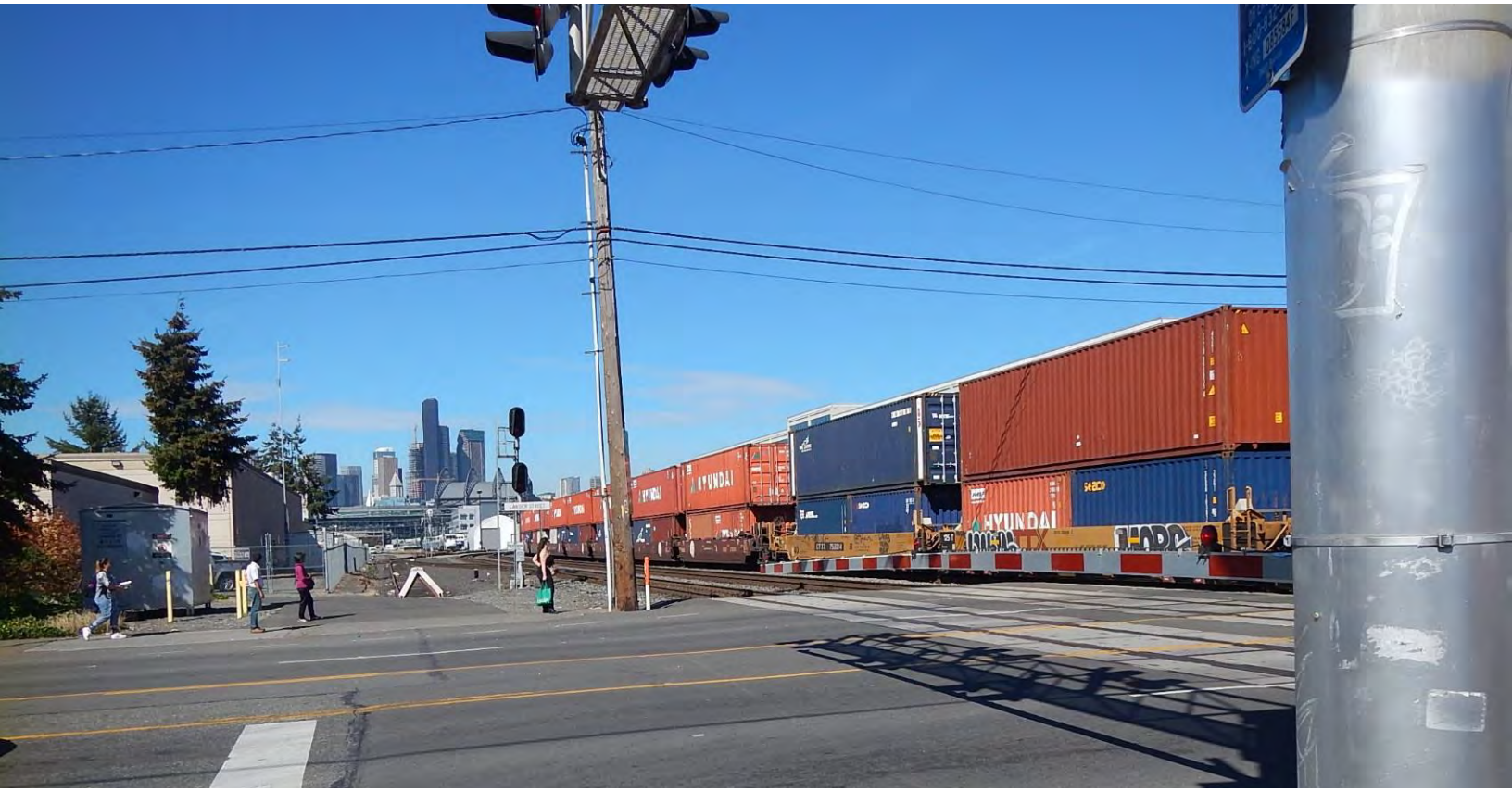
Seattle Department of Transportation

SOUTH LANDER STREET GRADE SEPARATION PROJECT

NOISE DISCIPLINE REPORT



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Michael Minor and Associates. 2017. South Lander Street Grade Separation Project, Noise Discipline Report. Prepared for the Seattle Department of Transportation. Seattle, WA. January 2017.

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ACRONYMS AND ABBREVIATIONS

CFR	Code of Federal Regulations
City	City of Seattle
dB	decibel
dBa	A-weighted decibels
EDNA	Environmental Design for Noise Abatement
FAST	Freight Action Strategy
FHWA	Federal Highway Administration
HOT	High-Occupancy Toll
Leq	equivalent sound level
Lmax	maximum noise levels
Lmin	minimum noise levels
mph	miles per hour
NAC	noise abatement criteria
NEPA	National Environmental Policy Act
SEPA	Washington State Environmental Policy Act
SMC	Seattle Municipal Code
SR	State Route
TNM	Traffic Noise Model
TS&L	type, size, and location
WNAC	Washington Noise Abatement Criteria
WSDOT	Washington State Department of Transportation

EXECUTIVE SUMMARY

The noise analysis was conducted for the City of Seattle's proposed S Lander St Grade Separation Project to document the existing conditions, the potential impacts of the project, and potential mitigation measures in accordance with the National Environmental Policy Act (NEPA) and the Washington State Environmental Policy Act (SEPA).

Project analysts reviewed the proposed S Lander St design to determine whether it would be subject to Federal Highway Administration (FHWA) criteria for a Type 1 noise study. The only FHWA Type 1 study criterion that the project potentially meets is the change in the roadway's vertical alignment. For a change in the vertical alignment to be considered Type 1, the realignment must include the removal of shielding, or alteration of the topography, such that it exposes the line of sight between noise-sensitive receivers and the roadway, and would thereby increase noise levels. A detailed review of the existing conditions and a comparison to the future conditions was performed to determine if this project is a Type 1 Project under the definition above and if a detailed noise analysis would be required.

Based on evaluation of the study area noise environment, topography, and existing structures, the analysis concluded that there are no sites where a noise-sensitive property would have a new line of sight to the proposed elevated S Lander St overpass, and the change in the horizontal alignment is only approximately 6 feet north of the existing roadway's centerline. As a result, the project does not meet the FHWA criteria for a Type 1 noise study. Therefore, a detailed noise analysis was not performed for the S Lander St Grade Separation Project. Based on the existing noise levels and potential future noise levels, a noticeable change is not expected in the overall noise environment. However, it is important to note that noise from the bells and gates at the at-grade S Lander St crossing, along with the required train horn at the crossing, would no longer be necessary, and these very noticeable noise sources would no longer be present.

Definitions

Line of sight is the line between two points, such as a person (the receptor) and the roadway (traffic noise source).

Noise-sensitive property refers to properties that have noise abatement criteria listed under the Federal Highway Administration traffic noise regulations.

Construction of the project would produce noise levels similar to those of other typical roadway and highway projects. Construction activities would be required to meet the City of Seattle Noise Control Ordinance, and any construction outside normal weekday daytime hours would require a noise variance from the City of Seattle.

1. INTRODUCTION AND PROJECT DESCRIPTION

This report documents the potential impacts related to traffic noise resulting from the proposed S Lander St Grade Separation Project. The study was conducted to satisfy the National Environmental Policy Act (NEPA) and will address requirements for the Washington State Environmental Policy Act (SEPA). This report describes the existing conditions, the potential impacts of the project, and potential mitigation measures.

An acoustical review of the proposed grade separation of the S Lander St rail crossing was performed to determine if the project meets the requirements for a detailed noise analysis under the Federal Highway Administration (FHWA) and Washington State Department of Transportation (WSDOT) noise analysis requirements. Projects that are identified as Type 1 under FHWA criteria are required to provide a detailed analysis of traffic noise using the FHWA Traffic Noise Model (TNM), identify potential traffic noise impacts, and consider noise abatement for any identified traffic noise impacts. If the project is not considered Type 1, then there is little potential for any new noise impacts or increased severity of existing impacts from the project, and a detailed noise analysis using TNM is not required. To aid in the understanding of this analysis, a brief introduction to acoustics, details on the proposed project, and other supporting information used to make this determination are provided in the following sections.

1.1 Project Background

The City of Seattle (City) proposes to build a bridge on S Lander St between 1st Ave S and 4th Ave S to provide a grade-separated crossing over the BNSF Railway's railroad tracks that will improve local traffic circulation and safety in the City's SODO neighborhood. S Lander St is an essential east-west corridor that is heavily used by freight and commuter traffic as well as pedestrians, bicycles, and transit. It serves one of the largest manufacturing and industrial centers in the state, including the Port of Seattle's seaport terminals. The street currently intersects with four BNSF tracks at an at-grade crossing located between Occidental Ave and 3rd Ave S. Available data indicate that more than half of the BNSF rail cars that move through Washington go through the S Lander St crossing, contributing to vehicular delays averaging over 4½ hours each day. These delays affect freight, commuters, local businesses, and the public. An overcrossing at this location would eliminate delays caused by train crossings, benefiting mobility and safety in the area.

The City envisioned the S Lander St Grade Separation Project nearly 20 years ago. It was one of the original Freight Action Strategy (FAST) Corridor projects (Texas Transportation Institute 1997), intended to improve railroad crossings along the BNSF Everett-Seattle-Tacoma rail corridor. There are currently two existing grade-separated crossings in the north end of SODO at S Royal Brougham Way and Edgar Martinez Dr (SR 519); to the south, the Spokane St Viaduct provides a route that passes above this set of railroad tracks. Between those two locations, S Lander St is the most viable of the remaining grade separation options because of its wide right-of-way, the distance between railroad tracks and adjacent streets, and the relatively small railroad crossing width. These factors allow for a shorter crossing that has sufficient space to reach the necessary clearance requirements over the tracks. The grade separation would be designed to provide the necessary vertical clearance over the railroad tracks while maintaining access to local businesses.

The S Lander St Grade Separation Project is a high-priority project in the Seattle Freight Master Plan and in the 2015 Plan to Move Seattle, the 10-year City strategic plan for increasing safety, reducing congestion, and balancing modal needs. It also supports the Industrial Areas component of the Seattle Comprehensive Plan and was identified as a Tier 1 project by the Seattle Industrial Areas Freight Access

Project. These plans have elevated the project as a City priority not only because of its safety, congestion, and multimodal access benefits, but also because of its important role in the regional freight network.

1.2 Project Location

The project area is shown in Figure 1-1. The project area extends along S Lander St from 1st Ave S on the west to 4th Ave S on the east. Improvements would generally be made within the existing 100-foot-wide City right-of-way.

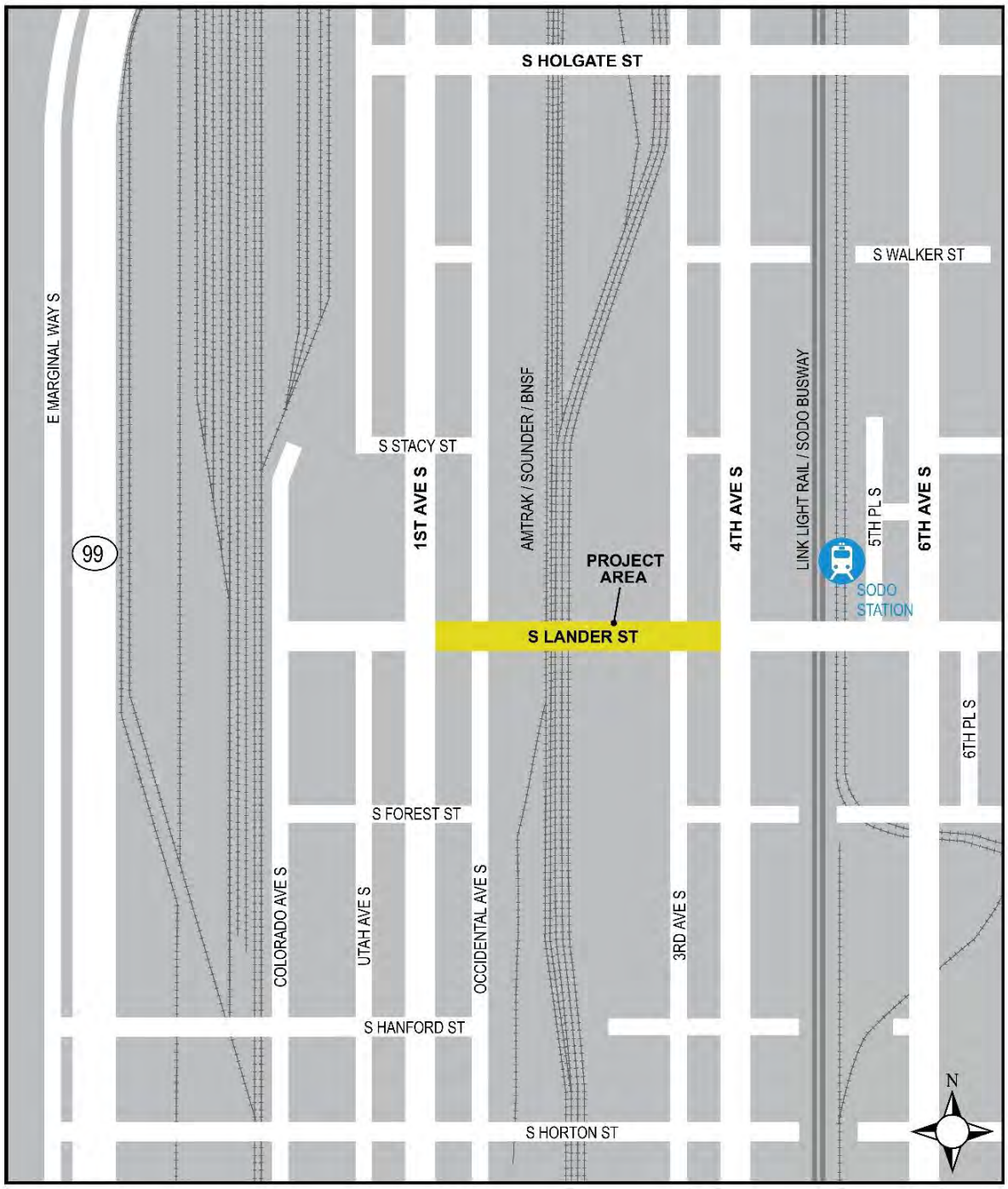

Figure 1-1. Project Area

1.3 Purpose and Need for the Project

The primary purpose of the project is to provide a grade separation between the roadway and the BNSF tracks to reduce delays and improve safety for all users. The City's goals and objectives for the S Lander St corridor have been documented in the Access Duwamish Report in 2000 (City of Seattle and Port of Seattle 2000) as well as the bridge type, size, and location (TS&L) study in 2016 (COWI 2016).

1.4 Project Description

The project would extend from 1st Ave S on the west to 4th Ave S on the east. Both of these roadways serve as major north-south arterials in the existing surface street network. The grade-separated structure would have a four-lane cross section, which would accommodate forecast traffic volumes through the year 2040.

Table 1-1 summarizes the main project design features related to the bridge alignment, local access, and nonmotorized facilities. Each of these elements is described in more detail in the following subsections.

Table 1-1. Summary of Project Design Features

Project Element	Description
Bridge alignment	Bridge centerline offset 6 feet north of existing S Lander St centerline.
Bridge profile	To meet the railroad track-clearance requirement of 23.5 feet and a desired maximum grade of 7%, the bridge would be 7 to 8 feet above Occidental Ave S, eliminating its existing intersection with S Lander St.
Cross section	67.5 feet in total width including exterior barriers. Includes two 12-foot lanes, two 11-foot lanes, a 14-foot-wide multi-use path, and a barrier between motorized and nonmotorized vehicles.
Nonmotorized facilities	14-foot-wide two-way shared use path on north side of the bridge.
Local access west of railroad tracks	Dead-end Occidental Ave S on each side of bridge.
Local access east of railroad tracks	Two-Way Connection—two-way surface street along south side of bridge, crossing under bridge to Seattle Public Schools John Stanford Center for Educational Excellence site.
S Lander St intersections at 1st Ave S and 4th Ave S	Westbound S Lander St approaching 1st Ave S—one left-turn lane, one through lane, and one right-turn lane. Eastbound S Lander St approaching 4th Ave S—one left-turn lane, one through lane, and one through right-turn lane.

1.4.1 Bridge Alignment and Cross Section

The proposed bridge alignment is offset 6 feet northward of the existing centerline of S Lander St as shown in Figure 1-2.

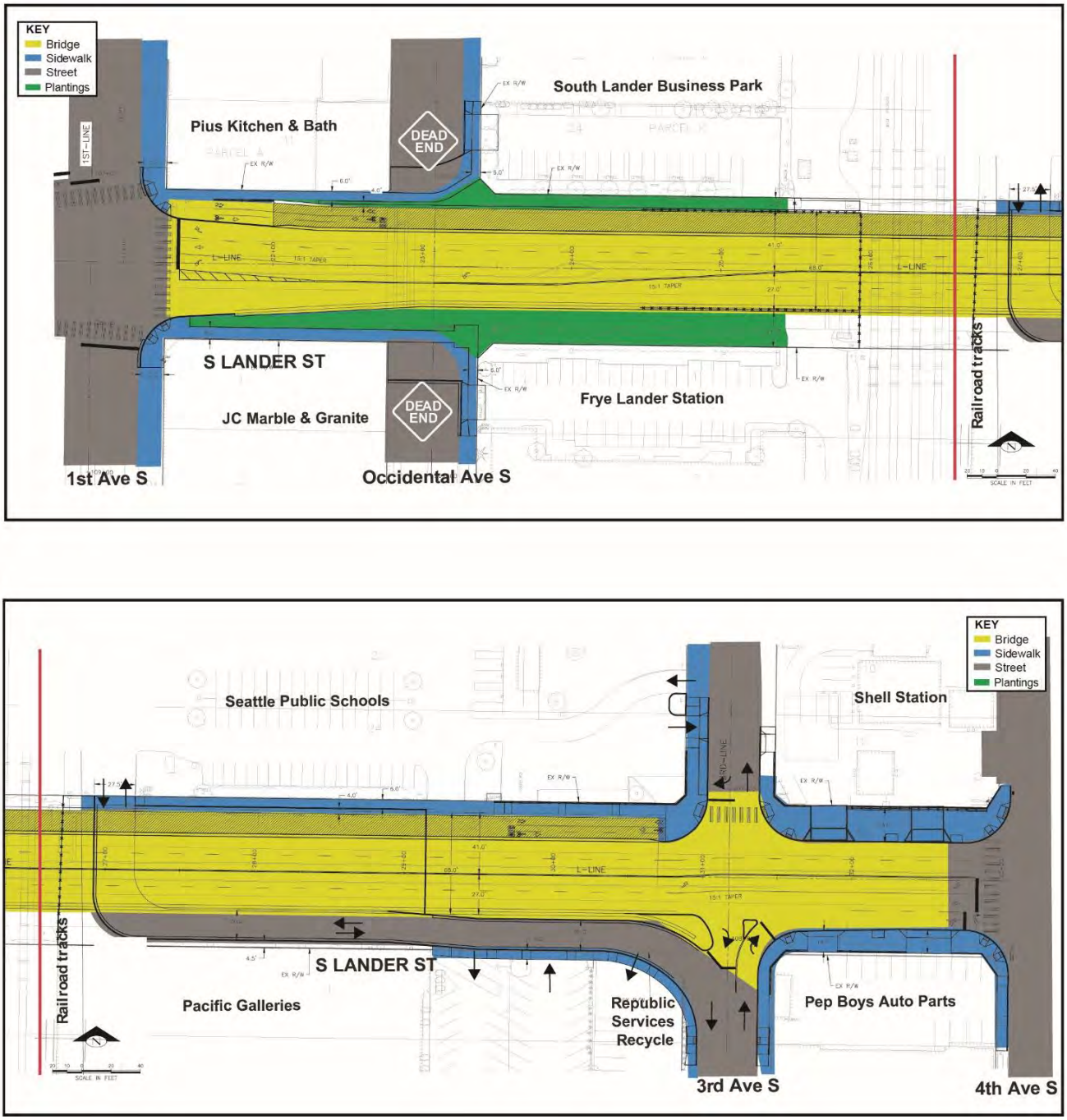

Figure 1-2. Proposed Alignment

A four-lane bridge is proposed for this project. The total width of the bridge would be 67.5 feet, with a cross section that would include a 14-foot-wide multi-use path for nonmotorized traffic (described below), one 12-foot lane (curbside) and one 11-foot lane in each direction, plus a 2-foot shoulder adjacent to the eastbound barrier and a 1.5-foot lane separator between the nonmotorized facilities and vehicle lanes. Figure 1-3 depicts the proposed bridge cross section.

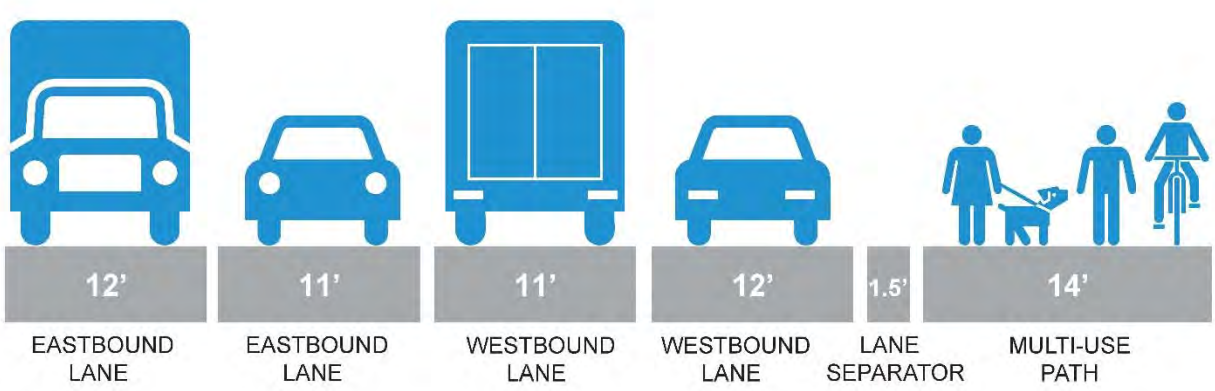

Figure 1-3. Proposed Bridge Cross Section

The bridge would be a 4-span structure, with drilled shaft foundations up to 200 feet in depth. Geofoam approaches, up to 20 feet in height, would be used to reduce the loading on the underlying utilities between exterior bridge barriers (not shown).

The proposed bridge must clear all BNSF railroad tracks by 23.5 feet and a future Amtrak rail line by 22.5 feet; the desired maximum grade for the roadway is 7 percent. Given those design parameters, the bridge approaches would meet Occidental Ave S about 7 to 8 feet above the existing street grade, which would eliminate the existing intersection. There would be more horizontal distance between the railroad tracks and 3rd Ave S to the east, and the intersection at S Lander St/3rd Ave S would be retained by raising 3rd Ave S by 2 to 3 feet.

1.4.2 Nonmotorized Facilities

The project would create a 14-foot-wide, two-way multi-use path on the north side of the bridge, separated from the vehicle lanes by a 1.5-foot lane separator (Figure 1-3). This configuration would accommodate the large majority of pedestrians in the corridor who walk along the north side, which is along the direct walking route between the Starbucks Center, the Seattle Public Schools John Stanford Center for Educational Excellence (district headquarters building), and the SODO Link light rail station. The 14-foot width is comparable to other multi-use trails such as the Elliott Bay Trail, the West Seattle Trail across the Spokane St swing bridge, and the SR 520 regional shared-use path across the new floating bridge. The multi-use path on S Lander St would provide capacity for shared use by both pedestrians and bicyclists, space for passing, and separation between vehicular and nonmotorized traffic. On the west, the path would continue to 1st Ave S. On the east, the dedicated path would end at 3rd Ave S; however, a wider sidewalk would be included between 3rd Ave S and 4th Ave S to accommodate the potential increase in bicycle activity.

In addition to the multi-use path on the bridge, sidewalks with a minimum width of 6 feet would be provided at street level adjacent to the Seattle Public School District headquarters, the access road to 3rd Ave S, and on each side of the roadway between 1st Ave S and Occidental Ave S (see Figure 1-2).

1.4.3 Local Access West of Railroad Tracks

The bridge approaches would be elevated above Occidental Ave S west of the railroad tracks, which would eliminate the ability to connect the street north and south of S Lander St. As a result, Occidental Ave S would be dead-ended north and south of the bridge. Figure 1-2 shows the proposed configuration.

Between 1st Ave S and the railroad tracks, the new structure would eliminate access to businesses from S Lander St because the roadway would be elevated above these sites. The driveways for the South Lander Business Park and Frye Lander Station would need to be moved to Occidental Ave S, with access to the arterial network provided via the S Forest St/1st Ave S intersection to the south and the S Stacy St/1st Ave S intersection to the north. Both of those intersections are signalized and provide access from all directions.

1.4.4 Local Access East of Railroad Tracks

Local access to the Seattle Public Schools, Pacific Galleries, and Republic Services properties located east of the railroad tracks would be provided via a two-way local roadway along the south side of S Lander St at the 3rd Ave S intersection, as shown in Figure 1-2.

1.4.5 Intersections at 1st Ave S and 4th Ave S

The intersection at S Lander St and 1st Ave S would be designed to accommodate three westbound lanes: a left-turn lane, a through lane, and a right-turn lane. The left-turn lane would allow the intersection to operate with protected or protected-permissive left-turn phasing, consistent with current operations. Only one through lane in each direction is necessary for the expected demand. A right-turn-only lane would allow the pedestrian crossing of the intersection's north leg to be separated from right-turn traffic, if necessary. One eastbound departure lane (leaving 1st Ave S) would be wide enough (or would have buffer space) to allow for large truck-turning movements.

The intersection at S Lander St and 4th Ave S would also be designed to accommodate three westbound lanes: a left-turn lane, a through lane, and a through/right-turn lane. The inside eastbound lane on the bridge would transition to the left-turn lane at this intersection, and signage would be provided to alert motorists that they are approaching a turn lane.

2. INTRODUCTION TO ACOUSTICS

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 sound is perceived as unpleasant, unwanted, or disturbingly loud, it is considered noise.

Sound is measured in terms of both loudness and frequency. The unit used to measure loudness is called a decibel (dB). A range from 0 to 120 dB is the typical range of human hearing. To account for the human ear's sensitivity to frequencies, an adjustment is made to the dB measurement scale. The adjusted scale, referred to as the A-weighted decibel scale, provides a more accurate measurement of what the human ear can actually hear. When the A-weighted scale is used, the decibel levels are designated as dBA. Normal human conversation ranges between 44 and 65 dBA when people are about 3 to 6 feet apart. Very slight changes in noise levels are generally not detectable by the human ear. The smallest change in noise level that a human ear can readily perceive is about 3 dBA, while increases of 5 dBA or more are clearly noticeable. For most people, a 10-dBA increase in noise levels is judged as a doubling of sound level, while a 10-dBA decrease in noise levels means that the noise is perceived to be half as loud. Noise levels during the day in a noisy urban area are frequently as high as 70 to 80 dBA. Table 2-1 shows sound levels from some common noise sources and their relative loudness.

Table 2-1. 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-horse power 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
Garbage disposal, food blender (2 feet), Pneumatic drill (50 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 automobile traffic (100 feet)	50	Quiet	1/8 as loud
Bedroom or quiet living room Bird calls	40		1/16 as loud
Quiet library, soft whisper (15 feet)	30	Very quiet	
High quality recording studio	20		
Acoustic test chamber	10	Just audible	
	0	Threshold of hearing	

Sources: Beranek (1988) and EPA (1971).

Some additional factors are considered when performing an analysis of traffic noise:

- 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 is used in most noise ordinances.
- The minimum noise level during a measurement period is denoted “Lmin,” while the maximum noise level is denoted “Lmax.”
- Under free-field conditions, where there are no reflections or additional attenuations, sound from a point source is known to decrease at a rate of 6 dB for each doubling of distance. This is commonly known as the inverse square law. For example, a sound level of 70 dB at a distance of 100 feet would decrease to 64 dB at 200 feet.
- Traffic noise on a busy highway is considered a line source rather than a point source. Noise from a line source is reduced by 3 dB per doubling of distance. Therefore, a sound level of 73 dBA at 50 feet would decrease to 70 dBA at 100 feet.
- For vehicle speeds, each 10-mph speed increase typically results in an increase in the noise level of 3 dB; conversely, a reduction in speed of 10 mph would reduce noise levels by 3 dB.

Noise levels for multiple nearby sources are not additive. For example, combining two 60-dB noises does not result in a noise level of 120 dB (which is near the pain threshold), but rather 63 dB, which is lower than the volume at which most people listen to their televisions.

3. NOISE REGULATIONS

This section summarizes noise regulations applicable to the S Lander St Grade Separation Project, specifically the FHWA traffic noise regulations and the City of Seattle Noise Control Ordinance.

3.1 FHWA Traffic Noise Regulations

The FHWA traffic noise abatement criteria (NAC) are provided in Title 23 of the Code of Federal Regulations (CFR) Part 772, Procedures for Abatement of Highway Traffic Noise and Construction Noise. These federal regulations outline when a detailed noise analysis is required and the traffic noise levels that trigger consideration of noise abatement. A detailed noise study is only required for a project that meets specific criteria and is considered to be a Type 1 Project, as defined by the FHWA and outlined below.

For projects that are considered Type 1, on-site noise monitoring and traffic counts are performed and used to validate the FHWA TNM. In addition, the existing, future no-build, and future build traffic noise levels must be modeled using TNM and traffic information from project traffic engineers. Using the modeled traffic noise levels, areas that meet or exceed the NAC will be considered for noise abatement. The NAC are dependent on the land use; potential impacts are evaluated using noise levels during the peak traffic hour of the day. Details on the NAC and FHWA land use categories are provided below.

If a project is not considered Type 1, no noise analysis or modeling using TNM is typically performed.

3.1.1 FHWA Type 1 Projects

As noted above, a technical noise analysis is required only for projects that are classified as Type 1 Projects as defined under 23 CFR Part 772.5. For a project to be considered a Type 1 Project, it must include one or more of the following:

Line of Sight

Line of sight is the line between two points, such as a person (the receptor) and the roadway (traffic noise source).

1. The construction of a highway on a new location; or
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;
    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; or
3. The addition of a through-traffic lane(s). This includes the addition of a through-traffic lane that functions as an HOV lane, High-Occupancy Toll (HOT) lane, bus lane, or truck climbing lane; or,
4. The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane; or,
5. The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange; or,
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, ride-share lot or toll plaza.
8. If a highway or roadway project is determined to be a Type 1 Project under this definition, then the entire project area as defined in the environmental document is a Type 1 Project.

The only FHWA Type 1 study criterion that the S Lander St Grade Separation Project potentially meets is the change in the roadway's vertical alignment. For a change in the vertical alignment to be considered Type 1, the realignment must include the removal of shielding, or alteration of the topography, such that it exposes the line of sight between noise-sensitive receivers and the roadway, and would thereby increase noise levels. A detailed review of the existing conditions and a comparison to the future conditions was performed to determine if this project is a Type 1 Project under the definition above and if a detailed noise analysis would be required. To aid in the understanding of this review, a discussion of the FHWA traffic noise abatement criteria is provided below in Section 3.1.2.

The fact that a project meets the requirements for a Type 1 analysis does not mean that the project is required to consider noise abatement measures. For a Type 1 Project to be considered for noise abatement, the project must have future noise levels that are predicted to meet or exceed the appropriate noise abatement criteria, based on the land use of the receiving property. Furthermore, any noise abatement must also meet the WSDOT criteria for reasonable and feasible noise abatement.

3.1.2 FHWA Land Use Categories and Traffic Noise Abatement Criteria

The FHWA NAC are based on the land use of the property receiving the noise. Land uses that are considered more sensitive to noise have lower NAC levels than land uses that are less sensitive to noise. Consideration of noise abatement is required when noise levels during project operation are expected to approach or exceed the NAC for the applicable land use category. FHWA allows each state to define the term "approach" in this context; WSDOT defines "approach" to mean a noise level that is within 1 dB of the FHWA NAC. For example, the FHWA NAC for residential uses is an hourly Leq that approaches or exceeds 67 dBA; therefore, the Washington NAC (abbreviated as the WNAC) is an Leq of 66 dBA. Noise-sensitive properties are also considered for noise abatement if the hourly traffic noise level is predicted to increase by 10 dB or more between the existing and future build conditions.

Table 3-1 provides a summary of the FHWA Land Use Categories and identifies the NAC and WNAC for each. Some types of uses—including industrial, manufacturing, retail, and warehousing facilities—do not have a NAC, and therefore would not be included in a traffic noise analysis.

3.1.3 Noise Analysis Study Area

The study area for an FHWA traffic noise analysis is limited by the area in which project construction is planned to take place. The only time the study area extends outside the limits of construction is if the logical termini for noise abatement measures, such as noise walls, would also extend outside the limits of construction. Because this project has clearly defined limits of construction at 4th Ave S and 1st Ave S, these two streets form the east-west boundaries of the project study area for the traffic noise analysis.

Table 3-1. Noise Abatement Criteria (NAC) by Land Use Category

Activity Category	Activity Criteria in hourly Leq (dBA)		Evaluation Location	Activity Description
	FHWA NAC	WSDOT NAC		
A	57	56	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[1]	67	66	Exterior	Residential (single- and multi-family units)
C[1]	67	66	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings
D	52	51	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios
E[1]	72	71	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties, or activities not included in A-D or F
F	--[2]	--[2]	--[2]	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing
G	--[2]	--[2]	--[2]	Undeveloped lands that are not permitted

Notes: 1. Includes undeveloped lands permitted for this activity category.
2. There is no traffic noise analysis performed for Land Use Activity Category F or G.

The northern and southern boundaries of the study area are determined by the potential for noise from the new bridge structure to meet or exceed the NAC. To ensure that all potentially affected properties were included in this analysis, a simple modeling process was used to determine the distance from the new elevated roadway to a point where noise levels would be below the WSDOT NAC for Category E (71 dBA Leq). The modeling process used the projected future traffic volumes and assumed a direct line of sight from the elevated roadway to the affected properties. Based on this process, properties within approximately 75 feet of the roadway would have noise levels at or above WSDOT Category E (71 dB Leq) from traffic on S Lander St. However, to ensure that all potential land uses that could be affected were included, properties out to 750 feet from the roadway were included in the project study area.

3.2 Seattle Noise Ordinance

3.2.1 Maximum Permissible Noise Levels

The City of Seattle has maximum permissible environmental noise level requirements that are found in the Seattle Municipal Code [SMC] Chapter 25.08; SMC Section 25.08.410. These noise levels are shown in Table 3-2. Similar to the FHWA NAC, the maximum permissible noise levels are based on the land use of the receiving property, as defined by the Washington State Environmental Designation for Noise Abatement (EDNA) in Chapter 173-60 of the Washington Administrative Code. The City explicitly mandates that the Leq descriptor be used. In addition, during a measurement interval, maximum noise levels (Lmax) may exceed the Leq exterior sound level limits shown in Table 3-2 by no more than 15 dBA (SMC Section 25.08.410(B)). From 10:00 pm to 7:00 am, on weekdays, and 9:00 am on weekends and legal holidays, the allowable maximum sound levels shown in Table 3-2 are reduced by 10 dBA in Class A EDNAs (residential zones).

Table 3-2. Maximum Permissible Noise Levels: Seattle Noise Control Ordinance

	EDNA Receiver of Noise (Maximum Allowable Sound Level in dBA Leq)		
EDNA Source of Noise	**Residential**	**Commercial**	**Industrial**
Class A Residential	55	57	60
Class B Commercial	57	60	65
Class C Industrial	60	65	70

3.2.2 Construction Noise Criteria

Under SMC Section 25.08.425, the sound level limits established by SMC Section 25.08.410 may be exceeded for non-impact construction equipment used on public projects, such as the S Lander St Grade Separation Project, between 7:00 am and 10:00 pm on weekdays, and between 9:00 am and 10:00 pm on weekends and legal holidays, by no more than the following:

- 25 dBA for equipment on construction sites, including, but not limited to, crawlers, tractors, dozers, rotary drills and augers, loaders, power shovels, cranes, derricks, graders, off-highway trucks, ditchers, trenchers, compactors, compressors, and pneumatic-powered equipment.
- 20 dBA for portable-powered equipment used in temporary locations in support of construction activities or used in the maintenance of public facilities, including, but not limited to, chainsaws, log chippers, lawn and garden maintenance equipment, and hand-powered tools.
- 15 dBA for powered equipment used in temporary or periodic maintenance or repair of the grounds and appurtenances of residential property, including, but not limited to, lawnmowers, powered hand tools, snow-removal equipment, and composters.

For impact types of equipment, including, but not limited to, pavement breakers, pile-drivers, jackhammers, sandblasting tools, or other types of equipment that create impulse sound or impact sound, the sound level limits established by SMC Section 25.08.425 may be exceeded in any 1-hour

period between 8:00 am and 5:00 pm on weekdays and 9:00 am and 5:00 pm on weekends and legal holidays, but in no event may the sound level for impact types of equipment exceed the following:

- Leq 90 dBA continuously
- Leq 93 dBA for 30 minutes
- Leq 96 dBA for 15 minutes
- Leq 99 dBA for 7.5 minutes

Sound levels in excess of Leq 99 dBA are prohibited unless authorized by variance. Construction impact equipment that produces sound levels less than 90 dBA must comply with sound level requirements for non-impact equipment between 7:00 am and 8:00 am, and again between 5:00 pm and 10:00 pm on weekdays, and between 9:00 am and 10:00 pm on weekends and legal holidays.

The sound levels for all types of construction equipment are measured at the property line of the receiver or at a distance of 50 feet from the equipment making the sound, whichever is greater. Furthermore, any type of equipment that exceeds the sound level limits in SMC Section 25.08.410, when measured from the interior of buildings within a commercial district, is prohibited between 8:00 am and 5:00 pm.

3.2.3 Haul Truck Noise Criteria

Sounds created by motor vehicles on public roadways, including haul trucks, are exempt from Seattle's previously described maximum permissible environmental noise levels. Instead, maximum permissible sound levels for haul trucks on public roadways are simply limited to 95 dBA (SMC Section 25.08.430 et seq.).

3.2.4 Noise Related to Back-Up Alarms

Sounds created by warning devices or alarms not operated continuously for more than 30 minutes per incident are exempt from the City of Seattle noise control requirements (SMC Section 25.08.530). For nighttime construction activity, the noise from the alarms would be addressed in permit conditions.

4. AFFECTED ENVIRONMENT

Figure 4-1 shows an overview of the project study area with land use classifications based on the FHWA criteria provided in Table 3-1. If the same parcel has two different land uses, the land use with the more stringent NAC is applied. Figure 4-1 shows the limits of project construction, the FHWA land use category for all land uses within 750 feet north and south of the new bridge, and the distance from the project limits (75 feet) within which noise levels would be at or above the NAC for FHWA Category E. The methods used to establish the study area are identified in section 3.1.3.

The BNSF Railway's mainline tracks are oriented in a north-south alignment through the heart of the project area. Freight trains, Amtrak passenger trains, and Sound Transit commuter trains share these tracks. Four east-west streets in SODO cross the mainline tracks at-grade: S Holgate St, S Lander St, S Horton St, and S Spokane St. Also, many rail siding and switching tracks spur off the mainline to reach local businesses or rail maintenance facilities. One switch track crosses S Lander St to reach the Republic Services recycling center and MacMillan-Piper distribution center at 150 S Horton St. Multiple tracks cross S Holgate St to serve the Amtrak and Sound Transit maintenance facilities.

Two north-south principal arterials—1st Ave S and 4th Ave S—flank each side of the mainline tracks. These arterials connect from E Marginal Way S near S Michigan St on the south through downtown Seattle on the north. Two local streets—Occidental Ave S and 3rd Ave S—provide local access to businesses located west and east of the tracks, respectively. Many driveways along S Lander St serve adjacent businesses. Most of the businesses have alternative access on an adjoining north-south street. The exception is Pacific Galleries, which has two parking lot driveways and an inactive, permanently disabled freight-loading door on S Lander St with no alternative access.

The existing roadway has a pavement width of 76 feet curb-to-curb, with an overall right-of-way width of 100 feet. The roadway has two travel lanes in both the eastbound and westbound directions, separated by a middle two-way left-turn lane, and parallel parking on both roadsides.

4.1 Land Use

Traffic noise studies applying the FHWA criteria use the actual land use as defined in Table 3-1 to determine the NAC, not the property's zoning designation in the City's Land Use Code. Therefore, the land uses identified in Figure 4-1 are based on on-site visits and a review of addresses and area mapping. It is important to note that the only areas considered for traffic noise analysis under FHWA's method are those structures within the limits of construction as defined in Section 3.1.3. As is identified on Figure 4-1, the study area for traffic noise is limited to structures between 4th Ave S and 1st Ave S. Based on this review, the land use in the study area is composed of FHWA Categories E and F, including manufacturing, industrial warehouses, offices, restaurants, and retail businesses.

Because residential uses (Category A) have a higher level of protection under the FHWA criteria, the study area was extensively reviewed to determine if there are any residences located along or near the project corridor. No residences were identified. Under SMC 23.50.014, the only residential use allowed in study area zoning designations is live-work artist studios, which are permitted as a conditional use only in buildings that existed before 1987. One building in the corridor, located on the southeast corner of the S Lander St/1st Ave S intersection, includes artist studios; however, further research has shown that these units are non-live-in spaces for artists, photographers, and designers. Thus, the project analysts concluded that there are no residences within the study area that currently have, or will have, a line of sight to S Lander St.

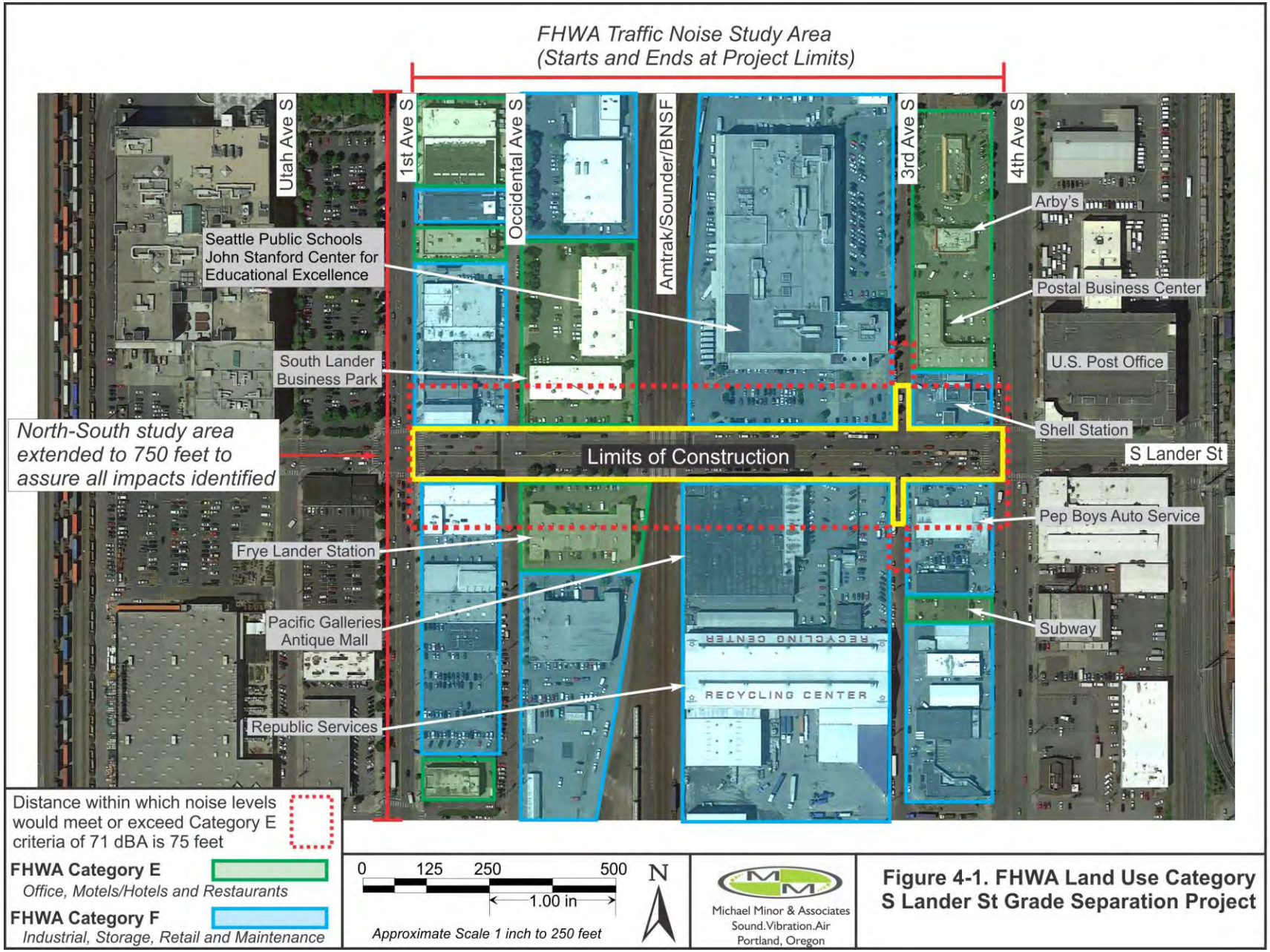

Figure 4-1. FHWA Land Use Category
S Lander St Grade Separation Project

Analysts also evaluated whether there were any institutional uses (FHWA Category D) in the study area. The Seattle Public Schools facility north of S Lander St is not a school, so does not qualify as Category D. The facility has large loading docks and multiple medium and heavy trucks on site, along with School District office space. Sites that have multiple uses, like this facility, are categorized based on whether or not the site generates significant noise. Because of the number of trucks accessing the facility, and the fact that those trucks are major contributors to the overall noise environment, the Seattle Public Schools facility falls under FHWA Category F. The Universal Life Church Monastery on Occidental Ave S is an office for an on-line church community, and no worship activities occur at this location. Therefore, the Universal Life Church Monastery is considered FHWA Category E rather than Category D.

As described in section 3.1.3, only those properties within approximately 75 feet north and south of S Lander St would have noise levels at or above the NAC for Category E (71 dB Leq). This distance was estimated assuming a direct line of sight to the new bridge. While noise from the roadway would still be audible beyond 75 feet, this noise would diminish with distance; receivers located more than 300 to 500 feet from S Lander St would be dominated by noise from other, closer roads and other unrelated commercial and industrial activities. Receivers located more than 500 feet from S Lander St are not likely to be affected by noise from the proposed S Lander St bridge, even with a new line of sight to the roadway.

4.2 Existing Noise Environment

Existing noise levels in the project area are currently dominated by traffic on S Lander St and other nearby major and minor arterial roadways. Other major noise sources include rail traffic, crossing gate bells, train horns, loading/unloading docks and truck activity at Republic Services, Seattle Public Schools John Stanford Center for Educational Excellence, and other industrial use activities, along with background noise from traffic on Interstate 5 and Alaskan Way. Other contributing noise sources include noise from commercial activities, construction projects, shipping and receiving at the Port of Seattle, aircraft overflights, and other miscellaneous activities associated with commercial and industrial areas.

In a draft report for an earlier design of the S Lander St Grade Separation Project (Geomatrix 2007), noise modeling estimated that traffic noise levels in 2007 ranged from 63 to 68 dBA. No actual measurement of noise was made for that analysis; noise levels were modeled based on existing traffic volumes. Actual noise levels would likely be much higher, because the FHWA TNM used assumes generally smooth-flowing traffic and does not account for any other noise sources in the area. Actual noise levels in the area are expected to range from 72 to 78 dBA when other noise sources, such as train traffic, train horns, heavy truck noise (from acceleration), industrial and commercial activities, aircraft overflights, and construction activities, are included.

5. CONSTRUCTION IMPACTS AND MITIGATION MEASURES

During construction, noise would result from the operation of heavy equipment needed to build the bridge structure, roadways, and various project features, such as retaining walls and sidewalks. These impacts would be localized in areas of active construction and would end when project construction is completed. Construction activities would be required to comply with the City of Seattle Noise Control Ordinance. Any construction noise that is above the permissible levels identified in the City of Seattle Noise Control Ordinance, outlined in Sections 3.2 through 3.2.4, would require a temporary noise variance from the City of Seattle.

5.1 Construction Equipment and Noise Levels

Equipment required to complete the S Lander St Grade Separation Project would include equipment typically used for transportation construction projects. Table 5-1 lists the typical equipment used for this type of project, the activities it would be used for, and the corresponding maximum noise levels that would be produced when measured at 50 feet from the sources under normal use.

Table 5-1. Construction Equipment and Reference Noise Levels

Equipment	Expected Project Use	Lmax[a] (dBA)
Air compressors	Pneumatic tools and general maintenance	70 to 76
Backhoe	General construction and yard work	78 to 82
Concrete pump	Pumping concrete	78 to 82
Concrete saws	Concrete removal and utilities access	75 to 80
Crane	Materials handling: removal and replacement	78 to 84
Excavator	General construction and materials handling	82 to 88
Forklifts	Staging area work and hauling materials	72
Haul trucks	Materials handling: general hauling	86
Jackhammers	Pavement removal	74 to 82
Loader	General construction and materials handling	86
Oscillator drill	Drilling roadway shafts	82 to 88
Pavers	Roadway paving	88
Power plants	General construction use: nighttime work	72
Pumps	General construction use: water removal	62
Pneumatic tools	Miscellaneous construction work	78 to 86
Tractor trailers	Material removal and delivery	86
Utility trucks	General project work	72
Vibratory equipment	Soil compacting	82 to 88
Welders	General project work	76

[a] Typical maximum noise level under normal operation as measured at 50 feet from the noise source.

dBA = decibel with A-weighting, Lmax = maximum noise level

Roadway and bridge construction projects typically involve several primary activity types, including demolition, active construction, and miscellaneous activities. The FHWA Construction Noise Model (FHWA 2006) was used to provide an estimate of the project construction noise levels during these activities, as well as to predict the maximum noise levels for each. These noise levels are shown in

Table 5-2. The actual noise levels experienced during construction would generally be lower than those described in Table 5-2 because these are the maximum noise levels for each activity. The noise levels presented here are for short periods of maximum construction activity and would occur for a limited period of time.

Table 5-2. Noise Levels for Typical Construction Phases

Scenario[1]	Equipment[2]	Lmax[3]	Leq[4]
Demolition, site preparation, and utilities relocation	Air compressors, backhoes, concrete pumps, cranes, excavators, forklifts, haul trucks, loaders, pumps, power plants, service trucks, tractor trailers, utility trucks, and vibratory equipment	88	87
Structures construction, track installation, and paving activities	Air compressors, backhoes, cement mixers, concrete pumps, cranes, forklifts, haul trucks, loaders, oscillator, pavers, pumps, power plants, service trucks, tractor trailers, utility trucks, vibratory equipment, and welders	88	88
Miscellaneous activities	Air compressors, backhoes, cranes, forklifts, haul trucks, loaders, pumps, service trucks, tractor trailers, utility trucks, and welders	86	83

1. Operational conditions under which the noise levels are projected.
2. Normal equipment in operation under the given scenario.
3. Lmax (dBA) is the highest maximum noise level for the construction equipment listed under the given scenario.
4. Leq (dBA) is a 1-hour energy average noise emission for construction equipment operating under the given scenario.

5.2 Construction Noise Mitigation

The contractor would be required to comply with the City of Seattle Noise Control Ordinance for construction during daytime hours (see Section 3.2). Any construction activities outside the allowable levels and/or times stipulated in the noise ordinance would require a noise variance from the City. If noise control mitigation is required to meet the requirements of the noise ordinance, actions may include:

- Use low-noise emission equipment.
- Implement noise-deadening measures for truck loading and operations.
- Ensure all equipment is equipped with proper mufflers.
- Minimize idling times for equipment.
- Locate stationary equipment away from noise-sensitive uses if possible.
- Monitor and maintain equipment to meet noise limits.

6. OPERATIONAL IMPACTS AND MITIGATION MEASURES

Operational noise from the proposed project was evaluated in two steps. The first step was to determine the level of analysis required by FHWA and WSDOT. During this first step, the project and project-related improvements were reviewed using the criteria described in Section 3.1.1 to determine if the project meets FHWA's requirements for a Type 1 noise analysis. Projects that meet these requirements have the potential to cause new noise impacts or increase the severity of existing impacts, and therefore are required to model existing, future no-build, and future build traffic noise levels using the FHWA TNM. For projects that do not meet the requirements for a Type 1 noise analysis, no detailed analysis or modeling with TNM are needed.

6.1 FHWA Type 1 Analysis

The project would extend from 1st Ave S on the west to 4th Ave S on the east. The approximately 68-foot-wide, grade-separated structure would have four vehicle lanes (two lanes in each direction) and a multi-use path for nonmotorized traffic. The proposed bridge must clear all BNSF railroad tracks by 23.5 feet and a future Amtrak rail line by 22.5 feet; the desired maximum grade for the roadway is 7 percent. The bridge approaches would meet Occidental Ave S about 8 to 9 feet above the existing street grade, which would eliminate the existing intersection. The distance between the railroad tracks and 3rd Ave S to the east would allow the intersection at S Lander St/3rd Ave S to be maintained by raising 3rd Ave S by 2 to 3 feet.

The proposed alignment would be offset from the existing centerline of the roadway by 6 feet. For the area between the railroad tracks and 3rd Ave S, a two-way surface street would connect from 3rd Ave S south of S Lander St to the Seattle Public Schools property. This roadway would also provide local access to properties south of the new bridge structure. Figure 1-2 shows an overview of the proposed alignment and Figure 1-3 shows the proposed cross section for the bridge.

6.1.1 Review of Changes to Vertical and Horizontal Alignment

The required clearance of an elevated structure over the railroad tracks is approximately 24 feet; therefore, the new elevation of the roadway surface would be approximately 30 to 32 feet above the existing grade. This increase in roadway elevation could allow noise from the new elevated roadway to propagate to receiver locations that are currently shielded by existing structures. Based on this fact, the primary concern is that there could be increased traffic noise at receivers that are currently shielded from S Lander St by existing buildings.

Between 4th Ave S and 3rd Ave S on the north side of S Lander St, the land use adjacent to S Lander St is a Shell automotive service station (FHWA Category F), with FHWA Category E offices and restaurants located north of the service station. The L-shaped building directly behind the Shell station, which contains Category E offices and restaurants, has solid concrete block construction facing S Lander St, which blocks noise on the southern side of the building. The side of the building adjacent to 4th Ave S has no external uses except the entrances, which would remain shielded from the elevated roadway by the building structure. The elevation of S Lander St at 3rd Ave S is only 6 feet higher than the existing roadway, and the building is well over 16 feet high. Directly north of the L-shaped building is an Arby's restaurant; however, this restaurant is more than 350 feet from S Lander St, which is far beyond the 75-foot distance at which FHWA Category E noise levels would be exceeded during project operation. Moreover, the restaurant has no exterior use, and the noise levels at this site are now, and will continue

to be, dominated by traffic on 4th Ave S. Based on this analysis, there are no noise-sensitive uses between 4th Ave S and 3rd Ave S to the north of S Lander St.

Between 4th Ave S and 3rd Ave S on the south side of S Lander St, there is a Pep Boys auto service shop (FHWA Category F) located immediately south of S Lander St, with a glass shop (FHWA Category F) and a Subway restaurant (FHWA Category E) located south of Pep Boys on 4th Ave S, approximately 250 feet south of S Lander St. At this location, there would be no change in the elevation of S Lander St compared to existing conditions and no new line of sight to any of these businesses.

Between 3rd Ave S and the railroad tracks, the elevation of the new roadway would range from 6 feet near 3rd Ave S to 31 feet near the railroad crossing. On the north side of S Lander St, the only structures are the Seattle Public Schools headquarters and maintenance building (FHWA Category F). The headquarters building is over 40 feet high, and elevating S Lander St for the overpass would not result in any new line of sight to the property. On the south side of S Lander St is a two-story FHWA Category F commercial and retail structure that houses the Pacific Galleries Antique Mall. Because the elevated roadway may slightly exceed the height of the building, the overpass could result in a new line of sight to the structure directly south of Pacific Galleries. However, this structure is the Republic Services recycling center, which is an FHWA Category F (industrial) land use and is therefore not considered noise-sensitive. Finally, as shown on Figure 4.1, the distance to the impact criteria would not extend to any of the Category E land uses and no noise impacts would be predicted even if the line of sight was broken. Based on the land uses and structure heights in this area, there would be no loss of shielding between 3rd Ave S and the railroad tracks. Figure 6-1 is a rendering of the view looking west from the southeast corner of the 3rd Ave S/S Lander St intersection, along the south side of S Lander St, showing the relative heights of the new bridge and the adjacent buildings.

(Simulation by HBB)

Figure 6-1. Visual Simulation Looking West from 3rd Ave S and S Lander St

Between the existing rail crossing and Occidental Ave S, the roadway elevation would range from approximately 30 to 32 feet above grade at the rail crossing to approximately 8 to 9 feet above grade at Occidental Ave S. North of S Lander St in this area is the South Lander Business Park, which houses

several offices (FHWA Category E). Directly behind the main business park building on S Lander St is a second building, which was also assumed to be an office building (Category E). Behind the second building is an industrial distributor (FHWA Category F). At the eastern end of the South Lander Business Park, the new bridge roadway surface would be 25 feet above the existing grade and could create a new line of sight to the rear of the second building. However, this line of sight would only occur along the railroad tracks, and there is no exterior use at the rear of the building. The front of the second building at the South Lander Business Park would continue to be shielded from S Lander St because the roadway elevation would be 10 feet in that location, while the building height is over 16 feet.

On the south side of S Lander St between the rail crossing and Occidental Ave S is an office building (FHWA Category E), with a distribution building (FHWA Category F) located directly behind. As described above for the properties north of S Lander St, the height of the new overpass in this location would create the potential for a new line of sight near the railroad tracks at the second building. However, because part of this building near the railroad tracks is FHWA Category F, it is not considered a noise-sensitive use and no noise study is required.

Between Occidental Ave S and 1st Ave S, the new S Lander St overpass would be 8 to 9 feet above the existing grade at Occidental, sloping down to meet the existing grade at 1st Ave S. The new structure would not be high enough to cause a new line of sight over the buildings north and south of the roadway because both are three-story buildings with heights well above the elevation of the overpass.

Because the new bridge would not result in new lines of sight between the roadway and any noise-sensitive uses, the change in vertical alignment would not meet the minimum requirement for Type 1 analysis in the FHWA criteria.

In addition to the change in the vertical alignment, the project would also move the horizontal alignment of S Lander St to the north by approximately 6 feet. This shift would result in the roadway centerline being closer to the Seattle Public Schools facility east of the railroad tracks and to the South Lander Business Park west of the tracks. The front of the Seattle Public Schools building (FHWA Category F) is over 150 feet from the roadway centerline, and the front of the southernmost building in the South Lander Business Park (FHWA Category E) is over 90 feet from the centerline. A northward shift of the centerline by 6 feet would not halve the distance between the roadway and these receivers; therefore, no measurable change in noise levels is expected, and the shift in horizontal alignment would not meet the minimum requirement for Type 1 analysis in the FHWA criteria.

6.1.2 Existing and Future Operational Noise Levels

Because the project does not qualify for a Type 1 noise analysis under FHWA regulations, no traffic noise modeling was performed. However, to aid in the understanding of the project effects, future noise levels are discussed and estimated for reference.

Noise levels in the project area are currently dominated by traffic on S Lander St and other nearby major and minor arterial roadways, railroad traffic, as well as background noise from traffic on Interstate 5 and Alaskan Way. These would continue to be the dominant noise sources in the future, with or without the proposed project.

The proposed project would change the existing noise characteristics somewhat through the addition of the new bridge. Noise from traffic on elevated structures is typically 2 to 3 dB louder than noise from at-grade alignments. Furthermore, because traffic would be elevated, noise from the traffic may carry slightly farther when compared to the existing at-grade alignment. However, given the existing traffic noise levels and rail traffic, any changes in noise levels (increases or decreases) are not likely to be

noticeable to people in adjacent buildings, pedestrians, bicyclists, or those traveling through the corridor in vehicles. The structural shielding from existing buildings would prevent most noise levels from propagating far from the corridor, and the slight reduction in shielding near the center of the overpass would not result in a notable increase in noise levels.

Train-related noise would continue to be part of the noise environment in the project area. However, there would be a reduction in train-related noise sources. The new bridge would eliminate the current requirement for trains to sound horns for the at-grade crossing at S Lander St, and the crossing bells and gates would be removed.

Overall, the noise environment with the project in place is expected to remain about the same as it is today because the traffic noise levels and train traffic in the area would continue to be the primary noise sources.

6.2 Operational Noise Mitigation

Because there are no sites where a noise-sensitive property would have a new line of sight to the proposed elevated S Lander St overpass, and the change in the horizontal alignment would only be approximately 6 feet north of the existing roadway centerline, the project does not meet the FHWA criteria for a Type 1 noise study. Therefore, a detailed noise analysis was not performed for the S Lander St Grade Separation project. Based on the existing noise levels and potential future noise levels, there is not expected to be a noticeable change in the overall noise environment, and no mitigation measures would be needed. It is important to note that noise from the at-grade crossing bells and gates, along with the required train horn at the crossing, would no longer be necessary, and those very noticeable noise sources would no longer be present.

7. CONCLUSION

Construction of the project would produce temporary noise levels similar to those of typical roadway and highway projects. Construction activities would be required to meet the City of Seattle Noise Control Ordinance. Any construction noise levels above those specified in the ordinance would require a construction noise variance from the City of Seattle. In addition, construction activities construction outside permissible hours of 7:00 am and 10:00 pm on weekdays, and between 9:00 am and 10:00 pm on weekends and legal holidays would require a noise variance from the City.

Because there are no sites where a noise-sensitive property would have a new line of sight to the proposed elevated S Lander St overpass, and the change in the horizontal alignment would only be approximately 6 feet, the project does not meet the FHWA criteria for a Type 1 noise study. Therefore, a detailed noise analysis was not performed for this project. Based on the existing noise levels and potential future noise levels, there is not expected to be a noticeable change in the overall noise environment. However, it is important to note that noise from the at-grade crossing bells and gates, along with the required train horn at the crossing, would no longer be necessary, and those very noticeable noise sources would no longer be present.

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