



**URBAN
SOLUTION
GROUP**

Colorado ECMC Form 2A Noise Mitigation Plan

**State Harvard/Yale Pad
Arapahoe County, Colorado**

Prepared for:

**Crestone Peak Resources Operating LLC
555 17th Street, Suite 3700
Denver, CO 80202**

*Crestone Peak Resources Operating LLC operates as a wholly owned subsidiary of Civitas Resources, Inc.

Prepared by:

**Urban Solution Group, LLC
3301 Lawrence Street, Suite 3
Denver, CO 80205**

September 4, 2024

REV2



RECORD OF REVISIONS

Rev#	Date	By	Summary of Revisions
0	2024/07/22	VJG	Initial Release
1	2024/08/28	GFS	Updated to show drilling operations on grid/line power
2	2024/09/04	BJP	Added BMP for electric production

TABLE OF CONTENTS

1	Executive Summary	1
2	Regulations and Noise Standards Summary.....	3
	Colorado ECMC Rule 423 Noise Regulation – Brief Overview	3
	Compliance Summary (Unadjusted)	5
	Maximum Permissible Noise Levels (Adjusted) - Summary	6
3	Summary of BMPs and Mitigation to be Implemented	7
4	Site Information.....	8
5	Compliance Points	9
6	Estimated Operations & Durations Schedule.....	9
7	Ambient Sound Level Survey.....	10
8	Noise Impact Assessment.....	12
	Methodology.....	12
	Equipment Information and Site Layouts	13
	Drilling Noise Model Results	14
	Completions Noise Model Results	19
	Production Noise Model Results.....	24
	Flowback Operations Review.....	27
9	Continuous Monitoring / Complaint Resolution	28
10	Conclusion	28
11	Notations	28
	Appendix 1 – Equipment Layouts	29
	Appendix 2 – Ambient Data and Charts.....	33
	Appendix 3 – Sound Fundamentals	36
	Appendix 4 – Glossary.....	39

Report Submitted to:

Nathan Bennett
Civitas Resources, Inc.
(570) 932-0776
nbennett@civiresources.com

Report Contact:

Vince Ginter
Urban Solution Group
(720) 749-2916
vince.ginter@urbansolutiongroup.com

1 EXECUTIVE SUMMARY

Urban Solution Group, LLC (Urban) was commissioned to prepare a Noise Mitigation Plan (NMP) for the proposed State Harvard/Yale Pad (Harvard/Yale Location) to be operated by **Crestone Resources Operating LLC** (Crestone), a wholly owned subsidiary of Civitas Resources, Inc. (Civitas). Crestone is proposing to develop oil and natural gas wells at the Harvard/Yale Pad located in Arapahoe County, Colorado. The purpose of this plan is to assess predicted environmental noise impacts from the proposed operations on the surrounding area as compared to the maximum permissible noise level (MPNL) limits described in the Colorado Energy and Carbon Management Commission (ECMC) Rule 423.

To facilitate this work, the following analyses were completed:

- Pre-operational ambient sound level survey for the surrounding area
- Completion of a full site-specific Noise Impact Assessment (NIA) with individual models for:
 - Drilling operations with the Patterson-UTI APEX 1500 Series Drilling Rig on grid/line power (no gensets)
 - Completions operations with a Liberty Oilfield Services Quiet Fleet
 - Production operations with the equipment and layout proposed by Crestone
- Specification of Best Management Practices (BMPs) that will be implemented at the proposed Harvard/Yale location such that all operations comply with noise regulations and minimize the environmental noise impact on the surrounding area

The results of the analyses with full implementation of the BMPs for the Harvard/Yale location are summarized on the following page:

Analysis Type	Result
Noise points of compliance	<ul style="list-style-type: none"> All residential building units are beyond 2,000 feet from the edge of the location. Thus, there are no noise points of compliance.
Pre-Operational Ambient Sound Level Survey	<ul style="list-style-type: none"> Ambient sound levels were measured at two locations near the Harvard/Yale location. Ambient adjustments to the MPNLs apply to production operations only.
Drilling Operations NIA	<ul style="list-style-type: none"> No mitigation required; Crestone to erect perimeter sound wall consisting of 2,600 linear feet of 32-foot-tall, STC32 engineered sound wall due to sensitive nature of the area as part of BMPs.
Completions Operations NIA	<ul style="list-style-type: none"> No mitigation required; Crestone to erect perimeter sound wall consisting of 2,600 linear feet of 32-foot-tall, STC32 engineered sound wall due to sensitive nature of the area as part of BMPs.
Flowback Operations	<ul style="list-style-type: none"> Utilizes a fraction of similar but smaller equipment compared to the three other operations studied; leave perimeter sound walls in place until flows are initiated.
Production Operations NIA	<ul style="list-style-type: none"> No noise mitigation required.

2 REGULATIONS AND NOISE STANDARDS SUMMARY

Noise for energy related facilities located in Colorado, is regulated through the Colorado Energy and Carbon Management Commission (ECMC) 423 series noise regulation. These regulations set the MPNLs, which limit noise emitted from energy facilities over a specified period, as measured at noise compliance points. These allowable limits are dependent on the land use zoning within the study area. An overview of the Colorado ECMC regulation is presented below.

Colorado ECMC Rule 423 Noise Regulation – Brief Overview

Section 423.b (1) of Colorado ECMC Rule 423 states that all Oil and Gas Operations will comply with the maximum permissible noise levels (MPNLs) in Table 1 below unless otherwise required by Rule 423.

Table 1. Maximum Permissible Noise Levels (Colorado ECMC Table 423-1)

Zone	Daytime (7:00 a.m. – 7:00 p.m.)	Nighttime (7:00 p.m. – 7:00 a.m.)
Residential/Rural/State Parks & Wildlife Areas	55 dB(A)	50 dB(A)
Commercial/Agricultural	60 dB(A)	55 dB(A)
Light industrial	70 dB(A)	65 dB(A)
Industrial	80 dB(A)	75 dB(A)
All Zones	60 dB(C)	60 dB(C)

Exceptions to these MPNLs for Drilling, Completions and Flowback Operations are outlined in section 423.b (2) as follows:

- A. In Residential/Rural or Commercial/Agricultural, MPNLs will be 60 dBA in the hours between 7:00 p.m. to 7:00 a.m. and 65 dBA in the hours between 7:00 a.m. to 7:00 p.m.; and
- B. In all zones MPNLs will be 65 dBC in the hours between 7:00 p.m. to 7:00 a.m. and 65 dBC in the hours between 7:00 a.m. to 7:00 p.m.

These MPNLs are applied at “noise points of compliance”. These points are chosen as outlined in section 423.a (5) of the Regulation:

(5) For proposed Oil and Gas Locations with a Working Pad Surface within 2,000 feet of one or more Residential Building Units (RBUs), at least one, and no more than six noise points of compliance where monitors will be located. Operators will identify noise points of compliance using the following criteria:

- A. Provide one noise point of compliance in each direction in which an RBU is located within 2,000 feet of the proposed Working Pad Surface.
- B. Noise points of compliance will be located at least 350 feet from the Working Pad Surface, and no less than 25 feet from the exterior wall of the RBU that is closest to the Working Pad Surface. If a Surface Owner or tenant refuses to provide the Operator with

access to install a noise monitor, then the noise point of compliance will be located at either the next-closest RBU or an alternative location approximately the same distance and direction from the Working Pad Surface.

Demonstration of compliance with noise level limits during operation is outlined in section 423.c (2) as follows:

A. In response to a complaint or at the Director's request, Operators will measure sound levels at 25 feet from the complainant's occupied structure towards the noise source for low frequency (dBC) indicated issues. For high frequency (dBA) measurement will be at the nearest point of compliance. For equipment installed at Oil and Gas Locations subject to a Form 2A approved prior to January 15, 2021, after the Commencement of Production Operations, no single piece of equipment will exceed the MPNLs listed in Table 423-1 as measured at a point 350 feet from the equipment generating the noise in the direction from which the complaint was received.

Finally, adjustments to the MPNLs based on the measured pre-existing ambient noise levels is allowed. However, the new maximum allowable noise levels for permanent facilities such as Production Operations are capped and based on cumulative noise levels. Ambient adjustments and cumulative noise levels are outlined in section 423.d of the Regulation as follows:

d. Cumulative Noise. All noise measurements will be cumulative.

(1) Noise measurements taken at noise points of compliance designated pursuant to Rule 423.a.(5) will take into account ambient noise, rather than solely the incremental increase of noise from the facility targeted for measurement.

(2) At new or substantially modified Oil and Gas Locations where ambient noise levels at noise points of compliance designated pursuant to Rule 423.a.(5) already exceed the noise thresholds identified in Table 423-1, then Operators will be considered in compliance with Rule 423, unless at any time their individual noise contribution, measured pursuant to Rule 423.c, increases noise above ambient levels by greater than 5 dBC and 5 dBA between 7:00 p.m. and 7:00 a.m. or 7 dBC and 7 dBA between 7:00 a.m. and 7:00 p.m. This Rule 423.d.(2) does not allow Operators to increase noise above the maximum cumulative noise thresholds specified in Table 423-2 after the Commencement of Production Operations.

(3) After the Commencement of Production Operations, if ambient noise levels already exceed the MPNLs identified in Table 423-1, under no circumstances will new Oil and Gas Operations or a significant modification to an existing Oil and Gas Operations raise cumulative ambient noise above the following:

Table 2. Maximum Cumulative Noise Levels (Colorado ECMC Table 423-2)

Zone	Daytime (7:00 a.m. – 7:00 p.m.)	Nighttime (7:00 p.m. – 7:00 a.m.)
Residential/Rural/State Parks & Wildlife Areas	65 dB(A)	60 dB(A)
Commercial/Agricultural	70 dB(A)	65 dB(A)
Light industrial	80 dB(A)	75 dB(A)
Industrial	90 dB(A)	85 dB(A)
All Zones	75 dB(C)	70 dB(C)

Compliance Summary (Unadjusted)

Under Colorado ECMC Rule 423, noise points of compliance can only be identified with respect to existing RBUs within 2,000 feet of the proposed oil and gas location. Since there are no existing RBUs within 2,000 feet of the proposed oil and gas location, there are no noise points of compliance for the proposed Harvard/Yale location.

The location is zoned with an agricultural land use designation based on information from the Arapahoe County Zoning Department. The applicable MPNLs as applied at the noise compliance points are summarized in the Table 3 below.

Table 3. Compliance Summary, Maximum Permissible Noise Levels (Unadjusted)

Zone	Operation	Daytime (7:00 a.m. – 7:00 p.m.)	Nighttime (7:00 p.m. – 7:00 a.m.)
Commercial/Agricultural	Drilling, Completions & Flowback	65 dB(A)	60 dB(A)
		65 dB(C)	65 dB(C)
	Production	60 dB(A)	55 dB(A)
		60 dB(C)	60 dB(C)

Maximum Permissible Noise Levels (Adjusted) - Summary

The results of the ambient sound level survey for the Harvard/Yale Location are presented in Section 7 of this document.

Section 423.d(2) of the Colorado ECMC Regulation allows for adjustments to the MPNLs if the measured ambient sound levels exceed the MPNLs. Colorado ECMC code allows for an adjustment of 7 dBA/dBC during daytime, and 5 dBA/dBC during nighttime for all operations (though production operations are also constrained by the cumulative maximums in Table 423-2 of Colorado ECMC Rule 423).

The ambient noise levels at Monitoring Point 2 exceed the daytime C-weighted MPNL of 60 dBC for production, and the MPNLs for the corresponding ambient measuring points are presented in Table 4 below.

Table 4. Adjusted Maximum Permissible Noise Levels for the Harvard/Yale Location

Phase	Receptor	Ambient Monitor Point #	Maximum Permissible Noise Levels	
			dBA	dBC
Drilling, Completions & Flowback	-	1	65 Day / 60 Night	65 Day / 65Night
	-	2	65 Day / 60 Night	65 Day / 65Night
Production	-	1	60 Day / 55 Night	60 Day / 60 Night
	-	2	60 Day / 55 Night	69.5 Day / 60 Night

3 SUMMARY OF BMPS AND MITIGATION TO BE IMPLEMENTED

Best Management Practices (BMPs) are practices that are designed to prevent or reduce impacts caused by oil and gas operations on the environment and wildlife, and to minimize adverse impacts to public health, safety, and welfare.

The BMPs that Crestone plans to implement for the proposed Harvard/Yale site are as follows:

- Crestone conducted a Noise Impact Assessment (NIA) for each phase of operations (drilling, completions, and production) to assess operational noise levels against the maximum permissible dBA and dBC noise levels stated in the Colorado ECOM Rule 423 noise regulation. Each phase of operation will comply with the MPNLs as summarized in Table 4 of this document.
- Prior to commencement of drilling and completion activities, a full perimeter, engineered sound wall consisting of approximately 2,600 linear feet of 32-foot-tall, STC32 wall will be installed around the edge of the well pad to reduce noise levels in the surrounding area.
- The drilling rig that will be utilized to drill the wells to total depth will be powered by electric grid power. Thus, the three gensets that normally operate during all drilling operations will be completely shut down and only used for emergency backup in the case that the electric grid is temporarily unavailable.
- Crestone will utilize a low noise completions fleet for all completions operations.
- Electric motor driven production equipment, powered by the local utility, will be utilized for production operations.
- Flowback operations and equipment were reviewed as part of this Noise Mitigation Plan (NMP). Flowback utilizes a fraction of similar, but smaller equipment compared to the three other operations studied. Perimeter sound walls will be left in place until drill out is complete and flows are initiated to appropriately manage noise levels for this operation.
- A pre-operational ambient sound level survey was conducted at the two locations outlined in Figure 2 of Section 7 to quantify pre-existing A- and C-weighted sound levels.
- Throughout the duration of preproduction operations and any construction lasting longer than 24 hours, Crestone will conduct continuous noise monitoring at the ambient monitoring locations described in Figure 2 of Section 7 of this document.
- If the drilling rig or completions fleet is changed prior to commencement of operations, the mitigation measures employed will be equally or more protective. A sundry form will be submitted to outline any changes, per code, as required.
- Crestone will post contact information to receive and address noise complaints arising from preproduction operations around the clock, 24 hours, 7 days per week. Upon receipt of a complaint, either directly to Crestone, or from the Colorado ECOM, a Crestone representative will contact the associated stakeholder within 48 hours of receipt.

4 SITE INFORMATION

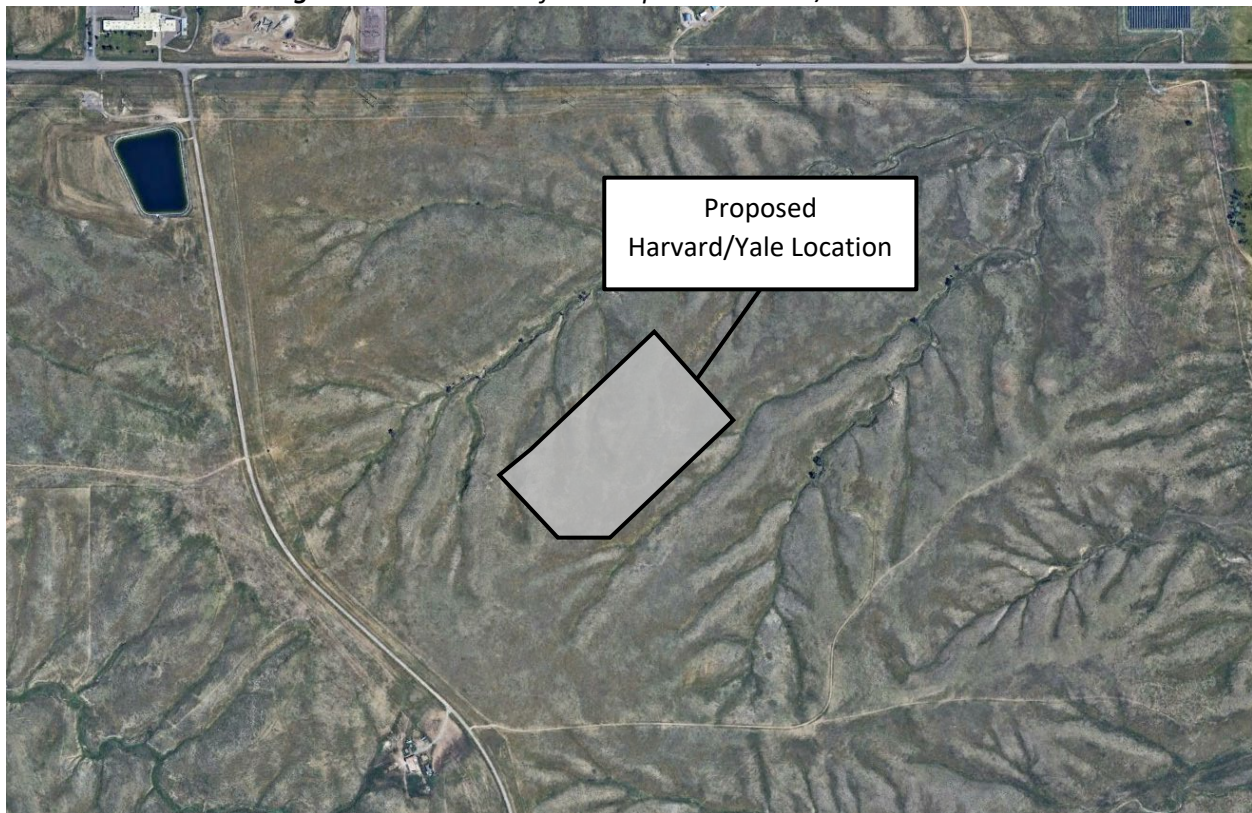
The proposed Harvard/Yale Location will be located near a private access road, situated south of E Quincy Ave, and west of Lowry Pit near Aurora, CO. The location is zoned with an Agricultural (A-1) land use designation based on information from the Arapahoe County Zoning Department. The closest major road, E Quincy Avenue, is a paved road that sees a moderate amount of traffic and is located approximately 2,000 feet north of the proposed Harvard/Yale Location.

The Harvard/Yale location is slated for drilling, completions, and production operations. Drilling is planned utilizing the Patterson-UTI APEX 1500 Series Drilling Rig (on grid power), and completions will be carried out with a Quiet Fleet from Liberty Oilfield Services. Planned production equipment is provided in Figure 15 of Appendix 1.

Detailed location information is presented below, and an aerial view of the proposed location is shown in Figure 1 below.

- Location:** NE 1/4 SE 1/4, SEC. 8, T5S, R64W, 6TH P.M.
- Drilling Rig:** Patterson-UTI APEX 1500 Series Drilling Rig (on Grid Power)
- Completions Equipment:** Liberty Oilfield Services Quiet Fleet
- Production Equipment:** Details provided in Figure 15 of Appendix 1
- Pad Location Coordinates:** 39.630286°N, 104.57009°W
- Regulation Noise Target:** Colorado ECMC Rule 423

Figure 1. Aerial View of the Proposed Harvard/Yale Location



5 COMPLIANCE POINTS

The MPNLs for all operations are applied at noise compliance points. These points are chosen as outlined in the ECMC Rule 423 noise regulation but are only applicable for existing occupied residential building units (RBUs) located within 2,000 feet of the proposed location. Since there are no occupied RBUs located within 2,000 feet of the proposed location, there are no noise points of compliance.

6 ESTIMATED OPERATIONS & DURATIONS SCHEDULE

The following table reflects Crestone’s planned construction and operations schedule for the Harvard/Yale Location at the time of this Noise Mitigation Plan. The schedule in Table 5 below includes an estimated duration of each stage of operation, including construction, drilling, completion, flowback, and production.

Table 5. Crestone’s Planned Operations Schedule

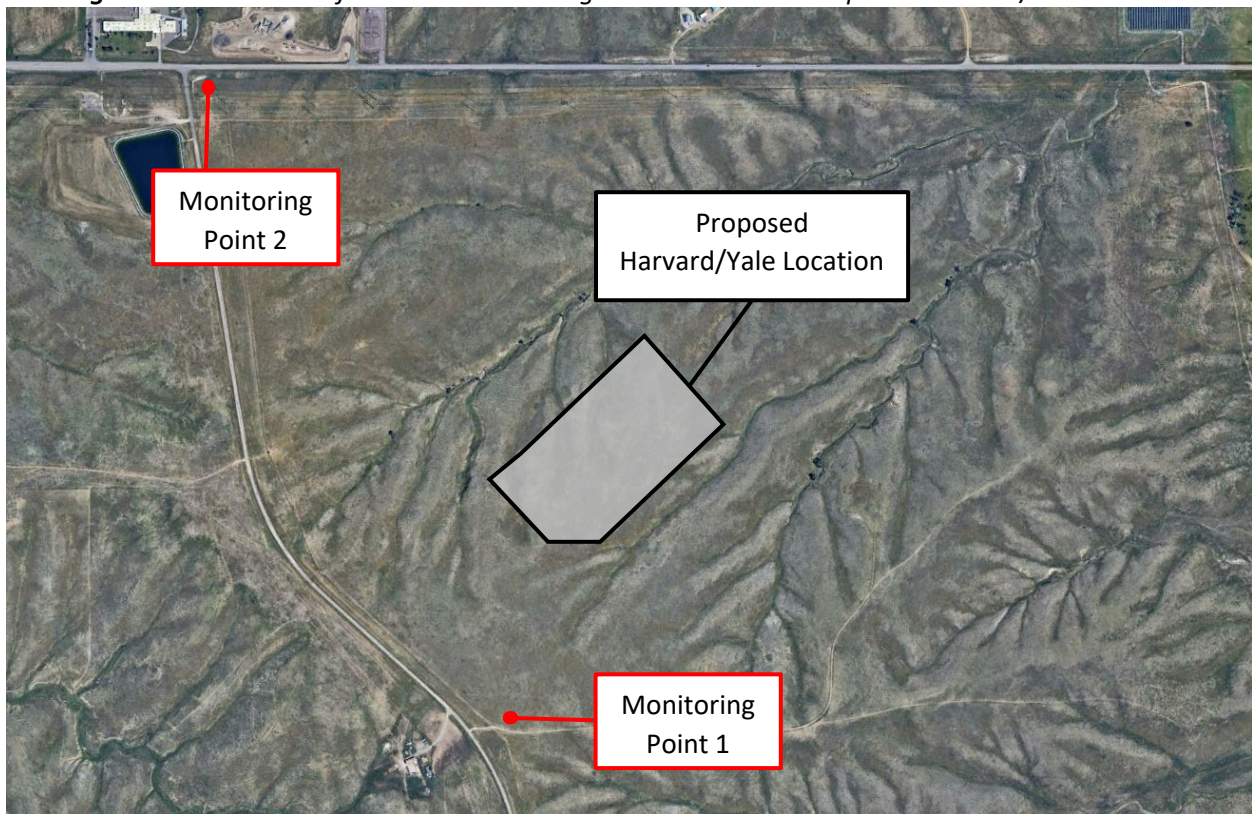
Phase	Duration (Days)	Estimated Start Date
Construction	60	Q2 2025
Drilling	90	Q2 2025
Completion	60	Q4 2025
Flowback	30	Q4 2025
Production	10,950 (30 years)	Q1 2026

7 AMBIENT SOUND LEVEL SURVEY

Section 423.b of the Colorado ECMC regulation requires that the operator conduct a background ambient noise survey to establish baseline conditions for both A-scale and C-scale noise levels near the site. Urban conducted a 72-hour ambient sound monitoring study to monitor and document pre-operational ambient sound levels using Type 1 noise monitoring stations. The sound level meters collect measurements of both A- and C-weighted decibel levels at the monitoring locations and are calibrated before and after the measurement period. Environmental data (temperature, wind speed, wind direction, humidity, rain duration, etc.) was recorded with a weather station attached to the sound level meter at Monitoring Point 1 situated approximately 1,780 feet south of the proposed Harvard/Yale location. The Leq average values are calculated by averaging 1-minute Leq noise levels when the wind speed is below 5 miles per hour, per Colorado ECMC guidelines.

The ambient monitoring locations in relation to the Harvard/Yale Location are shown in Figure 2 below. A-weighted and C-weighted sound levels were collected at both locations from Friday, July 12, 2024, at 7:00 p.m., to Monday, July 15, 2024, at 7:00 p.m., inclusive.

Figure 2. Aerial View of Ambient Monitoring Location and the Proposed Harvard/Yale Location



In addition to the ambient noise levels acquired, the sound level meter (SLM) was set to record audio files when the levels exceed 55 dBA in the daytime (7:00 a.m. – 7:00 p.m.) and 50 dBA in the nighttime (7:00 p.m. – 7:00 a.m.). Based on the recordings, the most common sounds for the monitoring locations include aircraft flyovers and wildlife.

Measured A- and C-weighted sound pressure level averages were not filtered for aircraft flyover events as these sounds can be considered part of the commonly occurring ambient acoustical environment. Because the Harvard/Yale site and the ambient monitoring points are in close proximity to four airports (Denver International Airport [DIA], Colorado Air and Space Port, Buckley Air Force Base, and Centennial Airport) and there are frequent, audible aircraft flyovers in the area (as observed in the recorded audio files), measurements taken during these flyovers were included in the ambient noise data processing. Although the Harvard/Yale location is outside the Airport Influence Areas (according to Arapahoe County GIS), in Q1 of 2024, two of the South-North runways at DIA (runways 35L and 35R) were utilized for 39.6% of total arrivals into the airport, with an additional 13.9% utilization for arrivals at the other two South-North runways (runways 34L and 34R) according to the 2024 1Q DEN Noise Report. This indicates that a significant number of aircraft travel from south to north on a daily basis (the same direction as from the Harvard/Yale location to DIA) and potentially cross over the proposed Harvard/Yale location, increasing the overall A- and C-weighted ambient noise levels in the area surrounding the proposed location.

Table 6 below presents the overall A- and C-weighted averages (Leq) for the 72-hour monitoring period for the SLM. The averages shown represent the overall sound levels when the wind speed was below five (5) miles per hour and when there were no adverse weather conditions (e.g., rain, thunder). Data was filtered to remove values when wind speeds exceed five (5) miles per hour, per Colorado ECMC guidelines.

Table 6. Overall Leq Background Ambient Noise Levels (Filtered for Wind Speed)

Location	Daytime Averages (Leq)		Nighttime Averages (Leq)		Overall Averages (Leq)	
	dBA	dBC	dBA	dBC	dBA	dBC
Monitoring Point 1	46.9	56.3	40.3	51.2	43.1	53.2
Monitoring Point 2	51.0	62.5	48.0	56.9	49.0	59.1

Figure 16 and Figure 17 in Appendix 2 contains a chart with the unfiltered hourly averages and wind speeds for the monitoring point.

8 NOISE IMPACT ASSESSMENT

A Noise Impact Assessment (NIA) was conducted for the proposed Harvard/Yale Location using a three-dimensional computer noise modeling software. This is a predictive model to aid in ascertaining the environmental impact of the proposed facility during all planned operations on the surrounding environment. The results of this assessment will compare the predicted levels of the Harvard/Yale Location operations to the permissible noise level limits described in the Colorado ECMC Rule 423 noise regulation.

A brief explanation of the methodology is presented first, followed by noise model results for drilling, completions, and production.

Methodology

All computer models and predicted noise levels generated for the assessment are developed with the commercial noise modeling software SoundPLAN 9.0. The ISO 9613-1 and 2 international standards are utilized in this software as they are widely accepted both internationally as well as in North America. The algorithms used in the commercial software package are based on methods and theory accepted in the environmental acoustics community. Both detailed equipment technical information and location specific topography, are used to generate comprehensive noise predictions that take into account environmental conditions, buildings, ground cover and barriers (natural, topographical, and otherwise). Note that actual field measurements may differ from modeled noise levels on any given day due to ever changing environmental factors and other noise sources in the study area not explicitly in the computer model. Table 7 below lists the conditions used in the model.

Table 7. Conditions Used in SoundPLAN 9.0 Software

Parameter	Modeled Input and Description
Temperature	55°F – Represents typical summer nighttime temperature
Topography	Modeled as is, with proposed location modified per grading plan
Wind Velocity	2.2 - 11.2 mph – ISO 9613 uses a slight downwind condition from each noise source to each receiver
Wind Direction	From the noise source to the receptor points
Relative Humidity	40% - Typical summer nighttime relative humidity
Ground Absorption	Ranges from 0.0 for water bodies & major roadways up to 1.0 for thick grasslands

It is assumed that facility operating conditions do not change significantly between the daytime and nighttime periods. The resulting predicted noise levels are compared to the MPNLs outlined in the Colorado ECMC noise regulation to determine if the subject facility is compliant.

The noise levels generated in this predictive model are strictly from oil and gas operations at the proposed facility. Pre-existing sound sources such as those from animals, weather, road traffic, and all other ambient sounds are not included in the noise models.

Equipment Information and Site Layouts

Drilling Operations at the Harvard/Yale location are carried out using the Patterson-UTI APEX 1500 Series Drilling Rig (on grid power). The sound power levels used in this NIA are taken from a sound signature report prepared by Urban in 2022. The drilling equipment layout for the Harvard/Yale Location is shown in Figure 13 of Appendix 1.

Completions Operations at the Harvard/Yale location are carried out using the Liberty Oilfield Services (LOS) Quiet Fleet. The sound power levels used for the LOS Quiet Fleet in this NIA are taken from a sound signature report prepared by Urban in 2024. The completions equipment layout for the Harvard/Yale Location is shown in Figure 14 of Appendix 1.

Production Operations at the Harvard/Yale location are implemented per the equipment layout supplied by Crestone. The sound power levels used for the production equipment in this NIA are taken from the Urban Solution Group internal database. The production equipment layout for the Harvard/Yale Location is shown in Figure 15 of Appendix 1.

Sound power levels used in each of the noise models were derived from sound pressure level measurements made for each noise source in the field. For each source, sound pressure levels were measured at specific locations on predefined measurement surfaces surrounding each noise source in accordance with ISO 3744 and ISO 3746. After raw data from the field was collected, it was uploaded to a computer for further analysis and post processing. Calculated sound power levels were entered into SoundPLAN 9.0 where they are adjusted slightly to align theoretical sound pressure levels produced by the model with the actual sound pressure levels collected on site. This additional calibration step was done to ensure potential noise contamination from neighboring equipment during data collection was removed from reported sound power levels for each piece of equipment.

Drilling Noise Model Results

Results for both unmitigated and mitigated drilling operations are presented below. The predicted levels only include sound levels from drilling operations and do not include ambient noise or noise contributions from other sources outside of the planned operations.

Though there are no RBUs within 2,000 feet of the pad, Crestone will implement a full perimeter sound wall for the Harvard/Yale location regardless. This full perimeter sound wall is not needed for compliance, but Crestone considers the area to be higher risk regarding noise sensitivity and is implementing the full perimeter sound wall to reduce the environmental noise impact on the surrounding area. The perimeter sound wall layout is shown in Figure 13 of Appendix 1 and consists of approximately 2,600 linear feet of 32-foot-tall, engineered sound wall rated at STC32.

There are no RBUs within 2,000 feet of the proposed Harvard/Yale location and thus, there is no tabular data presented in this section. Instead, noise contour maps are provided for the area surrounding the Harvard/Yale Pad. The contours are provided in 5 dB increments with the color scale indicating the sound level of each contour. Unmitigated drilling operations noise contour maps are presented in Figure 3 and Figure 4, whereas mitigated contours are shown in Figure 5 and Figure 6.

Figure 3. Unmitigated Drilling Noise Contour Map (dBA)

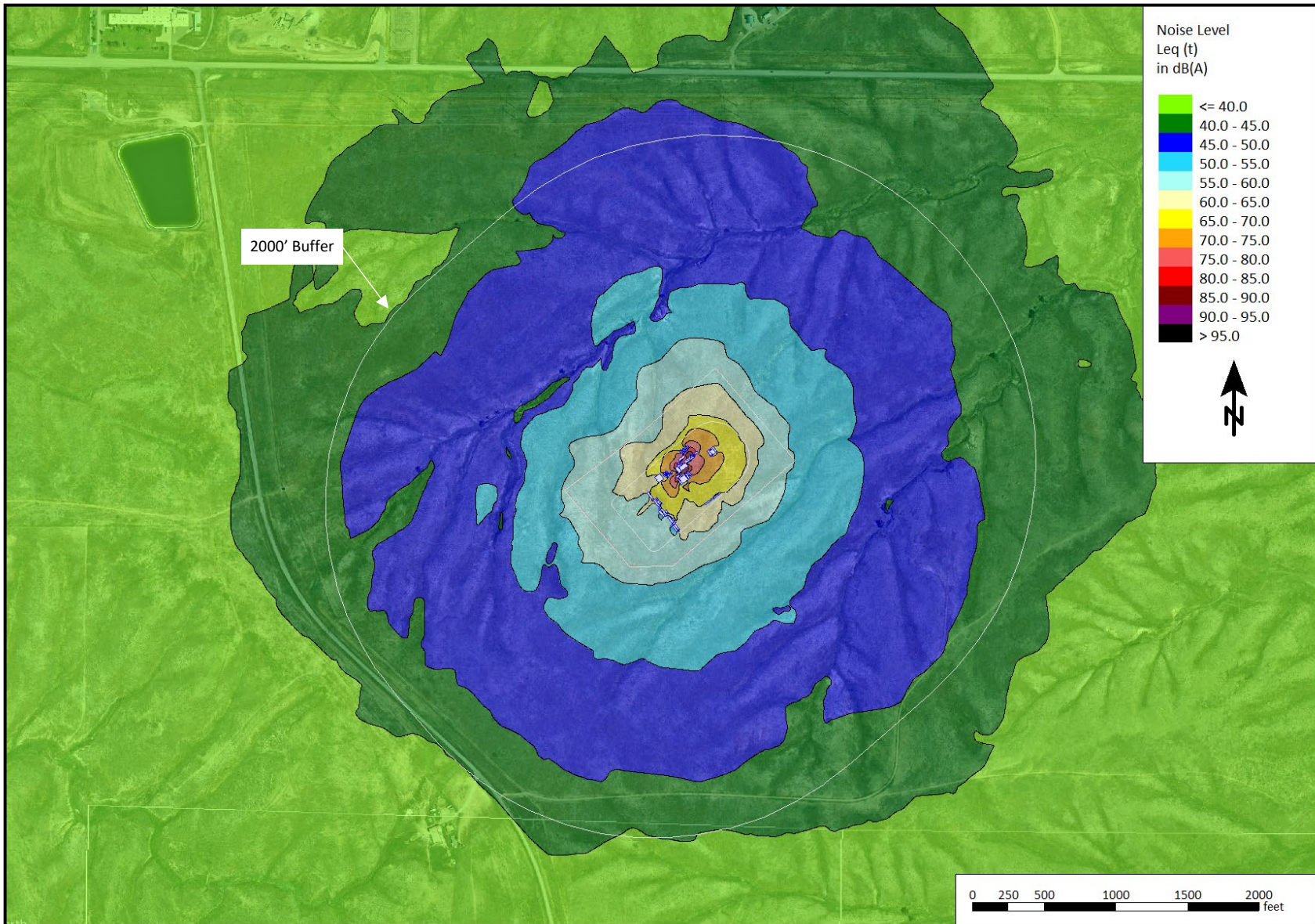


Figure 4. Unmitigated Drilling Noise Contour Map (dBC)

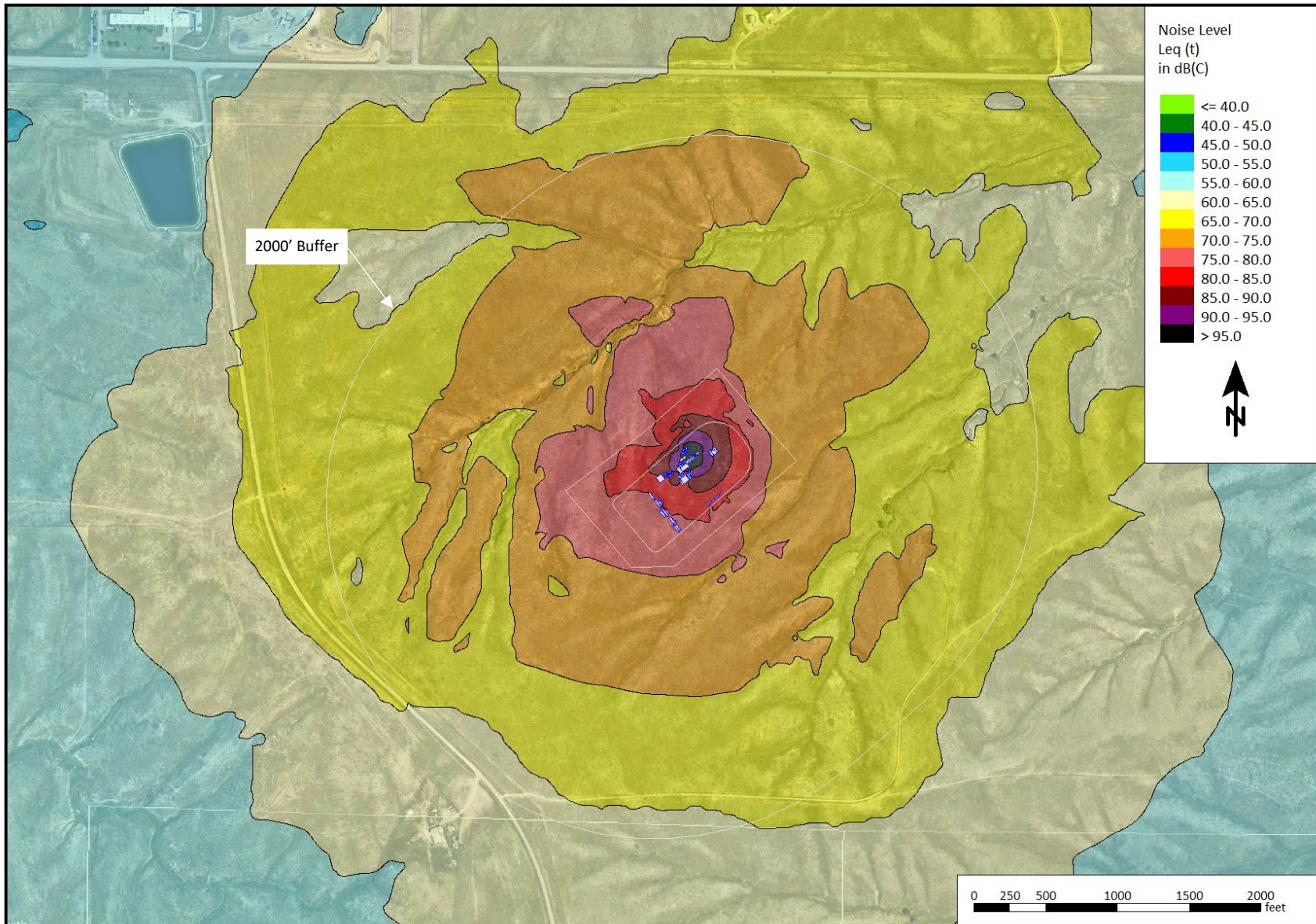


Figure 5. Mitigated Drilling Noise Contour Map (dBA)

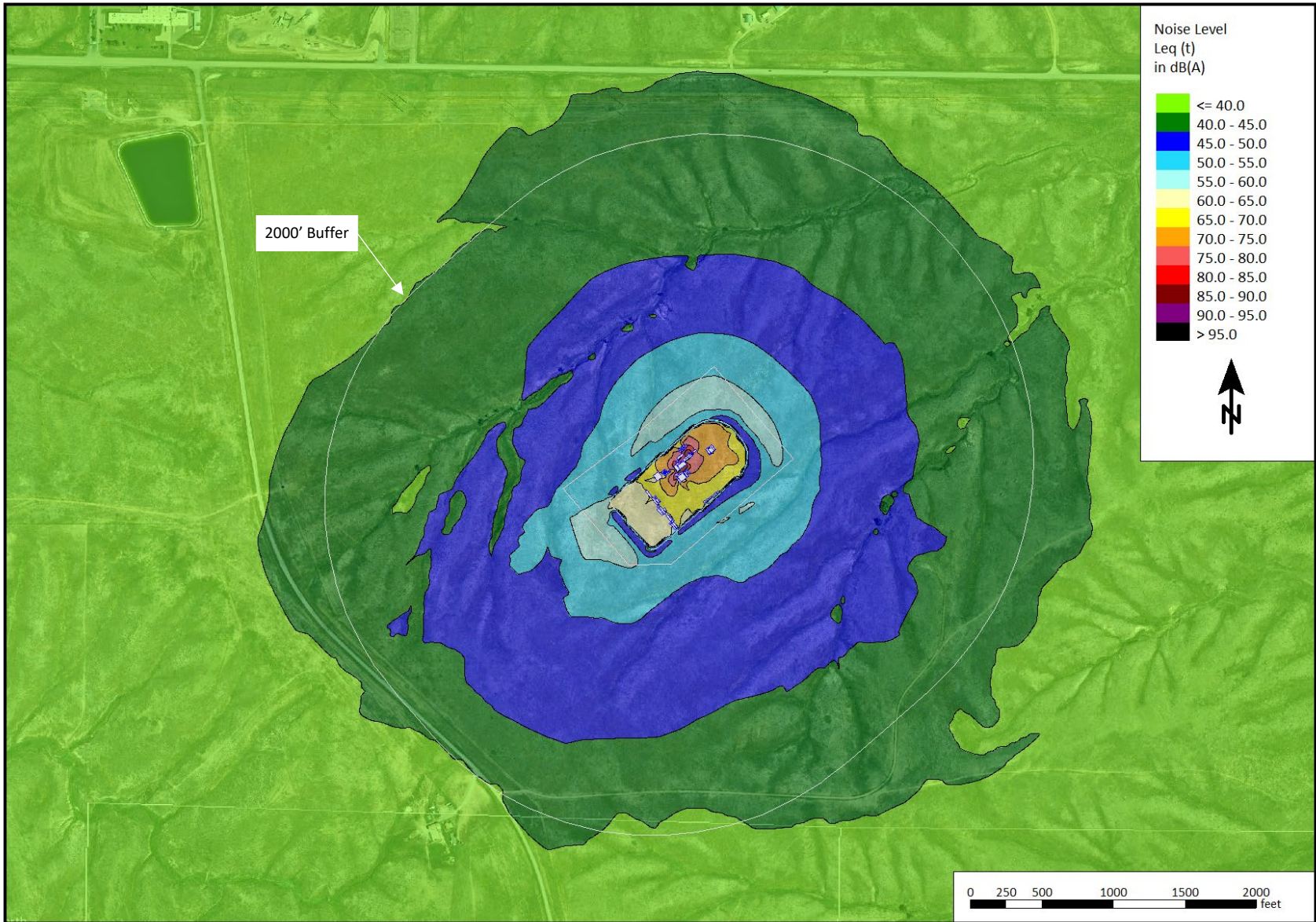
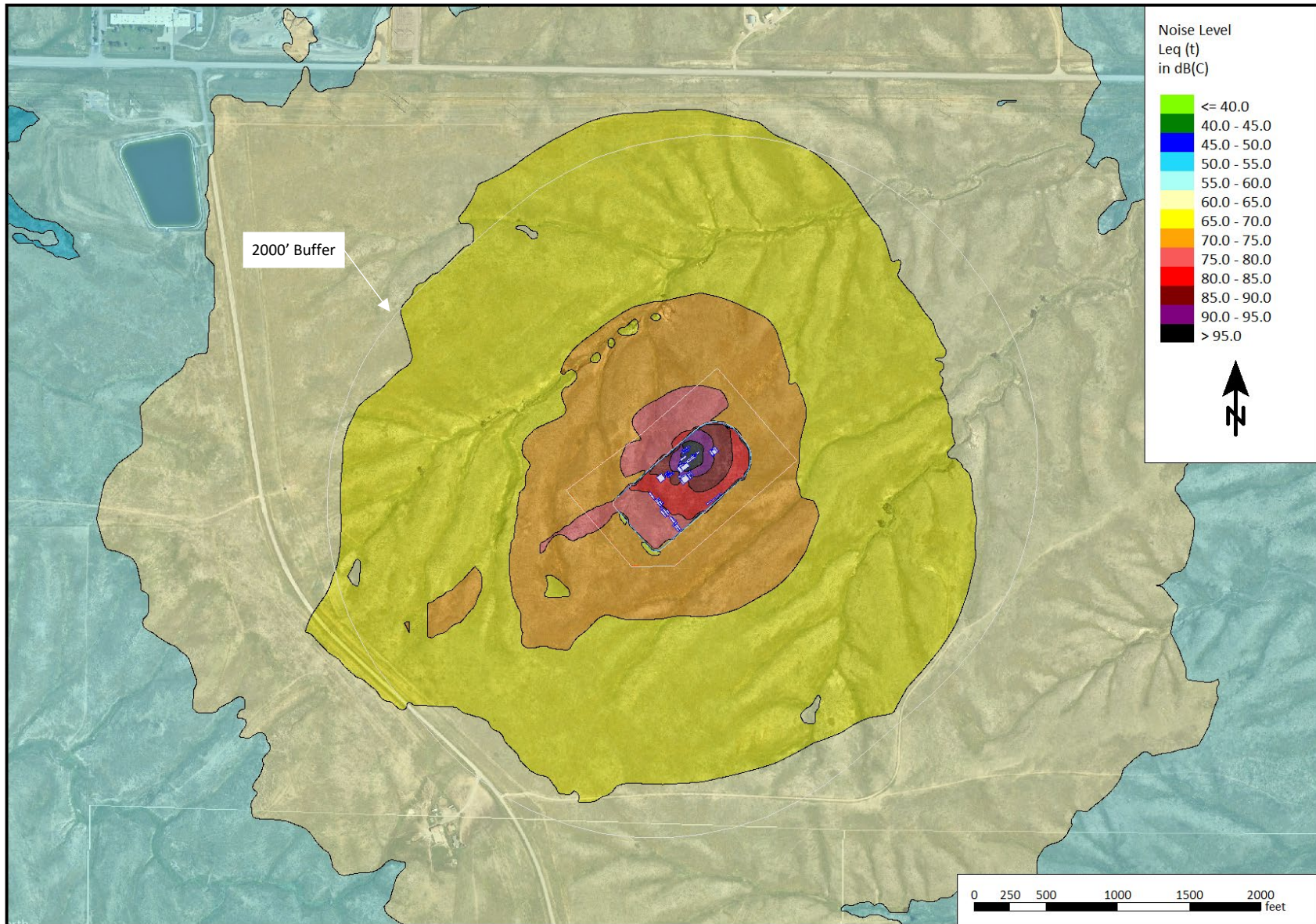


Figure 6. Mitigated Drilling Noise Contour Map (dBC)



Completions Noise Model Results

Results for both unmitigated and mitigated completions operations are presented below. The predicted levels only include sound levels from completions operations and do not include ambient noise or noise contributions from other sources outside of the planned operations.

Though there are no RBUs within 2,000 feet of the pad, Crestone will implement a full perimeter sound wall for the Harvard/Yale location regardless. This full perimeter sound wall is not needed for compliance, but Crestone considers the area to be higher risk regarding noise sensitivity and is implementing the full perimeter sound wall to reduce the environmental noise impact on the surrounding area. The perimeter sound wall layout is shown in Figure 14 of Appendix 1 and consists of approximately 2,600 linear feet of 32-foot-tall, engineered sound wall rated at STC32.

There are no RBUs within 2,000 feet of the proposed Harvard/Yale location and thus, there is no tabular data presented in this section. Instead, noise contour maps are provided for the area surrounding the Harvard/Yale Pad. The contours are provided in 5 dB increments with the color scale indicating the sound level of each contour. Unmitigated completions operations noise contour maps are presented in Figure 7 and Figure 8, whereas mitigated contours are shown in Figure 9 and Figure 10.

Figure 7. Unmitigated Completions Noise Contour Map (dBA)

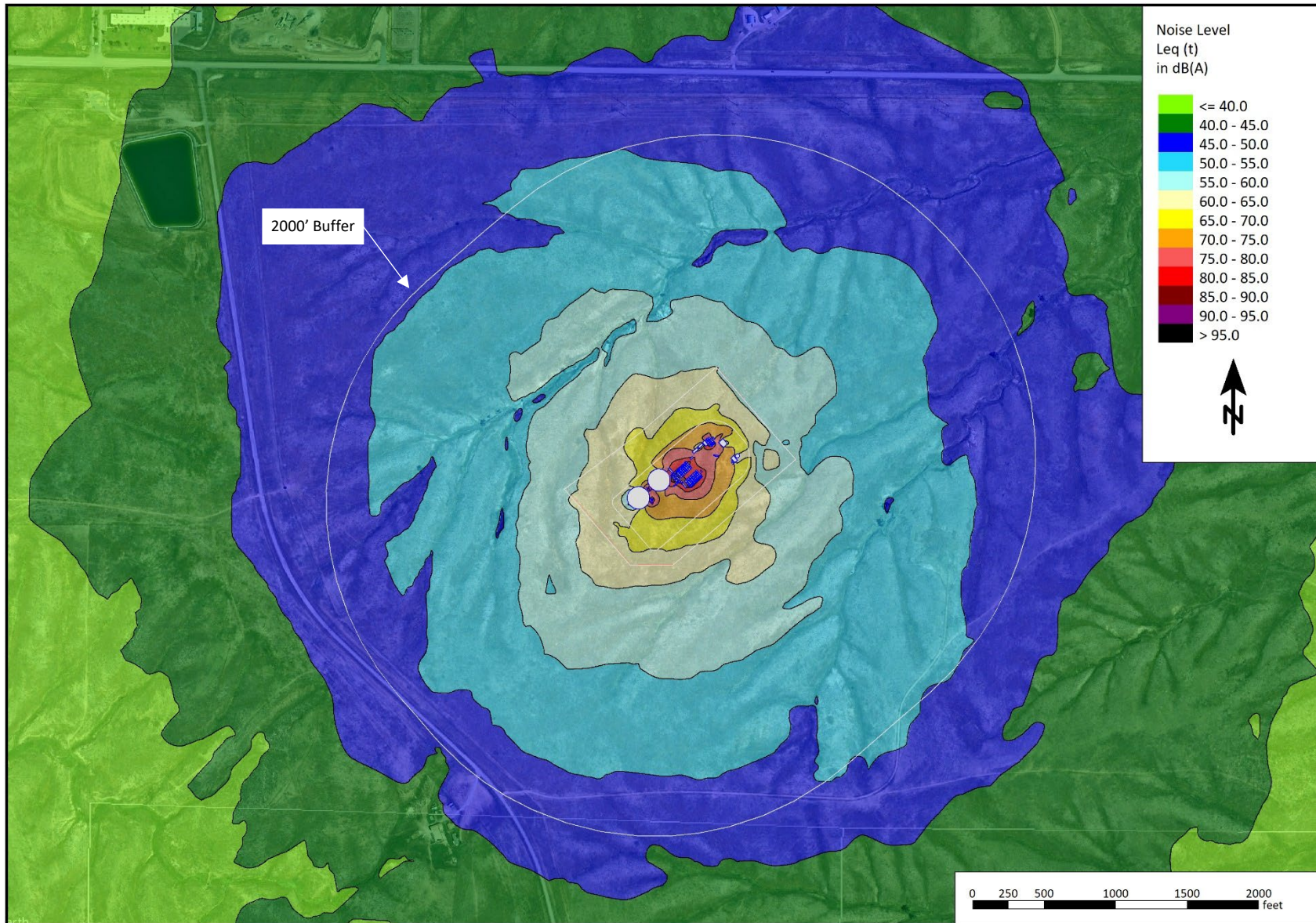


Figure 8. Unmitigated Completions Noise Contour Map (dBC)

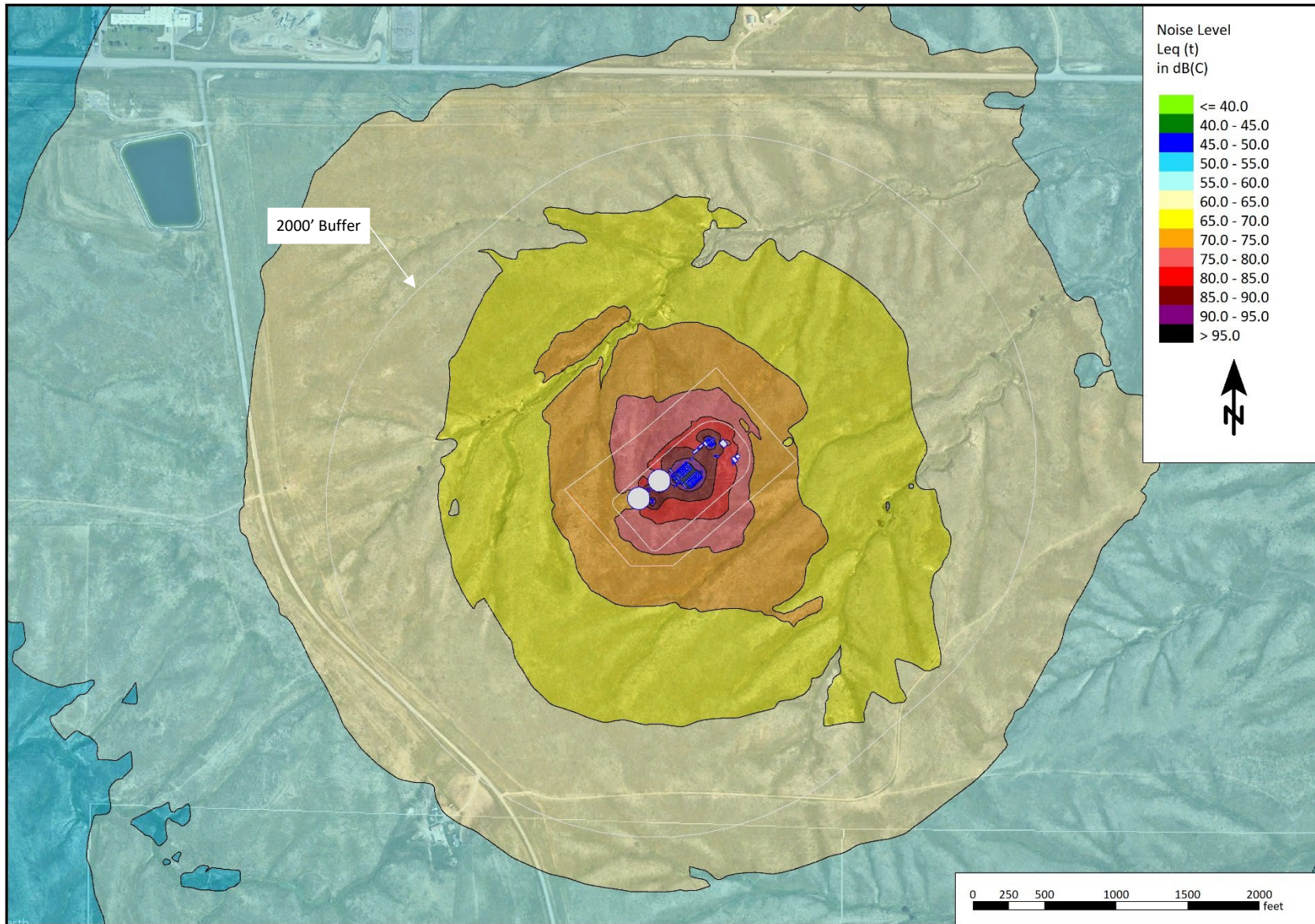


Figure 9. Mitigated Completions Noise Contour Map (dBA)

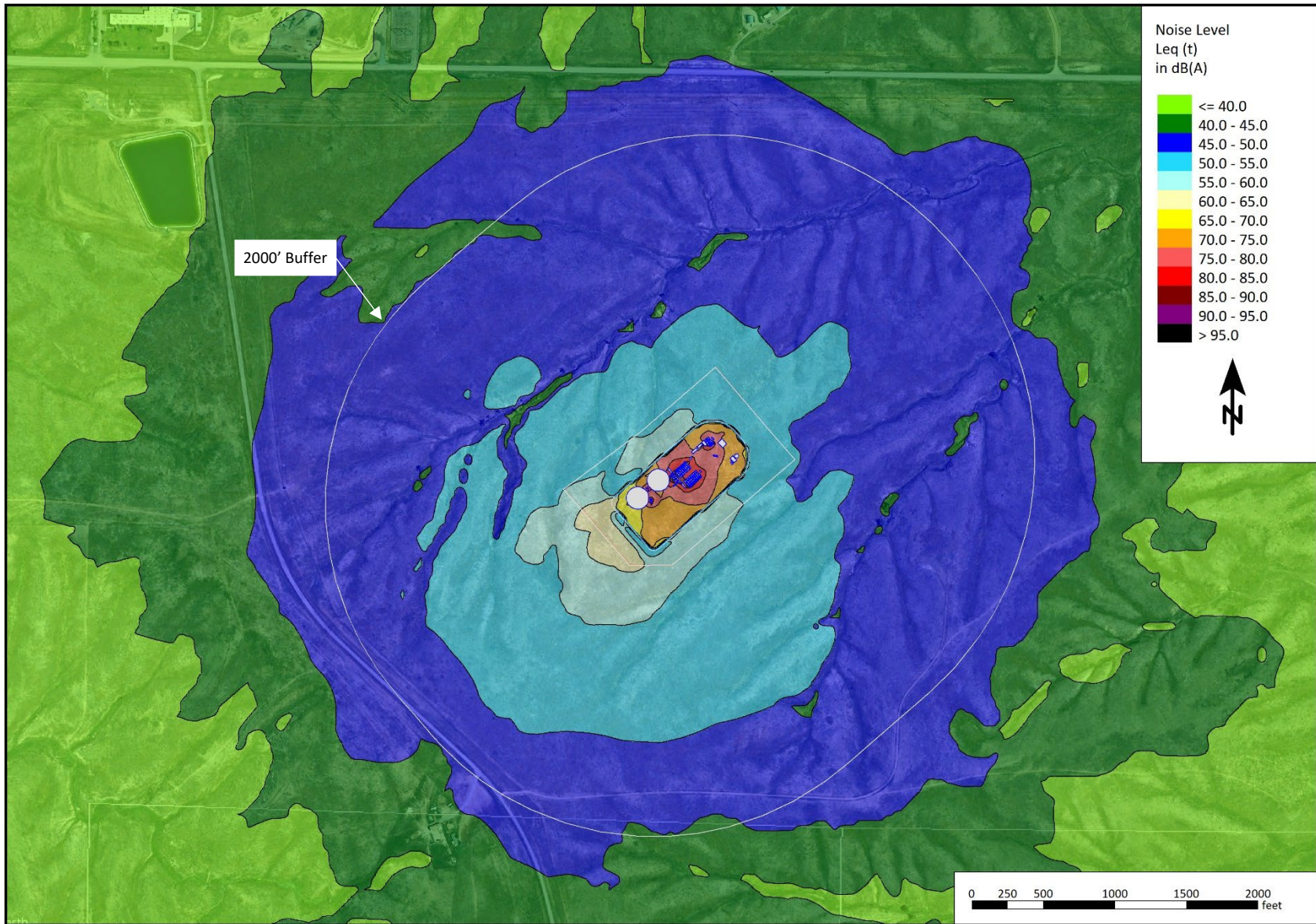
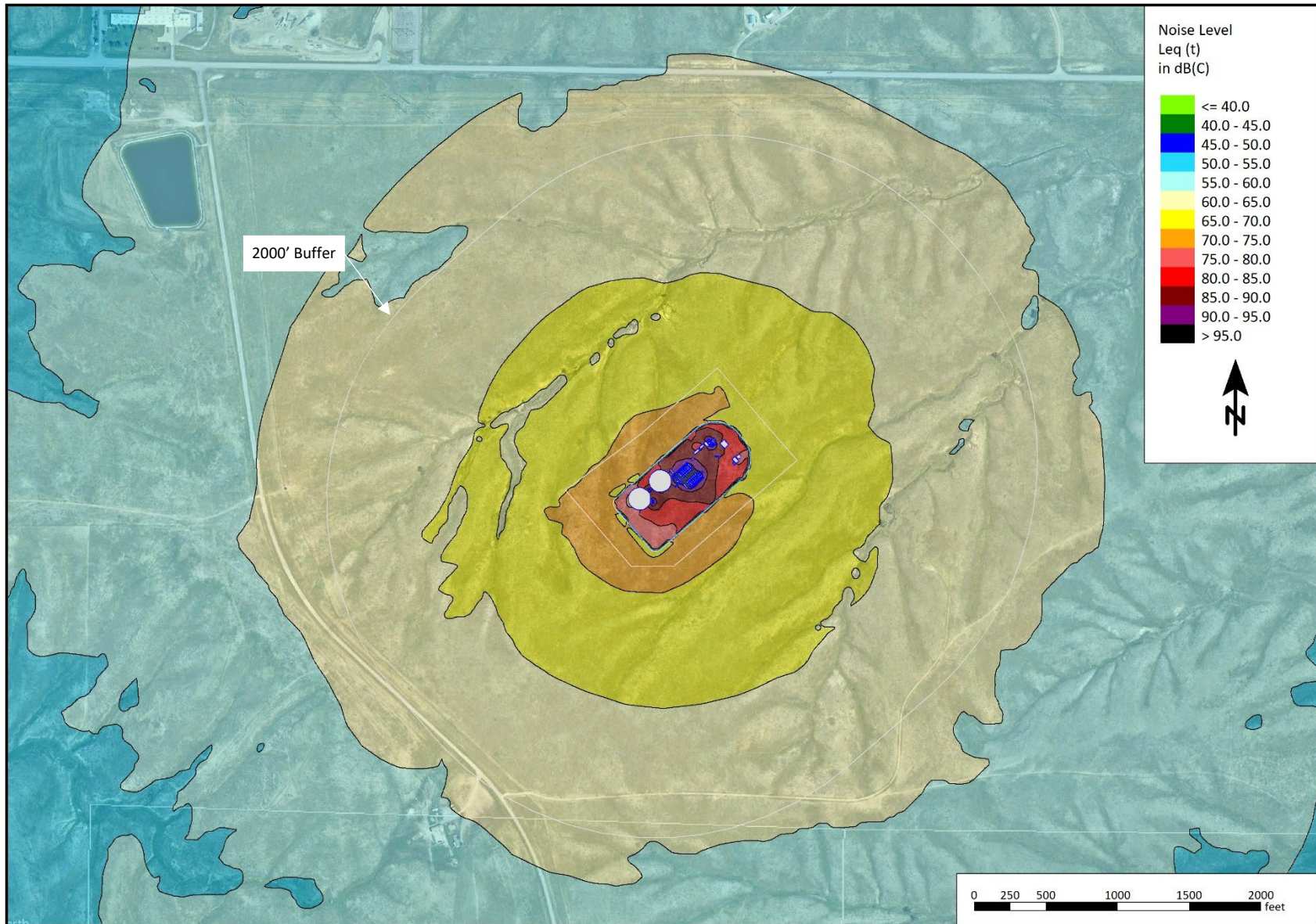


Figure 10. Mitigated Completions Noise Contour Map (dBC)



Production Noise Model Results

Model results for unmitigated production operations are presented below. The predicted levels only include sound levels from production operations and do not include ambient noise or noise contribution from other sources outside of the planned operations.

There are no RBUs within 2,000 feet of the proposed Harvard/Yale location and thus, there is no tabular data presented in this section. Instead, noise contour maps are provided for the area surrounding the Harvard/Yale Pad. The contours are provided in 5 dB increments with the color scale indicating the sound level of each contour. Unmitigated production operations noise contour maps are presented in Figure 11 and Figure 12.

Figure 11. Unmitigated Production Noise Contour Map (dBA)

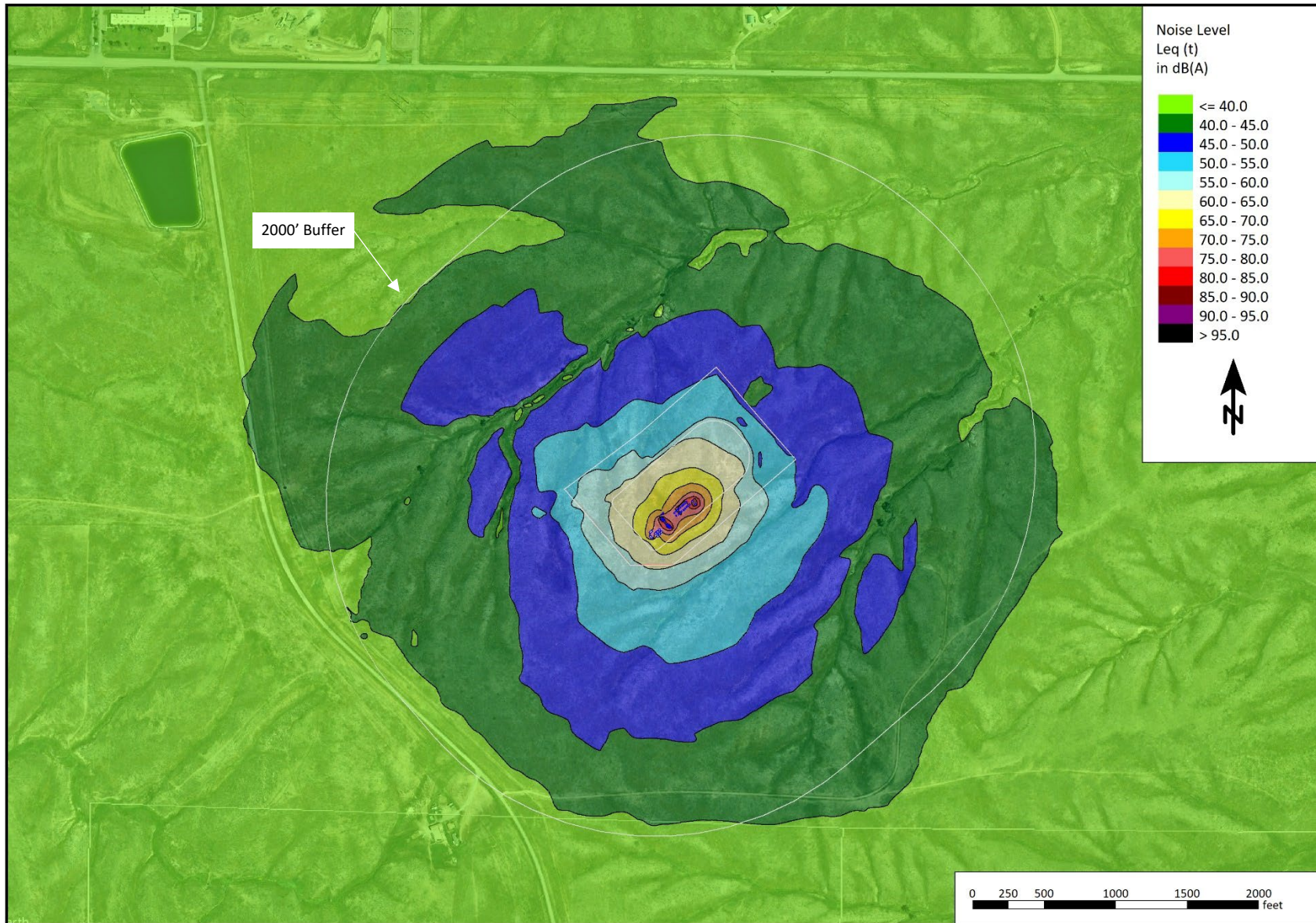
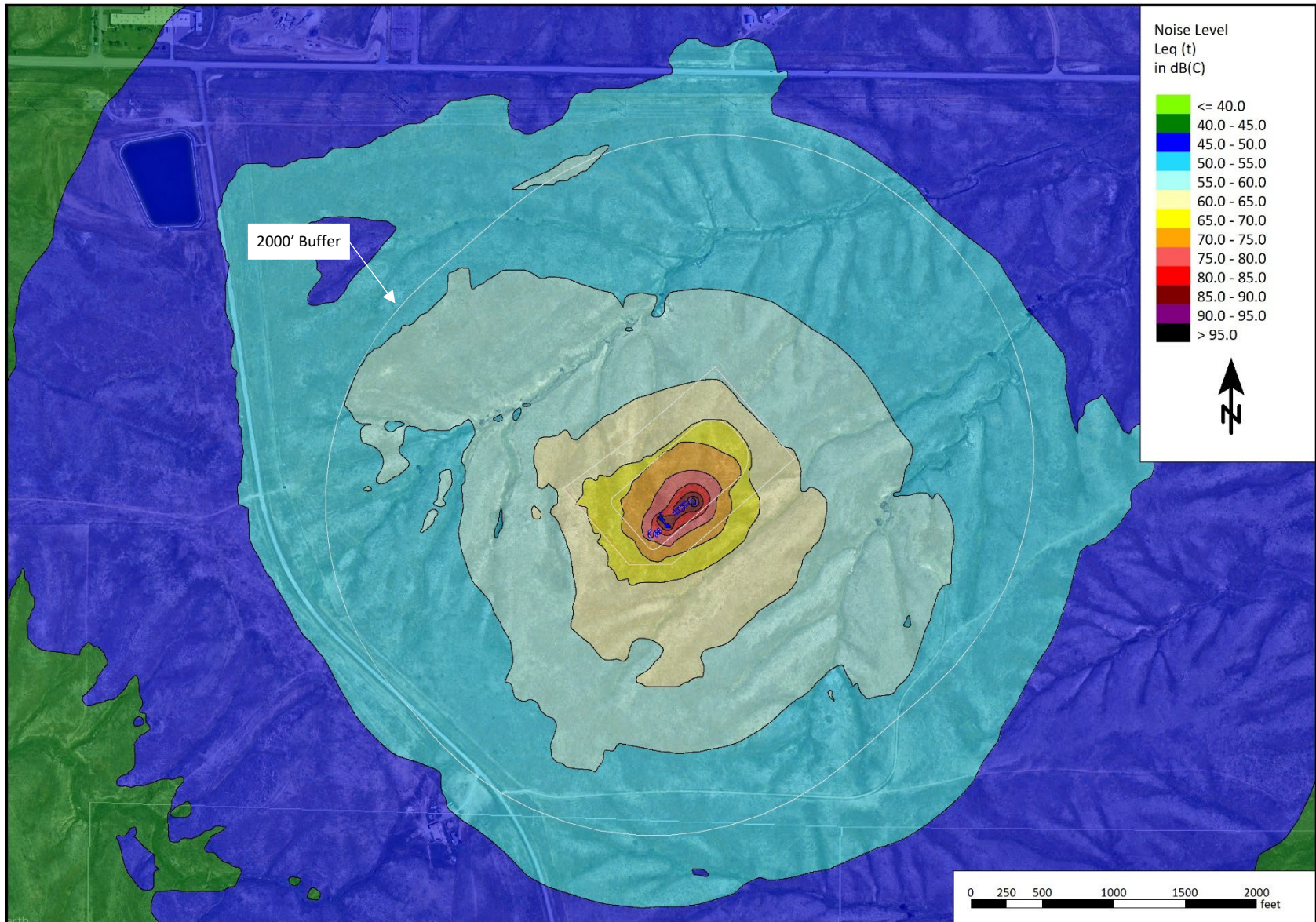


Figure 12. Unmitigated Production Noise Contour Map (dBC)



Flowback Operations Review

A review of flowback operations was carried out by Urban based on information supplied by Crestone. It was determined that flowback can be reduced to two simple, successive, operations from a noise perspective; these are “drill out” and “surface flow”. Both flowback operational components were assessed, and it was found that neither warrant noise modeling as outlined below.

The drill out operation utilizes equipment similar to a large production drilling rig, but much smaller in size, with reduced equipment quantities and produce much lower noise signatures as compared to the large production rig. This results in a noise signature of the drill out portion of flowback operation having much lower noise levels than either the production drilling rig or completions operations (on both a dBA and dBC basis).

The second part of the flowback operation is conducted once the drill out operation is complete, when well flows are initiated and directed to a series of temporary valves, screens, sand traps, separators, and mobile tanks instead of the production facility equipment. The temporary flowback equipment is similar to the production equipment already studied for production operations but utilizes smaller units with reduced quantities of individual equipment pieces, again with lower noise levels. This results in noise levels lower than the production operation studied in this assessment (on both a dBA and dBC basis). Since flowback operations are held to the higher MPNLs of preproduction operations instead of the lower MPNLs associated with production operations, there is very low risk from a nuisance environmental noise perspective for the surface flow portion of flowback operations.

Given the characteristics of the two components of the flowback operation outlined above and the fact that both the drill out and surface flow portions have noise levels significantly lower than other phases of operations assessed in this study, there is no need for special consideration (noise modeling, etc.) of the flowback operation as long as any perimeter sound walls needed for drilling/completions compliance are left in place until drill out is complete and surface flows are initiated.

9 CONTINUOUS MONITORING / COMPLAINT RESOLUTION

Throughout the duration of preproduction operations, Crestone will conduct Continuous Noise Monitoring at the ambient monitoring points shown in Figure 2 of Section 7.

Continuous monitoring services are deployed to provide continuous noise level documentation and compliance verification throughout preproduction operations. If a noise complaint is made to either Crestone directly (or to the Colorado ECMC), or the Local Government Designee, and the Operator is notified of the complaint, Crestone is able to reference continuous monitoring data and identify the source of any sound level 'spike(s)' throughout the monitoring period.

The sound level meters collect measurements of A- and C-weighted decibel (dB) levels by continuously sampling sound levels, logging the specified data every minute. The meters are calibrated before and after the measurement period to ensure accuracy. They also have an internal system check function that runs daily and will issue an alert if necessary, so that any issues detected can be attended to promptly. The hourly Leq values shown in Continuous Noise Monitoring reporting are calculated by averaging 1-minute Leq noise levels when the wind is below 5 miles per hour, per Colorado ECMC Rule 423 noise regulations.

Crestone will post contact information to receive and address noise complaints arising from preproduction operations around the clock, 24 hours, 7 days per week. Upon receipt of a complaint, either directly to Crestone or from the Colorado ECMC, Crestone will contact the associated stakeholder within 48 hours of receipt.

10 CONCLUSION

The results of the proactive planning, noise modeling, and implementation of Best Management Practices as discussed in this NMP indicate that noise levels generated by Crestone's proposed oil and gas operations at the Harvard/Yale Location are expected to comply with permissible noise levels required by the Colorado ECMC Rule 423 noise regulation for all operations proposed (drilling, completions, flowback, and production).

11 NOTATIONS

The services provided for this project were performed in accordance with generally accepted professional consulting services. No warranty, expressed or implied, is made or intended by rendition of these consulting services or by furnishing oral or written reports of the findings made. Urban Solution Group generated this report for the exclusive use of Crestone.

Appendix 1 – Equipment Layouts

Figure 13. Drilling Equipment and Soundwall Layout for the Patterson Automated Walking Rig System

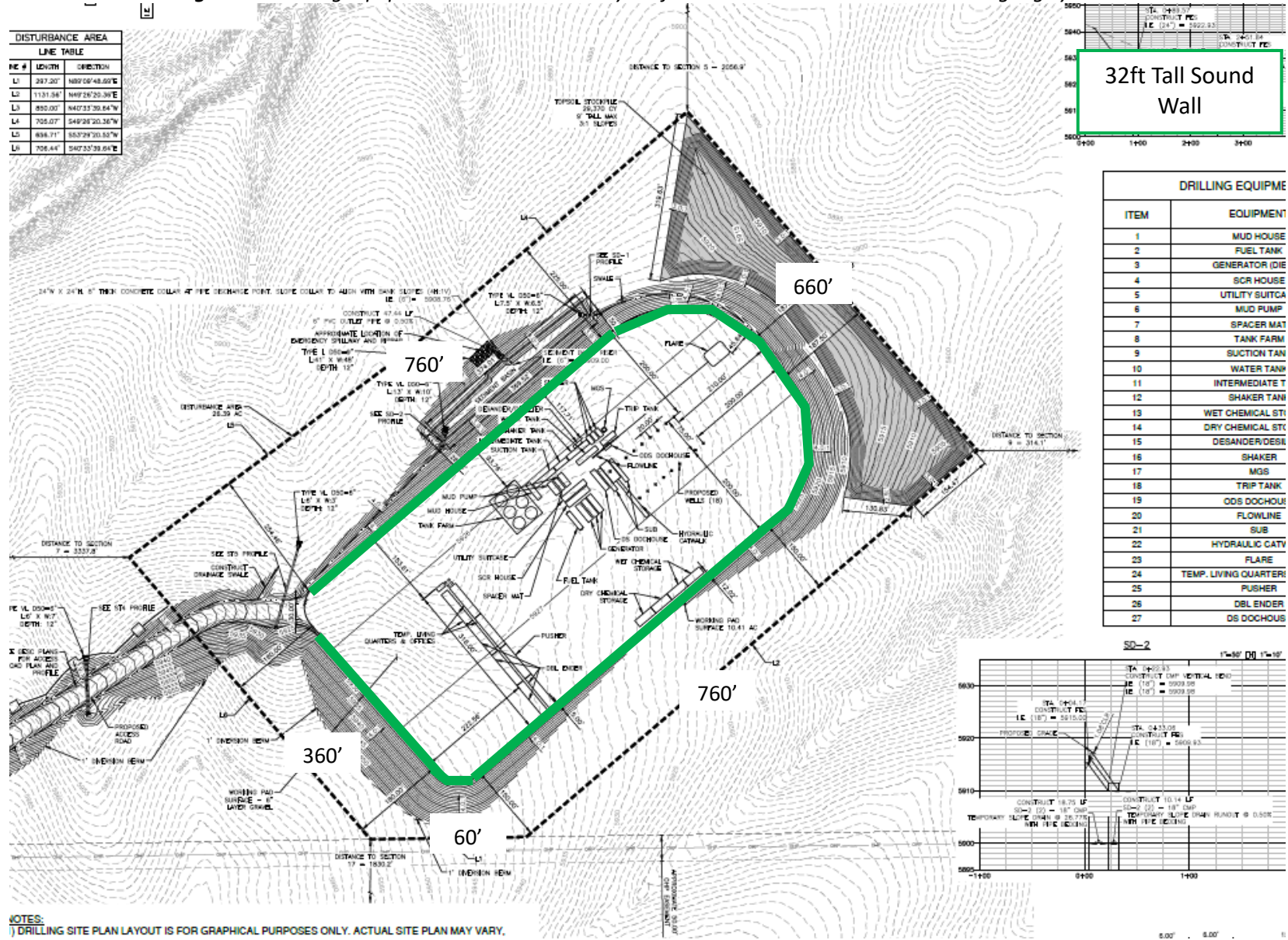


Figure 14. Completions Equipment and Soundwall Layout for the Liberty Quiet Fleet

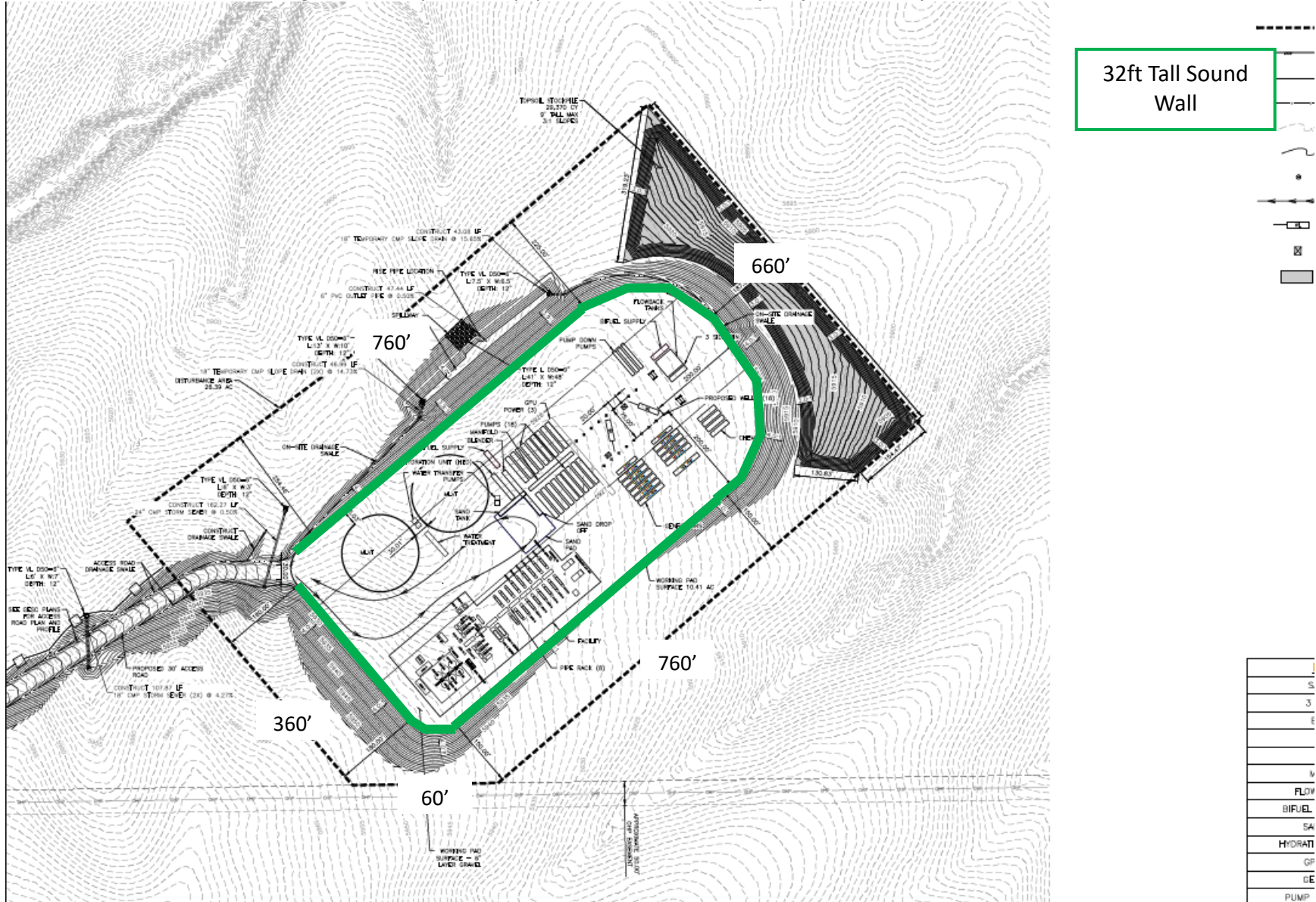
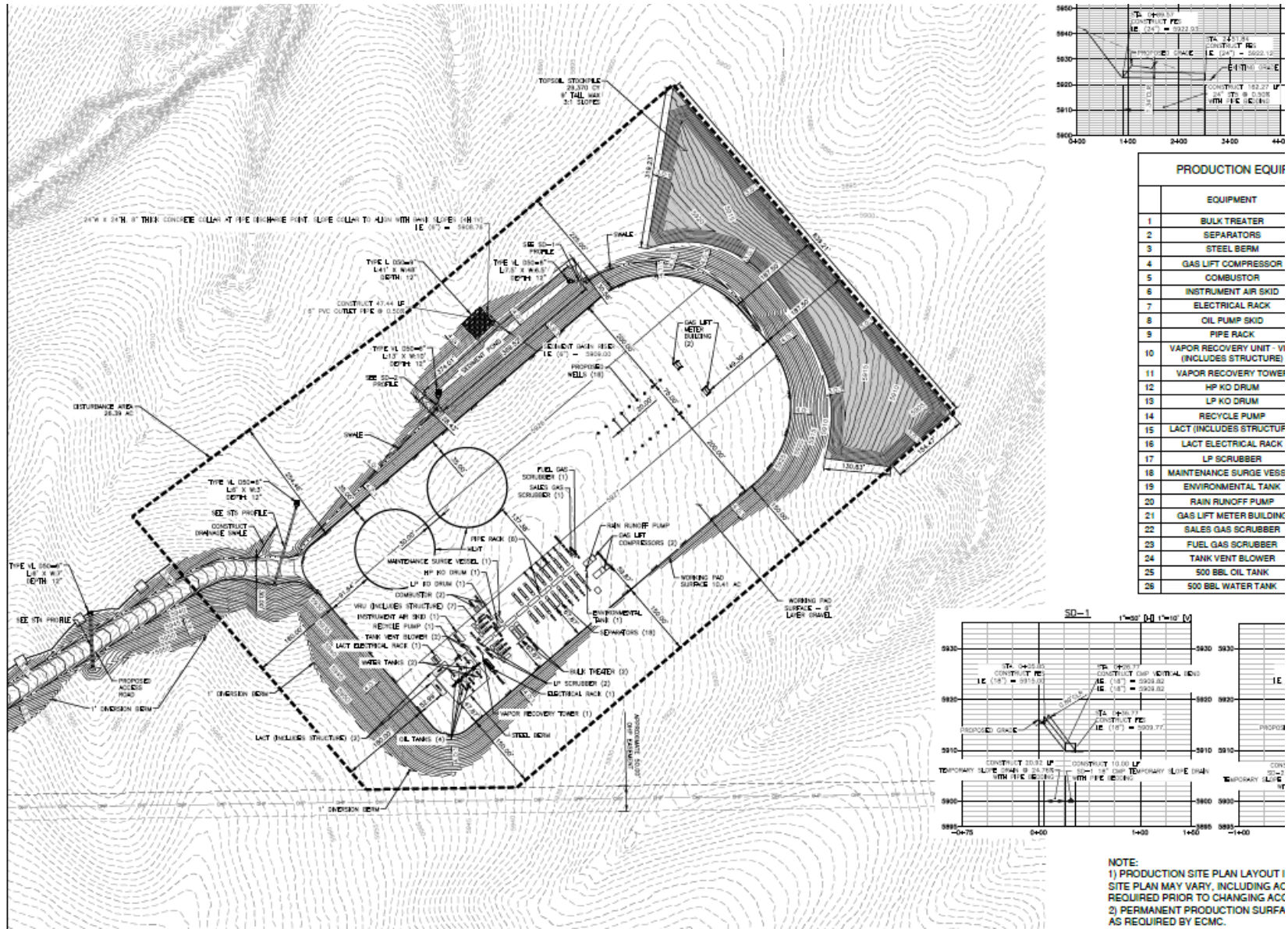


Figure 15. Production Equipment



Appendix 2 – Ambient Data and Charts

Figure 16. Chart of Unfiltered Hourly Averages for Monitoring Point 1

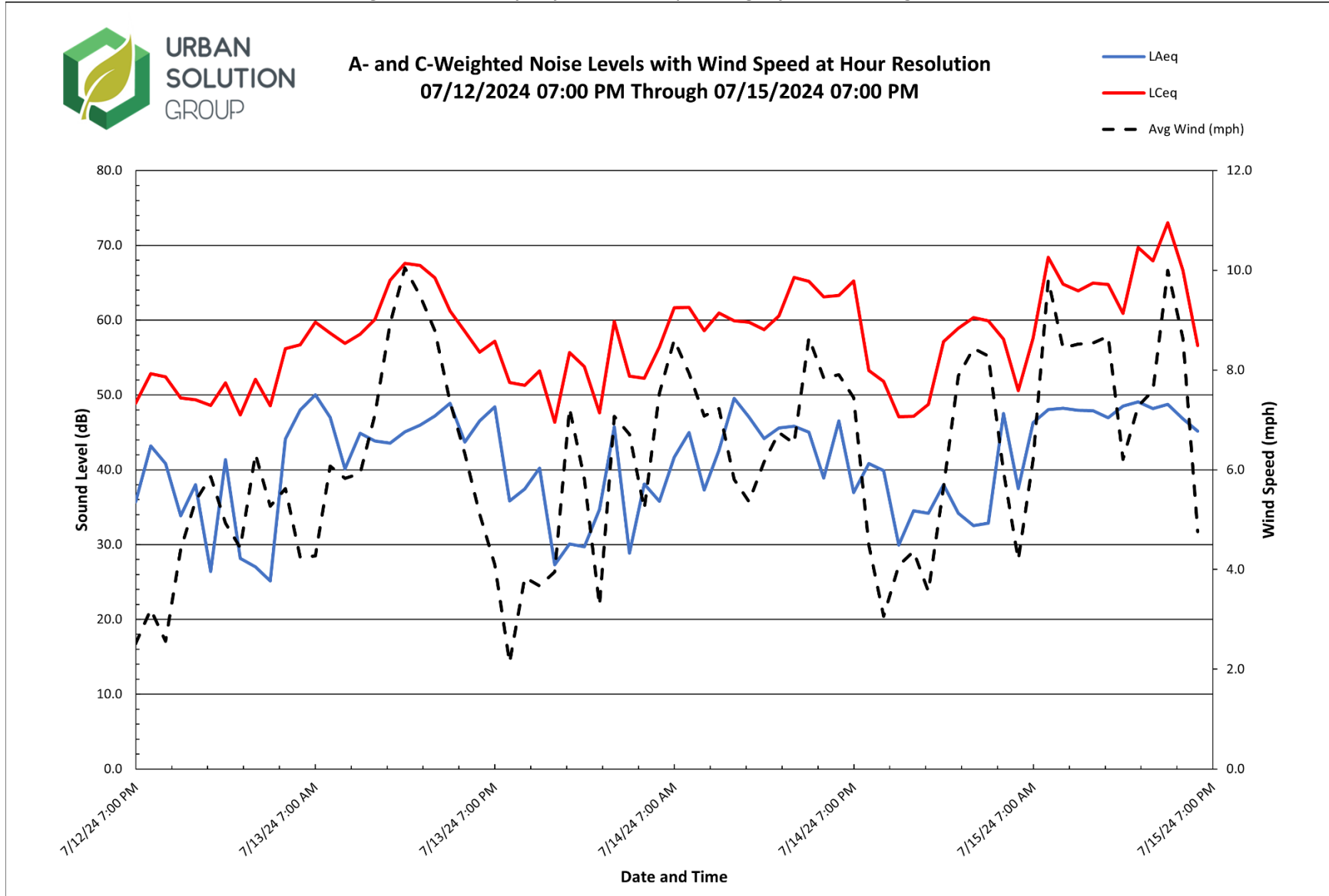
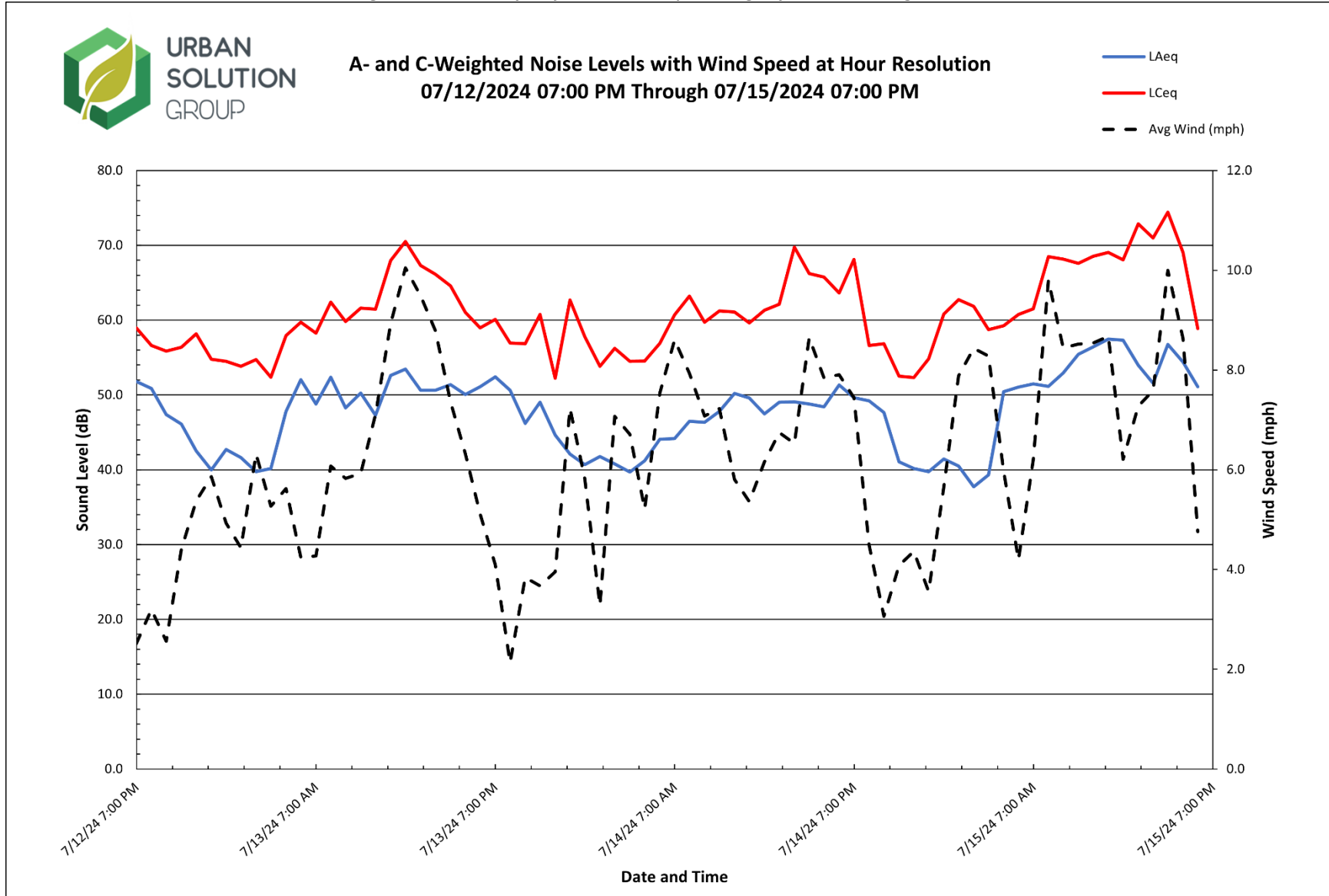


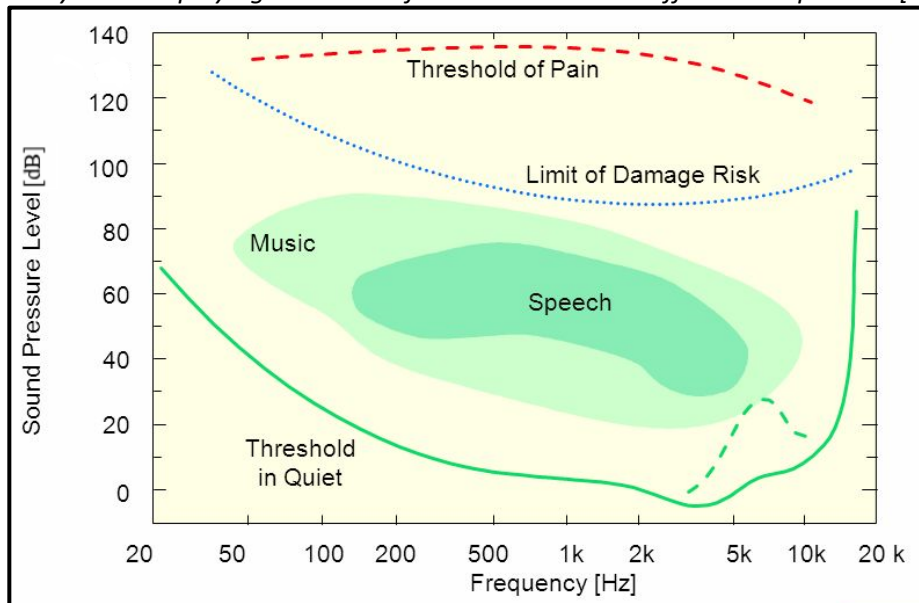
Figure 17. Chart of Unfiltered Hourly Averages for Monitoring Point 2



Appendix 3 – Sound Fundamentals

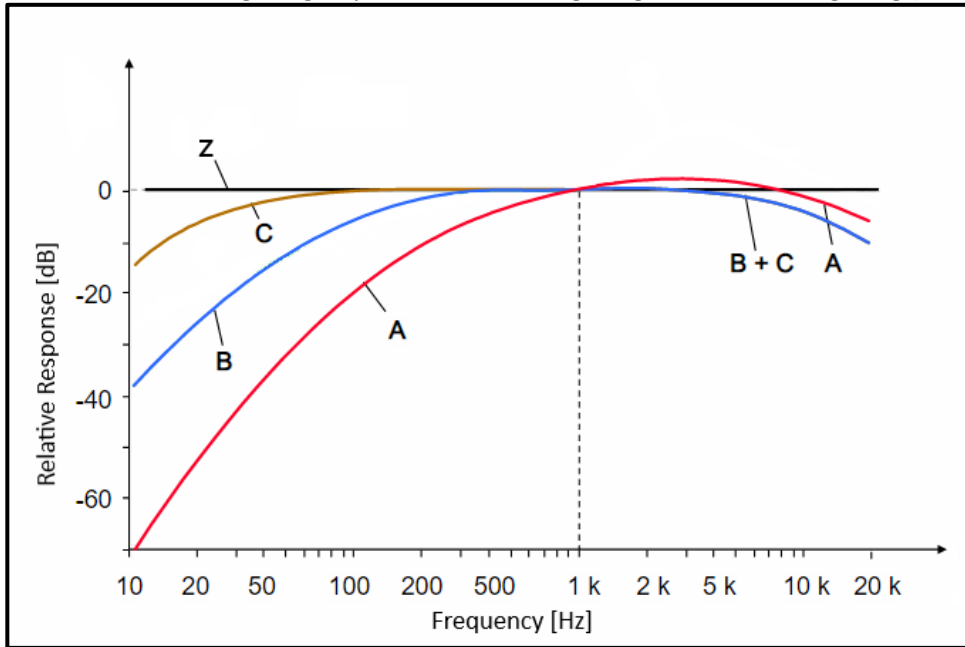
Sound is a series of vibrations transmitted through the air, or other medium, and can be heard when they are processed by the human ear. There are two important properties that describe sound; frequency and amplitude. Frequency is determined by the rate of movement and is measured in cycles per second, which is known as Hertz (Hz). A healthy human ear can hear 20 Hz – 20,000 Hz (Figure A). The sensation associated with frequency is commonly referred to as the pitch of a sound. High frequencies produce a higher pitch and vice versa. The amplitude of a sound is determined by the maximum displacement of air molecules produced by the vibrations. These displacements lead to pressure fluctuations in air, which are expressed in decibels (dB). Decibels are a logarithmic ratio of sound pressure over the standard threshold of hearing. The more energy a sound has, the larger the pressure fluctuations, resulting in a louder sound.

Figure A: Auditory Field Displaying Thresholds for a Human Ear at Different Frequencies [Bruel and Kjaer]



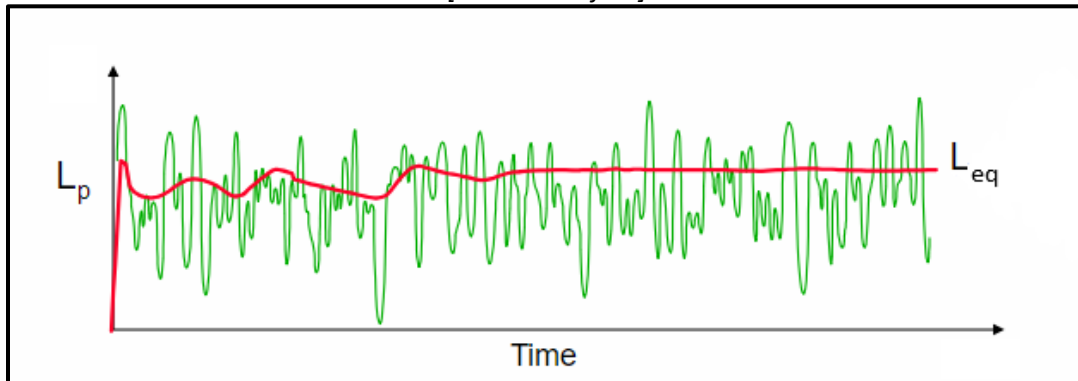
Frequency weightings are applied to measurements to provide a better match between measured results and human perception. Each weighting, in relation to their frequency components, allows for a consistent measurement of the different type of noise sources. A-weighted decibel sound pressure levels (dBA) are measurements recorded from a sound level meter measuring sounds similar to the response of the ear (Figure B). While C-weighted (dBC) measurements are for low-frequency components.

Figure B: Common Sound Weightings Up to 20 kHz, Z-Weighting Means No Weighting [Bruel and Kjaer]



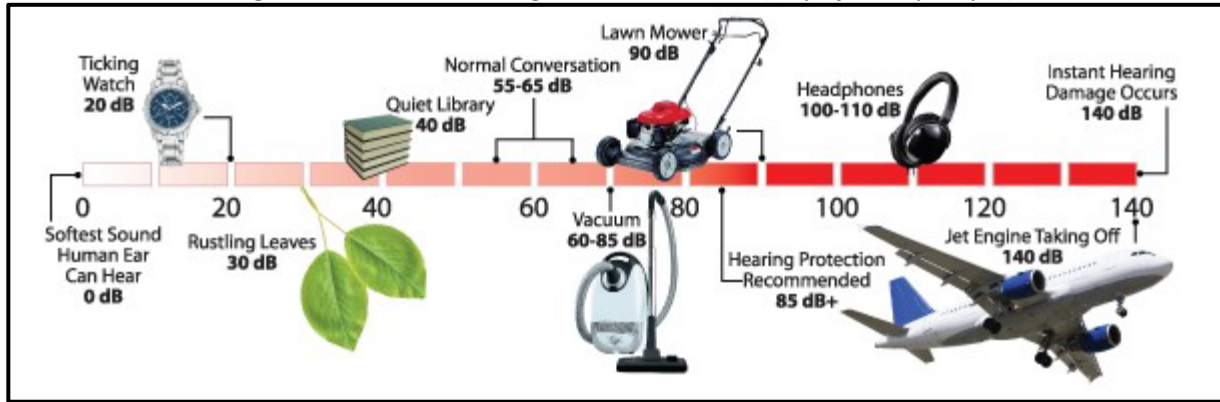
Each measurement has an exponential time factor. Slow time weighting is the most common for environmental noise measurements and will be used for these measurements. For recording over long periods of time, the sound level meter records each weighted decibel reading with an equivalent, or average, continuous sound level reading (L_{eq}). L_{eq} represents the same energy as the actual time varying sound signal (Figure C). L_{Aeq} refers to the equivalent continuous sound level for an A-weighted measurement.

Figure C: Sound Level Recording Displaying L_{eq} , a Steady-State Sound Level, Over a Noise Measurement [Bruel and Kjaer]



Environmental noise is a combination of various noise sources. These sources may include; vehicle traffic, aircraft flyovers, wind, weather disturbances, commercial or industrial activities, and other short-term events. These sources create “background noise”. Background noise varies throughout the day, generally following the cycle of human activity. Figure D below presents typical A-weighted (dBA) sound levels for common sources of sound.

Figure D: Common A-weighted Sound Levels [City of Albuquerque]



Appendix 4 – Glossary

Ambient Noise

All noises that exist in an area and are not related to facility. Ambient noise includes sound from other industrial noise not subject to this directive, transportation sources, animals and nature.

Average Sound Level

See Energy Equivalent Sound Level.

A-weighted sound level

The sound level as measured on a sound level meter using a setting that emphasizes the middle frequency components similar to the frequency response of the human ear.

Calibration

A procedure used for the adjustment of a sound level meter using a reference source of a known sound pressure level and frequency. Calibration must take place before and after the sound level measurements.

C-weighted Sound Level

The C-weighting approximates the sensitivity of human hearing at the industrial noise levels (above 85 dBA). The C-weighted sound level is more sensitive to the sounds used to assess the low- frequencies than the A-weighted sound level. It is sometimes used to assess the low-frequency content of complex sound environments.

Day Night Sound Level (Ldn)

Is the average noise level over a 24-hour period. The noise between the hours of 22:00 and 07:00 is artificially increased by 10 dB. The nighttime noise is weighted to consider the decrease in community background noise.

Daytime Average Sound Level

The time-averaged A-weighted sound level measured between the daytime hours, usually defined as 7:00 am to 7:00 pm.

Decibel (dB)

A unit of measure of sound pressure that compresses a large range of numbers into a more meaningful scale. The basic unit of measurement for sound levels.

dBA

The decibel (dB) sound pressure level filtered through the A filtering network to approximate human hearing response. See dB and A-weighted Sound Level.

dBC

The decibel (dB) sound pressure level filtered through the C filtering network. See dB and C-weighted Sound Level.



Energy Equivalent Sound Level (L_{eq})

The L_{eq} is a single-number average, sound level that represents cumulative acoustical energy as measured over a specified time interval.

Facility

Any operation used in exploration, processing, development and transportation of energy resources.

Frequency

The number of oscillations per second for a sound wave.

Impulse Noise

Unwanted, instantaneous sharp sounds that create sudden impulses of pressure similar to gunfire and explosions.

Noise Reduction

The difference in sound pressure level between two points.

Nighttime Average Sound Level (L_{night})

The time-averaged A-weighted sound level measured between the nighttime hours, usually defined as 7:00 pm to 7:00 am.

Ldn

See Day night sound level.

Leq

See Energy Equivalent Sound Level.

Noise

Generally understood as unwanted sound.

Noise Impact Assessment (NIA)

Identifies the expected sound level emanating from operations and receptor points are placed in locations related to compliance. It also identifies what the permissible sound level is and how it was calculated.

Noise Reduction Coefficient (NRC)

A single number rating of the sound absorption properties for a material. An NRC value of zero indicates the material is purely reflective. An NRC value of one indicates perfect absorption.

Octave Band

An octave band is a frequency band that spans one octave. A band is said to be an octave in width when the upper band frequency is twice the lower band frequency. Octave bands are commonly used in engineering acoustics. The nine common octave bands used for the study of industrial noise are identified by their center frequencies as 31.5Hz, 63Hz, 125Hz, 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz, and 8000 Hz.

Point Source

A source that radiates sound from a single point. Generally used to model equipment when looking at the sound impact over a large area.

Receiver

A person or piece of equipment that is affected by noise.

Sound

A series of vibrations transmitted through the air, or other medium, and can be heard when they are processed by the human ear.

Sound Level Meter (SLM)

An instrument that contains a microphone and filter used to measure sound levels, using standard frequency-weightings and exponentially weighted time averaging.

Sound Power Level

A physical measurement of the amount of power a sound source radiates into the surrounding air. It is the rate at which sound energy is emitted, or received, per unit time.

Sound Pressure Level (SPL)

The sound level received at a given location. The decibel equivalent of the rate of sound pressure waves at a measured location, usually with a microphone.

Sound Transmission Class (STC)

An integer rating that measures how well a barrier or building partition attenuates sound. Indicates how well a barrier is at stopping sound from transmitting through it.

1/3 Octave Band

The 1/3 octave band analysis provides a finer breakdown of sound energy distribution (compared to full octave band) as a function of frequency.