# Update to the Basalt Creek Parkway Extension Project Noise Technical Report

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# Executive Summary

Washington County is proposing to construct and operate the Basalt Creek Parkway Extension Project (Project) located near Tualatin and Wilsonville, Oregon. The Project proposes to extend Basalt Creek Parkway to provide a connection between Grahams Ferry and Boones Ferry Roads. The Parkway is planned to be a five-lane arterial with bicycle and pedestrian facilities, drainage, street lighting, a bridge across Sealy Ditch, and a new signalized intersection at Boones Ferry Road.

This 2020 Noise Technical Report (NTR) is an update to the one prepared by SLR Corporation in 2016 (SLR Corporation 2016). The justification for the update was because of a change in the roadway's horizontal or vertical alignment, as determined by the design team at the request of the Oregon Department of Transportation (ODOT). The update also considers independent changes in the existing roadway network occurring since 2016, specifically the section of Basalt Creek Parkway constructed west of Grahams Ferry Road providing a connection from Grahams Ferry Road to Tualatin-Sherwood Road. In 2016, this section of roadway was under construction and not open to traffic; therefore, the Existing Conditions and No-Build Alternative analyzed in the 2016 SLR NTR are updated in this 2020 NTR.

Traffic noise levels for Existing Conditions (2019) and for the No-Build and Build Alternatives in the design year (2043) were predicted for the Project area between Grahams Ferry Road and Lower Boones Ferry Road. Existing noise levels in the study area meet or exceed the ODOT noise abatement approach criteria (NAAC) at three receptors.

Like the Existing Conditions, No-Build noise levels are predicted to exceed the NAAC at three residential receptors, with one receptor experiencing an increase of up to 2 dB over Existing Conditions. The differences in noise levels from Existing to No-Build conditions would be from increased traffic on area roadways.

Build noise levels are predicted to impact 17 receptors. The changes in sound levels between the Existing Conditions and Build Alternatives would range from a decrease of 2 dB to an increase of 20 dB. The largest increases would be from the presence of a new roadway where there is none between Grahams Ferry Road and Lower Boones Ferry Road. Decreases in sound levels would occur from traffic using the new roadway rather than other previously used routes. Changes in sound levels between No-Build and Build conditions would result from the presence of the new roadway extension between Grahams Ferry Road and Lower Boones Ferry and increased traffic and other roadway alignment changes associated with the Project. There would be 11 impacted receptors with substantial noise increases due to the new roadway extension in a rural environment.

Due to exceedances of the ODOT NAAC and/or substantial noise increases, mitigation measures in the form of sound barriers or walls were evaluated but would not be feasible and reasonable per ODOT regulations; therefore, noise abatement is not recommended for this Project.

Construction noise would temporarily result in elevated noise levels at sensitive receptors near the Project. Construction noise abatement measures, such as having the contractor develop a noise control plan and maintaining equipment in good operating condition with functional mufflers, should be implemented to reduce noise where practicable.

The Project area contains undeveloped land, the use of which could change with future development. Based on noise modeling results, any proposed residential development within 88 feet from the outside edge of Basalt Creek Parkway travel lanes would have the potential to experience noise levels greater

than or equal to the thresholds of 65 dBA Leq(h) for NAAC Categories B (residential) and C (recreational). Another proposed commercial development within 14 feet from the outside edge of Basalt Creek Parkway would have the potential to experience noise levels greater than or equal to the threshold of 70 dBA Leq(h) for NAAC Category E (commercial) by the year 2043.

We recommend this report be provided to ODOT and the Planning Departments of Washington County, and the Cities of Tualatin and Wilsonville. This report will serve to inform these local governments of the effects of the proposed Project on local noise levels.

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# Glossary

**Activity Category B NAAC** The exterior noise impact criterion for Activity Category B is Leq(h) 65 dBA. This ODOT standard defines the noise levels constituting an impact for residences.

**Activity Category C NAAC** The exterior noise impact criterion for Activity Category C is Leq(h) 65 dBA. This ODOT standard defines the noise levels constituting an impact for active sports arenas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio stations, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.

**Activity Category D NAAC** The interior noise impact criterion for Activity Category D is Leq(h)50 dBA. This ODOT standard defines the noise levels constituting an impact for auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio stations, recording studios, schools, and television studios.

**Activity Category E NAAC** The exterior noise impact criterion for Activity Category E activities is Leq(h) 70 dBA. This ODOT standard defines the noise levels constituting an impact for hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A—D or F.

**Ambient Noise** The background sound of an environment in relation to which all foreground sounds are heard. Ambient noise level is a measure of the background noise of an environment over a given period, in decibels.

**A-Weighted Decibel (dBA)** This scale accounts for humans' ability to hear only a limited range of frequencies by filtering out those frequencies that the human ear does not respond to.

**Decibel (dB)** The decibel is a relative unit of measurement corresponding to one tenth of a bel. It is used to express the ratio of one value of a power or field quantity to another, on a logarithmic scale, the logarithmic quantity being called the power level or field level, respectively.

**Cumulative Impacts** The impact on the environment resulting from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions.

**Insertion Loss** The difference in sound level at a receiver location with and without the presence of a noise barrier.

**Leq(h)** Hourly equivalent sound pressure level.

**Receptor** An activity or unit represented by a measured or modeled receiver, also called an equivalent unit (subset of receiver).

**Receiver** Modeling or measurement location that represents noise sensitive land uses; can represent multiple receptors or equivalent units.

# Acronyms

| | |
|---|---|
| CFR | Code of Federal Regulations |
| dB | Decibel |
| dBA | A-Weighted Decibel |
| FHWA | Federal Highway Administration |
| NAC | Noise Abatement Criteria |
| NAAC | Noise Abatement Approach Criteria |
| NTR | Noise Technical Report |
| ODOT | Oregon Department of Transportation |
| TNM | Federal Highway Administration Traffic Noise Model |

# 1 Introduction

Basalt Creek Parkway is a new road in the Basalt Creek Planning Area, an 850-acre area between the cities of Tualatin and Wilsonville in unincorporated Washington County that has been identified for future development. New roadways are classified as a Type I noise project by the Oregon Department of Transportation (ODOT). Basalt Creek Parkway, between Tonquin and Grahams Ferry Roads, opened in 2017. ODOT is designing the Basalt Creek Parkway extension between Grahams Ferry and Boones Ferry Roads. Figure 1 provides a graphical representation of the locations of the Project improvements. Basalt Creek Parkway is being designed to be a five-lane arterial with bicycle and pedestrian facilities, drainage, and street lighting. The project includes a proposed bridge across Sealy Ditch and a new signalized intersection at Boones Ferry Road.[1]

Based on a preliminary alignment of the Parkway from 2016, Washington County had SLR Corporation prepare a Noise Technical Report (NTR) to identify potential Project noise impacts (SLR 2016). As part of the 2019 Project design efforts, the ODOT requested the design team determine if the roadway's horizontal and vertical alignments changed relative to the preliminary alignment studied by the 2016 NTR, as such a change would trigger an update to the 2016 NTR.

Horizontally, the design team concluded the Project alignment changed since 2016. The most notable location where there has been a shift in the horizontal proposed alignment is the area west of the Sealy Ditch. The alignment has been adjusted to avoid displacing the Carlon School, a historic school building.

Vertically, the design team has concluded the Project alignment has changed due to the design shifting and more accurate topographic data being the basis for the vertical design. One example is where the landing of the bridge and the alignment of the Project approaches Boones Ferry Road. The SLR report indicates "*The exact alignment and profile of the parkway and bridge structure have not been completely designed yet. The currently available design was used for modeling.*"[2] For this reason, it is not surprising the vertical alignment of the Project has changed.

This 2020 NTR is justified not only from the horizontal and vertical changes in the roadway's alignments but also because of changes to the existing roadway network since 2016. As part of a separate effort, Basalt Creek Parkway has been constructed west of Grahams Ferry Road providing a connection from Grahams Ferry Road to Tualatin-Sherwood Road. In 2016, while the roadway was under construction, it was not open to traffic. For this reason, the Existing Conditions analyzed in the 2016 SLR NTR are no longer accurate and should be updated. In addition, the No-Build Alternative analyzed in the 2016 SLR NTR should also be updated to ensure accurate prediction of noise levels along the recently constructed roadway.

[1] https://www.co.washington.or.us/LUT/TransportationProjects/basaltcreekparkway.cfm, accessed October 26, 2020

[2] SLR 2016, bottom of p. 9

This 2020 NTR Update addresses the additional model validation, modeling results, and abatement analysis for the noise sensitive areas located in the Basalt Creek Project area. The methodology, land use, traffic data, and construction abatement are the same as discussed in the 2016 NTR.

Sections 2 through 8 describe methodology, land use, Existing Conditions, the traffic noise analysis and noise impacts, construction noise, the range of potential abatement measures and information for local government officials. Section 9 contains the bibliographical information for references cited herein. Appendices A through C are introduced later in the document and provide amplifying details.

**Figure 1. Overview Map**

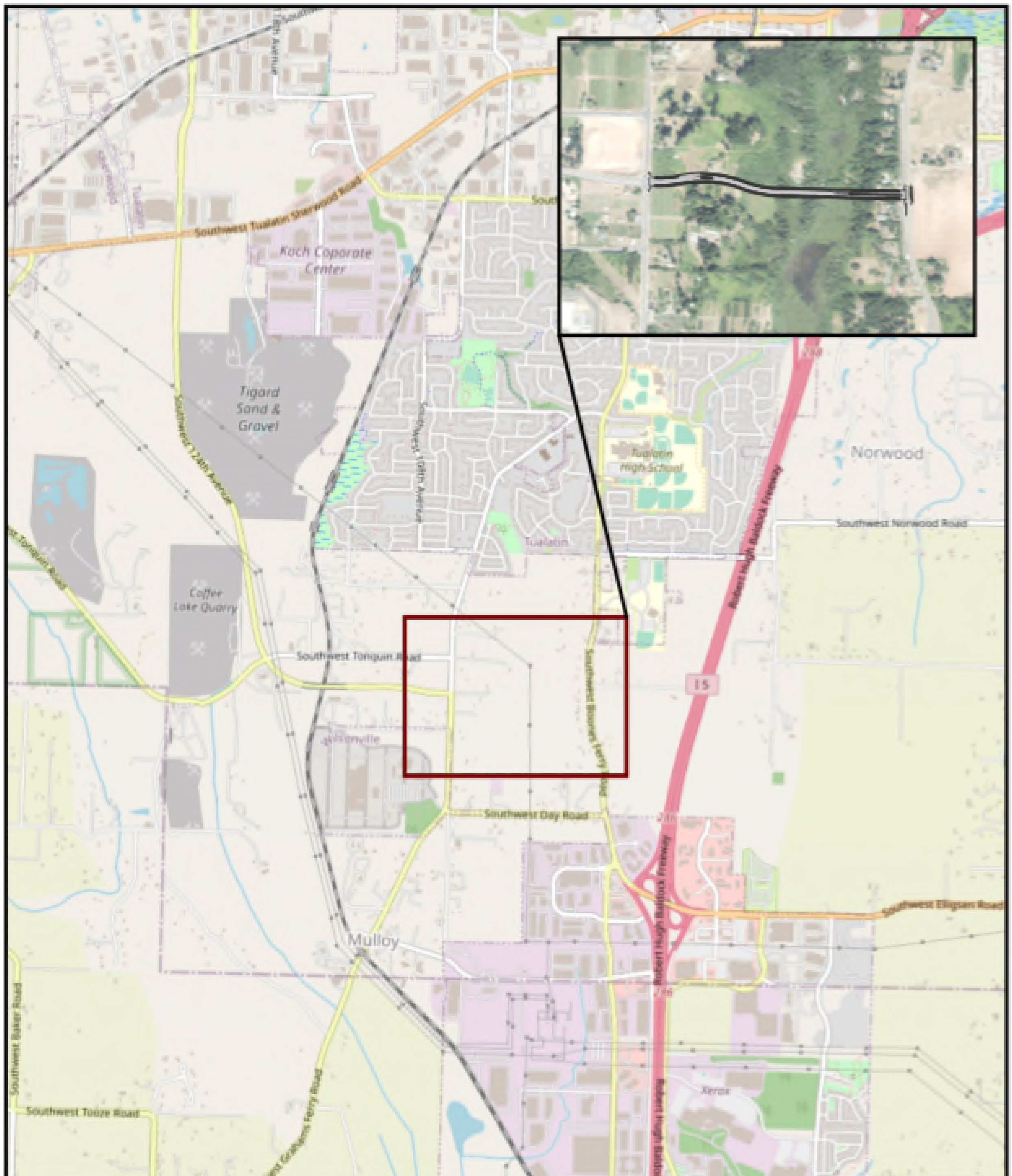


Figure 1
Overview Map

Oregon Department of Transportation

Basalt Creek Parkway Extension Project
Tualatin and Wilsonville, Oregon

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# 2 Methodology

This section has six subsections. The first three subsections address federal, state, county and local ordinances, regulations, and standards. The final three subsections discuss the source for traffic data used in the noise prediction model, the model itself and the validation of the model.

## 2.1 Federal and State Noise Standards and Criteria

The potential for noise impact of the Project was assessed in accordance with Federal Highway Administration (FHWA) and ODOT noise assessment regulations and guidelines. The FHWA regulations are set forth in 23 CFR Part 772. On July 13, 2010, FHWA published revised noise regulations that became effective on July 13, 2011 (FHWA 2011). ODOT prepared revisions to its noise policy in accordance with FHWA's requirements and revised policy which became effective July 13, 2011 (ODOT 2011).

An Interim Update to the ODOT Noise Manual was released in June 2020 (ODOT 2020). This update focused on a set of targeted changes to specific sections to provide modifications mainly to clarify the intent of ODOT's policy. The relevant changes have been documented in this updated NTR.

To assess the potential for impact on human activity from traffic noise, the FHWA established noise abatement criteria (NAC) for different categories of land use (see Table 1). These levels "represent the upper limit of acceptable traffic noise conditions." The NAC "represent a balancing of that which may be desirable with that which may be achievable." According to ODOT regulations, traffic noise impact occurs if the predicted traffic noise levels approach or exceed the NAC, or if the predicted traffic noise levels substantially exceed the existing noise levels. ODOT defines the word "approach" in "approach or exceed" as 2 decibels less than the FHWA NAC. ODOT defines the resultant decibel value as the Noise Abatement Approach Criteria (NAAC), identifying a substantial increase, relative to existing conditions, as an increase of at least 10 dB. The regulations further state that noise impact should be assessed for the worst hour traffic condition, which is either the peak vehicular hour or the peak truck hour for the design year.

In the SLR study, a comparison was made between the peak vehicular hour traffic and peak truck hour traffic using a straight-line flat earth FHWA Traffic Noise Model (TNM) run. Sound levels were calculated at an array of receptor points extending to 200 feet from a single roadway to ascertain the difference between the two traffic conditions. This effort was revised for the update and confirmed the findings of the original study that the peak vehicular hour was the worst of the two traffic conditions on a project-wide basis doing full three-dimensional (3D) modeling. However, when an updated comparison between the two traffic hours was completed there was variability in the worst case noise hour for the project with some receptors associated with the peak vehicular hour and some receptors associated with the peak truck hour. Therefore, for this 2020 NTR, all receptors are reported with their worst hour noise results, be it the peak vehicular hour or peak truck hour at each receptor. Each of these traffic data were used in the 3D TNM analysis for the Project. For these reasons, both the peak vehicular hour and peak truck hour are used in this analysis

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

This study evaluated Activity Categories C and E, i.e., recreation areas and outdoor eating areas for restaurants, respectively. Receptors in Activity Category C are considered noise impacted if predicted exterior noise levels, due to the Project, approach or exceed 67 dBA Leq(h) during the noisiest hour of the day. Therefore, the threshold for noise impact for NAAC Category C uses is 65 dBA Leq(h). Similarly, for Activity Category E uses, such as commercial restaurants, the threshold for noise impact is an exterior noise level, due to the Project, of 70 dBA Leq(h).

Any Category of land use that is noise sensitive (A, B, C, D, and E) would also be noise impacted if Project noise would cause a substantial increase over existing noise levels. As previously mentioned, ODOT defines a substantial increase as an increase, relative to Existing Conditions, of at least 10 decibels.

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

*Source: 23 CFR 772*

| Activity Category | NAC Leq(h)[1] | ODOT NAAC Leq(h)[1] | Description of Activity Category |
|---|---|---|---|
| A | 57 (Exterior) | 55 (Exterior) | Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose |
| B[2] | 67 (Exterior) | 65 (Exterior) | Residential |
| C[2] | 67 (Exterior) | 65 (Exterior) | Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings |
| D | 52 (Interior) | 50 (Interior) | Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios |
| E[2] | 72 (Exterior) | 70 (Exterior) | Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F |
| F | – | – | Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing |
| G | – | – | Undeveloped lands that are not permitted (without building permits) |

[1] Hourly Equivalent A-weighted Sound Level (dBA)
[2] Includes undeveloped lands permitted for this activity category

If the predicted design-year Build case noise levels approach or exceed the NAC during the worst traffic noise hour of the day or cause a substantial increase over existing noise, consideration of traffic noise reduction measures is necessary. For this study, noise levels throughout the study area were determined for Existing (2019) Conditions and for the 2043 No-Build and Build Alternatives.

## 2.2 Washington County Noise Ordinance

Noise control within Washington County is regulated under Chapter 8, Section 24 of the County's Code of Ordinances. The Code does not have set noise level limits for construction activities, but does provide allowable time periods when construction can occur. Per the Code of Ordinances, construction, including the use of pile drivers and other pneumatic devices, is permitted between the hours of 7:00 a.m. and 7:00 p.m. during weekdays and Saturdays, except for emergency work or issuance of variance.

## 2.3 City of Tualatin Noise Ordinance

The City of Tualatin, via Title 6, Chapter 6.14 of their administrative code allows construction noise to occur between the hours of 7:00 a.m. and 6:00 p.m. during weekdays. Project construction occurring outside of these hours would require ODOT obtain a variance from the City.

## 2.4 Traffic Data for Noise Prediction

Traffic data used in the noise models are summarized in Appendix B, were provided by DKS Associates for peak hour volumes and truck percentages for the 2019 Existing Conditions and the 2043 No Build and Build Alternatives (DKS 2020). Traffic data was developed using traffic tube counts obtained by actual field traffic counters at each of the modeled roadways in 2019 and were applied across the entire roadway network. Posted speeds were used for modeling the local network.

## 2.5 Noise Prediction Model

Per ODOT and FHWA guidelines, this 2020 NTR used version 2.5 of the FHWA's TNM to estimate existing and future Build case noisiest-hour roadway traffic noise levels. The modeled area extends approximately 1,000 feet from the new roadway alignment. The acoustical algorithms contained within the TNM have been validated with respect to carefully conducted noise measurement programs and show agreement in most cases for sites, with and without noise barriers.

Aerial photography, Geographic Information System, and design data (DOWL 2019) were used to create model the existing and future configurations in 3D with the TNM . The noise modeling accounts for such factors as propagation over different types of ground (acoustically soft and hard ground), elevated roadway sections, significant shielding effects from local terrain and structures, distance from the road, traffic speed, and hourly traffic volume. In some areas, local roadways without traffic were included in the modeling to help account for topographic and ground effects (i.e., acoustically reflective surfaces).

## 2.6 Validation

Model validation was presented in Section 3, 'Project Area Existing Conditions' of the 2016 NTR. For this 2020 NTR, additional validation measurements were performed to validate for the current conditions. Validation was performed for monitoring locations ML-01, ML-02, ML-03, shown in Figure 2, to determine whether TNM-predicted sound levels are within ±3 dB of measured levels. HMMH conducted a short-term (15-minute) measurement of Leq on Wednesday, November 6, 2019. The validation effort helped determine if terrain and other shielding effects changed relative to the previous modeling, with the opening of Basalt Creek Parkway to Grahams Ferry Road. For example, the area between Grahams Ferry

Road and Lower Boones Ferry Road is elevated, followed by ravine down to a creek traversed by the proposed project extension alignment.

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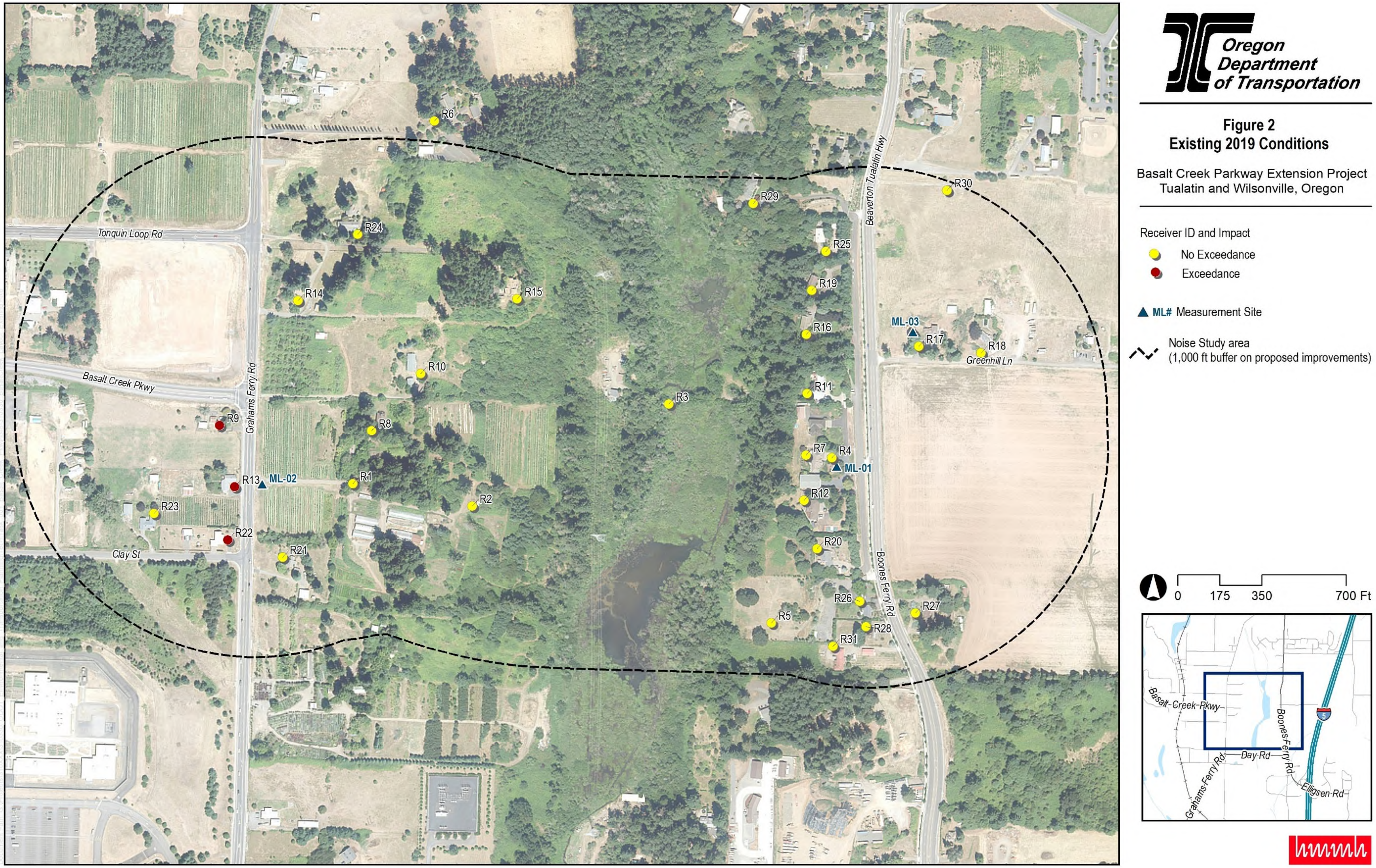
**Figure 2. Existing 2019 Conditions**



A comparison of predicted noise levels and measured noise levels for the monitoring locations are provided in Table 2. The modeled results are within ±3 dB, confirming the model accurately predicts noise levels for the area analyzed in this 2020 NTR. The updated validation run TNM files are included in Appendix A. Monitoring data and equipment calibration certificates are included in Appendix B.

**Table 2. Measured and Predicted Noise Levels**

*Source: HMMH Monitoring 2019*

| Monitoring Site | Street Address | Date/Start Time | Duration (Approx.) | Measured Noise Level (dBA(h) Leq) | TNM Predicted Noise Level (dBA (h) Leq) | Difference (dB) |
|---|---|---|---|---|---|---|
| ML-01 | 24137 SW Lower Boones Ferry Rd | 11-6-2019/1:25 PM | 15 minutes | 53.5 | 54.9 | 1.4 |
| ML-02 | 24130 Grahams Ferry Rd | 11-6-2019/2:20 PM | 15 minutes | 66.1 | 66.8 | 0.7 |
| ML-03 | 9415 SW Greenhill Ln | 11-6-2019/2:45 PM | 15 minutes | 60.0 | 57.4 | -2.6 |

Following validation, existing sound levels were predicted at 31 receiver IDs (representing 33 receptors). Sound levels were predicted at five feet above ground level. Existing terrain was included in the modeling to provide shielding for the receivers, where applicable.

# 3 Land Use

The study area extends approximately 1,000 feet from Project improvements. Existing land uses in the Basalt Creek vicinity include residential (Category B), Carlon School, a 4(f) and historic resource with no exterior use (Category D), and a plant nursery (Category E). Noise sensitivity at the nursery is unknown; however, it was included in the previous noise analysis and was carried forward as a Category E use in this updated analysis.

The land use receptors analyzed within the 1,000-foot buffer are the same as in the 2016 NTR in both name and location to allow comparisons to the 2016 NTR's results. There is also one potential right-of-way acquisition (R10) that was included in the 2016 NTR's build analysis, but since this acquisition has not been confirmed, it was still analyzed in this 2020 NTR.

Table 3 provides the number of noise sensitive land uses by ODOT noise policy land use type. Most (30) of the 33 identified uses are residential with a noise criterion of 65 dBA Leq(h). None of the uses are recreational.

The City of Tualatin Planning Department confirmed that there are no permits for development near the project area. There are, however, plans for unincorporated land to be annexed into the Tualatin city limits (Tualatin 2020).

**Table 3. Existing Land Uses**

*Source: HMMH analysis*

| ODOT NAAC Category (dBA Leq(h) Criteria) | Noise Land Use Designation | Total Number of Properties |
|---|---|---|
| B (65) | Residential | 30 |
| D (50) | Interior Historic School(1) | 1 |
| E (70) | Commercial | 2 |
| | **Total** | **33** |

Note: (1) the school's exterior has no use, therefore only the interior of the school is considered

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# 4 Existing Conditions

Predicted existing peak noise hour sound levels at receivers located within the project area are provided in Table 4. TNM files are shown in Appendix A. Predicted Existing Condition exterior sound levels range from 45 dBA Leq(h) to 70 dBA Leq(h) and under the peak noise hour conditions, three residences approach or exceed the NAAC. Figure 2 shows the location of the modeled receivers and exceedance conditions for the Existing Conditions. For receptors located further away from existing roadways, such as those near the future bridge crossing, it is possible that ambient sound levels are higher than the predicted traffic noise levels, i.e., there may be sources of noise other than road traffic.

**Table 4. Predicted Traffic Noise Levels**

*Source: HMMH analysis*

| Receiver ID | Land Use Description[1] | Number of Receptors | Activity Category | ODOT NAAC (dBA Leq(h)) ; | Existing Noise (dBA Leq(h))[2] | No-Build Alternative (dBA Leq(h))[2] | Change in Noise Level between Existing and No-Build Alternative (dB) | Build Alternative (dBA Leq(h)) [2] | Change in Noise Level between Existing and Build Alternative (dB)[2] |
|---|---|---|---|---|---|---|---|---|---|
| R1 | Commercial Nursery | 1 | E | 70 | 54 | 54 | 0 | 59 | 5 |
| R2 | Commercial Nursery | 1 | E | 70 | 48 | 49 | 1 | 57 | 9 |
| R3 | SF | 1 | B | 65 | 45 | 46 | 1 | 61 | **<u>16</u>** |
| R4 | SF | 2 | B | 65 | 53 | 55 | 2 | **<u>68</u>** | **<u>15</u>** |
| R5 | SF | 1 | B | 65 | 47 | 49 | 2 | 54 | 7 |
| R6 | SF | 1 | B | 65 | 48 | 49 | 1 | 50 | 2 |
| R7 | SF | 2 | B | 65 | 50 | 52 | 2 | **<u>68</u>** | **<u>18</u>** |
| R8 | Historic School Interior | 1 | D | 50 | 34 | 34 | 0 | 45 | **<u>11</u>** |
| R9 | SF | 1 | B | 65 | **<u>66</u>** | **<u>67</u>** | 1 | **<u>67</u>** | 1 |
| R10 | SF | 1 | B | 65 | 51 | 51 | 0 | **<u>71</u>** | **<u>20</u>** |
| R11 | SF | 1 | B | 65 | 50 | 51 | 1 | **<u>66</u>** | **<u>16</u>** |
| R12 | SF | 1 | B | 65 | 49 | 51 | 2 | 61 | **<u>12</u>** |
| R13 | SF | 1 | B | 65 | **<u>70</u>** | **<u>71</u>** | 1 | **<u>69</u>** | -1 |
| R14 | SF | 1 | B | 65 | 59 | 60 | 1 | 60 | 1 |
| R15 | SF | 1 | B | 65 | 47 | 48 | 1 | 57 | **<u>10</u>** |
| R16 | SF | 1 | B | 65 | 50 | 52 | 2 | 60 | **<u>10</u>** |
| R17 | SF | 1 | B | 65 | 56 | 58 | 2 | 62 | 6 |
| R18 | SF | 1 | B | 65 | 48 | 49 | 1 | 55 | 7 |
| R19 | SF | 1 | B | 65 | 52 | 54 | 2 | 59 | 7 |
| R20 | SF | 1 | B | 65 | 51 | 53 | 2 | 58 | 7 |
| R21 | SF | 1 | B | 65 | 61 | 62 | 1 | 60 | -1 |
| R22 | SF | 1 | B | 65 | **<u>68</u>** | **<u>68</u>** | 0 | **<u>66</u>** | -2 |
| R23 | SF | 1 | B | 65 | 55 | 55 | 0 | 55 | 0 |
| R24 | SF | 1 | B | 65 | 53 | 53 | 0 | 55 | 2 |
| R25 | SF | 1 | B | 65 | 54 | 55 | 1 | 60 | 6 |
| R26 | SF | 1 | B | 65 | 60 | 62 | 2 | **<u>66</u>** | 6 |
| R27 | SF | 1 | B | 65 | 63 | 64 | 1 | **<u>68</u>** | 5 |
| R28 | SF | 1 | B | 65 | 60 | 62 | 2 | **<u>66</u>** | 6 |
| R29 | SF | 1 | B | 65 | 46 | 47 | 1 | 53 | 7 |
| R30 | SF | 1 | B | 65 | 51 | 53 | 2 | 57 | 6 |
| R31 | SF | 1 | B | 65 | 52 | 54 | 2 | 58 | 6 |

**Summary**

| Element | Existing Conditions | No-Build Alternative | Build Alternative |
|---|---|---|---|
| Number of Receptors that Meet or Exceed NAAC | 3 | 3 | 12 |
| Receptors with Substantial Noise Increase | N/A | 0 | 11 |
| Total Exceedances/Impacts | 3 | 3 | 17 |
| Range of Sound Levels (dBA Leq(h))[4] | 45 to 70 | 46 to 71 | 50 to 71 |
| Range of Change in Sound Levels (dB)[5] | N/A | 0 to 2 | -2 to 20 |

Notes:

1. SF = Single-Family Residential;
2. **<u>Bold Underline</u>** indicates exceedance of NAAC.
3. Interior use calculated by subtracting FHWA adjustment factor of 20 dB for light frame buildings with ordinary stash (single pane windows).
4. Range of sound levels does not include interior use at R8
5. Relative to Existing conditions

# 5 Traffic Noise Analysis and Noise Impacts

Traffic noise analysis and impacts are provided in the following subsections for the No-Build Alternative (5.1) and Build Alternative (5.2).

## 5.1 No-Build Alternative Noise Levels

The No-Build Alternative exterior sound levels would range from 46 dBA Leq(h) to 71 dBA Leq(h). An increase of up to 2 dB over existing traffic noise levels is predicted for the No-Build Alternative (Receiver R8, exterior and interior). Three receivers representing three residences are predicted to meet or exceed the NAAC. Analysis locations with impact type are shown in Figure 3 and predicted sound levels at each analysis point are provided in Table 4.

## 5.2 Build Alternative Noise Levels

The Build Alternative exterior sound levels would range from 50 dBA Leq(h) to 71 dBA Leq(h). An increase of up to 20 dB over existing traffic noise levels is predicted for the Build Alternative. There would be 11 receptors impacted because of substantial noise increases per ODOT regulations (see underlined numbers in rightmost column of Table 4) and six of these would also exceed the NAAC. The increases would result from the presence of a new roadway where there was no roadway before. The new roadway would also shift some traffic from other roadways to the new Basalt Creek Parkway Extension instead. Reductions of up to 2 dB would result from this change in traffic, e.g., Receiver R22. Six residential units are predicted to meet or exceed the NAAC that would not be impacted by a substantial noise increase from the Project. Therefore, a total of 17 receptors would be impacted by traffic noise. Analysis locations with impact type are shown in Figure 4 and predicted sound levels at each analysis point are provided in Table 4.

**Figure 3. No Build 2043 Alternative**

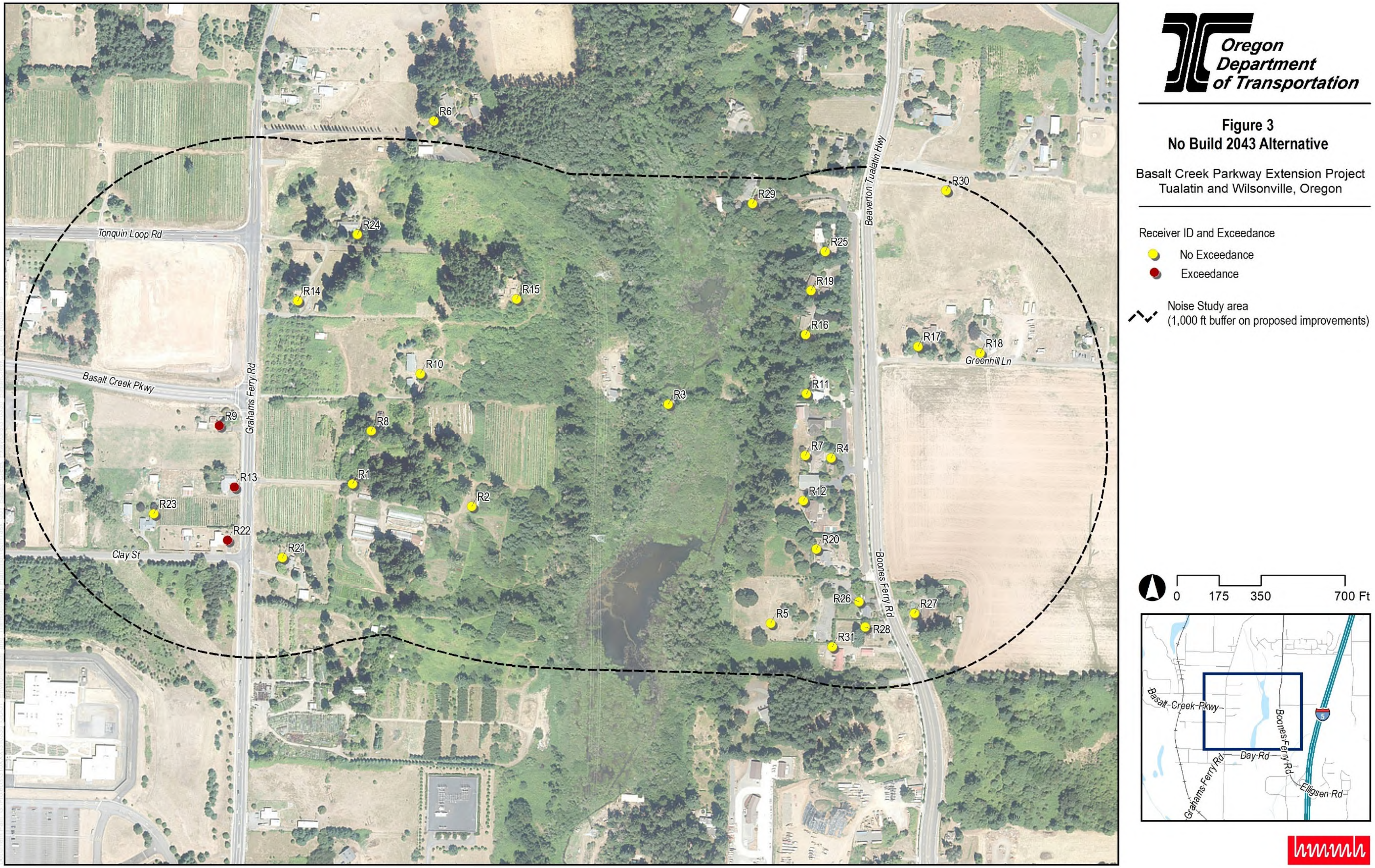
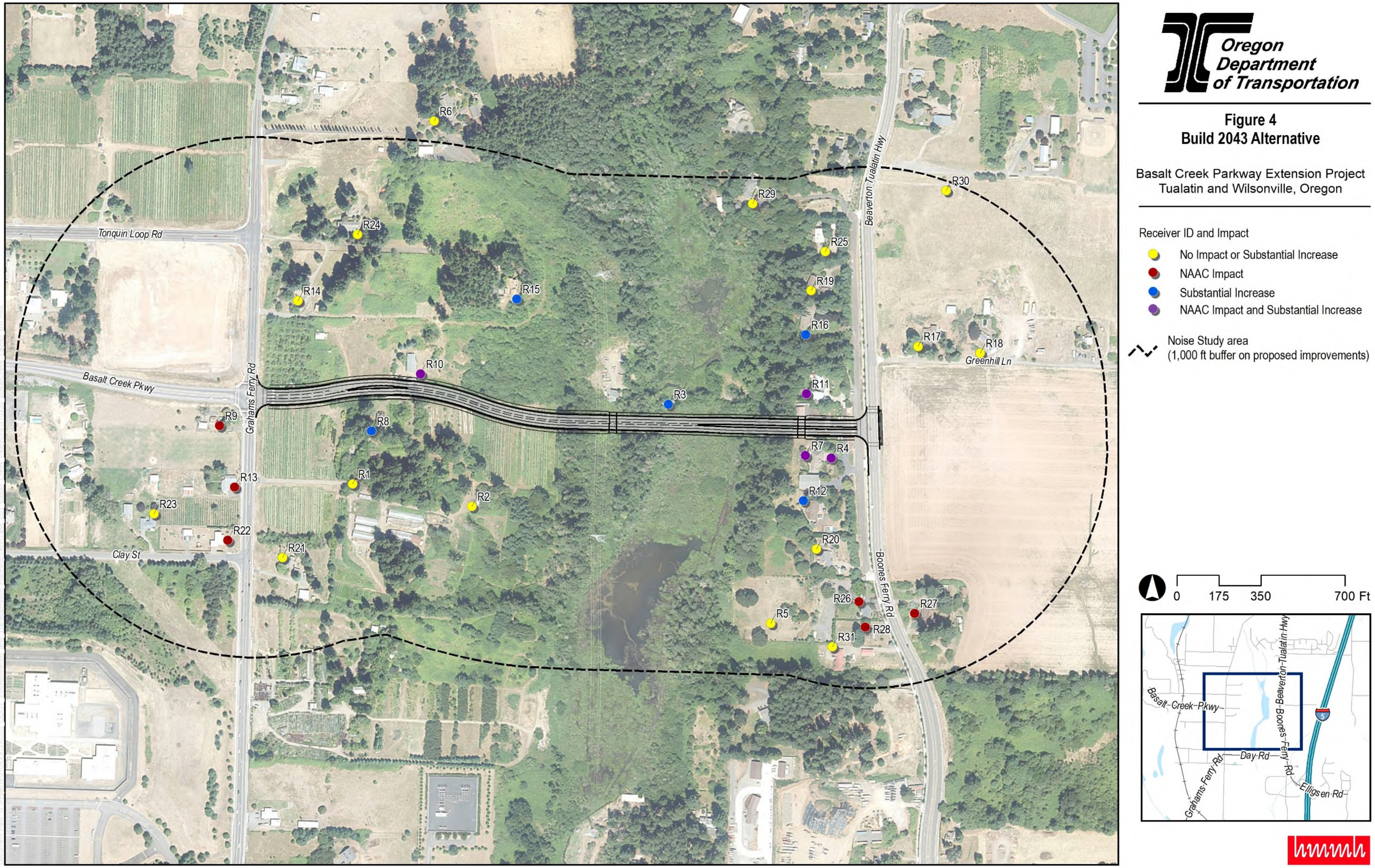


Figure 4. Build 2043 Alternative



# 6 Construction Noise

This section describes potential temporary construction noise impacts for the Project. The analysis included a qualitative assessment of noise from general construction of the roadway. Section 6.1 addresses general construction noise while Section 6.2 addresses construction noise abatement.

## 6.1 General Construction Noise

If the Build Alternative were constructed, sensitive land uses, and structures would be exposed to temporarily elevated noise and vibration levels from construction which may be a source of annoyance to the public.

Construction noise would be the result of operating construction equipment along the Project right of way (ROW). Noise levels from construction equipment would be dependent upon several factors such as the type of equipment, construction schedule, and distance to the equipment in use for the various Project construction activities.

Typical construction equipment maximum (single event) noise levels (Lmax) are provided in Table 5.

**Table 5. Typical Construction Equipment Noise Levels**

*Source: FHWA 2006*

| Equipment Description | Impact Device? | Acoustical use Factor (%) | Specified Lmax @ 50 ft (dBA, slow) | Measured Lmax @ 50 ft (dBA, slow) |
|---|---|---|---|---|
| All Other Equipment > 5 HP | No | 50 | 85 | -N/A- |
| Auger Drill Rig | No | 20 | 85 | 84 |
| Backhoe | No | 40 | 80 | 78 |
| Bar Bender | No | 20 | 80 | -N/A- |
| Blasting | Yes | -N/A- | 94 | -N/A- |
| Boring Jack Power Unit | No | 50 | 80 | 83 |
| Chain Saw | No | 20 | 85 | 84 |
| Clam Shovel (dropping) | Yes | 20 | 93 | 87 |
| Compactor (ground) | No | 20 | 80 | 83 |
| Compressor (air) | No | 40 | 80 | 78 |
| Concrete Batch Plant | No | 15 | 83 | -N/A- |
| Concrete Mixer Truck | No | 40 | 85 | 79 |
| Concrete Pump Truck | No | 20 | 82 | 81 |
| Concrete Saw | No | 20 | 90 | 90 |
| Crane | No | 16 | 85 | 81 |

**Table 5. Typical Construction Equipment Noise Levels**

*Source: FHWA 2006*

| Equipment Description | Impact Device? | Acoustical use Factor (%) | Specified Lmax @ 50 ft (dBA, slow) | Measured Lmax @ 50 ft (dBA, slow) |
|---|---|---|---|---|
| Dozer | No | 40 | 85 | 82 |
| Drill Rig Truck | No | 20 | 84 | 79 |
| Drum Mixer | No | 50 | 80 | 80 |
| Dump Truck | No | 40 | 84 | 76 |
| Excavator | No | 40 | 85 | 81 |
| Flat Bed Truck | No | 40 | 84 | 74 |
| Front End Loader | No | 40 | 80 | 79 |
| Generator | No | 50 | 82 | 81 |
| Generator (<25KVA, VMS signs) | No | 50 | 70 | 73 |
| Gradall | No | 40 | 85 | 83 |
| Grader | No | 40 | 85 | -N/A- |
| Grapple (on backhoe) | No | 40 | 85 | 87 |
| Horizontal Boring Hydr. Jack | No | 25 | 80 | 82 |
| Hydra Break Ram | Yes | 10 | 90 | -N/A- |
| Impact Pile Driver | Yes | 20 | 95 | 101 |
| Jackhammer | Yes | 20 | 85 | 89 |
| Man Lift | No | 20 | 85 | 75 |
| Mounted Impact hammer (hoe ram) | Yes | 20 | 90 | 90 |
| Pavement Scarifier | No | 20 | 85 | 90 |
| Paver | No | 50 | 85 | 77 |
| Pickup Truck | No | 40 | 55 | 75 |
| Pneumatic Tools | No | 50 | 85 | 85 |
| Pumps | No | 50 | 77 | 81 |
| Refrigerator Unit | No | 100 | 82 | 73 |
| Rivet Buster/chipping gun | Yes | 20 | 85 | 79 |
| Rock Drill | No | 20 | 85 | 81 |
| Roller | No | 20 | 85 | 80 |
| Sand Blasting (Single Nozzle) | No | 20 | 85 | 96 |
| Scraper | No | 40 | 85 | 84 |

**Table 5. Typical Construction Equipment Noise Levels**

*Source: FHWA 2006*

| Equipment Description | Impact Device? | Acoustical use Factor (%) | Specified Lmax @ 50 ft (dBA, slow) | Measured Lmax @ 50 ft (dBA, slow) |
|---|---|---|---|---|
| Shears (on backhoe) | No | 40 | 85 | 96 |
| Slurry Plant | No | 100 | 78 | 78 |
| Slurry Trenching Machine | No | 50 | 82 | 80 |
| Soil Mix Drill Rig | No | 50 | 80 | -N/A- |
| Tractor | No | 40 | 84 | -N/A- |
| Vacuum Excavator (Vac-truck) | No | 40 | 85 | 85 |
| Vacuum Street Sweeper | No | 10 | 80 | 82 |
| Ventilation Fan | No | 100 | 85 | 79 |
| Vibrating Hopper | No | 50 | 85 | 87 |
| Vibratory Concrete Mixer | No | 20 | 80 | 80 |
| Vibratory Pile Driver | No | 20 | 95 | 101 |
| Warning Horn | No | 5 | 85 | 83 |
| Welder/Torch | No | 40 | 73 | 74 |

## 6.2 Construction Noise Abatement

To avoid, minimize, and abate temporary adverse noise impacts, ODOT includes standard project specifications (290.32) for all projects to mitigate for construction noise impacts. The following construction measures reflect current ODOT standard specifications:

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

- Do not perform construction within 1,000 feet of an occupied dwelling on Sundays or legal holidays, or between the hours of 10:00 p.m. and 6:00 a.m. on other days, without the approval of the Engineer.
- Use Equipment with sound control devices no less effective than those provided on the original Equipment. Equipment with un-muffled exhausts is prohibited.
- Use Equipment complying with pertinent equipment noise standards of the EPA.
- Do not drive piling or perform blasting operations within 3,000 feet of an occupied dwelling on Sundays or legal holidays, or between the hours of 8:00 p.m. and 8:00 a.m. on other days, without the approval of the Engineer.

- Mitigate the noise from Rock crushing or screening operations performed within 3,000 feet of all occupied dwellings by placing material stockpiles between the operation and the affected dwellings, or by other means approved by the Engineer.

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

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

# 7 Range of Potential Abatement Measures

The following noise abatement selection criteria are used when considering potential noise abatement for noise impacts:

- Noise abatement benefits
- Opinions of impacted property owners
- Land use and zoning
- Controlled and uncontrolled access
- Cost of abatement
- Environmental impacts
- Absolute noise levels
- Non-traffic noise

Changes in alignment can be considered to prevent traffic noise impacts, but generally, changes in alignment shift impacts to other properties. Preventing impacts is an important part of noise control. In this project area, the largest contribution of traffic noise to the nearby sensitive receptors comes from the new Basalt Creek Parkway, Grahams Ferry Road, and Lower Boones Ferry Road mainline traffic volumes. The project would cause traffic noise levels to increase from Existing Conditions by a maximum of 20 dB.

Noise barriers are not common considerations in rural project areas like the Basalt Creek Parkway Extension Project because residences are somewhat isolated with larger properties and driveways. ODOT guidance states a noise barrier must meet feasibility and reasonableness criteria to be recommended for construction. Feasibility or constructability of an abatement measure includes acoustical and engineering factors. For the abatement to be feasible, ODOT requires that a simple majority of impacted receptors would achieve at least a 5 dBA reduction in noise levels. ODOT also considers engineering factors such as barrier height, safety, topography, drainage, utilities, and access issues when determining feasibility. ODOT considers barriers of all heights, but those exceeding 25 feet would likely exceed the reasonableness criteria, i.e., cost-effectiveness.

ODOT considers three factors to determine whether a noise barrier is reasonable: the viewpoints of the residents and property owners that benefit from the proposed abatement, the cost-effectiveness of the abatement measure, and the ODOT noise reduction design goal for abatement. All three factors must be met to satisfy the reasonableness criteria.

If a barrier meets cost reasonableness and achieves the design goal, ODOT distributes a survey by mail to benefitted residents to determine the residents' desire for abatement. If a majority (>50%) of those property owners and renters responding to the survey do not want the noise barrier, it would not be recommended for construction. A 'no' decision means that federal funds would not be available for future abatement at that location unless there was a project near the location that was defined as Type I (as defined by 23 CFR 772 and the ODOT Noise Manual). This reasonableness criterion is made during final design if the other two reasonableness criteria are met.

The second reasonableness criterion is the cost-effectiveness of the proposed abatement. All benefitted residences are considered in the calculation of cost-effectiveness. A benefitted residence is any impacted or non-impacted residence that would receive a noise reduction of 5 dBA or more. ODOT considers a reasonable cost to be a maximum of $25,000 per benefited residence. This cost is based on $20 per square foot for a post and panel barrier up to 16 feet tall. For wall heights greater than 16 feet up to 25 feet, the unit cost increases by 40 percent to $25 per square foot to cover the additional structural considerations.

Estimating costs for noise walls higher than 25 feet must be done on a case-by-case basis. In those cases, the noise analyst is required to consult with the ODOT Noise Program Coordinator (ODOT 2020).

Noise barriers typically only meet this criterion of $25,000 maximum per benefited residence where residences are located close together, such that several residences benefit from the noise barrier. Single residences or sparsely distributed residences on large lots seldom meet the cost-effectiveness criterion. If the cost of the proposed noise abatement exceeds allowable limits, a noise barrier would not be recommended.

Under special circumstances the typical maximum for reasonable cost of $25,000 per benefitted residence can be increased to a maximum of $35,000 per benefitted residence. To exceed the $25,000 limit, one of the following optional reasonableness criteria must be met:

- Large increases of 10 dBA or more in noise with the future Build condition over the existing condition;
- High noise levels, 70 dBA Leq(h) or higher;
- Areas of mixed land use zoning may not be recommended for abatement because land use may change, and long-term land use may be uncertain.

The third reasonableness criterion is the ODOT design goal. At least one benefited receptor must achieve the noise reduction goal of 7 dBA.

Noise abatement in the form of noise barriers (walls) were analyzed for the impacted receptors. Sections 7.1 through 7.5 provide the results of these analyses.

## 7.1 North Parkway Barrier

A sound barrier wall was analyzed to abate the noise exceedances under the Build conditions at receptors located on the north side of the Basalt Creek Parkway Extension. A barrier along the edge of roadway and on the bridge structure may provide abatement for impacted receptors at R3, R10 R11, R15, and R16.

A barrier with a length of 2,512 feet was analyzed at uniform heights ranging from 10-feet to 16-feet. The barrier would be feasible at a height of 10-feet or taller and at 16-feet tall, it would benefit three impacted receptors. At 16-feet tall, the barrier would also achieve the design goal of 7 dB reduction at one or more receptors; however, at any height analyzed, the wall is too costly with the wall at 16-feet costing $267,947 per benefitted receptor. For this reason, the barrier is not recommended for inclusion in the Project. Table 6 provides a summary of the barrier analyzed at 16 feet in height. TNM files are included in Appendix A and detailed barrier analysis tables are provided in Appendix C.

**Table 6. North Parkway Abatement Analysis**

*Source: HMMH Analysis, 2020*

| Barrier Name | Barrier Length (ft.) | Barrier Height (ft.) | Number of Impacted Receptors Benefitted | Total Number of Benefitted Receptors | Percent Feasible (%) | Total Barrier Cost | Cost Per Benefit | Determination |
|---|---|---|---|---|---|---|---|---|
| North Parkway Barrier | 2,512 | 16 | 3 | 3 | 60% | $1,004,800 | $267,947 | Feasible but not Reasonable (>$25,000 per benefit) |

## 7.2 South Parkway Barrier

A sound barrier wall was analyzed to abate the noise exceedances under the Build conditions at receptors located on the south side of the Basalt Creek Parkway Extension. A barrier along the edge of roadway and on the bridge structure may provide abatement for impacted receptors at R4, R7, R8, and R12 representing residences and the historic school.

A barrier with a length of 2,496 feet was analyzed at uniform heights ranging from 10-feet to 16-feet. The analysis demonstrated that the barrier would be feasible at a height of 12-feet or taller and at 16-feet tall, it would benefit seven impacted receptors. At 16-feet tall, the barrier would also achieve the design goal of 7 dB reduction at one or more receptors; however, at any height analyzed, the wall is too costly with the wall at 14-feet costing $114,103 per benefitted receptor. For this reason, the barrier is not recommended for inclusion in the Project. Table 7 provides a summary of the barrier analyzed at 14 feet in height. TNM files are included in Appendix A and detailed barrier analysis tables are provided in Appendix C.

**Table 7. South Parkway Barrier (Uniform Height)**

*Source: HMMH Analysis, 2020*

| Barrier Name | Barrier Length (ft.) | Barrier Height (ft.) | Number of Impacted Receptors Benefitted | Total Number of Benefitted Receptors | Percent Feasible (%) | Total Barrier Cost | Cost Per Benefit | Determination |
|---|---|---|---|---|---|---|---|---|
| South Parkway Barrier | 2,496 | 14 | 7 | 7 | 100% | $998,400 | $114,103 | Feasible but not Reasonable (>$25,000 per benefit) |

## 7.3 Boones Ferry Road Frontage Road Barrier

A sound barrier wall was analyzed to abate the noise exceedances at residential receptors located on the south side of the Basalt Creek Parkway Extension to the west of Lower Boones Ferry Road in front of a local frontage road. The wall may provide abatement for receptors being represented by four receivers (R4, R7, R12, and R20) representing residences.

A barrier with a length of 489 feet was modeled along between Lower Boones Ferry Road and the frontage road for abatement of sound levels to the impacted residences. Seven individual barrier analyses representing this sound wall at uniform heights ranging from 10 to 16 feet tall were evaluated.

As shown in Table 8, the barrier with a height of 16 feet would not benefit any of the impacted residences; therefore, the barrier is not feasible. TNM files are included in Appendix A.

**Table 8. Frontage Road Barrier**

*Source: HMMH Analysis 2020*

| Barrier Name | Barrier Length (ft.) | Barrier Height (ft.) | Number of Impacted Receptors Benefitted (>=65 dB) | Total Number of Benefitted Receptors (5 dB) | Percent Feasible (%) | Determination |
|---|---|---|---|---|---|---|
| Frontage Road Barrier | 489 | 16 | 0 | 0 | 0 | Not Feasible (<50% Benefitted) |

## 7.4 Impacts at R13 and R22

Two impacts would occur under the Build Alternative conditions along Grahams Ferry Road, specifically at receptors R13 and R22. Each of these receptors is a single-family residence with driveway access to Grahams Ferry Road. For a noise barrier to feasibly reduce traffic noise it would need to be constructed across these driveways blocking the line of sight to the roadway. Alternative access would need to be provided to these receptors to provide noise abatement in the form of a noise barrier. This is considered infeasible for noise abatement since it could not be constructed without causing additional ROW impact. For these reasons, a noise barrier is not recommended for abatement at this location.

## 7.5 Impacts at R26, R27, and R28

Three impacts would occur under the Build Alternative conditions along Lower Boones Ferry Road, specifically at receptors R26-R28. Each of these receptors is a single-family residence with driveway access to Lower Boones Ferry Road. For a noise barrier to feasibly reduce traffic noise it would need to be constructed across these driveways blocking the line of sight to the roadway. Alternative access would need to be provided to these receptors to provide noise abatement in the form of a noise barrier. This is considered infeasible for noise abatement since it could not be constructed without causing additional ROW impact. For these reasons, a noise barrier is not recommended for abatement at this location.

# 8 Information for Local Government Officials

ODOT will provide a copy of this report to the planning departments of the Cities of Tualatin and Wilsonville, and Washington County, making it possible for these agencies to inform development. Noise compatible planning techniques are also described in the FHWA publication “Entering the Quiet Zone: Noise Compatible Land Use Planning” (FHWA 2002).

At the time this report was prepared, several vacant lands were located within the study area. Most of the undeveloped areas are located to the north and south of the Basalt Creek Parkway Extension between Lower Boones Ferry Road and Grahams Ferry Road. Table 9 provides the distances to ODOT’s NAAC. Local agencies should consider whether residential (NAAC Category B), public use, such as schools and parks (NAAC Category C), and commercial uses (NAAC Category E) are compatible in these areas.

**Table 9. Distances to NAACs for Local Planning Agencies**

*HMMH Analysis, 2020*

| Roadway | Distance from edge of travel lane to NAAC B & C Threshold (feet) | Distance from edge of travel lane to NAAC E Threshold (feet) |
|---|---|---|
| Basalt Creek Parkway Extension | 88 | 13 |

# 9 References

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# Appendix A TNM Files

Provided electronically.

# Appendix B Traffic Data, Field Measurement Information and Laboratory Calibration Sheets

**Table B-1: Existing Peak Vehicle Hour Traffic for TNM**

*DKS, 2020*

| Roadway Segment | Direction | Posted Speed (hpg) | Total Volume | Cars | Medium Trucks | Heavy Trucks |
|---|---|---|---|---|---|---|
| Basalt Creek Parkway - West of Grahams Ferry Road | Westbound | 45 | 559 | 547 | 6 | 6 |
| Basalt Creek Parkway - West of Grahams Ferry Road | Eastbound | 45 | 559 | 547 | 6 | 6 |
| Grahams Ferry Road - North of SW Tonquin Road | Northbound | 45 | 728 | 700 | 14 | 14 |
| Grahams Ferry Road - North of SW Tonquin Road | Southbound | 45 | 728 | 700 | 14 | 14 |
| Grahams Ferry Road - SW Tonquin Road to SW Day Road | Northbound | 45 | 728 | 700 | 14 | 14 |
| Grahams Ferry Road - SW Tonquin Road to SW Day Road | Southbound | 45 | 728 | 700 | 14 | 14 |
| Grahams Ferry Road - South of SW Day Road | Northbound | 45 | 728 | 700 | 14 | 14 |
| Grahams Ferry Road - South of SW Day Road | Southbound | 45 | 728 | 700 | 14 | 14 |
| Tonquin Road - West of Grahams Ferry Road | Westbound | 30 | 480 | 471 | 4 | 4 |
| Tonquin Road - West of Grahams Ferry Road | Eastbound | 30 | 480 | 471 | 4 | 4 |
| Boones Ferry Road - North of SW Day Road | Northbound | 45 | 491 | 490 | 0 | 0 |
| Boones Ferry Road - North of SW Day Road | Southbound | 45 | 491 | 490 | 0 | 0 |
| Boones Ferry Road - South of SW Day Road | Northbound | 45 | 491 | 490 | 0 | 0 |
| Boones Ferry Road - South of SW Day Road | Southbound | 45 | 491 | 490 | 0 | 0 |

Note: Traffic on Day Road obtained from 2016 NTR (SLR 2016)

**Table B-2: No Build Peak Vehicle Hour Traffic for TNM**

*DKS, 2020*

| Roadway Segment | Direction | Posted Speed (mph) | Total Volume | Cars | Medium Trucks | Heavy Trucks |
|---|---|---|---|---|---|---|
| Basalt Creek Parkway - West of Grahams Ferry Road | Westbound | 45 | 750 | 737 | 6 | 6 |
| Basalt Creek Parkway - West of Grahams Ferry Road | Eastbound | 45 | 750 | 737 | 6 | 6 |
| Grahams Ferry Road - North of SW Tonquin Road | Northbound | 45 | 975 | 961 | 7 | 7 |
| Grahams Ferry Road - North of SW Tonquin Road | Southbound | 45 | 975 | 961 | 7 | 7 |
| Grahams Ferry Road - SW Tonquin Road to Basalt Creek Parkway | Northbound | 45 | 975 | 961 | 7 | 7 |
| Grahams Ferry Road - SW Tonquin Road to Basalt Creek Parkway | Southbound | 45 | 975 | 961 | 7 | 7 |
| Grahams Ferry Road - Basalt Creek Parkway to SW Day Road | Northbound | 45 | 975 | 961 | 7 | 7 |
| Grahams Ferry Road - Basalt Creek Parkway to SW Day Road | Southbound | 45 | 975 | 961 | 7 | 7 |
| Grahams Ferry Road - South of SW Day Road | Northbound | 45 | 975 | 961 | 7 | 7 |
| Grahams Ferry Road - South of SW Day Road | Southbound | 45 | 975 | 961 | 7 | 7 |
| Tonquin Road - West of Grahams Ferry Road | Westbound | 30 | 575 | 566 | 5 | 5 |
| Tonquin Road - West of Grahams Ferry Road | Eastbound | 30 | 575 | 566 | 5 | 5 |
| Boones Ferry Road - North of SW Day Road | Northbound | 45 | 725 | 724 | 0 | 0 |
| Boones Ferry Road - North of SW Day Road | Southbound | 45 | 725 | 724 | 0 | 0 |

Note: Traffic on Day Road obtained from 2016 NTR (SLR 2016)

**Table B-3: Build Peak Vehicle Hour Traffic for TNM**

*DKS, 2020*

| Roadway Segment | Direction | Posted Speed (mph) | Total Volume | Cars | Medium Trucks | Heavy Trucks |
|---|---|---|---|---|---|---|
| Basalt Creek Parkway - Grahams Ferry Road to Boones Ferry Road | Westbound | 45 | 980 | 956 | 12 | 12 |
| Basalt Creek Parkway - Grahams Ferry Road to Boones Ferry Road | Eastbound | 45 | 980 | 956 | 12 | 12 |
| Basalt Creek Parkway - West of Grahams Ferry Road | Westbound | 45 | 980 | 956 | 12 | 12 |
| Basalt Creek Parkway - West of Grahams Ferry Road | Eastbound | 45 | 980 | 956 | 12 | 12 |
| Grahams Ferry Road - North of SW Tonquin Road | Northbound | 45 | 638 | 633 | 2 | 2 |
| Grahams Ferry Road - North of SW Tonquin Road | Southbound | 45 | 638 | 633 | 2 | 2 |
| Grahams Ferry Road - SW Tonquin Road to Basalt Creek | Northbound | 45 | 638 | 633 | 2 | 2 |
| Grahams Ferry Road - SW Tonquin Road to Basalt Creek | Southbound | 45 | 638 | 633 | 2 | 2 |
| Tonquin Road - West of Grahams Ferry Road1 | Westbound | 30 | 575 | 566 | 5 | 5 |
| Tonquin Road - West of Grahams Ferry Road1 | Eastbound | 30 | 575 | 566 | 5 | 5 |
| Boones Ferry Road - North of Basalt Creek | Northbound | 45 | 1,410 | 1,386 | 12 | 12 |
| Boones Ferry Road - North of Basalt Creek | Southbound | 45 | 1,410 | 1,386 | 12 | 12 |

**Table B-4: Existing Peak Truck Hour Traffic for TNM**

*DKS, 2020*

| Roadway Segment | Direction | Posted Speed (mph) | Total Volume | Cars | Medium Trucks | Heavy Trucks |
|---|---|---|---|---|---|---|
| Basalt Creek Parkway - West of Grahams Ferry Road | Westbound | 45 | 546 | 529 | 8 | 8 |
| Basalt Creek Parkway - West of Grahams Ferry Road | Eastbound | 45 | 546 | 529 | 8 | 8 |
| Grahams Ferry Road - North of SW Tonquin Road | Northbound | 45 | 510 | 485 | 12 | 12 |
| Grahams Ferry Road - North of SW Tonquin Road | Southbound | 45 | 510 | 485 | 12 | 12 |
| Grahams Ferry Road - SW Tonquin Road to SW Day Road | Northbound | 45 | 510 | 485 | 12 | 12 |
| Grahams Ferry Road - SW Tonquin Road to SW Day Road | Southbound | 45 | 510 | 485 | 12 | 12 |
| Grahams Ferry Road - South of SW Day Road | Northbound | 45 | 510 | 485 | 12 | 12 |
| Grahams Ferry Road - South of SW Day Road | Southbound | 45 | 510 | 485 | 12 | 12 |
| Tonquin Road - West of Grahams Ferry Road | Westbound | 30 | 403 | 395 | 4 | 4 |
| Tonquin Road - West of Grahams Ferry Road | Eastbound | 30 | 403 | 395 | 4 | 4 |
| Boones Ferry Road - North of SW Day Road | Northbound | 45 | 311 | 308 | 2 | 2 |
| Boones Ferry Road - North of SW Day Road | Southbound | 45 | 311 | 308 | 2 | 2 |
| Boones Ferry Road - South of SW Day Road | Northbound | 45 | 311 | 308 | 2 | 2 |
| Boones Ferry Road - South of SW Day Road | Southbound | 45 | 311 | 308 | 2 | 2 |

Note: Traffic on Day Road obtained from 2016 NTR (SLR 2016)

**Table B-5: No Build Peak Truck Hour Traffic for TNM**

*DKS, 2020*

| Roadway Segment | Direction | Posted Speed (mph) | Total Volume | Cars | Medium Trucks | Heavy Trucks |
|---|---|---|---|---|---|---|
| Basalt Creek Parkway - West of Grahams Ferry Road | Westbound | 45 | 738 | 721 | 8 | 8 |
| Basalt Creek Parkway - West of Grahams Ferry Road | Eastbound | 45 | 738 | 721 | 8 | 8 |
| Grahams Ferry Road - North of SW Tonquin Road | Northbound | 45 | 688 | 662 | 13 | 13 |
| Grahams Ferry Road - North of SW Tonquin Road | Southbound | 45 | 688 | 662 | 13 | 13 |
| Grahams Ferry Road - SW Tonquin Road to Basalt Creek Parkway | Northbound | 45 | 688 | 662 | 13 | 13 |
| Grahams Ferry Road - SW Tonquin Road to Basalt Creek Parkway | Southbound | 45 | 688 | 662 | 13 | 13 |
| Grahams Ferry Road - Basalt Creek Parkway to SW Day Road | Northbound | 45 | 688 | 662 | 13 | 13 |
| Grahams Ferry Road - Basalt Creek Parkway to SW Day Road | Southbound | 45 | 688 | 662 | 13 | 13 |
| Grahams Ferry Road - South of SW Day Road | Northbound | 45 | 688 | 662 | 13 | 13 |
| Grahams Ferry Road - South of SW Day Road | Southbound | 45 | 688 | 662 | 13 | 13 |
| Tonquin Road - West of Grahams Ferry Road | Westbound | 30 | 475 | 461 | 7 | 7 |
| Tonquin Road - West of Grahams Ferry Road | Eastbound | 30 | 475 | 461 | 7 | 7 |
| Boones Ferry Road - North of SW Day Road | Northbound | 45 | 692 | 459 | 2 | 2 |
| Boones Ferry Road - North of SW Day Road | Southbound | 45 | 692 | 459 | 2 | 2 |

Note: Traffic on Day Road obtained from 2016 NTR (SLR 2016)

**Table B-6: Build Peak Truck Hour Traffic for TNM**

*DKS, 2020*

| Roadway Segment | Direction | Posted Speed (mph) | Total Volume | Cars | Medium Trucks | Heavy Trucks |
|---|---|---|---|---|---|---|
| Basalt Creek Parkway - Grahams Ferry Road to Boones Ferry Road | Westbound | 45 | 957 | 894 | 32 | 32 |
| Basalt Creek Parkway - Grahams Ferry Road to Boones Ferry Road | Eastbound | 45 | 957 | 894 | 32 | 32 |
| Basalt Creek Parkway - West of Grahams Ferry Road | Westbound | 45 | 957 | 894 | 32 | 32 |
| Basalt Creek Parkway - West of Grahams Ferry Road | Eastbound | 45 | 957 | 894 | 32 | 32 |
| Grahams Ferry Road - North of SW Tonquin Road | Northbound | 45 | 447 | 439 | 4 | 4 |
| Grahams Ferry Road - North of SW Tonquin Road | Southbound | 45 | 447 | 439 | 4 | 4 |
| Grahams Ferry Road - SW Tonquin Road to Basalt Creek | Northbound | 45 | 447 | 439 | 4 | 4 |
| Grahams Ferry Road - SW Tonquin Road to Basalt Creek | Southbound | 45 | 447 | 439 | 4 | 4 |
| Tonquin Road - West of Grahams Ferry Road1 | Westbound | 30 | 475 | 461 | 7 | 7 |
| Tonquin Road - West of Grahams Ferry Road1 | Eastbound | 30 | 475 | 461 | 7 | 7 |
| Boones Ferry Road - North of Basalt Creek | Northbound | 45 | 894 | 862 | 16 | 16 |
| Boones Ferry Road - North of Basalt Creek | Southbound | 45 | 894 | 862 | 16 | 16 |

**Table B-7: 15-Minute Traffic Counts and 1-Hour Traffic Equivalent for TNM Validation**

*HMMH, 2019*

| Measurement Location | Roadway | Traffic Count (15-minute) | | Traffic Volume for TNM (hour equivalent) |
|---|---|---|---|---|
| | | Vehicle Type | Quantity | Quantity |
| ML-01 | Lower Boones Ferry Rd NB | Automobiles | 74 | 296 |
| | | Medium Trucks | 5 | 20 |
| | | Heavy Trucks | 2 | 8 |
| | | Buses | 0 | 0 |
| | | Motorcycles | 0 | 0 |
| | Lower Boones Ferry Rd SB | Automobiles | 73 | 292 |
| | | Medium Trucks | 7 | 28 |
| | | Heavy Trucks | 5 | 20 |
| | | Buses | 0 | 0 |
| | | Motorcycles | 0 | 0 |
| ML-02 | Grahams Ferry (North of Basalt) NB | Automobiles | 14 | 56 |
| | | Medium Trucks | 1 | 4 |
| | | Heavy Trucks | 0 | 0 |
| | | Buses | 0 | 0 |
| | | Motorcycles | 0 | 0 |
| | Grahams Ferry (North of Basalt) SB | Automobiles | 15 | 60 |
| | | Medium Trucks | 0 | 0 |
| | | Heavy Trucks | 1 | 4 |
| | | Buses | 0 | 0 |
| | | Motorcycles | 0 | 0 |
| | Basalt Creek Parkway EB | Automobiles | 91 | 364 |
| | | Medium Trucks | 4 | 16 |
| | | Heavy Trucks | 9 | 36 |
| | | Buses | 0 | 0 |
| | | Motorcycles | 0 | 0 |
| | Basalt Creek Parkway WB | Automobiles | 84 | 336 |
| | | Medium Trucks | 4 | 16 |
| | | Heavy Trucks | 8 | 32 |
| | | Buses | 0 | 0 |
| | | Motorcycles | 0 | 0 |
| | Grahams Ferry (South of Basalt) NB | Automobiles | 98 | 392 |
| | | Medium Trucks | 5 | 20 |
| | | Heavy Trucks | 8 | 32 |
| | | Buses | 0 | 0 |
| | | Motorcycles | 0 | 0 |
| | | Automobiles | 106 | 424 |

| Measurement Location | Roadway | Traffic Count (15-minute) | | Traffic Volume for TNM (hour equivalent) |
|---|---|---|---|---|
| | | Vehicle Type | Quantity | Quantity |
| | Grahams Ferry (South of Basalt) SB | Medium Trucks | 4 | 16 |
| | | Heavy Trucks | 10 | 40 |
| | | Buses | 0 | 0 |
| | | Motorcycles | 0 | 0 |
| ML-03 | Boones Ferry Rd. NB | Automobiles | 72 | 288 |
| | | Medium Trucks | 6 | 24 |
| | | Heavy Trucks | 3 | 12 |
| | | Buses | 0 | 0 |
| | | Motorcycles | 1 | 4 |
| | Boones Ferry Rd. SB | Automobiles | 103 | 412 |
| | | Medium Trucks | 7 | 28 |
| | | Heavy Trucks | 0 | 8 |
| | | Buses | 2 | 8 |
| | | Motorcycles | 0 | 0 |

hmmh

PROJECT: Basalt Creek Exit: Graham's Ferry Road

JOB NO.: 310330.001

## SHORT-TERM NOISE MEASUREMENT SITE LOG

ASSESSMENT AREA: Boones Ferry MEASUREMENT SITE NO.: STM-1

ADDRESS: 24137 SW Lower Boones Ferry Rd.

OWNER: NA

DESCRIPTION: Rural setting single-family home

NOISE SOURCES: Traffic, residential noise, small aircraft

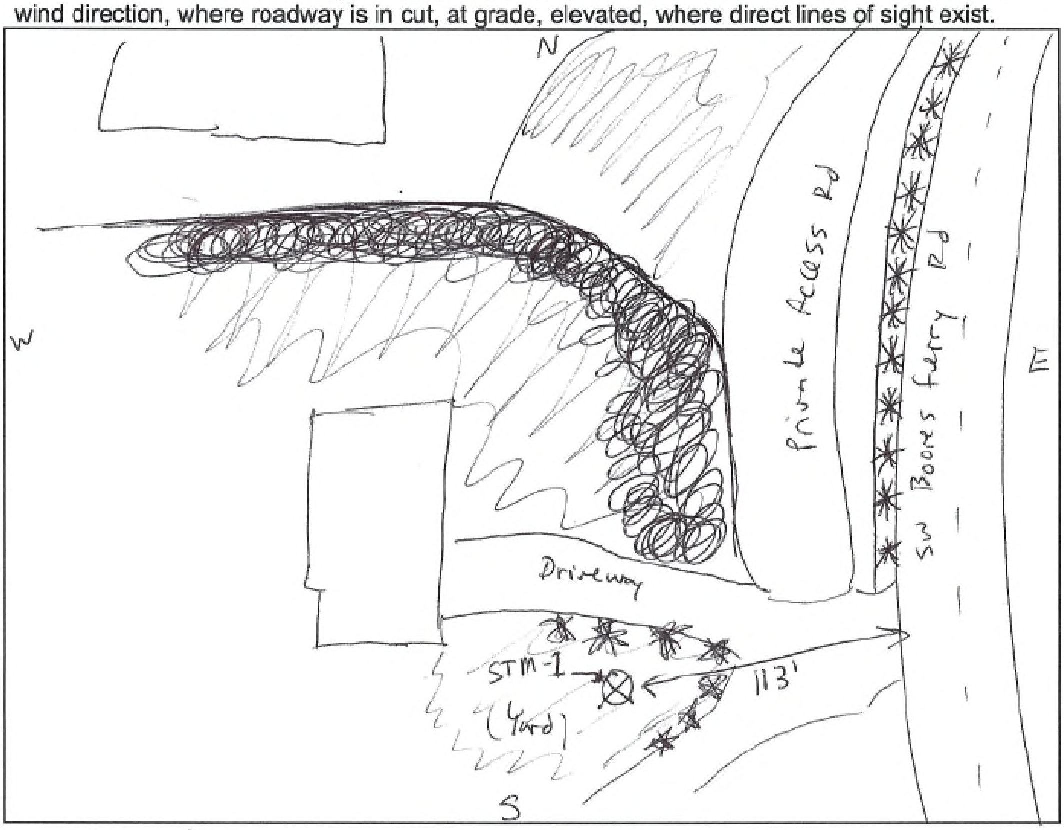
NOISE MONITOR: Kit 1 - LD 824 S/N: A0795

MICROPHONE: 40AQ S/N: 19907

CALIBRATOR: 1251 Norsonic S/N: 30878

TEMP. RANGE (°F): 56° WEATHER CONDITIONS: Sunny/clear

SITE SKETCH: Show roadway, homes, local roads, reference distances, arrows for North & wind direction, where roadway is in cut, at grade, elevated, where direct lines of sight exist.




PHOTOS: Yes GPS COORDINATES:

HARRIS MILLER MILLER & HANSON INC.

PROJECT: Basalt Creek Exit: Graham's Ferry Road
JOB NO.: 310330.001

## TRAFFIC VOLUME COUNT DATA SHEET

| | | | |
|---|---|---|---|
| ASSESSMENT AREA: | Residential, Rural | START TIME: | 1325 |
| MEASUREMENT SITE NO.: | ST M-1 | END TIME: | 1340 |
| ADDRESS/DESCRIPTION: | 24137 Lower Boones Ferry Rd, Tualatin OR | DATE: | 11/6/2019 |
| | | PERSONNEL: | DST/SRN |

**ROADWAY:** Lower Boones Ferry Rd

| | | DIRECTION 1: NB | DIRECTION 2: SB |
|---|---|---|---|
| **First Sample:** 15 **minutes**<br>**Start Time:** 1325 | | | |
| | Automobiles | 74 | 73 |
| | Medium Trucks (6 Tires) | 5 | 7 |
| | Heavy Trucks (>6 Tires) | 2 | 5 |
| | **Average speed (mph)** | 40-45 | 35-45 |
| **Second Sample:** ____ **minutes**<br>**Start Time:** | | | |
| | Automobiles | | |
| | Medium Trucks (6 Tires) | | |
| | Heavy Trucks (>6 Tires) | | |
| | **Average speed (mph)** | | |
| **Third Sample:** ____ **minutes**<br>**Start Time:** | | | |
| | Automobiles | | |
| | Medium Trucks (6 Tires) | | |
| | Heavy Trucks (>6 Tires) | | |
| | **Average speed (mph)** | | |
| **Fourth Sample:** ____ **minutes**<br>**Start Time:** | | | |
| | Automobiles | | |
| | Medium Trucks (6 Tires) | | |
| | Heavy Trucks (>6 Tires) | | |
| | **Average speed (mph)** | | |

HARRIS MILLER MILLER & HANSON INC.

# SHORT-TERM NOISE MEASUREMENT DATA SHEET

PROJECT: Basalt Creek Exit: Graham's Ferry Road

JOB NO.: 310330.001

MEASUREMENT SITE NO.: St m - 1

PERSONNEL: DST/SRN

ADDRESS/DESCRIPTION: 24137 SW Lower Boones Ferry

DATE: 11/6/2019

| # | 15 Minute Period Starting | Meas'd Leq (dBA) | √ or X | Autos | Medium Trucks | Heavy Trucks | Other Noise Sources | COMMENTS (Include Calibration Data) |
|---|---|---|---|---|---|---|---|---|
| 1 | 1325 | 53.54 | | | | | | Cal ✓ |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
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| 28 | | | | | | | | |
| 29 | | | | | | | | |
| 30 | | | | | | | | |

TOTAL Leq = SUBSET Leq =

√ = Other sources contributed to Leq X = Exclude period - contaminated by non-characteristic sources

>> ADD SKETCH AND WEATHER CONDITIONS TO REVERSE OR OTHER SHEET <<

HARRIS MILLER MILLER & HANSON INC.

STM1-Photo 1 facing towards Boones Ferry Road

STM1-Photo 2 facing away from Boones Ferry Road

PROJECT: Basalt Creek Exit: Graham's Ferry Road

JOB NO.: 310330.001

## SHORT-TERM NOISE MEASUREMENT SITE LOG

ASSESSMENT AREA: Grahams MEASUREMENT SITE NO.: STM - 2

ADDRESS: 24130 Grahams Ferry Rd, Tualatin OR

OWNER: NA

DESCRIPTION: Single family home in a rural setting

NOISE SOURCES: Traffic noise, residential/rural noise, aircraft noise

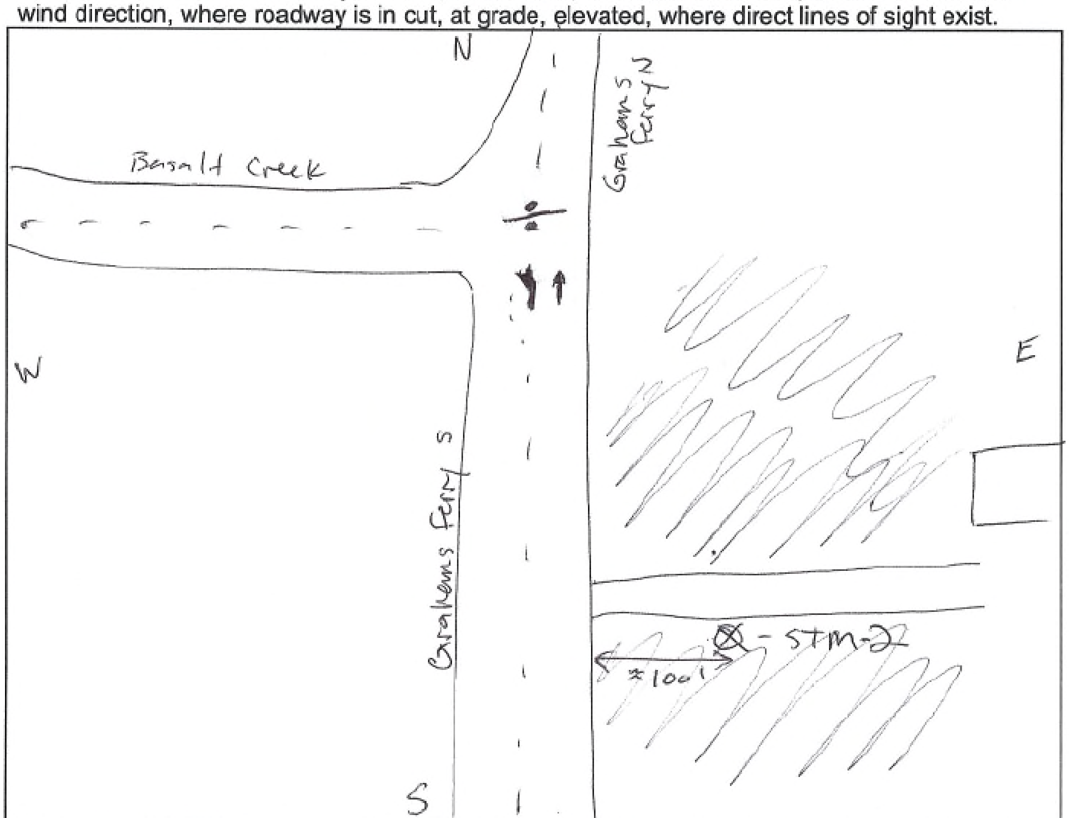
NOISE MONITOR: Kit 1 - LD 824 S/N: A0 795

MICROPHONE: 40AQ S/N: 19907

CALIBRATOR: 1251 Norsonic S/N: 30878

TEMP. RANGE (°F): 60° WEATHER CONDITIONS: Sunny <5 mph wind

SITE SKETCH: Show roadway, homes, local roads, reference distances, arrows for North & wind direction, where roadway is in cut, at grade, elevated, where direct lines of sight exist.




PHOTOS: Yes GPS COORDINATES: ____

HARRIS MILLER MILLER & HANSON INC.

PROJECT: Basalt Creek Exit: Graham's Ferry Road
JOB NO.: 310330.001

## TRAFFIC VOLUME COUNT DATA SHEET

| | | | |
|---|---|---|---|
| ASSESSMENT AREA: | | START TIME: | 1420 |
| MEASUREMENT SITE NO.: | STM-2 | END TIME: | 1435 |
| ADDRESS/DESCRIPTION: | 24130 Graham's Ferry Rd, Tualatin OR | DATE: | 11/6/2019 |
| | | PERSONNEL: | DST/SRN |

| ROADWAY: | | DIRECTION 1: | DIRECTION 2: |
|---|---|---|---|
| First Sample: 15 minutes<br>Start Time: 1420 | Grahams Ferry (South of Basalt) | NB | SB |
| | Automobiles | 98 | 106 |
| | Medium Trucks (6 Tires) | 5 | 4 |
| | Heavy Trucks (>6 Tires) | 8 | 10 |
| | **Average speed (mph)** | 20-40 | 20-40 |
| Second Sample: 15 minutes<br>Start Time: 1420 | Grahams Ferry (North of Basalt) | NB | SB |
| | Automobiles | 14 | 15 |
| | Medium Trucks (6 Tires) | 1 | Ø |
| | Heavy Trucks (>6 Tires) | Ø | 1 |
| | **Average speed (mph)** | 20-40 | 20-40 |
| Third Sample: 15 minutes<br>Start Time: 1420 | Basalt Creek Parkway | EB | WB |
| | Automobiles | 91 | 84 |
| | Medium Trucks (6 Tires) | 4 | 4 |
| | Heavy Trucks (>6 Tires) | 9 | 8 |
| | **Average speed (mph)** | 20-35 | 20-35 |
| Fourth Sample: ____ minutes<br>Start Time: | | | |
| | Automobiles | | |
| | Medium Trucks (6 Tires) | | |
| | Heavy Trucks (>6 Tires) | | |
| | **Average speed (mph)** | | |

HARRIS MILLER MILLER & HANSON INC.

## SHORT-TERM NOISE MEASUREMENT DATA SHEET

PROJECT: Basalt Creek Exit: Graham's Ferry Road

JOB NO.: 310330.001

MEASUREMENT SITE NO.: STM-2

ADDRESS/DESCRIPTION: 24130 Grahams Ferry Rd

PERSONNEL: DST/SRN

DATE: 11/6/2019

| # | 15 Minute Period Starting | Meas'd Leq (dBA) | √ or X | Autos | Medium Trucks | Heavy Trucks | Other Noise Sources | COMMENTS (Include Calibration Data) |
|---|---|---|---|---|---|---|---|---|
| 1 | 1420 | 66.06 | | | | | | Cal ✓ |
| 2 | | | | | | | | |
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TOTAL Leq =

SUBSET Leq =

√ = Other sources contributed to Leq

X = Exclude period - contaminated by non-characteristic sources

>> ADD SKETCH AND WEATHER CONDITIONS TO REVERSE OR OTHER SHEET <<

HARRIS MILLER MILLER & HANSON INC.


STM2-Photo 1 facing Grahams Ferry Road

STM2-Photo 2 facing away from Grahams Ferry Road

PROJECT: Basalt Creek Exit: Graham's Ferry Road

JOB NO.: 310330.001

## SHORT-TERM NOISE MEASUREMENT SITE LOG

ASSESSMENT AREA: ______ MEASUREMENT SITE NO.: STM-3

ADDRESS: 9415 SW Greenhill Ln, Tualatin OR

OWNER: NA

DESCRIPTION: Single family residential, rural setting

NOISE SOURCES: Traffic noise, residents @ home, aircraft flyover

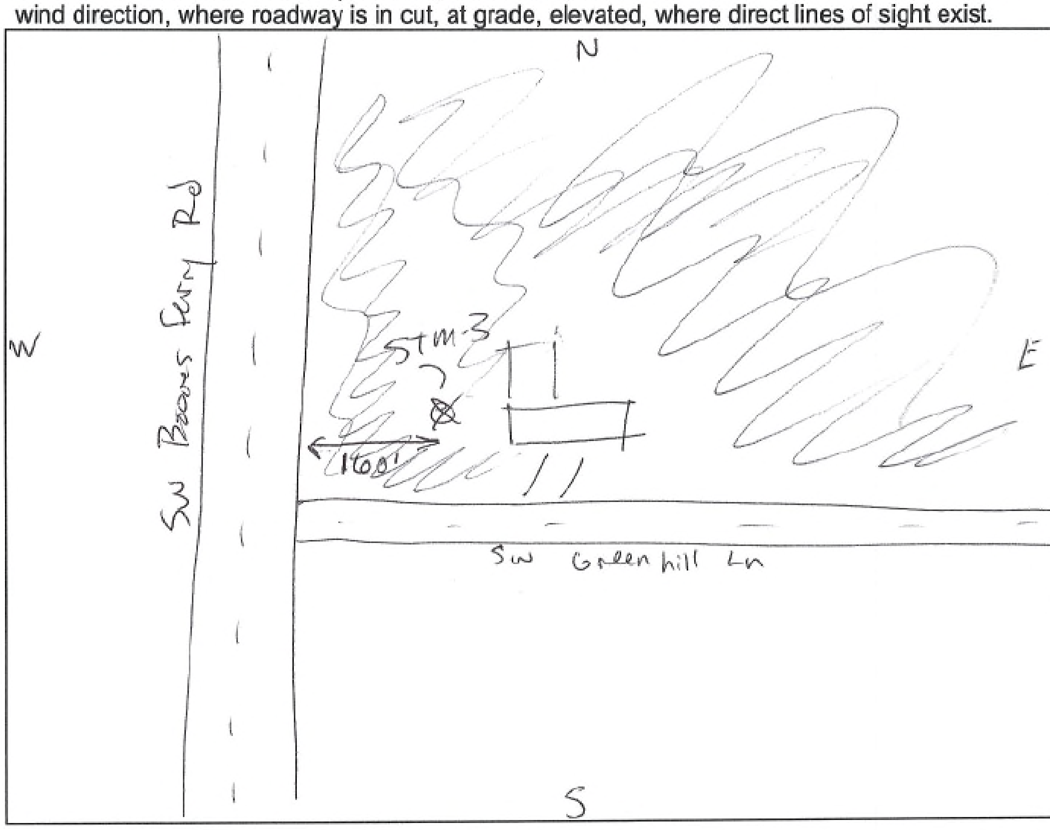
NOISE MONITOR: kit 1 - LD824 S/N: A0795

MICROPHONE: 40AQ S/N: 19907

CALIBRATOR: 1251 Norsonic S/N: 30878

TEMP. RANGE (°F): 60° WEATHER CONDITIONS: Sunny < wind 5mph

SITE SKETCH: Show roadway, homes, local roads, reference distances, arrows for North & wind direction, where roadway is in cut, at grade, elevated, where direct lines of sight exist.




PHOTOS: yes GPS COORDINATES: ______

HARRIS MILLER MILLER & HANSON INC.

PROJECT: Basalt Creek Exit: Graham's Ferry Road
JOB NO.: 310330.001

# TRAFFIC VOLUME COUNT DATA SHEET

| | | | |
|---|---|---|---|
| ASSESSMENT AREA: | Boones Ferry Rd | START TIME: | 1445 |
| MEASUREMENT SITE NO.: | STM-3 | END TIME: | 1500 |
| ADDRESS/DESCRIPTION: | 9415 SW Greenhill Rd | DATE: | 11/6/2019 |
| | Tualatin OR | PERSONNEL: | DST/SBN |

| ROADWAY: Boones Ferry Rd | | DIRECTION 1: NB | DIRECTION 2: SB |
|---|---|---|---|
| **First Sample:** 15 **minutes** **Start Time:** 1445 | | | |
| | Automobiles | 72 | 103 |
| | Medium Trucks (6 Tires) | 6 | 7 |
| | Heavy Trucks (>6 Tires) | 3 | 0 |
| | **Average speed (mph)** | 40-45 | 30-40 |
| | moto | 1 | 0 |
| | Bus | 0 | 2 |
| **Second Sample:** 15 **minutes** **Start Time:** 1445 | | | |
| | Automobiles | | |
| | Medium Trucks (6 Tires) | | |
| | Heavy Trucks (>6 Tires) | | |
| | **Average speed (mph)** | | |
| **Third Sample:** ___ **minutes** **Start Time:** ___ | | | |
| | Automobiles | | |
| | Medium Trucks (6 Tires) | | |
| | Heavy Trucks (>6 Tires) | | |
| | **Average speed (mph)** | | |
| **Fourth Sample:** ___ **minutes** **Start Time:** ___ | | | |
| | Automobiles | | |
| | Medium Trucks (6 Tires) | | |
| | Heavy Trucks (>6 Tires) | | |
| | **Average speed (mph)** | | |

HARRIS MILLER MILLER & HANSON INC.

## SHORT-TERM NOISE MEASUREMENT DATA SHEET

PROJECT: Basalt Creek Exit: Graham's Ferry Road

JOB NO.: 310330.001

MEASUREMENT SITE NO.: STM-3

PERSONNEL: DST/SRN

ADDRESS/DESCRIPTION: 9415 SW Greenhill Ln

DATE: 11/6/2019

| # | 15 Minute Period Starting | Meas'd Leq (dBA) | √ or X | Autos | Medium Trucks | Heavy Trucks | Other Noise Sources | COMMENTS (Include Calibration Data) |
|---|---|---|---|---|---|---|---|---|
| 1 | 1445 | 59.98 | | | | | | Cal ✓ |
| 2 | 1554 | 61.3 | | | | | | Aircraft flyover |
| 3 | | | | | | | | |
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| 30 | | | | | | | | |

TOTAL Leq =

SUBSET Leq =

√ = Other sources contributed to Leq

X = Exclude period - contaminated by non-characteristic sources

>> ADD SKETCH AND WEATHER CONDITIONS TO REVERSE OR OTHER SHEET <<

HARRIS MILLER MILLER & HANSON INC.

STM3-Photo 1 facing north

STM3-Photo 2 facing east

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

NVLAP® CALIBRATION
NVLAP Lab Code: 200625-0

# Calibration Certificate No.42283

| | |
|---|---|
| *Instrument:* | **Sound Level Meter** |
| *Model:* | **824** |
| *Manufacturer:* | **Larson Davis** |
| *Serial number:* | **A0795** |
| *Tested with:* | **Mic. 40AQ s/n 19907 & 40AE s/n 8310**<br>**Preamp. PRM902 s/n 1208 & s/n 3185** |
| *Type (class):* | **1** |
| *Customer:* | **Harris Miller Miller & Hanson Inc.** |
| *Tel/Fax:* | **781-229-0707 x3119 / 781-229-7939** |

*Date Calibrated:* **2/11/2019** *Cal Due:*

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

*Contains non-accredited tests:* __Yes **X** No
*Calibration service:* __ **Basic** **X** **Standard**
*Address:* **77 South Bedford Street, Burlington, MA 01803**

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

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

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

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

**Environmental conditions:**

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

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


Document stored Z:\Calibration Lab\SLM 2019\LD824-27dB_A0795_M1.doc Page 1 of 2

# Appendix C Detailed Noise Abatement Tables

**Table C-1: North Parkway Barrier Abated Sound Levels**

*HMMH, 2020*

| Receiver ID | Number of Receptors | Activity Category | ODOT NAAC (Leq(h) dB; | Wall Length | Existing Conditions (Leq(h) dBA) | | | Build Alternative (Leq(h) dBA) | | | Change in Sound Level (dB) | Impact Type | Build Alternative Abated (Leq(h) dBA) with 10-foot Wall | | | | Build Alternative Abated (Leq(h) dBA) with 12-foot Wall | | | | Build Alternative Abated (Leq(h) dBA) with 14-foot Wall | | | | Build Alternative Abated (Leq(h) dBA) with 16-foot Wall | | | | Feasibility 5 dB IL at over 50% of Impacted Receptors (yes/no) | Reasonableness 7 dB IL @ 1 or more Receptors (yes/no) | Cost Reasonableness ($ per Benefit) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | PVH | PTH | WCNH | PVH | PTH | WCNH | | | PVH | PTH | WCNH | IL | PVH | PTH | WCNH | IL | PVH | PTH | WCNH | IL | PVH | PTH | WCNH | IL | | | |
| R3 | 1 | B | 65 | 2512 | 45 | 43 | 45 | 58 | 61 | 61 | 16 | SI Impact | 49 | 50 | 50 | 11 | 49 | 50 | 50 | 11 | 49 | 49 | 49 | 12 | 49 | 49 | 49 | 12 | Yes | No | $ 267,946.67 |
| R10 | 1 | B | 65 | | 51 | 50 | 51 | 70 | 71 | 71 | 20 | Both | 70 | 71 | 71 | 0 | 70 | 71 | 71 | 0 | 69 | 70 | 70 | 1 | 68 | 69 | 69 | 2 | | | |
| R11 | 1 | B | 65 | | 50 | 49 | 50 | 65 | 66 | 66 | 16 | Both | 59 | 60 | 60 | 6 | 59 | 59 | 59 | 7 | 58 | 59 | 59 | 7 | 58 | 58 | 58 | 8 | | | |
| R14 | 1 | B | 65 | | 59 | 58 | 59 | 60 | 60 | 60 | 1 | No Impact | 59 | 59 | 59 | 1 | 59 | 59 | 59 | 1 | 58 | 58 | 58 | 2 | 58 | 58 | 58 | 2 | | | |
| R15 | 1 | B | 65 | | 47 | 46 | 47 | 55 | 57 | 57 | 10 | SI Impact | 53 | 55 | 55 | 2 | 52 | 54 | 54 | 3 | 51 | 52 | 52 | 5 | 50 | 51 | 51 | 6 | | | |
| R16 | 1 | B | 65 | | 50 | 49 | 50 | 59 | 60 | 60 | 10 | SI Impact | 58 | 58 | 58 | 2 | 57 | 57 | 57 | 3 | 57 | 57 | 57 | 3 | 57 | 57 | 57 | 3 | | | |
| R19 | 1 | B | 65 | | 52 | 51 | 52 | 59 | 59 | 59 | 7 | No Impact | 59 | 59 | 59 | 0 | 59 | 59 | 59 | 0 | 59 | 58 | 59 | 0 | 59 | 58 | 59 | 0 | | | |
| R24 | 1 | B | 65 | | 53 | 52 | 53 | 54 | 55 | 55 | 2 | No Impact | 53 | 54 | 54 | 1 | 53 | 54 | 54 | 1 | 53 | 53 | 53 | 2 | 52 | 53 | 53 | 2 | | | |

Notes: PVH = Peak Vehicular Hour, PTH = Peak Truck Hour, WCNH = Worst Case Noise Hour, IL = Insertion Loss in dB, SI Impact = Significant Increase Impact, Both = Exceedance of NAAC and SI Impact

**Table C-2: North Parkway Barrier Feasible/Reasonable Tests**

*HMMH, 2020*

| Feasible/Reasonable Test | Wall Height (feet) | | | |
|---|---|---|---|---|
| | 10 foot | 12 foot | 14 foot | 16 foot |
| Percent of Impacts Benefitted | 40% | 40% | 60% | 60% |
| Cost per Benefitted Receptor | $ 251,200.00 | $ 301,440.00 | $ 234,453.33 | $ 267,946.67 |
| Square Footage of Barrier | 25120 | 30144 | 35168 | 40192 |
| Total Barrier Cost | $ 502,400.00 | $ 602,880.00 | $ 703,360.00 | $ 1,004,800.00 |
| Total Benefits | 2 | 2 | 3 | 3 |
| Feasible (Yes/No) | Yes | Yes | Yes | Yes |
| Design Goal Achieved (Yes/No) | Yes | Yes | Yes | Yes |
| Cost Reasonable (Yes/No) | No | No | No | No |

### Table C-3: South Parkway Barrier Abated Sound Levels

*HMMH, 2020*

| Receiver ID | Number of Receptors | Activity Category | ODOT NAAC (Leq(h) dB; | Wall Length | Existing Conditions (Leq(h) dBA) | | | Build Alternative (Leq(h) dBA) | | | Change in Sound Level (dB) | Impact Type | Build Alternative Abated (Leq(h) dBA) with 10-foot Wall | | | | Build Alternative Abated (Leq(h) dBA) with 12-foot Wall | | | | Build Alternative Abated (Leq(h) dBA) with 14-foot Wall | | | | Build Alternative Abated (Leq(h) dBA) with 16-foot Wall | | | | Feasibility 5 dB IL at over 50% of Impacted Receptors (yes/no) | Reasonableness 7 dB IL @ 1 or more Receptors (yes/no) | Cost Reasonableness ($ per Benefit) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | PVH | PTH | WCNH | PVH | PTH | WCNH | | | PVH | PTH | WCNH | IL | PVH | PTH | WCNH | IL | PVH | PTH | WCNH | IL | PVH | PTH | WCNH | IL | | | |
| R1 | 1 | E | 70 | 2496 | 54 | 53 | 54 | 57 | 59 | 59 | 5 | No Impact | 54 | 57 | 57 | 2 | 54 | 56 | 56 | 3 | 53 | 55 | 55 | 4 | 53 | 55 | 55 | 4 | Yes | No | $ 116,480.00 |
| R2 | 1 | E | 70 | | 48 | 47 | 48 | 56 | 57 | 57 | 9 | No Impact | 52 | 55 | 55 | 2 | 51 | 53 | 53 | 4 | 50 | 52 | 52 | 5 | 49 | 51 | 51 | 6 | | | |
| R4 | 2 | B | 65 | | 53 | 52 | 53 | 67 | 68 | 68 | 15 | Both | 61 | 64 | 64 | 4 | 60 | 62 | 62 | 6 | 59 | 62 | 62 | 6 | 59 | 61 | 61 | 7 | | | |
| R7 | 2 | B | 65 | | 50 | 49 | 50 | 67 | 68 | 68 | 18 | Both | 59 | 61 | 61 | 7 | 57 | 59 | 59 | 9 | 57 | 59 | 59 | 9 | 57 | 58 | 58 | 10 | | | |
| R8 | 1 | D | 50 | | 34 | 33 | 34 | 43 | 45 | 45 | 11 | SI Impact | 39 | 41 | 41 | 4 | 38 | 40 | 40 | 5 | 37 | 39 | 39 | 6 | 36 | 37 | 37 | 8 | | | |
| R12 | 1 | B | 65 | | 49 | 48 | 49 | 60 | 61 | 61 | 12 | SI Impact | 57 | 59 | 59 | 2 | 56 | 57 | 57 | 4 | 55 | 57 | 57 | 4 | 55 | 56 | 56 | 5 | | | |
| R20 | 1 | B | 65 | | 51 | 50 | 51 | 58 | 58 | 58 | 7 | No Impact | 57 | 58 | 58 | 0 | 57 | 57 | 57 | 1 | 56 | 57 | 57 | 1 | 56 | 57 | 57 | 1 | | | |
| R21 | 1 | B | 65 | | 61 | 60 | 61 | 60 | 59 | 60 | -1 | No Impact | 59 | 59 | 59 | 1 | 59 | 59 | 59 | 1 | 59 | 59 | 59 | 1 | 59 | 59 | 59 | 1 | | | |

Notes: PVH = Peak Vehicular Hour, PTH = Peak Truck Hour, WCNH = Worst Case Noise Hour, IL = Insertion Loss in dB, SI Impact = Significant Increase Impact, Both = Exceedance of NAAC and SI Impact

### Table C-4: South Parkway Barrier Feasible/Reasonable Tests

*HMMH, 2020*

| Feasible/Reasonable Test | Wall Height (feet) | | | |
|---|---|---|---|---|
| | 10 foot | 12 foot | 14 foot | 16 foot |
| Percent of Impacts Benefitted | 33% | 83% | 83% | 100% |
| Cost per Benefitted Receptor | $ 249,600.00 | $ 119,808.00 | $ 116,480.00 | $ 114,102.86 |
| Square Footage of Barrier | 24960 | 29952 | 34944 | 39936 |
| Total Barrier Cost | $ 499,200.00 | $ 599,040.00 | $ 698,880.00 | $ 998,400.00 |
| Total Benefits | 2 | 5 | 6 | 7 |
| Feasible (Yes/No) | Yes | Yes | Yes | Yes |
| Design Goal Achieved (Yes/No) | Yes | Yes | Yes | Yes |
| Cost Reasonable (Yes/No) | No | No | No | No |

### Table C-5: Boones Ferry Road Frontage Road Barrier Abated Sound Levels

*HMMH, 2020*

| Receiver ID | Number of Receptors | Activity Category | ODOT NAAC (Leq(h) dB; | Wall Length | Existing Conditions (Leq(h) dBA) | | | Build Alternative (Leq(h) dBA) | | | Change in Sound Level (dB) | Impact Type | Build Alternative Abated (Leq(h) dBA) with 10-foot Wall | | | | Build Alternative Abated (Leq(h) dBA) with 12-foot Wall | | | | Build Alternative Abated (Leq(h) dBA) with 14-foot Wall | | | | Build Alternative Abated (Leq(h) dBA) with 16-foot Wall | | | | Feasibility 5 dB IL at over 50% of Impacted Receptors (yes/no) | Reasonableness 7 dB IL @ 1 or more Receptors (yes/no) | Cost Reasonableness ($ per Benefit) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | PVH | PTH | WCNH | PVH | PTH | WCNH | | | PVH | PTH | WCNH | IL | PVH | PTH | WCNH | IL | PVH | PTH | WCNH | IL | PVH | PTH | WCNH | IL | | | |
| R4 | 2 | B | 65 | 489 | 53 | 52 | 53 | 67 | 68 | 68 | 15 | Both | 67 | 68 | 68 | 0 | 67 | 68 | 68 | 0 | 67 | 68 | 68 | 0 | 67 | 68 | 68 | 0 | No | No | N/A |
| R7 | 2 | B | 65 | | 50 | 49 | 50 | 67 | 68 | 68 | 18 | Both | 67 | 68 | 68 | 0 | 67 | 68 | 68 | 0 | 67 | 68 | 68 | 0 | 67 | 68 | 68 | 0 | | | |
| R12 | 1 | B | 65 | | 49 | 48 | 49 | 60 | 61 | 61 | 12 | SI Impact | 60 | 61 | 61 | 0 | 60 | 61 | 61 | 0 | 60 | 61 | 61 | 0 | 60 | 61 | 61 | 0 | | | |
| R20 | 1 | B | 65 | | 51 | 50 | 51 | 58 | 58 | 58 | 7 | No Impact | 57 | 58 | 58 | 0 | 57 | 57 | 57 | 1 | 57 | 57 | 57 | 1 | 57 | 57 | 57 | 1 | | | |

Notes: PVH = Peak Vehicular Hour, PTH = Peak Truck Hour, WCNH = Worst Case Noise Hour, IL = Insertion Loss in dB, SI Impact = Significant Increase Impact, Both = Exceedance of NAAC and SI Impact

**Table C-6: Boones Ferry Road Frontage Road Barrier Feasible/Reasonable Tests**

*HMMH, 2020*

| Feasible/Reasonable Test | Wall Height (feet) | | | |
|---|---|---|---|---|
| | 10 foot | 12 foot | 14 foot | 16 foot |
| Percent of Impacts Benefitted | 0% | 0% | 0% | 0% |
| Cost per Benefitted Receptor | N/A | N/A | N/A | N/A |
| Square Footage of Barrier | N/A | N/A | N/A | N/A |
| Total Benefits | 0 | 0 | 0 | 0 |
| Feasible (Yes/No) | No | No | No | No |
| Design Goal Achieved (Yes/No) | N/A | N/A | N/A | N/A |
| Cost Reasonable (Yes/No) | N/A | N/A | N/A | N/A |