3.7 Noise and Vibration

Sound is a fundamental component of daily life. When sounds are perceived as desired, beneficial, or otherwise pleasing, they are typically considered as having a positive effect on daily life. When sounds are perceived as unpleasant, unwanted, or disturbingly loud, they are considered noise. Noise may interfere with a broad range of human activities in a way that degrades public health and welfare, important activities such as communication or sleep. Noise disturbance varies depending on the conditions and on the particular land uses and activities near the sound source and the sensitivity of those land uses.

Vibration is a motion described in terms of displacement, velocity, or acceleration. In contrast to airborne noise, ground-borne vibration is not a phenomenon that most people experience every day because background vibration usually well below the threshold of perception. People are usually sensitive to perceptible vibration. An increase in noise or vibration can affect the peacefulness, serenity, and sacredness of residential, commercial, recreational, and cultural locations.

This section describes noise and vibration in the study area. It then describes impacts on noise and vibration that could result under the no-action alternative or as a result of the construction and routine operation[1] of the proposed action. Finally, this section describes potential measures to mitigate impacts of the proposed action and any remaining unavoidable and significant adverse impacts.

3.7.1 What is the study area for noise and vibration?

The study area for noise and vibration consists of sensitive receptors near the project site that could be affected by noise and vibration from construction and routine operation. The study area also includes sensitive receptors that could be affected during routine rail transport along the Puget Sound & Pacific Railroad (PS&P)[2] rail line and vessel transport through Grays Harbor out to 3 nautical miles from the mouth of the harbor.

3.7.2 What laws and regulations apply to noise and vibration?

Laws and regulations for determining potential impacts on noise and vibration are summarized in Table 3.7-1. More information about these laws and regulations is provided in Appendix B, *Laws and Regulations*.

[1] Chapter 4, *Environmental Health and Safety*, addresses the potential impacts from increased risk of accidents (e.g., storage tank failure, train derailments, vessel collisions) and related consequences (e.g., release of crude oil).
[2] The PS&P rail line refers to the rail line between Centralia and the project site.

Table 3.7-1. Laws and Regulations for Noise and Vibration

Laws and Regulations	Description
Federal[3]	
EPA Railroad Noise Emission Standards (40 CFR 201) and FRA's Railroad Noise Emission Compliance Regulations (49 CFR 210)	Govern railroad noise levels at the source, specify noise level limits for locomotives and rail cars.
State	
Maximum Environmental Noise Levels (WAC 173-060)	Sets standards for permissible noise levels. However, surface carriers engaged in interstate commerce by railroad are exempt from these regulations.
Local	
Hoquiam: Public Noise Nuisances (HMC 3A.30)	Defines local noise ordinances, including those for construction.

EPA = U.S. Environmental Protection Agency; FRA = Federal Railroad Administration; CFR = Code of Federal Regulations; WAC = Washington Administrative Code; HMC = Hoquiam Municipal Code.

3.7.3 How were noise and vibration impacts evaluated?

This section describes the sources of information and methods used to evaluate impacts.

3.7.3.1 Information Sources

Noise-sensitive receptors were identified around the project site and along the PS&P rail line by survey of aerial orthophotography and development of geographic information system (GIS) data.

The following sources of input and information on construction equipment, facility operations, and railroad and vessel operations were incorporated into the analysis.

- Types of anticipated construction equipment.
- Distances from construction activity to residential areas.
- General noise characteristics of onsite operational equipment.
- PS&P line train operational data and number of trips.
- Vessel operational data and number of trips.
- Ambient noise monitoring data collected along the PS&P rail line.

3.7.3.2 Impact Analysis

The methods for the noise and vibration impact analysis are described as follows.

Noise

For construction on site and for rail operations along the PS&P rail line, Federal Railroad Administration (FRA)-adopted noise assessment methods developed by the Federal Transit

[3] No federal regulations are applicable to noise from onsite construction or operation of the proposed action, FRA/FTA noise and vibration analysis methods were used for informational purposes.

Administration (FTA) were used to calculate potential noise impacts. These methods are documented in the *Transit Noise and Vibration Impact Assessment* (FRA/FTA Manual) (Federal Transit Administration 2006). FRA generally relies on this manual for analysis of potential noise impacts from construction activities and the analysis of noise from conventional rail vehicles traveling at speeds below 90 miles per hour (Federal Railroad Administration 2012). To supplement guidance in the FRA/FTA Manual, freight rail source levels from the FRA *High Speed Ground Transportation Noise and Vibration Assessment* were used to characterize noise from freight rail vehicles (Federal Railroad Administration 2012).

Construction noise was assessed using the methods outlined in the FRA/FTA Manual. Construction noise levels for each type of equipment were determined at a distance of 50 feet from the source. These values were compared to the FRA/FTA Manual 30-day construction noise threshold to qualitatively assess the likelihood that construction activities for the proposed action would affect sensitive receptors around the project site.

Per the FRA/FTA Manual, noise impacts from increase rail traffic are determined by the increase in ambient noise level (day-night average sound level [L_{dn}][4] or hourly equivalent sound level [L_{eq}[5]],) depending on the type of receptor). The amount of increase that is acceptable depends on the existing ambient noise level. To establish the existing ambient noise level along the PS&P rail line, ambient noise data were collected during short-term and 24-hour intervals between March 28 and April 27, 2015.

FRA/FTA Manual noise impact criteria are based on the land use category of the receiving properties. The FRA/FTA Manual identifies three land use categories for assessing potential noise impacts.

- **Category 1**: Tracts of land where quiet is an essential element of their intended purpose, such as outdoor amphitheaters, concert pavilions, and national historic landmarks with significant outdoor use.
- **Category 2**: Residences and buildings where people normally sleep, including homes, hospitals, and hotels.
- **Category 3**: Institutional land uses (schools, places of worship, libraries) that are typically available during daytime and evening hours. Other uses in this category can include medical offices, conference rooms, recording studios, concert halls, cemeteries, monuments, museums, historical sites, parks, and recreational facilities.

Noise exposure values are reported as hourly equivalent sound level (L_{eq}[h]) for Category 1 and 3 land uses, and L_{dn} for residential land uses (Category 2).

A GIS survey was conducted to identify noise-sensitive land uses within approximately 500 feet of the PS&P rail line and within 1,000 feet of grade crossings (where the rail line and roadway cross at the same grade; no underpass or overpass) that could be subject to noise impacts from train horns. Although all developed land uses were evaluated, the focus of this study was on outdoor locations with frequent human use and façades of residential buildings where people normally sleep

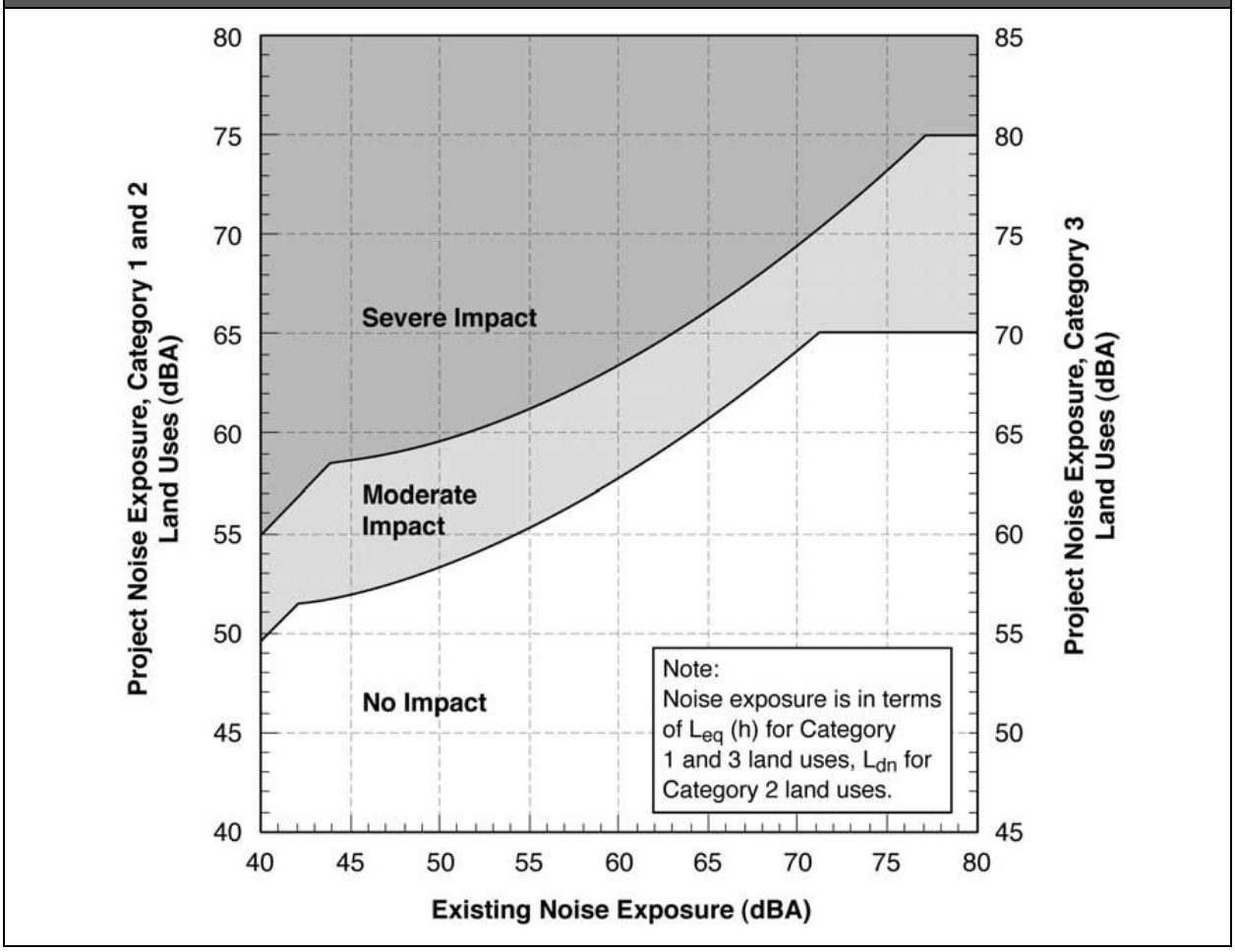
[4] The day-night sound level (L_{dn}) is essentially a 24-hour average noise level (in A-weighted decibels [dBA]) with a 10-decibel upward adjustment of noise levels occurring at night. This adjustment is made to account for most peoples' increased sensitivity to noise at night.

[5] The L_{eq}(h) a noise metric representing a constant sound level containing the same sound energy as the actual fluctuating sound over an hour. As such, the L_{eq} can be considered an energy-average sound level.

(Category 2 land uses). Commercial and industrial land uses were not included because most of these land uses are compatible with higher noise levels.

The FRA/FTA Manual defines two levels of potential impact, *moderate impact* or *severe impact*. The level of impact is determined by the existing level of noise exposure and the change in noise exposure that would result from a proposed action using a sliding scale according to the land uses affected. Noise impacts are assessed by comparing the existing outdoor noise exposure with future project-related outdoor noise levels, as illustrated in Figure 3.7-1. The criterion for each degree of impact is based on a sliding scale that is dependent on the existing noise exposure and noise exposure with the proposed action. As the existing level of noise exposure increases, the additional noise exposure causing a moderate or severe impact decreases.

Figure 3.7-1. FRA/FTA Manual Noise Impact Criteria



Source: Federal Transit Administration 2006.

The noise impact categories are as follows.

- **No impact.** The change in the noise level would result in an insignificant increase in the number of instances where people are highly annoyed by new noise.
- **Moderate impact.** The change in the noise level would be noticeable to most people but may not be enough to cause strong adverse community reactions.

- **Severe impact.** A significant percentage of people would be highly annoyed by the noise.

The contribution of the proposed action relative to the existing noise levels (Figure 3.7-1) would differ according to the level of existing noise exposure. This sliding scale recognizes that people who are already exposed to high levels of noise in the ambient environment are expected to tolerate smaller increases in noise in their community relative to locations with lower existing ambient levels. For example, a proposed action-related exposure of 55 dBA L_{dn} would result in no impact on a receptor with an existing noise exposure of 55 dBA L_{dn}. However, a proposed action-related exposure of 70 dBA L_{dn} would result in a severe impact for a receptor with an existing noise exposure of 70 dBA L_{dn}.

A general assessment-level analysis identified in the FRA/FTA Manual was conducted to compute noise from the increased rail traffic related to the proposed action at maximum throughput. Unlike passenger trains, freight trains do not run on a schedule. U.S. railroads evaluate each situation and dispatch trains based on a number of criteria, including available crew, number of cars, cost of fuel, and overall revenue. For this reason, rail events under the proposed action were assumed to be evenly distributed over a 24-hour day. Rail vehicles were assumed to operate at a speed of 25 miles per hour. Calculated noise levels associated with the proposed action trains were then compared with the moderate impact and severe impact criteria according to the existing ambient conditions recorded for a given sensitive receptor location. FRA/FTA Manual methods were then used to calculate the distances for moderate and severe impacts from the PS&P rail line to locations of moderate and severe impact. Residential structures and associated outdoor use areas in impact zones were counted using GIS analysis methods.

Noise generated from onsite operation of the proposed action was qualitatively compared to noise from existing operations.

Vessel noise levels were estimated by using measurements of vessel noise for both docked vessels and vessels underway. Measured vessel noise levels were extrapolated to distances to sensitive receptors. Calculated vessel noise levels were compared with calculated existing vessel noise levels to determine the relative magnitude of increased noise levels.

Vibration

Data and information provided in the *Transit Noise and Vibration Impact Assessment* (Federal Transit Administration 2006) were used to analyze the potential vibration impacts from construction of the proposed action, routine operations on site, and proposed action rail traffic along the PS&P rail line.

3.7.4 What sensitive receptors are in the study area?

This section provides a general description of the noise and vibration sensitive receptors in the study area that could be affected by construction and routine operation of the proposed action. This section describes sensitive receptors located near the project site, along the PS&P rail line, and in and along the shoreline of Grays Harbor.

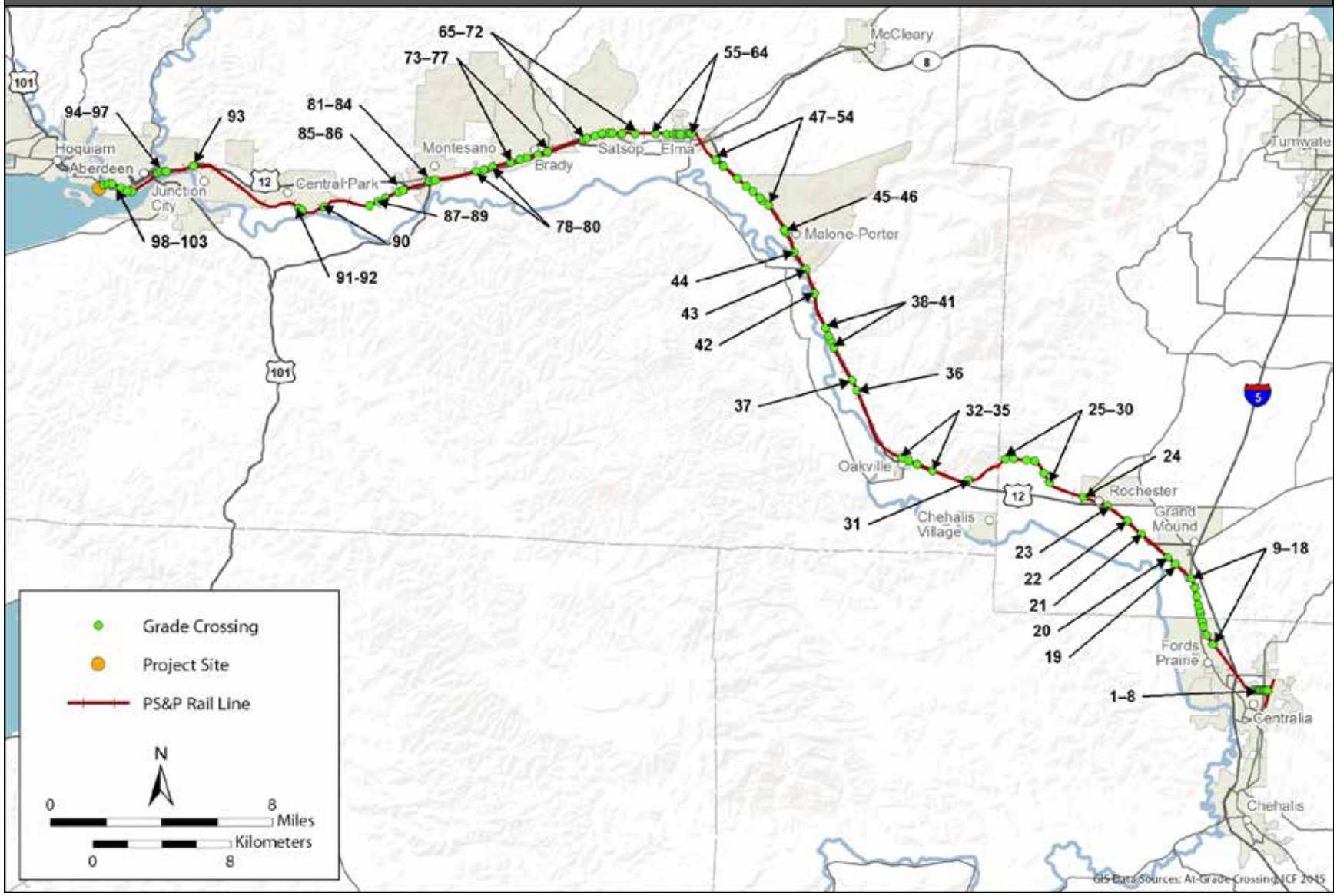
3.7.4.1 Project Site

Sensitive receptors near the project site include residences approximately 1,750 feet northeast from the project site.

3.7.4.2 PS&P Rail Line

The PS&P rail line crosses through several population centers and rural areas with varying densities of sensitive receptors between Centralia and the project site. Locations of grade crossings on the PS&P rail line are shown in Figure 3.7-2.

Figure 3.7-2. PS&P Rail Line Grade Crossings



As described in Section 3.7.3.2, *Impact Analysis*, the focus of this analysis was on residential land uses. Section 3.8, *Land and Shoreline Use*, describes the general land uses along the PS&P rail line. In summary, both the more densely populated areas and rural areas of the PS&P rail line include residential land uses, including residences near grade crossings. The PS&P rail line was subdivided into 10 segments according to land use characteristics and major nearby roadways to assess potential impacts. A summary of the analysis segments and the land use characteristics within each segment is shown in Table 3.7-2.

Table 3.7-2. Analysis Segments and Land Use Characteristics along the PS&P Rail Line[a]

Analysis Segment	Location	PS&P Rail Line Grade Crossing	General Land Use Characteristics	Distance From Rail to Receptor[b]
A	Centralia	1–8	Higher-density single family residential and commercial	45 feet
B	Unincorporated Centralia, Rochester (south of US Route 12)	9–20	Single-family residential and commercial	60 feet
C	Rochester (between US Route 12 and Littlerock Road SW)	21–24	Single-family residential and commercial	100 feet
D	Rochester (west of Littlerock Road SW)	25–30	Single-family residential and commercial	80 feet
E	Oakville	31–42	Lower-density single-family residential and commercial	80 feet
F	Malone-Porter	43–54	Lower-density single-family residential	50 feet
G	Elma-Satsop	55–72	Medium-density single-family residential	45 feet
H	Montesano	73–84	Medium-density single-family residential	45 feet
I	West of Montesano/east of Aberdeen	85–92	Medium-density single-family residential	50 feet
J	Aberdeen	93–103	Single-family residential and commercial	70 feet

[a] Additional information provided in Appendix G, *Noise Data*.
[b] Closest distance of a sensitive receptor from the centerline of the PS&P rail line.

3.7.4.3 Grays Harbor

The nearest sensitive receptor close to vessel activity at the Terminal 1 dock is a residential area approximately 2,900 feet to the northeast. The sensitive receptor (residential area) nearest to the Grays Harbor Navigation Channel is located approximately 1,800 feet away from vessel routes.

3.7.5 What is the existing noise and vibration environment in the study area?

This section describes the existing noise and vibration environment in the study area.

3.7.5.1 Noise

Existing noise sources at the project site are routine operations (including switching operations from the delivery and release of rail cars), operations at adjacent industrial facilities, operations from other industrial facilities in the Port of Grays Harbor area, vehicular traffic from Industrial Road and other nearby roadways, and occasional aircraft overhead. Existing noise sources around the Grays Harbor area includes noise generated by vessel operations, the natural environment including birds, and occasional aircraft overhead.

A field noise study was conducted to characterize existing ambient noise levels at sensitive receptors along the PS&P rail line. Long-term measurement sites were selected to capture daily noise level patterns and statistics continuously over 1-hour intervals. Day-night noise levels in terms of L_{dn} were calculated from hourly sound level data. Short-term measurement locations were selected to supplement the long-term measurements at surrounding land uses. These measurements were 10 minutes in duration and were attended by an observer to characterize noise levels based on audible sources during measurement intervals.

The average noise level ranged from 62 L_{dn} to 81 L_{dn} (Table 3.7-3). The most dominate sources in the study area are wayside and horn noise[6] from rail events on the PS&P rail line, automobile and truck traffic on highways such as Interstate 5, US Route 12 (US 12), and State Route 8 (SR 8), infrequent automobile and truck traffic on local roads, and light industrial noise. A summary of long-term measurements is shown in Table 3.7-3. Technical noise survey reports are included in Appendix G, *Noise Data*.

Table 3.7-3. Noise Levels at Long-Term Monitoring Locations

Location	Analysis Segment	Approximate Distance from PS&P Rail Line Centerline	Range of L_{dn} Values Measured	Average L_{dn} Value	Observed Noise Sources	Time of Measurement
1023 B Street, Centralia	A	50	72 to 86	81	PS&P rail line, frequent traffic on local roads	12:00 a.m. April 4 to 12:00 a.m. April 10, 2015
1102 G Street, Centralia	A	45	72 to 83	80	PS&P rail line, frequent traffic on local roads	12:00 a.m. April 4 to 12:00 a.m. April 10, 2015
1103 J Street, Centralia	A	45	71 to 82	77	PS&P rail line, frequent traffic on local roads	12:00 a.m. April 4 to 12:00 a.m. April 10, 2015
3900 Kuper Road, Centralia	B	110	70 to 74	72	PS&P rail line, frequent traffic on local roads	12:00 a.m. April 11 to 12:00 a.m. April 17, 2015
Old Hwy 9 & Tea Street SW, Rochester	B	130	68 to 74	70	PS&P rail line, frequent traffic on local roads	12:00 a.m. April 11 to 12:00 a.m. April 17, 2015

[6] Train engineers are required by FRA rules to begin to sound locomotive horns at least 15 seconds and not more than 20 seconds in advance of public grade crossings.

Location	Analysis Segment	Approximate Distance from PS&P Rail Line Centerline	Range of L_{dn} Values Measured	Average L_{dn} Value	Observed Noise Sources	Time of Measurement
19318 Grand Mound Way, Rochester	C	45	69 to 72	71	PS&P rail line, US Route12, truck traffic	12:00 a.m. April 4 to 12:00 a.m. April 10, 2015
180th at Little Rock, Rochester	C	180	66 to 70	68	PS&P rail line, US Route 12, truck traffic	12:00 a.m. April 4 to 12:00 a.m. April 10, 2015
205 Murrey, Oakville	E	185	61 to 72	68	PS&P rail line, US Route 12, truck traffic	12:00 a.m. March 28 to 12:00 a.m. April 3, 2015
22 Evergreen Village Lane, Elma	F	260	62 to 73	70	PS&P rail line, US Route 12, truck traffic	12:00 a.m. March 28 to 12:00 a.m. April 3, 2015
513 N 13th Street, Elma	G	190	62 to 70	67	PS&P rail line, infrequent traffic on local roads, light industrial	12:00 a.m. March 28 to 12:00 a.m. April 3, 2015
502 N 13th Street, Elma	G	25	66 to 76	71	PS&P rail line, infrequent traffic on local roads, light industrial	12:00 a.m. March 28 to 12:00 a.m. April 3, 2015
57 Hurd Road, Elma	G	85	64 to 71	68	PS&P rail line, infrequent traffic on local roads, light industrial	12:00 a.m. March 28 to 12:00 a.m. April 3, 2015
510 Foss Avenue, Satsop	G	65	67 to 75	72	PS&P rail line, infrequent traffic on local roads, light industrial	12:00 a.m. March 28 to 12:00 a.m. April 3, 2015
78 Devonshire, Montesano	H	90	67 to 73	69	PS&P rail line, US Route 12, truck traffic	12:00 a.m. March 28 to 12:00 a.m. April 3, 2015
140 S Chehalis Street, Aberdeen	J	230	67 to 75	72	PS&P rail line, truck traffic, local traffic, light industrial	12:00 a.m. March 28 to 12:00 a.m. April 3, 2015
2100 1st Street, Aberdeen	J	95	65 to 74	69	PS&P rail line, truck traffic, local traffic, light industrial	12:00 a.m. March 28 to 12:00 a.m. April 3, 2015

Location	Analysis Segment	Approximate Distance from PS&P Rail Line Centerline	Range of L_{dn} Values Measured	Average L_{dn} Value	Observed Noise Sources	Time of Measurement
11846 170th Avenue, Rochester	D	105	62 to 76	70	PS&P rail line, traffic on local roads	12:00 a.m. April 4 to 12:00 a.m. April 10, 2015
7220 Central Park Drive, Aberdeen	I	295	60 to 64	62	PS&P rail line, infrequent traffic on local roads	12:00 a.m. April 11 to 12:00 a.m. April 17, 2015

Source: Appendix G, *Noise Data*

3.7.5.2 Vibration

Vibration sources at the project site include the vibration created from rail car switching operations (delivery and release of rail cars), and heavy vehicles operating on Industrial Road adjacent to the project site. Vessel and other operations on the waters of Grays Harbor do not create vibration. Vibration sources along the PS&P rail line include existing train traffic (an average of 3 rail trips per day) as well as trucks and buses operating on highways and local roads.

Groundborne vibration from train passbys may intermittently cause perceptible vibration at locations directly adjacent to the PS&P rail line. Using generalized FRA/FTA Manual surface vibration data, a single passby from a locomotive-powered freight vehicle moving at 25 miles per hour would be expected to produce a vibration level of approximately 78 velocity decibels (VdB) at a distance of 50 feet, which is distinctly perceptible to humans inside of building structures. However, because rail events are infrequent as defined by the FRA/FTA Manual (fewer than 30 events per day), a vibration level of this magnitude is not considered to result in a significant "annoyed" response from people exposed to this level of groundborne vibration (Federal Transit Administration 2006). For these reasons, vibration measurements within the study area were not conducted.

3.7.6 What are the potential noise and vibration impacts?

This section describes noise and vibration impacts that could occur in the study area. Potential impacts of the no-action alternative are described first, followed by potential impacts of the proposed action.

3.7.6.1 No-Action Alternative

Under the no-action alternative, the applicant would continue to operate its existing facility as described in Chapter 2, *Proposed Action and Alternatives*. Although the proposed action would not occur, it is assumed that growth in the region would continue under the no-action alternative, which could lead to development of another industrial use at the project site within the 20-year analysis period (2017 to 2037). Such development could result in noise and vibration impacts similar to those described for the proposed action.

Existing rail traffic and associated noise from grade-crossing horns would continue at existing levels (an average of 3 trips per day) under the no-action alternative. As noted in Section 3.15, *Rail Traffic*,

no increase in rail traffic is anticipated over the analysis period, although train length may increase. Noise from train horns near grade crossings would still be required and would be the dominant noise source in rural areas along the PS&P rail line. The vibration generated by existing rail operations on the PS&P rail line would continue. Noise generated by existing vessel operations would also continue.

3.7.6.2 Proposed Action

This section describes the impacts that could occur in the study area as a result of construction and routine operation of the proposed action. First, this section describes impacts from construction of the proposed action. It then describes impacts of routine operation at the project site and routine rail and vessel transport to and from the project site.

Construction

Washington State maximum permissible noise level regulations (Washington Administrative Code [WAC] 173-60-040) and local noise regulations do not apply to construction noise during daytime hours. Construction of the proposed action would result in a temporary increase in noise and vibration from construction equipment operations. No nighttime construction is proposed.

Construction activities would involve the use of heavy construction equipment. Table 3.7-4 lists the construction equipment likely to be used during construction of the proposed action and associated typical noise levels, measured 50 feet away from the equipment.

Table 3.7-4. Typical Construction Equipment Noise Levels at 50 feet

Equipment	Noise Level (dBA)
Crane	88
Dozer Cat® D8 15.3 CY	85
Grader Cat® 14-H/14-foot blade	85
Dump truck 18 ton, 12 CY HWY	88
Excavator	81
Wheel loader cat 966/4.8 CY	85
Backhoe Cat® 345 99k/3 CY	80
Welder (Grp 4)	74
Genset 250 kW	81
Bobcat loader	85
Compactor, Cat® 816, 25 ton	82
Compressor, trailer 1,200 cfm	78
Light Plan/Genset, 6kW, 4/10	73

dBA = A-weighted decibel; CY = cubic yards; HWY = [on] highway; k = thousand; Grp = group; kW = kilowatt; cfm = cubic feet per minute

While construction noise associated with the equipment listed in Table 3.7-4 would likely be audible in nearby residential areas, the construction noise levels would be much lower than those listed in Table 3.7-4. These levels are based on the receptor being 50 feet from the source, while the distance of the project site to the nearest residence is approximately 1,750 feet. At this distance, noise levels from the equipment would range from approximately 42 A-weighted decibels (dBA) to 57 dBA in the adjacent residential areas. These noise levels are below the 30-day construction noise threshold

of 75 dBA L_{dn} for residential locations, as defined in the FRA/FTA Manual. Because of the relatively low level and temporary nature of construction noise, impacts from construction equipment operations on sensitive receptors would be low.

Construction of the storage tanks would require impact pile-driving. Pile-driving is expected to be the dominant noise source at the project site, compared with other construction equipment noise sources. Impact pile-driving lasting for approximately 2 to 3 months would be required for the storage tank foundations. Based on FRA/FTA Manual pile-driving noise measurement data, pile-driving noise levels would be approximately 70 dBA at the residential areas closest (approximately 1,750 feet away) to the pile-driving activity.[7] This value is lower than the 30-day construction noise threshold of 75 L_{dn} for residential locations. Therefore, noise impacts on sensitive receptors from pile-driving would be low.

Similarly, no severe pile-driving vibration impacts in the residential areas are expected because of the large distances between pile-driving activity and residential areas. For example, pile-driving vibration velocity levels would be approximately 0.0026 inch per second at the nearest residential areas 1,750 feet away. This value is below FTA's most stringent building damage criterion.[8]

Vibration levels associated with the construction equipment listed in Table 3.7-4 would also be low in the nearest residential areas, because vibration caused at the project site would be greatly reduced at the distance of the residential areas. For example, bulldozer vibration velocity levels at the nearest residence 1,750 feet away would be approximately 0.0001 inch per second, which is below most stringent building damage criterion, as documented in the FRA/FTA Manual. Effects of pile driving on aquatic species are discussed in Section 3.5, *Animals*.

Operations

This section describes impacts that would occur as a result of routine operations at the project site, rail transport along the PS&P rail line, and vessel transport through Grays Harbor.

Onsite

Onsite operations would generate noise and vibration from operations of equipment such as various pumps, compressors, and the marine vapor control unit. Loading and unloading of rail cars would also generate operational noise. Noise and vibration levels associated with these sources are expected to be similar to levels generated by other industrial sources. The City of Hoquiam noise ordinance would not apply to onsite operations.

Vessels docked at the Terminal 1 berth would be approximately 2,900 feet from the nearest residential area. Assuming a stationary vessel noise level of 65 dBA at 25 meters (European Commission 2013), vessel noise levels would be approximately 36 dBA[9] at the nearest residential area. This is a relatively low noise level and likely below ambient noise levels; therefore, no meaningful vessel noise impacts are expected.

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[7] Assuming no nighttime pile-driving, and a usage factor of 0.2 L_{dn}, the sound level would be 63 dBA. A usage factor of 0.2 is often used for impact pile-driving to account for the periodic nature of this noise source. See Federal Highway Administration *Roadway Construction Model User's Guide* (January 2006) for more information.

[8] The Federal Transit Administration's "extremely fragile historic building" damage criterion is a vibration velocity of 0.12 inch per second (2006).

[9] Note that this 36-dBA value is not expressed in terms of L_{dn}, but rather as a steady state noise level while the vehicle is docked.

Rail

Operation of the proposed action at maximum throughput would add approximately 1.25 unit train trips[10] per day on average (458 per year maximum) along the PS&P rail line to the average three train trips per day (1,235 per year) under the no-action alternative (Section 3.15, *Rail Traffic*). This increased frequency of rail traffic and the associated routine operational activities would increase noise and vibration.

Noise

Estimated noise levels with the proposed action were calculated based on the assumptions shown in Table 3.7-5.

Table 3.7-5. Railroad Operational Data Assumptions

	Existing Conditions	Proposed Action
Average trips per day	3.1 (west of Elma) 3.0 (east of Elma)	1.25
Number of locomotives per train	2.5	3
Number of cars per train	69.5	120
Speed (miles per hour)	25	25

As previously described, the focus of the noise analysis is on L_{dn} for locations where people sleep. Daytime loudest-hour noise levels (in terms of L_{eq}) were not analyzed, because the loudest hour at grade crossings and wayside locations under the proposed action would generally be characterized by a single train passby, which occurs under existing conditions.

The analysis considered two types of train noise.

- *Wayside* noise refers to the combined effect of locomotive noise and car/wheel noise.
- *Horn* noise refers to the sound of locomotive warning horns, which are sounded at public at-grade road/rail crossings. Because horn sounding is intentionally loud to warn motorists of oncoming trains, the horn noise footprint is often larger than the wayside noise footprint.

According to FRA/FTA Manual, rail noise impacts are determined by the extent to which rail traffic related to the proposed action would increase existing ambient noise levels. This relationship is nonlinear and has a lower allowable increase in noise level when existing ambient noise levels are relatively high. The number of receptors exposed to moderate or severe noise impacts by segment of the proposed action is shown in Table 3.7-6. As described previously, counts of moderate and severe impacts are based on FRA/FTA Manual general assessment methods and proposed rail events were assumed to be evenly distributed over a 24-hour day.

[10] A trip represents one-way travel; in other words, an inbound trip and an outbound trip are counted as two trips.

Table 3.7-6. Estimated Counts of Moderate and Severe Noise Impacts on the PS&P Rail Line—Proposed Action

Analysis Segment	Location	PS&P Rail Line Grade Crossings[a]	Number of PS&P Rail Line Grade Crossings	General Land Use Characteristics	Horn Noise		Wayside Noise	
					Moderate	Severe	Moderate	Severe
A	Centralia	1–8	8	Higher-density single family residential and commercial	37	0	0	0
B	Unincorporated Centralia, Rochester (south of US Route 12)	9–20	12	Single-family residential and commercial	4	1	0	0
C	Rochester (between US Route 12 and Littlerock Road SW)	21–24	4	Single-family residential and commercial	2	0	0	0
D	Rochester (west of Littlerock Road SW)	25–30	6	Single-family residential and commercial	2	0	0	0
E	Oakville	31–42	12	Lower-density single-family residential and commercial	3	0	0	0
F	Malone-Porter	43–54	12	Lower-density single-family residential	12	2	0	0
G	Elma-Satsop	55–72	18	Medium-density single-family residential	66	26	0	0
H	Montesano	73–84	12	Medium-density single-family residential	12	0	0	0
I	West of Montesano/east of Aberdeen	85–92	8	Medium-density single-family residential	23	4	0	0
J	Aberdeen	93–103	11	Single-family residential and commercial	9	0	0	0
Total					**170**	**33**	**0**	**0**

[a] See Figure 3.7-2 for the location of grade crossings.

Table 3.7-6 presents the number and general location of noise-sensitive receptors that would be exposed to increased noise from the addition of proposed action rail trips on the PS&P line as defined by the FRA/FTA Manual. Based on the analysis, the proposed action is not anticipated to result in a substantial increase in wayside noise. As noted in Table 3.7-6, the greatest potential for substantial noise increases would occur from increased train horns sounding at grade crossings for public safety.

Based on the analysis, moderate noise exposure would occur around grade crossings relatively evenly distributed along the PS&P rail line, with the most affected receptors in the Elma–Satsop area (66), followed by Centralia (37), and the area west of Montesano and east of Aberdeen (23). A total of 170 receptors would be affected. As shown in Table 3.7-6, 33 additional receptors would be exposed to severe impacts from horn noise at grade crossings. These impacts would occur where the rail line runs closest to residential land uses. The most potentially affected receptors would be in the Elma–Satsop area, where 26 receptors would be affected.

As described previously, the increase in the average L_{dn} at each of the receptors with moderate and severe impacts per FRA/FTA Manual methods would depend on the existing noise level. As the existing level of noise exposure increases, the additional noise exposure needed to cause a moderate or severe impact decreases. On average, potentially affected receptors would generally experience an average increase in noise exposure over the course of any given day. However, as noted previously, it is not possible to predict when trains would be traveling to and from the project site. All trains would continue to travel at the same speeds and would continue to sound horns consistent with existing operational practices. As noted above, the number of events per day would increase by approximately 1.25 trips per day on average, meaning sensitive receptors would experience train horns sounding 1.25 additional times per day, on average.

Table 3.7-7 illustrates the grade crossings anticipated to be exposed to the most substantial noise increases (i.e., severe impacts as defined in the FRA/FTA Manual). The grade crossings with the most severe impacts are listed first. Proposed action-related horn and wayside noise levels and counts of noise impacts at all grade crossings are shown in Appendix G, *Noise Data*.

Table 3.7-7. Estimated Number of Receptors at Grade Crossings with Severe Noise Impacts by Magnitude of Impact

Grade Crossing[a]	PS&P Rail Line Grade Crossing	Location	Severe Impacts	Moderate Impacts
61	North 11th Street	Elma	8	10
62	North 13th Street	Elma	8	6
58	North 6th Street	Elma	4	4
63	North 17th Street	Elma	4	4
91	Private Crossing	Central Park	4	10
47	Dunlap Road	Malone-Porter	2	0
55	N 2nd St, Elma	Elma	2	16
16	216th Ave SW, Centralia	Centralia	1	0
Total			**33**	**50**

[a] See Figure 3.7-2 for location of grade crossings.

As shown in Table 3.7-7, 26 of the 33 receptors (79%) exposed to severe impacts are located in Elma. Other locations with receptors exposed to severe impacts are located in the Central Park area (east of Aberdeen; four receptors), Malone-Porter area (southeast of Elma; two receptors), and Centralia (one receptor).

In addition to the severe impacts shown in Table 3.7-7, the eight grade crossings located in central Centralia have very high levels of existing surface transportation noise exposure at densely populated clusters of receptors along the PS&P rail line, many of which are located approximately 50 feet from the existing track and currently experience ambient levels as high as 81 dBA L_{dn}. Therefore, the moderate impacts at these receptors are called out separately in Table 3.7-8.

Table 3.7-8. Estimated Number of Receptors at Grade Crossings with Moderate Noise Impacts in Central Centralia

Grade Crossing[a]	PS&P Rail Line Grade Crossing	Location	Severe Impacts	Moderate Impacts
1	B Street	Centralia	0	4
2	North Tower Avenue (State Route 507)	Centralia	0	2
3	North Pearl St (State Route 507)	Centralia	0	2
4	E Street	Centralia	0	4
5	F Street	Centralia	0	4
6	G Street	Centralia	0	4
7	H Street	Centralia	0	7
8	J Street	Centralia	0	10
Total			**0**	**37**

[a] See Figure 3.7-2 for location of grade crossings.

Noise from surface carriers engaged in interstate commerce by railroad is exempt from Washington State maximum permissible noise level regulations. While noise barriers or building sound insulation could provide ways to reduce project related noise exposure for some receptors, elimination of locomotive horn sounding at the affected grade crossings would eliminate and not just reduce increased horn noise. The FRA Final Train Horn Rule (49 Code of Federal Regulations [CFR] 222) provides a safe and effective way to reduce locomotive horn noise through implementation of quiet zones. Quiet zones are areas in which horns are not required to be sounded as long as FRA safety requirements are met. Quiet zones can be established using a procedure established in FRA regulations through installation of enhanced safety measures at grade crossings such that train horns would not be required to be used. Implementation of each quiet zone requires cooperation by all applicable jurisdictions and is contingent on approval by FRA. Section 3.7.8.2, *Applicant Mitigation,* identifies mitigation for the applicant to coordinate with affected communities the creation of quiet zones for areas where noise from proposed action rail traffic would have the most severe noise impacts (Table 3.7-7). Additional factors to consider include the number of receptors affected, the effectiveness of the quiet zone, community views, and the extent to which ambient levels are already heavily influenced by noise from surface transportation.

Vibration

Vibration related to PS&P rail traffic is evaluated based on peak passby vibration level. Unlike noise, vibration impacts do not increase with increased train traffic unless the existing line is a heavily used rail corridor with more than 12 trains per day (Federal Transit Administration 2006). With the

addition of proposed action trains, an average of approximately 4.25 trips would occur on the PS&P rail line daily. Because peak passby vibration levels are primarily a function of train speed, and train speeds are not expected to increase as the result of the proposed action, negligible rail vibration impacts are expected compared to the no-action alternative.

Vessel

Operation of the proposed action at maximum throughput would result in an average of approximately one additional tank vessel trip[11] every other day (a maximum of 238 per year) along the navigation channel compared to the 436 large commercial vessel[12] trips under the no-action alternative (Section 3.17, *Vessel Traffic*). This increased traffic and associated routine operations could result in increased noise levels.

Vessels underway through the navigation channel pass by residences as close as 1,800 feet. Assuming a vessel noise level of 75 dBA at 25 meters (European Commission 2013) and a speed of 15 miles per hour, the sound exposure level[13] of a vessel passby would be 88 dBA at 25 meters. Using baseline existing vessel traffic of 1.2 trips per day, the corresponding L_{dn} value at the nearest residences would be approximately 20 dBA. The proposed action would increase vessel traffic to an average of approximately 1.8 trips per day, resulting in L_{dn} of approximately 30 at the nearest residences. Since this increase in noise level is minor, and because these L_{dn} values are far below ambient L_{dn} values typical for neighboring land uses, negligible noise impacts are expected from vessels underway.

3.7.7 What required permits and plans apply to noise and vibration?

No required permits or plans apply to noise and vibration.

3.7.8 What mitigation measures would reduce noise and vibration impacts?

This section describes the applicant mitigation measures that would reduce noise and vibration impacts from construction and routine operation of the proposed action.

3.7.8.1 Applicant Mitigation

The applicant will implement the following mitigation.

- To reduce construction noise at nearby sensitive receptors, the applicant will maintain construction and maintenance equipment in good working order with properly functioning mufflers to control noise.
- To address increased noise from rail traffic, the applicant will coordinate with PS&P and interested communities along the PS&P rail line on the creation of quiet zones, if requested. Elimination of locomotive horn sounding at the affected grade crossings would eliminate

[11] A trip represents one-way travel.
[12] The term *large commercial vessels* refers collectively to tank and cargo vessels.
[13] Sound exposure level normalizes the sound energy of a noise event as if it occurred in 1 second. The sound exposure level is used to compare two different noise events to each other and is also used to compute the L_{dn}.

impacts from increased horn noise. Quiet zones can be established using a procedure established in FRA regulations. The quiet zone allows the installation of enhanced safety measures at grade crossings such that train horns would not be required to be used. Implementation of a quiet zone is subject to FRA approval. Quiet zones include measures to maintain the level of safety while reducing noise.

3.7.9 Would the proposed action have unavoidable and significant adverse noise and vibration impacts?

Unavoidable and significant adverse impacts are described as follows for noise and vibration.

3.7.9.1 Noise

Implementation of the proposed action would result in increased rail traffic that could cause substantial increases in noise along the PS&P rail line, depending on the specific location. This could result in noise increases that meet the FRA/FTA criteria for severe impacts on sensitive receptors. These increases could occur near 8 grade crossings, representing approximately 33 total receptors and up to approximately 8 receptors affected at any one grade crossing. These severe noise impacts would be from train horn noise that is intended for public safety. In central Centralia, the proposed action would add noise to an existing noisy environment and cause moderate impacts per FRA/FTA Manual criteria. As described previously, railroad noise is exempt from Washington State and local noise limits; however, it is possible for communities to work with the FRA to apply for a quiet zone to limit train horn sounding. As noted in Section 3.7.8.2, *Applicant Mitigation*, the applicant will work with PS&P and interested parties to this end. However, as long as train horns continue to sound for safety at the grade crossings listed in Table 3.7-7, the potential for exposure to severe noise increases at these 8 grade crossings would remain. There would be no unavoidable and significant adverse impacts related to onsite construction or operation or vessel transport.

3.7.9.2 Vibration

The addition of proposed action trains to the PS&P line would have negligible rail vibration impacts. Therefore, there would be no unavoidable and significant adverse vibration impacts.