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WERLAU ENTERPRISES LLC

Liberty Sand & Gravel (MLF #30217)
Town of Fallsburg, Sullivan County, New York

NOISE IMPACT ASSESSMENT
FOR
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Respectfully submitted by: Werlau Enterprises LLC

Prepared by: Griggs-Lang Consulting Geologists, Inc.

April 2013

TABLE OF CONTENTS

1.0 INTRODUCTION

This Noise Impact Assessment was prepared for Werlau Enterprises LLC (Werlau) to assess potential noise impacts associated with modification of the mining permit for the Liberty Sand & Gravel Mine.

This Noise Impact Assessment:

- Identifies receptor locations around the project area;
- Presents ambient sound level measurements representative of the identified receptors;
- Provides measurements of equipment similar to that to be worked at the site;
- Provides expected worst-case sound levels due to the proposed activities at the nearest surrounding receptors using standard attenuation factors;
- Assesses the overall potential noise impact of the project based on the Noise Policy; and
- Recommends mitigation measures to reduce the potential for noise impact, if the findings indicate a potential for significant impact.

The Noise Impact Assessment utilizes standard noise assessment methodologies consistent with the New York State Department of Environmental Conservation (NYSDEC) Program Policy Memorandum: Assessing and Mitigating Noise Impacts.

2.0 SITE DESCRIPTION

2.1 Location

Liberty Sand & Gravel is an existing sand and gravel bank with an approved 18-acre life of mine area. The mine has had a New York State Department of Environmental Conservation (NYSDEC) Mined Land Reclamation Permit (Mined Land File 30217) and has been in continuous operation since the 1950's. The site is located on the north side of McIntosh Road, approximately 700 feet east of the intersection of McIntosh Road., Burnt Ridge Road., and Hysana Road., as shown on the Location Map in the Appendix of the Mined Land Use Plan. The area surrounding the site includes agricultural and second growth forest with rural residential areas.

Werlau proposes to modify the existing operation laterally from 18 acres to 25 acres. These added sand and gravel reserves will allow Liberty to continue to supply aggregate for the expected and continued community and commercial growth. Reserves in the existing permitted mine are expected to be depleted in 2013.

2.2 Present Condition of the Land

The Liberty Sand & Gravel Mine is an existing sand and gravel bank with a 18-acre life of mine area. It is currently worked above and below the water table. The modification area is wooded land.

The overall topography of the site consists of a southeast facing valley wall and a dredge pond within the existing excavation area, as shown on the Noise Impact Assessment Map in the Appendix of the Modified Mined Land Use Plan.

2.3 Proposed Operations

The proposed operations of the mine are outlined in the Modified Mined Land-Use Plan and summarized below.

The mine will continue to be worked using standard sand and gravel excavation methods. Any salable lumber that remains on the site will be selectively removed prior to any stripping activities. A bulldozer or equivalent will remove non-salable lumber and brush. Overburden will be pushed into perimeter berms by a bulldozer or equivalent. The above-water sand and gravel faces will be excavated by either a rubber-tire front-end loader or an excavator, typically in a single lift ranging in height from about 10 feet to about 35 feet (typically about 20 feet). Below water mining will be accomplished through the use of an excavator. Dredged material will be stockpiled for dewatering near the proposed processing plant. The dewatered sand and gravel will be fed to the processing plant by front end loader or equivalent.

Below water table mining will continue in the north end of dredge pond concurrently with above water table mining in Area A as outlined on the Mining Plan Map in the Appendix on the Modified Mined Land Use Plan. The above water faces will be worked in advance of the below water faces. Blending of the above and below water table sand will allow for maximum utilization of the reserves. Therefore, the above and below water mining operations will be worked to keep them as close together as is operationally practicable. The direction of mining is shown in more detail on the Mining Plan Map. Above water table excavations will occur in Areas B &C as outlined on the Mining Plan Map, starting in the southern portions of these areas with faces advancing to the northwest.

Processing will include crushing, screening and washing to produce a wide variety of salable products. All processing will continue to occur within the currently approved Life of Mine Area. The existing location of the processing plant is shown on the Noise Impact Assessment Map. No processing is being proposed within either Area B or C. The existing wash plant may shift in location slightly into Area A as the dredge pond limits move northward.

This Noise Impact Assessment has been prepared in accordance with the NYSDEC's Program Policy

Memorandum: Assessing and Mitigating Noise Impacts. Where appropriate, this report uses more sophisticated scientific formulae (these formulae are the basis for the approximations used in the Noise Policy) for calculating existing and projected noise levels associated with the mine. The concepts behind the formulas used in the report are explained in the following section.

3.0 SOUND CONCEPTS

3.1 Sound Pressure Levels

Noise is defined by the Department of Environmental Conservation's Assessing and Mitigating Noise Impacts program policy as "...any loud, discordant or disagreeable sound or sounds. More commonly, in an environmental context, noise is defined simply as unwanted sound."

Audible sound results when a sound source vibrates in the air at frequencies the human ear can perceive. Specifically, sound is produced as a wave motion in air, or other media, by a mechanical disturbance. The vibration of an object, if of sufficient magnitude, produces longitudinal (compressional) waves (sound waves) in the air, or other media, which radiate outward from the vibrating body much in the same manner that ripples spread out on the surface of a pond (2-dimensional) when a stone is thrown into it. This longitudinal wave propagation creates a fluctuation in the atmospheric pressure within the propagating media. The fluctuations in pressure (or pressure differences) are the sounds that are heard by the human ear. Sound pressure is the amplitude or measure of the difference between atmospheric pressure (with no sound present) and the total pressure (with sound present).

The sound pressure of an acoustic wave is measured in Pascals (Pa). The sound pressure level is measured in decibels (dB):

$$\mathbf{dB = 20 \log_{10}(P/P_{ref})}$$

Where: P = Sound pressure in pascals

P_{ref} = Reference pressure of $2\text{x}10^{-5}$ pascals

The decibel scale is logarithmic because the range of sound intensities that the human ear can detect is so large. Specifically, sharply painful sound is roughly 10 million times greater in pressure than the least audible sound. This pressure difference of 10 million pascals equates to a range of approximately 140 decibels, when presented logarithmically.

3.2 Equivalent Sound Level

Equivalent Sound Level (Leq) is defined as the equivalent continuous sound pressure level (in dB), and represents an average of the sound level history at a given site or location; A-Weighted Leq is designated as LAeq. Equivalent Sound Level is considered to be directly related to the effects of sound on people since it expresses the equivalent magnitude of the sound as a function of frequency of occurrence and time.

A-Weighted Equivalent Sound Level is calculated using the following equation:

$$L_{Aeq} = 10 \log \left(1/T \sum_{i=1}^{n} t_i \, 10^{Li/10}\right)$$

Where: T = total time (usually 24 hours)

t_i = usually an hourly time interval (with $\Sigma\, t_i = T$)

Li = Sound Pressure Level at time t_i measured in dBA

3.3 Frequency of Sound

The rate at which a sound source vibrates, or makes the air vibrate, determines the frequency of the transmitted sound wave. Only pure harmonic tones (such as those produced by a tuning fork) have a single frequency. Most sounds consist of a wide spectrum of sound frequencies that when summed constitute the sound heard. The range of frequencies that is audible to the human ear (approximately 20 to 20,000 Hertz (Hz.)) can be divided into 10 (center octave) or 30 (one-third octave) bands. A center octave band is a frequency range or interval whose upper frequency limit is twice the lower frequency limit. A center octave band can be further subdivided into three frequency bands; called one-third (1/3) octave bands. The octave band frequency ranges are presented in the table on the following page. The sound levels measured at each of these octave band frequencies are then logarithmically combined to obtain a total sound level for the audible range of frequencies.

3.4 Human Response to Frequency

Human hearing is less sensitive at very low and very high frequencies and as a result, low and very high frequency sound is perceived to be quieter than the actual dB level suggests. In order to account for this, weighting filters are applied when measuring sound. The filter that best mirrors the frequency response of the human ear to noise is the "A-weighted" filter. A-weighted sound levels are denoted as dB(A) or dBA. The chart on page 8 outlines the A-weighting adjustment factor applied to each octave band frequency.

3.5 Multiple Sound Sources

Sound levels from multiple sources are not added arithmetically. That is, two 60-decibel sounds do not equal a 120-decibel sound in intensity. Rather, sound levels are added logarithmically such that two 60-decibel sounds total approximately 63 decibels. If two sounds are of different intensities, the lower sound level (in dB) adds less to the higher sound intensity as the difference in intensities increases. If the difference between sound levels is 10 dB or more, the lower sound adds little if anything to the higher sound level. A 60-dB sound added to a 70-dB sound results in a total sound level of approximately 70.4 dB.

Multiple sound sources (all at an equal distance from a receptor or monitoring point) add to the overall sound pressure level as defined by the following equation:

$$[L_p]_{combined} = 10 \log_{10} \left[\sum_{\text{all sources, S}} 10^{[Lp[r]]_s/10} \right]$$

Where: $[L_p]_{combined}$ = total sound level (dBA)

Lp_s = sound level (dBA) of individual source (i.e. ith source)

r = Source-Receiver Distance

This formula is the basis for the simplified procedure shown in the NYSDEC Noise Policy. Two noise point sources of equal intensity will increase the overall sound pressure by approximately three dBA, and other point noise sources of less intensity will cause an increase up to three dBA depending on how close in intensity the other noise source(s) are to each other.

Octave Band Center Frequencies (in Hertz)			
Octave Band Central Frequency	**1/3 Octave Band Frequency**	**Approximate Lower Band Limit**	**Approximate Upper Band Limit**
31.5	25 31.5 40	20.9	41.8
63	50 63 80	41.8	83.5
125	100 125 160	83.5	167
250	200 250 315	167	333
500	400 500 630	333	667
1000	800 1000 1250	667	1333
2000	1600 2000 2500	1333	2666
4000	3150 4000 5000	2666	5332
8000	6300 8000 10000	5332	10664
16000	12500 16000 20000	10664	21328

From: "Noise and Vibration Control Engineering: Principles and Applications", Leo L. Beranek and Istvan L. Ver, editors, John Wiley & Sons, 1992.

Octave Band Center Frequencies (in Hertz)		
Octave Band Central Frequency	**1/3 Octave Band Frequency**	**A-Weighting Adjustment (dB)**
31.5	25	-44.7
	31.5	-39.4
	40	-34.6
63	50	-30.2
	63	-26.2
	80	-22.5
125	100	-19.1
	125	-16.1
	160	-13.4
250	200	-10.9
	250	-8.6
	315	-6.6
500	400	-4.8
	500	-3.2
	630	-1.9
1000	800	-0.8
	1000	0.0
	1250	0.6
2000	1600	1.0
	2000	1.2
	2500	1.3
4000	3150	1.2
	4000	1.0
	5000	0.5
8000	6300	-0.1
	8000	-1.1
	10000	-2.5
16000	12500	-4.3
	16000	-6.6
	20000	-9.3

From: "Noise and Vibration Control Engineering: Principles and Applications", Leo L. Beranek and Istvan L. Ver, editors, John Wiley & Sons, 1992.

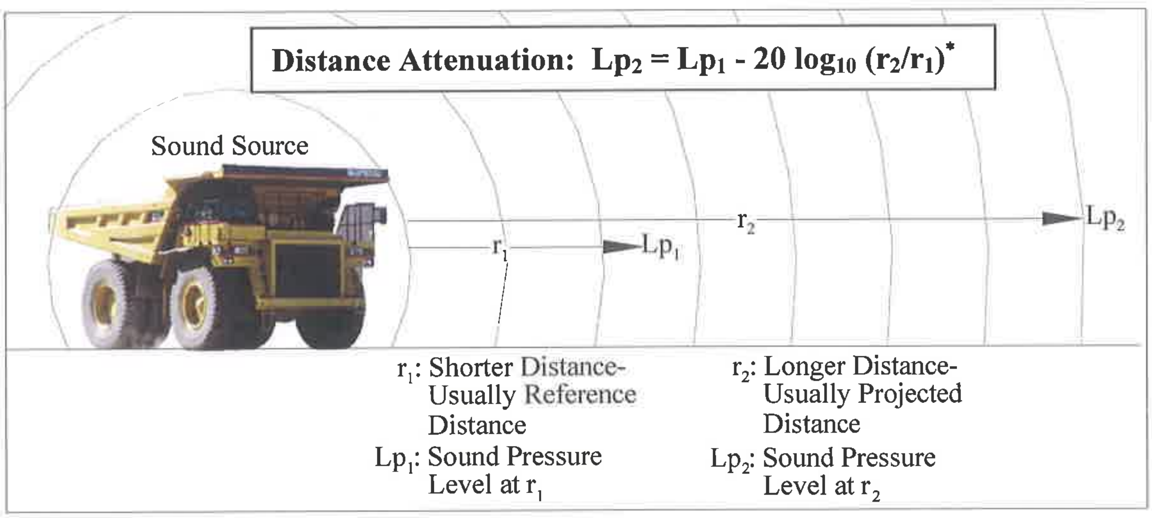
3.6 Attenuation

Attenuation is defined as a reduction in force, value, amount, or degree. Sound is attenuated by distance, intervening topography/barriers, the atmosphere and vegetation. The effectiveness of the attenuation is dependent on the distance between the noise source and the receptor for distance attenuation, the height, location and composition of the intervening topography/barrier for barrier attenuation, the temperature, pressure and humidity for atmospheric attenuation and the amount and type of intervening vegetation for attenuation due to vegetation.

3.6.1 Attenuation Due to Distance

The New York State Department of Environmental Conservation's "Assessing and Mitigating Noise Impacts" guidance states that "SPL changes in inverse proportion to the square of the distance from the sound source. At distances greater than 50 feet from a sound source, every doubling of the distance produces a 6 dB reduction on the sound."

As the distance between the sound source and receiver increases, the sound levels decrease by sound wave divergence. Sound attenuation by wave divergence can be estimated by the following formula:



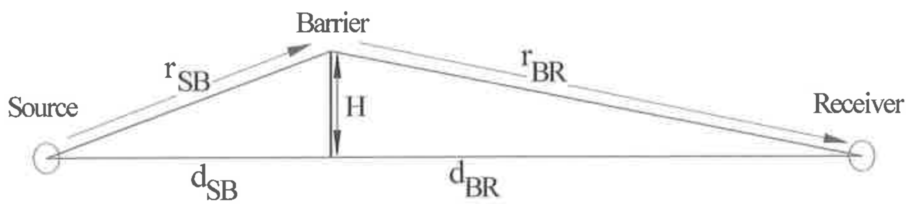
This relation is known as the inverse square law and is the fundamental tenet in determining noise attenuation over distance. It is the basis of the simplified distance attenuation method shown in the NYSDEC Noise Policy.

3.6.2 Attenuation Due to Barriers

Barriers such as natural topography, berms, mine faces, etc. between sound sources and receptors will attenuate sound. The effectiveness of the sound barriers will vary with sound frequency and barrier geometry (height and location of the barrier).

Noise reduction or attenuation due to intervening barriers is determined by first calculating the path length difference defined by the equation:

$$\mathbf{N^{0.5} = (2\,(r_{SB} + r_{BR} - d_{SB} - d_{BR}) / \lambda)^{0.5*}}$$



Where: $\mathbf{N^{0.5}}$ = Fresnel Number used in the Fresnel chart to determine the attenuation due to barriers.

$\mathbf{r_{SB}}$= Distance from source to top of barrier

$\mathbf{r_{BR}}$= Distance from top of barrier to receiver

$\mathbf{d_{SB}}$= Straight line distance from source to barrier

$\mathbf{d_{BR}}$= Straight line distance from barrier to receiver

λ = Wavelength in meters

When the barrier interrupts, or protrudes above, the line of sight the Fresnel Number will be positive. A negative Fresnel Number is used when the barrier is partial. With knowledge of the Fresnel Number, the sound attenuation resulting from a barrier can be obtained from the curves shown below for a point source or a line source and a specific frequency. The attenuation can then be calculated for each octave-band frequency for the source in question.

FRESNEL CHART FOR ESTIMATING ATTENUATION DUE TO BARRIERS

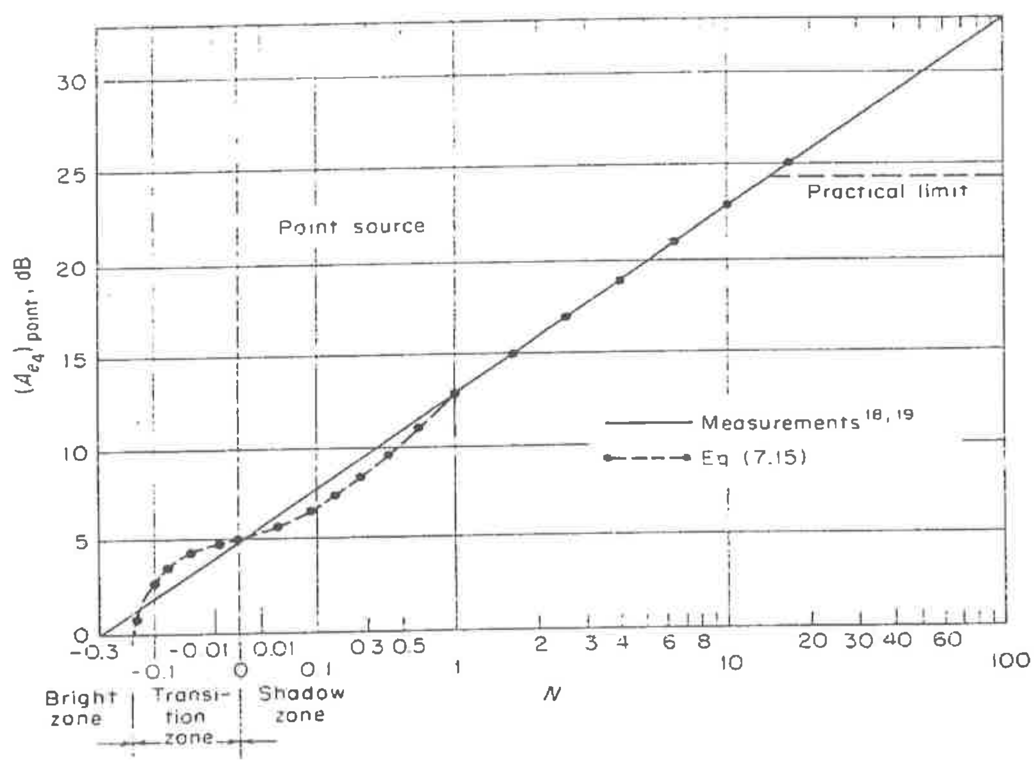


Fig. 7.8 Excess attenuation $(A_{e_4})_{point}$ of the sound from a point source by a rigid barrier as a function of Fresnel number N [see Eqs. (7.15) and (7.16)]. A negative N refers to the case where the receiver is able to see the source; i.e., $(\theta - \gamma) < \pi$.

3.6.3 Attenuation Due to Atmospheric Absorption

Sound energy is dissipated in air by two major mechanisms:

- Viscous losses due to friction between air molecules which results in heat generation (called "classical absorption"); and
- Relaxational processes: sound is momentarily absorbed in the air molecules and causes the molecules to vibrate and rotate. These molecules can then re-radiate sound at a later instant (like small echo chambers) which can partially interfere with the incoming sound.

For a standard pressure of one atmosphere, the absorption coefficient a (in dB/100m) can be calculated as a function of frequency f (Hz), temperature T (degrees Kelvin) and molar concentration of water vapor h (%) by:

$$\alpha = 869 \times f^2 \left\{ 1.84 \times 10^{-11} \left(\frac{T}{T_0}\right)^{1/2} + \left(\frac{T}{T_0}\right)^{-5/2} \left[0.01275 \frac{e^{-2239.1/T}}{F_{r,O} + f^2 / F_{r,O}} + 0.1068 \frac{e^{-3352/T}}{F_{r,N} + f^2 / F_{r,N}} \right] \right\}$$

$$F_{r,O} = 24 + 4.04 \times 10^4 h \frac{0.02 + h}{0.391 + h} \quad \text{Oxygen relaxation frequency (Hz)} \quad \text{Equation 9}$$

$$F_{r,N} = \left(\frac{T}{T_0}\right)^{-1/2} \left(9 + 280 h\, e^{\left\{-4.17\left(\left(\frac{T}{T_0}\right)^{-1/3} - 1\right)\right\}} \right) \quad \text{Nitrogen relaxation frequency (Hz)} \quad \text{Equation 10}$$

$$T_0 = 293.15\,°K \ (20°C)$$

The actual attenuation due to atmospheric absorption is given by the formula:

$$A_{abs} = \alpha / 100 \ (\mathrm{dB})$$

Where: α = absorption coefficient (dB/100m)

Attenuation due to atmospheric absorption was not considered in the calculations in an effort to be conservative because of the many atmospheric variables.

3.6.4 Attenuation Due to Indoor Transmission

Noise is attenuated by outdoor to indoor transmission. Noise is generally attenuated by approximately at least 15 dBA in a structure with closed windows and approximately five dBA in a structure with the windows partially open[1].

Attenuation due to indoor transmission was not considered in the calculations in an effort to be conservative.

[1] These figures are from the NYSDEC Noise Policy. Actual measurements and other sources indicate these figures can be as high as 20 and 15 dBA, respectively for closed and open windows.

3.6.5 Attenuation Due to Wooded Land

Sound attenuation by wooded lands is approximated by:

$$Ae_f = 0.01f^{1/3}r^3$$

Where: f = frequency of sound (Hz)

r = wooded lands path length between source and receiver (meters)

Ae_f = attenuation of sound due to wooded lands (dBA)

However, the limit is generally a total reduction of 10 dBA. The reason for the 10-dBA limit for any type of vegetation is that sound waves passing over the tree tops are frequently refracted back to the surface, due to downward atmospheric refraction caused by wind, temperature gradients, and turbulence. The NYSDEC Noise Policy states that "vegetation that is as least 100 feet in depth will reduce the sound levels by 3 to 7 dBA." To be consistent with the policy, attenuation due to wooded land is limited to seven dBA for the purpose of this study.

4.0 METHODOLOGY

4.1 Introduction

This section discusses the methodology and the measured sound level data used for determining the project related noise. The sound level projection findings and assessment of the potential for noise impact is discussed in Section 5.0.

Projected sound levels at receptors were calculated by using measured equipment sound levels for both existing mining activities and then factoring in attenuation from distance, barriers, and vegetation and adding the result to the existing ambient sound level.

4.2 Receptors

In order to determine the potential for noise impacts at proximal receptors, the following receptor information was determined:

- The location of the proximal receptors that would be most likely to be impacted by the project; and
- The existing ambient sound levels at the identified receptor location

[3] Noise and Vibration Control Engineering: Principles and Applications, Edited by Leo L. Beranek and Istvan L. Ver, John Wiley & Sons, Inc., New York, 1992, p. 184.

4.2.1 Receptor Locations

The NYSDEC guidance states that: "Appropriate receptor locations may be either at the property line of the parcel on which the facility is located or at the location of use or inhabitance on adjacent property." and "Reference points at other locations on adjacent properties can be chosen after determining that existing property usage between the property line and the reference point would not be impaired by noise, i.e., property uses are relatively remote from the property line."

Prior to selecting potential receptors and appropriate ambient monitoring locations the site and surrounding area was examined, operational plans were reviewed and typical existing area sound sources were identified. Preliminary sound readings were taken to calibrate and confirm the operator's ears and characterize the sounds in the area.

Noise receptor locations are labeled "R1" through "R3" on the Noise Impact Assessment Map in the Appendix. They are described in the chart below and represent the locations of use or inhabitance on properties surrounding the project area that are most likely to be impacted.

Receptor	Description
R1	Priebe residence located west-southwest of site
R2	Lewis residence located south of site
R3	Tenaglia residence located northwest of site

4.2.2 Ambient Sound Levels at Receptors

Ambient sound level measurements were taken at three locations "A1" through "A3", as shown on the Noise Impact Assessment Maps. All noise measurements were taken with a Norsonic 118 Type I sound level meter/analyzer. Ambient noise measurements were conducted using ASTM E-1503, Standard Test Method for Conducting Outdoor Sound Measurements Using a Digital Statistical Analysis System as a guideline. The instrument was calibrated before each measurement was taken and meter calibration was verified after the measurements were completed. Measurements were taken with the meter in slow response mode. Measurements were taken in a 15-minute interval, on the afternoon of January 24, 2013. Ambient sound level readings were taken when no equipment was operating at the mine. The table below shows the results of the ambient sound level monitoring and the receptors that each location represents.

Ambient Monitoring Location	Description	Receptor	Ambient Level (dBA)
A1	West end of property, 90' east of Burnt Ridge Road	R1	66.6
A2	South end of property, 100' north of McIntosh Road	R2	57.2
A3	On Property easement 200' east of Burnt Ridge Road	R3	49.1

Location A2 is near a commercial business and had a high ambient sound level that might be expected for a rural residential area.

4.3 Project Related Sound

The operational plans were reviewed to determine the nature and intensity of the operation and the locations and numbers of mining equipment.

4.3.1 Equipment Locations

A front end loader or an excavator and haul trucks will be the major sound-generating equipment that will operate on a daily basis at the site. Less frequently and for short durations, a bulldozer and/or excavator will be used to strip topsoil and perform basic maintenance within the mine.

Equipment locations were chosen to represent a worst case scenario for each receptor. For Receptor R1 the worst case conditions will occur when excavation is occurring on the western edge of Area A, adjacent to the current wash plant location. For Receptor R2, the worst-case conditions will occur when equipment will be working in the southernmost portion of Area A. For Receptor R3, the worst-case conditions will occur when equipment will be working in closest reasonable location in the westernmost portion of Area B. As mining progresses to the north in each respective mining area, impacts to all receptors will decrease due to increases in barrier, distance and vegetation attenuation. The worst-case equipment locations for all of the receptors are shown on the Noise Impact Assessment Map.

4.3.2 Measurement of Equipment Sound Levels

All equipment noise measurements were taken with a Norsonic 118 sound level meter/analyzer. The sound measurements were conducted using ASTM E-1503, Standard Test Method for Conducting Outdoor Sound Measurements Using a Digital Statistical Analysis System as a guideline. The instrument was calibrated before each measurement was taken and meter calibration was verified after the measurements were completed. Measurements were taken with the meter in slow response time. Sound measurements were taken from multiple directions while the equipment was performing routine activities. Representative measurements for the appropriate pieces of equipment were combined together where appropriate and projected to each of the receptors from the locations discussed above. To be more protective of the receptors, it was assumed the loudest side of the equipment was always facing the receptors (i.e. the measurements from the loudest direction were used). The data used in the calculations is described in the next section.

4.3.3 Equipment Sound Level Data

The chart in section 5.2 outlines the sound levels representative of the equipment that will be used at this site. The measured plant consists of a comparable screen and wash plant with an ancillary jaw crusher and mobile equipment such as front end loaders, excavators and haul trucks operating in the plant area. The equipment utilized at the site is comparable to or quieter than the measured equipment.

Stripping is done by bulldozer for a few days per year during the off-season when the site is not otherwise in operation. Therefore, this activity is very short-term and will not be significant.

5.0 RESULTS

5.1 Introduction

Worst-case sound levels from proposed conditions were projected to each receptor and compared to existing worst-case ambient sound levels to assess the potential for impact. Projected sound levels are based upon measured sound levels of equipment that will be used on-site with attenuation due to distance, barriers, and vegetation applied. To be conservative, attenuation due to atmospheric absorption, and indoor transmission were not factored into the calculations.

SOUND LEVELS OF EQUIPMENT USED IN THE ASSESSMENT (DB)

Frequency (Hz)	Processing Plant Area (dB @ 50')	Loader and Haul Truck (dB @ 50')	Excavator (dB @ 50')
31.5	72.0	75.2	70.3
63	71.5	85.8	80.7
125	81.0	71.7	85.6
250	75.1	70.4	76.2
500	77.0	67.2	70.5
1000	72.0	69.2	69.5
2000	71.3	70.3	66.6
4000	67.3	63.3	64.6
8000	59.1	56.0	60.9
16000	51.7	45.0	50.7
L_{eq} (dBA)	84.4	80.4	76.0

5.2 Projected Noise Levels

To model sound levels generated under conditions proposed under this application, worst case scenarios (loudest operating conditions) were run for each of the receptors. The operating noise associated with the proposed conditions was calculated and added to the worst-case ambient sound level measurements.

The following sound sources were combined at each receptor to determine worst-case sound levels under the proposed operation:

1. Modeled ambient sound level during typical mine operation.
2. The worst-case (loudest) sound levels generated by the front-end loader, excavator and haul truck operating simultaneously at the closest reasonable location within the proposed life of mine to each respective receptor.

It should be noted that only loading of trucks with an excavator or front end loader will occur in Areas B and C, in order to keep noise in these areas to a minimum. Portable processing plants will not be utilized in these areas. In addition, due to cycle times of the haul truck transporting material to the processing plant located within the current Life of Mine Area, typical loading noise will be reduced due to less time performing loading duties, as well as the continued operation of only the loader/excavator while the haul truck is en route to the processing plant.

The worst-case sound levels to be expected at each receptor location are summarized on the table below.

NOISE LEVELS AT RECEPTORS (dBA): DAILY OPERATIONS

	Processing Plant Area			Loader, Excavator and Haul Truck		
Receptor Location (Direction from Site)	Sound Level @ 50' (dBA)	Attenuation from distance, barriers, and vegetation (dBA)	Projected Worst-Case Sound Level (dBA)	Sound Level @ 75' (dBA)	Attenuation from distance, barriers, and vegetation (dBA)	Projected Worst-Case Sound Level (dBA)
R1 (West)	84.4	49.9	**34.5**	80.4	44.4	**36.0**
R2 (South)	84.4	37.0	**47.4**	80.4	27.8	**52.6**
R3 (West)	84.4	61.4	**23.0**	80.4	36.8	**43.6**

The spreadsheets showing the attenuation and resulting sound levels from the proposed daily operation are in the Appendix.

5.3 Comparison of Sound Levels at Receptors

The following table offers a comparison of sound levels under existing and proposed conditions:

COMPARISON OF DAILY OPERATION SOUND LEVELS AT RECEPTORS (dBA)

Receptor Location	Ambient Sound Level (dBA)	Plant Area Sound Level at R (dBA)	Loader, Excavator and Haul Truck Sound Level at R (dBA)	Combined Sound Level at R (dBA)	Projected Increase (dB)
R1	66.6	34.5	36.0	66.6	**+0.0**
R2	57.2	47.4	52.6	58.8	**+1.6**
R3	49.1	18.8	43.6	50.2	**+1.1**

The NYSDEC policy provides guidelines for identifying significant sound pressure level increases. The policy states, "Increases ranging from 0-3 dB should have no appreciable affect on receptors. Increases from 3-6 dB may have potential for adverse noise impacts only in cases where the most sensitive of receptors are present. Sound pressure increases of more than 6 dB may require a closer analysis of impact potential depending on existing SPLs and the character of surrounding land use and receptors."

The analysis described above, performed in accordance with the NYSDEC policy, indicates that Receptors R1, R2 and R3 will see worst-case increases of less than three dB, or no appreciable affect. Given the conservative nature of the analysis, the lack of any most sensitive receptors, and the tendency to err on the high side in terms of projected sound level increases, it is clear that the proposed project will have no adverse impacts to the existing sound levels for receptors within the surrounding area even under worst-case conditions.

The potential impact of impulse and other objectionable sounds is addressed in the mitigation measures in Section 6.2 below.

6.0 NOISE LEVEL MITIGATION MEASURES

6.1 Introduction

The NYSDEC policy states that if it is determined that potential noise impact cannot be reduced to a level of no significance by project design or operational features in the application, the evaluation will investigate alternatives and mitigation measures designed to avoid or reduce impacts to the maximum extent practicable per the requirements of the State Environmental Quality Review Act (SEQRA). Noise mitigation measures should be designed to avoid, or diminish significant noise effects to acceptable levels.

6.2 Mitigation Measures

The analysis presented above, indicates that there will not be a significant noise impact to any nearby receptors. However, several measures have been incorporated into the Mining Plan to mitigate noise impacts from the proposed operation. They are summarized below:

- *Limited stripping*—only those areas needed for one season's activity should be stripped at one time in order to maintain vegetated buffers as long as possible
- *Construction of perimeter berms*—stripped overburden will be stored in perimeter berms constructed in key areas to supplement the screening of the mining operations and should remain in place until the last parts of mining and reclamation to provide the maximum screening practicable for the longest period possible
- *Directional mining*—the mine will be generally worked from southeast to northwest portion of Areas A, B & C. This tool maximizes the distance, barrier, and vegetation attenuation afforded to the nearest receptors
- *Select location of processing plants and mining activities*—the processing plant and associated activities will continue to be located within the current Plant and Stockpile Area.
- *Location of stockpiles*--whenever practicable, stockpiles will be located between operating equipment and nearby off-site receptors.
- *Proper Maintenance*—all machinery will be equipped and maintained with mufflers in good working order
- *Use of flow through traffic patterns*—Haul roads should be laid out so that backing up of mobile equipment and sounding of backup alarms is avoided whenever possible
- *Limited use of jake brakes*—Truck drivers will be instructed to not use their jake brakes except in emergency situations
- *No slamming tail gates*—Truck drivers will be instructed to not slam their tail gates
- *Vehicle speeds*—Vehicle speeds will be limited on-site

These mitigation measures will insure that all potential impacts have been mitigated to the maximum extent practicable.

7.0 REFERENCES

1. Beranek, Leo L. and Istvan L. Ver, editors, "Noise and Vibration Control Engineering: Principles and Applications, John Wiley & Sons, 1992.

2. "Assessing and Mitigating Noise", NYSDEC Division of Environmental Permits, issued October 6, 2000, last revised February 2, 2001.

APPENDIX

SOUND MEASUREMENT WORKSHEETS--AMBIENT

SOUND MEASUREMENT WORKSHEET

Client:	Liberty Land Associates
Project:	Fallsburg Mine Mod
Site:	
Measurement Location	A-1

Measurements by: WTS **Date:** 1/24/13

Weather: Mostly clear, thin whispy clouds

Wind Speed/Direction: 5-10 MPH NW **Temperature (°F):** 15°

Humidity: **Precipitation:** —

Sound Level Meter: Norsonic Type 118 **Calibrator Model:** Norsonic Type 1443

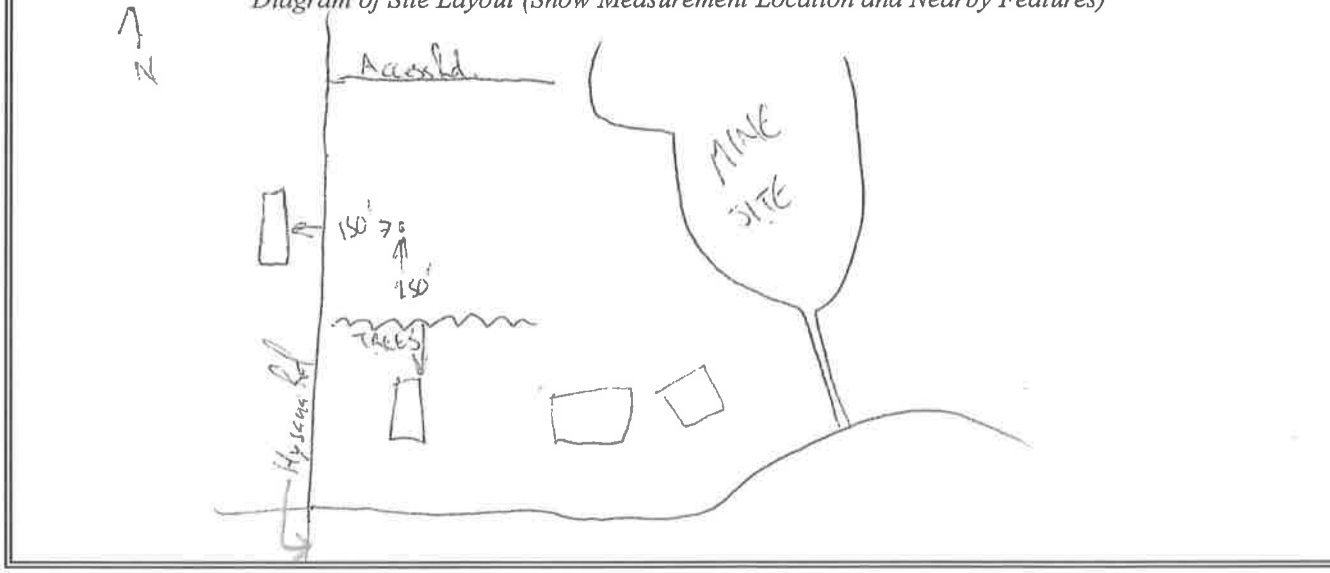
Time Calibrated Before Use: 1:30 PM **Time Calibrated After Use:** 1:52

Date of Factory Calibration: **Windscreen:** (Yes) No

Sound Meter Type: Type I Type II **Response:** Fast (Slow)

Type of Measurement: Octave Band (1/3 Octave Band) Composite

Diagram of Site Layout (Show Measurement Location and Nearby Features)



Purpose of Measurement: Ambient Baseline

Location of Sound Meter: Field west of mine site

Height of Microphone Above Ground: 4'

Microphone Angle (from horizontal): 40° **Direction of Microphone:** NW

Distance to Nearest Reflective Surface: 150'

Start Time: 1:32 **Stop Time:** 1:47 pm **File Name:** 130124-00015

Leq: 66.6 **Lmax:** 85.0 **Lmin:** 35.6

Griggs-Lang Consulting Geologists, Inc.
8 Brunswick Road Troy, NY 12180
Phone: (518) 270-5920 Fax: (518) 270-5922

Sound Producing Events During Measurement:

1:34 car
1:35 car
1:41 car
1:42 car
1:44 car

Griggs-Lang Consulting Geologists, Inc.
8 Brunswick Road Troy, NY 12180
Phone: (518) 270-5920 Fax: (518) 270-5922

SOUND MEASUREMENT WORKSHEET

Measurement Location: A-2

Client: Liberty Land Associates
Project: Fallsburg Mine Mod
Site:

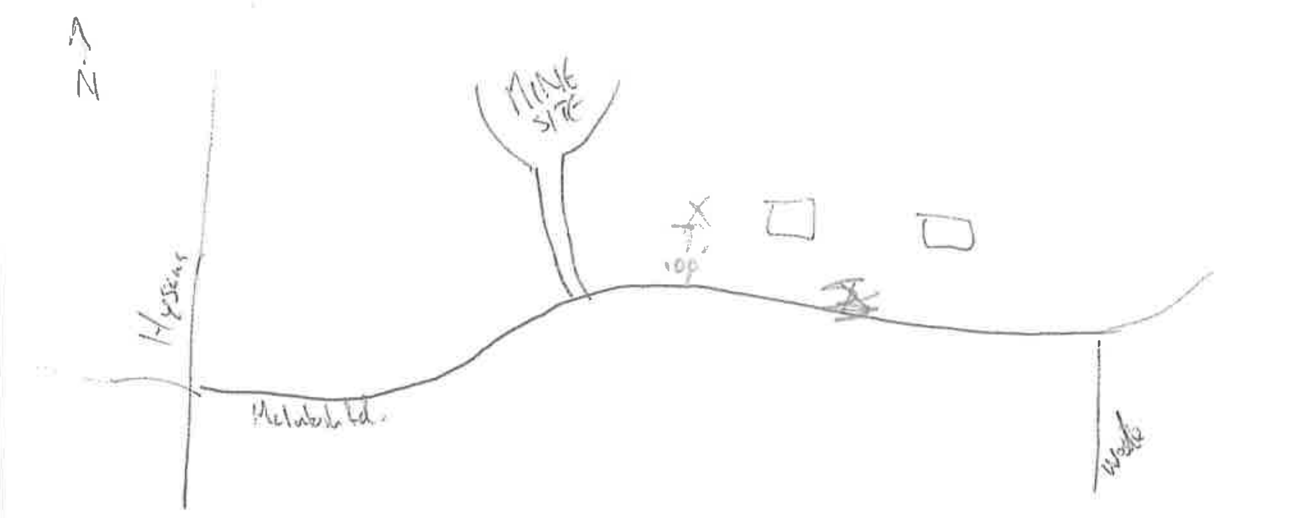
Measurements by: WTS **Date:** 1/24/13

Weather: Mostly clear, thin, whispy clouds
Wind Speed/Direction: 5-10 MPH NW **Temperature (°F):** 15°
Humidity: - **Precipitation:** -

Sound Level Meter: Norsonic Type 118 **Calibrator Model:** Norsonic Type 1443
Time Calibrated Before Use: 1:50 **Time Calibrated After Use:**
Date of Factory Calibration: **Windscreen:** (Yes) No

Sound Meter Type: Type I Type II **Response:** Fast (Slow)
Type of Measurement: Octave Band (1/3 Octave Band) Composite

Diagram of Site Layout (Show Measurement Location and Nearby Features)



Purpose of Measurement: Ambient Reading
Location of Sound Meter: Near McIntosh Rd, East of Site Entrance
Height of Microphone Above Ground: 48"
Microphone Angle (from horizontal): 40° **Direction of Microphone:**
Distance to Nearest Reflective Surface:

Start Time: 14:01 **Stop Time:** 14:16 **File Name:** 130124-00025

Leq: 83.9 **Lmax:** 107.9 **Lmin:** 35.6

Griggs-Lang Consulting Geologists, Inc.
8 Brunswick Road Troy, NY 12180
Phone: (518) 270-5920 Fax: (518) 270-5922

Sound Producing Events During Measurement:

2:02 - diesel truck in distance (Hysema Rd.) loud
2:01 - 2:10 chainsawing in distance loud/noisy
2:05 car
2:06 car
2:14 car
2:15 car
2:16 car
2:16 town truck salter/sander/plow

Griggs-Lang Consulting Geologists, Inc.
8 Brunswick Road Troy, NY 12180
Phone: (518) 270-5920 Fax: (518) 270-5922

SOUND MEASUREMENT WORKSHEET

Client: Liberty Land Associates
Project: Fallsburg Mono Mail
Site:

Measurement Location: A-3

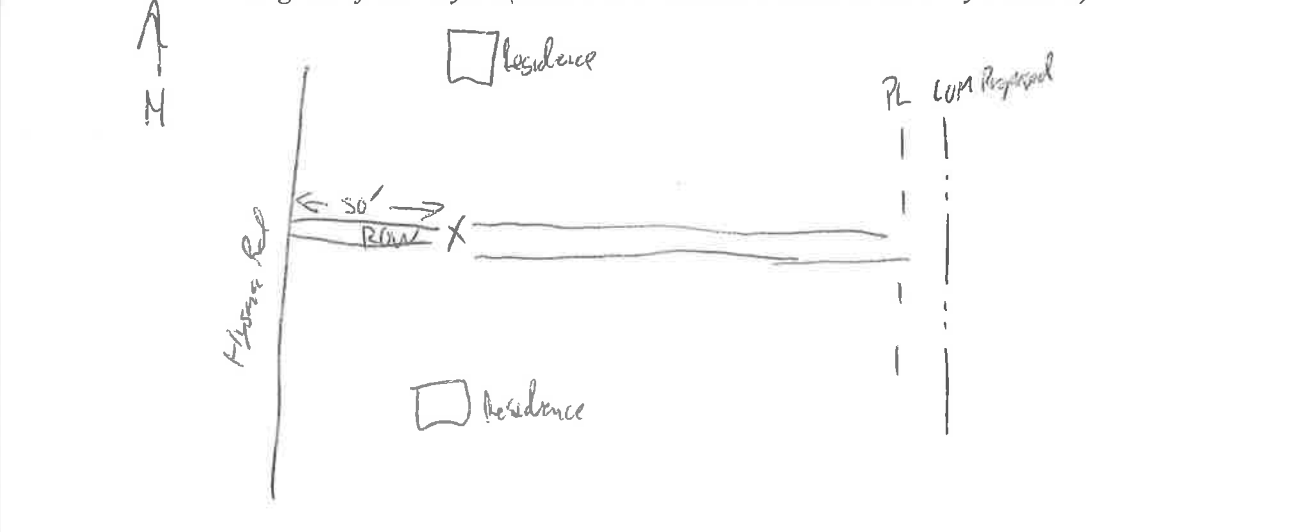
Measurements by: WTS **Date:** 1/24/13

Weather: Mostly Clear, Thin whispy clouds
Wind Speed/Direction: 5-10 MPH from NW **Temperature (°F):** 15°
Humidity: – **Precipitation:** –

Sound Level Meter: Norsonic Type 118 **Calibrator Model:** Norsonic Type 1443
Time Calibrated Before Use: 2:31 **Time Calibrated After Use:** 3:25
Date of Factory Calibration: **Windscreen:** (Yes) No

Sound Meter Type: Type I Type II **Response:** Fast (Slow)
Type of Measurement: Octave Band (1/3 Octave Band) Composite

Diagram of Site Layout (Show Measurement Location and Nearby Features)



Purpose of Measurement: Ambient Reading
Location of Sound Meter: On right of way near modification area 50' from road
Height of Microphone Above Ground: 4'
Microphone Angle (from horizontal): 40° **Direction of Microphone:** west
Distance to Nearest Reflective Surface: ~ 80'

Start Time: 2:51:30 **Stop Time:** 3:06:30 **File Name:** 130124-00035

Leq: 49.1 **Lmax:** 75.9 **Lmin:** 36.7

Griggs-Lang Consulting Geologists, Inc.
8 Brunswick Road Troy, NY 12180
Phone: (518) 270-5920 Fax: (518) 270-5922

Sound Producing Events During Measurement:

Near constant rooster crowing

cars @ 2:53, 2:55, 2:58, 3:01

Griggs-Lang Consulting Geologists, Inc.
8 Brunswick Road Troy, NY 12180
Phone: (518) 270-5920 Fax: (518) 270-5922

PROJECTED SOUND LEVELS WORKSHEETS

Werlau Enterprises
Liberty Sand & Gravel

R1-Loader and Haul Truck

Worst-case Loader and Haul Truck Location in Mod Area

Coordinates of Components	X	Y	Z
Source	441759.0	1082247.0	1470.0
Barrier	441052.0	1081997.0	1536.0
Receiver	440486.0	1081797.0	1535.0

Barrier Geometry	ft	m
A=	752.80	229.45
B=	600.30	182.97
D=	1351.76	412.02
A+B-D=		**0.41**

Sound Path Geometry

A		B		D	
"Source" to "Barrier" dist	"Source" and "Barrier" elev. diff.	"Barrier" to "Receiver" dist (ft)	"Barrier" and "Receiver" elev. diff.	"Source" to "Receiver" dist (ft)	"Source" and "Receiver" elev
749.90	66	600.30	1	1350.20	-65
752.80		600.30		1351.76	

Thickness of Vegetation (feet):	0
Thickness of Vegetation (meters):	0

Distance Attenuation:		28.8
Distance (ft)	1385	
Ref Distance (ft)	50	

Ambient Level at Receptor:	66.6

Freq. In Hertz	Attenuation Due to Vegetation (dB)	Wavelength in Meters (λ)	Fresnel Number, N=+/- [(2/λ)(A+B-D)]	Attenuation Due to Barrier (dB)	Equipment Sound Level Data (dB)	A-Weighted dBA Correction	Sound (dBA) with Barrier and Vegetation Attenuation
10	0.0	33.17	0.02	5.43	60.5	-70.4	-15.3
12.5	0.0	26.54	0.03	5.53	68.4	-63.4	-0.5
16	0.0	20.73	0.04	5.68	64.1	-56.7	1.7
20	0.0	16.59	0.05	5.83	60.8	-50.5	4.5
25	0.0	13.27	0.06	6.03	66.6	-40.7	19.9
31.5	0.0	10.53	0.08	6.27	75.2	-39.4	29.6
40	0.0	8.29	0.10	6.57	81.7	-34.6	40.6
50	0.0	6.63	0.12	6.90	86.6	-30.2	49.5
63	0.0	5.27	0.15	7.31	85.8	-26.2	52.3
80	0.0	4.15	0.20	7.80	88.3	-22.5	58.0
100	0.0	3.32	0.25	8.33	74.8	-19.1	47.4
125	0.0	2.65	0.31	8.93	71.7	-16.1	46.7
160	0.0	2.07	0.39	9.67	73.7	-13.4	50.6
200	0.0	1.66	0.49	10.41	70.5	-10.9	49.2
250	0.0	1.33	0.61	11.20	70.4	-8.6	50.6
315	0.0	1.05	0.77	12.08	69.7	-6.6	51.0
400	0.0	0.83	0.98	13.02	69.5	-4.8	51.7
500	0.0	0.66	1.23	13.94	67.2	-3.2	50.1
630	0.0	0.53	1.55	14.91	68.5	-1.9	51.7
800	0.0	0.41	1.96	15.93	68.5	-0.8	51.8
1000	0.0	0.33	2.46	16.89	69.2	0.0	52.3
1250	0.0	0.27	3.07	17.85	70.7	0.6	53.5
1600	0.0	0.21	3.93	18.92	73.4	1.0	55.5
2000	0.0	0.17	4.91	19.89	70.3	1.2	51.6
2500	0.0	0.13	6.14	20.00	67.4	1.3	48.7
3150	0.0	0.11	7.73	20.00	65.1	1.2	46.3
4000	0.0	0.08	9.82	20.00	63.3	1.0	44.3
5000	0.0	0.07	12.28	20.00	60.8	0.5	41.3
6300	0.0	0.05	15.47	20.00	59.7	-0.1	39.6
8000	0.0	0.04	19.64	20.00	56.0	-1.1	34.9
10000	0.0	0.03	24.55	20.00	51.6	-2.5	29.1
12500	0.0	0.03	30.69	20.00	49.3	-4.3	25.0
16000	0.0	0.02	39.28	20.00	45.0	-6.6	18.4
20000	0.0	0.02	50168.12	20.00	39.3	-9.3	10.0

dBA with barrier and vegetation attenuation:	64.9
dBA with distance, vegetation and barrier attenuation:	36.0
New Sound Level at Receptor:	66.6

Werlau Enterprises
Liberty Sand & Gravel

R2-Loader and Haul Truck

Worst-case Loader and Haul Truck Location in Mod Area

Coordinates of Components

	X	Y	Z
Source	441859.0	1081959.0	1465.0
Barrier	441794.0	1081767.0	1460.0
Receiver	441582.0	1081168.0	1455.0

Barrier Geometry

	ft	m
A=	202.77	61.80
B=	635.43	193.68
D=	838.16	255.47
A+B-D=		0.01

Sound Path Geometry

A		B		D	
"Source" to "Barrier" dist	"Source" and "Barrier" elev. diff.	"Barrier" to "Receiver" dist (ft)	"Barrier" and "Receiver" elev. diff.	"Source" to "Receiver" dist (ft)	"Source" and "Receiver" elev
202.70	-5	635.41	5	838.10	10
202.77		635.43		838.16	

Thickness of Vegetation (feet):	100
Thickness of Vegetation (meters):	30.48

Distance Attenuation:		24.5
Distance (ft)	840	
Ref Distance (ft)	50	

Ambient Level at Receptor:	58.6

Freq. In Hertz	Attenuation Due to Vegetation (dB)	Wavelength in Meters (λ)	Fresnel Number, N=+/- [(2/λ)(A+B-D)]	Attenuation Due to Barrier (dB)	Equipment Sound Level Data (dB)	A-Weighted dBA Correction	Sound (dBA) with Barrier and Vegetation Attenuation
10	0.7	33.17	0.00	0.00	60.5	-70.4	-10.54
12.5	0.7	26.54	0.00	0.00	68.4	-63.4	4.31
16	0.8	20.73	0.00	0.00	64.1	-56.7	6.65
20	0.8	16.59	0.00	0.00	60.8	-50.5	9.49
25	0.9	13.27	0.00	0.00	66.6	-40.7	25.03
31.5	1.0	10.53	0.00	0.00	75.2	-39.4	34.86
40	1.0	8.29	0.00	0.00	81.7	-34.6	46.08
50	1.1	6.63	0.00	0.00	86.6	-30.2	55.30
63	1.2	5.27	0.00	0.00	85.8	-26.2	58.41
80	1.3	4.15	0.01	0.00	88.3	-22.5	64.51
100	1.4	3.32	0.01	0.00	74.8	-19.1	54.31
125	1.5	2.65	0.01	0.00	71.7	-16.1	54.10
160	1.7	2.07	0.01	0.00	73.7	-13.4	58.67
200	1.8	1.66	0.01	0.00	70.5	-10.9	57.84
250	1.9	1.33	0.02	0.00	70.4	-8.6	59.90
315	2.1	1.05	0.02	0.00	69.7	-6.6	61.05
400	2.2	0.83	0.03	0.00	69.5	-4.8	62.47
500	2.4	0.66	0.03	0.00	67.2	-3.2	61.60
630	2.6	0.53	0.04	0.00	68.5	-1.9	64.01
800	2.8	0.41	0.05	0.00	68.5	-0.8	64.89
1000	3.0	0.33	0.07	0.00	69.2	0.0	66.17
1250	3.3	0.27	0.08	0.00	70.7	0.6	68.04
1600	3.6	0.21	0.11	0.00	73.4	1.0	70.86
2000	3.8	0.17	0.13	0.00	70.3	1.2	67.68
2500	4.1	0.13	0.17	0.00	67.4	1.3	64.58
3150	4.5	0.11	0.21	0.00	65.1	1.2	61.85
4000	4.8	0.08	0.27	0.00	63.3	1.0	59.48
5000	5.2	0.07	0.33	0.00	60.8	0.5	56.11
6300	5.6	0.05	0.42	0.00	59.7	-0.1	53.99
8000	6.1	0.04	0.53	0.00	56.0	-1.1	48.82
10000	6.6	0.03	0.66	0.00	51.6	-2.5	42.55
12500	7.0	0.03	0.83	0.00	49.3	-4.3	38.02
16000	7.0	0.02	1.06	0.00	45.0	-6.6	31.42
20000	7.0	0.02	1.33	0.00	39.3	-9.3	23.02

dBA with barrier and vegetation attenuation:	77.1
dBA with distance, vegetation and barrier attenuation:	52.6
New Sound Level at Receptor:	59.6

Werlau Enterprises
Liberty Sand & Gravel

R3-Loader and Haul Truck

Worst-case Loader and Haul Truck Location in Mod Area

Coordinates of Components

	X	Y	Z
Source	441826.0	1083163.0	1595.0
Barrier	441637.0	1083235.0	1620.0
Receiver	441441.0	1083323.0	1635.0

Barrier Geometry

	ft	m
A=	203.79	62.11
B=	215.37	65.65
D=	418.84	127.66
A+B-D=		0.10

Sound Path Geometry

A		B		D	
"Source" to "Barrier" dist	"Source" and "Barrier" elev. diff.	"Barrier" to "Receiver" dist (ft)	"Barrier" and "Receiver" elev. diff.	"Source" to "Receiver" dist (ft)	"Source" and "Receiver" elev
202.25	25	214.85	-15	416.92	-40
203.79		215.37		418.84	

Thickness of Vegetation (feet):	400
Thickness of Vegetation (meters):	121.92

Distance Attenuation:		19.1
Distance (ft)	450	
Ref Distance (ft)	50	

Ambient Level at Receptor:	49.1

Freq. In Hertz	Attenuation Due to Vegetation (dB)	Wavelength In Meters (λ)	Fresnel Number, N=+/-[(2/λ)(A+B-D)]	Attenuation Due to Barrier (dB)	Equipment Sound Level Data (dB)	A-Weighted dBA Correction	Sound (dBA) with Barrier and Vegetation Attenuation
10	2.6	33.17	0.01	5.11	60.5	-70.4	-17.61
12.5	2.8	26.54	0.01	5.13	68.4	-63.4	-2.94
16	3.1	20.73	0.01	5.17	64.1	-56.7	-0.82
20	3.3	16.59	0.01	5.21	60.8	-50.5	1.80
25	3.6	13.27	0.01	5.26	66.6	-40.7	17.09
31.5	3.9	10.53	0.02	5.33	75.2	-39.4	26.64
40	4.2	8.29	0.02	5.42	81.7	-34.6	37.53
50	4.5	6.63	0.03	5.52	86.6	-30.2	46.41
63	4.9	5.27	0.04	5.65	85.8	-26.2	49.12
80	5.3	4.15	0.05	5.81	88.3	-22.5	54.76
100	5.7	3.32	0.06	6.00	74.8	-19.1	44.07
125	6.1	2.65	0.07	6.22	71.7	-16.1	43.30
160	6.6	2.07	0.10	6.52	73.7	-13.4	47.18
200	7.0	1.66	0.12	6.85	70.5	-10.9	45.77
250	7.0	1.33	0.15	7.23	70.4	-8.6	47.59
315	7.0	1.05	0.19	7.70	69.7	-6.6	48.42
400	7.0	0.83	0.24	8.25	69.5	-4.8	49.47
500	7.0	0.66	0.30	8.84	67.2	-3.2	48.18
630	7.0	0.53	0.37	9.52	68.5	-1.9	50.10
800	7.0	0.41	0.48	10.30	68.5	-0.8	50.42
1000	7.0	0.33	0.59	11.08	69.2	0.0	51.14
1250	7.0	0.27	0.74	11.92	70.7	0.6	52.40
1600	7.0	0.21	0.95	12.89	73.4	1.0	54.53
2000	7.0	0.17	1.19	13.80	70.3	1.2	50.72
2500	7.0	0.13	1.48	14.74	67.4	1.3	46.98
3150	7.0	0.11	1.87	15.72	65.1	1.2	43.60
4000	7.0	0.08	2.38	16.75	63.3	1.0	40.57
5000	7.0	0.07	2.97	17.71	60.8	0.5	36.61
6300	7.0	0.05	3.74	18.71	59.7	-0.1	33.91
8000	7.0	0.04	4.75	19.75	56.0	-1.1	28.17
10000	7.0	0.03	5.94	20.00	51.6	-2.5	22.12
12500	7.0	0.03	7.42	20.00	49.3	-4.3	18.02
16000	7.0	0.02	9.50	20.00	45.0	-6.6	11.42
20000	7.0	0.02	11.88	20.00	39.3	-9.3	3.02

dBA with barrier and vegetation attenuation:	62.7
dBA with distance, vegetation and barrier attenuation:	43.6
New Sound Level at Receptor:	50.2

Werlau Enterprises
Liberty Sand & Gravel
Wash Plant to R1

Level 2 Assessment

Coordinates of Components

	X	Y	Z
Source	441735	1082208	1461
Barrier	441069	1081989	1536
Receiver	440486	1081797	1540

Barrier Geometry

	ft	m
A=	705.08	214.91
B=	613.82	187.09
D=	1317.26	401.50
A+B-D=		0.50

Sound Path Geometry

A		B		D	
"Source" to "Barrier" dist	"Source" and "Barrier" elev. diff.	"Barrier" to "Receiver" dist (ft)	"Barrier" and "Receiver" elev. diff.	"Source" to "Receiver" dist (ft)	"Source" and "Receiver" elev
701.08	75	613.80	-4	1314.88	-79
705.08		613.82		1317.26	

Thickness of Vegetation (feet):	0
Thickness of Vegetation (meters):	0

Distance Attenuation:		28.4
Distance (ft)	1317.26	
Ref Distance (ft)	50	

Ambient Sound Level at Receptor:	66.6

Freq. In Hertz	Attenuation Due to Vegetation (dB)	Wavelength in Meters (λ)	Fresnel Number, N=+/- [(2/λ)(A+B-D)]	Attenuation Due to Barrier (dB)	Equipment Sound Source Data (dB)	A-Weighted dBA Correction	Sound (dBA) with Barrier and Vegetation Attenuation
31.5	0.0	10.53	0.10	6.52	72.0	-39.4	26.1
63	0.0	5.27	0.19	7.73	71.5	-26.2	37.6
125	0.0	2.65	0.38	9.55	81.0	-16.1	55.4
250	0.0	1.33	0.75	11.98	75.1	-8.6	54.5
500	0.0	0.66	1.51	14.81	77.0	-3.2	59.0
1000	0.0	0.33	3.02	17.78	72.0	0.0	54.2
2000	0.0	0.17	6.04	20.00	71.3	1.2	52.5
4000	0.0	0.08	12.07	20.00	67.3	1.0	48.3
8000	0.0	0.04	24.14	20.00	59.1	-1.1	38.0
16000	0.0	0.02	48.29	20.00	51.7	-6.6	25.1

dBA with barrier and vegetation attenuation:	62.9
dBA with distance, vegetation and barrier attenuation:	34.5
Projected new sound level at receptor:	66.6
Increase over existing ambient sound level:	0.0

Werlau Enterprises
Liberty Sand & Gravel
Wash Plant to R2

Level 2 Assessment

Coordinates of Components

	X	Y	Z
Source	441735	1082208	1461
Barrier	441648	1081618	1455
Receiver	441582	1081168	1460

Barrier Geometry

	ft	m
A=	596.41	181.79
B=	454.84	138.64
D=	1051.19	320.40
A+B-D=		0.02

Sound Path Geometry

A		B		D	
"Source" to "Barrier" dist	"Source" and "Barrier" elev. diff.	"Barrier" to "Receiver" dist (ft)	"Barrier" and "Receiver" elev. diff.	"Source" to "Receiver" dist (ft)	"Source" and "Receiver" elev
596.38	-6	454.81	-5	1051.19	1
596.41		454.84		1051.19	

Thickness of Vegetation (feet):	160
Thickness of Vegetation (meters):	48.768

Distance Attenuation:		26.5
Distance (ft)	1051.19	
Ref Distance (ft)	50	

Ambient Sound Level at Receptor:	57.2

Freq. In Hertz	Attenuation Due to Vegetation (dB)	Wavelength In Meters (λ)	Fresnel Number, N=+/-[(2/λ)(A+B-D)]	Attenuation Due to Barrier (dB)	Equipment Sound Source Data (dB)	A-Weighted dBA Correction	Sound (dBA) with Barrier and Vegetation Attenuation
31.5	1.5	10.53	0.00	0.00	72.0	-39.4	31.1
63	1.9	5.27	0.01	0.00	71.5	-26.2	43.4
125	2.4	2.65	0.01	0.00	81.0	-16.1	62.5
250	3.1	1.33	0.03	0.00	75.1	-8.6	63.4
500	3.9	0.66	0.05	0.00	77.0	-3.2	69.9
1000	4.9	0.33	0.11	0.00	72.0	0.0	67.1
2000	6.1	0.17	0.21	0.00	71.3	1.2	66.4
4000	7.7	0.08	0.42	0.00	67.3	1.0	60.6
8000	9.8	0.04	0.84	0.00	59.1	-1.1	48.2
16000	10.0	0.02	1.68	0.00	51.7	-6.6	35.1

dBA with barrier and vegetation attenuation:	73.9
dBA with distance, vegetation and barrier attenuation:	47.4
Projected new sound level at receptor:	57.6
Increase over existing ambient sound level:	0.4

Werlau Enterprises
Liberty Sand & Gravel
Wash Plant to R3

Level 2 Assessment

Coordinates of Components	X	Y	Z
Source	441735	1082208	1461
Barrier	441565	1082794	1600
Receiver	441441	1083323	1640

Barrier Geometry	ft	m
A=	625.79	190.74
B=	544.81	166.06
D=	1166.92	355.68
A+B-D=		1.12

Sound Path Geometry

A		B		D	
"Source" to "Barrier" dist	"Source" and "Barrier" elev. diff.	"Barrier" to "Receiver" dist (ft)	"Barrier" and "Receiver" elev. diff.	"Source" to "Receiver" dist (ft)	"Source" and "Receiver" elev
610.16	139	543.34	-40	1153.11	-179
625.79		544.81		1166.92	

Thickness of Vegetation (feet):	690
Thickness of Vegetation (meters):	210.312

Distance Attenuation:		27.4
Distance (ft)	1166.92	
Ref Distance (ft)	50	
Ambient Sound Level at Receptor:		49.1

Freq. In Hertz	Attenuation Due to Vegetation (dB)	Wavelength in Meters (λ)	Fresnel Number, N=+/- [(2/λ)(A+B-D)]	Attenuation Due to Barrier (dB)	Equipment Sound Source Data (dB)	A-Weighted dBA Correction	Sound (dBA) with Barrier and Vegetation Attenuation
31.5	6.6	10.53	0.21	7.99	72.0	-39.4	18.0
63	8.4	5.27	0.43	9.94	71.5	-26.2	27.0
125	10.0	2.65	0.85	12.43	81.0	-16.1	42.5
250	10.0	1.33	1.69	15.29	75.1	-8.6	41.2
500	10.0	0.66	3.38	18.28	77.0	-3.2	45.5
1000	10.0	0.33	6.77	20.00	72.0	0.0	42.0
2000	10.0	0.17	13.53	20.00	71.3	1.2	42.5
4000	10.0	0.08	27.07	20.00	67.3	1.0	38.3
8000	10.0	0.04	54.14	20.00	59.1	-1.1	28.0
16000	10.0	0.02	108.28	20.00	51.7	-6.6	15.1

dBA with barrier and vegetation attenuation:	50.3
dBA with distance, vegetation and barrier attenuation:	23.0
Projected new sound level at receptor:	49.1
Increase over existing ambient sound level:	0.0