

CONFIDENTIAL



Noise Impact Assessment

Blehm 18-I Pad
Weld County, CO

Prepared for:

Bayswater Exploration and Production, LLC
730 17th Street, Suite 500
Denver, CO 80202

Prepared by:

Urban Solution Group, LLC
4230 Elati Street, Suite 200
Denver, CO 80216

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Table of Contents

1.	Executive Summary.....	1
2.	Site Information	3
3.	Regulations and Noise Standards Summary	4
4.	Methodology and Approach	5
5.	Unmitigated Noise Model Results	6
6.	Source Order Ranking – Unmitigated	11
7.	Mitigated Noise Model Results.....	12
8.	Conclusion.....	19
9.	Notations.....	19
	Appendix 1 – Sound Fundamentals	20
	Appendix 2 – Glossary.....	23

Report Submitted to:

Mark Brown
(303)893-2503
Bayswater Exploration and Production, LLC
mbrown@bayswater.us

Report Contact:

Eric Jacobs
(720) 708-2955
Engineer II
eric.jacobs@urbansolutiongroup.com

1. Executive Summary

Urban Solution Group, LLC (Urban) was commissioned to prepare a Noise Impact Assessment (NIA) report for the proposed Blehm 18-I Pad to be operated by **Bayswater Exploration and Production, LLC (Bayswater)**. Bayswater is proposing to develop oil and natural gas wells at the Blehm 18-I Pad located near Ault, Colorado. The purpose of this report was to assess predicted environmental noise impacts from the proposed operations on the surrounding environment caused by drilling and hydraulic fracturing (completions) operations. The results of this assessment will compare the predicted levels of the Blehm 18-I Pad operations to the permissible noise level limits described in COGCC Rule 423.

Location: Lot 3 SEC. 18, T7N, R66W, 6TH P.M.

Drilling Rig: Ensign Drilling Rig #153

Completions Rig: Halliburton Q10 XLE "Quiet" Frac Fleet

Pad Location Coordinates: 40°34'28.15"N, 104°49'34.54"W

Regulation Noise Target: Colorado Oil and Gas Conservation Commission (COGCC) Rule 423 (the Regulation)

Figure 1. Aerial View of the proposed Blehm 18-I Pad



(Executive Summary Continued)

The results of the NIA indicate the predicted unmitigated sound levels for the proposed operations are likely to exceed the C-weighted permissible noise levels required by COGCC Rule 423. Urban applied noise control measures and reduced the two phases of operations (drilling and completions) to comply with the maximum permissible noise levels allowed by the COGCC Rule 423. Below is a summary of the results.

Drilling Predicted Sound Levels – Bayswater Blehm 18-I Pad

Receptor	Approximate Distance & Direction from the Working Pad Surface (feet)	Maximum Permissible Noise Level		Drilling Unmitigated		Drilling Mitigated	
		dBA	dBC	dBA	dBC	dBA	dBC
1	560 SE	60.0	65.0	56.9	71.4	48.3	64.9
2	1,240 SE	60.0	65.0	52.7	66.9	45.3	62.0
3	1,610 SE	60.0	65.0	50.7	65.2	43.9	60.4
4	2,080 SW	60.0	65.0	48.7	62.5	40.7	58.1
5	1,620 W	60.0	65.0	51.4	64.8	44.7	60.4
6	1,970 W	60.0	65.0	49.9	63.5	43.6	59.5
7	1,620 W	60.0	65.0	50.2	64.9	45.5	61.3
8	1,890 W	60.0	65.0	51.7	64.8	45.1	60.5
9	1,705 NW	60.0	65.0	49.5	64.4	46.5	61.0
10	2,150 NW	60.0	65.0	47.4	62.6	46.4	59.8
11	2,210 NW	60.0	65.0	50.0	65.8	46.5	60.7

Completions Predicted Sound Levels – Bayswater Blehm 18-I Pad

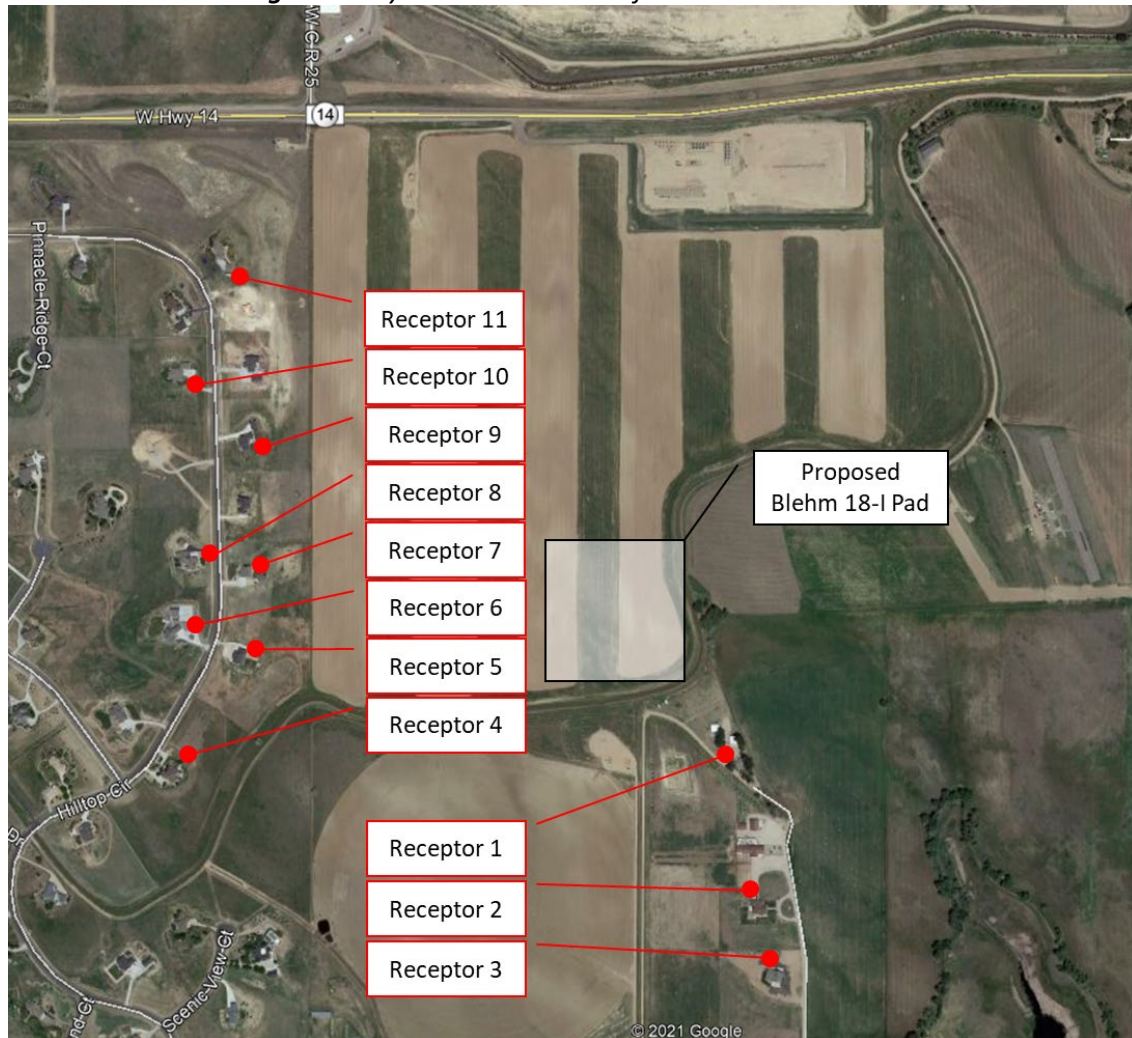
Receptor	Approximate Distance & Direction from the Working Pad Surface (feet)	Maximum Permissible Noise Level		Completions Unmitigated		Completions Mitigated	
		dBA	dBC	dBA	dBC	dBA	dBC
1	560 SE	60.0	65.0	64.8	74.0	50.2	63.7
2	1,240 SE	60.0	65.0	58.6	68.9	48.8	62.0
3	1,610 SE	60.0	65.0	56.2	66.9	47.7	60.8
4	2,080 SW	60.0	65.0	53.4	65.0	48.8	62.2
5	1,620 W	60.0	65.0	55.1	66.0	51.5	63.6
6	1,970 W	60.0	65.0	53.3	64.6	50.2	62.2
7	1,620 W	60.0	65.0	52.9	62.3	51.8	61.8
8	1,890 W	60.0	65.0	53.6	64.8	50.7	62.5
9	1,705 NW	60.0	65.0	50.6	58.3	49.0	59.3
10	2,150 NW	60.0	65.0	48.5	56.5	47.9	57.9
11	2,210 NW	60.0	65.0	48.0	56.1	48.4	57.8

2. Site Information

The proposed Blehm 18-I Pad is located northeast of Ault, CO and is south of U.S. Highway 14 and east of Weld County Road 23. The closest major road is U.S. Highway 14 and is located approximately 2,260 feet north of the pad. The coordinates for the location are 40°34'28.15"N, 104°49'34.54"W. Figure 2 below shows key receptor points and an aerial view of the Blehm 18-I Pad. The closest residential structure, Receptor 1, is approximately 560 feet west from the edge of pad.

The noise receptor points have been chosen to be consistent with the rules defined by the COGCC 423 series noise regulations. Receptor points indicate sensitive stakeholder receptors and are ordered by direction and distance from the proposed pad. Receptor points in this assessment were modelled at a distance of 25 feet from the occupied structure for both dBA and dBC predictions. Figure 2 shows the noise receptor points.

Figure 2. Key Receiver Locations for the Blehm 18-I Pad



3. Regulations and Noise Standards Summary

Noise for energy related facilities is regulated through the Colorado Oil and Gas Conservation Commission (COGCC) 423 series “Noise” regulations (the Regulation). The Regulation sets the maximum permissible noise level, which is the limit that the noise emanating from the energy facilities in the study area may not exceed over a specified period, as measured at noise points of compliance (the receptors). These allowable limits detailed in Section 423.b.(1), are dependent on the land use zoning within the study area and are defined in Table 1 below.

Table 1. COGCC Land Use Zone and Designated and Maximum Permissible Noise Levels

ZONE	Daytime (7:00 a.m. – 7:00 p.m.)	Nighttime (7:00 p.m. – 7:00 a.m.)
Residential/Rural/State Parks & State 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)

In section 423.b.(2), the Regulation states, “Unless otherwise required by Rule 423, drilling or completion operations, including Flowback: In Residential/Rural or Commercial/Agricultural, maximum permissible noise levels will be 60 db(A) in the hours between 7:00 p.m. to 7:00 a.m. (nighttime) and 65 db(A) in the hours between 7:00 a.m. to 7:00 p.m. (daytime); and in all zones maximum permissible noise levels will be 65 db(C) in the hours between 7:00 p.m. to 7:00 a.m. and 65 db(C) in the hours between 7:00 a.m. to 7:00 p.m.”

In the hours between 7:00 am and the next 7:00 pm, the noise levels permitted above may be increased by 10 dBA for a period not to exceed 15 minutes in any 1-hour period. The increase is permissible only for a 1-hour period during any 12 hours.

Noise levels from oil and gas facilities located on surface property owned, leased, or otherwise controlled by the operator shall be measured at the nearest point of compliance. Receptor points in this assessment were modelled at a distance of 25 feet from the occupied structure for both dBA and dBC predictions.

4. Methodology and Approach

This NIA was conducted using a three-dimensional computer noise modeling software. All models and predicted noise levels generated for this report were developed with Predictor V2021 software utilizing the ISO 9613-1/2 standard. This ISO 9613-1/2 standard is ± 3 dBA for distances of 0 feet (0 meters) to 3280 feet (1,000 meters). The algorithms used in the software are based on methods and theory that are accepted in the acoustics community. Actual field measurements may differ from modeled noise levels due to environmental factors and the presence of other noise sources. Table 2 lists the conditions used in the model.

Table 2. Conditions used in Predictor V2020 software

Parameter	Modeled Input and Description
Temperature	55°F – Represents typical summer nighttime temperature
Topography	3.3 ft Resolution
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 reception points
Relative Humidity	40% - Typical summer nighttime relative humidity
Ground Absorption	0.0 for water bodies and roads 0.6 for everywhere else

It is assumed that the facility operating conditions do not change significantly between the daytime and nighttime period. As such, the NIA analysis focuses solely on the nighttime period, as the Regulation is more stringent during the nighttime. The resulting predicted noise levels were compared to the maximum permissible noise levels described by the Regulation to determine if the subject facility is in compliance.

The noise levels generated in this report are strictly from oil and gas operations. Pre-existing sound sources such as those from animals, weather, road traffic, and all other ambient sounds are not included in the noise models. Actual field measurements may differ from modeled noise levels due to environmental factors and the presence of other noise sources.

Sound level data utilized in the drilling model was based on a sound signature obtained for the Ensign drilling rig #153 by Urban in May 2021.

Sound level data utilized in the completions model was based on a sound signature obtained for the Halliburton Q10 XLE Quiet Fleet by Urban in February 2020.

5. Unmitigated Noise Model Results

The results for unmitigated drilling and completions noise model are in Table 3 below. Unmitigated noise levels generated by the proposed operations are predicted to exceed A and C-weighted compliance levels allowed by the COGCC Rule 423. The receptor locations in the tables correspond to the locations identified in Figure 2. The predicted levels only include sound levels from drilling and completions operations and do not include ambient noise or noise contribution from other sources outside of the expected operations. Actual field measurements may differ to predicted levels due to varying local noise sources not associated with drilling and completions operations. The results of the noise model are shown as noise contour maps. The contours are provided in 5 dB increments with the color scale indicating the sound level of each contour band.

A-weighted noise contour maps for drilling and completions operations are shown in Figure 3 and Figure 5. C-weighted noise contour maps for drilling and completions operations are shown in Figure 4 and Figure 6.

Table 3. Unmitigated Noise Model Results

Receptor	Drilling Unmitigated Sound Levels		Completions Unmitigated Sound Levels	
	dBA	dBC	dBA	dBC
1	56.9	71.4	64.8	74.0
2	52.7	66.9	58.6	68.9
3	50.7	65.2	56.2	66.9
4	48.7	62.5	53.4	65.0
5	51.4	64.8	55.1	66.0
6	49.9	63.5	53.3	64.6
7	50.2	64.9	52.9	62.3
8	51.7	64.8	53.6	64.8
9	49.5	64.4	50.6	58.3
10	47.4	62.6	48.5	56.5
11	50.0	65.8	48.0	56.1

Figure 3. Unmitigated Drilling Noise Contour Map (dBA)

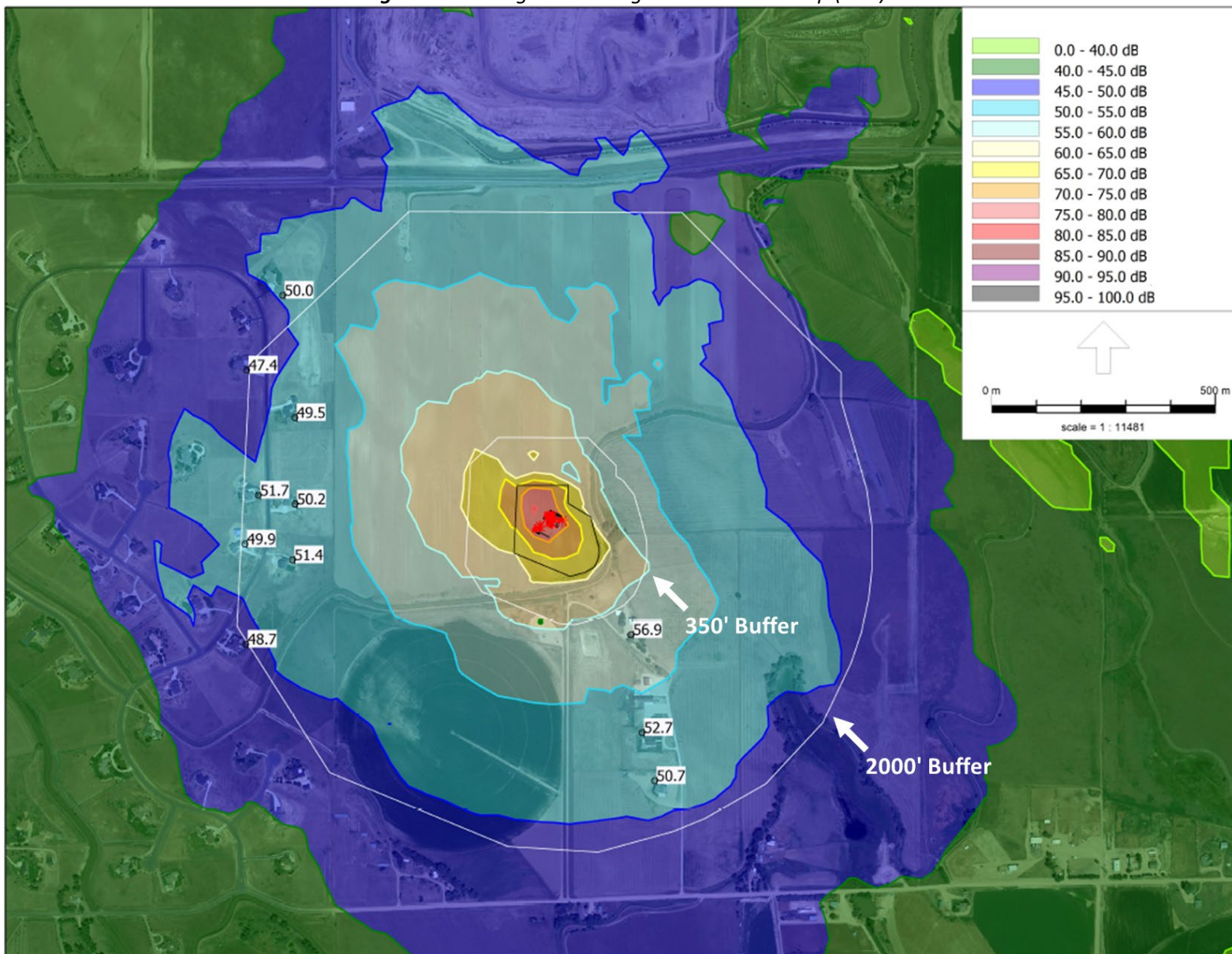


Figure 4. Unmitigated Drilling Noise Contour Map (dBC)

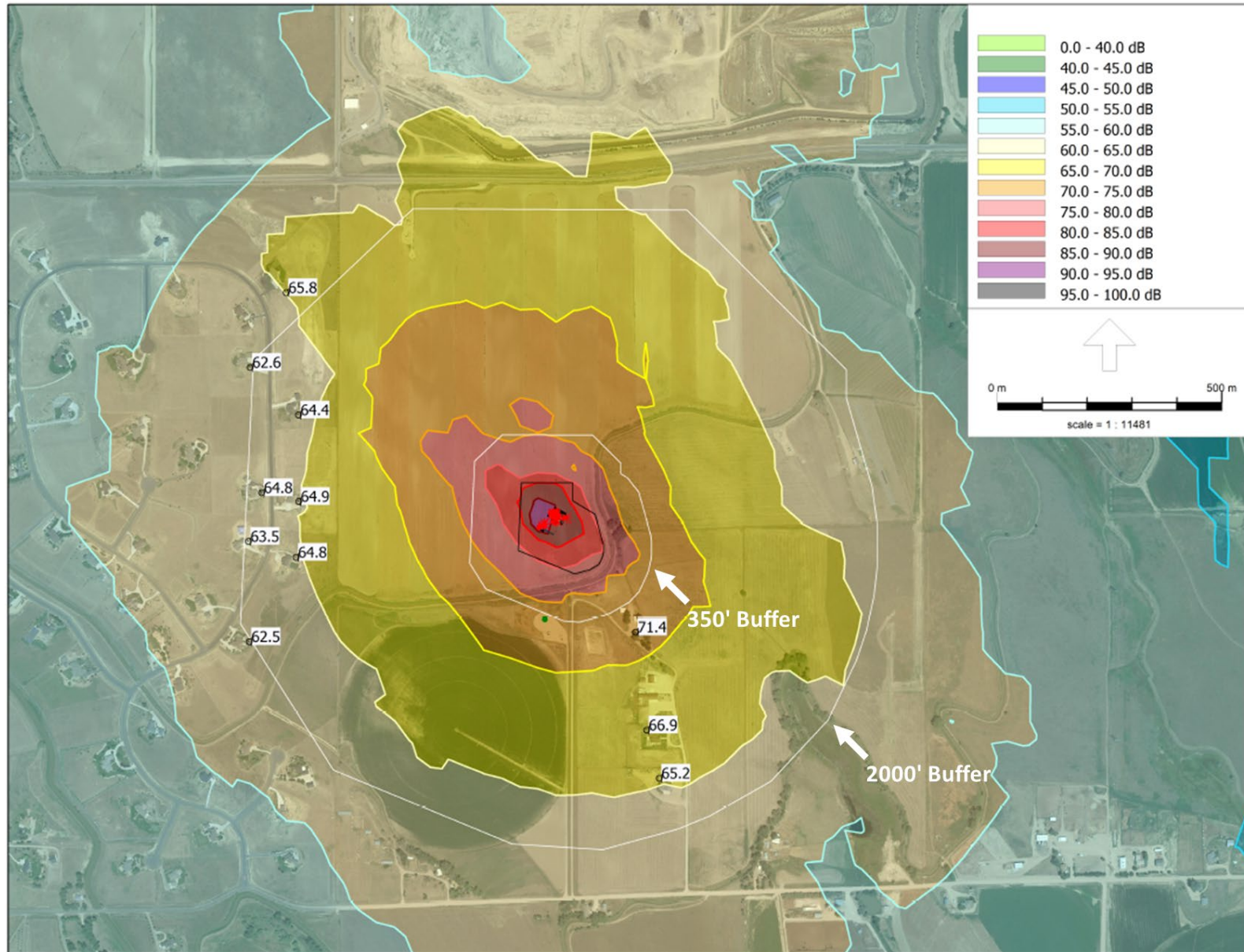


Figure 5. Unmitigated Completions Noise Contour Map (dBA)

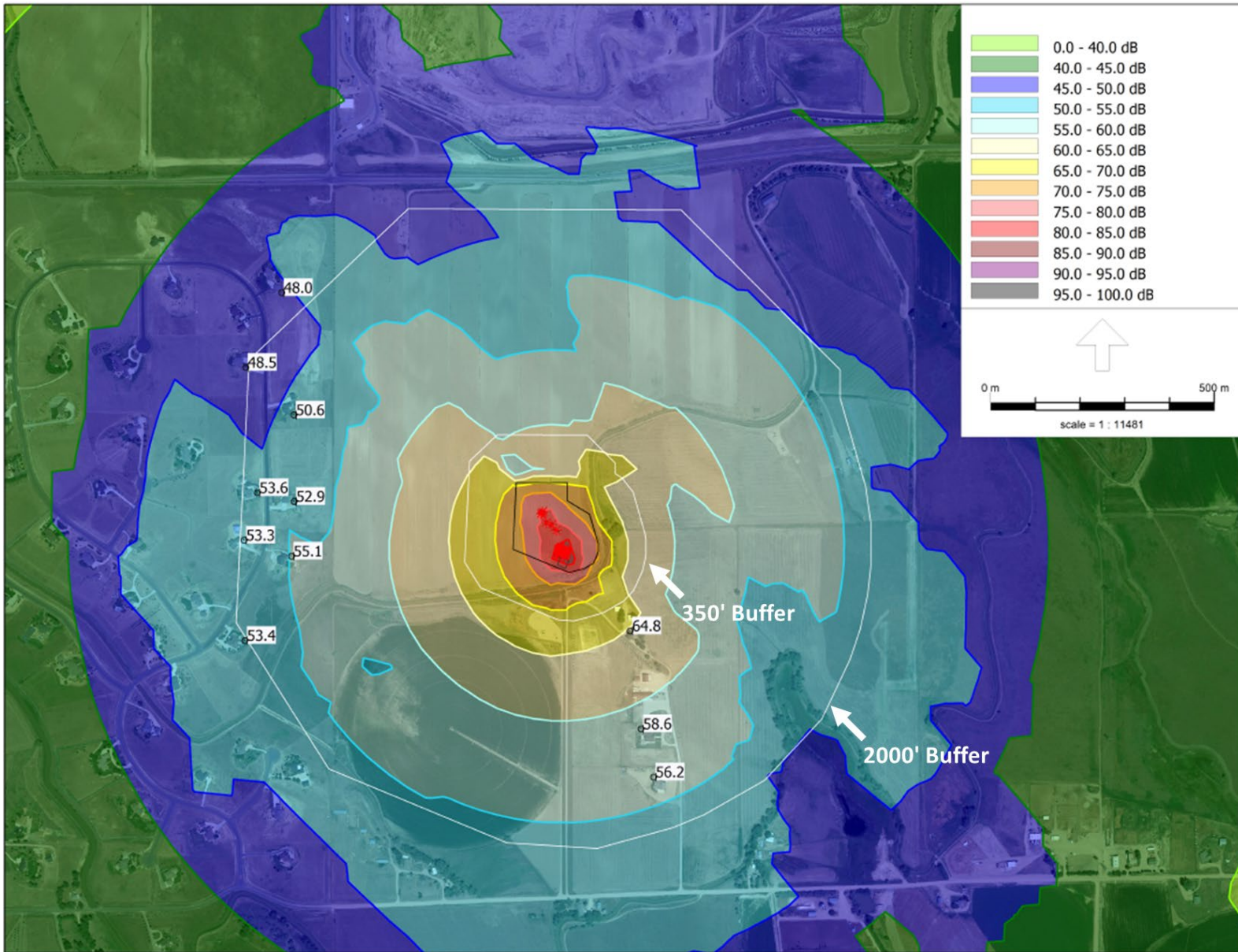
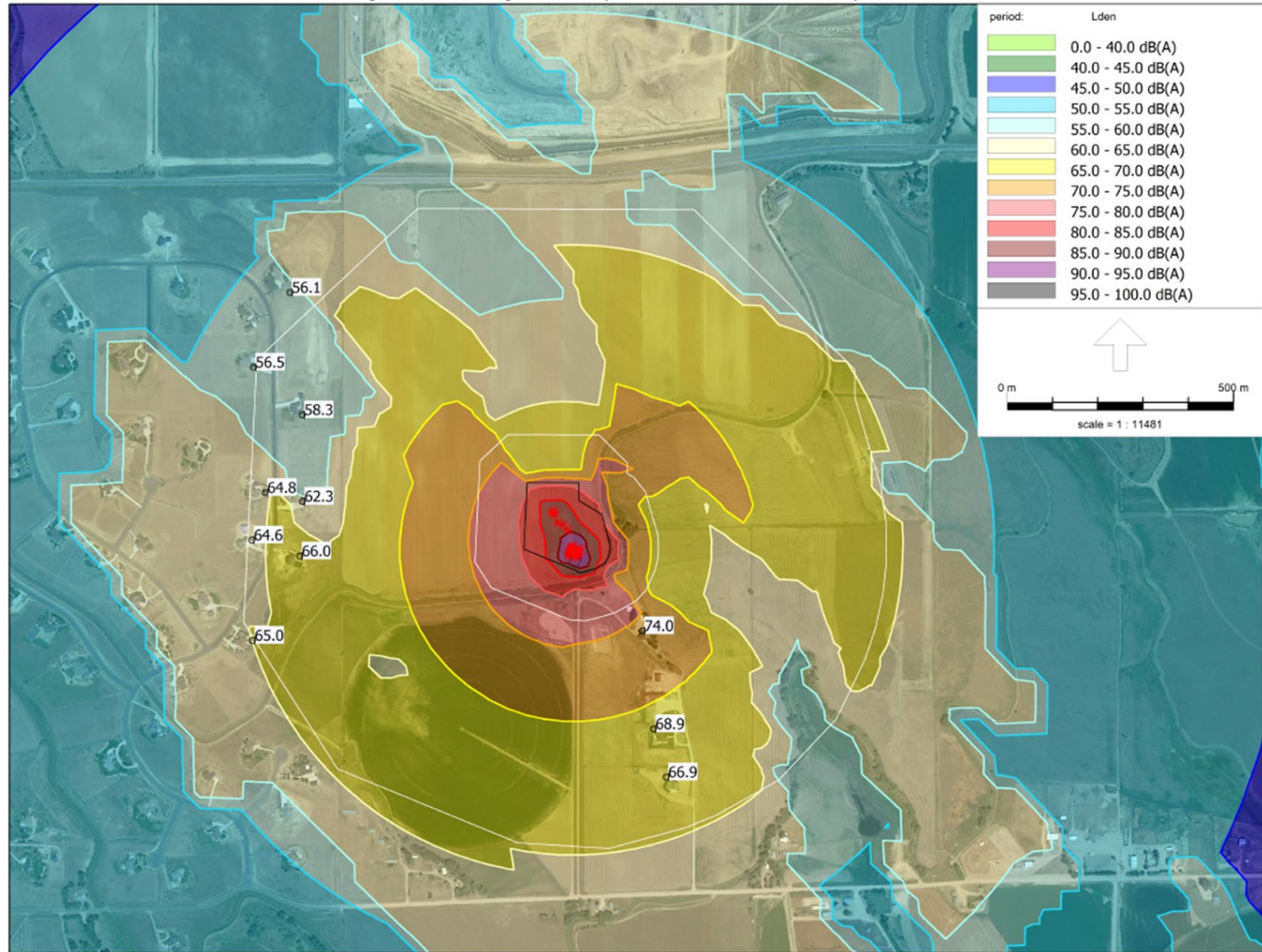


Figure 6. Unmitigated Completions Noise Contour Map (dBC)



6. Source Order Ranking – Unmitigated

Table 4 and Table 5 list the sound pressure levels (SPL) for the top ten dominant noise sources, for both the drilling phase and completions phase (respectively), received at the most impacted receptor, Receptor 1 (located approximately 560 feet southeast of the Blehm 18-I pad).

Table 4. Drilling Source Order Ranking – Receptor 1

Rank	Noise Source	SPL (dBA)	SPL (dBC)
1	3512 Exhaust Tip	50.3	60.8
2	3512 Exhaust Tip	49.1	60.6
3	3512C Exhaust Tip (1)	46.5	59.4
4	3512C Exhaust Tip (2)	46.4	59.4
5	3512 Gen Muffler	43.5	55.4
6	South side of resistor Bank	43.5	47.4
7	3512 Gen Muffler	43.4	55.3
8	3512C Gen Exhaust Pipe	42.6	56
9	Outward Shaker Plane	41.9	56.1
10	East side of resistor Bank	41.8	46.1
11+	Total for Remaining 41 Noise Sources	49.8	69.1
	Facility SPL	56.9	71.4
	Maximum Permissible Noise Levels	60.0	65.0

Table 5. Completions Source Order Ranking – Receptor 1.

Rank	Noise Source	SPL (dBA)	SPL (dBC)
1	Pump Truck	53.6	62.8
2	Pump Truck	53.5	62.7
3	Pump Truck	53.5	62.8
4	Pump Truck	53.4	62.7
5	Pump Truck	53.3	62.6
6	Pump Truck	53.3	62.6
7	Pump Truck	53.2	62.5
8	Pump Truck	53.0	62.3
9	Pump Truck	52.9	62.2
10	Pump Truck	52.9	62.3
11+	Total for Remaining 11 Noise Sources	59.4	68.5
	Facility SPL	64.8	74.0
	Maximum Permissible Noise Levels	60.0	65.0

The results above indicate the dominant noise for the drilling phase comes from the genset exhausts and rig mounted shakers. The results above also indicate the dominant noise for the completions phase comes from the pump trucks. If noise control is desired, it should aim at attenuating the dominant noise sources first, starting from the top of each list and moving down.

7. Mitigated Noise Model Results

Unmitigated sound levels at some noise points of compliance are expected to exceed maximum permissible noise levels outlined by the COGCC Rule 423. Noise control recommendations are designed to reduce operational noise levels to meet the maximum permissible noise levels outlined in COGCC Rule 423. Table 6 lists the noise control recommendations to reduce the SPL at the most impacted receiver (Receptor 1). The Noise Reduction (NR) is the total reduction in Facility SPL at the receptor expected by implementing the noise control recommendation. The NR listed for each item in the chart below is progressive and assumes the noise control items in previous steps have been implemented.

Mitigated noise levels were reduced and with the proposed noise mitigation outlined below, sound levels are predicted to comply with the maximum permissible noise levels of COGCC Rule 423. The sound wall layout included in Figure 7 reflects what was used for mitigation measures in the model for Blehm 18-I Pad.

Table 6. Noise Control Recommendations – Drilling Phase

Step	Noise Source	Noise Control Measure Description	Receptor 1	
			Noise Reduction (dBA/dBC)	Facility SPL (dBA/dBC)
-	-	Unmitigated Noise Levels	-	56.9/71.4
1	All Equipment	Install approximately 2040 linear feet of 32-Foot-Tall, STC-32, Engineered Sound Walls Around Perimeter of Working Pad Surface	2.1/1.5	54.8/69.9
2	Generators	Upgrade or replace the existing exhaust silencers with one that meets the specifications below in Table 8	8.2/4.2	48.7 /67.2
3	Rig and Ancillary Shakers	Install 60 feet of 32-Foot-Tall sound walls near the centrifuge and dry cutting bins and 40 feet of 24-foot-tall STC 43 sound walls near the rig mounted shakers	8.6/6.5	48.3/64.9

Table 7. Noise Control Recommendations – Completions Phase

Step	Noise Source	Noise Control Measure Description	Receptor 1	
			Noise Reduction (dBA/dBC)	Facility SPL (dBA/dBC)
-	-	Unmitigated Noise Levels	-	64.8/74.0
1	All Equipment	Install approximately 2,040 linear feet of 32-Foot-Tall, STC-32, Engineered Sound Walls Around Perimeter of Working Pad Surface	10.9/3.9	53.9/70.1
3	Gas Lift Comp Exhaust Pipe	Install 152 feet of 24-foot-tall STC 43 sound walls on the east side of the pump trucks and sand storage.	14.6/10.3	50.2/63.7

The placement of the barriers in the following configuration reflects the layout used in the noise model and will reduce the noise impact for the surrounding area. The lengths and location of all mitigation is approximate, final lengths will be determined on site. The thick blue lines denote 32-foot-tall, STC-32 barriers and the red lines denote 24-foot-tall STC-43 barriers.

Figure 7. Drilling and Completions Mitigation Layout

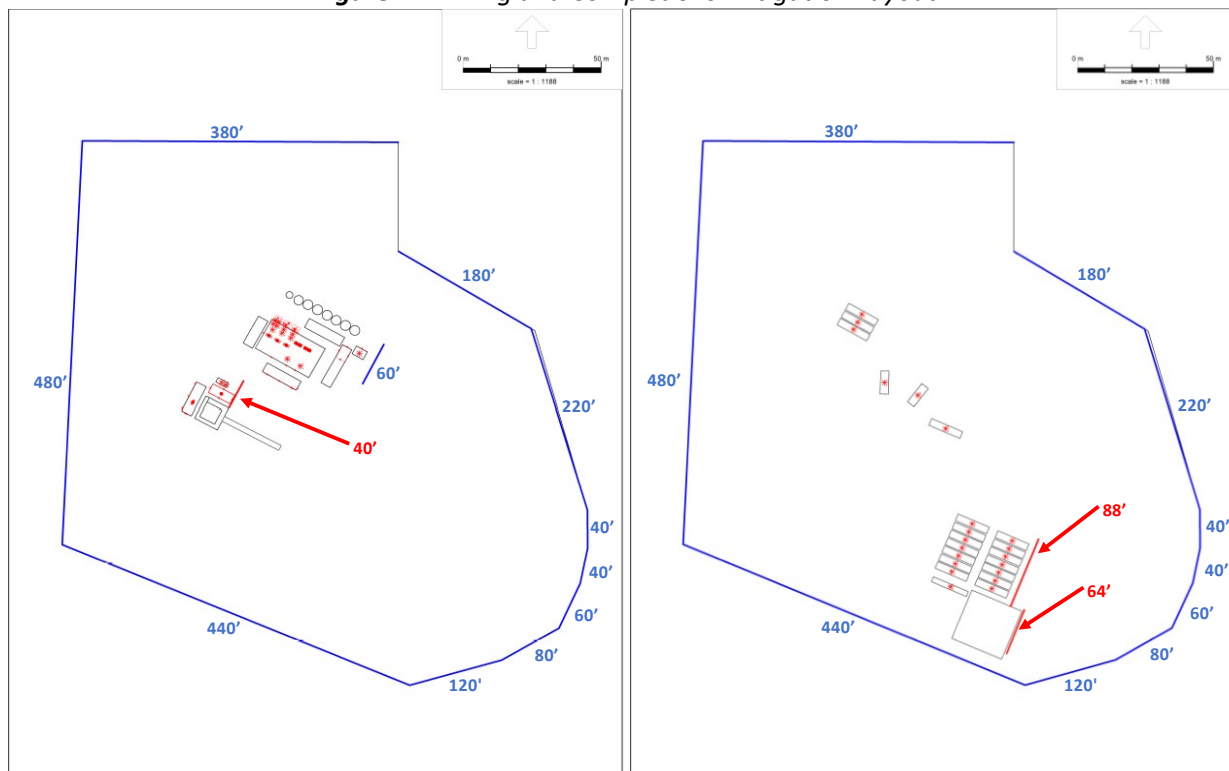


Table 8. Recommended Genset Exhaust Silencer Acoustic Specifications

Source Description	Octave Band Center Frequency (Hz)									Overall (dBA)	Overall (dBC)
	Dynamic Insertion Loss (dB)										
	31.5	63	125	250	500	1000	2000	4000	8000		
Exhaust Silencer	22	25	38	41	42	47	47	48	46	106.2	106.5

The results for the mitigated drilling and completions noise model are presented in Table 9. The receptor locations presented in both tables correspond to the locations identified in Figure 2.

A-weighted noise contour maps for mitigated drilling and completions operations are shown in Figure 8 and Figure 10. C-weighted noise contour maps for mitigated drilling and completions operations are shown in Figure 9 and Figure 11.

Table 9. Mitigated Noise Model Results

Receptor	Drilling Mitigated Sound Levels		Completions Mitigated Sound Levels	
	dBA	dBC	dBA	dBC
1	48.3	64.9	50.2	63.7
2	45.3	62.0	48.8	62.0
3	43.9	60.4	47.7	60.8
4	40.7	58.1	48.8	62.2
5	44.7	60.4	51.5	63.6
6	43.6	59.5	50.2	62.2
7	45.5	61.3	51.8	61.8
8	45.1	60.5	50.7	62.5
9	46.5	61.0	49.0	59.3
10	46.4	59.8	47.9	57.9
11	46.5	60.7	48.4	57.8

Figure 8. Mitigated Drilling Noise Contour Map (dBA)

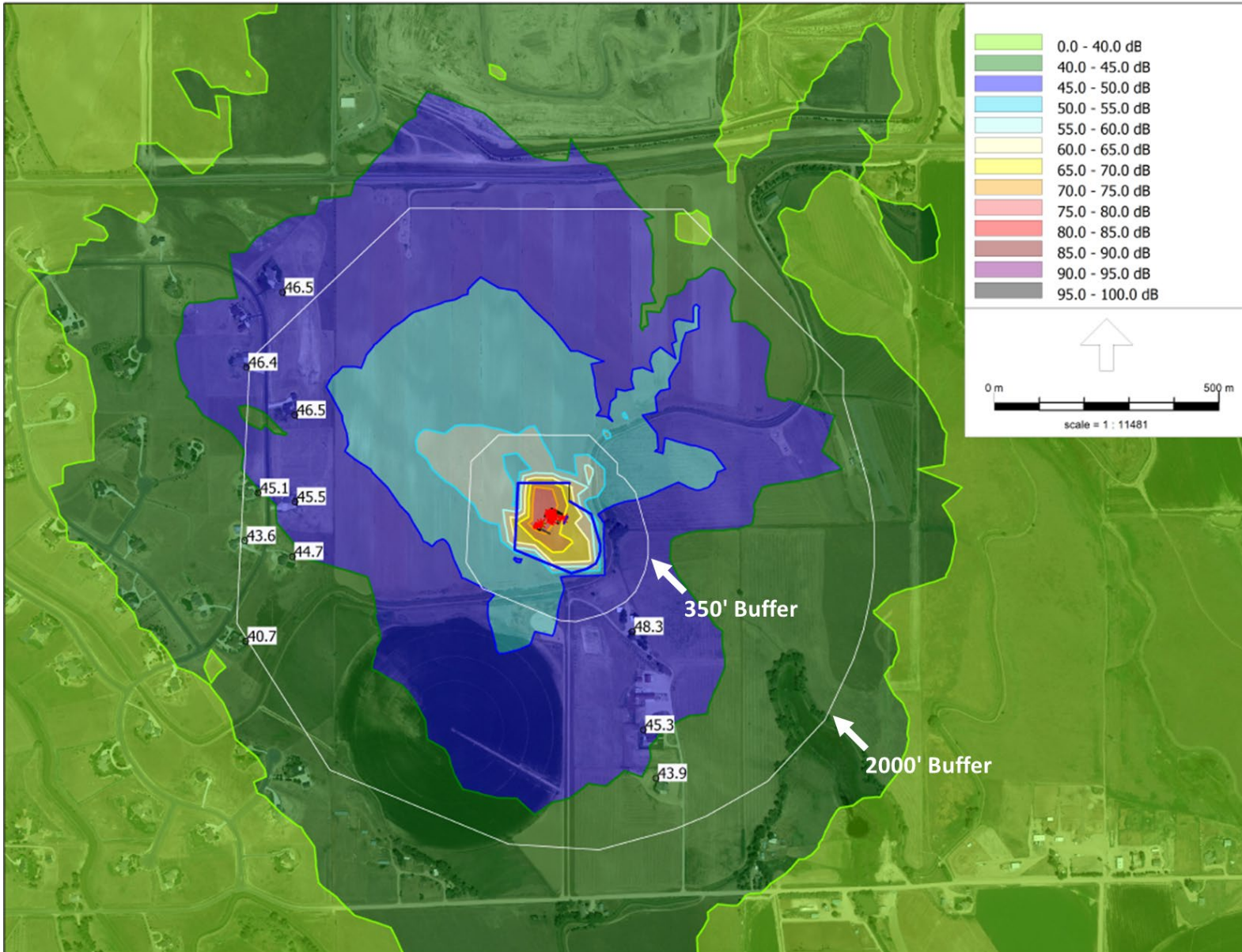


Figure 9. Mitigated Drilling Noise Contour Map (dBC)

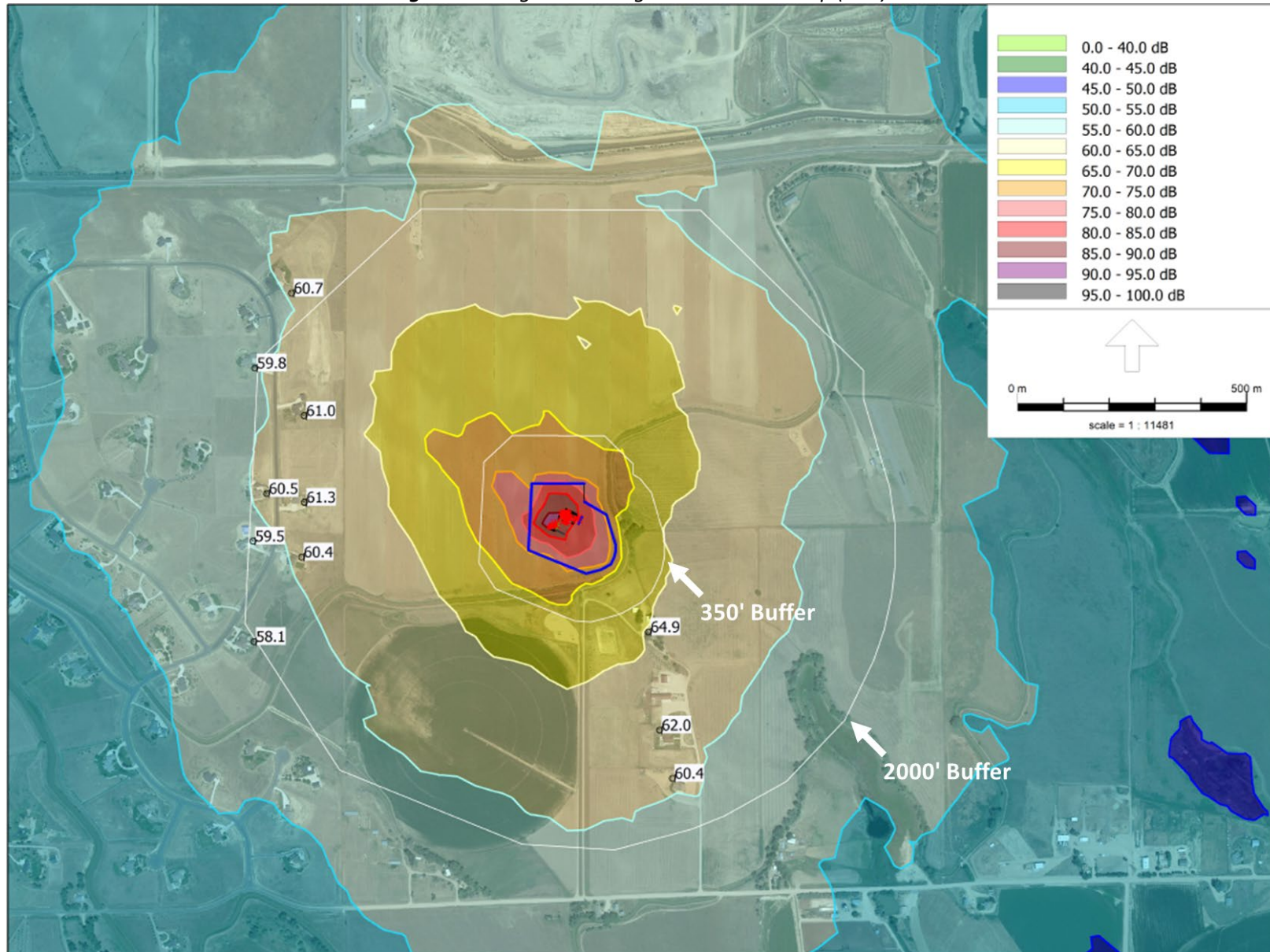


Figure 10. Mitigated Completions Noise Contour Map (dBA)

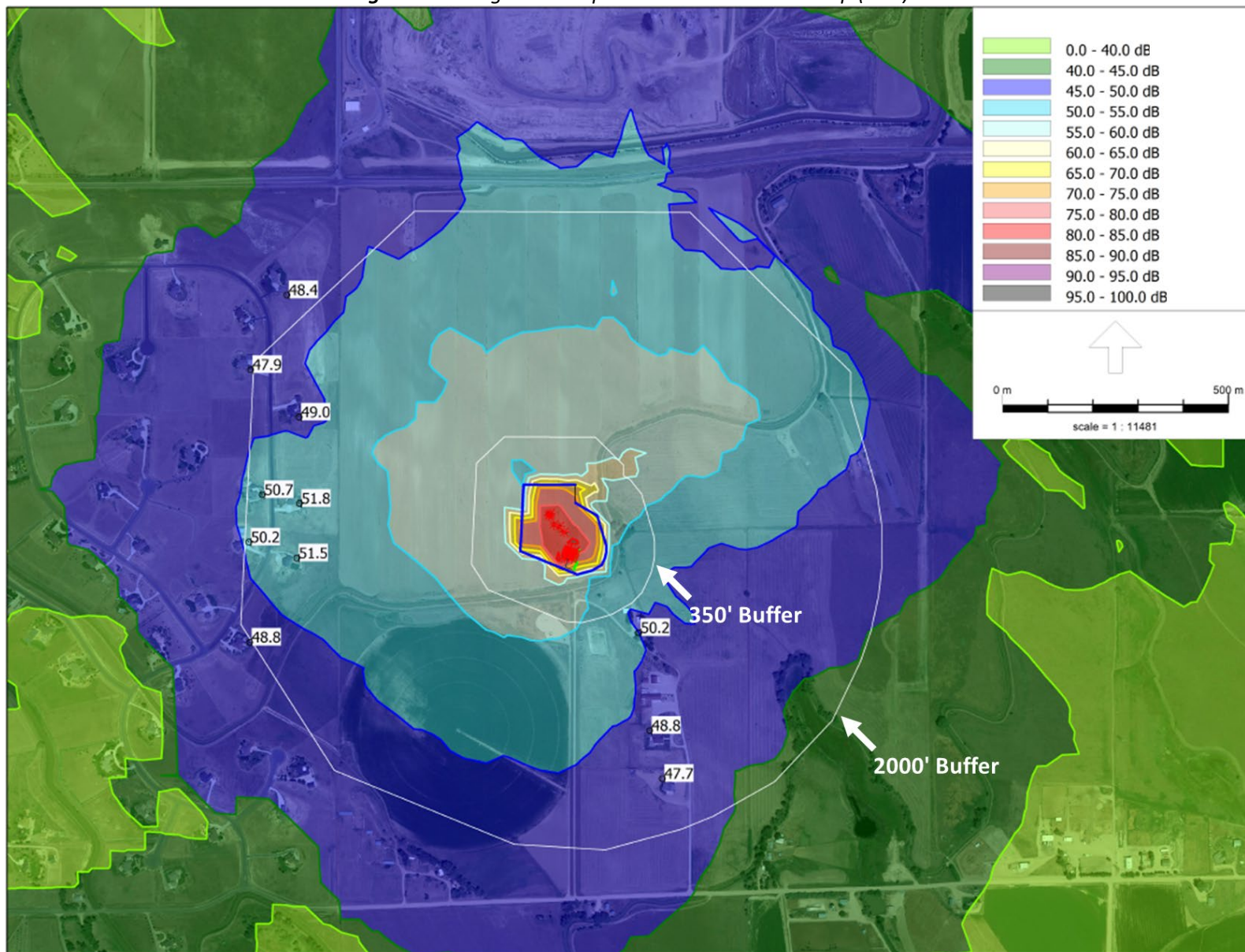
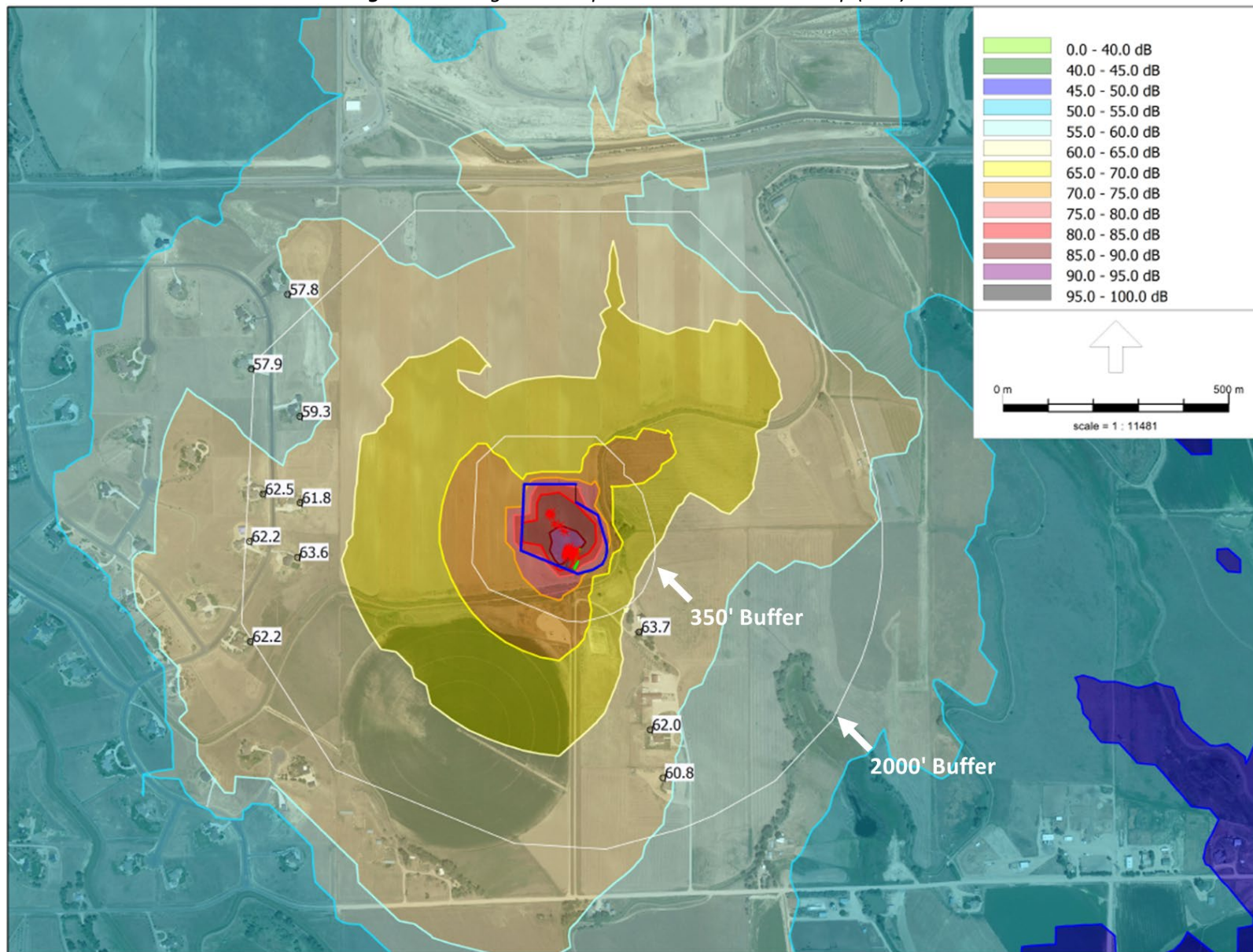


Figure 11. Mitigated Completions Noise Contour Map (dBC)



8. Conclusion

The results of the noise model indicate that mitigating both drilling and completions operations with the recommended noise control measures will result in operational noise levels that are expected to comply with permissible noise levels required by the COGCC Rule 423.

9. Notations

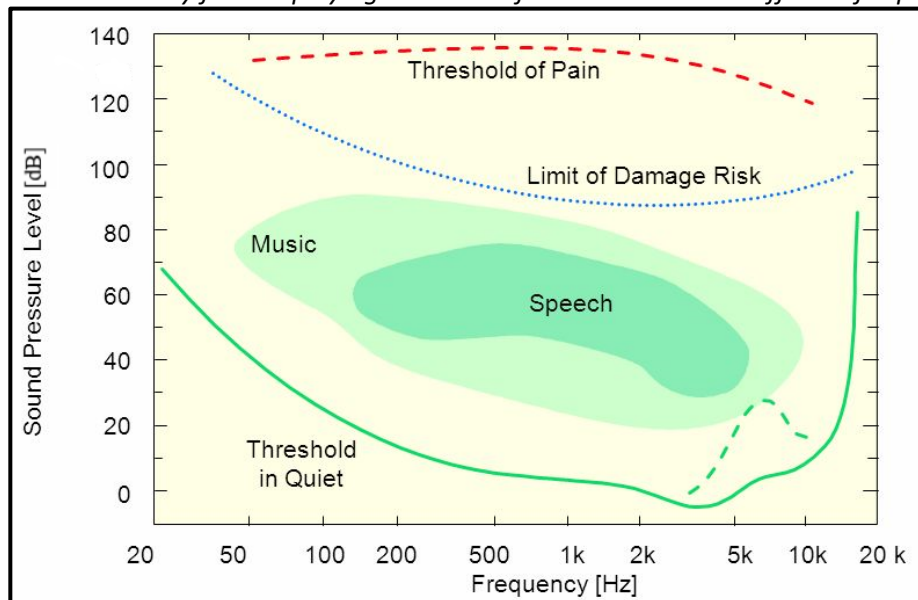
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Appendix 1 – Sound Fundamentals

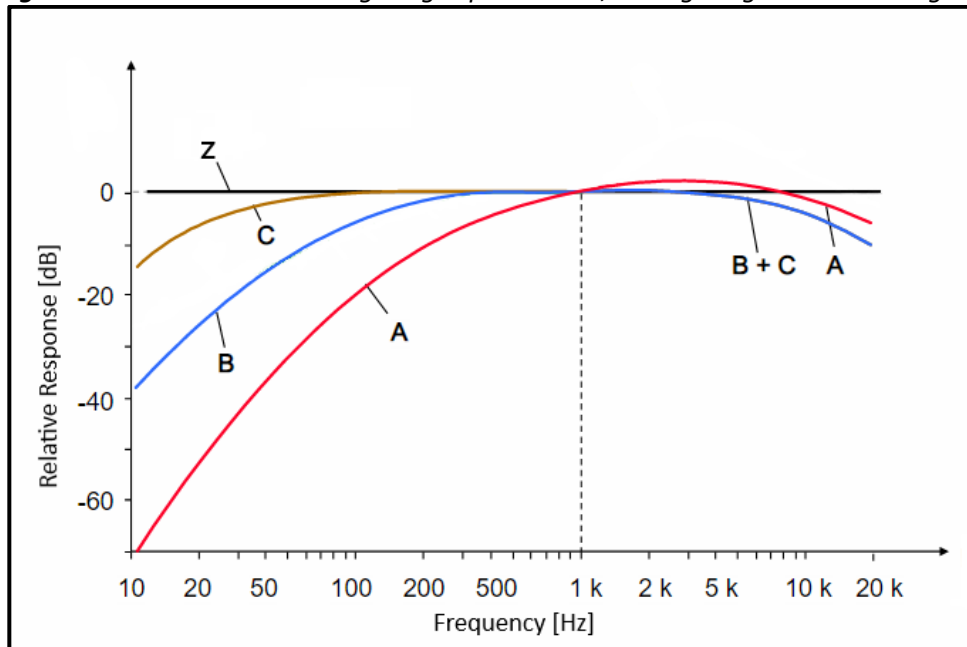
Sound is a series of vibrations transmitted through the air, or other medium, and can be heard when they are processed by the human ear. There are two important properties that describe sound; frequency and amplitude. Frequency is determined by the rate of movement and is measured in cycles per second, which is known as Hertz (Hz). A healthy human ear can hear 20 Hz – 20,000 Hz (Figure 12). 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 12. Auditory field displaying thresholds for a human ear at different frequencies



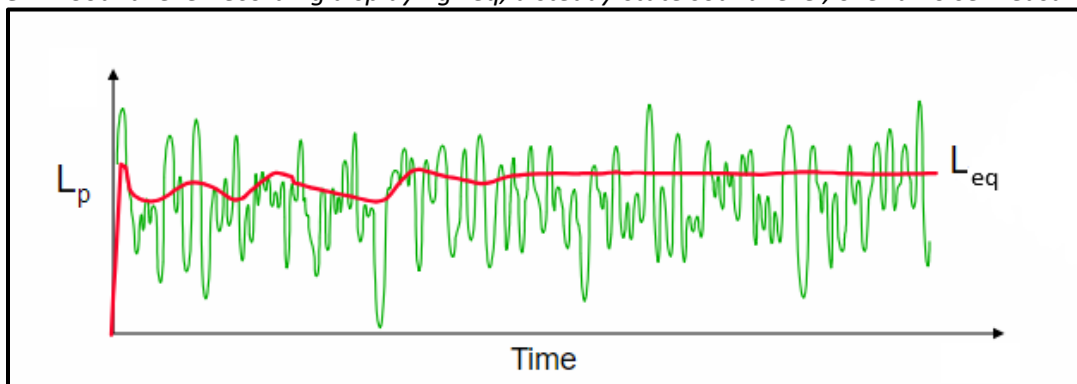
Frequency weightings are applied to measurements to provide a better match between measured results and human perception. Each weighting, in relation to their frequency components, allows for a consistent measurement of the different type of noise sources. A-weighted decibel sound pressure levels (dBA) are measurements recorded from a sound level meter measuring sounds similar to the response of the ear (Figure 13). While C-weighted (dBC) measurements are for low-frequency components.

Figure 13. Common sound weightings up to 20 kHz, Z-weighting means no weighting



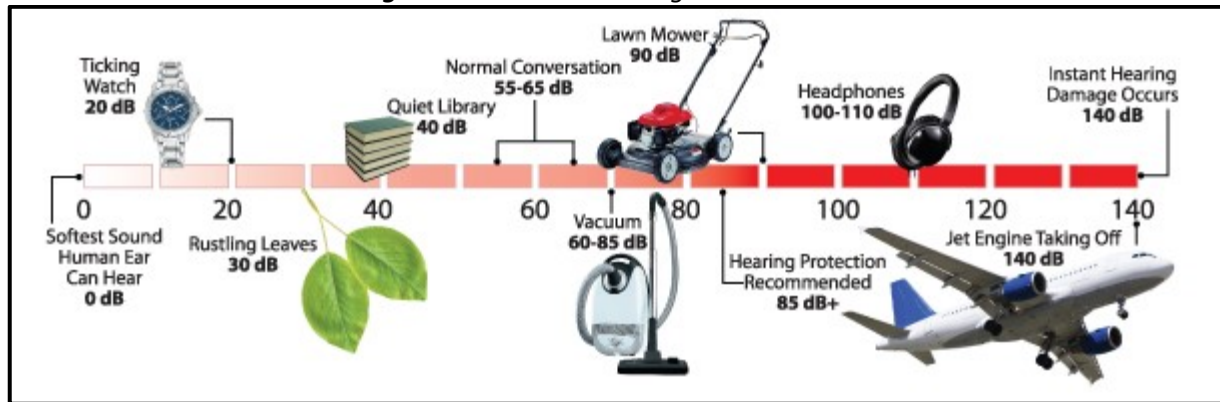
Each measurement has an exponential time factor. Slow time weighting is the most common for environmental noise measurements and will be used for these measurements. For recording over long periods of time, the sound level meter records each weighted decibel reading with an equivalent, or average, continuous sound level reading (L_{eq}). L_{eq} represents the same energy as the actual time varying sound signal (Figure 14). L_{Aeq} refers to the equivalent continuous sound level for an A-weighted measurement.

Figure 14. Sound level recording displaying L_{eq} , a steady-state sound level, over a noise measurement



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 15 presents typical A-weighted (dBA) sound levels for multiple sources of sound.

Figure 15. Common A-weighted sound levels



Appendix 2 – 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, which are usually 7:00 am to 7:00 pm (7:00 am to 9:00 pm for Weld County Code).

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

 L_{dn}

See Day night sound level.

 L_{eq}

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

A series of electronic filters separate sound into discrete frequency bands, making it possible to know how sound energy is distributed as a function of frequency. The octave band has a center frequency that is double the center frequency of the octave band preceding it.



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

The 1/3 octave band analysis provides a finer breakdown of sound distribution as a function of frequency.

