SOUND ANALYSIS

for

MARBLEMOUNT QUARRY
SKAGIT COUNTY, WASHINGTON

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CONTENTS

1. INTRODUCTION

This report describes sound levels associated with rock-mining activities at the proposed Marblemount Quarry near Marblemount in Skagit County, Washington. The report presents baseline sound levels measured near the site, noise-emission characteristics of proposed noise sources, calculated sound levels due to the proposed operations, and noise-mitigation measures.

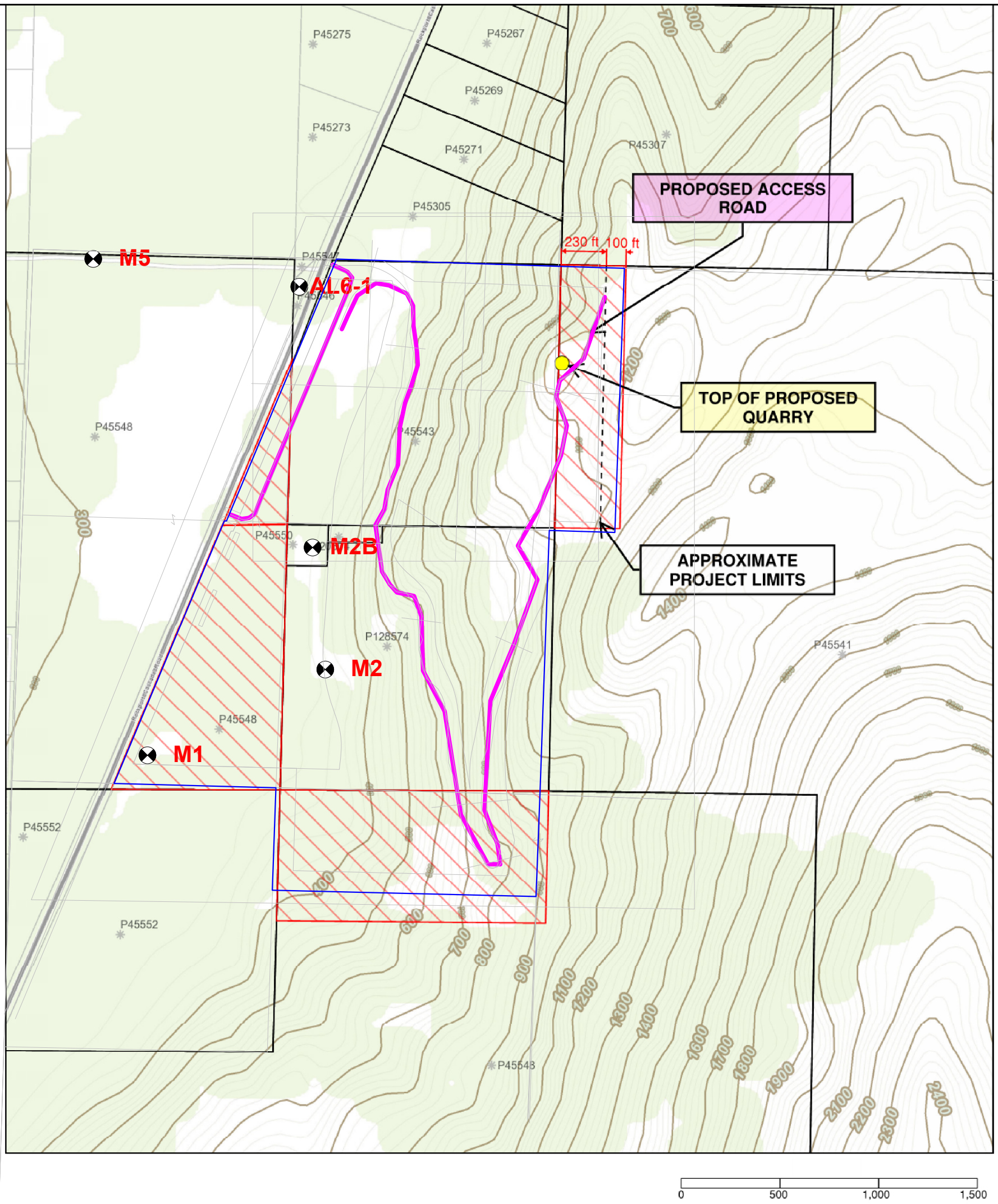
2. PROJECT SITE AND SURROUNDING LAND USES

A vicinity map of the proposed Marblemount Quarry, surrounding properties, and sound analysis locations is shown in Figure 2-1.

The project site is located in unincorporated Skagit County, Washington, south-southwest of the town of Marblemount.

The proposed quarry site comprises several parcels located on the east side of Rockport Cascade Road. The parcels forming the project site are zoned NRL (Natural Resource Lands) by Skagit County. All the parcels with the exception of P45541 (the northeast area of the site) belong to the County's Mineral Resource Overlay (MRO).

Neighboring parcels to the east, south, and southwest are also zoned NRL. Neighboring parcels to the north, on the east and west sides of Rockport Cascade Road, are zoned RRv (Rural Reserve) and contain residences. Parcels to the northwest are zoned OSRSI (Public Open Space of Regional/Statewide Importance).



Point Source
Line Source
Barrier
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Receiver

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Figure 2-1

Marblemount Quarry
Sound Analysis

Project Site and Sound Measurement Locations

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3. SOUND LEVEL DESCRIPTORS AND CRITERIA

3.1 Sound Level Descriptors

Sound is measured as sound level in units of decibels, dB. Environmental sound is often measured as A-weighted sound level in dBA. The A-weighting is a specific weighting filter in a sound level meter that corresponds to human hearing sensitivity at the various sound frequencies. People normally experience sound levels between about 30 and 90 dBA, depending on their activity. For example, a loud nearby vehicle, radio or power tool may produce 80 to 90 dBA, normal conversation is about 50 to 60 dBA, and a bedroom or quiet office is about 30 to 40 dBA.

Each 10-dB increase in sound level corresponds to a tenfold increase of sound energy, but is judged by a listener as only a doubling of loudness. The smallest changes in sound level considered clearly noticeable are about 3 to 5 dB.

Sound levels from two or more sources are combined using logarithms, not by adding the levels. When two levels are combined, the louder level predominates, and the combined level is the louder level plus 0 to 3 dBA. Some examples: 50 dBA combined with 50 dBA is 53 dBA; 50 dBA combined with 40 dBA results in 50.4 dBA, which is rounded off to 50 dBA since fractions of a dB are negligible from the point of view of human hearing.

Because sound levels fluctuate over time, several A-weighted sound level descriptors are used to characterize the sound over time. In this report, the following descriptors are used:

Leq	**Equivalent sound level, Leq**, is the most commonly used descriptor for measuring fluctuating sound. The Leq is the level of a constant sound that, over a given time period, contains the same amount of sound energy as the measured fluctuating sound.
Lmax	**Maximum sound level, Lmax**, is the highest instantaneous sound level for a given sound source, event or time period. Because the Lmax in a neighborhood will, unlike Leq, typically have large fluctuations from hour to hour and day to day, Lmax is seldom used to measure noise impact, except in cases where brief high-level sound is causing an impact such as sleep disturbance.

3.2 Skagit County Noise Regulations

Relevant Skagit County regulations are contained in Sections 14.16.440 – *Mineral Resource Overlay*, 14.16.480 – *Performance Standards*, and Chapter 9.50 – *Noise Control* of the Skagit County Code.

According to paragraph 14.16.440(10)(c), noise limits pertaining to mining operations within the County's Mineral Resource Overlay are as established in Chapter 173-60, *Maximum Environmental Noise Levels*, of the Washington Administrative Code (WAC). Permissible sound levels in 173-60 WAC are based on the Environmental Designation for Noise Abatement (EDNA) of source and receiving properties. The EDNA classification is assigned to Skagit County zones as stipulated in Paragraph 14.16.840(5), *Performance Standards - Noise*, of the Skagit County Code.

The parcels forming the project site and neighboring parcels to the east, south, and southwest are zoned NRL and are classified as Class C EDNA (Industrial). Neighboring parcels to the north, zoned RRv, are categorized as Class A EDNA (Residential). Parcels to the northwest, zoned OSRSI, are designated as Class B EDNA (Commercial).

The primary limits for noise produced at Class C EDNA properties and received at EDNA Class A and B properties are contained in Table 3-1.

TABLE 3-1
SKAGIT COUNTY PERMITTED SOUND LEVELS
FOR EDNA CLASS C NOISE SOURCES (dBA)

Time of Day	EDNA of Receiving Property	
	Class A	Class B
Daytime (7 a.m. to 10 p.m.)	60	65
Nighttime (10 p.m. to 7 a.m.)	50	65

In any one-hour period, the basic noise limits can be exceeded by 5 dBA for a total of 15 minutes or by 10 dBA for a total of 5 minutes or by 15 dBA for a total of 1.5 minutes. The 15-dBA short-term permitted exceedance corresponds to a noise limit on the hourly Lmax of 75 dBA (permitted for no more than 1.5 minutes) for Class A receiving properties during daytime hours.

The noise limits apply to all mining and processing equipment operating at the proposed Marblemount Quarry, including haul trucks operating within the site. According to Paragraph 9.50(3)(k) of the County Code, the limits do not apply to trucks operating on public roads, which are regulated by WAC 173-62 noise emission criteria for individual vehicles. Section 9.50.040(3)(e) exempts warning devices such as back-up alarms from the noise limits of Table 3-1.

4. EXISTING SOUND LEVELS

4.1 Sound Measurement Locations

Five locations were selected for measurements of baseline sound levels and are shown in Figure 2-1 as Locations M1, M2, M2B, M5, and AL6-1. The measurement locations were selected among accessible properties to approximate as best as possible the Sound Analysis locations presented in Section 6.2 and shown in Figure 7-1.

Locations M1, M2, and M2B are located within the proposed Quarry property and were selected to represent existing sound levels at the nearest residential properties north of the project (AL1-1 to AL4-1).

Locations M5 and AL6-1 represent the nearest Public Open-Space properties west of the project site.

4.2 Continuous and Short-Term Sound Measurements

Existing sound levels were monitored continuously for 24 hours at Locations M1 and M2. The sound monitoring was initiated at 2 p.m. on Thursday, December 6, 2018.

Additional, short-term (15-minute) measurements of sound levels in one-octave bands and A-weighted were conducted at Locations M2B, M5, and AL6-1. The short-term measurements took place from 3: 30 to 3:45 p.m. on Thursday, December 6 and from 1:00 to 1:45 p.m. on Friday, December 7, 2018.

The long-term noise monitoring was conducted using two Bruel & Kjaer 2238 Sound Level Meters. The short-term measurements were conducted using a Bruel & Kjaer 2250 Real-Time Spectrum Analyzer. All instruments conform to the specifications of ANSI S1.4 for Type I instruments.

All measurements were conducted at the first-story elevation of five feet above ground elevation.

Weather conditions were clear with average wind speeds of 0 to 6 mph from the north-northwest, daytime temperatures in the low 40s, and nighttime temperatures in the upper 10s degrees Fahrenheit. The weather conditions were within the range recommended by WAC 173-58, *Sound Level Measurement Procedures*.

A summary of the long-term and short-term measured sound levels, including overall Leq sound levels over several hours, is presented in Table 4-1.

TABLE 4-1
SUMMARY OF SOUND-LEVEL MEASUREMENTS (dBA)

Measurement Location	Measured Sound Levels	
	Daytime (7 a.m. to 10 p.m.)	Nighttime (10 p.m. to 7 a.m.)
M1	37-47 Overall 42	37-40 Overall 38
M2	37-46 Overall 41	37-40 Overall 37
M2B*	50**	*not measured*
M5*	40	*not measured*
AL6-1*	44	*not measured*

**15-minute measurement*
***Included jet aircraft flyover*

The main sources of existing noise at the measurement locations were intermittent traffic on Rockport Cascade Road, residential activity, a neighboring creek, and occasional aircraft flyovers. The hand-held measurements at Locations M5 and AL6-1 were paused for occasional vehicle pass-bys on Willow Lane, in the immediate vicinity of the sound level meter.

As shown in Table 4-1, the results of the continuous noise monitoring and short-term sound measurements were below Skagit County daytime and nighttime noise limits at all measurement locations. The comparison with noise limits is presented for reference only. The measured sound levels are produced by sources such as traffic and aircraft flyovers, which are not subject to the noise limits of Table 3-1.

5. PROPOSED OPERATIONS AND SOUND EMISSIONS

5.1 Proposed Operations

Proposed activities at the Marblemount Quarry consist of land clearing, drilling, blasting excavation, on-site transportation of rock by truck for stockpiling, sizing of rock using hydraulic splitters, load-out of rock, and equipment maintenance. Occasional and intermittent crushing, screening, and load-out of processed rock rip-rap and aggregate would occur.

Proposed hours of operation are 6:00 a.m. to 6:00 p.m. Monday to Saturday, with night shifts added as required for certain contracts. Proposed hours of equipment maintenance are 6 a.m. to 12 a.m. Monday to Saturday.

The locations and activities related to each of the operation's components, as assumed in the Sound Analysis, are described briefly below.

Rock Mining would occur in the north half of the property, within Parcels P45543 and a portion of Parcel P45541. The mining would occur on benches above the proposed mine floor elevation of 320 feet above sea level (ASL). Mining includes drilling, blasting, and on-site transportation for stockpiling. The resulting rock material would be trucked off-site or to the aggregate processing facility.

Material Processing would occur in the west part of the property, within Parcel P45543, at the existing elevation of 320 feet ASL. Armor stone processing would include excavators, hydraulic splitter for sizing, and stockpiling using a loader. Equipment would include a jaw crusher, cone crusher, sorting screens, and conveyors.

Haul Trucks transporting quarry products off site would access the site from Rockport Cascade Road at the northwest entrance (elevation 310 feet ASL). Seventy-five daily round-trips are expected. The haul road would travel through Parcels P45543, P128574, and P45548.

Perimeter buffers would be maintained as follows: 100' buffer areas to north, east, and south; 50' buffer area to the west.

5.2 Equipment Sound Emissions

Reference sound levels of proposed equipment at the Marblemount Quarry operation were obtained from the BRC Acoustics database. The source sound levels normalized to a reference distance of 50 feet are shown in Table 5-1.

TABLE 5-1
REFERENCE SOUND LEVELS OF PROPOSED EQUIPMENT
Leq, dBA

Source	Sound Level at 50 Feet
Terrain Clearing	
Dozer	81
Excavator	83
Mining	
Front shovel loading truck	83
Rock drill	84
Material Hauling	
Off-road heavy haul truck hauling rocks from working face to load-out area	78 each
Loader loading on-highway haul trucks	83
Processing Plant	
Cone crusher	88
Screen tower	89
Jaw crusher	80
Hydraulic splitter	80
Material Load-Out	
Loader loading truck	83
On-highway haul truck	78

As represented in Section 3.2, warning devices such as back-up alarms are exempt from the noise limits of Table 3-1.

6. CALCULATED SOUND LEVELS AND EVALUATION

6.1 Methodology and Sound-Modeling Scenarios

The sound-level calculations were performed using the CadnaA program, which is based on International Standard ISO 9613 for the prediction of environmental noise. The model takes into account the sound power level, directivity, location, and height of the noise sources, distance, ground cover and topography between the noise source and receiver, atmospheric conditions, and location and height of the receiver.

Three noise-modeling scenarios were selected for analysis in order to represent proposed mining, processing, and truck-haul operations.

Table 6-1 lists the modeled scenarios and assumptions regarding topographical features and location of equipment during proposed activities.

TABLE 6-1: NOISE MODELING SCENARIOS FOR PROPOSED OPERATIONS			
Scenario	Topographical Conditions	Description	Sound Source Locations
01	Mining Permit area (Parcels P45543, P45541) at existing elevations; 100' buffer areas to north, east, and south; 50' buffer area to west;	Clearing at northeast limit	Dozer and excavator at northeast limit, at existing elevation of 1080' ASL
	Access road and stockpile areas (Parcels P128574, P120304, P45550, P45548) at existing elevations; 100'-wide buffer south, 50'-wide buffer west, varying-width buffer area east	Clearing for access road	Rock drill, dozer, and excavator at north end of Parcel P128574 at elevation 920' ASL
02	Mining Permit area (Parcels P45543, P45541) at existing elevations;	Mining at northeast limit	Front shovel, off-highway haut truck, and rock drill at northeast limit, at existing elevation of 1080' ASL
	100' buffer areas to north, east, and south; 50' buffer area to west	Material hauling and load-out of rocks	• 4 truck round-trips per hour from east mining limit along proposed access road to loadout area; • 4 one-way on-highway-truck trips per hour from northwest entrance to south exit.
	Access road and stockpile areas developed (Parcels P128574, P120304, P45550, P45548); 100'-wide buffer south, 50'-wide buffer west, varying-width buffer area east	Processing	Equipment in proposed processing area (Parcel P45543), at elevation 320' ASL: • Cone crusher, screen tower, jaw crusher, hydraulic splitter; • Loader loading on-highway truck
03	Mining Permit area (Parcels P45543, P45541) mined to final elevations (mine floor approximately 320' ASL); 100' buffer areas to north, east, and south; 50' buffer area to west;	Mining on a lower bench	Front shovel, truck, and rock drill on a lower bench, at elevation 480' ASL
	Access road and stockpile areas (Parcels P128574, P120304, P45550, P45548) at final elevations (320 to 1050' ASL).	Material hauling and load-out of rocks	• 4 truck round-trips per hour along proposed access road from mining location to the loadout area; • 4 one-way on-highway-truck trips per hour from northwest entrance to south exit
	100'-wide buffer south, 50'-wide buffer west, varying-width buffer area east	Processing	Equipment in proposed processing area (Parcel P45543), at elevation 320' ASL: • Cone crusher, screen tower, jaw crusher, hydraulic splitter; • Loader loading on-highway truck

6.2 Sound Analysis Locations

For the purpose of analyzing sound levels from proposed operations, seven sound-analysis locations were selected to represent occupied properties and structures that may be affected by project sounds. The analysis locations are listed in Table 6-2 and shown in Figure 7-1.

TABLE 6-2
DESCRIPTION OF ANALYSIS LOCATIONS

Analysis Location	Description	Zoning
AL1-1	South property line of 59456 Rockport Cascade Road, Parcel P45305	RRv
AL2-1	First-story window of residence at 59504 Rockport Cascade Rd., Parcel P45271	RRv
AL3-1	First-story window of residence at 59534 Rockport Cascade Rd., Parcel P45269	RRv
AL4-1	First-story window of residence at 59573 Rockport Cascade Rd., Parcel P45277	RRv
AL5	East property line of Parcel P45303	OSRSI
AL5-1	First-story window of State Park building at 59117 Willow Lane, Parcel P45303	OSRSI
AL6-1	Parcel P45546	OSRSI

6.3 Calculated Sound Levels

Calculated Leq sound levels from the operations listed in Table 6-1 are shown in Table 6-3. The table also shows applicable Skagit County noise limits.

TABLE 6-3
CALCULATED SOUND LEVELS (dBA)
PROPOSED MINING OPERATIONS
WITHOUT ADDITIONAL NOISE MITIGATION

Scenario Description		Sound Levels at Analysis Locations						
		1-1	2-1	3-1	4-1	5	5-1	6-1
01	Total Leq during land clearing	34	30	35	35	33	38	34
	Leq from clearing at northeast limit	27	26	25	23	24	19	24
	Leq from clearing for access road	33	28	34	34	32	38	33
02	Total Leq during initial mining	***54***	50	47	46	55	51	58
	Leq from initial mining at northeast limit	29	29	28	26	27	22	27
	Leq from material hauling	***53***	45	39	38	47	38	52
	Leq from processing	49	49	47	46	54	50	57
03	Total Leq during late-stage mining	***54***	50	47	46	55	52	60
	Leq from mining on a lower bench	33	34	29	28	36	46	53
	Leq from material hauling	***53***	44	37	37	47	39	52
	Leq from processing	49	49	47	46	54	50	57
Skagit County daytime noise limits for Leq		60	60	60	60	65	65	65
Skagit County nighttime noise limits for Leq		50	50	50	50	65	65	65
Sound levels shown in Italics and underlined exceed Skagit County nighttime noise limits								

6.4 Evaluation

As shown in Table 6-3, calculated Leq sound levels from operations at the Marblemount Quarry meet Skagit County daytime noise limits during all proposed operations. Sound levels at Analysis Location 1-1 are expected to exceed the nighttime noise limit of 50 dBA during the last hour of the nighttime period. The elevated sound level would be produced during the first hour of the daytime work shift. The primary source is expected to be on-site rock haul over the access road to the stockpile and processing areas.

Recommendations for sound-mitigation measures during these operating conditions are provided in Section 7.

7. NOISE MITIGATION MEASURES

The calculated sound levels reported in Section 6 show sound levels exceeding Skagit County nighttime noise limits during future mining stages, primarily due to truck traffic on the on-site haul route.

Two levels of noise mitigation are presented in this section. The Level I noise-mitigation option is the minimum required for the project activities to comply with Skagit County noise limits. Level II noise mitigation is more extensive and was designed to ensure that project sound levels as received at nearby residences produce no significant increase in sound levels compared to typical baseline conditions.

The two levels of mitigation are presented in the following paragraphs.

Level I Mitigation (Minimum Required):

Construct a berm at the north property line, between the access road and the residential property to the north, as shown in Figure 7-1. The barrier top should be at a height of 12 feet above the existing terrain to the north (top of barrier at 322' ASL). In other words, the height of the barrier would be 12 feet at its west terminus and would taper off towards the east, as the underlying terrain rises. The total length of the berm would be approximately 425 feet.

Level II Mitigation (Recommended in Lieu of Level I):

Implement both of the following measures:

- Construct a berm at the north property line, between the access road and the residential property to the north, as shown in Figure 7-1. The barrier top should be at a height of 20 feet above the existing terrain to the north (top of barrier at 330' ASL). In other words, the height of the barrier would be 20 feet at its west terminus and would taper off towards

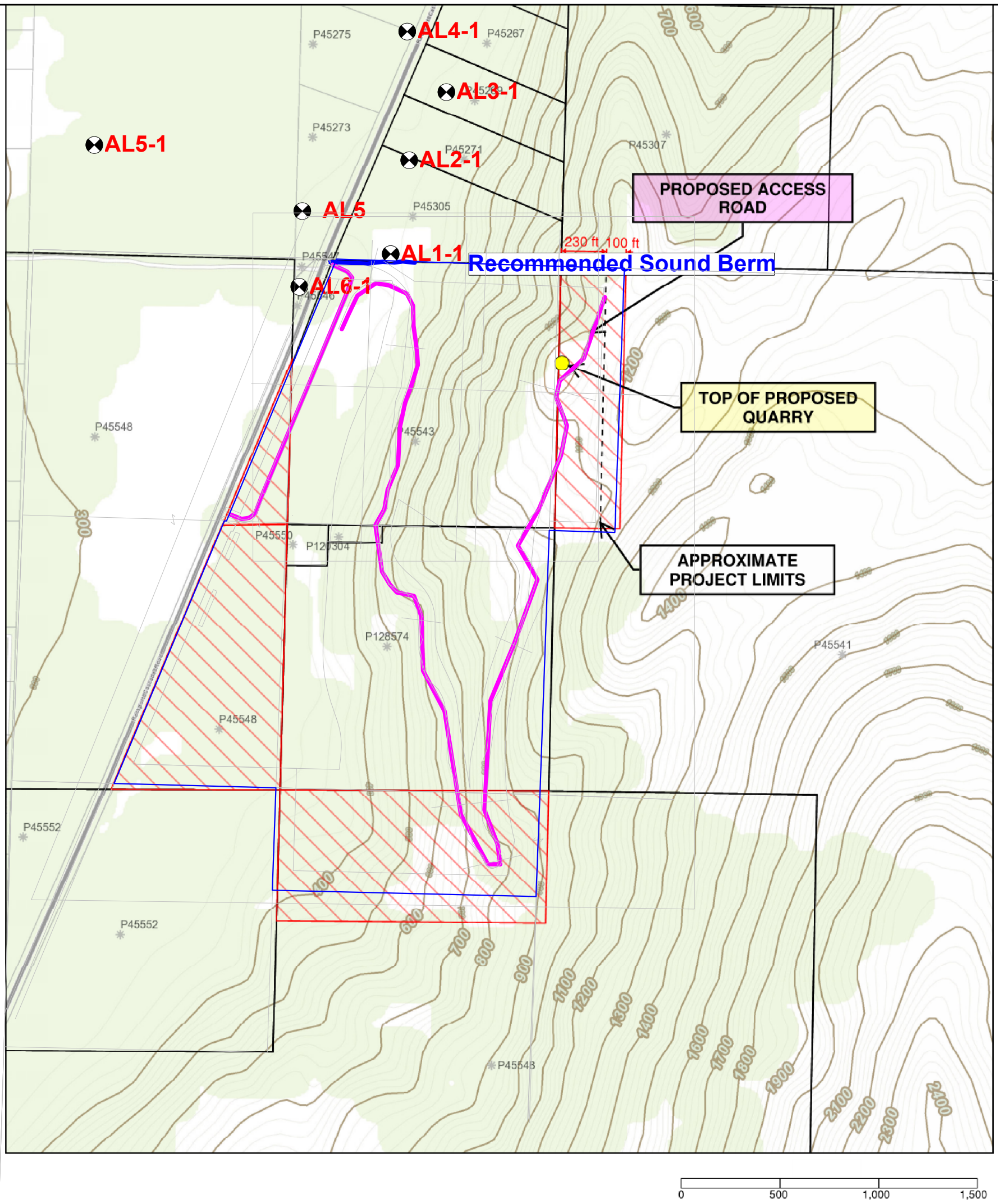
the east, as the underlying terrain rises. The total length of the berm would be approximately 430 feet.

- Restrict the hours of activity at the processing area to the daytime hours (starting at 7 a.m.).

Table 7-1 presents sound levels during initial mining and later-stage mining at a lower elevation with the two levels of noise mitigation. With Level I or Level II mitigation in place, Leq sound levels from all mining, processing, and material-hauling activities are expected to meet the Skagit County nighttime noise limits at all Analysis Locations.

The combined Tables 6-3 and 7-1 show that, with Level I mitigation in place, projected sound levels during some proposed phases of operation exceed the baseline sound levels at the Rural-Residential Analysis Locations by up to 10 dBA. As presented in Section 3.1 of this Analysis, a sound-level increase of 10 dBA is perceived as a doubling of loudness. While the sound levels meet Skagit County noise limits, the increases over baseline conditions would be clearly noticeable at the nearest neighboring properties.

With Level II mitigation in place, projected sound levels during all proposed phases of operation are within 5 dBA or less of baseline sound levels at the Rural-Residential Analysis Locations. As presented in Section 3.1 of this Analysis, a sound-level increase of 4 to 5 dBA is near the threshold between an imperceptible and a noticeable effect and therefore does not constitute a significant noise impact.



Point Source
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Figure 7-1

Marblemount Quarry
Sound Analysis

Sound Analysis Locations and Recommended Sound Berm

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TABLE 7-1
CALCULATED SOUND LEVELS (dBA)
PROPOSED MINING OPERATIONS
WITH LEVEL I OR LEVEL II NOISE MITIGATION

Scenario Description		Sound Levels at Analysis Locations						
		1-1	2-1	3-1	4-1	5	5-1	6-1
04 Mit I	Total Leq during initial mining with Level I mitigation: 12' high berm at north property line	50	50	47	46	55	51	58
	Leq from initial mining at northeast limit	29	29	28	26	27	22	27
	Leq from material hauling	49	43	39	38	46	38	52
	Leq from aggregate processing	44	49	47	46	54	50	57
05 Mit I	Total Leq during late-stage mining with Level I mitigation 12' high berm at north property line	50	50	47	46	55	52	60
	Leq from mining on a lower bench	33	34	29	28	36	46	53
	Leq from material hauling	49	43	37	37	46	39	52
	Leq from aggregate processing	44	49	47	46	54	50	57
04 Mit II	Total Leq during initial mining with Level II mitigation: 20' high berm at north property line, no early-morning processing	45	43	39	38	46	38	52
	Leq from initial mining at northeast limit	29	29	28	26	27	22	27
	Leq from material hauling	44	43	39	38	46	38	52
05 Mit II	Total Leq during late-stage mining with Level II mitigation 20' high berm at north property line, no early-morning processing	44	43	38	37	46	47	56
	Leq from mining on a lower bench	33	34	29	28	36	46	53
	Leq from material hauling	44	42	37	37	46	39	52
Skagit County daytime noise limits for Leq		60	60	60	60	65	65	65
Skagit County nighttime noise limits for Leq		50	50	50	50	65	65	65

8. SUMMARY AND CONCLUSIONS

The findings of the Sound Analysis are summarized as follows:

- Existing measured sound levels are at or below Skagit County noise limits at all measurement locations in the vicinity of the proposed quarry.

- Calculated sound levels from proposed operations at the Marblemount Quarry with noise mitigation meet applicable Skagit County noise limits at all Analysis Locations.

- The recommended noise-mitigation measures are as follows:

    - Level I: Construct a 12-foot high sound berm at the north property line, as described in Section 7;

      or,

    - Level II: (1) Construct a 20-foot high sound berm at the north property line, as described in Section 7, *and* (2) restrict the hours of material processing to daytime hours.

- With Level-II sound mitigation measures in place, project sound levels from the project would produce only a slight sound-level increase compared to existing baseline conditions and would not create any significant noise impacts.

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