



**URBAN  
SOLUTION  
GROUP**

## **Colorado ECMC Form 2A Noise Mitigation Plan**

**747 Pad  
Aurora, Colorado**

Prepared for:

Bison IV Operating, LLC  
518 17<sup>th</sup> Street, Suite 1800  
Denver, CO 80202

Prepared by:

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

November 12, 2024



# TABLE OF CONTENTS

1	Executive Summary .....	2
2	Regulations and Noise Standards Summary.....	3
	Colorado ECMC Rule 423 Noise Regulation – Brief Overview .....	3
	Compliance Summary (Unadjusted) .....	6
	Maximum Permissible Noise Levels (Adjusted) - Summary .....	7
3	Summary of BMPs and Mitigation to be Implemented .....	8
4	Site Information.....	9
5	Compliance Points .....	10
6	Estimated Operations & Duration Schedule .....	10
7	Ambient Sound Level Survey.....	11
8	Noise Impact Assessment.....	13
	Methodology.....	13
	Equipment Information and Site Layouts .....	14
	Drilling Noise Model Results .....	15
	Completions Noise Model Results .....	20
	Production Noise Model Results.....	25
	Flowback Operations Review.....	28
9	Continuous Monitoring / Complaint Resolution .....	29
10	Conclusion .....	30
11	Notations .....	30
	Appendix 1 – Equipment Layouts .....	31
	Appendix 2 – Ambient Data and Charts.....	35
	Appendix 3 – Sound Fundamentals .....	38
	Appendix 4 – Glossary.....	41

**Report Submitted to:**

Bryce Maifeld  
Bison IV Operating, LLC  
(720) 644-6997  
bmaifeld@bisonog.com

**Report Contact:**

Gareth Svanda  
Urban Solution Group  
(714) 510-4926  
gareth.svanda@urbansolutiongroup.com

## 1 EXECUTIVE SUMMARY

Urban Solution Group, LLC (Urban) was commissioned to prepare a Noise Mitigation Plan (NMP) for the proposed 747 oil and gas location to be operated by **Bison IV Operating, LLC** (Bison). Bison is proposing to develop oil and natural gas wells at the 747 Pad located in Aurora, 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 noise regulation.

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 Precision Drilling Super Triple 1200 Drilling Rig
  - Completions operations with a Liberty Oilfield Services Quiet Fleet
  - Production operations with the equipment and layout proposed by Bison
- Specification of Best Management Practices (BMPs) that will be implemented at the proposed 747 Pad such that all operations comply with both 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 747 Pad are summarized as follows:

Analysis Type	Result
Noise points of compliance	<ul style="list-style-type: none"> <li>• All residential building units are beyond 2,000 feet from the edge of the working pad surface. Thus, there are no noise points of compliance.</li> </ul>
Pre-Operational Ambient Sound Level Survey	<ul style="list-style-type: none"> <li>• Ambient sound levels were measured at two locations near the proposed pad</li> <li>• Ambient adjustments apply to all phases of operation as shown in Table 4</li> </ul>
Drilling Operations NIA	<ul style="list-style-type: none"> <li>• No mitigation required. Bison to erect an engineered sound wall on the east edge of pad: 680 linear feet of 32-foot-tall, STC32 wall due to sensitive nature of the area as part of BMPs.</li> </ul>
Completions Operations NIA	<ul style="list-style-type: none"> <li>• No mitigation required; Bison to erect an engineered sound wall on the east edge of pad: 680 linear feet of 32-foot-tall, STC32 wall due to sensitive nature of the area as part of BMPs.</li> </ul>
Flowback Operations	<ul style="list-style-type: none"> <li>• 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</li> </ul>
Production Operations NIA	<ul style="list-style-type: none"> <li>• No noise mitigation required.</li> </ul>

## 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. This regulation sets 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)**

There are no RBUs within 2,000 feet of the proposed 747 pad and thus, there are no noise points of compliance.

The location is zoned with an Airport District land use designation. The Airport District land use designation is not recognized by the ECMC, however the area most closely resembles a combined Industrial and Light Industrial land use designation. Therefore, to be conservative, the Light Industrial zoning MPNLs will be used for this location to assess compliance. The applicable MPNLs are 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.)
Light Industrial	Drilling, Completions & Flowback	70 dB(A)	65 dB(A)
		65 dB(C)	65 dB(C)
	Production	70 dB(A)	65 dB(A)
		60 dB(C)	60 dB(C)



### **Maximum Permissible Noise Levels (Adjusted) - Summary**

The results of the ambient sound level survey for the 747 Pad 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).

All adjusted MPNLs for the corresponding ambient measuring points are presented in Table 4 below.

**Table 4. Adjusted Maximum Permissible Noise Levels for the 747 Pad**

Phase	Receptor	Ambient Monitor Point #	Maximum Permissible Noise Levels	
			dBA	dBC
Construction, Drilling, and Completions	--	1	70 Day / 65 Night	<b>74.8 Day / 73 Night</b>
	--	2	70 Day / 65 Night	65 Day / 65 Night
Production	--	1	70 Day / 65 Night	<b>74.8 Day / 70 Night</b>
	--	2	70 Day / 65 Night	<b>71.2 Day / 66.4 Night</b>

### 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 Bison plans to implement for the proposed 747 site are as follows:

- Bison 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 of both codes as summarized in Table 4 in Section 2 of this document.
- Prior to commencement of drilling and completion activities, engineered sound wall consisting of approximately 680 linear feet of 32-foot-tall STC32 sound wall will be installed on the east edge of the well pad to reduce noise levels in the area.
- Bison will utilize a low noise completions fleet for all completions 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, Bison will conduct continuous noise monitoring at the monitoring locations described in Figure 13 of Section 9 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.
- Bison will post contact information to receive and address noise complaints arising from pre-production operations around the clock, 24 hours, 7 days per week. Upon receipt of a complaint, either directly to Bison, or from the Colorado ECOM, a Bison representative will contact the associated stakeholder within 48 hours of receipt.



## 4 SITE INFORMATION

The proposed 747 Pad will be located west of Jackson Gap Street and south of East 64th Avenue, in Aurora, CO. The pad is zoned with an Airport District land use designation. The Airport District land use designation is not recognized by the ECMC, however the area most closely resembles a combined Industrial and Light Industrial land use designation. Therefore, to be conservative, the Light Industrial zoning MPNLs will be used for this location to assess compliance. The closest major road is E-470 (Toll Road), located approximately one mile west of the proposed location.

The 747 Pad is slated for drilling, completions, and production operations. Drilling is planned utilizing the Precision Drilling Super Triple 1200 Drilling Rig and completions will be carried out with a Quiet Fleet from Liberty Oilfield Services. Planned production equipment is provided in Figure 16 of Appendix 1.

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

**Location:** W 1/2, NW 1/4, SEC. 08, T3S, R65W, 6TH P.M.

**Drilling Rig:** Precision Drilling Super Triple 1200 Drilling Rig

**Completions Equipment:** Liberty Oilfield Services Quiet Fleet

**Production Equipment:** Details provided in Figure 16 of Appendix 1

**Pad Location Coordinates:** 39.808871 N, 104.695542 W

**Regulation Noise Target:** Colorado ECMC Rule 423

**Figure 1.** Aerial View of the Proposed 747 Proposed Working Pad Surface



## 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 & DURATION SCHEDULE

The following table reflects Bison’s planned construction and operations schedule for the 747 Pad 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. Bison’s Planned Operations Schedule**

Phase	Duration (Days)	Estimated Start Date
Construction	30	Q2 2026
Drilling	108	Q2 2026
Completion	75	Q3 2026
Flowback	10	Q1 2027
Production	10,950 (30 years)	Q1 2027

## 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 each monitoring location and are calibrated before and after the measurement period. 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 747 Pad are shown in Figure 2 below. A-weighted and C-weighted sound levels were collected at each of the two locations from Friday November 1, 2024, at 12:00 a.m., to Monday November 4, 2024, at 12:00 a.m., inclusive. Wind speed, direction, and other environmental data was recorded with a weather station attached to the sound level meter at Monitoring Point 2 situated approximately 550 feet south of the 747 location.

**Figure 2. Aerial View of Ambient Monitoring Point Locations and the 747 Site**



In addition to the ambient noise levels acquired, the sound level meters (SLMs) were 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 vehicle traffic, airplanes, and nearby commercial facilities.

Table 6 below presents the overall A- and C-weighted averages (Leq) for the 72-hour monitoring period for all three ambient monitoring locations. The averages shown represent the overall sound levels when the wind speed was below five (5) miles per hour. Data was filtered to remove values when wind speeds exceed five (5) miles per hour, per Colorado ECMC guidelines (as well as during periods of rain, thunder, etc.).

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

Location	Daytime Averages (Leq)		Nighttime Averages (Leq)		Overall Averages (Leq)	
	dBA	dBC	dBA	dBC	dBA	dBC
Monitoring Point 1	53.1	67.8	51.5	68.0	<b>52.1</b>	<b>67.9</b>
Monitoring Point 2	52.0	64.2	48.7	61.4	<b>50.2</b>	<b>62.7</b>

Figure 17 to Figure 18 in Appendix 2 contain charts with the unfiltered hourly averages and wind speeds for each of the monitoring points.

## 8 NOISE IMPACT ASSESSMENT

A Noise Impact Assessment (NIA) was conducted for the proposed 747 Pad 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 747 site 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 both regulations 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 747 Pad are carried out using the Precision Drilling Super Triple 1200. The sound power levels used in this NIA are taken from a sound signature study completed by Urban. The drilling equipment layout for the 747 Pad is shown in Figure 14 of Appendix 1.

Completions operations at the 747 Pad 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 the sound signature study prepared by Urban. The completions equipment layout for the 747 Pad is shown in Figure 15 of Appendix 1.

Production operations at the 747 Pad are implemented per the equipment layout supplied by Bison. The sound power levels used for the production equipment in this NIA are taken from the Urban Solution Group internal database. Production equipment specified by Bison was matched with equivalent equipment for which noise data was available, in accordance with industry practice. The production equipment layout for the 747 location is shown in Figure 16 of Appendix 1.

The 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***

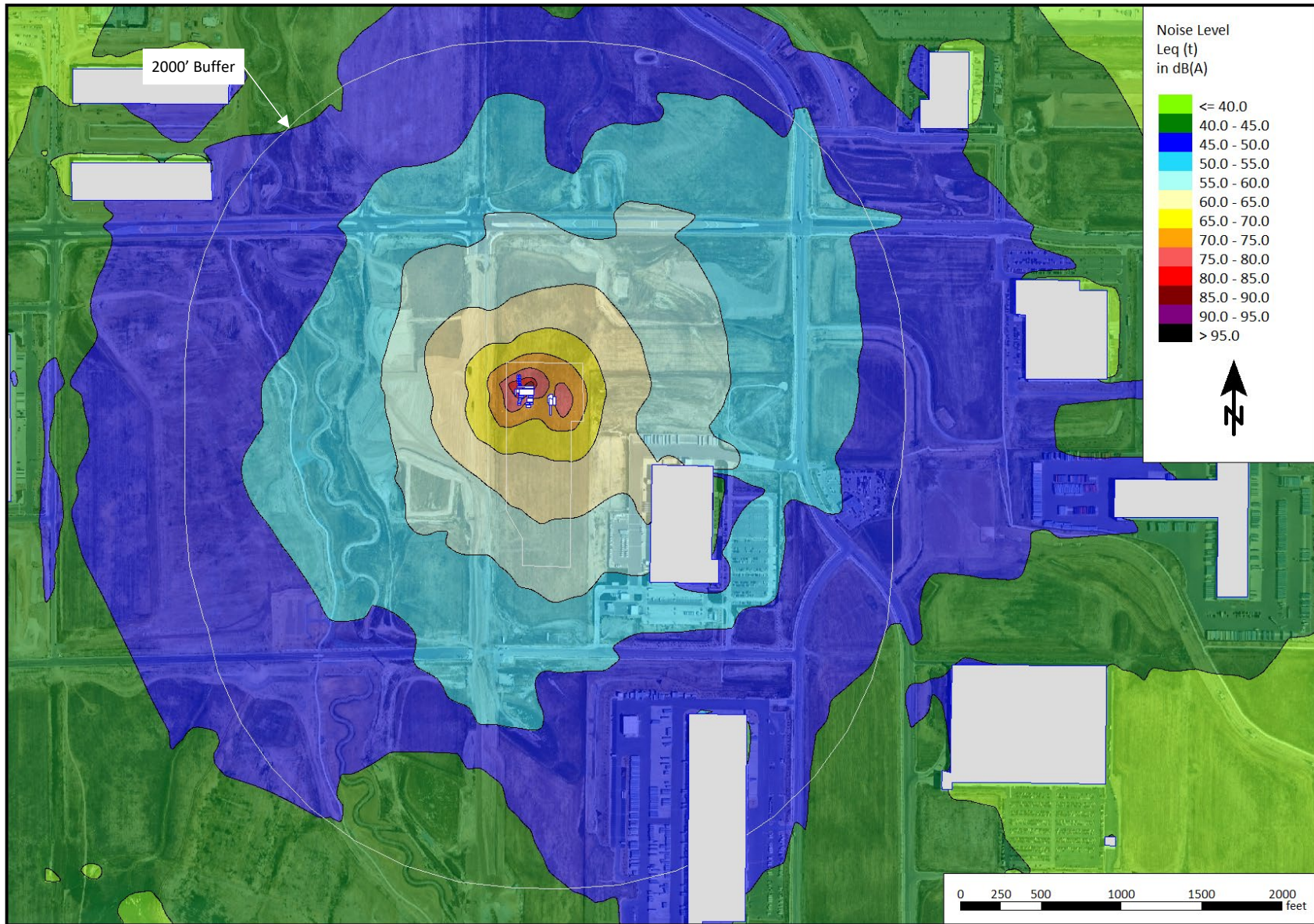
Results for unmitigated and mitigated drilling operations are presented on the following pages. The predicted levels only include sound levels from drilling operations and do not include ambient noise or noise contribution from other sources outside of the planned operations.

There are no RBUs within 2,000 feet of the proposed 747 site and thus, the location is compliant without mitigation. Though there are no RBUs within 2,000 feet of the proposed pad, Bison plans to erect a partial perimeter sound wall on the east edge of the pad for the 747 pad. This sound wall is not needed for compliance, but will reduce the environmental noise impact in this direction since Bison considers the area to be higher risk regarding noise sensitivity. The sound wall layout is shown in Figure 14 of Appendix 1 and consists of approximately 680 linear feet of 32-foot-tall, engineered sound wall rated at STC32.

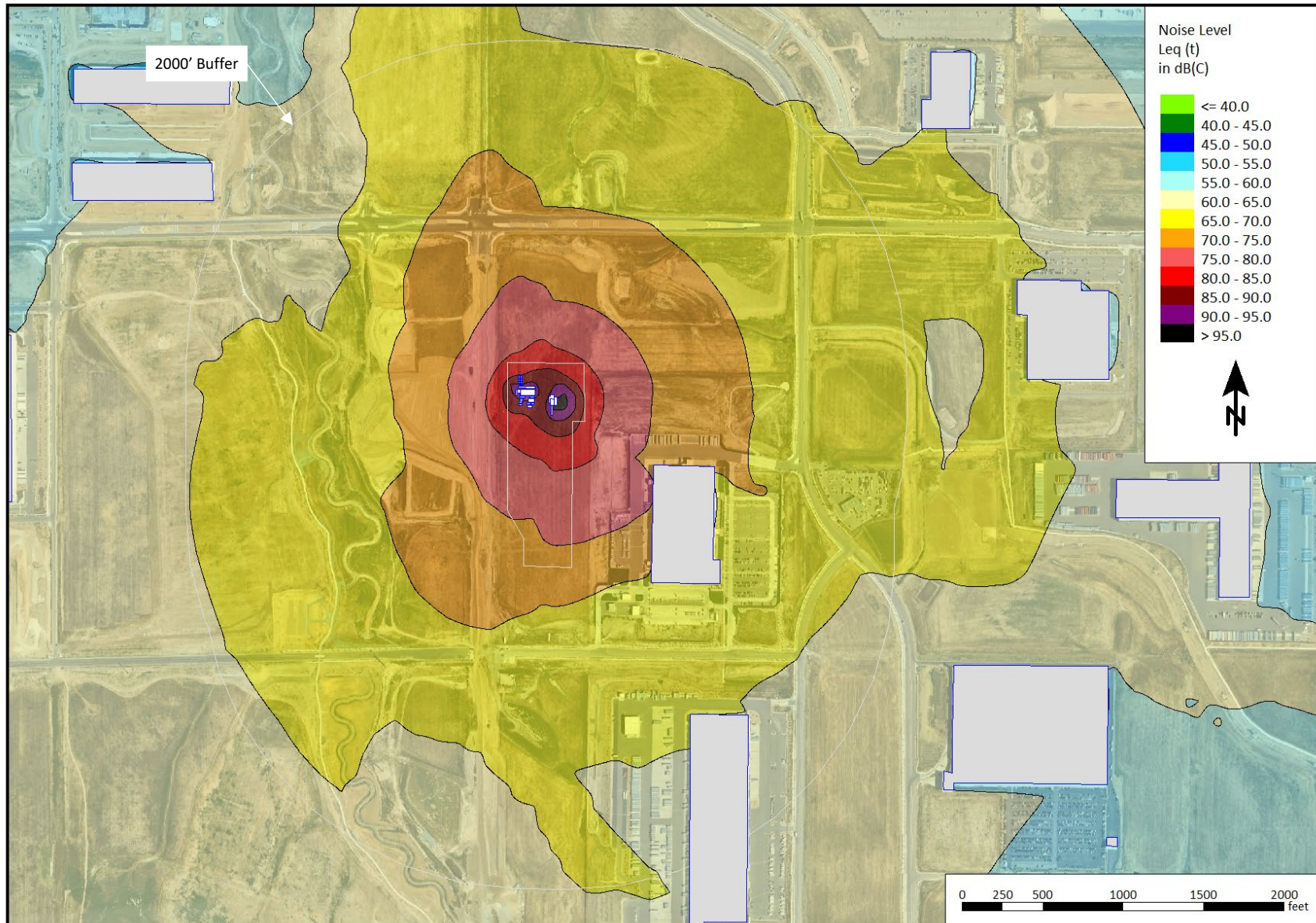
Since there are no RBUs within 2,000 feet of the proposed 747 site, there is no tabular data presented in this section. Instead, noise contour maps are provided for the area surrounding the 747 Pad. The contours are provided in 5 dB increments with the color scale indicating the sound level of each contour. 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)**

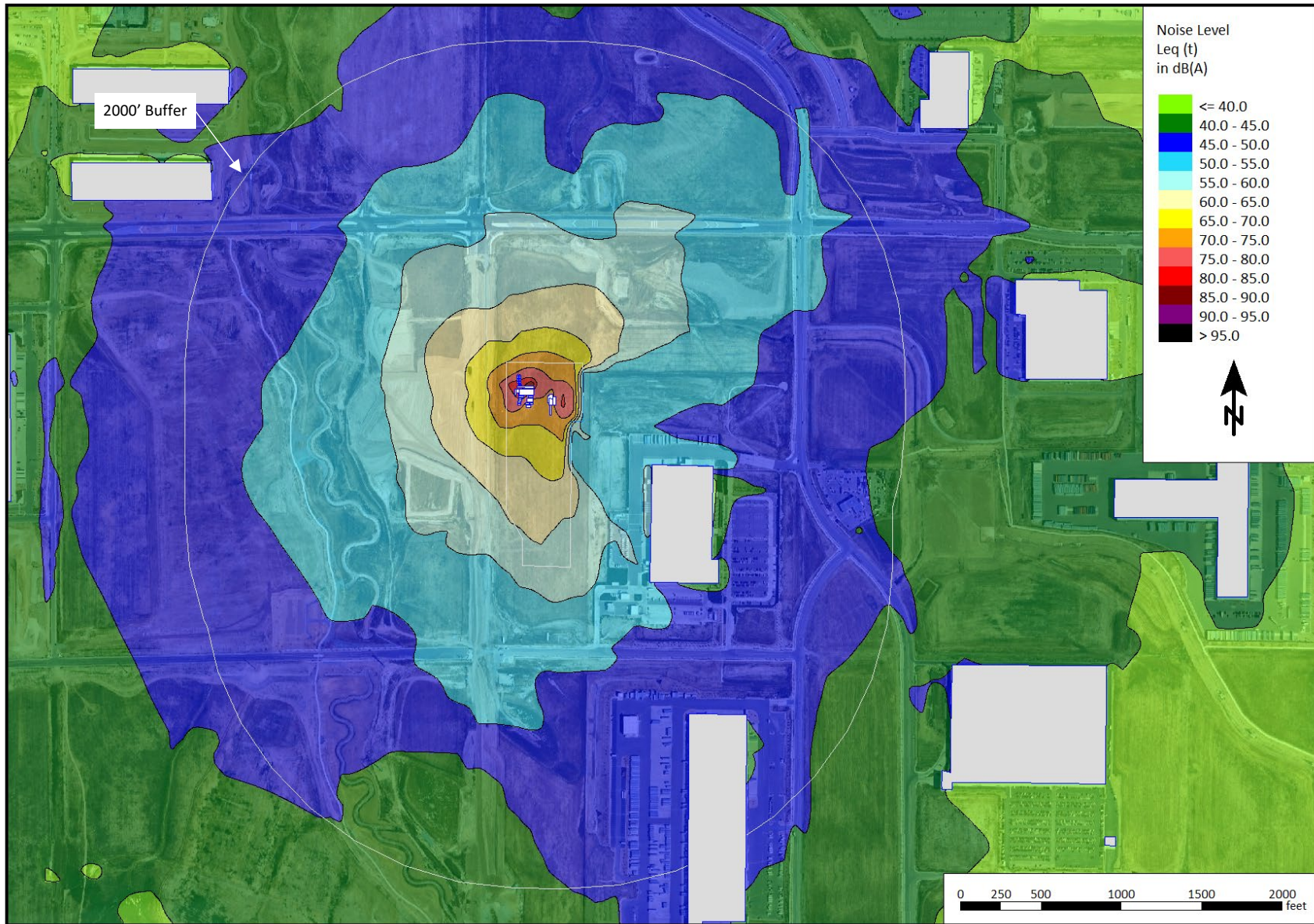
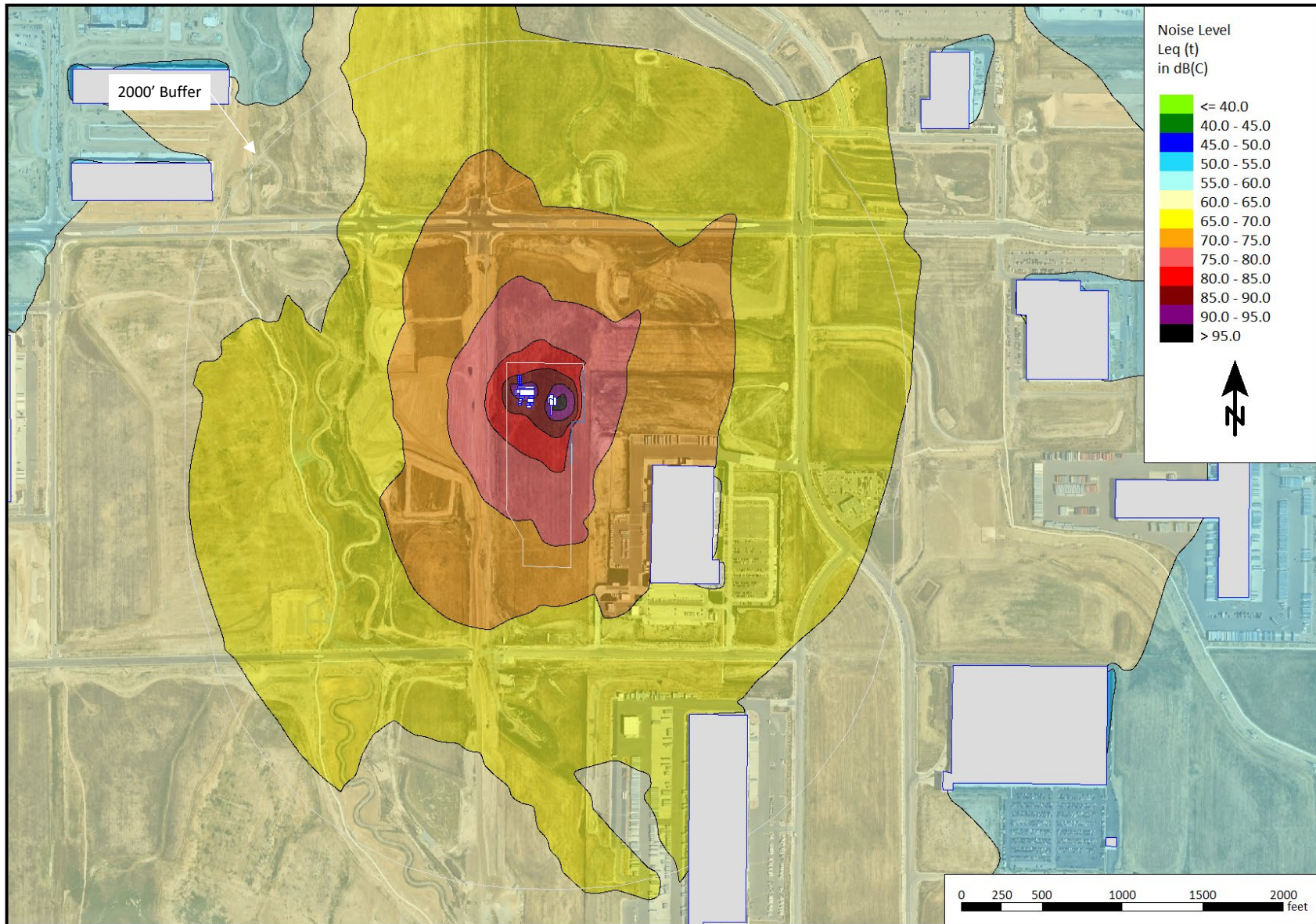


Figure 6. Mitigated Drilling Noise Contour Map (dBC)



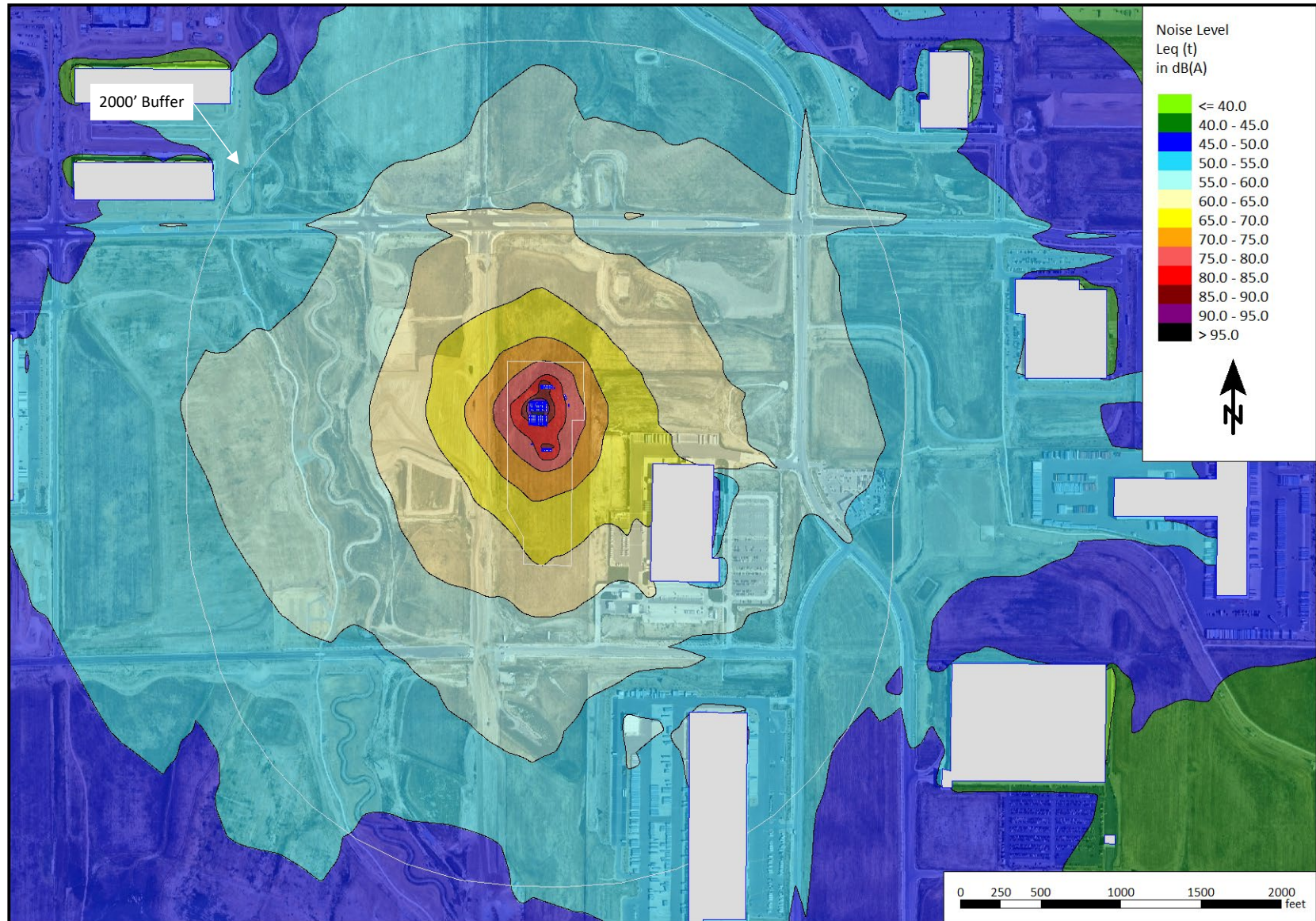
### **Completions Noise Model Results**

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

Though there are no RBUs within 2,000 feet of the proposed 747 pad, Bison plans to erect a sound wall on the east edge of the pad for the 747 pad regardless. This sound wall is not needed for compliance, but Bison considers the area to be higher risk regarding noise sensitivity and is implementing a sound wall to reduce the environmental noise impact. The sound wall layout is shown in Figure 15 of Appendix 1 and consists of approximately 680 linear feet of 32-foot-tall, engineered sound wall rated at STC32.

Since there are no RBUs within 2,000 feet of the proposed 747 site, there is no tabular data presented in this section. Instead, noise contour maps are provided for the area surrounding the 747 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)**

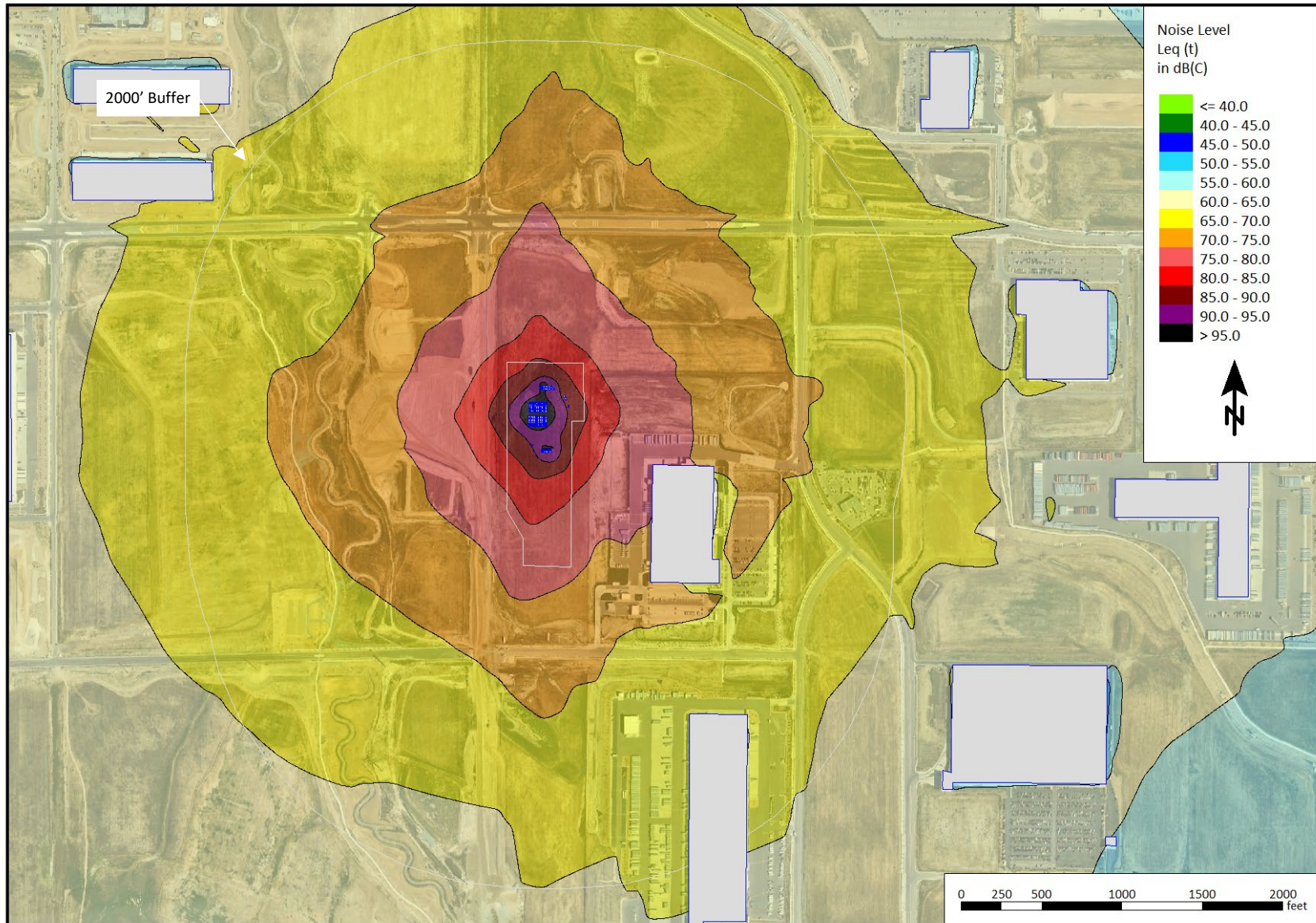
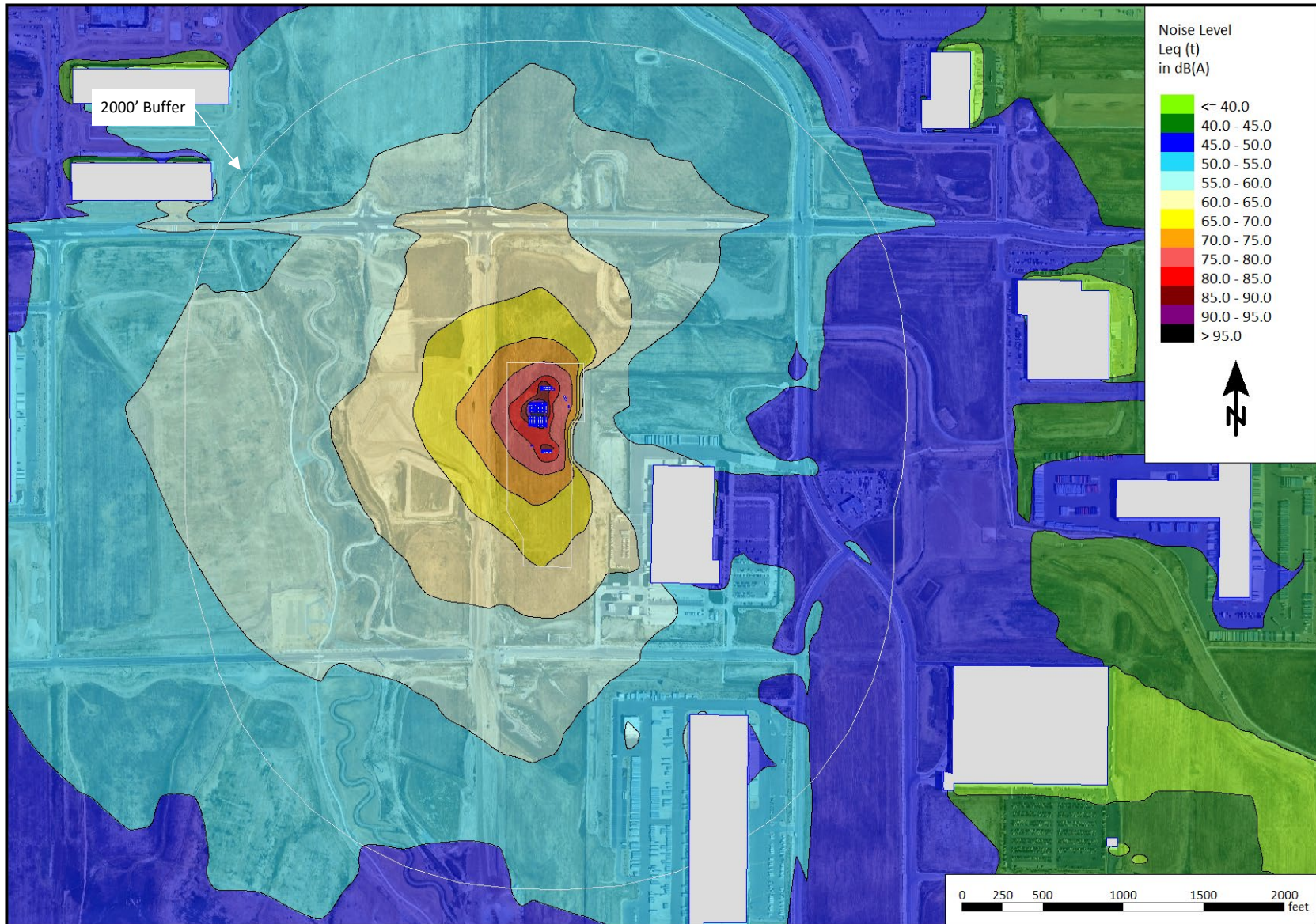
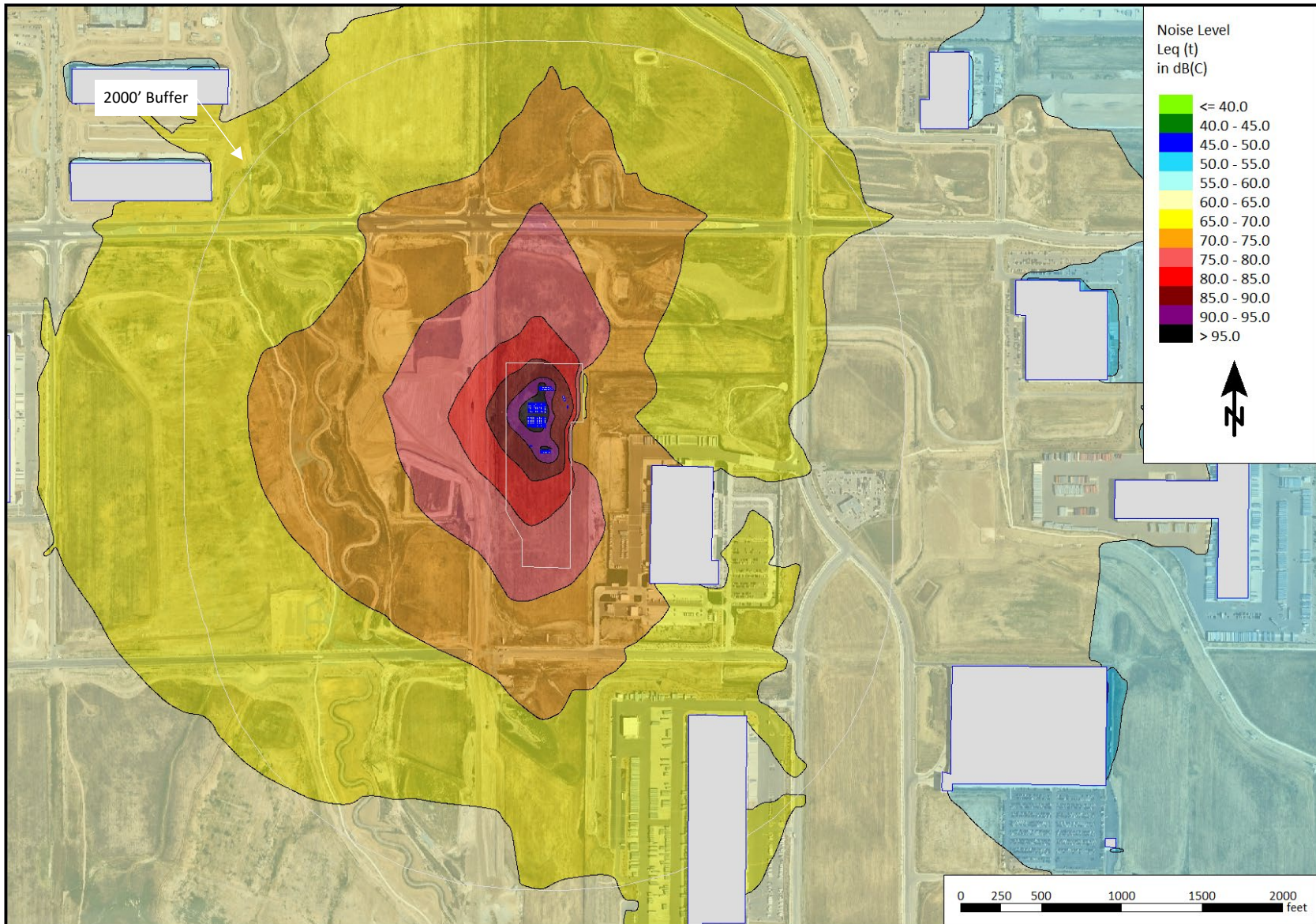


Figure 9. Mitigated Completions Noise Contour Map (dBA)



**Figure 10. Mitigated Completions Noise Contour Map (dBC)**



### **Production Noise Model Results**

Results for unmitigated production operations are presented on the following pages. 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 747 site and thus, the location is compliant without mitigation. Since there are no RBUs within 2,000 feet of the proposed 747 site, there is no tabular data presented in this section. Instead, noise contour maps are provided for the area surrounding the 747 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)**

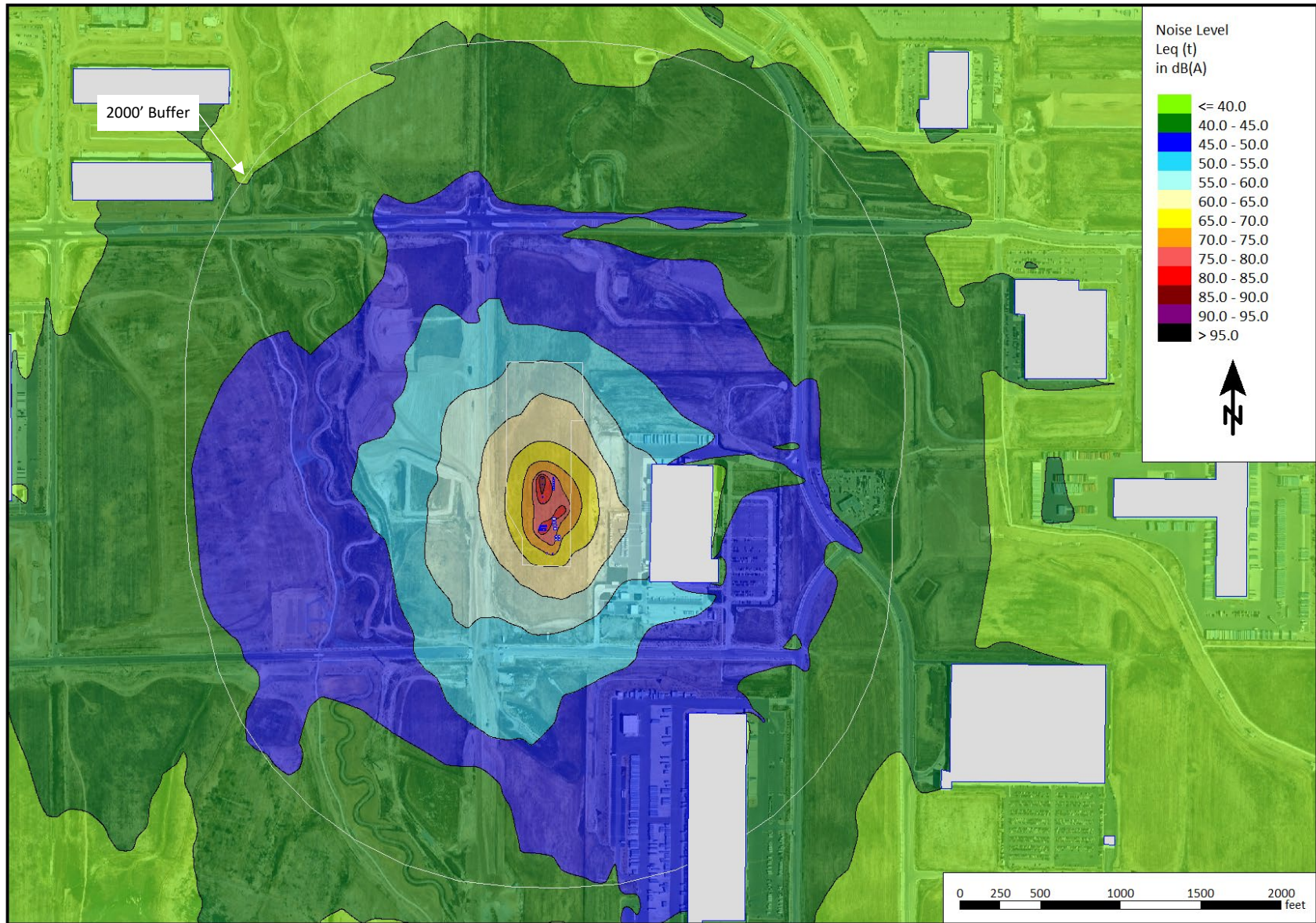
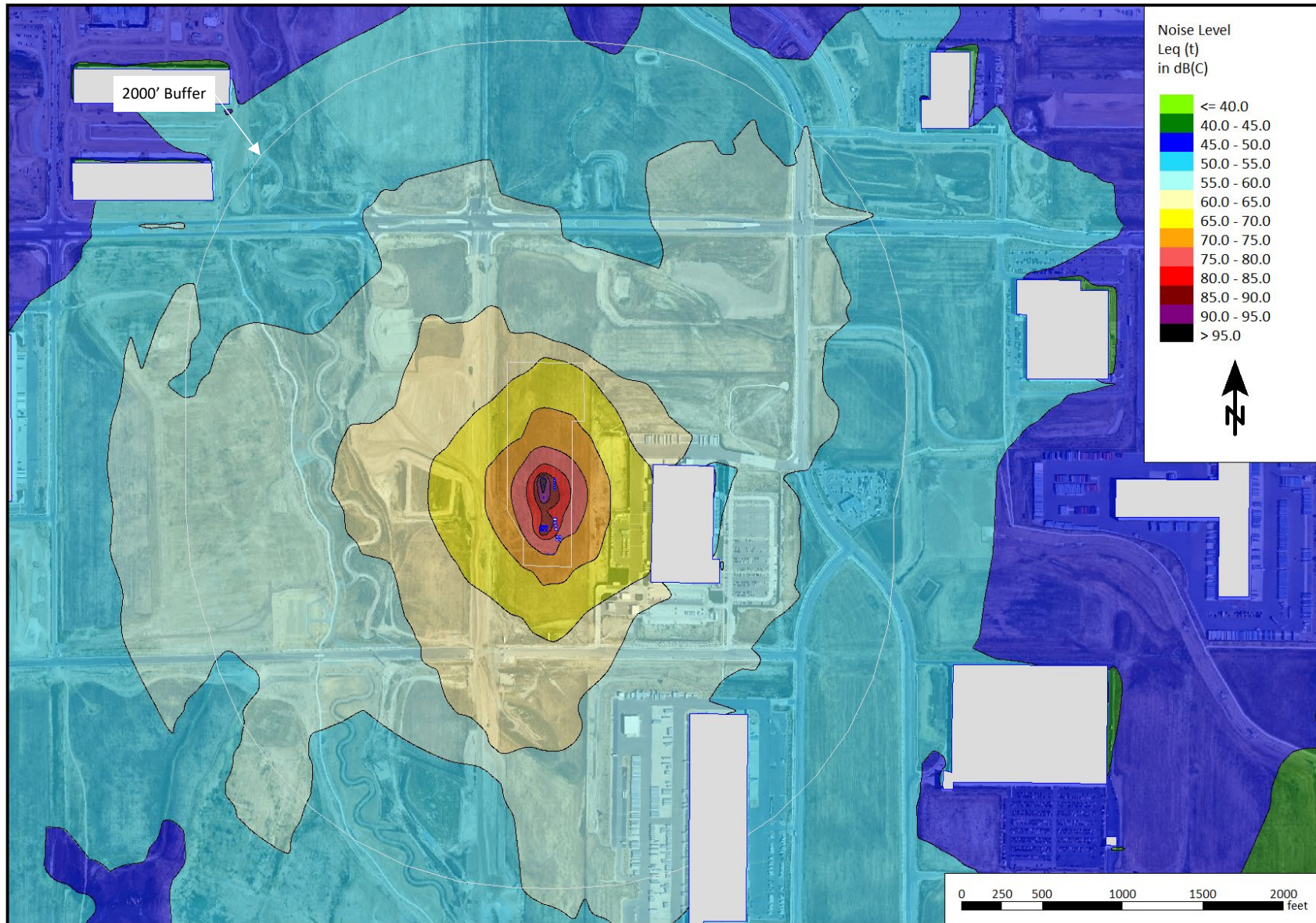


Figure 12. Unmitigated Production Noise Contour Map (dBC)



## **Flowback Operations Review**

A review of flowback operations was carried out by Urban based on information supplied by Bison. 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 pre-production operations, Bison will conduct Continuous Noise Monitoring at the monitoring points shown in Figure 13 below.

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 Bison directly (or to the Colorado ECMC), or the Local Government Designee, and the Operator is notified of the complaint, Bison 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 the Colorado ECMC Rule 423 noise regulation.

Bison 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 Bison or from the Colorado ECMC, Bison will contact the associated stakeholder within 48 hours of receipt.

**Figure 13. Aerial View of Continuous Monitoring Locations and the 747 Site**



## **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 Bison's proposed oil and gas operations at the 747 Pad 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 Bison IV Operating, LLC.

## **Appendix 1 – Equipment Layouts**









## **Appendix 2 – Ambient Data and Charts**



Figure 17. Chart of Unfiltered Hourly Averages for Monitoring Point 1

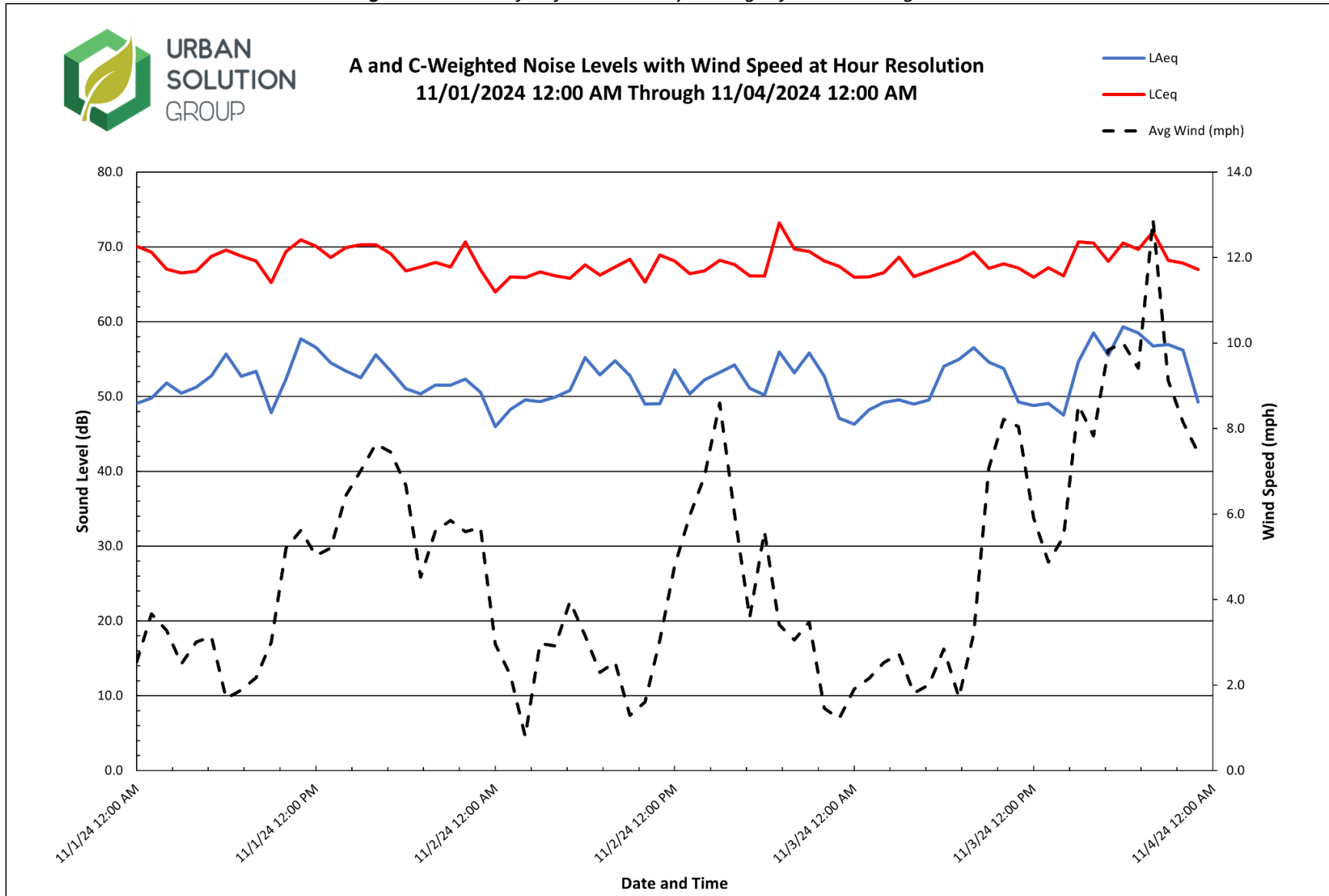
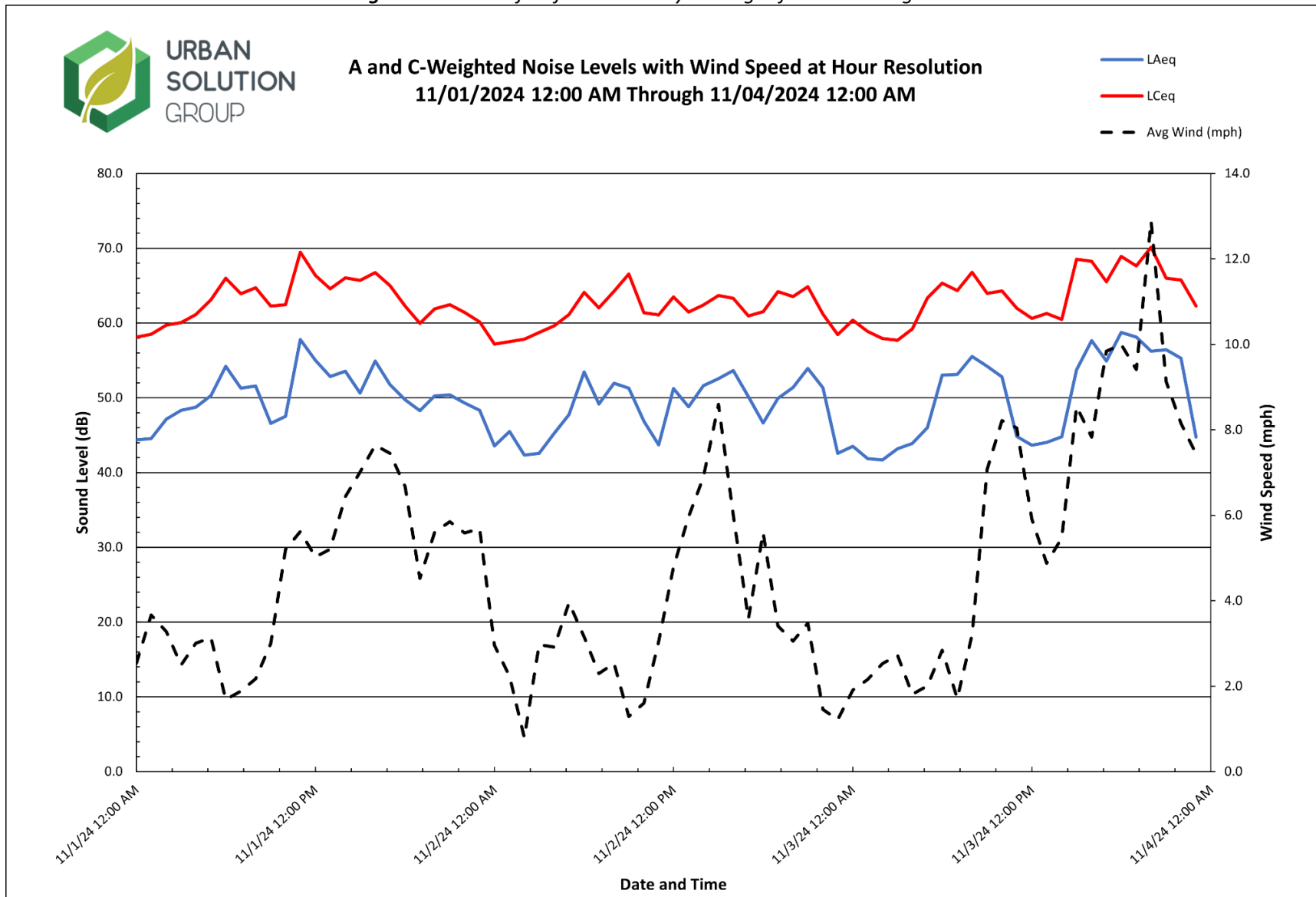


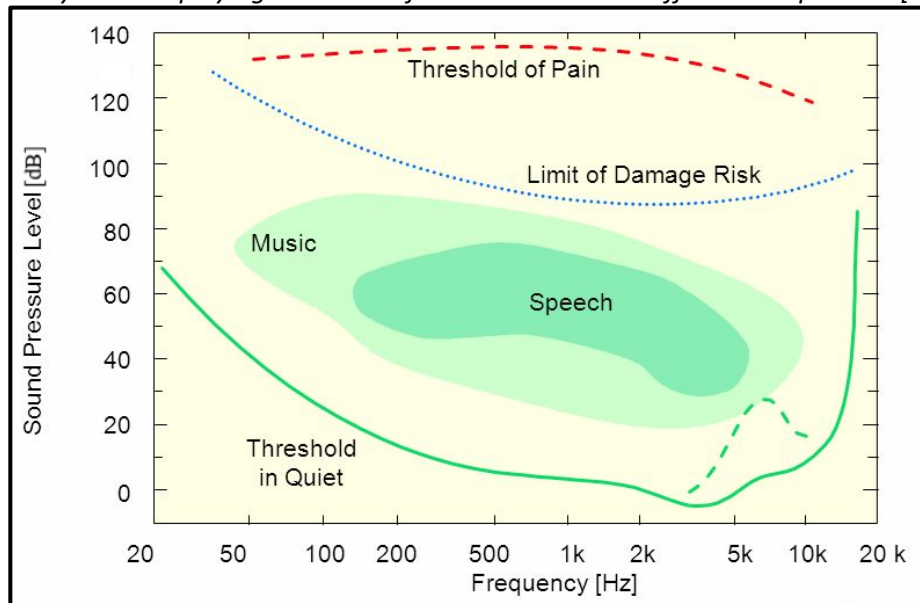
Figure 18. Chart of Unfiltered Hourly Averages for Monitoring Point 2



### **Appendix 3 – Sound Fundamentals**

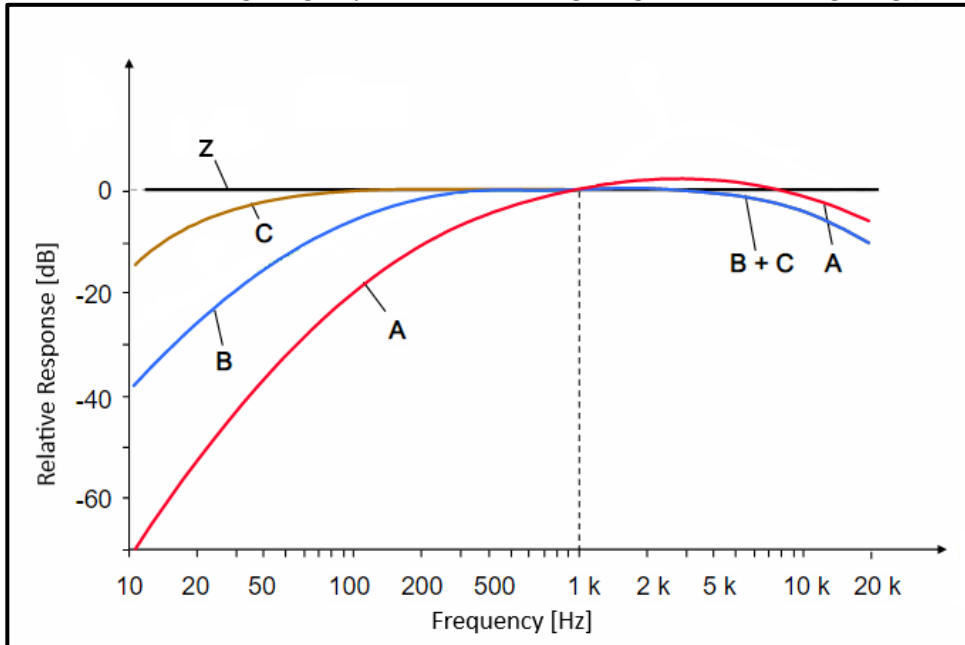
Sound is a series of vibrations transmitted through the air, or other medium, and can be heard when they are processed by the human ear. There are two important properties that describe sound; frequency and amplitude. Frequency is determined by the rate of movement and is measured in cycles per second, 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]**



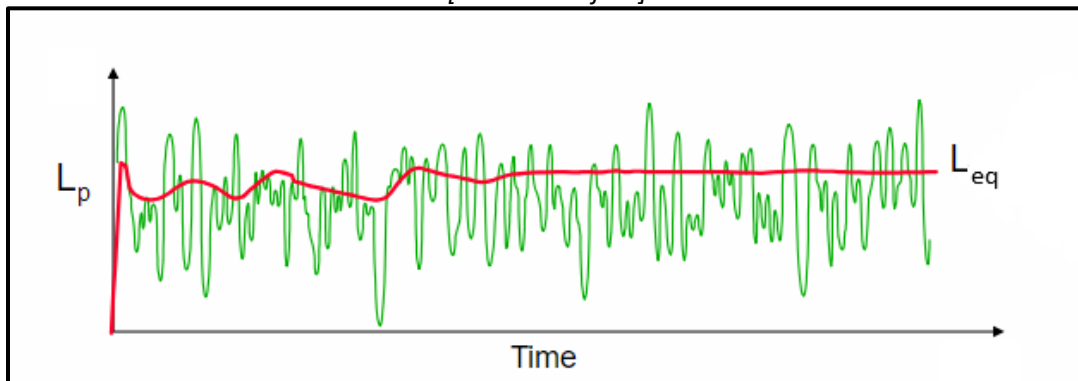
Frequency weightings are applied to measurements to provide a better match between measured results and human perception. Each weighting, in relation to their frequency components, allows for a consistent measurement of the different type of noise sources. A-weighted decibel sound pressure levels (dBA) 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]**



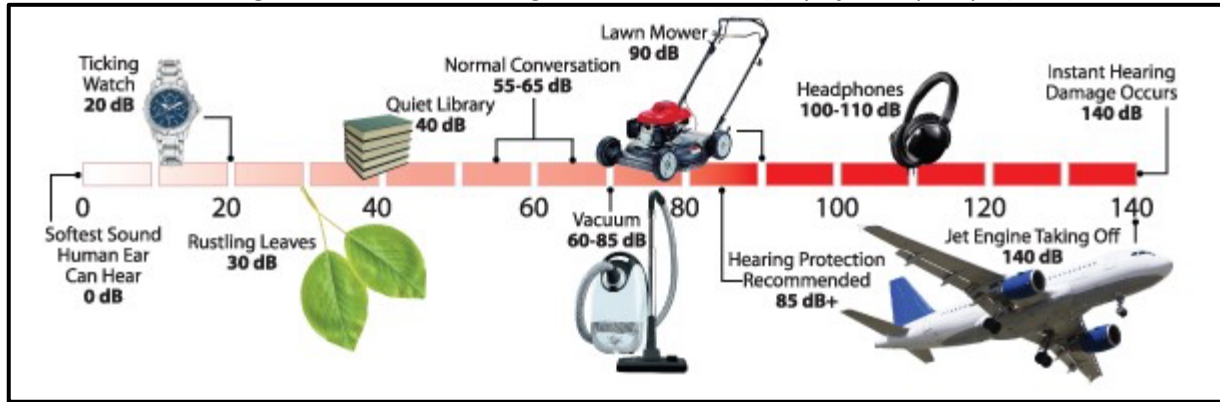
Each measurement has an exponential time factor. Slow time weighting is the most common for environmental noise measurements and will be used for these measurements. For recording over long periods of time, the sound level meter records each weighted decibel reading with an equivalent, or average, continuous 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 regulated operations and facilities. 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 for relatively loud sounds. The C-weighted sound level is also commonly used to assess low- frequency noise in conjunction with the A-weighted sound level.

### **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 Decibel and C-weighted Sound Level.

**Energy Equivalent Sound Level ( $L_{eq}$ )**

The  $L_{eq}$  is regarded as the average sound pressure level, where the single sound level value represents an amount of energy equal to that of an entire time-varying acoustic signal over a given period.

**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 numerical difference, in decibels, of the average sound pressure levels between two locations on either side of a sound wall, or silencer, etc.

**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 emitted 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.