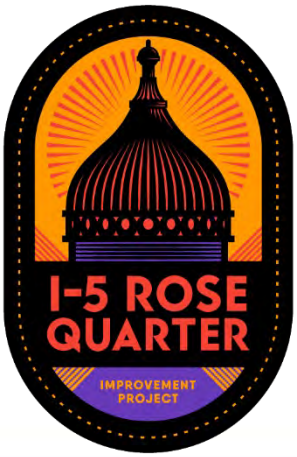
# NOISE STUDY SUPPLEMENTAL TECHNICAL REPORT

Oregon Department of Transportation

June 21, 2022



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# Contents

## Tables



## Figures

# Executive Summary

The Oregon Department of Transportation (ODOT) proposes the Interstate 5 (I-5) Rose Quarter Improvement Project (the Project) to improve the safety and operations on I-5 between Interstate 405 (I-405) and Interstate 84 (I-84), the Broadway/Weidler interchange, and adjacent surface streets in the vicinity of the Broadway/Weidler interchange. This report is a supplement to the 2019 Noise Study Technical Report for the Project (ODOT 2019a).

The Project is considered a Type I project because it would include the additions of auxiliary lanes and new ramp construction. Therefore, a noise analysis was prepared in conformance with 23 Code of Federal Regulations 772.

The peak noise impact hour (peak truck hour) was modeled to estimate noise levels for existing conditions (year 2017) and the Revised Build and No-Build Alternatives using traffic data forecasted for the design year (2045).

The noise analysis results show that under existing conditions, equivalent noise levels (Leq) (in A-weighted decibels [dBA]) predicted for the Project Area range from 54 to 75 dBA for outdoor use areas and 33 to 49 dBA for interior areas (school and medical facilities). Fifty-eight receivers representing 92 residential receptors, 2 medical facility outdoor use areas, 2 parks, and 1 daycare outdoor use area are predicted to have existing noise levels that meet or exceed ODOT Noise Abatement Approach Criteria (NAAC). Noise levels in exceedance of the Oregon NAAC under existing conditions are predominantly east of I-5.

The No-Build Alternative would generate noise levels between 55 to 75 dBA for outdoor use areas and 33 to 49 dBA for interior areas. Sixty-one receivers representing 98 residential receptors, 2 medical facility outdoor use areas, 2 parks, and 1 daycare outdoor use area would meet or exceed the ODOT NAAC for this alternative. No interior noise uses would meet or exceed the ODOT NAAC for this alternative.

The Revised Build Alternative would generate noise levels between 54 to 75 dBA for outdoor use areas and 32 to 50 dBA for interior areas. Fifty-one receivers representing 86 residential receptors, 2 medical facility outdoor use areas, 2 parks and 1 interior use at Harriet Tubman Middle School are predicted to meet or exceed the ODOT NAAC for this alternative. Compared to existing conditions noise levels under the Revised Build Alternative are predicted to decrease by up to 12 decibels (dB) or increase by up to 2 dB. Compared to the No-Build Alternative conditions noise levels under the Revised Build Alternative are predicted to decrease by up to 11 dB or increase by up to 3 dB. Decreases would be most pronounced near the highway cover that would act to attenuate traffic noise and provide a benefit to the surrounding community. Increases are associated with the widening of I-5, changes in ramp alignments and increases in traffic. Per ODOT Noise Manual (ODOT 2011), ODOT considers a 10-dBA increase over existing

noise levels to be substantial (ODOT 2011). Increases of 10 dBA were not predicted under the Revised Build Alternative.

ODOT intends to install highway traffic noise abatement measures in the form of a barrier along the I-5 northbound lanes approximately between the overcrossing of N Flint Avenue to the south and NE Russell Street to the north. The possibility of the likely abatement measure is based upon preliminary design work for a barrier cost of approximately $611,380 that would reduce noise levels by up to 10 dB for the Harriet Tubman Middle School as well as provide benefit to Lillis Albina Park. If during ODOT's final design process these conditions have substantially changed, the abatement measures might not be provided. A final decision of the installation of the abatement measure would be made upon completion of the project's final design, a cost estimating process, and the public involvement processes.

All other approaches to noise abatement would not be able to achieve the required noise reductions at adjacent properties because of challenges with complex traffic noise sources, or because elevation issues precluding the breaking of the line of sight between noise sources and receivers. Four of the walls analyzed could not feasibly reduce noise levels since they would not provide a 5-decibel reduction to enough impacted receptors and two of the walls were unable to meet ODOT's reasonableness criteria for cost effectiveness. As a result, these walls do not meet the ODOT feasible and reasonable criteria and are therefore, not recommended for inclusion in the Project

Information about construction noise mitigation and information for local officials remains unchanged relative to the 2019 Noise Study Technical Report.

# 1.0 INTRODUCTION

The I-5 Rose Quarter Improvement Project (Project) Environmental Assessment (EA) was released in February 2019. The Federal Highway Administration (FHWA) published a Finding of No Significant Impact (FONSI) and Revised EA (REA) for the Build Alternative on November 6, 2020. Since the issuance of the FONSI, the Oregon Department of Transportation (ODOT) has made changes to the design of the proposed Build Alternative to create a Revised Build Alternative and re-evaluated the changes in the context of the FONSI/REA. At the conclusion of the re-evaluation, FHWA and ODOT agreed that the design changes require additional analyses beyond what was presented in the REA, and FHWA rescinded the FONSI on January 18, 2022. This technical report supplements the 2019 Noise Study Technical Report (ODOT 2019a) with an evaluation of the noise impacts of the Revised Build Alternative compared to the No-Build Alternative and Build Alternative.

# 2.0 BUILD ALTERNATIVE DESIGN CHANGES

Changes to the Build Alternative include modification to the highway cover design and changes associated with advancements in other elements of the project design, some of which require expansion of the Project Area. This section describes the highway cover design changes and design changes that resulted from advancements in project engineering. The evaluation of these changes is presented in Section 6.2 of this supplemental technical report.

## 2.1 DESIGN PROCESS

Through 2021, ODOT facilitated an Independent Highway Cover Assessment, as directed by the Oregon Transportation Commission, that engaged the Project's advisory committees and community members in a series of collaborative workshops to explore the design opportunities for the highway cover. The purpose of the Independent Highway Cover Assessment was to understand stakeholder goals and objectives within the Project Area, generate potential highway cover scenarios, and assess the impacts and benefits of these scenarios. The Independent Highway Cover Assessment team worked directly with local community members from the historic Albina neighborhood to understand how the highway cover design concepts might best serve the historic Albina community. The Project's Historic Albina Advisory Board (HAAB), Executive Steering Committee (ESC) and the Community Oversight Advisory Board (COAC) also provided input as part of the Independent Highway Cover Assessment process. These sessions explored potential opportunities for economic development in the Albina community and the highway cover design concepts.

In July 2021, Oregon Governor Brown convened a series of meetings with Project stakeholders and community organizations to discuss the design concepts developed in the Independent Highway Cover Assessment. In August 2021, the HAAB—as supported by the ESC and the COAC, and through the Governor-led process—recommended "Hybrid 3" as the preferred highway cover design concept (Figure 1). The Hybrid 3 highway cover design concept represents a proposed community solution to maximize developable space on a single highway cover. The Hybrid 3 highway cover design concept maintains the commitment for the Project to create opportunities for the local community to grow wealth through business ownership and long-term career prospects through the Project's Disadvantaged Business Enterprise and workforce program. Following the community and stakeholder recommendations, in September 2021, the Oregon Transportation Commission directed ODOT to advance further evaluation of the Hybrid 3 highway cover design concept, with conditions related to the Project's funding process and other technical analyses.

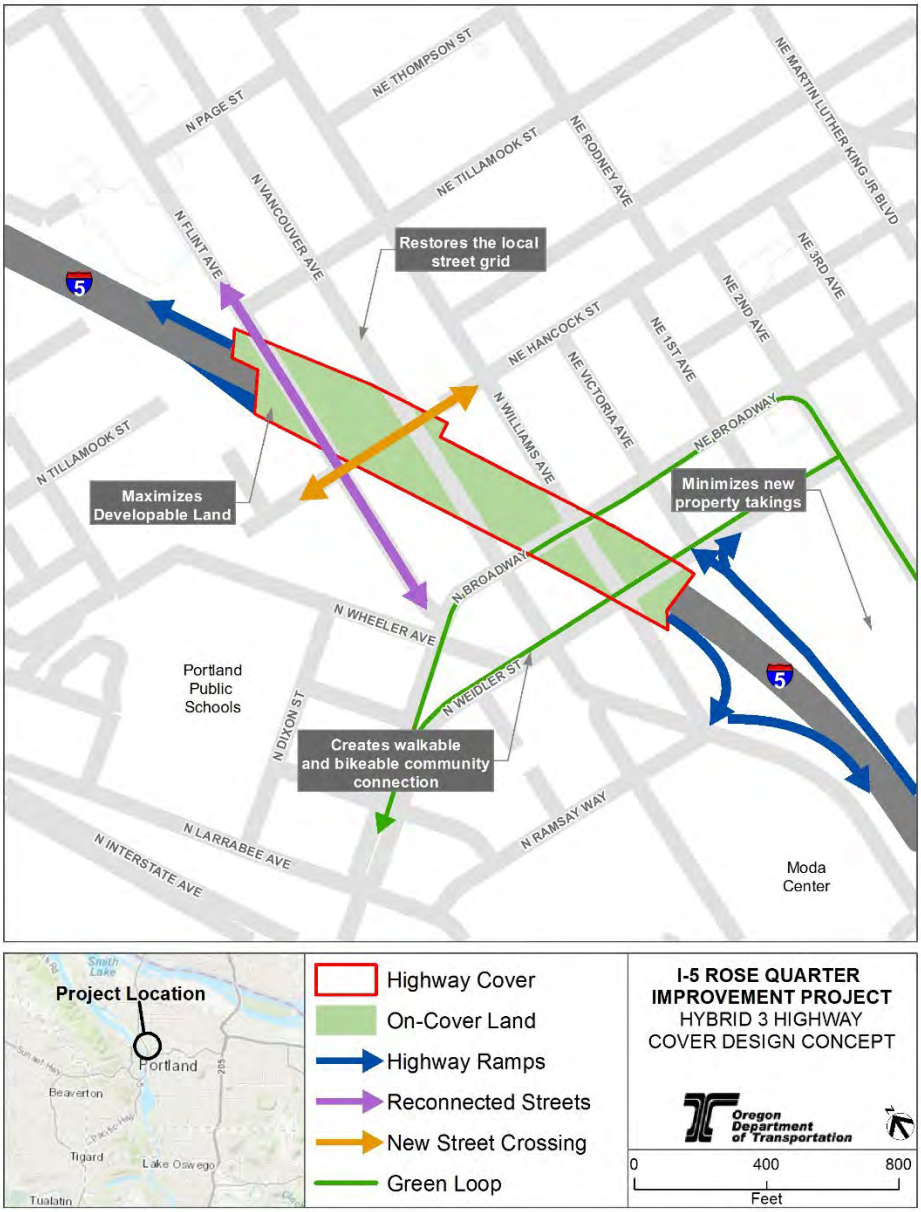
In January 2022, Governor Brown entered into a Letter of Agreement with the City of Portland, Metro, and Multnomah County that demonstrated their shared understanding and collective support for the Hybrid 3 concept as part of the Project. The Letter of Agreement specifically highlights the desire to connect the Lower Albina neighborhood, create buildable space, and enhance wealth-generating opportunities for the community, while simultaneously addressing the area's transportation needs. Additionally, the Letter of Agreement supports the development of a process to define the future development vision for what could ultimately be built on top of the highway cover upon Project completion – this process is referred to as a Community Framework Agreement. The Letter of Agreement states that the City of Portland will lead a Community Framework Agreement process and that it should be between the City of Portland, ODOT, other state agencies and local jurisdictions as necessary, with the participation of organizations that represent the Albina community and Black residents. Any future real estate or open space development on top of the cover would require executing long-term air rights and lease agreements, and that any such actions or decisions are subject at all times to applicable local, state, and federal laws including but not limited to land use and NEPA processes.

In June 2022, ODOT and the City of Portland executed an Intergovernmental Agreement (IGA), building upon the January 2022 Letter of Agreement. The IGA further states that the City will lead the future highway cover land use, programming and development processes and development of a Community Framework Agreement, in consultation with the ODOT to ensure the highway, local streets and resulting land parcels within the Project are coordinated. As such, ODOT would construct the highway cover as part of the Project and the City of Portland would lead the process to define what is ultimately built on the new land created by the Project's highway cover. In the IGA, both ODOT and the City agreed that ODOT will retain ownership of

the highway cover structure and the new developable area created on the highway cover structure upon Project completion.

The sections below describe the highway cover design changes and the design changes that resulted from advancements in project engineering and are incorporated into the Revised Build Alternative.

Figure 1 Hybrid 3 Highway Cover Design Concept



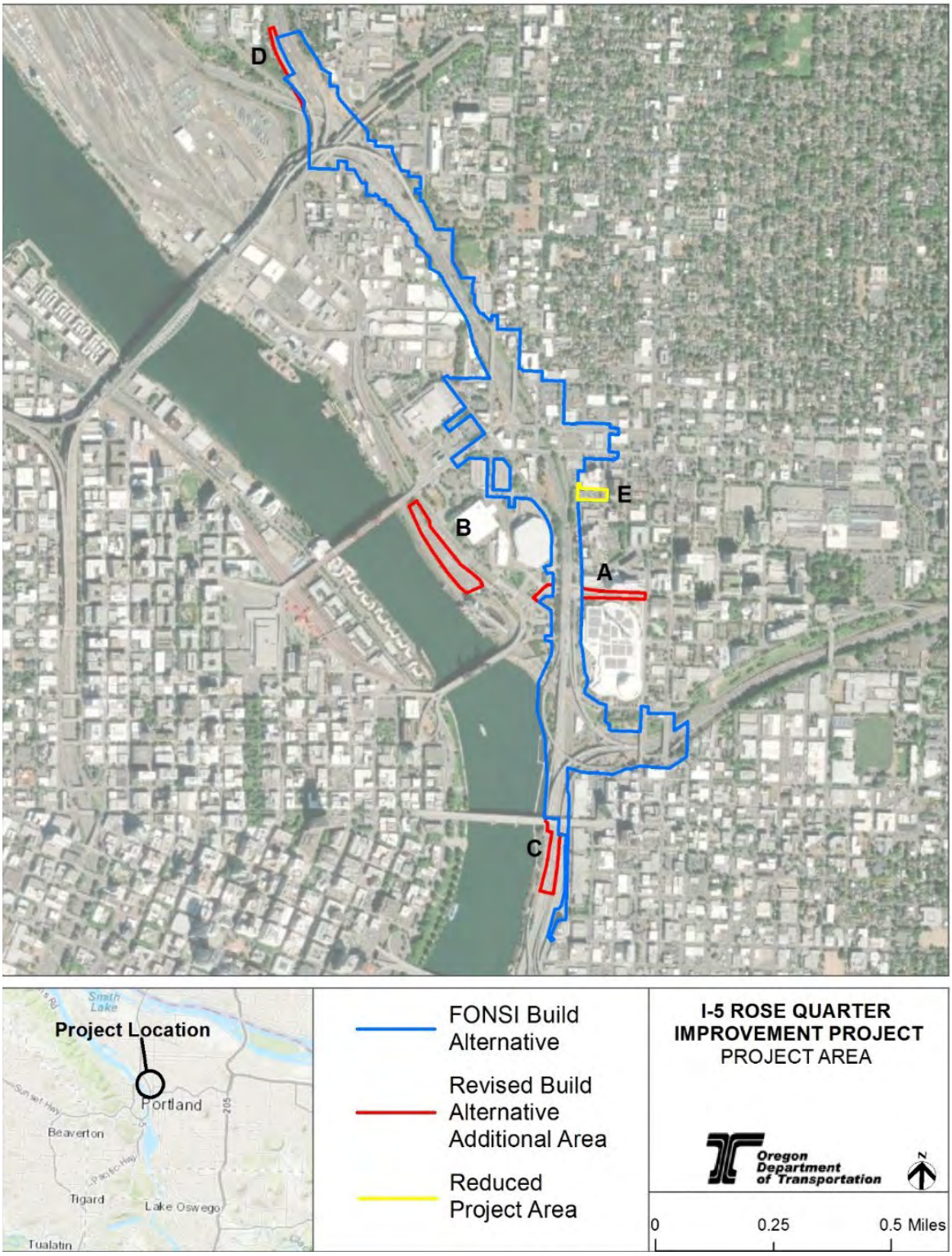
This section describes the highway cover design changes and design changes that resulted from advancements in project engineering and are incorporated into the Revised Build Alternative.

## 2.2 PROJECT AREA

The Project Area is defined as the area within which improvements are proposed, including where permanent modifications to adjacent parcels may occur and where potential temporary impacts from construction activities could result. As Project design information advanced, some changes required expansion of the Project Area presented in the REA and FONSI, and in one location the Project Area was reduced (Figure 2). In total, approximately 8.7 acres would be added to the Project Area. The changes are as follows, with letter references to the areas shown in Figure 2:

- A: Utility conflicts with Light Rail Transit (LRT) along NE Holladay Street between N Interstate Avenue and NE Martin Luther King Jr. Boulevard required expanding the Project Area by 1.9 acres to include additional overhead utility relocations (label A in Figure 2).
- B: An existing parking lot (known as Aegean Lot) south of N Interstate Avenue and the Broadway Bridge may be used for contractor staging during construction and is added to the Project Area (label B, Figure 2). ODOT identified this 4.3-acre construction staging area for contractor use based on its location, size, and suitability recognizing that, because of the urban setting and high-density land development in the construction area, it would be difficult for a construction contractor to find the space needed near or next to the project work areas for equipment staging, material storage, and the required co-location space for the contractor/construction personnel. This location meets all of the Project requirements: large level open space, proximity to the project work areas, and access for staging/storage of materials and equipment. Any materials stored in the area and site runoff would be subject to the same regulations as required throughout the project site.
- C: The southern end of the Project Area is expanded by 2.4 acres to include the portion of I-5 south of the Burnside Bridge proposed for a retrofit of the existing bridge rail, restriping the existing freeway, and installation of new guide signs (label C, Figure 2).
- D: At the northernmost end of the Project Area, a 1.1-acre area of ODOT right of way along the I-5 shoulders is now included in the Project Area for fiber optic conduit (label D, Figure 2).E: In one location, the Project Area was reduced by 1.0 acre. A parking lot west of the intersection of NE Clackamas Street and NE 2nd Avenue is no longer needed for the Project due to the removal of the Clackamas Bicycle and Pedestrian Crossing (label E, Figure 2).

Figure 2 Previous and Current Project Area.



## 2.3 I-5 MAINLINE IMPROVEMENTS CHANGES

The Build Alternative included relocation of the I-5 southbound on-ramp at N Wheeler Avenue to N/NE Weidler Street at N Williams Avenue via the new Weidler/Broadway/Ramsay highway cover, construction of auxiliary lanes and full shoulders (12 feet in width) on I-5 between I-405 and I-84 in both directions, and associated improvements to I-5 through the Project Area. The Revised Build Alternative includes the following changes to those elements of the Build Alternative:

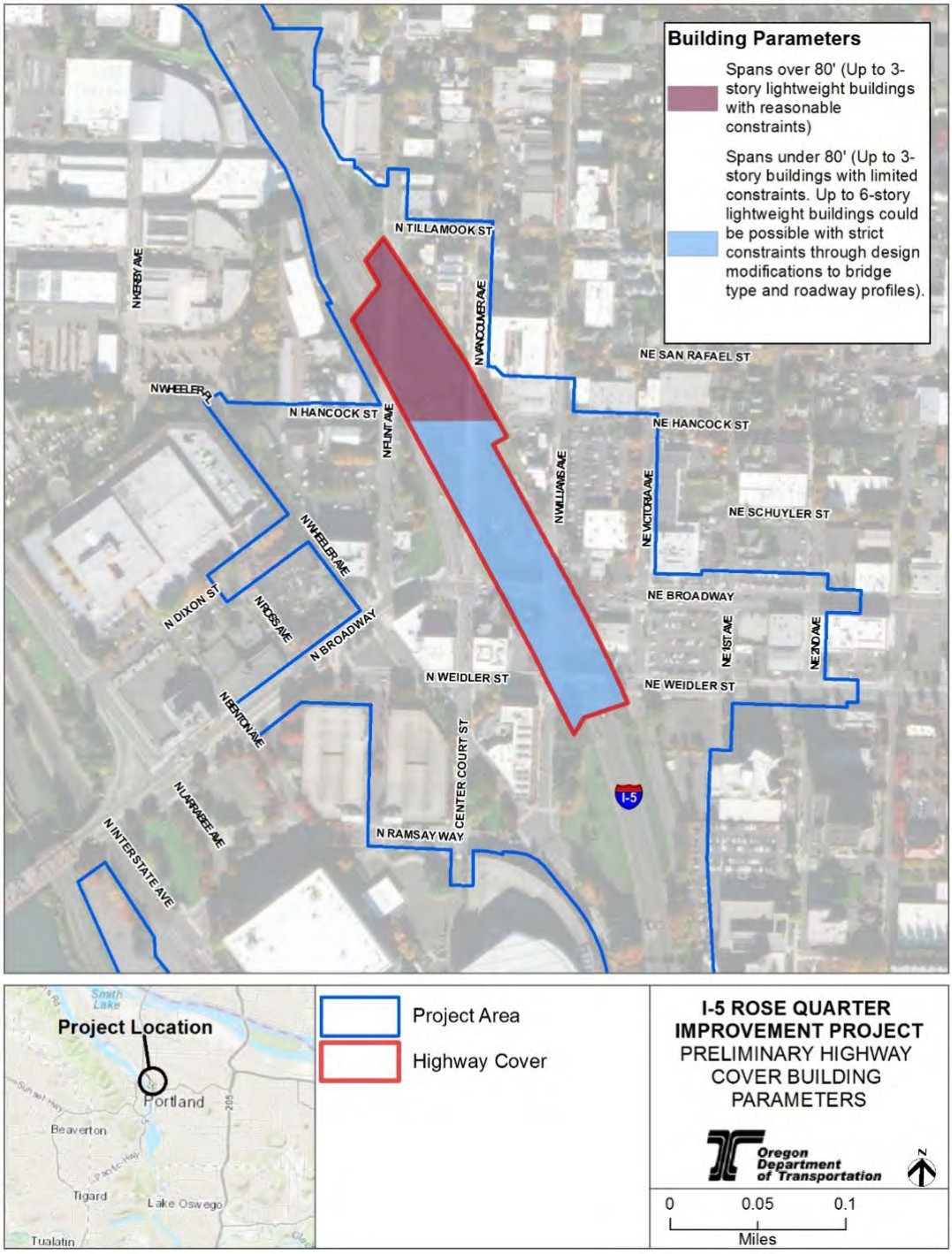
- Move the I-5 southbound exit ramp termini from N Broadway to N Williams Avenue at NE Wheeler Avenue.
- Reduce the freeway median shoulder through the entire Project Area, from 12 feet to 8 feet (4 to 5 feet within highway cover). The outside shoulder width of 12 feet remains unchanged.
- Relocate Noise Wall 24 from N Commercial Avenue near Harriet Tubman Middle School to attach to Walls 1 and 2 along the east edge of I-5.
- Keep the I-5 southbound entrance ramp from NE Wheeler Avenue/N Williams Avenue/ N Ramsay Way on the existing alignment rather than relocate it to parallel N Williams Avenue.
- On I-5 south of the Burnside Bridge: retrofit existing bridge rail, restripe freeway in both the northbound and southbound directions, and install new guide signs on an existing sign structure in the southbound direction.

## 2.4 HIGHWAY COVER CHANGES

The Build Alternative included the construction of two highway cover structures over I-5 for roadway crossings and other purposes. The Revised Build Alternative , based on Hybrid 3 (see Figure 1), includes the following changes to the highway covers:

- Provide one continuous highway cover over I-5 rather than separate covers at the existing N Flint Avenue, NE Weidler Street, NE Broadway, N Williams Avenue, and the N Vancouver Avenue overcrossings.
- Expand the limits of the highway cover by approximately 35 feet to the west, and approximately 400 feet to the north.
- Design and construct the highway cover to accommodate multi-story buildings. Due to span length and site constraints, design would constrain building size, location, type, and use on portions of the cover (Figure 3). Generally, buildings up to three stories could be accommodated throughout the highway cover. Buildings of up to six stories could be accommodated where span lengths are shorter than 80 feet with strict design constraints.

Figure 3 Building Parameters on the Cover




Future development on the highway cover would follow a community process according to the City-led Community Framework Agreement, as described in Section 2.1. ODOT anticipates this process could continue past completion of cover construction.

As part of the Project, ODOT anticipates programming interim uses on the highway cover for the time period between Project completion and when the City-led development process would be implemented. Upon Project completion, the added surface space created by the highway cover over I-5 could provide an opportunity for new and modern bicycle facilities, making the area more connected, walkable and bike friendly. It could also provide opportunity for various potential types of public spaces, to be precisely determined during the Project's final design phase and through robust community engagement, consisting of one or more of the following types of uses:

- Landscaped areas for active and passing recreation and/or to provide a buffer, backdrop and visual comfort, such as gardens, lawns or planter beds.
- Plazas and hardscaped open space for active and passive recreation, such as courts, plazas, splash pads, picnic areas, and community gathering spaces.
- Interpretive signage, historical markers, landmarks and other areas of historical recognition and narrative such as art pieces and other historical signage/kiosks and pavement focused on the historic Albina community.
- Temporary and lightweight vertical features to support episodic, mobile commercial activities such as a food market shed, eating pavilion, food carts, or picnic venues.

These features may be removed upon implementation of the development determined by the community process or may be incorporated into that development.

## 2.5 RELATED LOCAL SYSTEM MULTIMODAL IMPROVEMENTS CHANGES

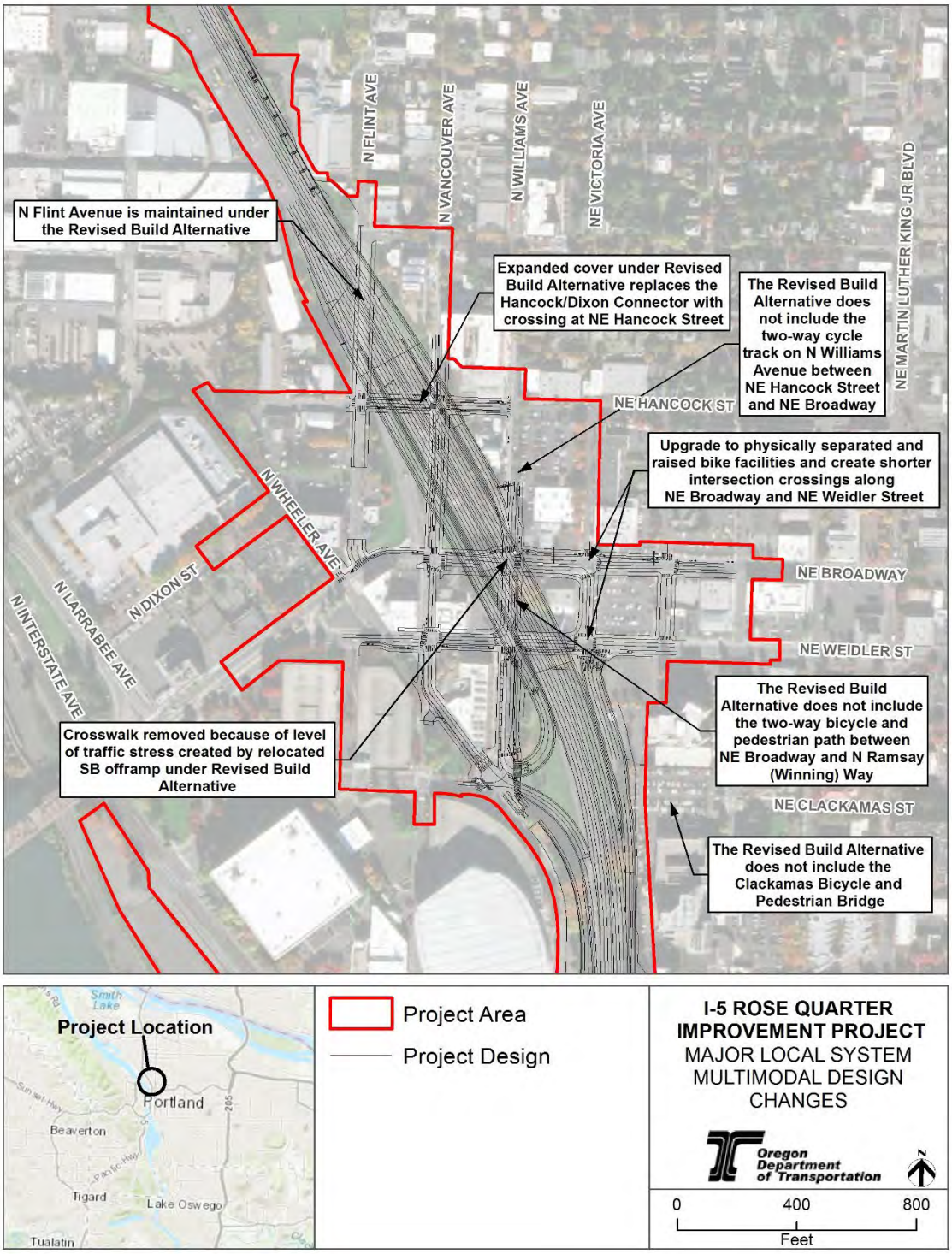
The Build Alternative included construction of a new bicycle and pedestrian bridge over I-5 at NE Clackamas Street and other local street improvements. The Revised Build Alternative includes the following changes to these improvements to accommodate the Hybrid 3 design concept and related changes in traffic patterns (see Figure 4 below):

- Remove the Clackamas Bicycle and Pedestrian Crossing from the Build Alternative.
- Construct wider sidewalks and bike lanes at sidewalk level and physically separated from the roadway with a curb and provide protected bike signal phases at multiple intersections along NE Broadway and NE Weidler Street.
- Connect N Flint Avenue across I-5 from NE Tillamook Street to N Hancock Street and terminate it at N Broadway.
- Remove the NE Hancock Street overcrossing of I-5 from N Williams Avenue to N Dixon Street as proposed in the Build Alternative. NE Hancock Street would be extended across I-5

and reconnect to NE Hancock Street west of N Flint Avenue as part of the expanded highway cover.

- Remove the two-way cycle track on N Williams Avenue between NE Hancock Street and NE Broadway and a two-way bicycle and pedestrian path between NE Broadway and N Ramsay Way from the design and instead convert the on-road bike lane to a protected bike lane, with a transition to the existing on-road bike lane south at or near NE Hancock Street.
- Close the crosswalk across NE Broadway on the west side of N Williams Avenue and the crosswalk across N Williams north of N Weidler Street.

Figure 4 Major Local System Multimodal Design Changes



# 3.0 REGULATORY FRAMEWORK

The regulatory framework is the same as was presented in the 2019 Noise Study Technical Report with two exceptions. In June 2020, ODOT published the first of two interim updates to the 2011 ODOT Noise Manual. The second interim update was published in July of 2021. These updates provide clarifications as to the intent of ODOT's noise policy, updated cost considerations for noise abatement, and new assessment methods for Noise Abatement Approach Criteria (NAAC) land uses C, D and E. This 2022 Noise Study Supplemental Technical Report updates the 2019 Noise Study Technical Report analysis to reflect these changes.

Cost considerations for noise abatement changed as follows:

- Noise walls up to 16 feet tall are estimated to cost $30 per square foot of surface area.
- Noise walls over 16 feet tall and up to 25 feet tall are estimated to cost $37.50 per square foot of surface area.
- The maximum allowable cost of noise abatement per benefitted residence is now $37,500 unless traffic noise levels are 70 A-weighted decibels (dBA) equivalent sound level (Leq) or greater in which case the maximum cost is increased to $52,500 per benefitted residence.
- Cost effectiveness of noise abatement for non-residential receptors is determined by finding the number of "Equivalent Residential Receptors" (ERR) and using that in determining the cost per benefitted residence. The ERR value is based on the number of people who spend time at a noise sensitive nonresidential receptor and how much time they spend there.

# 4.0 METHODOLOGY AND DATA SOURCES

The methodology and data sources are the same as those described in the 2019 Noise Study Technical Report with a few exceptions. First, the traffic data used in the Revised Build Alternative is different than that used in the Build Alternative. Second, since the 2019 Noise Study Technical Report was published, buildings that were under construction have been finished and are more accurately represented in the noise analysis. One of these buildings includes more balconies at residences than were identified in the 2019 Noise Study Technical Report, and these have been added to the models as sensitive receptors. Third, the ODOT Noise Manual has had two interim updates published in June 2020 (ODOT 2020) and July 2021 (ODOT 2021).

Traffic data in the noise analysis for the future build conditions was updated to reflect conditions that are expected to occur with the Revised Build Alternative.

## 4.1 AREA OF POTENTIAL IMPACT (API)

While the Project Area is different compared to what was included in 2019 Noise Study Technical Report, the noise API remains unchanged. This is because where the Project Area changed there are no additional noise sensitive receptors. Section 4.2 describes how land uses in the noise API changed since publication of the 2019 Noise Study Technical Report.

## 4.2 RESOURCE IDENTIFICATION AND EVALUATION

Noise measurement data was amended via three validation measurements at the following monitoring locations (Figure 5) to account for shielding from buildings between NE Weidler Street to the north and NE Multnomah Street to the south:

- M7 – Pacifica Senior Living Calaroga Terrace: the measurement was completed on March 7, 2022, between 10:00 a.m. and 10:15 a.m. near the entrance to the facility and at a distance coincident with the closest balconies facing I-5.
- M8 – Miracle Apartments: the measurement was completed on March 7, 2022, between 10:23 a.m. and 10:38 a.m. from the rooftop of the building because access to a balcony could not be obtained.
- M9 – Outdoor common area located on the east side of the Legacy medical facility north of NE Multnomah Street: the measurement was completed on March 7, 2022 between 10:44 a.m. and 11:03 a.m. from the grassy area east of the common outdoor area because Legacy staff indicated that only medically credentialed personnel can access the common area since it is used for rehabilitation of patients. The measurement was paused for approximately 2-minutes while a barking dog passed by from 10:53 a.m. to 10:55 a.m.

The measured noise levels, in conjunction with observed traffic volumes, were compared to the noise levels predicted by the existing conditions using the Traffic Noise Model (TNM). These levels matched within 3 dB, thereby showing that the modeling was reliable. The outcome of this comparison is provided in Table 1. Appendix A includes the noise measurement data sheets, coincident traffic counts, photos of each measurement location, and the laboratory calibration sheets for the sound level meter.

Figure 5. Additional Validation Measurements

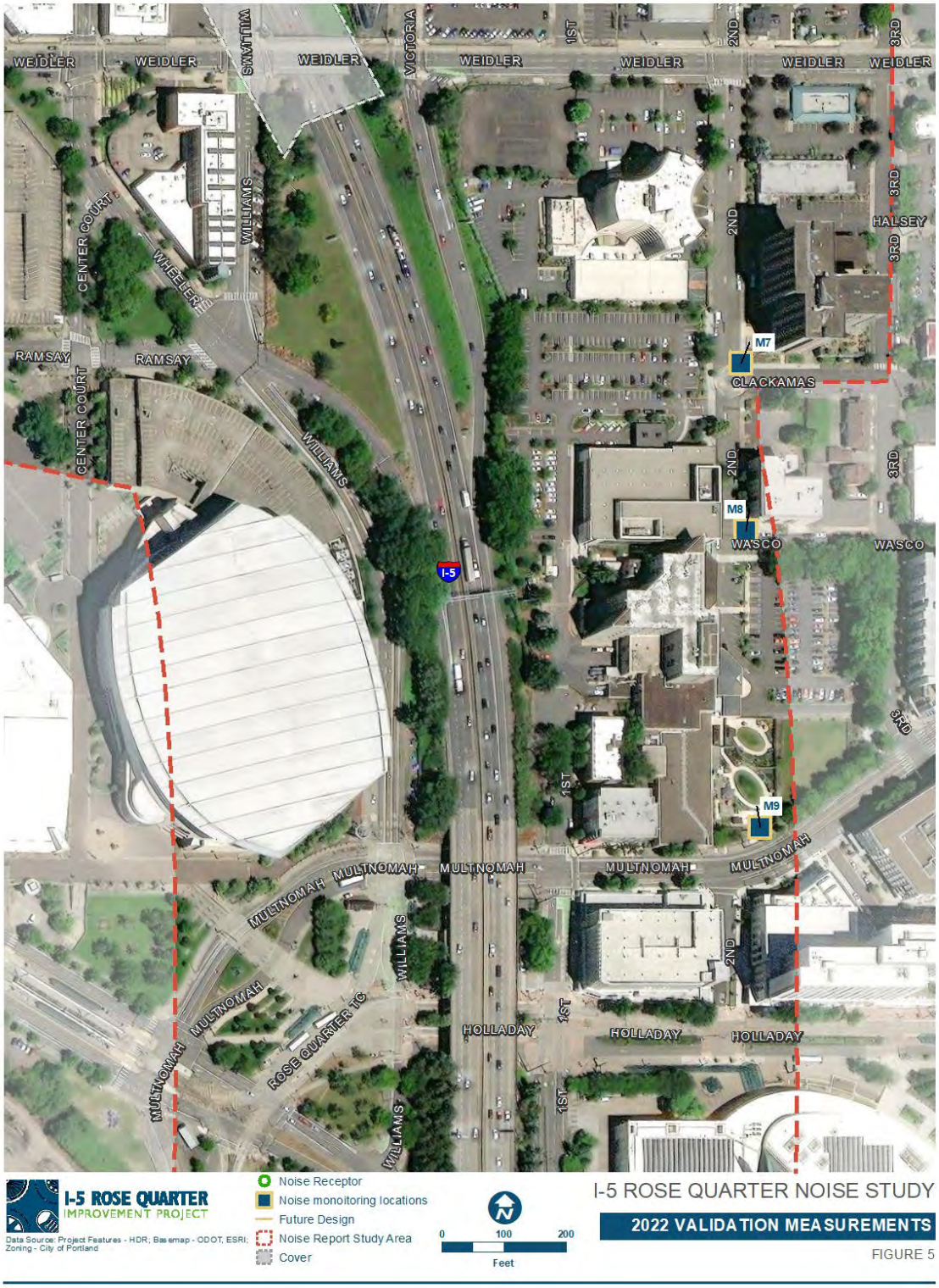


Table 1 Noise Levels Monitored in the API (Leq dBA)[1]

| Monitoring Site | Land Use (Activity Category) | Distance to Major Roadway Centerline (feet) [Roadway Name] | Monitored Level (dBA) | TNM Predicted Level (dBA) | Difference between Modeled and Measured Level (dB) |
|---|---|---|---|---|---|
| **M7** | B | 495 [I-5 Northbound] | 59.3 | 58.0 | -1.3 |
| **M8** | B | 420 [I-5 Northbound] | 64.0 | 64.1 | 0.1 |
| **M9** | C | 65 [Multnomah Street] | 57.5 | 57.5 | 0.0 |

[1] *Noise levels were documented electronically which is why the sound level is not displayed on the measurement data sheets in Appendix A.*

## 4.3 ASSESSMENT OF IMPACTS

The methods used to assess impacts are the same as those in the 2019 Noise Study Technical Report; however, changes to the geometry of the highway cover were considered in the new assessment of the tunnel effects. Specifically, the following analysis elements were determined based on the Revised Build Alternative and the National Cooperative Highway Research Program's (NCHRP) Supplemental Guidance on the Application of FHWA's Traffic Noise Model (TNM) (NCHRP 2014):

- A-weighted traffic noise levels were modeled in TNM for receivers adjacent to the highway cover openings.
- Roadways were modeled up until the point where they reach the highway cover portal because TNM cannot model roadways that are located within a tunnel. For the purposes of the traffic noise analysis, it is assumed that the dominant noise source comes from the highway and the cover openings because roadway noise is attenuated by the cover and walls of the cover itself. In other words, the highway acts as a barrier on all sides of the roadway noise source.
- The highway cover included in the Revised Build Alternative represents a tunnel for noise prediction purposes that would be approximately 465 meters long. Tunnels greater than 60 meters are considered "long tunnels", according to the NCHRP guidance.
- Distances from the roadway centerline and the tunnel opening to a receiver were evaluated for those adjacent to tunnel openings. Receivers located behind proposed

tunnel walls or more than 100 meters from a tunnel opening did not meet the criteria for application of adjustment factors (Table 2). Receivers R5, R6/M3, R19, 19a and R38 met the applicable criteria; therefore, a 1 dB adjustment was added to account for the acoustic effect of tunnel portals.

Table 2 A-weighted Adjustments to add to TNM-calculated Noise Levels

| Distance from Roadway Centerline (m) | Distance from Tunnel Opening (m) | Tunnel Effect (dB) to be Added to TNM-Calculated Noise Levels | | | |
|---|---|---|---|---|---|
| | | Single Lane (short tunnel) | Single Lane (long tunnel) | 2+ Lanes (short tunnel) | 2+ lanes (long tunnel) |
| **10** | 1 | 0 | 1 | 0 | 1 |
| | 5 | 1 | 3 | 2 | 5 |
| | 10 | 1 | 3 | 2 | 4 |
| | 25 | 1 | 1 | 1 | 2 |
| | 50 | 0 | 0 | 0 | 1 |
| | 100 | 0 | 0 | 0 | 0 |
| | 300 | 0 | 0 | 0 | 0 |
| **25** | 1 | 0 | 0 | 0 | 0 |
| | 5 | 0 | 0 | 0 | 1 |
| | 10 | 0 | 1 | 1 | 2 |
| | 25 | 1 | 1 | 1 | 2 |
| | 50 | 0 | 1 | 0 | 1 |
| | 100 | 0 | 0 | 0 | 0 |
| | 300 | 0 | 0 | 0 | 0 |
| **50** | 1 | 0 | 0 | 0 | 0 |
| | 5 | 0 | 0 | 0 | 0 |
| | 10 | 0 | 0 | 0 | 0 |
| | 25 | 0 | 1 | 0 | 1 |
| | 50 | 0 | 1 | 0 | 1 |
| | 100 | 0 | 0 | 0 | 1 |
| | 300 | 0 | 0 | 0 | 0 |
| **100** | 1 | 0 | 0 | 0 | 0 |
| | 5 | 0 | 0 | 0 | 0 |
| | 10 | 0 | 0 | 0 | 0 |
| | 25 | 0 | 0 | 0 | 0 |
| | 50 | 0 | 0 | 0 | 1 |
| | 100 | 0 | 0 | 0 | 1 |
| | 300 | 0 | 0 | 0 | 0 |

*Source: NCHRP 2014*

### 4.3.1 Indoor Noise Levels

The methodology for indoor noise levels is the same as in 2019 Noise Study Technical Report.

## 4.4 CUMULATIVE IMPACTS

The methodology for cumulative impacts is the same as in the 2019 Noise Study Technical Report.

## 4.5 LAND USE

There would be no changes to the land use methodology compared to what was analyzed in the 2019 Noise Study Technical Report.

# 5.0 AFFECTED ENVIRONMENT

The affected environment is the same as was evaluated in the 2019 Noise Study Technical Report with the following exceptions.

- The Legacy Laboratory Central facility was expanded to the north to include a new building.
- The Miracle Central Apartments across NE 2nd Avenue from the Legacy Laboratory Central facility was under construction when the 2019 Noise Study Technical Report was being prepared and has since been completed. Several balconies at the building are common outdoor use areas for residents of the apartments.
- There was a land use designation change in the southwest quadrant at the intersection of N Weidler Street and N Williams Avenue. In the Revised Build Alternative this building was identified as being a medical building; however, only the ground floor is a medical use (Hoover Detox Center) and the rest of the building is low-income housing (Madrona Studios). There is one outdoor use area, a set of benches, at the entrance to the building along N Weidler Street.
- An outdoor dining area (Cartside Food Carts) was constructed on North Williams Avenue south of North Hancock Street.
- A nonprofit organization, the Meyer Memorial Trust, constructed its headquarters in the southwest quadrant at the intersection of N Tillamook Street and N Vancouver Avenue adjacent to I-5. The building has an outdoor patio that is surrounded by an 8-foot privacy wall.

Each of these new or revised noise sensitive receptors are included in this 2022 Noise Study Supplemental Technical Report.

Following validation of the noise model, existing condition (2017) peak noise hour levels were modeled at 130 noise prediction sites (receivers), representing:

- 179 outdoor use areas at:
  - 170 residential units
  - 4 outdoor use areas at medical facilities
  - 2 parks
  - 1 active sport area
  - 1 church
  - 1 daycare use
  - 1 exterior use area at a non-profit
  - 1 outdoor eating area
- 10 indoor use areas at:
  - 9 medical facilities
  - 1 school (Harriet Tubman Middle School)

Sound levels were predicted at 5 feet above ground level. Table 3 includes the predicted sound levels and exceedances. Figure 6 through Figure 12 are maps of where the exceedances occur under the existing conditions. TNM runs for the noise analysis are provided in Appendix B.

Existing noise levels in the API are predicted to range from 33 dBA Leq to 49 dBA Leq at interior receivers and 54 dBA Leq to 75 dBA Leq at exterior receivers. These existing noise levels are slightly lower (by up to 1 dB) than those reported in the 2019 Noise Study Technical Report. because new buildings provide additional shielding that needed to be accounted for in the model. Specifically, the ranges reported in the 2019 Noise Study Technical Report were 34 dBA Leq to 49 dBA Leq for interior uses and 55 dBA Leq to 75 dBA Leq for exterior uses.

Fifty-eight receivers representing 92 residences (NAAC B), two parks (NAAC C), one daycare (NAAC C) and two exterior medical facilities (NAAC C) exceed the NAAC under the existing conditions.

Table 3 Predicted Peak Hour Sound Levels for the Existing Conditions (Leq dBA)

| Receiver[1] – Monitoring Location | Activity Category | Current Land Use | NAAC (dBA) | Number of Receptors | Existing Noise Level Year 2017 (dBA)[2, 3] | Exceeds NAAC (Yes/No) |
|---|---|---|---|---|---|---|
| **R1/M6** | B | Residential | 65 | 1 | 73 | Yes |
| **R2** | C | Medical Facility Exterior | 65 | 1 | 69 | Yes |
| **R3** | C | Medical Facility Exterior | 65 | 1 | 69 | Yes |
| **R4/M4** | C | Park | 65 | 1 | 72 | Yes |
| **R5** | D | School Interior | 50 | 1 | 49 | No |
| **R6/M3** | B | Residential | 65 | 1 | 63 | No |
| **R7** | B | Residential | 65 | 2 | 61 | No |
| **R8** | B | Residential | 65 | 1 | 71 | Yes |
| **R9** | B | Residential | 65 | 1 | 71 | Yes |
| **R10** | B | Residential | 65 | 1 | 72 | Yes |
| **R11** | B | Residential | 65 | 1 | 72 | Yes |
| **R12** | B | Residential | 65 | 1 | 73 | Yes |
| **R13** | B | Residential | 65 | 1 | 73 | Yes |
| **R14a** | B | Residential | 65 | 1 | 69 | Yes |
| **R14b** | B | Residential | 65 | 1 | 71 | Yes |
| **R14c** | B | Residential | 65 | 1 | 71 | Yes |
| **R14d** | B | Residential | 65 | 1 | 71 | Yes |
| **R14e** | B | Residential | 65 | 1 | 71 | Yes |
| **R15** | B | Residential | 65 | 2 | 57 | No |
| **R16/M5** | C | Church | 65 | 1 | 61 | No |
| **R17** | C | Daycare | 65 | 1 | 66 | Yes |
| **R18a** | D | Medical Facility Interior | 50 | 1 | 34 | No |
| **R18b** | D | Medical Facility Interior | 50 | 1 | 36 | No |
| **R19** | B | Bench outside Madrona Studios | 65 | 8 | 68 | Yes |

| Receiver[1] – Monitoring Location | Activity Category | Current Land Use | NAAC (dBA) | Number of Receptors | Existing Noise Level Year 2017 (dBA)[2, 3] | Exceeds NAAC (Yes/No) |
|---|---|---|---|---|---|---|
| **R19a** | D | Medical Facility Interior | 50 | 1 | 43 | No |
| **R20** | C | Recreational Area | 65 | 1 | 55 | No |
| **R21a** | B | Residential | 65 | 2 | 60 | No |
| **R21b** | B | Residential | 65 | 2 | 62 | No |
| **R21c** | B | Residential | 65 | 2 | 63 | No |
| **R21d** | B | Residential | 65 | 2 | 64 | No |
| **R21e** | B | Residential | 65 | 2 | 64 | No |
| **R21f** | B | Residential | 65 | 2 | 65 | Yes |
| **R21g** | B | Residential | 65 | 2 | 66 | Yes |
| **R21h** | B | Residential | 65 | 2 | 66 | Yes |
| **R21i** | B | Residential | 65 | 2 | 66 | Yes |
| **R21j** | B | Residential | 65 | 2 | 67 | Yes |
| **R21k** | B | Residential | 65 | 2 | 67 | Yes |
| **R21l** | B | Residential | 65 | 2 | 67 | Yes |
| **R21m** | B | Residential | 65 | 2 | 67 | Yes |
| **R22a** | B | Residential | 65 | 2 | 60 | No |
| **R22b** | B | Residential | 65 | 2 | 61 | No |
| **R22c** | B | Residential | 65 | 2 | 62 | No |
| **R22d** | B | Residential | 65 | 2 | 63 | No |
| **R22e** | B | Residential | 65 | 2 | 64 | No |
| **R22f** | B | Residential | 65 | 2 | 65 | Yes |
| **R22g** | B | Residential | 65 | 2 | 66 | Yes |
| **R22h** | B | Residential | 65 | 2 | 66 | Yes |
| **R22i** | B | Residential | 65 | 2 | 67 | Yes |
| **R22j** | B | Residential | 65 | 2 | 67 | Yes |
| **R22k** | B | Residential | 65 | 2 | 67 | Yes |
| **R22l** | B | Residential | 65 | 2 | 67 | Yes |
| **R22m** | B | Residential | 65 | 2 | 67 | Yes |

| Receiver[1] – Monitoring Location | Activity Category | Current Land Use | NAAC (dBA) | Number of Receptors | Existing Noise Level Year 2017 (dBA)[2, 3] | Exceeds NAAC (Yes/No) |
|---|---|---|---|---|---|---|
| **R23a** | B | Residential | 65 | 2 | 60 | No |
| **R23b** | B | Residential | 65 | 2 | 61 | No |
| **R23c** | B | Residential | 65 | 2 | 62 | No |
| **R23d** | B | Residential | 65 | 2 | 63 | No |
| **R23e** | B | Residential | 65 | 2 | 64 | No |
| **R23f** | B | Residential | 65 | 2 | 65 | Yes |
| **R23g** | B | Residential | 65 | 2 | 66 | Yes |
| **R23h** | B | Residential | 65 | 2 | 66 | Yes |
| **R23i** | B | Residential | 65 | 2 | 67 | Yes |
| **R23j** | B | Residential | 65 | 2 | 67 | Yes |
| **R23k** | B | Residential | 65 | 2 | 67 | Yes |
| **R23l** | B | Residential | 65 | 2 | 67 | Yes |
| **R23m** | B | Residential | 65 | 2 | 67 | Yes |
| **R24a** | B | Residential | 65 | 2 | 60 | No |
| **R24b** | B | Residential | 65 | 2 | 61 | No |
| **R24c** | B | Residential | 65 | 2 | 62 | No |
| **R24d** | B | Residential | 65 | 2 | 63 | No |
| **R24e** | B | Residential | 65 | 2 | 64 | No |
| **R24f** | B | Residential | 65 | 2 | 65 | Yes |
| **R24g** | B | Residential | 65 | 2 | 66 | Yes |
| **R24h** | B | Residential | 65 | 2 | 67 | Yes |
| **R24i** | B | Residential | 65 | 2 | 67 | Yes |
| **R24j** | B | Residential | 65 | 2 | 67 | Yes |
| **R24k** | B | Residential | 65 | 2 | 67 | Yes |
| **R24l** | B | Residential | 65 | 2 | 67 | Yes |
| **R24m** | B | Residential | 65 | 2 | 67 | Yes |
| **R25a** | B | Residential | 65 | 1 | 55 | No |
| **R25b** | B | Residential | 65 | 1 | 58 | No |
| **R25c** | B | Residential | 65 | 1 | 63 | No |

| Receiver[1] – Monitoring Location | Activity Category | Current Land Use | NAAC (dBA) | Number of Receptors | Existing Noise Level Year 2017 (dBA)[2, 3] | Exceeds NAAC (Yes/No) |
|---|---|---|---|---|---|---|
| **R25d** | B | Residential | 65 | 1 | 65 | Yes |
| **R26a** | B | Residential | 65 | 1 | 54 | No |
| **R26b** | B | Residential | 65 | 1 | 58 | No |
| **R26c** | B | Residential | 65 | 1 | 62 | No |
| **R26d** | B | Residential | 65 | 1 | 65 | Yes |
| **R27** | C | Medical Facility Exterior | 65 | 1 | 57 | No |
| **R28a** | B | Residential | 65 | 1 | 73 | Yes |
| **R28b** | B | Residential | 65 | 1 | 75 | Yes |
| **R28c** | B | Residential | 65 | 1 | 75 | Yes |
| **R28d** | B | Residential | 65 | 1 | 75 | Yes |
| **R28e** | B | Residential | 65 | 1 | 74 | Yes |
| **R29** | D | Medical Facility Interior | 50 | 1 | 45 | No |
| **R30a** | D | Medical Facility Interior | 50 | 1 | 33 | No |
| **R30b** | D | Medical Facility Interior | 50 | 1 | 38 | No |
| **R30c** | D | Medical Facility Interior | 50 | 1 | 44 | No |
| **R30d** | D | Medical Facility Interior | 50 | 1 | 45 | No |
| **R31a** | B | Residential | 65 | 1 | 55 | No |
| **R31b** | B | Residential | 65 | 1 | 58 | No |
| **R31c** | B | Residential | 65 | 1 | 63 | No |
| **R31d** | B | Residential | 65 | 1 | 65 | Yes |
| **R32a** | B | Residential | 65 | 1 | 56 | No |
| **R32b** | B | Residential | 65 | 1 | 58 | No |
| **R32c** | B | Residential | 65 | 1 | 59 | No |
| **R32d** | B | Residential | 65 | 1 | 64 | No |
| **R33a** | B | Residential | 65 | 1 | 56 | No |
| **R33b** | B | Residential | 65 | 1 | 58 | No |

| Receiver[1] – Monitoring Location | Activity Category | Current Land Use | NAAC (dBA) | Number of Receptors | Existing Noise Level Year 2017 (dBA)[2, 3] | Exceeds NAAC (Yes/No) |
|---|---|---|---|---|---|---|
| **R33c** | B | Residential | 65 | 1 | 59 | No |
| **R33d** | B | Residential | 65 | 1 | 63 | No |
| **R34a** | B | Residential | 65 | 1 | 56 | No |
| **R34b** | B | Residential | 65 | 1 | 58 | No |
| **R34c** | B | Residential | 65 | 1 | 59 | No |
| **R34d** | B | Residential | 65 | 1 | 63 | No |
| **R35a** | B | Residential | 65 | 1 | 55 | No |
| **R35b** | B | Residential | 65 | 1 | 57 | No |
| **R35c** | B | Residential | 65 | 1 | 60 | No |
| **R35d** | B | Residential | 65 | 1 | 64 | No |
| **R36a** | B | Residential | 65 | 1 | 55 | No |
| **R36b** | B | Residential | 65 | 1 | 57 | No |
| **R36c** | B | Residential | 65 | 1 | 60 | No |
| **R36d** | B | Residential | 65 | 1 | 64 | No |
| **R37a** | B | Residential | 65 | 1 | 56 | No |
| **R37b** | B | Residential | 65 | 1 | 57 | No |
| **R37c** | B | Residential | 65 | 1 | 59 | No |
| **R37d** | B | Residential | 65 | 1 | 63 | No |
| **R38-Meyer Trust** | C | Non-profit Exterior | 65 | 1 | 61 | No |
| **R39-Legacy Inside** | D | Medical Facility Interior | 50 | 1 | 44 | No |
| **R40-Legacy Bench** | C | Medical Facility Exterior | 65 | 1 | 56 | No |
| **R41 Cartside Food Trucks** | E | Exterior Dining | 70 | 1 | 66 | No |
| **R101** | C | Park | 65 | 1 | 70 | Yes |

*[1]Receivers can represent multiple receptors for multiple story buildings.*
*[2]Receptors that are predicted to exceed the ODOT NAAC have red "Yes" text.*
*[3]Interior noise level predictions were calculated using a reduction factor of 25 dB per Table 6 of the FHWA Highway Traffic Noise Analysis and Abatement Guidance (FHWA 2011).*

Figure 6. Existing Conditions Exceedances Map 1

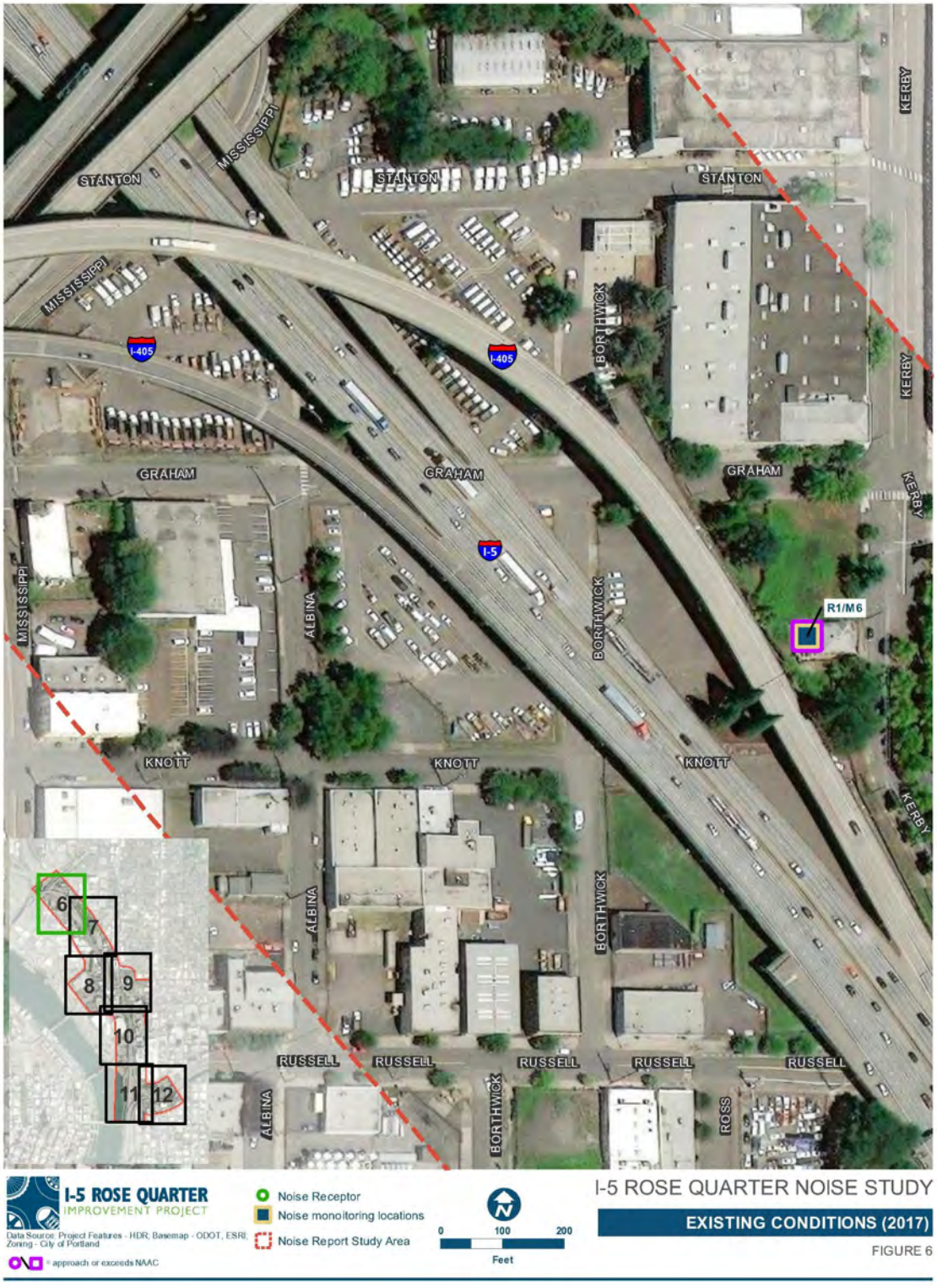


Figure 7. Existing Conditions Exceedances Map 2

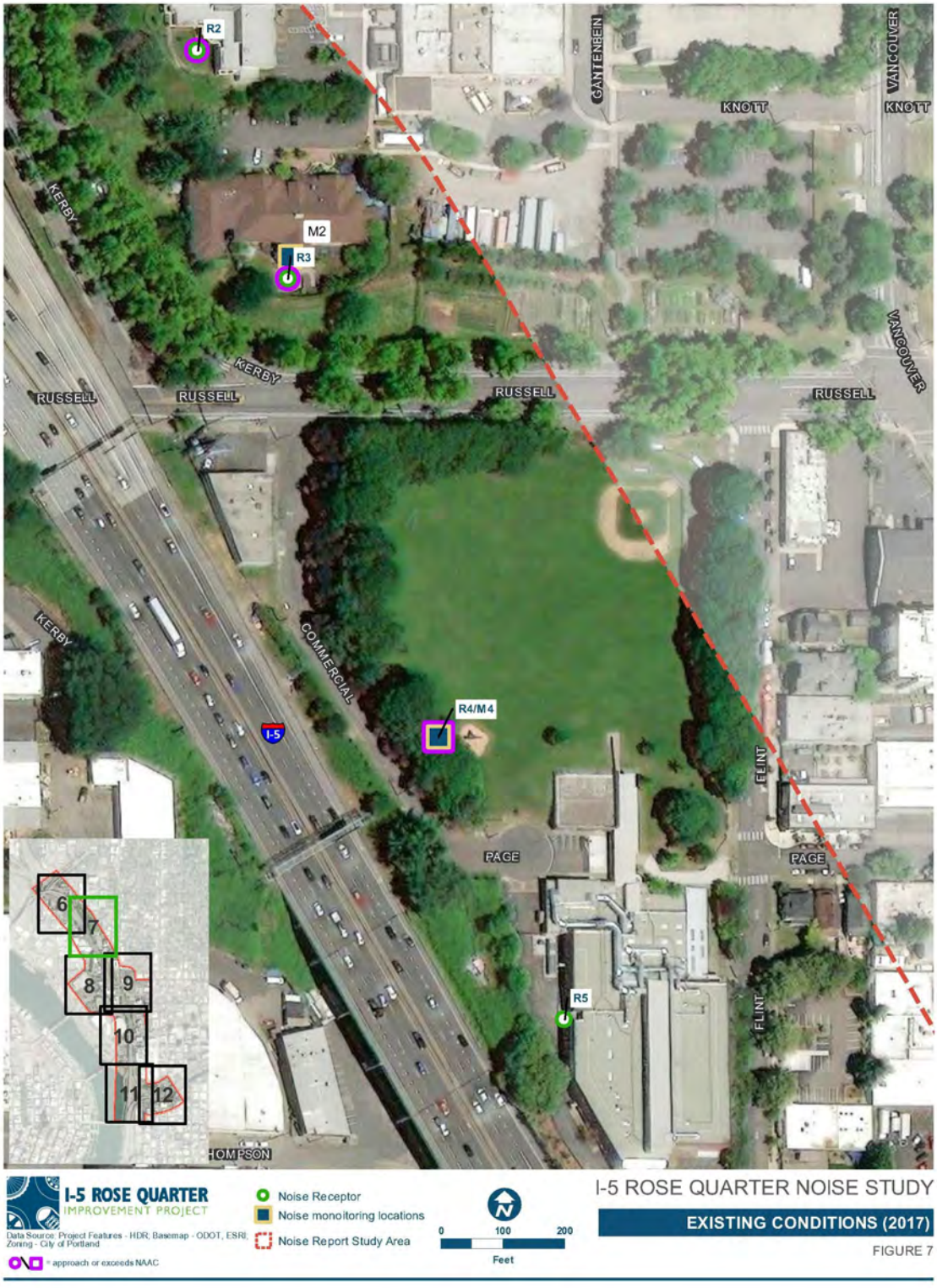


Figure 8. Existing Conditions Exceedances Map 3

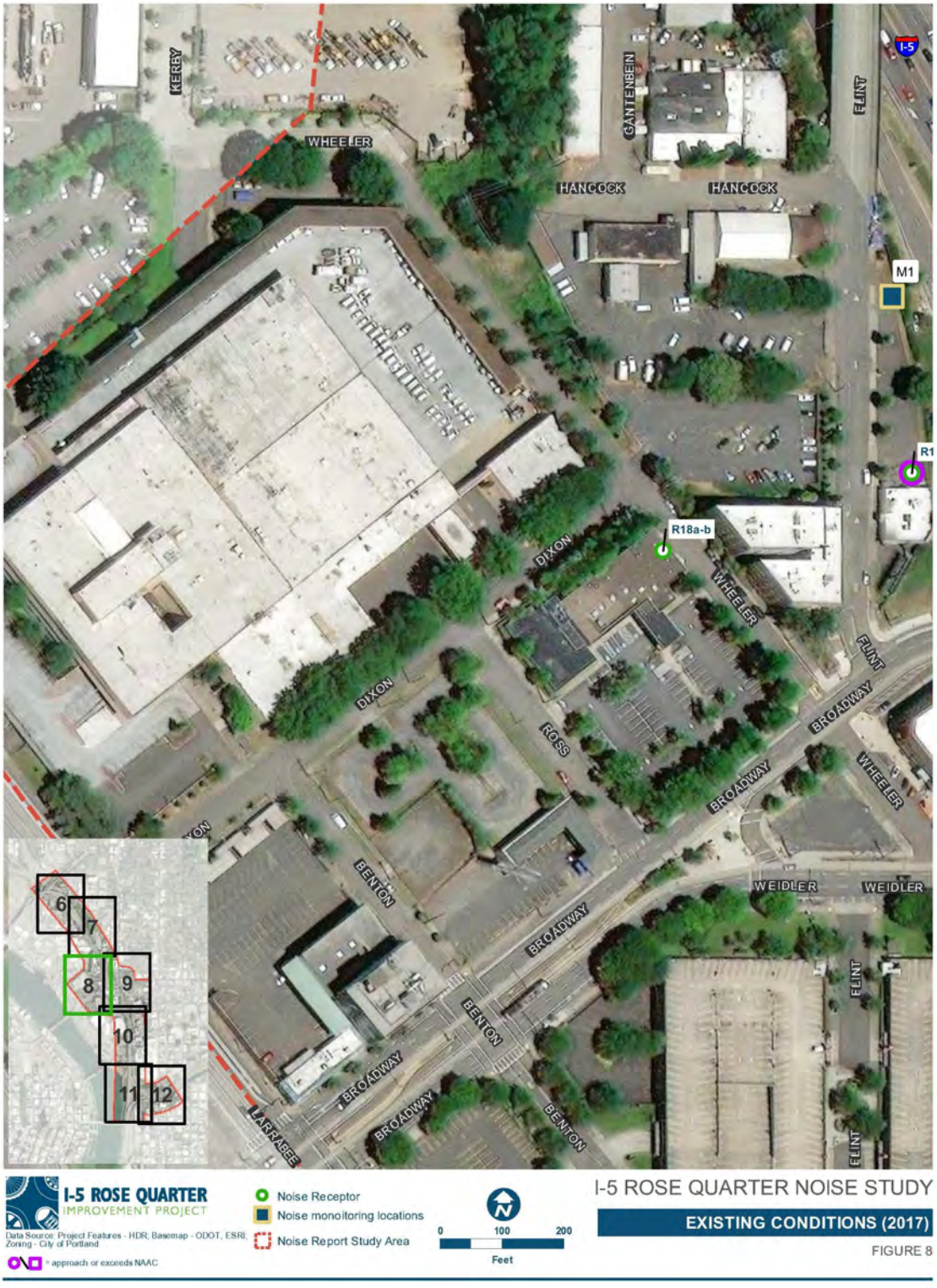


Figure 9. Existing Conditions Exceedances Map 4

Figure 10. Existing Conditions Exceedances Map 5

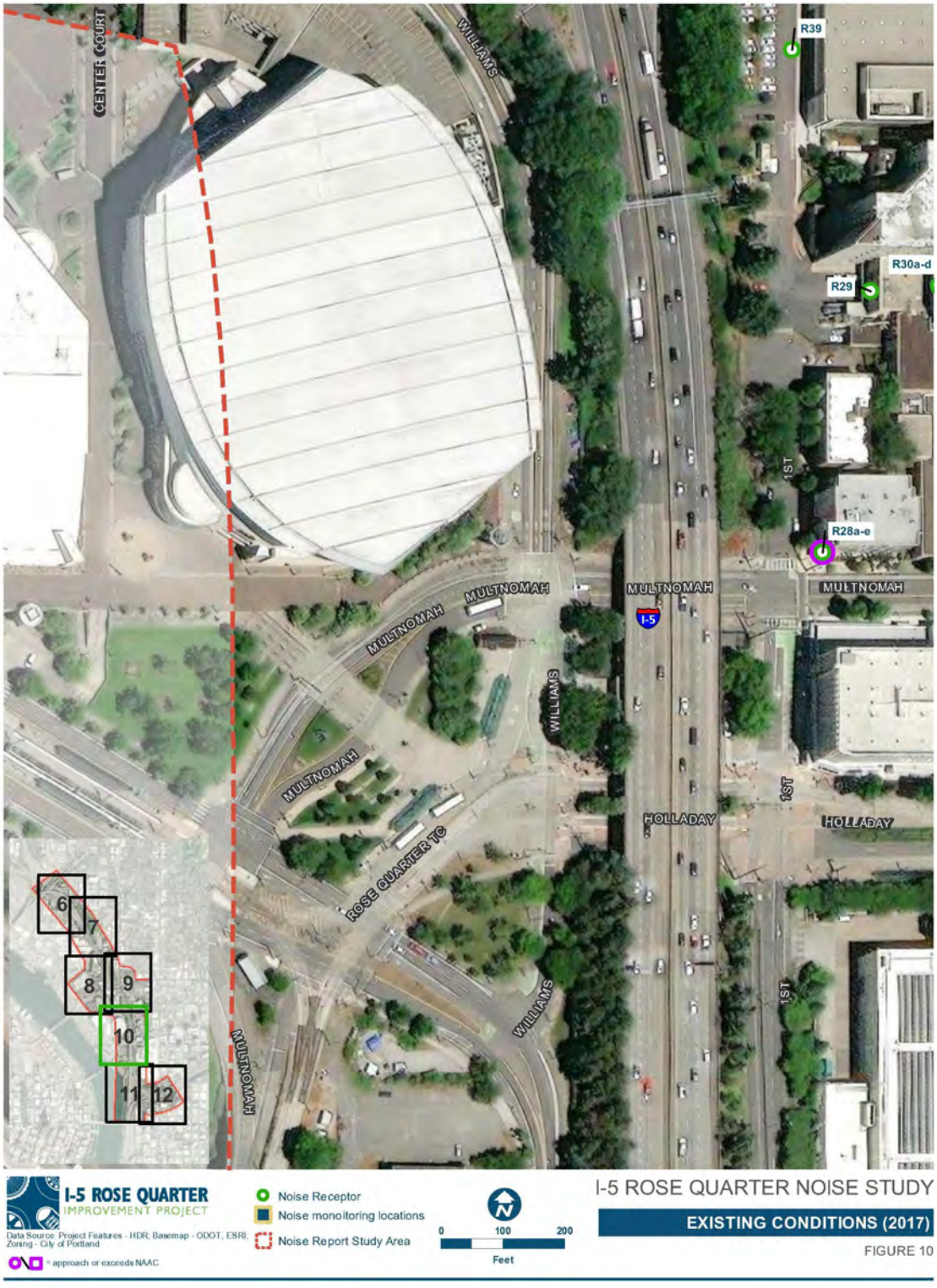
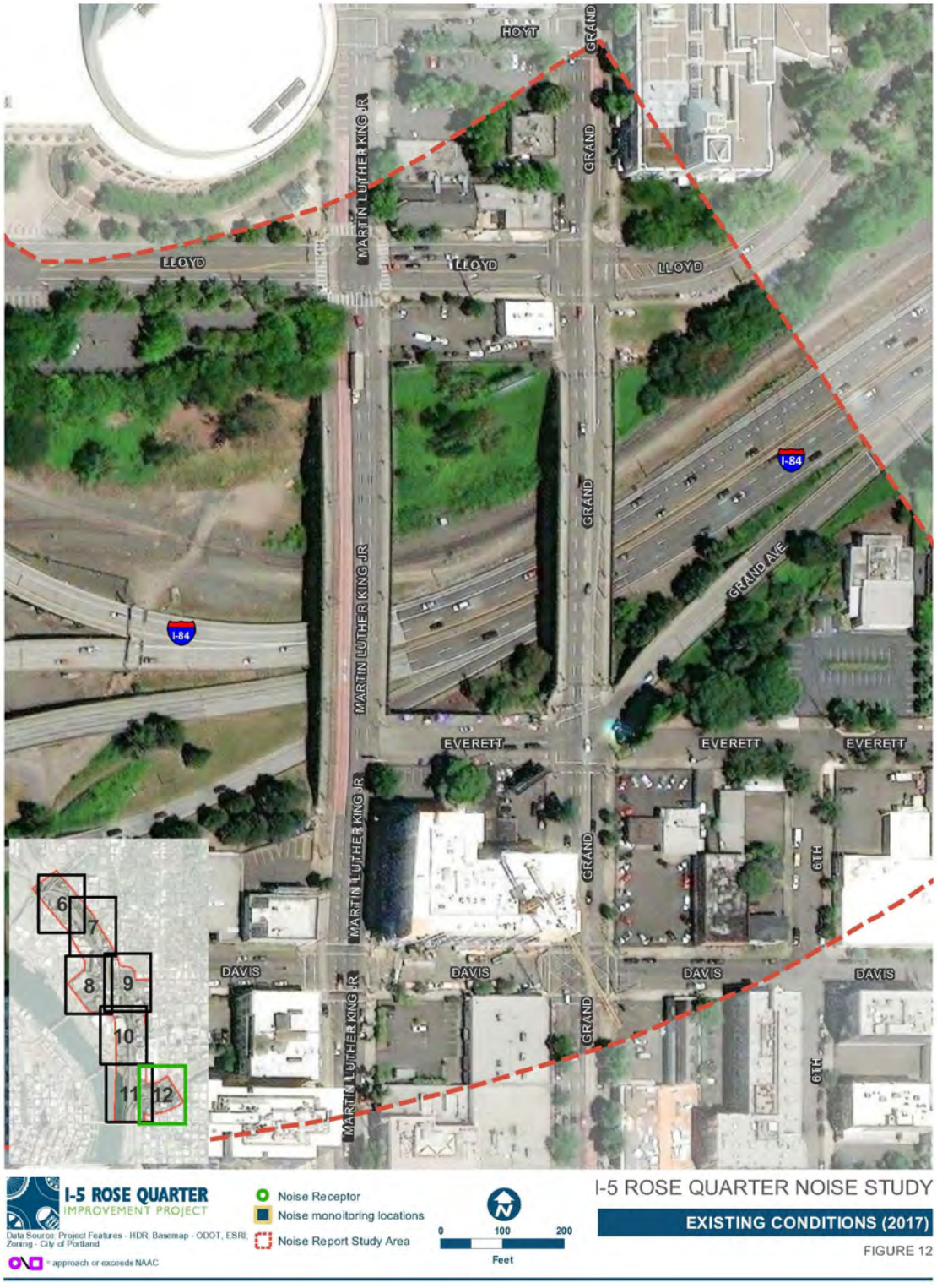


Figure 11. Existing Conditions Exceedances Map 6

Figure 12. Existing Conditions Exceedances Map 7



# 6.0 ENVIRONMENTAL CONSEQUENCES

This section presents differences between the Revised Build Alternative and updates in this noise analysis. Indirect and cumulative impacts remain unchanged relative to what was analyzed in the 2019 Noise Study Technical Report. The reason for no change to indirect impacts is the same reasoning used in the 2019 Noise Study Technical Report. Specifically, while the traffic data used in the noise analysis changed, they were developed by traffic engineers using assumptions about levels of future development in the region and captured the indirect or secondary effects that may result from the Project. The cumulative impacts are the same because there has been no change to the analysis that was presented in the 2019 Noise Study Technical Report.

## 6.1 NO-BUILD ALTERNATIVE

The No-Build Alternative consists of existing conditions and other planned and funded transportation improvement projects that would be completed in and around the Project Area by the design year (2045).

### 6.1.1 Direct and Indirect Impacts

Under the No-Build Alternative, the current road system would remain in place. Exceedances of the NAAC for the existing condition and No-Build Alternative are not considered to be "impacts" as defined in the ODOT Noise Manual (ODOT 2011).

The No-Build Alternative sound levels and exceedance conditions are provided in Figure 13 through Figure 19 as maps depicting the receptors with exceedances under the No-Build Alternative. Future (2045) No-Build Alternative noise levels in the API are predicted to range from 33 dBA Leq to 49 dBA Leq at interior receivers and 55 dBA Leq to 75 dBA Leq at exterior receivers. Relative to the 2019 Noise Study Technical Report No-Build Alternative, noise levels would be slightly less (by up to 1 dB lower) due to changes in land use requiring changes to receptor locations and inclusion of new buildings that provide attenuation. Specifically, the ranges reported in the Revised Build Alternative analysis were 34 dBA Leq to 49 dBA Leq for interior uses and 56 dBA Leq to 75 dBA Leq for exterior uses.

Sixty-one receptors representing 98 residences (NAAC B), two parks (NAAC C), one daycare (NAAC C) and two exterior medical facilities (NAAC C) would exceed the NAAC under the No-Build Alternative. The No-Build noise levels would range from 1 dB less to 1 dB greater than the existing noise levels. Traffic noise change for this alternative is attributed to projected changes in traffic distribution across the roadway network and changes in future traffic volumes in the No-Build Alternative. The TNM file for the No-Build Alternative is included Appendix B. The traffic data used in the analysis is included in Appendix C.

## 6.2 REVISED BUILD ALTERNATIVE

This section provides the analysis of the Revised Build Alternative. Short-term (construction) impacts would be the same as those described in the 2019 Noise Study Technical Report. Changes in direct impacts from the project are provided in the subsection that follows.

### 6.2.1 Direct and Indirect Impacts

The Revised Build Alternative sound levels and receptors with exceedance conditions (impacts) are provided in Figure 20 through Figure 26. Future (2045) Revised Build Alternative noise levels in the API are predicted to range from 32 dBA Leq to 50 dBA Leq at interior receivers and 54 dBA Leq to 75 dBA Leq at exterior receivers.

Fifty-one receptors representing 86 residences (NAAC B), two parks (NAAC C), two exterior medical facilities (NAAC C) and one interior area at Harriet Tubman Middle School (NAAC D) would exceed the NAAC. The Revised Build Alternative noise levels range from 12 dB less to 2 dB greater than the existing noise levels. Compared to the No-Build Alternative the Revised Build Alternative noise levels would range from 11 dB less to 3 dB greater. No substantial increases (10 dB or greater) are predicted.

The 2019 Noise Study Technical Report identified the Build Alternative noise levels would range from 36 dBA Leq to 51 dBA Leq at interior receivers and 56 dBA Leq to 76 dBA Leq at exterior receivers. In the 2019 Noise Study Technical Report, there were 76 receptors representing 117 residences (NAAC B), 1 park, 1 daycare, 2 medical facility exterior uses (NAAC C), and 1 indoor use at Harriet Tubman Middle School would exceed the NAAC.

Compared to the 2019 Noise Study Technical Report Build Alternative, the Revised Build Alternative would result in 31 less residential (NAAC B) impacts, 1 additional park impact, and 1 less daycare impact. Changes in noise levels and impact conditions between the Build Alternative and Revised Build Alternative are due to changes in noise sensitive land uses (i.e., newly constructed buildings that provide shielding where previously there was little or none), a different highway cover design, changes in the proposed roadway alignment, and revised traffic.

Reductions in noise levels relative to the existing conditions and No-Build Alternative would be most pronounced where the highway cover would be constructed. In these areas, noise sensitive receptors would experience a benefit from the project via reduced traffic noise levels since the roadways would be shielded by the highway cover.

Relative to the existing conditions and No-Build Alternative, changes in traffic noise are the result of widening I-5 and changing alignment, which brings some of the roadways such as on-ramps and off-ramps closer to sensitive receptors.

The TNM file for the Revised Build Alternative is included in electronic format in Appendix B. The traffic data used in the analysis is included in Appendix C.

Table 4 Predicted Peak Hour Sound Levels for the Existing and Future Conditions (Leq)

| Receiver[1] (R)1 – Monitoring Location | Activity Category | Current Land Use | NAAC (dBA) | Number of Receptors or ERR | Existing Noise Level Year 2017 (dBA)2, 3 | No-Build Alternative Noise Levels: Year 2045 (dBA)2, 3 | Revised Build Alternative Noise Levels: Year 2045 (dBA)2, 3 | NCHRP Tunnel Portal Adjustment (dB) 4 | Revised Build Alternative Increase over Existing (dB) | Revised Build Alternative Increase over No-Build (dB) | Existing Impact | No-Build Impact | Revised Build Impact |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R1/M6 | B | Residential | 65 | 1 | 73 | 73 | 73 | 0 | 0 | 0 | Yes | Yes | Yes |
| R2 | C | Medical Facility Exterior | 65 | 1 | 69 | 69 | 70 | 0 | 1 | 1 | Yes | Yes | Yes |
| R3 | C | Medical Facility Exterior | 65 | 1 | 69 | 69 | 69 | 0 | 0 | 0 | Yes | Yes | Yes |
| R4/M4 | C | Park | 65 | 17 | 72 | 72 | 72 | 0 | 0 | 0 | Yes | Yes | Yes |
| R5 | D | School Interior | 50 | 61 | 49 | 49 | 50 | 1 | 1 | 1 | No | No | Yes |
| R6/M3 | B | Residential | 65 | 1 | 63 | 63 | 63 | 1 | 0 | 0 | No | No | No |
| R7 | B | Residential | 65 | 2 | 61 | 61 | 59 | 0 | -2 | -2 | No | No | No |
| R8 | B | Residential | 65 | 1 | 71 | 72 | 65 | 0 | -7 | -7 | Yes | Yes | Yes |
| R9 | B | Residential | 65 | 1 | 71 | 71 | 63 | 0 | -9 | -8 | Yes | Yes | No |
| R10 | B | Residential | 65 | 1 | 72 | 72 | 63 | 0 | -9 | -9 | Yes | Yes | No |
| R11 | B | Residential | 65 | 1 | 72 | 72 | 65 | 0 | -8 | -7 | Yes | Yes | Yes |
| R12 | B | Residential | 65 | 1 | 73 | 73 | 64 | 0 | -9 | -9 | Yes | Yes | No |
| R13 | B | Residential | 65 | 1 | 73 | 73 | 65 | 0 | -9 | -8 | Yes | Yes | Yes |
| R14a | B | Residential | 65 | 1 | 69 | 69 | 58 | 0 | -11 | -11 | Yes | Yes | No |
| R14b | B | Residential | 65 | 1 | 71 | 71 | 60 | 0 | -12 | -11 | Yes | Yes | No |
| R14c | B | Residential | 65 | 1 | 71 | 72 | 61 | 0 | -11 |  | Yes | Yes | No |
| R14d | B | Residential | 65 | 1 | 71 | 72 | 61 | 0 | -11 | -11 | Yes | Yes | No |
| R14e | B | Residential | 65 | 1 | 71 | 72 | 62 | 0 | -10 | -10 | Yes | Yes | No |
| R15 | B | Residential | 65 | 2 | 57 | 57 | 56 | 0 | -1 | -1 | No | No | No |
| R16/M5 | C | Church | 65 | 1 | 61 | 61 | 60 | 0 | -1 | -1 | No | No | No |
| R17 | C | Daycare | 65 | 1 | 66 | 67 | 58 | 0 | -9 | -9 | Yes | Yes | No |
| R18a | D | Medical Facility Interior | 50 | 1 | 34 | 34 | 32 | 0 | -2 | -2 | No | No | No |
| R18b | D | Medical Facility Interior | 50 | 1 | 36 | 37 | 35 | 0 | -1 | -2 | No | No | No |
| R19 | B | Bench outside Madrona Studios | 65 | 8 | 68 | 69 | 66 | 1 | -2 | -3 | Yes | Yes | Yes |

| Receiver[1] (R)1 – Monitoring Location | Activity Category | Current Land Use | NAAC (dBA) | Number of Receptors or ERR | Existing Noise Level Year 2017 (dBA)2, 3 | No-Build Alternative Noise Levels: Year 2045 (dBA)2, 3 | Revised Build Alternative Noise Levels: Year 2045 (dBA)2, 3 | NCHRP Tunnel Portal Adjustment (dB) 4 | Revised Build Alternative Increase over Existing (dB) | Revised Build Alternative Increase over No-Build (dB) | Existing Impact | No-Build Impact | Revised Build Impact |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R-19a | D | Medical Facility Interior | 50 | 1 | 43 | 44 | 45 | 1 | 0 | 0 | No | No | No |
| R20 | C | Recreational Area | 65 | 1 | 55 | 55 | 54 | 0 | -1 | -1 | No | No | No |
| R21a | B | Residential | 65 | 2 | 60 | 60 | 60 | 0 | -1 | 0 | No | No | No |
| R21b | B | Residential | 65 | 2 | 62 | 62 | 62 | 0 | 0 | 0 | No | No | No |
| R21c | B | Residential | 65 | 2 | 63 | 63 | 63 | 0 | 0 | 0 | No | No | No |
| R21d | B | Residential | 65 | 2 | 64 | 64 | 64 | 0 | 0 | 0 | No | No | No |
| R21e | B | Residential | 65 | 2 | 64 | 65 | 64 | 0 | -1 | -1 | No | Yes | No |
| R21f | B | Residential | 65 | 2 | 65 | 66 | 65 | 0 | -1 | -1 | Yes | Yes | Yes |
| R21g | B | Residential | 65 | 2 | 66 | 66 | 66 | 0 | 0 | 0 | Yes | Yes | Yes |
| R21h | B | Residential | 65 | 2 | 66 | 66 | 66 | 0 | -1 | 0 | Yes | Yes | Yes |
| R21i | B | Residential | 65 | 2 | 66 | 67 | 66 | 0 | -1 | -1 | Yes | Yes | Yes |
| R21j | B | Residential | 65 | 2 | 67 | 67 | 66 | 0 | -1 | -1 | Yes | Yes | Yes |
| R21k | B | Residential | 65 | 2 | 67 | 67 | 66 | 0 | -1 | -1 | Yes | Yes | Yes |
| R21l | B | Residential | 65 | 2 | 67 | 67 | 67 | 0 | 0 | 0 | Yes | Yes | Yes |
| R21m | B | Residential | 65 | 2 | 67 | 67 | 67 | 0 | -1 | 0 | Yes | Yes | Yes |
| R22a | B | Residential | 65 | 2 | 60 | 60 | 60 | 0 | -1 | 0 | No | No | No |
| R22b | B | Residential | 65 | 2 | 61 | 62 | 62 | 0 | 0 | 0 | No | No | No |
| R22c | B | Residential | 65 | 2 | 62 | 63 | 63 | 0 | 0 | 0 | No | No | No |
| R22d | B | Residential | 65 | 2 | 63 | 63 | 64 | 0 | 0 | 1 | No | No | No |
| R22e | B | Residential | 65 | 2 | 64 | 65 | 64 | 0 | -1 | -1 | No | Yes | No |
| R22f | B | Residential | 65 | 2 | 65 | 65 | 65 | 0 | -1 | 0 | Yes | Yes | Yes |
| R22g | B | Residential | 65 | 2 | 66 | 66 | 66 | 0 | 0 | 0 | Yes | Yes | Yes |
| R22h | B | Residential | 65 | 2 | 66 | 67 | 66 | 0 | -1 | -1 | Yes | Yes | Yes |
| R22i | B | Residential | 65 | 2 | 67 | 67 | 67 | 0 | 0 | 0 | Yes | Yes | Yes |
| R22j | B | Residential | 65 | 2 | 67 | 67 | 67 | 0 | 0 | 0 | Yes | Yes | Yes |
| R22k | B | Residential | 65 | 2 | 67 | 67 | 67 | 0 | 0 | 0 | Yes | Yes | Yes |
| R22l | B | Residential | 65 | 2 | 67 | 67 | 67 | 0 | -1 | 0 | Yes | Yes | Yes |
| R22m | B | Residential | 65 | 2 | 67 | 68 | 67 | 0 | -1 | -1 | Yes | Yes | Yes |

| Receiver[1] (R)1 – Monitoring Location | Activity Category | Current Land Use | NAAC (dBA) | Number of Receptors or ERR | Existing Noise Level Year 2017 (dBA)2, 3 | No-Build Alternative Noise Levels: Year 2045 (dBA)2, 3 | Revised Build Alternative Noise Levels: Year 2045 (dBA)2, 3 | NCHRP Tunnel Portal Adjustment (dB) 4 | Revised Build Alternative Increase over Existing (dB) | Revised Build Alternative Increase over No-Build (dB) | Existing Impact | No-Build Impact | Revised Build Impact |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R23a | B | Residential | 65 | 2 | 60 | 60 | 60 | 0 | 0 | 0 | No | No | No |
| R23b | B | Residential | 65 | 2 | 61 | 61 | 61 | 0 | -1 | 0 | No | No | No |
| R23c | B | Residential | 65 | 2 | 62 | 62 | 62 | 0 | -1 | 0 | No | No | No |
| R23d | B | Residential | 65 | 2 | 63 | 63 | 63 | 0 | -1 | 0 | No | No | No |
| R23e | B | Residential | 65 | 2 | 64 | 64 | 64 | 0 | -1 | 0 | No | No | No |
| R23f | B | Residential | 65 | 2 | 65 | 65 | 65 | 0 | -1 | 0 | Yes | Yes | Yes |
| R23g | B | Residential | 65 | 2 | 66 | 66 | 66 | 0 | 0 | 0 | Yes | Yes | Yes |
| R23h | B | Residential | 65 | 2 | 66 | 67 | 66 | 0 | -1 | -1 | Yes | Yes | Yes |
| R23i | B | Residential | 65 | 2 | 67 | 67 | 67 | 0 | 0 | 0 | Yes | Yes | Yes |
| R23j | B | Residential | 65 | 2 | 67 | 67 | 67 | 0 | 0 | 0 | Yes | Yes | Yes |
| R23k | B | Residential | 65 | 2 | 67 | 67 | 67 | 0 | 0 | 0 | Yes | Yes | Yes |
| R23l | B | Residential | 65 | 2 | 67 | 67 | 67 | 0 | -1 | 0 | Yes | Yes | Yes |
| R23m | B | Residential | 65 | 2 | 67 | 67 | 67 | 0 | -1 | 0 | Yes | Yes | Yes |
| R24a | B | Residential | 65 | 2 | 60 | 60 | 60 | 0 | -1 | 0 | No | No | No |
| R24b | B | Residential | 65 | 2 | 61 | 61 | 62 | 0 | 0 | 1 | No | No | No |
| R24c | B | Residential | 65 | 2 | 62 | 63 | 62 | 0 | -1 | -1 | No | No | No |
| R24d | B | Residential | 65 | 2 | 63 | 64 | 64 | 0 | 0 | 0 | No | No | No |
| R24e | B | Residential | 65 | 2 | 64 | 65 | 65 | 0 | 0 | 0 | No | Yes | Yes |
| R24f | B | Residential | 65 | 2 | 65 | 66 | 66 | 0 | 0 | 0 | Yes | Yes | Yes |
| R24g | B | Residential | 65 | 2 | 66 | 66 | 66 | 0 | -1 | 0 | Yes | Yes | Yes |
| R24h | B | Residential | 65 | 2 | 67 | 67 | 67 | 0 | 0 | 0 | Yes | Yes | Yes |
| R24i | B | Residential | 65 | 2 | 67 | 67 | 67 | 0 | 0 | 0 | Yes | Yes | Yes |
| R24j | B | Residential | 65 | 2 | 67 | 67 | 67 | 0 | -1 | 0 | Yes | Yes | Yes |
| R24k | B | Residential | 65 | 2 | 67 | 67 | 67 | 0 | -1 | 0 | Yes | Yes | Yes |
| R24l | B | Residential | 65 | 2 | 67 | 68 | 67 | 0 | -1 | -1 | Yes | Yes | Yes |
| R24m | B | Residential | 65 | 2 | 67 | 68 | 67 | 0 | -1 | -1 | Yes | Yes | Yes |
| R25a | B | Residential | 65 | 1 | 55 | 56 | 55 | 0 | -1 | -1 | No | No | No |
| R25b | B | Residential | 65 | 1 | 58 | 59 | 58 | 0 | -1 | -1 | No | No | No |
| R25c | B | Residential | 65 | 1 | 63 | 63 | 62 | 0 | -2 | -1 | No | No | No |
| R25d | B | Residential | 65 | 1 | 65 | 66 | 65 | 0 | -1 | -1 | Yes | Yes | Yes |

| Receiver[1] (R)1 – Monitoring Location | Activity Category | Current Land Use | NAAC (dBA) | Number of Receptors or ERR | Existing Noise Level Year 2017 (dBA)2, 3 | No-Build Alternative Noise Levels: Year 2045 (dBA)2, 3 | Revised Build Alternative Noise Levels: Year 2045 (dBA)2, 3 | NCHRP Tunnel Portal Adjustment (dB) 4 | Revised Build Alternative Increase over Existing (dB) | Revised Build Alternative Increase over No-Build (dB) | Existing Impact | No-Build Impact | Revised Build Impact |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R26a | B | Residential | 65 | 1 | 54 | 55 | 54 | 0 | 0 | -1 | No | No | No |
| R26b | B | Residential | 65 | 1 | 58 | 58 | 57 | 0 | -1 | -1 | No | No | No |
| R26c | B | Residential | 65 | 1 | 62 | 63 | 62 | 0 | -1 | -1 | No | No | No |
| R26d | B | Residential | 65 | 1 | 65 | 65 | 65 | 0 | -1 | 0 | Yes | Yes | Yes |
| R27 | C | Medical Facility Exterior | 65 | 1 | 57 | 58 | 58 | 0 | 0 | 0 | No | No | No |
| R28a | B | Residential | 65 | 1 | 73 | 74 | 74 | 0 | 1 | 0 | Yes | Yes | Yes |
| R28b | B | Residential | 65 | 1 | 75 | 75 | 75 | 0 | 0 | 0 | Yes | Yes | Yes |
| R28c | B | Residential | 65 | 1 | 75 | 75 | 75 | 0 | 0 | 0 | Yes | Yes | Yes |
| R28d | B | Residential | 65 | 1 | 75 | 75 | 75 | 0 | 0 | 0 | Yes | Yes | Yes |
| R28e | B | Residential | 65 | 1 | 74 | 75 | 75 | 0 | 1 | 0 | Yes | Yes | Yes |
| R29 | D | Medical Facility Interior | 50 | 1 | 45 | 46 | 45 | 0 | 0 | -1 | No | No | No |
| R30a | D | Medical Facility Interior | 50 | 1 | 33 | 33 | 33 | 0 | 0 | 0 | No | No | No |
| R30b | D | Medical Facility Interior | 50 | 1 | 38 | 39 | 39 | 0 | 1 | 0 | No | No | No |
| R30c | D | Medical Facility Interior | 50 | 1 | 44 | 45 | 44 | 0 | 0 | -1 | No | No | No |
| R30d | D | Medical Facility Interior | 50 | 1 | 45 | 46 | 46 | 0 | 0 | 0 | No | No | No |
| R31a | B | Residential | 65 | 1 | 55 | 56 | 55 | 0 | 0 | -1 | No | No | No |
| R31b | B | Residential | 65 | 1 | 58 | 59 | 58 | 0 | -1 | -1 | No | No | No |
| R31c | B | Residential | 65 | 1 | 63 | 63 | 62 | 0 | -2 | -1 | No | No | No |
| R31d | B | Residential | 65 | 1 | 65 | 66 | 65 | 0 | -1 | -1 | Yes | Yes | Yes |
| R32a | B | Residential | 65 | 1 | 56 | 57 | 57 | 0 | 1 | 0 | No | No | No |
| R32b | B | Residential | 65 | 1 | 58 | 59 | 59 | 0 | 0 | 0 | No | No | No |
| R32c | B | Residential | 65 | 1 | 59 | 60 | 60 | 0 | 0 | 0 | No | No | No |
| R32d | B | Residential | 65 | 1 | 64 | 64 | 63 | 0 | -1 | -1 | No | No | No |
| R33a | B | Residential | 65 | 1 | 56 | 57 | 56 | 0 | 0 | -1 | No | No | No |
| R33b | B | Residential | 65 | 1 | 58 | 59 | 59 | 0 | 1 | 0 | No | No | No |
| R33c | B | Residential | 65 | 1 | 59 | 60 | 60 | 0 | 1 | 0 | No | No | No |
| R33d | B | Residential | 65 | 1 | 63 | 63 | 63 | 0 | -1 | 0 | No | No | No |

| Receiver[1] (R)1 – Monitoring Location | Activity Category | Current Land Use | NAAC (dBA) | Number of Receptors or ERR | Existing Noise Level Year 2017 (dBA)2, 3 | No-Build Alternative Noise Levels: Year 2045 (dBA)2, 3 | Revised Build Alternative Noise Levels: Year 2045 (dBA)2, 3 | NCHRP Tunnel Portal Adjustment (dB) 4 | Revised Build Alternative Increase over Existing (dB) | Revised Build Alternative Increase over No-Build (dB) | Existing Impact | No-Build Impact | Revised Build Impact |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R34a | B | Residential | 65 | 1 | 56 | 56 | 56 | 0 | 0 | 0 | No | No | No |
| R34b | B | Residential | 65 | 1 | 58 | 59 | 59 | 0 | 1 | 0 | No | No | No |
| R34c | B | Residential | 65 | 1 | 59 | 60 | 60 | 0 | 1 | 0 | No | No | No |
| R34d | B | Residential | 65 | 1 | 63 | 63 | 62 | 0 | -1 | -1 | No | No | No |
| R35a | B | Residential | 65 | 1 | 55 | 56 | 56 | 0 | 0 | 0 | No | No | No |
| R35b | B | Residential | 65 | 1 | 57 | 58 | 58 | 0 | 0 | 0 | No | No | No |
| R35c | B | Residential | 65 | 1 | 60 | 60 | 59 | 0 | -2 | -1 | No | No | No |
| R35d | B | Residential | 65 | 1 | 64 | 64 | 64 | 0 | 0 | 0 | No | No | No |
| R36a | B | Residential | 65 | 1 | 55 | 56 | 56 | 0 | 0 | 0 | No | No | No |
| R36b | B | Residential | 65 | 1 | 57 | 58 | 58 | 0 | 0 | 0 | No | No | No |
| R36c | B | Residential | 65 | 1 | 60 | 60 | 59 | 0 | -1 | -1 | No | No | No |
| R36d | B | Residential | 65 | 1 | 64 | 64 | 63 | 0 | -1 | -1 | No | No | No |
| R37a | B | Residential | 65 | 1 | 56 | 56 | 57 | 0 | 1 | 1 | No | No | No |
| R37b | B | Residential | 65 | 1 | 57 | 58 | 58 | 0 | 0 | 0 | No | No | No |
| R37c | B | Residential | 65 | 1 | 59 | 60 | 59 | 0 | -1 | -1 | No | No | No |
| R37d | B | Residential | 65 | 1 | 63 | 63 | 63 | 0 | -1 | 0 | No | No | No |
| R38--Meyer Trust | C | Non-profit Exterior | 65 | 1 | 61 | 62 | 56 | 1 | -6 | -6 | No | No | No |
| R39--Legacy Inside | D | Medical Facility Interior | 50 | 1 | 44 | 44 | 46 | 0 | 1 | 2 | No | No | No |
| R40-Legacy Bench | C | Medical Facility Exterior | 65 | 1 | 56 | 56 | 58 | 0 | 1 | 2 | No | No | No |
| R41-Cartside Food Trucks | E | Exterior Dining | 70 | 1 | 65 | 66 | 65 | 0 | -1 | -1 | No | No | No |
| R101 | C | Park | 65 | 1 | 70 | 71 | 72 | 0 | 2 | 1 | Yes | Yes | Yes |

*[1]Receivers can represent multiple receptors for multiple story buildings.*
*[2]Receivers that are predicted to exceed the ODOT NAAC have red "Yes" text.*
*[3]Interior noise level predictions were calculated using a reduction factor of 25 dB per Table 6 of the FHWA Highway Traffic Noise Analysis and Abatement Guidance (FHWA 2011).*
*[4]Precalculated adjustments were applied to the TNM-computed noise prediction to account for tunnel effects per the NCHRP Supplemental Guidance of the Application of FHWA's Traffic Noise Model (NCHRP 2014). Sound levels for the Revised Build Alternative include this adjustment where applicable.*

Figure 13. No-Build Alternative Exceedances Map 1

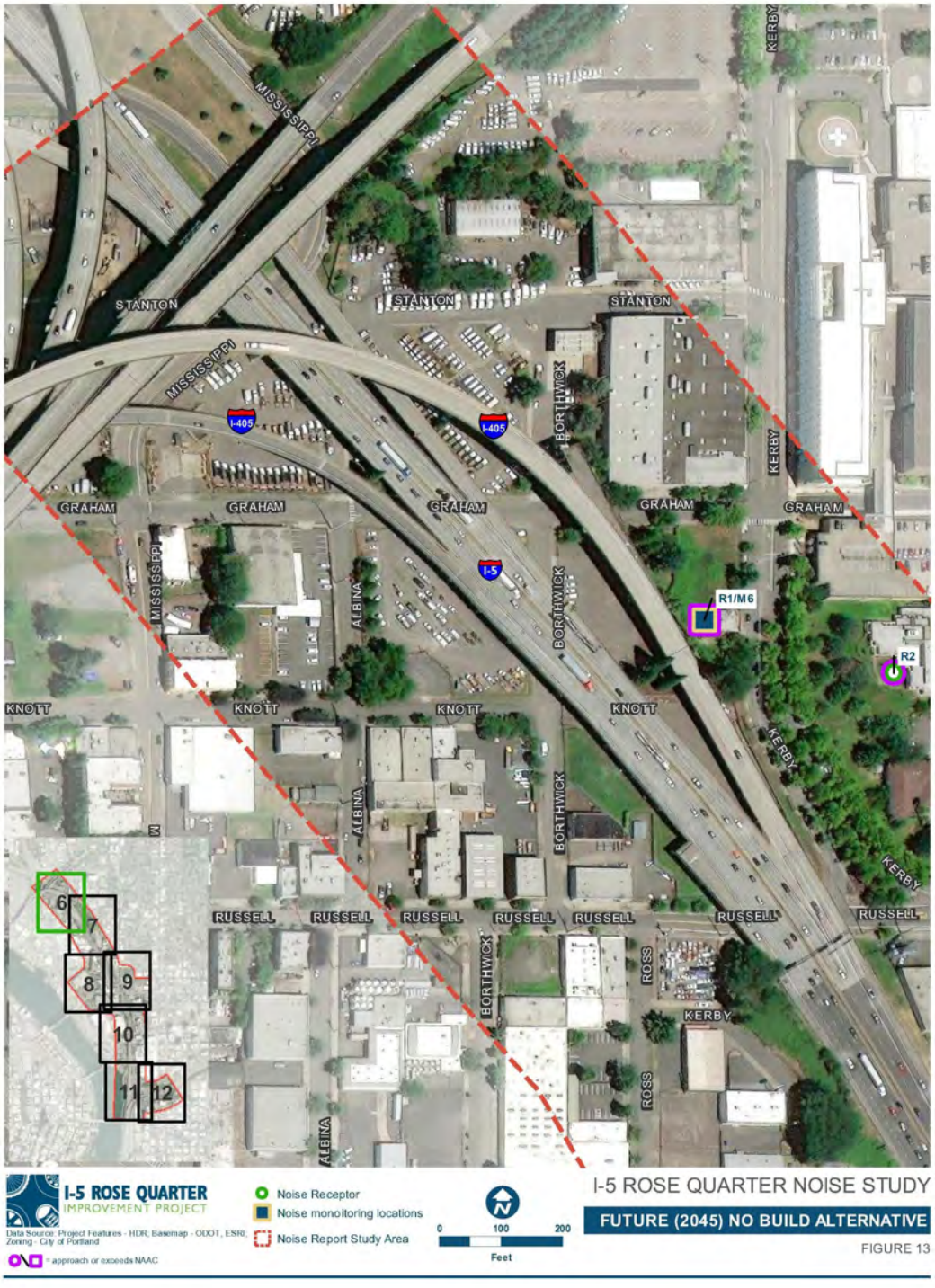


Figure 14. No-Build Alternative Exceedances Map 2

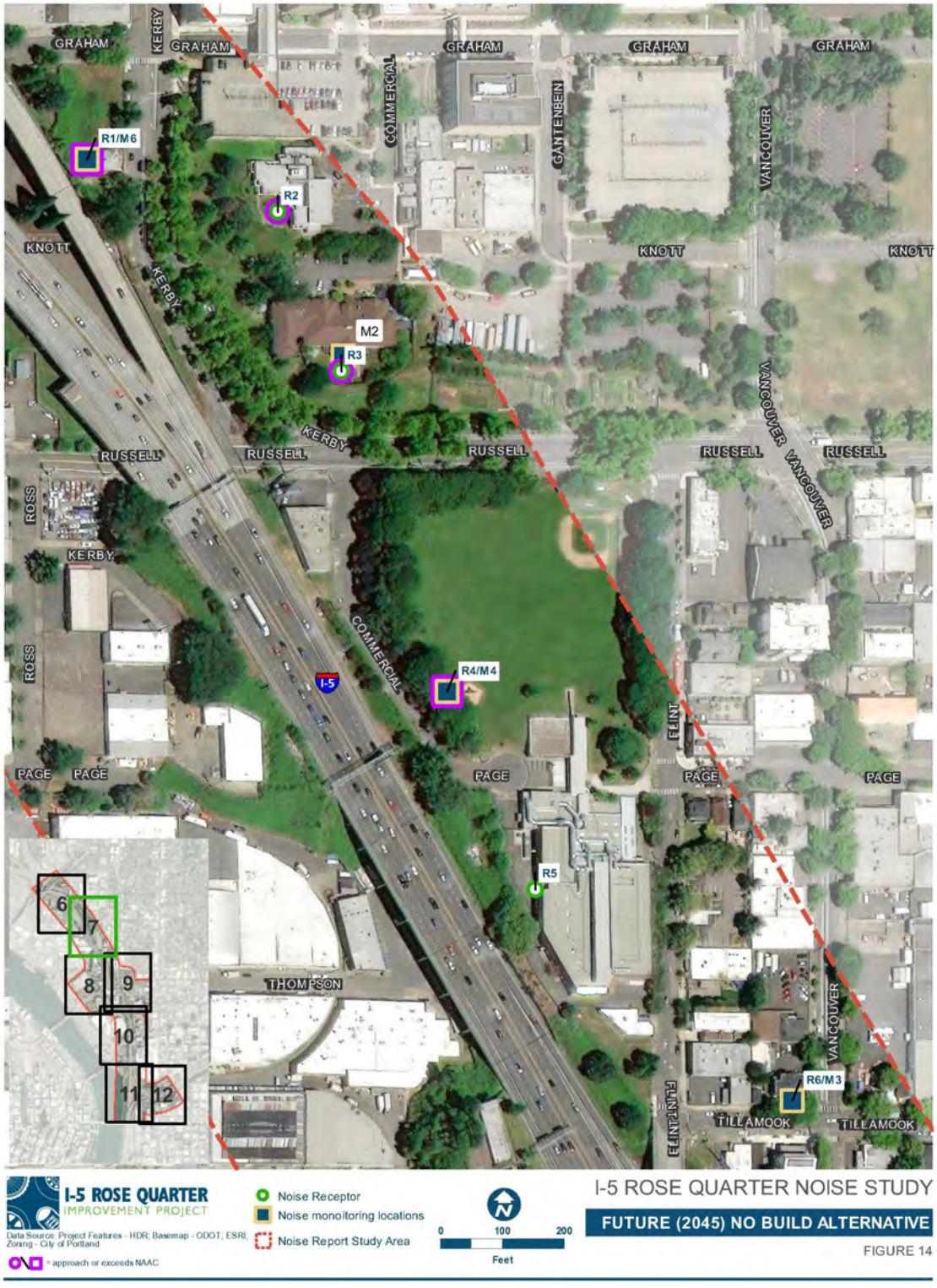


Figure 15. No-Build Alternative Exceedances Map 3

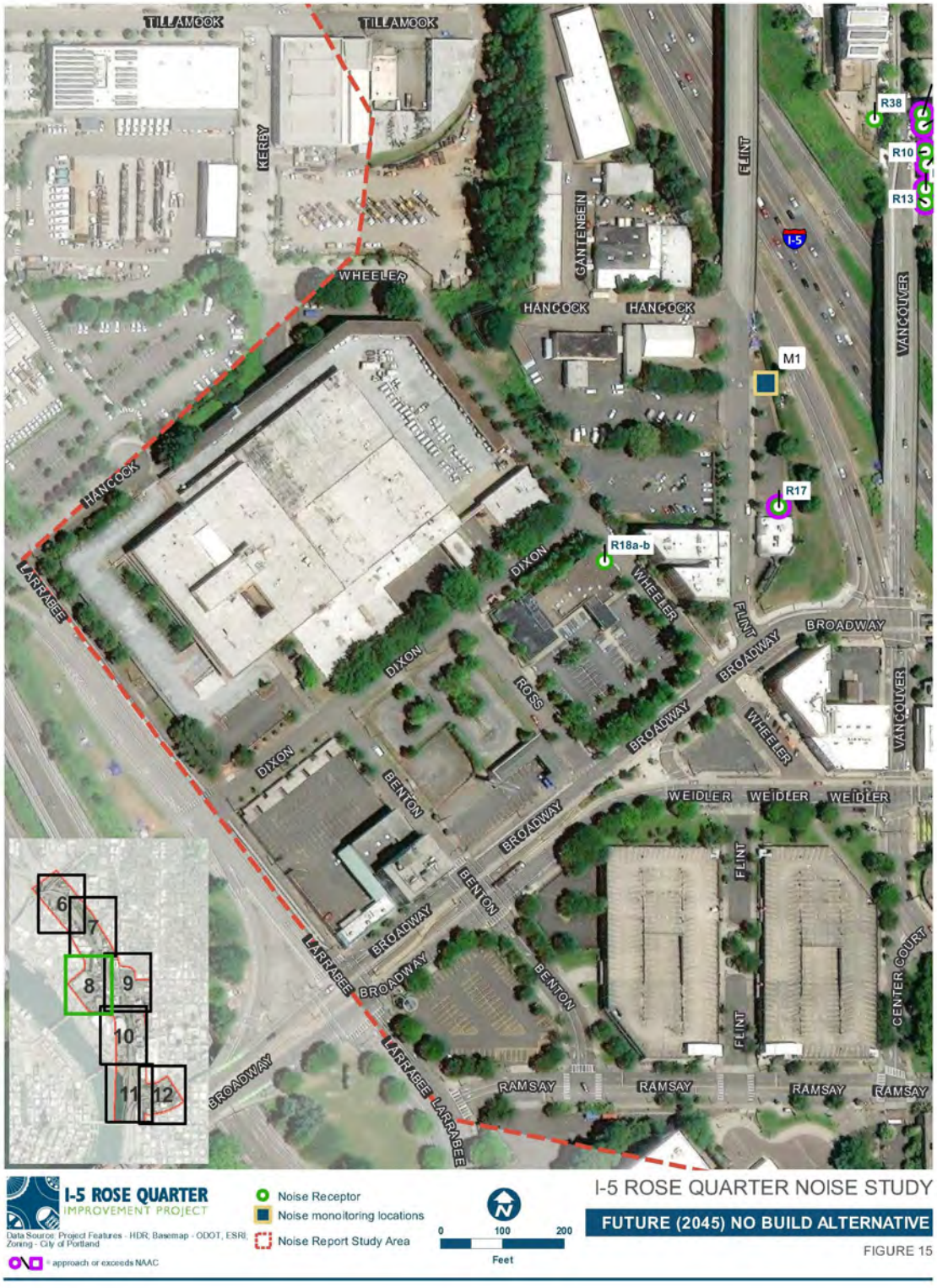


Figure 16. No-Build Alternative Exceedances Map 4

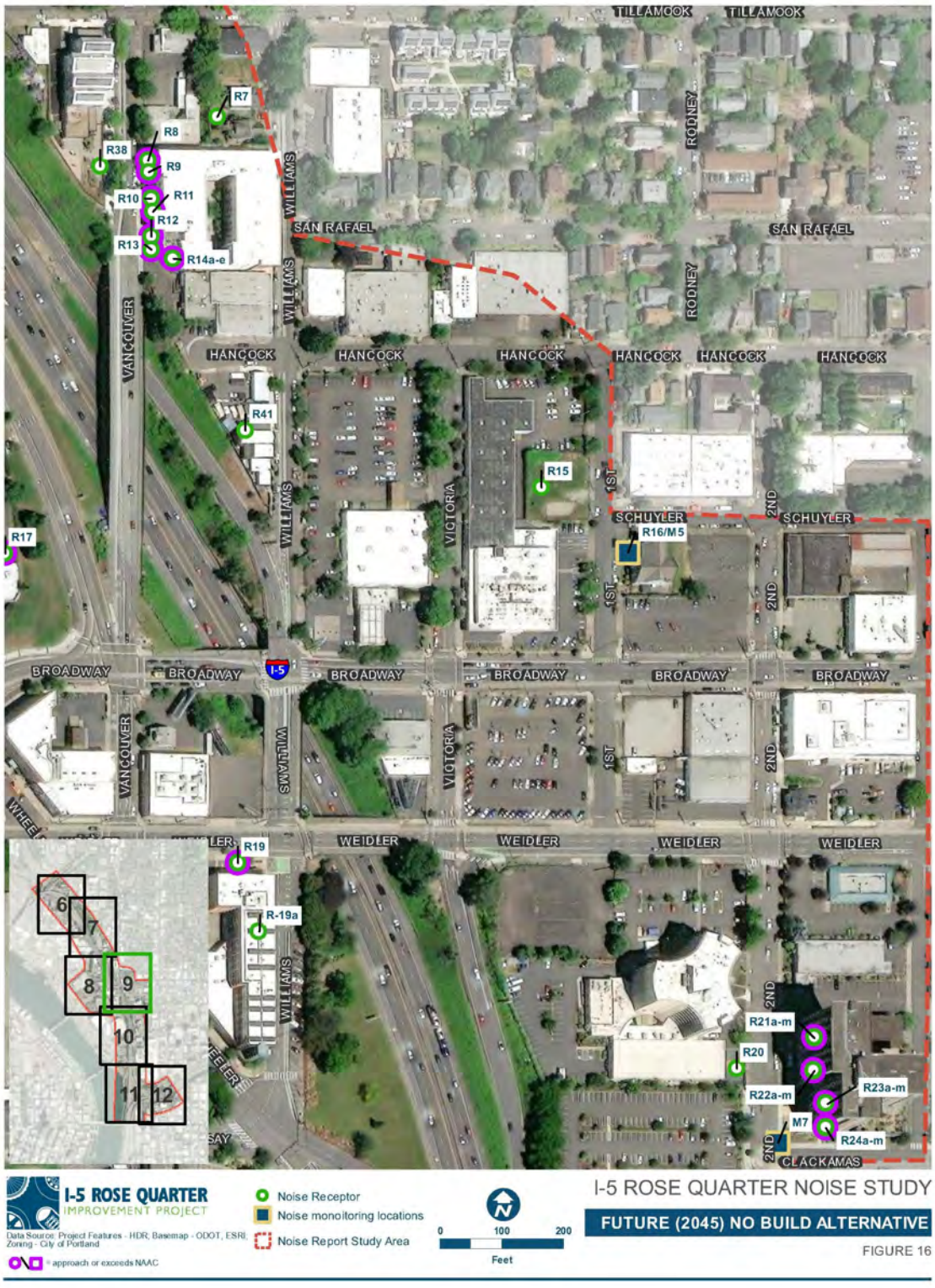


Figure 17. No-Build Alternative Exceedances Map 5

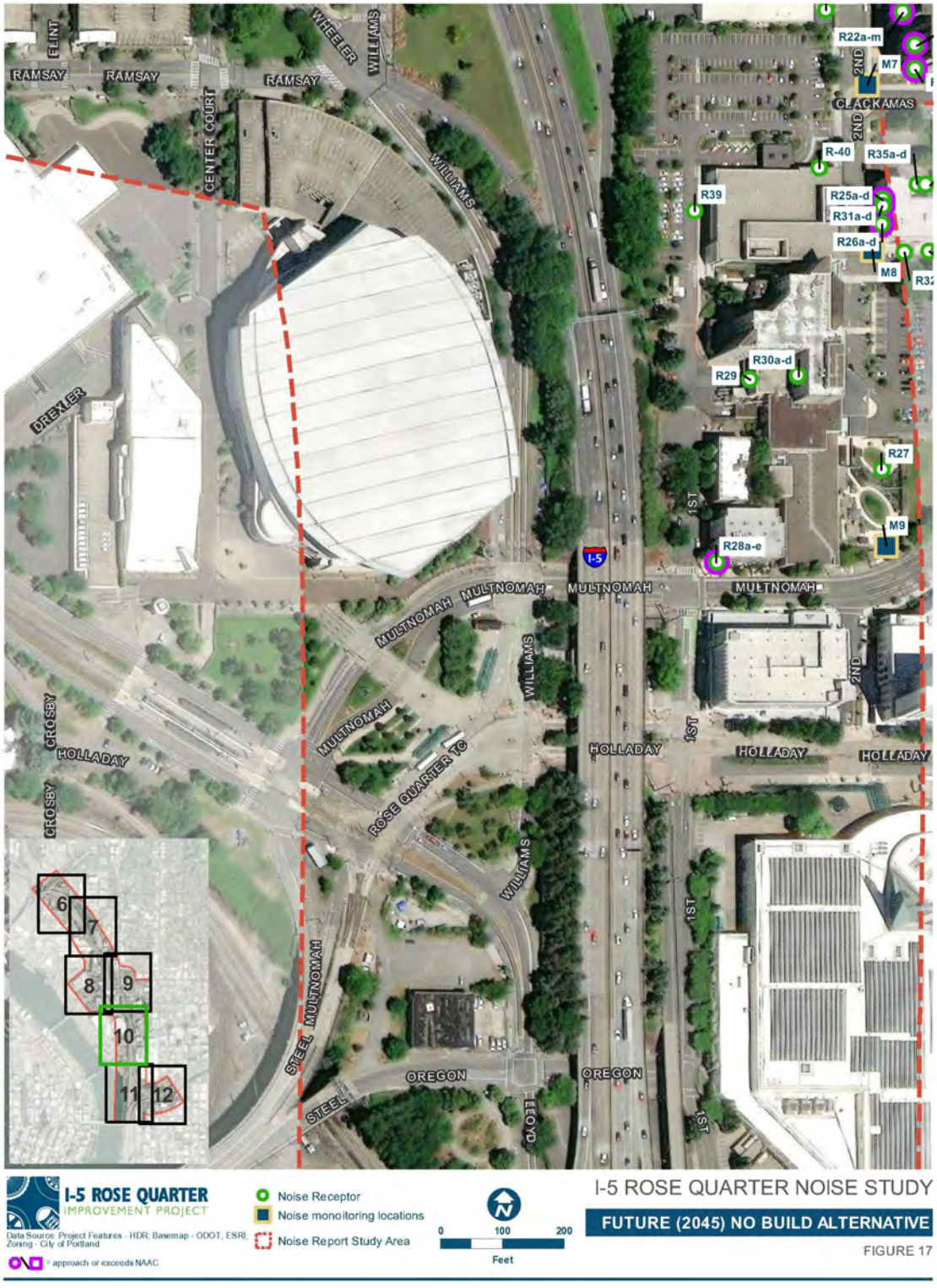


Figure 18. No-Build Alternative Exceedances Map 6

Figure 19. No-Build Alternative Exceedances Map 7

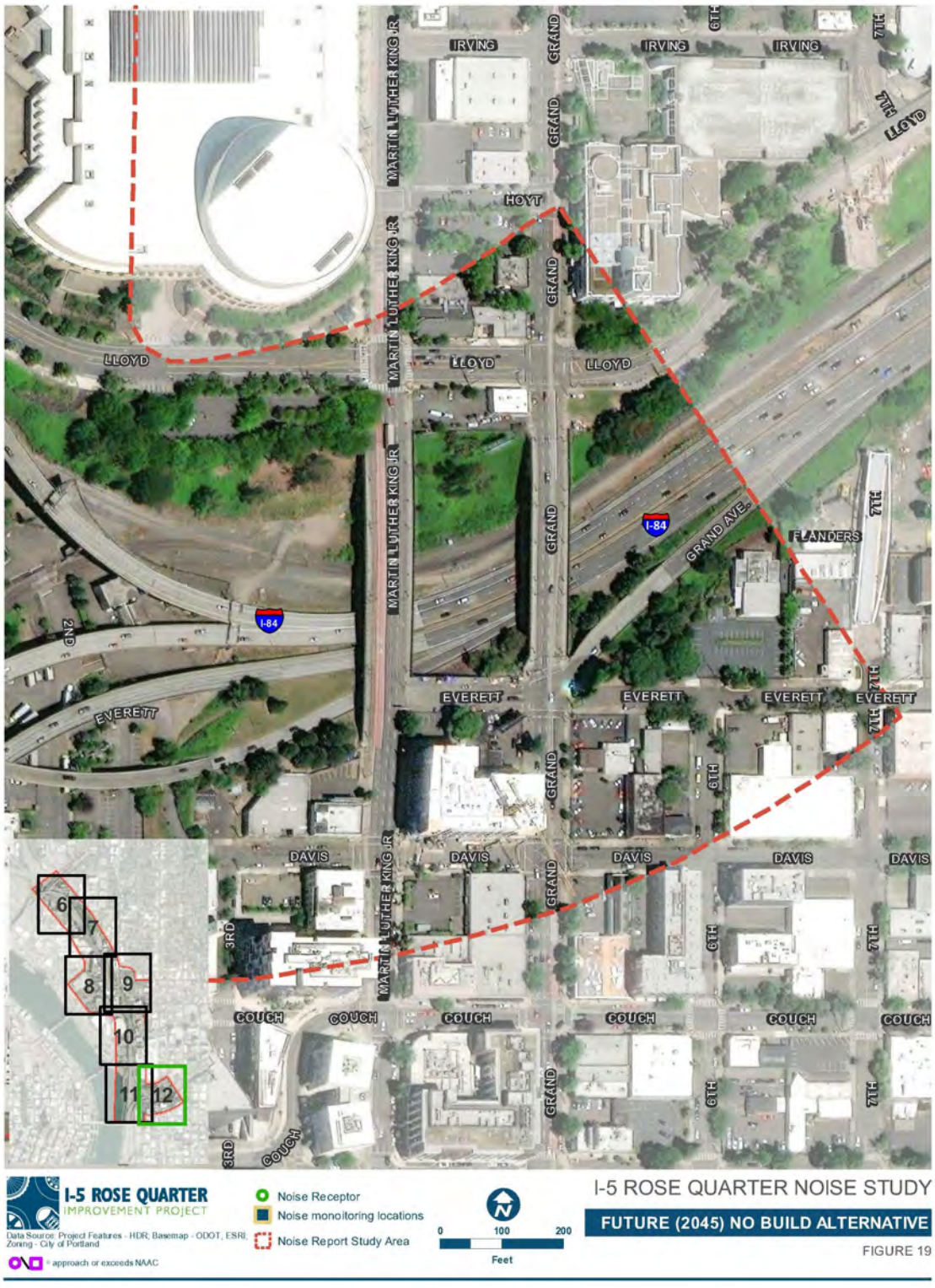


Figure 20. Revised Build Alternative Exceedances Map 1

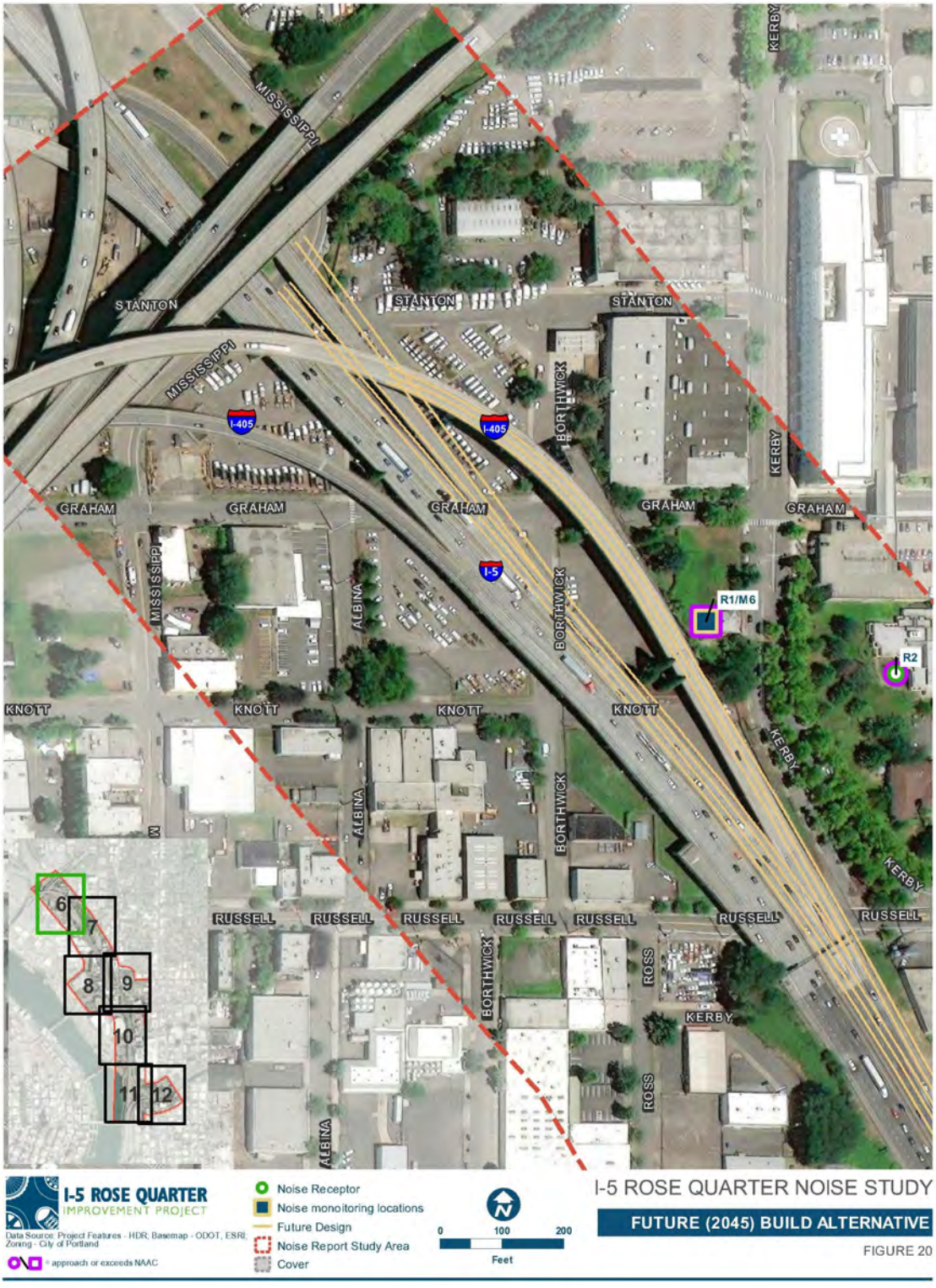


Figure 21. Revised Build Alternative Exceedances Map 2

Figure 22. Revised Build Alternative Exceedances Map 3

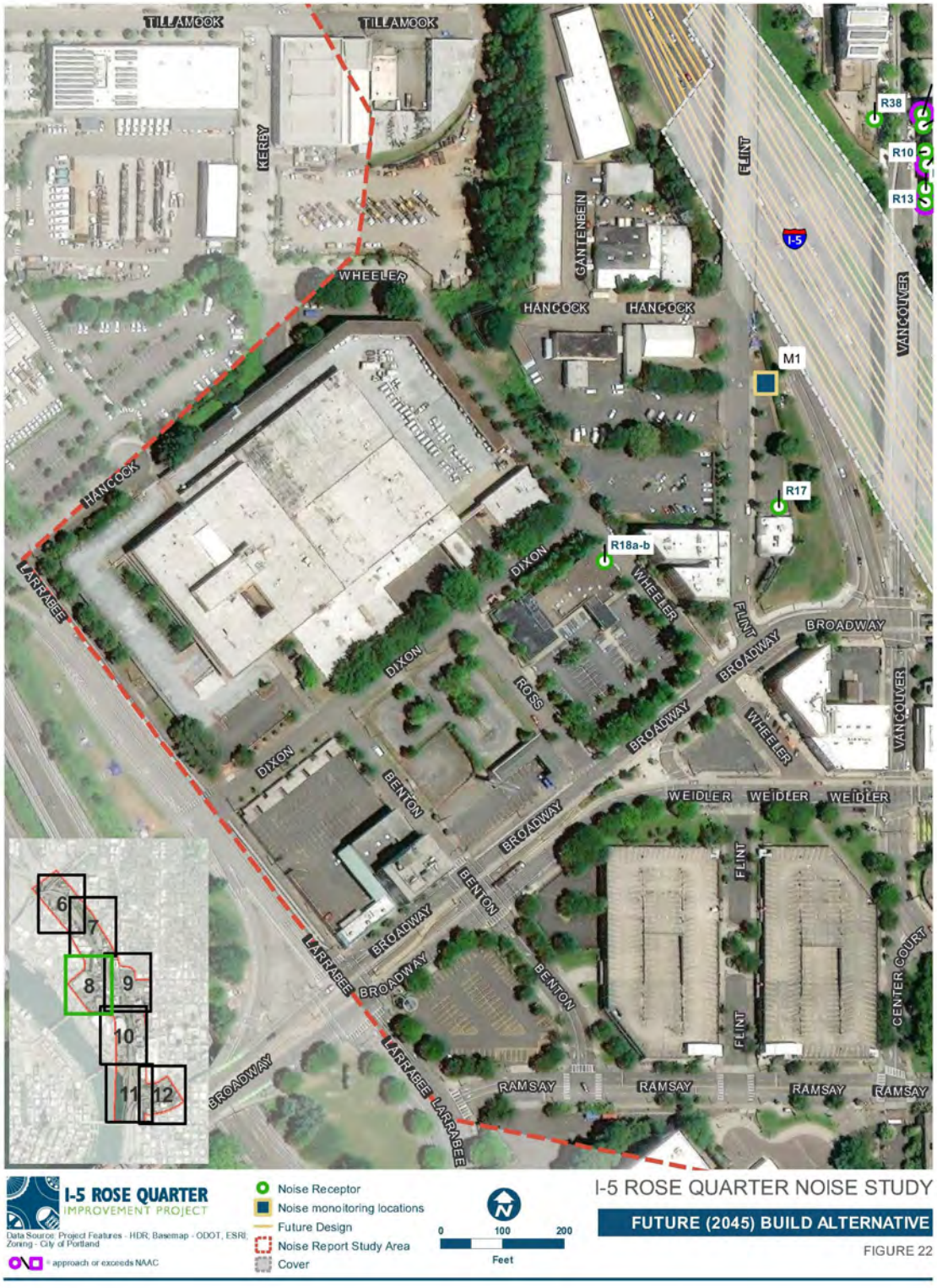


Figure 23. Revised Build Alternative Exceedances Map 4

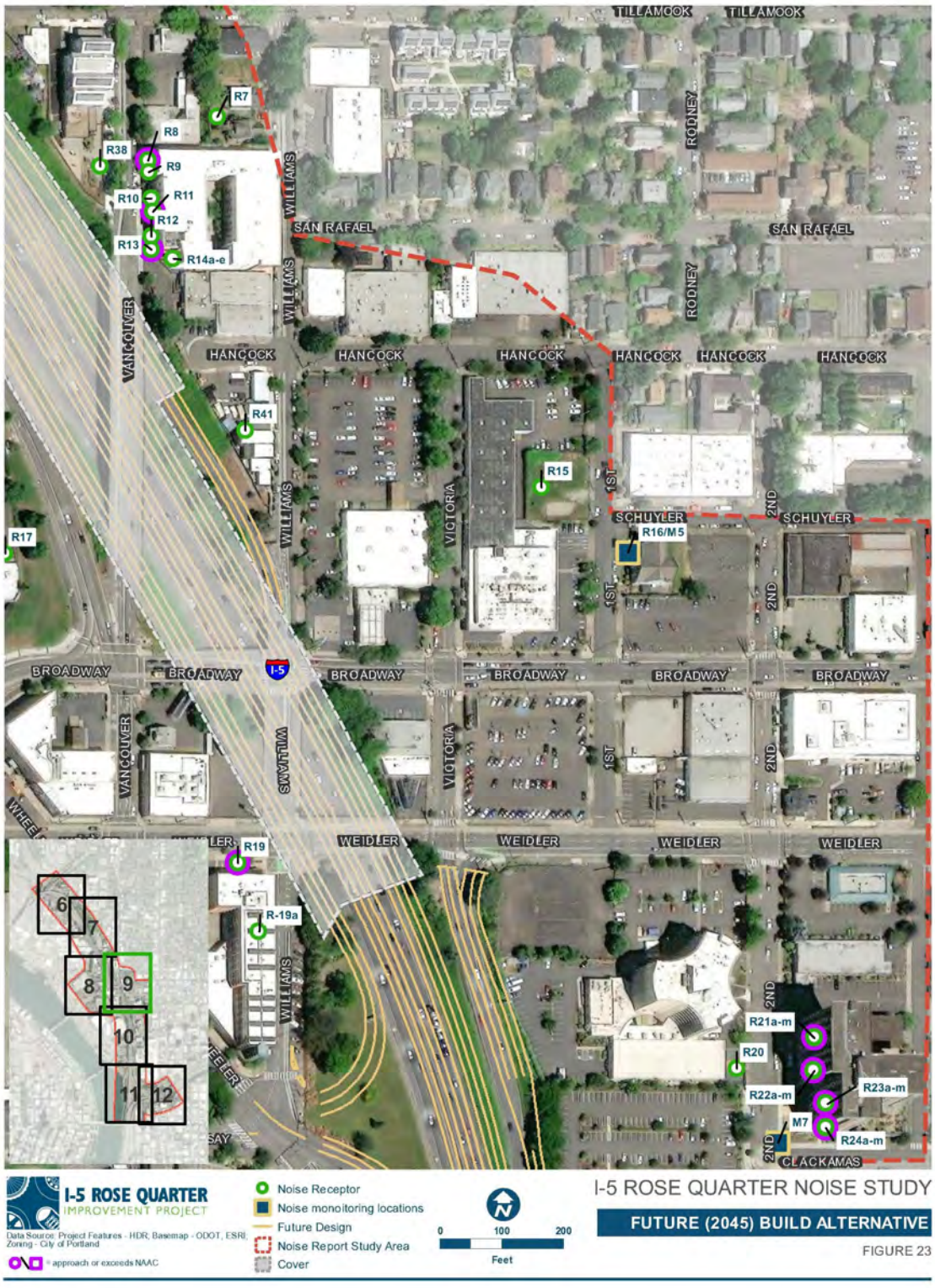


Figure 24. Revised Build Alternative Exceedances Map 5

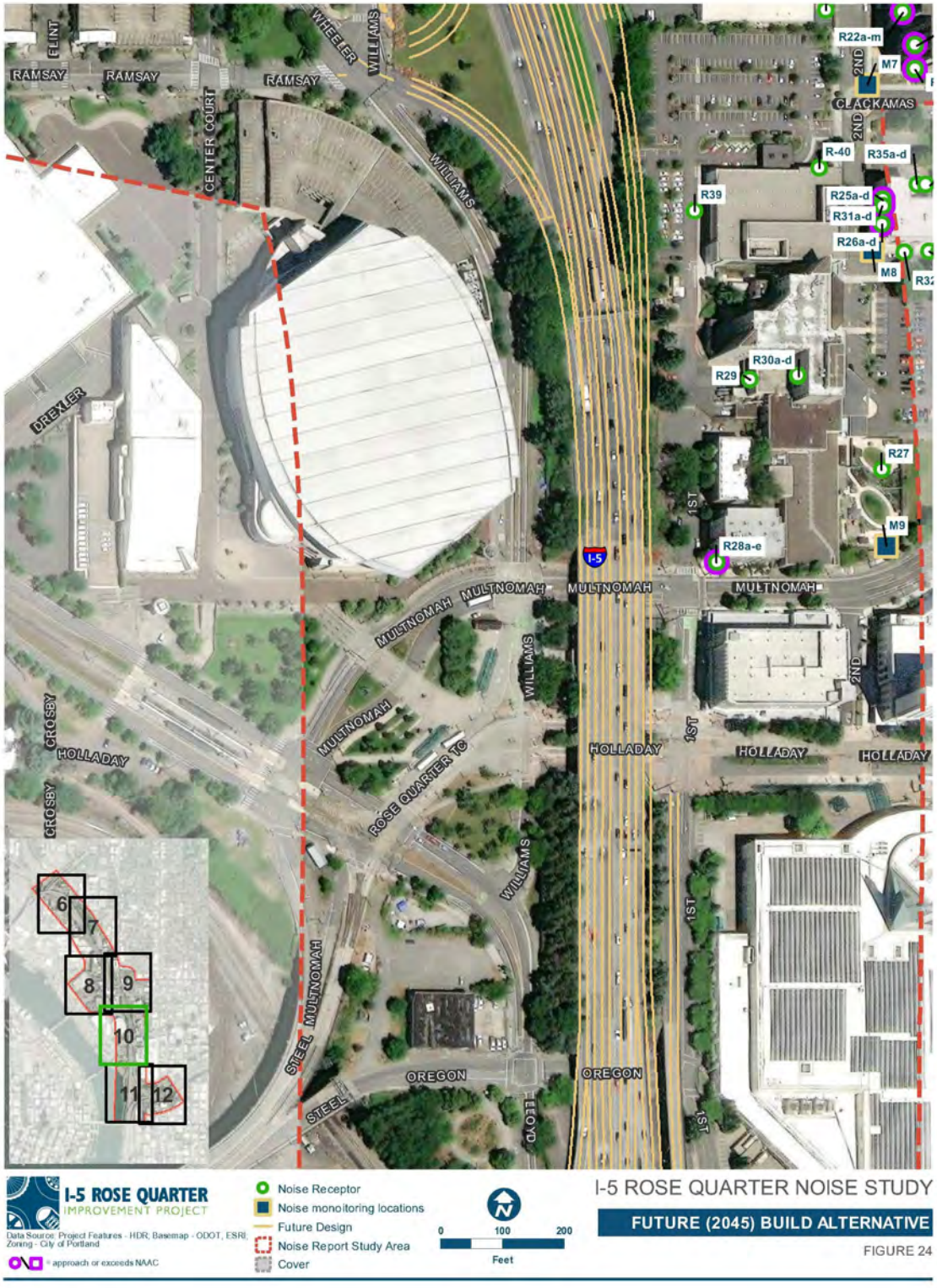
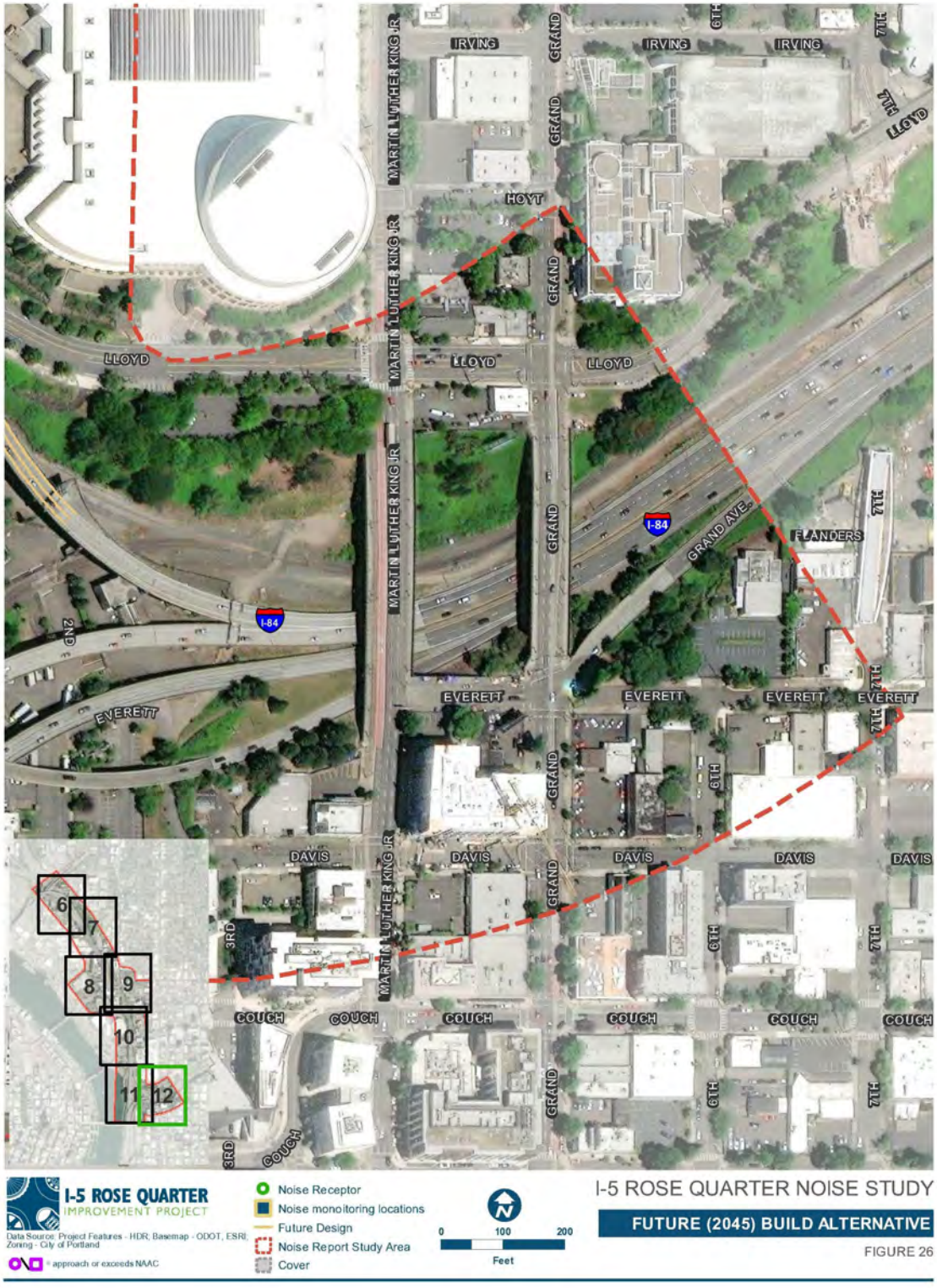


Figure 25. Revised Build Alternative Exceedances Map 6

Figure 26. Revised Build Alternative Exceedances Map 7



## 6.3 CONCLUSION

The Revised Build Alternative would have less noise impact than the No-Build Alternative. Specifically, the highway cover associated with the Revised Build Alternative would provide more shielding than the covers included in the Build Alternative. As a result, there would be 12 less residential exceedances and noise levels at the daycare would no longer exceed the NAAC. The Revised Build Alternative would impact the Harriett Tubman Middle School, which would not exceed the ODOT NAAC under the No-Build Alternative. Construction, indirect, and cumulative impact discussions for the No-Build and Revised Build alternatives would be the same as those included in the 2019 Noise Study Technical Report.

# 7.0 AVOIDANCE, MINIMIZATION, AND MITIGATION MEASURES

Construction noise mitigation would be the same as that documented in the 2019 Noise Study Technical Report. Operational noise mitigation, or abatement, would be different from that identified in the 2019 Noise Study Technical Report . The following subsections describe the revised operational noise mitigation.

## 7.1 OPERATIONAL NOISE MITIGATION

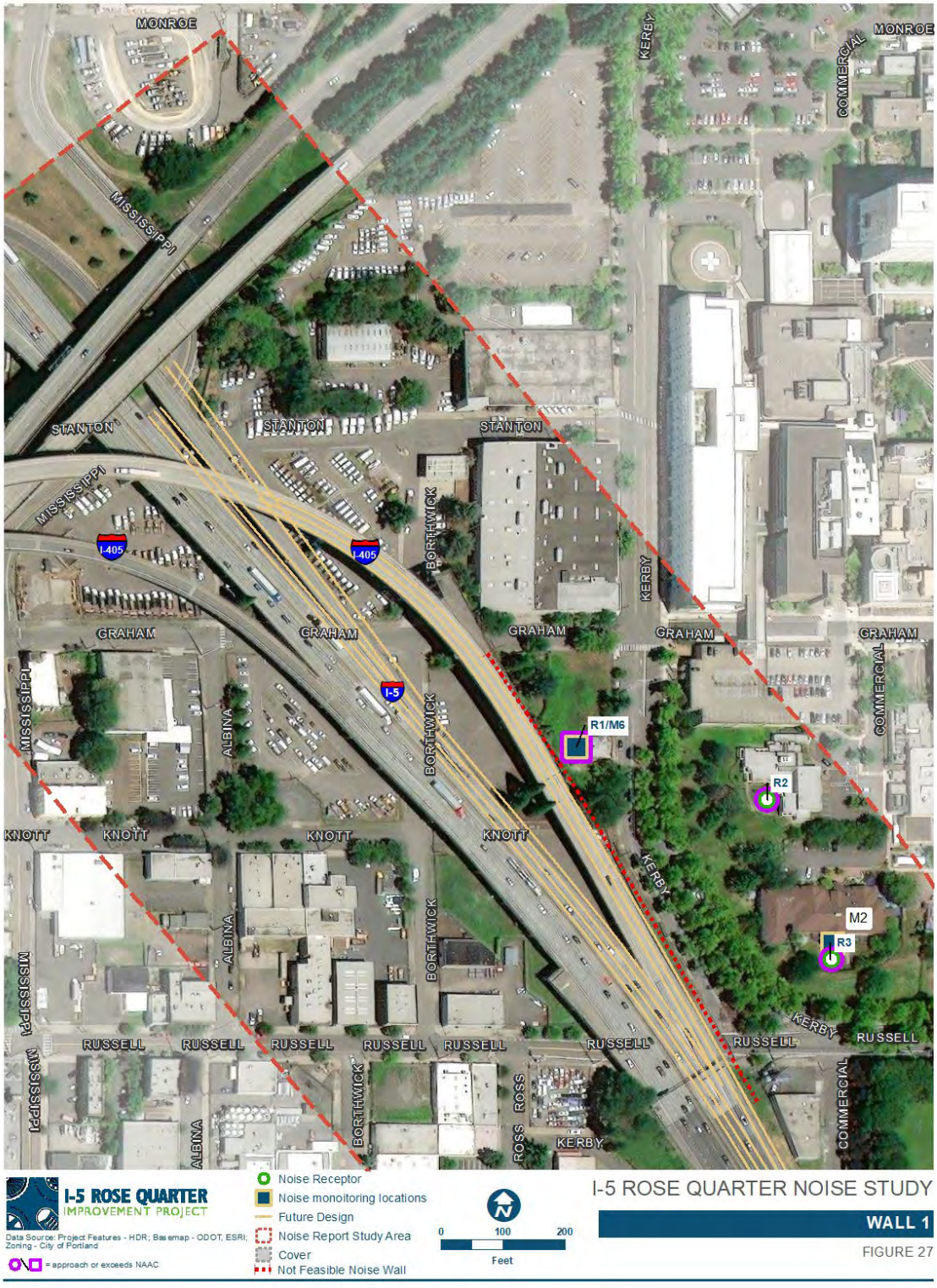
The 2019 Noise Study Technical Report evaluated six noise walls for operational noise mitigation. The operational mitigation analysis for the Revised Build Alternative considered the same six noise walls but updated the project geometry for the revised highway cover design and different on-ramp and off-ramp alignments. The analyses changed as documented in the subsections that follow. Appendix D provides the detailed tables for each of the walls analyzed.

### 7.1.1 Wall 1: Receivers 1 through 3

Receivers 1 through 3 represent one single-family residence and two medical facility outdoor use areas located east of I-5 adjacent to N Kerby Avenue. The equivalent residential receptor (ERR) for the two medical facility outdoor use areas was calculated assuming the same inputs as those in the 2019 Noise Study Technical Report (25 people using the outdoor areas for 2-hours per day). The ERR using these assumptions is 0.8 for each outdoor use area.

This study looked at an 825-foot-long noise barrier located on the I-5 to I-405 ramp structure to shield these receivers from freeway noise. Appendix D provides detailed information within Table D1 related to predicted wall performance (i.e., noise reductions due to the barrier [feasibility] and cost-effectiveness calculations based on the number of receptors benefitted [reasonableness]). Figure 27 is a map of the location of Wall 1. This study included wall heights between 10 and 16 feet for feasibility and reasonableness and shows that Wall 1 would not be able to achieve the minimum noise reduction goals and over 50-percent of the impacted receptors benefitted; therefore, the barrier would not be feasible and is not recommended for inclusion in the project. At heights taller than 16-feet, a barrier also would not be feasible and reasonable because, even if it would benefit all of the receptors, the barrier would be too costly to be found reasonable.

Figure 27. Revised Build Alternative Wall 1



### 7.1.2 Wall 2: Receivers 4 through 6

Receivers 4 through 6 represent one park (assumes 525 people use it 2 hours per day, or 17 ERRs), Harriet Tubman Middle School (interior NAAC D use, assumes 525 people using the school 7 hours per day, or 61 ERRs), and a single-family residence located east of I-5 adjacent to N Flint Avenue. The alignment of Wall 2 changed since it was analyzed in the 2019 Noise Study Technical Report to an alignment that is closer to I-5 in some areas. This new location is within the ODOT right-of-way and is a better location from a design perspective. Specifically, moving the wall closer to I-5 also allows for construction to occur from I-5 rather than from the non-highway side. Finally, the revised alignment also made it possible to site the wall on top of a retaining wall, which was identified for stability. In addition, engagement with Portland Public Schools indicated a preference to have the wall closer to the highway.

Additionally, relative to the noise wall evaluated in the 2019 Noise Study Technical Report, it is possible from this alignment to provide similar noise mitigation with a barrier shorter in height. Under the 2019 analysis, the elevations of the footing of the wall were unknown and it was assumed the footings would be at a similar height as that of the I-5 travel lanes. For the Revised Build Alternative, the design progressed and it is understood that the wall footings would be at a higher ground elevation than the I-5 travel lanes, which means that the wall can be shorter in height and achieve a similar top of wall height to what was included in the 2019 Noise Technical Report.

A 1,456-foot-long noise barrier was evaluated to shield these receivers from freeway noise. See Table D2 in Appendix D for details and Figure 28 for the location of Wall 2. The wall was analyzed for several different wall heights between 10 and 16 feet for feasibility and reasonableness and shows that Wall 2, at 12-feet in height, would achieve the minimum noise reduction goals, including one property with a design goal noise reduction of more than 7 dBA (in this case 10 dBA at R5) plus one additional benefitted property. The calculated cost of the mitigation ($7,795 per benefitted residence) is less than the allowable $37,500 per benefitted residence. Because the barrier would be feasible and reasonable, it is recommended for inclusion in the Project.

Figure 28. Revised Build Alternative Wall 2

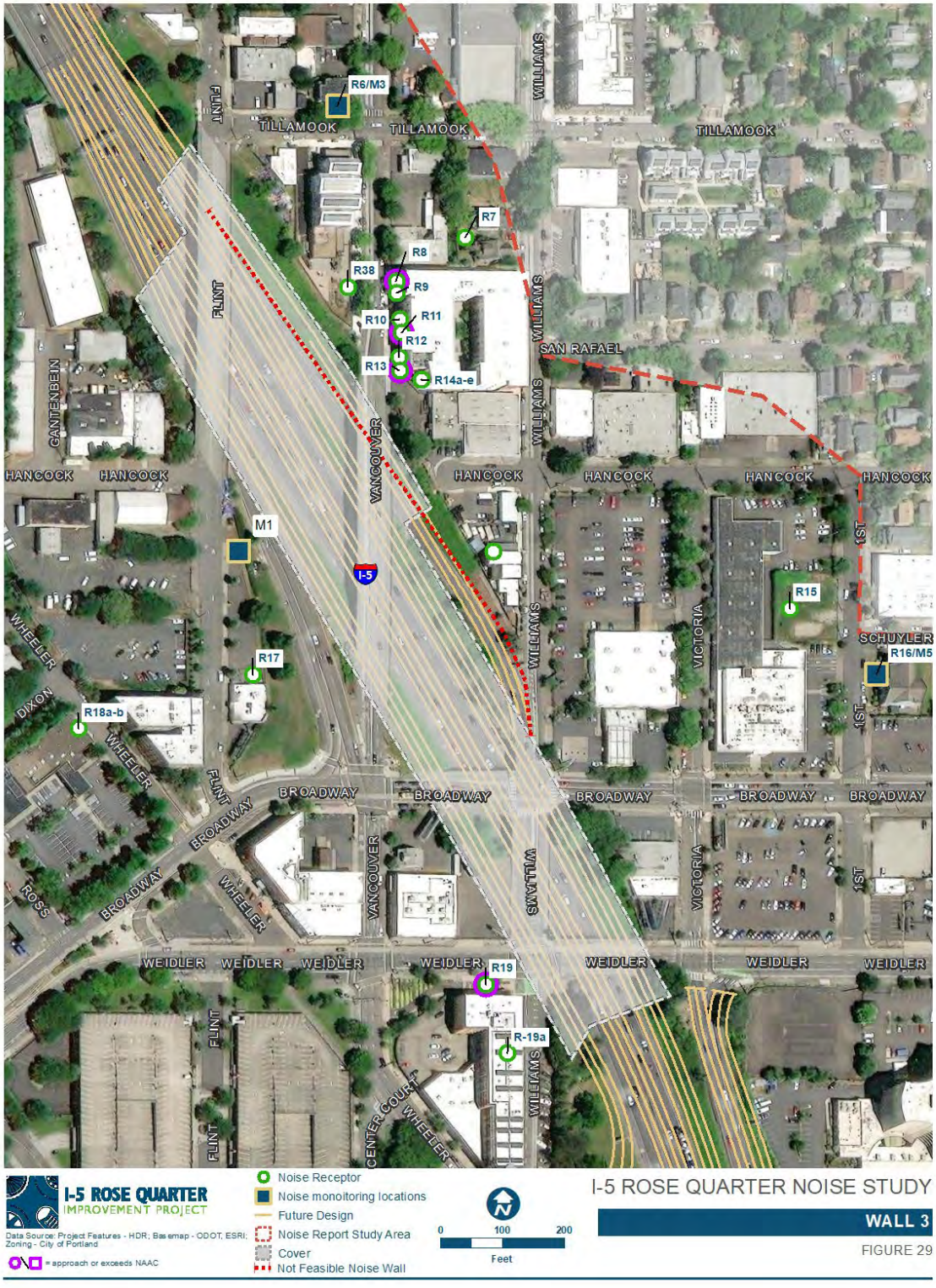
### 7.1.3 Wall 3: Receivers 7 through 14e

Receivers 7 through 14e represent 2 single-family residences and 11 balconies at residential units in multifamily buildings located east of I-5 adjacent to N Vancouver Avenue. Only three of the receptors would be impacted under the Revised Build Alternative (R8, R11 and R13). In the 2019 Noise Study Technical Report, Wall 3 was evaluated with Wall 2 to see if there would be benefits achieved from the walls as a system. Wall 3 was also analyzed individually in the 2019 Noise Study Technical Report. Under the Revised Build Alternative, the design is considerably different than the Build Alternative design at the Wall 3 location. Figure 29 depicts the Wall 3 alignment from the Build Alternative with the design of the Revised Build Alternative to illustrate why Wall 3 is no longer a feasible location for a noise barrier. Specifically, the highway cover would be part of the future conditions throughout the Wall 3 alignment.

Wall 3 was evaluated in the 2019 Noise Study Technical Report because there was a gap in the highway cover in this area; however, under the Revised Build Alternative the gap is removed. A noise barrier at this location under the Revised Build Alternative would provide minimal benefit because the cover would shield the noise from the highway. Wall 3 would not provide additional reduction sufficient to be feasible (i.e., 5 dB reduction at greater than 50% of impacted receptors); therefore, Wall 3 would not be feasible and is not recommended for inclusion in the Project.

Furthermore, the Revised Build Alternative analysis indicates that the highway cover would provide 7 dB to 9 dB reduction at impacted receptors relative to the No-Build Alternative conditions. Therefore, the project itself is predicted to provide benefit to the surrounding community.

Figure 29. Revised Build Alternative Wall 3



### 7.1.4 Wall 4: Receivers 20 through 30d

Receivers 20 through 30d represent 1 recreational area (a basketball court at the Crown Plaza hotel), 2 outdoor use areas medical facilities as well as 6 indoor uses, 104 balconies at residential units at the Calaroga Terrace building on the northeast corner of the intersection of NE Clackamas Street and NE 2nd Avenue, 36 balconies at residential units at a new mixed-use building constructed on the northeast corner of the intersection of NE Wasco Street and NE 2nd Avenue, and five balconies at residential units at the Milano Apartment Building located on the northeast corner of the intersection of NE Multnomah Street and NE 1st Avenue.

A 1,718-foot-long noise barrier (Wall 4a) with a height of 23-feet located immediately east of the edge of I-5 between NE Weidler Street and a point approximately 265 feet south of NE Holladay Street was evaluated to shield receivers in this area. The 2019 Noise Study Technical Report found that a noise barrier in this location would not provide benefit to the upper stories of multi-family high rise buildings and this finding remains true for this report since the design has not changed in this area significantly. As with the 2019 Noise Study Technical Report and consistent with Section 7.5.6 of the ODOT Noise Manual, this analysis does not exclude noise abatement for ground floor impacts because upper floors of these structures cannot benefit from abatement. Therefore, when determining whether a barrier could provide a 5 dBA reduction to a majority of benefitted receptors, higher floors of multi-family buildings that the barrier could not benefit were not counted as part of the total number of impacted receptors in this barrier analysis.

The wall analyzed (Wall 4a) follows a similar alignment as that analyzed in the 2019 Noise Study Technical Report. The 2019 Noise Study Technical Report analysis found that at a height of 23-feet, the wall would be feasible and reasonable. However, since publication of the 2019 Noise Study Technical Report, buildings have been developed between I-5 and sensitive receptors that provide shielding from the roadway noise along I-5. With these building elements present in the noise modeling, much of the impact conditions in the area are no longer predicted to be present under the Existing Conditions, No-Build Alternative, or Revised Build Alternative. This analysis found that the cost effectiveness criteria for reasonableness determination is not met because fewer receptors would benefit than the 2019 Noise Study Technical Report identified. Specifically, four of the seven impacted units would benefit, and there would be a total of 29 benefitted receptors (25 at non-impacted receptors). The cost of Wall 4a would be $1,418,775 and would cost $51,096 per benefitted residence. This is an amount that exceeds the reasonableness criteria for noise abatement. See Table D3 in Appendix D for details and Figure 30 for the location of Wall 4a.

The impacts from the Revised Build Alternative in this area would be focused near the I-5 overcrossing at NE Multnomah Street. To address these impacts, Wall 4b was analyzed with a shorter length (893-feet) and with heights ranging from 16-feet to 23-feet to determine if it

would be feasible and reasonable under the Revised Build Alternative. This study demonstrates that the wall can reduce noise impacts at the impacted receptors at 22-feet in height; however, the barrier would be too expensive to be cost reasonable. Specifically, three of the five impacted units in this area would benefit, and there would be a total of four benefitted receptors (one at a non-impacted receptor). The cost of Wall 4b would be $735,825 and would cost $183,956 per benefitted residence. This is an amount that exceeds the reasonableness criteria for noise abatement. See Table D4 in Appendix D for details and Figure 31 for the location of Wall 4b.

For the reasons discussed in this section Wall 4a or Wall 4b are not recommended for inclusion in the Project.

Figure 30. Revised Build Alternative Wall 4a

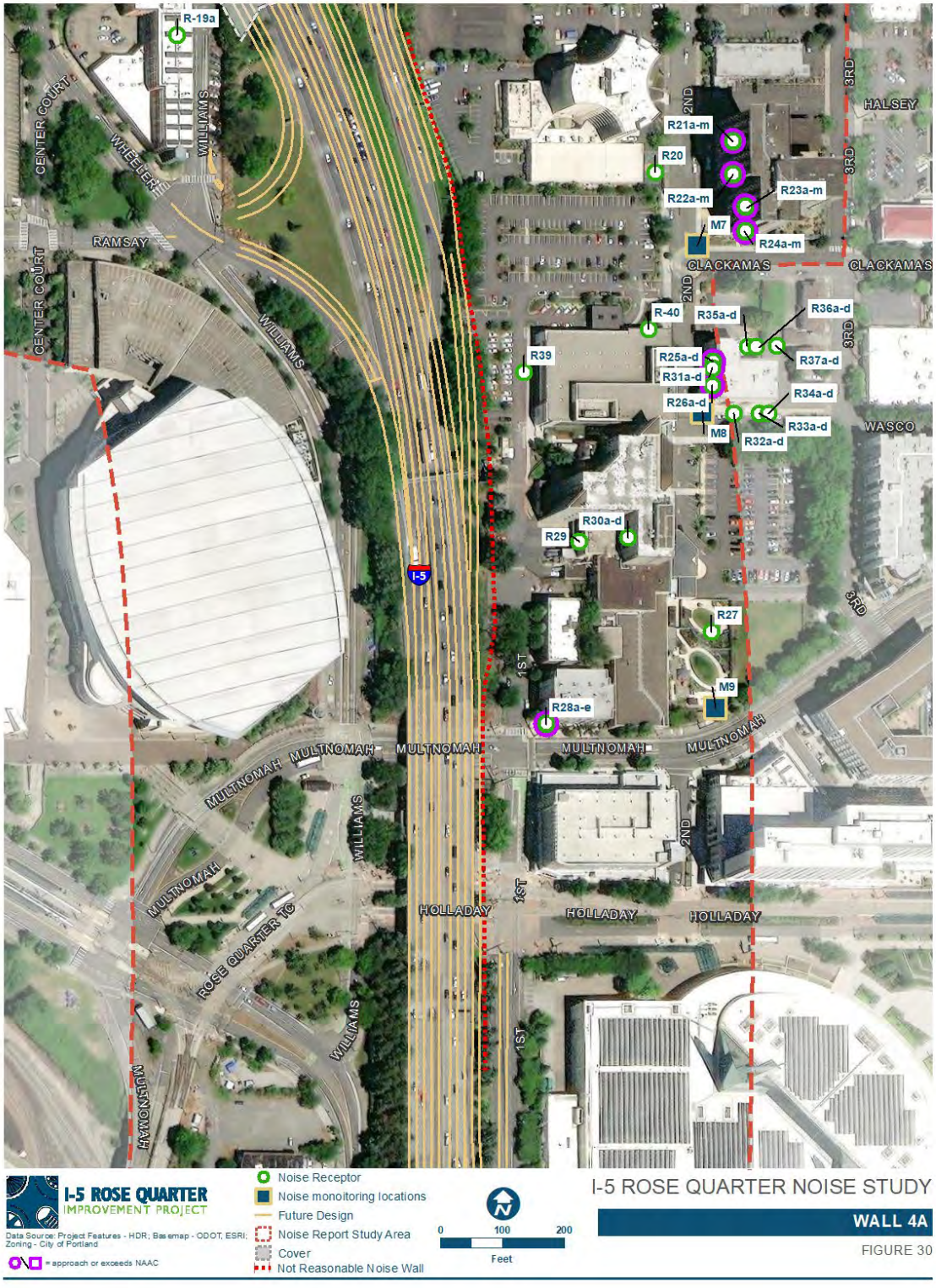
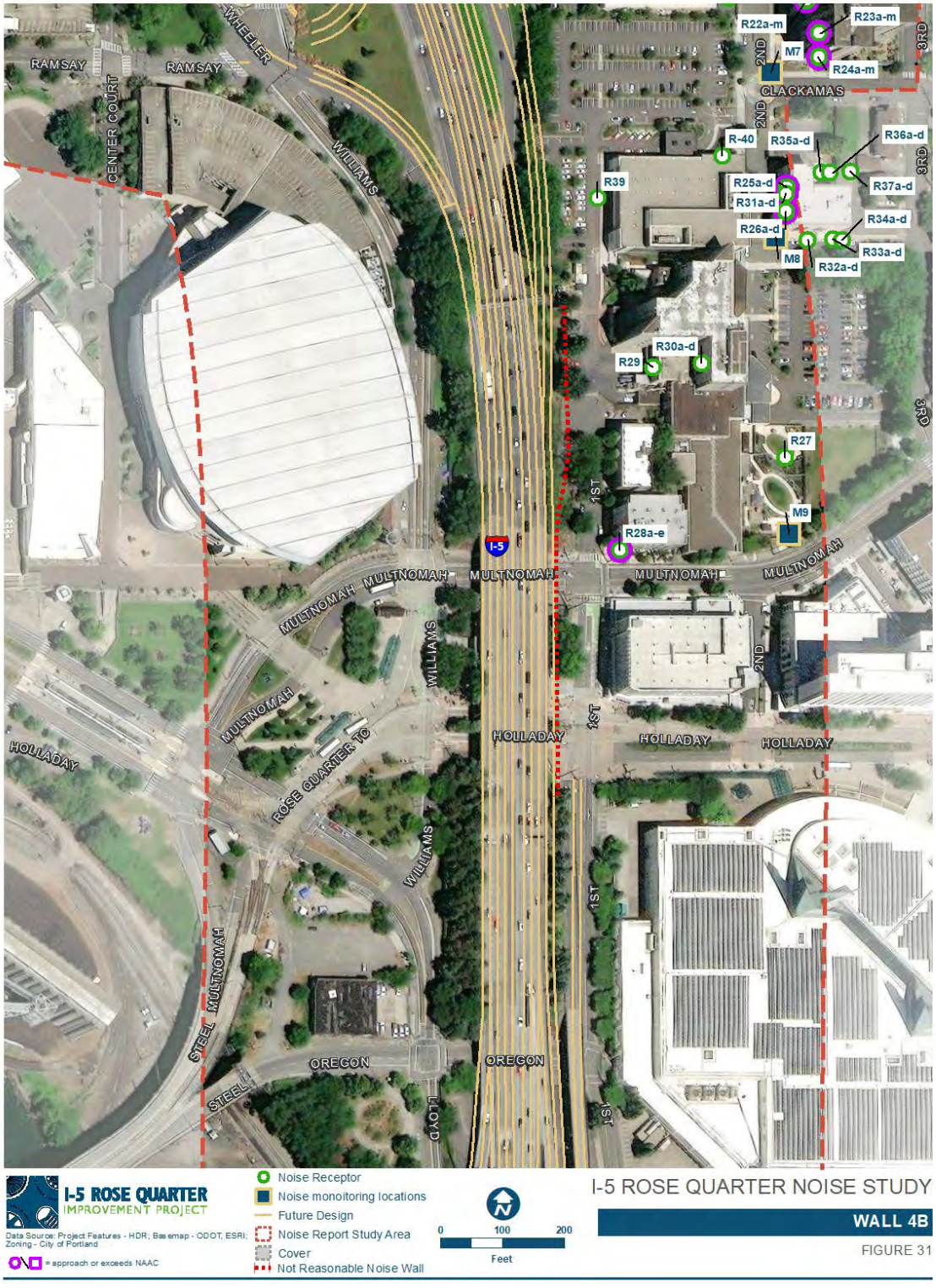


Figure 31. Revised Build Alternative Wall 4b



### 7.1.5 Wall 5: Receiver 17, Receiver 18a and Receiver 18b

Unlike the Build Alternative, receiver 17 would not be impacted by traffic noise under the Revised Build Alternative. Since there were no impacted receptors at this location, Wall 5 was not evaluated to provide noise mitigation.

### 7.1.6 Wall 6: Receiver 19 and 19a

Since the publication of the Revised Build Alternative, the land use determination at R19 was adjusted with the Hooper Detox Stabilization Center (R19a) only located at the ground floor. The remaining floors are part of an apartment building (Madrona Studios). The apartments have no outdoor use except for a public bench at the entrance to the apartments. R19a would not be impacted but R19 would be impacted. A noise wall cannot be constructed to block the line of sight from R19 to the busy roadways without cutting off access to the parking. Noise walls with gaps cannot feasibly reduce noise levels since the gap would allow noise to pass through unobstructed. For this reason, a noise wall is at this location not recommended for inclusion in the Project.

### 7.1.7 Wall for Receiver 101

ODOT prepared a noise technical memo (ODOT 2019b) to document the traffic noise analysis at R101, the Eastbank Esplanade Section 4(f) receptor (NAAC C), because the 2019 Noise Study Technical Report did not include this receptor. The 2019 memo describes the qualitative analysis of a noise wall to reduce noise levels at R101. This analysis updates the analysis in the 2019 memo to reflect the ODOT policy changes for NAAC C receptors. The same assumptions are used in this analysis as were used in the 2019 memo, i.e., people spend 136 seconds on average in the area of the Eastbank Esplanade protected by the hypothetical R101 wall. The calculated ERRs for R101 is 2. This comes from using the following assumptions in the ERR equation below:

# of persons per day (observed and extrapolated in 2019 memo) = 3,816 people

Average daily hours use per person (136 seconds per person): 0.0377778 hours

$$ERR = \left(\frac{\#Persons}{2.51\ Persons/Household}\right) x \left(\frac{Average\ Daily\ Hours\ Use}{24\ hours\ per\ Day}\right)$$

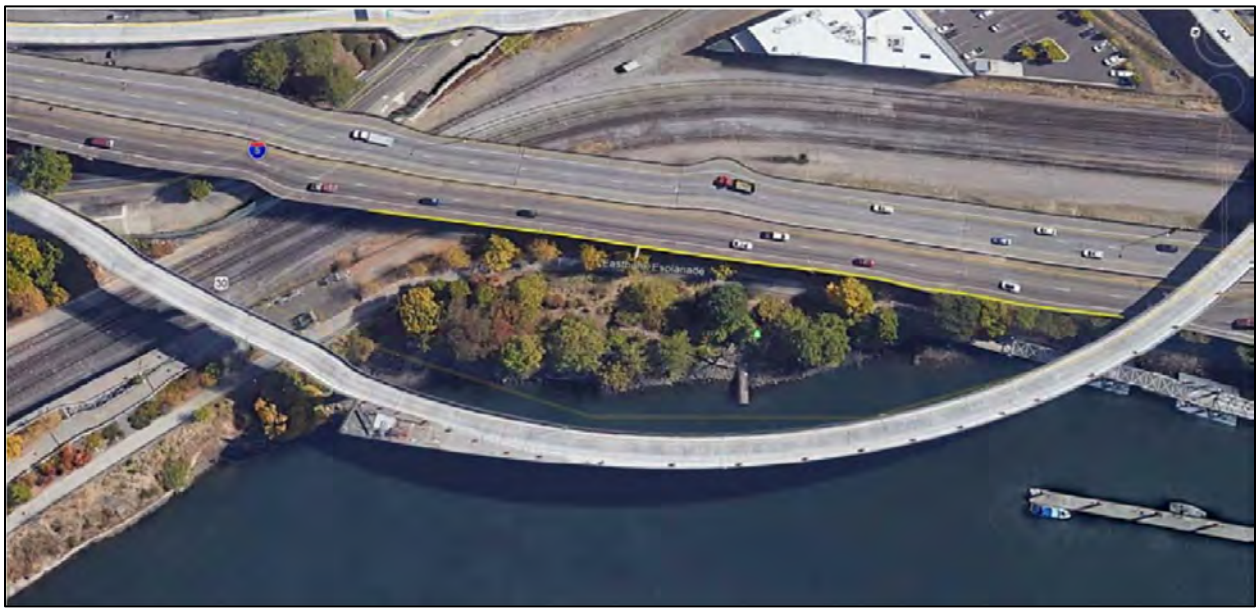
The resultant ERR of 2.39 multiplied by the maximum per benefitted residence amount of $52,000 equates to an allowable cost of $124,441. The hypothetical noise wall analyzed in the memo was 600 feet long and 10 feet tall. A barrier of this height and length would have a square footage of 6,000 and at $52.00 per square foot would cost $180,000. This is an amount

that is larger than the allowable cost of $124,441. Therefore, this noise wall is not recommended for inclusion in the Project.

The additional reasons why a more detailed analysis was not conducted remain unchanged relative to what was analyzed in the 2019 memo and can be summarized as:

- Since the Eastbank Esplanade is a trail that runs parallel to the highway, a barrier along I-5 southbound designed to reduce sound levels for the esplanade would have to be very long, and thus expensive.
- People using the Eastbank Esplanade are in most cases, moving along the trail and not spending time in one place.
- A barrier along I-5 southbound would do nothing to reduce train noise as that noise would still pass underneath I-5.
- A barrier along I-5 southbound would do nothing to reduce traffic noise from the I-5 southbound to I-84 eastbound ramp.
- A barrier along I-5 southbound would cast a shadow on the Esplanade which could be considered undesirable.

Figure 32. Hypothetical Noise Wall for R101 from 2019 ODOT Memo



## 7.2 UNAVOIDABLE IMPACTS

Complex noise environmental, topography, and the presence of above the ground floor receivers make effective noise abatement challenging within the API. Summaries of the evaluated noise barriers show that they do not meet ODOT's criteria for feasibility and/or reasonableness. As a result, fifty-one receivers representing 86 residential receptors, 2 medical facility outdoor use areas, 2 parks and 1 interior use at Harriet Tubman Middle School are predicted to meet or exceed the ODOT NAAC for the Revised Build Alternative.

## 7.3 STATEMENT OF LIKELIHOOD

Based on this noise study, ODOT intends to install highway traffic noise abatement measures in the form of a noise barrier (Wall 2) located east of I-5 adjacent to N Flint Avenue. The alignment of Wall 2 changed since it was analyzed in the 2019 Noise Study Technical Report to an alignment that is closer to I-5 in some areas. This noise wall was judged to be acoustically feasible by meeting the design goal of at least a 7 dBA reduction at one receiver, as well as achieving a better than 50% rate of benefits (at least a 5dBA noise reduction) at impacted receivers in the vicinity. In addition, the wall would be reasonable based upon the ODOT cost effectiveness requirements and is therefore recommended for further consideration. Further evaluation of feasibility and reasonableness would be made during final design, including a more detailed analysis of constructability, as well as the viewpoints of affected property owners and residents. The possibility of likely abatement measures is based upon preliminary design work for barriers. The calculated cost of the mitigation ($7,795 per benefitted residence) is less than the allowable $37,500 per benefitted residence. Because the barrier would be feasible and

reasonable, it is recommended for inclusion in the project. Wall 2 has one property with a design goal noise reduction of more than 7 dBA (in this case 10 dBA at R5) plus one additional benefitted property. If during ODOT's final design process these conditions have substantially changed, the abatement measures might not be provided. A final decision of the installation of the abatement measure(s) would be made upon completion of the project's final design, a cost estimating process, constructability review, and the public involvement processes.

# 8.0 PREPARERS

| NAME | DISCIPLINE | EDUCATION | YEARS OF EXPERIENCE |
|---|---|---|---|
| Scott Noel, AICP INCE | Noise | • BA Geography and Environmental Planning | 22 |
| Dillon Tannler | Noise | • BS Environmental Economic, Policy, & Management | 11 |
| Joseph Czech, PE | Noise | • BS Aeronautical Engineering | 34 |

# 9.0 REFERENCES


NCHRP (National Cooperative Highway Research Program). 2014. Supplemental Guidance on the Application of FHWA's Traffic Noise Model, Report 791. Transportation Research Board of the National Research Council.

ODOT (Oregon Department of Transportation).

2011. Noise Manual. July 2011.

2019a. I-5 Rose Quarter Noise Study Technical Report. January 2019.

2019b. I-5 Rose Quarter Esplanade Analysis Memorandum. May 2019.

2020. Manual Interim Update (June 2020). June 2020.

2021. Manual Interim Update (July 2021). July 2021

# Appendix A. Ambient Field Data Sheets, Photos, and Calibration Certificates

### *M7 – Photo of view to the north*

### *M7 – Photo of view to the south*

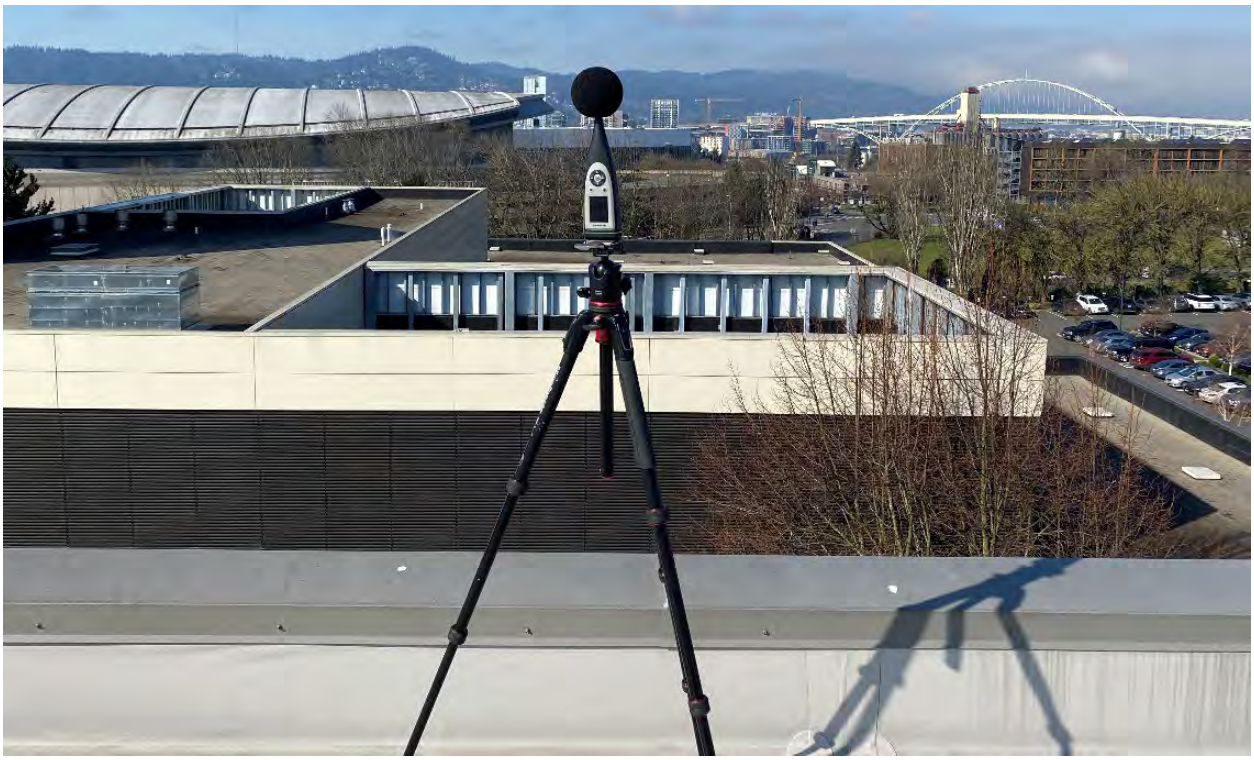
### *M7 – Photo of view to the east*

### *M7 – Photo of view to the west*

### *M8 – Photo of view to the northwest*

### *M8 – Photo of view to the south*

### *M8 – Photo of view to the west*



### *M9 – Photo of view to the south*

### *M9 – Photo of view to the east*

### *M9 – Photo of view to the west*

HARRIS MILLER MILLER & HANSON INC.

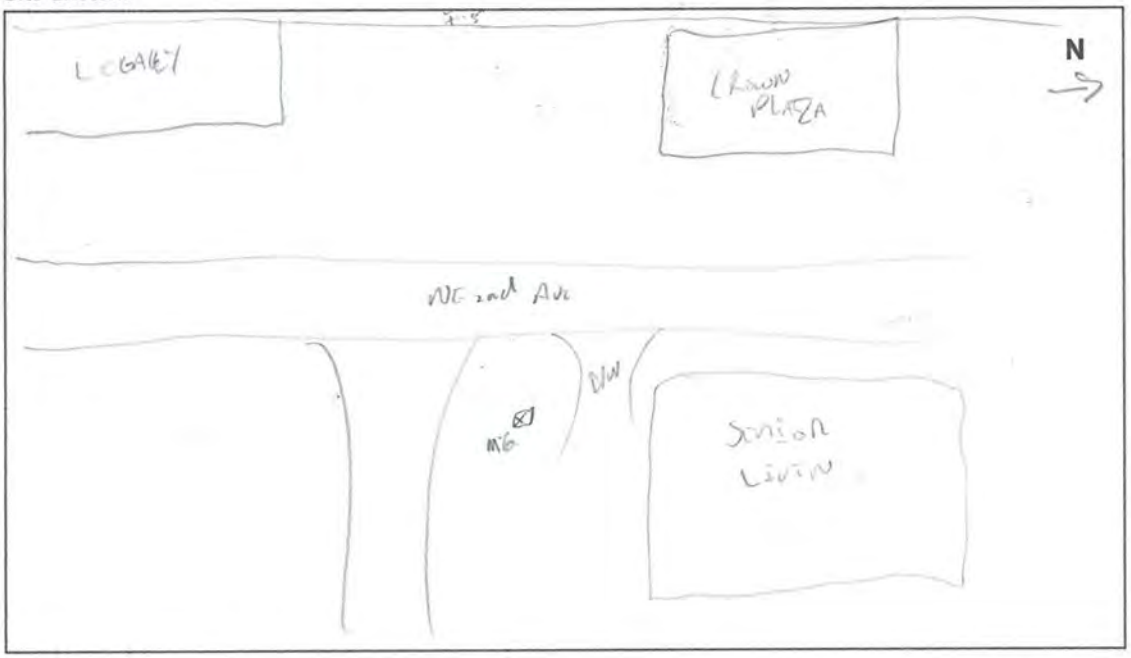
Project: I5RQ
Job Num: 310710
Personnel: SN/SP

**Monitoring Site Log**

Site Number: M7
Street Address: 1400 NE 2nd Ave
Owner/Description: Pacifica Senior Living
Noise/Vibe Sources: I-5 + Local Roads Dominant, occasional bird chirping

Instrument: 2245 S/N: 1.1 6
Front End: ↓ S/N: |
Calibrator: ↓ S/N: ↓
Start Date: 3/7/2022 End Date: 3/7/2022
Start Time: 10:00am End Time: 10:15am
Calibration: Start: 94 End: 94

**Site Sketch:**




**Weather Conditions:** Sunny, cool, no wind

**GPS Coordinates:**

**Photo Numbers:**



I-5 ROSE QUARTER IMPROVEMENT PROJECT

PROJECT: I5 RQ
JOB NO.: 310710

# TRAFFIC VOLUME COUNT DATA SHEET

ASSESSMENT AREA: M7
MEASUREMENT SITE NO.: N6
ADDRESS/DESCRIPTION: PACIFIC SOUTH LANE 1400 NE 2nd AVE

START TIME: 10:00am
END TIME: 10:15am
DATE: 3/7/22
PERSONNEL: SN/SP

**ROADWAY:** _____

| | DIRECTION 1: NB | DIRECTION 2: SB |
|---|---|---|
| **First Sample: 15 minutes** **Start Time:** _____ | I-5 | |
| Automobiles | 577 | 524 |
| Medium Trucks (6 Tires) | 40 | 39 |
| Heavy Trucks (>6 Tires) | 106 | 73 |
| **Average speed (mph)** | 45-60 | 45-60 |
| **Second Sample: 15 minutes** **Start Time:** _____ | I-5 NB OFF | |
| Automobiles | 142 | |
| Medium Trucks (6 Tires) | 2 | |
| Heavy Trucks (>6 Tires) | 1 | |
| **Average speed (mph)** | 30 | |
| **Third Sample: 15 minutes** **Start Time:** _____ | I-5 SB ON | |
| Automobiles | | 253 |
| Medium Trucks (6 Tires) | | 2 |
| Heavy Trucks (>6 Tires) | | 3 |
| **Average speed (mph)** | | 30-55 |
| **Fourth Sample: _____ minutes** **Start Time:** _____ | | |
| Automobiles | | |
| Medium Trucks (6 Tires) | | |
| Heavy Trucks (>6 Tires) | | |
| **Average speed (mph)** | | |

HARRIS MILLER MILLER & HANSON INC.

HARRIS MILLER MILLER & HANSON INC.

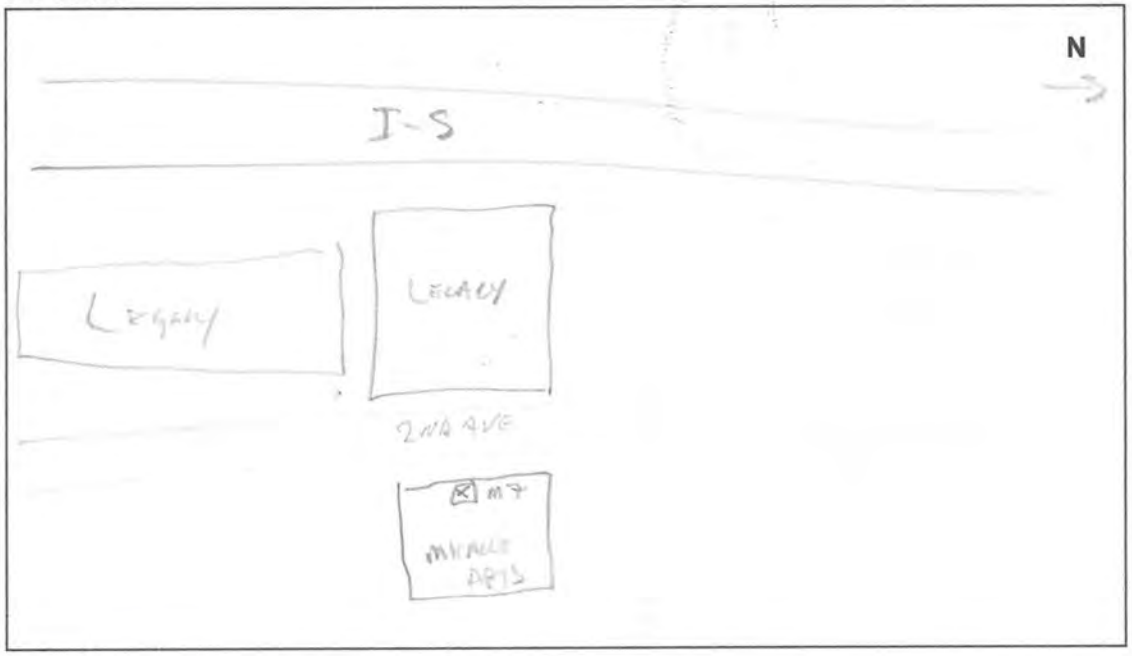
Project: ISRQ
Job Num: 310710
Personnel: SW/SP

**Monitoring Site Log**

Site Number: M8
Street Address: 806 NE 2nd AVE
Owner/Description: Miracle Apartments R25 + R26
Noise/Vibe Sources: I-5 Local streets
Some Noise from ROOFTOP HVAC at Legacy

Instrument: 2245 S/N: Kit 6
Front End: S/N:
Calibrator: S/N:
Start Date: 3/7/22 End Date: 3/7/22
Start Time: 10:23a End Time: 10:38a
Calibration: Start: 94 End: 94

**Site Sketch:**




**Weather Conditions:** Sunny no wind

**GPS Coordinates:**

**Photo Numbers:** No Access to Unit balcony so limit door provided access to ROOFTOP



I-5 ROSE QUARTER IMPROVEMENT PROJECT

PROJECT: I5R Q
JOB NO.: 210710

# TRAFFIC VOLUME COUNT DATA SHEET

| | | | |
|---|---|---|---|
| ASSESSMENT AREA: | M8 | START TIME: | 10.23a |
| MEASUREMENT SITE NO.: | M7 | END TIME: | 10:38a |
| ADDRESS/DESCRIPTION: | Miracle Auto. | DATE: | 3/7/22 |
| | | PERSONNEL: | SN/SP |

| ROADWAY: | I-5 | DIRECTION 1: NB | DIRECTION 2: SB |
|---|---|---|---|
| **First Sample:** 15 **minutes** | | | |
| **Start Time:** 10:23a | | | |
| Automobiles | | 529 | 579 |
| Medium Trucks (6 Tires) | | 33 | 39 |
| Heavy Trucks (>6 Tires) | | 54 | 70 |
| **Average speed (mph)** | | 45-60 | 45-60 |
| **Second Sample:** 15 **minutes** | I5 NB Off ramp | | |
| **Start Time:** 10:23a | | | |
| Automobiles | | 166 | |
| Medium Trucks (6 Tires) | | 3 | |
| Heavy Trucks (>6 Tires) | | 4 | |
| **Average speed (mph)** | | 30 | |
| **Third Sample:** 15 **minutes** | I5 SB on | | |
| **Start Time:** 10:23 | | | |
| Automobiles | | | 183 |
| Medium Trucks (6 Tires) | | | 4 |
| Heavy Trucks (>6 Tires) | | | 3 |
| **Average speed (mph)** | | | 30-55 |
| **Fourth Sample:** ____ **minutes** | | | |
| **Start Time:** | | | |
| Automobiles | | | |
| Medium Trucks (6 Tires) | | | |
| Heavy Trucks (>6 Tires) | | | |
| **Average speed (mph)** | | | |

HARRIS MILLER MILLER & HANSON INC.

**HARRIS MILLER MILLER & HANSON INC.**

Project: I5 RQ
Job Num: 310710
Personnel: SW/SP

## Monitoring Site Log

Site Number: M9
Street Address: 1225 NE 2nd AVE
Owner/Description: LEGACY BEHAVIORAL HEALTH
Noise/Vibe Sources: I5/Local Roads
Distant construction; Distant Banging dogs

Instrument: 2245 S/N: K:1 G
Front End: ↓ S/N: ↓
Calibrator: ↓ S/N: ↓
Start Date: 3/7/22 End Date:
Start Time: 10:44a End Time: 10:59a
Calibration: Start: 94 End: 94

**Site Sketch:**


**Weather Conditions:**

**GPS Coordinates:**

**Photo Numbers:** Could not access Rehab area because one needs to be a credentialed Medical provider.



I-5 ROSE QUARTER IMPROVEMENT PROJECT

PROJECT: I5R8
JOB NO.: 310710

# TRAFFIC VOLUME COUNT DATA SHEET

ASSESSMENT AREA: M9
MEASUREMENT SITE NO.: M8
ADDRESS/DESCRIPTION: LEGACY

START TIME: 10:44
END TIME: 11:08 PARCP
DATE: 3/7/2022
PERSONNEL: SM/SP

| ROADWAY: | | DIRECTION 1: | DIRECTION 2: |
|---|---|---|---|
| First Sample: 15 minutes, Start Time: 10:44 | I-5 | NB | SB |
| | Automobiles | 689 | 875 |
| | Medium Trucks (6 Tires) | 38 | 30 |
| | Heavy Trucks (>6 Tires) | 94 | 94 |
| | **Average speed (mph)** | 45-60 | 45-60 |
| Second Sample: 15 minutes, Start Time: 10:44 | I5 NB off | | |
| | Automobiles | 175 | X |
| | Medium Trucks (6 Tires) | 2 | X |
| | Heavy Trucks (>6 Tires) | - | X |
| | **Average speed (mph)** | 30 | X |
| Third Sample: 15 minutes, Start Time: 10:44 | Multnomah | EB | WB |
| | Automobiles | 17 | 20 |
| | Medium Trucks (6 Tires) | 1 1-Bus | 1 1-Bus |
| | Heavy Trucks (>6 Tires) | - | - |
| | **Average speed (mph)** | 20-25 | 20-25 |
| Fourth Sample: 15 minutes, Start Time: 10:44 | I-5 SB on | | |
| | Automobiles | X | 223 |
| | Medium Trucks (6 Tires) | X | 2 |
| | Heavy Trucks (>6 Tires) | X | 2 |
| | **Average speed (mph)** | X | 30-45 |

HARRIS MILLER MILLER & HANSON INC.

The Hottinger Bruel & Kjaer Calibration Laboratory
3079 Premiere Parkway Suite 120
Duluth, GA 30097
Telephone: 770/209-6907
Fax: 770/447-4033
Web site address: http://www.hbkworld.com

Calibration Certificate Number 1568.01

# CERTIFICATE OF CALIBRATION

Certificate No: CAS-503571-R3Z9B7-302



## CALIBRATION OF:

| | | | |
|---|---|---|---|
| Sound Level Meter: | Brüel & Kjær | 2245 | Serial No: 100486 |
| Microphone: | Brüel & Kjær | 4966 | Serial No: 3236858 |
| Supplied Calibrator: | Brüel & Kjær | 4231 | Serial No: 3025172 |
| Software version: | 1.1.2.386 | | |

## CLIENT:

Harris Miller Miller & Hanson Inc.
700 District Avenue Suite 800
Burlington, MA 01803

## CALIBRATION CONDITIONS:

Preconditioning: 4 hours at 23 ± 3 °C

Environment conditions See actual values in Environmental Condition sections

## SPECIFICATIONS:

This document certifies that the instrument as listed under "Model/Serial Number" has been calibrated and unless otherwise indicated under "Final Data", meets acceptance criteria as prescribed by the referenced Procedure. The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor *k* = 2 providing a level of confidence of approximately 95%. Statements of compliance, where applicable, are based on calibration results falling within specified criteria with no reduction by the uncertainty of the measurement. The calibration of the listed instrumentation, was accomplished using a test system which conforms with the requirements of ISO/IEC 17025, ANSI/NCSL Z540-1, and ISO 10012-1. For "as received" and/or "final" data, see the attached page(s). Items marked with one asterisk (*) are not covered by the scope of the current A2LA accreditation This Certificate and attached data pages shall not be reproduced, except in full, without the written approval of the Hottinger Brüel & Kjær Calibration Laboratory-Duluth, GA. Results relate only to the items tested. This instrument has been calibrated using Measurement Standards with values traceable to the National Institute of Standards and Technology, National Measurement Institutes or derived from natural physical constants.

## PROCEDURE:

Hottinger Brüel & Kjær Model 3630 Sound Level Meter Calibration System Software 7763 Version 8.1 - DB: 8.10 Test Collection 2245-4966.

## RESULTS:

| As Received Condition | As Received Data | Final Data |
|---|---|---|
| _X_ Received in good condition | _X_ Within acceptance criteria | _X_ Within acceptance criteria |
| ___ Damaged - See attached report | ___ Outside acceptance criteria | ___ Limited test - See attached details |
| | ___ Inoperative | |
| | ___ Data not taken | |

Date of Calibration: Mar. 15. 2021

Certificate issued: Mar. 15. 2021

Kyle Chancey

Calibration Technician

Harold Williams

Quality Representative

The Hottinger Brüel & Kjær Inc. Calibration Laboratory
3079 Premiere Parkway Suite 120
Duluth, GA 30097
Telephone: 770-209-6907
Fax: 770-447-4033
Web site address: http://www.hbkworld.com

**Calibration Certificate # 1568.01**

## CERTIFICATE OF CALIBRATION

No.: CAS-503571-R3Z9B7-902



## CALIBRATION OF:

Microphone: Brüel & Kjær Type 4966 Serial No. 3236858

## CUSTOMER:

Harris Miller Miller & Hanson, Inc
700 District Ave, Ste 800
Burlington, MA 01803

## CALIBRATION CONDITIONS:

| | | | |
|---|---|---|---|
| Environment conditions: | Air temperature: | 23 | °C |
| | Air pressure: | 98.195 | kPa |
| | Relative Humidity: | 35 | %RH |
| Applied polarization voltage: | 0 Vdc | | |

## SPECIFICATIONS:

This document certifies that the instrument as listed under "Type" has been calibrated and unless otherwise indicated under "Final Data", meets acceptance criteria as prescribed by the referenced Procedure. Statements of compliance, where applicable, are based on calibration results falling within specified criteria with no reduction by the uncertainty of the measurements. The calibration of the listed transducer was accomplished using a test system which conforms to the requirements of ISO/IEC 17025, ANSI/NCSL Z540-1, and guidelines of ISO 10012-1. For "as received" and "final" data, see the attached page(s). Items marked with one asterisk (*) are not covered by the scope of the current A2LA accreditation. This Certificate and attached data pages shall not be reproduced, except in full, without written approval of the Hottinger Brüel & Kjær Calibration Laboratory-Duluth, GA. Results relate only to the items tested. The transducer has been calibrated using Measurement Standards with values traceable to the National Institute of Standards and Technology, National Measurement Institutes or derived from natural physical constants.

## PROCEDURE:

The measurements have been performed with the assistance of the Hottinger Brüel & Kjær Inc. Microphone Calibration System B&K 9721 with application software WT9649 and WT9650 version 5.3.0.10 using calibration procedure: 4966 S251-FR01

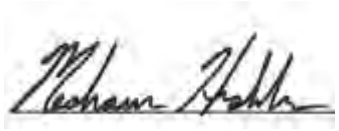
## RESULTS:

- [X] "As Received" Data: Within Acceptance Criteria
- [ ] "As Received" Data: Outside Acceptance Criteria
- [X] "Final" Data : Within Acceptance Criteria
- [ ] "Final" Data : Outside Acceptance Criteria

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k$ =2 providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from standards, calibration method, effect of environmental conditions and any short term contribution from the device under calibration.

Date of Calibration: 16 March, 2021

Certificate issued: 16 March, 2021



Harold Williams
Calibration Technician

Meshaun Hobbs
Quality Representative

The Hottinger Brüel & Kjær Inc. Calibration Laboratory
3079 Premiere Parkway Suite 120
Duluth, GA 30097
Telephone: 770-209-6907
Fax: 770-447-4033
Web site address: http://www.hbkworld.com

**Calibration Certificate # 1568.01**

## CERTIFICATE OF CALIBRATION

No.: CAS-503571-R3Z9B7-401



## CALIBRATION OF:

| | | | | | |
|---|---|---|---|---|---|
| Calibrator: | Brüel & Kjær | Type | 4231 | Serial No.: | 3025172 |
| | | IEC Class: | 1 | | |

## CUSTOMER:

Harris Miller Miller & Hanson, Inc
700 District Ave, Ste 800
Burlington, MA 01803

## CALIBRATION CONDITIONS:

| | | | |
|---|---|---|---|
| Environment conditions: | Air temperature: | 23 | °C |
| | Air pressure: | 97.987 | kPa |
| | Relative Humidity: | 34 | %RH |

## SPECIFICATIONS:

This document certifies that the acoustic calibrator as listed under "Type" has been calibrated and unless otherwise indicated under "Final Data", meets acceptance criteria as prescribed by the referenced Procedure. Statements of compliance, where applicable, are based on calibration results falling within specified criteria with no reduction by the uncertainty of the measurements. The calibration of the listed transducer was accomplished using a test system which conforms to the requirements of ISO/IEC 17025, ANSI/NCSL Z540-1, and guidelines of ISO 10012-1. For "as received" and "final" data, see the attached page(s). Items marked with one asterisk (*) are not covered by the scope of the current A2LA accreditation. This Certificate and attached data pages shall not be reproduced, except in full, without written approval of the Hottinger Brüel & Kjær Inc. Calibration Laboratory-Duluth, GA. Results relate only to the items tested. The transducer has been calibrated using Measurement Standards with values traceable to the National Institute of Standards and Technology, National Measurement Institutes or derived from natural physical constants. The acoustic calibrator has been calibrated in accordance with the requirements as specified in IEC60942.

## PROCEDURE:

The measurements have been performed with the assistance of Hottinger Brüel & Kjær Inc. acoustic calibrator calibration application
Software version 2.3.4 Type 7794 using calibration procedure 4231 Complete

## RESULTS:

- [X] "As Received" Data: Within Acceptance Criteria
- [ ] "As Received" Data: Outside Acceptance Criteria
- [X] "Final" Data : Within Acceptance Criteria
- [ ] "Final" Data : Outside Acceptance Criteria

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with EA-4/02from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the calibrator under calibration.

Date of Calibration: March 16, 2021

Certificate issued: March 16, 2021

Meshaun Hobbs
Calibration Technician

Harold Williams
Quality Representative

# Appendix B. TNM Runs in Electronic Format

# Appendix C. Traffic Data

Traffic data for the Revised Build Alternative is included in this appendix. Traffic data for the Existing Conditions and No-Build Alternative remain the same as what was in the 2019 Noise Study Technical Report.

**Hybrid 3 - Future Build 2045 Peak Truck Hour (9:00-10:00 AM) I-5 Mainline**

| Direction | Link | Speed, mph | All Vehicles | Motorcycles | Autos | Buses | Medium Trucks | Heavy Trucks |
|---|---|---|---|---|---|---|---|---|
| Northbound Mainline | I-5 Entrance to I-84 On Ramp (South of I-84 On Ramp) | 50 | 2,964 | 9 | 2,473 | 46 | 140 | 296 |
| Northbound Mainline | I-84 On Ramp to Weidler Off Ramp | 50 | 5,282 | 16 | 4,407 | 82 | 249 | 528 |
| Northbound Mainline | Weidler Off Ramp to Broadway On Ramp | 50 | 3,653 | 11 | 3,048 | 57 | 172 | 365 |
| Northbound Mainline | Broadway On Ramp to I-405 Off Ramp | 50 | 4,285 | 13 | 3,575 | 67 | 202 | 428 |
| Northbound Mainline | I-405 Off Ramp to Greeley Off Ramp | 50 | 2,768 | 8 | 2,309 | 43 | 131 | 277 |
| Southbound Mainline | Greeley On Ramp to I-405 On Ramp | 50 | 3,111 | 24 | 2807 | 35 | 89 | 157 |
| Southbound Mainline | I-405 On Ramp to Broadway Off Ramp | 50 | 4,393 | 33 | 3963 | 49 | 126 | 222 |
| Southbound Mainline | Broadway Off Ramp to Weidler On Ramp | 50 | 3,605 | 15 | 3,080 | 18 | 181 | 310 |
| Southbound Mainline | Weidler On Ramp to I-84 Off Ramp | 50 | 4,557 | 19 | 3,893 | 23 | 229 | 392 |
| Southbound Mainline | I-84 Off Ramp to I-5 South End | 50 | 3,026 | 13 | 2,585 | 15 | 152 | 261 |

**Hybrid 3 - Future Build 2045 Peak Truck Hour (9:00-10:00 AM) I-5 NB Mainline and Ramps (combined)**

| Direction | Link | Speed, mph | All Vehicles | Motorcycles | Autos | Buses | Medium Trucks | Heavy Trucks |
|---|---|---|---|---|---|---|---|---|
| Northbound | North of Greeley Off Ramp | 50 | 1,669 | 5 | 1392 | 26 | 79 | 167 |
| Northbound | Greeley Off Ramp | 35 | 1,099 | 3 | 917 | 17 | 52 | 110 |
| Northbound | I-405 Off Ramp to Greeley Off Ramp | 50 | 2,768 | 8 | 2309 | 43 | 131 | 277 |
| Northbound | I-405 WB Off Ramp | 50 | 1,517 | 2 | 1351 | 6 | 49 | 110 |
| Northbound | Broadway On Ramp to I-405 Off Ramp | 50 | 4,285 | 13 | 3575 | 67 | 202 | 428 |
| Northbound | Broadway On Ramp | 50 | 632 | 0 | 569 | 28 | 35 | 0 |
| Northbound | Weidler Off Ramp to Broadway On Ramp | 50 | 3,653 | 11 | 3048 | 57 | 172 | 365 |
| Northbound | Weidler Off Ramp | 45 | 1,629 | 0 | 1554 | 11 | 48 | 15 |
| Northbound | I-84 On Ramp to Weidler Off Ramp | 50 | 5,282 | 16 | 4407 | 82 | 249 | 528 |
| Northbound | I-84 WB On Ramp | 50 | 2,318 | 1 | 2189 | 11 | 54 | 64 |
| Northbound | I-5 Entrance to I-84 On Ramp (South of I-84 On Ramp) | 50 | 2,964 | 9 | 2473 | 46 | 140 | 296 |

**Hybrid 3 - Future Build 2045 Peak Truck Hour (9:00-10:00 AM) I-5 Ramps**

| Direction | Link | Speed, mph | All Vehicles | Motorcycles | Autos | Buses | Medium Trucks | Heavy Trucks |
|---|---|---|---|---|---|---|---|---|
| Northbound | I-84 WB On Ramp | 50 | 2,318 | 1 | 2,189 | 11 | 54 | 64 |
| Northbound | Weidler Off Ramp | 45 | 1,629 | 0 | 1,554 | 11 | 48 | 15 |
| Northbound | Broadway On Ramp | 50 | 632 | 0 | 569 | 28 | 35 | 0 |
| Northbound | I-405 WB Off Ramp | 50 | 1,517 | 2 | 1,351 | 6 | 49 | 110 |
| Northbound | Greeley Off Ramp | 35 | 1,099 | 3 | 917 | 17 | 52 | 110 |
| Southbound | Greeley On Ramp | 50 | 770 | 3 | 658 | 4 | 39 | 66 |
| Southbound | I-405 EB On Ramp | 50 | 1,282 | 0 | 1,120 | 14 | 46 | 101 |
| Southbound | Broadway Off Ramp* | 45 | 788 | 0 | 770 | 1 | 10 | 7 |
| Southbound | Weidler On Ramp | 50 | 952 | 1 | 875 | 12 | 40 | 23 |
| Southbound | I-84 EB Off Ramp | 40 | 1,531 | 1 | 1,414 | 10 | 53 | 53 |

**Hybrid 3 - Future Build 2045 Peak Truck Hour (9:00-10:00 AM) I-5 SB Mainline and Ramps (combined)**

| Direction | Link | Speed, mph | All Vehicles | Motorcycles | Autos | Buses | Medium Trucks | Heavy Trucks |
|---|---|---|---|---|---|---|---|---|
| Southbound | North of Greeley On Ramp | 50 | 2,341 | 21 | 2,149 | 31 | 50 | 91 |
| Southbound | Greeley On Ramp | 50 | 770 | 3 | 658 | 4 | 39 | 66 |
| Southbound | Greeley On Ramp to I-405 On Ramp | 50 | 3,111 | 24 | 2,807 | 35 | 89 | 157 |
| Southbound | I-405 EB On Ramp | 50 | 1,282 | 0 | 1,120 | 14 | 46 | 101 |
| Southbound | I-405 On Ramp to Broadway Off Ramp | 50 | 4,393 | 33 | 3,963 | 49 | 126 | 222 |
| Southbound | Broadway Off Ramp | 45 | 788 | 0 | 770 | 1 | 10 | 7 |
| Southbound | Broadway Off Ramp to Weidler On Ramp | 50 | 3,605 | 15 | 3,080 | 18 | 181 | 310 |
| Southbound | Weidler On Ramp | 50 | 952 | 1 | 875 | 12 | 40 | 23 |
| Southbound | Weidler On Ramp to I-84 Off Ramp | 50 | 4,557 | 19 | 3,893 | 23 | 229 | 392 |
| Southbound | I-84 EB Off Ramp | 40 | 1,531 | 1 | 1,414 | 10 | 53 | 53 |
| Southbound | I-84 Off Ramp to I-5 South End | 50 | 3,026 | 13 | 2,585 | 15 | 152 | 261 |

| Hybrid 3 - Future Build 2045 Peak Truck Hour (9:00-10:00 AM) Side Streets | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Road | Direction | Ramp Terminal/Intersection Links | Speed, mph | All Vehicles | Motorcycles | Autos | Buses | Medium Trucks | Heavy Trucks |
| Broadway St | Westbound | East of 2nd Ave | 30 | 1,218 | 2 | 1135 | 16 | 42 | 23 |
| | Westbound | 2nd Ave to Victoria Ave | 30 | 1,314 | 2 | 1225 | 17 | 45 | 25 |
| | Westbound | Victoria Ave to Williams Ave | 30 | 2,048 | 4 | 1937 | 16 | 64 | 27 |
| | Westbound | Williams Ave to Vancouver Ave | 30 | 1,535 | 3 | 1476 | 9 | 28 | 19 |
| | Westbound | Vancouver Ave to Benton Ave | 30 | 1,063 | 1 | 998 | 8 | 33 | 23 |
| Weidler St | Eastbound | West of Benton Ave | 30 | 663 | 1 | 618 | 9 | 23 | 13 |
| | Eastbound | Benton to Vancouver Ave | 30 | 700 | 1 | 653 | 9 | 24 | 13 |
| | Eastbound | Vancouver Ave to Williams Ave | 30 | 505 | 1 | 471 | 7 | 17 | 10 |
| | Eastbound | Williams Ave to Victoria Ave | 30 | 743 | 1 | 694 | 6 | 28 | 14 |
| | Eastbound | Victoria Ave to 2nd Ave | 30 | 1,501 | 1 | 1424 | 12 | 45 | 19 |
| | Eastbound | East of 2nd Ave | 30 | 1414 | 2 | 1318 | 19 | 48 | 27 |
| 2nd Ave | Northbound | South of Weidler St | 25 | 42 | 0 | 39 | 1 | 1 | 1 |
| | Northbound | Weidler St to Broadway St | 25 | 142 | 0 | 132 | 2 | 5 | 3 |
| | Northbound | North of Broadway St | 25 | 159 | 0 | 148 | 2 | 5 | 3 |
| | Southbound | North of Broadway St | 25 | 146 | 0 | 136 | 2 | 5 | 3 |
| | Southbound | Broadway St to Weidler St | 25 | 33 | 0 | 31 | 0 | 1 | 1 |
| | Southbound | South of Weidler St | 25 | 21 | 0 | 20 | 0 | 1 | 0 |
| Victoria Ave | Northbound | Weidler St to Broadway St | 25 | 768 | 0 | 717 | 5 | 33 | 13 |
| | Northbound | North of Broadway St | 25 | 54 | 0 | 50 | 1 | 2 | 1 |
| | Southbound | North of Broadway St | 25 | 25 | 0 | 23 | 0 | 1 | 0 |
| Williams Ave | Northbound | South of Winning Way | 25 | 8 | 0 | 0 | 8 | 0 | 0 |
| | Northbound | Winning Way to Weidler St | 25 | 739 | 0 | 631 | 22 | 43 | 43 |
| | Northbound | Weidler St to Broadway St | 25 | 500 | 0 | 416 | 15 | 36 | 33 |
| | Northbound | Broadway St to Hancock St | 25 | 425 | 1 | 396 | 6 | 15 | 8 |
| | Northbound | North of Hancock St | 25 | 530 | 1 | 494 | 7 | 18 | 10 |
| | Southbound | Between Broadway and Weidler | 25 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vancouver Ave | Southbound | North of Broadway St | 25 | 250 | 1 | 226 | 9 | 9 | 6 |
| | Southbound | Broadway St and Weidler St | 25 | 826 | 1 | 768 | 13 | 26 | 18 |
| | Southbound | Weidler to Winning Way | 25 | 1,022 | 1 | 937 | 28 | 41 | 15 |
| Kerby Ave | Southbound | North of Russell St | 25 | 191 | 0 | 166 | 0 | 21 | 4 |
| Russell St | Westbound | West of Kerby Ave | 25 | 167 | 0 | 159 | 0 | 6 | 1 |
| | Westbound | East of Kerby Ave | 25 | 271 | 0 | 253 | 0 | 13 | 6 |
| | Eastbound | East of Kerby Ave | 25 | 195 | 0 | 137 | 0 | 51 | 7 |
| | Eastbound | West of Kerby Ave | 25 | 281 | 0 | 199 | 0 | 74 | 8 |
| Kerby Ave | Northbound | North of Russell St | 25 | 191 | 0 | 166 | 0 | 21 | 4 |
| Flint Ave | Northbound | North of Hancock St | 25 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Southbound | North of Hancock St | 25 | 126 | 0 | 118 | 2 | 4 | 2 |
| Multnomah St | Eastbound | West of Wheeler Ave | 25 | 221 | 0 | 206 | 3 | 8 | 4 |
| | Eastbound | East of Wheeler Ave | 25 | 372 | 0 | 347 | 5 | 13 | 7 |
| | Westbound | East of Wheeler Ave | 25 | 286 | 0 | 267 | 4 | 10 | 5 |
| | Westbound | West of Wheeler Ave | 25 | 342 | 0 | 318 | 5 | 12 | 7 |
| Hancock St | Eastbound | West of Williams Ave | 25 | 8 | 0 | 8 | 0 | 0 | 0 |
| | Eastbound | East of Williams Ave | 25 | 8 | 0 | 8 | 0 | 0 | 0 |
| | Westbound | East of Williams Ave | 25 | 159 | 0 | 148 | 2 | 6 | 3 |
| | Westbound | West of Williams Ave | 25 | 54 | 0 | 50 | 1 | 2 | 1 |
| Dixon St | Eastbound | East of Ross Ave | 25 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Westbound | East of Ross Ave | 25 | 33 | 0 | 33 | 0 | 0 | 0 |

# Appendix D. Mitigation Analysis

**Table D1. Wall 1**

| Rec | NAAC | Existing Leq (dBA) | No-build Leq (dBA) | Build Leq (dBA) | Units or ERR | 10ft Leq with Mitigation (dBA) | 10ft Insertion Loss (dBA) | 11ft Leq with Mitigation (dBA) | 11ft Insertion Loss (dBA) | 12ft Leq with Mitigation (dBA) | 12ft Insertion Loss (dBA) | 13ft Leq with Mitigation (dBA) | 13ft Insertion Loss (dBA) | 14ft Leq with Mitigation (dBA) | 14ft Insertion Loss (dBA) | 15ft Leq with Mitigation (dBA) | 15ft Insertion Loss (dBA) | 16ft Leq with Mitigation (dBA) | 16ft Insertion Loss (dBA) | Recommended Wall Height 11ft: Number of Impacted Units | Receptors with IL >=7 dBA | Number of Benefited Receptors (IL >= 5 dBA) | Number of Impacted Receptors Benefited (IL >=5 dBA | Impacted Receptors Not Benefitted |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R3 | B | 69 | 69 | 69 | 1 | 68 | 1 | 68 | 1 | 68 | 1 | 67 | 2 | 67 | 2 | 67 | 2 | 67 | 2 | 1 | 0 | 0 | 0 | 1 |
| R2 | C | 69 | 69 | 70 | 1 | 69 | 1 | 69 | 1 | 68 | 2 | 68 | 2 | 68 | 2 | 68 | 2 | 68 | 2 | 1 | 0 | 0 | 0 | 1 |
| R1/M6 | C | 73 | 73 | 73 | 1 | 71 | 2 | 71 | 2 | 71 | 2 | 71 | 2 | 71 | 2 | 71 | 2 | 71 | 2 | 1 | 0 | 0 | 0 | 1 |
| | | | | | | | | | | | | | | | | | | | Total Receptors | 3 | 0 | 0 | 0 | 3 |

| | |
|---|---|
| Recommended Wall Height (ft) | 11ft |
| Length of Wall (ft) | 950 |
| Wall Area (sq.ft) | 10,453 |
| Wall Cost ($/sq.ft) | $35 |
| Total Cost of Selected Wall($) | $365,855 |
| Cost Effectiveness ($/Benefitted Residence) | NA |
| Cost Reasonableness Criteria ($/Benefitted Residence) | $37,500 |
| Cost Effectiveness< Cost Reasonableness? (yes/no) | No |
| Noise reduction design goal - One receiver achieves the noise reduction design goal of 7 dBA? (yes/no) | No |

Calculation of Feasible Abatement (majority of impacted receptors receive a minimum of 5 dBA IL?)

| | |
|---|---|
| % receiving 5 dBA IL | 0.00% |
| Feasible (>50%)? | No |
| Barrier Feasible & Reasonable | No |

KEY:
Indicates impacted receiver under condition evaluated
Benefitted Receiver ( IL >= 5 dBA)
Benefitted Receiver Achieving Noise Design Goal ( IL >=7 dBA)

**Table D2. Wall 2**

| Rec | NAAC | Existing Leq (dBA) | No-build Leq (dBA) | Build Leq (dBA) | Units or ERR | 10ft Leq with Mitigation (dBA) | 10ft Insertion Loss (dBA) | 11ft Leq with Mitigation (dBA) | 11ft Insertion Loss (dBA) | 12ft Leq with Mitigation (dBA) | 12ft Insertion Loss (dBA) | 13ft Leq with Mitigation (dBA) | 13ft Insertion Loss (dBA) | 14ft Leq with Mitigation (dBA) | 14ft Insertion Loss (dBA) | 15ft Leq with Mitigation (dBA) | 15ft Insertion Loss (dBA) | 16ft Leq with Mitigation (dBA) | 16ft Insertion Loss (dBA) | Recommended Wall Height 12ft: Number of Impacted Units | Receptors with IL >=7 dBA | Number of Benefited Receptors (IL >= 5 dBA) | Number of Impacted Receptors Benefited (IL >=5 dBA | Impacted Receptors Not Benefitted |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R6/M3 | B | 63 | 63 | 63 | 1 | 61 | 2 | 61 | 2 | 61 | 2 | 61 | 2 | 61 | 2 | 61 | 2 | 61 | 2 | 0 | 0 | 0 | 0 | 0 |
| R5 | D | 49 | 49 | 50 | 61 | 42 | 8 | 41 | 9 | 40 | 10 | 39 | 11 | 38 | 12 | 37 | 13 | 37 | 13 | 61 | 61 | 61 | 61 | 0 |
| R4/M4 | C | 72 | 72 | 72 | 17 | 69 | 3 | 68 | 4 | 67 | 5 | 67 | 5 | 66 | 6 | 66 | 6 | 65 | 7 | 17 | 0 | 17 | 17 | 0 |
| | | | | | | | | | | | | | | | | | | | Total Receptors | 78 | 61 | 78 | 78 | 0 |

| | |
|---|---|
| Recommended Wall Height (ft) | 12ft |
| Length of Wall (ft) | 1,456 |
| Wall Area (sq.ft) | 17,468 |
| Wall Cost ($/sq.ft) | $35 |
| Total Cost of Selected Wall($) | $611,380 |
| Cost Effectiveness ($/Benefitted Residence) | $7,795 |
| Cost Reasonableness Criteria ($/Benefitted Residence) | $37,500 |
| Cost Effectiveness< Cost Reasonableness? (yes/no) | Yes |
| Noise reduction design goal - One receiver achieves the noise reduction design goal of 7 dBA? (yes/no) | Yes |

Calculation of Feasible Abatement (majority of impacted receptors receive a minimum of 5 dBA IL?)

| | |
|---|---|
| % receiving 5 dBA IL | 100.00% |
| Feasible (>50%)? | Yes |
| Barrier Feasible & Reasonable | Yes |

KEY:
Indicates impacted receiver under condition evaluated
Benefitted Receiver ( IL >= 5 dBA)
Benefitted Receiver Achieving Noise Design Goal ( IL >=7 dBA)

## Table D3. Wall 4a

| Rec | Activity Category | Existing Leq (dBA) | No-build Leq (dBA) | Build Leq (dBA) - Hybrid 3 Alternative | Number of Units | 23ft EA Length: Leq with Mitigation (dBA) | 23ft EA Length: Insertion Loss (dBA) | Wall Height 23ft EA Length: Number of Impacted Units | Receptors with IL >=7 dBA | Number of Benefitted Units (IL >= 5 dBA) | Impacted Receptors Receiving IL >=5 dBA | Impacted Receptors Not Benefitted |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R20 | C | 55 | 55 | 54 | 1 | 50 | 4 | 0 | 0 | 0 | 0 | 0 |
| R21a | B | 61 | 60 | 60 | 2 | 57 | 3 | 0 | 0 | 0 | 0 | 0 |
| R21b | B | 62 | 62 | 62 | 2 | 58 | 4 | 0 | 0 | 0 | 0 | 0 |
| R21c | B | 63 | 63 | 63 | 2 | 59 | 4 | 0 | 0 | 0 | 0 | 0 |
| R21d | B | 64 | 64 | 64 | 2 | 60 | 4 | 0 | 0 | 0 | 0 | 0 |
| R22a | B | 61 | 60 | 60 | 2 | 55 | 5 | 0 | 0 | 2 | 0 | 0 |
| R22b | B | 62 | 62 | 62 | 2 | 57 | 5 | 0 | 0 | 2 | 0 | 0 |
| R22c | B | 63 | 63 | 63 | 2 | 58 | 5 | 0 | 0 | 2 | 0 | 0 |
| R22d | B | 64 | 63 | 64 | 2 | 59 | 5 | 0 | 0 | 2 | 0 | 0 |
| R23a | B | 60 | 60 | 60 | 2 | 54 | 6 | 0 | 0 | 2 | 0 | 0 |
| R23b | B | 62 | 61 | 61 | 2 | 56 | 5 | 0 | 0 | 2 | 0 | 0 |
| R23c | B | 63 | 62 | 62 | 2 | 57 | 5 | 0 | 0 | 2 | 0 | 0 |
| R23d | B | 64 | 63 | 63 | 2 | 58 | 5 | 0 | 0 | 2 | 0 | 0 |
| R24a | B | 61 | 60 | 60 | 2 | 55 | 5 | 0 | 0 | 2 | 0 | 0 |
| R24b | B | 62 | 61 | 62 | 2 | 56 | 6 | 0 | 0 | 2 | 0 | 0 |
| R24c | B | 63 | 63 | 62 | 2 | 57 | 5 | 0 | 0 | 2 | 0 | 0 |
| R24d | B | 64 | 64 | 64 | 2 | 59 | 5 | 0 | 0 | 2 | 0 | 0 |
| R25a | B | 56 | 56 | 55 | 1 | 53 | 2 | 0 | 0 | 0 | 0 | 0 |
| R25b | B | 59 | 59 | 58 | 1 | 56 | 2 | 0 | 0 | 0 | 0 | 0 |
| R25c | B | 64 | 63 | 62 | 1 | 58 | 4 | 0 | 0 | 0 | 0 | 0 |
| R25d | B | 66 | 66 | 65 | 1 | 61 | 4 | 1 | 0 | 0 | 0 | 1 |
| R26a | B | 54 | 55 | 54 | 1 | 53 | 1 | 0 | 0 | 0 | 0 | 0 |
| R26b | B | 58 | 58 | 57 | 1 | 56 | 1 | 0 | 0 | 0 | 0 | 0 |
| R26c | B | 63 | 63 | 62 | 1 | 59 | 3 | 0 | 0 | 0 | 0 | 0 |
| R26d | B | 66 | 65 | 65 | 1 | 61 | 4 | 1 | 0 | 0 | 0 | 1 |
| R27 | C | 58 | 58 | 58 | 1 | 57 | 1 | 0 | 0 | 0 | 0 | 0 |
| R28a | B | 73 | 74 | 74 | 1 | 69 | 5 | 1 | 0 | 1 | 1 | 0 |
| R28b | B | 75 | 75 | 75 | 1 | 69 | 6 | 1 | 0 | 1 | 1 | 0 |
| R28c | B | 75 | 75 | 75 | 1 | 70 | 5 | 1 | 0 | 1 | 1 | 0 |
| R28d | B | 75 | 75 | 75 | 1 | 70 | 5 | 1 | 0 | 1 | 1 | 0 |
| R28e | B | 74 | 75 | 75 | 1 | 73 | 2 | 1 | 0 | 0 | 0 | 1 |
| R29 | D | 45 | 46 | 45 | 1 | 33 | 12 | 0 | 0 | 1 | 0 | 0 |
| R30a | D | 33 | 33 | 33 | 1 | 32 | 1 | 0 | 0 | 0 | 0 | 0 |
| R30b | D | 38 | 39 | 39 | 1 | 36 | 3 | 0 | 0 | 0 | 0 | 0 |
| R30c | D | 44 | 45 | 44 | 1 | 42 | 2 | 0 | 0 | 0 | 0 | 0 |
| R30d | D | 46 | 46 | 46 | 1 | 44 | 2 | 0 | 0 | 0 | 0 | 0 |
| R39-Legacy Inside | D | 45 | 44 | 46 | 1 | 35 | 11 | 0 | 0 | 1 | 0 | 0 |
| R-40-Legacy Bench | C | 57 | 56 | 59 | 1 | 50 | 9 | 0 | 0 | 1 | 0 | 0 |
| | | | | | | | Total Receptors | 7 | 0 | 29 | 4 | 3 |

| | |
|---|---|
| Recommended Wall Height (ft) | 23 |
| Length of Wall (ft) | 1,718 |
| Wall Area (sq.ft) | 39,514 |
| Wall Cost ($/sq.ft) | $37.50 |
| Total Cost of Selected Wall($) | $1,481,775 |
| Cost Effectiveness ($/Benefitted Residence) | $51,096 |
| Cost Reasonableness Criteria ($/Benefitted Residence)* | $37,500 |
| Cost Effectiveness< Cost Reasonableness? (yes/no) | No |
| oise reduction design goal - One receiver achieves the noise reduction design goal of 7 dBA? (yes/no) | No |

| Calculation of Feasible Abatement (majority of impacted receptors receive a minimum of 5 dBA IL?) | |
|---|---|
| % receiving 5 dBA IL | 57.14% |
| Feasible (>50%)? | Yes |
| Barrier Feasible and Reasonable? | No |

**KEY:**

Indicates impacted receiver under Future Build Conditions

Benefitted Receiver ( IL >= 5 dBA)

Benefitted Receiver Achieving Noise Design Goal ( IL >=7 dBA)

Note:*ODOT policy states that Optional Reasonableness Criteria only apply "...after the required criteria in sections 7.4.1–7.4.3 are met." with 7.4.1 being viewpoints/voting by benefitted receptors, 7.4.2 cost reasonableness criteria, and 7.4.3 noise reduction deisgn goal. Because the cost criteria (7.4.2) is not met the noise wall has not "met" all of the criteria in these sections and Optional Reasonableness Criteria do not apply.

## Table D4. Wall 4b

| Rec | Activity Category | Existing Leq (dBA) | No-build Leq (dBA) | Build Leq (dBA) - Hybrid 3 Alternative | Number of Units | 16ft | | 17ft | | 18ft | | 19ft | | 20ft | | 21ft | | 22ft | | 23ft | | Recommended Wall Height 22ft | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Leq with Mitigation (dBA) | Insertion Loss (dBA) | Leq with Mitigation (dBA) | Insertion Loss (dBA) | Leq with Mitigation (dBA) | Insertion Loss (dBA) | Leq with Mitigation (dBA) | Insertion Loss (dBA) | Leq with Mitigation (dBA) | Insertion Loss (dBA) | Leq with Mitigation (dBA) | Insertion Loss (dBA) | Leq with Mitigation (dBA) | Insertion Loss (dBA) | Leq with Mitigation (dBA) | Insertion Loss (dBA) | Number of Impacted Units | Receptors with IL >=7 dBA | Number of Benefitted Units (IL >= 5 dBA) | Impacted Receptors Receiving IL >=5 dBA | Impacted Receptors Not Benefitted |
| R27 | C | 58 | 58 | 58 | 1 | 57 | 1 | 57 | 1 | 57 | 1 | 57 | 1 | 57 | 1 | 57 | 1 | 57 | 1 | 57 | 1 | 0 | 0 | 0 | 0 | 0 |
| R28a | B | 73 | 74 | 74 | 1 | 70 | 4 | 70 | 4 | 70 | 4 | 70 | 4 | 70 | 4 | 70 | 4 | 69 | 5 | 69 | 5 | 1 | 0 | 1 | 1 | 0 |
| R28b | B | 75 | 75 | 75 | 1 | 70 | 5 | 70 | 5 | 70 | 5 | 70 | 5 | 70 | 5 | 70 | 5 | 70 | 5 | 69 | 6 | 1 | 0 | 1 | 1 | 0 |
| R28c | B | 75 | 75 | 75 | 1 | 71 | 4 | 71 | 4 | 70 | 5 | 70 | 5 | 70 | 5 | 70 | 5 | 70 | 5 | 70 | 5 | 1 | 0 | 1 | 1 | 0 |
| R28d | B | 75 | 75 | 75 | 1 | 73 | 2 | 73 | 2 | 72 | 3 | 72 | 3 | 72 | 3 | 71 | 4 | 71 | 4 | 71 | 4 | 1 | 0 | 0 | 0 | 1 |
| R28e | B | 74 | 75 | 75 | 1 | 74 | 1 | 74 | 1 | 74 | 1 | 73 | 2 | 73 | 2 | 73 | 2 | 73 | 2 | 73 | 2 | 1 | 0 | 0 | 0 | 1 |
| R29 | D | 45 | 46 | 45 | 1 | 40 | 5 | 40 | 5 | 39 | 6 | 38 | 7 | 36 | 9 | 35 | 10 | 33 | 12 | 33 | 12 | 0 | 0 | 1 | 0 | 0 |
| R30a | D | 33 | 33 | 33 | 1 | 32 | 1 | 32 | 1 | 32 | 1 | 32 | 1 | 32 | 1 | 32 | 1 | 32 | 1 | 32 | 1 | 0 | 0 | 0 | 0 | 0 |
| R30b | D | 38 | 39 | 39 | 1 | 38 | 1 | 37 | 2 | 37 | 2 | 37 | 2 | 37 | 2 | 36 | 3 | 36 | 3 | 36 | 3 | 0 | 0 | 0 | 0 | 0 |
| R30c | D | 44 | 45 | 44 | 1 | 43 | 1 | 43 | 1 | 43 | 1 | 43 | 1 | 43 | 1 | 43 | 1 | 42 | 2 | 42 | 2 | 0 | 0 | 0 | 0 | 0 |
| R30d | D | 46 | 46 | 46 | 1 | 45 | 1 | 45 | 1 | 45 | 1 | 45 | 1 | 45 | 1 | 44 | 2 | 44 | 2 | 44 | 2 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | | | | | | | | | | | | Total Receptors | 5 | 0 | 4 | 3 | 2 |

| | | | |
|---|---|---|---|
| Recommended Wall Height (ft) | 22ft | | |
| Length of Wall (ft) | 893 | | |
| Wall Area (sq.ft) | 19,622 | Calculation of Feasible Abatement (majority of impacted receptors receive a minimum of 5 dBA IL?) | |
| Wall Cost ($/sq.ft) | $37.50 | | |
| Total Cost of Selected Wall($) | $735,825 | | |
| Cost Effectiveness ($/Benefitted Residence) | $183,956 | % receiving 5 dBA IL | 60.00% |
| Cost Reasonableness Criteria ($/Benefitted Residence) | $37,500 | Feasible (>50%)? | Yes |
| Cost Effectiveness< Cost Reasonableness? (yes/no) | No | Barrier Feasible and Reasonable? | No |
| Noise reduction design goal - One receiver achieves the noise reduction design goal of 7 dBA? (yes/no) | No | | |

KEY:

Indicates impacted receiver under Future Build Conditions

Benefitted Receiver ( IL >= 5 dBA)

Benefitted Receiver Achieving Noise Design Goal ( IL >=7 dBA)