Michael Minor & Associates
Sound . Vibration . Air
4923 SE 36th Avenue
Portland, Oregon 97202
503.220.0495 ~ fax 866.847.0495

Prepared for:	Jennifer Saugen, PE Perteet Inc.
Prepared by:	Melinda Cordasco, Noise Analyst Michael A. Minor, Principal
Date:	July 23, 2025
Subject:	Type 1 Noise Analysis Review
Project:	Nason Creek SR 207 Roadway Realignment Project

This memorandum was prepared to provide a Noise Analysis Review for the Nason Creek SR 207 Roadway Realignment Project being conducted by the Yakama Nation Fisheries. The analysis follows the Federal Highway Administration (FHWA) requirements from the United States Code of Federal Regulations (CFR) Part 772 (23 CFR Part 772), *Procedures for Abatement of Highway Traffic Noise and Construction Noise*, July 2010, and the Washington State Department of Transportation (WSDOT), *2020 Traffic Noise Policy and Procedures*, WSDOT, March 2020. These regulations are required to be followed for all federally funded roadway and highway projects. Under these policies, a noise analysis is only required for projects that meet the definition of a Type 1 project as defined below.

The purpose of this analysis is to determine if this Project meets the Federal Highway Administration (FHWA) and Washington State Department of Transportation (WSDOT) requirements for a Type 1 noise analysis. If the Project is not a Type 1 project, then it is unlikely to result in a perceptible change in traffic noise levels at noise-sensitive receivers in the Project area, and no noise analysis is required under FHWA or WSDOT policy. There are no other requirements for noise studies under FHWA and WSDOT policy that are applicable to this Project.

Provided in this memorandum are a Project description, figures showing the proposed Project, FHWA and WSDOT criteria for Type 1 projects, and a review of this Project under the Type 1 criteria. An introduction to traffic noise and acoustics is provided in Appendix A.

Project Description

Yakama Nation Fisheries (YNF) has partnered with the Washington State Department of Transportation (WSDOT)and the US Forest Service (USFS) to address on-going aquatic habitat and roadway infrastructure degradation along State Route 207 from mileposts 0.00 and 1.00 paralleling Nason Creek between river miles 3.2 and 4.6, in Chelan County, Washington. In this area State Route 207 aggressively constricts the historic floodway of Nason Creek, and seasonal flooding routinely damages the highway and causes impairment to salmon habitat within Nason Creek. To address these issues, YNF and WSDOT have developed a highway realignment project for the most impacted segment of SR 207. The proposed realignment begins approximately 1,400 ft north of the intersection with US Highway 2. It would shift a portion of the 2-lane highway east of the existing roadway and reconnect to the existing highway approximately 4,430 feet north of the intersection with US Highway 2. An overview of the Project is found in Figure 1.

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Figure 1. Nason Creek SR 207 Roadway Realignment Project Overview

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FHWA Type 1 Noise Analysis Considerations

Per FHWA and WSDOT regulations, any highway project receiving federal funds must be subject to a noise analysis if it meets any of the following criteria characterizing it as a Type 1 project:

1. The construction of a highway on a new location;
2. The physical alteration of an existing highway where there is either:

    a. Substantial Horizontal Alteration. A project that halves the distance between the traffic noise source and the closest receptor between the existing condition to the future build condition; or
    b. Substantial Vertical Alteration. A project that removes shielding, therefore exposing the line-of-sight between the receptor and the traffic noise source. This is done by either altering the vertical alignment of the highway or by altering the topography between the highway traffic noise source and the receptor;

3. The addition of a through-traffic lane(s). This includes the addition of a through-traffic lane that functions as a high-occupancy vehicle (HOV) lane, high-occupancy toll (HOT) lane, bus lane, or truck climbing lane;
4. The addition of an auxiliary lane, except when the auxiliary lane is a turn lane;
5. The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange;
6. Restriping existing pavement for the purpose of adding a through-traffic lane or an auxiliary lane; or
7. The addition of a new or substantial alteration of a weigh station, rest stop, rideshare lot, or toll plaza.

If a project is determined to be a Type 1 project, then the entire project corridor is a Type 1 project, not just the section or portion of the project that meets the above requirements.

The first question that must be answered is whether the proposed Project qualifies as a Type 1 project. To accomplish this task, the entire corridor was reviewed for any vertical or horizontal realignment that meets the criteria provided above. The results of the review and the Type 1 analysis figures are provided in the following section.

FHWA Type 1 Review: Nason Creek SR 207 Roadway Realignment Project

A review of the Project corridor was performed to determine whether the Project met any of the criteria that would require a Type 1 noise analysis. Of the seven Type 1 criteria listed above, the Project did not meet criteria numbers 1, 3, 4, 5, 6, and 7 based on the Project design drawings. The Project was reviewed to determine if it met the criteria for modifications to the horizontal or vertical roadway alignments.

Vertical Alignment

According to the Project design drawings, the roadway surface will not have sufficient change that will result in exposing the line-of-sight between any nearby receptors and the traffic noise source. Therefore, the Project does not meet the criterion for modifications to the vertical alignment.

Horizontal Alignment

The next step in the evaluation is a review of the corridor to identify locations that would be most likely to meet the FHWA Type 1 criterion for modifications to the horizontal alignment. Using CAD files with recent reference aerial photos, detailed measurements were taken from the identified locations to the nearest travel lane with and without the proposed Project.

Two representative residential locations were selected for this analysis. The two residential locations selected are the most likely locations to meet the FHWA Type 1 criterion, and therefore can be used for a review of the entire project corridor. As required by WSDOT and FHWA regulations, the locations used for the analysis at the property must be where frequent exterior activity is likely, and includes back yards, decks, and other areas where frequent outdoor activity may occur (e.g., backyards).

The measurements at the selected locations represent the worst-case distances at two nearby residences along the east side of the proposed realignment where the roadway would move closer to the residences. These analysis locations are denoted as M-1 and M-2 and are shown on Figure 2. Distance measurements are taken from the edge of the nearest travel lane to a noise analysis site.

The two worst-case analysis locations were evaluated to determine if the Project roadway realignment would move the nearest travel lane at least half the distance closer to the exterior use at each of the properties and, therefore, would meet the FHWA and WSDOT criterion requiring a Type 1 noise analysis. Table 1 provides the results of the measurements and evaluation. As shown in Table 1, the proposed realignment does not reduce the distance between any noise-sensitive properties and the proposed roadway by at least half the distance between the existing properties and existing roadway. Therefore, the Project fails to meet the Type 1 criterion for modifications to the horizontal alignment and a noise analysis is not required.

Table 1. FHWA Type 1 Horizontal Distance Measurements and Analysis					
Analysis Site Number	**Current Distance[1] (ft)**	**Distance with Project[2] (ft)**	**Change in Distance[3] (ft)**	**Half Current Distance[4] (ft)**	**Current Distance Reduced by Half or More**
M-1	283	208	75	141.5	No
M-2	330	203	127	165	No

Notes:

[1] Current Distance = Distance between the noise-sensitive property and the existing nearest travel lane.

[2] Distance with Project = Distance between the noise-sensitive property and the proposed nearest travel lane.

[3] Change in Distance = Difference (in feet) between the current distance and the proposed distance with the Project.

[4] Half Current Distance = the minimum distance that the proposed nearest travel lane would have to be realigned to meet the FHWA criteria requiring a Type 1 noise analysis.

Conclusion

Based on a review of the Project design and noise-sensitive properties in the corridor, the proposed Project does not meet the FHWA and WSDOT criteria that would require a noise analysis and, therefore, no detailed noise analysis was performed. Because the Project is not a Type 1 project, it is unlikely to result in a perceptible change in traffic noise levels at the noise-sensitive receivers in the Project area.

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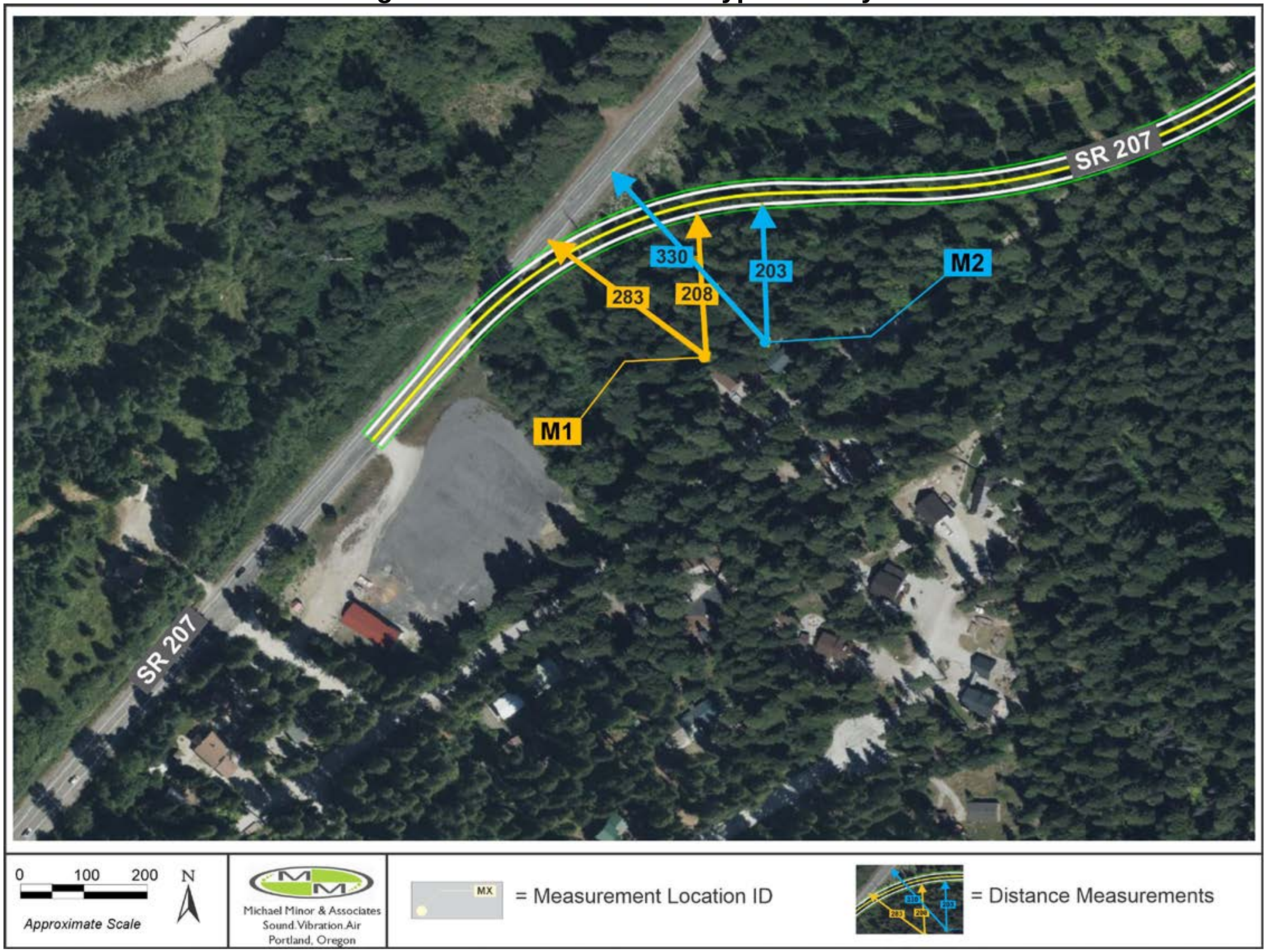
Figure 2. Site M-1 and M-2 Type 1 Analysis



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References

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Washington State Department of Transportation. 2020 Traffic Noise Policy and Procedures. WSDOT. March 2020.

Appendix A: Introduction to Acoustics

Sound is defined as any pressure variation that the human ear can detect, from barely perceptible sounds to sound levels that can cause hearing damage. The magnitude of air pressure variation from static (or normal) air pressure is a measure of the sound level. The number of cyclic pressure variations per second is the frequency of sound. When sounds are unpleasant, unwanted, or disturbingly loud, they tend to be classified as noise.

Compared with static air pressure, audible sound pressure variations range from the threshold of hearing: a very small 20 micro-Pascal (0.000020 Pascal, or commonly noted as 20 x 10-6 Pascal) up to 100 Pascal, a level so loud it is referred to as the threshold of pain. Because the ratio between these numbers is more than a million to one, using Pascal to describe sound levels can be awkward. The decibel (dB) measurement is a logarithmic conversion of air pressure level variations from Pascal to a unit of measure with a more convenient numbering system. This conversion not only allows for a more convenient scale, but it is also a more accurate representation of how the human ear reacts to variations in air pressure. Measurements made using the decibel scale are denoted dB.

In acoustic measurements, where the primary concern is the effect on humans, an “A”-weighted filter is normally used to compensate for the sound level readings. The A-weighted filter accounts for the limited hearing response that people have in the upper and lower frequency bands. Sound pressure level measurements made using the A-weighted filter are denoted as dBA. The A-scale is used in most ordinances and standards, including those standards applicable to this project.

The noise metric commonly used for the analysis of highway projects is the equivalent sound pressure level, Leq. The Leq is defined as the energy average noise level for a stated time period (for example, hourly). Other commonly used noise descriptors include the Lmax, the maximum sound level over a specified measurement period, and the Lmin, the lowest noise level over a specified measurement period.

Finally, the statistical noise metrics, denoted as Lxx, where “xx” indicates a percentage of time, are used to determine how long the noise levels are at or above a specific level. For example, the L10 is the sound level that is exceeded 10 percent of the time, or during a 1-hour measurement. An L10 of 85 dBA means the sound level was at or above 85 dBA for 6 minutes of that hour. Commonly used Lxx values include L2.5, L8.3, and L25. These statistical noise metrics correspond to the 5-, 10-, and 15-minute time levels for a 1-hour measurement period and coincide with the Washington state noise criteria discussed later in this report. Brief definitions and symbols for each of these noise metrics are given in Table X-1.

Table A-1. Noise Descriptors and Definitions

Leq	The average noise level, on an energy basis, over the measurement period, typically 1 hour
Lmax	The maximum noise level over the measurement period
Lmin	The minimum noise level over the measurement period
Lxx	The noise level that is equaled or exceeded for "x" percent of the time over the measurement period

It is also important to remember that when describing the magnitude of a noise source it will be stated in terms of sound level, with acoustic weighting and measurement metric. For example, the measured noise level was 70 dBA Leq. If no metric is listed, then the noise level presented is typically the instantaneous measured noise level, usually presented in a second-by-second manner. For example, the noise levels ranged from 50 to 60 dBA. Finaly, when describing a change in noise levels, it is provided in terms of the change in decibels; for example, the barrier reduces the noise levels by 10 dB (not dBA Leq).

Perception of Noise and Typical Noise Levels

For a sense of perspective, normal human conversation ranges between 44 dBA (quiet conversation) and 65 dBA (typical conversation) when people are about 3 to 6 feet apart. In most neighborhoods, nighttime noise levels are noticeably lower than daytime noise levels. In a quiet rural area at night, noise levels from crickets or winds rustling leaves on the trees can range between 35 and 40 dBA. As residents start their day and local traffic increases, the same rural area can have noise levels ranging from 50 to 60 dBA. While noise levels in urban neighborhoods are louder than rural areas, they share the same pattern of lower noise levels at night than during the day. Quiet urban nighttime noise levels range from 40 to 50 dBA. Noise levels during the daytime in a noisy urban area and near most major highways, like I-5 or I-90, are frequently as high as 65 to 80 dBA.

Perceptions of changes in traffic noise levels for an average person start 3 dB, the smallest noise-level change detectable by an average human ear. A 5 dB change in noise levels are clearly noticeable, and an increase of 10 dB is roughly equivalent to a doubling in the perceived sound level to the typical person. Or, conversely, a 10 dB reduction is typically perceived as a halving of the noise level and is considered a signification reduction in noise levels. Table A-2 provides a listing of some common noise sources and compares their relative loudness to that of an 80 dBA source, such as a heavy truck at 30 mph, a garbage disposal or food blender.

Table A-2. Sound Levels and Relative Loudness of Typical Noise Sources

Noise Source or Activity	Sound Level (dBA)	Subjective Impression	Relative Loudness (human judgment of different sound levels)
Jet aircraft takeoff from carrier (50 feet)	140	Threshold of pain	64 times as loud
50-horsepower siren (100 feet)	130		32 times as loud
Loud rock concert near stage, Jet takeoff (200 feet)	120	Uncomfortably loud	16 times as loud
Float plane takeoff (100 feet)	110		8 times as loud
Jet takeoff (2,000 feet)	100	Very loud	4 times as loud
Heavy truck or motorcycle (25 feet)	90		2 times as loud
Heavy Truck at 30 mph at 50 feet **Garbage disposal, food blender (2 feet)**	**80**	**Moderately loud**	**Reference loudness**
Vacuum cleaner (10 feet) Passenger car at 65 mph (25 feet)	70		1/2 as loud
Large store air-conditioning unit (20 feet)	60		1/4 as loud
Light auto traffic (100 feet)	50	Quiet	1/8 as loud
Bedroom or quiet living room	40		1/16 as loud
Quiet library, soft whisper (15 feet)	30	Very quiet	
High quality recording studio, Alaskan wilderness	20		
Acoustic test chamber	10	Just audible	
	0	Threshold of hearing	
Sources: Michael Minor & Associates, Inc.			

Factors Affecting Noise Levels and Propagation From the Source to the Receiver

Noise sources associated with transportation projects can include passenger vehicles, medium trucks, heavy trucks, motorcycles, and buses. Each of these vehicles produces noise; however, the source and magnitude of the noise can vary greatly depending on vehicle type, volume of traffic and the travel speeds. For example, while the noise from passenger vehicles occurs mainly from the tire-roadway interface and is therefore located very near to ground level, noise from heavy trucks is produced by a combination of noise from tires, engine, and the 10 to 12 foot tall exhaust stack, resulting in a noise source that is approximately six to eight feet above the ground.

Noise from vehicles increases with the speed at a rate factor of approximately 3 dB for each 10 mph of speed. Therefore, increasing speeds from 45 mph to 55 mph would increase the total noise by 3 dB. Conversely, a reduction of speed can also decrease the overall noise levels. Note that the 3 dB rule is most accurate once speeds are above 25 to 30 mph. Below 30 mph noise levels are governed mainly by acceleration and engine noise and vary little with speed.

Changes in traffic volumes also follow a 3 dB rule. For example, maintaining the travel speed and vehicle mixture, it takes a doubling of the traffic volumes to increase noise levels by 3 dB. Conversely, if volumes are cut in half, the noise levels would be reduced by approximately 3 dB.

There are also several factors that determine how sound levels decrease over a distance. Under ideal conditions, a point noise source in free space will attenuate at a rate of 6 dB each time the distance from the source doubles (using the inverse square law). An ideal line source (such as constant flowing traffic on a busy highway) reduces at a rate of approximately 3 dB each time the distance doubles. Under real-life conditions, however, interactions of sound waves with the ground often result in attenuation that is slightly higher than the ideal reduction factors given above. Other factors that affect the attenuation of sound with distance include existing structures, topography, foliage, ground cover, and atmospheric conditions, such as wind, temperature, and relative humidity.

Structures, existing hills, berms, and other surface features between the noise source and receiver location can reduce noise by physically blocking the sound transmission. Dense foliage and ground cover between the receiver and the noise source can also affect noise transmission. For example, sound will travel very well across reflective surfaces such as water and pavement but can be attenuated when the ground cover is field grass or an undeveloped area with dense foliage. However, in most cases, receivers within 100 to 300 feet of the highway will experience a minimal overall effect on the transmission of noise from foliage or ground cover, wind, temperature, or humidity.

Summary of Facts to Remember When Reviewing Traffic Noise Studies

The following list contains some of the most notable acoustic properties to remember when reviewing this noise analysis:

- The unit used to measure noise (sound) is the decibel, which is a conversion of the change in air pressure to a more convenient scale, denoted as dB.
- Because the human ear is less sensitive to lower and higher frequencies, a weighting scale was developed called A-Weighting, which is used for virtually all noise measurements, and is denoted as dBA.
- The minimum noise level during a measurement period is denoted Lmin, while the maximum noise level is denoted Lmax.
- The equivalent sound level (Leq) is the level of a constant sound for a specified period of time that has the same sound energy as an actual fluctuating noise over the same period of time. It is an energy average sound level and used in most noise ordinances, including those applicable to this noise study.
- Normal human conversation ranges between 44 and 65 dBA when people are about 3 to 6 feet apart.
- A 3 dB change in traffic noise is the minimum most people will notice in most urban environments and a 5 dB change in noise levels is perceptible to virtually everyone. A 10 dB increase is perceived as an approximate doubling of the loudness of the sound and represents a substantial change in loudness. Conversely, a 10 dB reduction in noise is perceived as half as loud and a substantial reduction in noise.
- Traffic noise on a busy highway is considered a line source and is reduced by 3 dB per doubling of distance. Therefore, 73 dBA at 50 feet would reduce to approximately 70 dBA at 100 feet.
- While solid structures and hillsides can result in measurable reductions in noise levels, under most conditions, foliage, ground cover, wind, temperature, or humidity will have little to no effect on the transmission of noise for receivers within 300 feet of the highway.