5.10 NOISE AND VIBRATION

This section addresses the adverse effects of noise and vibration and mitigation measures for the alternatives. The noise and vibration analysis incorporates field noise and vibration measurements, soil testing, modeling assumptions, land use information, and preliminary engineering details. Conclusions are supported by noise and vibration studies as noted in the text and bibliography.

5.10.1 INTRODUCTION

Noise Impact Criteria

Noise impact for this analysis is based on criteria defined in the 2006 FTA manual, *Transit Noise and Vibration Impact Assessment*. The FTA provides guidelines to assess project noise levels from mass transit systems, as well as noise criteria for impacts. The FTA Noise Impact Criteria were used to assess the changes in noise exposure based on the existing ambient conditions and the assumed BART operations for the year 2025. The FTA Noise Impact Criteria are founded on well-documented research on community reaction to noise and are based on change in noise exposure using a sliding scale. Although more transit noise is allowed in neighborhoods with high levels of existing noise, smaller increases in total noise exposure are allowed with increasing levels of existing noise.

The FTA Noise Impact Criteria groups noise sensitive land uses into the following three categories:

- **Category 1:** Buildings or parks where quiet is an essential element of their purpose, as well as outdoor amphitheaters and concert pavilions.
- **Category 2:** Residences and buildings where people normally sleep. This includes residences, hospitals, and hotels where nighttime sensitivity is assumed to be of utmost importance.
- **Category 3:** Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, churches, and certain parks and recreational facilities.

Ldn is used to characterize noise exposure for residential areas (Category 2). For other noise sensitive land uses, such as outdoor amphitheaters and school buildings (Categories 1 and 3), the maximum 1-hour Leq during the facility's operating period is used. There are two levels of impact included in the FTA Noise Impact Criteria, as summarized below:

- **FTA Severe Impact Criteria**: Severe noise impacts are considered "significant," as this term is used in NEPA and its implementing regulations. Noise mitigation will normally be specified for *Severe Impact* areas unless there is no practical method of mitigating the noise.

- **FTA Moderate Impact Criteria**: In this range of noise impact, other project-specific factors must be considered to determine the magnitude of the impact and the need for mitigation. These other factors can include the predicted increase over existing noise levels, the type and number of noise-sensitive land uses affected, existing outdoor-indoor sound insulation, and the cost effectiveness of mitigating noise to more acceptable levels.

The FTA Noise Impact Criteria are summarized in Figures 5.10-1 and 5.10-2. The future noise exposure would be the combination of the existing noise exposure and the additional noise exposure caused by the transit project. As shown these figures, three levels of noise impact are defined by the FTA guidelines: *No Impact*, *Moderate Impact,* and *Severe Impact*. A community noise impact associated with project train operation would be considered substantially adverse if the increase in cumulative noise level would exceed the threshold for *Severe Impact* as defined in Figures 5.10-1 and 5.10-2 depending on the type of land use impacted.

FTA's guidance states that noise mitigation should be applied to *Severe Impacts* unless there is no practical method of mitigating the noise. In the *Moderate Impact* range, other project factors should be considered in determining the need for noise mitigation. Two of the factors that FTA states should be considered in determining the need for mitigation at the *Moderate Impact* level include:

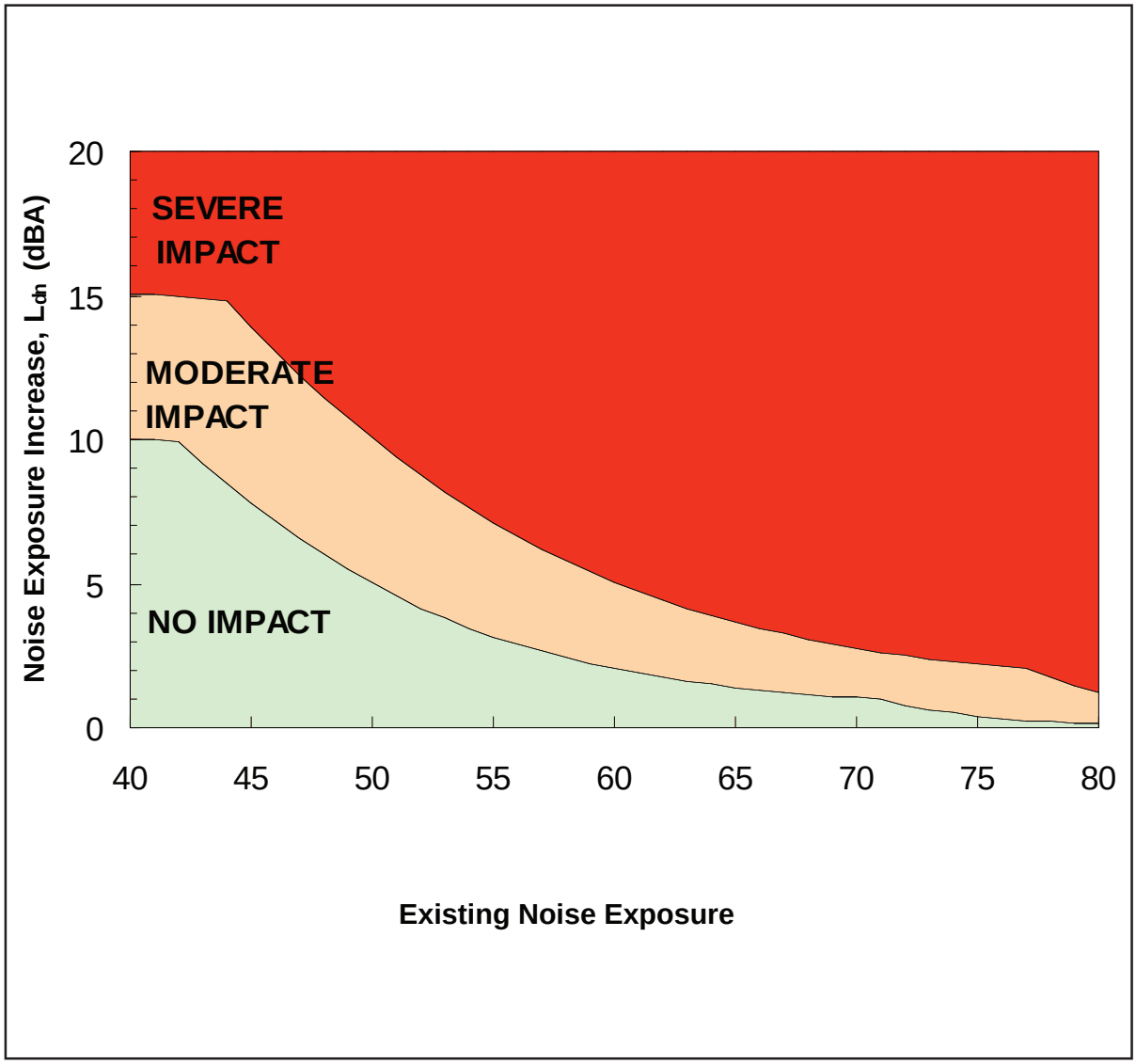
- the increase in noise due to the introduction of the project,

- providing cost effective mitigation measures relative to the amount of noise reduction required.

For this project, all *Severe Impacts* are proposed to be mitigated. At the *Moderate Impact* level, an increase in the noise levels of greater than 5 dBA due to the project is considered substantial enough to warrant noise mitigation. Thus where there is *Moderate Impact* and a projected increase of greater than 5 dBA in noise due to the project, mitigation is proposed. For locations in the *Moderate Impact* category with a projected increase in noise of 5 dBA or less, no noise mitigation is proposed.

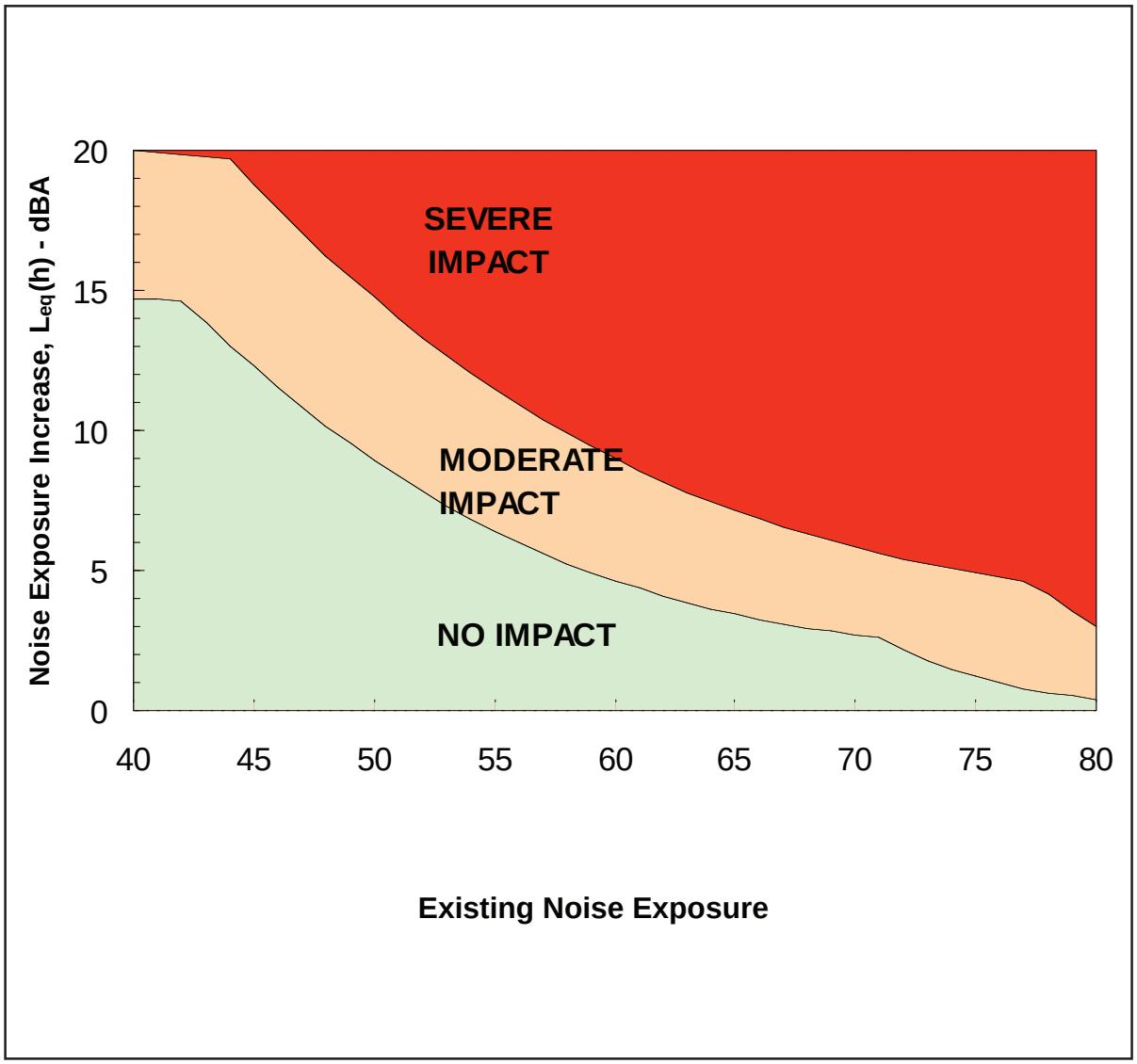
Vibration Impact Criteria

The ground-borne vibration impact criteria are based on land use and train frequency, as shown in Table 5.10-1. Some buildings, such as concert halls, recording studios, and theaters, can be very sensitive to vibration, but do not fit into any of the three land use categories listed in Tables 5.10-1 and 5.10-2. Both the BEP and SVRTP alternatives will constitute "frequent vibration events" of over 70 pass-bys per day. Due to the sensitivity of these buildings, they usually warrant special attention during the



Source: FTA Transit Noise and Vibration Impact Assessment, May 2006

Figure 5.10-1: Increase in Cumulative Noise Levels
Allowed by the FTA Criteria for Category 1 and 2 Land Uses



Source: FTA Transit Noise and Vibration Impact Assessment, May 2006.

Figure 5.10-2: Increase in Cumulative Noise Levels
Allowed by the FTA Criteria for Category 3 Land Uses

environmental evaluation of a transit project. Table 5.10-2 gives criteria for acceptable levels of ground-borne vibration for these types of special buildings. The criteria are provided in terms of frequent events since both the BEP and SVRTP alternatives are in this category.

It should also be noted that Tables 5.10-1 and 5.10-2 include separate FTA criteria for ground-borne noise, the "rumble" that can be radiated from the motion of room surfaces in buildings due to ground-borne vibration. Although expressed in dBA, which emphasizes the more audible middle and high frequencies, the criteria are set lower than for airborne noise to account for the annoying low-frequency character of ground-borne noise. Because airborne noise often masks ground-borne noise for aboveground (i.e., at –grade or elevated) rail systems, ground-borne noise criteria are primarily applied to subway operations where airborne noise is not a factor.

The majority of receivers studied for ground-borne noise and vibration fall under FTA Land Use Category 2, which includes residential land uses and those providing overnight accommodations (e.g. hotels and hospitals). General Assessment criteria are 35 dBA for ground-borne noise and 72 VdB for ground-borne vibration.

Table 5.10-1: FTA Ground-Borne Vibration and Noise Impact Criteria – Land Use

Land Use Category	Ground-Borne Vibration Impact (VdB re 1 micro-in/s) for Frequent[a] Events	Ground-Borne Noise Impact (dBA re 20 micro-Pascals) for Frequent[a] Events
Category 1: Buildings where low ambient vibration is essential for interior operations	65 VdB[b]	N/A[c]
Category 2: Residences and buildings where people normally sleep.	72 VdB	35 dBA
Category 3: Institutional land uses with primarily daytime use.	75 VdB	40 dBA

[a] Frequent Events is defined as more than 70 vibration events per day, which includes most rapid transit projects.

[b] This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration sensitive manufacturing or research will require detailed evaluation to define the acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the HVAC systems and stiffened floors.

[c] Vibration-sensitive equipment is not sensitive to ground-borne noise.

Source: Wilson Ihrig, 2008B.

Table 5.10-2: FTA Ground-Borne Vibration and Noise Impact Criteria - Buildings

Type of Building[b] or Room	Ground-Borne Vibration Impact (VdB re 1 micro-in/s) for Frequent[a] Events	Ground-Borne Noise Impact (dB re 20 micro-Pascals) for Frequent[a] Events
Concert Halls	65 VdB	25 dBA
TV Studios	65 VdB	25 dBA
Recording Studios	65 VdB	25 dBA
Auditoriums	72 VdB	30 dBA
Theaters	72 VdB	35 dBA

[a] Frequent Events is defined as more than 70 vibration events per day, which includes most rapid transit projects.
[b] If a building will rarely be occupied when trains are operating, there is no need to consider impact.
Source: Wilson Ihrig, 2008B.

5.10.2 NOISE IMPACT DISCUSSION

Modeling Assumptions

Noise sources evaluated for the BEP and SVRTP alternatives consisted of train operations, ancillary equipment, the proposed Maintenance Facility, and traffic noise. For reference, a single 75-foot-long train operating at a maximum of 80 mph on ballast and tie track with continuous welded rail would generate noise of 84 dBA at a distance of 50 feet from track centerline. The following assumptions were used in conducting the noise analysis of each alternative:

BART Vehicle Noise

- Trains would operate from 4:00 a.m. to 1:30 a.m. with 6-minute headways during peak service (6:00 a.m. to 7:30 p.m.), and 20-minute headways during off-peak service (4:00 a.m. to 6:00 a.m. and 7:30 p.m. to 1:30 a.m.).
- Ten-car BART trains were modeled (however, depending on the demand, as few as seven-car trains may be operating).
- Operating speed of 67 mph.
- BART train noise emission is based on measurement data for BART trains, which indicate that depending on train speed, operation on aerial structures produces noise levels that are from 3 to 5 dBA higher than operation on ballast and tie track.

Ancillary Equipment Noise

- Traction power substations and tunnel ventilation shafts would be the only ancillary equipment with potential to cause noise impact.
- It is generally possible to eliminate potential for noise impact from substations and ventilation shafts by including noise limits in the procurement documents.
- The ancillary equipment noise evaluation was based on the method included in the FTA guidance manual.
- Ventilation shaft noise was calculated based on measurements conducted at the BART South San Francisco Station ventilation building.

Maintenance Facility Noise

- Maintenance Facility noise was modeled using noise from low-speed BART vehicles and noise from ancillary sources described above.
- 5 dB was added to the train noise to account for wheel squeal from trains negotiating the storage track.
- The noise model assumes that BART would implement procedures to minimize public address announcements and the use of train horns during sensitive time periods.

Freight Train Noise

- Noise from the adjacent train movements was incorporated into the noise projections.
- The noise analysis included three freight trains a day and two freight trains at night traveling from north of the project to approximately Montague Expressway based on observations of daily movements.

Traffic Noise

- Traffic noise was evaluated using FHWA methods and the traffic noise.

No Build Alternative

Projects planned under the No Build Alternative would undergo their own environmental review to define adverse noise effects and determine appropriate mitigation measures. (See Section 2.6, Related Projects, for a list of future projects under the No Build Alternative.)

Noise

The No Build Alternative projects would likely result in adverse noise effects typically associated with transit vehicles and facilities and highway vehicles. Where state and federal criteria are exceeded, mitigation measures could include sound barriers, noise insulation, and construction restriction (including limiting the hours of certain activities like pile driving) among other measures.

Vibration

The No Build Alternative projects would likely result in adverse vibration effects typically associated with transit and highway vehicles and the construction of the facilities themselves. Where state and federal criteria are exceeded, mitigation measures could include trackway vibration dampening techniques and construction restrictions (including limiting the hours of specific activities like pile driving) among other measures.

BEP Alternative

Table 5.10-3, summarizes adverse noise effects to ground level sensitive receptors. The total number of affected ground level sensitive receptors affected before mitigation would vary from 269 to 271 depending on whether the Retained Cut or At Grade Option at Dixon Landing Road, Retained Cut Intermediate, or Long Option, and Las Plumas Yard or No New Yard options were chosen. However, adverse noise effects would be the same under the No New Yard and the Las Plumas Yard Options. After mitigation, the adverse noise effects would total 62 regardless of the option selected. However, only four of the adverse effects are considered severe.

Table 5.10-4 identifies the adverse noise effects by station number and locations that would exceed FTA criteria for impact prior to mitigation. Because adverse noise effects along the alignment would vary depending on the design options selected, Table 5.10-4 identifies whether the adverse effect is specific to an option or applies in general to the BEP Alternative. As shown in Table 5.10-4, all ground level *Severe Impacts* from the BEP Alternative can be mitigated below the FTA *Severe Impact* threshold except for four new residences located just south of Kato Road. Table 5.10-5 provides similar information for *Moderate Impacts* and the mitigation recommended to reduce the level of those impacts.

Table 5.10-3: BEP Alternative Summary of Noise Impacts to Ground Floor Residential Units Before and After Mitigation

Alignment Features	Number of *Severe Impacts* to Sensitive Receptors Before Mitigation	Number of *Moderate Impacts** to Sensitive Receptors Before Mitigation	Number of *Severe Impacts* to Sensitive Receptors After Mitigation	Number of *Moderate Impacts** to Sensitive Receptors After Mitigation
Total in BEP Alignment Excluding Options	66	130	0	39
At Grade Option at Dixon Landing	16	0	0	0
Retained Cut Option at Dixon Landing	14	0	0	0
Retained Cut Long Option	46	4	0	1
Retained Cut Intermediate Option	36	4	0	1
No New Yard	24	0	0	18
Las Plumas Yard	24	0	0	18
Total	140 – 152 depending on option	134	0	58

* Where the projected increase in noise level due to the project is greater than 5 dBA.

Source: Wilson Ihrig, 2008c

Table 5.10-4: BEP Alternative Projected *Severe Impacts*

Option	Civil Station	Receiver Location Address (# and Type)	Track Direction	Speed (MPH)	Distance From Near Track	Track Type	Existing Ambient Ldn	Noise Levels Without Mitigation (Total Ldn)	Mitigation Number	Noise Levels With Mitigation (Total Ldn)	Noise Level Increase with Mitigation	Impact Type after Mitigation
N/A	170+00 to 172+40	Castilleja Subdivision (4 Single-family)	NB	67 XO	58	FST	61	67	1	62	1.0	NI
At Grade Option at Dixon Landing	180+60 to 182+00	Park Homes at Mayfield Warm Springs Blvd (1 Multi-family)	NB	67	132	FST	57	63	2	62	4.7	NI
At Grade Option at Dixon Landing	182+50	Spinnaker Point Apartments (1 Multi-Family)	NB	67	38	FST	57	64	2	62	5.4	MI
At Grade Option at Dixon Landing	184+00	Spinnaker Point Apartments (1 Multi-Family)	NB	67	75	FST	57	63	2	61	4.1	MI
At Grade Option at Dixon Landing	184+50 to 186+00	Spinnaker Point Apartments (1 Multi-Family)	NB	67	95	FST	57	62	2	62	4.6	MI
At Grade Option at Dixon Landing	186+00 to 188+00	Spinnaker Point Apartments (1 Multi-Family)	NB	67	95	FST	57	62	2	62	4.6	MI
At Grade Option at Dixon Landing	189+50 to 191+00	Spinnaker Point Apartments (2 Multi-Family)	NB	67	42	FST	59	66	2	64	4.9	MI

Table 5.10-4: BEP Alternative Projected *Severe Impacts* Cont'd

Option	Civil Station	Receiver Location Address (# and Type)	Track Direction	Speed (MPH)	Distance From Near Track	Track Type	Existing Ambient Ldn	Noise Levels Without Mitigation (Total Ldn)	Mitigation Number	Noise Levels With Mitigation (Total Ldn)	Noise Level Increase with Mitigation	Impact Type after Mitigation
Retained Cut Option at Dixon Landing	180+60 to 182+00	Park Homes at Mayfield Warm Springs Blvd (1 Multi-family)	NB	67	132	FST	57	63	1	62	4.7	NI
Retained Cut Option at Dixon Landing	182+50	Spinnaker Point Apartments (1 Multi-Family)	NB	67	38	CT	57	65	3	63	6	MI
N/A	246+00 to 247+00	Berryessa St (1 single family home)	SB	67	230	AG	59	65	3	63	3.9	MI
N/A	247+00 to 248+50	Berryessa St (2 single family homes)	SB	67	255	AG	59	65	3	63	3.7	MI
N/A	248+50 to 250+50	Berryessa St (3 single family homes)	SB	67	280	AG	59	65	3	63	3.6	MI
N/A	330+00 to 332+50	Parc Metropolitan Condos (1 Multi-family)	SB	67	340	FST	60	68	10	62	2.4	MI
N/A	332+50 to 336+00	Parc Metropolitan Condos (4 Multi-family)	SB	67	94	FST	60	73	10	63	3.2	MI
Retained Cut Long	409+50 to 410+50	North Star Cir (2 single-family homes)	NB	67	115	CT	58	63	2	62	4.2	MI
Retained Cut Long	410+50 to 411+50	North Star Cir (2 single-family homes)	NB	67	140	CT	58	64	2	62	4.4	MI

Table 5.10-4: BEP Alternative Projected *Severe Impacts* Cont'd

Option	Civil Station	Receiver Location Address (# and Type)	Track Direction	Speed (MPH)	Distance From Near Track	Track Type	Existing Ambient Ldn	Noise Levels Without Mitigation (Total Ldn)	Mitigation Number	Noise Levels With Mitigation (Total Ldn)	Noise Level Increase with Mitigation	Impact Type after Mitigation
Retained Cut Long	413+50	North Star Pl (1 single-family home)	NB	67	95	AG	58	65	2	64	5.7	MI
Retained Cut Intermediate	409+50 to 410+50	North Star Cir (2 single-family homes)	NB	67	115	CT	58	63	2	62	4.2	MI
Retained Cut Intermediate	410+50 to 411+50	North Star Cir (2 single-family homes)	NB	67	140	CT	58	64	2	62	4.4	MI
Retained Cut Intermediate	413+50	North Star Pl (1 single-family home)	NB	67	95	AG	58	65	2	64	5.7	MI
N/A	417+00	Country Brook's Apt.'s, Canal Way (1 Multi-family)	NB	67	150	AG	58	69	2	63	4.9	MI
N/A	424+00	1897 Flickinger Ave (1 single-family home)	NB	67	55	AG	56	63	2	60	4.2	MI
N/A	424+50	1891 Flickinger Ave (1 single-family home)	NB	67	57	AG	56	63	2	60	4.2	MI
N/A	424+50 to 426+50	Flickinger Ave (3 single-family homes)	NB	67	53	AG	56	65	2	61	4.9	MI
N/A	427+00	1861 Flickinger Ave (1 single-family home)	NB	67	67	AG	56	65	2	60	4.2	MI
N/A	427+50	Flickinger Ave (1 single-family home)	NB	67	65	AG	56	65	2	60	4.2	MI
N/A	427+50 to 437+50	Flickinger Ave (18 single-family homes)	NB	67	50	AG	56	65	2	60	4.3	MI

Table 5.10-4: BEP Alternative Projected *Severe Impacts* Cont'd

Option	Civil Station	Receiver Location Address (# and Type)	Track Direction	Speed (MPH)	Distance From Near Track	Track Type	Existing Ambient Ldn	Noise Levels Without Mitigation (Total Ldn)	Mitigation Number	Noise Levels With Mitigation (Total Ldn)	Noise Level Increase with Mitigation	Impact Type after Mitigation
N/A	438+50 to 439+50	Flickinger Ave (2 single-family homes)	NB	67	65	AG	56	65	2	60	4.5	MI
N/A	440+50	Silvertree Drive (1 single-family home)	NB	67	177	AG	57	62	4	62	4.9	NI
N/A	441+00 to 449+50	Silvertree Drive (15 single-family homes)	NB	67	56	AG	58	63	4	62	4.2	MI
N/A	449+50 to 450+00	Silvertree Drive (1 single-family home)	NB	67	50	FST	58	66	4, 9	63	5.3	MI
N/A	450+00 to 451+50	Silvertree Drive (2 single-family homes)	NB	67	70	FST	58	65	4, 9	63	4.6	MI
N/A	451+50	Silvertree Drive (1 single-family home)	NB	67	63	FST	58	65	4, 9	63	5.4	MI
N/A	459+50 to 461+50	Cleo Springs Ct (4 single-family homes)	SB	67	55	FST	58	65	11	62	3.9	MI
N/A	462+00	Cleo Springs Ct (1 single-family home)	SB	67	85	FST	58	64	11	61	3.1	MI
N/A	464+00 to 465+00	Gordy Drive (2 single-family homes)	SB	67	80	FST	56	62	11	59	2.7	MI
N/A	471+00 to 472+00	Gordy Drive (5 single-family homes)	SB	67	48	FST	56	62	11	59	3.1	MI
N/A	473+00	Gordy Drive (1 single-family home)	SB	67	32	FST	56	63	11	60	3.6	MI

Table 5.10-4: BEP Alternative Projected *Severe Impacts* Cont'd

Option	Civil Station	Receiver Location Address (# and Type)	Track Direction	Speed (MPH)	Distance From Near Track	Track Type	Existing Ambient Ldn	Noise Levels Without Mitigation (Total Ldn)	Mitigation Number	Noise Levels With Mitigation (Total Ldn)	Noise Level Increase with Mitigation	Impact Type after Mitigation
N/A	466+00	Drumhead Ct (1 single-family home)	NB	67	55	FST	56	63	11	59	3.5	MI
N/A	471+50 to 478+00	Rue Avati (11 single-family homes)	NB	67	43	FST	56	62	11	59	3.1	MI
N/A	478+00 to 480+00	Rue Avati (3 single-family homes)	NB	67	75	FST	56	62	11	59	3.1	MI
N/A	476+50 to 478+50	Tersini Court (4 single-family homes)	SB	67	44	FST	56	62	11	59	3.5	MI
N/A	480+00	Prelude Drive (1 single-family home)	SB	67	55	FST	56	61	11	58	2.4	MI
N/A	480+50 to 484+00	Prelude Drive (7 single-family home)	SB	67	37	FST	56	62	11	59	3.2	MI
N/A	495+50	Briar Creek (1 single-family home)	SB	67	63	FST	57	62	5, 9	62	5.2	MI
N/A	496+00 to 497+00	Briar Creek (2 single-family homes)	SB	67	33	FST	57	66	5, 9	62	6	MI
N/A	497+30	Briar Creek (1 single-family home)	SB	67	60	FST	57	64	5, 9	63	6	MI
N/A	499+50 to 500+50	Rose Briar Way (2 single-family homes)	NB	67	43	FST	57	67	2, 9	63	5.9	MI
N/A	500+50	Rose Briar Way (1 single-family home)	NB	67	53	FST	57	66	2, 9	63	5.5	MI

Table 5.10-4: BEP Alternative Projected *Severe Impacts* Cont'd

Option	Civil Station	Receiver Location Address (# and Type)	Track Direction	Speed (MPH)	Distance From Near Track	Track Type	Existing Ambient Ldn	Noise Levels Without Mitigation (Total Ldn)	Mitigation Number	Noise Levels With Mitigation (Total Ldn)	Noise Level Increase with Mitigation	Impact Type after Mitigation
N/A	500+70 to 502+00	Rose Briar Way (2 single-family homes)	NB	67	53	FST	57	66	2, 9	63	5.5	MI
N/A	501+90	Rose Briar Way (1 single-family home)	NB	67	35	FST	57	68	2, 9	63	6.1	MI
N/A	502+30	Rose Briar Way (1 single-family home)	NB	67	53	FST	57	66	2, 9	63	5.5	MI
N/A	502+50 to 506+00	Rose Briar Way (7 single-family homes)	NB	67	47	FST	57	66	2, 9	63	5.9	MI
N/A	503+35	Rose Briar Way (1 single-family home)	NB	67	33	FST	57	68	2, 9	63	5.8	MI
N/A	498+00 to 499+30	Royal Crest Drive (2 single-family home)	SB	67	37	FST	57	68	3, 9	63	6.1	MI
N/A	499+30 to 500+00	Royal Crest Drive (2 single-family home)	SB	67	37	FST	57	70	3, 9	63	5.6	MI
N/A	500+00 to 501+70	Royal Crest Drive (4 single-family homes)	SB	67	37	FST	57	70	3, 9	63	5.6	MI
N/A	501+80	Royal Crest Drive (1 single-family home)	SB	67	37	FST	57	69	3, 9	63	5.8	MI
N/A	502+20 to 502+50	Royal Crest Drive (3 single-family homes)	SB	67	35	FST	57	69	2, 8	63	5.8	MI
N/A	504+00	Valley Crest Drive (1 single-family home)	SB	67	25	FST	57	65	3, 9	63	6.1	MI

Table 5.10-4: BEP Alternative Projected *Severe Impacts* Cont'd

Option	Civil Station	Receiver Location Address (# and Type)	Track Direction	Speed (MPH)	Distance From Near Track	Track Type	Existing Ambient Ldn	Noise Levels Without Mitigation (Total Ldn)	Mitigation Number	Noise Levels With Mitigation (Total Ldn)	Noise Level Increase with Mitigation	Impact Type after Mitigation
Las Plumas Yard Option	506+00 to 507+00	Rose Briar Way (3 single-family homes)	NB	67	47	FST	57	66	2, 9	63	5.9	MI
Las Plumas Yard Option	507+00 to 508+00	Rose Briar Way (3 single-family homes)	NB	67	45	FST	57	65	2, 9	65	5.5	MI
Las Plumas Yard Option	505+50 to 507+30	Aschauer Court (5 single-family homes)	SB	67	43	FST	57	64	3, 9	63	5.4	MI
Las Plumas Yard Option	507+50 to 509+50	Taida Street, Berryessa Villa (3 Multi-family)	NB	67	87	FST	57	73	2	63	5.5	MI
Las Plumas Yard Option	510+00 to 511+50	Taida Street, Berryessa Villa (2 Multi-family)	NB	67	66	FST	57	74	2	63	5.5	MI
Las Plumas Yard Option	511+50 to 513+00	Taida Street, Berryessa Villa (2 Multi-family)	NB	67	90	FST	57	73	2	63	5.7	MI
Las Plumas Yard Option	513+50 to 515+00	Winston Court, Berryessa Villa (1 Multi-family)	NB	67	42	FST	60	74	6	64	4.4	MI
Las Plumas Yard Option	516+00	Heavenly Bamboo Court, Regency Park (1 Multi-family)	NB	67	86	FST	60	70	6	63	2.5	MI
Las Plumas Yard Option	517+00	Fern Pine Court (1 Multi-family)	NB	67	86	FST	60	66	6	62	2.1	MI
Las Plumas Yard Option	518+50	Fern Pine Court (1 Multi-family)	NB	67	72	FST	60	65	6	62	1.5	NI

Table 5.10-4: BEP Alternative Projected *Severe Impacts* Cont'd

Option	Civil Station	Receiver Location Address (# and Type)	Track Direction	Speed (MPH)	Distance From Near Track	Track Type	Existing Ambient Ldn	Noise Levels Without Mitigation (Total Ldn)	Mitigation Number	Noise Levels With Mitigation (Total Ldn)	Noise Level Increase with Mitigation	Impact Type after Mitigation
Las Plumas Yard Option	N/A	Melody Lane (1 single-family home)	N/A	N/A	50 estimated	N/A	53	53	12	53	0	MI
No New Yard Option	506+00 to 507+00	Rose Briar Way (3 single-family homes)	NB	67	47	FST	57	66	2, 9	63	5.9	MI
No New Yard Option	507+00 to 508+00	Rose Briar Way (3 single-family homes)	NB	67	45	FST	57	65	2, 9	65	5.5	MI
No New Yard Option	505+50 to 507+30	Aschauer Court (5 single-family homes)	SB	67	43	FST	57	64	3, 9	63	5.4	MI
No New Yard Option	507+50 to 509+50	Taida Street, Berryessa Villa (3 Multi-family)	NB	67	87	FST	57	73	2	63	5.5	MI
No New Yard Option	510+00 to 511+50	Taida Street, Berryessa Villa (2 Multi-family)	NB	67	66	FST	57	69	2	63	5.5	MI
No New Yard Option	511+50 to 513+00	Taida Street, Berryessa Villa (2 Multi-family)	NB	67	90	FST	57	67	2	63	5.7	MI

Key:
NB: Northbound
SB: Southbound
XO: Cross-over switch with frog
EM: Embankment Ballast and tie Track
AG: At Grade Ballast and Tie Track
CT: Retained Open Cut
FST: Floating Slab Track on embankment or at-grade track
SI: Severe Impact as defined by FTA

Table 5.10-4: BEP Alternative Projected *Severe Impacts* Cont'd

MI: Moderate Impact as defined by FTA, but not necessarily greater than a 5 dBA increase

NI: No Impact as defined by FTA

Mitigation:

1. A sound wall on the northbound side of the BART track, 13 feet from track centerline and 14-15 feet above top of rail would mitigate impacts to ground level receptors. As an option, increasing the height of the developer's 10-foot wall to 14-15 feet would also mitigate Severe impacts.
2. At-Grade sound wall, north side of BART track (13 ft from track centerline)
3. At-Grade sound wall, south side of BART track (13 ft from track centerline)
4. Top of retaining wall on Open Cut, north side of BART track (10 ft from track centerline)
5. Top of retaining wall on Open Cut, south side of BART track (10 ft from track centerline)
6. Top of retaining wall on Open Cut, north side of BART track (13 ft from track centerline)
8. Bridge sound wall, south side of BART track (10 ft from track centerline)
9. Sound Absorptive Material
10. UPRR at-grade sound wall, south of UPRR track (16 feet from track centerline)
11. Slab Track Acoustical Absorption
12. At-Grate sound wall on the east side of the Las Plumas Yard

Source: Wilson Ihrig, 2008a

Table 5.10-5: BEP Alternative Projected *Moderate Impacts*

Option	Civil Station	Receiver Location Address (# and Type)	Track Direction	Speed (MPH)	Distance From Near Track	Track Type	Existing Ambient Ldn	Noise Levels Without Mitigation (Total Ldn)	Noise Levels With Mitigation (Total Ldn)	Level Increase	Impact Type	Mitigation Number
N/A	172+60	Warm Springs Village (1 Single-family)	NB	67 XO	96	FST	58	63	62	4.5	MI	1
N/A	231+00 to 238+00	Pescadero St (13 Single-family)	SB	67	330	AG	56	62	60	4.4	MI	2
N/A	238+50 to 243+00	Pescadero St (8 Single-family)	SB	67 XO	330	AG	56	62	60	4.4	MI	2
N/A	243+50	978 Pescadero St (1 Single-family)	SB	67 XO	330	AG	56	62	60	4.5	MI	2
N/A	244+00	970 Pescadero St (1 Single-family)	SB	67 XO	330	AG	56	62	60	4.5	MI	2
N/A	244+00 to 245+00	Coyote Street (3 Single-family)	SB	67 XO	360	AG	56	61	60	4.2	MI	2
N/A	250+50 to 253+00	Berryessa St (4 Single-family)	SB	67	302	AG	59	64	62	2.9	MI	2

Table 5.10-5: BEP Alternative Projected *Moderate Impacts* Cont'd

Option	Civil Station	Receiver Location Address (# and Type)	Track Direction	Speed (MPH)	Distance From Near Track	Track Type	Existing Ambient Ldn	Noise Levels Without Mitigation (Total Ldn)	Noise Levels With Mitigation (Total Ldn)	Level Increase	Impact Type	Mitigation Number
Retained Cut Long Option	409+50 to 410+50	North Star Cir (2 Single-family)	NB	67	115	CT	58	63	62	4.2	MI	1
Retained Cut Long Option	410+50 to 411+00	North Star Cir (2 Single-family)	NB	67	115	CT	58	63	62	4.4	MI	1
Retained Cut Intermediate Option	409+50 to 410+50	North Star Cir (2 Single-family)	NB	67	115	CT	58	63	62	4.2	MI	1
Retained Cut Intermediate Option	410+50 to 411+00	North Star Cir (2 Single-family)	NB	67	115	CT	58	63	62	4.4	MI	1
N/A	462+50 to 464+00	Gordy Dr (3 Single-family)	SB	67	72	FST	56	62	59	3.3	MI	6
N/A	473+60	Gordy Dr (1 Single-family)	SB	67	55	FST	56	63	59	3.2	MI	6
N/A	474+00	Gordy Dr (1 Single-family)	SB	67	85	FST	56	61	61	4.9	MI	6
N/A	459+00 to 462+50	Prosperity Ct (1 Single-family)	NB	67	105	FST	58	62	61	3.0	MI	6
N/A	460+50 to 462+50	Prosperity Ct (3 Single-family)	NB	67	53	FST	56	63	59	3.2	MI	6

Table 5.10-5: BEP Alternative Projected *Moderate Impacts* Cont'd

Option	Civil Station	Receiver Location Address (# and Type)	Track Direction	Speed (MPH)	Distance From Near Track	Track Type	Existing Ambient Ldn	Noise Levels Without Mitigation (Total Ldn)	Noise Levels With Mitigation (Total Ldn)	Level Increase	Impact Type	Mitigation Number
N/A	462+50 to 464+00	Prosperity Ct (2 Single-family)	NB	67	53	FST	56	63	60	3.6	MI	6
N/A	464+50	Prosperity Ct (1 Single-family)	NB	67	53	FST	56	63	60	3.6	MI	6
N/A	480+50 to 481+50	Rue Avati (2 Single-family)	NB	67	106	FST	56	62	60	4.3	MI	6
N/A	476+00	Tersini Ct (1 Single-family)	SB	67	83	FST	56	62	60	4.3	MI	6
N/A	478+60	Tersini Ct (1 Single-family)	SB	67	57	FST	56	61	58	2.1	NI	6
N/A	479+00	Tersini Ct (1 Single-family)	SB	67	93	FST	56	60	60	4.0	MI	6
N/A	481+50 to 483+00	Rue Avati (3 Single-family)	NB	67	57	FST	61	65	65	4.0	MI	6
N/A	484+00 to 485+50	Caloosa (3 Single-family)	NB	67	65	FST	61	64	64	2.6	MI	6
N/A	485+50 to 487+50	Caloosa (3 Single-family)	NB	67	63	FST	61	64	64	3.3	MI	6
N/A	495+50	Lundy Ave (1 Single-family)	NB	67	53	FST	57	63	62	4.9	MI	3, 5

Table 5.10-5: BEP Alternative Projected *Moderate Impacts* Cont'd

Option	Civil Station	Receiver Location Address (# and Type)	Track Direction	Speed (MPH)	Distance From Near Track	Track Type	Existing Ambient Ldn	Noise Levels Without Mitigation (Total Ldn)	Noise Levels With Mitigation (Total Ldn)	Level Increase	Impact Type	Mitigation Number
N/A	495+50	Briar Creek (1 Single-family)	SB	67	63	FST	57	62	62	4.7	MI	4, 5
N/A	497+50 to 499+50	Rose Briar Way (4 Single-family)	NB	67	40	FST	57	62	62	5.3	MI	1, 5

Key:
NB: Northbound
SB: Southbound
XO: Cross-over switch with fog
AG: At Grade Ballast and Tie Track
CT: Retained Open Cut
FST: Floating Slab Track on Embankment or At-Grade
MI: Moderate Impact as defined by FTA, but not necessarily greater than a 5 dBA increase
NI: No Impact as defined by FTA

Mitigation:
(1) At-Grade sound wall, north side of BART track (13 ft from track centerline)
(2) At-Grade sound wall, south side of BART track (13 ft from track centerline)
(3) Top of retaining wall on Open Cut, north side of BART track (10 ft from track centerline)
(4) Top of retaining wall on Open Cut, south side of BART track (10 ft from track centerline)
(5) Sound Absorptive Material
(6) Slab Track Acoustical Absorption

Source: Wilson Ihrig, 2008d

Station Noise Impacts

There are several noise sources associated with typical BART stations that have the potential to be intrusive to the adjacent communities. These sources include the public address system for at-grade and above ground stations, noise from emergency mechanical equipment, and traffic into and out of the parking lots.

The Milpitas Station site is located in the southeast quadrant of the intersection of the Montague Expressway and Capital Avenue. The site is largely surrounded by commercial and industrial land uses although there is a Residence Inn north of the site on the opposite side of the Montague Expressway and a large apartment complex (The Crossings at Montague) just south of the site. The measured sound level in the parking lot of the Residence Inn was 62 dBA not including freight train activities. The station activities would not likely increase noise exposure at the Residence Inn beyond existing levels caused by traffic on the Montague Expressway.

The measured sound level at the Montague Apartments was 51 dBA, which is a relatively low sound level. Most of the complex is well shielded from traffic on the Montague Expressway and Capitol Avenue either by other buildings in the complex or a large warehouse building just north of the complex. The warehouse is located in an area shown as the future bus transit center and parking lot. Removing the warehouse building will increase the noise levels at the north side of the complex. To avoid substantially increasing sound levels at The Crossings at Montague apartments, a 12-foot high sound wall will be designed to ensure that the FTA noise impact criteria will be achieved (ATS Consulting, 2005 and 2006a).

The Berryessa Station area has existing noise-sensitive residential uses to the east and commercial uses to the west. Background residential area noise levels were measured at 58 Ldn. BART train operations are projected to increase noise levels by 4.8 dBA for ground-level residences or a Moderate Impact and by 6.5 dBA for the second story and above or a Severe Impact regardless of whether the North or South Option were selected. Noise from moving buses and bus idling was also modeled and varies depending on the option. Residences near the busbays would be exposed to Severe Impact as a result of bus only operations.

Both alternatives include an 8-foot high community wall along residential areas to the east. This community wall would reduce Severe Impacts to a Moderate or less Impact for the BEP and SVRTP Alternatives North Option and SVRTP Alternative South Option except for the portion between Berryessa Road and the residential area to the north of Salamoni Court. An 8-foot high noise barrier would need to continue northward along the future transit facility surface parking lot and access road to Berryessa Road to reduce this noise impact to less than severe. With this community wall, the second story residences along Salamoni Court and on the eastern boundary to Mabury Road may still be impacted depending on the noise insulation reduction capability of existing residential construction. The need for additional noise insulation of these residences would need to be determined on a residence by residence basis.

Additional noise barriers are required for the BEP Alternative South Option at the Berryessa Station area to reduce BART and bus operational noise impacts. To reduce ground floor noise to acceptable levels, the following noise barriers are required; 1) a 12 foot high noise barrier along the eastern boundary between Salamoni Court and Mabury Road, 2) a 10 foot high noise barrier along Salamoni Court, and 3) a 8 foot high noise barrier on the eastern boundary of the surface parking lot north of Salamoni Court and continuing along the access road to Berryessa Road. Even with this mitigation, the second story residences between Salamoni Court and Mabury Road may be impacted depending on the noise insulation reduction capability of existing residential construction. The need for additional noise insulation of these residences would need to be determined on a residence by residence basis.

Traction Power Substation Noise Impacts

Only one of the traction power substations would be located less than 250 feet from the nearest sensitive residential or institutional properties. Potential adverse noise effects would occur at TPSS SMB located south of Trade Zone Boulevard. However, the combined Ldn of the train and the substation is 53 dBA, which is below the FTA Noise Impact Criterion of 56 dBA.

High Voltage Substation Noise Impacts

The two High Voltage Substations (SRC and SMR) are both located at least 250 feet from noise-sensitive land uses and would not exceed the FTA noise impact criteria.

Electrical Facilities

Electrical Facilities South of Trade Zone Boulevard may need a sound barrier depending on Final Design. The sound barrier would be no higher than 8 feet to achieve the FTA criteria (WIA, 2006d).

Emergency Power Generators

While emergency power generators would be located aboveground, they would be enclosed in either concrete or brick structures. By locating the generators within enclosed structures, there would be no adverse noise effect associated with periodic routine testing.

Crossover Tracks

North of Kato Road there are no noise-sensitive land uses and therefore, no additional adverse noise effects have been identified. South of Kato Road, two new residential projects have been approved by the City of Fremont east of the alignment. This includes the Castilleja Condominiums and Warm Springs Village. Subsequent noise analysis was prepared to address adverse noise effects from the new project design and land use change (WIA, 2006a).

Table 5.10-4 summarizes the noise assessment results with respect to the FTA Criteria with the crossover located south of Kato Road. The table provides the expected cumulative noise level the total number of affected residences with noise mitigation, and the type of mitigation recommended achieving the criteria. There would be four (4) residences with *Severe Impact* as defined by FTA and these adverse effects are associated with the noise from the crossover. To mitigate outdoor severe adverse noise effects at these residences would require a 14-foot high sound wall. A wall of this height may be infeasible due to cost and/or undesirable to the residences because of adverse visual effects. In addition, nine residences would have adverse noise effects to the second story and above. The second stories of these residences would be too high and close to the alignment for a feasible sound wall height (i.e., greater than 14 feet) to mitigate the noise. To mitigate adverse noise effects to second story and above would require substantial noise insulation of the structure or constructing a sound wall closer to the eastern track in combination with a sound wall.

Las Plumas Yard Option

The predicted noise exposure from all yard and shop related activities would exceed the FTA *Moderate Impact* criteria of 54 dBA by 4 dBA without mitigation. However, with the addition of a 10 foot sound wall, noise would be reduced to 53 dBA.

Traffic Noise Impact Assessment

No adverse effect from traffic noise is projected at any residential, institutional, or commercial receptors. A cumulative noise level approaching 67 dBA or a change of 12 dB are the thresholds set by Caltrans for substantial adverse effect (Traffic Noise Analysis Protocol, Caltrans, October 1998). The future increase in traffic is not substantial enough to exceed 66 dBA or cause a 12 dB increase in noise levels at sensitive receptors throughout the alignment area.

Alignment Impacts

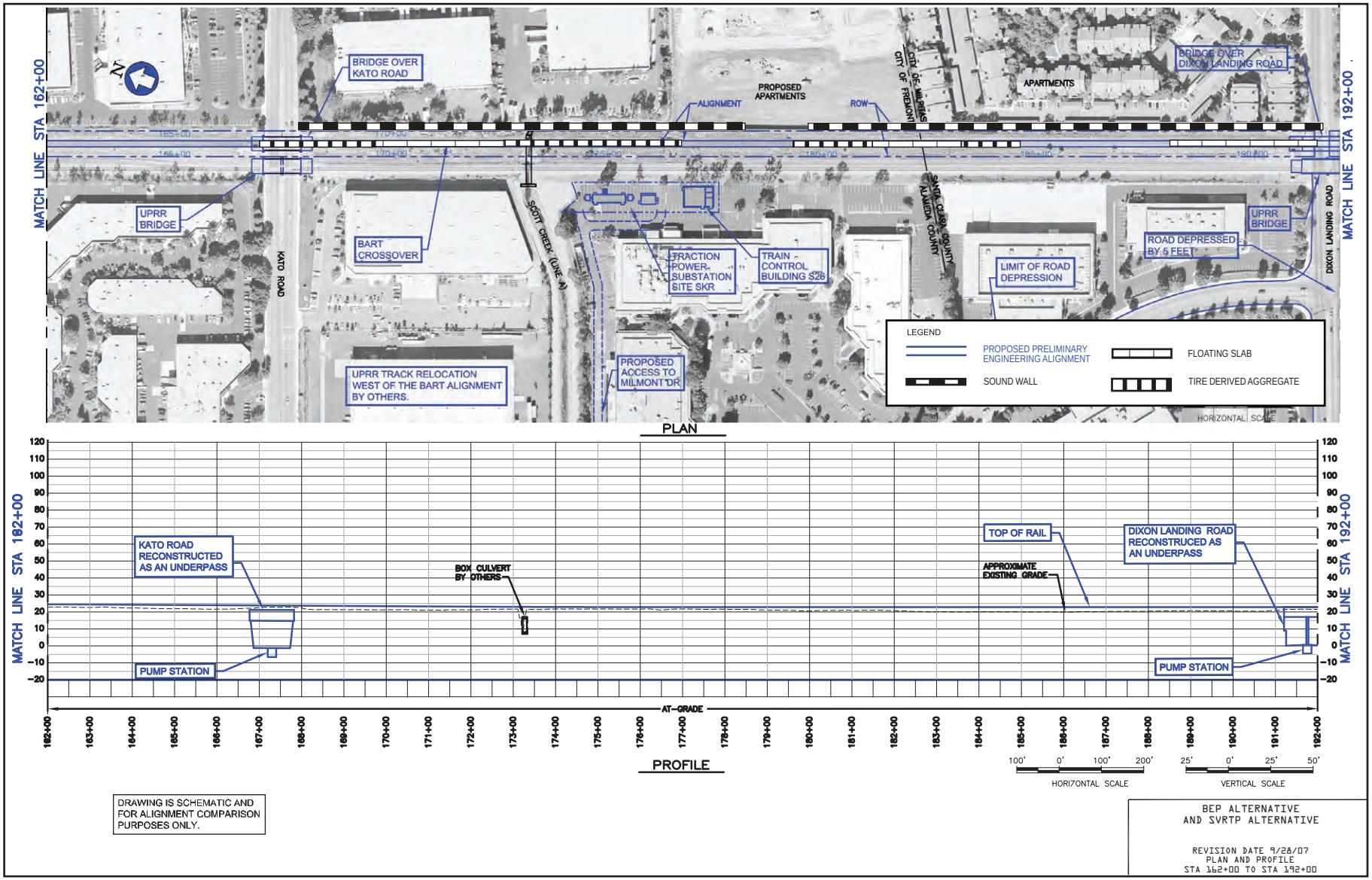
Six single-family residences located on Berryessa Street and two multi-family buildings located at the Parc Metropolitan Condominium complex would be expected to experience increases in noise levels resulting in *Severe Impact*. The area of effect due to UPRR trains and warning horns at the Dixon Landing crossing currently includes residences at the Spinnaker Apartments and at the Mobile Home Park. Eliminating warning horns from trains, would limit the area of effect to within the UPRR ROW.

> Mitigation Measure NV-1: Sound walls shall be installed to mitigate noise levels near residences affected by the BEP Alternative. Table 5.10-6 indicates the location of recommended sound walls. Approximately 12,500 linear feet of soundwalls would be needed, with each sound wall ranging in length from 250 to 1,730 feet. Typically, the location of the sound wall is either 10 feet or 13 feet from the track centerline, depending upon the track profile. Ten feet is for the retained open cut track and the aerial guideway, and 13 feet for the at-grade and embankment tracks. In areas where a sound wall is recommended on both

sides of the alignment, absorptive sound walls are the recommended noise mitigation. The locations of the sound walls are depicted in Figures 5.10-3a through 5.10-3m.

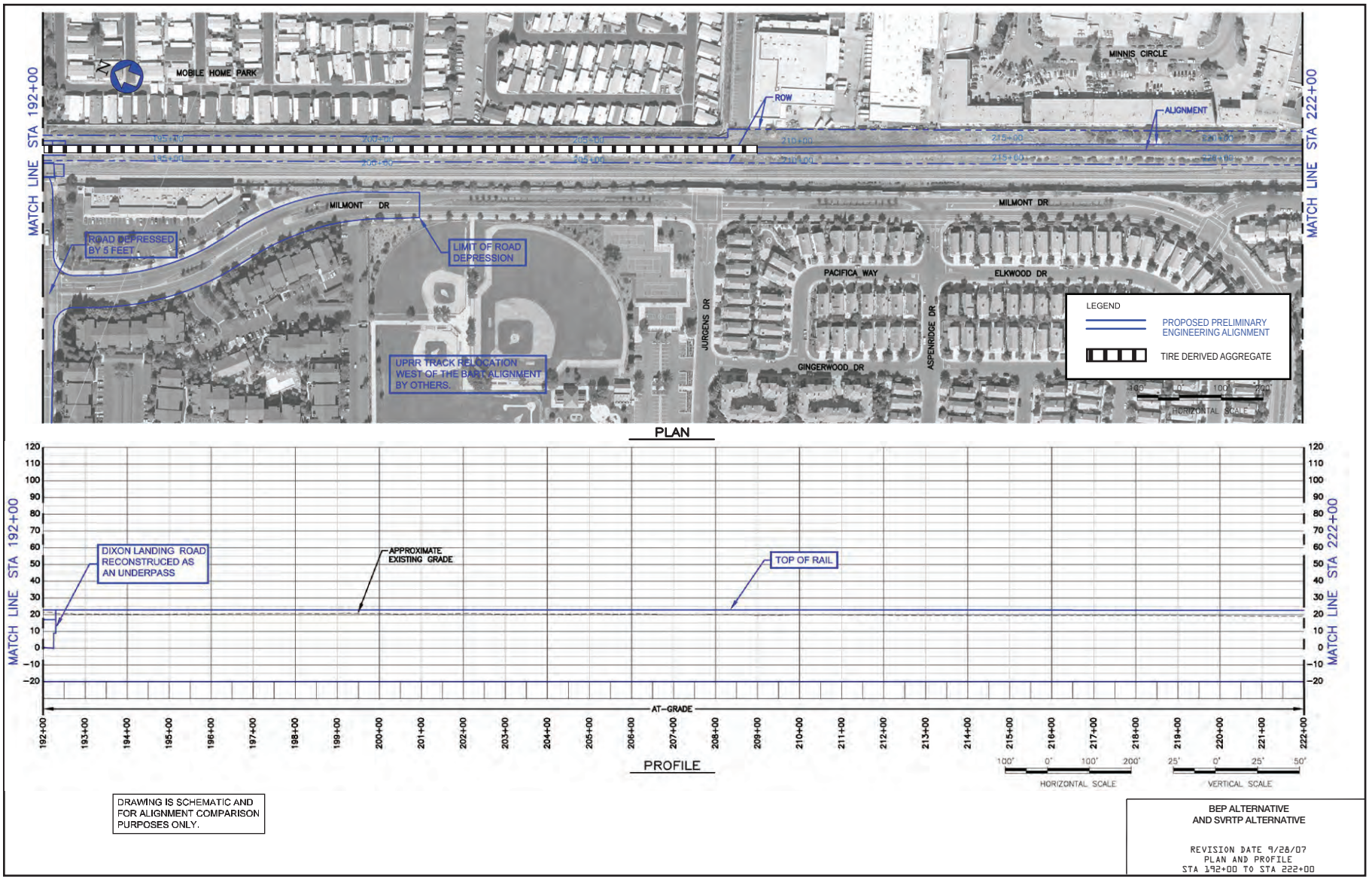
Both the BEP and SVRTP Alternatives include an 8-foot high community wall along residential areas to the east. This community wall would reduce Severe Impacts to a Moderate or less Impact for the BEP and SVRTP Alternatives North Option and SVRTP Alternative South Option except for the portion between Berryessa Road and the residential area to the north of Salamoni Court. An 8-foot high noise barrier would need to continue northward along the future transit facility surface parking lot and access road to Berryessa Road to reduce this noise impact to less than severe. With this community wall, the second story residences along Salamoni Court and on the eastern boundary to Mabury Road may still be impacted depending on the noise insulation reduction capability of existing residential construction. The need for additional noise insulation of these residences would need to be determined on a residence by residence basis.

To reduce ground floor noise to acceptable levels for the BEP Alternative and Berryessa Station area South Option, the following noise barriers are required; 1) a 12 foot high noise barrier along the eastern boundary between Salamoni Court and Mabury Road, 2) a 10 foot high noise barrier along Salamoni Court, and 3) a 8 foot high noise barrier on the eastern boundary of the surface parking lot north of Salamoni Court and continuing along the access road to Berryessa Road. Even with this mitigation, the second story residences between Salamoni Court and Mabury Road may be impacted depending on the noise insulation reduction capability of existing residential construction. The need for additional noise insulation of these residences would need to be determined on a residence by residence basis.



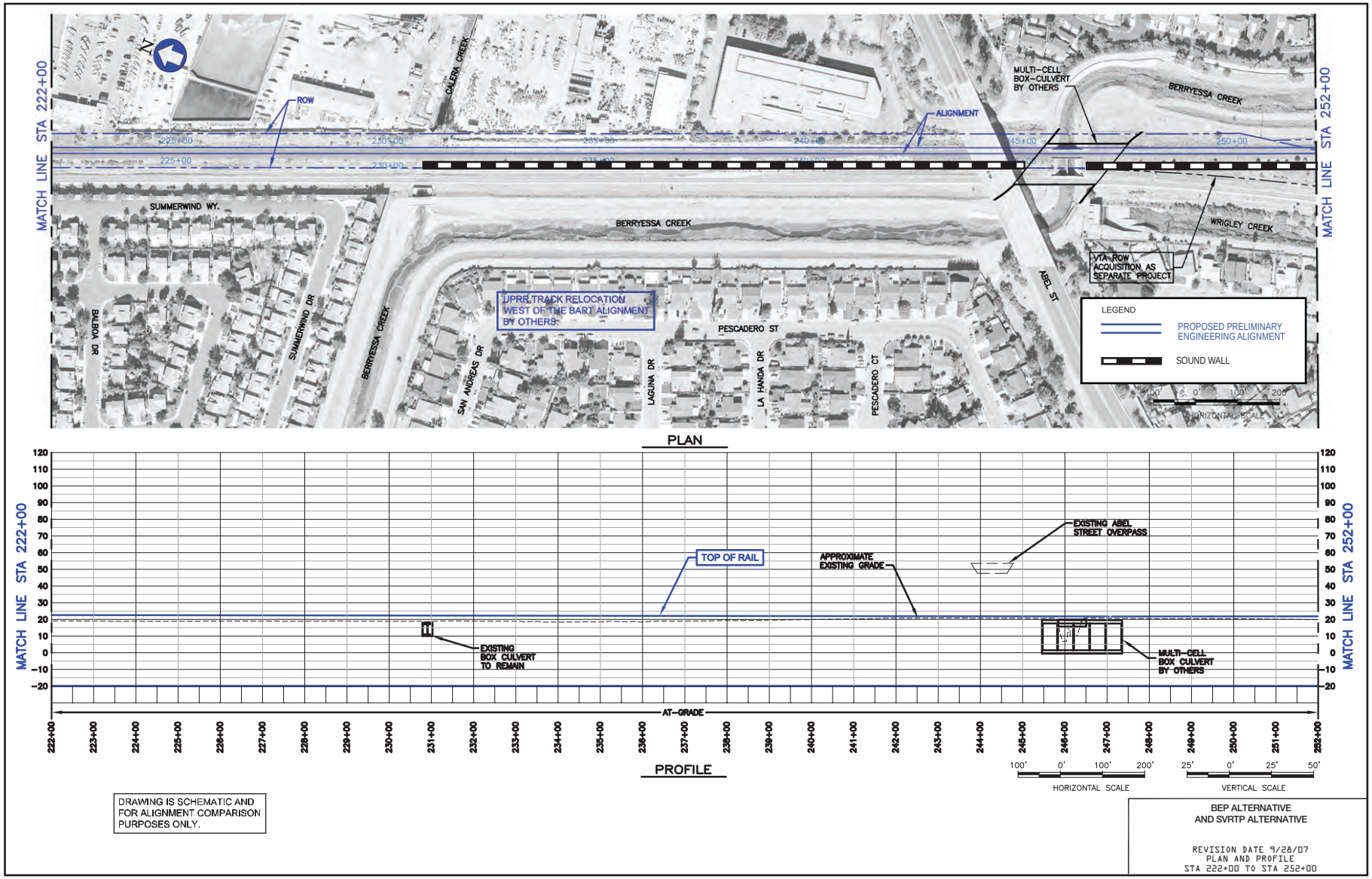
Source: Wilson Ihrig and VTA, 2008.

Figure 5.10-3A: Noise and Vibration Mitigation Locations



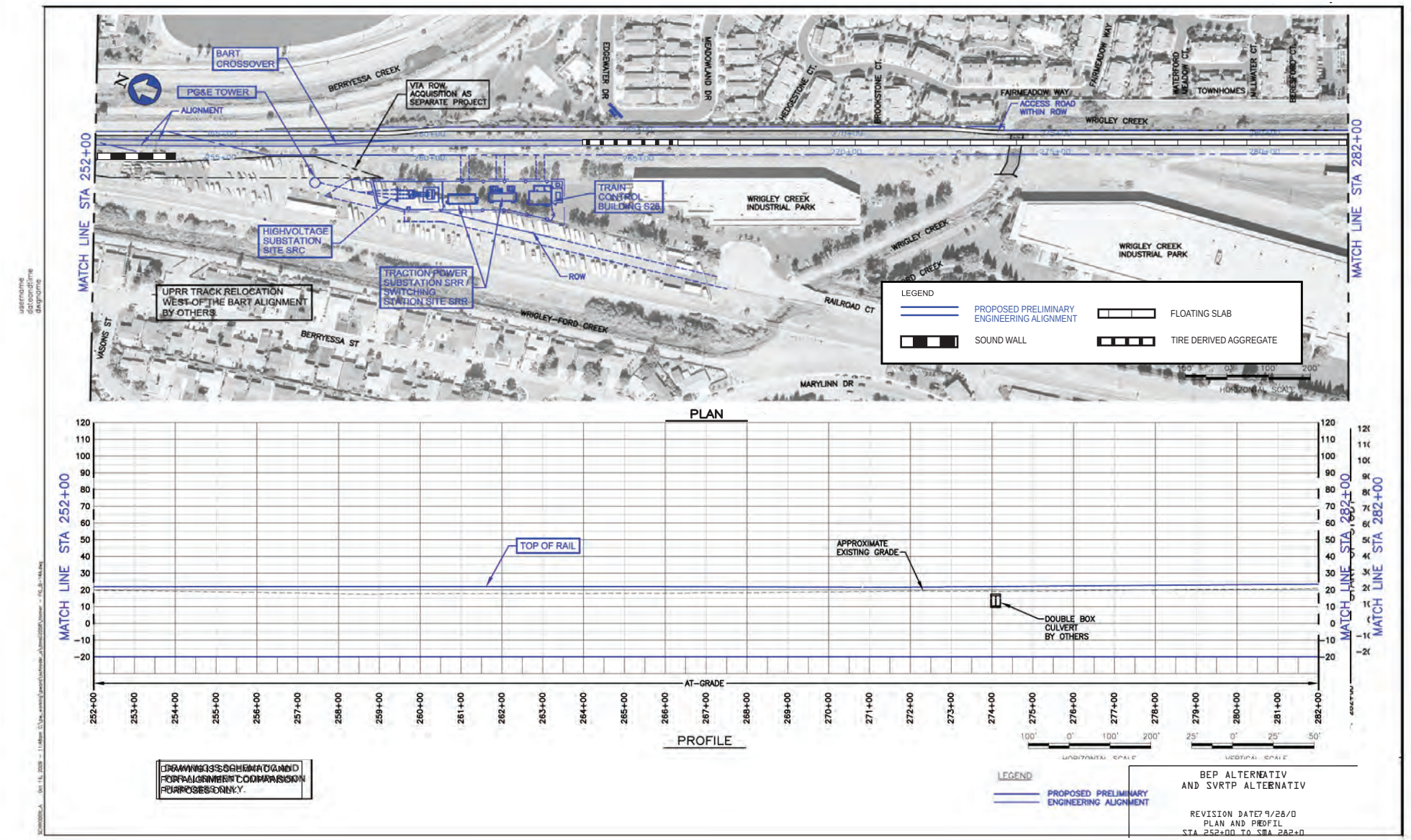
Source: Wilson Ihrig and VTA, 2008.

Figure 5.10-3B: Noise and Vibration Mitigation Locations



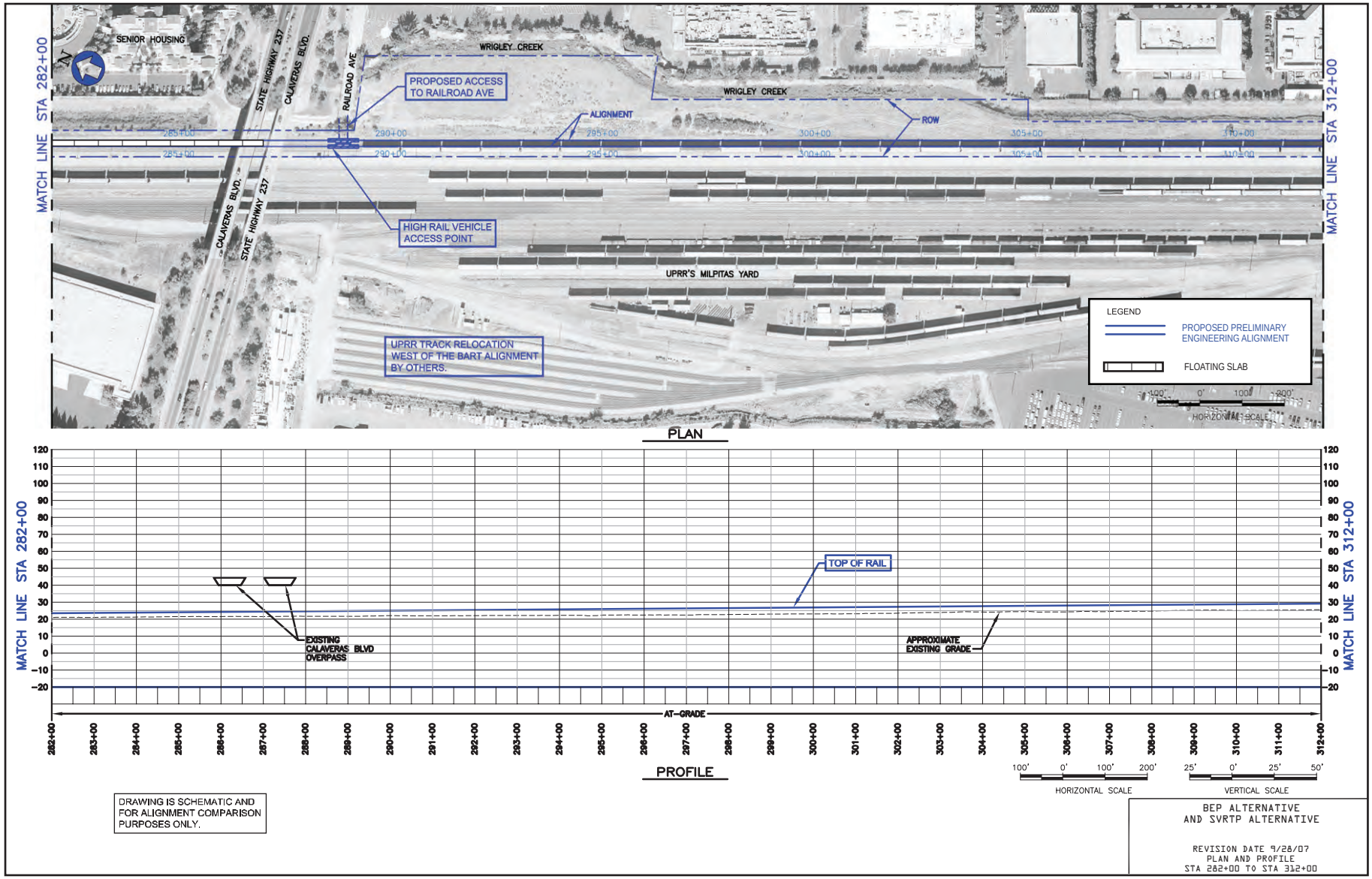
Source: Wilson Ihrig and VTA, 2008.

Figure 5.10-3C: Noise and Vibration Mitigation Locations



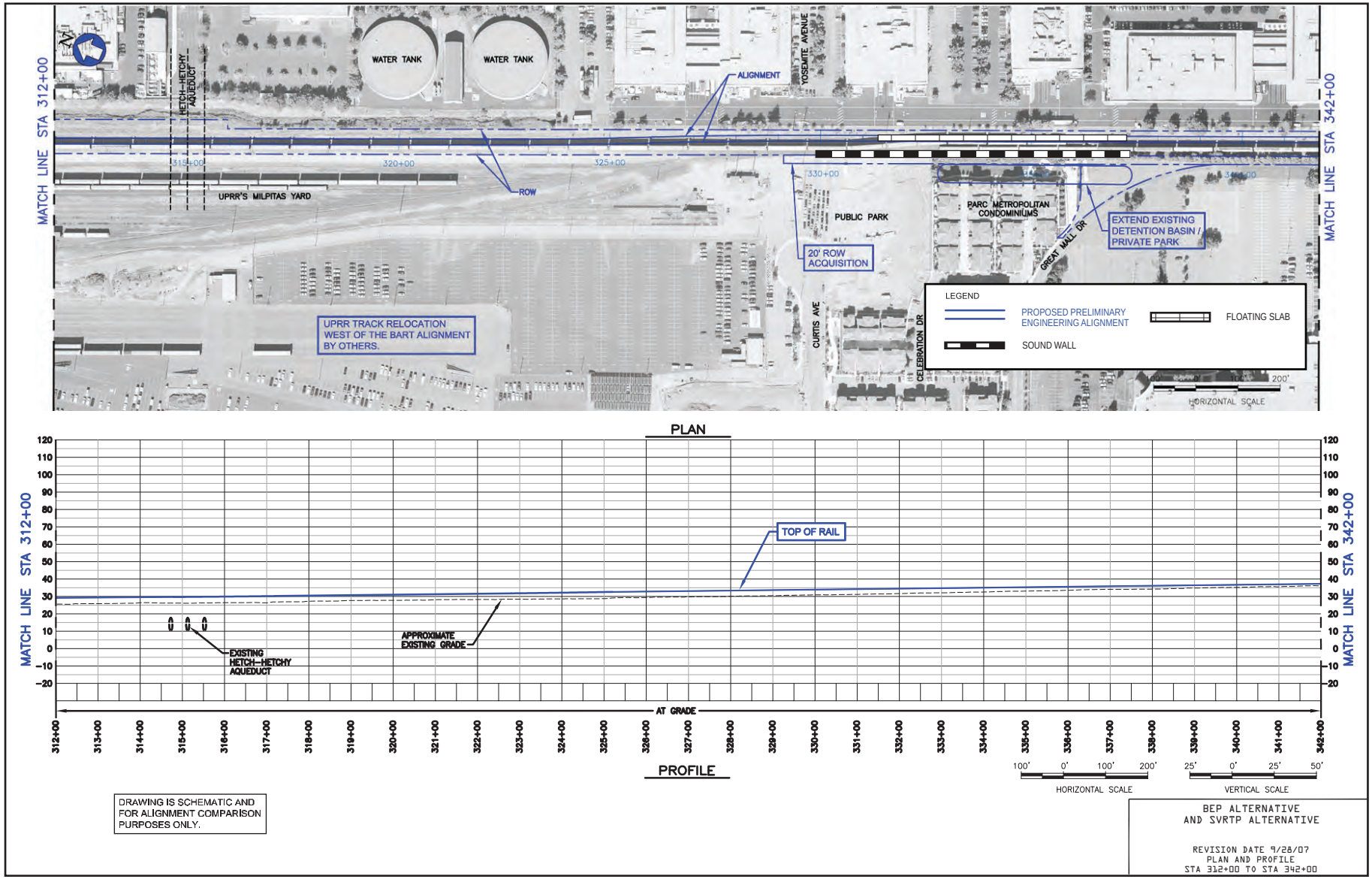
Source: Wilson Ihrig and VTA, 2008.

Figure 5.10-3D: Noise and Vibration Mitigation Locations



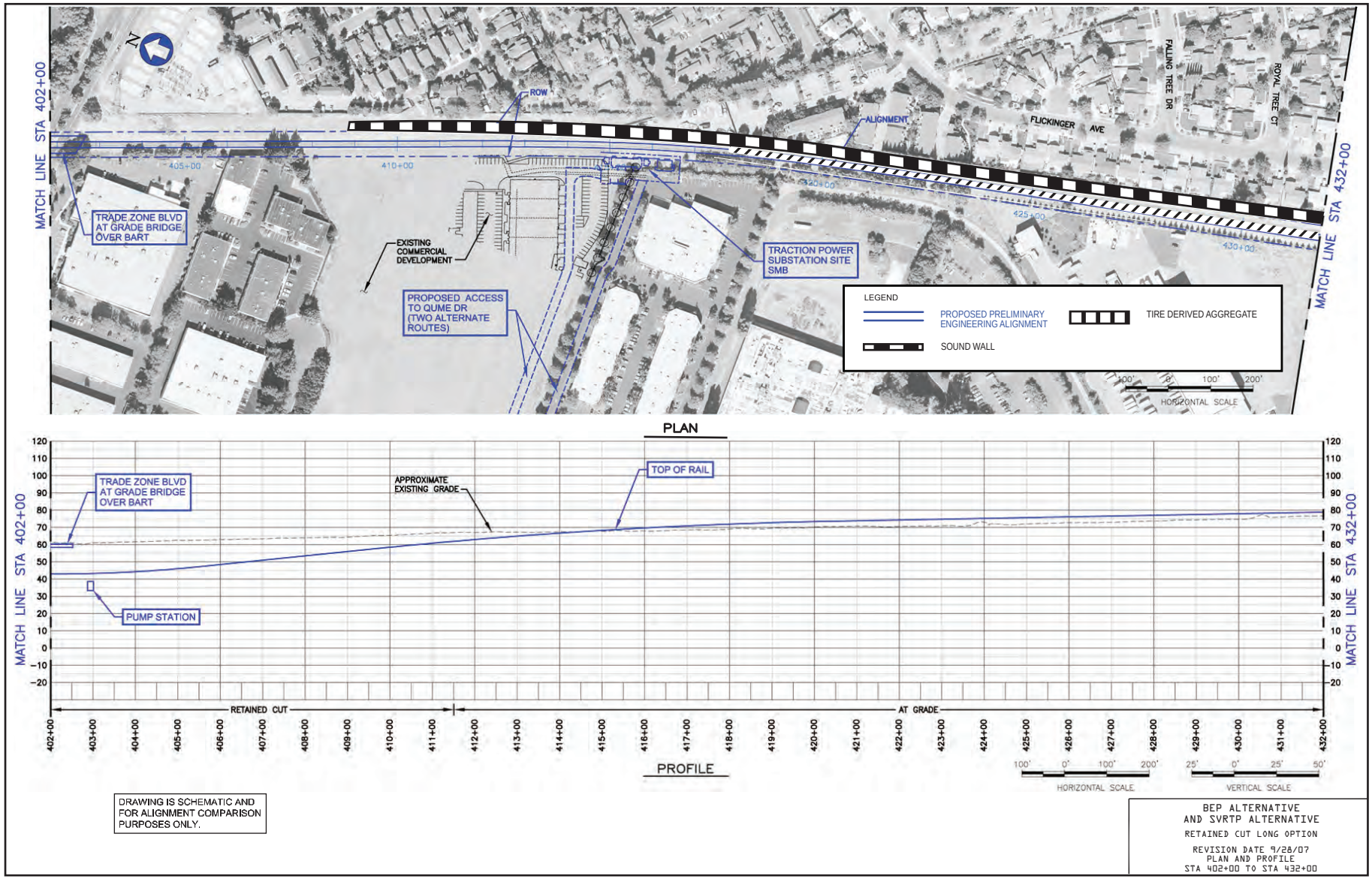
Source: Wilson Ihrig and VTA, 2008.

Figure 5.10-3E: Noise and Vibration Mitigation Locations



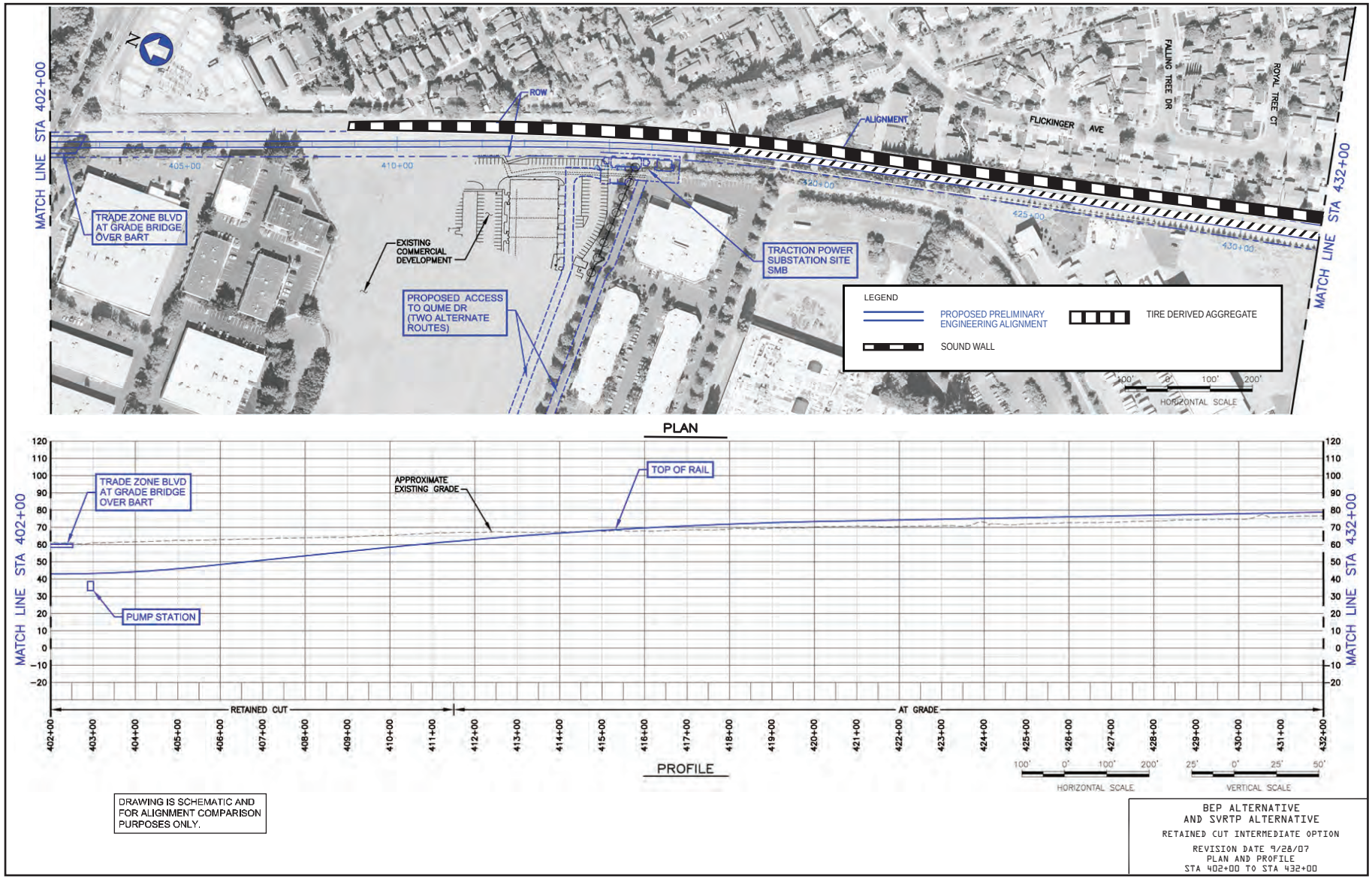
Source: Wilson Ihrig and VTA, 2008.

Figure 5.10-3F: Noise and Vibration Mitigation Locations



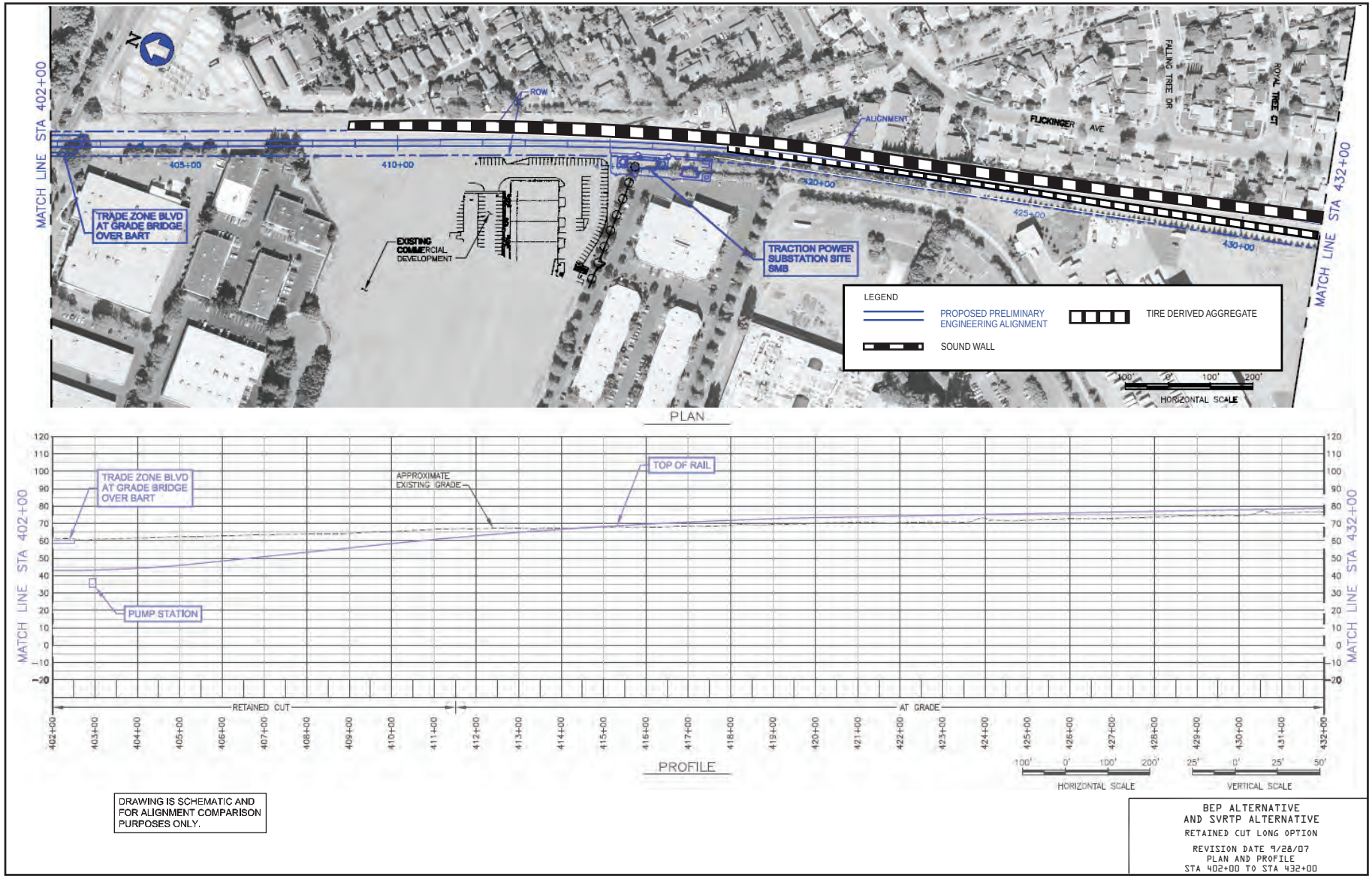
Source: Wilson Ihrig and VTA, 2008.

Figure 5.10-3G: Noise and Vibration Mitigation Locations



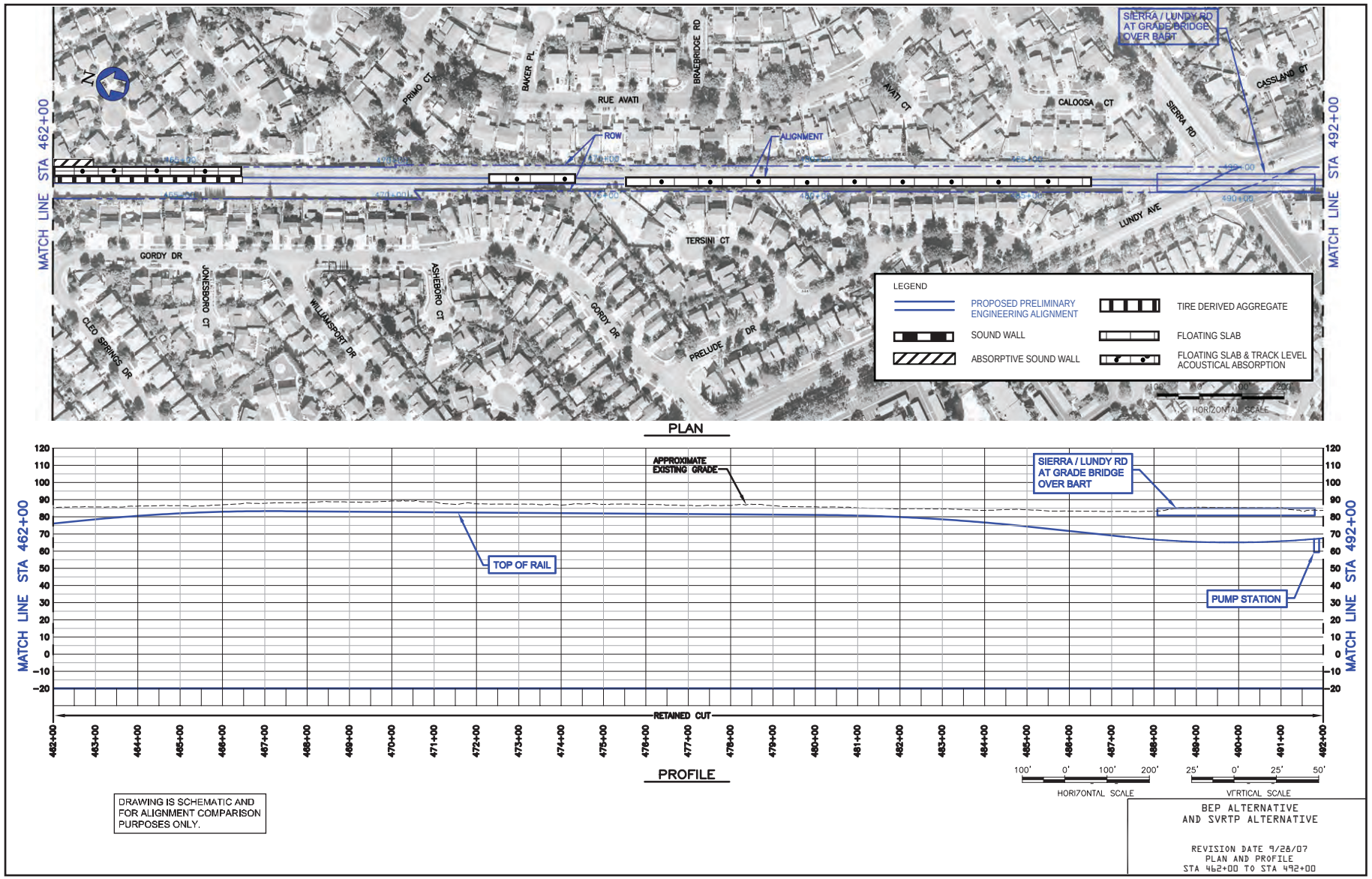
Source: Wilson Ihrig and VTA, 2008.

Figure 5.10-3H: Noise and Vibration Mitigation Locations



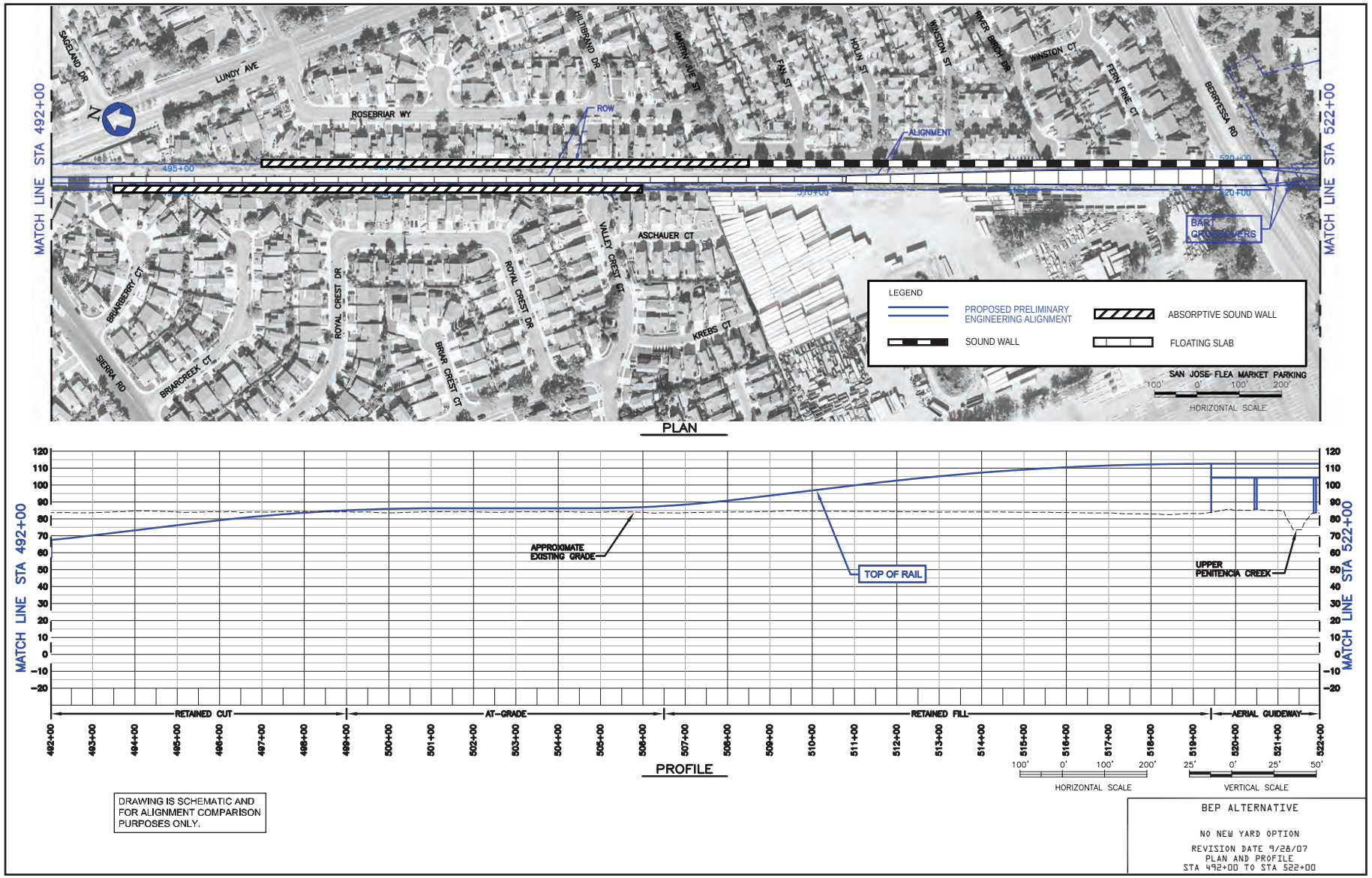
Source: Wilson Ihrig and VTA, 2008.

Figure 5.10-3l: Noise and Vibration Mitigation Locations



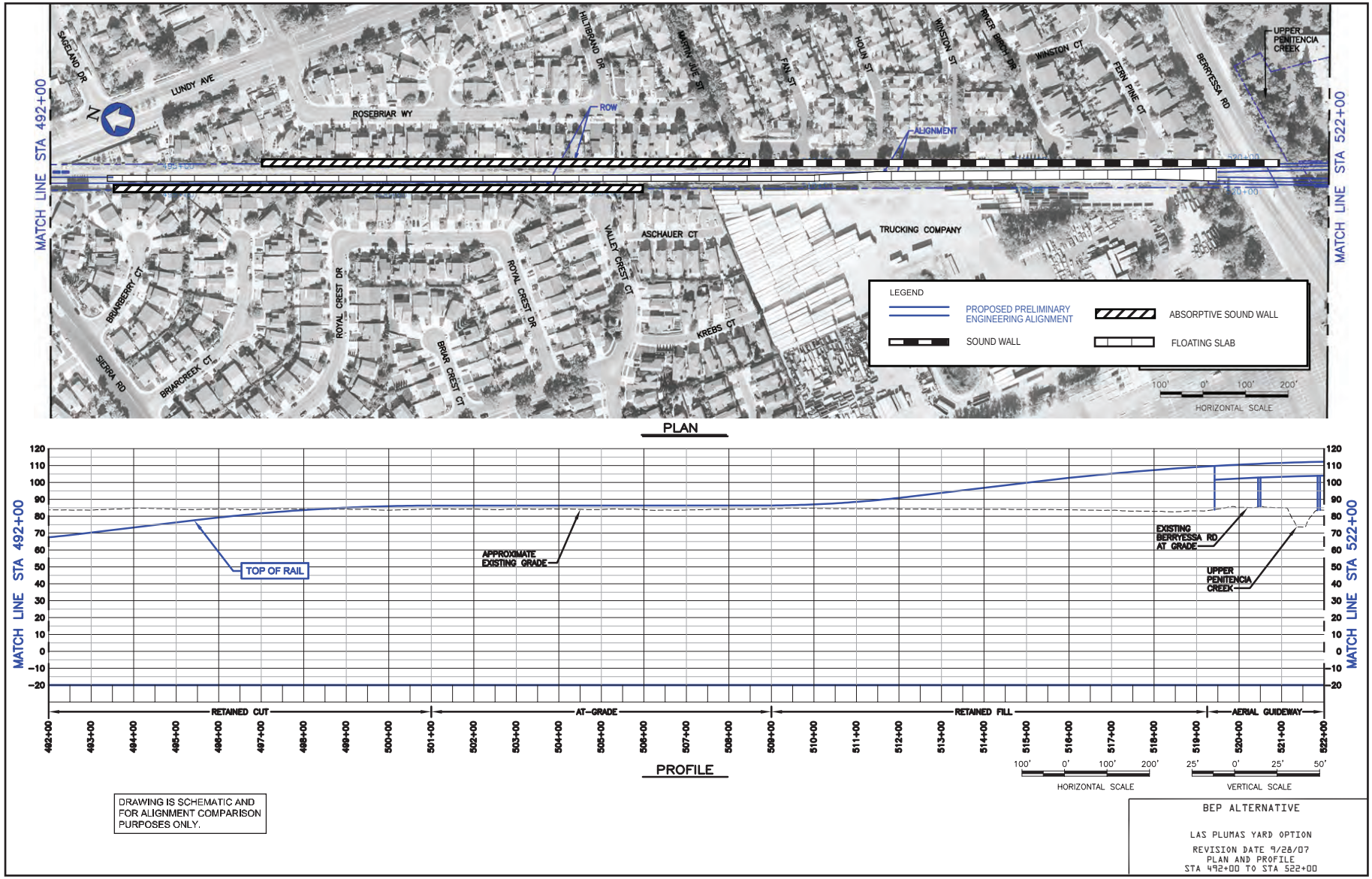
Source: Wilson Ihrig and VTA, 2008.

Figure 5.10-3J: Noise and Vibration Mitigation Locations



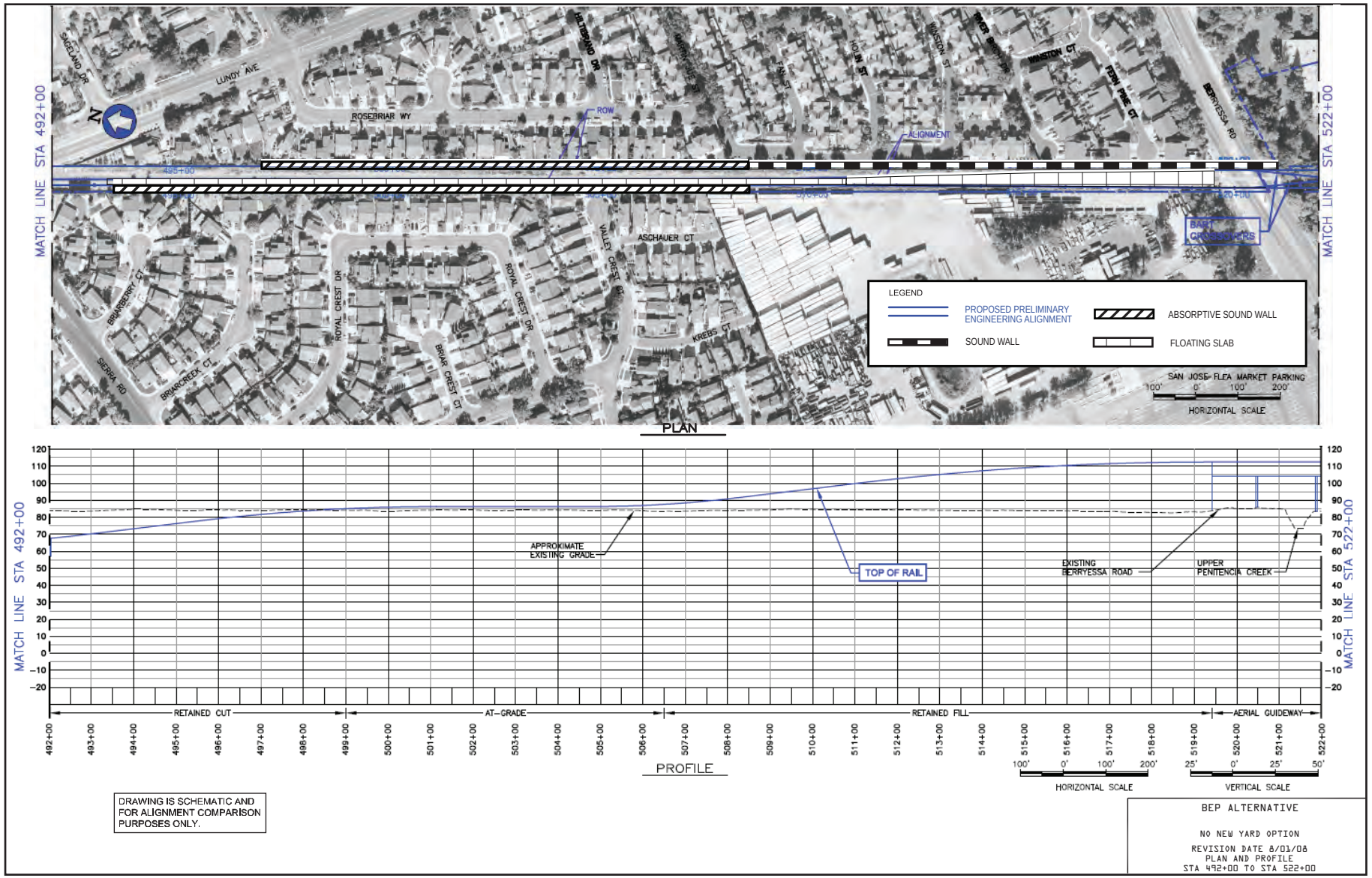
Source: Wilson Ihrig and VTA, 2008.

Figure 5.10-3K: Noise and Vibration Mitigation Locations



Source: Wilson Ihrig and VTA, 2008.

Figure 5.10-3L: Noise and Vibration Mitigation Locations



Source: Wilson Ihrig and VTA, 2008.

Figure 5.10-3M: Noise and Vibration Mitigation Locations

Table 5.10-6: Noise Wall Mitigation for the BEP Alternative

Option	Beginning Civil Station Number	Ending Civil Station Number	Side of Track	Height (feet)	Length (feet)
N/A	168+20	176+50	S2	14-15	830
At Grade Option at Dixon Landing	181+00	184+00	S2	7	300
Retained Cut Option at Dixon Landing	181+00	184+00	S2	8	300
N/A	186+00	192+20	S2	8	620
N/A	230+80	245+00	S1	4[c]	1420
N/A	246+50	254+00	S1	4	750
N/A	330+00	337+50	S1	12[a]	750
Retained Cut Long Option	409+00	412+50	S2	7[c]	350
Retained Cut Long Option	412+50	423+00	S2	7	1050
Retained Cut Intermediate Option	409+00	412+50	S2	7[c]	350
Retained Cut Intermediate Option	412+50	423+00	S2	7	1050
N/A	423+00	440+30	S2	9	1730
N/A	440+30	447+50	S2	8[c]	720
N/A	447+50	452+30	S2	10	480
N/A	493+50	506+00	S1	10[b]	1100
N/A	497+00	506+00	S2	10[b]	900
Las Plumas Yard Option	506+00	508+50	S1	9[b]	250
Las Plumas Yard Option	506+00	508+50	S2	10[b]	250
Las Plumas Yard Option	508+50	512+00	S2	8	350
Las Plumas Yard Option	512+00	515+50	S2	6	350
Las Plumas Yard Option	515+00	521+00	S2	4	550
Las Plumas Yard Option	[see Figure 5.10-3l]	[see Figure 5.10-3l]	N/A	10	1125
No New Yard Option	506+00	508+50	S1	9[b]	250
No New Yard Option	506+00	508+50	S2	10[b]	250
No New Yard Option	508+50	512+00	S2	6	350
No New Yard Option	512+00	515+50	S2	4	350
No New Yard Option	515+00	521+00	S2	4	550

S1 - Southbound Track; S2 - Northbound Track

[a] Sound Wall part of UPRR Relocation Project

[b] Absorptive Sound Wall

[c] Sound Wall to Mitigate *Moderate Impacts*

Source: Wilson Ihrig, 2008a

In the area of the alignment between Hostetter Road and Sierra Road, it was determined that a sound wall would not be a practical noise mitigation measure because receptors in this area have an existing sound wall at their backyard property line. It is estimated that the receptor's sound walls would provide shielding of wayside noise from the BEP Alternative of 15 dB, which is the maximum reduction of a sound wall recognized by FTA for a single noise barrier. As shown in Table 5.10-5, receptors in this area are projected to encounter a noise level increase of *Moderate Impact*. This is primarily due to the 3 dBA increase in noise levels associated with the floating slab track. Implementation of track level acoustical absorption would eliminate this increase.

Mitigation Measure NV-2: A 2,000 alignment feet of slab track acoustical absorption at track level shall be used to reduce adverse noise effects in the area of the alignment between Hostetter Road and Sierra Road. This mitigation shall occur between civil station 459+50 and 486+50 as indicated in Table 5.10-7.

Table 5.10-7: Locations for Track Level Acoustical Absorption for the BEP Alternative

Civil Station	Side of Track	Length (feet)
459+50 to 466+50	S1 & S2	700
472+30 to 474+30	S1 & S2	200
475+50 to 486+50	S1 & S2	1100

Source: Wilson Ihrig, 2008a.

Mitigation Measure NV-3: During the project start-up phase and prior to revenue operations, VTA will carry out noise testing along the civil stations where slab track acoustical absorption is being used as a mitigation measure. The testing is to ensure that the sound absorber is adequately attenuating the increased noise from the slab track. VTA will deliver a technical memo to FTA on the results of the testing. The testing will also serve to inform the need for additional wayside residential noise mitigation mentioned in NV-1 and NV-4.

Residences located on or at the second floor or higher would continue to experience noise levels that exceed FTA criteria, even with the recommended sound wall mitigation, which is considered to be the maximum feasible height. A total of approximately 425 residences (including single-family and individual units in multi-family) in 281 buildings would remain exposed to noise in excess of FTA Criteria for a *Severe Impact*. Where needed, these residences would be considered for improved building insulation as additional mitigation. Individual residence specific analysis of residual adverse noise effects would be conducted during final design to determine the noise attenuation provided by the existing

windows and exterior walls of each affected residence and the specific upgrades required to achieve an interior noise level of 45 Ldn. The developer's proposed window design will mitigate noise impacts to all living spaces above the ground floor.

Mitigation Measure NV-4: Noise insulation and other measures will be provided for residences with second floors or higher that are exposed to noise levels in excess of FTA criteria. The mitigation will be designed to achieve an interior noise level of 45 Ldn where feasible.

In addition to the recommended sound walls and retrofitting of multi-story residences with improved exterior sound isolation, sound absorptive material on the trackway structure would be necessary. This mitigation would primarily be needed for areas where the alignment runs in a retained cut. To further reduce adverse noise effects to multi-story residences a sound wall would be constructed on both sides of the track where the corridor is narrow (50 feet or less). Installation of sound absorptive material on the inside face of retaining walls and sound walls would further reduce sound levels by as much as 2 dBA. Otherwise, adverse noise effects could result in noise levels in excess of the FTA criteria. Table 5.10-8 identifies the location and length of recommended sound wall absorptive material that would be necessary in addition to the absorptive sound wall specified in Table 5.10-6. Figures 5.10-3a through 5.10-3m (above) show the locations of sound walls and sound absorptive materials.

Table 5.10-8: Locations for Sound Absorptive Material for the BEP Alternative

Civil Station	Side of Track	Length (feet)
460+80 to 487+00	S1 & S2	2620
491+80 to 508+50	S1 & S2	1670

Source: Wilson Ihrig, 2008a.

In addition to mitigation measures, the following standard BART practices are performed regularly and would reduce noise levels from the BEP Alternative:

- **Track Maintenance:** Regular track maintenance activities such as rail grinding and track inspection would reduce rail defects that could lead to higher than normal noise and vibration levels. Rail grinding smoothes the surface of train tracks by using specialized machines to cut away a thin layer of steel from the top and sides of the railhead. Regular rail grinding helps to minimize wayside noise and vibration generated by train passbys over defects or corrugations on the rail.

- **Vehicle Maintenance**: Regular vehicle maintenance activities such as periodic inspections and tests will help to identify problems and necessary corrective actions to minimize wayside noise and vibration levels. This includes wheel truing. Wheel truing is the process of cutting away a thin layer of steel on a wheel's outer diameter

(the "tread") to smooth out rough spots and ensure that the wheels are perfectly round. Because flat spots or rough wheels can cause excessive noise and vibration, wheel truing is a standard BART practice to minimize wayside noise and vibration levels.

SVRTP Alternative

The adverse noise effects and mitigation measures include those discussed for the BEP Alternative since the BEP Alternative alignment is similar to the first 9.3 miles of the SVRTP Alternative alignment. These adverse effects are summarized in Table 5.10-9 and the following text. Mitigation Measures NV-1, NV-2, NV-3 and NV-4 would also apply to the SVRTP Alternative.

Tunnel Ventilation Shafts

Tunnel ventilation shafts are located at the following locations; two at each of the Alum Rock, Downtown San Jose, and Diridon underground stations and two mid-tunnel structures- one located west of Coyote Creek and another located along Stockton Avenue south of Taylor Street. All of these locations are within the 250-foot screening distance where a potential adverse noise effect might occur.

- Tunnel Vent Shafts 3 and 3a option (Alum Rock Station area): The closest noise sensitive receptor is the Portuguese Band and Social Center. At this location, the Leq would be 48 dBA and the Lmax would be 48 dBA. Both of these noise levels are within the FTA Design criteria and would not result in an adverse noise effect.

- None of the five alternate locations for a ventilation structure west of Coyote Creek are anticipated to result in an adverse noise effect. However, the design will include provisions for a seven-foot long sound attenuator inline between the fan and surface and other measures as necessary at each of the five alternate locations to ensure compliance with the FTA Criteria (WIA, 2006d).

- There are four alternate locations for a ventilation structure near Stockton Avenue. The alternative locations are all east of Stockton Avenue and in an industrial area. Adverse noise effects would occur if not mitigated. Mitigation at the four alternate locations, depending on final design could require a seven-foot long sound attenuator and potentially a sound barrier to reduce the noise to below the FTA criteria (WIA, 2006d).

Ventilation fans will require periodic testing at high speeds to ensure proper operation during emergency conditions. To the extent possible, ventilation fan testing will be scheduled to minimize noise at nearby sensitive receptors.

Table 5.10-9: SVRTP Alternative Noise Impacts to Ground Floor Residential Units North of the Tunnel Before and After Mitigation

Alignment Features	Number of *Severe Impacts* to Sensitive Receptors Before Mitigation	Number of *Moderate Impacts** to Sensitive Receptors Before Mitigation	Number of *Severe Impacts* to Sensitive Receptors After Mitigation	Number of *Moderate Impacts** to Sensitive Receptors After Mitigation
Total in SVRTP Alignment Excluding Options	90	130	0	39
At Grade Option at Dixon Landing	16	0	0	0
Retained Cut Option at Dixon Landing	14	0	0	0
Retained Cut Long Option	46	4	0	1
Retained Cut Intermediate Option	36	4	0	1
Total	146 - 168 depending on options	134	0	40

* Where the projected increase in noise level due to the project is greater than 5 dBA

Source: Wilson Ihrig, 2008c.

Traction Power Substation

Residential uses are located to the southwest of Traction Power Substation SDS near Diridon/Arena Station. Noise levels are projected to exceed the criteria and therefore mitigation is required. An 8-foot high sound wall would reduce adverse noise effects to acceptable levels (WIA, 2006d).

Maintenance Facility Noise Impact Assessment

No adverse noise effects are projected from the proposed Maintenance Facility at the terminus of the BART alignment in Santa Clara. While, the City of San Jose has approved residential developments to the west of the existing railroad operations, they have also required 10- to 14-foot high sound walls to mitigate wayside noise from existing freight and commuter railroad service. However, at this location, the BART trains would be moving slowly in and out of the yard. Furthermore, the existing background noise levels at this location are dominated by traffic on I-880, heavy rail commuter and freight movements along the existing railroad line and San Jose International Airport (SJIA). As a result, the relatively lower noise levels from the BART trains would not add substantially to the noise environment. Most of the noisy activities associated with a maintenance facility occur at least 800 feet from the residences and would not add substantially to the noise environment.

As with the BEP Alternative, the following standard BART practices are performed regularly and would reduce noise levels from the SVRTP Alternative:

- **Track Maintenance:** Regular track maintenance activities such as rail grinding and track inspection would reduce rail defects that could lead to higher than normal noise and vibration levels. Rail grinding smoothes the surface of train tracks by using specialized machines to cut away a thin layer of steel from the top and sides of the railhead. Regular rail grinding helps to minimize wayside noise and vibration generated by train passbys over defects or corrugations on the rail.

- **Vehicle Maintenance**: Regular vehicle maintenance activities such as periodic inspections and tests will help to identify problems and necessary corrective actions to minimize wayside noise and vibration levels. This includes wheel truing. Wheel truing is the process of cutting away a thin layer of steel on a wheel's outer diameter (the "tread") to smooth out rough spots and ensure that the wheels are perfectly round. Because flat spots or rough wheels can cause excessive noise and vibration, wheel truing is a standard BART practice to minimize wayside noise and vibration levels.

5.10.3 GROUND-BORNE NOISE AND VIBRATION IMPACTS

Future levels of ground-borne noise and vibration from the BEP and SVRTP alternatives was determined through modeling. The methodology used for predicting future interior vibration and ground-borne noise levels from these alternatives was developed using recommendations in the 2006 FTA manual, Transit Noise and Vibration Impact

Assessment. The prediction model has been proven to produce reasonably accurate results as determined by comparison with post-construction, field measurement data (Wilson Ihrig, 2008B).

The prediction methodology is based on the assumption that vibration generated by a train through soil and buildings can be broken into independent elements, each of which can be quantified separately. These individual elements can then be combined to predict ground-borne noise and vibration. This model takes into account special alignment characteristics such as crossovers, retained cuts, embankments, tunnel geometry and tunnel construction type.

BEP Alternative

For residential land uses, the FTA criterion for ground-borne vibration is 72 VdB re 10^{-6} in/sec. For buildings that are primarily used for offices, the FTA criterion for ground-borne vibration is 84 VdB re 10^{-6} in/sec. Except for special cases, such as concert halls, recording studios, theaters, etc., the FTA does not recognize commercial or industrial land uses as sensitive receptors and therefore has no vibration criteria for these land uses. There are no such special-case uses adjacent to the BEP Alternative. The FTA also has criteria for vibration sensitive manufacturing facilities where the maximum allowed vibration levels are dependent on specific activities and equipment. No vibration sensitive manufacturing facilities were identified along the BEP Alternative alignment.

Alignment

Table 5.10-10 summarizes the line segment vibration analysis results. The table includes the number of adverse effects to residences by civil station and receiver location. There are no other types of adverse land use effects expected along the line segment. A total of 157 to 172 single-family and 36 to 40 multi-family buildings/150 to 171 residences would be affected without mitigation along the alignment. Particular areas of interest regarding adverse vibration effects are discussed below.

Kato Road Crossover

Ground vibration levels in the vicinity of track crossovers are typically higher than for track segments without crossovers. The higher vibration levels are generated by wheel impacts as the wheels cross frog gaps in turnout switches. This additional source of vibration acts like a point source at each frog gap. This increase is most apparent within 50 feet of a frog and decreases with increasing distance until there is no apparent affect beyond approximately 160 feet where the vibration becomes indistinguishable from standard trackwork.

The vibration level without mitigation was projected to the interior of the closest buildings at each of the residential areas to determine the maximum expected vibration levels inside those homes. The number of affected homes in each area was then estimated by projecting the distance from the alignment where there would be no adverse effect. Two types of vibration mitigation were evaluated: Tire Derived

Aggregate Underlayment (TDA) and Floating Slab Track (FST). While TDA has proven to be an effective mitigation on the VTA Vasona Light Rail Line, additional testing will be conducted on the BART system to ensure that the levels of mitigation are achieved.

A total of 29 residences would be affected without mitigation. As indicated in Table 5.10-10, FST is recommended to reduce train generated vibration for a portion of the proposed Castilleja Condominiums and TDA is recommended for the remaining Castilleja Condominiums and the proposed Warm Springs Village in order to meet the FTA Criteria. The FST design should have a primary resonance of no more than 8 Hz in order to sufficiently reduce the vibration generated by the BART trains.

Options at Dixon Landing Road

A total of 60 residences are affected with the At Grade Option at Dixon Landing as compared to 24 residences with the Retained Cut Option at Dixon Landing. With the recommended mitigation, there would be no remaining adverse vibration effects for either option.

Retained Cut Alignment Options

A summary of the results of the Ground-Borne vibration impact analyses for the two retained cut options is presented in Table 5.10-10. Among other findings, the vibration impact analysis concluded that approximately 32 multi-family residences within four buildings would be affected by vibration levels in excess of the FTA criteria regardless of the design option selected. The adverse effect is to the Parc Metropolitan Condominiums on the west side of the track.

Mitigation

Tire derived aggregate (TDA) and floating slab track with a design frequency of 8 Hz are the recommended vibration mitigation for the residences affected for all of the design options. The approximate length of mitigation needed varies slightly depending upon the option selected.

FTA has not approved TDA as a groundborne vibration mitigation measure. However, TDA installation on the VTA Vasona Line has demonstrated vibration attenuation characteristics in mid-frequency vibration range. TDA performs the same function as the more expensive ballast mats. FTA is interested in 1. finding another use for used tires, and 2. continuing the study of TDA as a vibration mitigation measure and possibly incorporating in the future as an approved measure. FTA remains concerned with the durability of TDA and whether it will maintain its full attenuation efficacy over time. In this regard, VTA will continue to field test its TDA installations and share the technical results with FTA.

Table 5.10-10: Ground-Borne Vibration Impacts for BEP Alternative Alignment

Option	Civil Station	Receiver Location	Track Direction	Speed (MPH)	Distance to Near Track CL. (feet)	Depth to Top of Rail (feet)	Track Type	FTA Detailed Criteria	Maximum ⅓ Octave Band Without Mitigation	Number of Impacts Without Mitigation	Preliminary Mitigation	Maximum ⅓ Octave Band With Mitigation	Number of Impacts With Mitigation
N/A	168+00 to 170+00	Castilleja Subdivision	NB	67	58	N/A	AG	72	77	8	TDA	71	0
N/A	170+00 to 172+40	Castilleja Subdivision	NB	67	58	N/A	AG XO	72	86	12	FST	69	0
N/A	172+60	Warm Springs Village	NB	67	83	N/A	AG XO	72	76	1	TDA	68	0
N/A	173+50 to 175+60	Warm Springs Village	NB	67	92	N/A	AG	72	73	7	TDA	67	0
N/A	176+00	Warm Springs Village	NB	67	96	N/A	AG	72	73	1	TDA	67	0
At Grade Option at Dixon Landing	180+60 to 182+00	Park Homes at Mayfield	NB	67	132	N/A	AG	72	73	7	TDA	71	0
At Grade Option at Dixon Landing	182+50	Spinnaker Points Apartments	NB	67	38	N/A	AG	72	77	6	FST	67	0
At Grade Option at Dixon Landing	184+00	Spinnaker Points Apartments	NB	67	75	N/A	AG	72	74	4	TDA	72	0

Table 5.10-10: Ground-Borne Vibration Impacts for BEP Alternative Alignment Cont'd

Option	Civil Station	Receiver Location	Track Direction	Speed (MPH)	Distance to Near Track CL. (feet)	Depth to Top of Rail (feet)	Track Type	FTA Detailed Criteria	Maximum ⅓ Octave Band Without Mitigation	Number of Impacts Without Mitigation	Preliminary Mitigation	Maximum ⅓ Octave Band With Mitigation	Number of Impacts With Mitigation
At Grade Option at Dixon Landing	189+50 to 191+00	Spinnaker Points Apartments	NB	67	42	N/A	AG	72	75	10	FST	65	0
At Grade Option at Dixon Landing	192+50 to 194+20	Friendly Village Mobile Homes	NB	67	49	N/A	AG	72	73	4	TDA	71	0
At Grade Option at Dixon Landing	194+20 to 196+20	Friendly Village Mobile Homes	NB	67	49	N/A	AG	72	73	5	TDA	71	0
At Grade Option at Dixon Landing	196+20 to 198+50	Friendly Village Mobile Homes	NB	67	49	N/A	AG	72	73	5	TDA	71	0
At Grade Option at Dixon Landing	198+50 to 200+50	Friendly Village Mobile Homes	NB	67	49	N/A	AG	72	78	5	TDA	72	0
At Grade Option at Dixon Landing	201+50	Friendly Village Mobile Homes	NB	67	49	N/A	AG	72	78	1	TDA	72	0
Retained Cut Option at Dixon Landing	182+50	Spinnaker Points Apartments	NB	67	38	1	CT	72	75	6	FST	67	0

Table 5.10-10: Ground-Borne Vibration Impacts for BEP Alternative Alignment Cont'd

Option	Civil Station	Receiver Location	Track Direction	Speed (MPH)	Distance to Near Track CL. (feet)	Depth to Top of Rail (feet)	Track Type	FTA Detailed Criteria	Maximum ⅓ Octave Band Without Mitigation	Number of Impacts Without Mitigation	Preliminary Mitigation	Maximum ⅓ Octave Band With Mitigation	Number of Impacts With Mitigation
Retained Cut Option at Dixon Landing	198+50 to 200+50	Friendly Village Mobile Homes	NB	67	49	4	CT	72	75	5	FST	63	0
Retained Cut Option at Dixon Landing	201+50	Friendly Village Mobile Homes	NB	67	49	1	CT	72	75	1	FST	63	0
Retained Cut Option at Dixon Landing	202+50 to 204+20	Milpitas Mobilodge, N Milpitas Blvd	NB	67	49	N/A	AG	72	78	4	FST	72	0
Retained Cut Option at Dixon Landing	204+20 to 207+00	Milpitas Mobilodge, N Milpitas Blvd	NB	67	49	N/A	AG	72	78	7	TDA	72	0
Retained Cut Option at Dixon Landing	207+50 to 208+00	Milpitas Mobilodge, N Milpitas Blvd	NB	67	52	N/A	AG	72	77	1	TDA	71	0
N/A	265+00	Edgewater Dr	NB	67	90	N/A	AG	72	73	1	TDA	71	0
N/A	266+00	Meadowland Dr	NB	67	92	N/A	AG	72	72[b]	1	TDA	70	0
N/A	267+50	Meadowland Dr	NB	67	70	N/A	AG	72	76	1	FST	65	0
N/A	268+20	Hedgestone Ct	NB	67	90	N/A	AG	72	74	1	TDA	71	0
N/A	269+00	Hedgestone Court	NB	67	40	N/A	AG	72	82	3	FST	63	0

Table 5.10-10: Ground-Borne Vibration Impacts for BEP Alternative Alignment Cont'd

Option	Civil Station	Receiver Location	Track Direction	Speed (MPH)	Distance to Near Track CL. (feet)	Depth to Top of Rail (feet)	Track Type	FTA Detailed Criteria	Maximum ⅓ Octave Band Without Mitigation	Number of Impacts Without Mitigation	Preliminary Mitigation	Maximum ⅓ Octave Band With Mitigation	Number of Impacts With Mitigation
N/A	270+00 to 271+00	Brookstone Court	NB	67	65	N/A	AG	72	79	3	FST	65	0
N/A	271+00 to 273+50	Fairmeadow Way	NB	67	44	N/A	AG	72	80	10	FST	65	0
N/A	273+50 to 275+50	Fairmeadow Way	NB	67	134	N/A	AG	72	73	6	TDA	71	0
N/A	276+00 to 278+00	Fairmeadow Way	NB	67	104	N/A	AG	72	75	4	FST	63	0
N/A	278+00 to 280+50	Millwater Ct	NB	67	104	N/A	AG	72	75	6	FST	63	0
N/A	281+00	Terrace Gardens Senior Housing	NB	67	115	N/A	AG	72	78	10	FST	72	0
N/A	283+00 to 286+00	Terrace Gardens Senior Housing	NB	67	143	N/A	AG	72	73	22	FST	67	0
Retained Cut Long Option	332+50 to 336+00	Parc Metropolitan Condos	SB	67	94	N/A	AG	72	79	32	FST	62	0
Retained Cut Long Option	419+00 to 420+50	BrookTree Square #5, Flickinger Way	NB	67	47	N/A	AG	72	72[b]	10	TDA	70	0
Retained Cut Long Option	420+50 to 423+00	BrookTree Square #'s 4, 3, 2, 1 Flickinger Way	NB	67	46	N/A	AG	72	72[b]	16	TDA	70	0

Table 5.10-10: Ground-Borne Vibration Impacts for BEP Alternative Alignment Cont'd

Option	Civil Station	Receiver Location	Track Direction	Speed (MPH)	Distance to Near Track CL. (feet)	Depth to Top of Rail (feet)	Track Type	FTA Detailed Criteria	Maximum ⅓ Octave Band Without Mitigation	Number of Impacts Without Mitigation	Preliminary Mitigation	Maximum ⅓ Octave Band With Mitigation	Number of Impacts With Mitigation
Retained Cut Long Option	424+00	1897 Flickinger Ave	NB	67	55	N/A	AG	72	77	1	TDA	70	0
Retained Cut Long Option	424+50	1891 Flickinger Ave	NB	67	47	N/A	AG	72	76	1	TDA	70	0
Retained Cut Long Option	424+90 to 425+90	Flickinger Ave	NB	67	66	N/A	AG	72	76	2	TDA	69	0
Retained Cut Long Option	426+15	Flickinger Ave	NB	67	53	N/A	AG	72	77	1	TDA	70	0
Retained Cut Long Option	427+00	1861 Flickinger Ave	NB	67	67	N/A	AG	72	76	1	TDA	69	0
Retained Cut Long Option	427+50	Flickinger Ave	NB	67	66	N/A	AG	72	76	1	TDA	69	0
Retained Cut Long Option	428+00	Flickinger Ave	NB	67	49	N/A	AG	72	76	1	TDA	70	0
Retained Cut Long Option	428+20 to 437+50	Flickinger Ave	NB	67	50	N/A	AG	72	74	17	TDA	67	0
Retained Cut Intermediate Option	332+50 to 336+00	Parc Metropolitan Condos	SB	67	94	N/A	AG	72	79	32	FST	62	0
Retained Cut Intermediate Option	419+00 to 420+50	BrookTree Square #5, Flickinger Way	NB	67	47	N/A	AG	72	72 [b]	10	TDA	70	0

Table 5.10-10: Ground-Borne Vibration Impacts for BEP Alternative Alignment Cont'd

Option	Civil Station	Receiver Location	Track Direction	Speed (MPH)	Distance to Near Track CL. (feet)	Depth to Top of Rail (feet)	Track Type	FTA Detailed Criteria	Maximum ⅓ Octave Band Without Mitigation	Number of Impacts Without Mitigation	Preliminary Mitigation	Maximum ⅓ Octave Band With Mitigation	Number of Impacts With Mitigation
Retained Cut Intermediate Option	420+50 to 423+00	BrookTree Square #'s 4, 3, 2, 1 Flickinger Way	NB	67	46	N/A	AG	72	72 [b]	16	TDA	70	0
Retained Cut Intermediate Option	424+00	1897 Flickinger Ave	NB	67	55	N/A	AG	72	77	1	TDA	70	0
Retained Cut Intermediate Option	424+50	1891 Flickinger Ave	NB	67	47	N/A	AG	72	76	1	TDA	70	0
Retained Cut Intermediate Option	424+90 to 425+90	Flickinger Ave	NB	67	66	N/A	AG	72	76	2	TDA	69	0
Retained Cut Intermediate Option	426+15	Flickinger Ave	NB	67	53	N/A	AG	72	77	1	TDA	70	0
Retained Cut Intermediate Option	427+00	1861 Flickinger Ave	NB	67	67	N/A	AG	72	76	1	TDA	69	0
Retained Cut Intermediate Option	427+50	Flickinger Ave	NB	67	66	N/A	AG	72	76	1	TDA	69	0
Retained Cut Intermediate Option	428+00	Flickinger Ave	NB	67	49	N/A	AG	72	76	1	TDA	70	0
Retained Cut Intermediate Option	428+20 to 437+50	Flickinger Ave	NB	67	50	N/A	AG	72	74	17	TDA	67	0

Table 5.10-10: Ground-Borne Vibration Impacts for BEP Alternative Alignment Cont'd

Option	Civil Station	Receiver Location	Track Direction	Speed (MPH)	Distance to Near Track CL. (feet)	Depth to Top of Rail (feet)	Track Type	FTA Detailed Criteria	Maximum ⅓ Octave Band Without Mitigation	Number of Impacts Without Mitigation	Preliminary Mitigation	Maximum ⅓ Octave Band With Mitigation	Number of Impacts With Mitigation
N/A	438+50 to 437+50	Flickinger Ave	NB	67	65	N/A	AG	72	76	2	TDA	69	0
N/A	441+00 to 449+50	Silvertree Dr	NB	67	54	N/A	AG	72	77	15	TDA	70	0
N/A	449+50 to 450+00	Silvertree Dr	NB	67	50	N/A	AG	72	79	1	FST	63	0
N/A	450+00 to 451+00	Silvertree Dr	NB	67	70	N/A	AG	72	74	2	TDA	70	0
N/A	473+30	Gordy Dr	SB	67	30	5	RC	72	76	1	FST	61	0
N/A	460+50 to 462+50	Prosperity Court	NB	67	40	11	RC	72	73	3	FST	68	0
N/A	462+50 to 464+00	Prosperity Court	NB	67	53	5	RC	72	75	2	FST	70	0
N/A	464+50	Prosperity Court	NB	67	53	4	RC	72	75	1	FST	70	0
N/A	476+50 to 478+50	Tersini Court	SB	67	40	5	RC	72	75	4	FST	62	0
N/A	480+00	Prelude Dr	SB	67	55	5	RC	72	72 [b]	1	FST	63	0
N/A	480+50 to 484+00	Prelude Dr	SB	67	37	5	RC	72	75	7	FST	65	0
N/A	484+00 to 485+50	Prelude Dr	SB	67	37	9	RC	72	74	3	FST	66	0
N/A	494+30	Briar Berry Court	SB	67	37	10	RC	72	73	1	FST	63	0

Table 5.10-10: Ground-Borne Vibration Impacts for BEP Alternative Alignment Cont'd

Option	Civil Station	Receiver Location	Track Direction	Speed (MPH)	Distance to Near Track CL. (feet)	Depth to Top of Rail (feet)	Track Type	FTA Detailed Criteria	Maximum ⅓ Octave Band Without Mitigation	Number of Impacts Without Mitigation	Preliminary Mitigation	Maximum ⅓ Octave Band With Mitigation	Number of Impacts With Mitigation
N/A	496+00 to 497+00	Briar Creek	SB	67	33	N/A	AG	72	74	2	TDA	70	0
N/A	497+30	Briar Creek	SB	67	60	N/A	AG	72	72 [b]	1	TDA	69	0
N/A	497+50 to 499+50	Rose Briar Way	NB	67	40	N/A	AG	72	75	4	TDA	70	0
N/A	499+50 to 500+50	Rose Briar Way	NB	67	43	N/A	AG	72	81	2	FST	64	0
N/A	500+50	Rose Briar Way	NB	67	53	N/A	AG	72	77	1	FST	64	0
N/A	500+70 to 502+00	Rose Briar Way	NB	67	53	N/A	AG	72	81	2	FST	65	0
N/A	501+90	Rose Briar Way	NB	67	35	N/A	AG	72	84	1	FST	65	0
N/A	502+30	Rose Briar Way	NB	67	53	N/A	AG	72	77	1	FST	64	0
N/A	502+50 to 507+00	Rose Briar Way	NB	67	47	N/A	AG	72	80	9	FST	63	0
N/A	503+35	Rose Briar Way	NB	67	33	N/A	AG	72	85	1	FST	66	0
N/A	498+00 to 499+30	Royal Crest Dr	SB	65	37	N/A	AG	72	76	2	TDA	70	0
N/A	499+30 to 500+00	Royal Crest Dr	SB	65	37	N/A	AG	72	79	2	FST	63	0
N/A	500+00 to 501+70	Royal Crest Dr	SB	60	37	N/A	AG	72	74	4	TDA	69	0

Table 5.10-10: Ground-Borne Vibration Impacts for BEP Alternative Alignment Cont'd

Option	Civil Station	Receiver Location	Track Direction	Speed (MPH)	Distance to Near Track CL. (feet)	Depth to Top of Rail (feet)	Track Type	FTA Detailed Criteria	Maximum ⅓ Octave Band Without Mitigation	Number of Impacts Without Mitigation	Preliminary Mitigation	Maximum ⅓ Octave Band With Mitigation	Number of Impacts With Mitigation
N/A	501+80	Royal Crest Dr	NB	67	51[a]	N/A	AG	72	79	1	FST	63	0
N/A	502+20 to 503+50	Royal Crest Dr	SB	60	35	N/A	AG	72	82	3	FST	63	0
N/A	504+00	Valley Crest Drive	SB	50	25	N/A	AG	72	85	1	FST	66	0
Las Plumas Yard Option	505+50 to 507+30	Aschauer Court	SB	50	43	N/A	AG	72	78	5	TDA	72	0
Las Plumas Yard Option	507+00 to 508+00	Rose Briar Way	NB	50	45	N/A	AG	72	81	2	FST	64	0
Las Plumas Yard Option	507+50 to 509+50	Taida Street, Berryessa Villa	NB	65	87	N/A	AG	72	76	4	TDA	72	0
Las Plumas Yard Option	510+00 to 511+50	Taida Street, Berryessa Villa	NB	65	66	N/A	AG	72	79	6	FST	61	0
Las Plumas Yard Option	511+50 to 513+00	Taida Street, Berryessa Villa	NB	60	90	N/A	AG	72	77	4	FST	57	0
Las Plumas Yard Option	513+50 to 515+00	Winston Court, Berryessa Villa	NB	65	50	N/A	EM	72	76	4	FST	70	0
Las Plumas Yard Option	516+00 to 516+50	Heavenly Bamboo Court, Regency Park	NB	50	30	N/A	EM	72	75	1	FST	70	0

Table 5.10-10: Ground-Borne Vibration Impacts for BEP Alternative Alignment Cont'd

Option	Civil Station	Receiver Location	Track Direction	Speed (MPH)	Distance to Near Track CL. (feet)	Depth to Top of Rail (feet)	Track Type	FTA Detailed Criteria	Maximum ⅓ Octave Band Without Mitigation	Number of Impacts Without Mitigation	Preliminary Mitigation	Maximum ⅓ Octave Band With Mitigation	Number of Impacts With Mitigation
Las Plumas Yard Option	517+00	Fern Pine Court	NB	50	28	N/A	EM	72	75	1	FST	71	0
Las Plumas Yard Option	518+50	Fern Pine Court	NB	50	25	N/A	EM	72	76	1	FST	71	0
No New Yard Option	505+50 to 507+30	Aschauer Court	SB	50	43	N/A	AG	72	78	5	TDA	72	0
No New Yard Option	507+00 to 508+00	Rose Briar Way	NB	50	45	N/A	AG	72	81	2	FST	64	0
No New Yard Option	507+50 to 509+50	Taida Street, Berryessa Villa	NB	65	87	N/A	EM	72	76	4	FST	68	0
No New Yard Option	510+00 to 511+50	Taida Street, Berryessa Villa	NB	65	66	N/A	EM	72	78	6	FST	69	0
No New Yard Option	511+50 to 513+00	Taida Street, Berryessa Villa	NB	60	90	N/A	EM	72	75	4	FST	67	0
No New Yard Option	513+50 to 515+00	Winston Court, Berryessa Villa	NB	65	42	N/A	EM	72	77	4	FST	70	0
No New Yard Option	516+00 to 516+50	Heavenly Bamboo Court, Regency Park	NB	50	22	N/A	EM	72	77	1	FST	71	0
No New Yard Option	517+00	Fern Pine Court	NB	50	20	N/A	EM	72	78	1	FST	72	0

Table 5.10-10: Ground-Borne Vibration Impacts for BEP Alternative Alignment Cont'd

Option	Civil Station	Receiver Location	Track Direction	Speed (MPH)	Distance to Near Track CL. (feet)	Depth to Top of Rail (feet)	Track Type	FTA Detailed Criteria	Maximum ⅓ Octave Band Without Mitigation	Number of Impacts Without Mitigation	Preliminary Mitigation	Maximum ⅓ Octave Band With Mitigation	Number of Impacts With Mitigation
No New Yard Option	518+50	Fern Pine Court	NB	50	20	N/A	EM	72	78	1	FST	72	0

[a] Vibration dominated from trains on far track at indicated receptors [b] 72 < Max ⅓ Octave Band < 72.5

Key:

NB = Northbound

SB = Southbound

EM = Embankment with ballasted track

AR = Aerial Structure

FST = 8 Hz Floating Slab Track

AG = At-Grade ballasted track

XO =Crossover

RC = Retained Cut

TDA = Tire Derived Aggregate under ballasted truck (assuming subsequent testing validates vibration reductions) or comparable mitigation

Source: Wilson Ihrig, 2006b

VTA was requested to perform further testing on TDA underlayment at its Vasona Light Rail Transit Line to support its vibration attenuation effectiveness and durability. Appendix K provides the results of this study (Final Report, Evaluation of Tire Derived Aggregate as Installed Beneath Ballast and Tie Light Rail Track, Wilson, Ihrig & Associates, Inc., 2009). The conclusion of this study were similar to tests in 2005 and 2006 and were that the use of TDA as an underlayment beneath ballast and tie track as a means for reducing wayside groundborne vibration was both practical and viable. The overall performance from the three sets of tests was that the reduction of wayside groundborne vibration due to transit train passbys was generally superior to that of ballast mat, but not as effective as floating slab trackbed. A peer review was also conducted and included in Appendix K (Peer Review of TDA Vibration Tests at VTA, Harris Miller Miller & Hanson, Inc., 2009). The peer review concluded that the results of the WIA reports support their conclusion that the TDA installations at VTA are effective in reducing ground-borne vibration."

> Mitigation Measure NV-5: Table 5.10-11 summarizes the vibration mitigation necessary to achieve the FTA criteria. The proposed mitigation is tire derived aggregate and 8 Hz floating slab. The locations of vibration mitigation are depicted on Figures 5.10-3a through 5.10-3m (above).
>
> Mitigation Measure NV-6: Upon project start-up, VTA will perform further testing on TDA underlayment at its Vasona LRT Line. The vibration testing should replicate the testing completed by Wilson, Ihrig & Associates and presented to FTA in 2009: Evaluation of Tire Derived Aggregate as Installed Beneath Ballast and Tie Light Rail Track, May 2009. The technical evaluation will then be presented to FTA for review and comment.

The mitigation recommendations do not include ballast mat as a mitigation approach for the BEP Alternative alignment. Ballast mat is mainly effective at frequencies above 25-30 Hz. Where vibration is dominated by lower frequencies, such as the case along the alignment, a ballast mat may only provide a reduction of about 1 VdB overall. The most effective, proven mitigation approach available for the Milpitas and Fremont portions of the project design is an 8 Hz floating slab track. Theoretically, the performance of the floating slab track can be improved by designing it with a lower resonance frequency.

Table 5.10-11: BEP Alternative Vibration Mitigation

Option	Civil Station	Mitigation
N/A	167+00 to 169+79 [a]	Tire Derived Aggregate
N/A	169+79[a] to 172+80[a]	8 Hz Floating Slab
N/A	172+80[a] to 177+00	Tire Derived Aggregate
At Grade Option at Dixon Landing	179+60 to 181+50	Tire Derived Aggregate [b]
At Grade Option at Dixon Landing	181+50 to 183+60	8 Hz Floating Slab
At Grade Option at Dixon Landing	183+60 to 185+00	Tire Derived Aggregate [b]
At Grade Option at Dixon Landing	188+50 to 192+00	8 Hz Floating Slab
At Grade Option at Dixon Landing	192+00 to 209+00	Tire Derived Aggregate [b]
Retained Cut Option at Dixon Landing	181+50 to 183+60	8 Hz Floating Slab
Retained Cut Option at Dixon Landing	197+50 to 204+20	8 Hz Floating Slab
Retained Cut Option at Dixon Landing	204+20 to 209+00	Tire Derived Aggregate [b]
N/A	264+00 to 266+30	Tire Derived Aggregate [b]
N/A	266+30 to 287+00	8 Hz Floating Slab
N/A	331+50 to 337+40	8 Hz Floating Slab
Retained Cut Intermediate and Retained Cut Long	418+00 to 432+00	Tire Derived Aggregate [b]
N/A	432+00 to 448+00	Tire Derived Aggregate [b]
N/A	448+00 to 452+00	8 Hz Floating Slab
N/A	459+50 to 466+50	8 Hz Floating Slab
N/A	472+30 to 474+30	8 Hz Floating Slab
N/A	475+50 to 486+50	8 Hz Floating Slab
N/A	493+30 to 506+00	8 Hz Floating Slab
No New Yard Option and Las Plumas Yard Option	506+00 to 519+50[c]	8 Hz Floating Slab

[a] Extents of proposed crossover

[b] Tire derived aggregate or comparable mitigation will be implemented

[c] North end of bridge structure over Berryessa Road

Source: Wilson Ihrig, 2006a

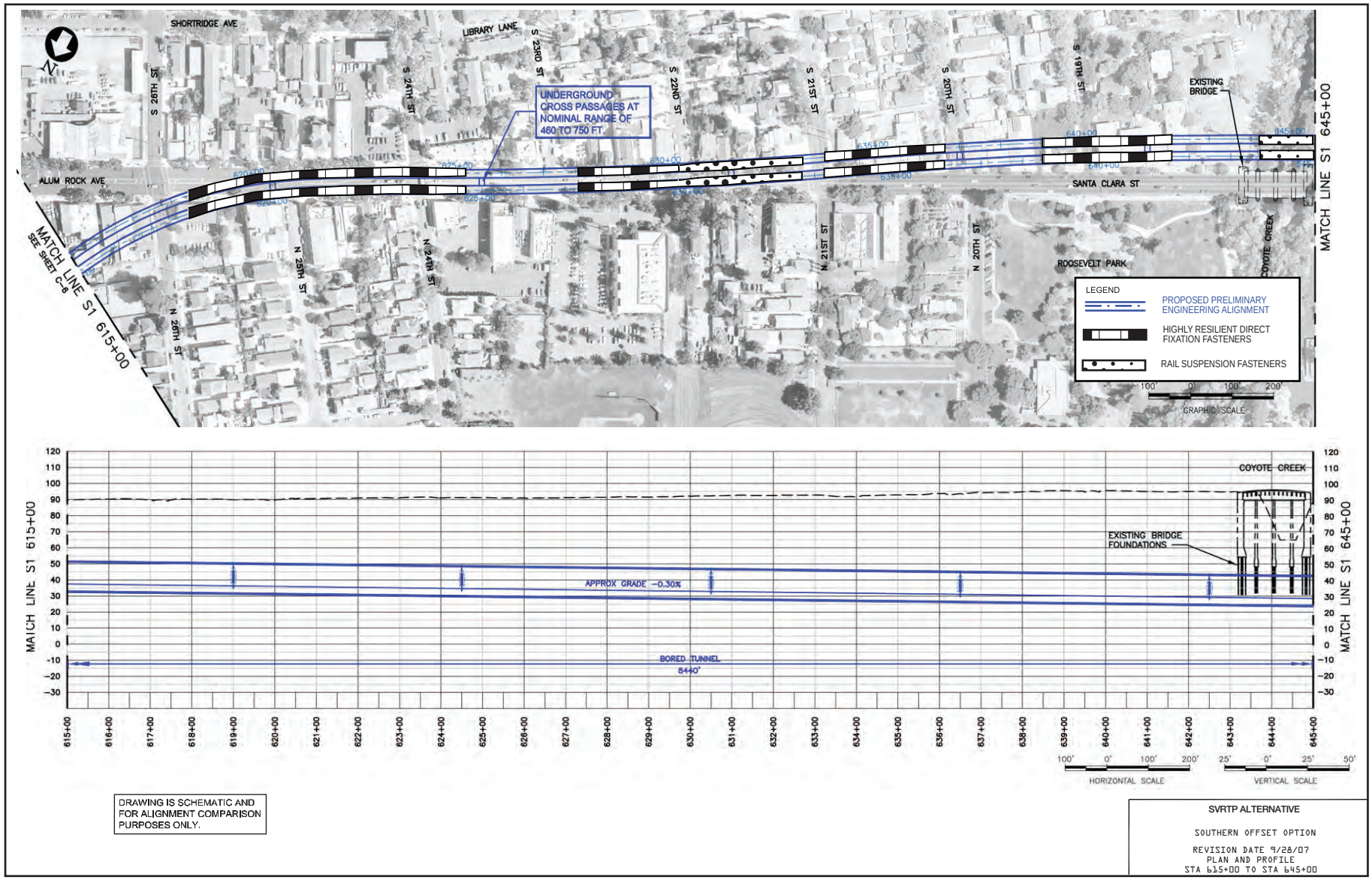
SVRTP Alternative

The adverse vibration effects and mitigation measures include those discussed for the BEP Alternative in addition to those discussed below. The 172 single family and 40 multi-family buildings/171 residences that would be affected without mitigation by vibration under the BEP Alternative would also be affected by the SVRTP Alternative. Mitigation measure NV-4 would apply in this location. The remainder of this section applies to the tunnel portion of the alignment that is specific to the SVRTP Alternative.

The analysis shows that 84 residences and other sensitive uses would be affected by ground-borne noise under the FTA criteria. These adverse effects are identified by civil station number and addressed as shown in Table 5.10-12. Table 5.10-12 also presents the predicted ground-borne noise levels for each affected location before mitigation, and the mitigated ground-borne noise levels for mitigation strategies.

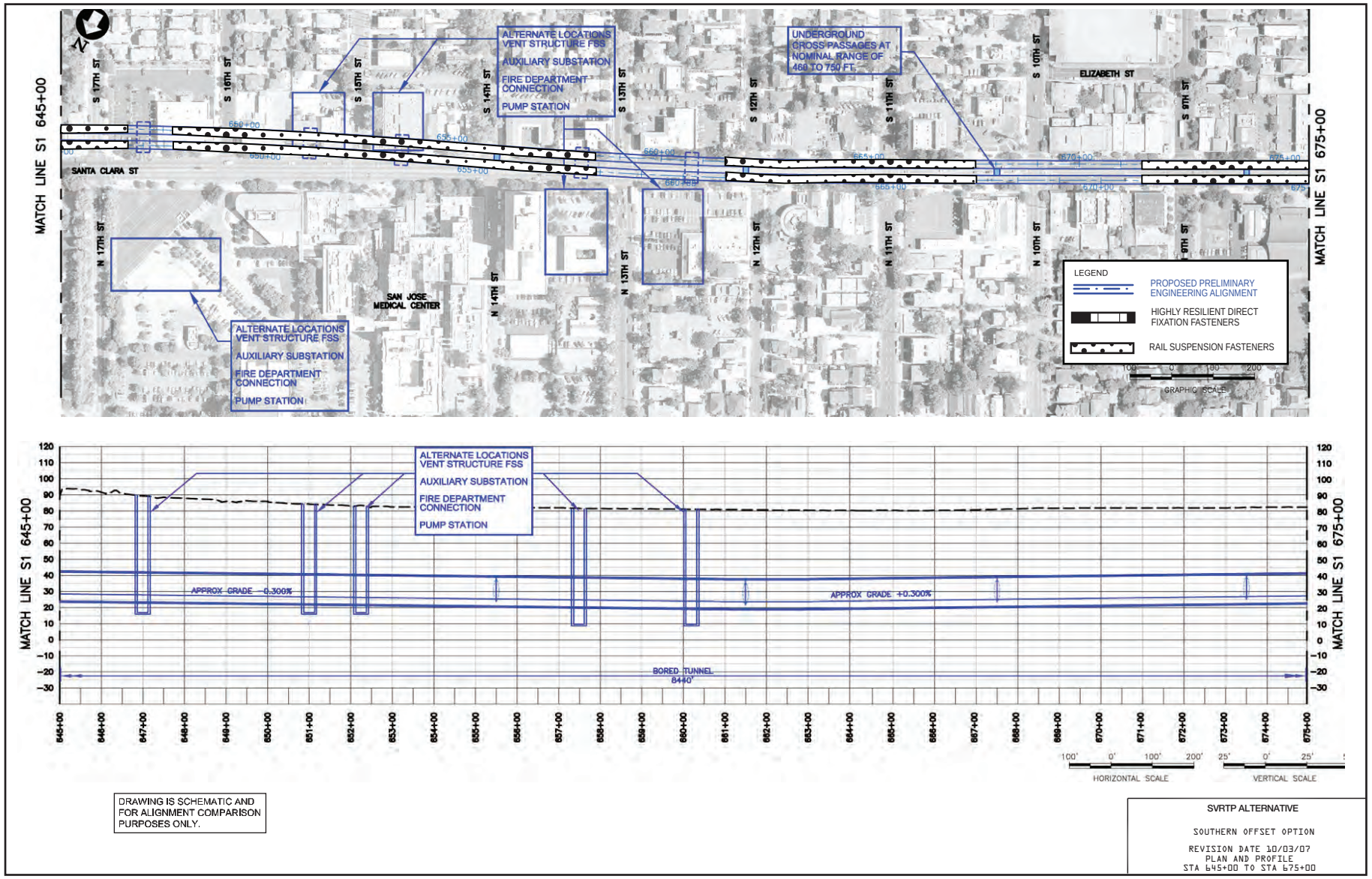
> Mitigation Measure NV-7: The mitigation strategies for ground-borne noise include highly resilient direct fixation rail fasteners (HRDF) and rail suspension fasteners (RSF). The locations for these mitigations are shown in Table 5.10-13 and Figures 5.10-3a through 5.10-3z (Figures 5.10a through 5.10-3m see above).

These mitigation measures would reduce adverse ground-borne noise effects to achieve the FTA noise criteria. They include approximately 7,357 linear feet of HRDF and 8,265 linear feet of RSF.



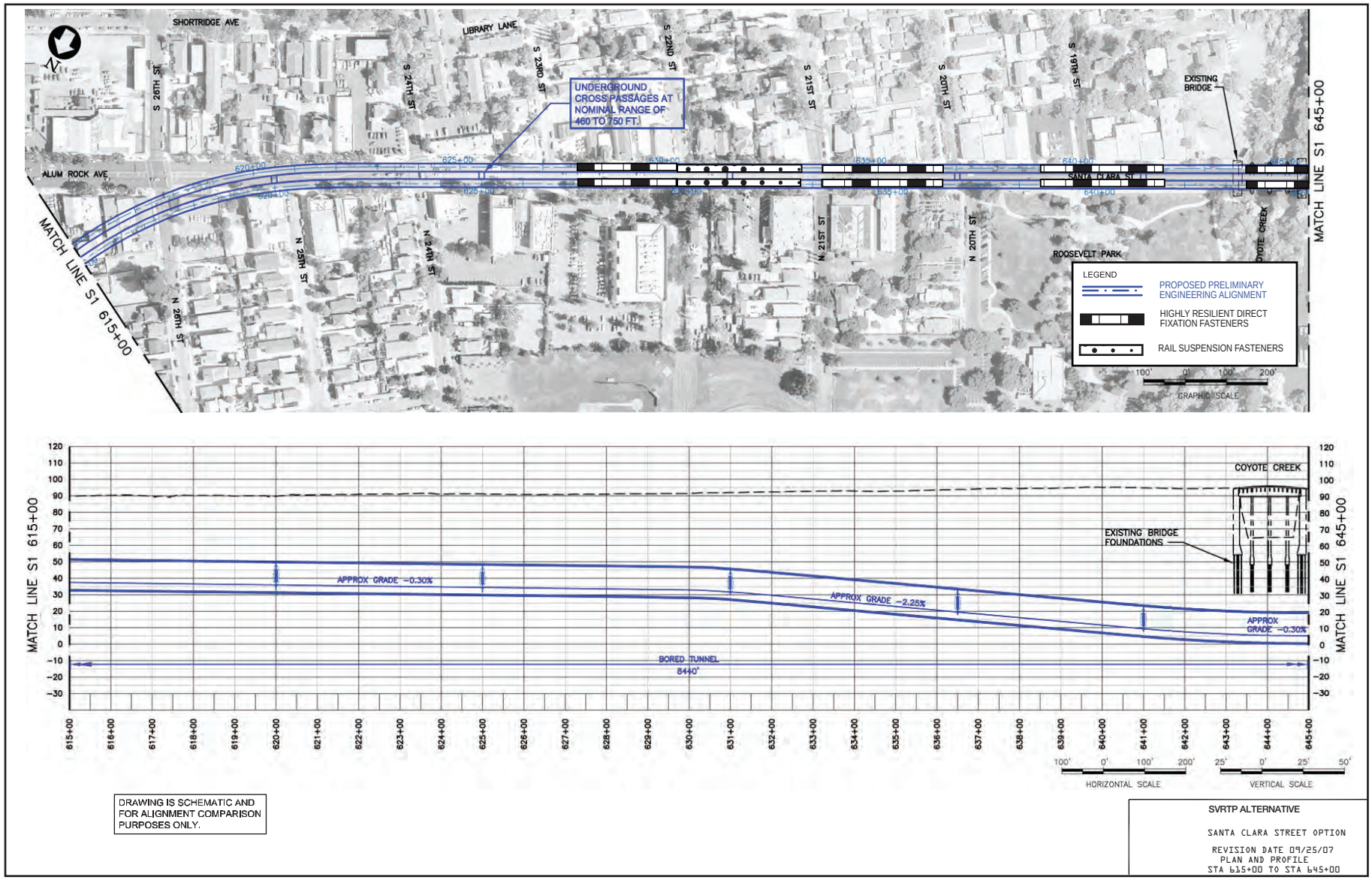
Source: Wilson Ihrig and VTA, 2008.

Figure 5.10-3N: Noise and Vibration Mitigation Locations



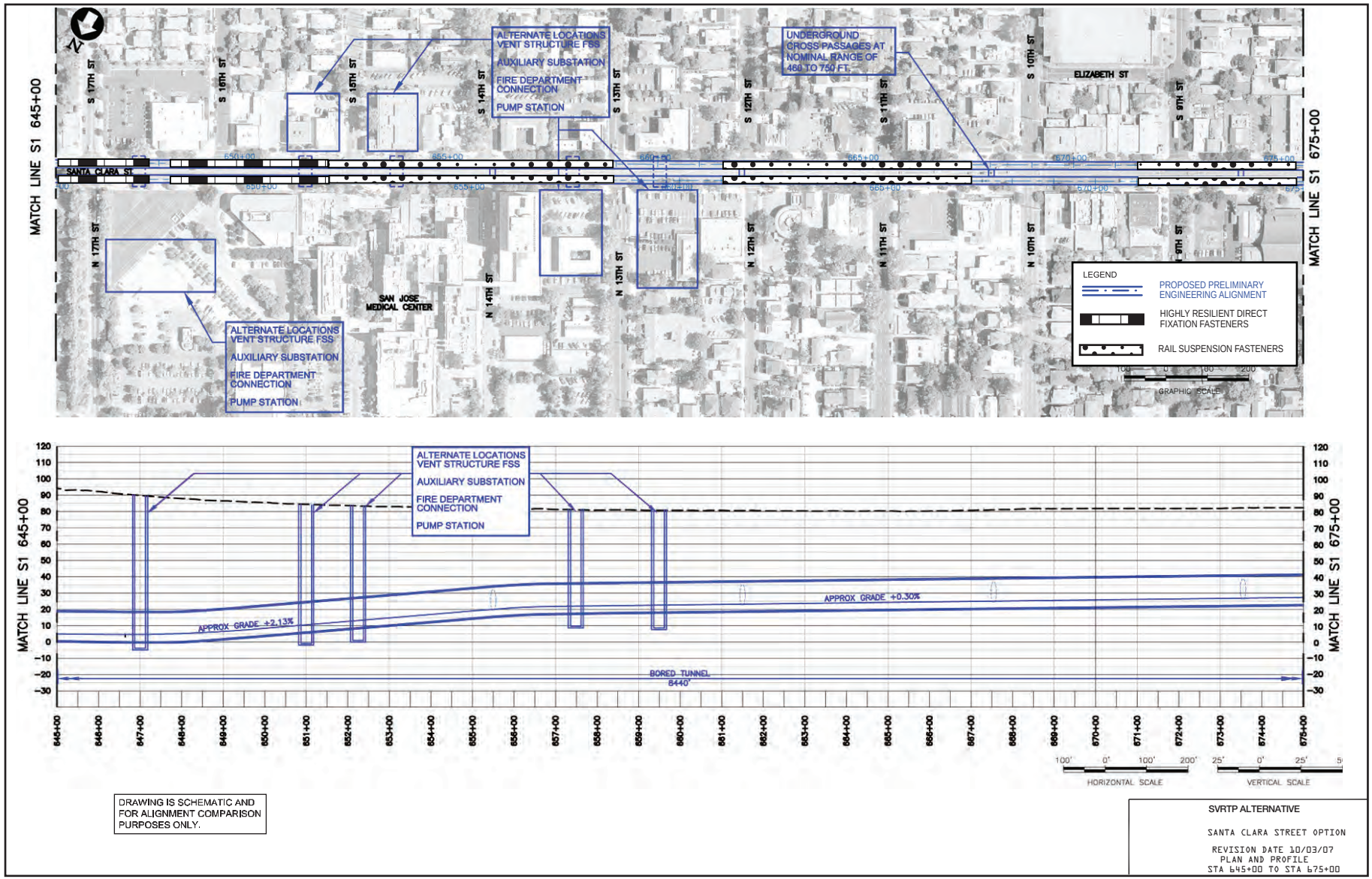
Source: Wilson Ihrig and VTA, 2008.

Figure 5.10-3O: Noise and Vibration Mitigation Locations



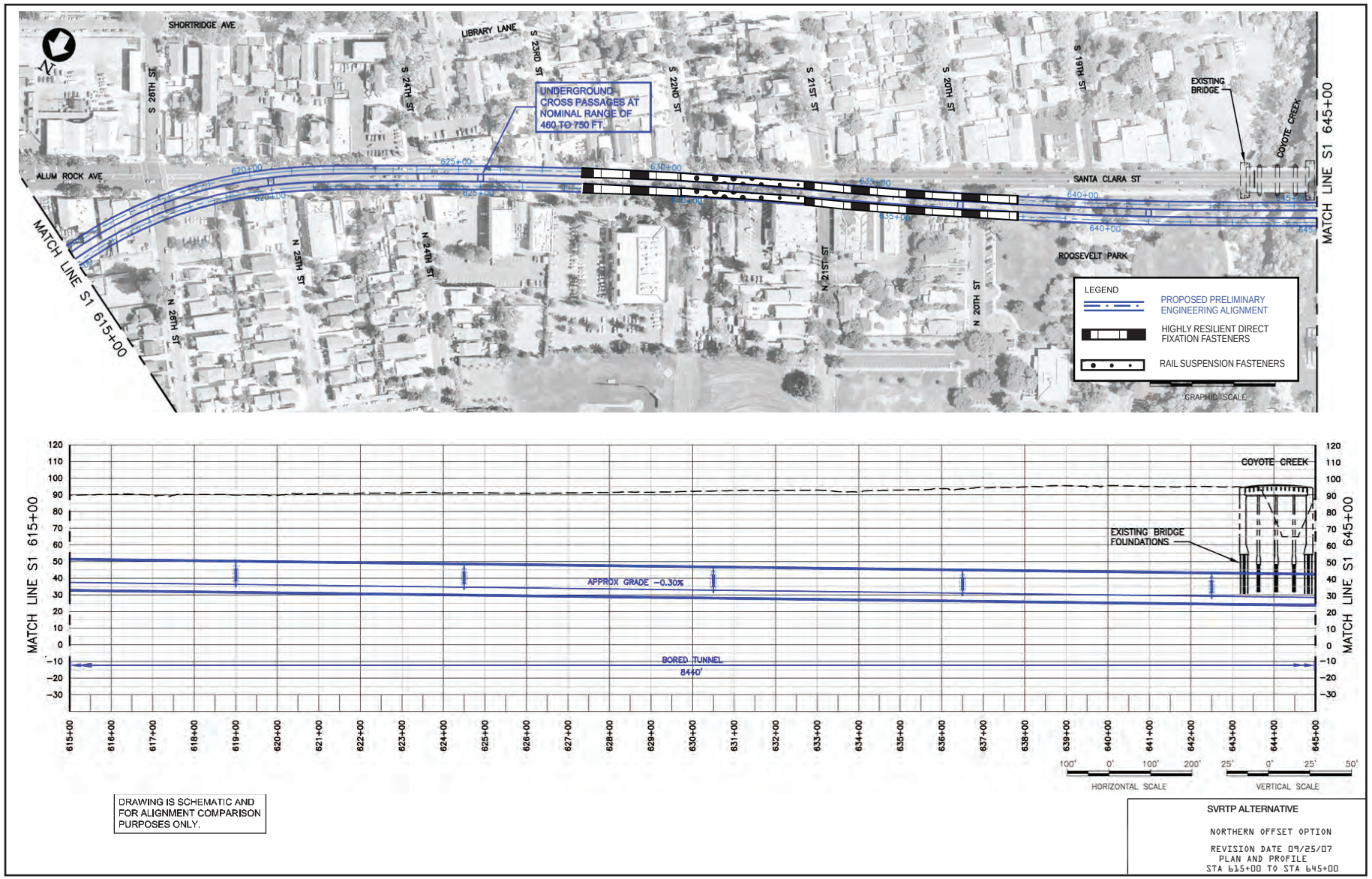
Source: Wilson Ihrig and VTA, 2008.

Figure 5.10-3P: Noise and Vibration Mitigation Locations



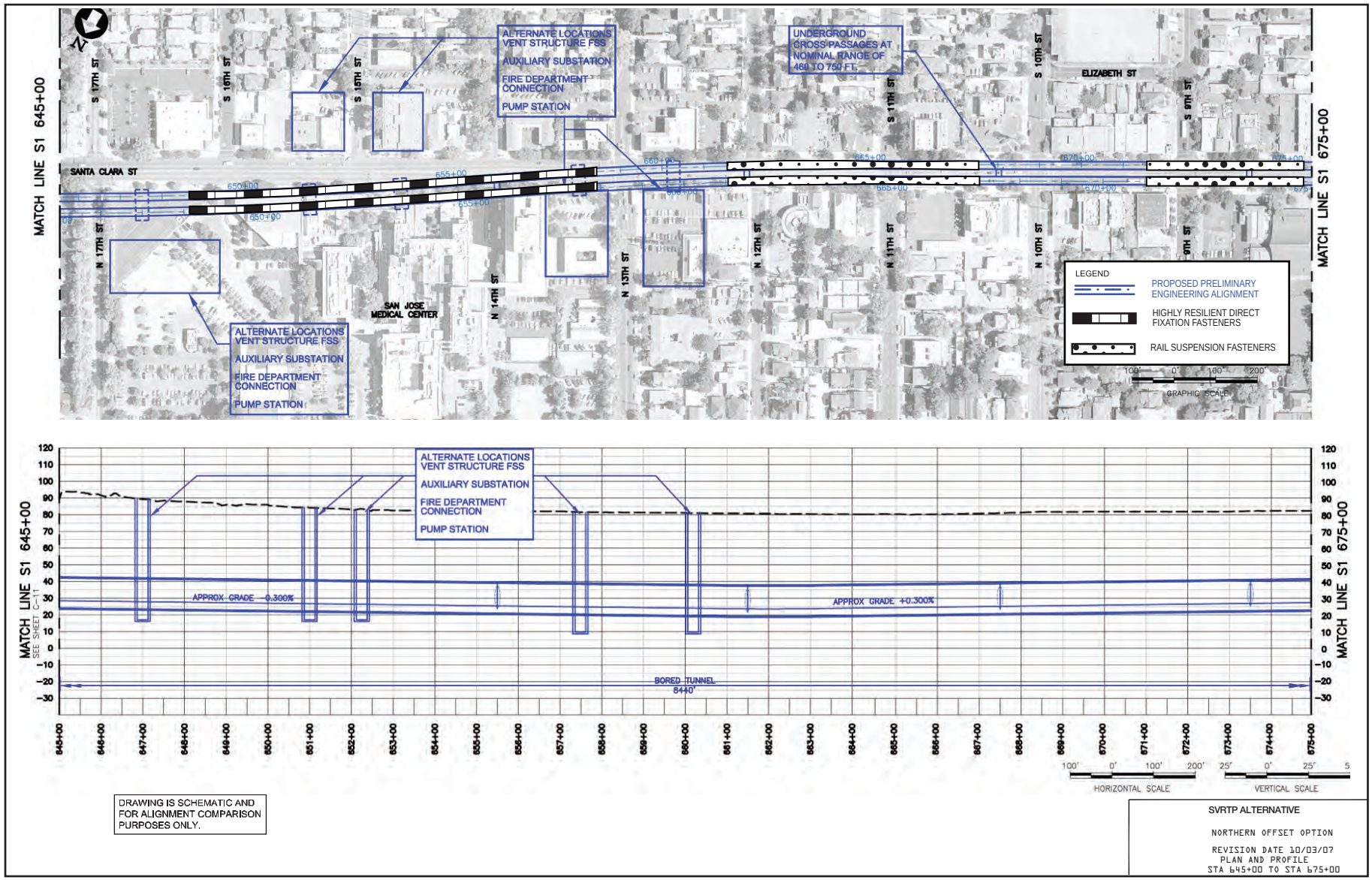
Source: Wilson Ihrig and VTA, 2008.

Figure 5.10-3Q: Noise and Vibration Mitigation Locations



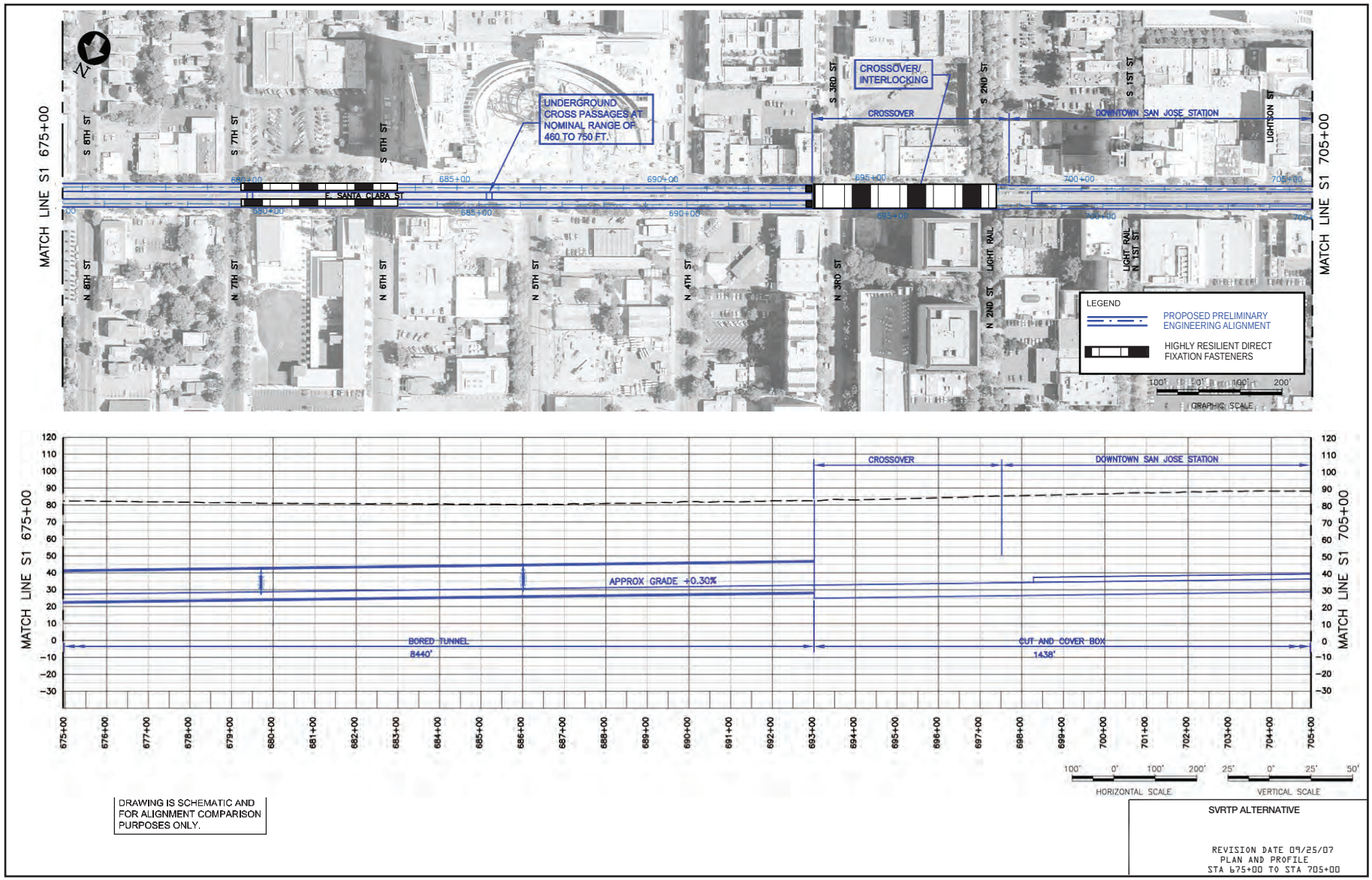
Source: Wilson Ihrig and VTA, 2008.

Figure 5.10-3R: Noise and Vibration Mitigation Locations



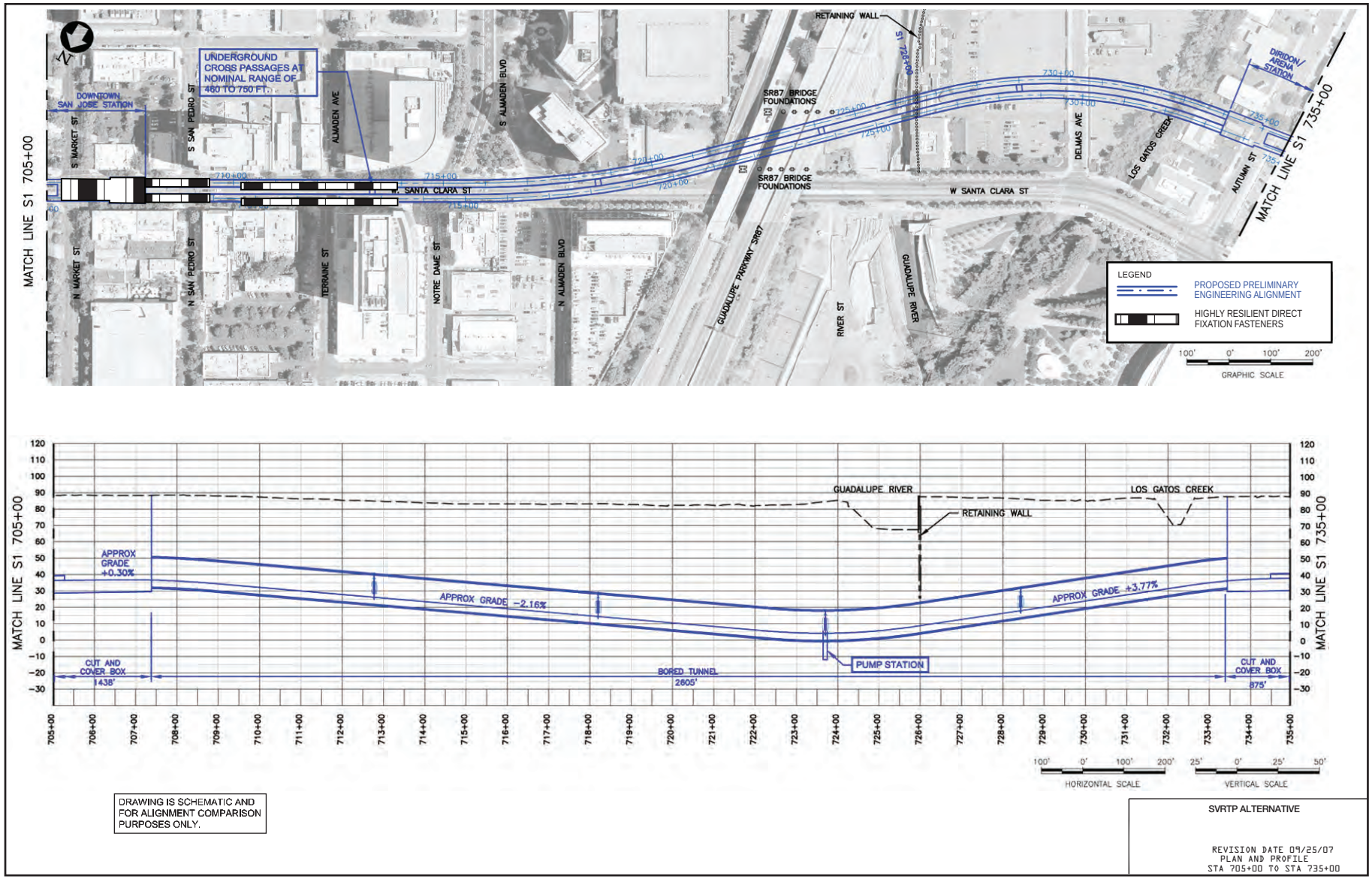
Source: Wilson Ihrig and VTA, 2008.

Figure 5.10-3S: Noise and Vibration Mitigation Locations



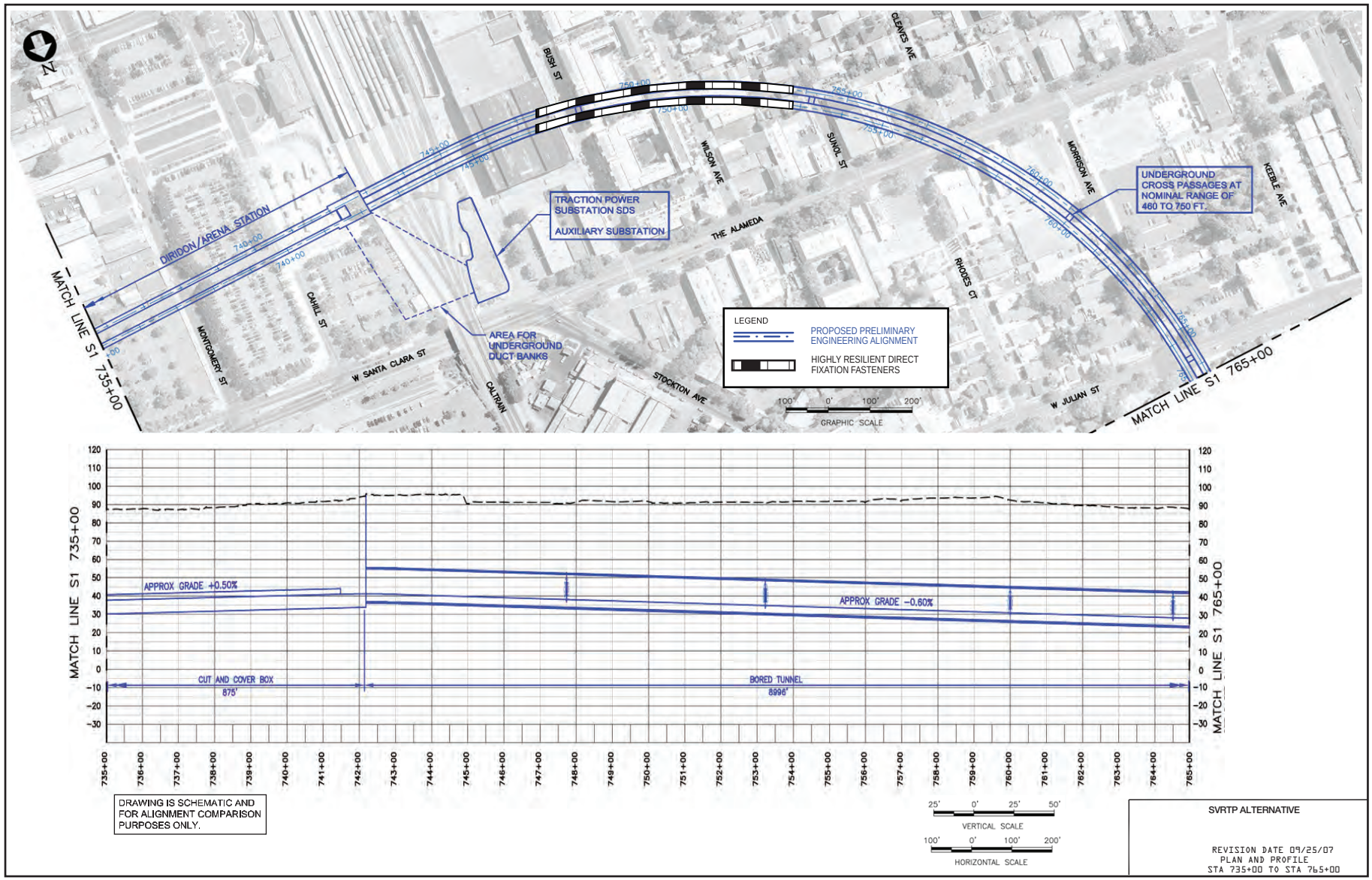
Source: Wilson Ihrig and VTA, 2008.

Figure 5.10-3T: Noise and Vibration Mitigation Locations



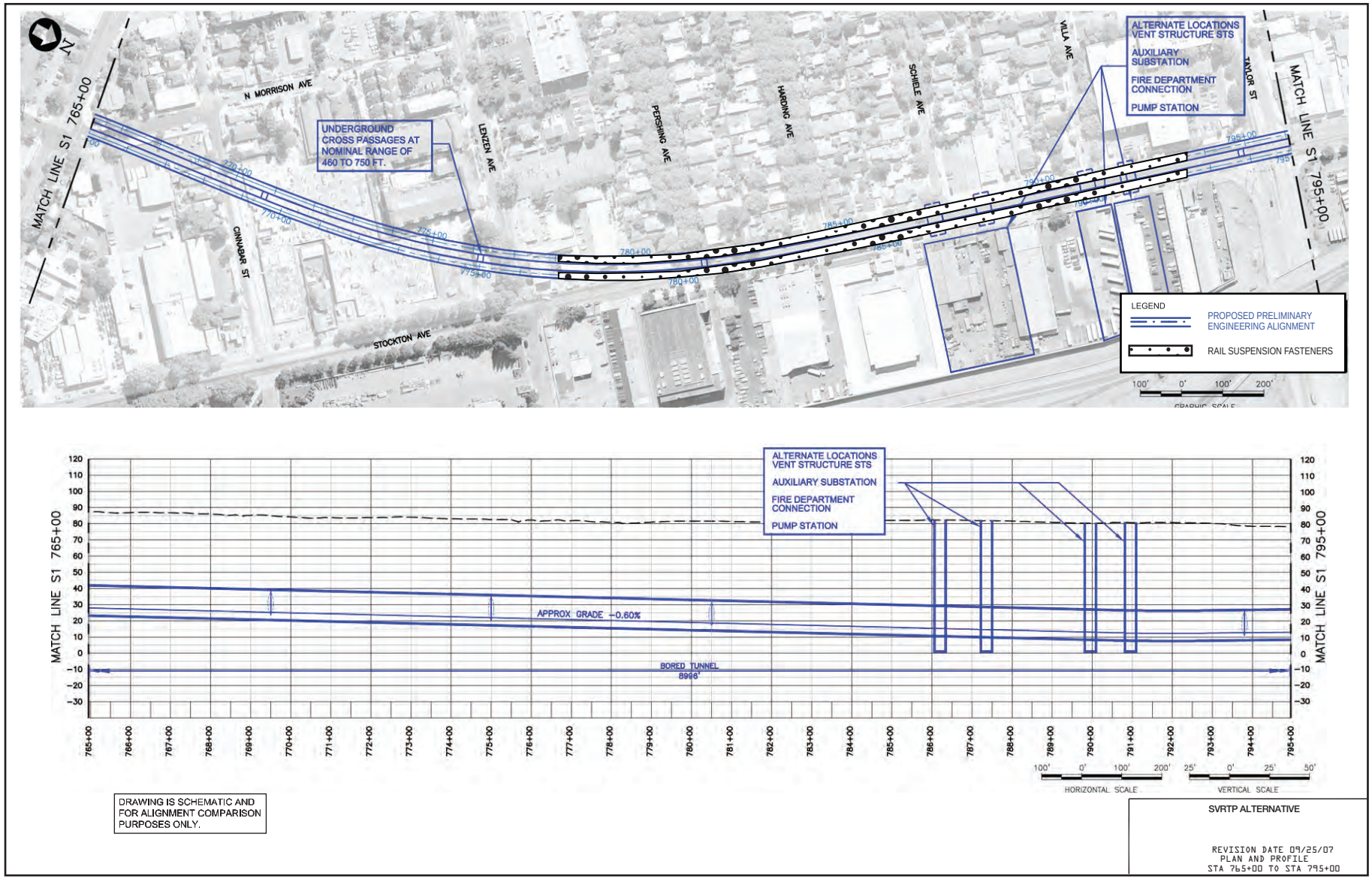
Source: Wilson Ihrig and VTA, 2008.

Figure 5.10-3U: Noise and Vibration Mitigation Locations



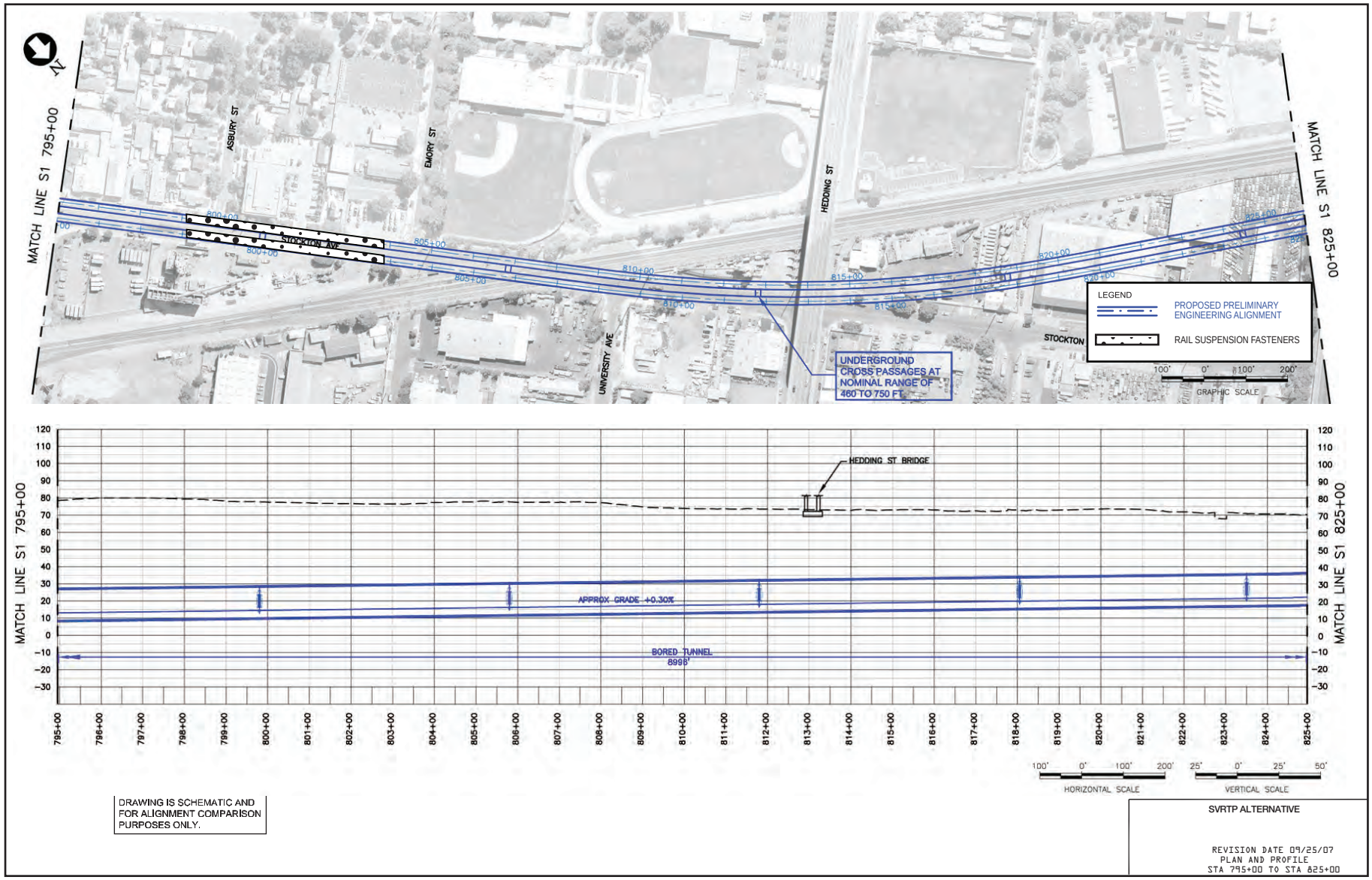
Source: Wilson Ihrig and VTA, 2008.

Figure 5.10-3V: Noise and Vibration Mitigation Locations



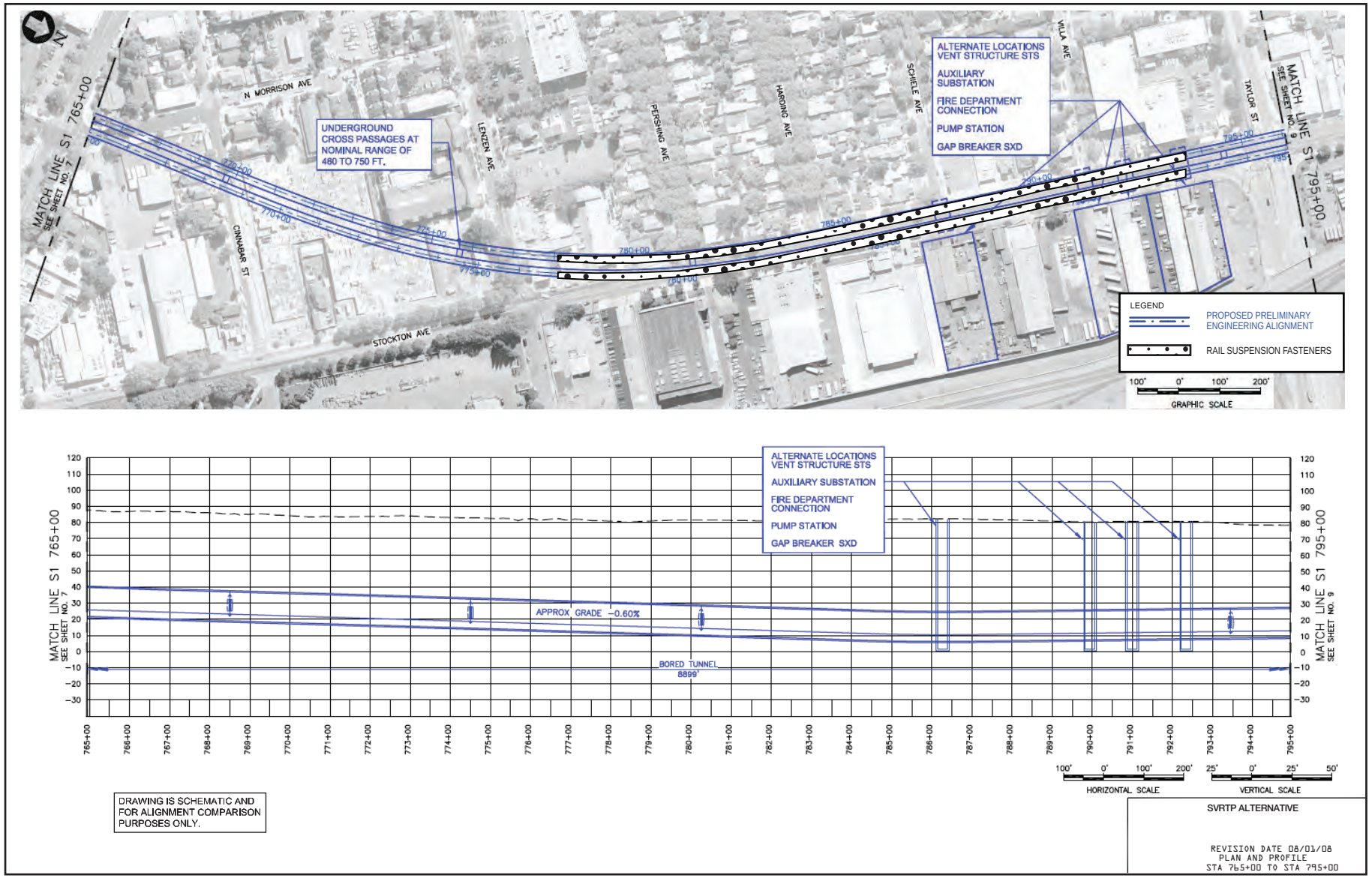
Source: Wilson Ihrig and VTA, 2008.

Figure 5.10-3W: Noise and Vibration Mitigation Locations



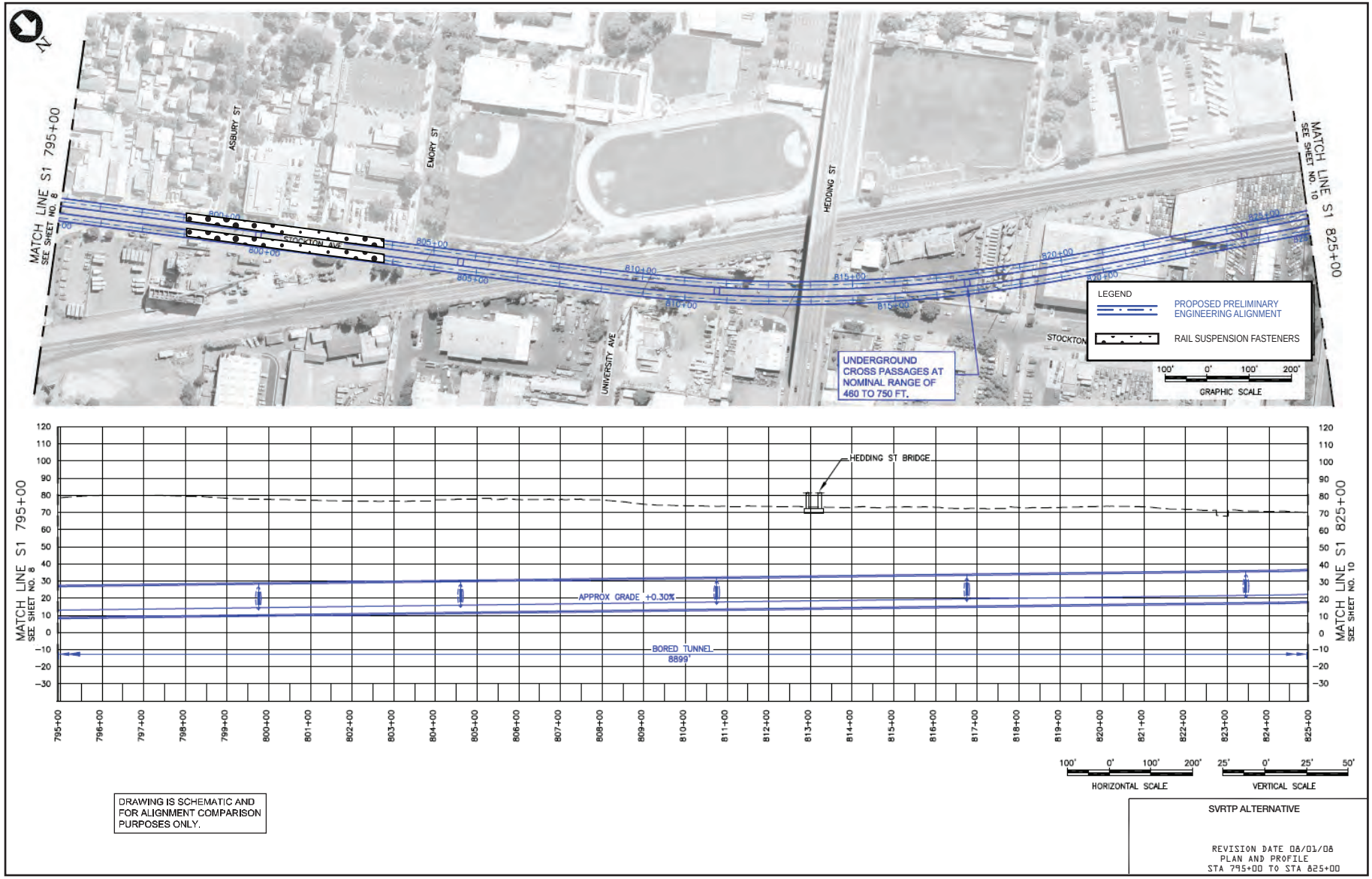
Source: Wilson Ihrig and VTA, 2008.

Figure 5.10-3X: Noise and Vibration Mitigation Locations



Source: Wilson Ihrig and VTA, 2008.

Figure 5.10-3Y: Noise and Vibration Mitigation Locations



Source: Wilson Ihrig and VTA, 2008.

Figure 5.10-3Z: Noise and Vibration Mitigation Locations

Table 5.10-12: Ground-Borne Noise Impacts for Tunnel Portion of SVRTP Alternative

Option	Civil Station	Receiver Location	Horizontal Distance to Near Track Centerline (feet)	Rail Depth (feet)	FTA GBN Criteria (dBA)	Maximum Projected GBN Without Mitigation (dBA)	Number of Receptors	Maximum Projected GBN With HRDF Mitigation (dBA)	Maximum Projected GBN With RSF Mitigation (dBA)
N/A	619	1226 East Santa Clara	75	54	35	39	1	34	N/A
N/A	622	Next to 1183 East Santa Clara	60	56	35	41	1	35	N/A
N/A	623	16 S 24th	115	56	35	36	1	31	N/A
N/A	623	20 N 24th	90	56	35	38	1	32	N/A
Santa Clara Street Option	629	1072 East Santa Clara	25	64	35	39	4	33	N/A
Santa Clara Street Option	630	1049 East Santa Clara	75	66	35	37	1	32	N/A
Santa Clara Street Option	631	1047 East Santa Clara	70	68	35	38	1	33	N/A
Santa Clara Street Option	631	1044 East Santa Clara	30	68	35	43	1	38	33
Santa Clara Street Option	632	1026-32 East Santa Clara	35	70	35	43	7	37	33
Santa Clara Street Option	635	968, A, B, C East Santa Clara	25	76	35	42	3	35	N/A
Santa Clara Street Option	640	892 East Santa Clara	25	86	35	41	4	35	N/A
Santa Clara Street Option	646	802 East Santa Clara	55	85	35	39	1	34	N/A
Santa Clara Street Option	649	748 East Santa Clara	40	79	35	41	4	35	N/A

Table 5.10-12: Ground-Borne Noise Impacts for Tunnel Portion of SVRTP Alternative Cont'd

Option	Civil Station	Receiver Location	Horizontal Distance to Near Track Centerline (feet)	Rail Depth (feet)	FTA GBN Criteria (dBA)	Maximum Projected GBN Without Mitigation (dBA)	Number of Receptors	Maximum Projected GBN With HRDF Mitigation (dBA)	Maximum Projected GBN With RSF Mitigation (dBA)
Santa Clara Street Option	649	725 East Santa Clara	35	79	35	36	1	31	N/A
Santa Clara Street Option	652	700 Block East Santa Clara	35	74	35	43	1	36	32
Santa Clara Street Option	651	716 East Santa Clara	50	76	35	40	4	34	N/A
Southern Offset Option	629	1072 East Santa Clara	25	64	35	39	4	33	N/A
Southern Offset Option	630	1049 East Santa Clara	82	66	35	37	1	31	N/A
Southern Offset Option	631	1047 East Santa Clara	93	65	35	36	1	30	N/A
Southern Offset Option	631	1044 East Santa Clara	25	65	35	44	1	38	34
Southern Offset Option	632	1026-32 East Santa Clara	25	65	35	45	7	40	35
Southern Offset Option	635	968, A, B, C East Santa Clara	25	65	35	42	3	35	N/A
Southern Offset Option	640	892 East Santa Clara	25	70	35	41	4	35	N/A
Southern Offset Option	640	9 19th Street	25	70	35	41	4	35	N/A
Southern Offset Option	646	802 East Santa Clara	25	66	35	44	1	38	33

Table 5.10-12: Ground-Borne Noise Impacts for Tunnel Portion of SVRTP Alternative Cont'd

Option	Civil Station	Receiver Location	Horizontal Distance to Near Track Centerline (feet)	Rail Depth (feet)	FTA GBN Criteria (dBA)	Maximum Projected GBN Without Mitigation (dBA)	Number of Receptors	Maximum Projected GBN With HRDF Mitigation (dBA)	Maximum Projected GBN With RSF Mitigation (dBA)
Southern Offset Option	649	748 East Santa Clara	25	62	35	44	4	38	33
Southern Offset Option	652	700 Block East Santa Clara	25	62	35	46	1	40	35
Southern Offset Option	651	716 East Santa Clara	25	63	35	46	4	40	35
Northern Offset Option	629	1072 East Santa Clara	25	64	35	39	4	33	N/A
Northern Offset Option	630	1049 East Santa Clara	70	66	35	38	1	33	N/A
Northern Offset Option	631	1047 East Santa Clara	77	65	35	37	1	32	N/A
Northern Offset Option	631	1044 East Santa Clara	37	65	35	41	1	36	32
Northern Offset Option	632	1026-32 East Santa Clara	40	65	35	42	7	36	32
Northern Offset Option	635	968, A, B, C East Santa Clara	57	67	35	36	3	29	N/A
Northern Offset Option	637	10 N 20th Street	62	69	35	36	1	30	N/A
Northern Offset Option	649	725 East Santa Clara	25	62	35	39	1	34	N/A
Northern Offset Option	652	700 Block East Santa Clara	45	62	35	41	1	35	N/A
N/A	663	525 East Santa Clara	35	62	35	43	2	36	31

Table 5.10-12: Ground-Borne Noise Impacts for Tunnel Portion of SVRTP Alternative Cont'd

Option	Civil Station	Receiver Location	Horizontal Distance to Near Track Centerline (feet)	Rail Depth (feet)	FTA GBN Criteria (dBA)	Maximum Projected GBN Without Mitigation (dBA)	Number of Receptors	Maximum Projected GBN With HRDF Mitigation (dBA)	Maximum Projected GBN With RSF Mitigation (dBA)
N/A	669	11 S 10th	30	62	35	47	4	40	35
N/A	674	390 East Santa Clara	30	60	35	47	4	40	35
N/A	693	111 East Santa Clara (at x-over)	58	50	35	38	4	32	N/A
N/A	694	19 N 3rd (at x-over)	30	50	35	40	4	33	N/A
N/A	698	42 East Santa Clara (at x-over)	85	51	35	39	4	32	N/A
N/A	706	141 West Santa Clara	30	52	35	39	4	32	N/A
N/A	748	754 Bush	0	53	35	36	20	30	N/A
N/A	748	754 Bush Building 5	0	53	35	40	8	34	N/A
N/A	750	5101 Wilson	0	55	35	40	20	34	N/A
N/A	750	51 Wilson	35	55	35	37	1	31	N/A
N/A	751	49 Wilson	0	55	35	40	1	34	N/A
N/A	752	34 Sunol	0	56	35	40	1	34	N/A
N/A	753	30 Sunol	0	56	35	40	1	34	N/A
N/A	753	24 Sunol	0	56	35	40	1	34	N/A
N/A	752	20 Sunol	0	56	35	40	1	34	N/A
N/A	754	33 Sunol	0	57	35	40	1	34	N/A
N/A	754	27 Sunol	0	57	35	40	1	34	N/A

Table 5.10-12: Ground-Borne Noise Impacts for Tunnel Portion of SVRTP Alternative Cont'd

Option	Civil Station	Receiver Location	Horizontal Distance to Near Track Centerline (feet)	Rail Depth (feet)	FTA GBN Criteria (dBA)	Maximum Projected GBN Without Mitigation (dBA)	Number of Receptors	Maximum Projected GBN With HRDF Mitigation (dBA)	Maximum Projected GBN With RSF Mitigation (dBA)
N/A	779	489 Stockton	10	61	35	43	1	38	33
N/A	780	493 Stockton	10	61	35	43	1	38	33
N/A	781	711 Pershing	70	63	35	40	1	36	31
N/A	783	549 Stockton	30	64	35	42	1	38	33
N/A	784	713 Harding	80	65	35	40	1	35	N/A
N/A	786	597 Stockton	35	67	35	42	1	37	33
N/A	786	599 Stockton	35	67	35	42	1	37	33
N/A	787	733 Schiele	170	67	35	36	1	31	N/A
N/A	789	625 Stockton	35	67	35	42	1	37	33
N/A	789	635 Stockton	45	67	35	42	1	37	32
N/A	790	641 Stockton	45	67	35	42	1	37	32
N/A	790	649 Asbury	55	67	35	41	1	36	32
N/A	800	702 Stockton	30	63	35	43	1	38	34
N/A	803	779 Stockton	50	61	35	42	1	37	33

KEY:
GBN = Ground-borne Noise
HRDF = highly resilient direct fixation fasteners or equivalent measures
RSF = Rail suspension fastener or equivalent measure
X-Over = Crossover (special track switches)
Source: Wilson Ihrig, 2008c

Table 5.10-13: Vibration Mitigation for SVRTP Alternative

Option	Civil Station [a]	Mitigation
N/A	617+90 to 624+60	HRDF
Santa Clara Street Option	627+30 to 629+70	HRDF
Santa Clara Street Option	629+70 to 632+70	RSF
Santa Clara Street Option	633+20 to 636+10	HRDF
Santa Clara Street Option	638+50 to 641+50	HRDF
Santa Clara Street Option	643+50 to 647+20	HRDF
Santa Clara Street Option	647+70 to 651+50	HRDF
Santa Clara Street Option	651+50 to 658+20	RSF
Santa Clara Street Option	661+80 to 667+00	RSF
Santa Clara Street Option	671+80 to 674+80	RSF
Southern Offset Option	627+30 to 629+70	HRDF
Southern Offset Option	629+70 to 632+70	RSF
Southern Offset Option	633+20 to 636+10	HRDF
Southern Offset Option	638+50 to 641+60	HRDF
Southern Offset Option	643+70 to 646+60	RSF
Southern Offset Option	647+70 to 657+90	RSF
Southern Offset Option	661+80 to 667+00	RSF
Southern Offset Option	671+80 to 674+80	RSF
Northern Offset Option	627+30 to 629+70	HRDF
Northern Offset Option	629+70 to 632+70	RSF
Northern Offset Option	632+70 to 637+90	HRDF
Northern Offset Option	648+10 to 657+90	HRDF
Northern Offset Option	661+80 to 667+00	RSF
Northern Offset Option	671+80 to 674+80	RSF
N/A	679+20 to 683+00	HRDF
N/A	692+85.50 to 697+41.17	HRDF [b]
N/A	705+40 to 709+00	HRDF
N/A	746+90 to 754+70	HRDF
N/A	776+70 to 792+40	RSF
N/A	798+05 to 802+80	RSF

HRDF = highly resilient direct fixation fasteners or equivalent measures
RSF = Rail suspension fastener or equivalent measure
Note:
[a] Civil station with respect to S1 track
[b] Mitigation for crossover switch
Source: Wilson Ihrig, 2008

5.10.4 CUMULATIVE IMPACTS

The operation of transportation facilities such as highways and airports are a primary source of noise in the corridor. Over time, as transportation demand in the corridor has increased, roadways and transit systems have expanded. This has resulted in an overall increase in noise levels in the corridor. Cities and counties have adapted to this trend by establishing land use standards and zoning ordinances that generally place less noise-sensitive land uses (commercial, office, and industrial uses) along major transportation facilities. One of the main issues stemming from this trend, as addressed by the general plans and general plan EIRs is the interface between public health and safety and increased noise levels. Cities and counties have enacted policies to prevent instances where the spatial relationship between sensitive receptors and harmful noise may result in adverse effects to the public's health and safety. Several of these policies are intended to achieve compatibility of existing and future noise levels with existing and future land uses. For instance, many cities have established exterior noise level guidelines and other measures including implementation of strategic site and building design, specialized building construction methods, and noise attenuation techniques.

The BEP and SVRTP alternatives would contribute to an increase in overall noise levels in the immediate project alignment and station areas. Adverse noise effects would primarily occur at the above ground alignment, at stations, and at the maintenance facility. While these noise increases would contribute to cumulative increases in noise levels, the BEP and SVRTP alternatives would not have a substantial adverse effect on surrounding noise levels due to the mitigation measures identified. Cumulative increases in noise levels are anticipated and planned for in the General Plans of the local jurisdictions and counties. The cumulative increases in noise levels are a byproduct of planned development and growth and each city has developed policies and strategies for addressing these anticipated increases in noise levels primarily through land use and zoning regulations and development standards.

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