
3)	PWL of Aboveground Piping & Components	98	98	95	95	98	108	115	110	105	118	
	Atten. of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
7500	Hemispherical Radiation	-75	-75	-75	-75	-75	-75	-75	-75	-75		
7500	Atm. Absorption (50% R.H., 60 deg F)	-1	-1	-2	-3	-5	-11	-23	-57	-103		
7500	Source Sound Level Contribution	22	22	18	17	18	22	17	0	0	24	
4)	PWL of "Standard" L.O. Coolers (2 Units)	110	108	105	100	98	95	92	90	88	101	
	NR of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
7500	Hemispherical Radiation	-75	-75	-75	-75	-75	-75	-75	-75	-75		
7500	Atm. Absorption (50% R.H., 60 deg F)	-1	-1	-2	-2	-5	-11	-23	-57	-103		
7500	Source Sound Level Contribution	34	32	28	23	18	9	0	0	0	19	
5)	PWL of Turbine Air Intake (2 Units)	119	119	119	121	123	129	135	161	154	163	
	Attenuation of Intake Silencer ("Standard")	-1	-4	-7	-16	-20	-30	-40	-50	-40		
	Attenuation of Air Intake Filter	-1	-4	-8	-9	-13	-26	-27	-27	-33		
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
7500	Hemispherical Radiation	-75	-75	-75	-75	-75	-75	-75	-75	-75		
7500	Atm. Absorption (50% R.H., 60 deg F)	-1	-1	-2	-3	-5	-11	-23	-57	-103		
7500	Source Sound Level Contribution	41	35	27	18	10	0	0	0	0	16	
6)	PWL of Exhaust Ducting & Muffler Body (2 Units)	108	105	100	96	92	88	82	78	75	94	
	Atten. of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
7500	Hemispherical Radiation	-75	-75	-75	-75	-75	-75	-75	-75	-75		
7500	Atm. Absorption (50% R.H., 60 deg F)	-1	-1	-2	-3	-5	-11	-23	-57	-103		Calc'd
7500	Source Sound Level Contribution	32	29	23	18	12	2	0	0	0	14	Ldn
Est'd Total Sound Contribution of Sound Sources at NSA #1		**49**	**48**	**41**	**31**	**25**	**22**	**18**	**0**	**0**	**30.2**	**36.6**

Meas'd Ambient Noise Level at NSA #1: Note (1)	**34.6**
"Total" Sound Contirbution: Est'd Station Noise and Ambient Noise	38.7
Potential Increase in Ambient Noise due to Station (dB)	**4.1**

Table A: Ruby Pipeline Wildcat Hills Station: Est'd Sound Contribution of the Compressor Installation at the Closest NSA (i.e., NSA #1, located 7,500 Ft. NNW of the Station Site Center). Included is the Est'd Increase in the Ambient Noise Level as a Result of the Compressor Installation.

Note (1): Existing ambient noise level based on meas'd sound data by H&K during a recent sound survey at site of Station.

NOTE: Muffler DIL & Equipment PWL values on this spreadsheet should not be used as the specified values. Refer to "Noise Control Measures" section in report or other company specifications for actual specified values.

DESCRIPTION OF ANALYSIS METHODOLOGY AND SOURCE OF SOUND DATA

ANALYSIS METHODOLOGY

In general, the predicted sound level contributed by the compressor units at the Station was calculated as a function of frequency from estimated unweighted octave-band (O.B.) sound power levels (PWLs) for each significant sound source associated with the compressor units. The following summarizes the acoustical analysis procedure for the Station:

- Initially, unweighted O.B. PWL values of the significant noise sources associated with the compressor units were determined from equipment manufacturer's sound data and/or actual sound level measurements performed by H&K at similar type of equipment/components expected for this natural gas compressor facility.

- Then, expected noise reduction (NR) or attenuation in dB per O.B. frequency due to any noise control measures, hemispherical sound propagation (discussed in more detail below*) and atmospheric sound absorption (discussed in more detail below**) were subtracted from the unweighted octave-band PWLs to obtain the unweighted O.B. SPLs of each noise source. Since sound shielding by buildings can influence the sound level contributed at the NSAs, we also included the sound shielding due to buildings, if appropriate. The sound attenuation effect due to foliage or land contour was not considered in the analysis although there probably will be some attenuation due to the topography located between the Station and nearby NSAs.

- Finally, the resulting estimated unweighted O.B. SPLs for all noise sources associated with the compressor unit (with noise control and other sound attenuation effects) were logarithmically summed, and the total O.B. SPLs for all noise sources were corrected for A-weighting to provide the estimated overall A-wt. sound level contributed by the compressor unit at the closest NSA. The previous estimated sound contribution of the Station at the closest NSA was utilized to estimate the Station noise contribution after installation of the compressor units.

*<u>Attenuation due to hemispherical sound propagation</u>: Sound propagates outwards in all directions (i.e., length, width, height) from a point source, and the sound energy of a noise source decreases with increasing distance from the source. In the case of hemispherical sound propagation, the source is located on a flat continuous plane/surface (e.g., ground), and the sound radiates hemispherically (i.e., outward, over and above the surface) from the sound source. The following equation is the theoretical decrease of sound energy when determining the resulting SPL values of a noise source at a specific distance ("r") of a receiver from the estimated PWL values:

> Decrease in SPL ("hemispherical propagation") from a noise source = **20*log(r) – 2.3 dB** where "r" is distance of the receiver from the noise source.

<u>Attenuation due to air absorption</u>: Air absorbs sound energy, and the amount of absorption ("attenuation") is dependent on the temperature and relative humidity (R.H.) of air and frequency of sound. For example, the attenuation due to air absorption for 1000 Hz O.B. SPL is approximately **1.5 dB per 1,000 feet for standard day conditions (i.e., no wind, 60 deg. F. and 70% or 50% R.H.).

ANALYSIS METHODOLOGY (NOISE ATTRIBUTABLE TO A BLOWDOWN EVENT)

The noise resulting from a blowdown event was estimated by using the "inverse-square law" and included some attenuation due to atmospheric sound absorption. Consequently, the estimated noise of a blowdown event at the receptor (closest NSA) was calculated as follows and assumes that the unsilenced unit gas blowdown is approximately **90 dBA** at 300 feet, and the closest NSA is approximately 7,500 feet from the unit blowdown silencer for the compressor addition:

SPL (receptor)= (Blowdown SPL at R1) – 20*log(R2/R1) – Atm. Atten. = **90 dBA** – 20*log (7500/300) – 15 dB = **47 dBA**

Where: R1 = Distance of Specified Blowdown Noise Level Requirement (i.e., 300 ft.)

R2 = Distance of the Receptor from the Blowdown Event (7,500 ft.)

SOURCE OF SOUND DATA

The following describes the source of sound data used for estimating the source sound levels and/or the source PWLs (i.e., turbine/compressors, auxiliary equipment and other components associated with the compressor installation).

(1) The estimated PWL values of equipment inside the building (i.e., turbine & compressor) were calculated from sound data measured by H&K on a similar type of gas compressor installation.

(6) Turbine exhaust PWL values for the Solar turbine were calculated from sound data provided by Solar (i.e., 2004 data from Solar Noise Prediction Booklet).

(7) The noise radiated from aboveground gas piping is primarily a result the noise generated by the gas compressors. Consequently, measurement of both near field and far field sound data on gas piping is presumed to be an accurate method of quantifying the noise associated with the new gas piping, and the estimated PWL values for gas piping used in the analysis were determined from near field and far field sound data by H&K on a similar type of compressor to that of the compressor installation.

(8) The estimated PWL values for the turbine LO cooler were designated to meet the design noise goal. Note that the estimated PWL for the coolers utilized in the acoustical analysis assumes some noise associated with piping associated with the coolers. The noise level for the LO cooler used in the analysis is generally higher than the sound level requirement in order that the analysis incorporates an acoustical "margin of safety."

(9) The estimated PWL values for the turbine air intake were calculated from sound data provided by Solar (i.e., 2004 data from Solar Noise Prediction Booklet), although the low-frequency SPLs were modified as a result of field acoustical tests by H&K.

(10) The estimated sound level of an unsilenced unit blowdown event was calculated from sound data measured on similar type of gas blowdown event.

End of Report

Subject: Wieland Flat Compressor Station (Elko County, Nevada): Results of an Ambient Sound Survey and Acoustical Analysis of a Proposed New Natural Gas Compressor Station associated with the Ruby Pipeline Project

Submitted to: **Ruby Pipeline, L.L.C.** (project applicant)

H&K Report No. 2280
Date of Report: October 10, 2008
H&K Job No. 4094
Submitted by: Paul D. Kiteck, P.E., **Hoover & Keith Inc.** (primary author)

REPORT SUMMARY

This report provides the results of an acoustical analysis for the **Wieland Flat Compressor Station** (referred to as "Station" in the report) associated with the proposed **Ruby Pipeline Project**. Also included are the results of the recent ambient sound survey at the proposed site of the Station.

The following table summarizes the ambient sound level at the nearby noise–sensitive areas (NSAs), the estimated sound contribution of the Station, and the estimated total sound contribution of the Station (i.e., sound contribution of the Station plus the ambient sound level). The results provided in this table are referred to as the "Noise Quality Analysis".

Noise Quality Analysis for Wieland Flat Station associated with Ruby Pipeline Project

Closest NSA(s)	Distance and Direction of NSA to the Station	Calc'd Ambient Ldn (via Meas'd Ld & Est'd Ln)	Est'd Sound Level (Ldn) of the Station	Est'd "Total" Ldn (Station Noise + Ambient Noise)	Potential Noise Increase
NSA #1	33,800 feet (SSW)	42.6 dBA	19.3 dBA	42.6 dBA	0.0 dB

The results of the acoustical analysis indicate that the sound contribution of the proposed Station should be significantly lower than **55 dBA** (L_{dn}) at the nearby NSAs, which is the FERC sound level requirement. Also, since the noise sources of the compressor installation that could cause perceptible vibration (e.g., turbine exhaust noise) will be adequately mitigated; there should not be any perceptible increase in vibration at any NSA after installation of the Station. In addition, due to the distance of the NSAs (i.e., approximately 6.4 miles to the closest NSA), the noise resulting from a unit gas blowdown

event or site construction activities at the Station should not have a noise impact on the surrounding environment.

1.0 INTRODUCTION

In this report, H&K provides the results of an acoustical analysis for the **Wieland Flat Compressor Station** (referred to as “Station” in the report), a new natural gas compressor station associated with the proposed **Ruby Pipeline Project**. Also included are the results of the recent ambient sound survey at the proposed site of the Station. The purpose of the ambient sound survey was to quantify the ambient sound levels and verify the noise-sensitive areas (NSAs) around the Station, such as residences, hospitals and schools. The purpose of the acoustical analysis is to quantify the sound contribution of the Station at nearby NSAs during full load operation and determine noise control measures to meet applicable sound criteria.

2.0 SOUND LEVEL CRITERIA

Certificate conditions set forth by the Office of Energy Projects (OEP) of the Federal Energy Regulatory Commission (FERC) require that the sound attributable to a new natural gas compressor station not exceed an equivalent day-night sound level (L_{dn}) of **55 dBA** at any nearby NSA. There apparently are no applicable state/local noise regulations. The L_{dn} is an energy average of the measured daytime L_{eq} (i.e., L_d) and measured nighttime L_{eq} (i.e., L_n) plus **10 dB**. For an essentially steady sound source that operates continuously over a 24-hour period and controls the environmental sound level (e.g., natural gas compressor station), the L_{dn} is approximately **6.4 dB** above the measured L_{eq}. Consequently, an L_{dn} of **55 dBA** corresponds to an L_{eq} of **48.6 dBA**. If both the L_d and L_n are measured, then the L_{dn} is calculated using the following formula:

$$L_{\text{dn}} = 10\log_{10}\left(\frac{15}{24}10^{L_{\text{d}}/10} + \frac{9}{24}10^{(L_{\text{n}}+10)/10}\right)$$

3.0 SITE/FACILITY DESCRIPTION

Figure 1 (**Appendix**, p. 7) is a general area layout around the Station showing the location of the nearby NSAs and the Station property line. The Station will be located in a remote and uninhabited area of Elko County, Nevada, approximately 30 miles north of Elko, NV. There are no NSAs within 1 mile of the Station site, and the closest NSA to the Station is a residence located approximately 33,800 feet (6.4 miles) south-southwest of the Station. In addition, the closest NSA is not in “line-of-sight” of the Station noise-generating sources due to the topography located between the NSA and Station (i.e., hills/terrain), and therefore, the topographic features could attenuate the noise of the Station.

The Station will consist of two (2) Solar Titan 130 gas turbine-driven centrifugal gas compressor units. The turbines/compressors will be installed inside a single building (i.e., Compressor Building) that is assumed to be located at the Station site center. The following describes the anticipated auxiliary equipment and other notable items associated with each compressor unit:

- Turbine exhaust system designed with a stack and “standard” Solar exhaust muffler;
- Turbine air intake filter system designed with a “standard” Solar silencer;
- Aboveground gas piping and associated components;
- “Standard” Solar outdoor lube oil cooler and back-up (“emergency”) generator(s).

In addition, there will also be two (2) types of gas blowdown events at the Station: (1) a type of maintenance gas blowdown that can occur when a compressor is stopped and gas between the suction/discharge valves & compressors is vented to the atmosphere via a blowdown stack (no blowdown silencer anticipated), and (2) an emergency shutdown (ESD) that will only occur at required DOT test intervals or in an emergency situation (gas leak or fire). The unit blowdown event occurs infrequently and only for a short time frame (e.g., unit blowdown event would persist for approximately 1 to 5 minutes).

4.0 MEASUREMENT METHODOLOGY, LOCATIONS AND RESULTS

One (1) location was chosen for measuring the ambient sound level at the closest NSA and one (1) sound measurement location at the site of the Station was reported. The following provides a description of the nearby NSA(s) and reported sound measurement positions:

Pos. 1: NSA #1: Residence located approximately 6.4 miles (i.e., 33,800 feet) SSW of the Station, and this residence is considered the closest NSA to the proposed Station.

Pos. 2: On the site of the Station property.

The sound survey was conducted by Orlando Fernandez of H&K during the daytime of September 24, 2008. During the site ambient sound survey, the temperature was 77 degree F., the wind was from the southwest and there was a mostly clear sky. At the reported sound measurement locations, the A-wt. equivalent sound levels (i.e., L_{eq}) and the unweighted octave-band (O.B.) sound pressure levels (SPLs) were measured at 5 feet above ground. The acoustical measurement system consisted of a Rion Model NA-27 Sound Level Meter (a Type 1 SLM per ANSI S1.4 & S1.11) equipped with microphone & windscreen. The SLM was calibrated with a microphone calibrator (calibrated within 1 year of the test date).

The following **Table 1** summarizes the measured ambient L_d, estimated ambient L_n and the resulting ambient L_{dn}, as calculated from the measured ambient L_d and estimated L_n.

Meas. Pos.	Description of the Nearby NSAs and associated Sound Measurement Location	Meas'd Ambient Ld (dBA)	Est'd Ambient Ln (dBA)	Calc'd Ambient Ldn (via Meas'd Ld & Est'd Ln)
Pos. 1	NSA #1: Residence 6.4 miles SSW of the Station site	37.0 dBA	37.0 dBA	42.6 dBA
Pos. 2	On the property of the proposed Station site	41.0 dBA	41.0 dBA	47.6 dBA

Table 1: Summary of Meas'd Ambient L_d, Est'd Ambient L_n and Calc'd Ambient L_{dn}

The ambient nighttime sound level (L_n) was not measured but based on our site observations, the ambient nighttime level should be similar to the measured ambient daytime sound level. At the reported sound measurement location at NSA #1, noise sources that contributed to the A-wt. sound level included wind-related noise (i.e., wind blowing in the grass/foliage), the noise of distant vehicles along Hwy. 225, sound of birds/insects and occasionally, distant dogs barking.

5.0 ACOUSTICAL ANALYSIS AND NOISE CONTROL MEASURES

5.1 Station Sound Contribution

The following Station sound sources that were considered significant during normal Station operation:

- Noise of the turbines/compressors that penetrates the Compressor Building;
- Noise of the turbine exhaust for each unit, and the turbine exhaust noise is considered the primary noise source that could generate perceptible vibration at the nearby NSAs;
- Noise radiated from outdoor aboveground gas piping;
- Noise of the outdoor lube oil cooler for each unit;
- Noise generated by the turbine air intake system for each unit;
- Noise radiated from the outdoor turbine exhaust ducting and body of exhaust muffler.

Table A (**Appendix**, p. 8) shows the calculation of the A-weighted sound level and the unweighted octave-band (O.B.) sound pressure levels (SPLs) at the closest NSA contributed by the compressor units along with the total Station sound contribution (i.e., Station noise plus ambient noise level) for standard day propagating conditions. This spreadsheet acoustical analysis includes the estimated noise reduction associated with the anticipated noise control measures. A description of the analysis methodology and source of sound data used for the analysis are provided at the end of the report (**Appendix**, p. 9–10).

5.2 Station Noise Control Measures

The following noise control measures are anticipated for the compressor units associated with the Station design:

(1) Turbines/compressors of the compressor units will be installed inside a single insulated metal building (i.e., Compressor Building);

(2) Exhaust system for each turbine will employ a “standard” Solar exhaust muffler;

(3) Air intake system will employ a “standard” Solar air intake silencer and filter;

(4) Each turbine will employ a “standard” Solar lube oil cooler.

5.3 Unit Blowdown Event and Site Construction Noise

The maximum "peak" sound level of the unit blowdown event associated with the compressor units is estimated to be an A-wt. sound level of **90 dBA** at a distance of 300 feet. As a result, the "peak" sound level of the unit blowdown event will be approximately **14 dBA** (i.e., L_{dn} of approximately **20** to **21 dBA**) at the closest NSA, located approximately 33,800 feet from the unit blowdowns. A description of the acoustical analysis methodology and source of sound data related to blowdown noise are provided in the **Appendix** (p. 10).

Due to the distance of the closest NSA (i.e., approximately 6.4 miles), the noise resulting from site construction activities at the Station should be significantly lower than **55 dBA** (L_{dn}), and consequently, site construction noise should not have a noise impact on the surrounding environment.

6.0 SUMMARY AND FINAL COMMENT

The following **Table 2** summarizes the estimated sound contribution of the Station at the closest NSA along with the total sound contribution of the Station (i.e., Station noise plus the ambient level). The results in this table are defined as the "Noise Quality Analysis".

Closest NSAs	Distance and Direction of NSA to the Station	Calc'd Ambient Ldn (via Meas'd Ld & Est'd Ln)	Est'd Ldn Of the Station	Est'd "Total" Ldn (Station Noise + Ambient Noise)	Potential Noise Increase
NSA #1	33,800 feet (SSW)	42.6 dBA	19.3 dBA	42.6 dBA	0.0 dB

Table 2: Noise Quality Analysis of the Wieland Flat Station for the Ruby Pipeline Project

The results of the acoustical analysis indicate that if the sound contribution of the proposed Station should be significantly lower than **55 dBA** (L_{dn}) at the nearby NSAs, which is the FERC sound level requirement. Also, since the noise sources of the compressor units that could cause perceptible vibration (e.g., turbine exhaust noise) will be adequately mitigated; there should not be any perceptible increase in vibration at any NSA after installation of the Station. In addition, due to the distance of the closest NSA from the Station (i.e., approximately 6.4 miles), the noise resulting from a unit blowdown event or site construction activities at the Station should not have a noise impact on the surrounding environment.

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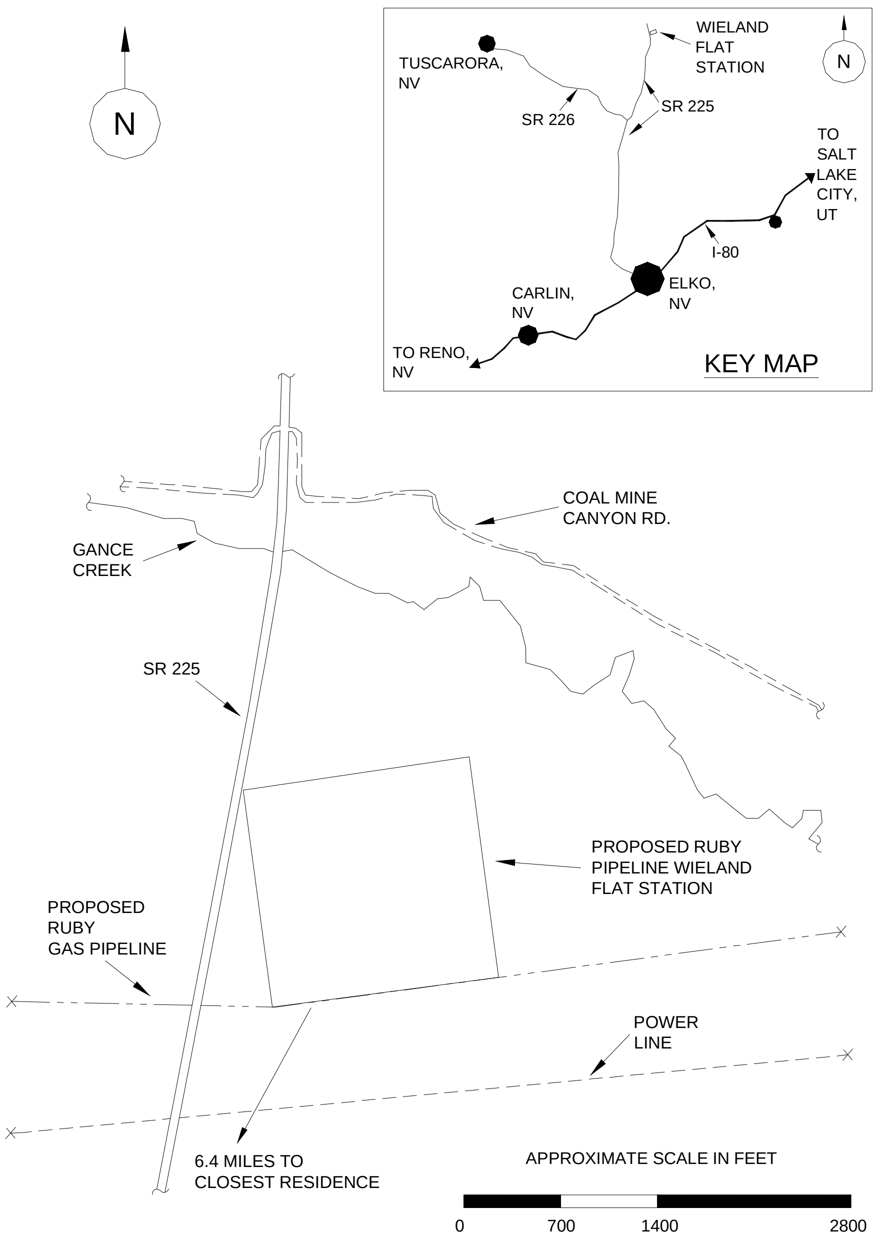

Figure 1: Wieland Flat Station (Ruby Pipeline Project): Area/Site Layout Showing the Area around the Site of the Station and the Nearby NSA(s)

Source No. & Dist (Ft)	Noise Sources and Other Conditions/Factors associated with Acoustical Analysis	PWL or SPL in dB Per Octave-Band Center Frequency (Hz) 31.5	63	125	250	500	1000	2000	4000	8000	A-Wt. Level	
1)	PWL of Turbines/Compressors radiated thru Bldg	114	114	116	117	115	117	118	122	118	126	
	Atten. of Bldg. (Includes Noise of Vent System)	-2	-8	-12	-15	-20	-22	-24	-25	-25		
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
33800	Hemispherical Radiation	-88	-88	-88	-88	-88	-88	-88	-88	-88		
33800	Atm. Absorption (50% R.H., 60 deg F)	-3	-3	-7	-14	-24	-51	-101	-257	-463		
33800	Source Sound Level Contribution	21	14	9	0	0	0	0	0	0	7	
2)	PWL of Unsilenced Turbine Exhaust (2 Units)	126	130	128	130	134	130	122	112	105	134	
	Atten. of Noise Control ("Standard" Muffler)	-3	-5	-10	-19	-28	-34	-34	-33	-22		
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
33800	Hemispherical Radiation	-88	-88	-88	-88	-88	-88	-88	-88	-88		
33800	Atm. Absorption (50% R.H., 60 deg F)	-3	-3	-7	-14	-24	-51	-101	-257	-463		
33800	Source Sound Level Contribution	32	33	23	9	0	0	0	0	0	12	
3)	PWL of Aboveground Piping & Components	100	100	98	98	102	110	120	112	108	122	
	Atten. of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
33800	Hemispherical Radiation	-88	-88	-88	-88	-88	-88	-88	-88	-88		
33800	Atm. Absorption (50% R.H., 60 deg F)	-3	-3	-7	-14	-24	-51	-101	-257	-463		
33800	Source Sound Level Contribution	9	8	3	0	0	0	0	0	0	7	
4)	PWL of "Standard" L.O. Coolers (2 Units)	110	108	105	100	98	95	92	90	88	101	
	NR of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
33800	Hemispherical Radiation	-88	-88	-88	-88	-88	-88	-88	-88	-88		
33800	Atm. Absorption (50% R.H., 60 deg F)	-3	-3	-7	-2	-24	-51	-101	-257	-463		
33800	Source Sound Level Contribution	19	16	10	10	0	0	0	0	0	8	
5)	PWL of Turbine Air Intake (2 Units)	119	119	119	121	123	129	135	161	154	163	
	Attenuation of Intake Silencer ("Standard")	-1	-4	-7	-16	-20	-30	-40	-50	-40		
	Attenuation of Air Intake Filter	-1	-4	-8	-9	-13	-26	-27	-27	-33		
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
33800	Hemispherical Radiation	-88	-88	-88	-88	-88	-88	-88	-88	-88		
33800	Atm. Absorption (50% R.H., 60 deg F)	-3	-3	-7	-14	-24	-51	-101	-257	-463		
33800	Source Sound Level Contribution	26	19	9	0	0	0	0	0	0	7	
6)	PWL of Exhaust Ducting & Muffler Body (2 Units)	108	105	100	96	92	88	82	78	75	94	
	Atten. of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
33800	Hemispherical Radiation	-88	-88	-88	-88	-88	-88	-88	-88	-88		
33800	Atm. Absorption (50% R.H., 60 deg F)	-3	-3	-7	-14	-24	-51	-101	-257	-463		Calc'd
33800	Source Sound Level Contribution	17	13	5	0	0	0	0	0	0	7	Ldn
Est'd Total Sound Contribution of Sound Sources at NSA #1		**34**	**34**	**24**	**13**	**0**	**0**	**0**	**0**	**0**	**12.9**	**19.3**

Meas'd Ambient Noise Level at NSA #1: Note (1)	**42.6**
"Total" Sound Contirbution: Est'd Station Noise and Ambient Noise	42.6
Potential Increase in Ambient Noise due to Station (dB)	**0.0**

Table A: Ruby Pipeline Wieland Flat Station: Est'd Sound Contribution of the Compressor Installation at the Closest NSA (i.e., NSA#1, located 33,800 Ft. SSW of the Station Site Center). Included is the Est'd Increase in the Ambient Noise Level as a Result of the Compressor Installation.

Note (1): Existing ambient noise level based on meas'd sound data by H&K during a recent sound survey at site of Station.

NOTE: Muffler DIL & Equipment PWL values on this spreadsheet should not be used as the specified values. Refer to "Noise Control Measures" section in report or other company specifications for actual specified values.

DESCRIPTION OF ANALYSIS METHODOLOGY AND SOURCE OF SOUND DATA

ANALYSIS METHODOLOGY

In general, the predicted sound level contributed by the compressor units at the Station was calculated as a function of frequency from estimated unweighted octave-band (O.B.) sound power levels (PWLs) for each significant sound source associated with the compressor units. The following summarizes the acoustical analysis procedure for the Station:

- Initially, unweighted O.B. PWL values of the significant noise sources associated with the compressor units were determined from equipment manufacturer's sound data and/or actual sound level measurements performed by H&K at similar type of equipment/components expected for this natural gas compressor facility.

- Then, expected noise reduction (NR) or attenuation in dB per O.B. frequency due to any noise control measures, hemispherical sound propagation (discussed in more detail below*) and atmospheric sound absorption (discussed in more detail below**) were subtracted from the unweighted octave-band PWLs to obtain the unweighted O.B. SPLs of each noise source. Since sound shielding by buildings can influence the sound level contributed at the NSAs, we also included the sound shielding due to buildings, if appropriate. The sound attenuation effect due to foliage or land contour was not considered in the analysis although there probably will be some attenuation due to the topography located between the Station and nearby NSAs.

- Finally, the resulting estimated unweighted O.B. SPLs for all noise sources associated with the compressor unit (with noise control and other sound attenuation effects) were logarithmically summed, and the total O.B. SPLs for all noise sources were corrected for A-weighting to provide the estimated overall A-wt. sound level contributed by the compressor unit at the closest NSA. The previous estimated sound contribution of the Station at the closest NSA was utilized to estimate the Station noise contribution after installation of the compressor units.

*<u>Attenuation due to hemispherical sound propagation</u>: Sound propagates outwards in all directions (i.e., length, width, height) from a point source, and the sound energy of a noise source decreases with increasing distance from the source. In the case of hemispherical sound propagation, the source is located on a flat continuous plane/surface (e.g., ground), and the sound radiates hemispherically (i.e., outward, over and above the surface) from the sound source. The following equation is the theoretical decrease of sound energy when determining the resulting SPL values of a noise source at a specific distance ("r") of a receiver from the estimated PWL values:

> Decrease in SPL ("hemispherical propagation") from a noise source = **20*log(r) – 2.3 dB**
> where "r" is distance of the receiver from the noise source.

<u>Attenuation due to air absorption</u>: Air absorbs sound energy, and the amount of absorption ("attenuation") is dependent on the temperature and relative humidity (R.H.) of air and frequency of sound. For example, the attenuation due to air absorption for 1000 Hz O.B. SPL is approximately **1.5 dB per 1,000 feet for standard day conditions (i.e., no wind, 60 deg. F. and 70% or 50% R.H.).

ANALYSIS METHODOLOGY (NOISE ATTRIBUTABLE TO A BLOWDOWN EVENT)

The noise resulting from a blowdown event was estimated by using the “inverse-square law” and included some attenuation due to atmospheric sound absorption. Consequently, the estimated noise of a blowdown event at the receptor (closest NSA) was calculated as follows and assumes that the unsilenced unit gas blowdown is approximately **90 dBA** at 300 feet, and the closest NSA is approximately 33,800 feet from the unit blowdown silencer for the compressor addition:

SPL (receptor)= (Blowdown SPL at R1) – 20*log(R2/R1) – Atm. Atten. = **90 dBA** – 20*log (33,800/300) – 35 dB = **14 dBA**

Where: R1 = Distance of Specified Blowdown Noise Level Requirement (i.e., 300 ft.)

R2 = Distance of the Receptor from the Blowdown Event (33,800 ft.)

SOURCE OF SOUND DATA

The following describes the source of sound data used for estimating the source sound levels and/or the source PWLs (i.e., turbine/compressors, auxiliary equipment and other components associated with the compressor installation).

(1) The estimated PWL values of equipment inside the building (i.e., turbine & compressor) were calculated from sound data measured by H&K on a similar type of gas compressor installation.

(11) Turbine exhaust PWL values for the Solar turbine were calculated from sound data provided by Solar (i.e., 2004 data from Solar Noise Prediction Booklet).

(12) The noise radiated from aboveground gas piping is primarily a result the noise generated by the gas compressors. Consequently, measurement of both near field and far field sound data on gas piping is presumed to be an accurate method of quantifying the noise associated with the new gas piping, and the estimated PWL values for gas piping used in the analysis were determined from near field and far field sound data by H&K on a similar type of compressor to that of the compressor installation.

(13) The estimated PWL values for the turbine LO cooler were designated to meet the design noise goal. Note that the estimated PWL for the coolers utilized in the acoustical analysis assumes some noise associated with piping associated with the coolers. The noise level for the LO cooler used in the analysis is generally higher than the sound level requirement in order that the analysis incorporates an acoustical “margin of safety.”

(14) The estimated PWL values for the turbine air intake were calculated from sound data provided by Solar (i.e., 2004 data from Solar Noise Prediction Booklet), although the low-frequency SPLs were modified as a result of field acoustical tests by H&K.

(15) The estimated sound level of an unsilenced unit blowdown event was calculated from sound data measured on similar type of gas blowdown event.

End of Report

Subject: Desert Valley Compressor Station (Humboldt County, Nevada): Results of an Ambient Sound Survey and Acoustical Analysis of a Proposed New Natural Gas Compressor Station associated with the Ruby Pipeline Project

Submitted to: **Ruby Pipeline, L.L.C.** (project applicant)

H&K Report No. 2281
Date of Report: October 10, 2008
H&K Job No. 4095
Submitted by: Paul D. Kiteck, P.E., **Hoover & Keith Inc.** (primary author)

REPORT SUMMARY

This report provides the results of an acoustical analysis for the **Desert Valley Compressor Station** (referred to as "Station" in the report) associated with the proposed **Ruby Pipeline Project**. Also included are the results of the recent ambient sound survey at the proposed site of the Station.

The following table summarizes the ambient sound level at the nearby noise–sensitive areas (NSAs), the estimated sound contribution of the Station, and the estimated total sound contribution of the Station (i.e., sound contribution of the Station plus the ambient sound level). The results provided in this table are referred to as the "Noise Quality Analysis".

Noise Quality Analysis for Desert Valley Station associated with Ruby Pipeline Project

Closest NSA(s)	Distance and Direction of NSA to the Station	Calc'd Ambient Ldn (via Meas'd Ld & Est'd Ln)	Est'd Sound Level (Ldn) of the Station	Est'd "Total" Ldn (Station Noise + Ambient Noise)	Potential Noise Increase
NSA #1	23,800 feet (west)	30.0 dBA	21.7 dBA	30.6 dBA	0.6 dB

The results of the acoustical analysis indicate that the sound contribution of the proposed Station should be significantly lower than **55 dBA** (L_{dn}) at the nearby NSAs, which is the FERC sound level requirement. Also, since the noise sources of the compressor installation that could cause perceptible vibration (e.g., turbine exhaust noise) will be adequately mitigated; there should not be any perceptible increase in vibration at any NSA after installation of the Station. In addition, due to the distance of the NSAs (i.e., approximately 4.5 miles to the closest NSA), the noise resulting from a unit gas blowdown event or site construction activities at the Station should not have a noise impact on the surrounding environment.

1.0 INTRODUCTION

In this report, H&K provides the results of an acoustical analysis for the **Desert Valley Compressor Station** (referred to as "Station" in the report), a new natural gas compressor station associated with the proposed **Ruby Pipeline Project**. Also included are the results of the recent ambient sound survey at the proposed site of the Station. The purpose of the ambient sound survey was to quantify the ambient sound levels and verify the noise-sensitive areas (NSAs) around the Station, such as residences, hospitals and schools. The purpose of the acoustical analysis is to quantify the sound contribution of the Station at the nearby NSAs during full load operation and determine noise control measures to meet applicable sound criteria.

2.0 SOUND LEVEL CRITERIA

Certificate conditions set forth by the Office of Energy Projects (OEP) of the Federal Energy Regulatory Commission (FERC) require that the sound attributable to a new natural gas compressor station not exceed an equivalent day-night sound level (L_{dn}) of **55 dBA** at any nearby NSA. There apparently are no applicable state/local noise regulations. The L_{dn} is an energy average of the measured daytime L_{eq} (i.e., L_d) and measured nighttime L_{eq} (i.e., L_n) plus **10 dB**. For an essentially steady sound source that operates continuously over a 24-hour period and controls the environmental sound level (e.g., natural gas compressor station), the L_{dn} is approximately **6.4 dB** above the measured L_{eq}. Consequently, an L_{dn} of **55 dBA** corresponds to an L_{eq} of **48.6 dBA**. If both the L_d and L_n are measured, then the L_{dn} is calculated using the following formula:

$$L_{dn} = 10\log_{10}\left(\frac{15}{24}10^{L_d/10} + \frac{9}{24}10^{(L_n+10)/10}\right)$$

3.0 SITE/FACILITY DESCRIPTION

Figure 1 (**Appendix**, p. 7) is a general area layout around the Station showing the location of the nearby NSAs and the Station property line. The Station will be located in a remote and uninhabited area of Humboldt County, Nevada, approximately 43 miles northwest of Winnemucca, NV. There are no NSAs within 1 mile of the Station site, and the closest NSA to the Station is a residence located approximately 23,800 feet (4.5 miles) south-southwest of the Station. In addition, the closest NSA is not in "line-of-sight" of the Station noise-generating sources due to the topography located between the NSA and Station (i.e., hills/terrain), and therefore, the topographic features could attenuate the noise of the Station.

The Station will consist of one (1) Solar Titan 130 gas turbine-driven centrifugal gas compressor unit. The turbine/compressor will be installed inside a single building (i.e., Compressor Building) that is assumed to be located at the Station site center. The following describes the anticipated auxiliary equipment and other notable items associated with the compressor unit:

- Turbine exhaust system designed with a stack and “standard” Solar exhaust muffler;
- Turbine air intake filter system designed with a “standard” Solar silencer;
- Aboveground gas piping and associated components;
- “Standard” Solar outdoor lube oil cooler and back-up (“emergency”) generator(s).

In addition, there will also be two (2) types of gas blowdown events at the Station: (1) a type of maintenance gas blowdown that can occur when a compressor is stopped and gas between the suction/discharge valves & compressors is vented to the atmosphere via a blowdown stack (no blowdown silencer anticipated), and (2) an emergency shutdown (ESD) that will only occur at required DOT test intervals or in an emergency situation (gas leak or fire). The unit blowdown event occurs infrequently and only for a short time frame (e.g., unit blowdown event would persist for approximately 1 to 5 minutes).

4.0 MEASUREMENT METHODOLOGY, LOCATIONS AND RESULTS

One (1) location was chosen for measuring the ambient sound level at the closest NSA and one (1) sound measurement location at the site of the Station was reported. The following provides a description of the nearby NSA(s) and reported sound measurement positions:

Pos. 1: NSA #1: Residence located approximately 4.5 miles (i.e., 23,800 feet) west of the Station, and this residence is considered the closest NSA to the proposed Station.

Pos. 2: On the site of the Station property.

The sound survey was conducted by Orlando Fernandez of H&K during the daytime of September 25, 2008. During the site ambient sound survey, the temperature was 68 degree F., the wind was from the northwest and there was overcast. At the reported sound measurement locations, the A-wt. equivalent sound levels (i.e., L_{eq}) and the unweighted octave-band (O.B.) sound pressure levels (SPLs) were measured at 5 feet above ground. The acoustical measurement system consisted of a Rion Model NA-27 Sound Level Meter (a Type 1 SLM per ANSI S1.4 & S1.11) equipped with microphone & windscreen. The SLM was calibrated with a microphone calibrator (calibrated within 1 year of the test date).

The following **Table 1** summarizes the measured ambient L_d, estimated ambient L_n and the resulting ambient L_{dn}, as calculated from the measured ambient L_d and estimated L_n.

Meas. Pos.	Description of the Nearby NSAs and associated Sound Measurement Location	Meas’d Ambient Ld (dBA)	Est’d Ambient Ln (dBA)	Calc’d Ambient Ldn (via Meas’d Ld & Est’d Ln)

Pos. 1	NSA #1: Residence 4.5 miles west of the Station site	24.0 dBA	24.0 dBA	30.0 dBA
Pos. 2	On the property of the proposed Station site	28.0 dBA	28.0 dBA	34.6 dBA

Table 1: Summary of Meas'd Ambient L_d, Est'd Ambient L_n and Calc'd Ambient L_{dn}

The ambient nighttime sound level (L_n) was not measured but based on our site observations, the ambient nighttime level should be similar to the measured ambient daytime sound level. At the reported sound measurement location at NSA #1, noise sources that contributed to the A-wt. sound level included wind-related noise (i.e., wind blowing in the grass/foliage), the noise of distant vehicles along Hwy. 140, sound of birds/insects and occasionally, distant dogs barking.

5.0 ACOUSTICAL ANALYSIS AND NOISE CONTROL MEASURES

5.1 Station Sound Contribution

The following Station sound sources that were considered significant during normal Station operation:

- Noise of the turbines/compressors that penetrates the Compressor Building;
- Noise of the turbine exhaust for each unit, and the turbine exhaust noise is considered the primary noise source that could generate perceptible vibration at the nearby NSAs;
- Noise radiated from outdoor aboveground gas piping;
- Noise of the outdoor lube oil cooler for each unit;
- Noise generated by the turbine air intake system for each unit;
- Noise radiated from the outdoor turbine exhaust ducting and body of exhaust muffler.

Table A (**Appendix**, p. 8) shows the calculation of the A-weighted sound level and the unweighted octave-band (O.B.) sound pressure levels (SPLs) at the closest NSA contributed by the compressor units along with the total Station sound contribution (i.e., Station noise plus ambient noise level) for standard day propagating conditions. This spreadsheet acoustical analysis includes the estimated noise reduction associated with the anticipated noise control measures. A description of the analysis methodology and source of sound data used for the analysis are provided at the end of the report (**Appendix**, p. 9–10).

5.2 Station Noise Control Measures

The following noise control measures are anticipated for the compressor units associated with the Station design:

(1) Turbines/compressors of the compressor units will be installed inside a single insulated metal building (i.e., Compressor Building);
(2) Exhaust system for each turbine will employ a "standard" Solar exhaust muffler;
(3) Air intake system will employ a "standard" Solar air intake silencer and filter;
(4) Each turbine will employ a "standard" Solar lube oil cooler.

5.3 Unit Blowdown Event and Site Construction Noise

The maximum "peak" sound level of the unit blowdown event associated with the compressor units is estimated to be an A-wt. sound level of **90 dBA** at a distance of 300 feet. As a result, the "peak" sound level of the unit blowdown event will be approximately **22 dBA** (i.e., L_{dn} of approximately **28** to **29 dBA**) at the closest NSA, located approximately 23,800 feet from the unit blowdowns. A description of the acoustical analysis methodology and source of sound data related to blowdown noise are provided in the **Appendix** (p. 10).

Due to the distance of the closest NSA (i.e., approximately 6.4 miles), the noise resulting from site construction activities at the Station should be significantly lower than **55 dBA** (L_{dn}), and consequently, site construction noise should not have a noise impact on the surrounding environment.

6.0 SUMMARY AND FINAL COMMENT

The following **Table 2** summarizes the estimated sound contribution of the Station at the closest NSA along with the total sound contribution of the Station (i.e., Station noise plus the ambient level). The results in this table are defined as the "Noise Quality Analysis".

Closest NSAs	Distance and Direction of NSA to the Station	Calc'd Ambient Ldn (via Meas'd Ld & Est'd Ln)	Est'd Ldn Of the Station	Est'd "Total" Ldn (Station Noise + Ambient Noise)	Potential Noise Increase
NSA #1	23,800 feet (west)	30.0 dBA	21.7 dBA	30.6 dBA	0.6 dB

Table 2: Noise Quality Analysis of the Desert Valley Station for the Ruby Pipeline Project

The results of the acoustical analysis indicate that if the sound contribution of the proposed Station should be significantly lower than **55 dBA** (L_{dn}) at the nearby NSAs, which is the FERC sound level requirement. Also, since the noise sources of the compressor units that could cause perceptible vibration (e.g., turbine exhaust noise) will be adequately mitigated; there should not be any perceptible increase in vibration at any NSA after installation of the Station. In addition, due to the distance of the closest NSA from the Station (i.e., approximately 6.4 miles), the noise resulting from a unit blowdown event or site construction activities at the Station should not have a noise impact on the surrounding environment.

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APPENDIX

- **FIGURE 1: GENERAL AREA LAYOUT AROUND THE SITE OF THE STATION SHOWING THE STATION PROPERTY**

- **ACOUSTICAL ANALYSIS OF THE STATION AND UNIT BLOWDOWN EVENT**

- **ANALYSIS METHODOLOGY (NOISE ATTRIBUTABLE TO THE COMPRESSOR UNITS AND UNIT BLOWDOWN EVENT) AND THE SOURCE OF SOUND DATA**

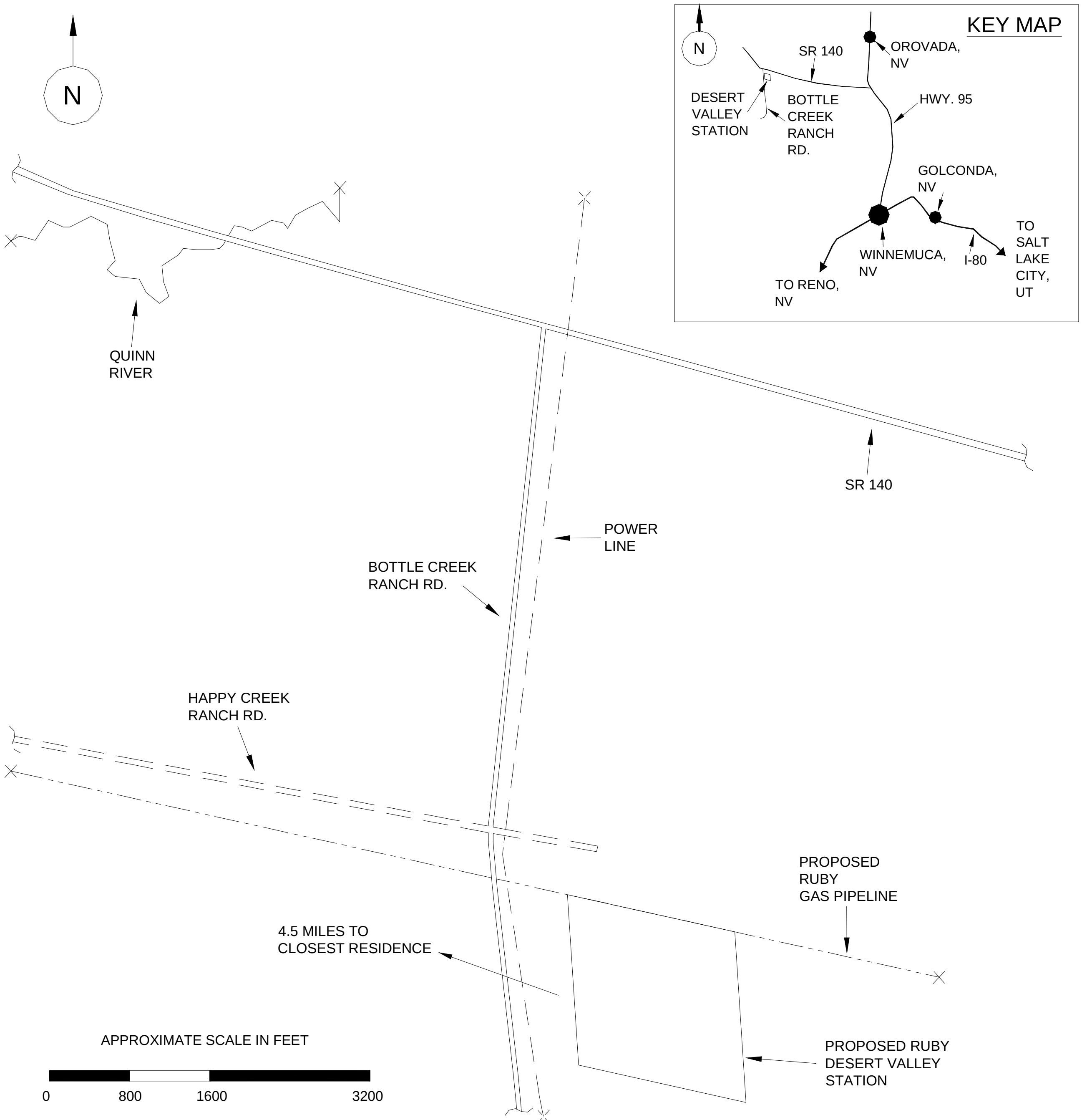

Figure 1: Desert Valley Station (Ruby Pipeline Project): Area/Site Layout Showing the Area around the Site of the Station and the Nearby NSA(s)

Source No. & Dist (Ft)	Noise Sources and Other Conditions/Factors associated with Acoustical Analysis	PWL or SPL in dB Per Octave-Band Center Frequency (Hz) 31.5	63	125	250	500	1000	2000	4000	8000	A-Wt. Level	
1)	PWL of Turbine/Compressor radiated thru Bldg.	114	114	116	117	115	117	118	122	118	126	
	Atten. of Bldg. (Includes Noise of Vent System)	-2	-8	-12	-15	-20	-22	-24	-25	-25		
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
23800	Hemispherical Radiation	-85	-85	-85	-85	-85	-85	-85	-85	-85		
23800	Atm. Absorption (50% R.H., 60 deg F)	-2	-2	-5	-10	-17	-36	-71	-181	-326		
23800	Source Sound Level Contribution	25	18	14	7	0	0	0	0	0	8	
2)	PWL of Unsilenced Turbine Exhaust (1 Unit)	124	128	126	128	130	128	120	110	105	131	
	Atten. of Noise Control ("Standard" Muffler)	-3	-5	-10	-19	-28	-34	-34	-33	-22		
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
23800	Hemispherical Radiation	-85	-85	-85	-85	-85	-85	-85	-85	-85		
23800	Atm. Absorption (50% R.H., 60 deg F)	-2	-2	-5	-10	-17	-36	-71	-181	-326		
23800	Source Sound Level Contribution	34	35	26	14	0	0	0	0	0	14	
3)	PWL of Aboveground Piping & Components	100	100	98	98	102	110	120	112	108	122	
	Atten. of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
23800	Hemispherical Radiation	-85	-85	-85	-85	-85	-85	-85	-85	-85		
23800	Atm. Absorption (50% R.H., 60 deg F)	-2	-2	-5	-10	-17	-36	-71	-181	-326		
23800	Source Sound Level Contribution	13	12	8	3	0	0	0	0	0	7	
4)	PWL of "Standard" L.O. Coolers (1 Unit)	108	106	104	98	96	94	92	90	88	100	
	NR of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
23800	Hemispherical Radiation	-85	-85	-85	-85	-85	-85	-85	-85	-85		
23800	Atm. Absorption (50% R.H., 60 deg F)	-2	-2	-5	-2	-17	-36	-71	-181	-326		
23800	Source Sound Level Contribution	21	18	14	11	0	0	0	0	0	9	
5)	PWL of Turbine Air Intake (1 Unit)	119	119	119	121	123	129	135	161	154	163	
	Attenuation of Intake Silencer ("Standard")	-1	-4	-7	-16	-20	-30	-40	-50	-40		
	Attenuation of Air Intake Filter	-1	-4	-8	-9	-13	-26	-27	-27	-33		
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
23800	Hemispherical Radiation	-85	-85	-85	-85	-85	-85	-85	-85	-85		
23800	Atm. Absorption (50% R.H., 60 deg F)	-2	-2	-5	-10	-17	-36	-71	-181	-326		
23800	Source Sound Level Contribution	30	23	14	1	0	0	0	0	0	8	
6)	PWL of Exhaust Ducting & Muffler Body (1 Unit)	108	105	100	96	92	88	82	78	75	94	
	Atten. of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
23800	Hemispherical Radiation	-85	-85	-85	-85	-85	-85	-85	-85	-85		
23800	Atm. Absorption (50% R.H., 60 deg F)	-2	-2	-5	-10	-17	-36	-71	-181	-326		Calc'd
23800	Source Sound Level Contribution	21	17	10	1	0	0	0	0	0	7	Ldn
Est'd Total Sound Contribution of Sound Sources at NSA #1		**36**	**36**	**27**	**17**	**0**	**0**	**0**	**0**	**0**	**15.3**	**21.7**

Meas'd Ambient Noise Level at NSA #1: Note (1)	**30.0**
"Total" Sound Contirbution: Est'd Station Noise and Ambient Noise	30.6
Potential Increase in Ambient Noise due to Station (dB)	**0.6**

Table A: Ruby Pipeline Desert Valley Station: Est'd Sound Contribution of the Compressor Installation at the Closest NSA (i.e., NSA#1, located 23,800 Ft. West of the Station Site Center). Included is the Est'd Increase in the Ambient Noise Level as a Result of the Compressor Installation.

Note (1): Existing ambient noise level based on meas'd sound data by H&K during a recent sound survey at site of Station.

NOTE: Muffler DIL & Equipment PWL values on this spreadsheet should not be used as the specified values. Refer to "Noise Control Measures" section in report or other company specifications for actual specified values.

DESCRIPTION OF ANALYSIS METHODOLOGY AND SOURCE OF SOUND DATA

ANALYSIS METHODOLOGY

In general, the predicted sound level contributed by the compressor unit at the Station was calculated as a function of frequency from estimated unweighted octave-band (O.B.) sound power levels (PWLs) for each significant sound source associated with the compressor unit. The following summarizes the acoustical analysis procedure for the Station:

- Initially, unweighted O.B. PWL values of the significant noise sources associated with the compressor unit were determined from equipment manufacturer's sound data and/or actual sound level measurements performed by H&K at similar type of equipment/components expected for this natural gas compressor facility.

- Then, expected noise reduction (NR) or attenuation in dB per O.B. frequency due to any noise control measures, hemispherical sound propagation (discussed in more detail below*) and atmospheric sound absorption (discussed in more detail below**) were subtracted from the unweighted octave-band PWLs to obtain the unweighted O.B. SPLs of each noise source. Since sound shielding by buildings can influence the sound level contributed at the NSAs, we also included the sound shielding due to buildings, if appropriate. The sound attenuation effect due to foliage or land contour was not considered in the analysis although there probably will be some attenuation due to the topography located between the Station and nearby NSAs.

- Finally, the resulting estimated unweighted O.B. SPLs for all noise sources associated with the compressor unit (with noise control and other sound attenuation effects) were logarithmically summed, and the total O.B. SPLs for all noise sources were corrected for A-weighting to provide the estimated overall A-wt. sound level contributed by the compressor unit at the closest NSA. The previous estimated sound contribution of the Station at the closest NSA was utilized to estimate the Station noise contribution after installation of the compressor units.

*<u>Attenuation due to hemispherical sound propagation</u>: Sound propagates outwards in all directions (i.e., length, width, height) from a point source, and the sound energy of a noise source decreases with increasing distance from the source. In the case of hemispherical sound propagation, the source is located on a flat continuous plane/surface (e.g., ground), and the sound radiates hemispherically (i.e., outward, over and above the surface) from the sound source. The following equation is the theoretical decrease of sound energy when determining the resulting SPL values of a noise source at a specific distance ("r") of a receiver from the estimated PWL values:

> Decrease in SPL ("hemispherical propagation") from a noise source = **20*log(r) – 2.3 dB** where "r" is distance of the receiver from the noise source.

<u>Attenuation due to air absorption</u>: Air absorbs sound energy, and the amount of absorption ("attenuation") is dependent on the temperature and relative humidity (R.H.) of air and frequency of sound. For example, the attenuation due to air absorption for 1000 Hz O.B. SPL is approximately **1.5 dB per 1,000 feet for standard day conditions (i.e., no wind, 60 deg. F. and 70% or 50% R.H.).

ANALYSIS METHODOLOGY (NOISE ATTRIBUTABLE TO A BLOWDOWN EVENT)

The noise resulting from a blowdown event was estimated by using the "inverse-square law" and included some attenuation due to atmospheric sound absorption. Consequently, the estimated noise of a blowdown event at the receptor (closest NSA) was calculated as follows and assumes that the unsilenced unit gas blowdown is approximately **90 dBA** at 300 feet, and the closest NSA is approximately 23,800 feet from the unit blowdown silencer for the compressor addition:

SPL (receptor)= (Blowdown SPL at R1) – 20*log(R2/R1) – Atm. Atten. = **90 dBA** – 20*log (23,800/300) – 30 dB = **22 dBA**

Where: R1 = Distance of Specified Blowdown Noise Level Requirement (i.e., 300 ft.)

R2 = Distance of the Receptor from the Blowdown Event (23,800 ft.)

SOURCE OF SOUND DATA

The following describes the source of sound data used for estimating the source sound levels and/or the source PWLs (i.e., turbine/compressor, auxiliary equipment and other components associated with the compressor installation).

(1) The estimated PWL values of equipment inside the building (i.e., turbine & compressor) were calculated from sound data measured by H&K on a similar type of gas compressor installation.

(16) Turbine exhaust PWL values for the Solar turbine were calculated from sound data provided by Solar (i.e., 2004 data from Solar Noise Prediction Booklet).

(17) The noise radiated from aboveground gas piping is primarily a result the noise generated by the gas compressors. Consequently, measurement of both near field and far field sound data on gas piping is presumed to be an accurate method of quantifying the noise associated with the new gas piping, and the estimated PWL values for gas piping used in the analysis were determined from near field and far field sound data by H&K on a similar type of compressor to that of the compressor installation.

(18) The estimated PWL values for the turbine LO cooler were designated to meet the design noise goal. Note that the estimated PWL for the coolers utilized in the acoustical analysis assumes some noise associated with piping associated with the coolers. The noise level for the LO cooler used in the analysis is generally higher than the sound level requirement in order that the analysis incorporates an acoustical "margin of safety."

(19) The estimated PWL values for the turbine air intake were calculated from sound data provided by Solar (i.e., 2004 data from Solar Noise Prediction Booklet), although the low-frequency SPLs were modified as a result of field acoustical tests by H&K.

(20) The estimated sound level of an unsilenced unit blowdown event was calculated from sound data measured on similar type of gas blowdown event.

End of Report

9H. Agency Correspondence