ENVIRONMENTAL NOISE IMPACT REPORT

Buckley Recycling Center
Enumclaw, WA

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I. INTRODUCTION

This report presents the Environmental Noise Impact study conducted for the new Buckley Recycling Center (BRC) located in Enumclaw, Washington. To understand the noise impact on the environment at this new site, we evaluated the the equipment noise levels at the existing BRC site to make predictions for how they will impact the surrounding properties at the new site. The existing site is located at 28225 West Valley Highway North, Auburn, Washington.

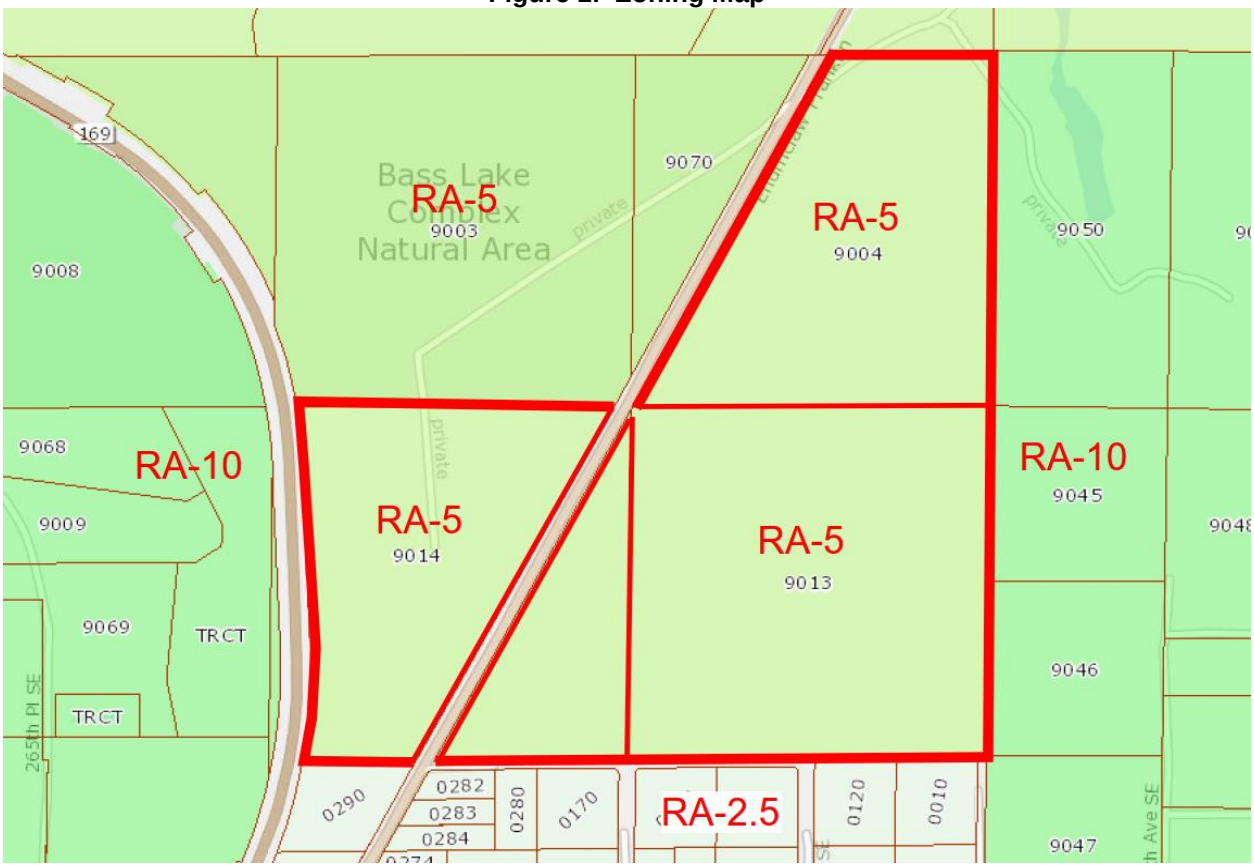
It is our understanding that BRC's typical daily operations include moving and processing of organic materials such as soil, plant matter, or wood. These operations involve large equipment used for hauling, grinding and excavating. We have measured the individual noise levels from each of the machines planned for use at the new site location, in order to develop guidelines for planning the future site to stay within the limitations provided by the King County Noise Ordinance.

Furthermore, the new BRC site has three phases for expansion of their operations within the new site. We have included these phases in our evaluation. As this report is full of many acoustical terms, please refer to the appendix for definitions and descriptors.

II. PROJECT SITE AND ZONING

The new site location, shown in the figure below, falls within an RA-5 zoning jurisdiction, which is considered "Rural". All surrounding properties are also considered "Rural".

Figure 1: Zoning Map



III. NOISE REGULATIONS AND CRITERIA

Criteria 1 – King County

Per King County Code Chapter 12.86 the maximum permissible sound levels are established based on the zoning of the source and receiving properties. These include Rural, Residential, Commercial and Industrial zoning designations. The maximum permissible Leq noise levels from section 12.86.110, based on the source and receiving properties are shown in the table below.

Table 1: Maximum Permissible Noise Levels (Leq)

District of Sound Source	District of Receiving Property			
	Rural	**Residential**	**Commercial**	**Industrial**
Rural	49	52	55	57
Residential	52	55	57	60
Commercial	55	57	60	65
Industrial	57	60	65	70

Between the hours of 10:00 pm and 7:00 am the noise limits in the table above are to be reduced by 10dBA for rural or residentially zoned properties to account for increased sensitivity during the evening hours.

During any single hour in the evening or daytime the noise limits in the table above may be exceeded for any receiving property by the following:

1. 5 dBA for a total of 15 minutes (25%) in any one-hour period.
2. 10 dBA for a total of 5 minutes (8%) in any one-hour period.
3. 15 dBA for a total of 1.5 minutes (2.5%) in any one-hour period.

Based on the rural zoning of the site and receiving properties, the maximum allowable noise at the receiving property lines is summarized in the table below.

Table 2: Maximum allowable Noise limits per King County
For A Rural Source to a Rural Receiver Property

	Daytime hours (7:00 AM to 10:00 PM	Nighttime hours (10:00 PM to 7:00 AM)
Average (Leq)	49 dBA	39 dBA
Maximum (Lmax)	64 dBA	54 dBA

Per King County Code, noise associated with trucks and other vehicles operating on public roads is exempt from the limits provided above. The limits only apply to the specific on site operations of the gravel mine.

Criteria 2 – U.S. Environmental Protection Agency (EPA) Guideline

The EPA has established non-statutory guidelines for evaluating noise increases caused by a project over existing sound levels. These are provided in the following table.

Table 3: EPA Guidelines

Change in Noise Level	Perception of Change
0-5 dB	a slight impact
5-10 dB	a significant impact
10 dB or more	a serious impact.

These criteria are guidelines only, and have no statutory authority, but will be used in this evaluation to determine level of potential impact.

Criteria 3 – Washington State Department of Transportation

Noise associated with traffic for project related activities is currently exempt from noise limitations as stated per King County Code. However, noise impacts due to changes in operations can be evaluated based on the level of change in sound level and the level considered acceptable for the type of land use.

These criteria are better described in Washington State Department of Transportation's (WSDOT) guidelines for noise levels. The Federal Highway Administration (FHWA) Code of Federal Regulations (CFR) Title 23 Part 772 has been adopted as it relates to evaluating noise impacts associated with traffic noise. Title 23 Part 772: Procedures for Abatement of Highway Traffic Noise and Construction Noise defines traffic noise impacts as noise levels that approach or exceed the noise abatement criteria or when the predicted noise levels significantly exceed the existing noise levels. The noise abatement criteria is provided in the following table. For this project, considering impacts to the existing adjacent properties, activity category B is assumed applicable.

Table 4: FHWA Noise Abatement Criteria

Category	Leq(h)	L_{10}(h)	Description of Activity Category
A	57 (Exterior)	60 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (Exterior)	70 (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (Exterior)	75 (Exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	--	--	Undeveloped lands.
E	52 (Interior)	55 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

IV. AMBIENT NOISE LEVELS AT FUTURE SITE

Existing sound levels were measured at two different locations in the vicinity of the project near the property lines. Locations were chosen in an attempt to capture current ambient noise levels at the nearest receiving property lines adjacent to the site to understand the current noise without the impact of the new BRC site. Measurement location 1 and location 2 best represent the ambient noise levels for residential neighborhoods, given that one is located near the highway and one is located farther away. These levels will be comparison to the predicted noise levels.

Measurements were conducted using Svantek 971 Sound Level Meters that conform to American National Standards Institute (ANSI) S1.4 for Type I instruments. All meters are with current calibration and have been locally calibrated prior to deployment at the site. Measurements were conducted between December 20 to December 21, 2016. Conditions during the measurement were overcast with no precipitation. Temperatures during the measurements were approximately 40 to 50 degrees Fahrenheit with wind speeds between 0 to 5 mph.

Figure 2: Measurement Locations

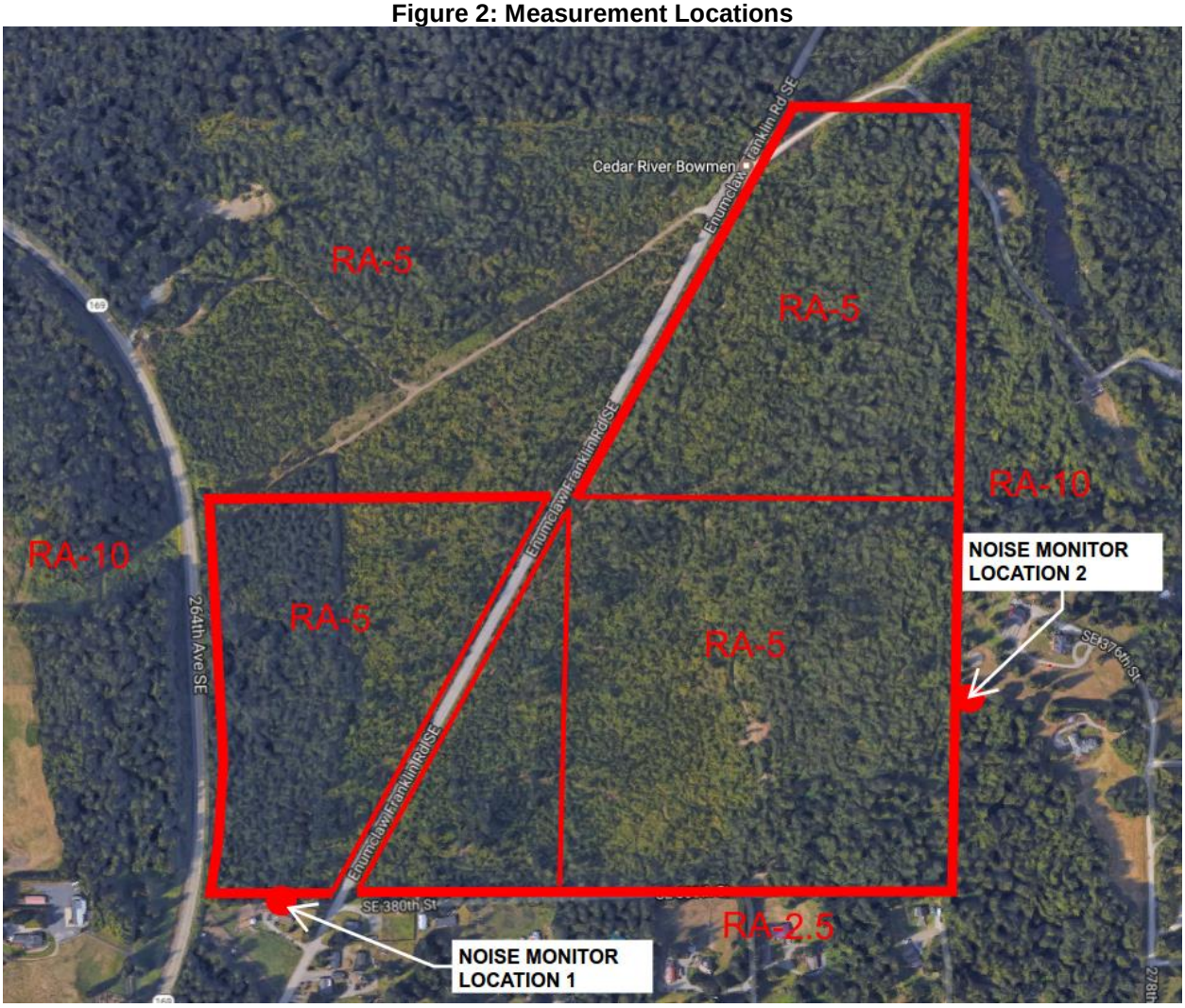


Table 5 summarizes the average Leq sound pressure levels at both measurement locations. The noise levels shown are considered the baseline sound levels for evaluation. The results of the 24-hour measurements are provided in a chart in the appendix.

Table 5: Measurement Results Summary

		Location 1	Location 2
Baseline Ambient Leq	Daytime	54	47
	Nighttime	47	39

Table 6: Regulations for Maximum Noise Levels

Noise Regulation		Location 1	Location 2
WAC Noise Limits	Daytime	55	55
	Nighttime	45	45
King County Limits	Daytime	49	49
	Nighttime	39	39

Location 1

Noise levels at Location 1 are primarily due to traffic activities associated with heavy trucks and cars passing along Enumclaw Franklin Road SE. Average daytime Leq sound pressure levels were at 54 dBA, which is 5 dBA above the 49 dBA King County daytime noise limit. Based on the FHWA guidelines in Table 4, this puts the neighborhood in Category A, which is defined as a generally quiet or serene environment.

Location 2

Noise levels at Location 2 are primarily due to local street traffic and other ambient noise from wind. This neighborhood is considered to be very quiet with average daytime Leq sound pressure levels were at 47 dBA, which is 2 dBA below the 49 dBA King County daytime noise limit. Based on the FHWA guidelines in Table 4, this also puts the neighborhood in Category A.

V. PROPOSED EQUIPMENT

Sound levels from the equipment involved in existing BRC site operations were measured to make predictions to the surrounding properties at the new site location. Each piece of equipment was run and measured separately at a distance of 25'. The measurements and equipment descriptions are provided in the following table.

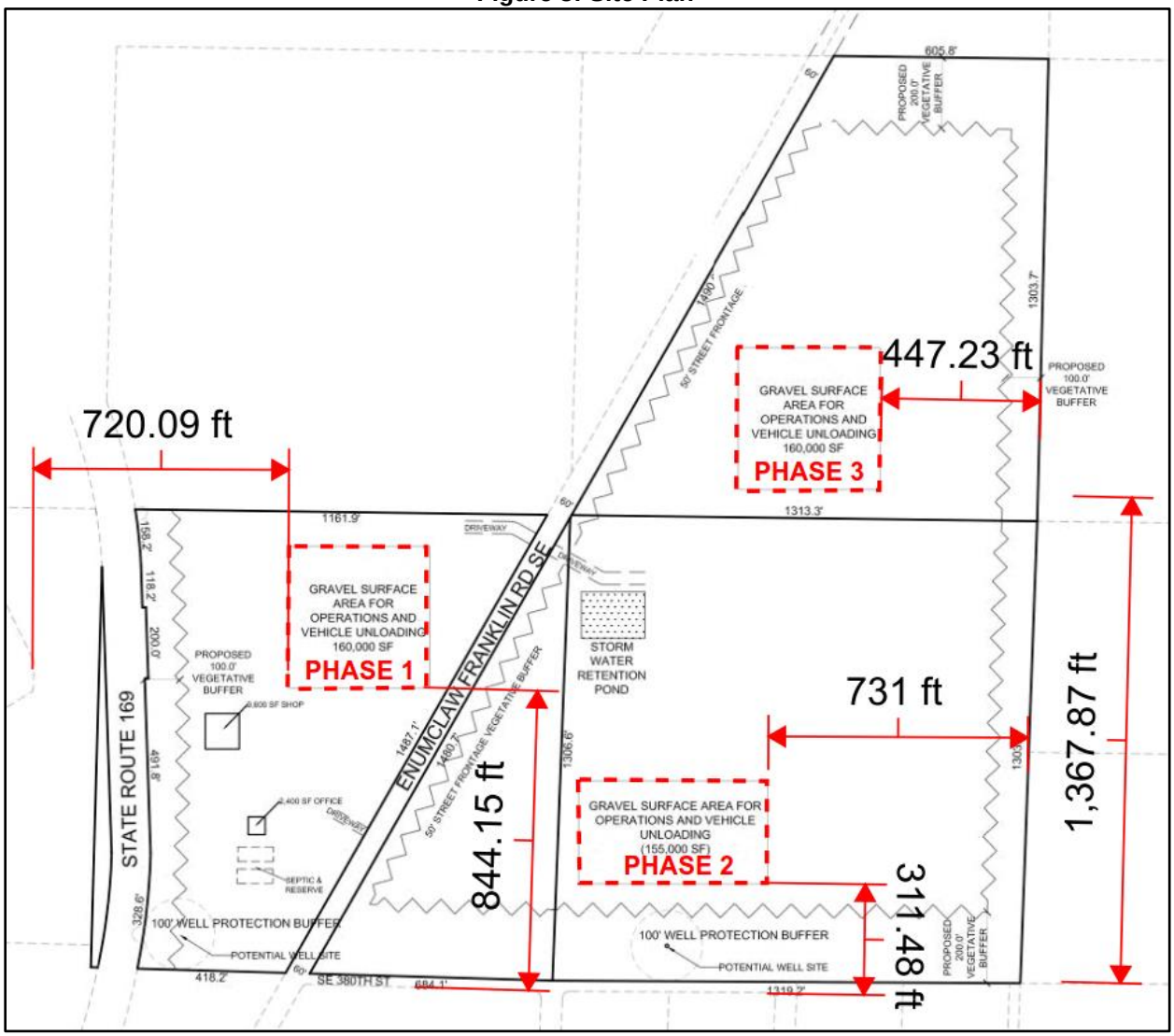
Table 6: Reference Sound Pressure Levels of Equipment @ 25 feet, dBA

Equipment Description	Leq @ a Distance of 25'
Diamond Z 1463 Stump Grinder	93 dBA
Retech Prospector Trammel Screen	84 dBA
John Deere 750C Dozer	83 dBA
Case Front Loader 1221E	78 dBA
Hitachi EX200 Excavator	76 dBA
John Deere 790E Excavator	76 dBA
Linkbelt LX330 Excavator	76 dBA
Total Noise Level from All Equipment Operating at Once	**95 dBA**

VI. PREDICTED SOUND LEVELS AT PROPERTY LINES FROM EQUIPMENT

Based on measured noise levels of each proposed piece of equipment listed in Table 6, we have calculated the noise impact on the adjacent property lines using the sum of all equipment noise levels. This represents the worst-case scenario for noise exposure in order to be conservative. Figure 5 below shows the approximate distances to the nearest adjacent property lines for each of the three phases.

Figure 3: Site Plan



Tables 7 - 9 show our calculation for predicted noise levels to the nearest property lines from the Phase 1 - 3 areas (as shown in Figure 5 above). The following describes these adjacent properties for each phase.

Phase 1 Adjacent Properties:
South: Existing residences with 200' vegetation buffer approximately 844 feet away.
West: Existing residences on the opposite side of SR-169 with 200' vegetation buffer approximately 720 feet away.
North: Undeveloped land not a concern.
East: Existing residences are far enough away to not be a concern.

Phase 2 Adjacent Properties:
South: Existing residences with 200' vegetation buffer approximately 311 feet away.
West: Existing residences are far enough away to not be a concern.
North: Undeveloped land not a concern.
East: Existing residences with 100' vegetation buffer approximately.

Phase 3 Adjacent Properties:
South: Existing residences.
West: Existing residences are far enough away to not be a concern.
North: Undeveloped land not a concern.
East: Existing residences with 100' vegetation buffer.

Table 7: Predicted Equipment Noise Levels at Nearest Property Lines from Phase 1 Area

Line	Application Factors (Phase 1 Area)	South PL	West PL	North PL	East PL
1	Sum of all Equipment Noise Levels (dBA). (Decibel Addition)	95	95	NA	95
2	Distance Factor (DF) for nearest property lines (dBA). Inverse-Square Law (Free Field): DF = 20*log (d1/d2)	-30 (808 ft)	-29 (716 ft)	--	-37 (1,717 ft)
3	Attenuation from vegetation buffer (dBA).	-12 (200 ft)	-12 (200 ft)	--	-9 (150 ft)
4	New equipment Sound Pressure Level at receivers. (Add lines 1 – 3)	**53 dBA**	**54 dBA**	**--**	**49 dBA**

As shown in Table 7, the noise levels at the Phase 1 Area are are predicted to exceed the 49 dBA daytime noise limit at the property lines to the south and west by approximately 4-5 dBA. Based on Table 3, this is considered a "slight impact". The equipment is expected to meet at the properties that lie to the east.

Table 8: Predicted Equipment Noise Levels at Nearest Property Lines from Phase 2 Area

Line	Application Factors (Phase 2 Area)	South PL	West PL	North PL	East PL
1	Sum of all Equipment Noise Levels (dBA). (Decibel Addition)	95	95	NA	95
2	Distance Factor (DF) for nearest property lines (dBA). Inverse-Square Law (Free Field): DF = 20*log (d1/d2)	-21 (279 ft)	-36 (1,550 ft)	--	-29 (731 ft)
3	Attenuation from vegetation buffer (dBA).	-12 (200 ft)	-15 (250 ft)	--	-6 (100 ft)
4	New equipment Sound Pressure Level at receivers. (Add lines 1 – 3)	**62 dBA**	**47 dBA**	**--**	**60 dBA**

As shown in Table 8, the noise levels at the Phase 2 Area are are predicted to exceed the 49 dBA daytime noise limit at the property lines to the south and east by approximately 11-12 dBA. Based on Table 3, this is considered a "serious impact". The equipment is expected to meet at the properties that lie to the west.

Table 9: Predicted Equipment Noise Levels at Nearest Property Lines from Phase 3 Area

Line	Application Factors (Phase 3 Area)	South PL	West PL	North PL	East PL
1	Sum of all Equipment Noise Levels (dBA). (Decibel Addition)	95	95	NA	95
2	Distance Factor (DF) for nearest property lines (dBA). Inverse-Square Law (Free Field): DF = 20*log (d1/d2)	-35 (1,376 ft)	-38 (2,066 ft)	--	-25 (447 ft)
3	Attenuation from vegetation buffer (dBA).	-12 (200 ft)	-15 (250 ft)	--	-6 (100 ft)
4	New equipment Sound Pressure Level at receivers. (Add lines 1 – 3)	**48 dBA**	**45 dBA**	**--**	**64 dBA**

As shown in Table 9, the noise levels at the Phase 3 Area are are predicted to exceed the 49 dBA daytime noise limit at the property lines to east by approximately 15 dBA. Based on Table 3, this is considered a “serious impact”. The equipment is expected to meet at the properties that lie to the south and the west.

These noise exceedances are primarily due to the Diamond Z Stump Grinder equipment which is 93 dBA alone. It will be necessary to mitigate equipment noise to comply at the property lines. In general, it will be necessary to move the equipment farther from the property lines to allow for more distance attenuation. Other methods of mitigation must also be implemented such as earth berms. These recommendations will be provided in a separate report.

VII. PREDICTED SOUND LEVELS AT PROPERTY LINES FROM HEAVY TRUCKS

The proposed BRC site will have hauling vehicles entering and leaving the site to drop off or pick up materials by way of Enumclaw Franklin Road SE. Traffic studies have been conducted which indicate that the Daily Traffic Volume (AWDT) for the BRC site is estimated to be 164 vehicle trips per day entering and leaving the site. Large or heavy trucks are expected to make up 20 percent of project traffic. According to the study the peak number of vehicles per hour is 22 vehicles entering and exiting the site. Therefore, the number of large or heavy trucks that will potentially be entering and leaving the site per hour is 4 – 5. According to BRC the site can support up to 4 large heavy trucks at one time. Therefore, our evaluation will use the sum noise level of 4 trucks.

Noise resulting from trucks and other vehicles not located on the project site is not covered by King County and Washington Administrative Code. However, when vehicles are located within project boundaries they are subject to the limits established under WAC 173-60. Traffic related noise impacts due to changes in operations can be evaluated based on the level of change in sound level and the level considered acceptable for the type of land use. These criteria are described in Washington State Department of Transportation's (WSDOT) guidelines for noise levels and the FHWA CFR Title 23 Part 772. For this project, considering impacts to residential properties, activity category B is assumed applicable.

The average noise levels from heavy or large trucks is shown in Table 10 below. These

Table 10: Reference Sound Pressure Levels of Heavy Trucks @ 25 feet, dBA

Equipment Description	Leq @ a Distance of 25'
Single Heavy Truck / Dump Truck operating on site	80 dBA
Total dBA from maximum of 4 trucks operating on site at one time	**86 dBA**

Tables 11 - 13 show our calculation for predicted noise levels to the nearest property lines from the Phase 1 - 3 areas (as shown in Figure 5) for large or heavy trucks entering and leaving the site. The noise levels were calculated by using the distance from the phased areas to the property lines, since these areas are expected to have truck activity for loading and unloading. This represents the worst case scenario for heavy truck noise.

Table 11: Predicted Heavy Truck Noise Levels at Nearest Property Lines from Phase 1 Area

Line	Application Factors (Phase 1 Area)	South PL	West PL	North PL	East PL
1	Sum of all Equipment Noise Levels (dBA). (Decibel Addition)	86	86	NA	86
2	Distance Factor (DF) for nearest property lines (dBA). Inverse-Square Law (Free Field): DF = 20*log (d1/d2)	-30 (808 ft)	-29 (716 ft)	--	-37 (1,717 ft)
3	Attenuation from vegetation buffer (dBA).	-12 (200 ft)	-12 (200 ft)	--	-9 (150 ft)
4	New equipment Sound Pressure Level at receivers. (Add lines 1 – 3)	**44 dBA**	**45 dBA**	**--**	**40 dBA**

As shown in Table 11, the noise levels at the Phase 1 Area are are predicted to comply with the 49 dBA daytime noise limit at all property lines.

Table 12: Predicted Heavy Truck Noise Levels at Nearest Property Lines from Phase 2 Area

Line	Application Factors (Phase 2 Area)	South PL	West PL	North PL	East PL
1	Sum of all Equipment Noise Levels (dBA). (Decibel Addition)	86	86	NA	86
2	Distance Factor (DF) for nearest property lines (dBA). Inverse-Square Law (Free Field): DF = 20*log (d1/d2)	-21 (279 ft)	-36 (1,550 ft)	--	-29 (731 ft)
3	Attenuation from vegetation buffer (dBA).	-12 (200 ft)	-15 (250 ft)	--	-6 (100 ft)
4	New equipment Sound Pressure Level at receivers. (Add lines 1 – 3)	**53 dBA**	**35 dBA**	**--**	**51 dBA**

As shown in Table 12, the noise levels from heavy trucks at the Phase 2 Area are are predicted to exceed the 49 dBA daytime noise limit at the property lines to the south and east by approximately 2-4 dBA. Based on Table 3, this is considered a “slight impact”. Heavy trucks are expected to meet at all other property lines.

Table 13: Predicted Heavy Truck Noise Levels at Nearest Property Lines from Phase 3 Area

Line	Application Factors (Phase 3 Area)	South PL	West PL	North PL	East PL
1	Sum of all Equipment Noise Levels (dBA). (Decibel Addition)	86	86	NA	86
2	Distance Factor (DF) for nearest property lines (dBA). Inverse-Square Law (Free Field): DF = 20*log (d1/d2)	-35 (1,376 ft)	-38 (2,066 ft)	--	-25 (447 ft)
3	Attenuation from vegetation buffer (dBA).	-12 (200 ft)	-15 (250 ft)	--	-6 (100 ft)
4	New equipment Sound Pressure Level at receivers. (Add lines 1 – 3)	**39 dBA**	**33 dBA**	**--**	**55 dBA**

As shown in Table 13, the noise levels at the Phase 3 Area are are predicted to exceed the 49 dBA daytime noise limit at the property line to east by approximately 6 dBA. Based on Table 3, this is considered a “significant impact”. Heavy trucks are expected to meet at all other property lines.

Certain events such as the slamming of dump truck gates can cause impact noise that can be as high as 100 dBA at 25 feet for a few seconds. Therefore, it will be important to instruct drivers not to do so with posted signage.

VIII. SUMMARY

This concludes our environmental noise impact evaluation of the proposed new site for the Buckley Recycling Center in Enumclaw, WA. It will be necessary to adopt additional noise mitigating measures for reducing noise impact to the receiving property lines.

For the purpose of our evaluation, we used the worst-case scenario for noise, by basing our noise predictions on the sum noise levels of all equipment operating at once, based on BRC's request. This will not be the typical scenario for noise but it is possible from time to time. Using a "worst-case scenario" prediction model is also beneficial to BRC so they know that our recommended mitigation will apply to even the busiest times.

Recommendations for mitigation will be provided in a separate report. The following can be concluded from this evaluation:

1. The predicted noise levels are expected to have an impact on at the nearby residential receiver properties.

2. Phase 1 area noise levels from equipment exceed the daytime noise limits at the west and south property lines as established by the KKC 12.88. Mitigation will be required.

3. Phase 2 area noise levels from equipment exceed the daytime noise limits at the east and south property lines as established by the KKC 12.88. Mitigation will be required.

4. Phase 3 area noise levels from equipment exceed the daytime noise limits at the east property line as established by the KKC 12.88. Mitigation will be required.

5. Phase 1 area noise levels from large heavy trucks meets the daytime noise limits at the west and south property lines as established by the KKC 12.88.

6. Phase 2 area noise levels from large heavy trucks exceeds the daytime noise limits at the south and east property lines as established by the KKC 12.88. Mitigation will be required.

7. Phase 3 area noise levels from large heavy trucks exceeds the daytime noise limits at the east property lines as established by the KKC 12.88. Mitigation will be required.

8. Truck drivers should be instructed to avoid slamming dump truck gates.

IX. APPENDIX: DESCRIPTORS

Sound is measured as a sound level in units of decibels (dB). Environmental sound as with most sound is measured as an A-weighted sound level (dBA). The A-weighting is a standard frequency weighting system based on the sensitivity of human hearing at various frequencies, particularly the greater sensitivity at mid and high frequency compared to lower frequencies.

People normally experience sound levels between 30 and 90 dBA. The lower level may be associated with a quiet bedroom or office and the higher value a loud vehicle, radio or power tool. Normal conversation has a noise level between 50 and 60 dBA.

Each 10 dB increase in sound level corresponds to a tenfold increase in sound energy but is judged by a listener as approximately a doubling of loudness. The smallest discernable changes in sound level are 2 to 3 dB. Changes of 5 dB are clearly noticeable.

Table 14

Change in Sound Level (dB)	Change in Apparent Loudness
1	Imperceptible (except for tones)
3	Just barely perceptible
5	Clearly noticeable
10	About twice (or half) as loud
20	About 4 times (or one-forth) as loud

Sound levels from two or more sources are combined using logarithmic addition, not by directly adding the levels. When two levels are combined, the louder level dominates. For instance, when 50 dBA is combined with 50 dBA the result is 53 dBA. However, when 50 dBA is combined with 40 dBA the result is 50.4 dBA, a negligible difference in terms of environmental noise.

Normally, sound levels increase the closer the receiver is to the noise source. The amount of sound level reduction with distance can be predicted based on the physical dimensions of the source and the distance to the listener. For small sources, sound levels decrease by 6 dB for every doubling of distance. For instance, if the sound level 50 feet from a source is 60 dBA, the sound level 100 feet from the source will be approximately 54 dBA.

Other factors may affect the sound level from a source at a particular listener including the presence of hills, berms and other barriers, and trees and ground foliage located between the source and listener.

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

Decibel
A basic metric for describing the amplitude of sound. A division of a uniform scale based on 10 times the logarithm to the base 10 of the relative value being compared to a reference value.

A-Weighting Decibel (dBA)
The A-weighting system is a specific filter that corresponds to the frequency response of the human ear.

Equivalent Sound Level (Leq)
This 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 event. The Leq is typically used as an approximation to the average sound level for the purpose of code compliance.