Noise and Vibration Technical Report

Multnomah County | Earthquake Ready Burnside Bridge Project

Portland, OR

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Earthquake Ready Burnside Bridge Noise and Vibration Technical Report

Prepared for

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CERTIFICATION

The technical material and data contained in this document were prepared under the supervision and direction of the undersigned, whose seal, as a professional engineer licensed to practice as such, is affixed below.

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Acronyms, Initialisms, and Abbreviations

AGL	above ground level
API	Area of Potential Impact
CFR	Code of Federal Regulations
dB	decibel
dBA	A-weighted decibel
EIS	Environmental Impact Statement
EQRB	Earthquake Ready Burnside Bridge
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GIS	geographic information system
I-5	Interstate 5
Leq	equivalent sound level
Leq(h)	hourly equivalent sound level
LiDAR	light detection and ranging
LOS	level of service
NAAC	Noise Abatement Approach Criteria
NAC	Noise Abatement Criteria
ODOT	Oregon Department of Transportation
PPV	peak particle velocity
QNM	Quarry Noise Model
RCNM	Roadway Construction Noise Model
TNM	Traffic Noise Model
VdB	vibration decibels

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Executive Summary

The Earthquake Ready Burnside Bridge Project (EQRB) proposes to rebuild or replace the Burnside Bridge with an earthquake resistant structure that can withstand a major Cascadia Subduction Zone earthquake. In support of an Environmental Impact Statement (EIS) pursuant to the National Environmental Policy Act, noise and vibration levels associated with the construction and operation of the Project's four Build Alternatives were calculated and compared to the Existing Conditions and No-Build Alternative to determine the potential for impacts.

Exterior Existing Condition (2019) traffic noise levels range from 59 A-weighted decibels (dBA) hourly equivalent sound level (Leq(h)) to 74 dBA Leq(h) and exceed the Oregon Department of Transportation (ODOT) noise abatement approach criteria (NAAC) at 267 residences or shared outdoor recreation areas at apartments, Tom McCall Waterfront Park, and the Vera Katz Eastbank Esplanade. For receptors where there is no exterior use, such as at places of worship and the University of Oregon Portland Campus, interior noise levels would range from 40 dBA Leq(h) to 43 dBA Leq(h) with none of these locations exceeding the NAAC. Traffic noise in the area is predominantly caused by traffic on Interstate 5 (I-5) and not from traffic on Burnside Street.

The No-Build Alternative, Enhanced Seismic Retrofit Alternative, and the two Replacement Alternatives with Short-span or Long-span Approaches (2045) would share the same alignment and traffic counts; therefore, these four Alternatives would have traffic noise levels similar to the Existing Condition. Exterior levels would range from 59 dBA Leq(h) to 75 dBA Leq(h) and are predicted to exceed the NAAC at 267 residences or shared outdoor recreation areas at apartments, Tom McCall Waterfront Park, and the Vera Katz Eastbank Esplanade. For receptors where there is no exterior use, such as at places of worship and the university, interior noise levels would range from 40 dBA Leq(h) to 43 dBA Leq(h) with none of these locations exceeding the NAAC. Under these Alternatives, noise levels are predicted not to change, on average, relative to the Existing Conditions.

The Replacement Alternative with Couch Extension (2045) noise levels would range from 60 dBA Leq(h) to 75 dBA Leq(h) and impacts would occur at 261 residences or shared outdoor recreation areas at apartments, Tom McCall Waterfront Park, and the Vera Katz Eastbank Esplanade. For receptors where there is no exterior use, such as at places of worship and the university, interior noise levels would range from 40 dBA Leq(h) to 43 dBA Leq(h) with none of these locations exceeding the NAAC. Relative to the Existing Conditions, some noise levels would increase and decrease by as much as 5 decibels (dB). Similar changes in sound levels are anticipated relative to the No-Build Alternative, ranging from a 5 dB decrease to a 5 dB increase in 2045. The reason for these changes is due to changes in the roadway alignment such as moving the westbound travel lanes further from and closer to sensitive receptors on the south and north sides of The Yard Apartment high rise, respectively.

Build Alternatives noise impacts were evaluated for noise abatement in the form of noise walls on the Burnside Bridge. Noise walls were found to be infeasible because they would not reduce traffic noise levels by at least 5 dB at over 50 percent of impacted receptors. The reason for insufficient noise reduction is because traffic noise would predominantly be from I-5, a roadway that would not be altered as part of EQRB or shielded by noise walls on Burnside Bridge.

Construction noise and vibration impacts may result from EQRB; implementing the 2021 ODOT's standard construction specifications and other mitigation measures would reduce and/or eliminate some of the impacts. Additionally, EQRB's construction contractor will be required to obtain a City of Portland noise variance permit, which will place further restrictions on EQRB noise to protect the surrounding community. Finally, vibration from construction activities would be kept below the impact thresholds identified in this report by using alternate construction methods, monitoring vibration levels when construction has the potential to damage structures, and/or by using hand tools where necessary.

The Project area does not contain undeveloped land; however, Category E and F land uses that do not have exterior uses could change with future development. Predicted sound levels for the portions of these areas closest to the dominant noise source (i.e., Naito Parkway or I-5) were calculated for the Build Alternatives worst noise hour and would be 64 dBA Leq(h) for areas along Naito Parkway at a distance of 18 feet, and 74 dBA Leq(h) along I-5 at a distance of 105 feet. This information, along with a copy of this report, will be sent to the City of Portland Planning Department and ODOT and will serve to inform local governments of the effects of the proposed Project on local noise levels.

1 Introduction

As a part of the preparation of the Environmental Impact Statement (EIS) for the Earthquake Ready Burnside Bridge (EQRB) Project, this technical report has been prepared to identify and evaluate potential noise and vibration impacts within the Project's Area of Potential Impact (API). See Section 3 for general definitions of the API and Section 5.1 for the noise API.

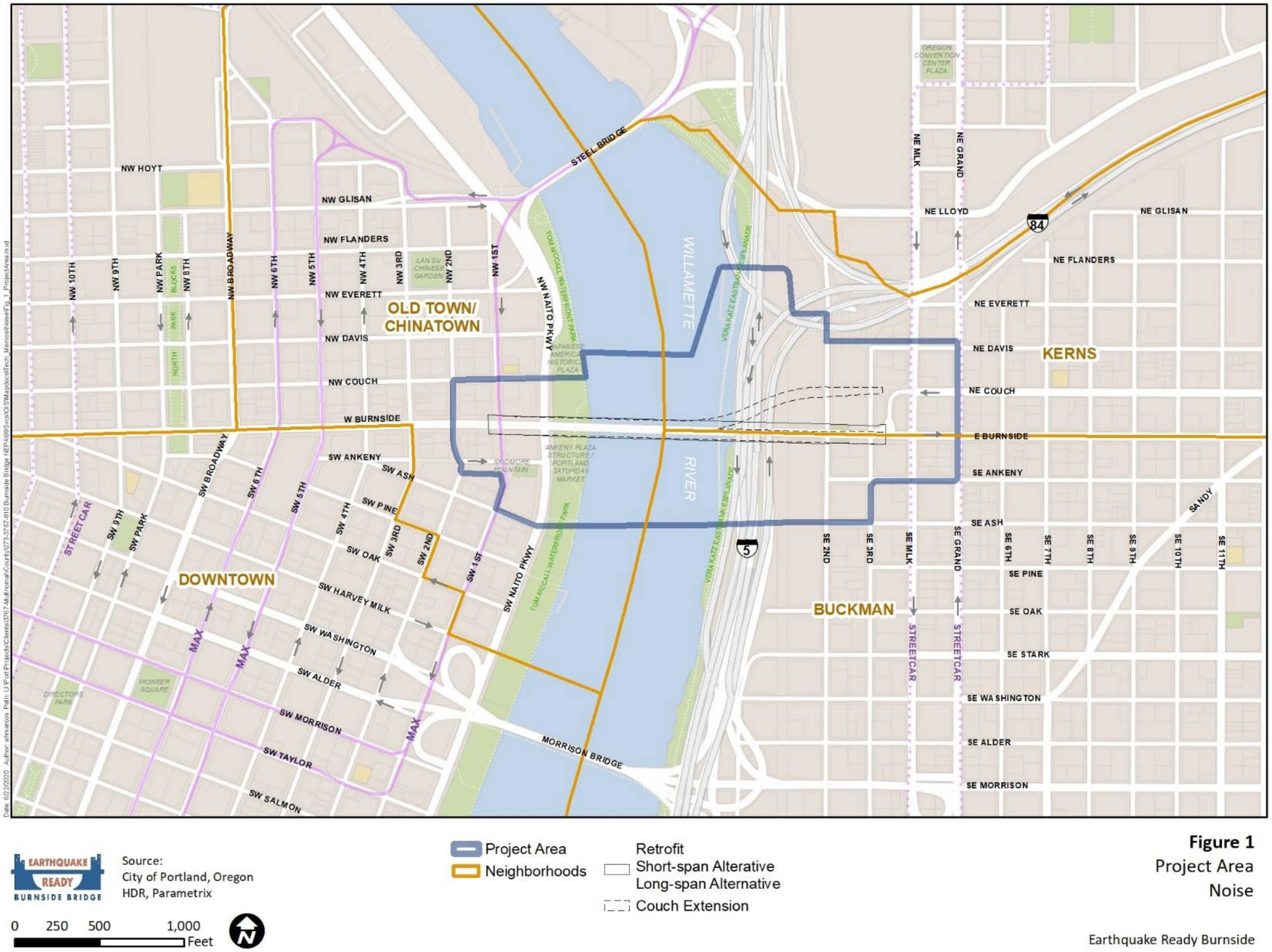
1.1 Project Location

As shown in Figure 1, the Project Area is located within the central part of the City of Portland. The existing Burnside Bridge crosses the Willamette River connecting the west and east sides of the city. The Project Area encompasses a one-block radius around the existing Burnside Bridge and W/E Burnside Street, from NW/SW 3rd Avenue on the west side of the river to NE/SE Grand Avenue on the east side. Several neighborhoods surround the area, including Old Town/Chinatown, Downtown, Kerns, and Buckman.

1.2 Project Purpose

The primary purpose of the Project is to build a seismically resilient Burnside Street lifeline crossing over the Willamette River that would remain fully operational and accessible for vehicles and other modes of transportation following a major Cascadia Subduction Zone (CSZ) earthquake. The proposed modified Burnside Bridge is planned to provide a reliable crossing for emergency response, evacuation, and economic recovery after an earthquake, and provide a long-term safe crossing with low-maintenance needs.

Figure 1. Project Area



2 Project Alternatives

The project alternatives' design, operations, and construction assumptions are described in detail in the draft *EQRB Description of Alternatives Report*. That report describes the alternatives' current design as well as operations and construction assumptions.

The EIS evaluates the No-Build Alternative and four Build Alternatives. Among the Build Alternatives, there is an Enhanced Seismic Retrofit Alternative that would replace certain elements of the existing bridge and would retrofit other elements. There are three Replacement Alternatives that would completely remove and replace the existing bridge. In addition, the EIS considers options for managing traffic during construction. Nomenclature for the alternatives/options are:

- No-Build Alternative
- Build Alternatives:
  - Enhanced Seismic Retrofit (Retrofit Alternative)
  - Replacement Alternative with Short-span Approach (Short-span Alternative)
  - Replacement Alternative with Long-span Approach (Long-span Alternative)
  - Replacement Alternative with Couch Extension (Couch Extension Alternative)
- Construction Traffic Management Options
  - Temporary Detour Bridge Option (Temporary Bridge) includes three modal options:
    - Temporary Bridge: All modes
    - Temporary Bridge: Transit, Bicycles and Pedestrians only
    - Temporary Bridge: Bicycles and Pedestrians only
  - Without Temporary Detour Bridge Option (No Temporary Bridge)

3 Definitions

The following terminology will be used when discussing geographic areas in the EIS:

- **Project Area –** The area within which improvements associated with the Project Alternatives would occur and the area needed to construct these improvements. The Project Area includes the area needed to construct all permanent infrastructure, including adjacent parcels where modifications are required for associated work such as utility realignments or upgrades. For the EQRB Project, the Project Area includes approximately a one-block radius around the existing Burnside Bridge and W/E Burnside Street, from NW/SW 3rd Avenue on the west side of the river and NE/SE Grand Avenue on the east side.
- **Area of Potential Impact –** Area of Potential Impact (API) - This is the geographic boundary within which physical impacts to the environment could occur with the

Project Alternatives. The API is resource-specific and differs depending on the environmental topic being addressed. For all topics, the API will encompass the Project Area, and for some topics, the geographic extent of the API will be the same as that for the Project Area; for other topics (such as for transportation effects) the API will be substantially larger to account for impacts that could occur outside of the Project Area. The API for noise and vibration is defined in Section 5.1.

- **Project vicinity –** The environs surrounding the Project Area. The Project vicinity does not have a distinct geographic boundary but is used in general discussion to denote the larger area, inclusive of the Old Town/Chinatown, Downtown, Kerns, and Buckman neighborhoods.

4 Legal Regulations and Standards

4.1 Laws, Plans, Policies, and Regulations

The following is a list of federal, state, and local laws, regulations, plans, and policies that guide or inform the assessment of noise and vibration:

- Federal laws or regulations related to the National Environmental Policy Act of 1969 compliance or resource protection
- 23 Code of Federal Regulations (CFR) 772
- Oregon Department of Transportation Noise Manual (ODOT 2011)
- City of Portland Charter and Code, Title 18 Noise Control and Title 33.262.050 Noise
- Federal Transit Administration (FTA) Noise and Vibration Impact Assessment Manual (FTA 2018)

4.2 Design Standards

The potential for noise impact from the Project was assessed in accordance with the Federal Highway Administration (FHWA) and ODOT noise assessment regulations and guidelines. The FHWA regulations are set forth in 23 CFR Part 772 (FHWA 2011), which also defines the federal highway aid projects classified as Type I. FHWA defines a Type I project as one of the following:

- The construction of a new highway on a new location.
- The physical alteration of an existing highway where there is either a substantial horizontal or vertical alteration.
- The addition of through-traffic lane(s), including the addition of a through-traffic lane that functions as a high-occupancy vehicle lane, high-occupancy toll lane, bus lane, or truck climbing lane.
- The addition of an auxiliary lane, except when the auxiliary lane is a turn lane.
- The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange.

- Restriping existing pavement for the purpose of adding a through-traffic lane or an auxiliary lane.
- The addition of a new or substantial alteration of a weigh station, rest area, ride-share lot, or toll plaza.

EQRB classifies as a Type I project because at least one of the Build Alternatives (such as those that include the Couch Extension) would include a substantial horizontal alteration.

On July 13, 2010, FHWA published revised noise regulations that became effective on July 13, 2011. ODOT prepared revisions to its noise policy in accordance with FHWA's requirements and revised policy, which became effective July 13, 2011 (ODOT 2011).

4.2.1 Noise Abatement Criteria

To assess the potential for impact on human activity from traffic noise, the FHWA established noise abatement criteria (NAC) for different categories of land use (see Table 1). Per the FHWA regulations, these NAC levels "represent the upper limit of acceptable traffic noise conditions" and the NAC "represent a balancing of that which may be desirable with that which may be achievable." According to the ODOT Noise Manual, traffic noise impact occurs when the predicted traffic noise levels *approach or exceed* the NAC, or when the predicted traffic noise levels substantially *exceed* the existing noise levels. ODOT defines the word "approach" in "approach or exceed" as 2 decibels (dB) less than the FHWA NAC. ODOT defines the resultant decibel value as the Noise Abatement Approach Criteria (NAAC). A substantial increase would occur if the increase, relative to Existing Conditions, would be 10 dB or greater. The ODOT Noise Manual further states that noise impact should be assessed for the worst noise hour traffic conditions, which are either the peak vehicular hour or the peak truck hour for the design year (ODOT 2011).

The NAAC are expressed in terms of A-weighted hourly equivalent sound levels. The A-weighted sound level, abbreviated dB(A) or dBA, is a measure of sound intensity with weighted frequency characteristics that corresponds to human subjective response to noise. Most environmental noise (and the A-weighted sound level) fluctuates from moment to moment; it is common practice to characterize the fluctuating level by a single number called the equivalent sound level (Leq). The Leq is the value or level of a steady, non-fluctuating sound that represents the same sound energy as the actual time-varying sound evaluated over the same time period. For traffic noise assessment, Leq is typically evaluated over a 1-hour period and may be denoted as Leq(h).

Table 1. FHWA Noise Abatement Criteria and ODOT Noise Abatement Approach Criteria

Activity Category	NAC Leq(h)[1]	ODOT NAAC Leq(h)[1]	Description of Activity Category
A	57 (Exterior)	55 (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[2]	67 (Exterior)	65 (Exterior)	Residential
C[2]	67 (Exterior)	65 (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 (Interior)	50 (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[2]	72 (Exterior)	70 (Exterior)	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F
F	–	–	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	–	–	Undeveloped lands that are not permitted (without building permits)

[1] A-weighted hourly equivalent sound level (dBA)

[2] Includes undeveloped lands permitted for this activity category

Source: 23 CFR Part 772.

If the predicted design-year Build case noise levels are predicted to approach or exceed the NAC during the noisiest hour of the day or cause a substantial increase in existing noise, consideration of traffic noise reduction measures is necessary. If it is found that such reduction measures would cause adverse social, economic, or environmental effects outweighing the benefits received, they may be dismissed from consideration. For this study, noise levels throughout the study area were estimated for Existing (2019) Conditions and for the 2045 No-Build and Build Alternatives.

4.2.2 Local Noise Regulations

The City of Portland has local noise regulations set forth in the City of Portland Code, Title 18, Noise Control (City of Portland 1997). The City code would not apply to operational noise from traffic on roadways in the vicinity of the Project but would apply to construction noise during the construction phase of the Project. For any construction work that occurs between 7:00 AM and 6:00 PM, the City of Portland Code section 18.10.060 allows construction noise levels of 85 dBA Leq(h) at 50 feet from the noise source. This standard does not apply to some equipment, i.e., trucks, pile drivers, pavement breakers, scrapers, concrete saws, and rock drills.

From 6:00 PM to 7:00 AM the following morning, and 6:00 PM Saturday to 7:00 AM the following Monday, and on legal holidays, the permissible sound levels of Section 18.10.010 of the City Code apply to all construction activities, except by variance, or for reasons of emergency. The exempted equipment of Section 18.10.060, listed above, is not exempted during these hours. During these restricted periods, noise levels must meet the standards in Section 18.10.010 (Maximum Permissible Sound Levels – Land Use Zones) unless a variance to the standards has been granted.

Notwithstanding Subsection B of the City of Portland Code Section 18.10.060, the permissible sound levels of Section 18.10.010 would apply to pile drivers from 6 PM to 8 AM the following morning, and 6 PM Friday to 8 AM the following Monday, and on legal holidays.

The owner of a site on which pile driving will occur would require a notice be mailed to all residences within 500 feet of the site. Mailing will occur no fewer than 30 days prior to the commencement of pile driving. The notice shall list the expected starting and ending dates for pile driving and give a telephone number for further information.

If roadway construction activities would be considered "industrial" in nature, the allowable noise levels at residential properties would be 60 dBA Leq(h) during nighttime hours (10:00 PM and 7:00 AM). Notwithstanding the sound levels in Section 18.10.010, the City code also states that no person shall cause or permit the operation of an impulsive noise source that has an unweighted peak sound pressure level in excess of 100 dB during daytime hours or 80 dB during nighttime hours.

4.2.3 Construction Vibration Impact Criteria

FTA's noise and vibration manual (FTA 2018) provides construction vibration damage criteria applicable to major infrastructure projects such as EQRB. The impact criteria for potential building damage shown in Table 2 are provided for four building types, each of which are assigned a peak particle velocity (PPV) in inches per second and vibration level in VdB, above which there is potential for damage.

Table 2. FTA Construction Vibration Damage Criteria

Building/Structural Category		Peak Particle Velocity (PPV), in/sec	Approximate Ground-borne Vibration Impact Level (Lv; VdB re 1 micro-inch/second)	Applicable to Project?
I	Reinforced-concrete, steel or timber (no plaster)	0.50	102	Yes
II	Engineered concrete and masonry (no plaster)	0.30	98	Yes
III	Non-engineered timber and masonry buildings	0.20	94	Yes
IV	Buildings extremely susceptible to vibration damage	0.12	90	No

Source: FTA 2018, Table 7-5; HMMH analysis

There are some FTA building/structure Category III historic buildings near the Project's construction effort. The Category III buildings are the most sensitive to vibration damage. No Category IV buildings are located near the Project; however, some of the historic buildings near the project have been conservatively assessed as being Category III.

Construction vibration can also be a source of annoyance for sensitive land uses near the Project. As shown in Table 3, FTA provides criteria based on vibration decibels (VdB) for assessing potential annoyance from construction vibration. There are no Category 1 uses near the Project but there are several Category 2 (residential) and Category 3 (institutional such as University of Oregon) uses.

Table 3. FTA Construction Vibration Annoyance Criteria

Land Use Category		Groundborne Vibration Impact Levels (VdB re 1 micro-inch/second)	Applicable to Project?
1	Buildings where vibration would interfere with interior operations.	65	No
2	Residences and buildings where people normally sleep.	72	Yes
3	Institutional land uses with primarily daytime use.	75	Yes

Source: FTA 2018, Table 6-3, Frequent Events (>70/day); HMMH analysis
VdB=velocity in decibels

4.3 Design Standards

There are no design standards specific to noise and vibration environmental impacts.

5 Affected Environment

5.1 Area of Potential Impact

The API for noise includes noise-sensitive land uses located within approximately 750 feet of the Project Alternatives and within 500 feet of haul routes, which are routes designated to haul material to and from construction sites. Detour routes and haul routes are considered part of short-term impacts and are therefore not considered in the Type I study. Because vibration attenuates more quickly with distance than noise, the vibration API is smaller, within approximately 300 feet of areas where earth disruption or off-road construction equipment would be located. Trucks using haul routes are not typically sources of vibration impacts; therefore, there is no API for vibration associated with the haul routes.

5.2 Resource Identification and Evaluation Methods

5.2.1 Published Sources and Databases

The following is a list of data used to determine and describe noise and vibration existing conditions for the Technical Report:

- Noise and vibration field measurements
- Existing land use geographic information systems (GIS) data obtained from Metro, the City, and the County
- Historic structures and any other 4(f) resources identified in the *EQRB Cultural Resources Technical Report* (Multnomah County 2021)

- Traffic data obtained via the analysis as documented in the *EQRB Transportation Technical Report* (Multnomah County 2021) (long-term/operational); as well as detour and haul route (short-term/indirect)

5.2.2 Field Visits and Surveys

Field visits to conduct short-term traffic noise measurements, hydro-acoustic underwater noise measurements, and vibration measurements were completed during the week of June 24-28, 2019 (Monday to Friday). Two short-term (15-minute) traffic measurements were taken to validate the FHWA Traffic Noise Model 2.5 (TNM 2.5 [FHWA 2004]) for purposes of determining the existing and future noise levels in the Project Area. Additional short-term traffic noise measurements were completed on Sunday, February 4, 2020.

Vibration measurements were conducted on both the east and west sides of the Willamette River near the bridge footings to determine ambient vibration from traffic for two 30-minute measurements on Friday, June 28, 2019.

5.3 Existing Conditions

Existing noise and vibration levels were measured and modeled for the Project. The results of these efforts are provided in the sub-sections that follow.

5.3.1 Existing Noise Conditions

Validation model runs were performed for the noise measurement locations at noise sensitive areas on the east and west sides of the Burnside Bridge. The monitoring sites are shown in Figure 2 and Figure 3 as purple triangles (validation measurements). Validation analysis was used to identify what additional terrain and other shielding effects are present in these areas. For example, at monitoring site M1, located approximately 100 feet north of the edge of the Burnside Bridge at ground level in Tom McCall Waterfront Park, the dominant noise source was from traffic on Interstate 5 (I-5) across the Willamette River; no traffic noise from Burnside could be detected at this location. A ground zone of water was added to represent the acoustically reflective water surface from the river. Validation runs were performed for monitoring sites M1 through M6 to confirm that TNM-predicted sound levels were within ±3 dB of measured levels.

A comparison of noise levels predicted for the monitoring sites, using TNM and noise levels measured in the field, is shown in Table 4. The modeled results are within 3 dB of the measurements, confirming TNM (and its inputs) reasonably predict noise levels for the analysis area. The electronic validation run TNM files are included in Appendix A.[1] Monitoring data and equipment calibration certificates are included in Appendix B.

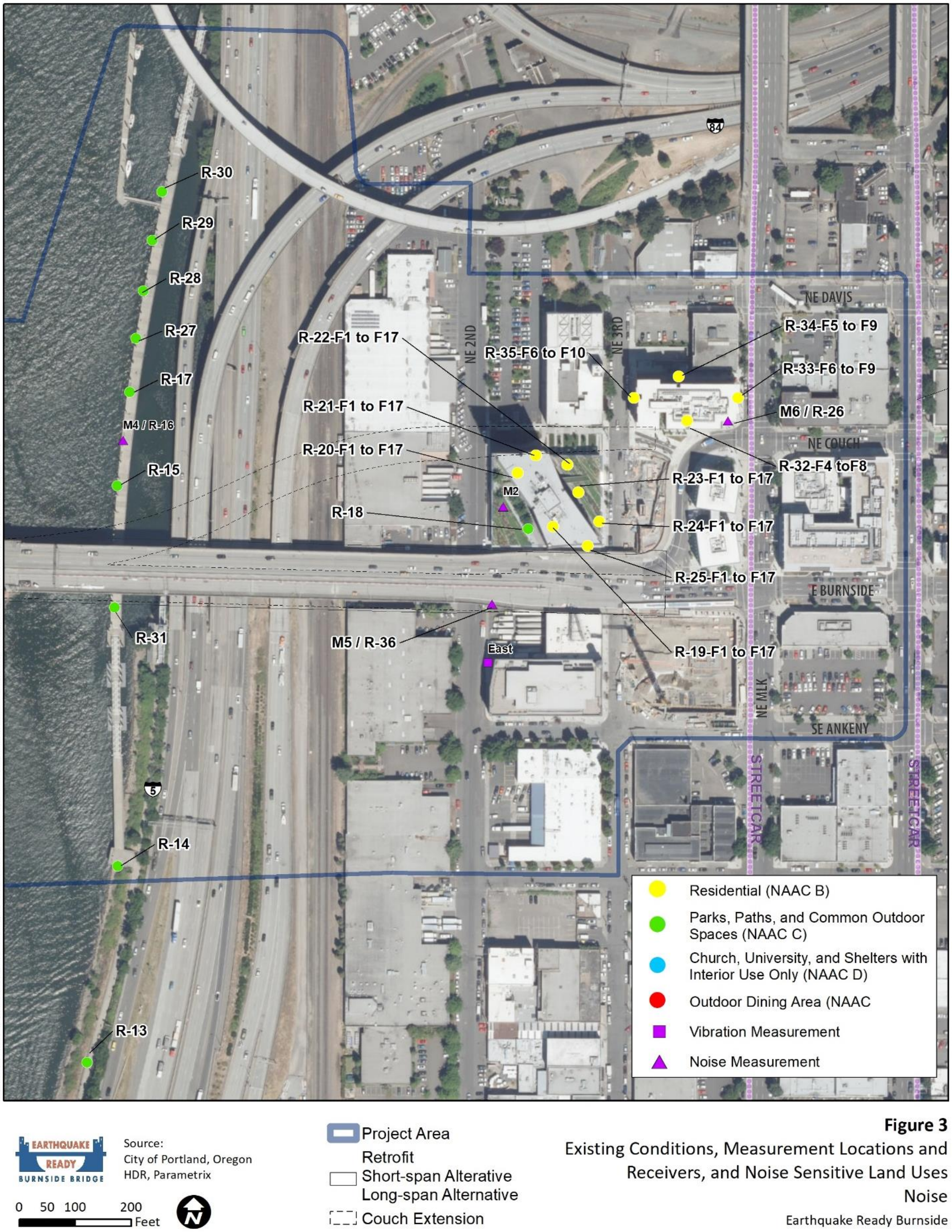
[1] These electronic files can only be opened and reviewed via FHWA's TNM software

Table 4. Monitored and Predicted Noise Levels for Validation of TNM

Monitoring Site ID	Location	Date / Start Time	Duration (Minutes Approx.)	Distance from Closest Burnside Bridge Traffic Lanes (feet)	Measured Noise Level (dBA Leq)	TNM Predicted Noise Level (dBA Leq)	Difference (Predicted minus Measured, dB)
M1	Naito Tom McCall Waterfront Park North of Bridge	6/25/2019/ 10:04 AM	45	100	63.7	65.8	2.1
M2	Yard Apartments	6/25/2019/ 11:42 AM	15	65	70.3	67.7	-2.6
M3/R4	Naito Tom McCall Waterfront Park South of Bridge	2/4/2020 9:23 AM	17	332	67.8	65.1	-2.7
M4/R16	Vera Katz Eastbank Esplanade North of Bridge	2/4/2020 9:57 AM	16	205	73.6	71.5	-2.1
M5/R36	Burnside Skatepark	2/4/2020 10:29 AM	15	22	65.9	63.3	-2.6
M6/R26	Cosube Coffee and Surf Shop	2/4/2020 10:52 AM	15	24	70.0	67.0	-3.0

Figure 2. Existing Conditions, Measurement Locations and Receivers, and Noise Sensitive Land Use Near West Landing

Figure 3. Existing Conditions, Measurement Locations and Receivers, and Noise Sensitive Land Use Near East Landing



Following validation, existing sound levels were predicted at 95 receivers representing exterior use areas at 303 NAAC B uses (residences); 16 NAAC C uses (parks, multi-use paths, and a barbeque/picnic table and recreation areas at apartment buildings such as patios and decks); 5 NAAC D uses (nonprofit homeless shelters, a church, and the University of Oregon Portland Campus buildings); and 1 NAAC E use (an outdoor dining area at a restaurant). Sound levels at Category D uses are predicted for interior uses and are assumed to be 25 dB lower than those predicted at the exteriors of those buildings. Additionally, just outside of the analysis area are several restaurants with outdoor seating for eating on SW Ankeny Street. While these areas are not included in the analysis, for informational purposes traffic noise levels at these receptors would be no higher than the exterior levels receptors R-1 and R-2. The receivers are shown in Figure 2 and Figure 3 as color-shaded circles.

Sound levels were predicted at 5 feet above ground level (AGL) for most first-floor residences, 15 feet AGL for second floor residences, 25 feet AGL for third floor residences, and so on. High-rise apartment building receptors were modeled at exterior use areas, specifically balconies. One exception is at the Yard Apartments, where the first-floor apartment balconies vary relative to the surrounding ground level terrain. Specifically, the first floor apartment balcony receptor height is 15 feet above the bridge deck and the fill supporting the building in this location, per the project's light detection and ranging (LiDAR) data; however, the first floor balcony receptor at the northwest corner of the building is 55 feet AGL. Additionally, FHWA's TNM has a maximum receiver height setting of 99 feet AGL. The Yard Apartments has 17 floors with receivers over 99 feet AGL; therefore, receivers over 99 feet AGL are grouped together and set to the maximum height that TNM will accept. Additionally, not all units of every apartment building have balconies; only those units with balconies (i.e., outdoor uses) were included.

Existing terrain was included in the modeling to represent the associated shielding effects for the receivers. Buildings modeled as barriers were also added to the modeling in areas where large buildings provide shielding for sensitive areas. The ground type for modeling was chosen as pavement, due to the urban environment; lawn ground zones were added where appropriate and the Willamette River was modeled as a water ground zone.

Peak *vehicular* hour volumes, which were developed by HDR and Parametrix using the Oregon Automated Traffic Data (HDR and Parametrix 2019) and found in Appendix A, are associated with speeds lower than the posted speeds on area roadways such as Burnside Street and I-5. During the peak *truck* hour, vehicles are operating at speeds close to posted speeds and are representative of level of service (LOS) C or LOS D. Under the peak *vehicular* hour, several roadways are operating at LOS E or worse. Consistent with ODOT's noise policy, peak *vehicular* hour noise levels and peak *truck* hour noise levels were modelled, and a comparison between the two was made.

Predicted existing peak vehicular hour and peak truck hour sound levels at analyzed receptors are in Appendix C, Table C-1. Electronic copies of the TNM files are provided as part of Appendix A. Exterior existing condition traffic noise levels under the peak vehicular hour and peak truck hour range from 59 to 72 dBA Leq(h) and 59 to 74 dBA Leq(h), respectively. Under the peak *vehicular* hour, the following meet or exceed the NAAC: 267 residences (NAAC B), a shared outdoor use area at the Yard Apartments (NAAC B) and 7 NAAC C uses across the Tom McCall Waterfront Park (3 seating areas or areas with information plaques)and the Vera Katz Eastbank Esplanade (5 benches).

Under the peak *truck* hour, the following meet or exceed the NAAC: 261 residences (NAAC B), a shared outdoor use area at the Yard Apartments (NAAC B) and 7 NAAC C uses across the Tom McCall Waterfront Park (3 seating areas or areas with information plaques) and the Vera Katz Eastbank Esplanade (5 benches). Because the number of exceedances is greater under the peak *vehicular* hour condition (267) than the peak *truck* hour (261), typically this would indicate that the peak *vehicular* hour conditions are the worst noise hour. However, on the west side of the river, the worst noise hour is associated with the peak *truck* hour due to truck traffic on area roadways such as Naito Parkway. On the east side of the river, the worst noise hour is the peak *vehicle* hour predominantly caused by traffic on I-5. For these reasons, the traffic noise study uses both peak vehicular hour traffic and peak truck hour traffic results for the worst noise hour depending on which side of the river a noise sensitive receptor is located.

5.3.2 Existing Vibration Conditions

Existing vibration levels were measured at two locations on the morning of Friday, June 28, 2019, for approximately 30 minutes at each location. Two seismic accelerometers were paired with a Brüel & Kjær 2270 sound and vibration level meter which was used to log the data collected. One location was on the west landing of the bridge, and the other was on the east landing of the bridge (purple squares in Figure 2 and Figure 3). Measurements included VdB and PPV in inches per second. On the west side landing, the measurements were completed at the southeast corner of the White Stag Building on the sidewalk. The west measurement location was conducted approximately 24 feet from the edge of southbound travel lane on Naito Parkway and 210 feet west of the southbound TriMet MAX tracks along NW 1st Avenue. Vibration events observed included heavy truck traffic on Naito Parkway and MAX trains on NW 1st Avenue.

The east side vibration measurement was conducted on the sidewalk near the northern end of the Autodesk building. The east side monitor was 27 feet from the northbound travel lane along SE 2nd Avenue and 290 feet from the Union Pacific Railroad. No heavy truck or train pass-by events occurred during the east landing measurement.

Table 5 provides a summary of the measured vibration levels. Ambient levels in Table 5 exclude the events listed. Average vibration event levels ranged between 62 and 68 VdB with ambient vibration levels averaging 58-59 VdB. To provide context, typical vibration levels are shown in Figure 4. The measured event vibration levels are in the range of a typical bus or truck (50 feet away) and within 3 VdB of the threshold of human perception.

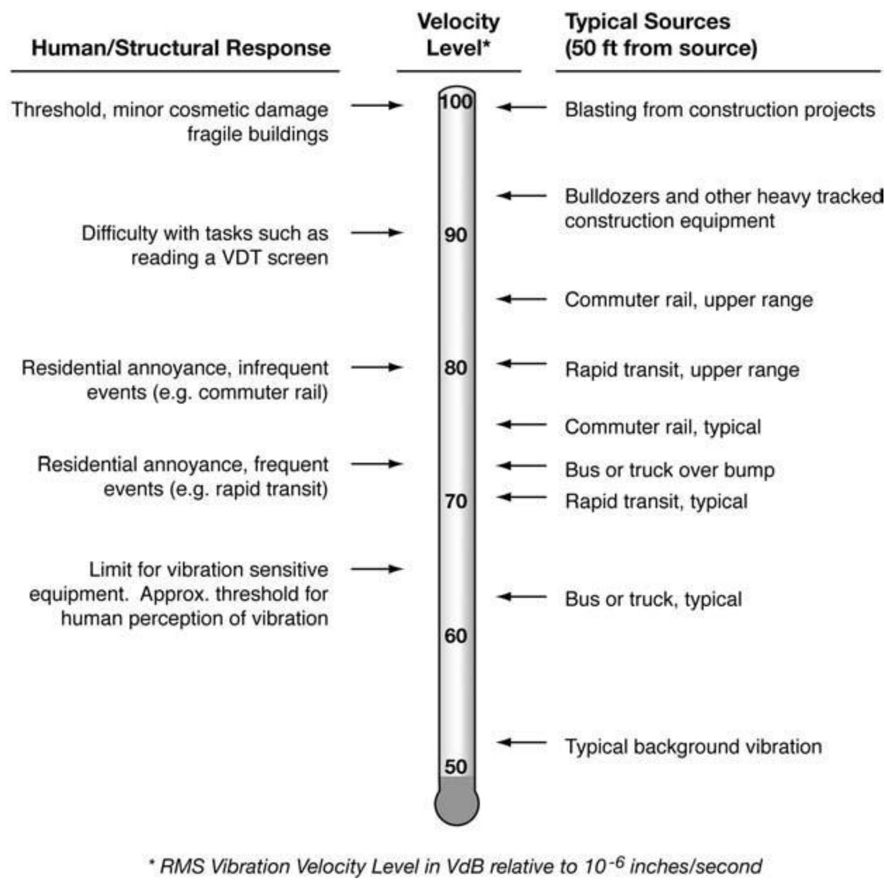
Table 5. Existing Vibration Levels

Location	Time of Day (duration minutes)	Measurement Event or Ambient	Max VdB if Event	Average VdB	Max PPV if Event (in/sec)	Average PPV (in/sec)
West Landing	7:20 AM (30 minutes)	Ambient	N/A	59	N/A	0.0031
		Heavy Truck going Southbound	78	68	0.0252	0.0081

Table 5. Existing Vibration Levels

Location	Time of Day (duration minutes)	Measurement Event or Ambient	Max VdB if Event	Average VdB	Max PPV if Event (in/sec)	Average PPV (in/sec)
		Heavy Truck going Northbound	73	67	0.0150	0.0089
		Heavy Truck going Southbound	79	67	0.0305	0.0099
		TriMet MAX Northbound	79	62	0.0319	0.0048
		TriMet MAX Southbound	71	62	0.0110	0.0042
East Landing	8:06 AM (30 minutes)	Ambient	N/A	58	N/A	0.0014

Figure 4. Typical Vibration Levels



VDT = video display terminal
Source: FTA 2018

6 Impact Assessment Methodology and Data Sources

The impacts analysis addresses the direct long-term (i.e., operational, day in and day out traffic noise), direct short-term (i.e., construction related), indirect and cumulative noise and vibration impacts of the Project Alternatives for design year 2045, including the No-Build Alternative for 2045. The noise analysis is consistent with the ODOT Noise Manual to address long-term noise impacts of the Project Alternatives on noise-sensitive land use in the build environment. Vibration analysis is conducted using the FTA methods to address the short-term vibration impacts of the project construction on noise-sensitive land use in the project environment.

6.1 Long-term Impact Assessment Methods

The analysis of direct long-term noise impacts considers long-term traffic noise levels predicted using the latest version (2.5) of the FHWA TNM for design year 2045.

6.2 Short-term Impact Assessment Methods

The analysis of direct short-term noise and vibration impacts considers:

- Construction noise assessed, implementing the prediction methods provided in the latest approved version of the FHWA Roadway Construction Noise Model (RCNM [FHWA 2019]) and implemented in the Quarry Noise Model (QNM [ODOT 2019]).
- Vibration from construction of the Project assessed, implementing the methods contained in the FTA Manual (FTA 2018).
    - Table 7-4 of the FTA Manual reproduced here as Table 6 lists vibration velocities and levels for typical construction equipment.

Table 6. Vibration Velocities and Levels for Typical Construction Equipment

Construction Equipment Description		FTA PPV 25 ft. from Source (in/sec)	Approximate Lv* at 25 ft. (VdB)
Pile Driver(impact)	Upper range	1.518	112
	Typical	0.644	104
Pile Driver (sonic)	Upper range	0.734	105
	Typical	0.170	93
Clam shovel drop (slurry wall)		0.202	94
Hydromill (slurry wall)	In soil	0.008	66
	In rock	0.017	75
Vibratory Roller		0.210	94
Hoe Ram		0.089	87
Large bulldozer		0.089	87
Caisson drilling		0.089	87

Loaded Trucks	0.076	86
Jackhammer	0.035	79
Small bulldozer	0.003	58

Source: FTA 2018, Table 7-4; *Lv – root mean square velocity in decibels, VdB re 1 micro-in/sec

- The FTA Manual provides methods for calculation of the propagation of the above-mentioned vibration velocities and levels from construction equipment to sensitive structures such as historic resources.
- The resultant velocities and levels are compared to FTA's impact and annoyance thresholds. Said thresholds are listed in Section 4.2.3.
- Mitigation measures are identified, as needed.

Noise from the construction haul route and general traffic detours is anticipated to use any public streets and cannot be narrowed down at this time to specific roadways because there is little to no restriction on where the trucks and detour traffic can operate. As a result, it would be too speculative to apply truck traffic to one specific route or another.

Construction noise analysis implemented in QNM included the following methods:

- Construction phases, equipment types and quantities, and locations of construction activities were identified in the *EQRB Construction Approach Technical Report* (Multnomah County 2021)
- Three-dimensional elements for QNM, such as terrain, were derived from the same terrain data used in the long-term noise modeling efforts
- Impedance data, such as hard acoustically reflective surfaces (pavement, water) were digitized in GIS and included in the QNM calculation
- Construction equipment sound source levels obtained from RCNM version 2.0 were assigned to each piece of equipment for each construction area identified
- Construction noise levels were calculated for each noise sensitive receptor in QNM by implementing the calculation methodology of RCNM
- QNM does not calculate Leq(h), instead it provides 24-hour Leq and day-night average sound levels (Ldn); therefore, to calculate the Leq(h) construction sources were applied to each time period as if they were operating hourly over the course of daytime and nighttime periods. This approach means that the 24-hour Leq value is the same as the Leq(h) since every hour of analysis has the same equipment operating.

6.3 Indirect Impact Assessment Methods

Because no induced growth in traffic or induced change in land use is expected there would be no indirect effects of this project on noise. Impacts from other transportation projects and land use changes are included in traffic data that were used in the long-term impact analysis for the Project Alternatives. No indirect noise impacts are anticipated.

6.4 Cumulative Impact Assessment Methods

Cumulative changes in traffic resulting from other planned transportation improvements and anticipated land use changes are included in the traffic model data in the long-term impact analysis for the Project Alternatives. For this reason, no additional cumulative impact analysis was necessary.

7 Environmental Consequences

Noise and vibration levels were predicted for five future (2045) alternatives: No-Build Alternative, Retrofit Alternative, Short-span Alternative, Long-span Alternative, and the Couch Extension Alternative (Appendix C, Table C-1).

7.1 No-Build

7.1.1 Direct Impacts

No-Build Alternative 2045 traffic noise levels are provided in Appendix C and Figure 2 and Figure 3 show the location of each receptor listed in Table C-1. Under the No-Build Alternative 2045 conditions, predicted exterior traffic noise levels would range from 59 dBA Leq(h) to 75 dBA Leq(h) and would exceed the NAAC at 267 NAAC B uses (residences), and 8 NAAC C uses across the Tom McCall Waterfront Park (3 seating areas or locations with information plaques) and Vera Katz Eastbank Esplanade (5 benches). For receptors where there is no exterior use, such as at places of worship and the university, interior noise levels would range from 40 dBA Leq(h) to 43 dBA Leq(h) with none of these locations exceeding the NAAC.

For the No-Build Alternative, relative to Existing Conditions, traffic noise levels are predicted to increase in some areas and decrease in others. On average, there would be no change. Increases up to 1 dB would be due to increased traffic volumes on area roadways. Decreases up to 1 dB would be due to reductions in traffic volumes on some roadways as other projects come online in the area network that would change traffic patterns in the area. As with the Existing Conditions, traffic noise levels would be highest for outdoor use areas located closest to I-5 on the east side of the Willamette River. Traffic noise levels on the west side of the river result mostly from I-5 traffic noise originating on the east side of the river but are also influenced by traffic on Burnside Street and Naito Parkway.

7.1.2 Indirect Impacts

The traffic projections for the No-Build Alternative include anticipated growth that would occur on area roadways with or without EQRB; therefore, indirect impacts are encompassed in the direct impact analysis.

7.2 Enhanced Seismic Retrofit

7.2.1 Direct Impacts

Construction of the Retrofit Alternative without a temporary bridge would last 3.5 years or 5 years if a temporary bridge is included. The following sections provide the noise and vibration analysis associated with the construction effort.

Short-term Direct Impacts

Analysis of temporary construction noise and vibration impacts was completed for the Retrofit Alternative. This effort included quantitative analysis of construction noise and vibration from the anticipated construction phases of the alternative:

- Demolition of the existing bridge and buildings
- Detour bridge construction
- Work bridge construction
- Cofferdam installation
- Construction of the west side approach
- River pier shaft installation (inside cofferdam)
- River pier ground improvements (Pier 1, Pier 4, and Bents 10, 24, and 26)
- Main span work
- Construction of the east side approach
- Roadway deck construction

These phases of construction and associated durations were identified as part of the *EQRB Construction Approach Technical Report* (Multnomah County 2021).

Noise

Construction noise levels for each of the phases listed above were calculated using RCNM as implemented in the QNM. Unmitigated noise levels, including the highest anticipated Leq(h), are provided in Appendix C for the same receptors as those analyzed in the TNM. Each of the construction phases result in different levels of impact to the surrounding community, with installation of the east side approach resulting in the highest anticipated sound levels [73 – 108 dBA Leq(h)] due to the requirement for extensive pile driving for the support of the structure. The phases with the next highest sound levels would be from installation of the Temporary Bridge and work bridge (57 – 105 dBA Leq(h)), again due to the use of pile driving to support the structure of the work bridge. Installation of the east approach would have the third highest construction noise (56 - 104 dBA Leq(h)), with the highest levels resulting from the construction effort being conducted near an apartment building, The Yard Apartments, near the east landing of the bridge and associated with pile driving. Demolition and construction of the west approach would also result in relatively high construction noise levels (i.e., 62 - 98 dBA Leq(h) and 63 – 96 dBA Leq(h), respectively). Construction noise impacts, both exceedances of the City of Portland impulsive noise restrictions and exceedances of the

City's construction noise limit of 85 dBA Leq(h), could be reduced by implementing various techniques described in Section 8. Additionally, the Project will be required to obtain a construction noise variance from the City of Portland to address any exceedances that may occur as a result of construction.

Noise from traffic using the Temporary Bridge was analyzed using FHWA's TNM assuming existing conditions level of traffic. While there would be some changes in sound levels associated with using the Temporary Bridge, they represent increases of at most 5 dB compared to the Existing Conditions or the No-Build Alternative. As a result, it is anticipated that traffic noise on the detour bridge would be noticeably higher than the Existing Conditions for some receptors. Decreases in sound levels of up to 3 dB are also predicted as a result of increase setback distance to the bridge traffic relative to the existing alignment. If the Temporary Bridge is not utilized, then that phase of construction noise would not occur nor would the associated traffic noise. In such a circumstance, traffic noise in the area would temporarily be reduced due to no traffic. However, all other bridge construction noise levels would be the same as analyzed. See Appendix C, Table C-1 for detour bridge traffic noise levels calculated for individual sensitive receptors.

STAGING AREAS

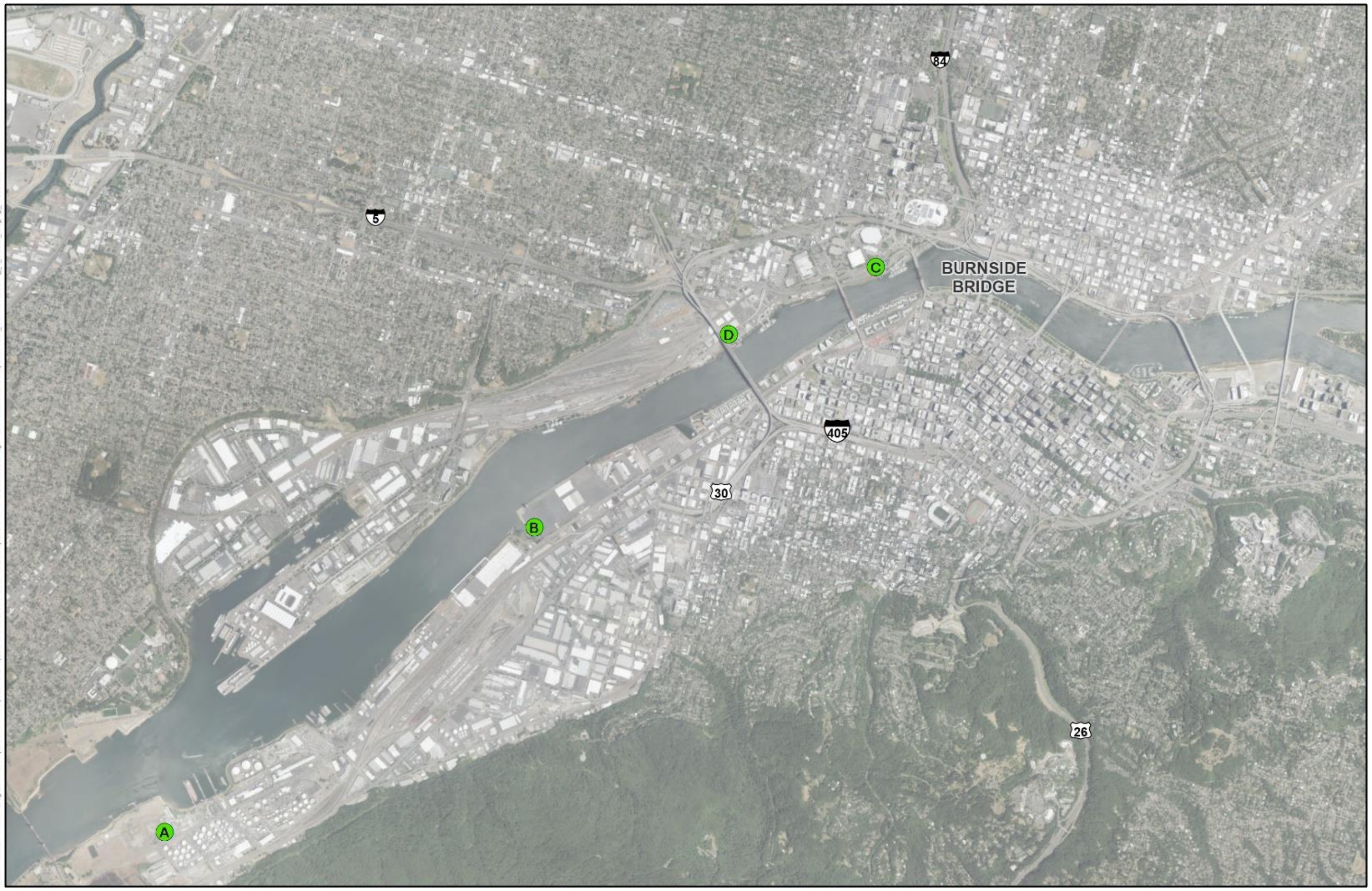
The construction contractor may use one or more off-site staging areas, outside the bridge study area to store and and/or assemble materials that would then be transported by barge to the construction site. Off-site staging could occur with any of the alternatives. Whether, where, and how to use such sites would be the choice of the contractor and therefore the actual site or sites are unknown at this time and detailed analysis of impacts is not possible. To address this uncertainty, four possible sites have been identified that represent a broader range of potential sites where off-site staging might occur (Figure 5). While the contractor could choose to use one of these or any other site, it is assumed that because of regulatory and time constraints on the contractor, any site they choose would need to be already developed with road and river access. It is also assumed that the contractor would be responsible for relevant permitting and/or mitigation required for use of a chosen site.

The four representative sites include:

A. Willamette Staging Option off Front Avenue
B. USACE Portland Terminal 2
C. Willamette Staging Option off Interstate Avenue
D. Ross Island Sand and Gravel Site

The staging areas would not result in noise impacts because there are no noise sensitive receptors located close enough to be affected. If the contractor chooses to use an off-site staging area, local, state, and federal regulations regarding construction would apply.

Figure 5. Construction Staging Areas



Source:
City of Portland, Oregon
HDR, Parametrix

0 0.25 0.5 1 Miles

Potential Off-site Staging Areas
A. Willamette Staging Option off Front Ave.
B. USACE Portland Terminal 2
C. Willamette Staging Option off Interstate Ave.
D. Ross Island Sand and Gravel

Figure 5
Potential Off-site Staging Areas

Earthquake Ready Burnside

Vibration

Construction vibration, like construction noise, would result in temporary elevated vibration levels; however, construction vibration attenuates more quickly with distance than noise.

Two pieces of construction equipment present the highest potential for vibration damage and annoyance: impact pile drivers and vibratory rollers. Additional equipment that may be used on the project such as a hoe ram, caisson drilling, and jackhammers were also analyzed. Distances from equipment where either damage or annoyance impacts would occur are provided in Table 7 and Table 8. Historic buildings that are Category III structures (see *EQRB Cultural Resources Technical Report*, Figure A-1, (Multnomah County 2021)) could be damaged by pile driving occurring within the distances shown in Table 7. In such locations the construction contractor may need to use drilled caissons for bridge foundations instead of pile driving or take other measures to avoid damaging nearby buildings. Additionally, there would be several Category 2 (residences and other locations where people sleep) and Category 3 (universities and institutional uses) land uses within the annoyance criteria limits for impact pile driving, use of the vibratory roller, and potentially the hoe ram. See Figure 2 and Figure 3 for the locations of sensitive land uses. Therefore, mitigation would be required for anticipated construction vibration (annoyance) impacts associated with the Project.

Table 7. Vibration Damage Analysis Results

Construction Equipment Description		Distance (feet) from Construction for Potential Damage for Building/Structural Category (re PPV)		
		1	2	3
Pile Driver(impact)	Upper range	53	75	100
	Typical	30	43	55
Pile Driver (sonic)	Upper range	33	46	60
	Typical	<25	<25	<25
Clam shovel drop (slurry wall)		<25	<25	26
Hydromill (slurry wall)	In soil	<25	<25	<25
	In rock	<25	<25	<25
Vibratory Roller		<25	<25	26
Hoe Ram		<25	<25	<25
Large bulldozer		<25	<25	<25
Caisson drilling		<25	<25	<25
Loaded Trucks		<25	<25	<25
Jackhammer		<25	<25	<25
Small bulldozer		<25	<25	<25

Source: HMMH analysis

Table 8. Vibration Annoyance Analysis Results

Construction Equipment Description		Distance (feet) from Construction for Potential Annoyance for Land Use Category 2	Distance (feet) from Construction for Potential Annoyance for Land Use Category 3
Pile Driver(impact)	Upper range	500	450
	Typical	300	240
Pile Driver (sonic)	Upper range	310	250
	Typical	125	100
Clam shovel drop (slurry wall)		140	110
Hydromill (slurry wall)	In soil	<25	<25
	In rock	<25	25
Vibratory Roller		140	110
Hoe Ram		80	65
Large bulldozer		80	65
Caisson drilling		80	65
Loaded Trucks		75	60
Jackhammer		40	35
Small bulldozer		<25	<25

Source: HMMH analysis

Long-term Direct Impacts

Long-term direct impacts associated with the Retrofit Alternative would be the same as those for the No-Build Alternative because the alignment of the bridge and accompanying traffic would be the same. There are no substantial increases in traffic noise from the alternative. Traffic noise abatement measures were evaluated for each of the impacts.

7.2.2 Indirect Impacts

The traffic projections for the Retrofit Alternative include anticipated growth that would be attributable to the alternative; therefore, indirect impacts are encompassed in the direct impact analysis. Given that the proposed project would not change the traffic capacity or throughput of the crossing, any indirect effects would likely be minor.

7.3 Replacement, Short-span or Long-span

Construction of the Short-span or Long-span Alternatives without a temporary bridge would last 4.5 years or 6.5 years if a temporary bridge is included. The following sections provide the noise and vibration analysis associated with the construction effort.

7.3.1 Direct Impacts

Short-term Direct Impacts

Construction noise and vibration impacts under the Short-span or Long-span Alternatives would be similar to the Retrofit Alternative because the same construction techniques would be implemented. The difference in construction noise under this alternative would occur as a result of the duration of construction being longer and more bents being required than the Retrofit Alternative. Because the Long-span Alternative would have even fewer bents than the Short-span Alternative, construction noise would differ as a result. See the *EQRB Construction Approach Technical Report* (Multnomah County 2021) for additional detail.

Long-term Direct Impacts

Long-term direct impacts associated with the Short-span or Long-span Alternatives would be the same as those for the No-Build Alternative because the alignment of the bridge and accompanying traffic would be the same. There would be no substantial increases in traffic noise from the Alternative. Traffic noise abatement measures were evaluated for each of the impacts.

7.3.2 Indirect Impacts

The traffic projections for the Short-span or Long-span Alternatives include anticipated growth that would be attributable to the alternative; therefore, indirect impacts are encompassed in the direct impact analysis. Given that the proposed project would not change the traffic capacity or throughput of the crossing, any indirect effects would likely be minor.

7.4 Replacement with Couch Extension

Construction of the Couch Extension Alternative without a temporary bridge would last 4.5 years or 6.5 years if a temporary bridge is included. The following sections provide the noise and vibration analysis associated with the construction effort.

7.4.1 Direct Impacts

Short-term Direct Impacts

Construction noise and vibration impacts under Couch Extension Alternative would be similar to the Retrofit Alternative because the same construction techniques would be implemented. The difference in construction noise under this alternative would occur at the east end of the bridge where the connection with the existing street network would differ. For example, the Couch Extension Alternative would have construction noise associated with its construction on the north side of the Yard Apartments which would result in higher noise levels on that side of the building and in the surrounding community. See the *EQRB Construction Approach Technical Report* (Multnomah County 2021) for additional detail on how this construction effort would differ.

Long-term Direct Impacts

Couch Extension Alternative 2045 traffic noise levels are provided in Appendix C, Table C-1. Figure 2 and Figure 3 show the location of each receptor listed in the table. Under the Couch Extension Alternative 2045 conditions, predicted exterior traffic noise levels would range from 60 dBA Leq(h) to 75 dBA Leq(h). Traffic noise impacts would occur at 261 NAAC B and 8 NAAC C uses across the Tom McCall Waterfront Park (3 benches or areas with information plaques) and the Vera Katz Eastbank Esplanade (5 benches). Impacts on the east side of the river such as those at The Yard Apartments and Vera Katz Eastbank Esplanade are predominantly a result of traffic noise from I-5. The remaining impacts on the west side of the river result mostly from I-5 traffic noise originating on the east side of the river but are also influenced by traffic on Burnside Street and Naito Parkway. For receptors where there is no exterior use, such as at places of worship and the university, interior noise levels would range from 40 dBA Leq(h) to 43 dBA Leq(h) with none of these locations exceeding the NAAC.

No substantial increases (i.e., 10 dB or greater) in noise would result from this alternative. Compared to the Existing Conditions, traffic noise levels are predicted to increase in some areas and decrease in others. Relative to the Existing Conditions the change in noise levels range from a 5 dB decrease to a 5 dB increase. Similar changes in sound levels are anticipated relative to the No-Build Alternative, ranging from a 5 dB decrease to a 5 dB increase in 2045. The reason for these changes is due to changes in the roadway alignment, such as moving the westbound travel lanes further from sensitive receptors on the south side of The Yard Apartment high rise and closer to the sensitive receptors on the north side of that building. Traffic noise levels would be highest for outdoor use areas near I-5. Traffic noise abatement measures on Burnside Bridge were evaluated for each of the impacts.

7.4.2 Indirect Impacts

The traffic projections for the Couch Extension Alternative include anticipated growth that would be attributable to the alternative; therefore, indirect impacts are encompassed in the direct impact analysis. Given that the proposed project would not change the traffic capacity or throughput of the crossing, any indirect effects would likely be minor.

7.5 Cumulative Effects

Cumulative noise and vibration effects include those that would result in incremental effects of the Project in combination with past, present, and reasonably foreseeable actions that, in combination, can result in short-term (such as construction) effects, or long-term effects. For the latter, traffic analysis for the project includes considerations of past, present, and reasonably foreseeable actions and since these traffic projects are the basis of the long-term direct impact analysis for the Project, cumulative effects are the same. Short-term noise and vibration cumulative effects could result from the overlapping construction periods and locations of the EQRB project and the I-5 Rose Quarter Project (I5RQ).

To put the short-term construction cumulative effect in context, if similar phases of construction on both projects, such as paving, and both construction efforts were happening in proximity up to a 6 dB increase in construction noise would be expected. This is highly unlikely to occur because of the logistics associated with roadway closures and other restrictions to movement in the project areas. Nevertheless, potential mitigation strategies are provided in Section 8 to reduce potential cumulative short-term effects.

7.6 Compliance with Laws, Regulations, and Standards

This Noise and Vibration Technical Report has been prepared in accordance and compliance with applicable laws, regulations, and standards.

7.7 Conclusion

Short-term and long-term noise and vibration impacts were analyzed for the Project. Most of the long-term traffic noise impacts are not a result of the Project; they are predominantly a result of I-5, which is the main source of traffic noise in the area. Table 9 is a summary of the impact conditions for the Existing Conditions as well as the No-Build and Build Alternatives. Mitigation measures, discussed in Section 8, were analyzed and found to be infeasible at reducing traffic noise from the Project (i.e., on Burnside Bridge). There would be no long-term vibration impacts from any Build Alternative operations once constructed.

Table 9. Summary of Impacted Receptors by Condition/Alternative

Alternative	Number of Impacted Receptors for NAAC Category				Total Number of Impacted Receptors
	B	C	D	E	
Existing Condition	267	7	0	0	272
No-Build Enhanced Retrofit Replacement, Short-span or Long-span	267	8	0	0	275
Replacement with Couch Extension	261	8	0	0	269

Short-term noise and vibration impacts are predicted to occur if specific construction equipment operates within the distances identified in Table 7 or Table 8. While these impacts are dependent upon the ultimate construction strategy identified by the construction contractor, this report finds that many of these impacts can be avoided by implementing various mitigation measures such as temporary noise barriers and restricting certain construction equipment and processes from operating in proximity to sensitive structures and lands.

8 Mitigation Measures

Mitigation measures, or abatement measures, were evaluated for the Short-span and long-term impacts resulting from the Build Alternatives.

8.1 Evaluation of Short-term Abatement Measures

To avoid, minimize, and abate temporary adverse noise and vibration impacts the following measures, as described in Section 290.32 of ODOT standard specifications, should be implemented to the extent practicable:

"**00290.32 Noise Control** - Comply with ORS 467, OAR 340-035, all other applicable Laws, and the following construction noise abatement measures:

- Do not perform construction within 1,000 feet of an occupied dwelling on Sundays or legal holidays, or between the hours of 10:00 p.m. and 6:00 a.m. on other days, without the approval of the Engineer.
- Use Equipment with sound control devices no less effective than those provided on the original Equipment. Equipment with un-muffled exhausts is prohibited.
- Use Equipment complying with pertinent equipment noise standards of the Environmental Protection Agency.
- Do not drive piling or perform blasting operations within 3,000 feet of an occupied dwelling on Sundays or legal holidays, or between the hours of 8:00 p.m. and 8:00 a.m. on other days, without the approval of the Engineer.
- Mitigate the noise from Rock crushing or screening operations performed within 3,000 feet of all occupied dwellings by placing material stockpiles between the operation and the affected dwellings, or by other means approved by the Engineer.

If a specific noise impact complaint occurs during the construction of the Project, one or more of the following noise mitigation measures may be required, at no additional cost to the Agency, as directed by the Engineer:

- Locate stationary construction Equipment as far from nearby noise sensitive properties as feasible.
- Shut off idling Equipment.
- Reschedule construction operations to avoid periods of noise annoyance identified in the complaint.
- Notify nearby residents whenever extremely noisy Work will be occurring.
- Install temporary or portable acoustic barriers around stationary construction noise sources.
- Operate electric-powered Equipment using line voltage power or solar power."

Multnomah County will obtain construction noise variances as needed from the City of Portland. Specifically, the contractor for the Project will be required to obtain construction noise variances from the City of Portland via their variance process. This effort will require the contractor to implement specific mitigation measures to reduce and minimize construction noise to the extent practicable.

Vibration-producing construction equipment shall be operated in such a manner to avoid damaging nearby sensitive structures and minimize annoyance to people living or utilizing institutional lands nearby. Specifically, the construction contractor will need to identify alternative construction methods in some areas to avoid damage and annoyance threshold limits identified in Table 7 and Table 8. Potential mitigation strategies may include implementing caisson drilling rather than pile driving and using hand tools where it is not possible to construct with heavy machinery outside of the distances identified in Table 7 and Table 8. Additionally, vibration monitoring during construction should be implemented at vibration sensitive structures to identify the onset of exceedance conditions so that the construction contractor may rectify any issues and avoid damage to nearby structures.

8.2 Evaluation of Long-term Abatement Measures

Traffic noise levels would be equal to or exceed the NAAC for a number of sensitive land uses as provided in Table 9. Traffic noise mitigation measures were evaluated for all these receptors.

Traffic noise abatement must be *feasible* and *reasonable* to be included in the Project's design. ODOT standards state that acoustical feasibility is achieved if a simple majority of impacted receptors achieve a 5 dB or greater insertion loss (reduction) because of the mitigation measure. In addition, feasibility also considers engineering factors such as safety, topography, environmental constraints (i.e., presence of wetlands), drainage, and excessive barrier height. For noise abatement to be reasonable, it must consider the viewpoints of the residents and property owners who would benefit from the mitigation measure, the cost-effectiveness of the abatement measure, and the noise reduction design goal of 7 dB at one or more benefited properties.

8.2.1 Noise Abatement Considerations

Several noise abatement options were considered for noise impacts under the Build Alternatives. Some of these options include speed restrictions, truck restrictions, and alignment changes. The posted speed limits on Burnside Street are already somewhat low for a major arterial. Reducing speeds also reduce mobility on the facility and are unlikely to reduce noise levels enough to be noticeable. Truck restrictions are not feasible because Burnside Street is one of the main routes for moving goods across the Willamette River.

ODOT also considers changes in Project alignment to abate traffic noise; however, the Project alignment has been identified to minimize property impacts potentially resulting from the Project, such as acquisitions. Furthermore, ODOT has found that shifting roadway alignments typically only results in shifting of noise impacts to other properties and is not a reasonable approach for abating traffic noise impacts.

Noise barriers, such as noise walls, are ODOT's preferred method for abating traffic noise impacts from a given project. For this Project, noise barriers in the form of noise walls were evaluated for all impacted receptors. A noise wall is *feasible* if it reduces noise levels at over 50 percent of impacted receptors by 5 dB or greater. A noise wall is *reasonable* if it costs no more than $25,000 per benefited receptor and achieves a 7 dB reduction at one or more receptors. For cost estimation purposes, 1 square foot of noise barrier is assumed to cost $20 to construct for walls up to 16 feet in height. For walls taller than 16 feet, it is assumed that they would cost $25 per square foot to construct.

Noise barriers were modeled along the edge of the Build Alternative structure unless Project engineers reasoned such a location would not be constructible. Walls were not analyzed along I-5 because that roadway is not part of the Project.

8.2.2 Noise Walls

Two noise walls were evaluated along each side of Burnside Bridge to determine if they could feasibly and reasonably reduce noise levels at the impacted receptors. Walls were evaluated for heights ranging from 10 to 24 feet. Regardless of the height, the analyzed noise walls could benefit one location, but not feasibly reduce traffic noise 5 dB or more at over 50 percent of impacted receptors. The noise walls would not be able to block the line of sight to the dominant noise source at affected receptors, specifically I-5 and Naito Parkway. For this reason, noise walls are not recommended for inclusion in this Project. Appendix D provides detailed noise abatement tables and figures for the analyzed walls.

8.3 Statement of Likelihood

Noise walls cannot feasibly reduce traffic noise at impacted receptors; therefore, noise walls are not recommended for inclusion in the Project.

9 Contacts and Coordination

Project work includes an extensive public involvement and agency coordination effort including local jurisdictions and neighborhoods within the Project Area.

At the appropriate time, agencies and organizations are notified of the intent to prepare an EIS through the Federal Register and other Project outreach activities. Interested organizations will have the opportunity to review and comment on the noise and vibration analysis through the course of the Project, including during the public comment period for the Draft EIS.

During the impacts analysis, ODOT was the only agency contacted for data and other information related to noise and vibration.

9.1 Information for Local Officials

ODOT's noise policy indicates traffic noise predictions be made for undeveloped lands to assist local agencies in their planning efforts. While there are no undeveloped lands in the traffic noise analysis area, there are a number of non-noise sensitive NAAC E and NAAC F uses. These lands are those that have no noise sensitive receptor analysis points shown in Figures 5-1 and 5-2 and theoretically could be redeveloped to be noise sensitive in the future. Currently, the NAAC E lands include areas along Naito Parkway, such as restaurants without outdoor seating, and industrial uses such as warehouses located between NE/SE 2nd Ave and I-5. Predicted sound levels for the portions of these areas closest to the dominant noise source (i.e., Naito Parkway or I-5) were calculated for the Build Alternatives worst noise hour. The results of these predictions are as follows:

- NAAC E along Naito Parkway at a distance of 18 feet 64 dBA Leq(h)
- NAAC F near I-5 at a distance of 105 feet 74 dBA Leq(h)

10 Preparers

Name	Professional Affiliation [firm or organization]	Education [degree or certification]	Years of Experience
Scott Noel	HMMH	Bachelors Geography and Environmental Planning	20
Dillon Tannler	HMMH	B.S. Economic, Environmental Policy, & Management	9
Joseph Czech, PE	HMMH	B.S. Aerospace Engineering	31

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City of Portland

1997 City of Portland Code, Title 18, Noise Control
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2019 Roadway Construction Noise Model 2.0
https://www.fhwa.dot.gov/environment/noise/construction_noise/rcnm2/

Federal Transit Administration

2018 Transit Noise and Vibration Impact Assessment
https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/118131/transit-noise-and-vibration-impact-assessment-manual-fta-report-no-0123_0.pdf

Multnomah County

2021a EQRB Construction Approach Technical Report. https://multco.us/earthquake-ready-burnside-bridge/project-library.

2021b EQRB Cultural Resources Technical Report. https://multco.us/earthquake-ready-burnside-bridge/project-library.

2021c EQRB Transportation Technical Report. https://multco.us/earthquake-ready-burnside-bridge/project-library.

Oregon Department of Transportation

2011 Noise Manual
https://www.oregon.gov/ODOT/GeoEnvironmental/Docs_Environmental/Noise-Manual.pdf

2019 Quarry Noise Model (QNM)
https://trid.trb.org/view/1628362

Appendix A. Federal Highway Administration Traffic Noise Model Electronic Files

Appendix B. Monitoring Data, Equipment Calibration Certificates, and Traffic

PROJECT: Burnside Bridge Replacement

JOB NO.: 310360

SHORT-TERM NOISE MEASUREMENT SITE LOG

ASSESSMENT AREA: WEST MEASUREMENT SITE NO.: 1

ADDRESS: WATERFRONT PARK

OWNER: CITY OF PORTLAND

DESCRIPTION: PUBLIC PARK

NOISE SOURCES: ROADWAY TRAFFIC, MAX TRAINS (DISTANT), WATERCRAFT

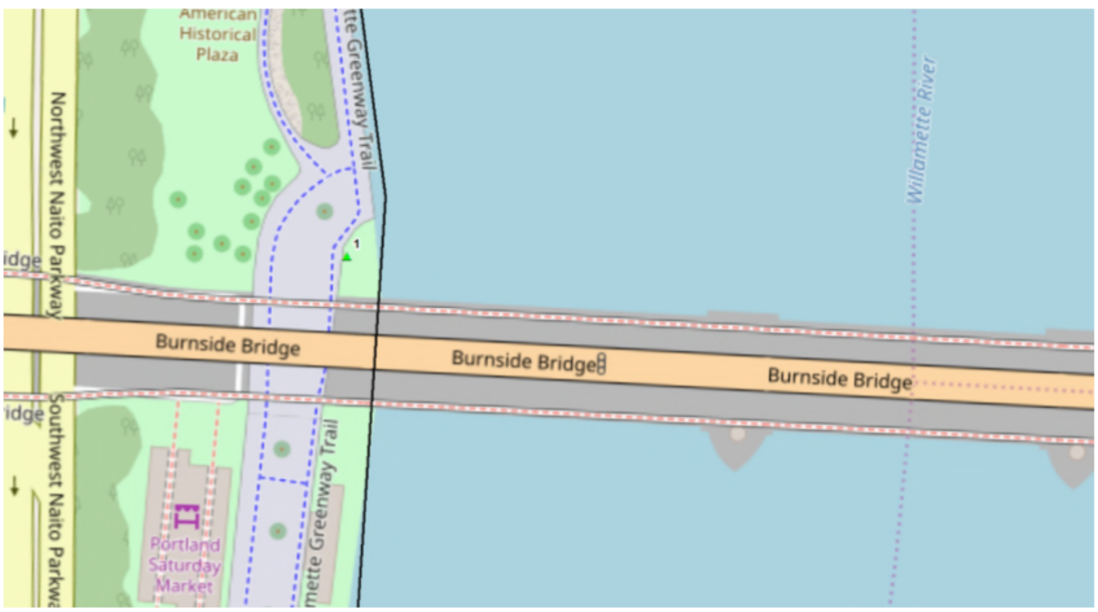
NOISE MONITOR: 824 S/N: KIT 1

MICROPHONE: LD S/N: KIT 1

CALIBRATOR: LD S/N: KIT 1

TEMP. RANGE (°F): 64 WEATHER CONDITIONS: SUNNY

SITE SKETCH:



PHOTOS: Yes GPS COORDINATES: Yes

HARRIS MILLER MILLER & HANSON INC.

SHORT-TERM NOISE MEASUREMENT DATA SHEET

PROJECT: Burnside Bridge Replacement
JOB NO.: 310360

MEASUREMENT SITE NO.: 1 PERSONNEL: SN/DT
ADDRESS/DESCRIPTION: Waterfront Park DATE: 6/25/19

#	36 Minute Period Starting	Meas'd Leq (dBA)	√ or X	Autos	Medium Trucks	Heavy Trucks	Other Noise Sources	COMMENTS (Include Calibration Data)
1	10:05	63.7						See traffic count sheet
2								
3								
4								
5								
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HARRIS MILLER MILLER & HANSON INC.

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PROJECT: Burnside Bridge Project
JOB NO.: 310360

TRAFFIC VOLUME COUNT DATA SHEET

ASSESSMENT AREA:	Park West	START TIME:	1009
MEASUREMENT SITE NO.:	STM-1	END TIME:	
ADDRESS/DESCRIPTION:	Naito Park	DATE:	6-25-19
		PERSONNEL:	DST / SRN

ROADWAY:	I-5	DIRECTION 1: NB	DIRECTION 2: SB
First Sample: 15 minutes **Start Time:** 1008			
	Automobiles	690	498
	Medium Trucks (6 Tires)	27	30
	Heavy Trucks (>6 Tires)	87	68
	Average speed (mph)	5 - 45	45 - 55
Second Sample: 15 minutes **Start Time:** 1020			
	Automobiles	266	873
	Medium Trucks (6 Tires)	27	24
	Heavy Trucks (>6 Tires)	12	21
	Average speed (mph)	50 - 55	50 - 60
Third Sample: ______ minutes **Start Time:**		I-5 SB inner lane	to EB 84
	Automobiles	159	284
	Medium Trucks (6 Tires)	9	27
	Heavy Trucks (>6 Tires)	18	39
	Average speed (mph)	45 - 60	45-55
Fourth Sample: _____ minutes **Start Time:**		NB Naito	SB
	Automobiles	54	93
	Medium Trucks (6 Tires)	6	9
	Heavy Trucks (>6 Tires)	0	6
	Average speed (mph)	15 - 35	15 - 35

HARRIS MILLER MILLER & HANSON INC.

Photo 1. Site 1: Tripod Mounted Sound Level Meter Tom McCall Waterfront Park North of Burnside Bridge Facing Southeast

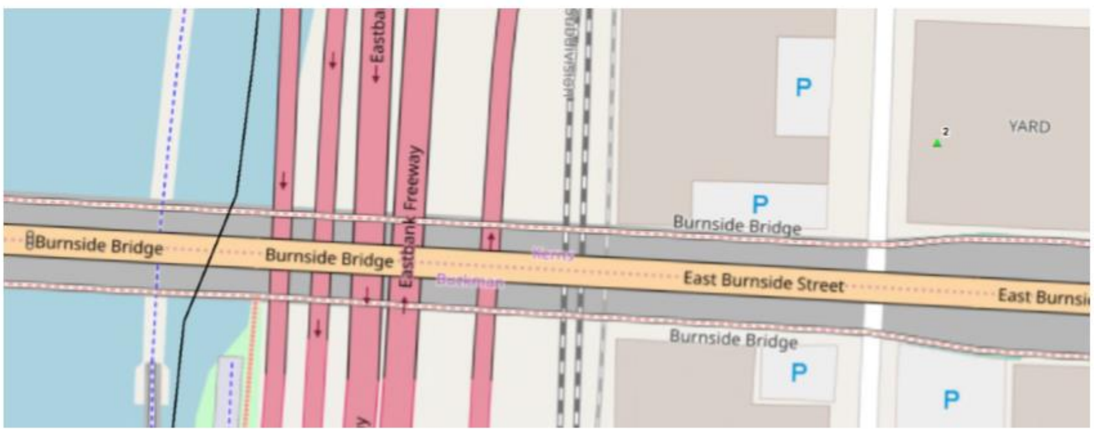
Photo 2. Site 1: Tripod Mounted Sound Level Meter Tom McCall Waterfront Park North of Burnside Bridge Facing Northeast

PROJECT:	Burnside Bridge Replacement
JOB NO.:	310360

SHORT-TERM NOISE MEASUREMENT SITE LOG

ASSESSMENT AREA:	EAST	MEASUREMENT SITE NO.:	2
ADDRESS:	22 NE 2ND AVE		
OWNER:	FPI MANAGEMENT		
DESCRIPTION:	MULTI-FAMILY BUILDING		
NOISE SOURCES:	ROADWAY TRAFFIC		
NOISE MONITOR:	824	S/N:	KIT 1
MICROPHONE:	LD	S/N:	KIT 1
CALIBRATOR:	LD	S/N:	KIT 1
TEMP. RANGE (°F):	69	WEATHER CONDITIONS:	SUNNY

SITE SKETCH:



PHOTOS: Yes GPS COORDINATES: Yes

HARRIS MILLER MILLER & HANSON INC.

SHORT-TERM NOISE MEASUREMENT DATA SHEET

PROJECT: Burnside Bridge Replacement

JOB NO.: 310360

MEASUREMENT SITE NO.: 2 PERSONNEL: SN/DT

ADDRESS/DESCRIPTION: Yard Apartments DATE: 6/25/19

#	15 Minute Period Starting	Meas'd Leq (dBA)	√ or X	Autos	Medium Trucks	Heavy Trucks	Other Noise Sources	COMMENTS (Include Calibration Data)
1	11:42	65.5						See traffic count sheet
2								
3								
4								
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HARRIS MILLER MILLER & HANSON INC.

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PROJECT: Burnside Bridge Project
JOB NO.: 310360

TRAFFIC VOLUME COUNT DATA SHEET

ASSESSMENT AREA:	East Burnside	START TIME:	1142
MEASUREMENT SITE NO.:	SIM-2	END TIME:	
ADDRESS/DESCRIPTION:	the Yards	DATE:	6-25
		PERSONNEL:	DST/SRN

		DIRECTION 1:	DIRECTION 2:
ROADWAY:	Burnside	EB	WB
First Sample: ______ **minutes** **Start Time:** ______			
	Automobiles	303	360
	Medium Trucks (6 Tires)	3	3
	Heavy Trucks (>6 Tires)	3	3
	Average speed (mph)	25-35	25-35
Second Sample: ____ **minutes** **Start Time:** ______	I-5 Bus MC	SB 7 3	NB
	Automobiles	948	697
	Medium Trucks (6 Tires)	39	59
	Heavy Trucks (>6 Tires)	21	21
	Average speed (mph)	55-65	55-65
Third Sample: ______ **minutes** **Start Time:** ______			
	Automobiles		
	Medium Trucks (6 Tires)		
	Heavy Trucks (>6 Tires)		
	Average speed (mph)		
Fourth Sample: _____ **minutes** **Start Time:** ______			
	Automobiles		
	Medium Trucks (6 Tires)		
	Heavy Trucks (>6 Tires)		
	Average speed (mph)		

HARRIS MILLER MILLER & HANSON INC.

Photo 3. Site 2: Tripod Mounted Sound Level Meter at the Yard Apartments Facing West

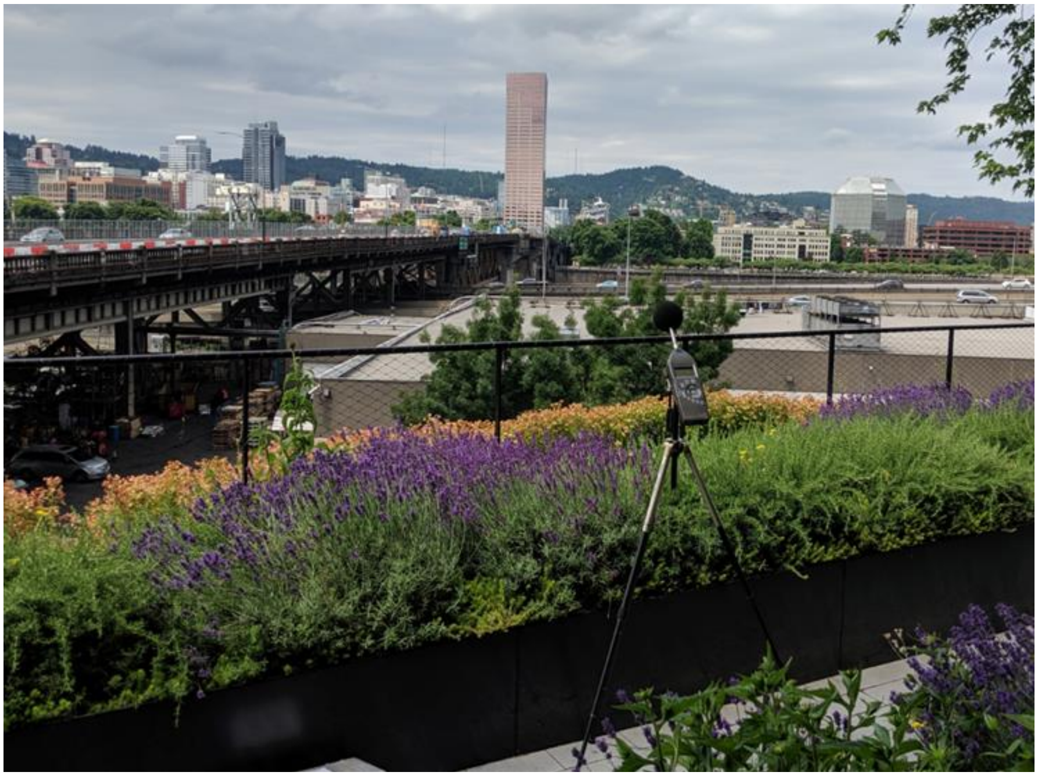
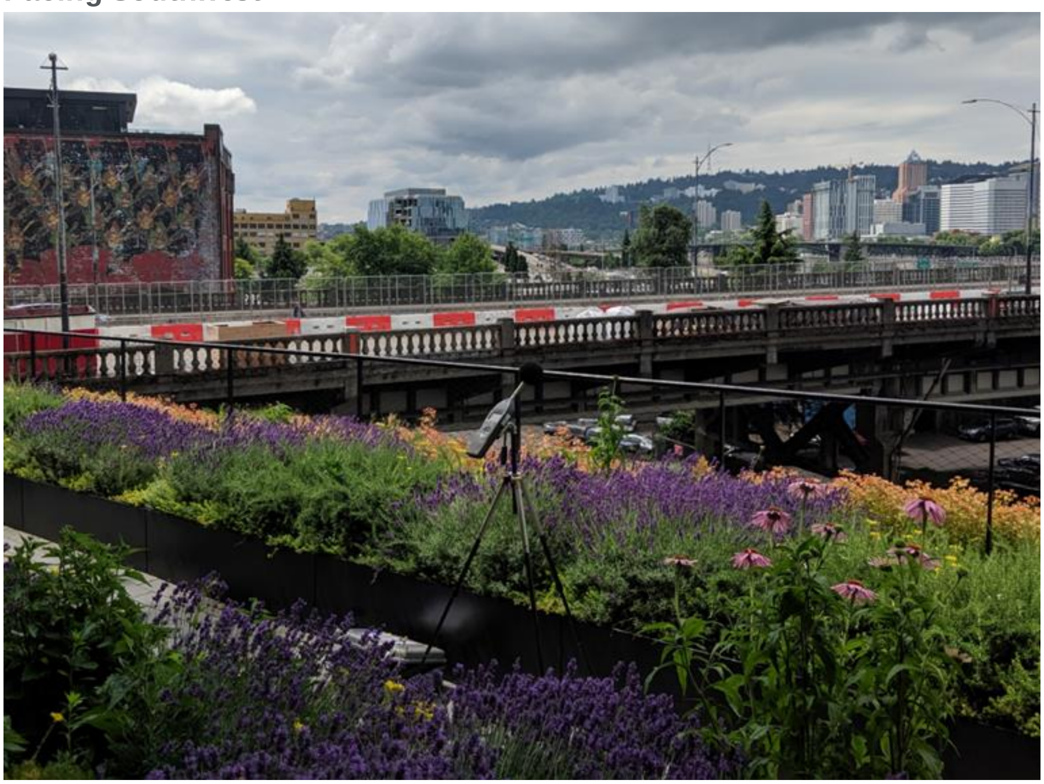


Photo 4. Site 2: Tripod Mounted Sound Level Meter at the Yard Apartments Facing Southwest



SHORT-TERM NOISE MEASUREMENT DATA SHEET

PROJECT: Burnside Bridge Replacement
JOB NO.: 310360

MEASUREMENT SITE NO.: 3 PERSONNEL: SN
ADDRESS/DESCRIPTION: Waterfront Park South DATE: 2/4/20

#	36 Minute Period Starting	Meas'd Leq (dBA)	√ or X	Autos	Medium Trucks	Heavy Trucks	Other Noise Sources	COMMENTS (Include Calibration Data)
1	9:24	67.8						See traffic count sheet
2								
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HARRIS MILLER MILLER & HANSON INC.

PROJECT: Burnside Bridge Replacement

JOB NO.: 310360

SHORT-TERM NOISE MEASUREMENT SITE LOG

ASSESSMENT AREA: WEST   MEASUREMENT SITE NO.: 3

ADDRESS: WATERFRONT PARK SOUTH OF BRIDGE

OWNER: CITY OF PORTLAND

DESCRIPTION: PUBLIC PARK

NOISE SOURCES: ROADWAY TRAFFIC, GEESE

NOISE MONITOR: B&K 2270   S/N: KIT 6

MICROPHONE: B&K   S/N: KIT 6

CALIBRATOR: B&K   S/N: KIT 6

TEMP. RANGE (°F): 34   WEATHER CONDITIONS: CLOUDY

SITE SKETCH:

PHOTOS: Yes   GPS COORDINATES: Yes

HARRIS MILLER MILLER & HANSON INC.

Photo 5. Site 3: Tripod Mounted Sound Level Meter Tom McCall Waterfront Park South of Burnside Bridge Facing Northeast

Photo 6. Site 3: Tripod Mounted Sound Level Meter Tom McCall Waterfront Park South of Burnside Bridge Facing Southwest

SHORT-TERM NOISE MEASUREMENT DATA SHEET

PROJECT: Burnside Bridge Replacement
JOB NO.: 310360

MEASUREMENT SITE NO.: 4 PERSONNEL: SN
ADDRESS/DESCRIPTION: Eastbank Esplanade DATE: 2/4/20

#	36 Minute Period Starting	Meas'd Leq (dBA)	√ or X	Autos	Medium Trucks	Heavy Trucks	Other Noise Sources	COMMENTS (Include Calibration Data)
1	9:57	73.6						See traffic count sheet
2								
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HARRIS MILLER MILLER & HANSON INC.

PROJECT: Burnside Bridge Replacement

JOB NO.: 310360

SHORT-TERM NOISE MEASUREMENT SITE LOG

ASSESSMENT AREA: EAST MEASUREMENT SITE NO.: 4

ADDRESS: EASTBANK ESPLANADE NORTH OF BRIDGE

OWNER: CITY OF PORTLAND

DESCRIPTION: PUBLIC PATH

NOISE SOURCES: ROADWAY TRAFFIC, GEESE

NOISE MONITOR: B&K 2270 S/N: KIT 6

MICROPHONE: B&K S/N: KIT 6

CALIBRATOR: B&K S/N: KIT 6

TEMP. RANGE (°F): 35 WEATHER CONDITIONS: CLOUDY

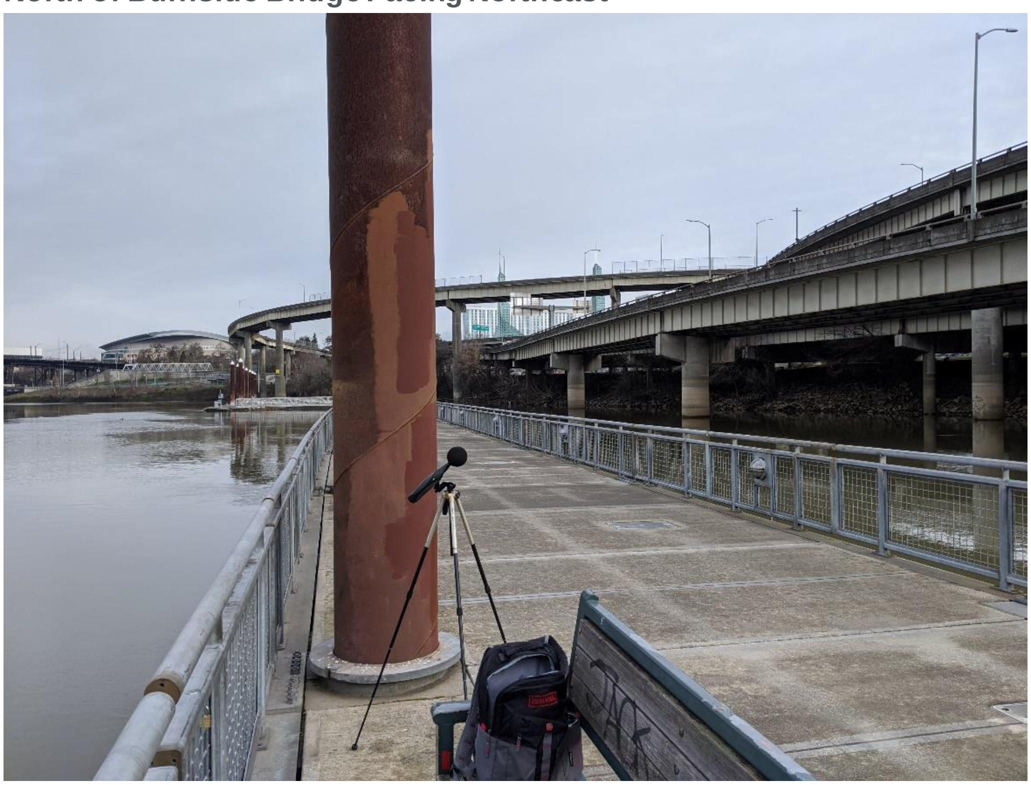
SITE SKETCH:

PHOTOS: Yes GPS COORDINATES: Yes

HARRIS MILLER MILLER & HANSON INC.

Photo 7. Site 4: Tripod Mounted Sound Level Meter Vera Katz Eastbank Esplanade North of Burnside Bridge Facing Southwest

Photo 8. Site 4: Tripod Mounted Sound Level Meter Vera Katz Eastbank Esplanade North of Burnside Bridge Facing Northeast



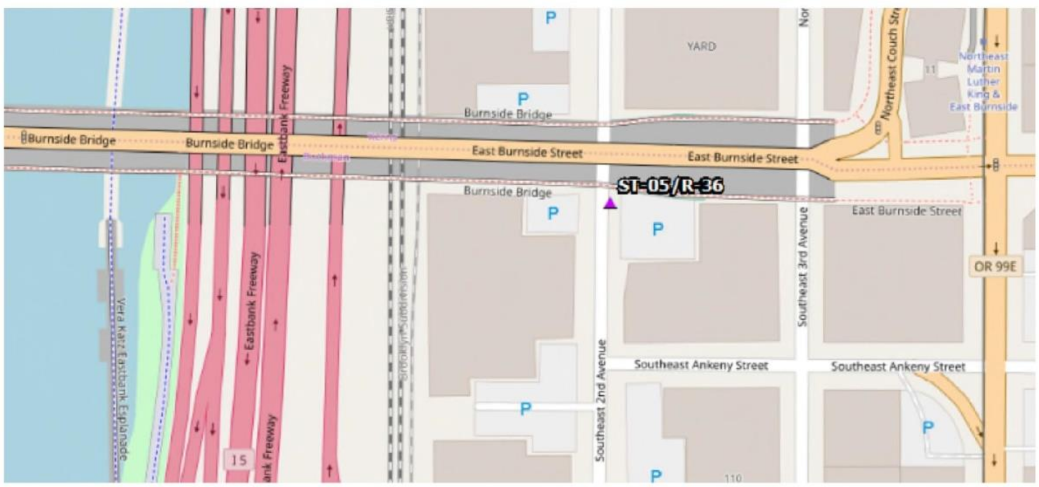
PROJECT: Burnside Bridge Replacement

JOB NO.: 310360

SHORT-TERM NOISE MEASUREMENT SITE LOG

ASSESSMENT AREA:	EAST	MEASUREMENT SITE NO.:	5
ADDRESS:	BURNSIDE SKATEPARK		
OWNER:	CITY OF PORTLAND		
DESCRIPTION:	PUBLIC SKATEPARK		
NOISE SOURCES:	ROADWAY TRAFFIC, GEESE		
NOISE MONITOR:	B&K 2270	S/N:	KIT 6
MICROPHONE:	B&K	S/N:	KIT 6
CALIBRATOR:	B&K	S/N:	KIT 6
TEMP. RANGE (°F):	35	WEATHER CONDITIONS:	CLOUDY

SITE SKETCH:



PHOTOS: Yes GPS COORDINATES: Yes

HARRIS MILLER MILLER & HANSON INC.

SHORT-TERM NOISE MEASUREMENT DATA SHEET

PROJECT: Burnside Bridge Replacement
JOB NO.: 310360

MEASUREMENT SITE NO.: 5 PERSONNEL: SN
ADDRESS/DESCRIPTION: Burnside Skatepark DATE: 2/4/20

#	36 Minute Period Starting	Meas'd Leq (dBA)	√ or X	Autos	Medium Trucks	Heavy Trucks	Other Noise Sources	COMMENTS (Include Calibration Data)
1	10:29a	65.9						See traffic count sheet
2								
3								
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HARRIS MILLER MILLER & HANSON INC.

Photo 9. Site 5: Tripod Mounted Sound Level Meter Burnside Skatepark Facing North

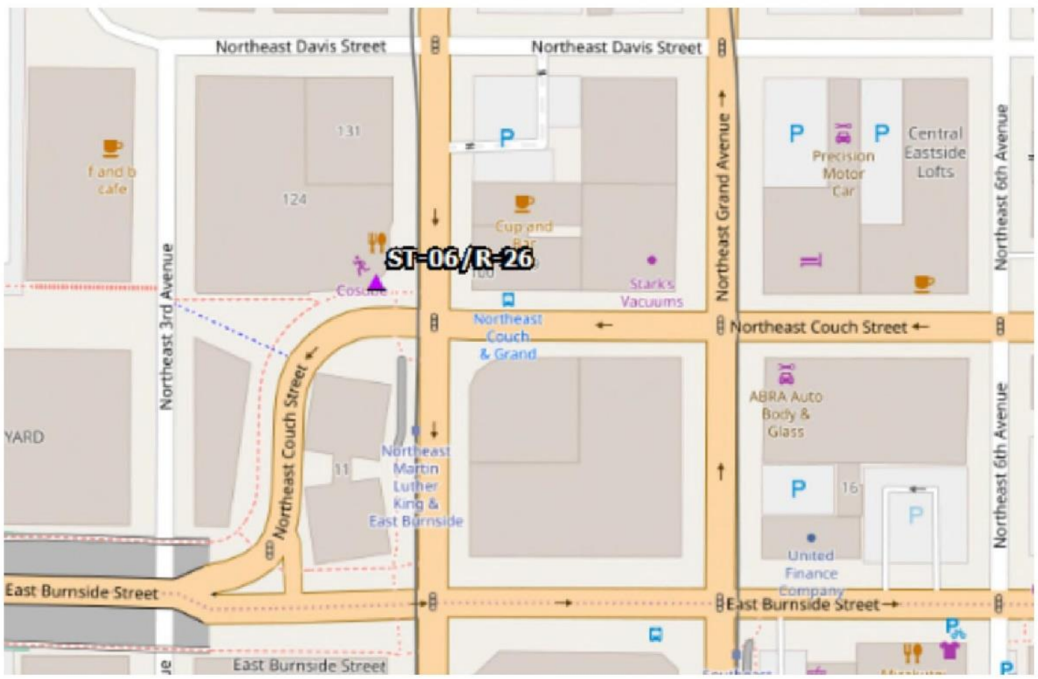
Photo 10. Site 5: Tripod Mounted Sound Level Meter Burnside Skatepark Facing West

PROJECT: Burnside Bridge Replacement
JOB NO.: 310360

SHORT-TERM NOISE MEASUREMENT SITE LOG

ASSESSMENT AREA: EAST   MEASUREMENT SITE NO.: 6
ADDRESS: COSUBE (COFFEE/SURF SHOP)
OWNER: COSUBE
DESCRIPTION: COFFEE SHOP/SURF SHOP
NOISE SOURCES: ROADWAY TRAFFIC (NO STREETCAR DURING MEASUREMENT)
NOISE MONITOR: B&K 2270   S/N: KIT 6
MICROPHONE: B&K   S/N: KIT 6
CALIBRATOR: B&K   S/N: KIT 6
TEMP. RANGE (°F): 35   WEATHER CONDITIONS: CLOUDY

SITE SKETCH:



HARRIS MILLER MILLER & HANSON INC.

SHORT-TERM NOISE MEASUREMENT DATA SHEET

PROJECT: Burnside Bridge Replacement

JOB NO.: 310360

MEASUREMENT SITE NO.: 6 PERSONNEL: SN

ADDRESS/DESCRIPTION: Cosube (coffee/surf shop) DATE: 2/4/20

#	36 Minute Period Starting	Meas'd Leq (dBA)	√ or X	Autos	Medium Trucks	Heavy Trucks	Other Noise Sources	COMMENTS (Include Calibration Data)
1	10:51a	70.0						See traffic count sheet
2								
3								
4								
5								
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HARRIS MILLER MILLER & HANSON INC.

Photo 11. Site 6: Tripod Mounted Sound Level Cosube Coffee and Surf Shop Outdoor Seating Area Facing Northeast

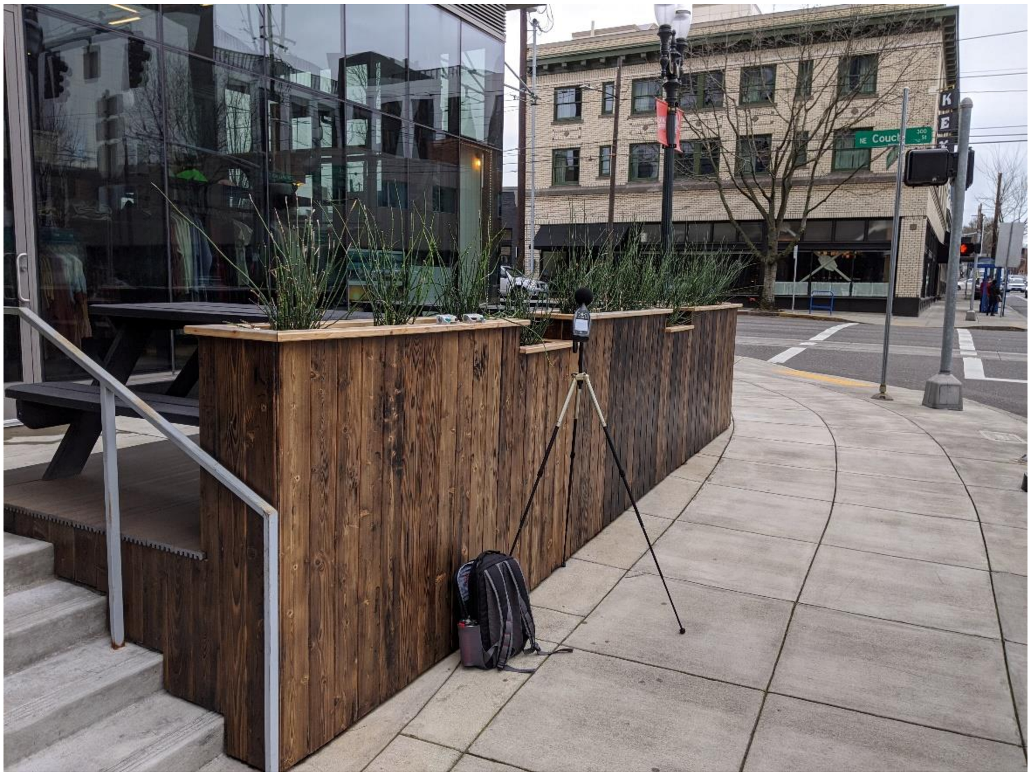
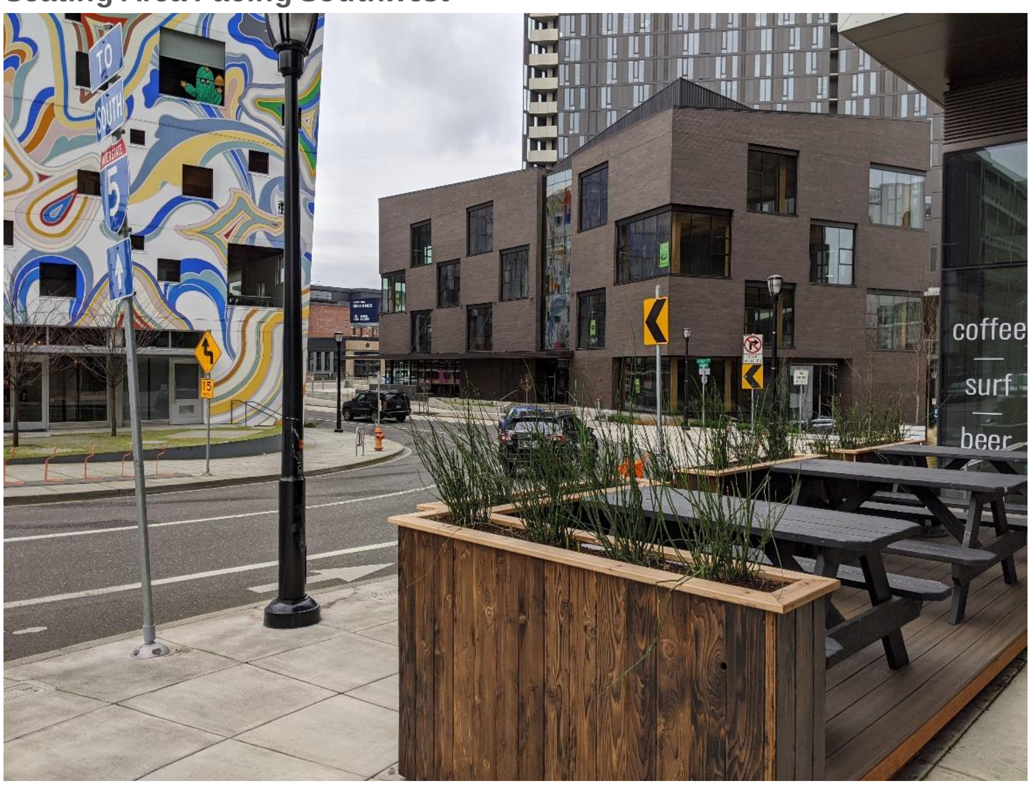


Photo 12. Site 6: Tripod Mounted Sound Level Cosube Coffee and Surf Shop Outdoor Seating Area Facing Southwest



Traffic Counts for Measurements 3, 4, 5 and 6

Roadway	Vehicle Type	ST-03 Count				ST-04 Count				ST-05 Count				ST-06 Count			
		15-Minute Count by Direction		1-Hour Equivalent by Direction		15-Minute Count by Direction		1-Hour Equivalent by Direction		15-Minute Count by Direction		1-Hour Equivalent by Direction		15-Minute Count by Direction		1-Hour Equivalent by Direction	
		NB/WB	SB/EB	NB/WB	SB/EB	NB/WB	SB/EB	NB/WB	SB/EB	NB/WB	SB/EB	NB/WB	SB/EB	NB/WB	SB/EB	NB/WB	SB/EB
Burnside Street	Passenger Vehicle	173	149	692	596	107	109	428	436	91	120	364	480	131	150	524	600
	Medium Truck	8	16	32	64	6	11	24	44	18	16	72	64	4	6	16	24
	Heavy Truck	2	2	8	8	1	1	4	4	4	0	16	0	2	0	8	0
	Bus	0	0	0	0	0	0	0	0	0	0	0	0	4	0	16	0
	Motorcycle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C-D/Morrison Off-ramp	Passenger Vehicle		126		504		367		1468		128		512		90		360
	Medium Truck		31		124		66		264		11		44		15		60
	Heavy Truck		15		60		55		220		8		32		12		48
	Bus		0		0				0		0		0		0		0
	Motorcycle		0		0				0		0		0		0		0
I-84 WB off-ramp to I-5 SB	Passenger Vehicle		462		1848		362		1448		380		1520		612		2448
	Medium Truck		49		196		40		160		27		108		50		200
	Heavy Truck		9		36		11		44		9		36		20		80
	Bus				0				0		0		0		0		0
	Motorcycle				0				0		0		0		0		0
I-5 Main Line	Passenger Vehicle	429	223	1716	892	272	196	1088	784	442	266	1768	1064	516	447	2064	1788
	Medium Truck	48	24	192	96	66	46	264	184	59	21	236	84	52	32	208	128
	Heavy Truck	59	38	236	152	29	32	116	128	58	43	232	172	63	66	252	264
	Bus	0	0	0	0			0	0	0	0	0	0	0	0	0	0
	Motorcycle	0	0	0	0			0	0	0	0	0	0	0	0	0	0
C-D NB / Morrison On-Ramp to I-84 EB	Passenger Vehicle	264		1056		249		996		284		1136		693		2772	
	Medium Truck	26		104		35		140		17		68		18		72	
	Heavy Truck	9		36		7		28		6		24		18		72	
	Bus			0				0		0		0		0		0	
	Motorcycle			0				0		0		0		0		0	
I-5 SB off-ramp to I-84 EB	Passenger Vehicle				0				0				0		193		772
	Medium Truck				0				0				0		24		96
	Heavy Truck				0				0				0		17		68
	Bus				0				0				0		0		0
	Motorcycle				0				0				0		0		0
Couch Street west of MLK Jr. Blvd	Passenger Vehicle													131		524	
	Medium Truck													4		16	
	Heavy Truck													2		8	
	Bus													4		16	
	Motorcycle													0		0	
Couch Street east of MLK Jr. Blvd	Passenger Vehicle													134		536	
	Medium Truck													4		16	
	Heavy Truck													2		8	
	Bus													4		16	
	Motorcycle													0		0	

Roadway	Vehicle Type	ST-03 Count				ST-04 Count				ST-05 Count				ST-06 Count			
		15-Minute Count by Direction		1-Hour Equivalent by Direction		15-Minute Count by Direction		1-Hour Equivalent by Direction		15-Minute Count by Direction		1-Hour Equivalent by Direction		15-Minute Count by Direction		1-Hour Equivalent by Direction	
		NB/WB	SB/EB	NB/WB	SB/EB	NB/WB	SB/EB	NB/WB	SB/EB	NB/WB	SB/EB	NB/WB	SB/EB	NB/WB	SB/EB	NB/WB	SB/EB
MLK Jr. Blvd north of Couch Street	Passenger Vehicle														236		944
	Medium Truck														22		88
	Heavy Truck														4		16
	Bus														1		4
	Motorcycle														0		0
MLK Jr. Blvd north of Couch Street	Passenger Vehicle														241		964
	Medium Truck														22		88
	Heavy Truck														4		16
	Bus														1		4
	Motorcycle														0		0
Naito Pkwy	Passenger Vehicle	56	55	336	330												
	Medium Truck	4	4	24	24												
	Heavy Truck	0	1	0	6												
	Bus	0	0	0	0												
	Motorcycle	0	0	0	0												

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP® CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.42283

Instrument:	**Sound Level Meter**	*Date Calibrated:* **2/11/2019**	*Cal Due:*
Model:	**824**	*Status:*	**Received** / **Sent**
Manufacturer:	**Larson Davis**	*In tolerance:*	**X** / **X**
Serial number:	**A0795**	*Out of tolerance:*	
Tested with:	**Mic. 40AQ s/n 19907 & 40AE s/n 8310** **Preamp. PRM902 s/n 1208 & s/n 3185**	*See comments:*	
		Contains non-accredited tests:	__Yes **X** No
Type (class):	**1**	*Calibration service:*	__ Basic **X** Standard
Customer:	**Harris Miller Miller & Hanson Inc.**	*Address:*	**77 South Bedford Street, Burlington, MA 01803**
Tel/Fax:	**781-229-0707 x3119 / 781-229-7939**		

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/26/2015
SLM & Dosimeters – Acoustical Tests, Scantek Inc., Rev. 7/6/2011

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31052	Oct 31, 2018	Scantek, Inc./ NVLAP	Oct 31, 2019
DS-360-SRS	Function Generator	33584	Oct 24, 2017	ACR Env./ A2LA	Oct 24, 2019
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Oct 1, 2018	ACR Env. / A2LA	Oct 1, 2019
HM30-Thommen	Meteo Station	1040170/39633	Nov 13, 2018	ACR Env./ A2LA	Nov 13, 2019
PC Program 1019 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Nov 11, 2018	Scantek, Inc./ NVLAP	Nov 11, 2019

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK).

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
23.0	100.78	38.7

Calibrated by:	Lydon Dawkins	**Authorized signatory:**	Steven E. Marshall
Signature	Lydon Dawkins	Signature	Steven E Marshall
Date	2/11/2019	Date	2/14/2019

Document stored Z:\Calibration Lab\SLM 2019\LD824-27dB_A0795_M1.doc

Page 1 of 2

Scantek, Inc.
CALIBRATION LABORATORY
ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®
CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.42291

Instrument:	**Acoustical Calibrator**	*Date Calibrated:* **2/7/2019** *Cal Due:*		
Model:	**CAL250**	*Status:*	**Received**	**Sent**
Manufacturer:	**Larson Davis**	*In tolerance:*	**X**	**X**
Serial number:	**4182**	*Out of tolerance:*		
Class (IEC 60942):	**1L**	*See comments:*		
Barometer type:		*Contains non-accredited tests:* __Yes _X_ No		
Barometer s/n:				
Customer:	**Harris Miller Miller & Hanson Inc.**	*Address:* **77 South Bedford Street, Burlington, MA 01803**		
Tel/Fax:	**781-229-0707 x3119 / 781-229-7939**			

Tested in accordance with the following procedures and standards:
Calibration of Acoustical Calibrators, Scantek Inc., Rev. 10/1/2010

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31052	Oct 31, 2018	Scantek, Inc./ NVLAP	Oct 31, 2019
DS-360-SRS	Function Generator	33584	Oct 24, 2017	ACR Env./ A2LA	Oct 24, 2019
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Oct 1, 2018	ACR Env. / A2LA	Oct 1, 2019
HM30-Thommen	Meteo Station	1040170/39633	Nov 13, 2018	ACR Env./ A2LA	Nov 13, 2019
140-Norsonic	Real Time Analyzer	1406423	Nov 3, 2018	Scantek / NVLAP	Nov 3, 2019
PC Program 1018 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
4134-Brüel&Kjær	Microphone	173368	Nov 11, 2018	Scantek, Inc. / NVLAP	Nov 11, 2019
1203-Norsonic	Preamplifier	14059	Feb 12, 2018	Scantek, Inc./ NVLAP	Feb 12, 2019

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK)

Calibrated by:	Lydon Dawkins	**Authorized signatory:**	Steven E. Marshall
Signature	Lydon Dawkins	Signature	Steven E. Marshall
Date	2/7/2019	Date	2/12/2019

Calibration Certificates or Test Reports shall not be reproduced, except in full, without written approval of the laboratory.
This Calibration Certificate or Test Reports shall not be used to claim product certification, approval or endorsement by NVLAP, NIST, or any agency of the federal government.
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Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®
CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.42298

Instrument: **Acoustical Calibrator**
Model: **4231**
Manufacturer: **Brüel and Kjær**
Serial number: **2579295**
Class (IEC 60942): **1**
Barometer type:
Barometer s/n:
Customer: **Harris Miller Miller & Hanson Inc.**
Tel/Fax: **781-229-0707 x3119 / 781-229-7939**

Date Calibrated: **2/8/2019** *Cal Due:*

Status:	**Received**	**Sent**
In tolerance:	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: __Yes _X_ No

Address: **77 South Bedford Street, Burlington, MA 01803**

Tested in accordance with the following procedures and standards:
Calibration of Acoustical Calibrators, Scantek Inc., Rev. 10/1/2010

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31052	Oct 31, 2018	Scantek, Inc./ NVLAP	Oct 31, 2019
DS-360-SRS	Function Generator	33584	Oct 24, 2017	ACR Env./ A2LA	Oct 24, 2019
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Oct 1, 2018	ACR Env. / A2LA	Oct 1, 2019
HM30-Thommen	Meteo Station	1040170/39633	Nov 13, 2018	ACR Env./ A2LA	Nov 13, 2019
140-Norsonic	Real Time Analyzer	1406423	Nov 3, 2018	Scantek / NVLAP	Nov 3, 2019
PC Program 1018 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
4134-Brüel&Kjær	Microphone	173368	Nov 11, 2018	Scantek, Inc. / NVLAP	Nov 11, 2019
1203-Norsonic	Preamplifier	14059	Feb 12, 2018	Scantek, Inc./ NVLAP	Feb 12, 2019

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK)

Calibrated by:	Lydon Dawkins	**Authorized signatory:**	Steven E. Marshall
Signature	Lydon Dawkins	Signature	Steven E Marshall
Date	2/8/2019	Date	2/12/2019

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Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®
CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.42332

Instrument:	**Sound Level Meter**	*Date Calibrated:* **2/14/2019**	*Cal Due:*
Model:	**2270**	*Status:*	**Received** / **Sent**
Manufacturer:	**Brüel and Kjær**	*In tolerance:*	X / X
Serial number:	**3024993**	*Out of tolerance:*	
Tested with:	**Microphone 4189 s/n 2616507**	*See comments:*	
	Preamplifier ZC0032 s/n 18967	*Contains non-accredited tests:* __Yes **X** No	
Type (class):	**1**	*Calibration service:* __ Basic **X** Standard	
Customer:	**Harris Miller Miller & Hanson Inc.**	*Address:*	**77 South Bedford Street Burlington, MA 01803**
Tel/Fax:	**781-229-0707 x3119 / 781-229-7939**		

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/26/2015
SLM & Dosimeters – Acoustical Tests, Sçantek Inc., Rev. 7/6/2011

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31061	Jul 30, 2018	Scantek, Inc./ NVLAP	Jul 30, 2019
DS-360-SRS	Function Generator	61646	Sep 7, 2018	ACR Env./ A2LA	Sep 7, 2020
34401A-Agilent Technologies	Digital Voltmeter	MY47022043	Sep 17, 2018	ACR Env./ A2LA	Sep 17, 2019
HM30-Thommen	Meteo Station	1040170/39633	Nov 13, 2018	ACR Env./ A2LA	Nov 13, 2019
PC Program 1019 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Nov 11, 2018	Scantek, Inc./ NVLAP	Nov 11, 2019

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK).

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
22.2	100.60	36.5

Calibrated by:	Jeremy Gotwalt	**Authorized signatory:**	Steven E. Marshall
Signature	Jeremy Gotwalt	Signature	Steven E. Marshall
Date	2/14/19	Date	2/14/2019

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Traffic Data Provided by Parametrix, ODOT ATR Data - Existing Conditions

				PM Peak Vehicular Hour (4-5pm)												Peak Truck Hour (10-11am)											
	Direction	Start Point	End Point	Speeds	Peak Volume	Cars #	Cars %	MT #	MT %	HT #	HT %	Bus #	Bus %	MC #	MC %	Speeds	Peak Volume	Cars #	Cars %	MT #	MT %	HT #	HT %	Bus #	Bus %	MC #	MC %
Burnside Street																											
	EB	2nd Ave	Couch St	25	1,575	1,531	97.2%	13	0.8%	2	0.1%	25	1.6%	5	0.3%	25	945	893	94.5%	25	2.6%	3	0.3%	24	2.5%	1	0.1%
	EB	Couch St	MLK Jr. Blvd	10	1,585	1,541	97.2%	13	0.8%	2	0.1%	25	1.6%	5	0.3%	25	950	898	94.5%	25	2.6%	3	0.3%	24	2.5%	1	0.1%
	EB	MLK Jr. Blvd	Grand Ave	10	1,605	1,560	97.2%	13	0.8%	2	0.1%	26	1.6%	5	0.3%	25	965	912	94.5%	25	2.6%	3	0.3%	24	2.5%	1	0.1%
	WB	Couch St	2nd Ave	35	1,125	1,095	97.3%	7	0.6%	0	0.0%	21	1.9%	2	0.2%	25	675	636	94.2%	33	2.9%	2	0.2%	25	2.2%	6	0.5%
Couch Street																											
	WB	Grand Ave	MLK Jr. Blvd	10	1,070	1,041	97.3%	6	0.6%	0	0.0%	20	1.9%	2	0.2%	25	640	603	94.2%	19	2.9%	1	0.2%	14	2.2%	3	0.5%
	WB	MLK Jr. Blvd	Burnside St	10	1,135	1,104	97.3%	7	0.6%	0	0.0%	22	1.9%	2	0.2%	25	680	641	94.2%	20	2.9%	1	0.2%	15	2.2%	3	0.5%
Grand Avenue																											
	NB	Ash St	Ankeny St	10	1,700	1,653	97.3%	12	0.7%	1	0.1%	30	1.8%	4	0.3%	30	1,020	962	94.4%	28	2.8%	3	0.3%	24	2.4%	3	0.3%
	NB	Ankeny St	Burnside St	10	1,715	1,668	97.3%	12	0.7%	1	0.1%	30	1.8%	4	0.3%	30	1,030	972	94.4%	28	2.8%	3	0.3%	24	2.4%	3	0.3%
	NB	Burnside St	Couch St	10	1,735	1,687	97.3%	12	0.7%	1	0.1%	30	1.8%	4	0.3%	30	1,040	636	94.4%	29	2.8%	3	0.3%	24	2.4%	3	0.3%
	NB	Couch St	Davis St	10	1,635	1,590	97.3%	11	0.7%	1	0.1%	29	1.8%	4	0.3%	30	980	925	94.4%	27	2.8%	2	0.3%	23	2.4%	3	0.3%
MLK Jr. Blvd																											
	SB	Davis St	Couch St	10	2,175	2,115	97.2%	16	0.8%	2	0.1%	36	1.7%	6	0.3%	30	1,305	1,232	94.4%	35	2.7%	4	0.3%	32	2.4%	3	0.2%
	SB	Couch St	Burnside St	10	2,110	2,051	97.2%	16	0.8%	2	0.1%	35	1.7%	6	0.3%	30	1,265	1,194	94.4%	34	2.7%	3	0.3%	31	2.4%	3	0.2%
	SB	Burnside St	Ankeny St	15	2,090	2,032	97.2%	16	0.8%	2	0.1%	35	1.7%	6	0.3%	30	1,255	1,185	94.4%	34	2.7%	3	0.3%	30	2.4%	3	0.2%
	SB	Ankeny St	Ash St	15	2,070	2,013	97.2%	16	0.8%	2	0.1%	35	1.7%	6	0.3%	30	1,240	1,171	94.4%	33	2.7%	3	0.3%	30	2.4%	2	0.2%
Naito Pkwy																											
	NB	Ash St	Ankeny St	15	630	614	97.5%	13	2.0%	1	0.2%	0	0.0%	2	0.3%	20	380	354	93.1%	25	6.6%	1	0.3%	0	0.0%	0	0.0%
	NB	Ankeny St	Couch St	15	600	585	97.5%	12	2.0%	1	0.2%	0	0.0%	2	0.3%	20	360	335	93.1%	24	6.6%	1	0.3%	0	0.0%	0	0.0%
	NB	Couch St	Davis St	15	665	648	97.5%	13	2.0%	1	0.2%	0	0.0%	2	0.3%	20	400	372	93.1%	26	6.6%	1	0.3%	0	0.0%	0	0.0%
	SB	Davis St	Couch St	20	660	647	98.1%	7	1.0%	1	0.2%	2	0.3%	3	0.4%	20	395	371	93.8%	17	4.3%	1	0.3%	4	1.1%	2	0.6%
	SB	Couch St	Ankeny St	20	775	760	98.1%	8	1.0%	2	0.2%	2	0.3%	3	0.4%	20	465	436	93.8%	20	4.3%	1	0.3%	5	1.1%	3	0.6%
	SB	Ankeny St	Ash St	20	860	844	98.1%	9	1.0%	2	0.2%	3	0.3%	3	0.4%	20	515	483	93.8%	22	4.3%	2	0.3%	6	1.1%	3	0.6%
SW/NW 2nd Avenue																											
	NB	Ash St	Ankeny St	10	530	517	97.5%	11	2.0%	1	0.2%	0	0.0%	2	0.3%	20	320	298	93.1%	21	6.6%	1	0.3%	0	0.0%	0	0.0%
	NB	Ankeny St	Burnside St	10	555	541	97.5%	11	2.0%	1	0.2%	0	0.0%	2	0.3%	20	335	312	93.1%	22	6.6%	1	0.3%	0	0.0%	0	0.0%
	NB	Burnside St	Couch St	10	475	463	97.5%	10	2.0%	1	0.2%	0	0.0%	1	0.3%	20	285	265	93.1%	19	6.6%	1	0.3%	0	0.0%	0	0.0%
	NB	Couch St	Davis St	10	275	268	97.5%	6	2.0%	1	0.2%	0	0.0%	1	0.3%	20	165	154	93.1%	11	6.6%	0	0.3%	0	0.0%	0	0.0%
I-5 NB																											
Mainline	NB			10	4,020	3,534	87.9%	157	3.9%	314	7.8%	12	0.3%	4	0.1%	35	4,530	3,778	83.4%	213	4.7%	453	10.0%	72	1.6%	14	0.3%
Off-Ramp	NB	I-84/Water Ave Off-ramp		10	2,605	2,290	87.9%	102	3.9%	203	7.8%	8	0.3%	3	0.1%	30	2,940	2,452	83.4%	138	4.7%	294	10.0%	47	1.6%	9	0.3%
Mainline	NB			10	1,415	1,244	87.9%	55	3.9%	110	7.8%	4	0.3%	1	0.1%	35	1,590	1,326	83.4%	75	4.7%	159	10.0%	25	1.6%	5	0.3%
On-Ramp	NB	Morrison Bridge On-ramp		10	990	870	87.9%	39	3.9%	77	7.8%	3	0.3%	1	0.1%	30	1,115	930	83.4%	52	4.7%	112	10.0%	18	1.6%	3	0.3%
Mainline	NB			15	2,405	2,114	87.9%	94	3.9%	188	7.8%	7	0.3%	2	0.1%	35	2,705	2,256	83.4%	127	4.7%	271	10.0%	43	1.6%	8	0.3%
On-Ramp	NB	I-84 WB On-ramp		20	1,175	1,033	87.9%	46	3.9%	92	7.8%	4	0.3%	1	0.1%	30	1,325	1,105	83.4%	62	4.7%	133	10.0%	21	1.6%	4	0.3%
Mainline	NB			15	3,580	3,147	87.9%	140	3.9%	279	7.8%	11	0.3%	4	0.1%	35	4,030	3,361	83.4%	189	4.7%	403	10.0%	64	1.6%	12	0.3%
I-5 SB																											
Mainline	SB			25	3,365	2,954	87.8%	128	3.8%	259	7.7%	24	0.7%	3	0.1%	45	3,260	2,784	85.4%	163	5.0%	280	8.6%	16	0.5%	16	0.5%
Off-Ramp	SB	I-84 EB Off-ramp		10	1,200	1,054	87.8%	46	3.8%	92	7.7%	8	0.7%	1	0.1%	30	1,165	995	85.4%	58	5.0%	100	8.6%	6	0.5%	6	0.5%
Mainline	SB			25	2,165	1,901	87.8%	82	3.8%	167	7.7%	15	0.7%	2	0.1%	45	2,095	1,789	85.4%	105	5.0%	180	8.6%	10	0.5%	10	0.5%
Off-Ramp	SB	Exit 300B (Morrison Bridge)		10	895	786	87.8%	34	3.8%	69	7.7%	6	0.7%	1	0.1%	30	865	739	85.4%	43	5.0%	74	8.6%	4	0.5%	4	0.5%
Mainline	SB			20	1,270	1,115	87.8%	48	3.8%	98	7.7%	9	0.7%	1	0.1%	45	1,230	1,050	85.4%	62	5.0%	106	8.6%	6	0.5%	6	0.5%
On-Ramp	SB	I-84 WB On-ramp		10	2,680	2,353	87.8%	102	3.8%	206	7.7%	19	0.7%	3	0.1%	40	2,595	2,216	85.4%	130	5.0%	223	8.6%	13	0.5%	13	0.5%
Mainline	SB			20	3,950	3,468	87.8%	150	3.8%	304	7.7%	28	0.7%	4	0.1%	45	3,825	3,267	85.4%	191	5.0%	329	8.6%	19	0.5%	19	0.5%

Traffic Data Provided by Parametrix, ODOT ATR Data - No Build and Build 2045

				PM Peak Vehicular Hour (5-6pm)												Peak Truck Hour (10-11am)											
	Direction	Start Point	End Point	Speeds	Peak Volume	Cars #	Cars %	MT #	MT %	HT #	HT %	Bus #	Bus %	MC #	MC %	Speeds	Peak Volume	Cars #	Cars %	MT #	MT %	HT #	HT %	Bus #	Bus %	MC #	MC %
Burnside Street																											
	EB	2nd Ave	Couch St	25	1,495	1,453	97.2%	12	0.8%	1	0.1%	24	1.6%	4	0.3%	25	895	846	94.5%	23	2.6%	3	0.3%	22	2.5%	1	0.1%
	EB	Couch St	MLK Jr. Blvd	10	1,505	1,463	97.2%	12	0.8%	2	0.1%	24	1.6%	5	0.3%	25	905	855	94.5%	24	2.6%	3	0.3%	23	2.5%	1	0.1%
	EB	MLK Jr. Blvd	Grand Ave	10	1,390	1,351	97.2%	11	0.8%	1	0.1%	22	1.6%	4	0.3%	25	835	789	94.5%	22	2.6%	3	0.3%	21	2.5%	1	0.1%
	WB	Couch St	2nd Ave	35	1,110	1,080	97.3%	7	0.6%	0	0.0%	21	1.9%	2	0.2%	25	665	626	94.2%	32	2.9%	2	0.2%	24	2.2%	6	0.5%
Couch Street																											
	WB	Grand Ave	MLK Jr. Blvd	10	1,195	1,163	97.3%	7	0.6%	0	0.0%	23	1.9%	2	0.2%	25	715	674	94.2%	21	2.9%	1	0.2%	16	2.2%	4	0.5%
	WB	MLK Jr. Blvd	Burnside St	10	1,120	1,090	97.3%	7	0.6%	0	0.0%	21	1.9%	2	0.2%	25	670	631	94.2%	19	2.9%	1	0.2%	15	2.2%	3	0.5%
Grand Avenue																											
	NB	Ash St	Ankeny St	10	1,450	1,410	97.3%	10	0.7%	1	0.1%	25	1.8%	4	0.3%	30	870	821	94.4%	24	2.8%	2	0.3%	20	2.4%	3	0.3%
	NB	Ankeny St	Burnside St	10	1,465	1,425	97.3%	10	0.7%	1	0.1%	26	1.8%	4	0.3%	30	880	830	94.4%	24	2.8%	2	0.3%	21	2.4%	3	0.3%
	NB	Burnside St	Couch St	10	1,685	1,639	97.3%	12	0.7%	1	0.1%	29	1.8%	4	0.3%	30	1,010	636	94.4%	28	2.8%	3	0.3%	24	2.4%	3	0.3%
	NB	Couch St	Davis St	10	1,540	1,498	97.3%	11	0.7%	1	0.1%	27	1.8%	4	0.3%	30	925	873	94.4%	25	2.8%	2	0.3%	22	2.4%	3	0.3%
MLK Jr. Blvd																											
	SB	Davis St	Couch St	10	1,640	1,594	97.2%	12	0.8%	1	0.1%	27	1.7%	5	0.3%	30	985	930	94.4%	26	2.7%	3	0.3%	24	2.4%	2	0.2%
	SB	Couch St	Burnside St	10	1,715	1,667	97.2%	13	0.8%	1	0.1%	29	1.7%	5	0.3%	30	1,030	973	94.4%	28	2.7%	3	0.3%	25	2.4%	2	0.2%
	SB	Burnside St	Ankeny St	15	1,830	1,779	97.2%	14	0.8%	1	0.1%	31	1.7%	5	0.3%	30	1,100	1,039	94.4%	29	2.7%	3	0.3%	27	2.4%	2	0.2%
	SB	Ankeny St	Ash St	15	1,800	1,750	97.2%	14	0.8%	1	0.1%	30	1.7%	5	0.3%	30	1,080	1,020	94.4%	29	2.7%	3	0.3%	26	2.4%	2	0.2%
Naito Pkwy																											
	NB	Ash St	Ankeny St	15	670	653	97.5%	13	2.0%	1	0.2%	0	0.0%	2	0.3%	20	400	372	93.1%	26	6.6%	1	0.3%	0	0.0%	0	0.0%
	NB	Ankeny St	Couch St	15	680	663	97.5%	14	2.0%	1	0.2%	0	0.0%	2	0.3%	20	410	382	93.1%	27	6.6%	1	0.3%	0	0.0%	0	0.0%
	NB	Couch St	Davis St	15	670	653	97.5%	13	2.0%	1	0.2%	0	0.0%	2	0.3%	20	400	372	93.1%	26	6.6%	1	0.3%	0	0.0%	0	0.0%
	SB	Davis St	Couch St	20	635	623	98.1%	6	1.0%	1	0.2%	2	0.3%	3	0.4%	20	380	356	93.8%	16	4.3%	1	0.3%	4	1.1%	2	0.6%
	SB	Couch St	Ankeny St	20	730	716	98.1%	7	1.0%	1	0.2%	2	0.3%	3	0.4%	20	440	413	93.8%	19	4.3%	1	0.3%	5	1.1%	3	0.6%
	SB	Ankeny St	Ash St	20	825	809	98.1%	8	1.0%	2	0.2%	2	0.3%	3	0.4%	20	495	464	93.8%	21	4.3%	1	0.3%	5	1.1%	3	0.6%
SW/NW 2nd Avenue																											
	NB	Ash St	Ankeny St	10	500	488	97.5%	10	2.0%	1	0.2%	0	0.0%	2	0.3%	20	300	279	93.1%	20	6.6%	1	0.3%	0	0.0%	0	0.0%
	NB	Ankeny St	Burnside St	10	510	497	97.5%	10	2.0%	1	0.2%	0	0.0%	2	0.3%	20	305	284	93.1%	20	6.6%	1	0.3%	0	0.0%	0	0.0%
	NB	Burnside St	Couch St	10	470	458	97.5%	9	2.0%	1	0.2%	0	0.0%	1	0.3%	20	280	261	93.1%	18	6.6%	1	0.3%	0	0.0%	0	0.0%
	NB	Couch St	Davis St	10	390	380	97.5%	8	2.0%	1	0.2%	0	0.0%	1	0.3%	20	235	219	93.1%	16	6.6%	1	0.3%	0	0.0%	0	0.0%
I-5 NB																											
Mainline	NB			10	4,250	3,736	87.9%	166	3.9%	332	7.8%	13	0.3%	4	0.1%	35	4,790	3,995	83.4%	225	4.7%	479	10.0%	77	1.6%	14	0.3%
Off-Ramp	NB	I-84/Water Ave Off-ramp		10	2,995	2,633	87.9%	117	3.9%	234	7.8%	9	0.3%	3	0.1%	30	3,380	2,819	83.4%	159	4.7%	338	10.0%	54	1.6%	10	0.3%
Mainline	NB			10	1,255	1,103	87.9%	49	3.9%	98	7.8%	4	0.3%	1	0.1%	35	1,410	1,176	83.4%	66	4.7%	141	10.0%	23	1.6%	4	0.3%
On-Ramp	NB	Morrison Bridge On-ramp		10	1,135	998	87.9%	44	3.9%	89	7.8%	3	0.3%	1	0.1%	30	1,280	1,068	83.4%	60	4.7%	128	10.0%	20	1.6%	4	0.3%
Mainline	NB			15	2,390	2,101	87.9%	93	3.9%	186	7.8%	7	0.3%	2	0.1%	35	2,690	2,243	83.4%	126	4.7%	269	10.0%	43	1.6%	8	0.3%
On-Ramp	NB	I-84 WB On-ramp		20	1,245	1,094	87.9%	49	3.9%	97	7.8%	4	0.3%	1	0.1%	30	1,400	1,168	83.4%	66	4.7%	140	10.0%	22	1.6%	4	0.3%
Mainline	NB			15	3,635	3,195	87.9%	142	3.9%	284	7.8%	11	0.3%	4	0.1%	35	4,090	3,411	83.4%	192	4.7%	409	10.0%	65	1.6%	12	0.3%
I-5 SB																											
Mainline	SB			25	3,460	3,034	87.7%	131	3.8%	266	7.7%	24	0.7%	3	0.1%	45	3,350	2,861	85.4%	168	5.0%	288	8.6%	17	0.5%	17	0.5%
Off-Ramp	SB	I-84 EB Off-ramp		10	1,235	1,083	87.7%	47	3.8%	95	7.7%	9	0.7%	1	0.1%	30	1,195	1,021	85.4%	60	5.0%	103	8.6%	6	0.5%	6	0.5%
Mainline	SB			25	2,225	1,951	87.7%	85	3.8%	171	7.7%	16	0.7%	2	0.1%	45	2,155	1,840	85.4%	108	5.0%	185	8.6%	11	0.5%	11	0.5%
Off-Ramp	SB	Exit 300B (Morrison Bridge)		10	920	807	87.7%	35	3.8%	71	7.7%	6	0.7%	1	0.1%	30	890	760	85.4%	45	5.0%	77	8.6%	4	0.5%	4	0.5%
Mainline	SB			20	1,305	1,144	87.7%	50	3.8%	100	7.7%	9	0.7%	1	0.1%	45	1,265	1,080	85.4%	63	5.0%	109	8.6%	6	0.5%	6	0.5%
On-Ramp	SB	I-84 WB On-ramp		10	2,755	2,416	87.7%	105	3.8%	212	7.7%	19	0.7%	3	0.1%	40	2,670	2,280	85.4%	134	5.0%	230	8.6%	13	0.5%	13	0.5%
Mainline	SB			20	4,060	3,561	87.7%	154	3.8%	313	7.7%	28	0.7%	4	0.1%	45	3,935	3,360	85.4%	197	5.0%	338	8.6%	20	0.5%	20	0.5%

Vehicle mix percentages and speeds same as Existing

I-5 PM Volumes calculated based on the difference between the Existing and No Build travel demand plots

Traffic Data Provided by Parametrix, ODOT ATR Data - Temporary Bridge

				PM Peak Vehicular Hour (5-6pm)												Peak Truck Hour (10-11am)											
	Direction	Start Point	End Point	Speeds	Peak Volume	Cars #	Cars %	MT #	MT %	HT #	HT %	Bus #	Bus %	MC #	MC %	Speeds	Peak Volume	Cars #	Cars %	MT #	MT %	HT #	HT %	Bus #	Bus %	MC #	MC %
Burnside Street																											
	EB	2nd Ave	Couch St	4	990	962	97.2%	8	0.8%	1	0.1%	16	1.6%	3	0.3%	10	595	562	94.5%	15	2.6%	2	0.3%	15	2.5%	1	0.1%
	EB	Couch St	MLK Jr. Blvd	6	1,150	1,118	97.2%	9	0.8%	1	0.1%	18	1.6%	3	0.3%	15	690	652	94.5%	18	2.6%	2	0.3%	17	2.5%	1	0.1%
	EB	MLK Jr. Blvd	Grand Ave	6	1,520	1,477	97.2%	12	0.8%	2	0.1%	24	1.6%	5	0.3%	15	910	860	94.5%	24	2.6%	3	0.3%	23	2.5%	1	0.1%
	WB	Couch St	2nd Ave	15	760	739	97.3%	5	0.6%	0	0.0%	14	1.9%	2	0.2%	15	455	429	94.2%	22	2.9%	2	0.2%	17	2.2%	4	0.5%
Couch Street																											
	WB	Grand Ave	MLK Jr. Blvd	10	725	705	97.3%	4	0.6%	0	0.0%	14	1.9%	1	0.2%	25	435	410	94.2%	13	2.9%	1	0.2%	10	2.2%	2	0.5%
	WB	MLK Jr. Blvd	Burnside St	10	770	749	97.3%	5	0.6%	0	0.0%	15	1.9%	2	0.2%	25	460	433	94.2%	13	2.9%	1	0.2%	10	2.2%	2	0.5%
Grand Avenue																											
	NB	Ash St	Ankeny St	10	1,785	1,736	97.3%	12	0.7%	1	0.1%	31	1.8%	4	0.3%	30	1,070	1,010	94.4%	29	2.8%	3	0.3%	25	2.4%	3	0.3%
	NB	Ankeny St	Burnside St	10	1,800	1,751	97.3%	13	0.7%	1	0.1%	32	1.8%	5	0.3%	30	1,080	1,019	94.4%	30	2.8%	3	0.3%	25	2.4%	3	0.3%
	NB	Burnside St	Couch St	6	1,630	1,585	97.3%	11	0.7%	1	0.1%	29	1.8%	4	0.3%	30	980	636	94.4%	27	2.8%	2	0.3%	23	2.4%	3	0.3%
	NB	Couch St	Davis St	6	1,785	1,736	97.3%	12	0.7%	1	0.1%	31	1.8%	4	0.3%	30	1,070	1,010	94.4%	29	2.8%	3	0.3%	25	2.4%	3	0.3%
MLK Jr. Blvd																											
	SB	Davis St	Couch St	9	2,500	2,431	97.2%	19	0.8%	2	0.1%	42	1.7%	7	0.3%	25	1,500	1,416	94.4%	40	2.7%	4	0.3%	36	2.4%	3	0.2%
	SB	Couch St	Burnside St	9	2,425	2,358	97.2%	18	0.8%	2	0.1%	41	1.7%	7	0.3%	25	1,455	1,374	94.4%	39	2.7%	4	0.3%	35	2.4%	3	0.2%
	SB	Burnside St	Ankeny St	9	1,985	1,930	97.2%	15	0.8%	1	0.1%	33	1.7%	5	0.3%	30	1,190	1,124	94.4%	32	2.7%	3	0.3%	29	2.4%	2	0.2%
	SB	Ankeny St	Ash St	9	1,965	1,910	97.2%	15	0.8%	1	0.1%	33	1.7%	5	0.3%	30	1,180	1,114	94.4%	32	2.7%	3	0.3%	29	2.4%	2	0.2%
Naito Pkwy																											
	NB	Ash St	Ankeny St	15	660	644	97.5%	13	2.0%	1	0.2%	0	0.0%	2	0.3%	20	395	368	93.1%	26	6.6%	1	0.3%	0	0.0%	0	0.0%
	NB	Ankeny St	Couch St	15	630	614	97.5%	13	2.0%	1	0.2%	0	0.0%	2	0.3%	20	380	354	93.1%	25	6.6%	1	0.3%	0	0.0%	0	0.0%
	NB	Couch St	Davis St	15	700	683	97.5%	14	2.0%	1	0.2%	0	0.0%	2	0.3%	20	420	391	93.1%	28	6.6%	1	0.3%	0	0.0%	0	0.0%
	SB	Davis St	Couch St	20	695	682	98.1%	7	1.0%	1	0.2%	2	0.3%	3	0.4%	20	415	389	93.8%	18	4.3%	1	0.3%	5	1.1%	2	0.6%
	SB	Couch St	Ankeny St	20	815	800	98.1%	8	1.0%	2	0.2%	2	0.3%	3	0.4%	20	490	460	93.8%	21	4.3%	1	0.3%	5	1.1%	3	0.6%
	SB	Ankeny St	Ash St	20	905	888	98.1%	9	1.0%	2	0.2%	3	0.3%	4	0.4%	20	545	511	93.8%	23	4.3%	2	0.3%	6	1.1%	3	0.6%
SW/NW 2nd Avenue																											
	NB	Ash St	Ankeny St	10	555	541	97.5%	11	2.0%	1	0.2%	0	0.0%	2	0.3%	20	335	312	93.1%	22	6.6%	1	0.3%	0	0.0%	0	0.0%
	NB	Ankeny St	Burnside St	10	585	570	97.5%	12	2.0%	1	0.2%	0	0.0%	2	0.3%	20	350	326	93.1%	23	6.6%	1	0.3%	0	0.0%	0	0.0%
	NB	Burnside St	Couch St	10	500	488	97.5%	10	2.0%	1	0.2%	0	0.0%	2	0.3%	20	300	279	93.1%	20	6.6%	1	0.3%	0	0.0%	0	0.0%
	NB	Couch St	Davis St	10	290	283	97.5%	6	2.0%	1	0.2%	0	0.0%	1	0.3%	20	175	163	93.1%	12	6.6%	1	0.3%	0	0.0%	0	0.0%
I-5 NB																											
Mainline	NB			9	4,050	3,560	87.9%	158	3.9%	316	7.8%	12	0.3%	4	0.1%	35	4,565	3,807	83.4%	215	4.7%	457	10.0%	73	1.6%	14	0.3%
Off-Ramp	NB	I-84/Water Ave Off-ramp		9	2,605	2,290	87.9%	102	3.9%	203	7.8%	8	0.3%	3	0.1%	30	2,940	2,452	83.4%	138	4.7%	294	10.0%	47	1.6%	9	0.3%
Mainline	NB			9	1,445	1,270	87.9%	56	3.9%	113	7.8%	4	0.3%	1	0.1%	35	1,625	1,355	83.4%	76	4.7%	163	10.0%	26	1.6%	5	0.3%
On-Ramp	NB	Morrison Bridge On-ramp		9	1,020	897	87.9%	40	3.9%	80	7.8%	3	0.3%	1	0.1%	30	1,150	959	83.4%	54	4.7%	115	10.0%	18	1.6%	3	0.3%
Mainline	NB			9	2,465	2,167	87.9%	96	3.9%	192	7.8%	7	0.3%	2	0.1%	35	2,775	2,314	83.4%	130	4.7%	278	10.0%	44	1.6%	8	0.3%
On-Ramp	NB	I-84 WB On-ramp		15	1,175	1,033	87.9%	46	3.9%	92	7.8%	4	0.3%	1	0.1%	30	1,325	1,105	83.4%	62	4.7%	133	10.0%	21	1.6%	4	0.3%
Mainline	NB			9	3,640	3,200	87.9%	142	3.9%	284	7.8%	11	0.3%	4	0.1%	35	4,100	3,419	83.4%	193	4.7%	410	10.0%	66	1.6%	12	0.3%
I-5 SB																											
Mainline	SB			15	3,415	2,998	87.8%	130	3.8%	263	7.7%	24	0.7%	3	0.1%	45	3,310	2,827	85.4%	166	5.0%	285	8.6%	17	0.5%	17	0.5%
Off-Ramp	SB	I-84 EB Off-ramp		10	1,230	1,080	87.8%	47	3.8%	95	7.7%	9	0.7%	1	0.1%	30	1,195	1,021	85.4%	60	5.0%	103	8.6%	6	0.5%	6	0.5%
Mainline	SB			15	2,185	1,918	87.8%	83	3.8%	168	7.7%	15	0.7%	2	0.1%	45	2,115	1,806	85.4%	106	5.0%	182	8.6%	11	0.5%	11	0.5%
Off-Ramp	SB	Exit 300B (Morrison Bridge)		10	915	803	87.8%	35	3.8%	70	7.7%	6	0.7%	1	0.1%	30	885	756	85.4%	44	5.0%	76	8.6%	4	0.5%	4	0.5%
Mainline	SB			15	1,270	1,115	87.8%	48	3.8%	98	7.7%	9	0.7%	1	0.1%	45	1,230	1,050	85.4%	62	5.0%	106	8.6%	6	0.5%	6	0.5%
On-Ramp	SB	I-84 WB On-ramp		10	2,680	2,353	87.8%	102	3.8%	206	7.7%	19	0.7%	3	0.1%	40	2,595	2,216	85.4%	130	5.0%	223	8.6%	13	0.5%	13	0.5%
Mainline	SB			15	3,950	3,468	87.8%	150	3.8%	304	7.7%	28	0.7%	4	0.1%	45	3,825	3,267	85.4%	191	5.0%	329	8.6%	19	0.5%	19	0.5%

Vehicle mix percentages and speeds same as Existing

Speed and volume information from O-D travel time analysis

Appendix C. Modeling Results

Table C-1. Predicted Traffic Noise Levels (dBA $L_{eq(h)}$)

Receiver	NAC Cat	Land Use	ODOT NAAC	No. of Uses	Existing Peak Vehicular Hour Noise (dBA Leq)	Existing Peak Truck Hour Noise (dBA Leq)	Existing Worst Noise Hour (dBA Leq)	Delta (dB)	No Build (2045) Peak Vehicular Hour Noise (dBA Leq)	No Build (2045) Peak Truck Hour Noise (dBA Leq)	No Build (2045) Worst Noise Hour (dBA Leq)	Delta (dB)	Build Short or Long Span Alt. (2045) Peak Vehicular Hour Noise (dBA Leq)	Build Short or Long Span Alt. (2045) Peak Truck Hour Noise (dBA Leq)	Build Short or Long Span Alt. (2045) Worst Noise Hour (dBA Leq)	Change vs. Existing (dB)	Change vs. No Build (dB)	Build Couch Connection (2045) Peak Vehicular Hour Noise (dBA Leq)	Build Couch Connection (2045) Peak Truck Hour Noise (dBA Leq)	Build Couch Connection (2045) Worst Noise Hour (dBA Leq)	Change vs. Existing (dB)	Change vs. No Build (dB)
R-01	D	Church	50	1	41	40	41	-1	41	39	41	0	41	39	41	0	0	41	39	41	0	0
R-02	C	Waterfront Park	65	1	63	63	63	0	63	63	63	0	63	63	63	0	0	63	63	63	0	0
R-03	C	Waterfront Park	65	1	63	64	64	1	64	64	64	0	64	64	64	0	0	64	64	64	0	0
R-04	C	Waterfront Park	65	1	64	64	64	0	64	65	65	1	64	65	65	1	0	64	65	65	1	0
R-05	C	Waterfront Park	65	1	63	64	64	1	64	64	64	0	64	64	64	0	0	64	64	64	0	0
R-06	C	Waterfront Park	65	1	64	65	65	1	65	65	65	0	65	65	65	0	0	64	65	65	0	0
R-07	D	Women's Shelter	50	1	41	40	41	-1	41	39	41	0	41	39	41	0	0	41	39	41	0	0
R-08	C	Waterfront Park	65	1	65	65	65	0	65	65	65	0	65	65	65	0	0	65	65	65	0	0
R-09	C	Japanese American Historical Plaza	65	1	63	64	64	1	63	64	64	0	63	64	64	0	0	63	64	64	0	0
R-10	D	University of Oregon	50	1	40	40	40	0	40	40	40	0	40	40	40	0	0	40	40	40	0	0
R-11	C	Waterfront Park	65	1	64	64	64	0	64	64	64	0	64	64	64	0	0	64	64	64	0	0
R-12	C	Waterfront Park	65	1	63	64	64	1	64	64	64	0	64	64	64	0	0	63	64	64	0	0
R-13	C	Eastbank Esplanade	65	1	72	72	72	0	72	72	72	0	72	72	72	0	0	72	72	72	0	0
R-14	C	Eastbank Esplanade	65	1	67	66	67	-1	67	66	67	0	67	66	67	0	0	67	66	67	0	0
R-15	C	Eastbank Esplanade	65	1	68	67	68	-1	68	67	68	0	68	67	68	0	0	68	67	68	0	0
R-16	C	Eastbank Esplanade	65	1	68	67	68	-1	68	67	68	0	68	67	68	0	0	68	67	68	0	0

Receiver	NAC Cat	Land Use	ODOT NAAC	No. of Uses	Existing Peak Vehicular Hour Noise (dBA Leq)	Existing Peak Truck Hour Noise (dBA Leq)	Existing Worst Noise Hour (dBA Leq)	Delta (dB)	No Build (2045) Peak Vehicular Hour Noise (dBA Leq)	No Build (2045) Peak Truck Hour Noise (dBA Leq)	No Build (2045) Worst Noise Hour (dBA Leq)	Delta (dB)	Build Short or Long Span Alt. (2045) Peak Vehicular Hour Noise (dBA Leq)	Build Short or Long Span Alt. (2045) Peak Truck Hour Noise (dBA Leq)	Build Short or Long Span Alt. (2045) Worst Noise Hour (dBA Leq)	Change vs. Existing (dB)	Change vs. No Build (dB)	Build Couch Connection (2045) Peak Vehicular Hour Noise (dBA Leq)	Build Couch Connection (2045) Peak Truck Hour Noise (dBA Leq)	Build Couch Connection (2045) Worst Noise Hour (dBA Leq)	Change vs. Existing (dB)	Change vs. No Build (dB)
R-17	C	Eastbank Esplanade	65	1	67	67	67	0	68	67	68	1	68	67	68	1	0	68	67	68	1	0
R-18	C	BBQ/ Recreation at Apartments	65	165	68	67	68	-1	67	67	67	-1	67	67	67	-1	0	66	67	67	-1	0
R-19-F1	B	Residential	65	1	67	66	67	-1	66	66	66	-1	66	66	66	-1	0	65	66	66	-1	0
R-19-F2	B	Residential	65	1	67	67	67	0	66	67	67	0	66	67	67	0	0	66	66	66	-1	-1
R-19-F3	B	Residential	65	1	67	67	67	0	67	67	67	0	67	67	67	0	0	66	67	67	0	0
R-19-F4	B	Residential	65	1	67	68	68	1	67	68	68	0	67	68	68	0	0	66	68	68	0	0
R-19-F5	B	Residential	65	1	67	68	68	1	67	68	68	0	67	68	68	0	0	67	68	68	0	0
R-19-F6	B	Residential	65	1	68	68	68	0	67	68	68	0	67	68	68	0	0	67	68	68	0	0
R-19-F7	B	Residential	65	1	68	68	68	0	68	69	69	1	68	69	69	1	0	67	68	68	0	-1
R-19-F8	B	Residential	65	1	68	68	68	0	68	69	69	1	68	69	69	1	0	67	69	69	1	0
R-19-F9 to F17	B	Residential	65	9	68	69	69	1	68	69	69	0	68	69	69	0	0	68	69	69	0	0
R-20-F1	B	Residential	65	1	66	67	67	1	66	67	67	0	66	67	67	0	0	66	67	67	0	0
R-20-F2	B	Residential	65	1	66	67	67	1	66	67	67	0	66	67	67	0	0	67	68	68	1	1
R-20-F3	B	Residential	65	1	67	68	68	1	67	68	68	0	67	68	68	0	0	67	68	68	0	0
R-20-F4	B	Residential	65	1	67	68	68	1	67	68	68	0	67	68	68	0	0	67	68	68	0	0
R-20-F5	B	Residential	65	1	67	68	68	1	67	68	68	0	67	68	68	0	0	67	68	68	0	0
R-20-F6	B	Residential	65	1	67	69	69	2	68	69	69	0	68	69	69	0	0	68	69	69	0	0

Receiver	NAC Cat	Land Use	ODOT NAAC	No. of Uses	Existing Peak Vehicular Hour Noise (dBA Leq)	Existing Peak Truck Hour Noise (dBA Leq)	Existing Worst Noise Hour (dBA Leq)	Delta (dB)	No Build (2045) Peak Vehicular Hour Noise (dBA Leq)	No Build (2045) Peak Truck Hour Noise (dBA Leq)	No Build (2045) Worst Noise Hour (dBA Leq)	Delta (dB)	Build Short or Long Span Alt. (2045) Peak Vehicular Hour Noise (dBA Leq)	Build Short or Long Span Alt. (2045) Peak Truck Hour Noise (dBA Leq)	Build Short or Long Span Alt. (2045) Worst Noise Hour (dBA Leq)	Change vs. Existing (dB)	Change vs. No Build (dB)	Build Couch Connection (2045) Peak Vehicular Hour Noise (dBA Leq)	Build Couch Connection (2045) Peak Truck Hour Noise (dBA Leq)	Build Couch Connection (2045) Worst Noise Hour (dBA Leq)	Change vs. Existing (dB)	Change vs. No Build (dB)
R-20-F7	B	Residential	65	1	68	69	69	1	68	69	69	0	68	69	69	0	0	68	69	69	0	0
R-20-F8	B	Residential	65	1	68	69	69	1	68	69	69	0	68	69	69	0	0	68	69	69	0	0
R-20-F9 to F17	B	Residential	65	9	68	69	69	1	68	69	69	0	68	69	69	0	0	68	69	69	0	0
R-21-F1	B	Residential	65	1	65	66	66	1	65	66	66	0	65	66	66	0	0	70	69	70	4	4
R-21-F2	B	Residential	65	1	65	66	66	1	65	66	66	0	65	66	66	0	0	70	69	70	4	4
R-21-F3	B	Residential	65	1	65	66	66	1	65	66	66	0	65	66	66	0	0	71	69	71	5	5
R-21-F4	B	Residential	65	1	65	66	66	1	65	66	66	0	65	66	66	0	0	71	69	71	5	5
R-21-F5 to F17	B	Residential	65	13	65	66	66	1	65	67	67	1	65	67	67	1	0	71	69	71	5	4
R-22-F1	B	Residential	65	1	59	59	59	0	59	59	59	0	59	59	59	0	0	62	61	62	3	3
R-22-F2	B	Residential	65	1	59	59	59	0	59	59	59	0	59	59	59	0	0	62	61	62	3	3
R-22-F3	B	Residential	65	1	59	59	59	0	59	59	59	0	59	59	59	0	0	62	61	62	3	3
R-22-F4	B	Residential	65	1	59	59	59	0	59	59	59	0	59	59	59	0	0	62	61	62	3	3
R-22-F5	B	Residential	65	1	59	59	59	0	59	59	59	0	59	59	59	0	0	62	61	62	3	3
R-22-F6	B	Residential	65	1	60	60	60	0	60	60	60	0	60	60	60	0	0	62	61	62	2	2
R-22-F7 to F17	B	Residential	65	11	66	67	67	1	66	67	67	0	66	67	67	0	0	67	68	68	1	1
R-23-F1	B	Residential	65	1	60	59	60	-1	60	60	60	0	60	60	60	0	0	60	60	60	0	0
R-23-F2	B	Residential	65	1	60	59	60	-1	60	59	60	0	60	59	60	0	0	60	60	60	0	0
R-23-F3	B	Residential	65	1	60	59	60	-1	60	59	60	0	60	59	60	0	0	60	60	60	0	0
R-23-F4	B	Residential	65	1	60	59	60	-1	60	59	60	0	60	59	60	0	0	60	60	60	0	0

Receiver	NAC Cat	Land Use	ODOT NAAC	No. of Uses	Existing Peak Vehicular Hour Noise (dBA Leq)	Existing Peak Truck Hour Noise (dBA Leq)	Existing Worst Noise Hour (dBA Leq)	Delta (dB)	No Build (2045) Peak Vehicular Hour Noise (dBA Leq)	No Build (2045) Peak Truck Hour Noise (dBA Leq)	No Build (2045) Worst Noise Hour (dBA Leq)	Delta (dB)	Build Short or Long Span Alt. (2045) Peak Vehicular Hour Noise (dBA Leq)	Build Short or Long Span Alt. (2045) Peak Truck Hour Noise (dBA Leq)	Build Short or Long Span Alt. (2045) Worst Noise Hour (dBA Leq)	Change vs. Existing (dB)	Change vs. No Build (dB)	Build Couch Connection (2045) Peak Vehicular Hour Noise (dBA Leq)	Build Couch Connection (2045) Peak Truck Hour Noise (dBA Leq)	Build Couch Connection (2045) Worst Noise Hour (dBA Leq)	Change vs. Existing (dB)	Change vs. No Build (dB)
R-23-F5	B	Residential	65	1	60	59	60	-1	60	60	60	0	60	60	60	0	0	60	60	60	0	0
R-23-F6	B	Residential	65	1	60	60	60	0	60	60	60	0	60	60	60	0	0	60	60	60	0	0
R-23-F7 to F17	B	Residential	65	11	65	66	66	1	65	66	66	0	65	66	66	0	0	66	66	66	0	0
R-24-F1	B	Residential	65	1	62	61	62	-1	62	61	62	0	62	61	62	0	0	61	60	61	-1	-1
R-24-F2	B	Residential	65	1	62	61	62	-1	62	61	62	0	62	61	62	0	0	60	60	60	-2	-2
R-24-F3	B	Residential	65	1	62	61	62	-1	62	61	62	0	62	61	62	0	0	60	60	60	-2	-2
R-24-F4	B	Residential	65	1	62	61	62	-1	62	61	62	0	62	61	62	0	0	60	60	60	-2	-2
R-24-F5	B	Residential	65	1	62	61	62	-1	62	61	62	0	62	61	62	0	0	60	60	60	-2	-2
R-24-F6	B	Residential	65	1	62	61	62	-1	62	61	62	0	62	61	62	0	0	60	60	60	-2	-2
R-24-F7 to F17	B	Residential	65	11	64	64	64	0	64	65	65	1	64	65	65	1	0	64	64	64	0	-1
R-25-F1	B	Residential	65	1	66	63	66	-3	67	64	67	1	67	64	67	1	0	61	61	61	-5	-6
R-25-F2	B	Residential	65	1	67	64	67	-3	67	65	67	0	67	65	67	0	0	63	63	63	-4	-4
R-25-F3	B	Residential	65	1	67	64	67	-3	67	65	67	0	67	65	67	0	0	63	63	63	-4	-4
R-25-F4	B	Residential	65	1	67	65	67	-2	67	65	67	0	67	65	67	0	0	63	63	63	-4	-4
R-25-F5	B	Residential	65	1	67	65	67	-2	67	66	67	0	67	66	67	0	0	63	64	64	-3	-3
R-25-F6	B	Residential	65	1	67	65	67	-2	67	66	67	0	67	66	67	0	0	64	64	64	-3	-3
R-25-F7	B	Residential	65	1	67	66	67	-1	67	66	67	0	67	66	67	0	0	64	65	65	-2	-2
R-25-F8	B	Residential	65	1	67	66	67	-1	67	67	67	0	67	67	67	0	0	65	65	65	-2	-2
R-25-F9 - F17	B	Residential	65	9	67	66	67	-1	68	67	68	1	68	67	68	1	0	65	66	66	-1	-2

Receiver	NAC Cat	Land Use	ODOT NAAC	No. of Uses	Existing Peak Vehicular Hour Noise (dBA Leq)	Existing Peak Truck Hour Noise (dBA Leq)	Existing Worst Noise Hour (dBA Leq)	Delta (dB)	No Build (2045) Peak Vehicular Hour Noise (dBA Leq)	No Build (2045) Peak Truck Hour Noise (dBA Leq)	No Build (2045) Worst Noise Hour (dBA Leq)	Delta (dB)	Build Short or Long Span Alt. (2045) Peak Vehicular Hour Noise (dBA Leq)	Build Short or Long Span Alt. (2045) Peak Truck Hour Noise (dBA Leq)	Build Short or Long Span Alt. (2045) Worst Noise Hour (dBA Leq)	Change vs. Existing (dB)	Change vs. No Build (dB)	Build Couch Connection (2045) Peak Vehicular Hour Noise (dBA Leq)	Build Couch Connection (2045) Peak Truck Hour Noise (dBA Leq)	Build Couch Connection (2045) Worst Noise Hour (dBA Leq)	Change vs. Existing (dB)	Change vs. No Build (dB)
R-26	E	Restaurant Outdoor Seating	70	1	69	67	69	-2	69	67	69	0	69	67	69	0	0	69	68	69	0	0
R-27	B	Residential	65	1	67	67	67	0	68	68	68	1	68	68	68	1	0	68	68	68	1	0
R-28	B	Residential	65	1	68	68	68	0	68	68	68	0	68	68	68	0	0	68	68	68	0	0
R-29	B	Residential	65	1	69	69	69	0	69	69	69	0	69	69	69	0	0	69	69	69	0	0
R-30	B	Residential	65	1	72	74	74	2	73	75	75	1	73	75	75	1	0	73	75	75	1	0
R-31	B	Residential	65	1	72	74	74	2	72	74	74	0	72	74	74	0	0	72	74	74	0	0
R-32-F1	B	Residential	65	1	66	63	66	-3	66	64	66	0	66	64	66	0	0	68	66	68	2	2
R-32-F2	B	Residential	65	1	65	63	65	-2	65	63	65	0	65	63	65	0	0	68	66	68	3	3
R-32-F3	B	Residential	65	1	65	63	65	-2	65	63	65	0	65	63	65	0	0	69	66	69	4	4
R-32-F4	B	Residential	65	1	64	63	64	-1	64	63	64	0	64	63	64	0	0	69	66	69	5	5
R-32-F5	B	Residential	65	1	65	63	65	-2	65	63	65	0	65	63	65	0	0	69	66	69	4	4
R-33-F1	B	Residential	65	1	67	69	69	2	67	68	68	-1	67	68	68	-1	0	66	68	68	-1	0
R-33-F2	B	Residential	65	1	66	68	68	2	66	67	67	-1	66	67	67	-1	0	65	67	67	-1	0
R-33-F3	B	Residential	65	1	66	68	68	2	66	67	67	-1	66	67	67	-1	0	65	67	67	-1	0
R-34-F1	B	Residential	65	1	64	65	65	1	64	65	65	0	64	65	65	0	0	64	65	65	0	0
R-34-F2	B	Residential	65	1	64	64	64	0	64	64	64	0	64	64	64	0	0	64	64	64	0	0
R-34-F3	B	Residential	65	1	63	64	64	1	63	64	64	0	63	64	64	0	0	63	64	64	0	0
R-35-F1	B	Residential	65	1	62	61	62	-1	62	62	62	0	62	62	62	0	0	62	62	62	0	0

Receiver	NAC Cat	Land Use	ODOT NAAC	No. of Uses	Existing Peak Vehicular Hour Noise (dBA Leq)	Existing Peak Truck Hour Noise (dBA Leq)	Existing Worst Noise Hour (dBA Leq)	Delta (dB)	No Build (2045) Peak Vehicular Hour Noise (dBA Leq)	No Build (2045) Peak Truck Hour Noise (dBA Leq)	No Build (2045) Worst Noise Hour (dBA Leq)	Delta (dB)	Build Short or Long Span Alt. (2045) Peak Vehicular Hour Noise (dBA Leq)	Build Short or Long Span Alt. (2045) Peak Truck Hour Noise (dBA Leq)	Build Short or Long Span Alt. (2045) Worst Noise Hour (dBA Leq)	Change vs. Existing (dB)	Change vs. No Build (dB)	Build Couch Connection (2045) Peak Vehicular Hour Noise (dBA Leq)	Build Couch Connection (2045) Peak Truck Hour Noise (dBA Leq)	Build Couch Connection (2045) Worst Noise Hour (dBA Leq)	Change vs. Existing (dB)	Change vs. No Build (dB)
R-35-F2	B	Residential	65	1	61	61	61	0	62	61	62	1	62	61	62	1	0	63	62	63	2	1
R-35-F3	B	Residential	65	1	61	61	61	0	61	61	61	0	61	61	61	0	0	63	62	63	2	2
R-36	C	Skate Park	65	1	62	62	62	0	63	62	63	1	63	62	63	1	0	63	64	64	2	1
R-37 (Portland Rescue Mission)	D	Shelter	50	1	41	39	41	-2	41	39	41	0	41	39	41	0	0	41	39	41	0	0
R-38 (U of Oregon Design/ Journalism)	D	University	50	1	43	42	43	-1	43	42	43	0	43	42	43	0	0	43	42	43	0	0
R-39 (Skidmore Fountain)	C	Fountain	65	1	60	60	60	0	60	60	60	0	60	60	60	0	0	60	60	60	0	0

Note: Interior sound levels are calculated by subtracting 25 dB from the predicted exterior sound levels which is consistent with FHWA 2011 guidance for masonry structures with single-glaze windows, see FHWA 23 CFR 772, Table 7.

Table C-2. Predicted Construction Noise Levels (dBA $L_{eq(h)}$) by Phase

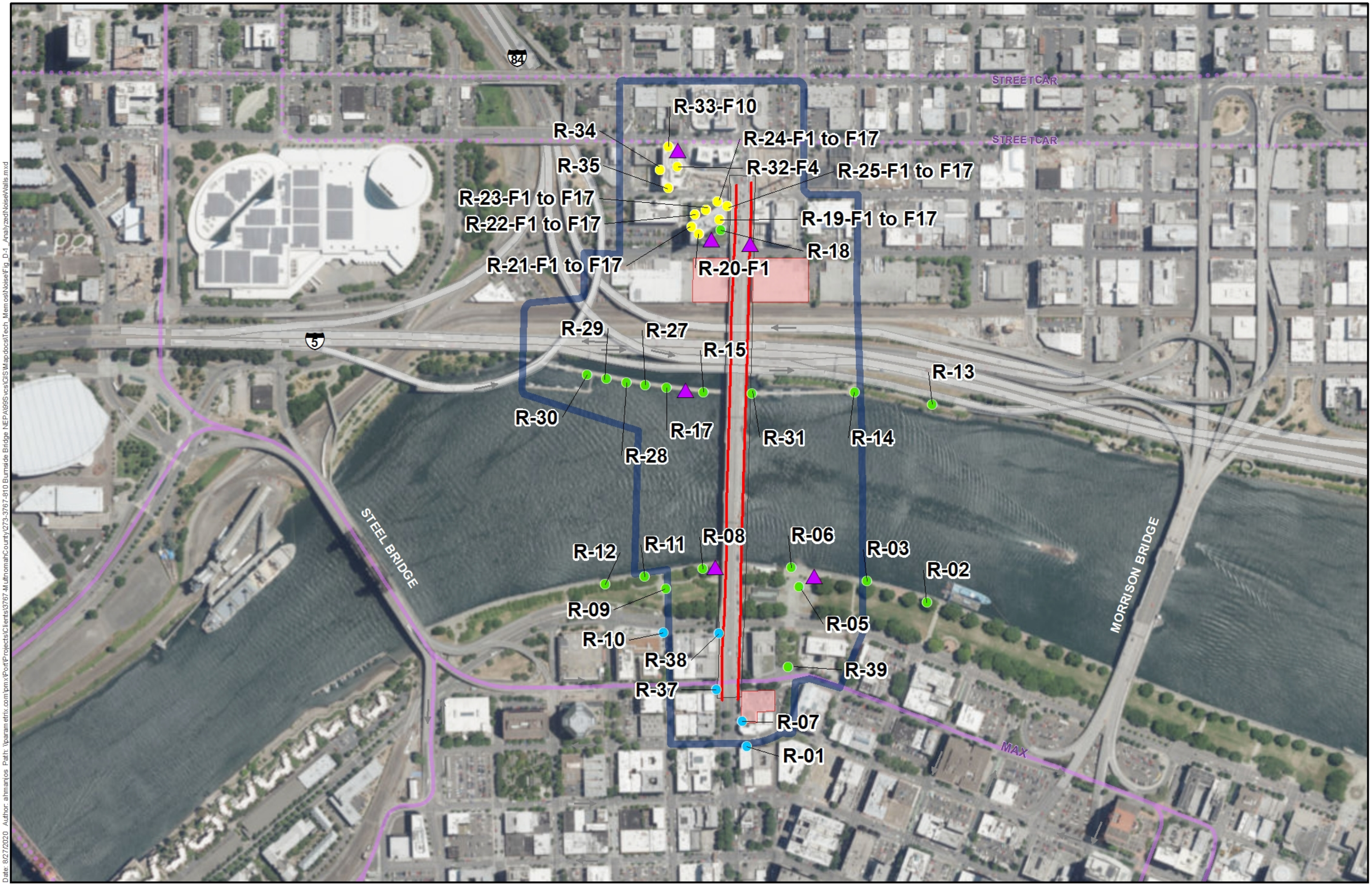
Receptor	Demolition	Detour Bridge	Work Bridge	Cofferdam Installation	West Side Approach	River Pier Shaft Installation	River Pier Ground Improvements (bent 10/Pier 4)	River Pier Ground Improvements (Pier 1/Bents 24-26)	Main Span Work	East Side Approach Short-span or Long-span)	East Side Approach (Couch Extension)	Roadway Deck Construction
R-01	73	84	60	58	80	59	37	20	29	59	76	73
R-02	65	80	71	52	63	50	49	20	40	73	80	70
R-03	74	80	76	55	68	53	54	32	45	77	83	73
R-04	72	81	75	58	75	57	52	35	46	76	85	74
R-05	73	79	67	57	77	56	46	33	40	68	77	74
R-06	80	85	79	64	74	63	57	46	57	79	86	78
R-07	92	92	59	57	88	59	35	20	28	57	75	83
R-08	90	87	80	71	90	71	55	43	61	80	87	83
R-09	75	78	73	58	82	58	48	31	48	71	82	72
R-10	77	91	61	59	89	55	37	26	34	60	74	75
R-11	75	82	82	59	77	60	54	29	59	78	85	73
R-12	72	81	78	54	77	53	53	23	53	76	83	72
R-13	79	82	78	56	63	55	54	47	43	78	81	67
R-14	69	89	73	56	63	56	52	52	39	77	80	67
R-15	90	88	105	69	69	68	69	55	63	95	101	85
R-16	83	86	100	64	69	64	64	54	61	89	96	82
R-17	80	83	94	61	69	61	59	53	58	84	92	79
R-18	92	102	62	51	68	52	35	44	36	60	102	86
R-19-F1	85	94	61	51	64	51	34	44	35	59	99	84
R-20-F1	83	92	62	53	70	50	35	42	37	59	104	88
R-21-F1	78	85	62	52	70	50	35	41	36	60	108	95
R-22-F1	88	94	74	53	69	52	41	51	46	66	101	86
R-23-F1	85	96	75	54	71	53	46	52	48	70	102	86
R-24-F1	93	89	74	52	67	52	42	51	45	67	99	83
R-25-F1	94	98	73	53	66	52	42	51	45	68	106	89
R-26	69	75	70	51	69	51	41	50	42	67	81	67
R-27	76	77	89	58	68	58	55	53	54	80	89	76
R-28	74	79	85	57	67	57	52	52	51	77	86	74
R-29	72	75	81	55	67	55	49	51	48	74	83	71
R-30	70	74	77	53	67	54	47	50	45	71	81	69
R-31	98	99	90	77	68	75	76	56	53	104	105	90
R-32-F1	70	74	69	52	69	51	43	50	43	69	82	68
R-33-F1	62	72	67	48	66	49	41	46	40	67	78	64
R-33-F2	62	72	67	48	66	49	41	46	40	67	78	64
R-33-F3	62	72	67	48	66	49	41	46	40	67	78	64
R-34-F1	67	75	73	52	70	52	45	50	47	71	88	73

Receptor	Demolition	Detour Bridge	Work Bridge	Cofferdam Installation	West Side Approach	River Pier Shaft Installation	River Pier Ground Improvements (bent 10/Pier 4)	River Pier Ground Improvements (Pier 1/Bents 24-26)	Main Span Work	East Side Approach Short-span or Long-span)	East Side Approach (Couch Extension)	Roadway Deck Construction
R-34-F2	67	75	73	52	70	52	45	50	47	71	88	73
R-34-F3	67	75	73	52	70	52	45	50	47	71	88	73
R-35-F1	65	74	73	51	70	51	44	48	45	70	86	71
R-36	96	105	63	50	68	51	40	48	37	62	103	87
R-37	96	91	57	59	96	59	33	20	28	56	73	87
R-38	94	99	62	59	95	58	38	29	37	61	77	85
Range	62-98	72-105	57-105	48-77	63-96	49-75	33-76	20-56	28-63	56-104	73-108	64-95

Appendix D. Detailed Noise Abatement Analysis Tables and Figures

Detailed Noise Abatement Analysis Acronyms:

AFG	Acoustical Feasibility Goal
E/C	Effectiveness/Cost Metric
I.L.	Insertion Loss
NRDG	Noise Reduction Design Goal



Project Area
Retrofit
Short-span Alterative
Long-span Alternative
Construction Staging

Noise Measurement
In-Kind Noise Walls

Residential (NAAC B)
Parks, Paths, and Common Outdoor Spaces (NAAC C)
Church, University, and Shelters with Interior Use Only (NAAC D)
Outdoor Dining Area (NAAC E)

EARTHQUAKE READY BURNSIDE BRIDGE

Source:
City of Portland, Oregon
HDR, Parametrix

0 250 500 1,000 Feet

Figure D-1
Analyzed Noise Walls - In-Kind Noise

Earthquake Ready Burnside

Basic Noise Barrier Optimization Tool 8/27/2020

Burnside Bridge Replacement Barrier for Short-span and Long-span Alternatives									
	10'	12'	14'	16'	18'	20'	22'	24'	Units
Average Wtd I.L. (benefited)									dBA
Maximum I.L.	4	4	4	4	4	4	4	4	dBA
Benefited/Impacted ≥ AFG	0	0	0	0	0	0	0	0	# of dwelling units
Benefited/Non Impact ≥ AFG	0	0	0	0	0	0	0	0	# of dwelling units
Total Benefited	0	0	0	0	0	0	0	0	# of dwelling units
Impacted Units ≥ NRDG	0	0	0	0	0	0	0	0	# of dwelling units
Benefited Units ≥ NRDG	0	0	0	0	0	0	0	0	# of dwelling units
Percent of impacts ≥ AFG	0%	0%	0%	0%	0%	0%	0%	0%	%
Percent of benefits ≥ NRDG									%
"Cost-Reasonable" ?									----
Surface Area	46,183	55,417	64,656	73,890	83,128	92,362	101,600	110,837	sq-feet
Surface Area/Ben Rec									sq-ft / ben rec
Barrier Length	4,618	4,618	4,618	4,618	4,618	4,618	4,618	4,618	ft
Min Height	10	12	14	16	18	20	22	24	ft
Max Height	10	12	14	16	18	20	22	24	ft
Avg Height	10	12	14	16	18	20	22	24	ft
Total Barrier Cost	923,660	1,108,340	1,293,120	1,477,800	2,078,200	2,309,050	2,540,000	2,770,925	$
Cost/Ben Rec									$ / ben rec
Effectiveness/Cost Metric (E/C)	-	-	-	-	-	-	-	-	----

ODOT Acoustical Feasibilty Goal (dBA)	5
ODOT Acoustical Feasibilty Goal (%)	51%
ODOT Noise Reduction Design Goal (dBA)	7
ODOT Noise Reduction Design Goal (%)	1%

Project Information
Burnside Bridge Replacement
310360
Bar_Bld_PHV
Barrier for Short-span and Long-span Alternatives
HMMH
Tara Cruz/Scott Noel
8/27/2020

No Barrier Analysis — No Barrier	
Total Units Exposed to Impact	19
# Impacts - NAC only	19
# Impacts - SI only	0
# Impacts - Both NAC & SI	0

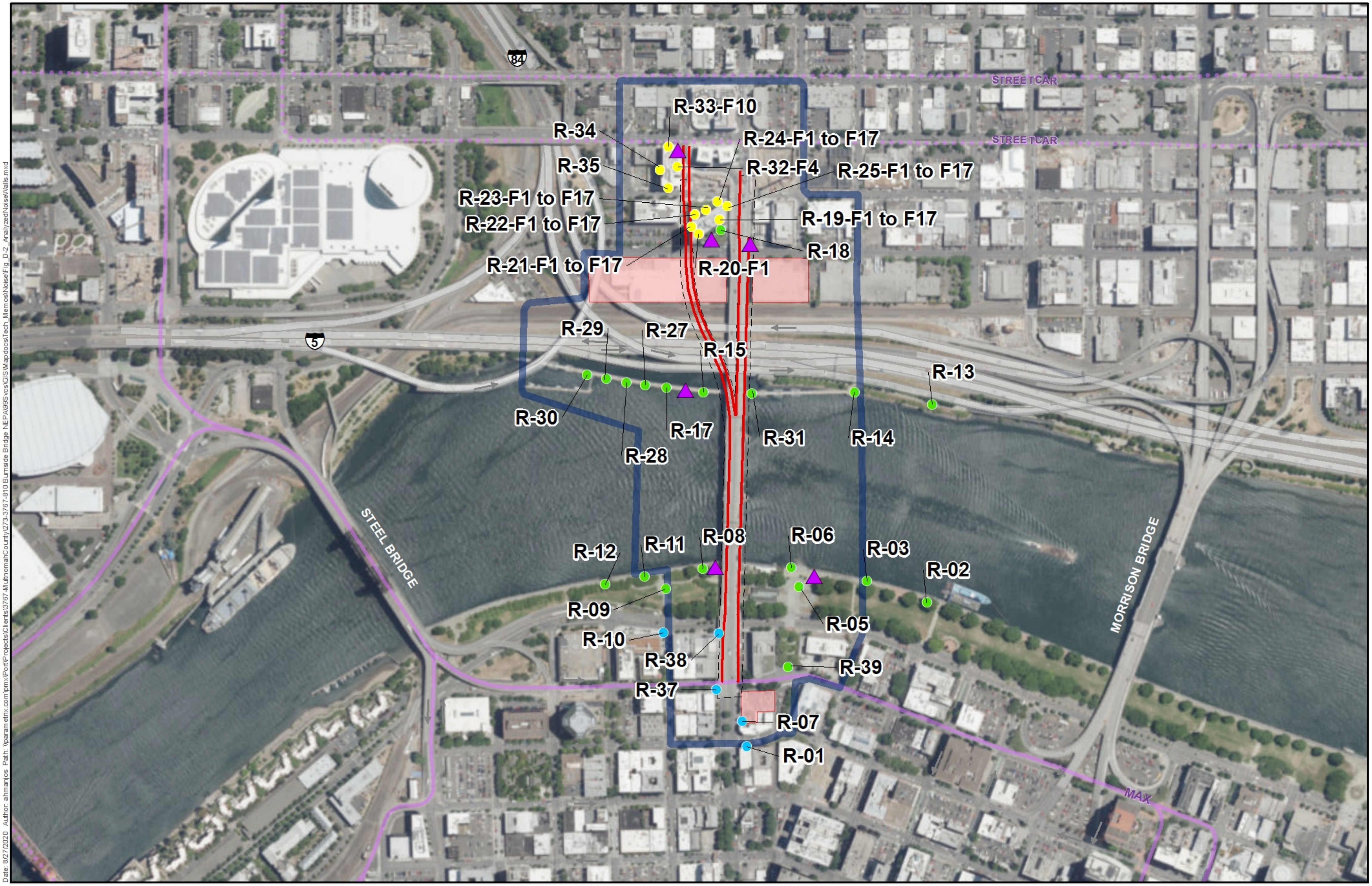
Enter SI Info

	10-ft Wall Bar10		12-ft Wall Bar12		14-ft Wall Bar14		16-ft Wall Bar16		E
Average Wtd I.L. (benefited) / Average Wtd I.L.		dB I.L. Avg		dB I.L. Avg		dB I.L. Avg		dB I.L. Avg	Average Wtd I.
Maximum I.L.	4	dB I.L. Max	4	dB I.L. Max	4	dB I.L. Max	4	dB I.L. Max	Maximum I.L.
Benefited/Impacted ≥ AFG	0	# Prot Units	0	# Prot Units	0	# Prot Units	0	# Prot Units	Benefited/Impa
Benefited/Non Impact ≥ AFG	0	# Units	0	# Units	0	# Units	0	# Units	Benefited/Non
Total Benefited	0	# Ben Units	0	# Ben Units	0	# Ben Units	0	# Ben Units	Total Benefited
Impacted Units ≥ NRDG	0	# Units	0	# Units	0	# Units	0	# Units	Impacted Units
Benefited Units ≥ NRDG	0	# Units	0	# Units	0	# Units	0	# Units	Benefited Units
Percent of impacts ≥ AFG	0%	% Ben Units	0%	% Ben Units	0%	% Ben Units	0%	% Ben Units	Percent of impa
Percent of benefits ≥ NRDG		% NRDG Units		% NRDG Units		% NRDG Units		% NRDG Units	Percent of ben
"Cost-Reasonable" ?									"Cost-Reasona
Surface Area	46183	Sq Feet	55417	Sq Feet	64656	Sq Feet	73890	Sq Feet	Surface Area
Surface Area/Ben Rec		Sq Feet		Sq Feet		Sq Feet		Sq Feet	Surface Area/B
Barrier Length	4,618	Feet	4,618	Feet	4,618	Feet	4,618	Feet	Barrier Length
Min Height	10.0	Feet	12.0	Feet	14.0	Feet	16.0	Feet	Min Height
Max Height	10.0	Feet	12.0	Feet	14.0	Feet	16.0	Feet	Max Height
Avg Height	10.0	Feet	12.0	Feet	14.0	Feet	16.0	Feet	Avg Height
Total Barrier Cost	$923,660		$1,108,340		$1,293,120		$1,477,800		Total Barrier C
Cost/Ben Rec									Cost/Ben Rec

Receiver ID	Row	FHWA Act Cat	No. of Dwelling Units	Type of Impact: Bld Leq > NAC?	Type of Impact: Sub. Inc.?	Impact?	No. of Impacted Units	Bar10 With Barrier Sound Levels, Impact and Benefit: Leq(dBA)	IL (db)	Impacted?	No. Benefited	Bar12 With Barrier Sound Levels, Impact and Benefit: Leq(dBA)	IL (db)	Impacted?	No. Benefited	Bar14 With Barrier Sound Levels, Impact and Benefit: Leq(dBA)	IL (db)	Impacted?	No. Benefited	Bar16 With Barrier Sound Levels, Impact and Benefit: Leq(dBA)	IL (db)	Impacted?	No. Benefited	With: Leq(dBA)
R-02	0	C	1	63				63	0			63	0			63	0			63	0			63
R-03	0	C	1	64				63	1			63	1			63	1			63	1			63
R-04	0	C	1	64				64	0			64	0			64	0			64	0			64
R-05	0	C	1	64				63	1			63	1			63	1			63	1			63
R-06	0	C	1	65		Impact!	1	64	1			64	1			64	1			64	1			64
R-08	0	C	1	65		Impact!	1	64	1			64	1			64	1			64	1			64
R-09	0	C	1	63				63	0			63	0			63	0			63	0			63
R-11	0	C	1	64				63	1			63	1			63	1			63	1			63
R-12	0	C	1	64				63	1			63	1			63	1			63	1			63
R-13	0	C	1	72		Impact!	1	72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72
R-14	0	C	1	67		Impact!	1	67	0	Impact! w/ Bar		67	0	Impact! w/ Bar		67	0	Impact! w/ Bar		67	0	Impact! w/ Bar		67
R-15	0	C	1	68		Impact!	1	68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68
R-16	0	C	1	68		Impact!	1	68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68
R-17	0	C	1	68		Impact!	1	67	1			67	1			67	1			67	1			67
R-18	0	C	1	67		Impact!	1	67	0	Impact! w/ Bar		66	1			66	1			66	1			66
R-19-F1	0	B	1	66		Impact!	1	66	0	Impact! w/ Bar		66	0	Impact! w/ Bar		65	1			65	1			65
R-20-F1	0	B	1	66		Impact!	1	66	0	Impact! w/ Bar		66	0	Impact! w/ Bar		65	1			65	1			65
R-21-F1	0	B	1	65		Impact!	1	65	0	Impact! w/ Bar		65	0	Impact! w/ Bar		65	0	Impact! w/ Bar		65	0	Impact! w/ Bar		65
R-22-F1	0	B	1	59				59	0			59	0			59	0			59	0			59
R-23-F1	0	B	1	60				60	0			60	0			60	0			60	0			60
R-24-F1	0	B	1	62				62	0			62	0			62	0			62	0			62
R-25-F1	0	B	1	67		Impact!	1	63	4			63	4			63	4			63	4			63
R-26	0	E	1	69				69	0			69	0			69	0			69	0			69
R-27	0	B	1	68		Impact!	1	67	1			67	1			67	1			67	1			67
R-28	0	B	1	68		Impact!	1	68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68
R-29	0	B	1	69		Impact!	1	69	0	Impact! w/ Bar		69	0	Impact! w/ Bar		69	0	Impact! w/ Bar		69	0	Impact! w/ Bar		69
R-30	0	B	1	73		Impact!	1	73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73
R-31	0	B	1	72		Impact!	1	72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72
R-32-F1	0	B	1	66		Impact!	1	66	0	Impact! w/ Bar		66	0	Impact! w/ Bar		66	0	Impact! w/ Bar		66	0	Impact! w/ Bar		66
R-33-F1	0	B	1	67		Impact!	1	67	0	Impact! w/ Bar		67	0	Impact! w/ Bar		67	0	Impact! w/ Bar		67	0	Impact! w/ Bar		67
R-34-F1	0	B	1	64				64	0			64	0			64	0			64	0			64
R-35-F1	0	B	1	62				62	0			62	0			62	0			62	0			62
R-36	0	C	1	63				63	0			63	0			63	0			63	0			63

Project Information	18-ft Wall			20-ft Wall			22-ft Wall			24-ft Wall		
	;ar18			Bar20			Bar22			Bar24		
	L.		dB I.L. Avg	Average Wtd I.L.		dB I.L. Avg	Average Wtd I.L.		dB I.L. Avg	Average Wtd I.L.		dB I.L. Avg
		4	dB I.L. Max	Maximum I.L.	4	dB I.L. Max	Maximum I.L.	4	dB I.L. Max	Maximum I.L.	4	dB I.L. Max
Burnside Bridge Replacement	cted ≥ AFG	0	# Prot Units	Benefited/Impacted ≥ AFG	0	# Prot Units	Benefited/Impacted ≥ AFG	0	# Prot Units	Benefited/Impacted ≥ AFG	0	# Prot Units
310360	Impact ≥ AFG	0	# Units	Benefited/Non Impact ≥ AFG	0	# Units	Benefited/Non Impact ≥ AFG	0	# Units	Benefited/Non Impact ≥ AFG	0	# Units
Bar_Bld_PHV	l	0	# Ben Units	Total Benefited	0	# Ben Units	Total Benefited	0	# Ben Units	Total Benefited	0	# Ben Units
Barrier for Short-span and Long-span Alternatives	≥ NRDG	0	# Units	Impacted Units ≥ NRDG	0	# Units	Impacted Units ≥ NRDG	0	# Units	Impacted Units ≥ NRDG	0	# Units
HMMH	; ≥ NRDG	0	# Units	Benefited Units ≥ NRDG	0	# Units	Benefited Units ≥ NRDG	0	# Units	Benefited Units ≥ NRDG	0	# Units
Tara Cruz/Scott Noel	acts ≥ AFG	0%	% Ben Units	Percent of impacts ≥ AFG	0%	% Ben Units	Percent of impacts ≥ AFG	0%	% Ben Units	Percent of impacts ≥ AFG	0%	% Ben Units
8/27/2020	efits ≥ NRDG		% NRDG Units	Percent of benefits ≥ NRDG		% NRDG Units	Percent of benefits ≥ NRDG		% NRDG Units	Percent of benefits ≥ NRDG		% NRDG Units
	ble" ?			"Cost-Reasonable" ?			"Cost-Reasonable" ?			"Cost-Reasonable" ?		
U.S. Department of Transportation Federal Highway Administration		83128	Sq Feet	Surface Area	92362	Sq Feet	Surface Area	101600	Sq Feet	Surface Area	110837	Sq Feet
	en Rec		Sq Feet	Surface Area/Ben Rec		Sq Feet	Surface Area/Ben Rec		Sq Feet	Surface Area/Ben Rec		Sq Feet
		4,618	Feet	Barrier Length	4,618	Feet	Barrier Length	4,618	Feet	Barrier Length	4,618	Feet
		18.0	Feet	Min Height	20.0	Feet	Min Height	22.0	Feet	Min Height	24.0	Feet
		18.0	Feet	Max Height	20.0	Feet	Max Height	22.0	Feet	Max Height	24.0	Feet
		18.0	Feet	Avg Height	20.0	Feet	Avg Height	22.0	Feet	Avg Height	24.0	Feet
	ost	$2,078,200		Total Barrier Cost	$2,309,050		Total Barrier Cost	$2,540,000		Total Barrier Cost	$2,770,925	
				Cost/Ben Rec			Cost/Ben Rec			Cost/Ben Rec		

Receiver ID	Row	FHWA Act Cat	No. of Dwelling Units	Barrier Sound Levels, Impact and Benefit			With Barrier Sound Levels, Impact and Benefit				With Barrier Sound Levels, Impact and Benefit				With Barrier Sound Levels, Impact and Benefit			
				IL (db)	Impacted?	No. Benefited	Leq(dBA)	IL (db)	Impacted?	No. Benefited	Leq(dBA)	IL (db)	Impacted?	No. Benefited	Leq(dBA)	IL (db)	Impacted?	No. Benefited
R-02	0	C	1	0			63	0			63	0			63	0		
R-03	0	C	1	1			63	1			63	1			63	1		
R-04	0	C	1	0			64	0			64	0			64	0		
R-05	0	C	1	1			63	1			63	1			63	1		
R-06	0	C	1	1			64	1			64	1			64	1		
R-08	0	C	1	1			64	1			64	1			64	1		
R-09	0	C	1	0			63	0			63	0			63	0		
R-11	0	C	1	1			63	1			63	1			63	1		
R-12	0	C	1	1			63	1			63	1			63	1		
R-13	0	C	1	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar	
R-14	0	C	1	0	Impact! w/ Bar		67	0	Impact! w/ Bar		67	0	Impact! w/ Bar		67	0	Impact! w/ Bar	
R-15	0	C	1	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar	
R-16	0	C	1	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar	
R-17	0	C	1	1			67	1			67	1			67	1		
R-18	0	C	1	1			66	1			66	1			66	1		
R-19-F1	0	B	1	1			65	1			65	1			65	1		
R-20-F1	0	B	1	1			65	1			65	1			65	1		
R-21-F1	0	B	1	0	Impact! w/ Bar		65	0	Impact! w/ Bar		65	0	Impact! w/ Bar		65	0	Impact! w/ Bar	
R-22-F1	0	B	1	0			59	0			59	0			59	0		
R-23-F1	0	B	1	0			60	0			60	0			60	0		
R-24-F1	0	B	1	0			62	0			62	0			62	0		
R-25-F1	0	B	1	4			63	4			63	4			63	4		
R-26	0	E	1	0			69	0			69	0			69	0		
R-27	0	B	1	1			67	1			67	1			67	1		
R-28	0	B	1	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar	
R-29	0	B	1	0	Impact! w/ Bar		69	0	Impact! w/ Bar		69	0	Impact! w/ Bar		69	0	Impact! w/ Bar	
R-30	0	B	1	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
R-31	0	B	1	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar	
R-32-F1	0	B	1	0	Impact! w/ Bar		66	0	Impact! w/ Bar		66	0	Impact! w/ Bar		66	0	Impact! w/ Bar	
R-33-F1	0	B	1	0	Impact! w/ Bar		67	0	Impact! w/ Bar		67	0	Impact! w/ Bar		67	0	Impact! w/ Bar	
R-34-F1	0	B	1	0			64	0			64	0			64	0		
R-35-F1	0	B	1	0			62	0			62	0			62	0		
R-36	0	C	1	0			63	0			63	0			63	0		



Project Area
Couch Extension
Construction Staging
Noise Measurement
Couch Noise Walls
Residential (NAAC B)
Parks, Paths, and Common Outdoor Spaces (NAAC C)
Church, University, and Shelters with Interior Use Only (NAAC D)
Outdoor Dining Area (NAAC E)

EARTHQUAKE READY BURNSIDE BRIDGE

Source:
City of Portland, Oregon
HDR, Parametrix

0 250 500 1,000 Feet

Figure D-2
Analyzed Noise Walls
Couch Extension
Noise
Earthquake Ready Burnside

U.S. Department of Transportation
Federal Highway Administration

Basic Noise Barrier Optimization Tool

8/27/2020

Burnside Bridge Replacement Replacement Bridge with Couch Extension Alternative									
	10'	12'	14'	16'	18'	20'	22'	24'	Units
Average Wtd I.L. (benefited)	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	dBA
Maximum I.L.	10	10	10	10	10	10	10	10	dBA
Benefited/Impacted ≥ AFG	1	1	1	1	1	1	1	1	# of dwelling units
Benefited/Non Impact ≥ AFG	1	1	1	1	1	1	1	1	# of dwelling units
Total Benefited	2	2	2	2	2	2	2	2	# of dwelling units
Impacted Units ≥ NRDG	1	1	1	1	1	1	1	1	# of dwelling units
Benefited Units ≥ NRDG	2	2	2	2	2	2	2	2	# of dwelling units
Percent of impacts ≥ AFG	6%	6%	6%	6%	6%	6%	6%	6%	%
Percent of benefits ≥ NRDG	100%	100%	100%	100%	100%	100%	100%	100%	%
"Cost-Reasonable" ?	No	No	No	No	No	No	No	No	----
Surface Area	67,917	81,502	97,568	108,659	122,250	135,832	149,416	163,000	sq-feet
Surface Area/Ben Rec	33,959	40,751	48,784	54,330	61,125	67,916	74,708	81,500	sq-ft / ben rec
Barrier Length	6,800	6,800	6,800	6,800	6,800	6,800	6,800	6,800	ft
Min Height	10	12	14	16	18	20	22	24	ft
Max Height	10	12	16	16	18	20	22	24	ft
Avg Height	10	12	14	16	18	20	22	24	ft
Total Barrier Cost	1,358,340	1,630,040	1,951,360	2,173,180	3,056,250	3,395,800	3,735,400	4,075,000	$
Cost/Ben Rec	679,170	815,020	975,680	1,086,590	1,528,125	1,697,900	1,867,700	2,037,500	$ / ben rec
Effectiveness/Cost Metric (E/C)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	----

ODOT Acoustical Feasibilty Goal (dBA)	5
ODOT Acoustical Feasibilty Goal (%)	51%
ODOT Noise Reduction Design Goal (dBA)	7
ODOT Noise Reduction Design Goal (%)	1%

Project Information	No Barrier Analysis		10-ft Wall			12-ft Wall		14-ft Wall		16-ft Wall		B
	No Barrier		Bar10			Bar12		Bar14		Bar16		
			Average Wtd I.L. (benefited)	8.5	dB I.L. Avg	Average Wtd I.L.	8.5	Average Wtd I.L.	8.5	Average Wtd I.L.	8.5	Average Wtd I.
			Maximum I.L.	10	dB I.L. Max	Maximum I.L.	10	Maximum I.L.	10	Maximum I.L.	10	Maximum I.L.
Burnside Bridge Replacement	Total Units Exposed to Impact	16	Benefited/Impacted ≥ AFG	1	# Prot Units	Benefited/Impacted ≥ AFG	1	Benefited/Impacted ≥ AFG	1	Benefited/Impacted ≥ AFG	1	Benefited/Impa
310360	# Impacts - NAC only	16	Benefited/Non Impact ≥ AFG	1	# Units	Benefited/Non Impact ≥ AFG	1	Benefited/Non Impact ≥ AFG	1	Benefited/Non Impact ≥ AFG	1	Benefited/Non
Bar_Bld_PHV	# Impacts - SI only	0	Total Benefited	2	# Ben Units	Total Benefited	2	Total Benefited	2	Total Benefited	2	Total Benefited
Replacement Bridge with Couch Extension Alternative	# Impacts - Both NAC & SI	0	Impacted Units ≥ NRDG	1	# Units	Impacted Units ≥ NRDG	1	Impacted Units ≥ NRDG	1	Impacted Units ≥ NRDG	1	Impacted Units
HMMH			Benefited Units ≥ NRDG	2	# Units	Benefited Units ≥ NRDG	2	Benefited Units ≥ NRDG	2	Benefited Units ≥ NRDG	2	Benefited Units
Tara Cruz/Scott Noel			Percent of impacts ≥ AFG	6%	% Ben Units	Percent of impacts ≥ AFG	6%	Percent of impacts ≥ AFG	6%	Percent of impacts ≥ AFG	6%	Percent of impa
8/27/2020			Percent of benefits ≥ NRDG	100%	% NRDG Units	Percent of benefits ≥ NRDG	100%	Percent of benefits ≥ NRDG	100%	Percent of benefits ≥ NRDG	100%	Percent of ben
			"Cost-Reasonable" ?	No		"Cost-Reasonable" ?	No	"Cost-Reasonable" ?	No	"Cost-Reasonable" ?	No	"Cost-Reasona
U.S. Department of Transportation Federal Highway Administration			Surface Area	67917	Sq Feet	Surface Area	81502	Surface Area	97568	Surface Area	108659	Surface Area
			Surface Area/Ben Rec	33959	Sq Feet	Surface Area/Ben Rec	40751	Surface Area/Ben Rec	48784	Surface Area/Ben Rec	54330	Surface Area/B
			Barrier Length	6,800	Feet	Barrier Length	6,800	Barrier Length	6,800	Barrier Length	6,800	Barrier Length
			Min Height	10.0	Feet	Min Height	12.0	Min Height	14.0	Min Height	16.0	Min Height
			Max Height	10.0	Feet	Max Height	12.0	Max Height	16.0	Max Height	16.0	Max Height
			Avg Height	10.0	Feet	Avg Height	12.0	Avg Height	14.4	Avg Height	16.0	Avg Height
			Total Barrier Cost	$1,358,340		Total Barrier Cost	$1,630,040	Total Barrier Cost	$1,951,360	Total Barrier Cost	$2,173,180	Total Barrier C
	Enter SI Info		Cost/Ben Rec	$679,170		Cost/Ben Rec	$815,020	Cost/Ben Rec	$975,680	Cost/Ben Rec	$1,086,590.00	Cost/Ben Rec

Receiver ID	Row	FHWA Act Cat	No. of Dwelling Units	Type of Impact: Bld Leq > NAC?	Type of Impact: Sub. Inc.?	Impact?	No. of Impacted Units	Bar10 With Barrier Sound Levels, Impact and Benefit: Leq(dBA)	IL (db)	Impacted?	No. Benefited	Bar12 With Barrier Sound Levels, Impact and Benefit: Leq(dBA)	IL (db)	Impacted?	No. Benefited	Bar14 With Barrier Sound Levels, Impact and Benefit: Leq(dBA)	IL (db)	Impacted?	No. Benefited	Bar16 With Barrier Sound Levels, Impact and Benefit: Leq(dBA)	IL (db)	Impacted?	No. Benefited	With: Leq(dBA)
R-02	0	C	1	63				63	0			63	0			63	0			63	0			63
R-03	0	C	1	64				64	0			63	1			63	1			63	1			63
R-04	0	C	1	64				64	0			64	0			64	0			64	0			64
R-05	0	C	1	64				63	1			63	1			63	1			63	1			63
R-06	0	C	1	64				64	0			64	0			64	0			64	0			64
R-08	0	C	1	64				64	0			64	0			64	0			64	0			64
R-09	0	C	1	63				63	0			63	0			63	0			63	0			63
R-11	0	C	1	64				63	1			63	1			63	1			63	1			63
R-12	0	C	1	64				63	1			63	1			63	1			63	1			63
R-13	0	C	1	72		Impact!	1	72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72
R-14	0	C	1	67		Impact!	1	67	0	Impact! w/ Bar		67	0	Impact! w/ Bar		67	0	Impact! w/ Bar		67	0	Impact! w/ Bar		67
R-15	0	C	1	68		Impact!	1	68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68
R-16	0	C	1	68		Impact!	1	68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68
R-17	0	C	1	68		Impact!	1	67	1			67	1			67	1			67	1			67
R-18	0	C	1	66		Impact!	1	65	1			65	1			65	1			65	1			65
R-19-F1	0	B	1	65		Impact!	1	64	1			64	1			64	1			64	1			64
R-20-F1	0	B	1	66		Impact!	1	66	0	Impact! w/ Bar		66	0	Impact! w/ Bar		66	0	Impact! w/ Bar		66	0	Impact! w/ Bar		66
R-21-F1	0	B	1	70		Impact!	1	67	3			67	3			67	3			67	3			67
R-22-F1	0	B	1	62				58	4			58	4			58	4			58	4			58
R-23-F1	0	B	1	60				57	3			57	3			57	3			57	3			57
R-24-F1	0	B	1	61				58	3			58	3			58	3			58	3			58
R-25-F1	0	B	1	61				59	2			59	2			59	2			59	2			59
R-26	0	E	1	69				59	10	Benefited/Non-Imp	1	59	10	Benefited/Non-Imp	1	59	10	Benefited/Non-Imp	1	59	10	Benefited/Non-Imp	1	59
R-27	0	B	1	68		Impact!	1	67	1			67	1			67	1			67	1			67
R-28	0	B	1	68		Impact!	1	68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68
R-29	0	B	1	69		Impact!	1	69	0	Impact! w/ Bar		69	0	Impact! w/ Bar		69	0	Impact! w/ Bar		69	0	Impact! w/ Bar		69
R-30	0	B	1	73		Impact!	1	73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73
R-31	0	B	1	72		Impact!	1	72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72
R-32-F1	0	B	1	68		Impact!	1	61	7	Benefited/Impact	1	61	7	Benefited/Impact	1	61	7	Benefited/Impact	1	61	7	Benefited/Impact	1	61
R-33-F1	0	B	1	66		Impact!	1	65	1			65	1			65	1			65	1			65
R-34-F1	0	B	1	64				64	0			64	0			64	0			64	0			64
R-35-F1	0	B	1	62				62	0			62	0			62	0			62	0			62
R-36	0	C	1	63				63	0			63	0			63	0			63	0			63

Project Information

Burnside Bridge Replacement
310360
Bar_Bld_PHV
Replacement Bridge with Couch Extension Alternative
HMMH
Tara Cruz/Scott Noel
8/27/2020

18-ft Wall			20-ft Wall			22-ft Wall			24-ft Wall		
ar18			Bar20			Bar22			Bar24		
L.	8.5	dB I.L. Avg	Average Wtd I.L.	8.5	dB I.L. Avg	Average Wtd I.L.	8.5	dB I.L. Avg	Average Wtd I.L.	8.5	dB I.L. Avg
	10	dB I.L. Max	Maximum I.L.	10	dB I.L. Max	Maximum I.L.	10	dB I.L. Max	Maximum I.L.	10	dB I.L. Max
cted ≥ AFG	1	# Prot Units	Benefited/Impacted ≥ AFG	1	# Prot Units	Benefited/Impacted ≥ AFG	1	# Prot Units	Benefited/Impacted ≥ AFG	1	# Prot Units
Impact ≥ AFG	1	# Units	Benefited/Non Impact ≥ AFG	1	# Units	Benefited/Non Impact ≥ AFG	1	# Units	Benefited/Non Impact ≥ AFG	1	# Units
	2	# Ben Units	Total Benefited	2	# Ben Units	Total Benefited	2	# Ben Units	Total Benefited	2	# Ben Units
≥ NRDG	1	# Units	Impacted Units ≥ NRDG	1	# Units	Impacted Units ≥ NRDG	1	# Units	Impacted Units ≥ NRDG	1	# Units
; ≥ NRDG	2	# Units	Benefited Units ≥ NRDG	2	# Units	Benefited Units ≥ NRDG	2	# Units	Benefited Units ≥ NRDG	2	# Units
acts ≥ AFG	6%	% Ben Units	Percent of impacts ≥ AFG	6%	% Ben Units	Percent of impacts ≥ AFG	6%	% Ben Units	Percent of impacts ≥ AFG	6%	% Ben Units
efits ≥ NRDG	100%	% NRDG Units	Percent of benefits ≥ NRDG	100%	% NRDG Units	Percent of benefits ≥ NRDG	100%	% NRDG Units	Percent of benefits ≥ NRDG	100%	% NRDG Units
ble" ?	No		"Cost-Reasonable" ?	No		"Cost-Reasonable" ?	No		"Cost-Reasonable" ?	No	
	122250	Sq Feet	Surface Area	135832	Sq Feet	Surface Area	149416	Sq Feet	Surface Area	163000	Sq Feet
en Rec	61125	Sq Feet	Surface Area/Ben Rec	67916	Sq Feet	Surface Area/Ben Rec	74708	Sq Feet	Surface Area/Ben Rec	81500	Sq Feet
	6,800	Feet	Barrier Length	6,800	Feet	Barrier Length	6,800	Feet	Barrier Length	6,800	Feet
	18.0	Feet	Min Height	20.0	Feet	Min Height	22.0	Feet	Min Height	24.0	Feet
	18.0	Feet	Max Height	20.0	Feet	Max Height	22.0	Feet	Max Height	24.0	Feet
	18.0	Feet	Avg Height	20.0	Feet	Avg Height	22.0	Feet	Avg Height	24.0	Feet
ost	$3,056,250		Total Barrier Cost	$3,395,800		Total Barrier Cost	$3,735,400		Total Barrier Cost	$4,075,000	
	$1,528,125		Cost/Ben Rec	$1,697,900		Cost/Ben Rec	$1,867,700		Cost/Ben Rec	$2,037,500	

Receiver ID	Row	FHWA Act Cat	No. of Dwelling Units	Barrier Sound Levels, Impact and Benefit			With Barrier Sound Levels, Impact and Benefit				With Barrier Sound Levels, Impact and Benefit				With Barrier Sound Levels, Impact and Benefit			
				IL (db)	Impacted?	No. Benefited	Leq(dBA)	IL (db)	Impacted?	No. Benefited	Leq(dBA)	IL (db)	Impacted?	No. Benefited	Leq(dBA)	IL (db)	Impacted?	No. Benefited
R-02	0	C	1	0			63	0			63	0			63	0		
R-03	0	C	1	1			63	1			63	1			63	1		
R-04	0	C	1	0			64	0			64	0			64	0		
R-05	0	C	1	1			63	1			63	1			63	1		
R-06	0	C	1	0			64	0			64	0			64	0		
R-08	0	C	1	0			64	0			64	0			64	0		
R-09	0	C	1	0			63	0			63	0			63	0		
R-11	0	C	1	1			63	1			63	1			63	1		
R-12	0	C	1	1			63	1			63	1			63	1		
R-13	0	C	1	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar	
R-14	0	C	1	0	Impact! w/ Bar		67	0	Impact! w/ Bar		67	0	Impact! w/ Bar		67	0	Impact! w/ Bar	
R-15	0	C	1	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar	
R-16	0	C	1	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar	
R-17	0	C	1	1			67	1			67	1			67	1		
R-18	0	C	1	1			65	1			65	1			65	1		
R-19-F1	0	B	1	1			64	1			64	1			64	1		
R-20-F1	0	B	1	0	Impact! w/ Bar		66	0	Impact! w/ Bar		66	0	Impact! w/ Bar		66	0	Impact! w/ Bar	
R-21-F1	0	B	1	3			67	3			67	3			67	3		
R-22-F1	0	B	1	4			58	4			58	4			58	4		
R-23-F1	0	B	1	3			57	3			57	3			57	3		
R-24-F1	0	B	1	3			58	3			58	3			58	3		
R-25-F1	0	B	1	2			59	2			59	2			59	2		
R-26	0	E	1	**10**	Benefited/Non-Imp	1	59	**10**	Benefited/Non-Imp	1	59	**10**	Benefited/Non-Imp	1	59	**10**	Benefited/Non-Imp	1
R-27	0	B	1	1			67	1			67	1			67	1		
R-28	0	B	1	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar	
R-29	0	B	1	0	Impact! w/ Bar		69	0	Impact! w/ Bar		69	0	Impact! w/ Bar		69	0	Impact! w/ Bar	
R-30	0	B	1	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
R-31	0	B	1	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar	
R-32-F1	0	B	1	**7**	Benefited/Impact	1	61	**7**	Benefited/Impact	1	61	**7**	Benefited/Impact	1	61	**7**	Benefited/Impact	1
R-33-F1	0	B	1	1			65	1			65	1			65	1		
R-34-F1	0	B	1	0			64	0			64	0			64	0		
R-35-F1	0	B	1	0			62	0			62	0			62	0		
R-36	0	C	1	0			63	0			63	0			63	0		