NOISE IMPACT ANALYSIS

AZUSA ROCK REVISED CUP APPLICATION

CITY OF AZUSA, CALIFORNIA

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EXECUTIVE SUMMARY

This report has been prepared to replace the earlier acoustical analyses by the same author for the same facility provided August 29, 2008 and September 17, 2009. This report is a freestanding document expanded to address supplemental issues and operational dynamics.

The following discussion constitutes the project noise and vibration technical study for the proposed amendment to the existing Azusa Rock operation located at the northern terminus of Fish Canyon Road in the City of Azusa California. The project proposes to amend the existing conditional use permit to allow for an exchange of mining rights on the easternmost 80+/- acres in return for the mining rights on the westerly 80 acres of the 270 acre property. In turn, mining operations on the easternmost portion of the 270 total acre parcel will cease and the reclamation plan for that portion of the parcel will be implemented.

Since the Azusa Rock operation is an existing, permitted quarry, the focus of this noise analysis is on the net difference between the baseline noise conditions that presently exist at the operation and those that would exist under the proposed project. This includes the potential noise and vibration impacts that would derive from a gradual westward shift of mining and of blasting required to fracture the hard rock found in the formation.

Mining activities and associated equipment operations would also change excavation relocation. A larger fleet of trucks would move more excavated rock from the working face to the primary crusher compared to existing operations. The noise from any on-going reclamation of the East Side is considered part of the existing environment. Off-site noise level changes at the closest Duarte residence are demonstrated to increase slightly (+4 dB), but still remain 20 dB below the noise ordinance standard for City of Duarte residences. Any increased levels will continue to be well below existing ambient levels.

Although future operations will continue to remain shielded by an intervening terrain ridge from the nearest homes on Brookridge Road and equestrian operations along Van Tassel Creek in adjacent Duarte, the closest points of possible site mining operations will decrease from a present 2,500 feet to a point 1,800 feet from the nearest Duarte homes. The mining equipment is mobile and is most heavily concentrated around the primary crusher. The acoustic center of noise generation was therefore used to evaluate mining and processing noise impacts. The average distances from the center of existing and proposed mining and processing operations and associated maximum noise are as follows to the closest sensitive receivers:

Location	***Existing****	***Proposed****
Nearest Azusa Homes	3,900 feet	5,600 feet
Nearest Duarte Homes	3,500 feet	3,100 feet

*to the acoustic center

Because of the logarithmic relationship between decibels and large propagation distances, the changes in distance will create only minor changes in off-site noise levels.

Noise Scales and Definitions

Sound is technically described in terms of the loudness (amplitude) of the sound and frequency (pitch) of the sound. The standard unit of measurement of the loudness of sound is the decibel (dB). Since the human ear is not equally sensitive to sound at all frequencies, special frequency-dependent rating scales have been devised to relate noise to human sensitivity. The A-weighted decibel scale dB(A) performs this compensation by discriminating against frequencies in a manner approximating the sensitivity of the human ear. Any further reference to decibels in this report written as “dB” should be understood to be A-weighted.

Decibels are based on the logarithmic scale. The logarithmic scale compresses the wide range in sound pressure levels to a more usable range of numbers in a manner similar to the Richter scale used to measure earthquakes. In general, a 1 dB change in the sound pressure levels of a given sound is detectable only under laboratory conditions. A 3-dB change in sound pressure level is considered a "just detectable" difference in most situations. A 5-dB change is readily noticeable by most people and a 10 dB change is considered a doubling (or halving) of the

subjective loudness. It should be noted that, generally speaking, a 3 dB increase or decrease in the average traffic noise level is realized by a doubling or halving of the traffic volume. Because few projects individually cause a doubling of traffic volumes on already heavily traveled roadways, most traffic noise impacts tend to be cumulative in nature.

In terms of human response to noise, a sound 10 dB higher than another is judged to be twice as loud; 20 dB higher four times as loud; and so forth. Everyday sounds normally range from 30 dB (very quiet) to 100 dB (very loud). Examples of various sound levels in different environments are shown in Table 1, Sound Levels and Human Response.

There are three general methods used to measure sound over a period of time: the Community Noise Equivalent Level (CNEL), the equivalent energy level (Leq), and the Day/Night Average Sound Level (Ldn).

CNEL: The predominant community noise rating scale used in California for land use compatibility assessment is the Community Noise Equivalent Level (CNEL). The CNEL reading represents the average of 24-hourly reading of equivalent levels, known as LEQ's, based on an A-weighted decibel with upward adjustments added to account for increased noise sensitivity in the evening and night periods. These adjustments are +5 dB for the evening (7:00 p.m. to 10:00 p.m.), and +10 dB for the night (10:00 p.m. to 7:00 a.m.). CNEL may be indicated by "dB CNEL" or just "CNEL."

Leq: The Leq is the sound level containing the same steady-state total energy over a given sample time period as a continuously varying ambient level. The Leq can be thought of as the steady (average) sound level which, in a stated period of time, would contain the same acoustic energy as the time-varying sound level during the same period. Leq is typically computed over 1-, 8- and 24-hour sample periods.

Ldn: Another commonly used method is the day/night average level or Ldn. The Ldn is a measure of the 24-hour average noise level at a given location. It was adopted by the United States Environmental Protection Agency (EPA) for developing criteria for the evaluation of community noise exposure. It is based on a measure of the average noise level over a given time period called the Leq. The Ldn is calculated by averaging the Leq's for each hour of the day at a given location after penalizing the "sleeping hours" (defined as 10:00 p.m. to 7:00 a.m.), by 10 dB to account for the increased sensitivity of people to noises that occur at night. In most applications, CNEL and Ldn are generally indistinguishable. The maximum noise level recorded during a noise event is typically expressed as Lmax. The sound level exceeded over a specified time frame can be expressed as Ln (i.e., L_{90}, L_{50}, L_{10}, etc.). L_{50} equals the level exceeded 50 percent of the time.

Table 1

Sound Levels and Human Response

Noise Source	Noise Level dB(A)	Response
	150	
Carrier Jet Operation	140	Harmfully Loud
	130	Pain Threshold
Jet Takeoff (200ft.) Discotheque	120	
Unmuffled Motorcycle Auto Horn (3 ft.) Rock'n Roll Band Riveting Machine	110	Maximum Vocal Effort Physical Discomfort
Loud Power Mower Jet Takeoff (2,000 ft) Garbage Truck	100	Very Annoying Hearing Damage (Steady 8-Hour Exposure)
Heavy Truck (50 ft.) Pneumatic Drill (50 ft.)	90	
Alarm Clock Freight Train (50 ft.) Vacuum Cleaner (10 ft.)	80	Annoying
Freeway Traffic (50 ft.)	70	Telephone Use Difficult
Dishwashers Air Conditioning Units (20 ft.)	60	Intrusive
Light Auto Traffic (100 ft.)	50	Quiet
Living Room Bedroom	40	
Library Soft Whisper (15 ft.)	30	Very Quiet
Broadcasting Studio	20	Just Audible
	10	Threshold of Hearing

Source: Melville C. Branch and R. Dale Beland, Outdoor Noise in the Metropolitan Environment, 1970 (p.2).

Noise Standards

State of California Guidelines: The State of California has established guidelines for acceptable community noise levels that are based on the CNEL rating scale. The guidelines rank noise land use compatibility in terms of "normally acceptable", "conditionally acceptable", and "clearly unacceptable" noise levels for various land use types. As shown in Table 2, Land Use Compatibility for Community Noise Exposure, single-family homes are "normally acceptable" in exterior noise environments up to 60 CNEL and "conditionally acceptable" up to 70 CNEL based on this scale. Multiple family residential uses are "normally acceptable" up to 65 CNEL and "conditionally acceptable" up to 70 CNEL. Schools, libraries and churches are "normally acceptable" up to 70 CNEL, as are office buildings and business, commercial and professional uses. Industrial, manufacturing, and utilities are "normally acceptable" up to 75 CNEL.

CNEL or Ldn-based standards are designed to insure land use compatibility with the acoustic environment for those noise sources pre-empted from local control. Such sources are mainly mobile sources such as cars, trucks, airplanes, trains, etc. Because local jurisdictions cannot regulate the noise strength of the source, they control the pattern of land use exposed to such sources. "Stationary" sources such as mining operations are amenable to control of the source itself rather than through general plan siting considerations.

Municipal Standards:

The City of Azusa Noise Control regulation is articulated in Chapter 88.31 of the Development Code. The code sets a daytime standard of 65 dB at any residential property line for single event impulsive sources. The City of Azusa noise standards for new non-impulsive shorter-duration events is an hourly average of 50 dB Leq from 7 a.m. to 10 p.m. The nocturnal standard is 5 dB more stringent. The City of Duarte noise standard is 70 dB for any noise event lasting less than one minute in duration. The hourly average standard from 7 a.m. to 9 p.m. for R1 or R2 properties is 55 dB Leq and 45 dB Leq from 9 p.m. to 7 a.m. Because the subject property is in the City of Azusa and because the City of Azusa standard is more stringent than the Duarte standard, the more stringent standard will be applied as a threshold of significance except for specific situations that apply only to City of Duarte receivers.

Table 2

Azusa Land Use Compatibility Guidelines for Exterior Community Noise

Land Use	Community Noise Exposure CNEL, dB			
	Normally Acceptable	Conditionally Acceptable	Normally Unacceptable	Clearly Unacceptable
Single Family, Multi-Family Homes, Duplex	50-60	60-70	70-75	Above 75
Mobile Homes	50-60	60-65	65-75	Above 75
Schools, Libraries, Churches, Hospitals, Nursing Homes	50-60	60-65	65-75	Above 75
Transient Lodging: Motels, Hotels	50-60	60-70	70-80	Above 80
Auditoriums, Concert Halls, Amphitheaters, Meeting Halls	-	50-60	60-70	Above 70
Sports Arena, Outdoor Spectator Sports, Amusement Parks	50-65	65-75	-	Above 75
Playgrounds, Neighborhood Parks	50-60	60-65	65-70	Above 70
Golf Courses, Riding Stables, Water Recreation, Cemeteries	50-65	65-70	Above 70	-
Office Buildings, Business and Professional	50-60	60-70	Above 75	-
Commercial Retail, Banks, Restaurants, Theaters	50-65	65-75	75-80	-
Industrial, Manufacturing, Utilities	50-65	65-80	-	-

Normally Acceptable: Specified land use is satisfactory based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements.

Conditionally Acceptable: New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning will normally suffice.

Normally Unacceptable: New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise insulation features included in the design.

Clearly Unacceptable: New construction or development should generally not be undertaken.

Source: Azusa General Plan Noise Element

Vibration Standards

Vibration may be described in terms of the physical motion of a vibrating object (displacement), the speed of motion (velocity), or the rate of change from negative to positive motion (acceleration). Velocity can be described in terms of the average amount of sway (the "root mean squared" or r.m.s. velocity), or the maximum velocity during a single oscillation. The peak particle velocity (PPV) in inches per second (ips) is the descriptor used in this discussion because it is most closely related to any possibility of structural damage. Table 3 shows some typical PPV's associated with earth disturbance activities and the human reaction to such vibration. Human perception is seen to be relatively pronounced before any structural damage is observed.

The Cities of Azusa and Duarte have no vibration performance standards in their municipal codes. For mining operations, the U. S. Department of the Interior has adopted a PPV standard of 1.0 ips for any home, school, church, etc. within a range of 300 to 5,000 feet from the blast site. This is equivalent to a 4.0 reading on the Richter Scale. Although such a level of vibration generally creates no perceptible structural damage, it is unsettling to people when in direct contact with the ground (carpet and building framework effectively attenuates ground vibration). Therefore, a more conservative threshold of significance of 0.20 ips for any single event is used in this analysis. This is five times more stringent than the USDI standard. A 0.20 ips PPV is approximately equivalent to a magnitude 2.7 quake on the Richter Scale. Such an event may be marginally noticeable when standing on a slab or other hard surface, but would not be noticeable on carpet or other cushioned floor covering.

TABLE 3
VIBRATION COMPARISONS

Peak Ground Velocity (inches/sec.)	Construction Sources	Structural Damage	Human Perception
0.01	Jackhammer @ 50 feet	None	Barely Perceptible
0.03	Truck or Dozer @ 50 feet	None	Easily Noticeable
0.10	---	Very Safe To Buildings	Strongly Noticeable
0.50	Pile Driver @ 50 feet	Very Safe To Buildings	Unpleasant
1.0	---	Low Probability Of Damage	Very Unpleasant
3.0	Blasting @ 50 feet	Low Probability Of Damage	Extremely Unpleasant
5.0	---	Minor Damage	Intolerable
10.0	---	Structural Damage	Intolerable

Source: Cowan, James, Architectural Design Guide, Mc Graw-Hill: New York (2000)

PROJECT IMPACTS

IMPACT SIGNIFICANCE CRITERIA (THRESHOLDS OF SIGNIFICANCE)

The City of Azusa noise standard of 65 dB for a single event is the applicable standard for project-related noise impacts from single events such as blasting. For vibration associated with blasting events, a threshold of 0.20 ips is used as the standard of significance in this analysis. For more typical sources such as heavy equipment operations, the applicable noise standards are 50 dB Leq from 7 a.m. to 10 p.m., and 45 dB Leq at night. The City of Duarte standards are slightly less restrictive for hourly daytime noise generation, but equal to the Azusa standards at night.

ANALYSIS APPROACH

Noise data from a major production blast (a peak charge event) was obtained at a distance of approximately 2,000 feet between the blast site and the noise meter for a direct line of sight condition (no intervening terrain). That reading was adjusted for distance and with terrain obstruction to simulate the maximum plausible noise for the existing site configuration and for the proposed western mining activities.

Blasting vibrations are measured in terms of the peak particle velocity for existing blasting events by an independent contractor at three locations on the project site. One monitoring location is typically at 2,700 feet from the blast to reasonably simulate the maximum plausible vibration exposure at the closest residence for the current mining plan. Another vibration monitoring station averages approximately 2,200 feet from the blast site which is a reasonable representation of the vibration effects if future blasting were to occur near the southwestern corner of the proposed mining area.

Heavy equipment noise "signatures" were derived from EPA data for construction operations. Average hourly noise levels were estimated by assuming that equipment operates under heavy load for approximately 30 minutes during any hour.

BLASTING NOISE IMPACTS

Two noise meters operating in the "Lmax" mode were used to measure the A-weighted noise boom during a heavy charge rock production blast. Both meters recorded 66 dBA at 2,000 feet under direct line of sight conditions. Had that event occurred as close as possible to the closest homes in Duarte (1,800 feet), the following noise levels would likely have been observed:

Existing mining plan = 66 dB - 2 dB distance adj. - 5 dB terrain screen = 59 dB Lmax

Prop. mining plan = 66 dB + 1 dB distance adj. - 6 dB terrain screen = 61 dB Lmax

Future maximum noise levels of 61 dB Lmax will be 4 dB below the City of Azusa's standard of 65 dB, and 9 dB below the City of Duarte's standard of 70 dB for peak single events. Furthermore, the net difference between the existing and proposed noise levels at the nearest receptors will be approximately + 2 dB. The threshold of human perception of noise level differences under ambient conditions is approximately 3 dB. Therefore, maximum noise levels associated with peak blasting event will not be perceptibly different for either scenario. In addition, the change in mining operations to create micro-benches that require smaller charges may more than off-set the small increase in blasting noise associated with the proposed western mining activities.

BLASTING VIBRATION IMPACTS

Eleven blast events were monitored to establish vibration levels as a function of ground-borne propagation distance. The measured peak particle velocities for these events at two locations that best simulate possible residential exposure were as follows:

Peak Particle Velocity	2700' to Blast Site	2200' to Blast Site
Non-detectable	6	2
0.005 inch/second	2	1
0.010 inch/second	3	6
0.015 inch/second	0	2
11-test average	0.005 inch/sec	0.009 inch/second

By way of a reference, a PPV of 0.005 inch/sec is a magnitude 0.0 on the Richter Scale. A level of 0.009 inch/sec is approximately magnitude 0.2. The maximum of 0.015 inch/sec is still well below a magnitude 1. The above measured vibration levels were extrapolated to the closest plausible residential separation distance for the proposed westward expansion (1,800 feet) using a standard power law spreading equation. The vibration level for a blast at 1,800 feet is calculated as 0.012 ips average, 0.020 ips worst-case. These levels are at least 10 times less than the adopted significance threshold of 0.20 ips. They correspond to a Richter Scale magnitude of 0.5 average and 0.9 worst-case. Such levels are barely perceptible to people. As noted under airborne noise, the reduction in charge size for the planned micro-benching mining procedures compared to current large bench production methods may more than compensate for any possible vibration increase associated with distance encroachment.

EQUIPMENT OPERATIONS NOISE

Equipment noise levels for the existing operation were compared to those from the proposed relocation. Noise levels from published inventories were presumed to decay due to distance spreading, atmospheric absorption and the blocking action of intervening terrain. The

reference noise levels at 50 feet from the source for the existing and future equipment fleet were calculated as follows (dBA):

Source	***Existing***	***Proposed***
Excavator	80	*
Dozer	83(2)	*
Loader	79	82(2)
Water Truck	88	88
Grader	-	85
Drill Rig	83	83
Drill Rigs	93(3)	96(6)
Composite	95 dB	97 dB

*remains on East Side for reclamation work, unchanged from existing, not anticipated to transfer to West Side

Off-site noise levels were adjusted for various correction factors to determine residual equipment noise relative to City of Azusa or Duarte standards. Noise levels will be reduced from their 50-foot measured reference levels by the following factors:

Load Adjustment - Equipment does not operate at 100% load (max power) for an entire hour. An average of 50% power per hour was assumed.

Distance Adjustment - Sound levels reduce by geometrical spherical spreading losses at a rate of 6 dB for each doubling of the source-receiver distance. The assumed location of the sound source was the center of operations since the standard is an hourly average.

Absorption Adjustment - Molecular absorption acts like a viscous substance that reduces wave amplitude, particulatily for shorter wavelengths. The rate of absorption attenuation is typically 1-2 dB for each doubling of distance beyond the initial 1,000 feet of travel.

Terrain Obstruction - Sound wave propagation is strongly line-of-sight. Receivers within the "sound shadow" behind an obstruction experience measurably reduced noise levels. The degree of attenuation depends upon the size of the barrier. Attenuation levels range from minimal (-5 dB), limited (-10 dB), substantial (-15 dB), massive (-20 dB) and maximum theoretical (-23 dB).

Application of these attenuation factors leads to the following predicted equipment noise (dB Leq):

	Existing		*Proposed*	
	Azusa	**Duarte**	**Azusa**	**Duarte**
Reference Level	95	95	97	97
Load Adjustment	-3	-3	-3	-3
Distance Adjustment	-38	-37	-41	-36
Absorption Adjustment	-5	-4	-9	-3
Terrain Obstruction	-15	-20	-15	-20
Residual	34	31	29	35
Standard (day)	50	55	50	55
Standard (night)	45	45	45	45

The encroachment of the aggregate extraction activity will slightly increase noise levels in Duarte, but levels will remain 20 dB below the daytime standard and 10 dB below the nocturnal standard. Levels at the closest Azusa homes will decrease even further. Equipment operations noise impacts will be less-than-significant.

A comparison of the maximum plausible noise change at the closest residence in Duarte was made by comparing noise levels from equipment operations at the points of minimum possible set-back. Under the current permit, the minimum possible separation to homes on Brookridge is 2,225 feet. With the requested westward expansion, the minimum set-back is 1,800 feet. Both locations are screened by a substantial intervening ridge. Assuming that an excavator dozer, loader and two haul trucks might operate within a small space with minimum separation, the resulting noise levels are as follows (dB Leq):

	Existing (2,225 feet)	***Proposed (1,800 feet)***
Reference Level	92	92
Load Adjust	-3	-3
Distance Adjust	-33	-31
Absorption Adjust	-2.5	-2
Terrain Adjust	-20	-20
Residual	33.5	36

The proposed change in the closest point of approach would increase maximum noise levels by +2.5 dB. The change in the plausible maximum is almost identical to the calculated change in average levels based upon using the acoustical center of noise emissions. Changes of 2.5 dB are only marginally perceptible under ambient conditions.

Mining activity noise levels will be superimposed upon background noise from localized sources and the hum from distant traffic. The noise ordinances in Azusa or Duarte are focused on the noise "signature" of a specific activity unless background levels already exceed standards. Background noise levels at residential areas closest to the project site are low such

that this possible relaxation of standards is not applicable. Nevertheless, it is instructive to compare project-related noise impacts to background conditions as a frame of reference. Baseline noise levels were measured on December 9 and 10, 2010, at the closest Azusa and Duarte homes to the project site. Measurements were also made at the nearest Duarte homes that may have a limited future line-of-sight (LOS) when mining activities daylight at the far northwest corner of the proposed expansion area. Measurements were as follows (dB Leq):

	Day	***Evening***	***Night***
Azusa (Mirador)	51	50	49
Duarte (Brookridge)	45	44	48
Duarte (LOS)	42	45	49

Addition of the proposed project noise to the baseline produces the following result:

		Day	***Evening***	***Night***
Azusa	**Baseline**	51	50	49
	Project	29	29	29
	Combined	51	50	49
	Standard	50	50	45
Duarte	**Baseline**	45	44	48
	Project	35	35	35
	Combined	45	44	48
	Standard	55	55	45

Project activities will not measurably change the baseline condition.

If mining activities daylight to the far northwest corner, approximately one mile from some Duarte homes, noise attenuation from the intervening topography is lost. The calculated noise exposure for these homes under LOS conditions is (dB):

Reference Level	97
Load Adjustment	3
Distance Adjustment	40
Absorption	9
Residual	45 dB

Both daytime and nighttime noise standards would be met in Duarte, but the nighttime standard would be met with a zero margin of safety. Therefore, future mining should be restricted to daytime hours where there is a direct LOS to the nearest residences.

CONCLUSION

In examining the net difference between the noise and vibration conditions that would result from the existing approved Azusa Rock operations and those that would occur as a result of the proposed project, it is concluded that the proposed westward shift in mining operations will not create noise or vibration effects that would exceed adopted significance thresholds or cause a substantially noticeable difference than the effects that will occur under the existing plan for those operations closest to the receptors.

Although the proposed project will move the closest operations approximately 700 feet closer to the nearest receptors, maximum airborne noise levels will be 4 dB below the City of Azusa's standard of 65 dB, and 9 dB below the City of Duarte's standard of 70 dB for peak single events. Furthermore, the net difference between the existing and proposed noise levels at the nearest receptors will be approximately +2 dB, which is considered less than significant.

For ground vibrations, neither the peak measured event, nor an 11-blast average created vibration levels that would exceed the adopted significance threshold of 0.20 ips at the closest homes. In addition, the reduction in charge size for the planned micro-benching mining procedures compared to current large bench production methods may more than compensate for any possible vibration increase associated with distance encroachment.

No significant impacts have been identified by this analysis. However, since nocturnal noise levels during clear LOS conditions to off-site Duarte homes with be met with a 0 dB margin of safety, it is recommended that mining activities during this particular condition should be restricted to daytime hours. No other mitigation measures are proposed.

Equipment operations noise will continue to be shielded by a very substantial topographic barrier. The combination of a increased operations fleet and a decrease of set-back distance may cause noise levels at the closest Duarte residences to increase by +4 dB. An increase of +4 dB will still be well below ambient levels, and thus not perceptible or significant. However, hourly average noise will remain at 10 dB below the allowable Duarte nocturnal noise ordinance level, and 20 dB below the daytime standard. Levels at the nearest Azusa residences will decrease slightly because of increased distance set-back associated with the proposed relocation.