Sound Profile Assessment of Iron Horse Development, Hanover County, Virginia

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1.0 Executive Summary

This Sound Profile Assessment evaluates noise transmissions from typical data center equipment (chillers, transformers, and generators) at the proposed Iron Horse data center development in Hanover County, Virginia, to the surrounding neighborhood. The purpose of this assessment is to document the Project's sound profile at residences and schools within 500 feet of the development, as required by Virginia Code § 15.2-2209.4, in support of rezoning 78 acres for data center use.

Noise criteria were based on the Hanover County Noise Ordinance residential limits (Chapter 16, § 16-10) and the Client's Proffers, dated June 2, 2026. These limits are 57 dBA / 73 dBC during daytime hours and 52 dBA / 68 dBC during nighttime hours. Normal operations must meet both daytime and nighttime limits. Sound levels due to generator maintenance operations, which are limited to the hours of 8:00 am – 4:00 pm, Monday to Friday, must comply with the daytime requirements.

The existing ambient sound level was measured with Class 1 meters at four on-site locations from August 25th through September 1st, 2026. The dominant sources were traffic, insects, and birds. At the quietest measurement location (after filtering out insect noise), sound levels during the quietest moments (L_{90}, or the sound level exceeded 90% of the time) ranged from 32 to 50 dBA. On the west side of the Iron Horse property, closer to I-95, the L_{90} ranged from 41 to 56 dBA.

A 3D acoustic propagation model was developed in SoundPLAN using ISO 9613-2:2024 methodology. The model incorporates site topography and surrounding features, using conservative conditions, and predicts sound levels at multiple residential receivers. Contour plots were also generated to illustrate sound propagation in the surrounding area, including Hanover County residences within 500 feet of the development. Two standard operating scenarios were evaluated: (1) normal continuous operation of all transformers and chillers and (2) maintenance operation during daytime with continuous operation of all transformers and chillers at full capacity and one to two generators per building operating concurrently throughout the site for maintenance purposes. Emergency operations, with all chillers and generators operating concurrently, are exempt from all local noise regulations.

With the mitigation assumed in this study—intentional building siting, sound barrier walls, lower-noise equipment, acoustic generator enclosures, and chiller mitigation systems—predicted levels for normal and maintenance operations meet the Project's noise criteria. On that basis, it is feasible for a data center development at this site to be designed to meet the applicable noise requirements.

This sound profile assessment is a feasibility study based on available data. The predicted sound levels are subject to change as the project is designed, but compliance with the ordinance and proffered limits will be maintained. The project will provide a detailed noise impact assessment with the permitting application.

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2.0 List of Abbreviated Terms

dB	Decibel
dBA	A-weighted Decibels
dBC	C-weighted Decibels
LAS_{max}	Maximum A-weighted SPL using a slow detector
LA_{eq}	Equivalent continuous sound level (A-weighted)
L_{eq}	Equivalent continuous sound level (unweighted)
LW	Sound Power Level
SPL	Sound Pressure Level
RH	Relative Humidity
Hz	Hertz
Lmax	Maximum sound level
Lmin	Minimum sound level
°C	Degrees Celsius
sq-m	Square meters
NIA	Noise Impact Assessment
ISO	International Organization for Standardization
INCE	Institute of Noise Control Engineering
Bd. Cert.	Board Certified

3.0 Introduction

Soundscape Consulting has completed a Sound Profile Assessment for the proposed Iron Horse data center development (Project/Facility) located near 13000 Mt. Hermon Rd, Hanover County, Virginia. The Project area is shown in Figure 1. This assessment evaluates the potential noise transmission from the mechanical equipment serving this facility to the adjacent properties within Hanover County, including all Hanover County residences and schools within 500 feet of the property.

This report describes the relevant noise regulations, details of the Project and its surroundings, the data used for noise level predictions, available noise mitigation approaches, and the results of these predictions.



Figure 1: Project Area for the Proposed Iron Horse Data Center Development, Hanover County, VA

4.0 Terminology

A brief glossary of pertinent acoustics terminology is provided in Appendix A.

5.0 Applicable Noise Regulations and Project Criteria

5.1 Federal

There are no federal laws or regulations that apply to the Project's noise emissions.

5.2 State of Virginia

The State of Virginia recently amended Article 1 of Chapter 22 of Title 15.2 to include Section 15.2-2209.4. This new section, which was approved 4/13/2026 and took effect on 7/1/2026, requires that High Energy Use Facilities (HEUF) submit a site assessment to examine the sound profile of the HEUF on residential units and schools located within 500 feet of the HEUF property boundary. This sound profile assessment is to be submitted prior to any approval of a rezoning application, special exception, or special use permit for HEUFs (facilities with 100 MW or more power capacity).

5.3 Hanover County

Hanover County, VA, Code of Ordinances Section 16-10 defines the maximum permissible sound pressure levels, as shown below in Table 1. These limits apply to sound generated within the proposed Iron Horse development and are to be measured at or within the neighboring property boundaries.

Table 1: Maximum Permissible Sound Pressure Levels (Lav) [(1)] Table

Land Use Designation Where Noise is Measured	Daytime (7:00 a.m.—10:00 p.m.)	Nighttime (10:00 p.m.—7:00 a.m.)
Agricultural and Residential	57 dBA	52 dBA
Commercial	67 dBA	62 dBA
Industrial	77 dBA	77 dBA

1. Lav (dBA) is defined by the County as: the average A-weighted sound pressure level measured over any continuous four-hour period. For steady mechanical noise, the difference between hourly Leq and 4-hour Leq is minimal. This report treats continuous mechanical noise as equivalent to a 4-hour L_{eq} (Lav per the ordinance terminology)
2. "The emission of sound in the performance of emergency work" is exempt from the above limits.

5.4 Project Proffers

The Iron Horse proffers, dated June 2, 2026, state that the project must also ensure that noise levels at its boundary lines do not exceed 73 dBC during daytime hours and 68 dBC during nighttime hours. These dBC limits were based upon the new limits for data centers in Prince William County, which exempts sound from emergency generators.

5.5 Project Sound Criteria

The project's noise criteria are summarized in Table 2; these limits apply to the neighboring properties in Hanover County. The dBA and dBC metrics apply different frequency weightings to the same sound. The dBA metric is used to represent human hearing, while the dBC metric captures more low-frequency sound energy that has the potential to transmit indoors.

Table 2: Iron Horse Project Noise Criteria

Daytime 4-hour L_{eq} (7:00 a.m. - 10:00 p.m.)		Nighttime 4-hour L_{eq} (10:00 p.m. - 7:00 a.m.)	
A-weighted	**C-weighted**	**A-weighted**	**C-weighted**
57 dBA	73 dBC	52 dBA	68 dBC

6.0 Project Description

WestDulles Properties is seeking to rezone 78 acres of land near the intersection of Patrick Henry Road (Route 54) and I-95 for data center use. This parcel would be combined with 102 acres already zoned for data center use by the Town of Ashland. The proposed data center is a 600 MW facility. It is assumed that the development would include multiple data center buildings and outdoor mechanical equipment areas (including chillers, backup generators, and electrical transformers) at grade adjacent to the buildings. The proposed site area is shown in Figure 2.

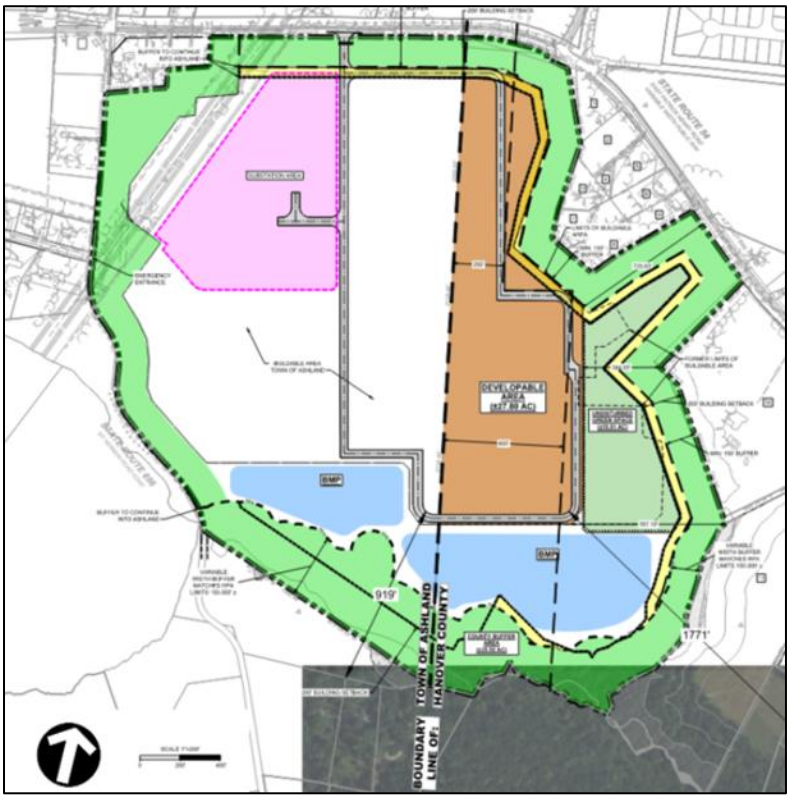

Figure 2: Project Area for the Proposed Iron Horse Development

7.0 Ambient Noise Survey

Ambient sound levels were measured at four locations within the Project area from August 25th through September 1st, 2026. Figure 3 shows the locations of noise monitoring equipment and Figure 4 shows a photo of one of the meters installed on-site (Location 2).

Sound levels were measured in third-octave bands with NTi Audio model XL2-TA acoustic analyzers with model MC230 microphones and model MA220 preamps. These systems are Class 1 Type Approved, meeting the requirements of IEC 61672 and ANSI S1.4. This equipment has been calibrated within the past two years, to a reference traceable to the National Institute of Standards and Technology (NIST) by the equipment manufacturer or a laboratory in the business of providing calibration services. Sensitivity was checked in the field, before and after measurements, using a handheld sound level calibrator conforming to the Class 1 requirements of IEC 60942 and ANSI S1.40.

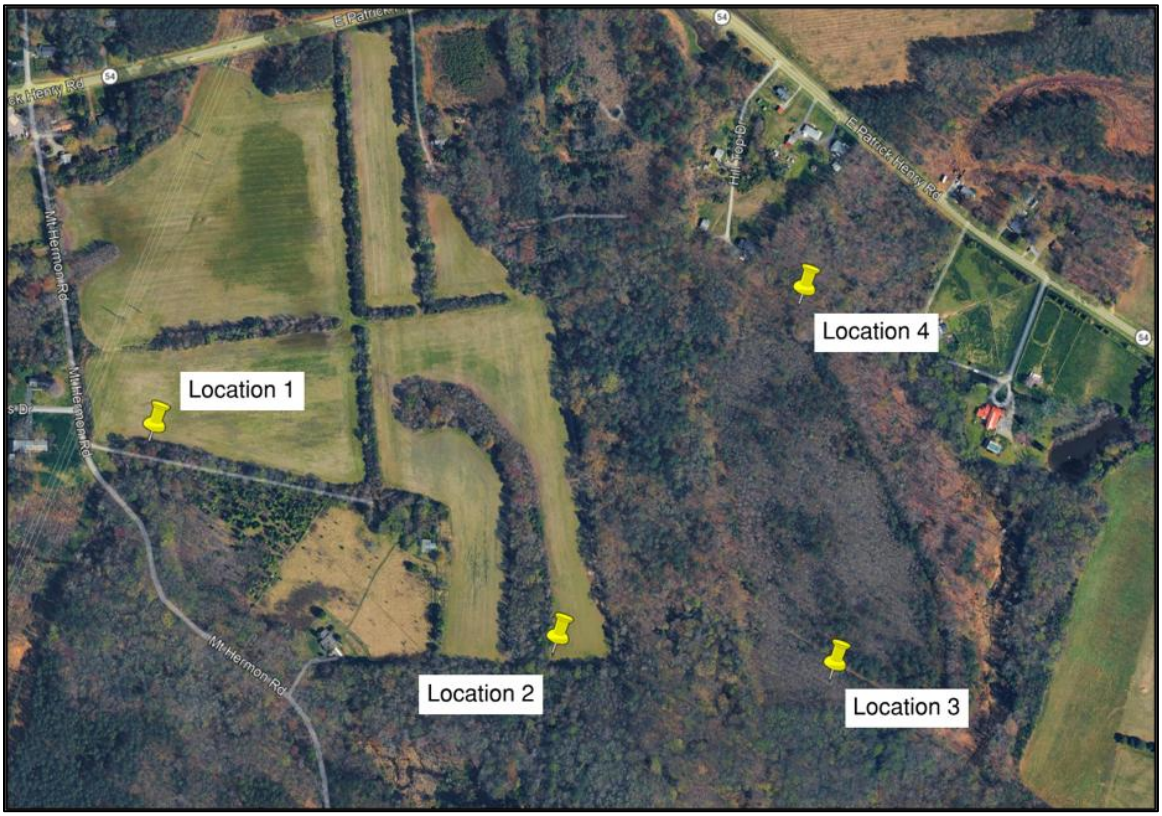

Figure 3: Sound Level Meter Locations



Figure 4: Sound Level Meter – Location 2

Table 3 contains the range of hourly sound levels measured during daytime and nighttime at each measurement location for the entire 7-day measurement period. All measurements have been filtered to exclude insect noise (2.5-8kHz) to provide an accurate picture of the quietest ambient levels (winter). See Figure 5 for a visual of the filter applied to insect noise.

Table 3: Overall Measured Levels for Daytime/Nighttime

Locations	Hourly LA_{eq}		Hourly LA_{90}		Hourly LC_{eq}	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
Location 1	44-58 dBA	47-58 dBA	41-56 dBA	43-56 dBA	59-76 dBC	59-69 dBC
Location 2	36-58 dBA	42-57 dBA	33-54 dBA	38-54 dBA	53-66 dBC	54-66 dBC
Location 3	36-55 dBA	38-52 dBA	32-50 dBA	34-50 dBA	51-65 dBC	53-65 dBC
Location 4	43-52 dBA	38-53 dBA	35-50 dBA	34-51 dBA	54-65 dBC	51-64 dBC

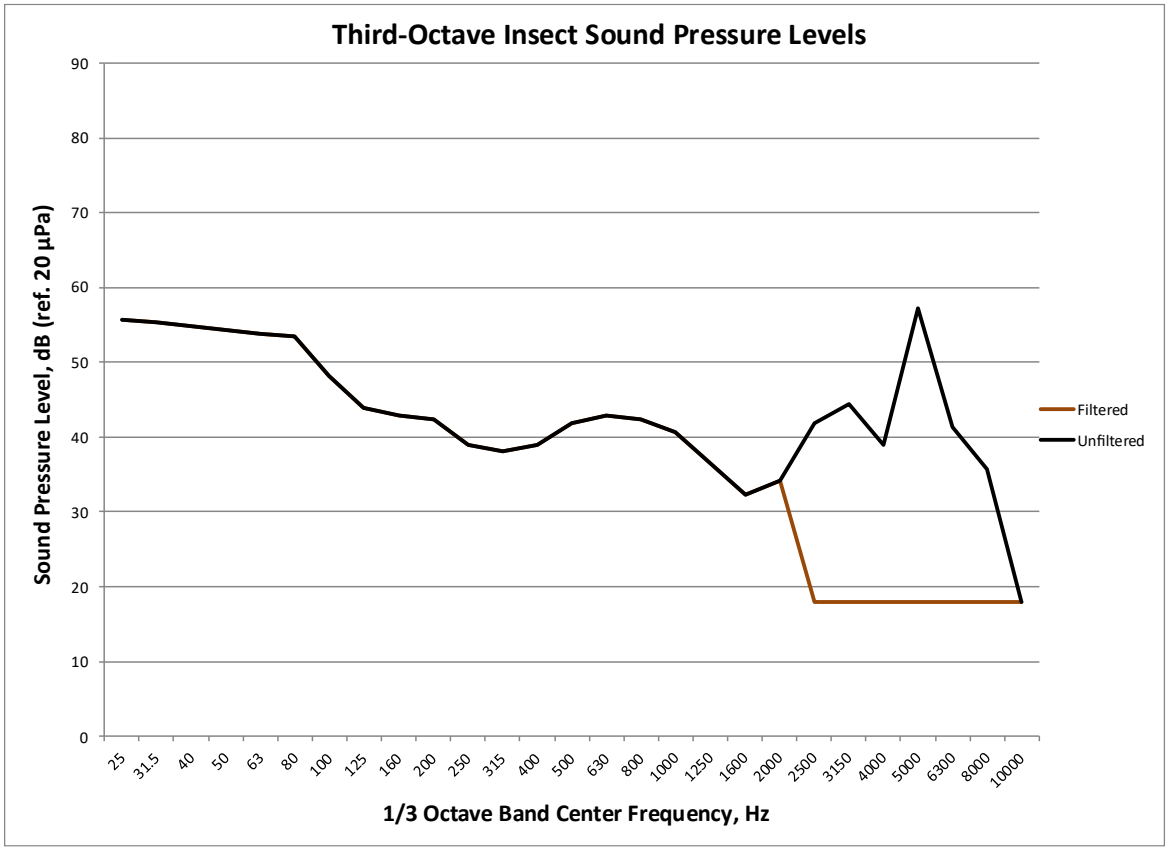

Figure 5: Insect Noise Filter Comparison

We logged sound levels at 1-second intervals (LA_{eq} and LA_{90}) for the 7-day measurement period at each location. These 1-second interval sound levels were used to calculate hourly levels at each location; an example graph showing hourly levels over a 2-day period at Location 1 is shown in Figure 6.

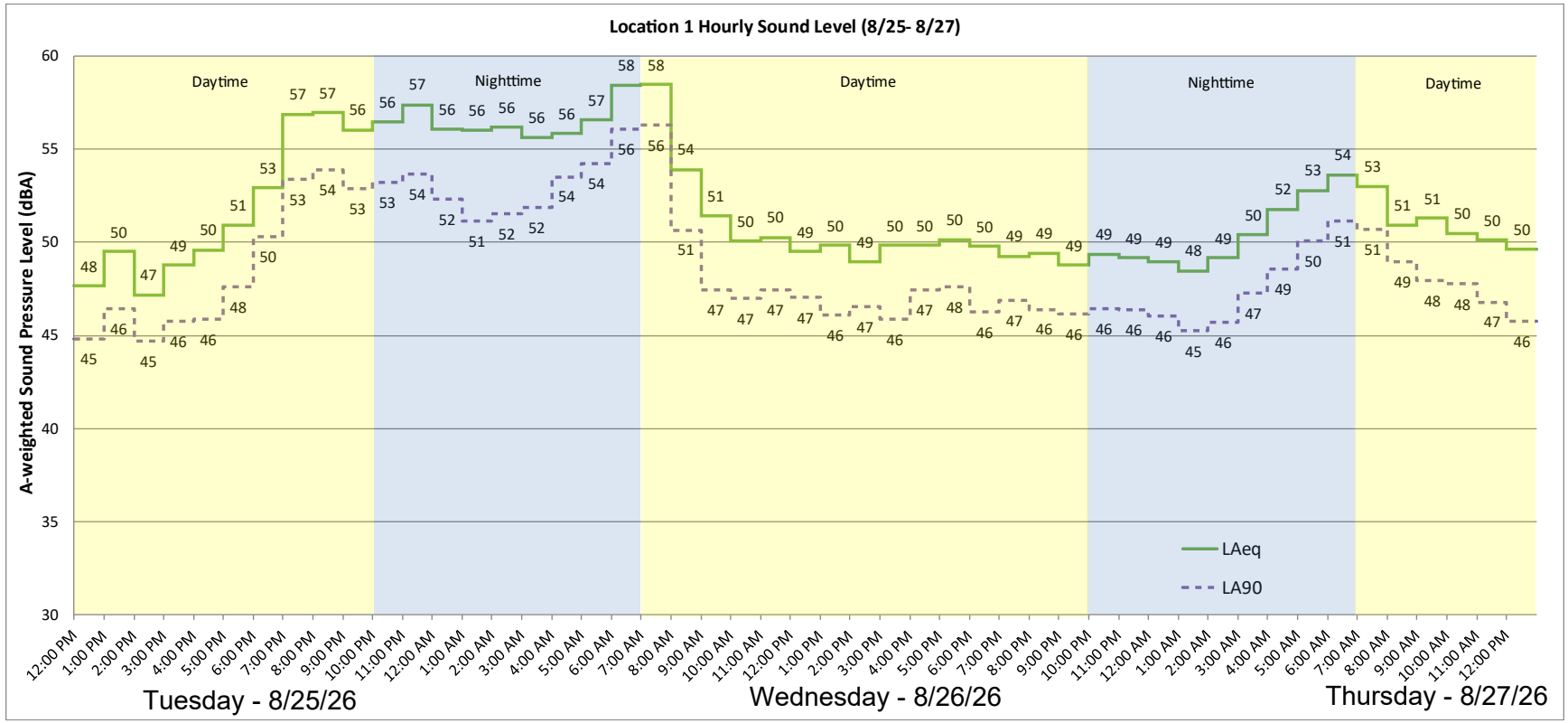

Figure 6: Example Graph - Location 1 Hourly Sound Levels (8/25 – 8/27)

8.0 Acoustic Modeling Methodology

The commercially available and widely used software, SoundPLAN, was employed to develop a three-dimensional noise model of the Project (with a representative data center site concept plan and associated equipment) and its surrounding area. This model represents the area's topography, surrounding buildings, and noise sources. The sound propagation across the site and surrounding area was calculated within the model to determine the expected noise levels at selected receiver locations.

Table 4 summarizes the noise modeling parameters used in this analysis. Noise levels were predicted in accordance with International Organization for Standardization (ISO) Standard 9613-2:2024, *Attenuation of Sound During Propagation Outdoors*.

Table 4: Sound Modeling Parameters

Parameter	Value
Digital Terrain Map (DTM)	Project site and surrounding areas: existing topography provided by Client. Extended surrounding area: Google Maps and Google Earth elevations derived from free SRTM elevation data.
Ground Factor (G)	G = 0.0 for urban environments, pavement, concrete, and water G = 0.7 for forested and grassy areas
Receiver/Grid Height	1.5 m high at the Project property boundaries and surrounding residences
Source Height	Top of the sound sources
Source Sound Power Levels	See Table 6
Source Directivity	omnidirectional
Temperature/Humidity	10°C, 70% RH
Cmet (meteorological adjustment)	0 (none)
Source Range	Project site and surrounding area
Dense Vegetation	No foliage attenuation

8.1 Project Sound Sources

Source levels were based upon equipment (chillers, back-up generators, and transformers) used for similar data center projects, and the equipment sizes and quantities were scaled based on the expected 600 MW power capacity of the site.

The following equipment and assumptions were used in this analysis:

Table 5: Modeled Equipment with Mitigation Measures

Equipment Type	Quantity	Manufacturer	Model & Details
Air-cooled, 500-ton Screw Chillers	442	York	YVAA0523JZV46BAVNXX, with mitigation system; assumes operations with 100% load during daytime and 75% load at night
3 MW Diesel Generators	200	Cummins	QSK95-G9 60Hz, 100% load, in Level 2 enclosure
Transformers	7		145 MVA (no additional mitigation)

A wide variety of noise mitigation strategies are available to the project. For this feasibility assessment, the following types of sound mitigations were applied to the estimated noise source levels:

- Intentional siting and arrangement of buildings and equipment to optimize attenuation of sound emissions
- Noise barriers
- Low-noise equipment
- Chiller mitigation systems
- Acoustic generator enclosures

The octave band sound power levels used in the model for each source are provided below in Table 6.

Table 6: Mitigated Equipment Sound Power Levels (dB)

Source	Sound Power Levels (dB) at Octave Band Center Frequencies, Hz									dBA
	31.5	63	125	250	500	1000	2000	4000	8000	
Chillers – low-sound option with mitigation system, 75% load [1]	91	91	92	86	88	84	76	81	78	90
Chillers – low-sound option with mitigation system, 100% load [1]	94	94	95	90	88	88	81	83	82	92
Generators – with L2 enclosure, 100% load [2]	114	114	112	111	105	105	104	100	109	112
Transformers – 145 MVA [3]	93	99	101	96	96	90	85	80	73	96

1. Manufacturer did not provide sound power data for the 31.5 Hz octave band; levels were assumed to be equal to the 63 Hz octave band
2. Enclosure levels were estimated from enclosure data for a similar product by the same manufacturer
3. Calculated spectra for typical transformer

Note that the low-frequency data needed for calculating overall C-weighted sound levels (dBC) is not often published by manufacturers, especially sound levels at 31 Hz. For this feasibility assessment, we used engineering judgement to estimate low-frequency sound levels based on the available frequency data. Specifically, where manufacturer spectra are incomplete below 63 Hz, the 31.5 Hz level was set equal to the level at 63 Hz. The dBC results are therefore approximate and should be confirmed with vendor data or shop tests during the design of the development.

8.2 Receivers

Noise levels were predicted at twenty-five (25) Hanover County residential receiver locations that have some portion of the lot within 500 feet of the Project (indicated by the green dashed line in Figure 7). There are no schools located within 500 feet of the Project. Although Virginia Law only requires this study to assess areas within Hanover County, we also predicted sound levels at individual residences within the Town of Ashland that have portions of the lot within 500 feet of the Project.

The individual receiver locations (numbered 1-40 in Figure 7) are located on the side of each dwelling closest to the Project. Addresses are in Table 7. Noise contours were also plotted over the surrounding area of Hanover County so that Project-related sound levels can be visualized across a wider area.

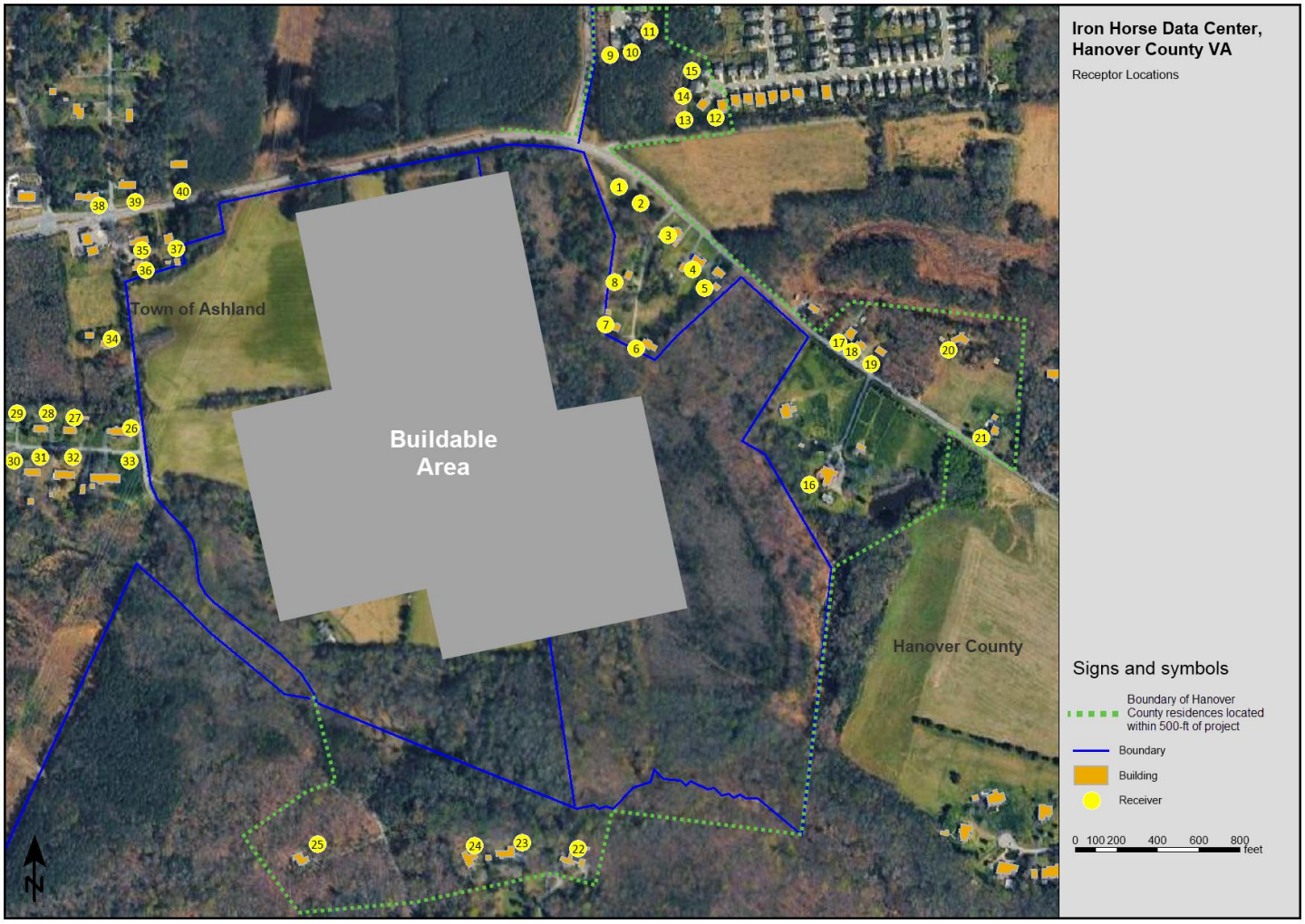

Figure 7: Modeled Receiver Locations

Table 7: Modeled Residential Receiver Addresses

Receiver	Receiver Address
1	10141 East Patrick Henry Road, Ashland, VA
2	10135 East Patrick Henry Road, Ashland, VA
3	10125 East Patrick Henry Road, Ashland, VA
4	10115 East Patrick Henry Road, Ashland, VA
5	10109 East Patrick Henry Road, Ashland, VA
6	13078 Hill Top Drive, Ashland, VA
7	13083 Hill Top Drive, Ashland, VA
8	13097 Hill Top Drive, Ashland, VA
9	13400 Dyson Trail Circle, Ashland, VA
10	13404 Dyson Trail Circle, Ashland, VA
11	13408 Dyson Trail Circle, Ashland, VA
12	10841 Providence Woods Lane, Ashland, VA
13	10845 Providence Woods Lane, Ashland, VA
14	10848 Providence Woods Lane, Ashland, VA
15	10844 Providence Woods Lane, Ashland, VA
16	10067 East Patrick Henry Road, Ashland, VA
17	10076 East Patrick Henry Road, Ashland, VA
18	10072 East Patrick Henry Road, Ashland, VA
19	10068 East Patrick Henry Road, Ashland, VA
20	10052 East Patrick Henry Road, Ashland, VA
21	10034 East Patrick Henry Road, Ashland, VA
22	10133 Camden Lane, Ashland, VA
23	10132 Camden Lane, Ashland, VA
24	12902 Mount Hermon Road, Ashland, VA
25	12915 Mount Hermon Road, Ashland, VA
26	*100 Mechumps Drive, Ashland, VA**
27	*102 Mechumps Drive, Ashland, VA*
28	*104 Mechumps Drive, Ashland, VA*
29	*106 Mechumps Drive, Ashland, VA*
30	*107 Mechumps Drive, Ashland, VA*
31	*105 Mechumps Drive, Ashland, VA*
32	*103 Mechumps Drive, Ashland, VA*
33	*101 Mechumps Drive, Ashland, VA*
34	*13089 Mount Hermon Road, Ashland, VA*
35	*10267 East Patrick Henry Road, Ashland, VA*
36	*13110 Mount Hermon Road, Ashland, VA*
37	*10259 East Patrick Henry Road, Ashland, VA*
38	*100 Frances Road, Ashland, VA*
39	*101 Frances Road, Ashland, VA*
40	*10250 East Patrick Henry Road, VA*

* Receiver locations in *italics* are located within the Town of Ashland and outside the scope of this study

8.3 Modeled Equipment Scenarios

Noise levels were predicted for two operating conditions: (1) Normal continuous operation of all transformers and chillers – during daytime and nighttime hours; and (2) Maintenance operations with all transformers, chillers, and 1-2 generators running concurrently at each building, which would occur during daytime hours only.

9.0 Predicted Project Noise Levels

With the model parameters and mitigations discussed in Section 8.0, noise levels were predicted for the two operating conditions (normal operations and maintenance operations modes). Noise contour maps are provided below for each operating condition to help visualize the predicted noise transmissions to the surrounding area due to the proposed Project.

9.1 Normal Operating Conditions

The modeled noise level ranges at the nearest residences with normal continuous operation of all transformers and chillers, with mitigation, are shown below in Table 8. A-weighted noise contours are shown in Figure 8 and C-weighted contours are shown in Figure 9. The color-coded ranges in the table below also correspond to the colored contours in each chart.

The model results show that it is feasible for the normal operations of a data center project to meet the project criteria with available mitigations.

Table 8: Predicted Noise Level Ranges at Receiver Locations – Normal Operating Conditions with Mitigation
Predicted Sound Levels at all Receiver Locations are below 52 dBA and 68 dBC Nighttime Limits

Receiver	Overall dBA	Overall dBC
1	37 - 42	< 53
2	37 - 42	< 53
3	< 37	< 53
4	< 37	< 53
5	< 37	< 53
6	42 - 47	53 - 58
7	42 - 47	53 - 58
8	< 37	< 53
9	42 - 47	53 - 58
10	42 - 47	53 - 58
11	42 - 47	< 53
12	37 - 42	< 53
13	37 - 42	< 53
14	37 - 42	< 53
15	37 - 42	< 53
16	< 37	< 53
17	37 - 42	< 53
18	37 - 42	< 53
19	37 - 42	< 53
20	37 - 42	< 53

Receiver	Overall dBA	Overall dBC
21	37 - 42	< 53
22	47 - 52	53 - 58
23	47 - 52	53 - 58
24	47 - 52	53 - 58
25	47 - 52	53 - 58
26	*42 - 47*	*53 - 58*
27	*42 - 47*	*53 - 58*
28	*42 - 47*	*53 - 58*
29	*37 - 42*	*53 - 58*
30	*42 - 47*	*53 - 58*
31	*42 - 47*	*53 - 58*
32	*42 - 47*	*53 - 58*
33	*42 - 47*	*53 - 58*
34	*47 - 52*	*53 - 58*
35	*42 - 47*	*53 - 58*
36	*42 - 47*	*53 - 58*
37	*42 - 47*	*53 - 58*
38	*42 - 47*	*53 - 58*
39	*42 - 47*	*53 - 58*
40	*47 - 52*	*53 - 58*

* Predictions subject to change as the project is designed

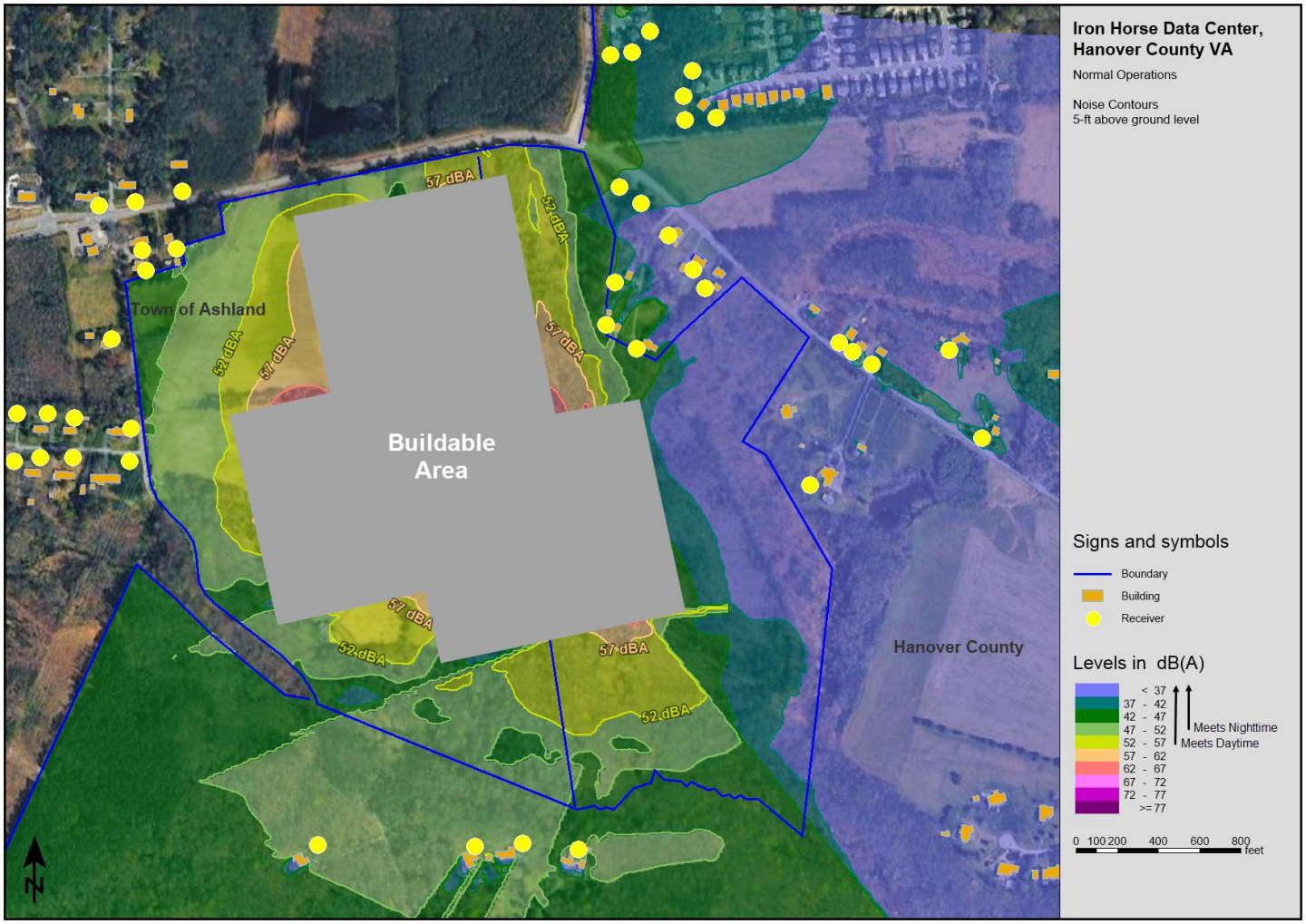

Figure 8: A-weighted Noise Contour Map – Normal Operations

(Blue, Teal, Green, and Lime Shaded Areas Meet 52 dBA Nighttime Limit)

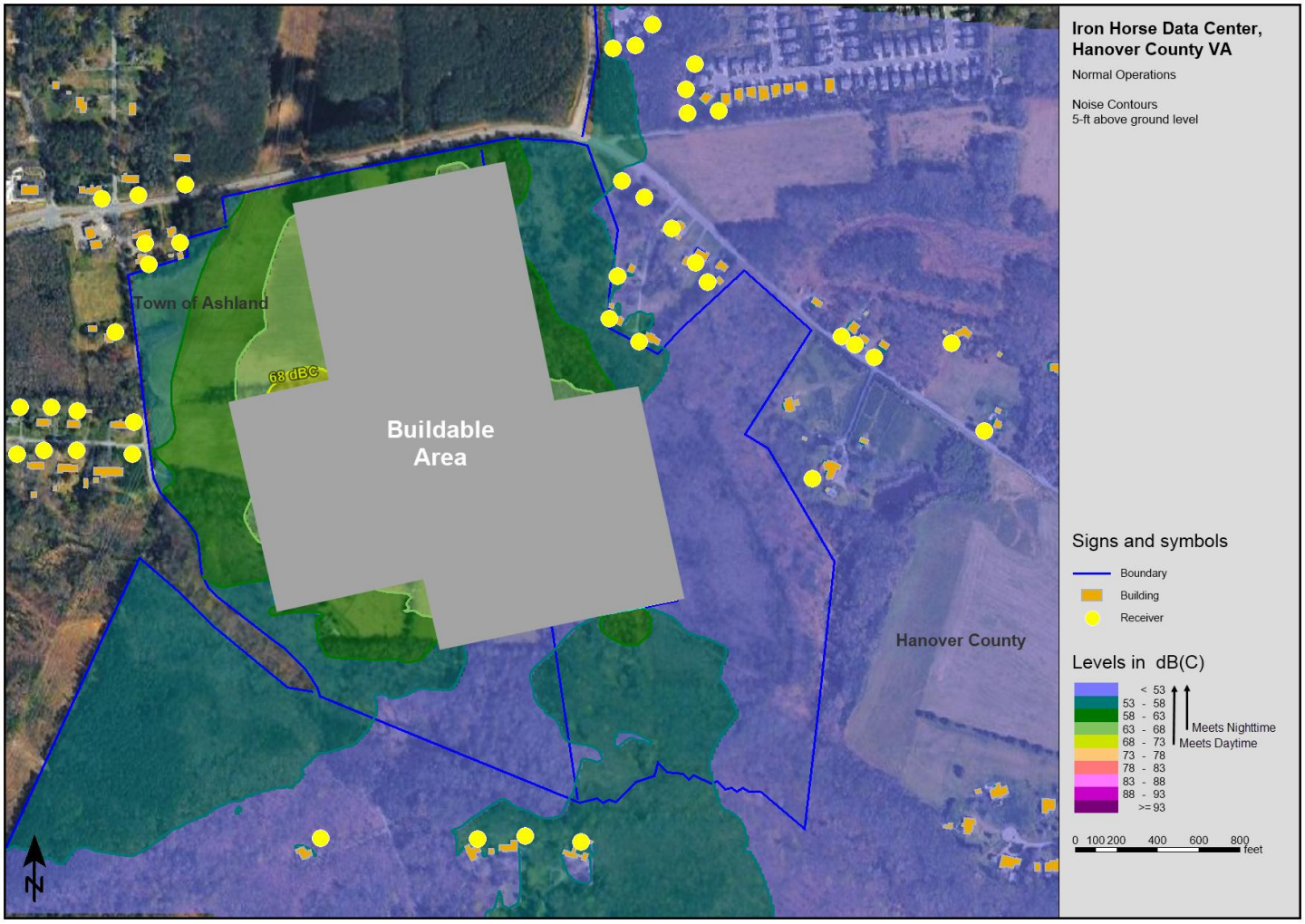

Figure 9: C-weighted Noise Contour Map – Normal Operations

(Blue, Teal, Green, and Lime Shaded Areas Meet 68 dBC Nighttime Limit)

9.2 Maintenance Operations

The modeled noise level ranges at the nearest residences with maintenance operation of all transformers and chillers and 1-2 generators operating in maintenance mode at each building are shown below in Table 9. A-weighted noise contours are shown in Figure 10 and C-weighted contours are shown in Figure 11. The model results show that it is feasible for the maintenance operations of a data center project to meet the project criteria with available mitigations.

Table 9: Predicted Noise Level Ranges at Receiver Locations – Maintenance Operations with Mitigation
Predicted Sound Levels at all Receiver Locations are below 57 dBA and 73 dBC Daytime Limits

Receiver	Overall dBA	Overall dBC
1	52 - 57	63 - 68
2	52 - 57	63 - 68
3	42 - 47	58 - 63
4	42 - 47	58 - 63
5	42 - 47	58 - 63
6	52 - 57	63 - 68
7	52 - 57	63 - 68
8	37 - 42	58 - 63
9	47 - 52	63 - 68
10	47 - 52	63 - 68
11	47 - 52	63 - 68
12	47 - 52	63 - 68
13	47 - 52	63 - 68
14	52 - 57	58 - 63
15	47 - 52	58 - 63
16	37 - 42	58 - 63
17	42 - 47	58 - 63
18	42 - 47	58 - 63
19	42 - 47	58 - 63
20	42 - 47	58 - 63

Receiver	Overall dBA	Overall dBC
21	42 - 47	58 - 63
22	52 - 57	63 - 68
23	52 - 57	63 - 68
24	52 - 57	63 - 68
25	47 - 52	63 - 68
26	*52 - 57*	*63 - 68*
27	*47 - 52*	*63 - 68*
28	*47 - 52*	*58 - 63*
29	*47 - 52*	*58 - 63*
30	*42 - 47*	*58 - 63*
31	*42 - 47*	*58 - 63*
32	*47 - 52*	*58 - 63*
33	*47 - 52*	*63 - 68*
34	*52 - 57*	*63 - 68*
35	*52 - 57*	*63 - 68*
36	*52 - 57*	*63 - 68*
37	*47 - 52*	*63 - 68*
38	*47 - 52*	*58 - 63*
39	*47 - 52*	*58 - 63*
40	*47 - 52*	*58 - 63*

* Predictions subject to change as the project is designed

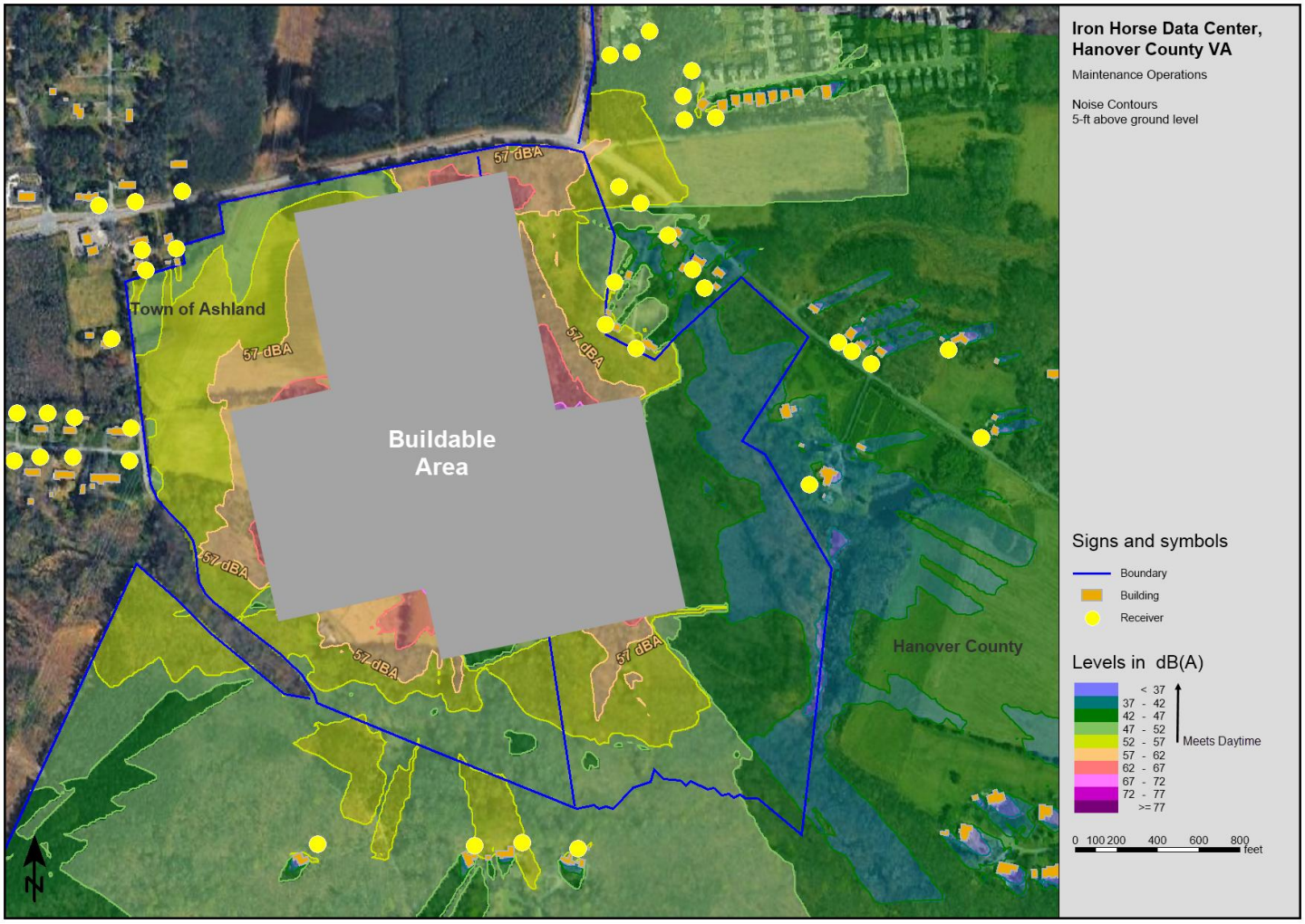

Figure 10: A-weighted Noise Contour Map – Maintenance Operations

(Blue, Teal, Green, Lime, and Yellow Shaded Areas Meet 57 dBA Daytime Limit)

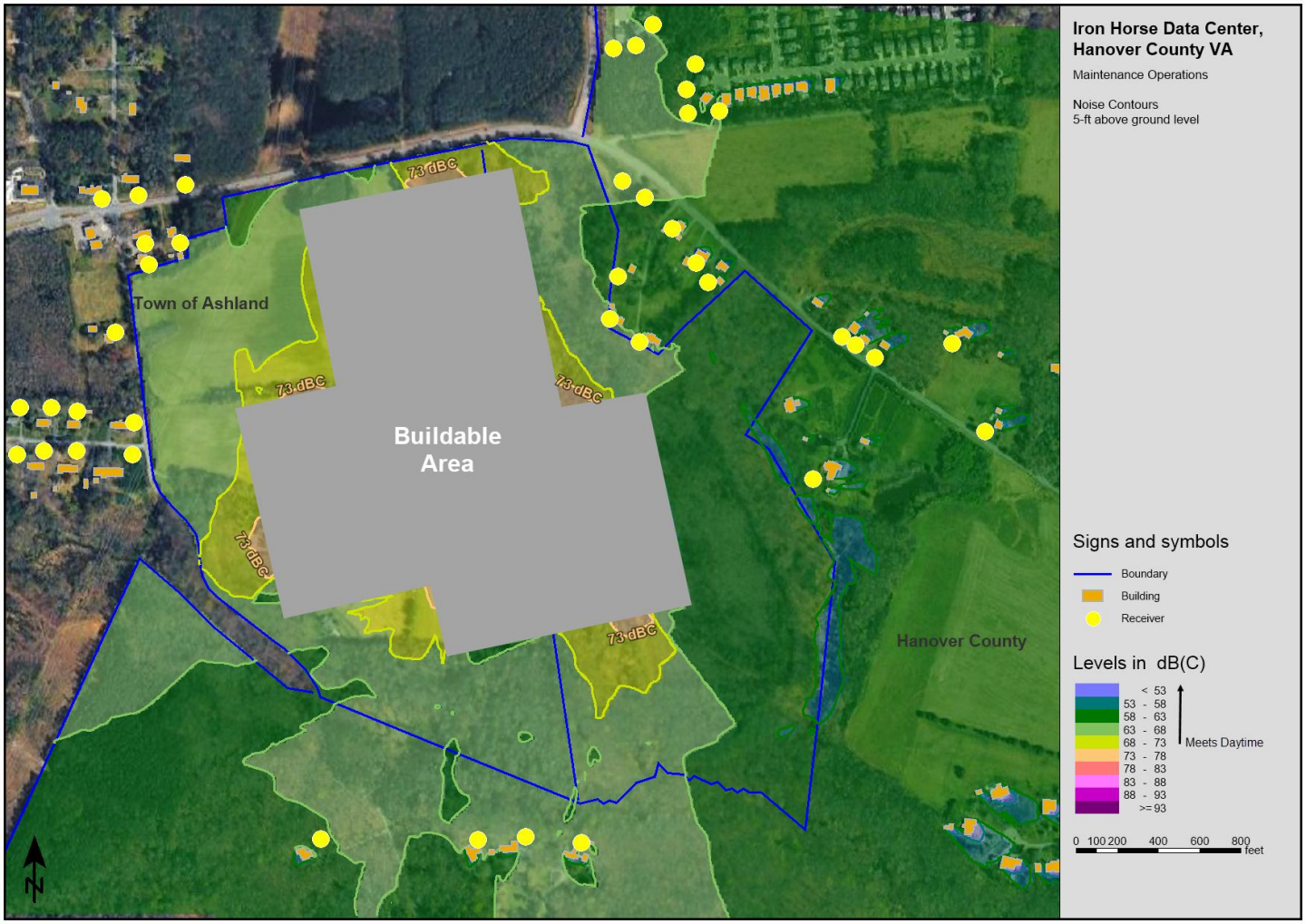

Figure 11: C-weighted Noise Contour Map – Maintenance Operations

(Blue, Teal, Green, Lime, and Yellow Shaded Areas Meet 73 dBC Daytime Limit)

10.0 Sound Profile Assessment and Conclusions

This assessment evaluated the potential noise transmission from a conceptual data center site plan to the surrounding residential properties in accordance with local and State noise regulations, as well as levels proffered by the Client.

This assessment included 442 500-ton chillers, 1-2 3MW generators per building during maintenance operations (daytime), and seven 145 MVA transformers, along with available mitigation measures, which include:

- Intentional siting and arrangement of buildings and equipment to optimize attenuation of sound emissions
- Noise barriers
- Low-noise equipment
- Chiller mitigation systems
- Acoustic generator enclosures

Table 10 shows the sound level criteria applicable to the Project. As shown in the table, receivers analyzed in this assessment during Normal and Maintenance operations do not exceed any of the sound level limits with the mitigation included in the model.

Table 10: Sound Level Criteria Applicable to the Project and the Number of Receivers Exceeding Limits with Mitigation

Sound Level Criteria	Sound Level Limit (dBA)	Sound Level Limit (dBC)	Number of Receivers Exceeding Criteria	
			Normal Operations	Maintenance Operations
Hanover County Code of Ordinances § 16-10, Daytime	57	--	0	0
Hanover County Code of Ordinances § 16-10, Nighttime	52	--	0	n/a
Proffered C-weighted Levels, Daytime	--	73	0	0
Proffered C-weighted Levels, Nighttime	--	68	0	n/a

Based on the modeling and assumptions documented in the report, it is feasible for a data center development on the Iron Horse property to meet all Project sound level criteria during Typical and Maintenance operations.

This feasibility study was based on available data. The results are subject to change as the project is designed, but compliance with the ordinance and proffered limits will be maintained, and a noise impact assessment based on updated project data will be provided with the permitting application.

Appendix A: Acoustical Terminology

Sound level is measured in units called decibels (abbreviated dB). Decibels are logarithmic rather than linear quantities and thus a doubling of the sound level does not translate to a mathematical doubling of decibels. Also, the human ear does not interpret a doubling of sound energy (two sources instead of one) as a doubling of loudness. The logarithmic nature of dB and the human subjective perception of relative sound levels result in the following approximate rules for judging increases in sound.

- 3 dB sound level increase or decrease - just noticeable
  (the addition of one identical sound source to an existing source)
- 5 dB sound level increase or decrease - clearly perceptible and is often considered significant
  (the addition of two identical sound sources to an existing source)
- 10 dB sound level increase or decrease - perceived as twice as loud/half as loud
  (the addition of nine identical sound sources to an existing source)

These perceived changes in the sound level are mostly independent of the absolute sound level. That is, a 35 dB sound will be perceived as twice as loud as a 25 dB sound, and a 60 dB sound will be perceived as twice as loud as a 50 dB sound.

Octave bands - Audible sound occurs over a wide frequency range, from low pitched sounds at approximately 20 hertz (Hz) to high pitched sounds at 20,000 Hz. These frequencies are commonly grouped into octave bands or 1/3 octave bands. Building mechanical systems generally produce noise in the 63 Hz to 1000 Hz octave bands, with the lower frequency noise generated by large fans. Speech is predominantly contained in the 250 Hz to 2000 Hz octave bands.

A-weighted sound level - Humans do not hear equally well at all frequencies. We are especially poor at hearing low frequency sound and are best at hearing sound in the frequency range of speech. A microphone does not have these same characteristics. Therefore, when sound is being measured to determine how well people will be able to hear it, a "weighting" or microphone-to-human correction factor is applied to the sound level measured using a microphone. The most common weighting is the "A-weighting" and the resulting sound level is expressed in A-weighted decibels (dBA). This weighting reduces the low frequency sound, slightly increases the sound at the dominant frequencies of speech, and slightly lowers the sound level at high frequencies.

C-weighted sound level – This weighting scheme does not discount the low-frequency energy contribution to the overall sound level. It is useful for describing sounds that contain a substantial amount of low-frequency energy, such as sound from mechanical equipment and music.

Sound Power and Sound Pressure Levels - Sound pressure can be directly measured by a microphone. Outdoor sound pressure levels are influenced by the distance and orientation of the receiver, obstructions, and ground absorption between the source and receiver, the temperature, and wind gradients. Sound power is a physical property of the source alone and is not influenced by the external environment. It is an important parameter which is used for rating and comparing sound sources. The sound power is calculated by taking sound pressure or sound intensity measurements according to strict standards and calculation procedures. Conversely, the sound pressure level at a particular location can be calculated from the sound power level for a given source and the environmental factors affecting the sound propagation path between the source and receiver.

Decibel addition is not on an arithmetic basis but on a logarithmic basis. This means that the level produced from two sound sources of 60 dBA is 63 dBA and not 120 dBA. While acoustics consultants use this mathematical formula for this calculation, the table below provides a shorthand method of estimation. Only two numbers can be added at a time using this method. For three or more numbers, the process below must be repeated multiple times.

When two dB values differ by…	…add the following dB to the higher value.
0 or 1	3
2 or 3	2
4 to 9	1
10 or more	0

Examples:

43 dB + 44 dB = 47 dB (difference between numbers is 1, so add 3 to the highest value)
43 dB + 48 dB = 49 dB (difference between numbers is 5, so add 1 to the highest value)
43 dB + 53 dB = 53 dB (difference between numbers is 10 dB, so add 0 to the highest value)

Equivalent sound level (L_{eq}) is essentially the average sound level in an environment. However, the L_{eq} is not a simple arithmetic average of the sound level over time, but is a logarithmic average of the sound energy level over a period of time. L_{eq} can be measured for any time period, but is typically measured for some increment or fraction of an hour such as 15 minutes, 1 hour, or 24 hours. Steady sounds, such as fan noise, can be accurately measured for much shorter periods of time, such as 30 to 60 seconds.

Average sound level (L_{av}) is used in the Hanover County noise ordinance to indicate the equivalent sound level over a 4-hour period, which can also be noted as the $L_{eq,4\text{-}hr}$.

Statistical sound levels, as they are most often called, quantify the sound level exceeded during a period of time for the measurement period. For example, the L_{90} sound level is the sound level exceeded during 90% of the measurement period. If the measurement period is 60 minutes long, then the L_{90} is the sound level exceeded during 54 minutes. It is most often lower than the L_{eq}. The L_{90} is generally considered to be the "background" sound level, which is the baseline level that is present most of the time. Another commonly used statistical level is the L_{10}. The L_{10} is the sound level exceeded during 10% of the measurement period. If the measurement period is 60 minutes long, then L_{10} is the sound level exceeded during 6 minutes of the measurement period. L_{10} can be used to quantify the fluctuating sound levels in an environment. L_{01} is often used as the maximum sound level for perceptibility and analysis in the design of interior spaces where music and amplified speech could disturb need to be sound isolated.

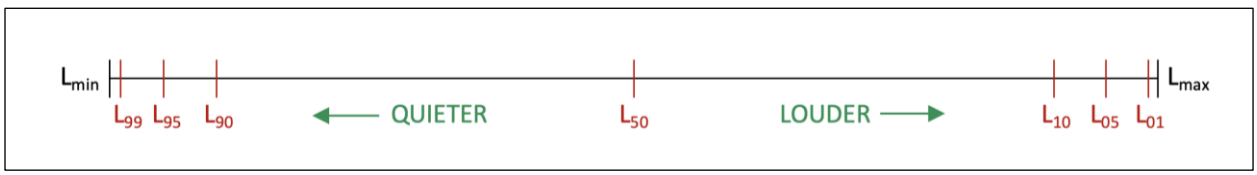

Figure 12: Relative Scaling of Statistical Sound Levels

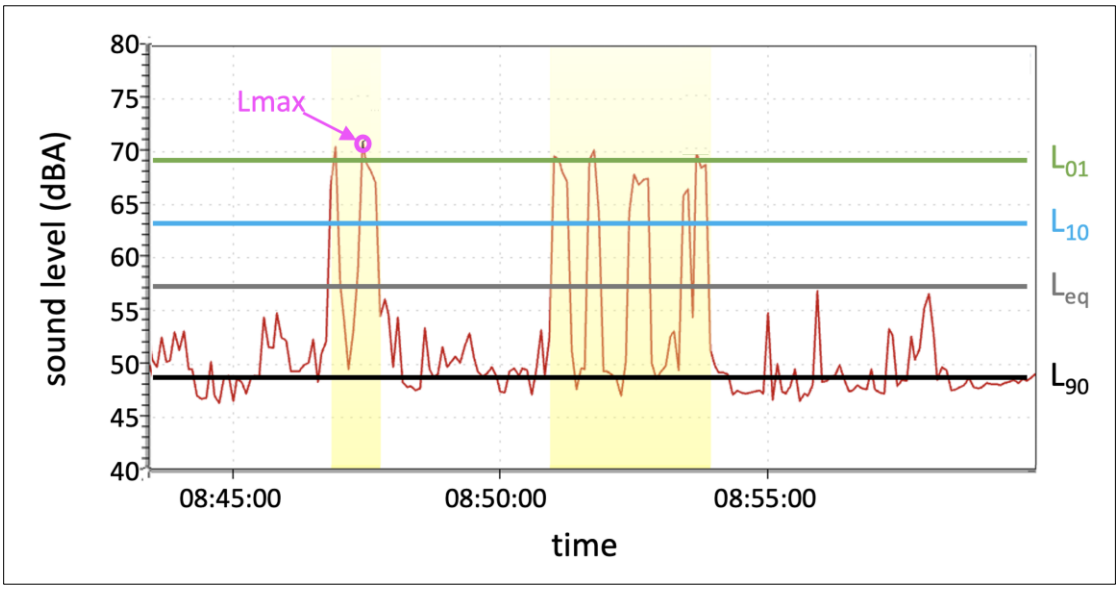

Figure 13: Statistical Sound Levels, Lmax, and Leq Applied to a Sound Signal

The **ambient or background sound level** often refers to the indoor or outdoor sound level without the sound source of interest but with other sounds that contribute to the level. For example, if the sound level of an outdoor condensing unit is being assessed, the extraneous sound of traffic and other mechanical equipment should also be measured to determine if it affects the measurement of the condensing unit. If it does, then a correction factor can be applied.