Appendix O
Noise Impact Analysis

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Chehalis River Basin Flood Damage Reduction Project

NEPA Environmental Impact Statement

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APPENDIX O: NOISE IMPACT ANALYSIS

Noise and Vibration Concepts and Terminology

Noise and vibration may mean different things to different readers. However, from a regulatory perspective, these terms are defined as quantitative measures of human activity.

Sound is measured in decibels (dB). The sensitivity of the human ear to sound depends on the frequency (or pitch) of the sound, and some people hear some frequencies better than others. To address normal variations in human hearing, noise measurement readings can be adjusted based on a relative scale (referred to as the A-weighted decibel [dBA]). More specifically, the dBA measures sound reflective of how the average human ear responds to sound; the range of human hearing typically ranges from 0 dBA (the threshold of hearing) to about 140 dBA (the threshold for pain). Regulatory agencies use dBA to measure sound and consider the land use and time of day in determining acceptable noise levels (DOH 2019). Acceptable noise levels during the day are higher than during the night, and industrial land use in urban areas will have a higher limit than residential land use in urban areas. Noise is measured through the use of several measurements, including the following:

- **Equivalent Sound Level (Leq)** is the constant noise level that would result in the same total sound energy being produced over a given period. It is useful for representing a varying sound source over time as a single number.
- **Maximum Sound Level (Lmax)** is the maximum sound level.

Ground-borne vibration is a technical term to define human-made motions in the ground, as opposed to vibration caused by geological changes such as earthquakes, through the ground. For example, explosions, jackhammers, trains, and heavy trucks can all cause ground-borne vibrations. Ground vibration is measured in terms of peak particle velocity (PPV), which is the maximum velocity experienced by any point in a structure during a vibration event.

Methods

The levels of noise and vibration associated with project activities were assessed using accepted screening tools (models).

Lewis County has adopted the noise standards set by the Washington Department of Ecology (Ecology). Ecology has developed the following three Environmental Designations for Noise Abatement (EDNA) or reduction (Washington Administrative Code [WAC] 173-60-040):

- EDNA A: This designation generally corresponds to residential/recreational areas and uses. Normally acceptable noise levels in EDNA A areas range up to 55 to 60 dBA.
- EDNA B: This designation generally corresponds to commercial uses. Normally acceptable noise levels in EDNA B areas range up to 57 to 65 dBA.

- EDNA C: This designation generally corresponds to industrial and agricultural uses. Normally acceptable noise levels in EDNA C areas range up to 60 to 70 dBA.

Ecology has set noise limits under WAC 173-60-040 that prohibit noise exceeding the maximum permissible noise levels as determined by the EDNA system. However, WAC 173-60-050 establishes the following exemptions:

- Sounds created by blasting are exempt from the provisions of WAC 173-60-040 between the hours of 7:00 a.m. and 10:00 p.m.
- Sounds originating from temporary construction sites as a result of construction activity and sounds originating from forest harvesting and silvicultural activity are exempt from the provisions of WAC 173-60-040, except when such sounds affect EDNA A areas between the hours of 10:00 p.m. and 7:00 a.m.
- Sounds created by motor vehicles, licensed or unlicensed, when operated off public highways are exempt from the provisions of WAC 173-60-040 except when such sounds are received in EDNA A areas.

Construction Noise and Vibration

Noise levels were assessed using the Federal Highway Administration's Roadway Construction Noise Model (RCNM), which can be used to assess noise levels from typical construction equipment (FHWA 2006). The model was used to identify the short-term changes in noise during construction and to determine whether noise levels could affect nearby noise-sensitive land uses. It was assumed that construction workers would employ the use of noise-protective gear, and therefore this analysis considered the effects of noise on people nearby rather than on those constructing the project. Results from the RCNM analysis are included in the tables at the end of this appendix.

Construction activities typically require the use of numerous pieces of noise-generating equipment. These activities would temporarily increase noise levels when they are occurring. Noise levels would change depending on the construction phase, equipment type and duration of use, distance between the noise source and the person hearing it, and presence or absence of noise attenuation barriers. For example, buildings, walls, or other structures can help to reduce the amount of noise that people can hear. Table 1 presents the typical noise level of common construction equipment from a distance of 50 feet. For reference, heavy traffic at 300 feet is 60 dBA, and a gas-powered lawnmower at 100 feet is 75 dBA.

Table 1
Typical Noise Levels of Common Construction Equipment

TYPE OF EQUIPMENT	TYPICAL SOUND LEVEL AT 50 FEET (DBA) LMAX
Blasting	94
Crane	81
Grader	85
Rock drill	81
Dozer	82
Chain saw	84
Pickup Truck	75
Dump truck	76
Generator	70
Concrete batch plant	83
Front-end loader	79
Compactor	83
Backhoe	78

Note:
Source: FHWA 2006

Certain construction activities, such as blasting, construction truck operation, foundation drilling/grouting, material processing, RCC placement, and compaction may cause vibrations. Of these, blasting that is extremely close (within a few feet) has the greatest potential to affect neighboring structures. However, vibrations from construction activities rarely reach levels that damage structures. Typical vibration levels from construction equipment are provided in Table 2.

Table 2
Vibration Velocities for Construction Equipment

EQUIPMENT	PPV AT 25 FEET (INCHES PER SECOND)
Loaded trucks	0.076
Jackhammer	0.035
Large bulldozer	0.089
Small bulldozer/backhoe	0.003

Note:
Source: FTA 2018

The United States Bureau of Mines has established a PPV of 2.0 inches per second at the closest structure to prevent structural damage. However, some buildings, depending on age or construction materials, may be more susceptible to vibration. The construction vibration damage criterion for buildings that are extremely susceptible to vibration damage is a PPV of 0.12 inches per second. This is the strictest PPV vibration threshold established by the Federal Transit Administration.

Operational Noise and Vibration

Operational sources of noise and vibration would be limited mainly to maintenance activities and were qualitatively assessed. The analysis considered the potential for noise from vehicle traffic for employees, facility operation, and maintenance. Vibration associated with operational activities is expected to be minimal and would not cause any damage.

References

DOH (Washington Department of Health), 2019. "Noise and Your Health." Washington State Department of Health.
Accessed at: https://www.doh.wa.gov/CommunityandEnvironment/Noise.

FHWA (Federal Highway Administration), 2006. *Construction Noise Handbook*. Final Report. August 2006. Accessed at: http://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/.

FTA (Federal Transit Administration), 2018. *Transit Noise and Vibration Impact Assessment Manual*. FTA Report No. 0123. Prepared by the John A. Volpe Transportation Systems Center. September 2018. Accessed at: https://www.transit.dot.gov/research-innovation/transit-noise-and-vibration-impact-assessment-manual-report-0123.