CENTRAL VALLEY GAS STORAGE, LLC

AMBIENT SOUND SURVEY
AND NOISE IMPACT EVALUATION

H&K Report No. 2366
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REPORT SUMMARY

In this report, we present the results of an April 27, 2009 ambient sound survey and subsequent noise impact analysis associated with the proposed **Central Valley Natural Gas Storage Project**, a new compressor station (hereinafter "Station") and remote storage wells (hereinafter "Well Pad Site") to be owned and operated by **Central Valley Gas Storage, LLC**. The purpose of the ambient sound survey and acoustical analysis is to:

- Document the existing acoustic environment and locate the noise-sensitive areas (NSAs) around the proposed Station and Well Pad Site.
- Project the sound level contribution that would result from operating the proposed Station.
- Project the sound level contribution that would result from operating a potential temporary compressor unit at the Well Pad Site.
- Project the temporary construction noise for the Station and Well Pad Site.
- Determine noise control measures and noise specifications for the Station and Well Pad Site equipment to insure that the facility meets applicable sound level criteria.

SOUND CRITERIA

There are no specific applicable Federal or State noise requirements for this facility. Per Mr. Dave Buehler of ICF Jones & Stokes, Mr. Kent Johanns (Associate Planner with Colusa County) in a November 2008 discussion regarding applicable noise standards for the proposed project, has advised ICF Jones & Stokes that the 55 L_{dn} noise standard in the County's general plan noise element should be used to evaluate noise impacts from the proposed project.

LONG TERM NOISE IMPACTS

The following table summarizes the measured ambient sound levels and Long Term Noise Impacts for the proposed Central Valley Compressor Station at the closest NSAs:

Long Term Noise Impact Assessment - Proposed Central Valley Compressor Station

NSAs	Distance/ Direction to Prop. Comp. Building	Meas'd Ambient Morning L_d (dBA)	Meas'd Ambient Afternoon L_d (dBA)	Meas'd Ambient Nighttime L_{dn}	Calc'd Ambient L_{dn} (dBA)	Est'd L_{eq} of Proposed Central Valley Station at Full Load (dBA)	Calc'd L_{dn} of Proposed Central Valley Station at Full Load (dBA)	Meas'd Ambient L_{dn} + Calc'd L_{dn} of Central Valley Station (dBA)	Potential Noise Increase (dB)
NSA #1 (House)	1,900 ft. SE	38.1	47.5	43.1	**49.5**	**41.7**	**48.1**	**51.8**	**2.3**
NSA #2 (House)	2,400 ft. NE	42.3	43.0	39.4	**46.5**	**39.2**	**45.6**	**49.1**	**2.6**

The results of our measurements, observations and analysis indicate that the L_{dn} sound contribution of the proposed Station at NSA #1 and NSA #2 is 48.1 and 45.6 dBA, respectively. Therefore, assuming the recommended noise control measures are followed and successfully implemented, it is our opinion that the sound level attributable to the proposed Station should meet the County noise criteria at the nearby NSAs.

SHORT TERM NOISE IMPACTS

Short term noise impacts include the noise of construction equipment for the Station and Well Pad Site, storage well drill rig noise, service rig noise for the proposed observation wells, and the temporary compressor unit to be located at the Well Pad Site.

General Construction Noise

Construction will be temporary and short-term in nature, and it should be limited to daytime hours. These facts along with the distance between the Station and Well Pad Site and the NSAs, suggest that impacts due to construction noise activities should be minimal. If needed, noise abatement techniques can be implemented during the construction phase to mitigate any construction related noise disturbances to nearby NSAs.

Drill Rig Activities for New Storage Wells

Nine new storage wells will be drilled at the Well Pad Site. New well drilling will occur 24 hours/day, 7 days a week, and each new well is estimated to take approximately 6-10 days to drill. The following table summarizes the noise impact assessment for the closest NSAs (NSA #1 & NSA #3) during drill rig operations at the new storage wells assuming standard drill rig equipment is employed.

Short Term Noise Impact Assessment – Drill Rig Activity for New Storage Wells

NSAs	Distance/ Direction to Proposed Storage Wells	Meas'd Ambient Morning L_d (dBA)	Meas'd Ambient Afternoon L_d (dBA)	Meas'd Ambient Nighttime L_{dn}	Calc'd Ambient L_{dn} (dBA)	Est'd L_{eq} of Storage Well Drill Rig Noise (dBA)	Calc'd L_{dn} of Storage Well Drill Rig Noise (dBA)	Meas'd Ambient L_{dn} + Est'd L_{dn} of Drill Rig Noise (dBA)	Potential Noise Increase (dB)
NSA #1 (House)	1,550 ft. NE	38.1	47.5	43.1	**49.5**	**44.1**	**50.5**	**53.1**	**3.6**
NSA #3 (Houses)	1,700 ft. S-SE	45.6	48.3	46.0	**52.6**	**43.0**	**49.4**	**54.3**	**1.7**

The noise impact analylsis indicates that the L_{dn} sound contribution of drill rig operations at NSA #1 and NSA #3 is 50.5 and 49.4 dBA, respectively. Because of the potential variability of drill rig operations, it is recommended that Central Valley meet with the nearby NSAs prior to drill rig set up activities and prior to commencement of nighttime activities to explain the project schedule

and planned well site activities. In the event that noise attributable to drill rig activities becomes objectionable and if it exceeds applicable criteria, Central Valley could offer temporary relocation or compensation as a mitigation measure for this relatively short term impact.

Service Rig Activities for Proposed Observation Wells

Five well locations may be subject to service rig activity. Service rig activities will occur 12 hours/day, 7 days a week, and each well is estimated to take approximately 3-5 days to complete. The following table summarizes the noise impact assessment, at the closest NSAs, for the five well sites during service rig operations assuming standard service rig equipment is employed.

Short Term Noise Impact Assessment – Service Rig Activity for Existing Wells

NSAs	Distance/ Direction to Closest Service Rig	Meas'd Ambient Morning L_d (dBA)	Meas'd Ambient Afternoon L_d (dBA)	Meas'd Ambient Nighttime L_{dn}	Calc'd Ambient L_{dn} (dBA)	Est'd L_{eq} of Service Rig Noise (dBA)	Calc'd L_{dn} of Service Rig Noise (dBA)	Meas'd Ambient L_{dn} + Est'd L_{dn} of Service Rig Noise (dBA)	Potential Noise Increase (dB)
NSA #3 (Houses)	650 ft. S of SaraLouise #1	45.6	48.3	46.0	**52.6**	**50.7**	**48.7**	**54.1**	**1.5**
NSA #3 (Houses)	1,200 ft. S-SW of Southam #2	45.6	48.3	46.0	**52.6**	**43.4**	**41.4**	**52.9**	**0.3**
NSA #1 (House)	1,250 ft. NE of Southam #3	38.1	47.5	43.1	**49.5**	**42.9**	**40.9**	**50.1**	**0.6**
NSA #1 (House)	925 ft. E-NE of Southam #4	38.1	47.5	43.1	**49.5**	**46.6**	**44.6**	**50.7**	**1.2**
NSA #3 (Houses)	650 ft. N of Zum. #1-36	45.6	48.3	46.0	**52.6**	**50.7**	**48.7**	**54.1**	**1.5**

The noise impact assessment indicates that the L_{dn} sound contribution of service rig operations at NSA #1 and NSA #3 is estimated to range from 40.9 to 48.7 dBA. Because of the potential variability of service rig operations, it is recommended that Central Valley meet with the nearby NSAs prior to service rig set up activities and prior to commencement of activities to explain the project schedule and planned well site activities. It should be noted that service rig activities only occur during daytime hours which should minimize any noise impact associated with service rig activities.

Temporary Compressor Unit

A 1,500 HP compressor unit will be temporarily located at the Well Pad Site for initial storage field injection while the permanent Station is being constructed. The following table depicts the noise impact assessment at the closest NSAs for the temporary compressor unit:

Short Term Noise Impact Assessment – Temporary Compressor Unit

NSAs	Distance/ Direction to Temp. Comp. Unit	Meas'd Ambient Morning L_d (dBA)	Meas'd Ambient Afternoon L_d (dBA)	Meas'd Ambient Nighttime L_{dn}	Calc'd Ambient L_{dn} (dBA)	Est'd L_{eq} of Temp. Comp. Unit at Full Load (dBA)	Calc'd L_{dn} of Temp. Comp. Unit at Full Load (dBA)	Meas'd Ambient L_{dn} + Calc'd L_{dn} of Temp. Comp. Unit (dBA)	Potential Noise Increase (dB)
NSA #1 (House)	1,675 ft. NE	38.1	47.5	43.1	**49.5**	**42.2**	**48.6**	**52.1**	**2.6**
NSA #3 (Houses)	2,000 ft. S-SE	45.6	48.3	46.0	**52.6**	**40.2**	**46.6**	**53.5**	**1.0**

The noise impact analysis indicates that the L_{dn} sound contribution of the proposed temporary compressor unit at NSA #1 and NSA #3 is 48.6 and 46.6 dBA, respectively. Therefore, assuming the recommended noise control measures are followed and successfully implemented, it is our opinion that the sound level attributable to the temporary compressor unit should meet the County noise criteria at the nearby NSAs.

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1.0 INTRODUCTION

In this report, we present the results of an April 27, 2009 ambient sound survey and subsequent noise impact analysis associated with the proposed **Central Valley Natural Gas Storage Project**, a new compressor station (hereinafter "Station") and remote storage wells (hereinafter "Well Pad Site") to be owned and operated by **Central Valley Gas Storage, LLC**. The purpose of the ambient sound survey and acoustical analysis is to:

- Document the existing acoustic environment and locate the noise-sensitive areas (NSAs) around the proposed Station and Well Pad Site.
- Project the sound level contribution that would result from operating the proposed Station.
- Project the sound level contribution that would result from operating a potential temporary compressor unit at the Well Pad Site.
- Project the temporary construction noise for the Station and Well Pad Site.
- Determine noise control measures and noise specifications for the Station and Well Pad Site equipment to insure that the facility meets applicable sound level criteria.

2.0 SOUND CRITERIA

2.1 General

In general, there are two (2) types of ordinances (i.e., codes and/or regulations) that sometimes are employed by federal, state and/or local agencies to regulate and control environmental noise:

(1) A "nuisance-type" noise ordinance in which generating an unreasonably loud, disturbing and unnecessary noise within a specific distance and/or area (e.g., city limits) is prohibited. As such, this type of noise ordinance does not provide quantitative noise emission levels (i.e., permissible sound levels) at specific times and locations.

(2) A "quantitative-type" or "zoning" ordinance in which permissible sound levels at specific distances, specific times and zoned land use areas are given. For quantitative-type noise regulations, the most common metric used for quantifying noise of a facility is the A-weighted (A-wt.) sound level (in dBA). Some state and municipal noise regulations include permissible unweighted octave-band sound pressure levels (SPL in dB) in addition to maximum permissible A-wt. sound levels. There are also other methods and metrics, such as L_{eq} or L_{dn}, which are used to correlate a human reaction to an intruding sound.

For reference, a summary of acoustical terminology and typical metrics used to measure and regulate environmental noise is provided at the end of this report in **Appendix F**, (pp. F-1 to F-3).

2.2 State and Federal Requirements

There are no applicable State or Federal Regulations that are applicable to this facility.

2.3 Colusa County Requirements

Colusa County Noise Element

The Colusa County Noise Element ("Noise Element"), adopted in 1989, addresses environmental noise factors that affect the suitability of land for human use, noting that California Government Code Section 65302(g) states that the *general plan* must include a Noise Element.

The Noise Element contains *recommended noise standards* for Land Use Category per Table SAFE-3: Noise/Land Use Compatibility. Our interpretation of the recommended noise standards is that the most stringent recommendation for the Station and Well Pad Site is that the sound level at the nearby residences (i.e., noise sensitive areas) is *normally acceptable* if the sound level does not exceed 55 dBA L_{dn}. If the Station and Well Pad Site can meet this noise recommendation, the proposed land use for the facility should be acceptable and within the noise policy/recommendations in the Noise Element.

The L_{dn} is an energy average of the daytime L_{eq} (i.e., L_d) and nighttime L_{eq} (i.e., L_n) plus 10 dB. For an essentially steady sound source that operates continuously (e.g., compressor station) over a 24-hour period and controls the environmental sound level, 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** (i.e., A-wt. sound level or L_{eq} as measured with a sound level meter).

Colusa County Code

Chapter 13, NOISE, of the Colusa County Code (hereinafter "Code") limits the noise from a "sound truck" and "sound-amplifying equipment". As defined in the Code, a sound truck "shall mean any motor vehicle, or other vehicle, having mounted thereto, or attached thereto, any sound-amplifying equipment". As defined in the Code, sound-amplifying equipment "shall mean any machine or device for the amplification of the human voice, music, or any other sound.

APPENDIX I, ZONING of the Code contains ORDINANCE NO. 534[1], which is the county's zoning ordinance. Article 8, Development Standards includes the following noise requirements:

Article 8. Development Standards.

Sec. 8.01. General. The following minimum development standards shall apply to all buildings and uses in all zoning districts unless specific development standards of those zones are more restrictive, then the more restrictive standard shall apply.

(a) Noise. Noise generated by the proposed use as measured at the nearest residential zoned property shall not exceed a day-night of 60 dB, or a median hourly noise level of fifty dBA in daytime (seven a.m. to ten p.m.) and forty-five dBA nighttime (ten p.m. to seven a.m.), whichever is more restrictive. If the ambient noise level at the receiving residential property exceeds the applicable standard, the standard shall be increased in one decibel increments to include the ambient noise level.

Summary of Applicable Colusa County Noise Criteria

Mr. Dave Buehler of ICF Jones & Stokes (Central Valley's environmental consultant) has advised H&K that the Article 8 Development Standards in the Colusa County Code are not applicable to the proposed project because none of the land in the project area is zoned for residential use. Per Mr. Dave Buehler of ICF Jones & Stokes, Mr. Kent Johanns (Associate Planner with Colusa County) in a November 2008 discussion regarding applicable noise standards for the proposed project, has advised ICF Jones & Stokes that the 55 L_{dn} noise standard in the County's general plan noise element should be used to evaluate noise impacts from the proposed project.

3.0 DESCRIPTION OF SITE AND PROPOSED COMPRESSOR STATION

3.1 Description of the Site

Figure 1 (p. A-1) depicts the proposed **Station and Well Pad Site** and surrounding area. The Station will provide injection and withdrawal service for the proposed **Central Valley Gas Storage Field**. The proposed facility is located in Colusa County, CA approximately 12 miles north of the City of Colusa.

[1] ORDINANCE NO. 534, AN ORDINANCE OF THE COUNTY OF COLUSA, STATE OF CALIFORNIA ADOPTING ZONING REGULATIONS AND ESTABLISHING LAND USE ZONES AND REGULATIONS FOR THE USE OF LAND AND BUILDINGS IN THE UNINCORPORATED AREAS OF THE COUNTY OF COLUSA.

The surrounding area consists of level terrain, rural farm residences and farmlands. The closest NSA is a rural residence that is approximately 1,900 ft. SE and 1,550 ft. NE of the Station and Well Pad Site, respectively. The Station is also located adjacent to an existing storage facility for old trailers and equipment.

3.2 Description of the Station Equipment

Figure 2 (p. A-2) depicts the proposed Station plot plan. The noise impact analysis assumes that the facility will include three 3,550 HP Cat 3612 engine driven separable compressor units. The following describes auxiliary equipment and other notable items associated with the new station:

- Compressor building for the engine driven separable compressor units
- SCR and oxidation catalyst systems
- Engine inlet air systems
- Engine jacketwater/auxiliary water coolers
- Gas aftercooling
- Aboveground gas piping
- Gas dehydration system and field gas regulators

3.3 Description of the Well Pad Site Equipment

Figure 3 (p. A-3) depicts the proposed Well Pad Site plot plan which is approximately 2,000 ft. S of the Station. The Well Pad Site contains nine new storage wells, an aboveground salt water storage tank and water injection well. A 1,500 HP skid mounted compressor unit will be temporarily located at the Well Pad Site for initial storage field injection while the permanent Station is being constructed.

3.4 Description of Proposed Observation Wells

There are five well locations that are subject to a Service Rig being on site in order to convert existing or previously abandoned wells to storage observations wells. They are: Sara Louise #1, Southam #2, Southam #3, Southam #4 and Zumwalt #1-36 as shown in **Figure 1** (p. A-1) In addition, the CVGS Test Well may also be converted to an observation well. For study purposes this well locaton can be considered equal to Southam #3 as it is only 200 feet south and east of Southam #3.

4.0 MEASUREMENT METHODOLOGY

4.1 Sound Measurement Locations

Three (3) locations were chosen to measure the sound levels near the closest NSAs located around the proposed Station and Well Pad Site and the measurement locations are depicted on **Figure 1**. The following is a description of the NSAs and the selected sound measurement positions:

Pos. 1: Adjacent to NSA #1: A single house located on Southam Road, approximately 1,900 ft. SE of the proposed compressor building and 1,550 ft. NE of the proposed Well Pad Site (i.e. closest new Storage Well).
Pos. 2: Adjacent to NSA #2: A single house located on Paradise Road, approximately 2,400 ft. NE of the proposed compressor building.
Pos. 3: Adjacent to NSA #3: Two houses located on Dodge Road, approximately 1,700 ft. S-SE of the proposed Well Pad Site (i.e., closest new Storage Well).

4.2 Data Acquisition and Sound Measurement Equipment

Ambient sound measurements for the proposed compressor station were performed by Larry Lengyel of H&K on the morning, afternoon and nighttime on April 27, 2009. At the reported sound measurement locations, the A-wt. equivalent sound levels (L_{eq}) and unweighted octave-band sound pressure levels (SPLs) were performed at approximately 5 ft. 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 a 1/2-inch microphone with a windscreen, and the SLM was calibrated within 1 year of the sound test date. The sound measurements at the nearby NSAs attempted to exclude "extraneous sound" such as a car passing immediately by the measurement position and the sound measurements were typically performed during periods of minimum audible traffic noise.

5.0 MEASUREMENT RESULTS

5.1 Measured Sound Level Data

Table A (p. B-1) shows the measured daytime L_{eq} (i.e., L_d) and the measured nighttime L_{eq} (i.e., L_n) along with the average of the measured L_d and L_n since more than one (1) sample of the sound level was measured. In addition, **Table A** includes an estimated day-night average sound level (i.e., L_{dn}), as calculated from the measured L_d and L_n. Meteorological conditions during the tests are summarized in **Table B** (p. B-1). The measured unweighted octave-band SPLs at the reported sound measurement positions and the average of the octave-band SPLs are provided in **Tables C - E** (p. B-2).

The following **Table 2** summarizes the measured morning ambient L_d, measured afternoon ambient L_d, and measured nighttime ambient L_n at the NSAs along with the calculated L_{dn} (as calculated from the measured L_d and L_n).

Meas. Position	NSAs	Distance/Direction to Compressor Building or Well Pad Site	Meas'd Morning L_d (dBA)	Meas'd Afternoon L_d (dBA)	Meas'd Afternoon L_n (dBA)	Calc'd L_{dn} (dBA)
Pos. 1	House (NSA #1)	1,900 ft. SE of Comp. Bldg.	38.1	47.5	43.1	**49.5**
Pos. 2	House (NSA #2)	2,400 ft. NE of Comp. Bldg.	42.3	43.0	39.4	**46.5**
Pos. 3	Houses (NSA #3)	1,700 ft. S-SE of Well Pad Site	45.6	48.3	46.0	**52.6**

Table 2: Summary of the Measured Ambient Sound Levels and the Calculated L_{dn} at the Closest NSAs

It is our opinion that the measured sound level data adequately quantifies the existing ambient sound levels around the site for the meteorological conditions that occurred during the sound survey.

5.2 Observations during the Site Sound Tests

At all the NSAs, daytime audible sounds included mostly distant vehicle traffic noise, wind, distant dogs, distant aircraft, and birds. At all the NSAs, nighttime audible sounds consisted of wind noise.

6.0 NOISE IMPACT EVALUATION – LONG TERM IMPACTS

6.1 Significant Sound Sources

The noise impact evaluation considers the noise produced by all significant sound sources associated with the proposed Station that could impact the sound contribution at the nearby NSAs. A description of the analysis methodology and source of sound data is provided in **Appendix C** (p. C-3). The following sound sources are considered significant:

- Engine-compressor noise that penetrates the compressor building
- Noise of the engine exhausts
- Noise of each engine exhaust piping and SCR/ oxidation catalyst housing
- Noise of the inlet air systems
- Noise of the unitized engine JW/AW coolers (i.e., fin-fan coolers)
- Noise of the unitized gas aftercoolers (i.e., fin-fan coolers)
- Noise radiated by above ground compressor station piping

6.2 Estimated Sound Contribution of Station at Nearby NSAs

Tables F & G (pp. C-1 to C-2) show the calculation (i.e., spreadsheet analysis) of the estimated octave-band SPLs and the A-wt. sound level, at NSA #1 & NSA #2, contributed by the significant noise sources associated with the proposed facilities for standard day propagating conditions (i.e., no wind, 60 deg. F., 70% R.H.). This spreadsheet analysis includes the potential noise reduction due to the anticipated and/or recommended noise control measures for equipment.

6.3 Noise Impact Assessment

Table 3 below depicts the Noise Impact Assessment for the nearby NSAs for the proposed Station:

NSAs	Distance/ Direction to Prop. Comp. Building	Meas'd Ambient Morning L_d (dBA)	Meas'd Ambient Afternoon L_d (dBA)	Meas'd Ambient Nighttime L_{dn}	Calc'd Ambient L_{dn} (dBA)	Est'd L_{eq} of Proposed Central Valley Station at Full Load (dBA)	Calc'd L_{dn} of Proposed Central Valley Station at Full Load (dBA)	Meas'd Ambient L_{dn} + Calc'd L_{dn} of Central Valley Station (dBA)	Potential Noise Increase (dB)
NSA #1 (House)	1,900 ft. SE	38.1	47.5	43.1	**49.5**	**41.7**	**48.1**	**51.8**	**2.3**
NSA #2 (House)	2,400 ft. NE	42.3	43.0	39.4	**46.5**	**39.2**	**45.6**	**49.1**	**2.6**

Table 3: Proposed Central Valley Compressor Station Noise Impact Assessment

As noted above in **Table 3**, the estimated L_{eq} sound contribution of the proposed Station at NSA #1 and NSA #2 is 41.7 and 39.2 dBA, respectively. The calculated L_{dn} sound contribution, via the estimated L_{eq}, of the proposed Station at NSA #1 and NSA #2 is 48.1 and 45.6 dBA, respectively.

6.4 Compressor Unit Blowdowns

The sound levels associated with high pressure gas venting are a function of initial blowdown pressure, the diameter and type of blowdown valve, and the diameter and arrangement of the downstream vent piping. As expected, blowdown sound levels are loudest at the beginning of the blowdown event and they decrease as the blowdown pressure decreases. The following **Table 4** summarizes the expected sound levels for normal blowdown events (i.e., unit start up and shut down) at the closest NSA:

"Normal" Blowdown Sound Source	Closest NSA	Distance / Direction to Proposed Comp. Bldg.	Est'd Initial Sound Level for Blowdown Event (dBA)
Proposed Comp. Units	House (NSA #1)	1,900 ft. SE	44

Table 4: Estimated Initial Sound Levels for "Normal" Blowdown Event

As noted above in **Table 4**, the estimated sound contribution of a normal blowdown event is 44 dBA, noting that normal blowdown noise is a short duration event of approximately 5 minutes.

7.0 NOISE IMPACT EVALUATION – SHORT TERM IMPACTS

Short term noise impacts include the noise of general construction equipment for the Station and Well Pad Site, storage well drill rig noise, service rig noise for the observation wellsites, and the temporary compressor unit to be located at the Well Pad Site.

7.1 Station and Well Pad Site General Construction Noise Impact and Recommendations

The construction activities will be performed with standard heavy equipment, such as track-excavators, backhoes, bulldozers, dump trucks, cement trucks, etc. The most prevalent sound source during construction of the Station and Well Pad Site is anticipated to be the internal combustion engines used to power construction equipment. The sound level impact at NSAs from construction activities is dependent on the type of construction equipment used, the duration of use for each piece of construction equipment, the amount of construction equipment used simultaneously and the distance between the construction equipment and the NSAs. All of these factors are expected to change throughout the construction period, making a quantitative prediction of construction noise problematic.

Construction will be temporary and short-term in nature, and it should be limited to daytime hours. These facts along with the distance between the Station and Well Pad Site and the NSAs, suggest that impacts due to construction noise activities should be minimal. If needed, noise abatement techniques can be implemented during the construction phase to mitigate any construction related noise disturbances to nearby NSAs.

7.2 Drill Rig Noise and Service Rig Noise Impact and Recommendations

Noise Impact Assessment of Drill Rig for Proposed Storage Wells

Nine new storage wells will be drilled at the Well Pad Site. New well drilling will occur 24 hours/day, 7 days a week, and each new well is estimated to take approximately 6-10 days to drill. The estimated sound contribution of the drill rig activities was only performed for NSA #1 and NSA #3 since the sound contribution of the drilling operations at other more distant NSAs typically should be equal to or less than the sound contribution at these NSAs. A description of the acoustical analysis methodology is provided in **Appendix D**.

The following **Table 5** summarizes the noise impact assessment for NSA #1 and NSA #3 during drill rig operations at the new storage wells assuming standard drill rig equipment is employed.

NSAs	Distance/ Direction to Proposed Storage Wells	Meas'd Ambient Morning L_d (dBA)	Meas'd Ambient Afternoon L_d (dBA)	Meas'd Ambient Nighttime L_{dn}	Calc'd Ambient L_{dn} (dBA)	Est'd L_{eq} of Storage Well Drill Rig Noise (dBA)	Calc'd L_{dn} of Storage Well Drill Rig Noise (dBA)	Meas'd Ambient L_{dn} + Est'd L_{dn} of Drill Rig Noise (dBA)	Potential Noise Increase (dB)
NSA #1 (House)	1,550 ft. NE	38.1	47.5	43.1	**49.5**	**44.1**	**50.5**	**53.1**	**3.6**
NSA #3 (Houses)	1,700 ft. S-SE	45.6	48.3	46.0	**52.6**	**43.0**	**49.4**	**54.3**	**1.7**

Table 5: Drill Rig Noise Impact Assessment for Proposed Storage Wells

As noted above in **Table 5**, the estimated L_{eq} sound contribution of drill rig operations at NSA #1 and NSA #3 is 44.1 and 43.0 dBA, respectively. The calculated L_{dn} sound contribution, via the estimated L_{eq}, of drill rig operations at NSA #1 and NSA #3 is 50.5 and 49.4 dBA, respectively. Because of the potential variability of drill rig operations, it is recommended that Central Valley meet with the nearby NSAs prior to drill rig set up activities and prior to commencement of nighttime activities to explain the project schedule and planned well site activities. In the event that noise attributable to drill rig activities becomes objectionable and if it exceeds applicable criteria, Central Valley could offer temporary relocation or compensation as a mitigative measure for this relatively short term noise impact.

Noise Impact Assessment Service Rig for Observation Well Sites

There are five well locations that are subject to a Service Rig being on site in order to convert existing or previously abandoned wells to storage observations wells. Service rig

activities will occur 12 hours/day, 7 days a week, and each well is estimated to take approximately 3-5 days to complete. The estimated sound contribution of the service rig activities was only performed for the closest NSAs since the sound contribution of the service rig operations at other more distant NSAs typically should be equal to or less than the sound contribution at these NSAs. A description of the acoustical analysis methodology is provided in **Appendix D**.

The following **Table 6** summarizes the noise impact assessment for the five well sites during service rig operations at the well sites assuming standard service rig equipment is employed.

NSAs	Distance/ Direction to Closest Service Rig	Meas'd Ambient Morning L_d (dBA)	Meas'd Ambient Afternoon L_d (dBA)	Meas'd Ambient Nighttime L_{dn}	Calc'd Ambient L_{dn} (dBA)	Est'd L_{eq} of Service Rig Noise (dBA)	Calc'd L_{dn} of Service Rig Noise (dBA)	Meas'd Ambient L_{dn} + Est'd L_{dn} of Service Rig Noise (dBA)	Potential Noise Increase (dB)
NSA #3 (Houses)	650 ft. S of SaraLouise #1	45.6	48.3	46.0	**52.6**	**50.7**	**48.7**	**54.1**	**1.5**
NSA #3 (Houses)	1,200 ft. S-SW of Southam #2	45.6	48.3	46.0	**52.6**	**43.4**	**41.4**	**52.9**	**0.3**
NSA #1 (House)	1,250 ft. NE of Southam #3	38.1	47.5	43.1	**49.5**	**42.9**	**40.9**	**50.1**	**0.6**
NSA #1 (House)	925 ft. E-NE of Southam #4	38.1	47.5	43.1	**49.5**	**46.6**	**44.6**	**50.7**	**1.2**
NSA #3 (Houses)	650 ft. N of Zum. #1-36	45.6	48.3	46.0	**52.6**	**50.7**	**48.7**	**54.1**	**1.5**

Table 6: Service Rig Noise Impact Assessment for Existing Wells

As noted above in **Table 6**, the L_{eq} sound contribution of service rig operations at NSA #1 and NSA #3 is estimated to range from 42.9 to 50.7 dBA. The calculated L_{dn} sound contribution, via the estimated L_{eq}, of service rig operations at NSA #1 and NSA #3 is estimated to range from 40.9 to 48.7 dBA. Because of the potential variability of service rig operations, it is recommended that Central Valley meet with the nearby NSAs prior to service rig set up activities and prior to commencement of activities to explain the project schedule and planned well site activities. It should be noted that service rig activities only occur during daytime hours which should minimize any noise impact associated with service rig activities.

7.3 Temporary Well Pad Site Compressor Unit

A 1,500 HP compressor unit will be temporarily located at the Well Pad Site for initial storage field injection while the permanent Station is being constructed. **Table 7** below depicts the Noise Impact Assessment for the nearby NSAs for the temporary

compressor unit and a description of the acoustical analysis methodology is provided in **Appendix E**.

NSAs	Distance/ Direction to Temp. Comp. Unit	Meas'd Ambient Morning L_d (dBA)	Meas'd Ambient Afternoon L_d (dBA)	Meas'd Ambient Nighttime L_{dn}	Calc'd Ambient L_{dn} (dBA)	Est'd L_{eq} of Temp. Comp. Unit at Full Load (dBA)	Calc'd L_{dn} of Temp. Comp. Unit at Full Load (dBA)	Meas'd Ambient L_{dn} + Calc'd L_{dn} of Temp. Comp. Unit (dBA)	Potential Noise Increase (dB)
NSA #1 (House)	1,675 ft. NE	38.1	47.5	43.1	**49.5**	**42.2**	**48.6**	**52.1**	**2.6**
NSA #3 (Houses)	2,000 ft. S-SE	45.6	48.3	46.0	**52.6**	**40.2**	**46.6**	**53.5**	**1.0**

Table 7: Proposed Temporary Compressor Unit Noise Impact Assessment

As noted above in **Table 7**, the estimated L_{eq} sound contribution of the proposed temporary compressor unit at NSA #1 and NSA #3 is 42.2 and 40.2 dBA, respectively. The calculated L_{dn} sound contribution, via the estimated L_{eq}, of the proposed temporary compressor unit at NSA #1 and NSA #3 is 48.6 and 46.6 dBA, respectively.

8.0 NOISE CONTROL REQUIREMENTS – STATION

The following section provides recommended noise control measures and equipment noise specifications along with other assumptions that may affect the noise generated by the facility.

8.1 Compressor Building

Building Structure

- As a minimum, walls/roof should be constructed with exterior steel of 18 gauge and interior layer of 6-inch thick unfaced mineral wool (e.g., 6.0-8.0 pcf uniform density) covered with a 24 gauge perforated liner. Thermal insulation, such as "R-19", should not be used as a substitute for the 6.0-8.0 pcf material.
- Personnel entry doors should have a minimum STC-36 sound rating and could include door glazing if a 2' x 2' maximum view port is employed (e.g., 1/2 inch thick laminated glazing or double pane safety glass). Doors should seal well with the doorframe and be self-closing.
- No windows, skylights or louvers should be installed. No ridge vent shall be permitted.
- All voids and openings in the building walls resulting from penetrations should be patched and well sealed.

- As a minimum, each roll-up door should be a 22 gauge insulated type design (e.g., 22 gauge exterior with a 24 gauge backskin with insulation core) and should be completely weather stripped.

Building Ventilation

- The building ventilation system should be designed to properly ventilate (and cool) the building and equipment during maximum outside ambient temperatures with all personnel and equipment doors closed. Personnel and/or equipment doors should only be opened during maintenance activities.
- The A-wt. sound level for each ventilation inlet should not exceed **50 dBA** at **50 feet** from the building penetration (i.e., inlet louver, acoustic inlet hood, etc.). The A-wt. sound level for each ventilation exhaust outlet should not exceed **50 dBA** at **50 feet** from the building penetration (i.e., exhaust louver, exhaust hood, etc.). Each ventilation inlet and exhaust outlet shall assume that the following sound pressure levels exist inside the compressor building at and adjacent to the ventilation equipment:

SPLs per Octave-Band Center Freq. & A-Wt. Level

31.5	63	125	250	500	1000	2000	4000	8000	dBA
90	98	98	98	100	98	95	95	90	**103**

- The ventilation system inlet and exhaust systems shall be designed to control interior building sound paths from the inlet and exhaust flow paths, interior building sound paths across ventilation system components (i.e., ducting break-in noise, etc.,) and sound that is generated by ventilation equipment (i.e., supply fans, exhaust fans, louvers, tempering coils, etc).

8.2 Engine Exhaust Systems

The exhaust system for the proposed compressor engine should provide the following dynamic insertion loss (DIL) values at the rated operating conditions:

DIL Values in dB per Octave-Band Center Freq. for Exhaust System

31.5	63	125	250	500	1000	2000	4000	8000
22	30	38	44	46	46	44	34	27

The following are other items associated with the exhaust system that should be addressed:

- Exhaust piping (including the mixing tube) located between the building and SCR/oxidation catalyst housing should be completely covered with an acoustical lagging consisting of a heavy-gauge steel jacketing (min. 18 gauge) along with a 3-inch thick inner layer of mineral wool or ceramic fiber insulation (6-8 pcf density).
- The expansion joint/flanges between the mixing tube and SCR/oxidation catalyst housing should be covered with a with a removable/reusable acoustical blanket material. The blanket material typically consists of a core of 2-inch thick needled fiber mat (6.0-8.0 pcf density) and a liner material of mass-loaded vinyl (1.0-1.25 psf surface weight) that is covered with a coated fiberglass cloth. The inner layer of insulation should be covered with a stainless steel mesh instead of coated fiberglass cloth.

8.3 Engine Air Intake Systems

The most effective and recommended method to silence the engine air intake system is to employ an absorptive-type silencer in-line with the air intake piping (i.e., inside the building) with the air intake filter located outside of the building. The following are the recommended DIL values for the "in-line" air intake silencer:

DIL Values in dB per Octave-Band Center Freq. (in Hz) for In-Line Silencer

31.5	63	125	250	500	1000	2000	4000	8000
3	8	14	24	30	30	30	30	20

An example of an "in-line" silencer that could be employed is a Universal Model SU5 Absorptive Silencer. The air intake filter should meet the following DIL values:

DIL Values in dB per Octave-Band Center Freq. (in Hz) for Air Intake Filter

31.5	63	125	250	500	1000	2000	4000	8000
2	4	8	12	15	20	20	20	15

Note: These DIL values are assumed to be typical for an air intake filter.

8.4 Unitized Engine Jacket Water / Auxiliary Water Coolers

The A-wt. sound level of each jacket-water cooler for the proposed compressor unit should not exceed **65 dBA** at a distance of **50 feet** from the unit perimeter at the rated operating conditions (i.e., all fans and motors in operation), which is equivalent to a sound power level (PWL) of approximately **97-98 dBA**. The cooler supplier should provide the A-wt. sound level and the unweighted octave-band SPLs at **50 feet** from the cooler with all fans/motors operating. Nonetheless, the cooler fan tip speed should not exceed 9,000 fpm with V-Belt drive.

8.5 Unitized Gas Aftercoolers

The A-wt. sound level of each gas aftercooler should not exceed **65 dBA** at a distance of **50 feet** from the unit perimeter at the rated operating conditions (i.e., all fans and motors in operation), which is equivalent to a sound power level (PWL) of approximately **97-98 dBA**. The cooler supplier should provide the A-wt. sound level and the unweighted octave-band SPLs at **50 feet** from the cooler with all fans/motors operating. Nonetheless, the cooler fan tip speed should not exceed 9,000 fpm with V-Belt drive.

8.6 Aboveground Gas Piping

The results of our analysis indicate that the aboveground piping should not need to be acoustically insulated.

8.7 Dehydration System

As a minimum, it is assumed that the dehydration system regeneration gas heater will be designed and specified to meet an A-Wt. sound level of **60 dBA** at **50 feet** from the heater perimeter at the rated maximum operating conditions (includes any noise radiated from the heater stack opening). A "low noise" box-type burner assembly shall be utilized.

8.8 Field Gas Regulators

Pressure reducing valves should be capable of meeting a sound level requirement of **85 dBA** (i.e., typically **3 feet** from piping downstream of valve).

8.9 Miscellaneous Equipment

Gas Blowdown Silencers (i.e., unit piping purge/unit blowdown): These silencers should not exceed **60 dBA** at **300 ft**. (as measured 5 ft. above the ground), and to meet this noise goal, the "effective length" of the silencer section for the unit blowdown silencer would typically be 20 feet.

Starting Air / Starting Gas Vent Silencer: It is recommended that these sound sources are silenced to **50 dBA** at **300 ft**. (as measured 5 ft. above the ground).

Fuel Gas Skids: It is recommended that any fuel gas skids be designed with regulators that can achieve **85 dBA** at **3 ft**. for the worst case design conditions (i.e., anticipated maximum pressure drop and flow across the regulator valve).

Station Standby Generator: It is recommended that any standby generator should not exceed **60 dBA** at **100 ft**. from the auxiliary building at rated operating conditions. This sound specification includes, but is not limited to, the following noise sources associated with the generator: (1) noise of the engine-generator that penetrates the auxiliary building, (2) noise of the exterior jacket/auxiliary water cooler, (3) noise of the engine exhaust (hospital/critical grade muffler should be employed), and (4) noise of the air intake system. It is further recommend that this potential noise source and noise control measures be further analyzed when additional information is available during the detailed design phase.

9.0 NOISE CONTROL REQUIREMENTS – TEMPORARY RENTAL COMPRESSOR UNIT

The following section provides recommended noise control measures and equipment noise specifications along with other assumptions that may affect the noise generated by the temporary rental compressor unit.

9.1 Partial Enclosure or Partial Barrier

A partial enclosure (i.e., Wildcat Building) may be utilized to reduce the temporary compressor unit noise to the adjacent NSAs. A Wildcat Building generally encloses the entire package and the engine driven cooler air enters through right angle passages and exhausts through the building roof.

Alternatively, a three sided absorptive barrier could possibly be utilized, noting that additional information on the proposed rental unit as well as package orientation is required for a final determination. Although there are several types of barrier materials that could be employed, the barrier system could be constructed of a Type LSE Noise Barrier Wall System, as fabricated/supplied by Sound Fighter Systems. This type of noise barrier could be the most cost effective system and it is designed with a 100% sound-absorbing interior surface (i.e., barrier surface that faces the compressor equipment). In order for the barrier to be effective, it is necessary that it is located in close proximity to the noise producing equipment. The Sound Fighter barrier system also includes options for single and double personnel doors that can be incorporated into the barrier layout as desired. Individual sections of the Sound Fighter barrier system can be removed to facilitate major maintenance if necessary.

As an alternative, the barrier system could be constructed with a 4-inch thick metal panel system designed with a sound-absorptive surface that faces the equipment. For example, the metal panels could be fabricated with a 12 or 14-ga. galvanized steel outer shell and an insulating fill (e.g., 8.0 pcf mineral wool) covered with a 22-ga. perforated galvanized steel interior liner.

9.2 Engine Exhaust System

The exhaust system for the proposed compressor engine should include a muffler system that provides the following dynamic insertion loss (DIL) values at the rated operating conditions:

DIL Values in dB per Octave-Band Center Freq. for Exhaust Muffler System

31.5	63	125	250	500	1000	2000	4000	8000
12	18	22	26	30	30	30	30	22

The exhaust muffler shall include 3 chambers.

9.3 Engine Air Intake System

A standard engine mounted air inlet filter may be utilized.

9.4 Engine Driven Vertical JW/AW/Gas Aftercooler

The A-wt. sound level of each of the engine driven vertical cooler should not exceed **66 dBA** at a distance of **50 feet** from the cooler at the rated operating conditions, which is equivalent to a sound power level (PWL) of approximately **98-99 dBA**. The cooler fan tip speed would not be expected to exceed 9,500 fpm to meet this noise requirement.

10.0 FINAL COMMENT

Long Term Impacts - Station

The results of our measurements, observations and analysis indicate that the L_{dn} sound contribution of the proposed Station at NSA #1 and NSA #2 is 48.1 and 45.6 dBA, respectively. Therefore, assuming the recommended noise control measures are followed and successfully implemented, it is our opinion that the sound level attributable to the proposed Station should meet the County noise criteria at the nearby NSAs.

Short Term Impacts - Station and Well Pad Site General Construction

Construction will be temporary and short-term in nature, and it should be limited to daytime hours. These facts along with the distance between the Station and Well Pad Site and the NSAs, suggest that impacts due to construction noise activities should be minimal. If needed, noise abatement techniques can be implemented during the construction phase to mitigate any construction related noise disturbances to nearby NSAs.

Short Term Impacts – Drill Rig and Service Rig Activities

The noise impact analylsis indicates that the L_{dn} sound contribution of drill rig operations at NSA #1 and NSA #3 is 50.5 and 49.4 dBA, respectively. Because of the potential variability of drill rig operations, it is recommended that Central Valley meet with the nearby NSAs prior to drill rig set up activities and prior to commencement of nighttime activities to explain the project schedule and planned well site activities. In the event that noise attributable to drill rig activities becomes objectionable and if it exceeds applicable criteria, Central Valley could offer temporary relocation or compensation as a mitigation measure for this relatively short term impact.

The noise impact assessment indicates that the L_{dn} sound contribution of service rig operations at NSA #1 and NSA #3 is estimated to range from 40.9 to 48.7 dBA. Because of the potential variability of service rig operations, it is recommended that Central Valley meet with the nearby NSAs prior to service rig set up activities and prior to commencement of activities to explain the project schedule and planned well site activities. It should be noted that service rig activities only occur during daytime hours which should minimize any noise impact associated with service rig activities.

Short Term Impacts – Temporary Compressor Unit

The noise impact analysis indicates that the L_{dn} sound contribution of the proposed temporary compressor unit at NSA #1 and NSA #3 is 48.6 and 46.6 dBA, respectively. Therefore, assuming the recommended noise control measures are followed and successfully implemented, it is our opinion that the sound level attributable to the temporary compressor unit should meet the County noise criteria at the nearby NSAs.

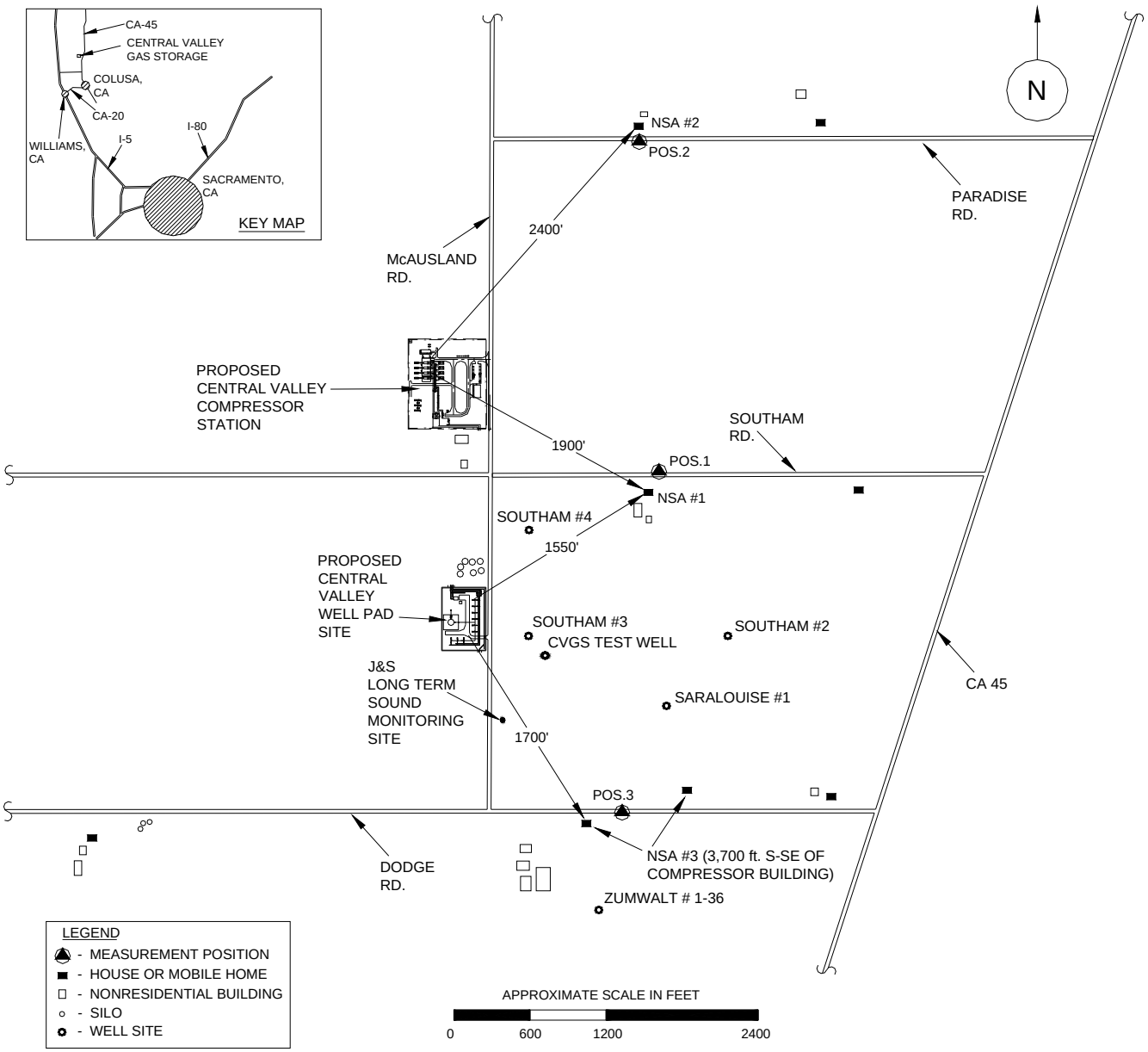

Figure 1: **Proposed Central Valley Gas Storage Compressor Station and Remote Well Pad Site and Surrounding Area**

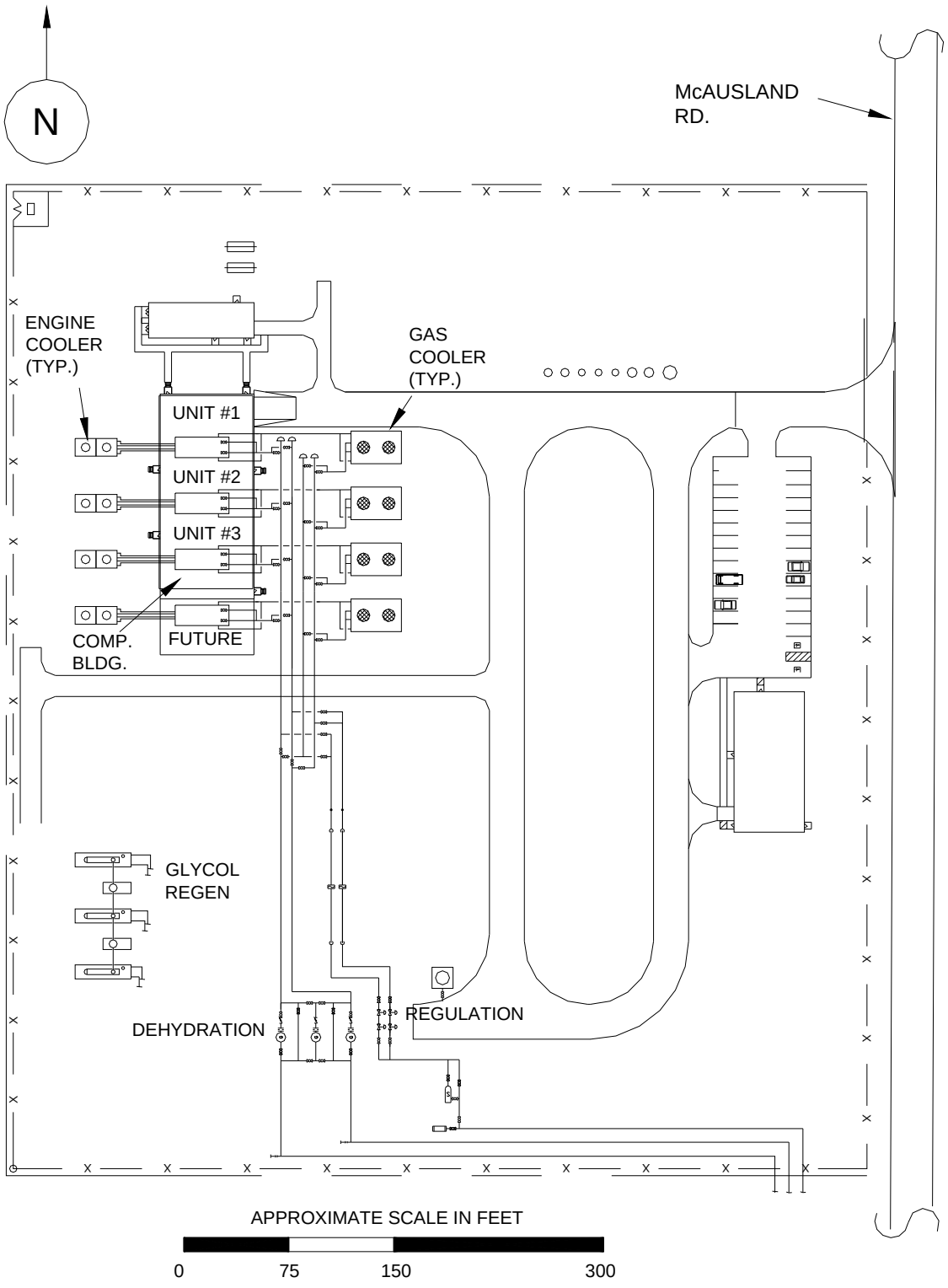

Figure 2: **Proposed Central Valley Gas Storage Compressor Station Plot Plan**

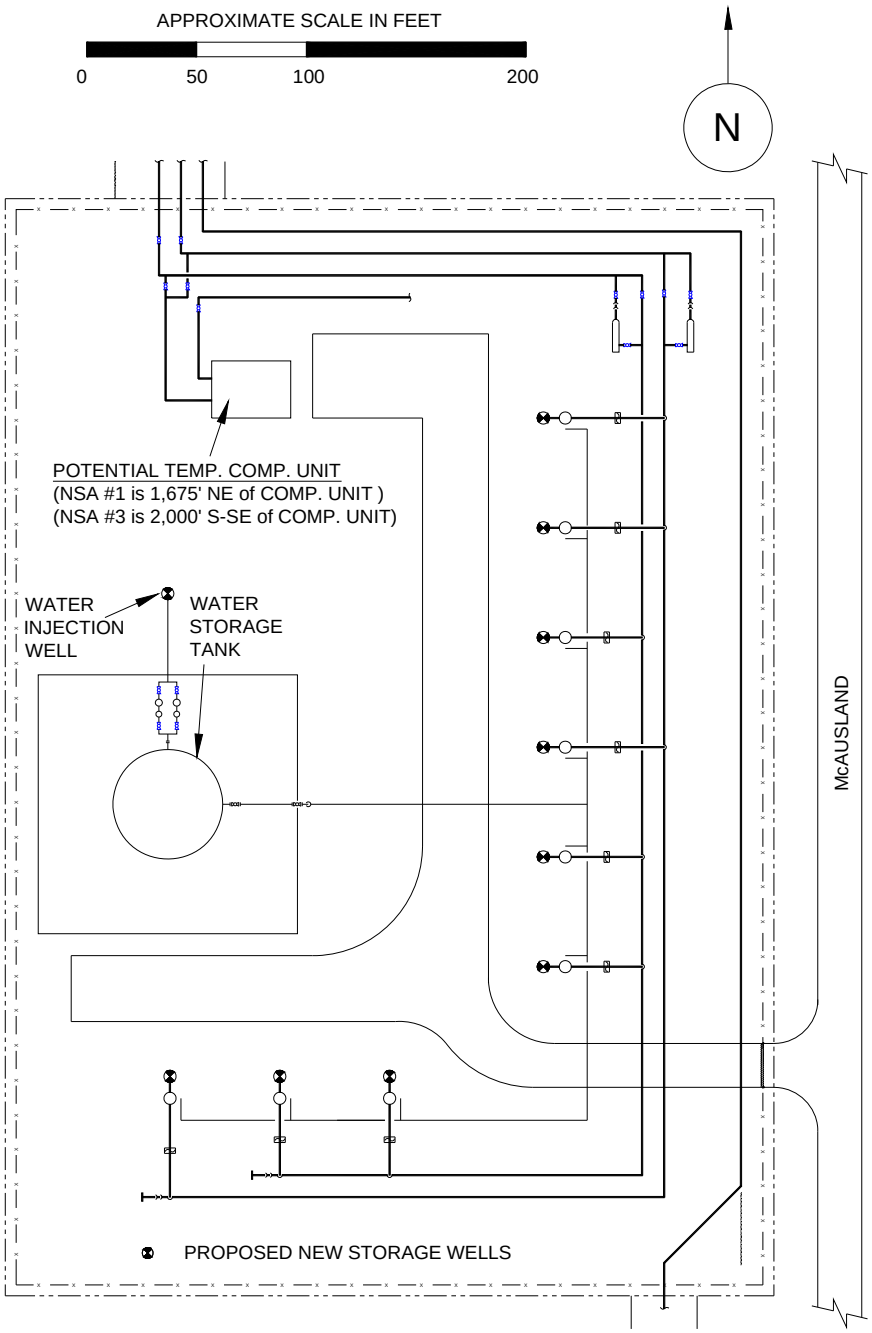

Figure 3: **Proposed Central Valley Gas Storage Well Pad Site Plot Plan**

Measurement Set		Measured A-Wt. Sound Levels (dBA)					
		D-time	Avg'd	N-time	Avg'd	Calc'd	
Position	**Time of Test**	Leq(Ld)	Ld	Leq(Ln)	Ln	Ldn	**Notes/Observations**
Pos. 1: House	11:30 AM	36.3					Daytime: Mostly distant vehicle traffic noise, wind,
on Southam Rd., approx.	11:31 AM	38.0					distant dogs, distant aircraft, and birds.
1,900 ft. SE of	11:32 AM	40.1					Nighttime: wind
Compressor Building	3:31 PM	46.9					
	3:32 PM	47.9					
	3:33 PM	47.7	**42.8**				
	11:37 PM			48.5			
	11:38 PM			40.9			
	11:39 PM			40.1	**43.1**	**49.5**	
Pos. 2: House	11:37 AM	43.6					Daytime: Mostly distant vehicle traffic noise, wind,
on Paradise Rd., approx.	11:38 AM	41.1					distant dogs, distant aircraft, and birds.
2,400 ft. NE of	11:39 AM	42.8					Nighttime: wind
Compressor Building	3:40 PM	42.4					
	3:42 PM	42.5					
	3:43 PM	44.4	**42.8**				
	11:44 PM			42.3			
	11:45 PM			38.2			
	11:51 PM			38.5	**39.4**	**46.5**	
Pos. 3: Houses	11:13 AM	46.1					Daytime: Mostly distant vehicle traffic noise, wind,
on Dodge Rd., approx.	11:14 AM	46.1					distant dogs, distant aircraft, and birds.
1,700 ft. S-SE of	11:15 AM	45.5					Nighttime: wind
Well Pad Site	3:09 PM	47.8					
	3:10 PM	50.2					
	3:12 PM	47.2	**47.1**				
	11:17 PM			44.4			
	11:18 PM			46.5			
	11:19 PM			47.2	**46.0**	**52.6**	

Table A: **Central Valley Gas Storage: Summary of the Daytime Ambient Sound Levels and Nighttime Ambient Sound Levels as Measued on April 27, 2009 along with the Calc'd Ambient Ldn, as Calculated from the Meas'd Ld and Meas'd Ln**

Note: Ldn is calculated using the following formula:

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

Measurement Set		Temp.	R.H.	Wind	Wind	Peak	
Position	**Date/Time of Testing**	**(°F)**	**(%)**	**Direction**	**Speed**	**Wind**	**Sky Conditions**
Pos. 1 - 3	11:00 AM - 3:55 PM (4/27/07)	45 - 69	60 - 70	Wind from the	4 - 6	12	Partly Cloudy morning
	Daytime (Morning &Afternoon)			South/SE	mph	mph	Overcast afternoon
Pos. 1 - 3	11:00 PM - 11:55 PM (4/27/09)	48 - 51	72	Wind from the	6	6 - 8	Overcast (mostly cloudy)
	Nighttime (Before Midniight)			South/SE	mph	mph	

Table B: **Central Valley Gas Storage: Meteorological Conditions During the Daytime and Nighttime Sound Measurements around the Proposed Site on April 27, 2009**

Measurement Set		Sound Pressure Level (SPL) in dB per Octave-Band Frequency (in Hz)									A-Wt.
Position	Time of Test	31.5	63	125	250	500	1000	2000	4000	8000	Level
Pos. 1: House	11:30 AM	50.9	45.4	38.0	29.9	32.7	33.2	26.4	23.9	17.3	36.3
on Southam Rd., approx.	11:31 AM	49.5	42.9	36.8	32.8	35.3	34.2	28.1	27.6	18.6	38.0
1,900 ft. SE of	11:32 AM	49.4	41.9	38.4	35.3	37.7	37.3	28.9	23.0	17.4	40.1
Compressor Building	**Average SPL**	**49.9**	**43.4**	**37.7**	**32.7**	**35.2**	**34.9**	**27.8**	**24.8**	**17.8**	**38.1**
Pos. 2: House	11:37 AM	55.3	48.5	48.9	38.2	39.2	39.6	32.7	35.4	20.7	43.6
on Paradise Rd., approx.	11:38 AM	59.2	48.1	44.8	39.4	40.6	33.4	28.4	31.8	23.4	41.1
2,400 ft. NE of	11:39 AM	58.6	48.6	45.3	40.6	40.8	38.3	30.1	32.8	21.4	42.8
Compressor Building	**Average SPL**	**57.7**	**48.4**	**46.3**	**39.4**	**40.2**	**37.1**	**30.4**	**33.3**	**21.8**	**42.3**
Pos. 3: Houses	11:13 AM	55.6	54.0	54.1	44.8	39.5	37.8	38.3	38.8	31.2	46.1
on Dodge Rd., approx.	11:14 AM	53.8	55.4	51.3	42.8	34.6	36.9	41.1	38.3	35.7	46.1
1,700 ft. S-SE of	11:15 AM	53.5	53.4	47.2	41.6	32.5	34.8	39.8	40.1	35.3	45.5
Well Pad Site	**Average SPL**	**54.3**	**54.3**	**50.9**	**43.1**	**35.5**	**36.5**	**39.7**	**39.1**	**34.1**	**45.6**

Table C: **Central Valley Gas Storage: Meas'd Morning Ambient A-Wt. Sound Levels and Unweighted O.B. SPLs as Meas'd on April 27, 2009 during the Ambient Sound Survey**

Measurement Set		Sound Pressure Level (SPL) in dB per Octave-Band Frequency (in Hz)									A-Wt.
Position	Time of Test	31.5	63	125	250	500	1000	2000	4000	8000	Level
Pos. 1: House	3:31 PM	59.8	54.0	50.8	45.4	43.7	39.4	38.3	37.9	37.6	46.9
on Southam Rd., approx.	3:32 PM	63.7	55.1	50.0	46.0	44.6	40.6	39.8	38.9	37.8	47.9
1,900 ft. SE of	3:33 PM	64.9	56.4	50.8	46.6	43.9	40.7	39.6	38.4	37.2	47.7
Compressor Building	**Average SPL**	**62.8**	**55.2**	**50.5**	**46.0**	**44.1**	**40.2**	**39.2**	**38.4**	**37.5**	**47.5**
Pos. 2: House	3:40 PM	59.5	53.4	48.4	43.1	38.7	36.3	32.0	30.1	31.1	42.4
on Paradise Rd., approx.	3:42 PM	57.9	51.6	46.9	41.2	37.3	38.0	34.1	31.5	29.0	42.5
2,400 ft. NE of	3:43 PM	59.8	54.9	50.0	47.3	40.7	38.1	33.7	30.3	29.5	44.4
Compressor Building	**Average SPL**	**59.1**	**53.3**	**48.4**	**43.9**	**38.9**	**37.5**	**33.3**	**30.6**	**29.9**	**43.0**
Pos. 3: Houses	3:09 PM	62.0	55.5	45.5	39.8	39.5	42.0	44.2	34.0	25.5	47.8
on Dodge Rd., approx.	3:10 PM	56.3	58.5	49.2	46.5	44.2	44.7	45.4	38.1	25.7	50.2
1,700 ft. S-SE of	3:12 PM	59.5	52.0	46.5	40.7	39.9	42.8	42.4	34.7	25.9	47.2
Well Pad Site	**Average SPL**	**59.3**	**55.3**	**47.1**	**42.3**	**41.2**	**43.2**	**44.0**	**35.6**	**25.7**	**48.3**

Table D: **Central Valley Gas Storage: Meas'd Afternoon Ambient A-Wt. Sound Levels and Unweighted O.B. SPLs as Meas'd on April 27, 2009 during the Ambient Sound Survey**

Measurement Set		Sound Pressure Level (SPL) in dB per Octave-Band Frequency (in Hz)									A-Wt.
Position	Time of Test	31.5	63	125	250	500	1000	2000	4000	8000	Level
Pos. 1: House	11:37 PM	67.6	60.2	50.7	46.6	48.1	41.7	38.8	32.2	24.7	48.5
on Southam Rd., approx.	11:38 PM	53.1	52.4	42.3	39.9	40.4	34.4	30.0	26.7	22.4	40.9
1,900 ft. SE of	11:39 PM	53.4	52.4	43.6	39.7	38.2	34.4	30.1	26.3	21.9	40.1
Compressor Building	**Average SPL**	**58.0**	**55.0**	**45.5**	**42.1**	**42.2**	**36.8**	**33.0**	**28.4**	**23.0**	**43.1**
Pos. 2: House	11:44 PM	55.7	52.6	56.6	39.6	33.2	31.7	27.9	25.6	19.3	42.3
on Paradise Rd., approx.	11:45 PM	55.1	49.3	50.2	39.6	32.5	30.6	24.2	21.1	17.9	38.2
2,400 ft. NE of	11:51 PM	54.6	49.2	49.5	40.9	32.9	31.4	25.0	21.4	19.0	38.5
Compressor Building	**Average SPL**	**55.1**	**50.4**	**52.1**	**40.0**	**32.9**	**31.2**	**25.7**	**22.7**	**18.7**	**39.4**
Pos. 3: Houses	11:17 PM	65.4	58.0	51.8	46.6	42.3	37.0	31.5	24.1	18.1	44.4
on Dodge Rd., approx.	11:18 PM	61.2	56.7	53.4	48.0	45.1	39.6	34.6	27.9	21.6	46.5
1,700 ft. S-SE of	11:19 PM	64.3	57.1	54.0	48.7	45.5	40.1	35.8	30.8	30.5	47.2
Well Pad Site	**Average SPL**	**63.6**	**57.3**	**53.1**	**47.8**	**44.3**	**38.9**	**34.0**	**27.6**	**23.4**	**46.0**

Table E: **Central Valley Gas Storage: Meas'd Nighttime Ambient A-Wt. Sound Levels and Unweighted O.B. SPLs as Meas'd on April 27, 2009 during the Ambient Sound Survey**

Source No. & Dist (Ft)	SOURCE PWL & EST'D. SOUND LEVEL CONTRIBUTIONS AT SPEC. DISTANCE	PWL or SPL in dB Per Octave-Band Center Freq. (Hz) 31.5	63	125	250	500	1000	2000	4000	8000	A-Wt. Level	
1)	PWL of Eng.-Comp. Casing Noise	119	122	120	121	120	119	117	115	113	124	
	PWL of Eng.-Comp. Casing Noise (3 units)	124	127	125	126	125	124	122	120	118	129	
	NR of Noise Control (18 gage)	-8	-14	-20	-28	-38	-45	-45	-45	-45		
	Misc. Atten.	0	0	0	0	0	0	0	0	0		
1900	Hemispherical Radiation	-63	-63	-63	-63	-63	-63	-63	-63	-63		
	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-1	-3	-6	-14	-26		
	Source Sound Level Contribution	52	49	41	33	22	12	8	0	0	30	
2)	PWL of Exhaust Noise	125	133	137	131	127	129	129	117	105	134	
	PWL of Exhaust Noise (3 units)	130	138	142	136	132	134	134	122	110	138	
	Atten of Exhaust System	-20	-28	-36	-42	-44	-44	-42	-32	-25		
	Misc. Atten.	0	0	0	0	0	0	0	0	0		
1900	Hemispherical Radiation	-63	-63	-63	-63	-63	-63	-63	-63	-63		
	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-1	-3	-6	-14	-26		
	Source Sound Level Contribution	46	46	42	29	23	23	23	12	0	31	
3)	PWL of Exh. Piping, SCR & Muffler Body	105	103	101	99	96	97	95	93	82	102	
	PWL of Exh. Piping, SCR & Muffler (3 units)	110	108	106	104	101	102	100	98	87	106	
	NR of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten.	3	2	1	-2	-4	-6	-6	-6	-6		
1900	Hemispherical Radiation	-63	-63	-63	-63	-63	-63	-63	-63	-63		
	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-1	-3	-6	-14	-26		
	Source Sound Level Contribution	49	46	43	37	32	29	25	14	0	35	
4)	PWL of Int. Noise w/ Cat "Standard" filter	89	85	83	83	84	85	86	95	86	97	
	PWL of Int. Noise w/ stand. filter (3 units)	94	90	88	88	89	90	91	100	91	102	
	Atten of Air Intake Silencer	-2	-8	-14	-20	-28	-30	-30	-25	-15		
	Misc. Atten.	0	0	0	0	0	0	0	0	0		
1900	Hemispherical Radiation	-63	-63	-63	-63	-63	-63	-63	-63	-63		
	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-1	-3	-6	-14	-26		
	Source Sound Level Contribution	28	18	10	3	0	0	0	0	0	7	
5)	PWL of Eng. JW/AW Cooler	108	106	100	96	93	90	88	86	83	96	
	PWL of Eng. JW/AW Cooler (3 units)	113	111	105	101	98	95	93	91	88	101	
	NR of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten.	0	0	0	0	0	0	0	0	0		
1900	Hemispherical Radiation	-63	-63	-63	-63	-63	-63	-63	-63	-63		
	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-1	-3	-6	-14	-26		
	Source Sound Level Contribution	49	47	41	36	33	28	24	13	0	35	
6)	PWL of Aftercooler	108	106	100	96	93	90	88	86	83	96	
	PWL of Aftercoolers (3 units)	113	111	105	101	98	95	93	91	88	101	
	NR of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten.	0	0	0	0	0	0	0	0	0		
1900	Hemispherical Radiation	-63	-63	-63	-63	-63	-63	-63	-63	-63		
	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-1	-3	-6	-14	-26		
	Source Sound Level Contribution	49	47	41	36	33	28	24	13	0	35	
7)	PWL of Gas Piping	103	105	103	98	92	90	87	82	79	96	
	PWL of Gas Piping (3 units)	108	110	108	103	97	95	92	87	84	101	
	NR of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten.	0	0	0	0	0	0	0	0	0		
1900	Hemispherical Radiation	-63	-63	-63	-63	-63	-63	-63	-63	-63		
	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-1	-3	-6	-14	-26		Calc'd
	Source Sound Level Contribution	44	46	44	38	32	28	23	9	0	35	Ldn
Est'd Total Contribution of Proposed Comp. Units		**57**	**55**	**50**	**44**	**39**	**35**	**30**	**19**	**8**	**41.7**	**48.1**

General Note: DIL, NR and PWL values on this spreadsheet should not be used as the specified values. Refer to the "Noise Control Measures" in the report or other company specifications for the actual specified PWL of equip., noise reduction (NR) of pipe lagging or building construction, and DIL values of silencers assoc. with the prop. equipment.

Table F: Estimated Sound Contribution of Proposed Compressor Station at NSA #1

Source No. & Dist (Ft)	SOURCE PWL & EST'D. SOUND LEVEL CONTRIBUTIONS AT SPEC. DISTANCE	PWL or SPL in dB Per Octave-Band Center Freq. (Hz) 31.5	63	125	250	500	1000	2000	4000	8000	A-Wt. Level	
1)	PWL of Eng.-Comp. Casing Noise	119	122	120	121	120	119	117	115	113	124	
	PWL of Eng.-Comp. Casing Noise (3 units)	124	127	125	126	125	124	122	120	118	129	
	NR of Noise Control (18 gage)	-8	-14	-20	-28	-38	-45	-45	-45	-45		
	Misc. Atten.	0	0	0	0	0	0	0	0	0		
2400	Hemispherical Radiation	-65	-65	-65	-65	-65	-65	-65	-65	-65		
	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-2	-4	-7	-18	-33		
	Source Sound Level Contribution	50	47	39	31	20	10	4	0	0	27	
2)	PWL of Exhaust Noise	125	133	137	131	127	129	129	117	105	134	
	PWL of Exhaust Noise (3 units)	130	138	142	136	132	134	134	122	110	138	
	Atten of Exhaust System	-20	-28	-36	-42	-44	-44	-42	-32	-25		
	Misc. Atten.	0	0	0	0	0	0	0	0	0		
2400	Hemispherical Radiation	-65	-65	-65	-65	-65	-65	-65	-65	-65		
	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-2	-4	-7	-18	-33		
	Source Sound Level Contribution	44	44	40	27	21	21	19	6	0	28	
3)	PWL of Exh. Piping, SCR & Muffler Body	105	103	101	99	96	97	95	93	82	102	
	PWL of Exh. Piping, SCR & Muffler (3 units)	110	108	106	104	101	102	100	98	87	106	
	NR of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten.	3	2	1	-2	-4	-6	-6	-6	-6		
2400	Hemispherical Radiation	-65	-65	-65	-65	-65	-65	-65	-65	-65		
	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-2	-4	-7	-18	-33		
	Source Sound Level Contribution	47	44	41	35	30	27	21	8	0	33	
4)	PWL of Int. Noise w/ Cat "Standard" filter	89	85	83	83	84	85	86	95	86	97	
	PWL of Int. Noise w/ stand. filter (3 units)	94	90	88	88	89	90	91	100	91	102	
	Atten of Air Intake Silencer	-2	-8	-14	-20	-28	-30	-30	-25	-15		
	Misc. Atten.	0	0	0	0	0	0	0	0	0		
2400	Hemispherical Radiation	-65	-65	-65	-65	-65	-65	-65	-65	-65		
	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-2	-4	-7	-18	-33		
	Source Sound Level Contribution	26	16	8	1	0	0	0	0	0	7	
5)	PWL of Eng. JW/AW Cooler	108	106	100	96	93	90	88	86	83	96	
	PWL of Eng. JW/AW Cooler (3 units)	113	111	105	101	98	95	93	91	88	101	
	NR of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten.	0	0	0	0	0	0	0	0	0		
2400	Hemispherical Radiation	-65	-65	-65	-65	-65	-65	-65	-65	-65		
	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-2	-4	-7	-18	-33		
	Source Sound Level Contribution	47	45	39	34	31	26	20	7	0	32	
6)	PWL of Aftercooler	108	106	100	96	93	90	88	86	83	96	
	PWL of Aftercoolers (3 units)	113	111	105	101	98	95	93	91	88	101	
	NR of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten.	0	0	0	0	0	0	0	0	0		
2400	Hemispherical Radiation	-65	-65	-65	-65	-65	-65	-65	-65	-65		
	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-2	-4	-7	-18	-33		
	Source Sound Level Contribution	47	45	39	34	31	26	20	7	0	32	
7)	PWL of Gas Piping	103	105	103	98	92	90	87	82	79	96	
	PWL of Gas Piping (3 units)	108	110	108	103	97	95	92	87	84	101	
	NR of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten.	0	0	0	0	0	0	0	0	0		
2400	Hemispherical Radiation	-65	-65	-65	-65	-65	-65	-65	-65	-65		
	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-2	-4	-7	-18	-33		Calc'd
	Source Sound Level Contribution	42	44	42	36	30	26	19	3	0	33	Ldn
Est'd Total Contribution of Proposed Comp. Units		**55**	**53**	**48**	**42**	**36**	**32**	**27**	**14**	**8**	**39.2**	**45.6**

General Note: DIL, NR and PWL values on this spreadsheet should not be used as the specified values. Refer to the "Noise Control Measures" in the report or other company specifications for the actual specified PWL of equip., noise reduction (NR) of pipe lagging or building construction, and DIL values of silencers assoc. with the prop. equipment.

Table G: Estimated Sound Contribution of Proposed Compressor Station at NSA #2

DESCRIPTION OF THE ANALYSIS METHODOLOGY AND THE SOURCE OF SOUND DATA

ANALYSIS METHODOLOGY

In general, the predicted sound level contributed by the facility was calculated as a function of frequency from estimated octave-band sound power levels (PWLs) for each significant sound source associated with the proposed compressor station equipment. The following summarizes the analysis procedure:

- Initially, unweighted octave-band PWLs for each noise source (without noise control) were determined from actual sound measurements performed by H&K on similar equipment and/or obtained from the equipment manufacturer.
- Then, expected noise reductions in dB per octave-band frequency due to any designated noise control measures for each source were subtracted from the estimated PWL.
- Next, octave-band SPLs for each source (with noise control) were determined by compensating for sound attenuation due to propagation (hemispherical radiation) and atmospheric sound absorption.
- 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. Effects of vegetation or land contour were typically not considered in this analysis.
- Finally, the estimated octave-band SPLs for each source (with noise control and other sound attenuation effects) were corrected for A-weighting, and the total SPLs of all sound sources were logarithmically summed and corrected for A-weighting to provide the estimated A-wt. sound level contributed at the specified distance(s) by the proposed facility.

SOURCE OF SOUND DATA

The following describes the source of sound data for estimating the source sound levels and source PWLs used in the noise impact analysis. Note that equipment noise levels and acoustical performance of mufflers/silencers utilized in the acoustical analysis (i.e., spreadsheet analysis) are generally higher than the sound level requirement for the new equipment to insure that the design incorporates an acoustical “margin of safety.”

- Engine exhaust PWL values were calculated from sound data recently measured in the field by H&K on a similar unit. The DIL values for the exhaust muffler system utilized in the acoustical analysis are generally lower than the recommended values in order that the noise design analysis incorporates an acoustical “margin of safety”.
- The estimated PWL values of equipment inside the building (i.e., engine-driven compressor and equipment) were calculated from sound data measured by H&K on a similar compressor installation.
- The estimated PWL values of the outdoor aboveground gas piping were determined from sound measurements by H&K on gas piping similar to that of the proposed compressor installation.
- The estimated PWL values for engine jacket water/auxiliary water cooler and gas aftercooler were designated to meet the design noise goal. The noise level for the coolers used in the acoustical analysis is generally higher than the sound level requirement in order that the noise design analysis incorporates an acoustical “margin of safety.”
- The estimated PWL for the engine air intake were calculated from measured sound data in the field tests by H&K on similar engines.

DESCRIPTION OF ANALYSIS METHODOLOGY AND SPREADSHEET ANALYSES FOR WELL SITES

Brief Description of the Drill Rig Equipment for New Storage Wells

The following describes typical primary equipment and other items (e.g., potential noise sources) associated with the drill rig. New well drilling will occur 24 hours/day, 7 days a week, and each new well is estimated to take approximately 6-10 days to drill.

- Drawworks: Cooper LTO-550 double drum hoist powered by a 450 HP diesel engine
- Derrick: 104' x 260,000 lb. capacity
- Triplex positive displacement plunger pumps (e.g., 500 HP diesel engines)
- Engine-driven electric generator set (e.g., CAT 300 HP)
- Mud mixing/cleaning equipment (e.g., 50 HP centrifugal pumps) and water pump
- Fluid systems shale shakers (associated with the mud mixing/cleaning equipment)
- Crane(s), dozer, (CAT D7G), loader(s), backhoe and/or forklift
- Engine-driven light plants (i.e., used for nighttime operation)

Brief Description of the Service Rig Equipment for Proposed Observation Wells

The following describes typical primary equipment and other items (e.g., potential noise sources) associated with the service rig. Service rig operations will occur 12 hours/day, 7 days a week, and the service rig operations for each observation well is estimated to take approximately 3-5 days. In general, the service rig for the the proposed observation wells is smaller than the drill rig that is required for the new storage wells.

- Derrick/drawworks with associated power swivel unit
- Duplex positive displacement plunger pumps (e.g., 200-300 HP diesel engines)
- Engine-driven electric generator set(s)
- Mud tank with miscellaneous motor-driven pumps
- Backhoe, dozer, and forklift

Description of Noise Assessment Methodology and Source of Sound Data

In general, the predicted sound level contributed by drilling operations at each new well site and service rig operations at the proposed observation well sites was calculated as a function of frequency from estimated unweighted octave-band sound power levels (PWLs) and A-wt. PWL of the respective drilling operations. The following summarizes the acoustical analysis procedure:

- Initially, unweighted octave-band PWLs of the specific drill rig or service rig were determined from actual sound level measurements on a similar type of equipment.
- Then, expected attenuation in dB per O.B. frequency due to hemispherical sound propagation, atmospheric sound absorption and attenuation due to foliage (if appropriate) were subtracted from the

unweighted O.B. PWLs to obtain the unweighted O.B. sound pressure levels (SPLs) of the drilling operations.

- Finally, the resulting estimated unweighted octave-band SPLs for the drill rig or service rig operations, including sound attenuation effects, were corrected for A-weighting, and the total octave-band SPLs of the operations were logarithmically summed and corrected for A-weighting to provide the estimated overall A-wt. sound level contributed by the operations at the specified distance(s).
- If the resulting sound level without additional noise control measures (i.e., barrier) were greater than applicable criteria, the noise reduction of noise control was applied to determine the sound of drill rig and/or service rig with additional noise control measures.
- Drill Rig operations are to be continuous (i.e., 24 hours/day), and the L_{dn} contribution of the Drill Rig activities is approximately 6.4 dB above the sound level contribution of Drill Rig Activities. Service Rig operations are to limited to daytime hours (i.e., 15 hours/day or less); and the L_{dn} contribution of Service Rig activities due is approximately 2.0 dB below the sound level contribution of Service Rig Activities.

Estimated Sound Level Contribution of Peak Drill Rig Activities at NSA #1 and NSA #3

NSA #1 and NSA #3 are approximately 1,550 ft. NE and 1,700 ft. S-SE of the center of the Well Pad Site, respectively, where the nine new storage wells are to be located. The following **Tables H & I** depict the estimated sound level contribution at NSA #1 and NSA #3 for drill rig activities for the new storage wells at the Well Pad Site:

Dist (Ft) or	SOURCE PWL & EST'D SOURCE SOUND	SPL or PWL in dB Per Octave-Band Center Freq. (Hz)									A-Wt.	Calc'd
Calculation	CONTRIBUTIONS AT SPECIFIED DISTANCE	31.5	63	125	250	500	1000	2000	4000	8000	Level	Ldn
	Peak PWL of Drill Rig	122	118	114	104	104	105	106	102	98	111	
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
1550	Hemispherical Radiation	-62	-62	-62	-62	-62	-62	-62	-62	-62		
1550	Atm. Absorption (70% R.H., 60 deg F)	0	0	-1	-1	-2	-4	-9	-16	-23		
Est'd Total Sound Contribution w/No Additional NC		**60**	**56**	**52**	**41**	**40**	**40**	**35**	**25**	**13**	**44.1**	**50.5**
	Atten. Of Additional Noise Control	0	0	0	0	0	0	0	0	0		
Est'd Total Sound Contribution w/o additional Noise Control		**60**	**56**	**52**	**41**	**40**	**40**	**35**	**25**	**13**	**44.1**	**50.5**

Table H: Analysis of Drill Rig Noise for Proposed Storage Wells for Central Valley Facility: Est'd Sound Contribution of Drill Rig Operation at NSA #1 (1,550 ft. NE of Closest Drill Rig)

Dist (Ft) or	SOURCE PWL & EST'D SOURCE SOUND	SPL or PWL in dB Per Octave-Band Center Freq. (Hz)									A-Wt.	Calc'd
Calculation	CONTRIBUTIONS AT SPECIFIED DISTANCE	31.5	63	125	250	500	1000	2000	4000	8000	Level	Ldn
	Peak PWL of Drill Rig	122	118	114	104	104	105	106	102	98	111	
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
1700	Hemispherical Radiation	-62	-62	-62	-62	-62	-62	-62	-62	-62		
1700	Atm. Absorption (70% R.H., 60 deg F)	0	0	-1	-1	-2	-4	-10	-17	-26		
Est'd Total Sound Contribution w/No Additional NC		**60**	**56**	**51**	**41**	**39**	**38**	**33**	**23**	**10**	**43.0**	**49.4**
	Atten. Of Additional Noise Control	0	0	0	0	0	0	0	0	0		
Est'd Total Sound Contribution w/o additional Noise Control		**60**	**56**	**51**	**41**	**39**	**38**	**33**	**23**	**10**	**43.0**	**49.4**

Table I: Analysis of Drill Rig Noise for Proposed Storage Wells for Central Valley Facility: Est'd Sound Contribution of Drill Rig Operation at NSA #3 (1,700 ft. S-SE of Closest Drill Rig)

Estimated Sound Level Contribution of Peak Service Rig Activities at NSA #1 and NSA #3

There are five well sites that will be reworked with a service rig:

NSA #1: 1,650 ft. N of SaraLouise #1
1,250 ft. NW of Southam #2
1,250 ft. NE of Southam #3 and CVGS Test Well
925 ft. E-NE of Southam #4
3,330 ft. N of Zumwalt #1-36

NSA #3: 650 ft. S of SaraLouise #1
1,200 ft. S-SW of Southam #2
1,625 ft. S-SE of Southam #3 and CVGS Test Well
2,300 ft. S-SE of Southam #4
650 ft. N of Zumwalt #1-36

The following **Tables J thru N** depict the estimated daytime sound level contribution at the closest NSA for the five well sites that will be reworked with a service rig:

Dist (Ft) or	SOURCE PWL & EST'D SOURCE SOUND	SPL or PWL in dB Per Octave-Band Center Freq. (Hz)									A-Wt.	Calc'd
Calculation	CONTRIBUTIONS AT SPECIFIED DISTANCE	31.5	63	125	250	500	1000	2000	4000	8000	Level	Ldn
	Peak PWL of Service Rig	120	116	112	102	102	13	104	100	96	108	
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
650	Hemispherical Radiation	-54	-54	-54	-54	-54	-54	-54	-54	-54		
650	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	0	-1	-2	-4	-7	-10		
Est'd Total Sound Contribution w/No Additional NC		**66**	**62**	**58**	**48**	**47**	**0**	**46**	**40**	**32**	**50.7**	**48.7**
	Atten. Of Additional Noise Control	0	0	0	0	0	0	0	0	0		
Est'd Total Sound Contribution w/o additional Noise Control		**66**	**62**	**58**	**48**	**47**	**0**	**46**	**40**	**32**	**50.7**	**48.7**

Table J: Analysis of Service Rig Noise for SaraLouise #1 for Central Valley Facility: Est'd Sound Contribution Service Rig Operation at Closest NSA (NSA #3, 650 ft. S of Service Rig Site Center)

Dist (Ft) or	SOURCE PWL & EST'D SOURCE SOUND	SPL or PWL in dB Per Octave-Band Center Freq. (Hz)									A-Wt.	Calc'd
Calculation	CONTRIBUTIONS AT SPECIFIED DISTANCE	31.5	63	125	250	500	1000	2000	4000	8000	Level	Ldn
	Peak PWL of Service Rig	120	116	112	102	102	13	104	100	96	108	
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
1200	Hemispherical Radiation	-59	-59	-59	-59	-59	-59	-59	-59	-59		
1200	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-2	-3	-7	-12	-18		
Est'd Total Sound Contribution w/No Additional NC		**61**	**57**	**52**	**42**	**41**	**0**	**38**	**29**	**19**	**43.4**	**41.4**
	Atten. Of Additional Noise Control	0	0	0	0	0	0	0	0	0		
Est'd Total Sound Contribution w/o additional Noise Control		**61**	**57**	**52**	**42**	**41**	**0**	**38**	**29**	**19**	**43.4**	**41.4**

Table K: Analysis of Service Rig Noise for Southam #2 for Central Valley Facility: Est'd Sound Contribution of Service Rig Operation at Closest NSA (NSA #3, 1,200 ft. S-SW of Service Rig Site Center)

Dist (Ft) or	SOURCE PWL & EST'D SOURCE SOUND	SPL or PWL in dB Per Octave-Band Center Freq. (Hz)									A-Wt.	Calc'd
Calculation	CONTRIBUTIONS AT SPECIFIED DISTANCE	31.5	63	125	250	500	1000	2000	4000	8000	Level	Ldn
	Peak PWL of Service Rig	120	116	112	102	102	13	104	100	96	108	
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
1250	Hemispherical Radiation	-60	-60	-60	-60	-60	-60	-60	-60	-60		
1250	Atm. Absorption (70% R.H., 60 deg F)	0	0	-1	-1	-2	-3	-8	-13	-19		
Est'd Total Sound Contribution w/No Additional NC		**60**	**56**	**52**	**41**	**41**	**0**	**37**	**28**	**18**	**42.9**	**40.9**
	Atten. Of Additional Noise Control	0	0	0	0	0	0	0	0	0		
Est'd Total Sound Contribution w/o additional Noise Control		**60**	**56**	**52**	**41**	**41**	**0**	**37**	**28**	**18**	**42.9**	**40.9**

Table L: Analysis of Service Rig Noise for Southam #3 for Central Valley Facility: Est'd Sound Contribution of Service Rig Operation at Closest NSA (NSA #1, 1250 ft. NE of Service Rig Site Center)

Dist (Ft) or	SOURCE PWL & EST'D SOURCE SOUND	SPL or PWL in dB Per Octave-Band Center Freq. (Hz)									A-Wt.	Calc'd
Calculation	CONTRIBUTIONS AT SPECIFIED DISTANCE	31.5	63	125	250	500	1000	2000	4000	8000	Level	Ldn
	Peak PWL of Service Rig	120	116	112	102	102	13	104	100	96	108	
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
925	Hemispherical Radiation	-57	-57	-57	-57	-57	-57	-57	-57	-57		
925	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-1	-2	-6	-9	-14		
Est'd Total Sound Contribution w/No Additional NC		**63**	**59**	**55**	**44**	**44**	**0**	**41**	**34**	**25**	**46.6**	**44.6**
	Atten. Of Additional Noise Control	0	0	0	0	0	0	0	0	0		
Est'd Total Sound Contribution w/o additional Noise Control		**63**	**59**	**55**	**44**	**44**	**0**	**41**	**34**	**25**	**46.6**	**44.6**

Table M: Analysis of Service Rig Noise for Southam #4 for Central Valley Facility: Est'd Sound Contribution of Service Rig Operation at Closest NSA (NSA #1, 925 ft. E-NE of Service Rig Site Center)

Dist (Ft) or	SOURCE PWL & EST'D SOURCE SOUND	SPL or PWL in dB Per Octave-Band Center Freq. (Hz)									A-Wt.	Calc'd
Calculation	CONTRIBUTIONS AT SPECIFIED DISTANCE	31.5	63	125	250	500	1000	2000	4000	8000	Level	Ldn
	Peak PWL of Service Rig	120	116	112	102	102	13	104	100	96	108	
	Misc. Atten. (Shielding or Ground Effect)	0	0	0	0	0	0	0	0	0		
650	Hemispherical Radiation	-54	-54	-54	-54	-54	-54	-54	-54	-54		
650	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	0	-1	-2	-4	-7	-10		
Est'd Total Sound Contribution w/No Additional NC		**66**	**62**	**58**	**48**	**47**	**0**	**46**	**40**	**32**	**50.7**	**48.7**
	Atten. Of Additional Noise Control	0	0	0	0	0	0	0	0	0		
Est'd Total Sound Contribution w/o additional Noise Control		**66**	**62**	**58**	**48**	**47**	**0**	**46**	**40**	**32**	**50.7**	**48.7**

Table N: Analysis of Service Rig Noise for Zumwalt #1-36 for Central Valley Facility: Est'd Sound Contribution Service Rig Operation at Closest NSA (NSA #3, 650 ft. N of Service Rig Site Center)

Source No. & Dist (Ft)	SOURCE PWL & EST'D. SOUND LEVEL CONTRIBUTIONS AT SPEC. DISTANCE	PWL or SPL in dB Per Octave-Band Center Freq. (Hz) 31.5	63	125	250	500	1000	2000	4000	8000	A-Wt. Level	
1)	PWL of Eng.-Comp. Casing Noise	112	115	113	114	113	112	110	108	106	117	
	NR of Building/Enclosure	-3	-6	-9	-12	-15	-18	-18	-18	-18		
	Shielding	0	0	0	0	0	0	0	0	0		
1675	Hemispherical Radiation	-62	-62	-62	-62	-62	-62	-62	-62	-62		
	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-1	-3	-5	-13	-23		
	Source Sound Level Contribution	47	47	41	39	35	29	25	15	3	36	
2)	PWL of Exhaust Noise	118	124	130	124	120	123	122	109	96	127	
	Atten of Exhaust Silencer	-10	-16	-20	-24	-28	-28	-28	-28	-20		
	Misc. Atten.	0	0	0	0	0	0	0	0	0		
1675	Hemispherical Radiation	-62	-62	-62	-62	-62	-62	-62	-62	-62		
	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-1	-3	-5	-13	-23		
	Source Sound Level Contribution	46	46	47	37	29	30	27	6	0	36	
3)	PWL of Exhaust Piping & Muffler Body	103	100	99	97	96	94	93	100	83	103	
	NR of Noise Control	0	0	0	0	0	0	0	0	0		
	Existing Shielding	0	0	0	0	0	0	0	0	0		
1675	Hemispherical Radiation	-62	-62	-62	-62	-62	-62	-62	-62	-62		
	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-1	-3	-5	-13	-23		
	Source Sound Level Contribution	41	38	36	34	33	29	26	25	0	35	
4)	PWL of Int. Noise w/ standard filter	87	85	87	85	85	87	95	99	93	102	
	NR of Noise Control	0	0	0	0	0	0	0	0	0		
	Comp. Bldg. Shielding	0	0	0	0	0	0	0	0	0		
1675	Hemispherical Radiation	-62	-62	-62	-62	-62	-62	-62	-62	-62		
	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-1	-3	-5	-13	-23		
	Source Sound Level Contribution	25	23	24	22	22	22	28	24	8	31	
5)	PWL of Eng. JW/AW/Gas Cooler	110	108	102	98	95	92	90	88	85	98	
	NR of Noise Control (Berm)	0	0	0	0	0	0	0	0	0		
	Comp. Bldg. Shielding	0	0	0	0	0	0	0	0	0		
1675	Hemispherical Radiation	-62	-62	-62	-62	-62	-62	-62	-62	-62		
	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-1	-3	-5	-13	-23		
	Source Sound Level Contribution	48	46	39	35	32	27	23	13	0	34	
6)	PWL of Gas Piping	100	98	96	92	93	91	88	83	80	96	
	NR of Noise Control	0	0	0	0	0	0	0	0	0		
	Comp. Bldg. Shielding	0	0	0	0	0	0	0	0	0		
1675	Hemispherical Radiation	-62	-62	-62	-62	-62	-62	-62	-62	-62		
	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-1	-3	-5	-13	-23		Calc'd
	Source Sound Level Contribution	38	36	33	29	30	26	21	8	0	31	Ldn
Est'd Total Contribution of Proposed Comp. Unit		**52**	**51**	**49**	**43**	**39**	**36**	**33**	**28**	**11**	**42.2**	**48.6**

General Note: DIL, NR and PWL values on this spreadsheet should not be used as the specified values. Refer to the "Noise Control Measures" in the report or other company specifications for the actual specified PWL of equipment, noise reduction (NR) of pipe lagging or building construction, and DIL values of mufflers/silencers associated with the proposed equipment.

Table O: Estimated Sound Contribution of Temporary Compressor Unit at NSA #1

Source No. & Dist (Ft)	SOURCE PWL & EST'D. SOUND LEVEL CONTRIBUTIONS AT SPEC. DISTANCE	PWL or SPL in dB Per Octave-Band Center Freq. (Hz) 31.5	63	125	250	500	1000	2000	4000	8000	A-Wt. Level	
1)	PWL of Eng.-Comp. Casing Noise	112	115	113	114	113	112	110	108	106	117	
	NR of Building/Enclosure	-3	-6	-9	-12	-15	-18	-18	-18	-18		
	Shielding	0	0	0	0	0	0	0	0	0		
2000	Hemispherical Radiation	-64	-64	-64	-64	-64	-64	-64	-64	-64		
	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-1	-3	-6	-15	-27		
	Source Sound Level Contribution	45	45	40	37	33	27	22	11	0	34	
2)	PWL of Exhaust Noise	118	124	130	124	120	123	122	109	96	127	
	Atten of Exhaust Silencer	-10	-16	-20	-24	-28	-28	-28	-28	-20		
	Misc. Atten.	0	0	0	0	0	0	0	0	0		
2000	Hemispherical Radiation	-64	-64	-64	-64	-64	-64	-64	-64	-64		
	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-1	-3	-6	-15	-27		
	Source Sound Level Contribution	44	44	46	35	27	28	24	2	0	34	
3)	PWL of Exhaust Piping & Muffler Body	103	100	99	97	96	94	93	100	83	103	
	NR of Noise Control	0	0	0	0	0	0	0	0	0		
	Existing Shielding	0	0	0	0	0	0	0	0	0		
2000	Hemispherical Radiation	-64	-64	-64	-64	-64	-64	-64	-64	-64		
	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-1	-3	-6	-15	-27		
	Source Sound Level Contribution	39	36	35	32	31	27	23	21	0	33	
4)	PWL of Int. Noise w/ standard filter	87	85	87	85	85	87	95	99	93	102	
	NR of Noise Control	0	0	0	0	0	0	0	0	0		
	Comp. Bldg. Shielding	0	0	0	0	0	0	0	0	0		
2000	Hemispherical Radiation	-64	-64	-64	-64	-64	-64	-64	-64	-64		
	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-1	-3	-6	-15	-27		
	Source Sound Level Contribution	23	21	23	20	20	20	25	20	2	29	
5)	PWL of Eng. JW/AW/Gas Cooler	110	108	102	98	95	92	90	88	85	98	
	NR of Noise Control (Berm)	0	0	0	0	0	0	0	0	0		
	Comp. Bldg. Shielding	0	0	0	0	0	0	0	0	0		
2000	Hemispherical Radiation	-64	-64	-64	-64	-64	-64	-64	-64	-64		
	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-1	-3	-6	-15	-27		
	Source Sound Level Contribution	46	44	38	33	30	25	20	9	0	32	
6)	PWL of Gas Piping	100	98	96	92	93	91	88	83	80	96	
	NR of Noise Control	0	0	0	0	0	0	0	0	0		
	Comp. Bldg. Shielding	0	0	0	0	0	0	0	0	0		
2000	Hemispherical Radiation	-64	-64	-64	-64	-64	-64	-64	-64	-64		
	Atm. Absorption (70% R.H., 60 deg F)	0	0	0	-1	-1	-3	-6	-15	-27		Calc'd
	Source Sound Level Contribution	36	34	32	27	28	24	18	4	0	29	Ldn
Est'd Total Contribution of Proposed Comp. Unit		**50**	**50**	**48**	**41**	**37**	**34**	**31**	**24**	**8**	**40.2**	**46.6**

General Note: DIL, NR and PWL values on this spreadsheet should not be used as the specified values. Refer to the "Noise Control Measures" in the report or other company specifications for the actual specified PWL of equipment, noise reduction (NR) of pipe lagging or building construction, and DIL values of mufflers/silencers associated with the proposed equipment.

Table P: Estimated Sound Contribution of Temporary Compressor Unit at NSA #3

DESCRIPTION OF THE ANALYSIS METHODOLOGY AND THE SOURCE OF SOUND DATA

ANALYSIS METHODOLOGY

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

- Initially, unweighted octave-band PWLs for each noise source (without noise control) were determined from actual sound measurements performed by H&K on similar equipment and/or obtained from the equipment manufacturer.
- Then, expected noise reductions in dB per octave-band frequency due to any designated noise control measures for each source were subtracted from the estimated PWL.
- Next, octave-band SPLs for each source (with noise control) were determined by compensating for sound attenuation due to propagation (hemispherical radiation) and atmospheric sound absorption.
- 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. Effects of vegetation or land contour were typically not considered in this analysis.
- Finally, the estimated octave-band SPLs for each source (with noise control and other sound attenuation effects) were corrected for A-weighting, and the total SPLs of all sound sources were logarithmically summed and corrected for A-weighting to provide the estimated A-wt. sound level contributed at the specified distance(s) by the proposed facility.

SOURCE OF SOUND DATA

The following describes the source of sound data for estimating the source sound levels and source PWLs used in the noise impact analysis. Note that equipment noise levels and acoustical performance of mufflers/silencers utilized in the acoustical analysis (i.e., spreadsheet analysis) are generally higher than the sound level requirement for the new equipment to insure that the design incorporates an acoustical “margin of safety.”

- Engine exhaust PWL values were calculated from sound data recently measured in the field by H&K on a similar unit. The DIL values for the exhaust muffler system utilized in the acoustical analysis are generally lower than the recommended values in order that the noise design analysis incorporates an acoustical “margin of safety”.
- The estimated PWL values of equipment inside the building (i.e., engine-driven compressor and equipment) were calculated from sound data measured by H&K on a similar compressor installation.
- The estimated PWL values of the outdoor aboveground gas piping were determined from sound measurements by H&K on gas piping similar to that of the proposed compressor installation.
- The estimated PWL values for engine jacket water/auxiliary water cooler and gas aftercooler were designated to meet the design noise goal. The noise level for the coolers used in the acoustical analysis is generally higher than the sound level requirement in order that the noise design analysis incorporates an acoustical “margin of safety.”
- The estimated PWL for the engine air intake were calculated from measured sound data in the field tests by H&K on similar engines.

Summary of Typical Metrics for Regulating Environmental Noise & Acoustical Terminology Discussed in the Report

(1) Decibel (dB): A unit for expressing the relative power level difference between acoustical or electrical signals. It is ten times the common logarithm of the ratio of two related quantities that are proportional to power. When adding dB or dBA values, the values must be added logarithmically. For example, the logarithmic addition of **35 dB** plus **35 dB** is **38 dB**.

(2) Human Perception of Change in Sound Level

- A **3 dB** change of sound level is barely perceivable by the human ear
- A **5 or 6 dB** change of sound level is noticeable
- If sound level increases by **10 dB**, it appears as if the sound intensity has doubled.

(3) A-Weighted Sound Level (dBA): The A-wt. sound level is a single-figure sound rating, expressed in decibels, which correlates to the human perception of the loudness of sound. The dBA level is commonly used to measure industrial and environmental noise since it is easy to measure and provides a reasonable indication of the human annoyance value of the noise. The dBA measurement is not a good descriptor of a noise consisting of strong low-frequency components or for a noise with tonal components.

(4) Background or Ambient Noise: The total noise produced by all other sources associated with a given environment in the vicinity of a specific sound source of interest, and includes any Residual Noise.

(5) Sound Pressure Level (L_p or SPL): Ten times the common logarithm to the base 10 of the ratio of the mean square sound pressure to the square of a reference pressure. Therefore, the sound pressure level is equal to 20 times the common logarithm of the ratio of the sound pressure to a reference pressure (20 micropascals or 0.0002 microbar).

(6) Octave Band Sound Pressure Level (SPL): Sound is typically measured in frequency ranges (e.g., high-pitched sound, low-pitched sound, etc.) that provides more meaningful sound data regarding the sound character of the noise. When measuring two noise sources for comparison, it is better to measure the spectrum of each noise, such as in octave band SPL frequency ranges. Then, the relative loudness of two sounds can be compared frequency range by frequency range. As an illustration, two noise sources can have the same dBA rating and yet sound completely different. For example, a high-pitched sound concentrated at a frequency of 2000 Hz could have the same dBA rating as a much louder low-frequency sound concentrated at 50 Hz.

(7) Daytime Sound Level (L_d) & Nighttime Sound Level (L_n): L_d is the equivalent A-weighted sound level, in decibels, for a 15 hour time period, between 07:00 to 22:00 Hours (7:00 a.m. to 10:00 p.m.). L_n is the equivalent A-weighted sound level, in decibels, for a 9 hour time period, between 22:00 to 07:00 Hours (10:00 p.m. to 7:00 a.m.).

(8) Equivalent Sound Level (L_{eq}): The equivalent sound level (L_{eq}) can be considered an average sound level measured during a period of time, including any fluctuating sound levels during that period. In this report, the L_{eq} is equal to the level of a steady (in time) A-weighted sound level that would be equivalent to the sampled A-weighted sound level on an energy basis for a specified measurement interval. The concept of the measuring L_{eq} has been used broadly to relate individual and community reaction to aircraft and other environmental noises.

(9) Day-Night Sound Level (L_{dn}): The L_{dn} is an energy average of the measured daytime L_{eq} (L_d) and the measured nighttime L_{eq} (L_n) plus **10 dB**. The **10-dB** adjustment to the L_n is intended to compensate for nighttime sensitivity. As such, the L_{dn} is not a true measure of the sound level but represents a skewed average that correlates generally with past sound surveys which attempted to relate environmental sound levels with physiological reaction and physiological effects. For a steady sound source that operates continuously over a 24-hour period and controls the environmental sound level, an L_{dn} is approx. **6.4 dB** above the measured L_{eq}.

(10) Sound Level Meter (SLM): An instrument used to measure sound pressure level, sound level, octave-band SPL, or peak sound pressure level, separately or in any combinations thereof. The measured weighted SPL (i.e., A-Wt. Sound Level or dBA) is obtained by the use of a SLM having a standard frequency-filter for attenuating part of the sound spectrum.

SOUND LEVELS FOR TYPICAL ACTIVITIES **REFERENCE AND COMMUNITY RESPONSES**

Subjective Human Response and Conversation	Home and Industrial (Indoor Noise)	dBA Scale (Level)	Community and Traffic (Outdoor Noise)	Reference Loudness	Community Reaction To Outdoor Noise
		-- 140 --	Aircraft Carrier		
Threshold of Pain			Military Jet Aircraft		
		-- 130 --			
			Large Siren at 100 Ft.		
			Jet Takeoff at 200 Ft.	16 Times	
	Rock Band (Max.)	-- 120 --		as Loud	
Threshold of			Thunderstorm Activity		
Discomfort	Discotheque (Max.)			8 Times	
		-- 110 --	Elevated Train	as Loud	
	Symphonic Music (Max.)				
Maximum Vocal Effort			Auto Horn at 5 Ft.	4 Times	
	Industrial Plant	-- 100 --		as Loud	
Very Loud			Compacting Trash Truck		
	Newspaper Printing Rm.			2 Times	
Shouting in Ear		-- 90 --	Heavy Truck at 25 Ft.	as Loud	Vigorous Action
	Food Blender				and Law Suits
	Symphonic Music (Typ.)		Motorcycle at 25 Ft.	Reference	
Shouting		-- 80 --		Loudness	Threats of
	Garbage Disposal		Small Truck at 25 Ft.		Legal Action
Very Annoying	Alarm Clock		Heavy Traffic at 50 Ft.		Appeals to Officials
		-- 70 --		1/2 as Loud	Widespread
Moderately Loud	Vacuum Cleaner		Avg. Traffic at 100 Ft.		Complaints
	Electric Typewriter				
Normal Conversation		-- 60 --		1/4 as Loud	Sporadic Complaints
	Air Conditioner at 20 Ft.				
			Light Traffic at 100 Ft.		No Reaction,
	Typical Office	-- 50 --		1/8 as Loud	Although Noise
Quiet					is Noticeable
	Living Room		Typical Suburban Area		
	Bedroom	-- 40 --			
			Birdsong		
Very Quiet	Library				
		-- 30 --			
Soft Whisper	Broadcasting Studio		Rural Area		
				Just Audible	
		-- 20 --			
				Threshold	
		-- 10 --		of Hearing	
Hoover & Keith Inc. (Consultants in Acoustics)					
11391 Meadowglen, Suite D					
Houston, Texas 77082		-- 0 --			